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Annual European Union greenhouse gas inventory 1990–2011 and inventory report 2013

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EXECUTIVE SUMMARY

ES.-1. BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES AND CLIMATE CHANGE

The European Union (EU), as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories for the years 1990 to t-2 and within the area covered by its Member States (i.e. domestic emissions taking place within its territory).

The present inventory also constitutes the EU-15 submission under the Kyoto Protocol and covers information and data from Member States available until 15 May 2013. Under the Kyoto Protocol, the EU-15 took on a common commitment to reduce emissions by 8 % between 2008 and 2012 compared to emissions in the 'base year' ([1]). The EU-27 does not have a common target under the Kyoto Protocol in the same way as the EU-15.

The legal basis for the compilation of the EU inventory is Decision No. 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([2]). The purpose of this Decision is:

1. to monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States;
2. to evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol;
3. to implement UNFCCC and Kyoto Protocol obligations relating to national programmes, greenhouse gas inventories, national systems and registries of the EU and its Member States, and the relevant procedures under the Kyoto Protocol;
4. to ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the EU and its Member States to the UNFCCC secretariat.

In 2013, the Decision was revised and replaced by a new Monitoring Mechanism Regulation, that has enhanced the reporting rules on GHG emissions to meet requirements arising from current and future international climate agreements as well as the 2009 EU Climate and energy package. Starting in 2014, inventory reporting will take place under this new legal instrument.

The EU GHG inventory comprises the direct sum of the national inventories compiled by the EU Member States making up the EU-15 and the EU-27. Energy data from Eurostat are used for the reference approach for CO_2 emissions from fossil fuels developed by the Intergovernmental Panel on Climate Change (IPCC).

The main institutions involved in the compilation of the EU GHG inventory are the Member States, the European Commission Directorate-General Climate Action (DG CLIMA), the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), Eurostat, and the Joint Research Centre (JRC).

([1]) For the EU-15, the base year for CO_2, CH_4 and N_2O is 1990; for fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EU inventory is the sum of Member State inventories, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for the Netherlands, Portugal and the United Kingdom.

([2]) OJ L 49, 19.2.2004, p.1. Note that Decision No. 280/2004/EC entered into force in March 2004. Therefore, the compilation of the 2004 inventory report started under the previous Council Decision 1999/296/EC.

The process of compiling the EU GHG inventory is as follows. Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG CLIMA, with a copy to the EEA. The EEA and its ETC/ACM, Eurostat, and JRC then perform initial checks on the submitted data. The draft EU GHG inventory and inventory report are circulated to Member States for review and comments by 28 February. Member States check their national data and the information presented in the EU GHG inventory report, send updates if necessary, and review the EU inventory report itself by 15 March. The EEA and its ETC/ACM prepare the final EU GHG inventory and inventory report by 15 April for submission by the European Commission to the UNFCCC Secretariat. A resubmission is prepared by 27 May if needed.

The EU adopted the Climate and Energy Package in April 2009. The package underlines the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal, the EU committed to a unilateral emission reduction target of 20% ([3]) by 2020, compared with 1990 levels, and agreed to a reduction of 30% provided that other major emitters agree to take on their fair share of a global reduction effort.

Both trading (i.e. EU Emissions Trading Scheme (ETS)) and non-trading sectors will contribute to the 20 % objective. Minimising overall reduction costs implies a 21 % reduction in emissions from EU ETS sectors compared to 2005 by 2020, and a reduction of approximately 10 % compared to 2005 by 2020 for non-EU ETS sectors. The non-trading sectors broadly include direct emissions from households and services, as well as emissions from transport, waste, and agriculture. The non-trading sectors currently represent about 60 % of total greenhouse gas emissions.

Information on Land Use activities and Land-Use Change and Forestry (LULUCF) activities is covered in the Kyoto Protocol under Art. 3.3 (afforestation, reforestation and deforestation) and Art. 3.4. (forest land management, cropland management, grazing land management, and revegetation). Detailed information on 3.3 and 3.4 LULUCF activities are provided in chapter 11 of this report.

In addition, all parties to the Kyoto Protocol must provide information on how they are striving to implement their greenhouse gas commitments in such a way as to minimise potential adverse social, environmental and economic impacts on developing countries. This information is required under Article 3, paragraph 14 of the Protocol and is included in chapter 15.

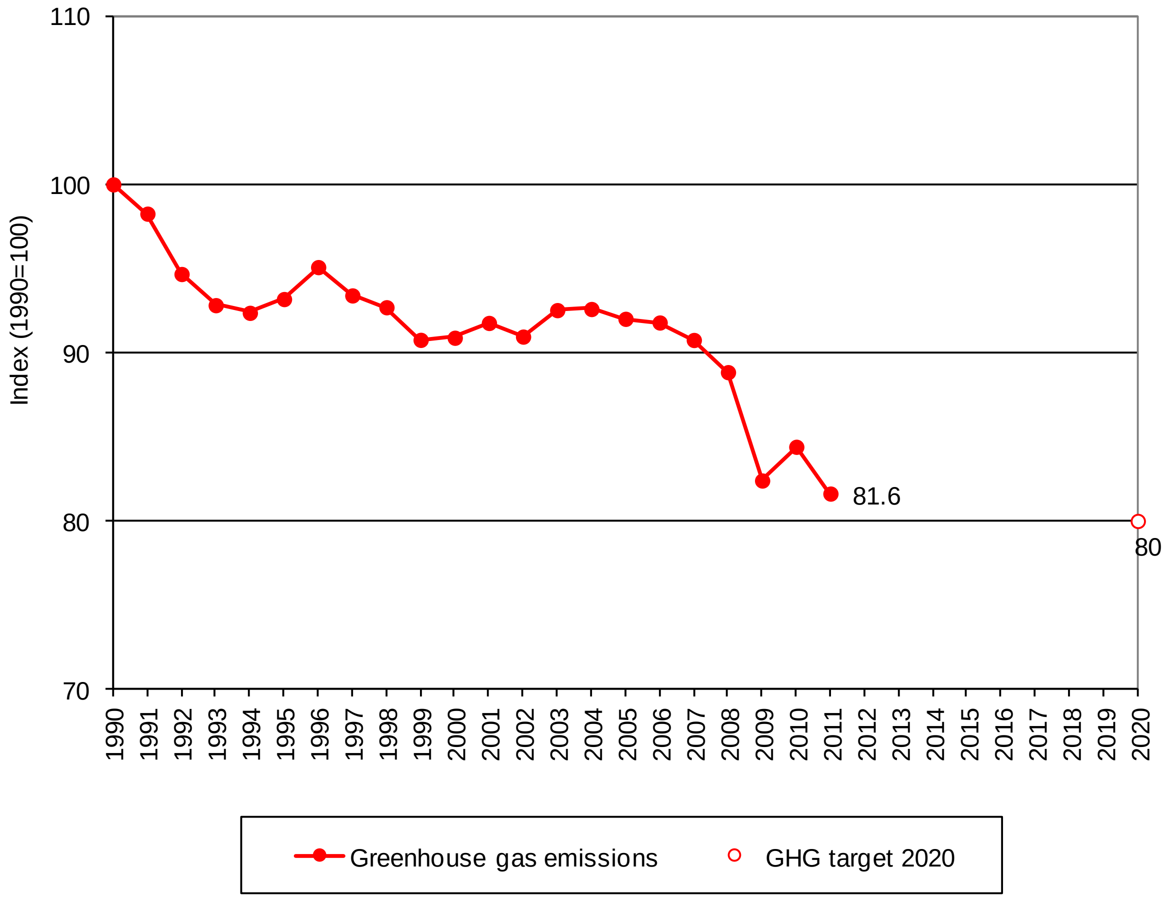
[3] All emission information for EU-27 in this report uses 1990 as the starting point when addressing emission reductions. EU-27 does not have a common target under the Kyoto Protocol in the same way as EU-15.

ES.-2. SUMMARY OF GREENHOUSE GAS EMISSION TRENDS IN THE EU

EU-27

Total GHG emissions, without LULUCF, in the EU-27 decreased by 18.4 % between 1990 and 2011 (-1024 million tonnes CO_2 equivalents). Emissions decreased by 3.3 % (155.0 million tonnes CO_2 equivalents) between 2010 and 2011 (Figure ES.1).

Figure ES.1 EU-27 GHG emissions 1990–2011 (excl. LULUCF)



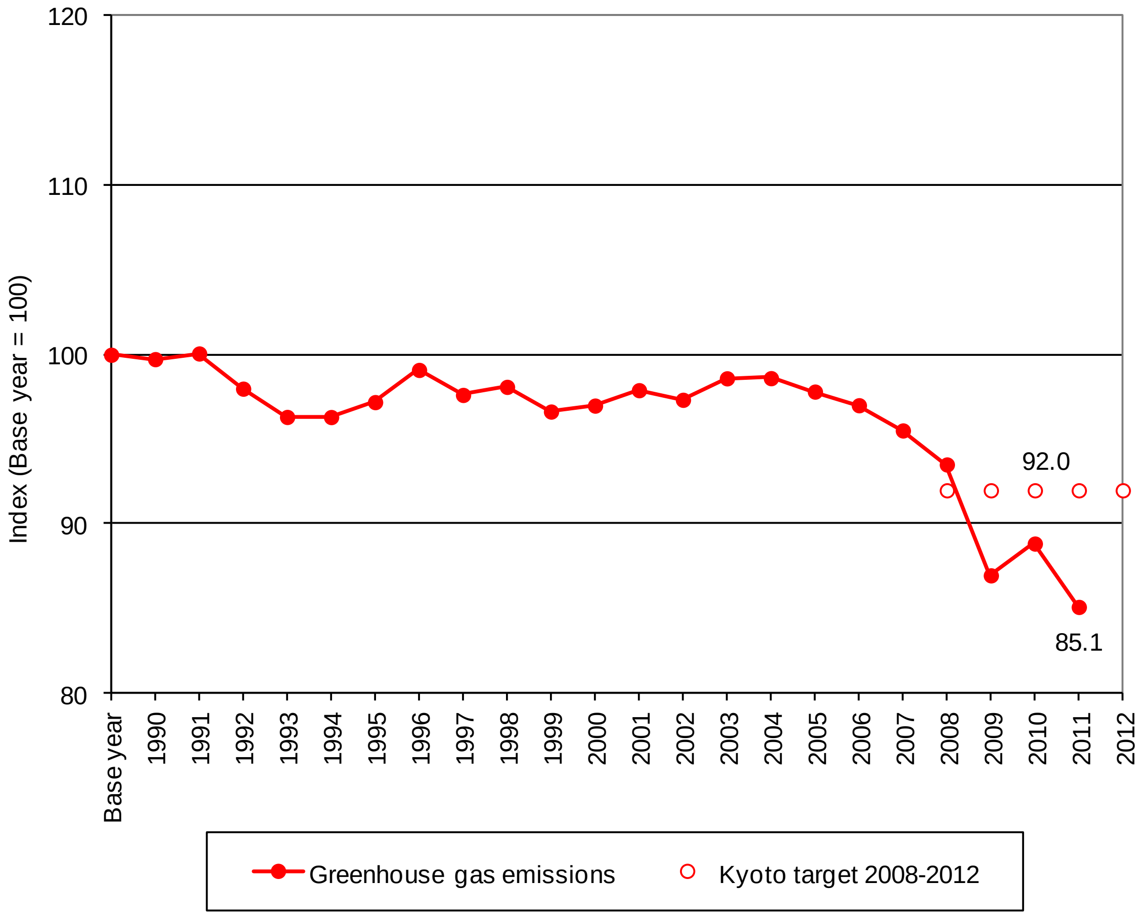
Notes: *GHG emission data for the EU-27 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories. Note that the 80% EU target for 2020 includes international aviation and it is therefore not directly comparable with the 1990-2011 GHG emissions shown in the graph.*

EU-15

In 2011, total GHG emissions in the EU-15, without LULUCF, were 14.7 % (624 million tonnes CO_2 equivalents) below 1990 levels, and 14.9 % (635 million tonnes CO_2 equivalents) below its Kyoto base year levels. Emissions decreased by 4.2 % (159.6 million tonnes CO_2 equivalents) between 2010 and 2011.

Under the Kyoto Protocol, the EU agreed to reduce its GHG emissions by 8 % by 2008-12 compared to its 'base year'[4]. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks, and the use of Kyoto mechanisms. Since 2009, total GHG emissions have been below the EU-15 Kyoto target (Figure ES.2).

Figure ES.2 EU-15 GHG emissions 1990–2011 compared with target for 2008–12 (excl. LULUCF)



Notes: *GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories. Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent. The EU-15 would need to reduce greenhouse gas emissions by about 341 million tonnes, on average between 2008-2012, in order to meet its 8% Kyoto Protocol reduction target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks, and the use of Kyoto mechanisms.*

Main trends by source category, 1990-2011

Table ES.1 shows the sources with the largest contribution to the change in total GHG emissions in the EU-15 and EU-27 between 1990 and 2011. Over the 21-year period, EU-15 emissions decreased by 14.7 %, while EU-27 emissions decreased by 18.4 % (Table ES.3).

[4] Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent.

Table ES.1 Overview of EU-27 and EU-15 source categories whose emissions increased or decreased by more than 20 million tonnes CO_2 equivalents in the period 1990–2011

Source category	EU-15	EU-27
	Million tonnes (CO_2 eq.)	
Road Transportation (CO_2 from 1A3b)	100.3	152.1
Consumptions of halocarbons (HFC from 2F)	69.5	80.1
Cement Production (CO_2 from 2A1)		-23.1
Production of halocarbons (HFC from 2E)	-26.7	-26.7
Nitric Acid Production (N_2O from 2B2)	-29.8	-40.6
Enteric fermentation (CH_4 from 4A)	-21.4	-47.4
Manufacture of Solid fuels (CO_2 from 1A1c)	-49.2	-49.5
Adipic Acid Production (N_2O from 2B3)	-58.2	-59.1
Solid waste disposal on land (CH_4 from 6A)	-66.4	-62.7
Agricultural soils (N_2O from 4D)	-37.3	-68.0
1B Fugitive emissions from fuels (CH_4)	-50.4	-73.4
Households and servicies (CO_2 from 1A4)	-118.4	-177.8
Iron and Steel Production (CO_2 from 1A2a +2C1)	-47.8	-85.4
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-128.4	-226.6
Public Electricity and Heat Production (CO_2 from 1A1a)	-87.8	-226.5
Total	**-623.85**	**-1,024.2**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 20Mt CO_2 equivalent the sum for each country grouping EU-15/EU-27 does not match the total change listed at the bottom of the table. CO_2 emissions from 'cement production' in EU-15 fell by less than 20 million tones.*

Main trends by source category, 2010–2011

Table ES.2 shows the sources making the largest contribution to the change in GHG emissions in the EU-15 and EU-27 between 2010 and 2011. This year, EU-15 emissions decreased by 4.2 %, while EU-27 emissions decreased by 3.3 % (Table ES.3).

Table ES.2 Overview of EU-27 and EU-15 source categories whose emissions increased or decreased by more than 3 million tonnes CO_2 equivalents in the period 2010–2011

Source category	EU-15	EU-27
	Million tonnes (CO_2 eq.)	
Agricultural Soils (N_2O from 4D)		4.2
Solid Waste Disposal (CH_4 from 6A)		-3.6
Iron and Steel Production (CO_2 from 1A2a +2C1)	-4.4	-3.6
Nitric acid production (N_2O from 2B2)	-3.8	-4.0
Road Transportation (CO_2 from 1A3b)	-8.6	-8.4
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	-10.5	-10.7
Public Electricity and Heat Production (CO_2 from 1A1a)	-28.9	-19.7
Households and servicies (CO_2 from 1A4)	-93.9	-104.3
Total	**-159.6**	**-155.0**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2 equivalents, the sum for each country grouping does not match the total change listed at the bottom of the table. N_2O emissions from 'agricultural soils' in EU-15 increased by less than 3 million tonnes and CH_4 emissions from 'solid waste disposal' decreased by less than 3 million tonnes.*

Main reasons for emission changes in the EU-15, 2010-2011

The 159.6 million tonne (CO_2 equivalents) decrease in GHG emissions between 2010-2011 was mainly due to the following factors (Table ES.2):

- A strong emission decrease in households and services (-93.9 million tonnes or -15.3 %) in almost all EU-15 Member States. Milder winter conditions and the lower demand for heating can partly explain lower emissions in 2011 compared to 2010.
- Decreasing emissions in electricity and heat production (-28.9 million tonnes or -3.2 %) in particular in the UK and France. In both countries, reductions in demand for electricity was accompanied by greater use of nuclear power and lower use of gas (UK) and coal (France) for electricity generation.
- Decreasing emissions in road transportation (-8.6 million tonnes or -1.2 %), following a decreasing trend for the forth consecutive year, which was driven by reductions in both passenger and freight transportation.
- Reduced emissions in the category ‘manufacturing industries excluding iron and steel industry’ (-10.5 million tonnes or -2.8 %) in particular in Greece, Italy, Portugal, Spain and the UK. The main reasons were a decline in cement production (Greece, Portugal, Spain, and Italy) and a fuel shift from oil to natural gas in the UK manufacturing industry.
- A slight decrease in emissions from iron and steel production (-4.4 million tonnes or -3 %) following a substantial increase in emissions in 2010 (+29.6 million tonnes or +25.8 %), which was caused by a significant increase in crude steel production due to the recovery from the economic crisis.
- A substantial decrease in emissions from nitric acid production (-3.8 million tonnes or -40 %) mainly driven by decreases in Belgium, France and the United Kingdom.

For the EU-27, GHG emissions decreased by 3.3 % in 2011. This decrease in emissions came amid positive economic growth in most EU Member States between 2010 and 2011. GDP increased by 1.6 % in the EU-27, although economic growth was lower than in 2010. A milder 2011 winter compared to 2010 can partly explain lower fossil fuel emissions, as higher winter temperatures, on average, led to lower heating demand and lower emissions from the residential and commercial sectors. The number of heating degree days (an indicator of household demand for heating) fell by about 10 % in 2011 compared to 2010, as reported by Eurostat. In general, GHG emissions decreased in the majority of key sectors in 2011, particularly those relying on fossil fuel combustion. On average, the total consumption of fossil fuels decreased by 5 % in the EU 27. There was, however, an increase in the carbon intensity of fossil fuels at EU level, which prevented GHG emissions from decreasing more in 2011. The use of solid fuels, such as hard coal and lignite, increased by 1.8 %, whereas the use of liquid fuels decreased by 4 %. The consumption of natural gas fell starkly by 10.6 % in 2011. The contribution of renewables was significantly lower than in previous years. Biomass combustion increased by less than 1 % in the EU-27 in 2011 and hydroelectricity production contracted by 16 % in 2011. Wind and solar, however, continued increasing strongly in 2011. Nuclear electricity consumption also declined in the EU-27 in 2011 compared to 2010, mainly due to a very strong reduction in Germany.

For a detailed analysis, see 'Why did greenhouse gas emissions decrease in the EU in 2011? EEA analysis', which will be available from 29 May 2013 at **http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2013**

Table ES.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2011 (million tonnes)	2010-2011 (million tonnes)	Change 2010-2011 (%)	Change 1990-2011 (%)	Change base year–2011 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78.2	79.0	82.8	-2.2	-2.6%	6.0%	4.8%	-13.0%
Belgium	143.1	145.7	120.2	-11.6	-8.8%	-16.0%	-17.5%	-7.5%
Denmark	68.7	69.3	56.2	-5.0	-8.1%	-18.1%	-18.9%	-21.0%
Finland	70.4	71.0	67.0	-7.5	-10.1%	-4.9%	-5.6%	0.0%
France	556.4	563.9	485.5	-28.7	-5.6%	-12.7%	-13.9%	0.0%
Germany	1250.3	1232.4	916.5	-27.0	-2.9%	-26.7%	-25.6%	-21.0%
Greece	104.6	107.0	115.0	-2.2	-1.9%	10.0%	7.5%	25.0%
Ireland	55.2	55.6	57.5	-4.0	-6.5%	4.1%	3.4%	13.0%
Italy	519.0	516.9	488.8	-11.5	-2.3%	-5.8%	-5.4%	-6.5%
Luxembourg	12.9	13.2	12.1	-0.15	-1.3%	-6.2%	-8.1%	-28.0%
Netherlands	211.8	213.0	194.4	-14.8	-7.1%	-8.2%	-8.8%	-6.0%
Portugal	61.0	60.1	70.0	-1.4	-2.0%	14.8%	16.4%	27.0%
Spain	282.8	289.8	350.5	1.8	0.5%	23.9%	21.0%	15.0%
Sweden	72.8	72.2	61.4	-4.0	-6.2%	-15.5%	-14.8%	4.0%
United Kingdom	767.3	776.3	552.6	-41.3	-7.0%	-28.0%	-28.8%	-12.5%
EU-15	**4254.5**	**4265.5**	**3630.7**	**-159.6**	**-4.2%**	**-14.7%**	**-14.9%**	**-8.0%**
Bulgaria	109.5	132.6	66.1	5.8	9.6%	-39.6%	-50.1%	-8.0%
Cyprus	6.1	Not applicable	9.2	-0.3	-3.1%	50.3%	Not applicable	Not applicable
Czech Republic	196.0	194.2	133.5	-3.9	-2.9%	-31.9%	-31.3%	-8.0%
Estonia	40.5	42.6	21.0	1.0	4.8%	-48.3%	-50.8%	-8.0%
Hungary	99.0	115.4	66.1	-1.8	-2.6%	-33.2%	-42.7%	-6.0%
Latvia	26.3	25.9	11.5	-0.5	-4.5%	-56.3%	-55.6%	-8.0%
Lithuania	48.8	49.4	21.6	0.5	2.3%	-55.7%	-56.3%	-8.0%
Malta	2.0	Not applicable	3.0	0.02	0.8%	50.6%	Not applicable	Not applicable
Poland	457.0	563.4	399.4	-2.3	-0.6%	-12.6%	-29.1%	-6.0%
Romania	244.4	278.2	123.3	6.7	5.8%	-49.5%	-55.7%	-8.0%
Slovakia	71.8	72.1	45.3	-0.6	-1.3%	-36.9%	-37.1%	-8.0%
Slovenia	18.4	20.4	19.5	0.0	0.1%	5.8%	-4.1%	-8.0%
EU-27	**5574.4**	**Not applicable**	**4550.2**	**-155.0**	**-3.3%**	**-18.4%**	**Not applicable**	**Not applicable**

([a]) *As Cyprus, Malta and the EU-27 do not have targets under the Kyoto Protocol's first commitment period, they do not have applicable Kyoto Protocol base years.*

ES.-3. SUMMARY OF EMISSIONS AND REMOVALS BY MAIN GREENHOUSE GAS

EU-27

Table ES.4 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2011. The most important GHG by far is CO_2, accounting for 82.3 % of total EU-27 emissions in 2011 excluding LULUCF. In 2011, EU-27 CO_2 emissions without LULUCF were 3 743Tg, which was 15.1 % below 1990 levels. Compared to 2010, CO_2 emissions decreased by 3.8 %. Emissions of CH_4 and N_2O decreased in 2011, while HFCs and PFCs increased in 2011.

Table ES.4 Overview of EU-27 GHG emissions and removals from 1990 to 2011 in CO_2-equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Net CO_2 emissions/removals	4,143	3,851	3,822	3,963	3,944	3,927	3,790	3,449	3,595	3,445
CO_2 emissions (without LULUCF)	4,407	4,139	4,112	4,246	4,250	4,196	4,101	3,770	3,891	3,743
CH_4	596	535	480	428	422	415	409	400	397	389
N_2O	522	462	417	389	376	376	367	346	336	335
HFCs	28	40	47	61	64	69	72	76	80	81
PFCs	20	14	10	6	5	5	4	3	3	4
SF_6	11	15	10	8	8	7	7	6	7	6
Total (with net CO_2 emissions/removals)	**5,320**	**4,918**	**4,786**	**4,856**	**4,819**	**4,799**	**4,650**	**4,280**	**4,417**	**4,260**
Total (without CO_2 from LULUCF)	**5,584**	**5,205**	**5,076**	**5,138**	**5,126**	**5,068**	**4,961**	**4,602**	**4,714**	**4,558**
Total (without LULUCF)	**5,574**	**5,195**	**5,066**	**5,129**	**5,117**	**5,059**	**4,952**	**4,593**	**4,705**	**4,550**

EU-15

Table ES.5 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2011. In the EU-15, the most important GHG is also CO_2, accounting for 82.7 % of total EU-15 emissions in 2011. In 2011, EU-15 CO_2 emissions without LULUCF were 3 003 Tg, which was 10.8 % below 1990 levels. Compared to 2010, CO_2 emissions decreased by 4.8 %. As in the EU-27, CH_4 and N_2O emissions decreased in the last year, whereas HFC emissions increased in 2011.

Table ES.5 Overview of EU-15 GHG emissions and removals from 1990 to 2011 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Net CO_2 emissions/removals	3,224	3,128		3,319	3,282	3,249	3,143	2,876	2,980	2,823
CO_2 emissions (without LULUCF)	3,367	3,298	3,373	3,484	3,467	3,408	3,332	3,067	3,155	3,003
CH_4	438	410	369	320	313	308	304	298	296	289
N_2O	400	379	339	308	295	294	286	275	266	264
HFCs	28	40	45	54	56	59	63	66	69	71
PFCs	17	12	8	5	5	5	4	3	3	3
SF_6	11	15	10	8	7	7	6	6	6	6
Total (with net CO_2 emissions/removals)	**4,118**	**3,984**	**3,960**	**4,014**	**3,959**	**3,922**	**3,806**	**3,524**	**3,620**	**3,457**
Total (without CO_2 from LULUCF)	**4,261**	**4,154**	**4,144**	**4,179**	**4,144**	**4,081**	**3,995**	**3,716**	**3,796**	**3,636**
Total (without LULUCF)	**4,255**	**4,146**	**4,138**	**4,173**	**4,138**	**4,075**	**3,989**	**3,710**	**3,790**	**3,631**

ES.-4. SUMMARY OF EMISSIONS AND REMOVALS BY MAIN SOURCE AND SINK CATEGORIES

EU-27

Table ES.6 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2011. The most important sector by far is Energy (i.e. combustion and fugitive emissions) accounting for 79.4 % of total EU-27 emissions in 2011. The second largest sector is Agriculture (10.1 %), followed by Industrial Processes (7.3 %).

Table ES.6 **Overview of EU-27 GHG emissions in the main source and sink categories 1990 to 2011 in CO_2-equivalents (Tg)**

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
1. Energy	4,297	4,029	3,981	4,084	4,080	4,015	3,936	3,659	3,763	3,614
2. Industrial Processes	458	437	390	403	400	412	388	323	335	332
3. Solvent and Other Product Use	17	14	13	11.993	12	12	11	10	10	10
4. Agriculture	600	517	505	478	474	475	474	463	460	461
5. Land-Use, Land-Use Change and Forestry	-255	-277	-280	-273	-298	-260	-303	-313	-288	-290
6. Waste	204	198	177	152	150	146	142	139	137	133
7. Other	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5,320**	**4,918**	**4,786**	**4,856**	**4,819**	**4,799**	**4,650**	**4,280**	**4,417**	**4,260**
Total (without LULUCF)	**5,574**	**5,195**	**5,066**	**5,129**	**5,117**	**5,059**	**4,952**	**4,593**	**4,705**	**4,550**

EU-15

Table ES.7 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2011. More detailed trend descriptions are included in Chapters 3 to 9.

Table ES.7 **Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2011 CO_2-equivalents (Tg)**

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
1. Energy	3,282	3,206	3,259	3,348	3,329	3,265	3,200	2,972	3,048	2,898
2. Industrial Processes	353	350	310	311	303	308	292	254	261	253
3. Solvent and Other Product Use	13	12	11	9.667	10	9	9	8	8	8
4. Agriculture	433.9	412	413	385	380	380	379	370	369	370
5. Land-Use, Land-Use Change and Forestry	-137	-163	-177	-159	-180	-153	-183	-186	-170	-174
6. Waste	172	166	144	119	116	113	109	106	104	102
7. Other	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4,118**	**3,984**	**3,960**	**4,014**	**3,959**	**3,922**	**3,806**	**3,524**	**3,620**	**3,457**
Total (without LULUCF)	**4,255**	**4,146**	**4,138**	**4,173**	**4,138**	**4,075**	**3,989**	**3,710**	**3,790**	**3,631**

ES.-5. SUMMARY OF EU MEMBER STATE EMISSION TRENDS

Table ES.8 gives an overview of Member State contributions to EU GHG emissions for 1990–2011. Member States show large variations in GHG emission trends.

Table ES.8 Overview of Member States' contributions to EU GHG emissions excluding LULUCF from 1990 to 2011 in CO_2-equivalents (Tg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	78	80	80	93	90	87	87	80	85	83
Belgium	143	150	146	143	139	134	137	124	132	120
Denmark	69	76	68	64	72	67	64	61	61	56
Finland	70	71	69	69	80	78	70	66	75	67
France	556	552	559	558	546	536	531	508	514	486
Germany	1,250	1,118	1,041	998	1,000	976	975	911	944	916
Greece	105	109	126	135	131	134	130	124	117	115
Ireland	55	59	68	69	69	68	68	62	61	58
Italy	519	530	551	574	564	555	541	491	500	489
Luxembourg	13	10	10	13	13	12	12	12	12	12
Netherlands	212	223	213	209	206	204	203	198	209	194
Portugal	61	72	84	88	83	81	78	75	71	70
Spain	283	313	379	433	424	432	399	363	349	350
Sweden	73	74	69	67	67	66	63	59	65	61
United Kingdom	767	709	674	658	654	644	630	577	594	553
EU-15	**4,255**	**4,146**	**4,138**	**4,173**	**4,138**	**4,075**	**3,989**	**3,710**	**3,790**	**3,631**
Bulgaria	110	76	60	64	65	68	67	58	60	66
Cyprus	6	7	9	9	10	10	10	10	9	9
Czech Republic	196	151	146	145	147	148	142	133	137	133
Estonia	41	20	17	18	18	21	20	16	20	21
Hungary	99	80	78	79	78	76	74	67	68	66
Latvia	26	13	10	11	12	12	12	11	12	11
Lithuania	49	22	20	23	24	26	25	20	21	22
Malta	2	2	3	3	3	3	3	3	3	3
Poland	457	432	385	390	406	408	400	381	402	399
Romania	244	173	134	142	146	143	140	120	117	123
Slovakia	72	53	49	51	51	49	49	44	46	45
Slovenia	18	19	19	20	21	21	21	19	19	20
EU-27	**5,574**	**5,195**	**5,066**	**5,129**	**5,117**	**5,059**	**4,952**	**4,593**	**4,705**	**4,550**

The overall EU GHG emission trend is dominated by the two largest emitters, Germany and the United Kingdom, accounting for about one third of total EU-27 GHG emissions. These two Member States have achieved total GHG emission reductions in 2011 of 549 million tonnes of CO_2-equivalents compared to 1990[5].

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants, and the economic restructuring of the five new Länder after German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production, and N_2O emission reduction measures in the production of adipic acid.

(5) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

France and Italy were the third- and fourth-largest emitters in 2011, with a share of 10.7 % each. Italy's GHG emissions were 5.8 % below 1990 levels in 2011. Italian GHG emissions increased from 1990, due primarily to increases in road transport, electricity and heat production, and petroleum refining. However, Italian emissions decreased significantly from 2004. France's emissions were 12.7 % below 1990 levels in 2011. In France, large reductions were achieved in N_2O emissions from adipic acid production, but CO_2 emissions from road transport and HFC emissions from consumption of halocarbons increased considerably between 1990 and 2011.

Poland and Spain are the fifth- and sixth-largest emitters in the EU-27, accounting for 8.8 % and 7.7 % of total EU-27 GHG emissions in 2011. Spain increased emissions by almost 24 % between 1990 and 2011. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 12.6 % between 1990 and 2011 (-29.1 % since the base year, which in the case of Poland is 1988). The main factors for decreasing emissions in Poland — as for other new Member States — were the decline of energy-inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

ES.-6. INTERNATIONAL AVIATION AND MARITIME TRANSPORT

Emissions of greenhouse gases from international aviation and shipping activities increased constantly between 1992 and 2007. Emissions decreased between 2007 and 2010 in the EU-27, partly reflecting the economic recession, but have increased again in 2011. EU greenhouse gas emissions from international aviation are lower than for international maritime transport, but were growing more rapidly until 2007. The average annual EU-27 growth rates in emissions since 1990 were 3.3 % and 2.0 %, respectively. Total GHG emissions from international transport reached 299 million of CO_2 equivalents in 2011.

For detailed information on emissions from international bunkers see chapter 3.7 of this report.

ES.-7. INFORMATION ON RECALCULATIONS

The UNFCCC has permanently fixed the base year emissions for the EU-15 (at 4 265.5 million tonnes of CO_2-equivalents) based on reviews during 2007 and 2008. However, recalculations of past emissions data occur every year based on the inventory improvements that Member States are required to undertake for the whole time series.

Based on EU Member States' GHG inventories in 2013, total EU-15 GHG emissions in 2010 were 0.2% lower than reported in 2012 GHG inventories. Total EU-15 emissions in 1990 reported in 2012 GHG inventories were 0.1% higher than 1990 emissions reported in 2012 inventories.

Table ES.9 Overview of major recalculations in the EU-15 in 1990

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO2	UK	-1 030	-0.4	Updated emission factor for combustion at gas separation plant under 1A1c.
1A2_Manufacturing Industries and Construction CO2	France	2 489	3.0	La prise en compte des données individuelles pour le calcul des émissions de CO2, CH4 et N2O dans différents secteurs de la combustion pour les procédés énergétiques avec contact, afin d'obtenir des facteurs d'émission rapportés à la consommation de combustibles et non plus à la production. Ce travail nécessite d'être affiné l'année prochaine.
1A2_Manufacturing Industries and Construction CO2	UK	2 212	2.2	Liquid fuels: Addition of estimates of emissions from combustion of byproducts at ethylene crackers following UNFCCC review.
4A_Enteric fermentation CH4	Germany	2 890	10.8	New national method in 4.A Enteric Fermentation \ Cattle \ Option A \ Dairy Cattle Re-allocation within the cattle category in 4.A Enteric Fermentation \ Cattle \ Option A \ Non-Dairy Cattle Updated "piglets per sow" ratio in 4.A Enteric Fermentation \ Swine.
4B_Manure management CH4	Spain	1 242	31.6	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4B_Manure management CH4	France	-3 979	-32.4	Les séries statistiques de 1990 à 2011 portant sur les effectifs animaux ont été modifiées suite au Recensement Agricole de 2010. Ces modifications ont eu un impact sur les données d'activités et sur les facteurs d'émissions pour les catégories animales agrégées. Les VS des bovins ont été mis à jour suite à la livraison des premiers résultats de l'étude MONDFERENT. Cette mise à jour méthodologique permet d'améliorer la transparence de la méthode et s'accompagne d'une mise en cohérence des calculs d'émissions de méthane entérique et de méthane liées à la gestion des déjections. Les valeurs utilisées pour le paramètre FCM ont été modifiées, passant d'un climat « tempéré » à un climat « froid » pour la métropole, suite à la revue ESD de l'année 2012.
4B_Manure management N2O	Germany	1 348	52.5	New emission factor in 4.B Manure Management \ Solid storage and dry lot. Digesters are now part of liquid systems in 4.B Manure Management \ Liquid system.
6B_Waste water handling CH4	UK	1 398	502.4	Consultation with water companies has lead to updated data.

***Note**: Explanations for recalculations as provided by the Parties in their national greenhouse gas inventory reports*

Table ES.10 Overview of major recalculations in the EU-15 in 2010

		2010		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO2	Germany	2 677	0.8	Final data available from the national energy balance.
1A2_Manufacturing Industries and Construction CO2	UK	3 047	4.6	Liquid fuels: Addition of estimates of emissions from combustion of byproducts at ethylene crackers following UNFCCC review.
1A2_Manufacturing Industries and Construction CO2	Spain	-3 780	-6.1	El cambio de alcance más relevante es la revisión sistemática que se hace del balance de combustibles que se utiliza específicamente para el inventario de emisiones. Debe reseñarse aquí que para el último año de cada edición del inventario sólo se dispone de los cuestionarios energéticos internacionales, y de éstos a veces sólo un avance, lo que implica en general que en la edición del año siguiente deban ser revisadas las cifras que en el año anterior se habían tomado de dichos cuestionarios al disponerse en este momento posterior de la información de los propios balances energéticos de AIE y EUROSTAT.
1A3_Transport CO2	Belgium	2 858	11.9	Final energy balance available; Liquid Fuels: Copert EFs according ICR.
1A3_Transport CO2	UK	-1 578	-1.3	Liquid fuels: Updated fleet composition and vkm data.
1A4_Other sectors CO2	Germany	4 617	3.2	Gaseous fuels: final data available from the national energy balance.
1A4_Other sectors CO2	France	1 844	1.8	Pour tout le secteur, les consommations de combustibles ont été mises à jour. De plus, la répartition des consommations entre les secteurs résidentiel et tertiaire a été modifiée, entrainant un ajustement des émissions de l'année 2010 touchant principalement le CO2 (-1,38 Tg pour le tertiaire, +2,84 Tg pour le résidentiel, +0,39 Tg pour l'agriculture et la pêche).
1A4_Other sectors CO2	Belgium	-2 208	-6.8	Brussels: new OFFREM run. Flanders: integration of results from a new survey (automn 2012) RBC: update (validation) of the 2010 regional energy balance. Final EB for Wallonia and Flanders (-19,5 PJ for Flanders).
2B_Chemical industries CO2	Belgium	-1 387	-44.0	Flanders: optimization emissions 2010 for cat. 2B5/other (completed survey by the industry). Flanders: re-allocation of some emission to flaring from 2B5 to 6C2 flaring (complete timeseries, 592 kton CO2 in 2010).
2C_Metal production CO2	France	1 170	34.0	Les consommations d'énergie et matière fournies par la FFA ont été mises à jour pour 2010. De plus, une modification des teneurs en carbone des combustibles et matières premières, à partir de la moyenne 2001-2008 calculée grâce aux bilans de la Fédération Française de l'Acier, entrainent des modifications des émissions de CO2 sur toute la période (+0,15 Tg CO2 en 1990, +1,25 Tg CO2 en 2010).
2F_Consumption of halocarbons HFC	France	-1 784	-10.7	Toute la période d'inventaire a été revue suite à l'étude de ERelE réalisée en 2012. Un nouveau type de HFC, le HFC-245fa, est rapporté. Celui-ci apparait sous l'appellation « Unspecified mix of HFCs » dans la Table2(II).Fs1. D'importantes modifications ont eu lieu suite à la mise en place d'une nouvelle méthodologie de calcul des émissions d'aérosols techniques et à de nouvelles données de ventes pour les aérosols pharmaceutiques.
2F_Consumption of halocarbons HFC	Germany	-2 634	-23.4	Implementation of an improved calculation method with new data sources and changed EFs.
4A_Enteric fermentation CH4	Spain	-1 433	-11.6	New national methodology introduced.
4B_Manure management CH4	Spain	1 158	21.4	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4B_Manure management CH4	France	-3 596	-26.5	Les séries statistiques de 1990 à 2011 portant sur les effectifs animaux ont été modifiées suite au Recensement Agricole de 2010. Ces modifications ont eu un impact sur les données d'activités et sur les facteurs d'émissions pour les catégories animales agrégées. Les VS des bovins ont été mis à jour suite à la livraison des premiers résultats de l'étude MONDFERENT. Cette mise à jour méthodologique permet d'améliorer la transparence de la méthode et s'accompagne d'une mise en cohérence des calculs d'émissions de méthane entérique et de méthane liées à la gestion des déjections. Les valeurs utilisées pour le paramètre FCM ont été modifiées, passant d'un climat « tempéré » à un climat « froid » pour la métropole, suite à la revue ESD de l'année 2012.
6A_Solid waste disposal on land CH4	Germany	3 045	34.0	New statistical data for CH4-recovery.
6A_Solid waste disposal on land CH4	France	-6 587	-42.1	La soumission précédente était basée sur le principe d'une non prise en compte du captage faute de pouvoir l'estimer sur la base des mesures comme demandé par l'équipe de revue CCNUCC de septembre 2010. Suite à l'enquête auprès des ISDND, l'estimation 2013 intègre la prise en compte du captage du biogaz généré et sa combustion en torchères ou installations de valorisation.
6B_Waste water handling CH4	UK	1 276	377.9	Consultation with water companies has lead to updated data.
6B_Waste water handling CH4	Spain	-1 651	-70.1	New information available about domestic and commercial wastewater.

Note: *Explanations for recalculations as provided by the Parties in their national greenhouse gas inventory reports*

For detailed information on recalculations see chapter 10 and the sector-specific recalculations.

ES.-8. INFORMATION ON INDIRECT GREENHOUSE GAS EMISSIONS

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: the former three substances are precursor substances for ground-level ozone which itself is a greenhouse gas. Sulphur emissions can contribute to formation of microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation.

Table ES.11 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990–2011. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-85 %), followed by CO (-67 %), NMVOC (-57 %) and NO_x (-49 %).

Table ES.11 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2011 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	(Gg)									
NOx	13 673	12 023	10 490	9 482	9 175	8 866	8 140	7 453	7 246	6 966
CO	53 825	42 345	31 937	23 992	22 568	22 087	20 478	18 419	19 239	17 844
NMVOC	15 270	12 596	10 237	8 385	8 239	7 621	7 178	6 824	6 751	6 549
SO2	16 459	9 986	6 144	4 572	4 353	4 142	3 090	2 668	2 451	2 390

In the EU-27, SO_2 emissions decreased by 78 %, followed by CO (–64 %), NMVOC (–55 %) and NO_x (–48 %) (Table ES.12).

Table ES.12 Overview of EU-27 indirect GHG and SO_2 emissions for 1990–2011 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	(Gg)									
NOx	16 996	14 676	12 674	11 573	11 292	10 938	10 125	9 284	9 145	8 821
CO	66 440	51 296	38 708	30 561	29 226	28 526	27 121	24 839	25 882	24 103
NMVOC	17 845	14 411	11 873	9 975	9 847	9 182	8 749	8 267	8 225	7 993
SO2	25 204	16 733	10 401	8 243	8 074	7 743	6 375	5 616	5 434	5 616

EU Member States also annually report emissions of these same substances to the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (LRTAP). The Member States also report emissions of NO_x, NMVOCs and SO_2 under the EU's National Emissions Ceilings Directive (NECD).

ES.-9. INFORMATION ON USING EU ETS FOR NATIONAL GHG INVENTORIES IN EU MEMBER STATES

This report also includes an analysis of the use of data and emissions reported under the European Union Greenhouse Gas Emission Trading System (EU ETS) for preparing national GHG inventories in the EU-15. The analysis shows that most Member States used the ETS data to improve and refine the estimation and reporting of CO_2 emissions from energy and industrial processes. All 27 Member States indicated that they used ETS data at least for quality assurance/quality control purposes and checked data consistency between both sources (chapter 1.3.2 and chapter 16.2.2).

Fourteen Member States indicated that they directly use the verified emissions reported by installations under the ETS. Twenty-one Member States used ETS data to improve country-specific emission factors and 17 Member States reported that they used activity data (e.g. fuel use) provided under the ETS in the national inventory. The use of ETS data improved the quality of greenhouse gas inventory data with respect to completeness (additional emission sources can be estimated for which no data were available before the EU ETS), accuracy (e.g. due to improved country-specific emission factors), and improved allocation of emissions to correct CRF source categories.

Annexes published on CD-ROM and the EEA website only:

Annex 1: Additional information for EU-15

Annex 1.1: Key category analysis and uncertainty estimates

Annex 1.2: CRF tables

Annex 1.3: Status reports

Annex 1.4: CRF Table Summary 1A, Summary 2, 8(a), 8(b) and 9

Annex 1.5: CRF Tables Energy

Annex 1.6: CRF Tables Industrial processes

Annex 1.7: CRF Tables Solvent use

Annex 1.8: CRF Tables Agriculture

Annex 1.9: CRF Tables LULUCF

Annex 1.10: CRF Tables Waste

Annex 1.11: CRF table 10

Annex 1.12: EU-15 MS CRF tables and National inventory reports

Annex 1.13: EU SEF tables

Annex 2: Additional information for EU-27

Annex 2.1: Key category analysis

Annex 2.2: CRF tables

Annex 2.3: Status reports

Annex 2.4: CRF Table Summary 1A, Summary 2 and 8(a)

Annex 2.5: CRF Tables Energy

Annex 2.6: CRF Tables Industrial processes

Annex 2.7: CRF Tables Solvent use

Annex 2.8: CRF Tables Agriculture

Annex 2.9: CRF Tables LULUCF

Annex 2.10: CRF Tables Waste

Annex 2.11: CRF table 10

Annex 2.12: EU-27 MS CRF tables and National inventory reports

Annex 2.13: EU SEF tables

Annex 3: EU SEF submission

PART 1: ANNUAL INVENTORY SUBMISSION (EU-15)

1 INTRODUCTION TO THE EU GREENHOUSE GAS INVENTORY

This report is the annual submission of the European Union (EU) to the United Nations Framework Convention on Climate Change (UNFCCC). It presents the greenhouse gas (GHG) inventory of the EU, the process and the methods used for the compilation of the EU inventory as well as GHG inventory data of the individual EU Member States for 1990 to 2011. The GHG inventory data of the Member States are the basis of the EU GHG inventory. The data published in this report are also the basis for the progress evaluation report of the European Commission, required under Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

This report aims to present transparent information on the process and methods of compiling the EU GHG inventory. It addresses the relevant aspects at EU level, but does not describe detailed sectoral methodologies of the Member States' GHG inventories. Detailed information on methodologies used by the Member States is available in the national inventory reports of the Member States, which are included in Annex 1.12. Note that all Member States' submissions (common reporting format (CRF) tables and inventory reports), which are included in Annex 1.12 and made available at the European Environment Agency (EEA) website, are considered to be part of the EU inventory. Several chapters in this report refer to information provided by the Member States, where additional insights can be gained. In many cases this Member State information is presented in summary overview tables.

The EU greenhouse gas inventory has been compiled under Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (6). The emissions compiled in the EU GHG inventory are the sum of the respective emissions in the respective national inventories, except for the Intergovernmental Panel on Climate Change (IPCC) reference approach for CO_2 from fossil fuels. Since the data are revised and updated for all years, they replace EU data previously published, in particular, the *Annual European Union greenhouse gas inventory 1990–2010 and inventory report 2012* (EEA, 2012).

This part of the EU GHG inventory report includes data for the EU-15 Member States. The EU-15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. This part includes all the detailed information provided in previous reports for the EU-15.

1.1 Background information on greenhouse gas inventories and climate Change

The annual EU GHG inventory is required for two purposes.

Firstly, the EU, as the only regional economic integration organisation having joined the UNFCCC and the Kyoto Protocol as a Party, has to report annually on GHG inventories within the area covered by its Member States.

Secondly, under the EU GHG Monitoring Mechanism Decision, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the EU's commitments under the UNFCCC and the Kyoto Protocol. For this purpose, the

(6)OJ L 49, 19.2.2004, p. 1.

Commission has to prepare a progress evaluation report, which has to be forwarded to the European Parliament and the Council. The annual EU inventory is the basis for the evaluation of actual progress.

The legal basis of the compilation of the EU inventory is Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (7). The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol; (3) implement the UNFCCC and the Kyoto Protocol as regards national programmes, greenhouse gas inventories, national systems and registries of the EU and its Member States, and the relevant procedures under the Kyoto Protocol; (4) ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the EU and its Member States to the UNFCCC Secretariat.

Under the provisions of Article 3.1 of Decision No 280/2004/EC, the Member States shall determine and report to the Commission by 15 January each year (year X) inter alia:

their anthropogenic emissions of greenhouse gases listed in Annex A to the Kyoto Protocol (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride SF_6)) during the year before last (X – 2);

provisional data on their emissions of carbon moNO_xide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and volatile organic compounds (VOCs) during the year before last (year X – 2), together with final data for the year three-years previous (year X – 3);

their anthropogenic greenhouse gas emissions by sources and removals of carbon dioxide by sinks resulting from land-use, land-use change and forestry during the year before last (year X – 2);

information with regard to the accounting of emissions and removals from land-use, land-use change and forestry, in accordance with Article 3(3) and, where a Member State decides to make use of it, Article 3(4) of the Kyoto Protocol, and the relevant decisions thereunder, for the years between 1990 and the year before last (year X – 2);

any changes to the information referred to in points (1) to (4) relating to the years between 1990 and the year three-years previous (year X – 3);

the elements of the national inventory report necessary for the preparation of the EU greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

The reporting requirements for the Member States under Council Decision 280/2004/EC are elaborated in the Commission Decision 2005/166/EC laying down rules implementing Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (8). According to the Council Decision and the Commission Decision the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EU and its Member States use the '*UNFCCC guidelines on reporting and review*' (Document FCCC/CP/2002/8), and prepare inventory information in the common reporting format (CRF) and the 'national inventory report' that contains background information.

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(7)OJ L 49, 19.2.2004, p. 1.
(8)OJ L 55, 1.3.2005, p. 57.

In accordance with UNFCCC guidelines, the EU and its Member States use the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories* (IPCC, 2000), which is consistent with the *Revised 1996 IPCC guidelines for national greenhouse gas inventories* (IPCC, 1997).

1.1.1 A description of the institutional arrangements for inventory preparation

Figure 1.1 shows the inventory system of the European Union. The Directorate General Climate Action of the European Commission has overall responsibility for the inventory of the European Union (EU) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Union. DG Climate Action is supported in the establishment of the inventory by the following main institutions: the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) (9).

(9) The Statistical Office of the European Communities (Eurostat) and the Joint Research Centre (JRC) are DGs of the European Commission. For simplicity reasons, these institutions are referred to as 'Eurostat' and the 'JRC' in this report.

Figure 1.1 Inventory system of the European Union

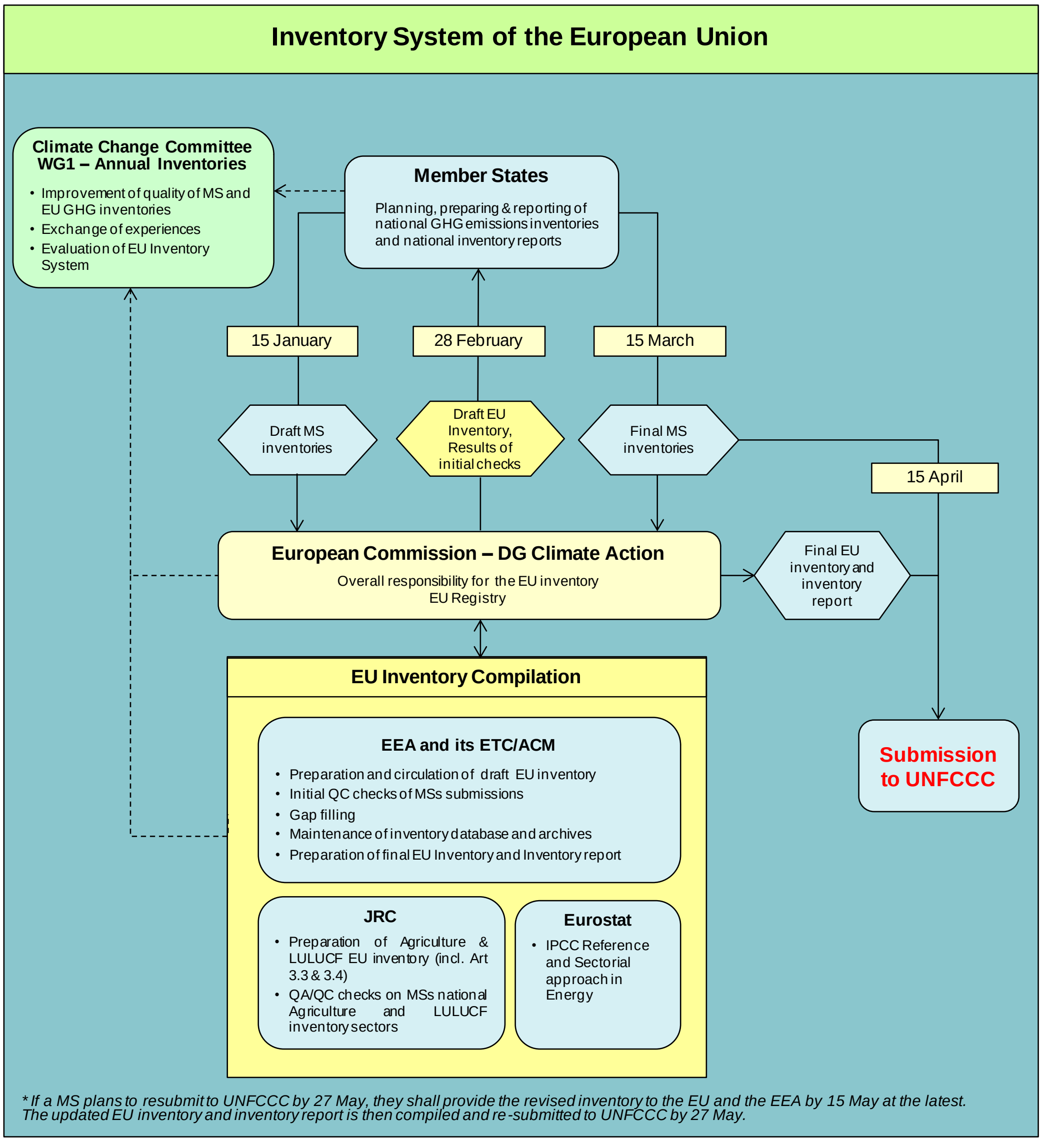


Table 1.1 gives and overview on responsibilities for the compilation of the EU GHG inventory submission in 2013.

Table 1.1 Responsibility list for the compilation of the EU GHG inventory submission in 2013

	Name	EC GHG inventory/inventory report compilation				Quality management system			
		Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
European Commission	Velina Pendolovska (DG Clima) velina.pendolovska@ec.europa.eu	X			Chapter 13 Changes national system	X			
	Ronald Velghe (DG Clima) ronald.velghe@ec.europa.eu				Chapter 12 Kyoto units, Chapter 14 Changes to registry			SEF tables	
	Cecile Pierce (DG Clima) cecile.pierce@ec.europa.eu				Chapter 12 Kyoto units, Chapter 14 Changes to registry			SEF tables	
	Adrian Leip (JRC) adrian.leip@jrc.ec.europa.eu			4				4	
	Janka Szemesova (JRC) janka.szemesova@shmu.sk				4				4
	Giacomo Grassi (JRC) giacomo.grassi@jrc.ec.europa.eu							5 + KP LULUCF	
	Viorel Blujdea (JRC) viorel.blujdea@jrc.ec.europa.eu			5 + Chapter 11 KP LULUCF				5 + KP LULUCF	
	Raul Abad-Vinas (JRC) raul.abad-vinas@jrc.ec.europa.eu				5 + Chapter 11 KP LULUCF				5 + Chapter 11 KP LULUCF
	Michael Goll (Eurostat) Michael.Goll@ec.europa.eu			1A Reference approach				1A Reference approach	
EEA and ETC-ACM	Ricardo Fernandez (EEA) ricardo.fernandez@eea.europa.eu	X				X			
	Spyridoula Ntemiri (EEA) spyridoula.ntemiri@eea.europa.eu				X				X
	David Simoens (EEA) david.simoens@eea.europa.eu								ReportNet, Data checks

Name	EC GHG inventory/inventory report compilation				Quality management system			
	Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
Nicole Mandl (ETC-ACM, UBA-V) nicole.mandl@umweltbundesamt.at		X		Chapter 2, 17 Trend explanations		X		
Michael Gager (ETC-ACM; UBA-V) michael.gager@umweltbundesamt.at				Data manager, SEF tables			Inventory compilation	SEF tables
Bernd Gugele (ETC-ACM; UBA-V) bernd.gugele@umweltbundesamt.at			1A1				1A1	X
Stephan Poupa (ETC-ACM; UBA-V) stephan.poupa@umweltbundesamt.at			1A2, 1A4, 1A5				1A2, 1A4, 1A5	
Sabine Schindlbacher (ETC-ACM; UBA-V) sabine.schindlbacher@umweltbundesamt.at			1B, 3				1B, 3	
Heide Jobstmann(ETC-ACM; UBA-V) heide.jobstmann@umweltbundesamt.at				2C, 2D, 2E, 2F, 2G				2C, 2D, 2E, 2F, 2G
Lorenz Moosmann (ETC-ACM, UBA-V lorenz.moosmannr@umweltbundesamt.at			2C, 2D, 2E, 2F, 2G				2C, 2D, 2E, 2F, 2G	
Traute Köther (ETC-ACM; UBA-V) traute.koether@umweltbundesamt.at				3			Internal evaluation	3
Marion Pinterits (ETC-ACM; UBA-V) marion.pinterits@umweltbundesamt.at				Chapter 10 Recalculations, support UBA work				X
Andreas Zechmeister (ETC-ACM; UBA-V) andreas.zechmeister@umweltbundesamt.at				Chapter 1 Uncertainties				
Hubert Fallmann hubert.fallmann@umweltbundesamt.at				EU-ETS verification				
Giorgos Mellios (ETC-ACM; Emisia) giorgos.m@emisia.com			1A3 + bunkers				1A3 + bunkers	
Matina Kastori(ETC-ACM; Emisia) matina.k@emisia.com				1A3 + bunkers				1A3 + bunkers
Ralph Harthan (ETC-ACM; Oeko) r.harthan@oeko.de			6				6	

	Name	EC GHG inventory/inventory report compilation				Quality management system			
		Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
	Anke Herold (ETC-ACM; Oeko) a.herold@oeko.de			2A, 2B	EU-ETS			2A, 2B	
	Ulrike Doering (ETC-ACM; Oeko) u.doering@oeko.de				Chapter 3.14, improvements related to the review				
	Lukas Emele (ETC-ACM; Oeko) l.emele@oeko.de				support Oeko work				support Oeko work

Table 1.2 shows the main institutions and persons involved in the compilation and submission of the EU-15 inventory.

Table 1.2 List of institutions and experts responsible for the compilation of Member States' inventories and for the preparation of the EU inventory

Member State/EU institution	Contact address
Austria	Manfred Ritter Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Belgium	Peter Wittoeck Federal Department of the Environment Place Victor Horta 40, B-1060 Brussels
Denmark	Ole-Kenneth Nielsen Aarhus University Frederiksborgvej 399, PO Box 358, DK-4000 Roskilde
Finland	Riitta Pipatti Statistics Finland PB 6 A, FIN-00022 Statistics Finland
France	Ministère de l'Écologie, de l'Énergie,du Développement Durable et de la Mer (MEEDDM) en charge des Technologies vertes et des Négociations sur le climat Direction Générale de l'Energie et du Climat (DGEC) Arche de La Défense Paroi Nord 92055 La Défense CEDEX Frédérique Millard Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 7 Cité Paradis, F-75010 Paris Jean-Pierre Fontelle
Germany	Michael Strogies Federal Environmental Agency Wörlitzer Platz 1, D-06844 Dessau-Roßlau
Greece	Ms Irini Nikolaou, Ministry of Environment, Energy and Climate Change Villa Kazouli, Kifisias 241 Athens, Greece
Ireland	Paul Duffy Environmental Protection Agency PO Box 3000, Johnstown Castle, Co. Wexford, Ireland
Italy	M. Contaldi, R. de Lauretis, D. Romano National Environment Protection Agency (ANPA) Via Vitaliano Brancati 48, I-00144 Rome
Luxembourg	Eric De Brabanter Département de l'Environnement Ministère du Développement durable et des Infrastructures L-2918 Luxembourg Dr Marc Schuman Administration de l'Environnement 16 rue Eugène Ruppert L-2453 Luxembourg
Netherlands	Wim van der Maas National Institute for Public Health and the Environment P.O. Box 1, 3720 BA Bilthoven, The Netherlands
Portugal	Teresa Costa Pereira Agência Portuguesa do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Spain	Maj Britt Larka Abellán Dirección General de Calidad y Evaluación Ambiental y Medio Natural Ministerio de Agricultura, Alimentación y Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Ms. Stina Gustafsson Ministry of Environment Tegelbacken 2 S-103 33 Stockholm Sweden Mrs. Maria Lidén The Swedish Environmental Protection Agency

Member State/EU institution	Contact address
	S-106 48 Stockholm Sweden
United Kingdom	Joanna MacCarthy, Helen Champion Department of Energy and Climate Change 3 Whitehall Place, London SW1A 2AW, UK
European Commission	Velina Pendolovska European Commission, DG Climate Action Beaulieu, BU-24 4/42, Brussels, Belgium
European Environment Agency (EEA)	Ricardo Fernandez, Spyridoula Ntemiri, David Simoens European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)	Nicole Mandl, Michael Gager, Manfred Ritter European Topic Centre on Air Pollution and Climate Change Mitigation Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Michael Goll Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
Joint Research Centre (JRC)	Giacomo Grassi, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA), Italy

1.1.2 The Member States

All EU-15 Member States are Annex I parties to the UNFCCC. Therefore, all EU-15 Member States have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all EU Member States are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the European Commission by 15 January every year under Council Decision 280/2004/EC.

The European Union’s inventory is based on the inventories supplied by Member States. The total estimate of the EU greenhouse gas emissions should accurately reflect the sum of Member States’ national greenhouse gas inventories. Member States are responsible for choosing activity data, emission factors and other parameters used for their national inventories as well as the correct application of methodologies provided in the IPCC 1996 Guidelines, IPCC Good Practice Guidance and IPCC Good Practice Guidance for LULUCF. Member States are also responsible for establishing quality assurance/quality control (QA/QC) programmes for their inventories. The QA/QC activities of each Member State are described in the respective national inventory reports and summarised in the European Union inventory report.

Apart from submitting their national GHG inventories and inventory reports the Member States take part in the review and comment phase of the draft EU inventory report, which is sent to the Member States by 28 February each year. The purpose of circulating the draft EU inventory report is to improve the quality of the EU inventory. The Member States check their national data and information used in the EU inventory report and send updates, if necessary. In addition, they comment on the general aspects of the EU inventory report.

The Member States also take part in the Climate Change Committee established under Decision No 280/2004/EC. The purpose of the Climate Change Committee is to assist the European Commission in its tasks under Decision No 280/2004/EC.

Under Council Decision 280/2004/EC all Member States are required to establish national systems. Table 1.3 summarises the information on national systems/institutional arrangements in the EU-15 Member States.

Table 1.3 Summaries of institutional arrangements/national systems of EU-15 Member States

MS	Institutional arrangements/national systems	Source
Austria	Austria has a centralized inventory system, with all the work related to inventory preparation being carried out at a single national entity. The most important legal arrangement is the Austrian Environmental Control Act (Umweltkontrollgesetz), which defines the main responsibility for inventory preparation and identifies the Umweltbundesamt as the single national entity with the overall responsibility for inventory preparation. Within the Umweltbundesamt the "Inspection Body for Emission Inventories" is responsible for the compilation of the greenhouse gas inventory. Within the inventory system specific responsibilities for the different emission source/sink categories ("sector experts") are defined. Sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts are also responsible for the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system, the head of the "Inspection body for GHG inventory"approves the methodological choices. Finally, sector experts perform Quality Assurance and Quality Control (QA/QC) activities. The Austrian Inventory is based on the SNAP nomenclature and has to be transformed into the UNFCCC CRF to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC. As part of the QMS's documentation and archiving procedures a reliable data management system has been established to fulfil the data collecting and reporting requirements. This ensures the necessary documentation and archiving for future reconstruction of the inventory and con-sequently enables easy access to up-to-date and previously submitted data for the quantitative evaluation of recalculations. As part of the QMS (Corrective and Preventive Actions) an efficient process is established to grant transparency when collecting and analyzing findings by UNFCCC review experts or any other issues concerning the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Any findings and discrepancies are documented; responsibilities, resources and a time schedule are attributed to each of these in the improvement plan. Measures, which include possible recalculations, are taken by the sector experts. The national energy balance is the most important data basis for the Austrian Air Emissions Inventory. The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and with the Federal Ministry of Economics and Labour to annually prepare the national energy balance. The compilation of several other relevant statistics is regulated by law. Other data sources include reporting obligations under national and European regulations and reports of companies and associations. The main data sources used for activity data were: • Energy Balance from Statistik Austria; EU-ETS; Steam boiler database (for the sector Energy) • Energy Balance from Statistik Austria (for the sector Transport) • National production statistics, import/export statistics; EU-ETS; direct information from industry or associations of industry (for the sector Industry) • Short term statistics for trade and services, Austrian foreign trade statistics, structural business statistics, surveys at companies and associations (for the sector Solvents) • National Studies, national agricultural statistics obtained from Statistik Austria (for the sector Agriculture) • National forest inventory obtained from the Austrian Federal Office and Research Centre for Forests (for the sector LULUCF) • National agricultural statistics and land use statistics obtained from Statistik Austria • Database on landfills (1998-2007) + Electronic Data Management (from 2008 on; incl. data for 2011). The main sources for emission factors are: (1) national studies for country specific emission factors, (2) plant-specific data reported by plant operators (3) IPCC GPG (4) Revised IPCC 1996 Guidelines (5) EMEP/EEA air pollutant emission inventory guidebook .	Austria's Annual Greenhouse Gas Inventory 1990–2010 Mar 2012 pp 24ff

MS	Institutional arrangements/national systems	Source
Belgium	In the Belgian federal context, major responsibilities related to environment lie with the regions. Compiling greenhouse gas emissions inventories is one of these responsibilities. Each region implements the necessary means to establish their own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined to compile the national greenhouse gas emission inventory. Since 1980, the three regions have been developing different methodologies (depending on various external factors) for compiling their atmospheric emission inventories. During the last years important efforts are made to tune these different methodologies, especially for the most important (key) sectors. Obviously, this requires some co-ordination to ensure the consistency of the data and the establishment of the national inventory. This co-ordination is one of the permanent tasks of the Working Group on « Emissions » of the Coordination Committee for International Environmental Policy (CCIEP), where the different actors decide how the regional data will be aggregated to a national total, taking into account the specific characteristics and interests of each region as well as the available means. This working group consists of representatives of the 3 regions and of the federal public services. The Interregional Environment Unit (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three regions and for compiling the national inventory. The National inventory report is than formally submitted to the National Climate Commission, established by the Cooperation agreement of 14 November 2002, for approval, before its submission to the secretariat of the United Nations Framework Convention on Climate Change and to the European Commission, under the Council Decision 280/2004/EC concerning a Mechanism for Monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.	Belgium's GHG Inventory (1990 – 2009) National Inventory Report Jan 2011 p 2 No major change since 2010 submission
Denmark	On behalf of the Ministry of the Environment and the Ministry of Climate,Energy and Building the Danish Centre for Environment and Energy (DCE)is responsible for the calculation and reporting of the Danish national emission inventory to the EU, the UNFCCC (United Nations Framework Convention on Climate Change) and UNECE CLRTAP (Convention on Long-Range Transboundary Air Pollution). Hence, the Danish Centre for Environment and Energy (DCE), Aarhus University, prepares and publishes the annual submission for Denmark to the EU and UNFCCC of the National Inventory Report and the GHG inventories in the Common Reporting Format, in accordance with the UNFCCC guidelines. Furthermore, DCE is responsible for reporting the national inventory for the Kingdom of Denmark to the UNFCCC. DCE is also the body designated with overall responsibility for the national inventory under the Kyoto Protocol for Greenland and Denmark. The work concerning the annual greenhouse gas emission inventory is carried out in cooperation with Danish ministries, research institutes, organisations and companies. The Government of Greenland is responsible for finalising and transferring the inventory for Greenland to DCE. The Faroe Islands Environmental Agency is responsible for finalising and transferring the inventory for the Faroe Islands to DCE. There are now data agreements in place with both Greenland and the Faroe Islands ensuring the data delivery. These agreements contain deadlines for when DCE is to receive the data and documentation. DCE has been and is engaged in work in connection to the meetings of the Conference of Parties (COP) to the UNFCCC and the meetings of the parties (COP/MOP) to the Kyoto protocol and its subsidiary bodies, where the reporting rules are negotiated and settled. Furthermore, DCE participates in the EU Monitoring Mechanism, Working Group 1 (WG1), where the guidelines, methodologies etc. on inventories to be prepared by the EU Member States are regulated.	Denmark's National Inventory Report 2012: Emission Inventories 1990-2010 Mar 2012 p 36f

MS	Institutional arrangements/national systems	Source
Finland	In accordance with the Government resolution of 30 January 2003 on the organisation of climate policy activities of Government authorities in Finland, Statistics Finland assumed the responsibilities of the National Entity for Finland´s greenhouse gas inventory from the beginning of 2005. Statistics Finland as the general authority of the official statistics of Finland is independently responsible for greenhouse gas inventory submissions under the UNFCCC, the Kyoto Protocol and the EU monitoring mechanism. Besides Statistics Finland, the Finnish Environment Institute, MTT Agrifood Research Finland and the Finnish Forest Research Institute take part in the inventory preparation. Statistics Finland acquires also parts of the inventory calculations as purchased services from VTT (Technical Research Centre of Finland) and Finavia. In Finland the national system, as intended in the Kyoto Protocol (Article 5.1), is based, besides regulations concerning Statistics Finland, on agreements on the production of emission/removal estimations and reports between the inventory unit at Statistics Finland and the expert organisations mentioned above. Statistics Finland has also agreements with the responsible ministries defining the responsibilities and collaboration in relation to the reporting requirements under the UNFCCC and Kyoto Protocol, as well as the EU monitoring mechanism. In Finland the National System is established on a permanent footing and it guides the development of emission calculation in the manner required by the agreements. The National System is designed and operated to ensure the transparency, consistency, comparability, completeness, accuracy and timeliness of greenhouse gas emission inventories. The quality requirements are fulfilled by implementing consistently the inventory quality management procedures. A detailed description of the National Greenhouse Gas Inventory System in Finland can be found from the report "National Greenhouse Gas Inventory System in Finland" which is available on the web: http://stat.fi/greenhousegases. The following changes in Finland's national system have been implemented during 2010: Finavia did not renew the contract for the estimation of the emissions from aviation. The intention was that Eurocontrol would take over this task. Negotiations with Eurocontrol had been initiated earlier, but the general assembly of the Eurocontrol gave its acceptance for the provision on the data for inventory purposes only late in 2010. Eurocontrol will start developing a portal, from which its member states could retrieve the information needed to estimate the emissions for the national GHG. Finland will participate in this development work. However, the project has progressed very slowly and implementation of the portal will take place at the earliest in 2012. Finavia has agreed to provide Statistics Finland with the necessary data and support for the inventory calculations until the agreement with Eurocontrol is implemented. Finavia currently responsible for the negotiations on this issue with Eurocontrol, and will also take part in the development of the portal mentioned above. Finavia will also provide further technical assistance in this issue, depending on the details of the future agreement with Eurocontrol. For 2009 the emissions from aviation were estimated based on data provided by Finavia and calculations made by Statistics Finland. The agreement between Statistics Finland and the Energy Market Authority has been updated in 2010. The new agreement defines in more detail the collaboration as well as contents and timelines for data/other information exchange between the organisations in the reporting of the data to UNFCCC secretariat. The new agreement gives Statistics Finland also access to the more detailed data collected by the Energy Market authority.	GHG Emissions in Finland 1990-2010 Draft Jan 2012, p 20 ff.

MS	Institutional arrangements/national systems	Source
France	The responsibility of the definition and control of the National Air Pollutant Emissions Inventory System (Système National d'Inventaires d'Emission et de Bilans dans l'Atmosphère (SNIEBA)) is pertained by the Ministère de l'Ecologie, du Développement Durable, et de l'Energie (MEDDE). The MEDDE is in charge of overseeing production of the inventories and overall coordination of the system. Other ministries and public bodies contribute to the emission inventories by providing data and statistics used in the preparation of the inventories. The MEDDE has entrusted CITEPA (Interprofessional Technical Centre for Studies on Air Pollution or Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) with the following tasks: preparing the emission inventories with regard to methods and preparing their updating, data collection and processing, data storage, production of the reports and various means of disseminating the information, control and quality management. CITEPA assists the MEDDE in overall coordination of the National Air Pollutant Emissions Inventory System. Mention should be specifically made of the coordination that must be ensured between the emission inventories and emitter registers such as the E-PRTR and the greenhouse gas emission allowance register in the frame of the ETS directive, not forgetting other aspects (guides published by the MEDDE, the annual pollutant emission reporting system, etc.). The MEDDE provides CITEPA with all information it has at its disposal under existing legislation and regulations, such as the annual notifications made by Classified Installations under the pollutant emission reporting system, as well as the results of different studies providing greater knowledge on emissions that it commissioned either internally (ie within its departments) or from other bodies, such as the National Institute for Industry, Environment and Risks (INERIS). The MEDDE steers the Emissions Inventories Consultation and Information Group (GCIIE) whose tasks are to: • give its opinion on the results of estimates produced in the inventories, • give its opinion on the changes made to the methodology for estimating emissions, • give its opinion on the action plan for improving inventories for the future, issue recommendations on all subjects directly or indirectly linked to emission inventories in order to ensure consistency and smooth running of actions, and encourage synergies, etc., • recommend actions for improving the estimation of emissions in the context of research programmes. The GCIIE is made up of representatives: • of the Ministry of Ecology, Energy, Sustainable Development and Sea (MEDDE), and specifically the General Directorate for Energy and Climate (DGEC), General Directorate for Spatial Planning, Housing and Nature (DGALN), the General Directorate for Infrastructure, Transport and Maritime Affairs (DGITM), and the General Directorate for Civil Aviation (DGAC) • of the Ministère de l'agriculture, de l'alimentation, de la pêche, de la ruralité et de l'aménagement du territoire (MAPRAT), particularly the Statistics and Forward Studies Department (SSP) and the General Directorate for Agricultural, Agri-food and Land Policies (DGPAAT), the Ministère de l'Economie, des Finances et de l'Industrie (MINEFI), and specifically the General Directorate of the National Institute of Statistics and Economic Studies (INSEE), the General Directorate of the Treasury and Economic Policy (DGTPE) and the General Directorate of Companies (DGE), • of the General Sustainable Development Commission (CGDD), particularly the Observation and Statistics Department.	Elements de communication au 15 janvier dans le cadre du mecanisme de surveillance des emissions de gaz a effet de serre dans la communaute et la misen oeuvre du protocol de Kyoto Jan 2013 p5ff.

MS	Institutional arrangements/national systems	Source
Germany	The national Inventory System in Germany fulfils the requirements of the Guidelines for National Systems (Decision 19/CMP.1), which are also binding under the European Decision 280/2004/. The use of the IPCC-Guidelines and IPCC Good Practice Guidance and a continuous Quality Management and continuous improvement of the inventory ensure a transparent, consistent, comparable, complete and accurate inventory. In an agreement of state secretaries representing the ministries involved in emission reporting (June 2007) the Federal Environment Agency (Umweltbundesamt) was appointed as the National Coordination Agency for emission inventory reporting, acting as the Single National Entity.The Agreement by State Secretaries on the National System entails: • Definition of responsibilities relative to the relevant sources and sink categories among the departments • Determination of the Federal Environment Agency as the Single National Enity • Implementation of a National Co-ordinating Committee of the departments • Determination of resources for inventories and reporting Other involved institutions and agencies: • Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) • Federal Ministry for Consumer Protection, Food and Agriculture (BMELV) and the Heinrich von Thünen Institut • Federal Ministry of of the Interior (BMI) together with the Federal Statistical Office • Federal Ministry of Defence (BMVg) • Federal Ministry of Finance (BMF) • Federal Ministry of Economis and Technology (BMWi) • Federal Ministry of Transport, Building and Urban Affairs (BMVBS) Tasks of the National Coordination Agency (Umweltbundesamt) are: • Serving as the central Focal Point for all inventory and reporting Issues • Assure and coordinate information and data flow • Planning of the inventories • Compilation of the inventories • Archiving of the inventories • Quality control and Quality Assurance To establish and assure data stream the National Coordination Agency has conclude agreements with other state and non-state institutions, like the economy, institutions of the federal state and other federal institutions To meet these tasks the National Coordination Agency has developed a database "Zentrale System Emissionen" (which is the main instrument for documentation and quality assurance on the level of data) and the Quality system "Emissionsinventare" (which regulates responsibilities and quality targets). The National Coordination Agency within UBA cooperates with other units within UBA. For coordination of the tasks within UBA a working team "Arbeitskreis Emissionsinventare" was installed. Research centres contribute to inventory compilation with research projects that are carried out within the Framework, inter alia, of the research programme "Umweltforschungsplan".	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2010 Mar 2012 pp 65 ff. (submitted in German, translation provided by Germany via direct communication)

MS	Institutional arrangements/national systems	Source
Greece	The Ministry of Environment, Energy and Climate Change, MEECC (former Ministry for the Environment, Physical Planning and Public Works) is the governmental body responsible for the development and implementation of environmental policy in Greece, as well as for the provision of information concerning the state of the environment in Greece in compliance with relevant requirements defined in international conventions, protocols and agreements. Moreover, the MEECC is responsible for the co-ordination of all involved ministries, as well as any relevant public or private organization, in relation to the implementation of the provisions of the Kyoto Protocol, according to the Law 3017/2002 with which Greece ratified the Kyoto Protocol. In this context, the MEECC has the overall responsibility for the national GHG inventory, and the official consideration and approval of the inventory prior to its submission. The entities participating in the organizational structure of the National Inventory System are: The MEECC designated as the national entity responsible for the national inventory, which keeps the overall responsibility, but also plays a more active role in the inventory planning, preparation and management. The National Technical University of Athens (NTUA) / School of Chemical Engineering, which has the technical and scientific responsibility for the compilation of the annual inventory. Governmental agencies and ministries, international associations, along with individual private industrial companies. The MEECC, as the national entity, has the overall responsibility for the national GHG inventory. Among its responsibilities are the following: • The co-ordination of all ministries and governmental agencies involved, as well as any relevant public or private organization. In this context, it oversees the operation of the National System and decides on the necessary arrangements to ensure compliance with relevant decisions of the COP and the COP/MOP. • The official consideration and approval of the inventory prior to its submission. • The response to any issues raised by the inventory review process under Article 8 of the Kyoto Protocol, in co-operation with the technical consultant (NTUA Inventory Team), who has the technical and scientific responsibility for the inventory planning, preparation and management of all sectors, as mentioned above. • The timely submission of the GHG inventory to the European Commission and to the UNFCCC Secretariat • The keeping of the Centralised Inventory File, which is delivered to the institute which has the technical responsibility for the inventory planning, preparation and management (currently NTUA) at the beginning of each inventory cycle. The Centralised Inventory File is kept at the premises of MEECC. • The administration of the National Registry. • The supervision of Quality Assurance/Quality Control Plan (QA/QC). As it appears from the above description, the role of the MEECC is not narrowed to the coordination of the entities involved in the inventory process and to facilitate the activity data transfer from the data providers to the NTUA's Inventory Team. MEECC has an active role in monitoring and overseeing the inventory process through continuous communication and frequent scheduled and / or ad-hoc meetings with the Inventory Team of NTUA and the competent ministries or other agencies involved.	Greece – Climate change emission inventory Information under Article 3(1) of the Decision 280/2004/EC, Jan 2011, pp 3-6
Ireland	The Environmental Protection Agency is required to establish and maintain databases of information on the environment and to disseminate such information to interested parties (Section 52 of the Environmental Protection Agency Act of 1992 (DOE, 1992)). The Act states that the Agency must provide, of its own volition or upon request, information and advice to Ministers of the Government in the performance of their duties (Section 55). This includes making available such data and materials as are necessary to comply with Ireland's reporting obligations and commitments within the framework of international agreements. These requirements are the regulatory basis on which the EPA prepares annual inventories of greenhouse gases and other important emissions to air in Ireland. It is in this context that in 1995 the Department of the Environment, Community and Local Government (DECLG) designated the EPA as the inventory agency with responsibility for the submission of emissions data to the UNFCCC Secretariat and to the Secretariat for the Convention on Long-Range Transboundary Air Pollution (CLRTAP).	Ireland National Inventory Report 2013,GHG emissions 1990-2011 reported to the European Commission Jan 2013 p 1

<table>
<tr><th>MS</th><th>Institutional arrangements/national systems</th><th>Source</th></tr>
<tr><td>Italy</td><td>A Legislative Decree, issued on 7th March 2008, institutes the National System for the Italian Greenhouse Gas Inventory. The Institut of Environmental Protectioen and Research (ISPRA), former Agency for Environmental Protection and Technical Services (APAT) is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory. The Ministry for the Environment, Land and Sea is responsible for the endorsement of the inventory and for the communication to the Secretariat of the Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism.

The Institute annually develops a national system document which includes all updated information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information. The last year report is publicly available at: http://www.apat.gov.it/site/_files/NationalSystemItaly08.pdf.

A specific unit of the Agency is responsible for the compilation of the Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory in the framework of both the Convention on Climate Change and the Convention on Long Range Transboundary Air Pollution.

The whole inventory is compiled by the agency; scientific and technical institutions and consultants may help in improving information both on activity data and emission factors of some specific activities. All the measures to guarantee and improve the transparency, consistency, comparability, accuracy and completeness of the inventory are undertaken.

ISPRA bears the responsibility for the general administration of the inventory, co-ordinates participation in reviews, publishes and archives the inventory results.

Specifically, ISPRA is responsible for all aspects of national inventory preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC 1996 Revised Guidelines, the IPCC Good Practice Guidance and Uncertainty management and the IPCC Good Practice Guidance for land use, land- use change and forestry, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common Reporting Format, the response to the review process, the updating and data storage.

Different institutions are responsible for statistical basic data and data publication, which are primary to ISPRA for carrying out emission estimates. These institutions are part of the National Statistical System (Sistan), which provides national official statistics, and therefore are asked periodically to update statistics; moreover, the National Statistical System ensures the homogeneity of the methods used for official statistics data through a coordination plan, involving the entire public administration at central, regional and local levels.

The National Statistical System is coordinated by the Italian National Institute of Statistics (ISTAT). Ministries, public agencies and other bodies are obliged to provide the data and information specified in the annual statistical plan; the same obligations regard the private entities. All the data are protected by the principles of statistical disclosure control and can be distributed and communicated only at aggregate level. The main Sistan products, which are primarily necessary for the inventory compilation, are:
• National Statistical Yearbooks, Monthly Statistical Bulletins, by ISTAT (National Institute of Statistics)
• Annual Report on the Energy and Environment, by ENEA (Agency for New Technologies, Energy and the Environment)
• National Energy Balance (annual), Petrochemical Bulletin (quarterly publication), by MSE (Ministry of Economic Development)
• Transport Statistics Yearbooks, by MINT (Ministry of Transportation)
• Annual Statistics on Electrical Energy in Italy, by TERNA (National Independent System Operator)
• Annual Report on Waste, by ISPRA
• National Forestry Inventory, by MIPAAF (Ministry of Agriculture, Food and Forest Policies).
• The national emission inventory itself is a Sistan product.</td><td>Italian Greenhouse Gas Inventory
1990-2007
National Inventory Report 2009, Apr 2009, pp 20-23</td></tr>
</table>

MS	Institutional arrangements/national systems	Source
Luxembourg	A Grand-Ducal Regulation11 designates a Single National Entity, the National Inventory Compiler and the National GHG Inventory Focal Point. It also defines and allocates specific responsibilities for the realization of the GHG Inventories both within the Single National Entity and within the other administrations and/or services that are involved in the inventory preparation in the future. The previously cited regulation designates the Environment Agency (Administration de l'Environnement, AEV)12 as the "Single National Entity with overall responsibility for the GHG Inventory". Overall management of the Single National Entity is assigned to one staff member of the Environment Agency that is nominated GHG Inventory Focal Point. The Agency also acts as "National Inventory Compiler" compiling and checking the information and GHG emission estimates coming from sector experts working in other administrations or services.The Environment Agency has therefore the "technical" knowledge and responsibility for the GHG Inventories, but the "political" responsibility is staying with the Department of the Environment of the Ministry of Sustainable Development and Infrastructures – hereafter designated as MDDI-DEV – acting as UNFCCC National Focal Point. Thus, it is the Ministry that officially submits the inventories and their related reports to the UNFCCC Secretariat and the European Commission.Luxembourg has, thus, adopted an "integrated approach" to avoid redundant and overlapping activities in different administrative services. This concentration of air emissions reporting in one department also allows an improved consistency between different reporting schemes. As an example, indirect GHG and SO_2 emissions that are to be recorded in the GHG inventory – and that, as indicated previously, need to be re-evaluated in the light of the revision of the inventories Luxembourg is compiling for the UNECE CLRTAP and under the "NEC Directive" – are extracted and adapted from the CLRTAP/NEC reporting schemes.	National Inventory Report 1990-2011 Luxembourg May 2013 pp 38-39

Netherlands	The Ministry of Infrastructure and Environment (IenM) has overall responsibility for climate change policy issues including the preparation of the inventory. In August 2004, IenM assigned SenterNovem (now NL Agency) executive tasks bearing on the National Inventory Entity (NIE), the single national entity required under the Kyoto Protocol. In December 2005, NL Agency was designated by law as the NIE. In addition to co-ordinating the establishment and maintenance of a National System, the tasks of NL Agency include overall co-ordination of improved QA/QC activities as part of the National System and co-ordination of the support/response to he UNFCCC review process. The National System is described in more detail in the Fourth and Fifth National Communication (VROM 2006b, 2009). Since 1 January 2010, RIVM has been assigned by IenM as co-ordinating institute for compiling and maintaining the pollutants emission register/inventory (PRTR system), containing about 350 pollutants including the greenhouse gases. The PRTR project system is used as basis for the NIR and for filling the CRF. After the general elections in the Netherlands in 2010, the responsibilities of the former VROM moved to the restructured Ministry of Infrastructure and Environment (IenM). The Dutch PRTR has been in operation in the Netherlands since 1974. This system encompasses data collection, data processing and registering and reporting emission data for about 350 policy-relevant compounds and compound groups that are present in air, water and soil. The emission data is produced in an annual (project) cycle (RIVM, 2012). This system is also the basis for the national greenhouse gas inventory. The overall co-ordination of the PRTR is outsourced by the ministry (IenM) to the RIVM. The main objective of the PRTR is to produce an annual set of unequivocal emission data that is up-to-date, complete, transparent, comparable, consistent and accurate. In addition to RIVM, various external agencies contribute to the PRTR by performing calculations or submitting activity data. These include: CBS (Statistics Netherlands), PBL (Netherlands Environmental Assessment Agency), TNO (Netherlands Organisation for Applied Scientific Research), Rijkswaterstaat Environment, Centre for Water Management, Deltares and several institutes related to the Wageningen University and Research Centre (WUR). The NIR part 1 is prepared by RIVM as part of the PRTR project. Most institutes involved in the PRTR also contribute to the NIR (including CBS and TNO). In addition, NL Agency is involved in its role as NIE. NL Agency also prepares the NIR part 2 and takes care of integration and submission to the UNFCCC in its role as NIE. Submission to the UNFCCC only takes place after approval by IenM.	Greenhouse Gas Emissions in the Netherlands 1990-2011 Mar 2013

Portugal	In order to comply with the commitments at the international and EC levels, respectively, the Article 5(1) of the Kyoto Protocol and Decision 280/2004/EC of the European Parliament and of the Council, a National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants - (SNIERPA) was created. This system contains a set of legal, institutional and procedural arrangements that aim at ensuring the accurate estimation of emissions by sources and removals by sinks of air pollutants, as well as the communication and archiving of all relevant information. The principal objective of the national system is to prepare and ensure the transparency, consistency, comparability, completeness, accuracy and timeliness of the inventory of air pollutants (INERPA), in accordance with the directives defined at international and EC levels, in order to make easier and more cost-effective the tasks of inventory planning, implementation and management, The system was established through Council of Ministers Resolution 68/2005, of 17 March, which defines the entities relevant for its implementation, based on the principle of institutional cooperation. This clear allocation of responsibilities is essential to ensure the inventory takes place within the defined deadlines. For the sake of efficiency, the Portuguese national system has been broadened to include a wider group of air pollutants than just GHG not covered by the Montreal Protocol, allowing for improvements in information quality, as well as an optimisation of human and material resources applied to the preparation of the inventory. Three bodies are established with differentiated responsibilities. These are: 1. The Portuguese Environmental Agency (APA)/ Ministry of Ministry for the Environment and Land Use Planning, is the Responsible Body responsible for: the overall coordination and updating of the National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants (INERPA); the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives. 2. CAOS Sustentabilidade, was a private company contracted by APA to support the inventory unit on the development of a methodological approach and the implementation of a procedure to quantify KP-LULUCF activities. 3. The sectoral Focal Points work with APA in the preparation of INERPA, and are responsible for fostering intra and inter-sectoral cooperation to ensure a more efficient use of resources. Their main task includes coordinating the work and participation of the relevant sectoral entities over which it has jurisdiction. It is also the Focal Points duty to provide expert advice on methodological choice, emission factor determination and accuracy of the activity data used. Focal Points play a vital role in sectoral quality assurance and methodological development. The involved entities are public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body. All governmental entities have the responsibility to ensure, at a minimum, co-funding of the investment needed to ensure the accuracy, completeness and reliability of the emissions inventory. The RCM also includes a procedure for the official consideration of the inventory. This consideration is done at the level of the designated representatives of Focal Points and Involved Entities. The SNIERPA is composed of three technical elements: 1. A Quality Control and Quality Assurance System (QA/QC System) 2. A Methodological Development Programme (MDP), and 3. An integrated IT system for the management (SIGA) of the SNIERPA (this last not yet implemented).	Short Portuguese National Inventory Report on Greenhouse Gases, 1990-2010, Jan 2012, pp 1-6

Spain	The Directorate General of Environmental Quality and Assessment and Natural Affairs (DG-CEAMN) at the Ministry of Agriculture, Food and Environment (MAGRAMA) is the National Authority for the National Air Pollutant Emissions Inventory System. Within DG-CEAMN is the Subdirectorate General of Air Quality an Industrial Environment (SG-CAyMAI) the body charged with the execution of the inventory and processing the information collected from the various sources. The air pollutant emissions inventories are considered to be statistics for State purposes and as such, in accordance with article 149.1.31 of the Spanish Constitution, are performed on the basis of the exclusive responsibility of the State. In this sense, the regulatory frame of reference is provided by the Spanish Public Statistical Function Act (Law 12 dated May 9th, 1989) and by 2009-2012 National Statistical Plan, approved by Royal Decree 1663 dated October 17th, 2008 (National Statistical Plan is updated every four years. New 2013-2016 Statistical Plan was approved by Royal Decree 168 dated December 7th, 2012). With regard to data collection, law 12/1989 establishes two different regimes for the regulation of statistics depending on wether data are demanded in a compulsory manner or individuals are free to provide information voluntarily. Since they form part of the National Statistical Plan and their preparation represents an obligation for the Spanish State under European Union regulations, emissions inventories fall into the first of these two regimes, i.e. the submission of data by individuals is compulsory. The DG-CEAMN is the national entity under the Spanish national inventory system. (Order MAM/1444/2006). It is technically supported by the company Análisis Estadístico de Datos, S.A. (AED) in the effective ejecution and general inventory development and also integrates the STEPA-UPV cooperation for the agriculture sector and with TRAGSATEC to reinforce the LULUCF sector specially supplementary information requested for Kioto Protocol and other punctual aspects related. With regard to the participation of ministerial departments and according to the aforementioned quote about the concretion of responsabilities of the Contact Points within Ministerial Department and Autonomous Organisms for providing of information required for the preparation of the Inventory. Ministry of Industry, Tourism and Trade Ministry of Economy and Competitiveness Ministry of Health, Social Policy and Equality Ministry of Development Ministry of Defense Ministry of the Interior	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2011 March 2013 (submitted in Spanish, translated)

Sweden	The Swedish Ministry of Environment is the single national entity and has overall responsibility for the inventory. The Swedish EPA is responsible for co-ordinating the activities for producing the inventory, maintaining the reporting system and also for the final quality control and quality assurance of the inventory. The Swedish EPA sends the inventory to Ministry of the Environment and – on behalf of the Ministry of Environment – submits the inventory to the EU and to the UNFCCC. Finally, the Swedish EPA is responsible for national publication of the greenhouse gas inventory. The Swedish EPA engages consultants with expert skills to conduct the inventory and reporting in the area of climate change. During the spring of 2005, the Swedish EPA completed a negotiated procurement of services under the terms of the Public Procurement Act. After procurement had been completed, a framework contract was signed with the consortium Swedish Environmental Emissions Data (SMED)2, consisting of the Swedish Meteorological and Hydrological Institute (SMHI), Statistics Sweden (SCB), the Swedish University of Agricultural Sciences (SLU) and the Swedish Environmental Research Institute (IVL). The contract between the Swedish EPA and SMED runs for nine years and thus covers the whole first commitment period under the Kyoto Protocol. SMED receives data and documentation from responsible authorities as described above and produces most of the data and documentation in the Swedish inventory. The regular inventory work is organized as a project involving all SMED organizations. The project is run by a project management team with one person from each organization. The Swedish Meteorological and Hydrological Institute is main responsible for production of gridded emission data. Statistics Sweden is main responsible for the energy sector, the agriculture sector and parts of the waste sector, but is also involved in industrial processes since these are closely connected to the energy sector. The Swedish University of Agricultural Sciences is responsible for the LULUCF sector. The Swedish Environmental Research Institute is main responsible for the industrial process sector, the solvents and other products use sector and also parts of the waste sector and energy sector. On behalf of the Swedish EPA, SMED also conducts development projects necessary for improving the inventory. The process of inventory preparation is carried out differently for the different sectors: ENERGY- STATIONARY COMBUSTION: Activity data is collected for the following subgroups: Energy industries: Data from quarterly fuel statistics, a total survey conducted by Statistics Sweden at plant level and by fuel type. For some petroleum refining plants, data from the European Union Emission Trading Scheme (ETS) is used. Manufacturing industries: Data mainly from the quarterly fuel statistics, a sample survey conducted by Statistics Sweden. In some cases data from the industrial energy statistics is used as a complement. All data is at plant level and by fuel type. Other sectors: Data from official statistical reports prepared by Statistics Sweden at national level and by fuel type. ENERGY- MOBILE COMBUSTION: Data on fuel consumption at national level and by fuel type is collected and used in combination with emissions data and fuel data from the National Road Administration, the National Rail Administration, the Civil Aviation Administration and the Swedish Military. INDUSTRIAL PROCESSES: The reported data for industrial processes is mainly based on information from environmental reports. The data in the environmental reports refer to emissions derived from plant specific measurements or estimates such as mass balances. The use of default emission factors is limited. SOLVENT AND OTHER PRODUCT USE: Data used for estimating emissions from solvent and other product use are based on emission factors and national activity data obtained from the Products register kept by the Swedish Chemicals Agency. AGRICULTURE: Data on animal numbers, crop areas, yields, sales of manure, manure management and stable periods are taken from official statistical reports published by the Swedish Board of Agriculture and Statistics Sweden. Some complementary information is collected from organisations and researchers, such as the Swedish Dairy Association, Swedish Poultry Meat Association, SLU and the Swedish Institute of Agricultural and Environmental Engineering. LAND USE, LAND USE CHANGE AND FORESTRY: Estimates presented in the LULUCF sector are mainly based on data from the SLU. The SLU is responsible for the National Forest Inventory, which focuses on living biomass, and for the Swedish Forest Soil Inventory, that focuses on dry organic matter and on soil organic carbon. The two inventories are integrated and use the same infrastructure for the field sample. WASTE: Statistics on deposited waste quantities, methane recovery and nitrogen emissions from wastewater handling, are provided by the Swedish Association of Waste Management (Avfall Sverige, former RVF), Statistics Sweden, the Swedish Forest Industries Federation and the Swedish EPA. If new data on organic content in household waste or other relevant research is published, such reports are also considered. A new system for handling emission data, entitled TPS, has been developed and used for the first time in submission 2007. It supports data input from Microsoft Excel sheets, and provides different types of quality gateways.	National Inventory Report Sweden 2012 Mar 2012 pp 36 ff.

United Kingdom	The UK Greenhouse Gas Inventory is compiled and maintained by a consortium led by Ricardo-AEA – the Inventory Agency - under contract to the Climate, Energy, Science and Analysis (CESA) Division in the UK Department of Energy and Climate Change (DECC). Ricardo-AEA is directly responsible for producing the emissions estimates for CRF categories Energy (CRF sector 1), Industrial Processes (CRF sector 2), Solvent and Other Product Use (CRF sector 3), and Waste (CRF Sector 6). Ricardo-AEA is also responsible for inventory planning, data collection, QA/QC and inventory management and archiving. Aether, a partner within the consortium, is responsible for compiling emissions from railways and for the overseas territories and crown dependencies, and for reviewing, updating and making improvements to the QA/QC procedures that are in place. Agricultural sector emissions (CRF sector 4) are produced by Rothamsted Research, under contract to Defra. Land Use, Land-Use Change and Forestry emissions (CRF sector 5) are calculated by the UK Centre for Ecology and Hydrology (CEH), under separate contract to CESA (DECC). DECC is the **Single National Entity** responsible for submitting the UK's greenhouse gas inventory (GHGI) to the UNFCCC. Ricardo-AEA, in collaboration with Aether and other partners compiles the GHGI on behalf of DECC, and produces disaggregated estimates for the Devolved Administrations within the UK. Key Data Providers include other Government Departments such as Department for Environment, Food and Rural Affairs (Defra) and Department for Transport (DfT), Non-Departmental Public Bodies such as the Environment Agency for England and Wales (EA), Northern Ireland Environment Agency (NIEA) and the Scottish Environment Protection Agency (SEPA), private companies such as Tata Steel, BP Chemicals, and business organisations such as the UK Petroleum Industry Association (UKPIA) and the Mineral Products Association (MPA).	UK Greenhouse Gas Inventory 1990-2011 Short NIR, Jan 2013 pp 3-4

1.1.3 The European Commission, Directorate-General Climate Action

The European Commission’s DG Climate Action in consultation with the Member States has the overall responsibility for the EU inventory. Member States are required to submit their national inventories and inventory reports under Decision No 280/2004/EC to the European Commission, DG Climate Action; and the European Commission, DG Climate Action itself submits the inventory and inventory report of the EU to the UNFCCC Secretariat, on behalf of the European Union. In the actual compilation of the EU inventory and inventory report, the European Commission, DG Climate Action, is assisted by the EEA including the EEA’s ETC/ACM and by Eurostat and the JRC.

The consultation between the DG Climate Action and the Member States takes place in the Climate Change Committee established under Article 9 of Decision No 280/2004/EC. The Committee is composed of the representatives of the Member States and chaired by the representative of the DG Climate Action. Procedures within the Committee for decision-making, adoption of measures and voting are outlined in the rules of procedure, adopted in November 2003. In order to facilitate decision-making in the Committee, three working groups have been established: Working Group 1 ‘Annual inventories’, Working Group 2 ‘Assessment of progress (effect of policies and measures, projections)’ and Working Group 3 ‘Emission trading’.

The objectives and tasks of Working Group 1 under the Climate Change Committee include:

- the promotion of the timely delivery of national annual GHG inventories as required under the monitoring mechanism;
- the improvement of the quality of GHG inventories on all relevant aspects (transparency, consistency, comparability, completeness, accuracy and use of good practices);
- the exchange of practical experience on inventory preparation, on all quality aspects and on the use of national methodologies for GHG estimation;
- the evaluation of the current organisational aspects of the preparation process of the EU inventory and the preparation of proposals for improvements where needed.

1.1.4 The European Environment Agency

The European Environment Agency assists the European Commission, DG Climate Action, in the compilation of the annual EU inventory through the work of the EEA's European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), which is an international consortium working with the EEA under a framework partnership agreement. The activities of the EEA's ETC/ACM include:

- initial checks of Member States' submissions in cooperation with Eurostat, and the JRC, up to 28 February and compilation of results from initial checks (status reports, consistency and completeness reports);
- consultation with Member States in order to clarify data and other information provided;
- preparation and circulation of the draft EU inventory and inventory report by 28 February based on Member States' submissions;
- preparation of the final EU inventory and inventory report by 15 April (to be submitted by the Commission to the UNFCCC Secretariat);
- assisting Member States in their reporting of GHG inventories by means of supplying software tools.

The tasks of the EEA and the ETC/ACM are facilitated by the European environmental information and observation network (Eionet), which consists of the EEA as central node (supported by European topic centres) and national institutions in the EEA member countries that supply and/or analyse national data on the environment (see http://eionet.eea.europa.eu). Member States shall report the information reported pursuant to Article 3(1) of Decision No 280/2004/EC to the Commission with a copy to the European Environment Agency. Member States should use the EEA's ReportNet's central data repository under the Eionet for making available their GHG submissions to the European Commission and the ETC/ACM (see http://cdr.eionet.europa.eu/).

1.1.5 The European Topic Centre on Air Pollution and Climate Change Mitigation

The EEA's European Topic Centre on Air and Climate Change Mitigation (ETC/ACM) was established by a contract between the lead organisation Institute for Public Health and the Environment (RIVM) in the Netherlands and EEA for the years 2011-2013. The EEA's ETC/ACM involves 10 organisations and institutions in eight European countries. The technical annex for the 2011 work plan for the EEA's ETC/ACM and an implementation plan specify the specific tasks of the EEA's ETC/ACM partner organisations with regard to the preparation of the EU inventory. Umweltbundesamt Austria is the task leader for the compilation of the EU annual inventory in the EEA's ETC/ACM, including all tasks mentioned above.

The EEA's ETC/ACM provides software tools for Member States to compile national GHG inventories and to convert their national inventory from Corinair-SNAP source category codes into the required CRF source categories. The main software tools are CollectER, for compiling and updating national emission inventories, ReportER, for reporting the emissions in the required format, e.g. CRF, and the CRF Aggregator, developed to ensure the EU submission is fully consistent with member state's (MS) submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission. In addition, separate software tools are available to prepare estimates of emissions from agriculture and road transport. These tools are being used by several Member States. The ETC/ACM adapts the tools regularly to the latest changes in reporting requirements.

A new ETC procurement exercise is underway to ensure continuity of EU GHG inventory preparation. A new contract between the EEA and the ETC will be in place by end 2013 to ensure continued delivery for future years also. As of 27/05/13, the tendering process has finished and the evaluation of the bidder/s is underway. A new consortium will be agreed in June 2013 for operation in 2014-2018.

1.1.6 Eurostat

Eurostat collects national energy statistics reported under the EU Energy Statistics Regulation on an annual basis. These data are used for the estimation of the IPCC Reference Approach and the Sectoral Approach. The EEA compares the results of the two approaches with MS CRF submissions. These comparisons are sent to MS during the consultation on the Draft EU GHG inventory by 28/02. The Energy Statistics Regulation (Regulation EC/1099/2008) is the basis for MS reporting of energy data to Eurostat. Article 6(2) of the Energy statistics regulation stipulates: 'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'. The consistency of energy balances and CRF activity data is essential for good quality GHG estimates in the energy sector, and therefore it is at the core of the QA/QC activities at EU level.

1.1.7 Joint Research Center

The Joint Research Centre (JRC) performs the QA/QC of the LULUCF and Agriculture sectors and is responsible of the writing of the respective chapters. The QA/QC main activity is the annual checking of early versions of the each national GHG inventory. Focus is on errors and inconsistencies, with numerous interactions with national representatives for clarifications and improvements. Specific completeness and consistency checks are also carried out. For LULUCF, additional efforts to help member states in improving their reporting include annual technical workshops (http://afoludata.jrc.ec.europa.eu/index.php/public_area%5Cevents_policy), dedicated EU-funded projects, the AFOLU database (http://afoludata.jrc.ec.europa.eu/index.php/public_area/data_and_tools), and a forest growth model whose results which may be used by countries to compare with their estimates. More information is provided in the QAQC sections of the LULUCF and Agriculture chapters.

1.2 A description of the process of inventory preparation

The annual process of compilation of the EU inventory is summarised in Table 1.4. The Member States submit their annual GHG inventory by 15 January each year to the European Commission’s DG Climate Action. Then, the ETC/ACM, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACM transfers the nationally submitted data from the xml-files into the CRF aggregator database which was developed for aggregating the EU submission from member state (MS) submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission.

Table 1.4 Annual process of submission and review of Member States inventories and compilation of the EU inventory

Element	Who	When	What
1. Submission of annual greenhouse gas inventories (complete common reporting format (CRF) submission and elements of the national inventory report) by Member States under Decision No 280/2004/EC	Member States	15 January	Elements listed in Article 3(1) of Decision 280/2004/EC as elaborated in Articles 2 to7 in particular: Greenhouse gas emissions by sources and removals by sinks, for the year n –2 And updated time series 1990- year n –3, depending on recalculations; Core elements of the NIR Steps taken to improve estimates in areas that were previously adjusted under Article 5.2 of the Kyoto Protocol (for reporting under the Kyoto Protocol)
2. 'Initial check' of Member States' submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	As soon as possible after receipt of Member State data, at the latest by 1 April	Initial checks and consistency checks (by EEA). Comparison of energy data provided by Member States on the basis of the IPCC Reference Approach with Eurostat energy data (by Eurostat and Member States) and check of Member States' agriculture and land use, land-use change and forestry (LULUCF) inventories by DG JRC (in consultation with Member States).
3. Compilation of draft EU inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft EU inventory (by EEA), based on Member States' inventories and additional information where needed.
4. Circulation of draft EU inventory	Commission (DG Climate Action) assisted by the EEA	28 February	Circulation of the draft EU inventory on 28 February to Member States. Member States check data.
5. Submission of updated or additional inventory data and complete national inventory reports by Member States	Member States	15 March	Updated or additional inventory data submitted by Member States (to remove inconsistencies or fill gaps) and complete final national inventory reports.
6. Estimates for data missing from a national inventory	Commission (DG Climate Action) assisted by EEA	31 March	The Commission prepares estimates for missing data by 31 March of the reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
7. Comments from Member States regarding the Commission estimates for missing data	Member States	8 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
8. Final annual EU inventory (incl. EU inventory report)	Commission (DG Climate Action) assisted by EEA	15 April	Submission to UNFCCC of the final annual EU inventory. This inventory will also be used to evaluate progress as part of the monitoring mechanism.
9. Circulation of initial check results of the EU submission to Member States	Commission (DG Climate Action) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EU submission as soon as possible after their receipt to those Member States, which are affected by the initial checks.
10. Response of relevant Member States to initial check results of the EU submission	Member States	Within one week from receipt of the findings	The Member States, for which the initial check indicated problems or inconsistencies provide their responses to the initial check to the Commission.
11. Any resubmissions by Member States in response to the UNFCCC initial checks	Member States	For each Member State, same as under the UNFCCC initial checks phase Under the Kyoto Protocol: the resubmission should be provided to the Commission by 15 May at the	Member States provide to the Commission the resubmissions which they submit to the UNFCCC Secretariat in response to the UNFCCC initial checks. The Member States should clearly specify which parts have been revised in order to facilitate the EU resubmission. As the EU resubmission also has to comply with the deadlines specified in the guidelines under Article 8 of the Kyoto Protocol, the resubmission has to be sent to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, but not later than 15 May..

Element	Who	When	What
		latest	
12. Submission of any other resubmission after the initial check phase	Member States	When additional resubmissions occur	Member States provide to the Commission any other resubmission (CRF or national inventory report) which they provide to the UNFCCC Secretariat after the initial check phase.

On 28 February, the draft EU GHG inventory and inventory report are circulated to the Member States for review and comment. The Member States check their national data and information used in the EU inventory report and send updates, if necessary, and review the EU inventory report by 15 March. This procedure should assure the timely submission of the EU GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EU submission to the UNFCCC Secretariat is consistent with Member States' UNFCCC submissions.

The final EU GHG inventory and inventory report is prepared by the EEA's ETC/ACM by 15 April for submission to the UNFCCC Secretariat. Resubmissions of the EU GHG inventory and inventory report are prepared by 27 May, if needed. By 15 May, Member States provide to the Commission any resubmission in response to the UNFCCC initial checks which affect the EU inventory, in order to guarantee that the EU resubmission to the UNFCCC Secretariat is consistent with the Member States' resubmissions. By the end of May the inventory and the inventory report are published on the EEA website (http://www.eea.europa.eu) and the data are made available through the EEA data service (http://dataservice.eea.europa.eu/dataservice) and the EEA GHG data viewer (http://www.eea.europa.eu/pressroom/data-and-maps/data/data-viewers/greenhouse-gases-viewer).

1.3 General description of methodologies and data sources used

1.3.1 The compilation of the EU GHG inventory

The EU inventory is compiled in accordance with the recommendations for inventories set out in the 'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories' (FCCC/SBSTA/2004/8), to the extent possible. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. Finally, for the compilation of the EU GHG inventory, Decision No 280/2004/EC and the Commission Decision 2005/166/EC. The Decision has been revised, to be replaced in 2013 by a Monitoring Mechanism Regulation that aims to enhance the reporting rules on GHG emissions to meet requirements arising from current and future international climate agreements as well as the 2009 EU Climate and energy package. Future inventory reporting will take place under this new legal instrument.

The EU-15 GHG inventory is compiled on the basis of the inventories of the 15 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report. Table 1.5 shows the base year emissions for EU-15 Member States and EU-15 as fixed in the respective initial review reports.

Table 1.5 **Base year emissions for EU-15 Member States and EU-15**

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions[10]) (Tonnes CO_2 equivalents)
Austria	1990	1990	79,049,657
Belgium	1990	1995	145,728,763
Denmark 2)	1990	1995	69,323,336
Finland	1990	1995	71,003,509
France	1990	1990	563,925,328
Germany	1990	1995	1,232,429,543
Greece	1990	1995	106,987,169
Ireland	1990	1995	55,607,836
Italy	1990	1990	516,850,887
Luxembourg	1990	1995	13,167,499
Netherlands	1990	1995	213,034,498
Portugal	1990	1995	60,147,642
Spain	1990	1995	289,773,205
Sweden	1990	1995	72,151,646
United Kingdom 2)	1990	1995	776,337,201
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4,265,517,719

Source: Initial review reports of the EU-15 Member States (www.unfccc.int)
Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
The base year emissions relate to the EU territory of Denmark and the UK.

Of the EU-15 Member States, 12 Member States have chosen 1995 as the base year for fluorinated gases while Austria, France and Italy have chosen 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for Ireland, the Netherlands, Portugal and the UK.

The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key category analysis (Section 1.5) is separately performed at EU-15 level (11).

Since Member States use different national methodologies, national activity data or country-specific emission factors in accordance with IPCC and UNFCCC guidelines, these methodologies are reflected in the EU GHG inventory data. The EU believes that it is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidance to use different methodologies for one source category across the EU especially if this helps to reduce uncertainty and improve consistency of the emissions data provided that each methodology is consistent with the IPCC good practice guidance.

In general, no separate methodological information is provided at EU level except summaries of methodologies used by Member States. However, for some sectors quality improvement projects have been organised/are ongoing with the aim of further improving estimates at Member State level. These

[10] Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO2 equivalent

(11) However, the choice of the emission calculation methodology is made at Member State level and is based on the key category analysis of each individual Member State.

sectors include energy background data, emissions from international bunkers, emissions and removals from LULUCF, emissions from industrial processes, agriculture and waste.

The EU-15 CRF Table Summary 3 in Annex 1.2 provides information on methodologies and emission factors used by the Member States. These tables have been compiled on the basis of the information provided by the Member States in their CRF Table Summary 3. In addition, information on methods, activity data and emission factors was used which was provided by the Member States in accordance with Annex I of Commission Decision 2005/166/EC. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EU key source.

Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 1.12. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 1.12 and made available at the EEA website, are considered to be part of the EU submission.

1.3.1.1 *Internal consistency of the EU CRF tables*

In principle every single EU value is aggregated from the respective value of the EU Member States. However, sometimes there are consistency problems when compiling the EU CRF tables (i.e. the sum of sub-categories is not equal to the category total) in those categories where Member States have difficulties to allocate emissions to the sub-categories. Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain sub-category. At Member State level, the use of the notation keys makes transparent the reason for not providing emission estimates. However, at EU-15 level, the sub-category emission value is the sum of Member States emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, the CRF tables now include the values or notation keys reported by the MS as comments. In addition, Annexes 1.4-1.10 of this report include the CRF tables for the sectors for each EU-15 Member State. In order to address this problem, some source categories have been reallocated for the EU CRF tables.

A second problem is the reporting of Member States in "grey cells" which need to be included in the CRF reporter manually.

A third problem occurs where MS report potential fluorinated gas emissions but do not report actual emissions. In these cases the potential emissions are included in the national totals, but they are lost when aggregating the EU actual emissions. Therefore, the potential emissions are added manually into the CRF reporter for these Member States.

Table 1.6 lists the procedures applied for the EU-15 Member States.

Table 1.6 **Manual changes in the CRF Reporter**

CRF Table	Member State	Year	Sector	Source category	Parameter	Manual changes/inclusion in the CRF reporter
Table1B2	SE	1990-2011	Energy	1.B.2.a.5	N_2O	Add pollutant N_2O under 1B2a5 and include emissions from grey cells.
Table1B2	GB	1990-2011	Energy	1.B.2.b.1	N_2O	Add pollutant N_2O under 1B2b1 and include emissions from grey cells.
Table1s1	DE	1990-2011	Energy	1.B.2	CO	Add pollutant CO under 1.B.2.b.5.1 and include emissions from grey cells.
	EU	1990-2011	Energy	1.AB	all	CRF Reporter: Enter Reference Approach and delete MS comments
Table2(I)s1	DE, SE, PL	1990-2011	Ind. Processes	2.A.1	NO_x, NMVOC, CO	Add new gases under 2A1 and include emissions
Table2(I)s1	DE, PT	1990-2011	Ind. Processes	2.A.2	NO_x, NMVOC, SO_2	Add new gases under 2A2 and include emissions
Table2(I)s1	SE	1990-2011	Ind. Processes	2.A.2	SO_2	Add pollutant SO_2 under 2A2 and include emissions from grey cells
Table2(I)s1	PT	1990-2011	Ind. Processes	2.A.6	CH_4	Include PT CH_4 emissions from grey cells
Table2(I)s1	EU	1990-2011	Ind. Processes	2.A.7	CO_2, CH_4, NO_x, CO, NMVOC, SO_2	Exclude glass production from other non-specified and delete MS comments
Table2(I)s1	HU	1990-2003	Ind. Processes	2.B.2	CO_2	Add pollutant CO_2 under 2B2 and include emissions from grey cells (EEA finding).
Table2(I)s1	EU	1990-2011	Ind. Processes	2.B.5	CO_2, CH_4	Exclude 2.B.5.1 - 2.B.5.5 from other non-specified and delete MS comments
Table2(1).A-Gs2	DE	1990-2011	Ind. Processes	2.C.1.1	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	ES	1990-2011	Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	GB	1990-2011	Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	PL		Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	NO	1990-2011	Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	SE	1990-2011	Ind. Processes	2.D.1	CH_4, N_2O	Add pollutants CH_4, N_2O under 2D1 and include emissions from grey cells.
Table2(1).A-Gs2	PL, NO		Ind. Processes	2.D.1	CO_2	Add pollutant CO_2 under 2D1 and include emissions from grey cells.
Table2(II)	FR	1990-2011	Ind. Processes	2.E.2	HFC-365mcf	Include FR emissions from HFC-365mcf in COT2T equivalents and delete MS comments
Table2(II).E	EU	1990-2011	Ind. Processes	2.E.3	PFC-A	Be sure that EUC notation keys are the sum of MS notation keys (EEA finding)
Table2(II).F	EU	1990-2011	Ind. Processes	2.F	all	CRF Reporter: Enter emissions from CRF table 2(II).F
Table2.F	FR		Ind. Processes	2.F.2.1	HFC-365mcf	Include FR emissions from HFC-365mcf under Unspecified mix of HFCs and delete MS comments
Table2(II)	EE		Ind. Processes	2.F.2	HFC-365mcf	Include EE emissions from HFC-365mcf under Unspecified mix of HFCs and delete MS comments
Table2(I)s1	BG, CY, MT	1990-2011	Ind. Processes	2.F.9	HFC-P, PFC-P	Make sure that potential emissions are accounted for (run CRF Aggregator report 'APE') and include them under 2.F.9
Table4s1	LU, NL	1990-2011	Agriculture	4.A.1	CH_4	Add LU, NL mature dairy cattle under dairy cattle and delete MS comments
Table4.A	EU	1990-2011	Agriculture	4.A	all	Enter additional information from SBDT4A, JRC (not population, except for cattle)
Table 4.As2	EU	1990-2011	Agriculture	4.A	all	Enter additional information from SBDT4As2, JRC (not population)
Table4s1	LU, NL	1990-2011	Agriculture	4.B.1	CH_4	Add LU, NL mature non-dairy, young cattle under non-dairy cattle and delete MS comments
Table4.B(a)	EU	1990-2011	Agriculture	4.B	all	Enter additional information from SBDT 4B(a), JRC (not population, except for cattle)
Table4.B(a)s2	EU	1990-2011	Agriculture	4.B	all	Enter additional information from SBDT 4B(a)s2, JRC (not population)
Table4.B(b)	EU	1990-2011	Agriculture	4.B	all	Enter additional information from SBDT 4B(b), JRC (not population)
Table4s2	ES	1990-2011	Agriculture	4.D	NO_x	Add pollutant NO_x under 4D4 and include emissions from grey cells.
Table4.D	EU	1990-2011	Agriculture	4.D	all	Enter additional information from SBDT 4D, JRC (only additional information - fraction)
Table4.E	EU	1990-2011	Agriculture	4.E.1	CH_4, N_2O	Be sure that EUC notation keys are the sum of MS notation keys (EEA finding)
Summary1A	ES, PT	1990-2011	Agriculture	4.F.5	SO2	Add pollutant SO_2 under 4F5 and include emissions from grey cells.
Table4.F	EU	1990-2011	Agriculture	4.F	all	Enter additional information from SBDT 4F, JRC (not crop production, not biomass burned)
Table5	FI	1990-2011	LULUCF	5.G	CO_2	Include additional information from 5.G
Table5	GB	1990-2011	LULUCF	5.G	CO_2	Include additional information from 5.G
Table5	CY	1990-2011	LULUCF	5.G	CO_2	Include additional information from 5.G
Summary1.A	FR	1990-2011	LULUCF	5.G	NMVOC, SO_2	Include additional information from 5.G
Table5	FR		LULUCF	5.G	CO_2, CH_4	Include additional information from 5.G
Summary1.A	IT	1990-2011	LULUCF	5.G	SO2	Include additional information from 5.G
5(III)	DE	1990-2011	LULUCF	5.G	N_2O	Include additional information from 5.G
5(III)	PT	1990-2011	LULUCF	5.G	N_2O	Include additional information from 5.G
5(IV)	DE	1990-2011	LULUCF	5.G	CO_2	Include additional information from 5.G
5(IV)	NL	1990-2011	LULUCF	5.G	CO_2	Include additional information from 5.G
5(IV)	NO	1990-2011	LULUCF	5.G	CO_2	Include additional information from 5.G
5(I)	IS	1990-2011	LULUCF	5.G	N_2O	Include additional information from 5.G
5(II)	IS	1990-2011	LULUCF	5.G	N_2O	Include additional information from 5.G
	EU	1990, 2009	KP.LULUCF	KP LULUCF	all	CRF Reporter: Enter KP.LULUCF data from EU MS manually
Table6	ES	1990-2011	Waste	6.A.1	N_2O	Add pollutant N_2O under 6A1 and include emissions from grey cells.
Table6	ES	1990-2011	Waste	6.A.3	N_2O, SO_2	Add pollutants N_2O, SO_2 under 6A3 and include emissions from grey cells.
Table6.A,C	IS	1990-2011	Waste	6.C	CO_2, CH_4, N_2O	Include aggregated emissions from 6.C under 6.C.2 Other

1.3.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

In January 2005 the European Union Greenhouse Gas Emission Trading System (EU ETS) commenced operation as the largest multi-country, multi-sector Greenhouse Gas Emission Trading System world-wide. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003.The European emissions trading system (ETS) covers around 11,000 installations across the 27 Member States of the European Union as well as airlines. Article 14 of the Emission Trading (ET) Directive requires Member States to ensure that emissions are monitored in accordance with specific monitoring and reporting guidelines (MRG)[12], which are legally binding. This legal guidance was revised and the revised guidance will apply for the reporting in 2013, and to the reports that competent authorities receive in 2014. The changes to the EU ETS Monitoring and Reporting Regulation will be described when the inventory data for the year 2013 will be submitted (2015 submission). Since 1 January 2005, all installations covered by the ETS have been required to monitor and report their emissions. Data for the installations covered by the ETS are reported by plant operators to competent authorities since 2005 based on a monitoring plan elaborated by the company and approved by the competent authority in accordance with the methodologies established in the monitoring and reporting guidelines. The monitoring plan covers the following elements:

(a) the description of the installation and activities carried out by the installation to be monitored;

(b) information on responsibilities for monitoring and reporting within the installation;

(c) a list of emissions sources and source streams to be monitored for each activity carried out within the installation;

(d) a description of the calculation based methodology or measurement based methodology to be used;

(e) a list and description of the tiers for activity data, emission factors, oxidation and conversion factors for each of the source streams to be monitored;

(f) a description of the measurement systems, and the specification and exact location of the measurement instruments to be used for each of the source streams to be monitored;

(g) evidence demonstrating compliance with the uncertainty thresholds for activity data and other parameters (where applicable) for the applied tiers for each source stream;

(h) if applicable, a description of the approach to be used for the sampling of fuel and materials for the determination of net calorific value, carbon content, emission factors, oxidation and conversion factor and biomass content for each of the source streams;

(i) a description of the intended sources or analytical approaches for the determination of the net calorific values, carbon content, emission factor, oxidation factor, conversion factor or biomass fraction for each of the source streams;

(j) if applicable, a list and description of non-accredited laboratories and relevant analytical procedures including a list of all relevant quality assurance measures, e.g. inter-laboratory comparisons;

(k) if applicable, a description of continuous emission measurement systems to be used for the monitoring of an emission source, i.e. the points of measurement, frequency of measurements, equipment used, calibration procedures, data collection and storage procedures and the approach for corroborating calculation and the reporting of activity data, emission factors and alike;

[12] Commission Decision 2007/589/EC of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. OJ L 229, 31.8.2007, p.1ff

(l) if applicable, a comprehensive description of the approach and the uncertainty analysis, if not already covered by items (a) to (k) of this list;

(m) a description of the procedures for data acquisition, handling activities and control activities as well as a description of the activities (see Section 10.1-3);

(n) where applicable, information on relevant links with activities undertaken under the EU ecomanagement and audit scheme (EMAS) and other environmental management systems (e.g. ISO14001:2004), in particular on procedures and controls with relevance to greenhouse gas emissions monitoring and reporting.

Similar to the IPCC Good Practice Guidance, the ETS monitoring and reporting guidance is based on a tier system which defines a hierarchy of different ambition levels for activity data, emission factors and oxidation or conversion factors. The operator must, in principle, apply the highest tier level, unless he can demonstrate to the competent authority that this is technically not feasible or would lead to unreasonably high costs. The reported emissions of each installation are verified by independent verifiers for each plant in each reporting year.

Thus, the ETS generates a data set on verified installation-specific CO_2 emissions for the sectors covered by the scheme for the EU-27, Croatia, Iceland, Norway and Liechtenstein. The ETS includes CO_2 emissions from energy industries and manufacturing industries, in particular combustion installations, mineral oil refineries, coke ovens, production and processing of ferrous metals, and mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials) if the installations exceed certain capacity thresholds. In 2008 the scope of the EU ETS has been expanded to include petrochemical cracking installations, mineral wool production and black carbon production. At the moment, the greenhouse gases covered under the EU ETS are CO_2 (since 2005), and N_2O (since 2010) in some Member States which have unilaterally included nitric acid production in the EU ETS. Aviation was included in the EU ETS as from 1 January 2012. For commercial airlines, the system covers CO_2 emissions from flights within and between countries participating in the EU ETS (except Croatia, until 2014). International flights to and from non-ETS countries are also covered, but as a goodwill gesture the European Commission has proposed deferring the scheme's application to these for 2012 to allow time for agreement on a global framework for tackling aviation missions to be reached in autumn 2013. However, other greenhouse gases and activities will be included in the scope of the EU ETS from 2013 onwards.

The plant-specific emissions data reported by operators under the EU ETS can be used in different ways for the purposes of the national GHG inventories:

1. Reported verified emissions can be directly used in the GHG inventory to report CO_2 emissions for a specific source category. This requires a number of careful checks, e.g. whether the coverage of the respective ETS emissions is complete for the respective source category and that ETS activities and CRF source categories follow the same definitions. If ETS emissions are not complete, the emissions for the remaining part of the source category not covered by the EU ETS have to be calculated separately and added to the ETS emissions.
2. Emission factors (or other parameters such as oxidation factors) reported under the EU ETS can be compared with emission factors used in the inventory and they can be harmonised if the EU ETS provides improved information.
3. Activity data reported under the EU ETS can be used directly for the GHG inventory, in particular for source categories where energy statistics face difficulties in disaggregating fuel consumption to specific subcategories, e.g. to specific industrial sectors.
4. Data from EU ETS can be used for more general verification activities as part of national quality assurance (QA) activities without the direct use of emissions, activity data or emission factors.

5. Data from EU ETS can improve completeness of the estimation of IPCC source categories when additional data for sub-categories become available from EU ETS.
6. ETS data can improve the allocation of industrial combustion emissions to sub-categories under 1A2 Manufacturing Industries and Construction;
7. The comparison of the data sets can be used to improve the uncertainty estimation for the GHG inventories based on the ranges of data reported by installations.

1.3.2.1 *Differences in technical monitoring and reporting provisions between GHG inventories and the EU ETS*

There are a number of detailed technical provisions that are different in the monitoring and reporting guidelines for the EU ETS and the IPCC guidelines. These differences can lead to different reported CO_2 emissions under the EU ETS and in the GHG inventory. Some of these issues may also prevent inventory compilers from using verified emissions reported under the ETS directly for emission reporting in the national GHG inventory or may also raise concerns by the expert review teams during the inventory review if Member States directly used verified emissions reported under the ETS for the reporting in the national GHG inventory. Some of these differences have been removed after the first phase of the EU ETS when the 2004 ETS MRG were replaced by the 2007 ETS MRG (applicable for emissions occurring from 2008 onwards), however some new differences have been introduced in the second phase.

Scope of activities and installation boundaries

The ETS includes CO_2 emissions from energy industries and manufacturing industries, in particular combustion installations, mineral oil refineries, coke ovens, production and processing of ferrous metals, and mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials) if the installations exceed certain capacity thresholds. Such capacity thresholds are not used for the inventory reporting. In addition different understandings of installation boundaries (furthermore, completeness of the installations included in an industry sector group) and the interpretation as to what constitutes certain activities under the EU ETS, may be different to a source category for the inventory reporting. The scope of activities and the installation boundaries need careful consideration before ETS data are used for inventory purposes.

Determination of tiers

Both versions of the EU ETS monitoring and reporting guidelines are based on methodological tiers. For cost effectiveness reasons higher tier levels (i.e. lower uncertainty) are only required for larger emission sources. However, in the inventory reporting the key category analysis determines which methodological tier should be used. The tier for the inventory is selected based on the contribution of a source category to the total emission level and the emission trend. If a source category is determined as key, all emissions from this source/sector have to be estimated based on the same minimum tier methodology.[13]

In the ETS reporting tiers apply at installation level based on the emissions at the particular installation (thresholds are < 50 kt, ≥ 50 kt and ≤ 500 kt and > 500 kt CO_2). Also within installations minor sources may use different tiers than major sources. At sectoral level, e.g. for cement and lime production, verified emissions can result from small, medium and large emitters and may therefore be based on different ETS tiers. For inventory key categories, it can happen that not all verified emissions

[13] The general rule is that if a subcategory represents less than 25-30% of the total emissions of the category, Tier 1 may be used. However, this is not explicitly stated in the IPCC GPG for all categories.

reported under the EU ETS comply with the tier level required for the GHG inventory. This may happen in particular where estimates are based on default parameters.

In GHG inventories, time series consistency is a mandatory requirement which has also implications on the choice of methodology. Plant-specific and measured data is often not available for the whole time series. It may be challenging in particular for the time before the start of the EU ETS (i.e. before 2005). In GHG inventory reviews, the ERT has in some cases recommended Parties not to use EU ETS data because challenges in producing a consistent times series back to 1990 based on the use of EU when the ETS data is used.

Fuel emission factors and net calorific values

The 2004 ETS MRG used default fuel emission factors from 1996 IPCC reporting guidelines[14] and net calorific values from 2000 IPCC Good Practice guidance which is consistent with the UNFCCC reporting guidelines under the Convention and the Kyoto Protocol. The revised 2007 ETS MRG use default fuel emission factors and net calorific values from 2006 IPCC Guidelines for national GHG inventories which have been adopted for reporting under the UNFCCC only for the inventory submissions from 2015 onwards (for the reporting year 2013). Thus, starting from 2008 the reporting under the ETS, emissions may have been estimated with fuel-specific default EF that are not acknowledged under the UNFCCC. However, this may not affect the reporting practice substantially as both IPCC and the ETS guidelines require countries and installations to use measured/ installation-specific or country-specific EFs and NCVs. For all fuels for which the reporting is based on installation-specific or country-specific EFs, the different default parameters have no impact (country-specific parameters are normally used for all major fuel types). As the inventory also covers small installations, average carbon contents of fuels and NCVs can vary between the inventory and the ETS data.

Oxidation factor

The Tier 1 method of the 2004 ETS MRG for combustion installations assumed an oxidation factor of 0.99 for conversion of C to CO_2 for all solid fuels and of 0.995 for all other fuels. IPCC 1996 Guidelines recommend 0.98 for coal, 0.99 for oil and oil products, 0.995 for gas and 0.99 for peat and electricity generation.[15] The 2007 ETS MRG changed the Tier 1 requirement to the use of an oxidation factor of 1.0 (i.e. default assumption of 100% oxidation).

[14] With few exceptions such as shale oil for which IPCC guidelines don't provide a value.

[15] Table 1-6 Revised 1996 IPCC Guidelines for national GHG Inventories, Reference manual, chapter energy.

Table 1.7 **Comparison of default oxidation factors used for GHG inventories and for ETS reporting**

	Fraction of carbon oxidised, default parameters for tier 1		
Fuel type	**1996 IPCC Guidelines valid for GHG inventories until 2014**	**2004 ETS MRG**	**2007 ETS MRG**
Coal	0.98	0.99	1
Oil and oil products	0.99	0.995	1
Gas	0.995	0.995	1
Peat for electricity generation	0.99	0.99	1

The impact of these differences in the default assumptions for the oxidation factors on the emission estimation depends on the extent to which Member States and installations use tier 1 and the default parameters in their reporting.

Transferred CO_2

The 2004 version of the ETS MRG included a specific provision for "transferred CO_2" which allowed to subtract CO_2 which is not emitted from the installation but transferred out of the installation as a pure substance, as a component of fuels or directly used as a feedstock in the chemical or paper industry, from the calculated level of emissions for an installation.[16] CO_2 that is transferred out of the installation for the following uses could be considered as transferred CO_2:

- pure CO_2 used for the carbonation of beverages,
- pure CO_2 used as dry ice for cooling purposes,
- pure CO_2 used as fire extinguishing agent, refrigerant or as laboratory gas,
- pure CO_2 used for grains disinfestations,
- pure CO_2 used as solvent in the food or chemical industry,
- CO_2 used as feedstock in the chemical and pulp industry (e.g. for urea or carbonates).

In the reporting under the UNFCCC such subtraction is not allowed if the carbon is only stored for a short time (such as for beverages or dry ice) and consequently the intermediate binding of CO_2 in downstream manufacturing processes and products should not be subtracted from CO_2 emissions.[17]

Thus, for Member States applying the provisions for transferred CO_2 in the first phase of the ETS, this provision introduced some differences in accounting of CO_2 emissions. In quantitative terms this was not very relevant as the quantities deducted from transferred CO_2 under the EU ETS were rather small as indicated in the responses to the questionnaires provided by Member States pursuant to Article 21 of the ETS Directive.

In the revised version of the ETS MRG from 2007, the application of the provision requires approval by the competent authority and is only applicable if "the subtraction is mirrored by a respective reduction for the activity and installation which the respective Member State reports in its national

[16] Decision 2004/156/EC, p. 7ff

[17] The CO_2 capture and storage from limestone in the Finnish pulp and paper industry for PCC production has been accepted in the UNFCCC reviews as a long-term storage for CO2.

inventory submission to the UNFCCC." Thus, the revision of the ETS MRG made the reporting of transferred CO_2 consistent with the GHG inventory.

With regard to carbon capture and storage, the rules for CCS are stricter under the ETS than under the UNFCCC, e.g. the EU ETS does not allow taking into account emission reductions due to CCS of biomass plants or carbon capture and storage when the CO_2 is stored in long-term products. With regard to the storage of CO_2 in products also 2006 IPCC Guidelines for GHG inventories include changes that will only enter into effect in the future.

Verification

All annual emissions reports submitted by installations in the EU ETS must be verified by an *independent, impartial and competent* body or person, the "EU ETS verifier". The verifier needs an official authorisation by the Member State to perform the verification. In most Member States the verifier needs an accreditation for this purpose. From 2013 onwards, when the MRG are replaced by Regulations (i.e. directly legally binding in all Member States), the accreditation becomes a requirement in all Member States. Accreditation in the EU ETS follows closely the internationally recognised ISO 14064 standard.

Verification in the EU ETS requires "reasonable assurance" (i.e. the highest assurance levels available in verification standards). It is required that verifiers are competent for the particular industry sector of the installation under consideration. A site visit is virtually always required. Thus, the mandatory and independent verification is a suitable means of ensuring that the data in the EU ETS is free of material misstatements.

The scope of verification is based on the installation's boundaries and monitoring methods as laid down in the approved monitoring plan by the competent authority. Note that the verification covers the data generated as well as the compliance of the operator with the approved monitoring plan. Thus, emissions are checked by verifiers only under EU ETS rules. It is the responsibility of the (governmental) body responsible for the national inventory to decide how the data can be used for inventory purposes. Thus, not verification, but the inventory's QA/QC procedures are applied to any use of the verified EU ETS data. Nevertheless it must be noted that EU ETS data is of very high quality in general.

1.3.2.2 *Use of EU ETS data in 2013*

Based on the information submitted in the national inventory reports (NIRs) in 2013 to the UNFCCC secretariat or the European Commission, all 27 Member States indicated that they used ETS data at least for QA/QC purposes (see Table 1.8). A large number of MS used plant-specific emission factors reported under the EU ETS also for the purposes of the national GHG inventory, 16 MS used activity data and 14 Member States directly used reported emissions.

Table 1.8: Use of ETS data for the purposes of the national GHG inventory

Member State	Status of use of ETS data	Use of emissions	Use of Activity data	Use of emission factors	Use for quality assurance
Austria	Used	✓	✓	✓	✓
Belgium	Used	✓		✓	✓
Bulgaria	Used	✓	✓	✓	✓
Cyprus	Used			✓	✓
Czech Republic	Used	✓	✓	✓	✓
Denmark	Used	✓		✓	✓
Estonia	Used				✓
France	Used	✓	✓	✓	✓
Finland	Used	✓	✓	✓	✓
Germany	Used		✓	✓	✓
Greece	Used		✓	✓	✓
Hungary	Used	✓	✓	✓	✓
Ireland	Used	✓		✓	✓
Italy	Used		✓	✓	✓
Latvia	Used	✓	✓	✓	✓
Lithuania	Used		✓		✓
Luxembourg	Used				✓
Malta	Used		✓		✓
Netherlands	Used				✓
Poland	Used	✓			✓
Portugal	Used		✓	✓	✓
Romania	Used			✓	✓
Slovakia	Used		✓	✓	✓
Slovenia	Used		✓	✓	✓
Spain	Used	✓	✓	✓	✓
Sweden	Used	✓	✓	✓	✓
United Kingdom	Used	✓		✓	✓

Source: NIR 2013 submissions

The use of ETS verified emissions for inventory purposes varies between MS and for different source categories inter alia dependent on the fact whether the verified ETS emissions cover a CRF source category completely or only partly due to the thresholds applied for installations under the EU-ETS. When the verified ETS emissions only covers a source partly, the remaining parts need to be estimated based on other datasets and in this situation it may be preferable to use one consistent data source for the inventory reporting and use ETS data mostly for QA/QC purposes.

A mostly complete coverage of ETS verified emissions and inventory CRF categories occurs for most Member States for emissions from solid fuels under category 1.A.1.a Public Electricity and Heat Production, however there are few exceptions where the coverage is only 70-80%. For other fuels for this category, the coverage is lower, e.g. for liquid fuels it varies between 30-99%, for natural gas between 80-100%.

The coverage of the category 1.A.2 Manufacturing Industries and Construction with ETS data differs strongly among MS and shows a large variation depending on the installation sizes in MS:

An almost complete coverage of verified emissions under the ETS occurs for 1.A.1.b Petroleum Refining (only for one MS no complete coverage).

For the majority of MS the total emissions of CRF categories 1.A.2.a and 2.C.1 process and energy-related emissions from iron and steel production are completely covered under the ETS, however there are some exceptions of MS for which this coverage is only 70-80%.

Fugitive emissions from flaring of oil and gas are also mostly fully covered by the EU-ETS, but often not by exactly 100%, but a share between 90-99%.

Emissions from 2A1 cement production are completely covered under the ETS, but for the other mineral products source categories the ETS coverage is usually incomplete and there are smaller plants below the ETS thresholds, e.g. for lime production, limestone and dolomite use, bricks and tiles, soda ash production or ceramics production. Glass production is however mostly covered by 100% by the ETS with very few exceptions in MS.

The following sections provide a detailed overview of the use of ETS data in the EU-27 Member States. The information is mainly based on the NIRs, as well as on the assessment conducted for this report.

1.3.2.3 *Austria*

General

At the moment, the greenhouse gases covered under the EU ETS in Austria are CO_2 (since 2005) and N_2O (since 2010). Austria unilaterally opted-in N_2O as of 2010. Since 2013 N_2O and PFCs will be included in the EU ETS at EU level. About one third of total Austrian GHG emissions currently result from installations under the EU-ETS (~31 Tg CO_2 in 2011).

Currently the following industrial branches are fully covered by the national ETS data:

- Refineries,
- Iron and steel manufacturing industries,
- Non-metallic mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials),
- Pulp and paper manufacturing industries.

Combustion plants of other industrial branches (including power plants) are considered if their thermal plant capacity exceeds 20 MWth (excluding boilers < 3 MW, biomass-boilers and hazardous and municipal waste incineration boilers).

In Austria ETS data is submitted by means of a standard calculation sheet which includes numerical data about multiple fuels, processes and material flows. Additionally a written QA/QC report has to be submitted. For fuel combustion and industrial processes the following numerical data is reported:

- Activity data: mass or volume of fuel consumption/process input material.
- Net calorific value of fuel
- Oxidation factor of fuel/conversion factor of process material
- CO_2 emission factor of fuel or process material
- Share of non fossil CO_2 in case of "non-traded fuels"

For sites with complex material flows (e.g. refineries, iron and steel plants) carbon mass balance data is reported alternatively:

- Activity data: mass or volume of material flow
- Net calorific value of material
- Carbon content of material

Direct CO_2 measurements have not been submitted.

The ETS reports include data about "traded-fuels" (e.g. different types of coal and fuel oils, natural gas) as well as "non-traded fuels" (e.g. industrial wastes, biomass). For each of the "traded fuels" a national default NCV and a national default CO_2 emission factor may be selected for emission calculation. For "non-traded fuels" plant operators have to make their own estimate of carbon content and NCV.

The allocation of ETS emissions to CRF categories was based on NACE codes reported by installations and therefore harmonized with energy statistics. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Energy

ETS ‘bottom up’ data 2005–2010 are used for calculation of emission data in categories 1A1 Energy Industries, 1A2 Manufacturing Industries and Combustion and 1A4a Commercial/Institutional. About 200 plants reported 800 fuel and material flows yearly which have been considered in the inventory. ETS fuel masses/volumes and NCVs are used for activity data calculation. The remaining activity data is calculated by means of remaining fuel masses/volumes and averaged NCVs from the energy balance. ETS CO_2 emissions are considered by fuel. The remaining CO_2 emissions are calculated by remaining activity data and "national default" emission factors.

- 1A1a Public Electricity and Heat: For the years 2005–2011 CO_2 emissions from plants with a total boiler capacity of $\geq$ 20 MW_{th} are taken from ETS reports and CO_2 emissions from plants < 20 MW_{th} are calculated by means of national default emission factors and remaining fuel consumption of the energy balance. Coal consumption is fully covered by the ETS. Large point source activity data from 2005 onwards is considered from ETS reporting.
- 1A1b Petroleum refining: CO_2 emissions 2002 to 2005 are reported by the Austrian Association of Mineral Oil Industries which are consistent with ETS 2005 data. For the year 2006 onwards reported ETS data is used.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: For 2005 to 2011 CO_2 emissions and activity data of natural gas storage compressors are taken from ETS data.
- 1A2c Chemicals: For the years 2005 to 2011 CO_2 ETS data are considered. CO_2 emissions from industrial waste: From 2005 on ETS data is considered with plant specific emissions and energy consumption.
- 1A2d Pulp, Paper and Print: For the years 2005 to 2011 CO_2 ETS data are considered. CO_2 emissions from industrial waste: From 2005 on ETS data is considered with plant specific emissions and energy consumption. In general ETS data shows slightly higher energy consumption (in terms of TJ) than current energy statistics, therefore ETS data is used from 2005 onwards.
- 1A2e Food Processing, Beverages and Tobacco: For the years 2005 to 2011 CO_2 ETS data are considered.
- 1A2f Manufacturing Industries and Construction – Cement Clinker Production: CO_2 emissions from 2004 to 2011 are taken from the ETS allocation plan survey and ETS data. For the years 2005–2011 ETS data are taken. From 2002 on a share of petrol coke use is allocated to magnesia production from dolomite by using ETS data. After 2005 the share of waste which contains 100% biomass has been taken from ETS data.

- 1A2f Manufacturing Industries and Construction – Other: For 2005 to 2011 ETS data is considered for glass, bricks & tiles and lime manufacturing plants.

Industrial processes

Verified CO_2 emissions reported under the EU ETS were available for the years 2005-2011. These emissions have been incorporated in the inventory as far as possible. The relevant sources are 2.A.1 Cement Production, 2.A.2 Lime Production, 2.A.3 Limestone and Dolomite Use, 2.A.7a Bricks production, 2.A.7b Magnesia Sinter Plants, 2.A.7c Glass production and 2.C.1 Iron and Steel Production. Special attention was given to time-series consistency. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

- 2A1 Cement production: For 2005–2011 CO_2 emissions taken from the studies were checked against the verified CO_2 emissions reported under the ETS – no deviations were identified
- 2A2 Lime Production: For 2005–2011 verified CO_2 emissions reported under the ETS were used for the inventory. These data cover the whole lime producing industry in Austria. For the years from 2005 onwards detailed, verified data from the ETS is available: some plants calculate emissions based on data of the raw material, most calculate emissions from data of produced lime; thus the activity data reported under the ETS for some plants is production volumes, for others the amount of used raw materials. The emission values for 2005 onwards are verified under the ETS. The IEF are compared with IPCC default values. The Association of the Stone & Ceramic Industry reported total CO_2 emissions, which were compared with the ETS data.
- 2A3 Limestone and Dolomite Use: For 2005–2011 verified CO_2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. The use of limestone in chemical industry is included in the inventory since 2005. Under ETS plant operators are calculating the emissions on the basis of the Austrian Ordinance regarding monitoring, reporting and verification of GHG emissions. Since 2005 ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values.
- 2A7 Glass production: Since 2005, ETS background data provided more detailed information on the actual carbon content of the carbonates used. Therefore, the IEFs since 2005 are slightly different compared to the IPCC default values. For 2005–2011 verified CO_2 emissions and activity data, reported under the ETS, were considered for the inventory. These data cover small amounts of other carbonates used in glass industry that have been included from 2005 onwards.
- 2A7 Bricks Production: For 2005-2011 verified CO_2 emissions, reported under the ETS, were used for the inventory. These data cover the whole brick industry in Austria.
- 2A7 Magnesia Sinter Production: For 2005-2011 verified CO_2 emissions reported under the ETS were used in the inventory. The operator reported total CO_2 emissions, which were compared with the ETS data and found to accord.
- 2C1 Iron and Steel: For 2005-2011 verified CO_2 emissions, reported under the ETS, were used in the inventory, which is a similar – slightly more detailed - approach as for the years before. The ETS data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel. For pig iron production the values for 2005-2011 correspond to the background (for consistency reasons just carbonatious ore) data given in the ETS report. For 2005–2011 CO_2 emissions from non-carbonatious ore – calculated by its C content – and other additives – including plastics and coal fines used as reducing agents – were taken into account additionally. This information became available from background data reported under the ETS. Since 2005 the IEF is quite stable, because background data reported under the ETS allowed accounting for reducing agents other than coke. For electric arc furnace steel production for 2005–2011 verified CO_2 emissions, reported under the ETS, were taken for the inventory. For 2005–2011 detailed information on the carbon mass balance applied by the company to calculate total emissions from pig iron and BOF steel were available due to the ETS. Thus it was possible to validate CO_2 emissions with this background data.

1.3.2.4 *Belgium*

General

The Flemish region has taken into account the information from the EU-ETS data in a sense that reported sources in the EU-ETS framework are compared with the reported sources in the greenhouse gas emission inventory (integrated environmental reports, regional energy balance). When major changes are detected in the reported emissions of CO_2 and/or energy data between these two datasets, the involved industry is contacted and data are optimized if necessary. Since the beginning of 2010 this work started in a more organized way in the Flemish region. A study is conducted at that time to examine the differences more in detail between energy and CO_2 data reported under the ETS and the data used in energy balances (energy use) and in emission reporting (CO_2). Since 2005 EU-ETS data are integrated in the Flemish greenhouse gas inventory in the sectors of glass and ceramic (category 2A7) and in the iron and steel sector (categories 1A2a and 2C). The emissions of these sectors were recalculated for the historical years with the same methodology as the one used for EU-ETS-purposes.

The information related to GHG emissions in Walloon region is used to calculate the emissions of the most important emitters in the energy, industry and waste sectors. In particular, the information coming from the obliged reporting under the ETS-Directive is used in the preparation of the inventory of the greenhouse gases. Among others, data obtained from industrial companies concerned by the ETS-process are systematically cross-checked with certified reports in the framework of that mechanism.

Procedures have been implemented in Brussels region to cross-check the data used in the inventories with other data from the Institute. These data are coming from other departments which use them for other requirements (e.g. PRTR, ETS, environmental reports) and help to check the completeness of the inventory. Some data have been revised following these checks and this work will be continued in the future.

Energy

- 1A1b Petroleum Refining: The emissions of CO_2 are reported to the responsible authorities by the Belgian Petroleum Federation and the petroleum refining companies. Since 2005 (emissions 2004) these emissions are reported by the companies on an obligatory basis via their annual environmental reports. These emissions are completely in line with the emissions reported under the ETS-Directive.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Since 2005, the CO_2 emissions in Wallonia have been giving directly by the plant under the ETS. It’s difficult to use these ETS data (coke oven gas analyses) to make a recalculation for the complete time series as there were 5 coke plants in 1990, 4 of them are now closed and there is only one coke plant left since 2009 in Wallonia.
- 1A2 Manufacturing Industries and Construction: For some specific fuels, some industries perform analyses of these fuels and certainly since 2004, more analyses of the fuels are performed by the plants under the ETS-Directive on f.i. solid fuels, blast furnace gas, coke oven gas and waste fuels. These plant-specific emission factors are taking into account in the inventory as much as possible. The latter is the case for the iron and steel sector, cement and lime sectors. In the Flemish region the emissions of CO_2 for the biggest steel plant are revised for the complete time series during the 2011 submission mainly because of inconsistencies in emissions during the last years between the GHG inventory and the emissions reported under the ETS-Directive. In the lime and cement plants, only located in the Walloon region, the CO_2 emission factors for liquid fuels and gaseous fuels are taken from the IPCC 1996 guidebook. Concerning the solid and waste fuels, an average emission factor has been calculated with plant analyses (2005 to 2008) and applied for the previous years. Since 2005, the CO_2 emissions from solid fuel and waste are reported directly by

the companies through the ETS-obligation and based on their fuel consumption and fuel analyses. In the Walloon region, some QC-tests are performed in the course of 2012. In particular in the categories 1A2a, 1A2c, 1A2e and 1A2f, a recalculation with the ETS-data is performed.

Industrial Processes

- 2A7 Glass Production: In the meantime more companies in the Flemish region did revise their calculation methodology for estimating their emissions of CO_2 based on the methodology used in the framework of the EU-ETS Directive. During the 2009 submission, the process emissions of CO_2 were newly added for a company as a result of their emission reporting in the framework of the EU-ETS Directive. An estimation of the previous years (1990-2004) was performed by using the same methodology as used in the framework of the EU-ETS (C-content of raw materials used).
- 2C Metal Production: During the 2011 submission the emissions of CO_2 of the biggest plant in Flanders in the iron and steel sector were completely revised in the Flemish region and based on the ETS-methodology instead of C-balance-approach in previous submissions. This revision took place mainly because of inconsistencies in emissions between the GHG emission inventory and the emissions reported from the emission trading directive. The 2nd company involved in this category in the Flemish region produces stainless steel. During the 2013 submission this methodology is optimized and made consistent with the ETS-reporting data. Since 2005, CO_2 emissions in Wallonia have been obtained directly by the obliged reporting of the plants under the emission trading scheme.

1.3.2.5 *Denmark*

General

The EU ETS data for power plants account for 51 % of the CO_2 emission from stationary combustion. In the Danish inventory plant or activity based CO_2 emission factors have been derived for power plants combusting coal and oil, refinery gas and flare gas in refineries, fuel gas and flare gas at off-shore installations, cement production, production of brick and tiles and lime production. For all these sources the EU ETS reports are only used in the Danish inventory for plants using high tier methods. The EU ETS data have been applied for the years 2006 onwards.

Energy

Fuel combustion

The CO_2 emission factors for some large power plants and for combustion in the cement industry and refineries are plant specific and based on the reporting to the EU Emission Trading Scheme (EU ETS). In addition emission factors for off-shore gas turbines and refinery gas is based on EU ETS data. The EU ETS data have been applied for the years 2006 - 2011.

- Power plants, coal: EU ETS data for 2011 were available from 15 coal fired power plant units. The plant specific information accounts for 98 % of the Danish coal consumption and 47 % of the total CO_2 emission from stationary combustion plants. In 2011, only 2 % of the CO_2 emission from coal consumption was based on the emission factor, whereas 98 % of the coal consumption was covered by EU ETS data. The emission factors for coal combustion in source category 1A1a Public electricity and heat production in the years 2006-2011 refer to the implied emission factors of the EU ETS data estimated for each year. For the years 1990-2005, the emission factor for coal in source category 1A1a Public electricity and heat production refer to the average IEF for 2006-2009.
- Power plants, residual oil: EU ETS data for 2011 based on higher tier methodologies were available from 13 plants combusting residual oil. The EU ETS data accounts for 44 % of the residual oil consumption in stationary combustion (including EU ETS data for cement production). The emission factors for residual oil combustion in source category 1A1a Public electricity and heat production in the years 2006-2011 refer to the implied emission factors of the EU ETS data estimated for each year.
- Power plants, gas oil: EU ETS data for 2011 based on higher tier methodologies were available from 2 plants combusting gas oil. Plant specific EU ETS data have been utilised for a few plants in the 2006 - 2011 emission inventories. In 2011, 0.04 % of the CO_2 emission from gas oil consumption was based on EU ETS data.
- Industrial plants: Plant specific CO_2 emission factors have also been applied for some industrial plants including cement industry, sugar production, glass wood production, lime production, and vegetable oil production. The EU ETS data set also includes CO_2 emission factors for petroleum coke and waste applied in industrial plants.
- Off-shore gas turbines: EU ETS data have been applied to estimate an average CO_2 emission factor for natural gas applied in offshore gas turbines. EU ETS data for the fuel consumption and CO_2 emission for off shore gas turbines are available for the years 2006-2011. Based on data for each oilfield implied emission factors have been estimated for 2006-2011. The average value for 2006-2009 has been applied for the years 1990-2005.
- Refinery gas: The emission factor applied for refinery gas refers to EU ETS data for the two refineries in operation in Denmark. Implied emission factors for Denmark have been estimated annually based on the EU ETS data since 2006. The average implied emission factor (57.6 kg per GJ) for 2006-2009 have been applied for the years 1990-2005.
- Anodic carbon: Anodic carbon has been applied in Denmark in 2009-2011 in two mineral wool production units. EU ETS data are available for both plants and thus the area source emission factor have not been applied.
- Petroleum coke: Plant specific EU ETS data have been utilised for the cement production for the years 2006 - 2011. This consumption represents more than 98 % of the consumption of petroleum coke in Denmark. Plant specific emission factors from EU ETS data are now available for one power plant and the cement production plant. Both plants state emission factors that are higher than 92 kg/GJ. Thus, the area source emission factor 93 kg/GJ that is based on EU ETS data for 2006-2010 will be applied in the next inventory for all years.

- Waste: Plant specific EU ETS data have been utilised for cement production in the 2006 - 2011 emission inventories.

Fugitive emissions

Reporting to the European Emission Trading Scheme (EU ETS) are available in the annual EU ETS reports for refineries, offshore oil and gas extraction facilities and the natural gas treatment plant, concerning fugitive emissions. EU ETS data are only included in the national emission inventory if higher tier methodologies are applied. The EU ETS data used are fully in line with the requirements in the IPCC good practice guidance and are considered the best data source on CO_2 emission factors due to the legal obligation for the relevant companies to make the accounting following the specified EU decisions.

- Flaring: Emissions from flaring are estimated from the amount of gas flared offshore, in gas treatment/storage plants and in refineries and from the corresponding emission factors. From 2006 data on offshore flaring (flared amounts, calorific values and CO_2 emission factors) are given in the reports under the EU ETS and thereby flaring can be split to the individual production units.
- Oil refining: The refineries deliver information on consumption of fuel gas and fuel oil. The calorific values are given by the refineries in the reporting for EU ETS from 2006.

Industrial Processes

- 2A1 Cement production: There is only one producer of cement in Denmark, Aalborg Portland Ltd. The activity data for the production of cement clinker is obtained from the company and the CO_2 emission is from the company report to EU ETS.
- 2A5: Bricks and Tiles: For 2006-2011 emission factors have been derived from CO_2 emissions reported by the brickworks to EU-ETS (confidential reports from approximately 20 brickworks) and production statistics.
- 2A5: Expanded clay products: For 2006-2011 emission factors for clay products have been derived from CO_2 emissions reported to EU-ETS and production statistics.
- 2D: Sugar production: From the year 2006-2010 the CO_2 emission compiled by the company for EU-ETS is used in the inventory.

Uncertainties

For coal and refinery gas combustion, the uncertainty of the CO_2 emission factor is lower in 2011 than in 1990 due to availability of EU ETS data.

1.3.2.6 *Finland*

General

At sectoral level verified emissions from EU ETS have complete coverage for

- Cement Production
- Lime production
- Iron and steel production

Finland also indicates how many of the total plants are included in the ETS in other sectors:

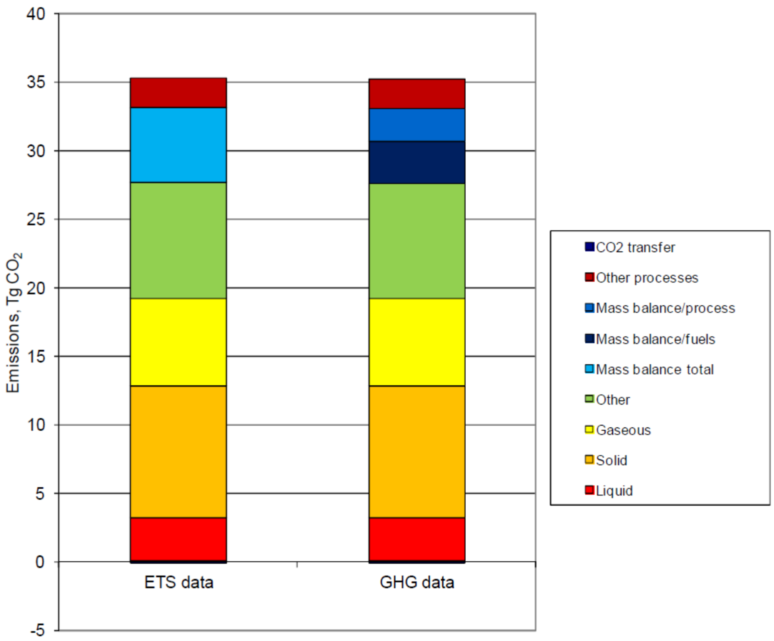
- Limestone and Dolomite Use: 26 plants out of 34 covered by ETS
- Glass Production: 4 plants out of 5
- Hydrogen Production: 2 plants out of 6

The EU ETS data obtained from the Energy Market Authority has become an increasingly important source of activity and emission data for the inventory. It has been used as prime source of activity data (especially for emissions in the Industrial process sector) and for comparison of fuel consumption and CO_2 emissions of specific installations (mainly energy emissions).

CO_2 emission data taken from the EU ETS are annually compared with the calculated emission data in the ILMARI system. Both systems include point source (bottom-up) data. In the ILMARI system the plants included in the ETS are marked. Thus summaries of total ETS and non-ETS plants can be made easily. Total CO_2 emissions taken from the ETS data were 35.1 Tg in 2011. The corresponding amount taken from the GHG inventory data was 35.2 Tg. In the ETS data 171.8 Gg of CO_2 and in the GHG data 172.3 Gg of CO_2 was transferred out of the ETS plants. The reduced amount is different because the storage factor in the inventory is based on annual data and in the ETS a predetermined average storage factor is used. The difference between the ETS and GHG data is 0.5 Tg, z% of total ETS. There are more differences in the allocation of emissions to CRF categories, which can be seen in Figure 1.2.

The most important difference is in the Iron and steel sector, which is almost totally allocated to Industrial Processes in the ETS data. All iron and steel plants calculate and report their emissions according to the mass balance approach in the ETS. In the GHG inventory emissions are split between Energy and Industrial Processes. Another difference is the emissions of combustion of catalytic cracking coke in oil refineries, which is included in the Energy sector in the inventory and in Industrial Processes in the ETS.

Figure 1.2: CO_2 emissions of ETS plants compared with the corresponding emissions reported in the greenhouse gas inventory in 2011



Source: NIR of Finland, submission 2013, p.82, Figure 3.2-2

From 2008 onwards ETS plants have been using mostly measured plant level calorific values and emission factors.

NCVs, CO_2 emission factors and fuel consumption data taken from the ETS plants were aggregated to the most detailed fuel code level and compared with the corresponding data in the ILMARI system. If there were significant differences, corrections were done in the ILMARI data (either plant-specific NCVs of emission factors or both). Concerning the most common and the most important fuels, the differences in aggregated NCVs and EFs were generally less than +-1%. For wood fuels the differences in NCVs were somewhat larger (generally +-3%). This result was expected, mainly due to difficulties of plant operators in disaggregating different types of wood residues to existing fuel code system, but also due to variations in the moisture content of wood fuels. The difference in total amount of woodfuels in TJs was 1.7% in 2010.

Energy

Emissions from fuel combustion are by far the largest source of greenhouse gas emissions in Finland, and many point sources in this category are part of the EU Emission Trading Scheme. Monitored data for CO_2 emissions from these sources have become available from the emission trading system for the inventory years 2005 - 2010. In the Energy sector ETS data have been mainly used in:

- identifying missing point sources
- checking and verifying fuel consumption data
- verifying emission data
- verifying NVCs and CO_2 emission factors by fuel type
- defining national NCV and CO_2 emission factor for hard coal, starting from 2008.

The work to input the data from the ETS system in the GHG database system (ILMARI) has started during 2010. At the moment the ETS plants and data are included in the ILMARI for plant level verification. In 2011 more routines were developed to flag differences in the plant level data. The actual corrections and imputations are still performed manually. Finland is looking for ways to use more automatic imputation routines.

Until 2007 the national CO_2 EF for hard coal is based on a research study. Starting from 2008 the installations in EU ETS are obliged to monitor the CO_2 EF. In this submission, the country specific CO_2 EF for hard coal has been determined based on the ETS data, starting from 2008.

The PCC production data has been crosschecked with other data sources. Statistics Finland has collected plant specific data on the production amounts by PCC plant for the relevant years from the VAHTI database (national environmental permit registry) and the production statistics (plant specific data from Statistics Finland’s manufacturing industry surveys). The data have also been crosschecked with the amount of captured and transferred CO_2 reported under the EU ETS. These data exist for the years 2005-2011 and include the captured and transferred amount of CO_2 by plant. The differences in the PCC production data from the various sources have been very small. The amount calculated and reported by Statistics Finland in the greenhouse gas inventory has been approximately 97 per cent of the data reported to EU ETS 2005-2007. The difference is assumed to account for possible losses during transfer and production.

Industrial Processes

- 2A1 Cement Production: Data for clinker production for the years 1990-2006 are received directly from the company and for years 2007-2011 from EU ETS data. All activity data for years 1990-2006 have been received directly from the company, but as a result of comparison of this data and EU ETS data, it was decided to give up inquiries because data received from the company for year 2005-2007 and in EU ETS data were equal. The emissions of the most recent five years have been compared with EU ETS data. Differences between those figures have been less than 3%. For three years calculated emissions are higher than reported in EU ETS and for two years lower.
- 2A2 Lime Production: Emissions from 2005 onwards have been calculated using production data reported to the EU ETS data. The total amount of produced lime has also been checked from industrial statistics. The calculation method was slightly updated due to new information of activity data in EU ETS, as only pure lime (=CaO+MgO amounts) are used as activity data (impurities have been written off the amount of lime). All other years (1990-2004) production amount was recalculated using assumption (Emissions permit, 2010) that about 6 per cent of product is impurities. The recalculated emission data for years 2005-2011 of all plants have been verified with ETS data (all plants are included in EU Emission Trading Scheme) and differences in emissions have been found to be about 1%.
- 2A3 Limestone and Dolomite Use: Activity data are collected directly from individual companies the EU ETS data have been used. Most of the data for the earlier years have been received from individual companies, EU ETS and a small part has been estimated using industrial statistics. Also data on previously uncertain limestone and dolomite users have been checked using industrial statistics. The calculated emission data of 26 plants (out of 34) have been verified with ETS data and differences have been found to be 2-5%. Higher emissions have been formed because in EU ETS companies calculate emissions using default emission factors and in the inventory emission factors are based on assumption that not all limestone and dolomite are calcinated in the process.
- 2A7 Glass Production: The consumption of limestone and dolomite has been used as activity data when calculating emissions from limestone and dolomite use. Activity data for 2011 are collected directly from individual companies and the EU ETS data. Most of the data for the earlier years have been received from individual companies, EU ETS and a smallish part have been estimated using industrial statistics. The calculated emission data of 4 plants (out of 5) have been verified with ETS data and emissions have been found to be almost equal (+/-2%). Reason for difference is that in the inventory calculation not all carbonate is assumed to be calcinated in the production process.
- 2B5: Hydrogen Production: The calculated emission data of two plants (out of 6) have been verified with ETS data and emissions have been found to be equal. These two plants are biggest emitters in this category, amount of their emissions represents more than 90% of category's emissions.
- 2C1: Iron and Steel Production: From 2005 on, all four iron and steel plants in Finland report to the EU ETS. Starting from 2007 submission (2005 data), the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation.

1.3.2.7 *France*

General

Where all facilities in a given sector are covered by the ETS, consistency with the inventory is ensured by taking into account the information given by the installations that is audited by a recognized organization and by the French administration. If only some of the facilities in a sector are within the scope of the ETS, their statements under the ETS are also taken into account but the balance is accounted by other means to ensure consistency.

Energy

- 1A1 Energy industry: CO_2 emissions are determined by using emission factors for each fuel. National values are applied except when specific factors as justified by operators under the ETS are available (especially since 2005). Calculated emissions are compared with the emissions data reported under the ETS.
- 1A2f Iron and Steel: verification was conducted with ETS data which showed the same emissions and variations.
- 1A2f Combustion emissions from cement plants: Emissions data as reported under the ETS is used since 2004.
- 1A3a Pipeline compressors: The emission factor is determined based on data derived from the ETS since 2008.
- 1A3e compressor stations: For CO_2 the emissions reported under the EU ETS are used.
- 1A1b Petroleum refining: CO_2 emissions are declared by the plants under the EU ETS and are used in the inventory as there is a complete coverage of ETS sector.
- 1A1c Transformation of fuels: For gas transformation all emissions are covered by the ETS and ETS data are used.
- 1B2: CO_2 emissions from refining and regeneration of catalysts in crackers and related emission factors are taken from EU ETS data.

Industrial Processes

- 2A1 Cement Production: France directly uses the emissions reported under the ETS since 2004. The data reported in the emission declarations are consistent with the EU ETS data and the data under E-PRTR since 2004.
- 2A2 Lime Production: ETS data are used for the inventory reporting since 2004, in particular to correct impurity of carbonate sources.
- 2A7 Glass Production: ETS data are used for the inventory reporting. They are completed with the remaining glass production not covered by the ETS. For this part of the production national emission factors are used..
- 2A7 Bricks and Tiles Production: The emissions from ETS plants are taken directly from the ETS reports. These emissions are complemented based on the remaining national production and emission factors taken from ETS reports.
- 2C1 Iron and steel: Work by FFA is in progress to harmonize CO_2 emissions from iron and steel with the verified emissions reported under the EU ETS.

1.3.2.8 *Germany*

General

For source categories that are covered under the EU ETS, the ETS data are used for QA/QC purposes and improvement of the quality of the GHG inventory. In 2006 a research project compared ETS emissions and inventory emissions and developed allocation rules how the ETS emissions should be allocated to inventory categories. Then a formalized procedure was developed for the annual data exchange between ETS authority and the inventory system. ETS data are generally used for verification and QA purposes but not directly in the inventory. EFs from ETS data are also used. AD from ETS data are not used because these data are confidential and would decrease the transparency of the GHG inventory.

In the CRF table 1s1 (Energy) Germany reports additional source categories that include the combustion emissions from source categories covered by the ETS (glass, cement and ceramics). This additional voluntary reporting considerably enhances the comparability of ETS emissions with inventory emissions at sectoral level.

Germany reports that the large amount of datasets (35,000) reported in the ETS poses limits for the use in the inventory, because additional checks would be necessary to ensure methodological consistency across all datasets which would be very time consuming due to the large amount of ETS datasets in Germany.

Energy

The NIR generally indicates that ETS data are used for verification purposes. Both systems, the inventory and the ETS, refer to a list of "basic" CO_2 emission factors in the energy sector.

- 1A3e: As a new data source for natural gas compressors fuel use is taken directly from the ETS since 2005.

Industrial Processes

- 2A1 Cement Production: EFs between inventory and ETS are largely consistent, deviation of 1%. Uncertainties from the EU ETS are used for the uncertainty estimation.
- 2A2 Lime Production: AD are taken into account in lime balance. Uncertainties from the EU ETS are used for the uncertainty estimation.
- 2A7: Glass Production: Emissions were compared with ETS emissions and found to be insignificant different, as ETS data included emissions from water glass production, which was not included in the inventory calculation.
- 2A7 Ceramics Production: ETS data were checked, but due to incomplete coverage cannot be directly used for the estimation.
- 2C1 Iron and Steel: the method used is different between the inventory and the ETS, therefore results can only be compared at aggregate level.

1.3.2.9 *Greece*

General

The energy data used for the calculation of emissions derived from the national energy balance and the reports of installations under the EU ETS.

Energy

Emission factors: The determination of emission factors was based on data derived from verified ETS reports and IPCC guidelines. The national energy balance and the verified ETS reports are the main sources of information regarding fuel consumption by sector and activity. For the period 2006-2011 plant specific values for CC were used, based on verified EU-ETS reports.

- ETS data of years 2005-2010 were used for the disaggregation of energy consumption into different activities / technologies. Average emission factors per fuel and source category / activity were estimated by combining ETS data and IPCC default emission factors per technology / activity and fuel. Emissions were calculated by multiplying the fuel consumption obtained from national energy balance per activity by the average emission factors of the respective source activity and fuel, which has been estimated as above-mentioned.

- 1A1a Public Electricity and Heat: For the public electricity and heat sector and for the years 2005-2011, a CO_2 EF of NG, based on plant specific data (ETS reports), was calculated (plant specific EF). The allocation of energy consumption by technology was made on the basis of Public Power Corporation (PPC) verified ETS reports on the installed capacity and the characteristics of electricity production plants.
- 1A1b Petroleum Refining: GHG emissions from refineries are calculated on the basis of fuel consumption (liquid and gaseous fuels only) which is obtained from the national energy balance and plant specific data derived from verified ETS reports and the estimated emission factors described previously. It is noted that only CO_2 and N_2O emissions from catalytic cracking are included in this sub-source category, while CH_4 emissions are supposed to be included in Fugitive emissions from fuels.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Data collected during the formulation of the NAP for the period 2005 – 2007 and verified ETS reports (for years 2005 - 2011) were used in this inventory. CO_2 EF of natural gas was estimated to comprise emissions from the processing of sour gas, based on data derived from verified ETS reports.
- 1A2 Manufacturing Industries and Construction: Data collected (through questionnaires) during the formulation of the NAP for the period 2005 –2007 and verified installation ETS reports of 2005 - 2011 provided significant information regarding the structure of energy demand in industry per activity / technology. Energy consumption in activities not included in the EU emissions trading scheme (e.g. grey iron foundries) is estimated on the basis of the official data (national energy balance). For 2005 - 2011 activity data for steel production were available through the verified ETS reports. Primary aluminium production and ferroalloys production are included, among others, in the energy balance sector of Non ferrous metals. The available plant specific energy consumption data (heavy fuel oil) refer only to primary aluminium production and cover the years 1990 and 1998 – 2003 and 2005 - 2011. On the basis of those data an average specific consumption is estimated (heavy fuel oil consumption per aluminium produced) which is used for the estimation of energy consumption for the period 1991 – 1997. The specific consumption for 2004 is kept constant at 2003 levels. For 2005 - 2011 plant specific energy consumption data were available through the verified ETS reports. The rest of the energy consumption in the sector (according to the energy balance data) refers exclusively to steam production in boilers.
- Energy consumption in Non metallic minerals is disaggregated into energy consumption for cement production (SNAP 030311), lime production (SNAP 030312), ceramics production (SNAP 030319) and glass production (SNAP 030105) according to verified ETS reports of years 2005 - 2011.
- Data on the non-energy consumption of fuels derive from the national energy balance. However, plant specific data derived from verified ETS reports and information provided by specific Greek industries resulted to the improvement of reallocation of non-energy use fuels from the energy to the industrial processes sector: The non-energy use of natural gas for ammonia production and for hydrogen production has been reallocated in industrial processes sector, by using data from ETS reports and plant specific information. The non-energy use of natural gas for hydrogen production is included in the industrial processes sector, by using data from ETS reports and information from Public Gas Corporation.
- Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, by using data from ETS reports and plant specific information, emissions from solid fuels for ferroalloys production are reallocated to the industrial processes sector, as from 2010 submission.
- National and international aviation: Recalculations of the whole time series were performed for both domestic and international aviation. These recalculations are due to: i) a transmission mistake of the LTO number given by the Hellenic Aviation Authority (the mistake was identified during the QC procedure that included cross check with data from EUROCONTROL) and ii) the reestimation of the fuel consumption per flight based on the ETS reports of year 2010. Because of a problem

with the fuel consumption reported for domestic aviation, the ETS reports were taken into account in order to specify the average fuel consumption per flight.

Industrial Processes

CO_2 emissions from the majority of mineral and metal industries, as well as PFC emissions from aluminium production are estimated on the basis of country-specific emission factors. These emission factors derive of plant specific activity and emission data, in the context of the EU ETS, as well as from other information received by the plants and by the Hellenic Statistical Authority. Activity data for the calculation of emissions from industrial processes are provided by a variety of sources, including plant specific information from industrial processes collected through questionnaires for the formulation of the NAP and verified reports under the EU ETS (years 2005-2011).

- 2A1 Cement Production: For the years 2005-2011 detailed data have been accessed via the verified ETS reports of the plants. These data refer to the quantities of carbonate raw material ($CaCO_3$, $MgCO_3$) used for the production of clinker. Emissions prior to 2005 in the past were calculated using the Tier 2 methodology, based on clinker production. Following the change of the methodology to Tier 3, and according to the IPCC GPG (plant specific data became available in the context of EU ETS reports), the overlap methodology has been used in order to ensure the consistency of the time-series. The uncertainty of the current category's estimations is quite low (2% for EF and AD), since the emissions are plant-specific and the reports of the emissions are being verified by accredited verifiers (all the cement plants of Greece are members of the EU ETS).
- 2A2 Lime Production: The emissions are estimated making use of plant-specific data provided by the verified reports of the plants under the ETS. The IEF shows important fluctuations, as it has been already stated in previous NIRs. This can be attributed to the fact that activity data reported are calculated using ElStat data for hydrated, non-hydrated and hydraulic lime, as described in the IPCC GPG, although the emissions are calculated according to the verified ETS reports, as provided by the plants. The uncertainty of the estimate is medium, although data derive from plant-specific, detailed reports of the plants in the context of the EU ETS.
- 2A3 Limestone and dolomite use: Steel production: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005-2011); Ceramics production: Carbonates consumption data (in the context of the ETS reports) have been used to estimate emissions in the years 2005-2010. Activity data refer to CaCO3 and MgCO3 consumption (emission factors 0.44 and 0.522 respectively). SO_2 scrubbing: For years 2005-2011 data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. Emissions have increased considerably in 2010-2011, having an annual increase in emissions of 9.42%. It should be noted however that all the reports made available in the ETS context have been additionally checked by external accredited verifiers, as defined by the Greek ETS system, and also that whenever available data are being cross-checked with information from different sources (i.e. in the case of magnesia production).
- 2A7 Glass Production: Since February 2006 there is only one plant operating in Greece, whereas since 2005 this plant used to have two factories. Production data have been given for both factories for years 2005- 2006 and for the only plant left for the years 2007-2010. Also for the years 2005-2010 the reports in the EU ETS context have been extensively used. Activity data for the period 2001 – 2004 were collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the NAP for the period 2005 – 2007, according to the EU Directive 2003/87/EC.
- 2B5 Production of other chemicals: CO_2 emissions for H2 production are estimated on the basis of the natural gas consumed for the process. Data are provided by DEPA for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2010. Hydrogen production emissions refer to years after 1997, as natural gas consumption refers to the imported Natural Gas that was introduced in1996 to the Greek energy system Data are provided by the Public Gas Company (DEPA) for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2011. For years where data from both DEPA and the EU ETS are available, namely

years 2005-2011, the consumed quantities of natural gas are being cross-checked. In addition, the ETS reports used in the estimation of CO_2 emissions from Hydrogen Production are verified by the accredited verifiers of the Greek Emissions Trading System.

- 2C1 Iron and Steel: Activity data are plant specific and are based on the verified reports under the EU ETS context. According to information received by the ElStat, all the iron and steel plants of the country are included in the EU ETS. The uncertainty associated with the CO_2 EF is quite low (5%) since all the carbon content is reported by the plants. The same value has been used for the uncertainty of the activity data, accounting mainly for the weighting error in the plant specific reports of the ETS system.
- 2C2 Ferroalloys Production and primary aluminium production: Activity data for 2005-2011 derive of the verified reports of the industry under the EU ETS.

QA/QC

Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. Hellenic Statistical Authority and ETS reports) as well as time-series assessment in order to identify changes that cannot be explained. It should be noted that information and data collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the National Allocation Plan (NAP) for the period 2005 – 2007, according to the EU Directive 2003/87/EC (and its transposition to the national Law, JMD 2004) along with the data from the verified reports from installations under the EU ETS for years 2005-2010 constituted a significant source of information and an additional quality control check.

- Activity data comparison: Cross-checking between energy consumption data derived from national energy balance and plant specific energy consumption data of major industrial plants derived from verified ETS reports is performed.
- Emissions comparison: Verified ETS reports were used for the computation of plant specific CO_2 EFs and NCVs. For quality control purposes emissions calculated by applying PS EFs and NCVs are compared with the emissions calculated by using IPCC defaults EFs and NCVs derived from energy balance. By this way emission estimations were verified. The most appropriate EFs and NCVs per sector are selected and applied.

1.3.2.10 *Ireland*

General

The annual ETS compilation serves as an important source of activity-specific and company-specific data on CO_2 emissions, fuel use and emission factors for major combustion sources and industrial processes. The emission trading scheme covers approximately 100 installations in Ireland with combined CO_2 emissions of 15,770 Gg in 2011, accounting for 27.4 per cent of total greenhouse gas emissions. The ETS returns to the ETU provide for the complete coverage of CO_2 estimates in a number of sub-categories under 1.A.1 (Energy Industries) and 2.A. (Mineral Products

The Emissions Trading Unit (ETU) within the Climate Resource and Research Programme of the OCLR is a key component of the national system The ETU are responsible for administering the European Union Emissions Trading Scheme (ETS), under Directive 2003/87/EC (EP and CEU, 2003), in Ireland and, as such, provide annual verified emissions data to the inventory team. The ETS returns to the ETU provide for the complete coverage of CO_2 estimates for in a number of sub-categories under 1.A.1 Energy Industries and 2.A. Mineral Products. When the allocation to these categories from the ETS raw data is completed, the output is returned to the ETS administrator in OCLR for final checking against the source data. This ensures the efficient and consistent transfer of the verified ETS emissions estimates into the national inventory. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States.

Energy

The incorporation of the ETS data in the Energy sector for the last several submissions is again considered an important step towards improved reliability and accuracy of the estimates for categories 1.A.1 and 1.A.2. Thorough checking of this input is achieved in collaboration with colleagues in the Climate Change and Environmental Research Programme (CCERP) of the EPA, which acts as the competent authority for the ETS in Ireland. Following receipt of the raw ETS data from CCERP, the inventory experts allocate the CO_2 estimates and corresponding energy amounts to the appropriate sub-categories for CRF reporting and then return the compilation to the CCERP contact person for final checking and accounting of any amendments following the ETS verification process. This ensures that where ETS emissions estimates cover a category completely, such as in 1.A.1, the verified CO_2 values are transferred directly to the national inventory and consistency of results is guaranteed. In the case where the CO_2 estimates from ETS do not completely cover the category, as for 1.A.2, the benefit is realised as better information on fuels and more representative emission factors, which improves the top-down estimates of emissions obtained using the energy balance.

As for all years since 2005, CO_2 estimates reported under the ETS for 2011 are used to achieve complete bottom-up results in respect of some important sub-categories in this sector for the 2011 inventory. This is a significant advance in terms of accuracy as the ETS estimates are verified and they represent a large proportion of the total emissions from the Energy sector.

The fuel combustion CO_2 emission factors for solid fuels used by participants under ETS take account of the fact that a very small fraction (typically less than 1 per cent) of fuel carbon may remain un-oxidised and IPCC oxidation factors appropriate to these fuels are applied when computing the emissions under the scheme.

- 1A1 Energy Industries: The Annual Installation Emissions Reports (AIER) submitted by ETS participants in respect of their CO_2 emissions and fuel combustion in 2011 under Directive 2003/87/EC were used to report the complete inventory for category 1.A.1. The emissions data from a total of 22 individual installations – 19 electricity generating stations in 1.A.1.a, one oil refinery in 1.A.1.b and two peat briquetting plants under 1.A.1.c – are the basis for compiling the results in this important category. In each of the three sub-categories, the verified CO_2 estimates reported by the ETS participants were used directly and the corresponding fuel use as given in the national energy balance was used to estimate CH_4 and N_2O emissions using the appropriate IPCC emission factors. The summarised CO_2 emissions compiled in the ETS database according to fuel type for all installations that constituted sub-category 1.A.1.a in 2011 are aggregated to report the CO_2 emissions for this category.

- 1A1a Public Electricity and Heat Production: The CO_2 emissions for sub-category 1.A.1.a obtained from AEIRs are estimated by ETS operators using tier 3 methodologies. The summarised CO_2 emissions compiled in the ETS database according to fuel type for all installations that constituted sub-category 1.A.1.a in 2011 are aggregated to report the CO_2 emissions for this category. The CO_2 emissions estimates compiled through ETS for sub-category 1.A.1.a are cross-checked with a separate long-standing data flow to the inventory agency covering plant-specific emissions for electricity generating stations that are used to report on the Large Combustion Plant Directive and the Convention on Long-Range Transboundary Air Pollution. The aggregated CO_2 emissions reported in the latter data-flow correspond to the compilation available under the ETS for all years since the ETS data became available.
- 1A1b Petroleum Refining: One small oil refinery accounts for the emissions reported under 1.A.1.b Petroleum Refining. The reported CO_2 emissions are those available from the ETS database. These emissions are estimated using tier 2 methodologies in accordance with the monitoring and verification guidelines for combustion activities set down in Decision 2004/156/EC. Because high-pressure gas, low-pressure gas and residual fuel oil account for the bulk of the emissions in 1.A.1.b in all years and the emission factors for these fuels do not fluctuate significantly, the emissions reported using ETS data are consistent with the annual estimates for historical years.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Emissions for 1.A.1.c Manufacture of Solid Fuels and Other Energy Industries were reported for the first time in the 2006 submission and refer to the production of peat briquettes from milled peat in two plants. The 2011 values for CO_2 are also taken from ETS returns which are based on tier 2 methodologies in accordance with the monitoring and verification guidelines for combustion activities set down in Decision 2004/156/EC.
- 1A2 Manufacturing Industry and Construction: The combustion CO_2 emissions in a variety of installations across the CRF sub-categories 1.A.2.a through 1.A.2.f are covered by the ETS Directive 2003/87/EC but the total CO_2 emissions in any sub-category cannot be reported for Ireland using ETS data alone, as in the case of the sub-categories under 1.A.1. The ETS data are instead used to compare fuel quantities reported under ETS with corresponding amounts given in the preliminary national energy balance and to determine improved country-specific emission factors that can be applied for particular fuels and sub-categories. Information provided from the ETS on fuel data have been used to develop an annual country-specific CO_2 emission factor for petroleum coke since 2005. Petroleum coke is used in sub-categories 1.A.2.b, e and f. The average of the five years between 2005 and 2009 of yearly specific emission factors is applied to years from 1990 to 2004, as ETS data is only available from 2005 onwards.

Industrial Processes

The process CO_2 emissions for the relevant source categories under *2.A Mineral Products* are largely covered by Directive 2003/87/EC (EP and CEU, 2003) on emissions trading in the EU and full use is made of this data source for the compilation of the national inventory. In general, the annual verified CO_2 emissions in respect of the installations concerned are used directly for the years covered by the ETS. The category-level emission factors indicated by EU ETS data are used together with the best available production data to obtain the emissions estimates for years previous to 2005.

- 2A1 Cement Production: As the EU ETS subsequently became operational, plant specific CO_2 emissions and corresponding clinker production data are also available for all cement plants for the years 2004 through 2011 and these data are used directly to report emissions for category 2.A.1 in

Ireland. The revised estimates for category 2.A.1 were included in the 2006 submission and no further recalculations have been made since the EU ETS data were adopted as the best available for inventory purposes.

- 2A2 Lime Production: As in the case of cement production, lime producers provided their own estimates of CO_2 emissions from lime manufacture for the development of NAP1 under Directive 2003/87/EC on ETS. These were calculated in accordance with the methods described in the supporting Decision 2004/156/EC, thus providing detailed information on emission estimates and activity data for another important source of CO_2 emissions in *Industrial Processes*. The CO_2 estimates for lime production in 2011 have been obtained from the ETS returns to the EPA. EU ETS data for the years 2005 to 2011 are used to confirm the estimates for the years 1990-2004.
- 2A3 Limestone and Dolomite Use: The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone ($CaCO_3$) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to $CaCO_3$. A further minor use of limestone relevant to *2.A.3 Limestone and Dolomite Use* in Ireland is its application in the purification of sugar produced from sugar beet. However, sugar production ceased in 2006 and the only information on emissions is that obtained under ETS in respect of 2005 and 2006.
- 2A4 soda Ash Production and Use: The emissions associated with soda ash use by one company in Ireland are reported by the company under ETS for the years 2005-2011 and have been used directly in the inventory. Activity data for years prior to the ETS data were sourced by the inventory agency from the company. These data were combined with an emission factor of 0.41 t CO_2/t soda ash, indicated by the ETS data. This approach has allowed a full 1990-2011 time series of emissions to be included in the inventory.
- 2A7 Other Mineral Products: The emissions of CO_2 from glass production (which ceased in 2009) as well as the emissions arising from the use of clays and shale as a raw material in the manufacture of bricks and ceramics are reported under this CRF category. Similar to other categories under *2.A,* information from individual plants that are participants in the Emissions Trading Scheme is utilised to report the emissions estimates in the national inventory. Glass production is treated as a separate sub-category under 2.A.7, and a full time-series of CO_2 emissions has been developed. In the case of crystal glass, the CO_2 emissions are based on the use of potassium carbonate and sodium carbonate use (soda ash) as reported under ETS, using the emission factors of 0.415 t CO_2/t Na2CO3 and 0.267 t CO_2/t K2CO3, provided by the ETS monitoring and reporting guidelines. The company concerned has supplied estimates for all years up to and including 2009, when the plant closed. In the case of bricks and ceramics, the ETS data for two companies provide estimates of emissions for the years 2005-2011 and a further two companies for the years 2005-2008 which have now ceased trading, along with the corresponding quantities of carbonate input materials and the relevant emission factors. The emissions for the years prior to ETS are calculated from the companies' estimates of material use and their respective average ETS emission factors.

1.3.2.11 ***Italy***

General

Data from the Italian Emissions Trading Scheme database are incorporated into the national inventory whenever the sectoral coverage is complete. Activity data collected in the framework of the EU ETS scheme do not cover the overall energy sector, whereas the official statistics available at national level, such as the National Energy Balance (BEN) and the energy production and consumption statistics supplied by Terna, provide the complete basic data needed for the emission inventory. ETS data are always used to develop country-specific emission factors and to check activity data levels.

The inventory agency ISPRA collects data from the industrial associations under the ETS and other European directives, Large Combustion Plant and INES/E-PRTR, and makes use of these data in the preparation of the national inventory ensuring the consistency of time series.

Energy

From 2005 onwards, also the EU ETS "verifier's reports" cover almost the entire sector, for energy consumptions, combustion emissions and process emissions.

- 1A1 Public Electricity and Heat: From year 2005 onwards a valuable source of information is given by the reports prepared for each industrial installation subject to EU ETS scheme. Those reports are prepared by independent qualified verifiers and concern the CO_2 emissions, emission factors and activity data, including fuel used. ISPRA receives copy of the reports from the competent authority (Ministry of Environment) and has been able to extract the information relative to electricity production. The information available is very useful but not fully covering the electricity production sector or the public electricity production. The EU ETS does not include all installations, only those above 20 MWe, it is made on a point source basis so the data include electricity and heat production while the corresponding data from TERNA, concerning only the fuel used for electricity production, are commercially sensitive, confidential and they are not available to the inventory team. Anyway the comparison of data collected by TERNA with those submitted to the EU ETS allows identifying possible discrepancies in the different datasets and thus providing the Ministry of Economic Development experts with useful suggestions to improve the energy balance.
- 1A1b Petroleum Refining: From 2005, the weighted average of CO_2 emission factor reported by operators in the framework of the EU ETS scheme is used for petroleum coke, refinery gas and synthesis gas from heavy residual fuels. Other sources of information are the yearly reporting obligations for the large combustion plants under European Directive (LCP) and the EPRTR registry; both surveys include most of refineries but not all emission sources.
- 1A2 Energy Industries: From 2008, natural gas and fuel oil consumptions reported in the CRF for this sector, are those communicated by the operators of the plants included in the sector in the framework of the EU ETS scheme. The consumptions of these fuels, especially for natural gas, are higher than those reported for the previous years. Fuel consumption reported in the sector is subtracted from the total fuel consumption to produce energy, guaranteeing that over and under estimation are avoided. Data collected by other surveys that include EU ETS and E-PRTR, have been used to cross-check the energy balance data, fuels used and EFs. Total CO_2 emissions reported in the E-PRTR by the operators are equal to those reported under the EU ETS scheme. Other sources of information are the yearly survey performed for the E-PRTR, since 2003, and EU ETS; both surveys include main industrial operators, but not all emission sources. In particular from 2005 onwards the detailed reports by operators subject to EU ETS constitute a valuable source of data. In general, in the industrial sector ETS data source is used for cross checking BEN data. Energy/emissions data from EU ETS survey of industrial sectors should be normally lower than the corresponding BEN data because only part of the installations / sources of a certain industrial sub sector are subject to EU ETS. In case of missing sources or lower figures in BEN than ETS, at fuel sector level, a verification procedure starts. Since 2007 data, ISPRA verifies actual data from both sources and communicate to MSE eventual discrepancies. This starts a verification procedure that eventually can modify BEN data. However, Italy underlines that EU ETS data do not include all industrial installations and cannot be used directly to estimate sectoral emissions for a series of reasons that will be analyzed in the following, sector by sector.
- 1A2 Iron and Steel: For this sector, all main installations are included in EU ETS, but not all sources of emission. Only part of the processes of integrated steel making is subject to EU-ETS, in particular the manufacturing process after the production of row steel was excluded up to 2007 and only the lamination processes have been included from 2008 onwards. Moreover, the recovered coal gases used to produce electricity and steam are not included. So the EU ETS data is only of limited use for this subsector and the procedure set up starting from the total carbon input to the

steel making process, is still the most comprehensive one to estimate the emissions to be reported in 1.A.2.a. Of course, data available from EU ETS are used for cross-checking the BEN data, with an aim to improve the consistency of the data set. These plants are also reported in E-PRTR, but not all sources are included.

- 1A2 Non-Ferrous Metals: Those plants are mostly excluded from EU ETS; some aluminium producing plants will be included from 2013, but only for CO_2 and PFCs emissions from the production process.
- 1A2 Chemicals: The use of EU ETS data for this subsector is rather complex because generally chemical plants are excluded from EU ETS while petrochemical plants are included.
- 1A2 Pulp and Paper and Print: Most of the operators in the paper and pulp sector are included in EU ETS, while only a few of the printing installations are included. The problem for the EU ETS data source for this subsector is that the data are reported on a point source basis, including the production of electricity. The ETS data contain info on the energy and emissions relative to electricity, but this data are not subject to verification and appear not reliable. On the other hand, the inventory team has no access to the detailed, plant by plant, database of electricity producing plants so the emissions reported in the ETS survey cannot be divided between those belonging to table 1.A.1.a and table 1.A.2.d.
- 1A2 Other: This sector comprises emissions from many different industrial subsectors, some of which are subject to EU ETS and some not. Construction material subsector is energy intensive and it is subject to EU ETS. In the national energy database (BEN), the data for construction material are reported separately and they can be cross cheeked with ETS survey. However, in the construction material subsector, there are many small and medium size enterprises, so the operators subject to ETS are only a part of the total.
- 1B Refineries: Fugitive CO_2 emissions in refineries are mainly due to catalytic cracking production processes, sulphur recovery plants, flaring and emissions by other production processes processes including transport of crude oil and oil products. Total fugitive emissions from refineries are calculated on the basis of the total crude oil losses reported in the National Energy Balance. These emissions are then distributed among the different processes on the basis of average emission factors agreed and verified with the association of industrial operators (UP) and yearly updated, from 2000, on the basis of data supplied by the plants in the framework of the European Emissions Trading Scheme. In particular in the EU-ETS context, refineries report CO_2 emissions for flaring and for processes separately.

Industrial Processes

- 2A Mineral Products: Under the EU-ETS, operators are requested to report activity data and CO_2 emissions as information verified and certified by auditors who check for consistency to the reporting criteria. Activity data and emissions reported under EU-ETS and EPER/EPRTR are compared to the information provided by the industrial associations. In particular, comparisons have been carried out for cement, lime, limestone and dolomite, and glass sectors. The general outcome of this verification step shows consistency among the information collected under different legislative framework and the information provided by the relevant industrial associations.
- 2A1 Cement: Emission data reported under the different obligations are in accordance for all the facilities. In the framework of the EU-ETS as well as the EPRTR registry, 51 plants out of 58 reported in 2011 their data representing more than 98% of total national clinker production. Under the EU-ETS, cement plants communicate emissions and activity data split between energy and processes phases and specifying the amount of carbonates and additives; both activity data and emissions are independently verified and certified as requested by the EU-ETS directive.
- 2A2 Lime: CO_2 emissions from lime have been estimated on the basis of production activity data supplied by ISTAT (ISTAT, several years up to 2008) Emission data reported under adding the amount of lime produced and used in other industrial processes (e.g. iron and steel production); emission factors have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association (CAGEMA, 2005). In particular since 2009, information available in the frame of the ETS reporting obligation has allowed us having the lime productions at facility level together with CO_2 emissions data (both activity data and CO_2 emissions are certified). In particular since 2009, information available in the frame of the ETS reporting obligation has allowed us having the lime productions at facility level together with CO_2 emissions data (both activity data and CO_2 emissions are certified).
- 2A3 Limestone and Dolomite Use: CO_2 emissions from limestone and dolomite use are related to the use of limestone and dolomite in bricks, tiles and ceramic production, paper production and also in the treatment of flue gases from power plants. Detailed production activity data and emission factors have been supplied in the framework of the European emissions trading scheme and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations (ANDIL, 2000; ANDIL, several years; ASSOPIASTRELLE, several years; ASSOPIASTRELLE, 2004). The activity data for 2010 have been updated in the present submission. Additional information will be available from 2013, in the context of the EU ETS with the entry of new plants for sectors not previously included, which will be used to verify emission estimates.
- 2A7 Other – Glass: CO_2 emissions from glass production have been estimated taking into account activity data (ISTAT, several years) and emission factors estimated on the basis of information supplied by 53 facilities in the framework of the European emissions trading scheme.
- 2B5 Other – Carbon black: Three facilities have been carrying out this production which consists basically on cracking of feedstock oil (a mixture of PAH) at 1200 – 1900 °C. CO_2 emissions from carbon black production have been estimated on the basis of information supplied directly by the Italian production plants also in the framework of the EU ETS for the last years.
- 2C1 Iron and Steel: From 2000 CO_2 emissions and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. For 2002-2011 data have also been supplied by all the four integrated iron and steel plants in the framework of the European EPER/E-PRTR registry not distinguished for combustion and processes. The iron and steel sector emissions reported in the national EPER/E-PRTR registry and for the Emissions Trading Scheme are compared and checked.
- 2C2 Ferroalloys: CO_2 emissions from ferroalloys have been estimated on the basis of activity data published in the national statistical yearbooks (ISTAT, several years) until 2001. Time series of

ferroalloys activity data have been reconstructed from 2002 on the basis of statistical information (ISTAT, 2003), personal communication (Italghisa, 2011) and on the basis of production data communicated to EPRTR register and to ETS from the only plant of ferroalloys in Italy The comparison between EPRTR and ETS data revealed some differences: further investigation led to a direct contact with the plant and to rectify the incorrect activity data.

- 2C3 Aluminium Production: From 2005 certificated emission values and parameters, including anode effects, have been communicated under EU-ETS (ALCOA, 2010). Emissions from primary aluminium production have been also checked with data reported under EU-ETS.

1.3.2.12 *Luxembourg (NIR 2010, NIR 2013 not yet available)*

General

For large point sources − and after careful assessment of data plausibility − activity data that are reported by facilities are preferably used. Indeed, these data usually reflect the actual consumptions better than aggregated national statistics data, because the facility is supposed having the best information about its own emissions. Such plant specific data have been used for CRF sectors 1 and 2. Luxembourg′s planned improvement for the future foresees to considerably extent the use of consumption and emission data provided by facilities either in the framework of the EU-ETS and of the E-PRTR in its inventories. Comparison of data is possible between figures reported by industry participating to the ETS, and the distributor′s figures as well as emission reports of plant operators. This is the only country specific information on uncertainty that is available.

Energy

Activity data for large facilities that have reporting obligations under the European Union Emission Trading Scheme (EU-ETS) is cross-checked from two sources: reports obtained directly from the operator under its operational permit obligations and the EU-ETS registry operator. Both are hosted at the Environment Agency. A list with the large energy consuming facilities along with their respective fuel consumption has been compiled and enables the Single National Entity to quickly cross-check this data with the EU-ETS data. Thus, completeness can be checked on a more systematic basis.

Industrial Processes

- 2A1 Cement Production: QA/QC: The calculated plant-specific EFs are consistent with the 2007 ETS Tier 1 Guidelines default EF.
- 2A7 Glass Production: The use of soda ash is accounted for in IPCC sub-category 2A7 – Other – Glass Production. The amount of soda ash used in 2011 in the glass production was 75461 t (Source: verified ETS data). There is no other soda ash use in Luxembourg. QA/QC: The calculated CO_2 emission is consistent with the calculated value according to the 2007 ETS Guidelines’ carbonates method.
- 2C1 Iron and Steel Production: QA/QC: The calculated plant-specific emission factor for steel production in 2004 is consistent with the calculated emission factors for the 3 electric arc furnaces (EAF) for the years 2005 and 2006 according to the ETS guidelines 2004.

1.3.2.13 *The Netherlands*

General

In 2012, a quantitative assessment was made of the possible (in)consistencies in CO_2 emissions between data from ETS, NIR and National Energy Statistics. The figures that were analyzed concerned about 40% of the CO_2 emissions in the Netherlands in 2011. The differences could reasonably be explained (e.g. different scope) within the given time available for this action.

Energy

In the energy sector ETS data has been used for QA/QC purposes.

Industrial Processes

- 2B2 Nitric Acid Production: From 2008 onwards, the N_2O emissions of HNO3 production in the Netherlands were opted in in the European emission trading scheme (EU-ETS). For this purpose the companies developed monitoring plans that were approved by the Dutch Emissions authority (NEa), the government organization responsible for EU ETS in the Netherlands. In 2012 the companies again sent the verified emission reports to NEa. The reported and verified emissions (2011) by the companies to NEa were checked against those as reported in the CRF tables (2011). No differences were found between the emission figures in the CRF and the verified emissions in the emission reports under EU ETS.

1.3.2.14 *Portugal*

General

According to the NIR 2013, Portugal still plans to better integrate data from ETS into the GHG inventory and to streamline the collection of data and emission estimates between the inventory and the ETS.

Energy

- Thermo-electricity power plants: Since EU-ETS data is available for inventory use plant specific Carbon content was used in those cases where fuel analysis were made by the plant operator.
- Desulfurization in Large Point Source Energy Plants in Mainland Portugal*:* Since both these energy plants are included in the EU-ETS the CO_2 ratio reported under this scheme was used in the inventory – 0.44 ton CO_2/ton Ca.
- Large Point Source Energy Plants: Plant specific CO_2 emission factors for hard coal, fuel-oil and natural gas factors obtained in the EU-ETS have been used. Data on fuel consumption, by fuel type, for LPS are available from different sources, including EU-ETS. For the latest years (mainly 2009 onwards) the EU-ETS completely replaced the other sources of information. Although different information sources have been used the consistency in time series is guaranteed considering that the same original source (power plant companies) is ultimately used.
- Desulfurization in Large Point Source Energy Plants in Mainland Portugal: Values for the total lime consumed for desulfurization in each plant were obtained in the EU-ETS.
- Energy Plants in Azores and Madeira Autonomous Regions: The quantity of residual fuel-oil, diesel oil and GPL used in Madeira and Azores in electricity production is available from the following two sources: Madeira and Azores Regional Environmental entities and EU-ETS.
- 1A1b Petroleum Refining: The quantities of fuel consumption from 1990 to 2004 in boilers and furnaces were collected directly from individual units under the Large Combustion Plants (LCP) directive and may be observed in the next figure for fuel oil and fuel gas. Since 2005 data source is EU-ETS. Consumption expressed in energy was calculated with a time series of Low Heating Values. This time series reflects actual information given by each refinery also under LCP directive (1990-2004) or EU-ETS (since 2005) and are weighted averages for all three plants. For Oporto and Sines refineries, CO_2 emission factors were obtained directly from EU-ETS data. For Lisbon refinery, CO_2 emission factors were derived from IPCC (1997). In a similar mode that was done for large power plants, and according to the explanations provided before, a comparison was done for total consumption in all refinery units between the data in INERPA (from EU-ETS) and the Energy

Balance. There is an agreement between the two sources of information for the initial years of the period, although not so good for the last years. Portugal will address these differences with DGEG. Following UNFCCC ERT suggestions, it was made a streamline between National Inventory and EU-ETS data. It were addressed emissions related to the consumption of fuels previously not considered in the National Inventory (Acid Soluble Oil (ASO), Off Gas and Tail Gas) concerning Sines refinery data.

- 1A2 Manufacturing Industries and Construction: Data on fuel consumption for LPS were obtained from several sources including since 2009 inventory from EU-ETS. The most important improvement in this sector is the continuing streamline with EU-ETS and DGEG's energy balance, mainly for sectors like Steel production and Chemical industry. Other changes were made to the cement industry sector in the 2012 inventory. These changes concern the inclusion of Lime Production activities as LPS in the inventory. This improvement resulted from the ongoing integration of EU-ETS data in the inventory. Production data for Kraft paper pulp was obtained from EU-ETS – 2010 onwards. There were recalculations to this source category: Update for the Natural Gas consumption in a Pulp/Paper installation. New values come from EU-ETS (2003-2010). The most important improvement in this sector is the continuing streamline with EU-ETS and DGEG's energy balance, mainly for sectors like Steel production and Chemical industry.
- 1B2a.iv Refining and Storage: For FCC, and other processes where there happens recovery of catalysts, activity data is total coke burnt. Annual burning of coke in Sines refinery, both in FCC and in platforming is available from PETROGAL up to 2003. Combustion of coke from catalysts in Oporto refinery was only available for 2001-2002, and was assumed constant over the period 1990-2004. From 2005 onwards, data is obtained directly from EU-ETS for both Sines and Oporto refineries.
- 1B2c Venting and Flaring in Oil Industry: Emission factors for CO_2 were derived from EU-ETS data for Sines and Oporto refineries and from US-EPA (1991) for Lisbon refinery. Total flare gas consumed in the three units and Low Heating Value was made available from PETROGAL for the period 1990-2004. Since 2005 data is obtained from EU-ETS.
- Further improvements: Better integration between activity data in the air emissions inventory and other surveys such as LCP directive, Autocontrolo program, EPER/E-PRTR, the EU-ETS and the energy surveys (co-generation) made annually by DGEG. Contacts are being made to implement it. Particular work is being done to streamline the collection of data and emission estimates between the inventory and the EU-ETS, following the promotion efforts that are being made by the European Commission.

Industrial Processes

- 2A1 Cement Production: EU-ETS method A from Annex VII of Decision 2007/589/EC and data on consumption of raw materials is used from 2005 onwards.
- 2A2 Lime Production: EU-ETS method A from Annex VIII of Decision 2007/589/EC is used from 2005 onwards. From 2005 onwards, data on consumption of raw materials was obtained from EU-ETS. Lime production was obtained from National Statistics (INE) IAPI industrial survey for 1990-2010 period and estimated based on EU-ETS fuel consumption data for 2011.
- 2A3 Limestone, Dolomite and Carbonate Use: For this industry sector, although the consumption of carbonate bearing materials is not known for the whole period, a consumption factor was developed based on the information received under the European Emission Trading Scheme (EU-ETS), and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series.
- 2A7 Glass Production: Recalculations were made based on EU-ETS data concerning raw materials consumption, fuels consumption and cullet incorporation. Recalculations are particularly relevant in CH_4 emissions.
- 2C1 Iron and Steel: The CO_2 emission factors for Electric Arc Furnace, and that were used for each one of the two iron and steel plants that are included in the European Union Emission Trading

Scheme (EU-ETS), were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke from 2002 onwards. It was assumed that the same carbon content exists in both scrap and final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives. The great majority of CO_2 emissions result from EAF and BOF furnaces with only a small contribution from coke oven and blast furnace, and hence furnaces data is what basically determines overall uncertainty. For year 1990 data information was collected directly from industrial plants and it is mostly probably of good quality. The same situation applies from 2002 onwards (plant specific and EU-ETS data). Recalculations were made from 2002 onwards, assuming that since then there is only secondary steel production, Portugal implemented EU-ETS methodology both for fuel consumption and process related CO_2 emissions.

1.3.2.15 *Spain*

General

ETS data have been used for verification purposes. An agreement with the departments of the environment ministry, the industry ministry and the Autonomous Regions has been signed for this purpose. To improve further the inventory, it is planned to continue updating the inventory by including information derived from the EU ETS. The agreement for harmonization (streamlining) is still valid.

Energy

- 1A1a : plant-specific data reported by power plants was cross checked with EU ETS emissions
- 1A2f: Emission factors are used based on ETS data.
- In the 2011 submission, CO_2 emissions from power plants in the inventory were compared with the verified reports from installations under the EU ETS for QA/QC purposes.
- CO_2 emissions were also compared for refineries to detect unusual values and outliers.
- For the iron and steel industry such comparison could not yet be performed due to the access to the information. For coke oven plants not located at integrated steel plants, it has been found that data could not be used directly due to a more aggregated level of information provided under the ETS (no differentiation of processes, thus allocation of combustion and emissions to coke oven plants only is difficult).
- For the cement industry, the CO_2 EF from combustion of tyres was revised based on information provided under the EU ETS for the years 1997 to 2010.

Industrial processes

- 2A1 Cement production: Data on consumption of raw materials, emission factors and CO_2 emissions were obtained for the period 2005-2009 from EU-ETS.
- 2A2 Lime Production: Emissions between the GHG inventory and ETS reports have also been compared for lime production and to complete information provided by the industrial association ANCADE.

1.3.2.16 *Sweden*

General

The coverage of ETS emissions in relation to total CO_2 emissions is 31.7% in 2008, 29.5% in 2009, 34.6% in 2010, and 32.2% in 2011.

Data from the European Union Emission Trading Scheme (ETS) is used since submission 2007 and emission years 2005 and later for oil refineries (CRF 1A1b, 1B2a and 1B2C21), as a SMED study during 2006 showed that this is the most accurate data source for these facilities. In addition, ETS data is used for the three cement producing facilities 2008 and onwards, one plant in CRF 1A2e for 2006 and one plant in CRF 1A2c for 2008 and onwards, since the ETS data contains more detailed information on fuel types for these facilities. ETS data is also used for verification of other data sources, e.g. energy statistics and environmental reports. For example, energy statistics for large facilities within the chemical industry and the steel producing industry are regularly compared with ETS data, and if major differences should be discovered, further investigations will be made. As mentioned above, for technical reasons, it is not possible to use ETS data as major source of activity data. Another reason not to use ETS data as the main data source is that in some facilities, only some of the installations within the facility are included in the trading scheme, and the definition of which installations that should be included has changed between the first and second trading periods.

Energy

- 1A1b Petroleum Refining: Data from the EU Emission Trading System (ETS) are used for four refinery plants for 2005 and later years. For the fifth plant data from environmental reports were used. In 2008 and later years, the quality of ETS data is considered to be very high for all five of the refineries, and thus this is the primary data source for the GHG inventory. For refinery gas, plant specific CO_2 emission factors reported to the ETS are used for 2008 and later, since they are considered to be more accurate then the older standard emission factor. For each of the five refineries, ETS data for the latest year are verified against the refineries' legal environmental reports.
- 1A2c Chemicals: For one of the largest facilities, including two plants, ETS data is the activity data source for 2008 and later. Before 2008, this facility was not fully covered by energy statistics or ETS data, so environmental reports and several energy surveys were used in order to get complete data for this important facility. One calcium carbide manufacturing facility uses coke both as a fuel and as a reductant in the production process. In submission 2013, it was revealed that the reporting of this coke consumption is not properly allocated in the energy statistics, and several years the total amounts reported were obviously too low. For this reason, activity data from environmental reports and in later years ETS are used for this coke consumption in submission 2013. The company also provided a time series of CO_2 emissions covering the period 2001-2010, which was used to calculate the year specific emission factors. These new emission factors were implemented in submission 2012, and thus the inconsistent time series used in submission 2011, where the "old" emission factor was used 1990-2007 and the considerably lower emission factors reported to ETS were used for 2008-2009, has now been corrected. For the largest plants in terms of emissions and fuel consumption, both environmental reports and ETS data are used for verification of the estimates based on energy statistics.
- 1A2f Other Industries: For 2008 and later, activity data for the three plants within the cement production industry is taken from the EU ETS system.
- 1B2A1 Hydrogen production plants at refineries: Both CO_2 and non- CO_2 emissions are estimated using the Tier 2 method. Activity data as consumed amount of fuels (butane gas and naphtha, respectively for the two plants) and CO_2 emissions are taken from the company´s report to the EU ETS system.
- 1B2C2 Flaring: For the years 2005 and later, data from the EU ETS system has been used when possible. Data from the EU ETS system are verified against data from environmental reports and vice versa. In submission 2010 EU ETS data was analyzed carefully. It was concluded that the notation key for flaring of natural gas (NE in earlier sub-missions) could be changed, since no such flaring could be found in the EU ETS data and all plants that might be flaring are included in the EU ETS. The coherence between environmental reports and ETS data is checked when possible, and when differences occur, the facilities are contacted for verification. For a few plants that flare small amounts of gas, activity data as amount of flared gas is shown neither in the environmental reports, nor in the ETS data.

Industrial Processes

- 2A1 Cement production: Cement production occurs at three facilities in Sweden (owned by one company), with one being dominant. Emission data are obtained from environmental reports, EU ETS and by direct contacts with the facilities. From 2005, the company reports plant-specific data on CO_2 emissions to the EU ETS. The CO_2 emissions are based on production of clinker and CaO content of clinker, but also include CO_2 contained in released non-recycled dust (CKD and by-pass) as prescribed by the national guidelines for reporting to the EU ETS. Also CO_2 emissions from organic carbon of raw meal are included in the CO_2 emissions reported in the EU ETS. Activity data and CO_2 emissions are reported to the EU ETS and have thus been verified by an accredited verification body. In the previous submission, CO_2 emissions from organic carbon in the raw material were double-counted for the years 2005 – 2010. For these years CO_2 emissions from organic carbon are included in emissions reported in EU ETS. In submission 2103 this has been corrected. Due to this recalculation reported CO_2 emissions 2005 - 2010 were reduced with around 2% per year, representing between 26 and 30 Gg CO_2.
- 2A3 Limestone and Dolomite Use: Data on the use of limestone and dolomite have been acquired from environmental reports, the ETS and through direct contacts with the companies. For facilities part of the EU ETS, data on CO_2 emissions should however be used for verification of calculated CO_2 emissions using the IPCC default values.
- 2A4 Soda Ash Production and Use: Data on the use of soda ash have been acquired from the ETS and through direct contacts with the reporting companies. The data used for national GHG estimations from soda ash use is believed to be more consistent and complete, compared with the data from national statistics, since the data for the inventory is collected from the ETS, from the environmental reports of the facilities or by direct contact with the plants.
- 2A7 Glass production: Activity data and emissions are mainly collected from the ETS or from the facilities yearly environmental reports.
- 2A7 Light expanded clay aggregates (LECA), roofing tile, brick and ceramic production: From 2005 and onwards, the equivalent data for LECA is acquired through the ETS and the Swedish LECA producer´s annual report. For roofing tile, brick and ceramics production, activity and emission data from 2005 and onwards is acquired through the ETS. The data in the ETS does not always separate between emissions from limestone/dolomite use and CO_2 emissions from other carbon containing raw material (i.e. from the clay and other carbonates used) needed for the production. In order to as far as possible report an accurate total process-related CO_2 emission for the facilities included in this 2A7 sub-code, Sweden have chosen to report all CO_2 emissions in 2A7. As there is a lack of data before 2005, the reported emissions for 2005 are extrapolated for 1990-2004.
- 2C1 Iron and steel production: All plants in this category report their emissions in environmental reports. For plants included in the EU-ETS the report data is scrutinized and compared to EU-ETS data. EU-ETS data is applied wherever it is judged to be appropriate in line with the Good Practice Guidance. Detailed carbon mass balances are compiled for plants included in the reporting according to EU ETS, but due to confidentiality reasons the mass balances cannot be included in the NIR.
- 2C1.1 Secondary Steel Production: In most cases, data from the Swedish enquiry for the Swedish national allocation plan (NAP) for the EU ETS could be used for the years 1998-2002. Data for 1990-1997 and 2003-2004 has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, from the facilities environmental reports and through contacts with the companies. Data in the ETS includes information concerning carbon bound in products, slag, etc, but also other sources for process related CO_2 emissions. Prior to submission 2010, these other emissions were not included for all facilities. Estimates of these missing CO_2 emissions were performed using ETS data for 2005 – 2008 and production data for years before 2005. All CO_2 emissions presented for the facilities in ETS 2005 – 2011 are included in 2C1.1 in submission 2013. Reported CO_2 emissions until year 2008 are for all facilities, except the one which closed down in 2004, based on data in the ETS.

- 2C1.2 Primary Iron and Steel Production: From 2005, ETS data is used and 1990-2004, information has been acquired from the plant. The emissions are verified using national statistics from Statistics Sweden on amounts of coke, anthracite and output material. Activity data (amount of pig iron produced) on integrated pig iron and steel production along with CO_2 emissions and consumed amounts of energy gases (coke oven gas, blast furnace gas and LD-gas) and other fuels, are reported by the plants in the environmental reports since 2003. Mass-carbon balances and associated CO_2 emissions are also reported to the EU-ETS since 2005. For some years, CO_2 emissions to the EU-ETS did not include all plant stations (rolling mills), and additional information from the plants was obtained in order to ensure that no omissions occurred. Since 2008 annual CO_2 emissions reported by the plants in their environmental reports are equal to those reported to the EU ETS. For 2003 onwards, information on activity data and emissions for all plants (CRF 1A1c, 1A2a, 1B1c and 2C1.2) are taken from the environmental reports.
- 2C1.3 Iron ore mining, dressing, sintering and iron ore pellets production: Amounts of bentonite and organic binder used for the production of iron ore pellets and the corresponding CO_2 emissions are for later years collected from the EU ETS. For earlier years the amounts of bentonite and organic binder were provided by the company and EFs for bentonite and organic binder from the EU ETS were used for the calculations.
- 2C5 Other metal production: Both plants in this category report their emissions in yearly environmental reports. For the one plant included in the EU-ETS the reported activity data and emissions are analysed and compared to EU-ETS data. Where EU-ETS data is judged to be appropriate and in line with the Good Practice Guidance, it is applied.

1.3.2.17 *United Kingdom*

The EU ETS data are used to inform activity data estimates for heavy industry sectors, carbon dioxide emission factors of UK fuels within those sectors, and for comparison of fuel allocations to specific economic sectors against data presented in the Digest of UK Energy Statistics (DUKES), published by the Department of Energy and Climate Change (DECC).

Energy

The inventory agency generates annual estimates to account for all of these emission sources, effectively re-allocating a share of the DUKES non-energy use to either combustion or process emission sources in the inventory. The evidence that the inventory agency uses to make these estimates includes annual reporting by plant operators (e.g. EU ETS returns include data on the use of process off-gases in the chemical and petrochemical production sector).

- 1A1 Energy Industries: The activity statistics used to calculate the emission are fuel consumption statistics taken, mainly from DUKES (DECC, 2012), with supplementary data from other UK data sources such as EU ETS reporting and process operators' data. Emission factors are taken from data sources including UK-specific, site-specific data sets (EU ETS, EEMS, operators' data). The factors in Baggott et al, 2004 are supplemented by emission factors based on high quality site-specific emissions data available from the EU ETS data set, covering 2005-2011, and from the EEMS dataset (1997-2011). EU ETS data are used for the most significant sources of carbon in 1A1. CO_2 emission factors for coal, fuel oil, petroleum coke, natural gas and sour gas use in power stations and fuel oil, petroleum coke, and refinery fuel gas (OPG) use in refineries are based on data reported to the EU Emissions Trading System (EU ETS) for the years 2005-2011. These data are of high quality, and available for all significant UK power plants and refineries - some very small power stations, e.g. on remote islands, will not report to EU ETS but their fuel use will be negligible. The factors in Baggott et al, 2004 cover the period 1990-2003 and are considered the best available data for that period and so for many sources within 1A1, emission estimates for 1990-2003 are based on factors from Baggott et al, 2004, and emission estimates for 2005 onwards are based on factors derived from EU ETS data. Extrapolation back from the EU ETS data across the entire time series is not considered sufficiently reliable to replace the factors taken from the 2004 review. For petroleum coke, fuel oil, gas oil and burning oil, statistics that are available through sources such as EU ETS returns indicate higher fuel use in the UK energy sector than is implied by the energy statistics. DUKES reports less fuel burnt by power producers than is reported by operators either directly to the inventory agency or via the EU Emissions Trading System (EU ETS). Therefore fuel oil, gas oil, and burning oil are reallocated from industry to power stations to ensure consistency with operator data, while maintaining consistency with the overall fuel consumption data in DUKES. For OPG, analysis of EU ETS data from refineries for the 2012 submission identified a discrepancy in activity data between EU ETS and DUKES. Based on data from EU ETS and the refinery trade association, UKPIA, a systematic under-report was identified in the UK energy balance data for the refinery sector from 2004 onwards. The estimates for 2004 in the UK GHGI are therefore based on UKPIA data, whilst the data for 2005 onwards are based on EU ETS data. Significant differences have been found between petroleum coke consumption derived from EU ETS data compared with the petroleum coke use given in DUKES. Therefore the emission estimates are based on the EU ETS total, and the activity data for this fuel is then calculated for 2005 onwards based on the reported EUETS emission and an emission factor provided by the refinery sector (UKPIA, 2012). Mismatches was identified between EEMS emissions and DECC DUKES data from PPRS, with gaps in DUKES: From 2003 onwards for LPG/OPG use in oil terminals, and prior to 2001 for gas use in onshore terminals. These gaps have been filled using EEMS and EU ETS activity data for these facilities. EU ETS data also indicates that more natural gas is used by the downstream gas industry in gas compressor stations than is available in DUKES for the sector. So, for the year 2005 onwards, an adjustment is made to the gas consumption data in the inventory with gas transferred from 1A2 to 1A1c to ensure that the inventory figure matches the figure given in EU ETS. In the DUKES published in 2002, DECC (formally DTI) stopped collecting the activity data about oil and gas extraction previously used to estimate these emissions. EU ETS data have been used for the years 2008 to 2011, and EEMS activity data trends have been used to derive estimates for 2003 to 2007 for this activity. Emissions from petroleum coke consumption in refineries are based on DUKES data and an emission factor (UKPIA, 2012) from 1990 to 2004, and EU ETS emissions data from 2005 onwards. As explained in Section 3.2.6.2, the EU ETS emissions data are not consistent with the data presented in DUKES for this sector. The time series of fuel consumption presented in DUKES has been compared with the estimates derived from the EU ETS data and the UKPIA emission factor. The differences are mostly small, and represent an underestimate in DUKES from 2005 to 2008 and in 2011, and an over estimate in 2009 and 2010. For emission factors, the main issue regarding consistency is the use of factors taken from Bagott et al, 2004 for the years 1990-2003 and then the use of EU ETS-based emission factors from 2005 onwards for certain sectors, with interpolated values used for 2004. Emission factors and activity data are kept under review and analysis of EU ETS data will continue.

- 1A2 Manufacturing Industries and Construction: The allocation of activities and emissions between combustion and process source categories for iron and steel and other "contact industries" in the UK GHGI are as consistent as possible with data provided directly from operators (e.g. Tata Steel integrated steelworks data), UK energy statistics and EU ETS (where process emissions are reported separately from combustion emissions). Emission factors for carbon are almost exclusively derived from UK data. Site-specific data, (including both EU ETS data, and data provided by process operators directly or via industrial trade associations) is aggregated up to generate factors for a small number of sectors. The reallocation of fuel activity data from UK energy statistics is required to reconcile the inventory fuel data with other data for fuel users outside the industrial sector, for example data from EU ETS for gas distributors, and process operators in the case of power stations. In general, emission factors are taken from a consistent source across the time series so few time series consistency issues arise. Some EU ETS data are used for coal-fired autogenerators and other large combustion plant such as lime kilns and the use of factors from Baggott et al, 2004 for the earlier part of the time series does result in a step change in the factors for the period 2003-2005. In the case of lime kilns, the EU ETS-based factors show considerable variation over the period 2005-2011 and so the step change between non-ETS data in 2003 and ETS data in 2005 is considered an acceptable trend using the best available data for the source. For coal-fired autogeneration, the earlier factors are typically 5 to 10% higher; this may indicate that the time series of emission factors are inaccurate, or it may indicate that the impact of EU ETS has led to switching of fuel sources by the plant operators.

- 1A4 Other Sectors: Independent sources were used to estimate gas oil used by the rail sector while data provided by industrial sites reporting under emission trading schemes (EU ETS) were used to derive an allocation of gas oil consumption by stationary combustion sources in different industry, commercial and other sectors.

- 1B2 Oil and Natural Gas: The EU ETS data cover a smaller scope of installations and of sources within those installations (EU ETS data for upstream oil and gas facilities include combustion sources during 2005-7 (Phase 1 EU ETS) and combustion and flaring sources in 2008-11 (Phase II EU ETS). The EU ETS reporting scope excludes other GHG emission sources such as venting, process sources, fugitives, well testing emissions and methane from oil loading / unloading and oil storage.), but the EU ETS data are verified by third parties and are therefore useful to use as a quality check for the combustion and flaring emissions source estimates within the national inventory. Environmental reporting by oil and gas terminals in the UK includes from 2005 onwards, combustion CO_2 emissions at terminals have been reported under EU ETS, and from 2008 onwards combustion and flaring CO_2 emissions at terminals has been reported under EU ETS. The scope is not as comprehensive as EEMS or IPPC, but the data are useful to check carbon emission factors and to inform a de-minimis emission value for each site. Therefore, for oil and gas terminals the EU ETS data provides useful additional detail, where facilities may not report to EEMS but do report facility-wide (i.e. aggregated across all sources) emission estimates under IPPC/EPR. The EU ETS data provides emission estimates that can be broken down by fuel and between combustion and flaring sources, to augment the IPPC emissions data. The inventory agency combines UK energy statistics, the EEMS data, EU ETS and IPPC data to derive the oil and gas sector estimates. Where the EU ETS or IPPC data are inconsistent with the EEMS data, the inventory agency works with the DECC Offshore Inspectorate and facility operators to determine the best available data for each source. Emissions from flaring in 2010 across oil and gas sites were revised upwards by a total of 36.8 kt CO_2e due to new estimates for one offshore facility (Douglas Platform) and one oil terminal (Sullom Voe). These revisions were due to (i) access to the EU ETS dataset for all offshore sites helping to identify that the Douglas platform had under-reported flaring emissions to EEMS in 2010, and (ii) review of IPPC reported data for the (two) regulated facilities at Sullom Voe – the terminal and the boiler plant – and correction of flaring data previously reported for 2010.

Industrial Processes

- 2A1 Cement Production: Emissions reported to the inventory agency by the Mineral Products Association have been cross checked with plant specific data reported in the EU ETS to ensure complete coverage of all emissions.

- 2A2 Lime Production: The UK previously based estimation of lime production emissions on limestone and dolomite consumption data, which were readily available (British Geological Survey, 2012). However, site-specific data from EU ETS and other sources have suggested a much higher production of lime in recent years, and so the activity data used in the UK inventory have now been revised to take into account this alternative information. The EU ETS data consist of CO_2 emission estimates and activity data from 2005 onwards. Prior to 2005 there are no EU ETS data, and data are also missing for 2005-2006 for some lime kilns because of UK exemptions from the EU ETS for some sites in those years. So, between 1994 and 2004, CO_2 emission estimates for lime production are based on emissions data published in the Pollution Inventory (PI). The PI data are mostly for total CO_2 i.e. include emissions from both decarbonisation and fuel combustion, but estimates of the CO_2 from decarbonisation only are made using EU ETS data and PI data for 2006-2008, both of which give fuel combustion emissions separately from decarbonisation. The PI-based data, like the EU ETS data, suggest that the BGS activity data, previously used in the UK inventory, are too low. EU ETS data are used for the period from 2005 onwards and exclusively so, from 2008 onwards, and the later part of the time series is therefore judged to be high quality. EU ETS data for the sugar processes does not, provide any evidence that any of the CO_2 is emitted at sites producing lime for use by the chemicals industry and sugar production (the soda ash processes are not part of EU ETS at the moment). Cross comparison of the BGS data with the EU ETS data as a means of verification has indicated a potential under report in the BGS data. This has led to a change in the methodology to ensure completeness of the inventory reporting. The inventory has been updated to replace the BGS data with information from the ETS and the Pollution Inventory.

- 2A3 Limestone and Dolomite Use: Data on gypsum produced in FGD plant has previously been taken from the British Geological Survey (2012), but these data are not always consistent with site-specific emissions data available from EU ETS, and so now a composite series of activity data is used with BGS data for 1994-2004, and EU ETS data for 2005-2011. BGS data for 2005 are in very good agreement with EU ETS data for that year, and so it has been assumed that BGS data for 1994-2004 are also comparable with the later EU ETS data. In the case of FGD plant, there is a change in methodology between 2004 and 2005 because of the availability of high quality EU ETS data from 2005 onwards, whereas previously BGS data have to be used. However, BGS and EU ETS-based emission estimates for 2005 are very close, and for 2006-2011 are within 8% of each other.
- 2A7 Other Mineral Products: EU ETS returns suggest that small quantities of carbonates could also be used in rock wool manufacture so this part of the inventory will be reviewed for the next version. Carbon dioxide emissions may also occur from the use of other materials in the glass and brick industries, for example other carbonates such as potassium and barium carbonate. Emissions are likely to be very small although some emissions data are available through EU ETS sources which may allow a time series of emission estimates to be generated in future. EU ETS data suggests that there is some small use of limestone and dolomite at some sites involved in the manufacture of continuous filament glass fibre and glass wool and so, as with stone wool, the inventory methodology should be reviewed.
- 2C1 Iron and Steel Production: Additional checks are undertaken for emissions from integrated steel works with a comparison of the results of the carbon balance approach used, with emissions reported by the operator of UK integrated steelworks. This comparison is made more difficult by differences in the scope of data from different sources but the analysis still demonstrates that the carbon balance gives emission estimates that are close to those available from EU ETS sources. Incorporation of EU ETS/operator data into the inventory methodology is under review, although the differences in scope currently make it difficult to make progress in this area.
- 6B1 Industrial Waste Water Treatment: There is some evidence from the EU ETS dataset that several UK food and industry facilities collect methane from anaerobic digestion systems and use the gas a fuel source.

1.4 Description of key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000). A key category is defined as an emission source that has a significant influence on a country’s GHG inventory in terms of the absolute level of emissions, the trend in emissions, or both.

In addition to the key category analysis at EU-15 level, every Member State provides a national key category analysis which is independent from the assessment at EU-15 level18. The EU-15 key category analysis is not intended to replace the key category analysis by Member States. The key category analysis at EU-15 level is carried out to identify those categories for which overviews of Member States’ methodologies, emission factors, quality estimates and emission trends are provided in this report. In addition, the EU-15 key category analysis helps identifying those categories that

18 A comparison of the EC key category analysis with the key category analysis of the Member States (without LULUCF) in 2006 showed that most EC key categories are also key categories in the Member States. The Member States’ key categories covered 92 % of the emissions of the 78 EC key categories in 2006.

should receive special attention with regard to QA/QC at EU level. The Member States use their key category analysis for improving the quality of emission estimates at Member State level.

To identify key categories of the EU-15, the following procedure was applied:

- Starting point for the key category identification for this report were the CRF sectoral report tables and sectoral background data tables (for energy), i.e. CRF Tables 1A(a), 2(I), 3, 4, 5, 6 of the EU-15 GHG inventory. All categories where GHG emissions/removals occur were listed, at the most disaggregated level available at EU-15 level and split by gas.
- A level assessment was carried out for the years 1990 and 2011 and a trend assessment was performed for 1990 to 2011. The assessment was carried out for emissions excluding LULUCF and including LULUCF.
- The key category analysis excluding LULUCF resulted in the identification of 76 key categories for the EU-15 and cover 96 % of total EU-15 GHG emissions in 2011. The key category analysis including LULUCF resulted in 82 key categories (see Annex 1.1).

The results of the EU-15 key category analysis excluding LULUCF is presented in

Table 1.9. In addition, the table also shows for each key category the share of emissions estimated with higher tier methods. It shows that for most key categories more than 75 % of EU-15 emissions are calculated with higher methods.

More details related to the key category analysis are included in Annex 1.1. In Chapters 3 to 9 for each key category overview tables are presented which include the Member States' contributions to the EU-15 key source in terms of level and trend.

Table 1.9 Key categories for the EU-15 (Gg CO_2 equivalents)

Source category gas	Gg CO_2 equ.		Trend	Level		share of higher Tier
	1990	2011		1990	2011	
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	60 401	230 731	T	L	L	95%
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	123 584	25 984	T	L	L	97%
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	12 897	37 820	T	L	L	96%
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	752 470	566 986	T	L	L	96%
1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)	3 869	16 631	T	0	L	100%
1 A 1 b Petroleum refining: Liquid Fuels (CO_2)	96 150	96 843	T	L	L	99%
1 A 1 b Petroleum refining: Solid Fuels (CO_2)	3 575	575	T	0	0	100%
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)	15 768	18 786	T	L	L	100%
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)	82 793	32 268	T	L	L	100%
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	17 543	16 705	0	L	L	100%
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	7 307	3 459	T	L	0	100%
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	116 157	83 712	T	L	L	100%
1 A 2 b Non-Ferous Metals: Solid Fuels (CO_2)	3 295	539	T	0	0	85%
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	35 016	34 909	T	L	L	91%
1 A 2 c Chemicals: Liquid Fuels (CO_2)	38 776	22 093	T	L	L	98%
1 A 2 c Chemicals: Other Fuels (CO_2)	5 427	7 514	T	0	L	100%
1 A 2 c Chemicals: Solid Fuels (CO_2)	8 412	3 548	T	L	0	100%
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	12 646	19 489	T	L	L	99%
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	10 317	2 890	T	L	0	97%
1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)	5 119	931	T	0	0	88%
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	16 156	24 721	T	L	L	92%
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	17 155	4 991	T	L	0	86%
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	6 461	2 340	T	0	0	91%
1 A 2 f Other: Gaseous Fuels (CO_2)	91 532	111 192	T	L	L	100%
1 A 2 f Other: Liquid Fuels (CO_2)	118 310	80 472	T	L	L	94%
1 A 2 f Other: Other Fuels (CO_2)	3 388	10 251	T	0	L	96%
1 A 2 f Other: Solid Fuels (CO_2)	113 432	29 832	T	L	L	95%
1 A 3 a Civil Aviation: Jet Kerosene (CO_2)	12 697	15 244	T	L	L	96%
1 A 3 b Road Transportation: Diesel oil (CO_2)	268 931	504 285	T	L	L	90%
1 A 3 b Road Transportation: Diesel oil (N_2O)	1 647	5 269	T	0	0	98%
1 A 3 b Road Transportation: Gasoline (CH_4)	4 076	780	T	0	0	99%
1 A 3 b Road Transportation: Gasoline (CO_2)	363 056	225 369	T	L	L	86%
1 A 3 b Road Transportation: Gasoline (N_2O)	4 182	1 329	T	0	0	98%
1 A 3 b Road Transportation: LPG (CO_2)	7 323	7 869	0	L	L	96%
1 A 3 c Railways: Liquid Fuels (CO_2)	7 817	4 984	0	L	0	76%
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)	8 762	9 112	0	L	L	70%
1 A 3 d Navigation: Residual Oil (CO_2)	6 738	7 521	0	L	L	74%
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	60 058	89 126	T	L	L	94%
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	74 044	40 836	T	L	L	90%
1 A 4 a Commercial/Institutional: Other Fuels (CO_2)	956	4 505	T	0	0	97%
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	27 789	2 283	T	L	0	100%
1 A 4 b Residential: Gaseous Fuels (CO_2)	161 967	203 894	T	L	L	96%
1 A 4 b Residential: Liquid Fuels (CO_2)	169 602	107 261	T	L	L	86%
1 A 4 b Residential: Solid Fuels (CO_2)	74 513	11 717	T	L	L	79%
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)	8 716	11 082	T	L	L	94%
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)	56 750	48 499	0	L	L	70%

1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)	3 712	379	T	0	0	85%
1 A 5 a Stationary: Solid Fuels (CO_2)	4 667	8	T	0	0	100%
1 A 5 b Mobile: Liquid Fuels (CO_2)	13 717	5 033	T	L	0	80%
1 B 1 a Coal Mining: (CH_4)	42 968	6 081	T	L	L	80%
1 B 2 a Oil: (CO_2)	7 994	8 948	0	L	L	91%
1 B 2 b Natural gas: (CH_4)	25 537	17 048	T	L	L	95%
1 B 2 c Venting and flaring: (CO_2)	6 733	5 541	0	L	L	94%
2 A 1 Cement Production: (CO_2)	80 174	61 581	T	L	L	97%
2 A 2 Lime Production: (CO_2)	17 181	15 930	0	L	L	86%
2 A 3 Limestone and Dolomite Use: (CO_2)*	7 992	5 966	0	L	L	77%
2 B 1 Ammonia Production: (CO_2)	18 729	15 312	0	L	L	69%
2 B 2 Nitric Acid Production: (N_2O)	35 723	5 881	T	L	L	98%
2 B 3 Adipic Acid Production: (N_2O)	58 927	764	T	L	0	100%
2 B 5 Other: (CO_2)	10 878	15 545	T	L	L	87%
2 C 1 Iron and Steel Production: (CO_2)	46 932	36 187	T	L	L	100%
2 C 3 Aluminium production: (PFC)	13 247	776	T	L	0	100%
2 E 1 By-product Emissions: (HFC)	21 158	348	T	L	0	100%
2 E 1 By-product Emissions: (SF_6)	1 559	0	T	0	0	NA
2 E 2 Fugitive Emissions: (HFC)	6 381	429	T	0	0	100%
2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)	88	56 666	T	0	L	91%
2 F 2 Foam Blowing: (HFC)	12	3 303	T	0	0	99%
2 F 3 Fire Extinguishers: (HFC)	0	2 860	T	0	0	100%
2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)	34	6 022	T	0	L	95%
4 A 1 Cattle: (CH_4)	118 045	100 363	T	L	L	100%
4 A 3 Sheep: (CH_4)	16 752	12 647	0	L	L	71%
4 B 1 Cattle: (CH_4)	19 012	17 746	0	L	L	88%
4 B 13 Solid Storage and Dry Lot: (N_2O)	19 307	14 805	0	L	L	89%
4 B 8 Swine: (CH_4)	15 956	15 695	0	L	L	84%
4 D 1 Direct Soil Emissions: (N_2O)	113 376	96 563	0	L	L	28%
4 D 2 Pasture, Range and Paddock Manure: (N_2O)	33 191	27 565	0	L	L	54%
4 D 3 Indirect Emissions: (N_2O)	80 529	65 623	T	L	L	31%
6 A 1 Managed Waste disposal on Land: (CH_4)	125 386	66 887	T	L	L	100%
6 A 2 Unmanaged Waste Disposal Sites: (CH_4)	13 948	5 651	T	L	L	100%
6 B 1 Industrial Wastewater: (CH_4)	5 503	5 769	0	0	L	38%
6 B 2 Domestic and Commercial Wastewater: (CH_4)	8 337	4 974	0	L	0	20%
6 B 2 Domestic and Commercial Wastewater: (N_2O)	9 537	9 500	0	L	L	8%

** Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. The use of plant-specific data reported and verified under the EU ETS by Member States can be considered as equivalent to a Tier 2 or Tier 3 method. It is difficult to calculate a specific share of EU emissions calculated with higher tier methods in the absence of such IPCC definitions and due to the fact that MS's estimates are mostly composed by several sources with independent estimation methods, using partly higher tiers, partly default methods.*

A Tier 2 key category analysis including LULUCF was performed on the basis of Tier 1 uncertainty estimates as presented in Chpter 1.6 and is included in Annex 1.1. The comparison with Tier 1 key category analysis shows that:

- Tier 2 key category analysis results in significantly fewer key categories than Tier 1 key category analysis for both level and trend assessment.
- Source category N_2O emissions from 4D agricultural soils is by far the largest key category if uncertainties are included in the level assessment while the trend assessment results in CO_2 emission from 5C grassland as the most important key category.

1.5 Information on the quality assurance and quality control plan

1.5.1 Quality assurance and quality control of the European Union inventory

The European Union GHG inventory is based on the annual inventories of the Member States. Therefore, the quality of the European Union inventory depends on the quality of the Member States' inventories, the QA/QC procedures of the Member States and the quality of the compilation process of the European Union inventory. The Member States and also the European Union as a whole implemented QA/QC procedures in order to comply with the IPCC good practice guidance.

The EU QA/QC programme describes the quality objectives and the inventory quality assurance and quality control plan for the EU GHG inventory including responsibilities and the time schedule for the performance of the QA/QC procedures: Definitions of quality assurance, quality control and related terms used are those provided in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for National Systems under the Kyoto Protocol. The EU QA/QC programme is reviewed, modified and/or updated as appropriate.

The European Commission (Directorate General Climate Action) is responsible for coordinating QA/QC activities for the EU inventory and ensures that the objectives of the QA/QC programme are implemented and the QA/QC plan is developed. The European Environment Agency (EEA) is responsible for the annual implementation of QA/QC procedures for the EU inventory.

The overall objectives of the EU QA/QC programme are:

- To establish quality objectives for the EU GHG inventory taking into account its specific nature of the EU GHG inventory as a compilation of MS GHG inventories,
- To implement the quality objectives in the design of the QA/QC plan defining general and specific QC procedures for the EU GHG inventory submission taking into account the specific nature of the EU GHG inventory,
- to provide an EU inventory of greenhouse gas emissions and removals consistent with the sum of Member States' inventories of greenhouse gas emissions and removals submitted to the EU and covering the EU geographical area,
- to ensure the timeliness of MS GHG inventory submissions to the EU for the compilation of the EU's GHG inventory
- to ensure the completeness of the EU GHG inventory, inter alia by implementing procedures to estimate any data missing from the national inventories, in consultation with the MS concerned
- to contribute to the improvement of quality of Member States' inventories and
- to provide assistance for the implementation of national QA/QC programmes.
- .

A number of specific objectives have been elaborated in order to ensure that the EU GHG inventory complies with the UNFCCC inventory principles of transparency, completeness, consistency, comparability, accuracy and timeliness.

The QA/QC Plan includes quality control procedures taken place before and during the compilation of the EU GHG inventory. In addition, QA procedures, procedures for documentation and archiving, the time schedules for QA/QC procedures and the provisions related to the inventory improvement plan are included.

QC procedures are performed at several different stages during the preparation of the European Union inventory. Firstly, a range of checks are used to determine the consistency and completeness of Member States' data so that they may be compiled in a transparent manner at EU level. Secondly, checks are carried out to ensure that the data are compiled correctly at EU level to meet the overall reporting requirements. Thirdly, a number of checks are conducted with regard to data archiving and documentation to meet various other data quality objectives.

Based on the EU QA/QC programme a quality management manual was developed which includes all specific details of the QA/QC procedures (in particular checklists and forms). The structure of the EU quality management manual has been developed on the basis of the Austrian quality management manual. The reason for using the Austrian manual as a template for the EU manual is that the EU GHG inventory is compiled by Umweltbundesamt Austria and the implementation of the annual QA/QC procedures are coordinated by Umweltbundesamt Austria. By using the Austrian quality manual as a template for the EU quality manual the EU can benefit from the experience made during the set-up of the Austrian quality management system which is accredited under ISO 1720; procedures and documents from the Austrian system have been taken and adapted according to the need of the EU quality management system.

The EU quality management manual is structured along three main processes (management processes, inventory compilation processes, supporting processes) of the quality management system (

Table 1.10).

Table 1.10 Structure of the EU quality management manual

Chapter		Chapter description
Management processes		
ETC 01	EU inventory system	Describes the organisation and responsibilities within the EU GHG inventory system
ETC 02	QA/QC programme	Describes the preparation and evaluation of the EU QA/QC programme by the European Commission
ETC 03	Quality management system	Describes the responsibilities and the structure of the quality management system and gives an overview of the forms and checklists used
ETC 04	Quality management evaluation	Describes the evaluation of the status and effectiveness of the quality management system
ETC 05	Correction and prevention	Describes the procedures for the correction and prevention of mistakes that occur in the EU inventory
ETC 06	Information technology systems	Describes the information technology systems used such as CIRCA, Reportnet and the systems set up at Umweltbundesamt Austria
ETC 07	External communication	Describes the communication with Member States and other persons and institutions
Inventory compilation processes		
ETC 08	QC MS submissions	Describes the quality control activities performed on the GHG inventories submitted by the EU Member States
ETC 09	QC EU inventory compilation	Describes the quality control activities performed during the compilation of the EU GHG inventory including checks of database integrity
ETC 10	QC EU inventory report	Describes the checks carried out during and after the compilation of the EU GHG inventory report
Supporting processes		
ETC 11	Documents	Describes the production, change, proofreading, release and archiving of quality management documents
ETC 12	Documentation and archiving	Describes the procedure for preparing documentation and archiving

The quality checks performed during inventory compilation process are the central part of the quality manual. Quality checks are made at three levels:

1.5.1.1 *Quality control MS submissions*

The QC activities of MS submissions include two elements; checking the completeness of the Member States CRF tables and checking the consistency of Member States GHG data. The completeness checks of Member States' submissions are carried out by EEA/ETC-ACM by using a similar status report form as used by the UNFCCC Secretariat. The completed status reports are sent to Member States by 28 February.

In particular, Member States are asked to check:

1. whether the status reports are correct, in particular with regard to the completeness checks (reporting of "NE") in sheet 3 of the status and consistency reports. Sheet 4 of the status and consistency report flags potential findings from the QA/QC checks performed using the web-based communication tool during February. The status reports of the Member States' submissions are included in Annex 1.3 of this report.

2. the QA/QC findings flagged in the web-based communication tool.

3. if the correct data/information has been included in the draft CRF tables/draft inven-tory report.

Member States are asked to respond to the findings included in the web-based communication tool and to provide comments to the Draft EU GHG inventory and inventory report by latest 15 March to the EU inventory team.

The consistency checks of Member States data primarily aim at identifying main problems in time series of emissions and implied emissions factors, implied emissions factors across Member States and sub-category sums. For the time series checks the algorithms of the UNFCCC secretariat are used. In addition, the ETC/ACM identifies potential problems by comparison with the previous year's inventory submission of the Member States and checks the completness of the CRF tables needed for the compilation of the EU inventory.

In addition an action plan was implemented for the first time in 2011 aiming at improving the completeness regarding NEs of the EU greenhouse gas inventory.

1) Given the fairly wide interpretations and applications of notation keys, the identification of a "real" gap needs expert assessment which is provided by the UNFCCC review and which cannot be automated by existing EU internal procedures. Thus any action plan proposed by the EU needs to continue to be based primarily on the UNFCCC review reports. This is in particular evident with regards to the KP LULUCF, where a carbon pool can be not reported ('NR' should be used) provided that transparent and verifiable information is provided indicating that the pool is not a source, while notation keys such as NO and NA may also sometimes be linked to incomplete estimates. In this respect it needs to be stressed that the late availability of the review reports complicates the follow-up with Member States related to potential missing GHG estimates before the next EU inventory submission. In 2010, 3 Member states review reports were published by 9.4.2010, one by 13.4.2010, two by 15.4.2010, one by 19.4.2010 and one by 20.4.2010.

2) The notation key ‘NE’ is not in all cases an indication of a problem and neither the IPCC guidelines nor the UNFCCC review guidelines foresee an automatic procedure of gap filling when NEs are reported. For example, the notation "NE" can be used if there are no methods available in the 1996 rev. IPCC Guidelines. Overall, a fair and complete analysis of the use of "NE" including the situations highlighted in point 1 above was considered to be indispensable.

Given the above considerations the specific steps of the action plan followed since 2011 are as follows:

1. Member States are required by Decision 280/2004 to submit their national GHG inventories electronically to the European Commission by 15 January of each year. A software program was created by the EEA so that upon submission of the relevant XML/CRF files a report is generated containing a list of all non-estimated source categories per Member State, specifying which of these source categories have been flagged in the Saturday Papers and for which ones IPCC methods are available. This report is then immediately notified to each Member State. During February the experts of the EU inventory team consulted and discussed with Member States’ experts inter alia:
    a) how MS have addressed and documented (or plan to address) the potential issues flagged in their Saturday Papers regarding missing estimates;
    b) the need for applying gap-filling procedures and the selection of the most appropriate methods;
    c) the need to use different notation keys.
2. The completeness of Member States' national submissions with regard to individual CRF tables is documented in the ‘status reports’ sent to the Member States on 28 February. In 2011, the EEA redesigned the ‘status reports’ to include a specific section on the provision of information relating to completeness, focusing on the latest inventory year. This new section is based on the automatic checks and the additional bilateral discussions with MS during January and February as specified above. It reflects the status of the consultation with the MS and lists the follow-up expected from the MS by 15 March. According to the procedures and time scales described in Annex VI of the Implementing Provisions, the Draft EU inventory was sent to MS by 28 February. Updated or additional inventory data submitted by MS (to remove inconsistencies or fill gaps) and complete final national inventory reports are submitted to the European Commission by 15 March.
3. In cases where, even after the two preceding steps a Member State's GHG inventory as submitted to the European Commission by 15 March still contained NEs for categories where IPCC methods exist, and/or if such reporting has been identified as a problem in previous reviews, then the EU inventory experts, in close cooperation with Member States, prepare the missing GHG source estimates in accordance with the gap-filling provisions in articles 13-16 of Commission Decision 2005/166/EC. In addition, for one Member States also NEs from fugitive emissions from oil and gas were gap-filled (see section 16.5) Article 16 requires Member States to use the gap-filled estimates in their national submissions to the UNFCCC to ensure consistency between the EU inventory and Member States’ inventories.
4. A general assessment of completeness is included in the EU Greenhouse Gas Inventory Report (section 1.7 of the 2011 EU NIR). For transparency reasons, since 2011 the EU’s inventory submission contains an improved description of this section to reflect the additional improvements discussed above.
5. In addition to the steps detailed above the regular QA/QC procedures established to ensure the transparency, accuracy, comparability, consistency, and completeness of the EU inventory continue to be applied. The WG1 on annual inventories continues to address issues of completeness giving them priority and the EU internal reviews will further focus on identifying issues that may lead to an underestimation of emissions as we are approaching the end of the first commitment period.

Since 2012 the completeness checks have been extended to the use of the notation key NO and NA. All cases where less than seven Member States reported NO or NA and all other MS reported emission estimates were checked by the sector experts and clarified with Member States, if needed.

For the sectors energy, industrial processes, agriculture, LULUCF and waste sector-specific checks are performed by the sector experts. In addition, the EU sector experts receive the results of checks with the UNFCCC outlier tool before they are sent to the Member States.

The results of the consistency and completeness checks as well as the main findings of the sector specific checks are documented in the web-based QA/QC communication tool. This tool is accessible for MS inventory coordinators and inventory experts. The Member States are asked to respond to findings in this tool and if needed provide revised emission estimates or additional information.

For every updated inventory submission provided by the MS by 15 March follow-up checks are performed by the sector experts and additional findings are documented in the QA/QC communication tool and the status reports are completed. In addition it is checked if issues identified in the status reports and in the QA/QC communication tool (initial checks), which are relevant for the EU inventory (report) have been clarified by the MS. If this is not the case MS are contacted for clarification.

1.5.1.2 *Quality control EU inventory compilation*

After the initial checks of the emission data, the ETC/ACM transfers the national data from the xml-files into the ETC/ACM CRF aggregator database. The version of the data received by ETC/ACM are numbered, in order to be traced back to their source. The ETC/ACM CRF aggregator database is maintained and managed by Umweltbundesamt Austria.

As the EU GHG inventory is compiled on the basis of the inventories of the EU Member States, the focus of the quality control checks performed during the compilation of the EU GHG inventory lays on checking if the correct MS data are used, if the data can be summed-up (same units are used) and that the summing-up is correct. Finally, the consistency and the completeness of the EU GHG inventory is checked. All the checks are carried out for the original submission by 15 April each year and for any resubmission. Two checklists are used for this purpose: 'Inventory preparation/consistency' and 'Data file integrity'.

1.5.1.3 *Quality checks EU inventory report*

The checks carried out during and after the compilation of the EU GHG inventory report are specified in the checklist 'EU inventory report'. They cover a.o. checks of data consistency between the inventory and the inventory report, data consistency between the tables and the text, but also checks of the layout.

The circulation of the draft EU inventory and inventory report on 28 February to the EU Member States for reviewing and commenting also aims to improve the quality of the EU inventory and inventory report. The Member States check their national data and information used in the EU inventory report and send updates, if necessary, and review the EU inventory report. This procedure should assure the timely submission of the EU GHG inventory and inventory report to the UNFCCC secretariat and it should guarantee that the EU submission to the UNFCCC secretariat is consistent with the Member States UNFCCC submissions.

Finally, also the detailed analysis of GHG emission trends of the EU and each EU Member State after the submission of the EU inventory to the UNFCCC also contributes to improving the quality of the

EU GHG inventory. This analysis is carried out in the annual EU GHG trend and projections report; the report identifies sectoral indicators, for socio-economic driving forces of greenhouse gas emissions, by using Member States indicator submissions under Council decision 280/2004 or data from Eurostat and from Member States' detailed inventories. In addition, it compares and analyses Member States' emission trends in the EU key sources and provides main explanations, either socio-economic developments or policies and measures, for these trends in some Member States.

1.5.1.4 *EU internal review*

A collaborative internal review mechanism is established within the European Union so that all participants (MS, EEA, Eurostat, and JRC) may contribute to the identification of shortcomings and propose amendments to existing procedures. The review activities with experts from Member States are coordinated by the ETC/ACM under Working Group I and take place during the period from April through September each year. The synthesised findings of collaborative reviews provide a basis for the planned progressive development of inventories both at Member state and at EU level.

The EU internal reviews 2010 and 2009 focussed on potential under-estimations of the MS inventories as identified in the UNFCCC review reports 2008 and on the use of EU-ETS data in the GHG inventories. In 2008, the internal review was a follow-up of the EU initial review assessed the completeness and comparability (consistent allocation) of Member States' emissions in the sector Industrial Processes. In addition, N_2O emissions from road transport were reviewed. In 2007, the internal review focused on the uncertainty estimates by identifying potential outliers of MS uncertainty estimates. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production', 1.B 'Fugitive emissions from fuels', 2.A 'Mineral products', 2B 'Chemical industry', 2C 'Iron and steel production' and fluorinated gases, 2.E 'Production of halocarbons and SF_6' and 2.F 'Consumption of halocarbons and SF_6'. In 2005, the EU internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'.

EU internal review 2012 (Review under the 'Effort Sharing Decision')

In 2012 a comprehensive EU internal review was carried out in order to determine the emission allocations 2013-2020 for the EU internal GHG emission reduction target 2020. In the climate and energy package the European Union has committed itself to reduce greenhouse gas emissions by 20% below 1990 levels by 2020. The package comprises two pieces of legislation related to GHG emissions:

1. A revision and strengthening of the Emissions Trading System (ETS), the EU's key tool for cutting emissions cost-effectively. A single EU-wide cap on emission allowances will apply from 2013 and will be cut annually, reducing the number of allowances available to businesses to 21% below the 2005 level in 2020. The free allocation of allowances will be progressively replaced by auctioning, and the sectors and gases covered by the system will be somewhat expanded.
2. An 'Effort Sharing Decision' (ESD) governing emissions from sectors not covered by the EU ETS, such as transport, housing, agriculture and waste. Under the Decision each Member State has agreed to a binding national emissions limitation target for 2020 which reflects its relative wealth. The targets range from an emissions reduction of 20% by the richest Member States to an increase in emissions of 20% by the poorest. These national targets will cut the EU's overall emissions from the non-ETS sectors by 10% by 2020 compared with 2005 levels.

The ESD sets out the 2020 emission limit of a Member State in relation to its 2005 emissions, and its emission limits from 2013 to 2020 form a linear trajectory. In accordance with Article 3.2 of the ESD, the starting point of the linear trajectory is defined as the average annual ESD emissions during 2008, 2009 and 2010 in 2009 (for Member States with positive limits under Annex II of the ESD) or in 2013 (for Member State with negative limits). The annual emission allocations shall be determined using reviewed and verified emission data. Thus, complete emission inventories for the reference years (2005, and 2008-2010) must be available and reviewed prior to determining the annual emission allocations in 2012.

The ESD review in 2012, coordinated by the EEA, was carried out by an independent review team comprising of four lead reviewers and 18 sector experts. This team reviewed all 27 EU Member States and Croatia (Croatia will become EU member on 1 July 2013) in a desk review (May 2012) and a centralized review (June 2012). The review was coordinated by the EEA as the ESD review secretariat. The ESD review took into account both the existing quality assurance/quality control procedures for Member States' emission inventory submissions under Decision 280/2004/EC and the separate inventory review process occurring under the UNFCCC. The specific activities of the 2012 technical review included:

1. analysis of the Member States' implementation of recommendations related to improving inventory estimates in accordance with the 1996 IPCC Guidelines and the IPCC good practice guidance as listed in the UNFCCC Annual Review Reports from the 2010 and 2011 UNFCCC review processes (8)and where UNFCCC recommendations have not been implemented, assess that the Member State has provided adequate justification for these;
2. assessment of the time series consistency of the greenhouse gas emissions estimates with a particular focus on the 2005 and 2008-2010 estimates;
3. a check whether problems identified for one Member State in UNFCCC reviews also were problems for other Member States (whether identified by the UNFCCC expert review team or not);
4. an assessment of any recalculations made by a Member State in their inventory since the previous submission, and assess whether these are transparently reported and in accordance with IPCC good practice guidance;
5. a follow-up on any outstanding findings from existing and extended stage 1 and 2 checks;
6. provision of an estimate for any 'technical correction' to emission estimates reported by a Member State where it is believed that emissions reported by the Member State are underestimated and state the significance of these 'technical corrections' in comparison to the overall reported inventory estimates. An evidence-based justification for technical corrections was documented in the review reports of the relevant Member State. A record of correspondence with the Member State concerning the recommended 'technical correction' was retained by the review secretariat.
7. If available and appropriate, the TERT used additional technical information in the review process, such as EU-ETS data, information from Eurostat and other international organisations.

The 2012 initial review under the ESD can be seen as a more robust and consistent QA of MS GHG inventories that have lead to improvements in the quality of the EU and its Member States GHG inventory submissions to UNFCCC in 2013.

Specific activities for the LULUCF sector are described under Ch. 7.10 Quality Assurance and Quality control.

1.5.1.5 *UNFCCC reviews*

In addition, European Union QA procedures aim to build on the issues identified during the independent UNFCCC inventory review of Member States' inventories. Quality assurance procedures based on outcomes of the UNFCCC inventory review consist of the:

- Annual compilation of issues identified during the UNFCCC inventory review related to sectors, key source categories and the major inventory principles transparency, consistency, completeness, comparability and accuracy for all Member States;
- Identification of major issues from the compilation and discussion of ways to resolve them in Working Group 1 under the Climate Change Committee, including identification and documentation of follow-up actions that are considered as necessary within Working Group 1;
- Reviews of the extent to which issues identified through this procedure in previous years have been addressed by Member States;
- Ongoing investigations of ways to produce a more transparent inventory for the unique circumstances of the European Union.

1.5.1.6 *Improvement plan*

Based on the findings of the UNFCCC reviews, the EU internal review and other recommendations the improvement plan for the EU GHG inventory is compiled before the annual compilation process starts. After the finalisation of the annual EU GHG inventory it is evaluated if the improvements planned have been implemented.

1.5.2 Overview of quality assurance and quality control procedures in place at Member State level

As the EU GHG inventory is based on the annual inventories of the EU Member States, the quality of the EU inventory depends on the quality of the Member States' inventories and their QA/QC procedures. Table 1.11 gives an overview of QA/QC procedures in place for the EU-15 Member States. The information is taken from the Member State national inventory reports 2011, 2012 and 2013.

Table 1.11 Overview of quality assurance and quality control procedures in place for EU-15 MS at Member State level (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Austria	A quality management system (QMS) has been designed to achieve to the objectives of goodpractice guidance, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates. The QMS is based on the International Standard ISO/IEC 17020 General Criteria for the operation of various types of bodies performing inspections. The QMS ensures that all requirements of a type A inspection body as stipulated in ISO/IEC 17020 are met, which include strict independence, impartiality and integrity. Since December 2005 the Umweltbundesamt has been accredited as inspection body (Id.No.241) in accordance with the Austrian Accreditation Law. The implementation of QA/QC procedures as required by the IPCC-GPG support the development of national greenhouse gas inventories that can be readily assessed in terms of quality and completeness. The QMS as implemented in the Austrian inventory includes all elements of the QA/QC system outlined in IPCC-GPG Chapter 8 "Quality Assurance and Quality Control", and goes beyond. It also comprises supporting and management processes in addition to the QA/QC procedures in inventory compilation and thus ensures agreed standards not only within (i) the inventory compilation process and (ii) supporting processes (e.g. archiving), but also for (iii) management processes (e.g. annual management reviews, internal audits, regular training of personnel, error prevention). The Austrian Quality Management System is described in detail in Austria's NIR 20127). Changes to the QMS since the last submission On the 13th and 14th January 2011 a comprehensive external audit by the accreditation body took place at the Umweltbundesamt. This 'Re-Accreditation' is obligatory every 5 years and aims at examining the "Inspection Body for Emission Inventories" respectively its QM-System in detail. Only minor measures were to be implemented, generally it confirmed the inspection body's commitment to high quality, and approved conformity with the standard renewing the accreditation of 2005. On April 3rd 2012 an external audit led by a representative appointed by the accreditation body has taken place to assess the QM system with regard to compliance with the underlying standard ISO 17020, to check its implementation in practice and to assure that measures and recommendations as set out in previous audits have been implemented accordingly. Such an audit is obligatory every 15 months. The final judgement of the auditor confirmed the compliance and practicability of the QM system; only two small improvement measures regarding transparency of the System have been raised that could easily be implemented in the Quality Management Manual. Following a recommendation of the accreditation audit to streamline the documentation of the management system, a completely revised quality manual was produced; in the course of this work the revision of ISO/IEC 17020 was taken into account, the new manual being more userfriendly and providing an improved presentation of requirements relating to reporting obligations in the context of emission inventories. The management processes of the QMS and the process of inventory preparation remained mostly unchanged; however the documentation and some blanks and checklists have been improved (e.g. the checklists for QA/QC that have been incorporated into the documentation files, and simplification of the management review process and report, respectively).	Austria's Annual Greenhouse Gas Inventory 1990–2011 Jan 2013 - p 27
Belgium	Belgium did submit a full QA/QC plan of the Belgian national system for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol on the 20th of October 2008 to the UNFCCC-experts as a demand of the UNFCCC-centralized review carried out from the 1st to the 6th of September 2008. In the final Annual Review Report of UNFCCC (Report of the individual review of greenhouse gas inventories of Belgium submitted in 2007 and 2008) the ERT concluded that the QA/QC plan has been prepared and implemented in accordance with the IPCC good practice guidance. This plan is revised during the 2010 submission to the UNFCCC-secretariat. The overall QA/QC responsibilities on the Belgian GHG inventory are carried out at IRCEL/CELINE the Belgian interregional environment Agency which is the national inventory agency responsible for international obligations related to air emissions reporting. As a consequence, the quality and assurance controls already carried out within the responsible regions, are supplemented by the QA/QC performed to the national Belgian inventory. After completion of the Belgian greenhouse gas emission inventory by IRCEL/CELINE, the regions and IRCEL/CELINE carry out further quality control checks of the national inventory before the official submission takes place. IRCEL/CELINE is the final responsible for the national inventory, and any change at this stage is conducted only by IRCEL/CELINE, after co-ordination with the relevant regional contacts. The QC checks are described in section 1.6.1.5. of the BE NIR. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002 and results became available in 2003. The purpose of these audits was to analyse the difficulties encountered while compiling the regional emission inventories into the national inventory in order to improve the quality and completeness of the Belgian national emission inventory and to evaluate the differences between the process at that time and the obligations in the framework of the UNFCCC & IPCC Guidelines and the Kyoto Protocol. The results of these audits of greenhouse gases inventories showed clearly that the Belgian national inventory is of qualitative good value. The difference between the situation in Belgium at that time and the fulfilling of the IPCC Guidelines was mainly the absence of the complete implementation of the IPCC Good Practice Guidance for the Belgian emission inventory with respect to setting up a quality system. Technical working groups are set up since the beginning of 2003 to investigate in detail the implementation of the Good Practice Guidance for the different sectors in Belgium and to harmonise the 3 regional emission inventories in Belgium as much as possible. The overall conclusion in the different technical working groups was that appropriate methods are used for all sectors and in accordance with the IPCC Good Practice Guidance. All three regions perform their own QC procedures. The Tier 1 QC checks conducted at the regional and the national level are also included in the BE NIR.	Belgium's GHG Inventory (1990-2009) Jan 2011 pp 13-15

MS	Description of the national QA/QC activities	Source
Denmark	The Quality Control (QC) and Quality Assurance (QA) plan for greenhouse gas emission inventories performed by the Danish National Environmental Research Institute is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan. The quality planning is based on the following definitions as outlined by the ISO 9000 standards as well as the Good Practice Guidance (IPCC, 2000): • Quality management (QM) Coordinates activity to direct and control with regard to quality. • Quality Planning (QP) Defines quality objectives including specification of necessary operational processes and resources to fulfil the quality objectives. • Quality Control (QC) Fulfils quality requirements. • Quality Assurance (QA) Provides confidence that quality requirements will be fulfilled. • Quality Improvement (QI) Increases the ability to fulfil quality requirements. The QA/QC work is supported by an inventory file system, where all data, models and QA/QC procedures and checks are stored. The QA/QC plan will continuously improve these activities in the future. The Danish Quality Concept foresees quality management, quality planning, quality control, quality assurance and quality improvement. The strategy for process-oriented QC is based on setting up a system for the process of the inventory work. In the Danish Annual EC Greenhouse Gas Report 2010: Inventories 1990-2008 it is stated that the QA/QC programme has not been changed.	Danish Annual EC GHG report 2010: Inventories 1990-2008 Jan 2010, p 2 No change since 2010 submission
Finland	Statistics Finland has the overall responsibility for the GHG inventory in Finland, including the responsibility for co-ordinating the quality management measures at the national level. The quality coordinator steers and facilitates the quality assurance and quality control (QA/QC) process. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. Experts on each inventory sector implement and document the QA/QC procedures. All the participating organisations are represented in the inventory working group set up to support the process of producing annual inventories and the fulfilment of reporting requirements. The working group advances collaboration and communication between the inventory unit and the experts in charge of the different reporting sectors and ensures the implementation of the QA/QC process of the inventory. Statistics Finland has also set up an advisory board that functions as a higher level forum for collaboration and communication with the parties involved in the national system. Issues related to QA/QC are discussed at the meetings of the inventory working group (3-7 meetings per year) and at the bilateral quality meetings between the inventory unit and the expert organisations (once a year). The main findings and conclusions concerning the inventory's quality and improvement needs are communicated to the advisory board. An electronic quality manual including e.g. guidelines, plans, templates and checklists is in place and available to all parties of the national inventory system via the Internet. Statistics Finland bears the responsibility for archiving the quality manual and for submissions of annual inventories (CRF tables and NIR). Expert organisations contributing to the sectoral calculations archive the primary data used, internal documentation of calculations (including the sector-specific QC checklists) and sectoral CRF tables. Statistics Finland co-ordinates the participation of the partners of the national system in the reviews, as well as responses to issues raised by the reviews of the UNFCCC Secretariat. The quality objectives and the planned general QC and QA procedures regarding all sectors are set in the QA/QC plan. This is a checklist that specifies the actions, schedules and responsibilities in order to attain the quality objectives and to provide confidence in the Finnish national system's capability to deliver high-quality inventories. The QA/QC plan is written in Finnish and updated yearly. The QA/QC plan is part of the electronic quality manual of the inventory and archived according to the inventory unit's archive formation plan. The QC procedures used in Finland's GHG inventory comply with the IPCC Good Practice Guidance. General inventory QC checks (IPCC GPG 2000, Table 8.1 and IPCC GPG LULUCF 2003, Table 5.5.1) include routine checks of the integrity, correctness and completeness of the data, identification of errors and deficiencies and documentation and archiving of the inventory data and quality control actions. Categoryspecific QC checks including technical reviews of the source categories, activity data, emission factors and methods are applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revisions have taken place. Once the experts have implemented the QC procedures, they complete the QA/QC form for each source/sink category, which provides a record of the procedures performed. Results of the completed QC checks are recorded in the internal documents for the calculation and archived in the expert organisations. Key findings are summarised in the sector-specific chapters of this NIR. Several QC checks are implemented at Statistics Finland during the compilation of the CRF Tables. Parallel with the 2011 inventory preparation, a specific excel workbook was established to improve the assessment of results, emission trends and to ease the detection of errors and inconsistencies. In addition, the QA/QC of member states' submissions conducted under the European Community GHG Monitoring Mechanism (e.g. completeness checks, consistency checks and comparisons across Member States) produces valuable information on errors and deficiencies, and the information is taken into account before Finland submits its final annual inventory to the UNFCCC. ISO 9001 certification has been under consideration. However, the advantages (e.g. the perspective of a third party assessment) and costs (e.g. the amount of resources required for registration) of certification have been evaluated, and it has been decided not to apply for the ISO 9001 compliance certification. Even without certification Finland continues to utilize the ISO 9001 as a benchmark for the general quality management system of the inventory.	GHG Emissions in Finland 1990-2011 Draft, Jan 2013 p 30 ff.

MS	Description of the national QA/QC activities	Source
France	The national emissions inventory system is set up, by incorporating the usual criteria applicable to Quality Management Systems (QMS). CITEPA, in charge of preparing the national emissions inventories from a technical viewpoint, has put in place a system for quality assurance and quality control based on the ISO 9001 standard . This approach has been confirmed by the fact that CITEPA was awarded a certificate issued by the French Quality Management Body (AFAQ) in 2004. This was renewed in 2007 and in 2010 and follow-up audits were conducted in between. The task of preparing the national emissions inventories is covered by the QMS via several specific processes (see Quality Manual – confidential in-house document). In this framework, several processes for quality assurance and quality control of the inventories are incorporated into the different processes and procedures implemented, corresponding to the different phases and actions. The overall objective of the quality assurance and quality control programme focuses on the production of national emissions and sinks inventories in line with requirements issued in the different national and international frameworks covered by the SNIEPA. These requirements concern the definition, implementation and application of procedures and methods aimed at meeting the criteria on traceability, exhaustiveness, consistency, comparability and punctuality required by international and EU institutions, as part of the commitments France has signed up to. Quality control is incorporated into the different phases of the processes and procedures developed by the bodies involved in the national system in order to achieve the objectives and targets set. The CITEPA, the body responsible for the technical coordination and compilation of the inventories is in charge of monitoring quality control and issues recommendations aimed at improving, completing and developing the necessary processes and procedures. These procedures can be automatic or manual, take the form of a check-list, feasibility, consistency, exhaustiveness, trend analysis and simulation tests, etc. They are implemented at several stages in the process of conducting the inventory. Quality assurance is provided through several measures designed to subject the inventories to reviews for the purpose of obtaining comments and assessments from stakeholders, generally with expert knowledge.	direct communication, March 2011
Germany	The quality system "Qualitätssystem Emissionsinventare" (QSE) is built on the requirements of the IPCC Good Practice Guidance (defined in chapter 8), the national requirements in Germany and the internal Structure within Umweltbundesamt (the national Coordination Centre for GHG inventory compilation). QSE covers all steps of the inventory preparation. It was made binding within Umweltbundesamt by means of the UBA-in-house directive 11/2005 (a regulatory framework). QSE regulates responsibilities within the QA/QC system. The quality control checks for Tier 1 (pursuant paragraph 14 (g) of the Guidelines for National Systems) were carried out for 2006 reporting the first time. They were sent as QC check lists to the experts together with the request for data. The minimum requirements according to the QA/QC system for implementation, description and documentation of the QA/QC measures are carried out together with the respective contribution to the inventory. A general description of quality aims is given in the QSE-Handbook (derived from the IPCC Good Practice Guidance). According to the requirements for the IPCC GPG and Paragraph 12 (d) of the Guidelines for National Systems the necessary QA/QC activities should be summarized in a QA/QC plan. The QA/QC plan is combined with the checklist for QA/QC. For 2008, 2009 and 2010 reporting the checklists for sectoral experts were improved. Thus, both the QA/QC plans and QA/QC checklists are an instrument for the inspection of the fulfillment of the international requirements and allow for control over the quality of the inventory. In the quality improvement plan all potentials for improvement and additionally the findings from the independent inventory review are documented. Data are documented in a central archive. Either data are stored in the central archive directly or if for a given reason (e.g. confidentiality of the data) data is not stored in the central archive reference is given to place were the data is stored..	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2010 Mar 2012 p 82 ff. (submitted in German, translation provided by Germany via direct communication)

MS	Description of the national QA/QC activities	Source
Greece	A QA/QC system is being implemented since April 2004. It has been developed by the previous technical consultant (NOA) and is still being used by NTUA. A revision of the system was performed in May 2008, according to the experience gained from 2008 and 2009 submission, resulting in the current version 1.2. As mentioned above, the supervision of QA/QC system is performed by MEECC. The system is based on the ISO 9001:2000 standard and its quality objectives, as stated in the quality management handbook, are the following: 1. Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. 2. Continuous improvement of GHG emissions/removals estimates. 3. Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. The accomplishment of the above-mentioned objectives can only be ensured by the implementation, from all the members of the Inventory Team of the QA/QC procedures included in the plan for: • data collection and processing, • applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals, • making quantitative estimates of inventory uncertainty, • archiving information and record keeping and • compiling national inventory reports. The QA/QC system developed covers the following processes: • QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the above-mentioned quality objectives. • Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. • Archiving inventory information, comprising activities related to centralised archiving of inventory information and the compilation of the national inventory report. • Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public. • Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory. • Inventory improvement, that is related to the preparation and the justification of any recalculations made. The implementation of the plan started in April 2004 and the first internal review was carried out in June 2004, following procedures and manuals (available only in Greek) developed by in house staff and outside consultants. The current in use version of the QA/QC manual was revised in May 2008. All the procedures described there, are followed by both the MEECC and the NTUA staff members. Furthermore, annual internal audits take place by MEECC/NTUA between January to March of each year and audits by independent local experts are planned and implemented. Moreover, as it will be described in the chapters of the NIR and in the sections entitled "Sourcespecific QA/QC and verification", source-specific Tier 2 QC procedures are applied in the majority of source categories for quality control and verification purposes..	Climate Change Emissions Inventory, Information under Article 3(1) of the Decision 280/2004/ EC, Jan 2013, p 10 f.
Ireland	In early 2005, the inventory agency in Ireland commissioned a project with UK consultants NETCEN to establish formal QA/QC procedures that would meet the needs of the UNFCCC reporting requirements. The project developed a QA/QC system including a documented QA/QC plan and procedures along with a QA/QC manual. The manual provides a general overview of the QA/QC system. In addition, the manual provides guidance and templates for appropriate quality checking, documentation and traceability. The selection of source data, calculation methodologies, peer and expert review of inventory data and the annual requirements for continuous improvement for the inventory are also outlined in the manual. The QA/QC plan identifies the specific data quality objectives related to the principles of transparency, consistency, completeness, comparability and accuracy required for Ireland's national inventory and provides specific guidance and documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting.	Ireland National Inventory Report 2012,GHG emissions 1990-2010 reported to the UNFCCC Mar 2012 p 16

MS	Description of the national QA/QC activities	Source
Italy	ISPRA has elaborated an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitates the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establishes quality objectives. Particularly, an inventory QA/QC procedures has been drawn up which describes QA/QC procedures and verification activities to be followed during the inventory compilation and helps in the inventory improvement. Furthermore, specific QA/QC procedures and different verification activities implemented thoroughly the current inventory compilation, as part of the estimation process, are figured out in the annual QA/QC plans Checklists are compiled annually by the inventory experts and collected by the QA/QC coordinator. These lists are also registred in the 'reference' database. General QC procedures also include data and documentation gathering. Specifically, the inventory analyst for a source category maintains a complete and separate project archive for that source category; the archive includes all the materials needed to develop the inventory for that year and is kept in a transparent manner All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors as well as methodologies are referenced to their data sources. Particular attention is paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. To this end, a major improvement which increases the transparency of the inventory has been the development of a 'reference' database. After each reporting cycle, all database files, spreadsheets and official submissions are archived as 'read-only' mode in a master computer Quality assurance procedures regard some verification activities of the inventory as a whole and at sectoral level. Feedbacks for the Italian inventory derive from communication of data to different institutions and/or at local level. For instance, the communication of the inventory to the European Community results in a pre-check of the GHG values before the submission to the UNFCCC and relevant inconsistencies may be highlighted. Comparisons between national activity data and data from international databases are usually carried out in order to find out the main differences and an explanation to them (ENEA/MAP/APAT, 2004). Emission intensity indicators among countries (e.g. emissions per capita, industrial emissions per unit of value added, road transport emissions per passenger car, emissions from power generation per kWh of electricity produced, emissions from dairy cows per tonne of milk produced) can also be useful to provide a preliminary check and verification of the order of magnitude of the emissions. This is carried out at European and international level by considering the annual reports compiled by the EC and the UNFCCC as well as related documentation available from international databases and outcome of relevant workshops.	Italian Greenhouse Gas Inventory 1990-2010 National Inventory Report 2012, March 2012, pp 38-41

MS	Description of the national QA/QC activities	Source
Luxembourg	Luxembourg′s Quality Management System (QMS) of the GHG Inventory is organised in three layers (Figure 1-4): a) Performance processes Performance processes directly concern the compilation of the GHG Inventory. They comprise input data, data acquisition, calculations, and generation of CRF tables and NIR as well as quality control checks and the outcomes of the NIR and CRF-tables. b) Management processes Management processes control the system′s performance by defining quality objectives, responsibilities, quality assurance procedures, improvement plans and the personnel′s qualifications and obligations. c) Supporting processes Supporting processes assist the system′s performance by providing technical requirements and standards. The overall responsibility for the establishment and existence of a Quality Management System (QMS), in order to prepare the national inventory of greenhouse gases and air pollutants, lies with the Environment Agency (Administration de l′Environnement, AEV). Being designated by a grand-ducal regulation26 as the single national entity (SNE), the AEV, has the overall technical responsibility for the national GHG Inventory. Political responsibility lies with the Ministry of Sustainable Development and Infrastructure (MDDI). Within the AEV, the Air & Noise Division is responsible for the following tasks: The National Inventory Compiler (NIC): · supervises the inventory preparation process for various obligations as outlined below; · is the national inventory focal point to the Ministry (MDDI). The national, European and international obligations are: · UNECE Convention on Long Range Transboundary Air Pollution and its protocols · UNFCCC & Kyoto Protocol · European Union: · EU GHG Monitoring Mechanism (280/2004/EC & 2005/166/EC) · NEC Directive (2001/81/EC) · Ambient Air Quality Directive (2008/50/EC). Due to Luxembourg′s clear extent, its QMS deals with a manageable quantity of documents. Following are the specifications of Luxembourg′s Quality Management System: · firm build-up with a quality manual consisting of a chart with all relevant documents, handling instructions and deadlines for check (Figure 1-4); · good manageability (instead of a complex system); · usable and effective quality control procedures (user-friendly, clearly arranged). Since the QMS has been implemented in the year 2008, it has evolved continuously and many improvements have already been realised. The QMS shall ensure and continuously improve the quality (measured by transparency, accuracy consistency, comparability, completeness (TACCC) and timeliness) of Luxembourg′s GHG Inventory in order to fulfil the party′s obligations according to articles 3, 5 and 7 of the Kyoto Protocol. The QMS therefore supplies procedures to: · check integrity, correctness and completeness of data; · identify errors and omissions reduce uncertainties of emission estimates; · document and archive inventory calculation sheets and background data.	National Inventory Report 1990-2011, May 2013 pp 59-62

MS	Description of the national QA/QC activities	Source
Netherlands	As part of its National System, the Netherlands has developed and implemented a QA/QC program (NL Agency, 2011). This program is yearly assessed and updated, if needed. The Monitoring Protocols were elaborated and implemented in order to improve the transparency of the inventory (including methodologies, procedures, tasks, roles and responsibilities with regard to inventories of greenhouse gases). Transparent descriptions and procedures of these different aspects are described in the protocols for each gas and sector and in process descriptions for other relevant tasks in the National System. The protocols are assessed annually and updated if needed. Various QC issues: Inconsistencies in the key category analysis between CRF and NIR were analysed and removed. The key category analysis is updated in the NIR (Annex 1) as well as the CRF files. The Expert Review Team (ERT) recommended providing more information in the NIR report and protocols, that was until now only included in background information. The Netherlands has updated the protocols; for various sectors this implies that more information is included in the protocols, as requested by the ERT. The ERT recommended providing more specific information on sector specific QC activities. In 2009 and early 2010, a project was performed to re-assess and update both the information on uncertainties and on sector specific QC activities [Ecofys, 2010]. The PRTR task forces continue to work on the implementation of the recommendations from this report in 2012. The Netherlands continues its efforts to include the correct notation keys in the CRF files. General QC checks were performed. To facilitate these general QC checks, a checklist was developed and implemented. A number of general QC checks have been introduced as part of the annual work plan of the PRTR and are also mentioned in the monitoring protocols. The QC checks included in the work plan aim at covering issues such as consistency, completeness and correctness of the CRF data. The general QC for the present inventory was largely performed in the institutes involved as integrated part of their PRTR work (Wever, 2011). The PRTR task forces fill in a standard-format database with emission data for 1990–2011 (with the exception of LULUCF). After a first check of the emission files by RIVM and TNO for completeness, the (corrected) data are available to the specific task force for checking consistency checks and trend analysis (comparability, accuracy). The task forces have access to information about the relevant emissions in the database. Several weeks before the dataset was fixed, a trend verification workshop was organised by RIVM (December, 2012). The result of this workshop including actions for the task forces to resolve the identified clarification issues are documented at RIVM. Required changes to the database are then made by the task forces. Basic LULUCF data (e.g. Forest Inventories, Forests statistics and land use maps) have a different routing compared to the other basic data (see figure 1.1). QA/QC for these data are described in the description of QA/QC of the outside agencies (Wever, 2011). Quality Assurance for the current NIR includes the following activities: A peer and public review, on the basis of the draft NIR in January/February 2013. In preparing this NIR, the results of former UNFCCC reviews, including the preliminary results of the 2012 in-country review. The QA/QC activities generally aim at a high-quality output of the emissions inventory and the National System; these are in line with international QA/QC requirements (IPCC Good Practice Guidance).	Greenhouse Gas Emissions in the Netherlands 1990-2011 Jan 2013 p32 ff.

MS	Description of the national QA/QC activities	Source
Portugal	APA has the overall responsibility for the national inventories in Portugal, including the competence for the coordination of the Quality Assurance (QA) and Quality Control System (QC). The inventory staff is responsible for the implementation of QA/QC procedures related to data gathering, handling, processing, documenting, archiving and reporting procedures related to the inventory, namely QC1 Each Involved Entity (IE) within the Portuguese national system (SNIERPA) contributing with data to the inventory is responsible for the quality of their own data. A request for information on the specific QC or QA procedures is to be sent to IEs in order to document such procedures, its results and also the uncertainty calculations. A QA/QC coordinator is designated in order to ensure that the objectives of the QA/QC plan are met and to guarantee the good implementation of the QA\QC procedures defined. The QA/QC system is composed of two main elements: • QA/QC Plan; • Procedures Manual. The first schedules the application of the general (QC1) and specific (QC2) as well as QA procedures, described in detail in a Manual (in Portuguese language), to be applied to defined source/sink categories. The procedures were defined according to Good Practice and Uncertainty Management Guide (IPCC, 2000) and adapted to the specific National Inventory (INERPA) characteristics. QC1 procedures defined in the QA/QC Manual include a series of checklists, which consider basic checks on the accuracy of data acquisition processes (including, e.g, transcription errors) and checks on calculation procedures, data and parameters. It includes also cross-checking among subcategories in terms of data consistency, verification of NIR and CRF tables. Documentation and archiving procedures include checks on information handling which should enable the recalculation of the inventory. QC2 procedures, on the other hand, include technical verifications of emission factors, activity data, comparison of results among different approaches. Both QC1 and QC2 procedures are to be applied by the inventory team during the inventory calculation and compilation following a yearly defined QA/QC plan. The results of quality control of national submissions under the EC GHG Monitoring Mechanism (e.g. completeness checks, consistency checks), and the issues raised during the annual review process of the UNFCCC or other reviews, constitute additional processes of technical verification and represent valuable sources of error detection and methodological improvement.	Portuguese National Inventory Report on Greenhouse Gases, 1990-2011 Jan 2013, p 18
Spain	The QA/QC plan is an internal document with the aim to improve the inventory. It is revised periodically and adapted to changes in the procedures of inventory preparation. The objectives of the QA/QC plan are: Timeliness: to reach this target a time schedule for specific tasks and respective check points are established. Completeness: an exhaustive analysis is done of the Inventory's basic SNAP nomenclature (which corresponds to the nomenclatures used in the rest of the Inventory formats), all the cross-tab activities with pollutants for which references for emission estimates are provided, and with reference to these methods, an analysis is made and the basic data necessary for the application of selected estimation method is collected. Consistency: a parameter or variable is only introduced once in the data base. This assures that a parameter that is used several times in the inventory is always the same. Consistency of time series is achieved by subjecting primary data to quality control. Outliers in the time series are identified and checked. Comparability: the Spanish Inventory should be comparable with inventories from other countries. To achieve this goal definitions and nomenclature are based on SNAP and CRF. Accuracy: priority for the use of methods of higher tier is given to key categories. Transparency: the reproducibility of the inventory should be granted. For this aim processes that generate emissions, the variables of activities and their origins, the algorithms and emission factors and the estimated emissions are documented in SNAP format. Improvement of the inventory: all the preceding objectives lead to this final objective of Inventory improvement and as such contribute to the shame, with all the quality assurance and control elements mentioned. The DG-CEAMN as single national entity of the NIS is responsible for the quality control and quality assurance system. For this task DG-CEAMN receives technical assistance from AED.	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2011 March 2013 (submitted in Spanish, translated)

MS	Description of the national QA/QC activities	Source
Sweden	In order to fulfill the obligations of reporting to the UNFCCC and the EU, the Swedish EPA has set up a quality system as part of the national system. The struc-ture of the quality system follows the PDCA cycle (Plan, Do, Check, Act). This is an adopted model for how systematic quality and environmental management activity is to be undertaken according to international standards to ensure that quality is maintained and developed. The quality system includes several procedures such as training of staff, inventory planning and preparation, QA/QC procedures, publication, data storage, and fol-low-up and improvements. All QA/QC procedures are documented in a QA/QC plan. The QA/QC plan also includes a scheduled time frame describing the differ-ent stages of the inventory from its initial development to final reporting. The qual-ity system ensures that the inventory is systematically planned, prepared and fol-lowed up in accordance with specified quality requirements so that the inventory is continuously developed and improved. **Quality control:** Quality control is the check that is made during the inventory on different types of data, emission factors and calculations that have been made. The quality control takes place according to general requirements (Tier 1) which apply to all types of data used as support material for the reporting, and specific requirements for quali-ty control (Tier 2) which are applied to certain types of data and/or emission sources. In this inventory, general Tier 1 QC measures, according to Table 8.1 in IPCC Good Practice Guidance (2000), have been carried out as follows: • Transcription errors in data input • Calculations are made correctly • Units and conversion factors are correct • Integrity of database files • Consistency in data between source categories • Correct movement of inventory data between processing steps • Recalculations, checked and documented • Completeness check • Comparison of last submission's estimates to previous estimates • Documentation of changes that may influence uncertainty estimates In addition, source specific Tier 2 QC procedures are carried out for several categories. All QC measures performed are documented by SMED in QC checklists for each CRF code or group of codes. After completion of the initial compilation of the inventory, a QC-team within SMED reviews all QC checklists. In addition, the project management team performs checks of submission data using the functional-ity of the CRF Reporter (i.e. checks of completeness, time-series consistency and recalculation explanations). Quality assurance: Key categories should be subject to external peer review according to the Tier 2 of the Good Practice Guidance. The Swedish QA/QC system includes national peer reviews by sectoral authorities. The peer review is defined in the Ordinance (2005:626) Concerning Climate Reporting and is, for all sectors, conducted by a person who has not taken part in the inventory preparation. The Swedish EPA is responsible for coordinating the annual peer review. This means, among other things, ensuring that the peer reviewers have received the necessary training. The peer review includes methodology and emissions factors used, as well as comparisons of activity and emission data with other national statistics. The reviewers also identify areas for improvement, which consolidates the basis for improve-ments in coming submissions. Results from the national peer review are docu-mented in review reports. Recommendations from the review reports are collected to the list of suggested improvements described in section 1.3.8. The UNFCCC secretariat administers an international peer review of Swedish re-porting after submission.. The submission will also be reviewed by the EU. Recommendations from this review will be handled in the same way as recommendations from the UNFCCC review and the national peer review.	National Inventory Report Sweden 2013 Jan 2013 pp 47, 53ff

MS	Description of the national QA/QC activities	Source
United Kingdom	The UK Greenhouse Gas Inventory and the National Atmospheric Emissions Inventory are compiled and maintained together by Ricardo-AEA (the Inventory Agency), on behalf of the Department for Energy and Climate Change (DECC) and the Department for Food and Rural Affairs (DEFRA). Ricardo-AEA prepares the GHG submissions to the EC under the EUMM and to the UNFCCC. The data compilation for some source sectors of the UK inventory are performed by other contractors (i.e. Rothamsted Research compile the agriculture sector, CEH compile the land use, land-use change and forestry sector). Much of the data received by Ricardo-AEA for the UK GHGI compilation come from other government departments, agencies, research establishments or consultants working on behalf of UK government or for trade associations. Some of the organisations (e.g. DECC, the Office of National Statistics and British Geological Survey) qualify as the UKs National Statistical Agencies referred to in the Guidance and abide by strict statistical QA/QC standards. Other organisations (e.g. CEH, providing the LULUCF estimates and the Environment Agency, providing regulated point source data) supply important datasets for the Inventory and have their own QA/QC systems. Whilst these organisations have their own QA/QC systems, Ricardo-AEA is responsible for co-ordinating inventory-wide QA/QC activities relating to the submitted datasets. In addition, Ricardo-AEA is working continuously with organisations supplying data to the GHG inventory to encourage them to demonstrate their own levels of QA/QC that comply with either IPCC Good Practice Guidance or the UK's National Statistics standards. The QA/QC system includes three core components. 1. The QA/QC plan which is maintained by the GHGI's QA/QC manager (at Ricardo-AEA) and defines the specific Quality Objectives and QA/QC activities required in undertaking the compilation and reporting of GHG estimates. The plan also assigns roles, responsibilities and a timeline for completion of QA/QC activities. 2. QA/QC implementation includes the physical undertaking of the QA/QC activities throughout the data gathering, compilation and reporting phases of the annual emission estimation cycle and in accordance with the QA/QC plan. 3. Documentation and archiving which includes a) transparent documentation of all data sources, methods, and assumptions used in estimating and reporting the GHG inventory; and b) transparent documentation of all QA/QC implementation including records of activities undertaken, findings/issue logs, recommendations and any necessary actions taken or planned.	UK Greenhouse gas Inventory 1990-2011:, March 2013, p 65 ff.

1.5.3 Further improvement of the QA/QC procedures

One of the most important activities for improving the quality of national and EU GHG inventories is the organisation of workshops and expert meetings under the EU GHG Monitoring Mechanism. Sector-specific workshops are conducted under the Monitoring Mechanism that aim to address specific inventory issues and develop follow-up activities with the aim to address problems, clarify approaches and to improve the quality of Member States' inventory submissions. The follow-up activities are subsequently addressed in meetings of WG 1 under the Climate Change Committee.

In September 2004 a 'Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems' was organised. The Workshop facilitated the exchange of experience of Member States in the implementation of Quality Control (QC) and –Assurance (QA) procedures and the implementation of the National Inventory System. The workshop brought together experts from 17 Member States, the European Commission (DG ENV, JRC), EEA, ETC/ACM and an observer from the UNFCCC secretariat. For details of the workshop see the workshop report available on the website of the ETC/ACM: http://air-climate.eionet.europa.eu/docs/meetings/040902_GHG_MM_QAQC_WS/meeting040902.html

A number of other workshops and expert meetings have been organised in recent years with a focus on sector-specific quality improvements. Table 1.12 lists the most important workshops.

Table 1.12 **Overview of workshops and expert meetings organised under the EU GHG Monitoring Mechanism**

Workshop/expert meeting	Date and venue
Energy balances, ETS and CRF activity data	27-28 June 2013, Eurostat, Luxembourg
Improvement of Fluorinated-gas inventories	21 May 2013, EEA, Copenhagen
LULUCF and KP-LULUCF technical workshop	27 February – 01 March 2013, JRC, Ispra
JRC technical workshop on LULUCF reporting under the Kyoto Protocol	21 November 2011, Brussels, Belgium
Technical workshop on projections of GHG emissions and removals in the LULUCF sector	27-28 January 2010, Ispra, Italy
JRC technical workshop on LULUCF issues under the Kyoto Protocol	9-10 November 2010, Brussels, Belgium
Reporting on supplementary information under the Kyoto Protocol starting in 2010	2 March 2009, Berlin, Germany
Technical workshop on LULUCF reporting issues under the Kyoto Protocol	13-14 November 2008, JRC, Ispra, Italy
Workshop on the implications of the implementation of the 2006 IPCC Guidelines for national GHG inventories	30 - 31 October 2008, EEA, Copenhagen, Denmark
2nd workshop on data consistency between National GHG inventories and reporting under the EU ETS	13-14 September 2007, EEA, Copenhagen, Denmark
Expert meeting on the estimation of CH_4 emissions from solid waste disposal sites with the First Order Decay method	8-9 March 2006, EEA, Copenhagen, Denmark
Workshop on data consistency between National GHG inventories and reporting under the EU ETS	9-10 February 2006, EEA, Copenhagen, Denmark
Training workshop on the use of CRF Reporter for the experts of the European Union	12-13 September 2005, EEA, Copenhagen, Denmark
EU workshop on uncertainties in greenhouse gas inventories	5-6 September 2005, Helsinki, Finland
Workshop on Inventories and projections of greenhouse gas emissions from waste	2-3 May 2005, EEA, Copenhagen, Denmark
Expert meeting on improving the quality of. greenhouse gas emission inventories for category 4D	21-22 October 2004, JRC, Ispra, Italy
Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems	2-3 September 2004, EEA, Copenhagen, Denmark
Workshop on emissions of greenhouse gases from aviation and navigation	17-18 May 2004, EEA, Copenhagen, Denmark
Enlargement Training Workshop on Emission Inventory Improvement and Uncertainty Assessment	27-28 November 2003, JRC, Ispra, Italy
2003/06/24 Workshop on energy balances and energy related GHG emision inventories	24-25 June 2003, EEA, Copenhagen, Denmark
Workshop on Inventories and Projections of GHG and Ammonia Emissions from Agriculture	27-28 February 2003, EEA, Copenhagen, Denmark

Most of the workshop reports are available at the website of the EEA/ETC-ACM: http://acm.eionet.europa.eu/meetings/past_html

LULUCF workshops organized by Joint Research Center of the European Comission are all available at: http://afoludata.jrc.ec.europa.eu/index.php/public_area%5Cevents_policy

1.6 Uncertainty evaluation

The EU-15 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates, which were submitted from the Member States in their GPG Table 6.1. The first review shows, that most MS provide uncertainty information for nearly every source category, even though two countries just submit data for their key sources. Due to this fact, the sectoral EU and EU total of emissions in the following tables might not always meet exactly the value which is reported as “true” total compare to the values in the individual trend chapters.

Uncertainties were estimated on detailed level and aggregated to six main sectors ‘Energy’, ‘Fugitive emissions’, Industrial processes’, ‘Agriculture’, ‘LULUCF’ and ‘Waste’. Within these sectors the available MS uncertainty estimates were grouped by source categories. Then for each source category a range of uncertainty estimates was calculated: the lower bound of the range was calculated by assuming that all uncertainty estimates within a source category are uncorrelated; the upper bound of estimates was calculated by assuming that all uncertainty estimates within a source category are correlated. Then a single uncertainty estimate was calculated for each source category based on the assumption that MS uncertainty estimates are correlated if they use Tier 1 methods and/or default emission factors. After having calculated the uncertainty estimates for each source category, the uncertainty estimates for the sectors and for total GHG emissions were calculated.

Estimation of trend uncertainty: The EU uncertainty estimate is rather complicated due to potential correlations between MS uncertainties. Therefore, an analytical method, which allows more flexibility than IPCC Tier 1, was compiled.

Trend in MS n category x was defined as

$$\mathbf{Trend_{n,x} = E_{n,x}(t) - E_{n,x}(0)} \qquad \mathbf{(1)}$$

Where E(t) denotes emissions in the latest inventory year and E(0) emissions in the base year.

Variance for each MS and source category was calculated by using the perceptual uncertainty estimates reported by MS, and assuming normal distributions. Uncertainties in trends of different MS and source categories were then calculated using first order approximation of error propagation.

The assumptions of correlation between years (0 and t) and between different MS are important for the estimation of trend uncertainty. However, there is not enough information about strengths of different correlations. Effect of correlation was tested both with the analytical method developed, and by using MC simulation, where Normal distribution was used in all the cases to ensure comparability with analytical estimates. Table 1.13 presents an example of such comparison made in 2006. The source category chosen for the example is 4D, N_2O emissions from agricultural soils, as this category has a major effect on inventory uncertainty in most MS. Both the effects of correlations between years and between Member States were tested.

Table 1.13 Trend uncertainty for EU-15 emissions 2006 of N_2O from agricultural soils by using different assumptions of correlation estimated using Monte Carlo simulation

Years correlate	MS correlate	Trend uncertainty
YES	YES	-27 to +26
YES	NO	±13
NO	YES	-294 to +292
NO	NO	-116 to +115

Note: “YES” denotes full correlation between years or Member States. Trend uncertainty is presented as percentage points.

The results of the comparison revealed that assumption on correlation between years has much larger effect on trend uncertainty than the assumption on correlation between MS. In the IPCC GPG 2000, it is suggested to assume that emission factors between years are fully correlated, and activity data are independent. However, in the EU uncertainty estimate, it is assumed that activity data uncertainties also correlate to some extent between years, because typically the same data collection methods are used each year. Therefore, for simplicity, in EU uncertainty estimate it was decided to assume that emissions between years are fully correlated, even though this may underestimate trend uncertainty to some extent.

In the example in Table 1.14, uncertainty decreased when correlation between MS was added to the correlation between years. However, this is not always the case; in another example considering EU-15 MS estimates for 1A1a CO_2, uncertainty was ±0.2% when it was assumed that years correlate and MS estimates are independent. When a correlation between MS was added, the uncertainty decreased to ±0.1%.

Correlation between MS is difficult to quantify, especially in case of trend uncertainty, where correlation between different MS in different years should also be quantified. Furthermore, effect of correlation on uncertainty (increasing or decreasing) depends on the direction and magnitude of trend for each MS and each source category. Therefore, a simple conservative assumption cannot be made. Therefore, for simplicity, it was assumed in trend uncertainty estimate that MS are independent[19].

In general, the caveats of the method used are the same as in IPCC Tier 1, i.e. the result gives the most reliable results when uncertainties are small, and it assumes normal distributions even though this cannot actually be the case when uncertainties are >100%. However, these issues do not seem to have any major effect on the results, as can be seen from Table 1.14, where waste sector uncertainties are presented both with analytical method and Monte Carlo simulation. When uncertainty increases, also the difference between the two methods increases.

Table 1.14 Comparison of trend uncertainty estimates 2005 for EU-15 Waste Sector using the modified Tier 1 method and Monte Carlo simulation (Tier 2).

Sector	GHG	Tier 1	Tier 2
6A. Landfills	CH_4	±12	±12
6B. Wastewater	CH_4	±27	-28 to +27
6B. Wastewater	N_2O	±9	±9
6C. Waste incineration	CO_2	±7	±7
6C. Waste incineration	CH_4	±23	-23 to +24
6C. Waste incineration	N_2O	±18	±18
Waste Other	CH_4	±990	-976 to +993
Total Waste Sector		±11	±11

Note: Trend uncertainty is presented as percentage points.

Furthermore, trend uncertainty was calculated as in Equation 1, and the resulting confidence intervals were divided by base year estimate (best estimate) to obtain the relative change. The results would have been somewhat different, if trend uncertainty were calculated as in Equation 2:

$$\mathbf{Trend_{n,x} = [E_{n,x}(t)-E_{n,x}(0)]/ E_{n,x}(0)} \qquad \mathbf{(2)}$$

However, the effect of the choice between Eq 1 and 2 depends also on the direction and magnitude of trend in different MS, and without further consideration it cannot be stated whether choice of Eq 1 yielded a conservative estimate or not.

Lack of knowledge of different correlations, and many assumptions make the interpretation of EU trend uncertainty difficult, and therefore it should not be compared with uncertainty estimates of other countries. However, trend uncertainty calculations are internally consistent, and therefore the results can be used e.g. to assess which categories are the most important sources of trend uncertainty in the EU inventory.

[19] When the correlation assumptions were simplified, IPCC Tier 1 method could also have been used

Table 1.15 shows the main results of the uncertainty analysis for the EU-15. The lowest level uncertainty estimates are for fuel combustion activities (1.2 %), the highest estimates are for agriculture (75.9 %). Overall level uncertainty estimates including LULUCF of all EU-15 GHG emissions is calculated with 8.3 % and excluding LULUCF slightly lower with 7.9 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for fuel combustion activities (+/- 0.4 percentage points), the highest estimates are for LULUCF (25.2 percentage points). Overall trend uncertainty (including LULUCF) of all EU-15 GHG emissions is estimated to be 1.1 percentage points.

More detailed uncertainty estimates for the source categories are provided in Chapters 3-8.

Table 1.15 Tier 1 uncertainty estimates of EU-15 GHG emissions for the main sectors

Source category	**Gas**	**Emissions 1990**	**Emissions 2011**	**Emission trends 1990-2011**	**Level uncertainty estimates based on MS uncertainty estimates**	**Trend uncertainty estimates based on MS uncertainty estimates**
1.A Fuel combustion activities	all	3 182 229	2 853 395	-10.3%	1.2%	0.4%
1.B Fugitive emissions	all	91 121	42 066	-53.8%	12.1%	7.1%
2. Industrial processes	all	347 030	250 674	-27.8%	9.0%	7.0%
3. Solvents and other product use	all	8 012	5 417	-32.4%	38.1%	5.5%
4. Agriculture	all	433 047	368 929	-14.8%	75.9%	7.4%
6. Waste	all	171 330	101 593	-40.7%	26.3%	12.7%
5. LULUCF	all	-128 679	-142 485	10.7%	31.7%	25.2%
Total (incl LULUCF)	**all**	**4 104 089**	**3 479 590**	**-15.2%**	**8.3%**	**1.4%**
Total (excl LULUCF)	**all**	**4 232 769**	**3 622 074**	**-14.4%**	**7.9%**	**1.1%**

Note: Emissions are in Gg CO_2 equivalents

This is the second year an uncertainty analysis for Tier 2 (Monte-Carlo-Simulation) was conducted for each sector. The analysis includes all uncertainty data, which were reported for the member states. In detail, these are nearly 1,500 individual data rows for all MS at subsector level and gas.

In all input and output parameters, uncertainty has been expressed as normal probability density function. Consistent with the IPCC requirements, the uncertainty range is presented as range with 95% probability of a given value being within boundaries. Thus the boundaries were given as the 2.5 and 97.5-percentiles from the mean value.

During the Monte-Carlo-Analysis the emissions and the combined uncertainty (uncertainty for emission factor and activity data) with normal distribution functions were simulated through 10.000 iterations. Therefore, for each individual level a standard derivation of emissions were generated. The results for this Tier 2 analysis can be found in the following tables (Table 1.16, Table 1.17).

Table 1.16 Tier 2 uncertainty estimates of EU-15 GHG emissions per main sector

Source category	Gas	**Base year emissions 1990** (average simulation value)	**Last Year 2011 emissions** (average simulation value)	**Level uncertainty estimates based on MS uncertainty estimates** medium (2.5 - 97.5 percentile)

1.A Fuel combustion activities	all	3 181 961	2 853 460	1% (0,99 - 0,99)
1.B Fugitive emissions	all	90 883	41 988	11,1% (10,8 - 11,4)
2. Industrial processes	all	346 737	250 547	4,8% (4,8 - 4,8)
3. Solvents and other product use	all	8 023	5 433	33,7% (32,8 - 34,6)
4. Agriculture	all	423 898	366 713	43,9% (43,01 - 44,8)
6. Waste	all	-129 034	-142 269	26,4% (25,996 - 26,9)
5. LULUCF	all	171 043	101 472	20,6% (20,6 - 20,6)

Note: Emissions are in Gg CO_2 equivalents and are mean values of the Monte-Carlo-Analysis

Table 1.17 Tier 2 uncertainty estimates of EU-15 GHG emissions per gases

		CO_2	CH_4	N_2O	PFC	HFC	SF_6	total GHG
1990	Mean value	3 232.35	427.85	381.80	30.00	10.02	11.50	4 093.51
	Standard deviation	32.17	17.65	97.09	1.46	0.39	0.37	104.84
	2s	2.0%	8.3%	50.9%	9.8%	7.8%	6.4%	**5.1%**
2011	Mean value	2 859.83	284.28	254.99	69.64	3.47	5.14	3 477.35
	Standard deviation	24.19	11.47	79.57	5.41	0.58	0.17	83.88
	2s	1.7%	8.1%	62.4%	15.5%	33.2%	6.5%	**4.8%**

In September 2005 a workshop on uncertainties in greenhouse gas inventories was organised in Helsinki (Finland). The aim of the workshop was to share information and experience on uncertainty assessment, to discuss needs for further guidance, and to improve comparability of uncertainty estimates across different Member States. The main objectives were to help Member States to compile/improve uncertainty estimates and to help develop the uncertainty assessment of the EU inventory. The workshop brought together experts from 16 Member States, the European Commission (DG ENV, JRC), ETC-ACM, as well as from Norway and Russia. UNFCCC secretariat sent their statement in a written form to the workshop. The workshop produced recommendations on the following topics: a) EU Uncertainty assessment and implications on Member State uncertainty assessment and b) Uncertainty assessment at Member State level.

Table 1.18 gives an overview of information provided by EU-15 Member States on uncertainty estimates in their national inventory reports 2010 and presents summarised results of these estimates. For some Member States, either a national inventory report was available, which did not include quantitative uncertainty analysis, or no national inventory report was available at all.

Table 1.18 Overview of uncertainty estimates available from EU-15 Member States

Member State	Austria		Belgium	Denmark	Finland	France	Germany	Greece	
Citation	NIR Mar 2013, pp.44-45		NIR Apr 2013, pp.45-46	NIR May 2013, p.78	NIR Apr 2013, p.37	NIR, Mar 2013, p. 45	NIR Mar 2013 , p.119	NIR, Mar 2013, pp. 35-38	
Method used	Tier 1		Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes		Yes	Yes	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex IV)	
Years and sectors included	emissions: 2010; trends: 1990-2010; excluding LULUCF		emissions: 2011; trends: 1990-2011; including LULUCF	emissions: 2011; trend:1990 - 2011; excluding LULUCF	emissions: 2011; trends: 1990-2011; including LULUCF	emissions: 2010; trends: 1990-2010; including LULUCF	emissions: 2011; trends: 1990-2011; including LULUCF	emissions: 2011; trends: 1990-2011; including LULUCF	
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (e. L.)
CO_2				5.8%				2.7%	
CH_4				19%				43.8%	
N_2O				42%				89.9%	
F-gases				46%				170.2 %	
Total	22.7%	4.62%	5.64%	5.2%	i. L.: 32% e. L.: 6%	i. L.: 20.7% e. L.: 18.0%	6.3%	8.94%	8.71%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2				±2.9% points					
CH_4				±13.0% points					
N_2O				±12.5% points					
F-gases				±54% points					
Total	±2.8% points	±2.18 % points	±2.54% points	±2.7% points	i. L.: ±33% points e. L.: ±8% points	i. L.: ±3.7% points e. L.: ±2.1% points	6.5%	±10.08 % points	±9.81 % points

Member State	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Citation	NIR May 2013, p.26	Uncertainty Table 2013	Uncertainty Table 2013	Uncertainty Table 2013	NIR Mar 2012, pp.17-19	Uncertainty Table 2013	NIR Mar 2013, p.57	Uncertainty Table 2013
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes	Yes	-	Yes (Annex 7)	Yes (Annex B)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 7)
Years and sectors included	emissions: 2011; trend: 1990-2011; all categories (i.L.)	emissions: 2011; trend: 1990 -2011; all categories (i.L.)	emissions: 2011, trend: 1990-2011; all categories (e.L.)	emissions: 2011; trend: 1990-2011; all categories (e.L.)	emissions: 2010, trend: 1990-2010; all categories (e.L.)	emissions: 2011; trend: BY-2011; excluding LULUCF	emissions: 1990 and 2011; trend: 1990-2011; including LULUCF	emissions: 1990, 2010; trend: BY - 2010, including LULUCF
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2				2%	4.7%	-		
CH_4				16%	25.6%	-		
N_2O				43%	124.7%	-		
F-gases				40%	71.2%			
Total	7.09% (e.L.) 12.51% (i.L.)	6.0% (i.L.) 3.0% (e.L.)	3.36% (i.L.) 2.4% (e.L.)	3%	16.3%	12.3% (e.L.) 14.7% (i.L.)	4.5%	i. L.: 21% e. L.: 20.8%
Uncertainty in trend (%)	Tier1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2								
CH_4								
N_2O								
F-gases								
Total	i.L.:± 6.62% points e.L.:±2.3% points	i.L.:± 5.0% points e.L.:±3.0% points	i.L.: ±3.10% points e.L.: ±0.97% points		±14.4% points	i.L.: ±2.4% points e.L.: ±2.3% points	±2.0% points	i. L.: ±3.28% points e. L.: ±3.21% points

1.7 General assessment of the completeness

1.7.1 Completeness of Member States' submissions

The EU GHG inventory is compiled on the basis of the inventories of the EU Member States. Therefore, the completeness of the EU inventory depends on the completeness of the Member States' submissions. Table 1.19 summarises timeliness and completeness of the EU-15 Member States' submissions in 2013. It shows that GHG inventories for 2011 were submitted by all EU-15 Member States by 15 March 2013 (cut off date for the 15 April submission). The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 1.3.

Table 1.19 Date, mode and content of submissions of EU-15 Member States in 2013 (status 28 March 2013)

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
AT	15.01.2013	CDR	AUT-2013-v1.1		1990-2011	2008-2011	short NIR
AT	15.03.2013	CDR	AUT-2013-v1.3	x	1990-2011	2008-2001	x
AT	09.04.2013	CDR	-	x	-	-	-
AT	08.05.2013	CDR	-	x	-	-	-

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
BE	15.01.2013	CDR	BEL-2013-v1.2		1990-2011	2008-2011	NIR 2012
BE	15.03.2013	CDR	BEL-2013-v1.3	x	1990-2011	2008-2011	x
BE	15.04.2013	CDR	BEL-2013-v1.5	-	1990-2011	2008-2011	x
DK	15.01.2013	CDR	DNM-2013-v1.2		1990-2011	1990, 2008-2011	short NIR
DK	15.03.2013	CDR	DNM-2013-v1.3		1990-2011	1990, 2008-2011	x
DK	15.03.2013	CDR	-	x	-	-	-
DK	10.04.2013	CDR	-	x	-	-	-
DK	08.05.2013	CDR	DNM-2013-v2.1	-	1990-2011	1990, 2008-2011	-
DK	08.05.2013	CDR	-	-	-	-	x
DK	17.04.2013	CDR	-	x	-	-	-
FI	15.01.2013	CDR	FIN-2013-v1.2		1990-2011	2008-2011	x
FI	15.03.2013	CDR	FIN-2013-v1.3	x	1990-2011	2008-2011	x
FI	10.04.2013	CDR	-	x	-	-	-
FI	15.04.2013	CDR	FIN-2013-v1.4	-	1990-2011	2008-2011	x
FR	14.01.2013	CDR	FRK-2013-v1.1		1990-2011	2008-2011	short NIR (fr)
FR	15.03.2013	CDR	FRK-2013-v1.2		1990-2011	2008-2011	NIR (fr)
FR	15.03.2013	CDR	-	x	-	-	-
DE	15.01.2013	CDR	DEU-2013-v1.1		1990-2011	2008-2011	NIR (de)
DE	15.03.2013	CDR	same as above		same as above	same as above	x
DE	12.04.2013	CDR	-	x	-	-	-
DE	15.04.2013	CDR	-	-	-	-	x
GR	15.01.2013	CDR	GRC-2013-v1.1		1990-2011	2008-2011	short NIR
GR	15.03.2013	CDR	GRC-2013-v1.2		1990-2011	2008-2011	x
GR	19.03.2013	CDR	-	x	-	-	-
GR	10.04.2013	CDR	-	x	-	-	-
GR	16.05.2013	CDR	GRC-2013-v1.3	-	1990-2011	2008-2011	x
IE	15.01.2013	CDR	IRL-2013-v1.2		1990-2011	2008-2011	short NIR
IE	14.03.2013	CDR	IRL-2013-v1.3	x	1990-2011	2008-2011	x
IE	10.04.2013	CDR	-	x	-	-	-
IE	10.05.2013	CDR	IRL-2013-v1.5	-	1990-2011	2008-2011	x
IT	15.01.2013	CIRCA	ITA-2013-v1.1		1990-2011	2008-2011	-
IT	15.03.2013	CIRCA	ITA-2013-v1.2	x	1990-2011	2008-2011	x
IT	14.05.2013	CIRCA	ITA-2013-v2.1	-	1990-2011	2008-2011	-
LU	15.01.2013	CDR	LUX-2013-v1.1		1990-2011	2008-2011	-
LU	15.03.2013	CDR	-	x	-	-	-

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
LU	15.03.2013	CDR	LUX-2013-v1.2		1990-2011	2008-2011	-
LU	09.04.2013	CDR	-	x	-	-	-
LU	16.04.2013	CDR	-	-	-	-	x
NL	15.01.2013	CDR	NLD-2013-v1.1		1990-2011	2008-2011	x
NL	15.01.2013	CDR	same content as before		see above	see above	see above
NL	15.03.2013	CDR	NLD-2013-v1.2	x	1990-2011	2008-2011	x
NL	15.04.2013	CDR	NLD-2013-v1.3	x	1990-2011	2008-2011	x
PT	15.01.2013	CDR	PRT-2013-v1.1		1990-2011	1990, 2008-2011	short NIR
PT	15.03.2013	CDR	PRT-2013-v1.2		1990-2011	1990, 2008-2011	x
PT	11.04.2013	CDR	-	x	-	-	-
PT	15.05.2013	CDR	PRT-2013-v1.3	-	1990-2011	1990, 2008-2011	-
PT	15.05.2013	CDR	-	-	-	-	x
ES	11.01.2013	CDR	ESP-2013-v1.1		1990-2011	1990, 2008-2011	NIR (es)
ES	15.03.2013	CDR	ESP-2013-v1.3		1990-2011	1990, 2008-2011	NIR (es)
ES	15.04.2013	CDR	ESP-2013-v1.4	x	1990-2011	1990, 2008-2011	NIR (es)
SE	15.01.2013	CDR	SWE-2013-v1.1		1990-2011	2008-2011	x
SE	15.03.2013	CDR	-	x	-	-	x
SE	09.04.2013	CDR	-	x	-	-	-
GB	15.01.2013	CDR	GBE-2013-v1.2		1990-2011	2008-2011	short NIR
GB	15.03.2013	CDR	GBE-2013-v1.3		1990-2011	2008-2011	x
GB	11.04.2013	CDR	-	x	-	-	-

The grey xml files have been used for the EU-15 inventory

In response to the Saturday paper 2010 the EU mobilized the mechanisms of its national system to further enhance its QA/QC programme and develop an appropriate action plan, in consultation with the MS, geared in particular towards complementing the existing procedures and improving the completeness regarding NEs of the EU greenhouse gas inventory in 2011 and beyond (see description in Chapter 13). During February and March intensive consultation between the EU inventory team and the Member States took place. In some cases the EU inventory team recommended Member States to provide estimates and/or change the use of notation keys. After this consultation the number of NEs in the Member States' GHG inventories was reduced significantly. As a result of this consultation and the improvements in response to the UNFCCC review cycle 2010 the number of NEs at EU-15 level were reduced by about 40% in the 2011 submission compared to the 2010 submission. Annex 1.4 provides a list of all NEs and IEs and includes explanations taken from the Member States' CRF Tables 9. This information is equivalent to CRF Table 9 which cannot be filled-in automatically for the EU-15 due to the amount of information from the Member States.

The following table provides an overview of the general completeness sections of the Member States' National Inventory Reports.

Table 1.20 Description of completeness taken from EU-15 Member States submissions 2013

MS	Description of the completeness	Source
Austria	"NE" is used for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where "NE" is used in an inventory for emissions or removals, both the NIR and the CRF completeness table indicate why emissions or removals have not been estimated. For emissions by sources and removals by sinks of greenhouse gases marked by "NE" check-ups are in progress to establish if they actually are "NO" (not occurring). As part of the improvement programme of the inventory, it is planned that these source or sink categories are either estimated or allocated to "NO".	Austria's Annual Greenhouse Gas Inventory 1990–2011 Mar 2013 p. 47
Belgium	All sources and sinks included in the IPCC 1996 Guidelines are covered with the exception of the following (very) minor sources: - CO_2 from asphalt roofing (2A5), due to missing activity data; - CO_2 from road paving (2A6), due to missing activity data; All direct and indirect greenhouse gases and SO_2 are covered in the Belgian inventory. The geographic coverage is complete. There is no part of the Belgian territory not covered by the inventory.	Belgium's Greenhouse Gas Inventory (1990–2011) Mar 2013 p. 45
Germany	Bei den noch berichteten „Not Estimated— (NE) handelt es sich vor allem um nicht berechnete Emissionen, die laut IPCC GPG (2003, p.1.11) nicht von einem Land berichtet werden müssen, da diese Emissionen in den Appendices 3a.2, 3a.3 und 3a.4. aufgeführt sind. Einige der Emissionsdaten, die dem UBA zur Verfügung stehen, stehen aus Gründen des Datenschutzes unter Geheimhaltung und werden zwar vollständig, aber nur aggregiert berichtet. Im Rahmen einer Vereinbarung zwischen der Deutschen Emissionshandelsstelle (DEHSt) und der Nationalen Koordinierungsstelle wird der regelmäßige Datenaustausch sichergestellt.	Nationaler Inventarbericht zum deutschen Treibhausgasinventar 1990-2011 Mar. 2013 p. 121
Denmark	The Danish greenhouse gas emission inventories for 1990-2011 include all sources identified by the Revised 1996 IPCC Guidelines and the 2000 IPCC Good Practice Guidance. Some very minor sources have not been estimated due to lack of methodology, activity data or emission factors, i.e.: In the Solvent and other product use sector currently only N_2O emissions from anaesthesia and some other minor uses are included in CRF category 3D, Denmark will try to obtain activity data for use of N_2O in aerosol cans. N_2O emissions from anaesthesia are only included from 2000 onwards. Direct and indirect CH_4 emissions from agricultural soils are not estimated. Direct and indirect soil emissions are considered of minor importance for CH_4. No methodology is available in the IPCC Guidelines. Emissions from harvested wood products are not reported due to lack of data. Several possible sources of CH_4 in the LULUCF sector are also reported as not estimated. For more detail please see Chapter 7. In the Waste sector CO_2 emissions from managed waste disposal on land are not estimated. According to the 1996 IPCC Guidelines: "Decomposition of organic material derived from biomass sources (e.g., crops, forests), which are regrown on an annual basis is the primary source of CO_2 released from waste. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology." Emissions of N_2O from accidental fires are reported as not estimated due tolack of emission factors.	Denmark's National Inventory Report 2013 Mar 2013 Annex 5
Finland	Finland has provided estimates for all significant IPCC source and sink categories according to the detailed CRF classification. Estimates are provided for the following gases: CO_2, N_2O CH_4, F-gases (HFC, PFC and SF_6), NMVOC, NO_x, CO and SO_2. In accordance with the IPCC Guidelines, international aviation and marine bunker fuel emissions are not included in national totals. The geographical coverage of the inventory is complete. It includes emissions from the autonomic territory of Åland (Ahvenanmaa). The emissions for the territory of Åland are not reported separately. A complete set of CRF tables are provided for all years and the estimates are calculated in a consistent manner..	Greenhouse Gas Emissions in Finland 1990 - 2011 Mar 2013 p39
France	Les inventaires rapportés dans le cadre de la CCNUCC et du Protocole de Kyoto dans le présent rapport couvrent la période 1990-2011 avec un pas annuel. L'année de référence est 1990 pour toutes les substances. Le champ géographique couvert par la CCNUCC est l'ensemble constitué par les 96 départements de la Métropole et tous les territoires français situés Outre-mer. Ces derniers se classent en : • Pays et territoires d'Outre-mer (PTOM), non-inclus dans l'Union Européenne (Polynésie Française, Wallis-et-Futuna, Mayotte, Nouvelle-Calédonie8, Saint-Pierre-et-Miquelon, et les Terres Australes et Antarctiques Françaises), • Territoires d'Outre-mer inclus dans l'UE (Outre-mer hors PTOM) comprenant les DOM de Guadeloupe, Martinique, Guyane, et La Réunion, et les COM de Saint-Barthélemy et Saint- Martin	Rapport National d'inventaire pour la France au titre de la convention cadre des nations unies sur les changements climatiques et du protocole de Kyoto Mar 2013 p 46

MS	Description of the completeness	Source
Greece	In the present inventory report, which supersedes all previous ones, estimates of GHG emissions in Greece for the years 1990-2011 are presented. Emissions estimates included in the CRF tables submitted and discussed in the present report, cover the whole territory of Greece. All major sources are reported including emissions estimates for indirect greenhouse gases and SO_2. Completeness gaps in the present inventory submission that will be discussed in more details in the relevant chapters include: • CO_2 from organic chemicals production and asphalt roofing-road paving with asphalt are not estimated due to lack of emission factors in the IPCC GPG. • Potential emissions of f-gases have not been estimated, due to the lack of data. The initial planof Greece was to collect data concerning imports and exports of f–gases (in bulk) by the Hellenic Statistic authority. Nevertheless since these compounds were not reported per f-gas type but aggregately to the ElStat, the estimation of potential emissions was not possible. Moreover in line to the implementation of the improvement plan of 2012 the inventory team has been into close collaboration with National Association of Refrigeration Importing & Trading Companies and a form has been send to all their members asking for the quantities of f-gases imported, exported and sold per blend and year. Since the respond of the companies for 2011 was 50%, the inventory team couldn't use these data for the estimation of potential emissions. For the implementation of EC Regulation No 842/2006 a Common Ministerial Decision 18694 has been published in Greece on the 11th of April 2012. The above mention regulation defined among others the data collection procedures regarding the enterprises that produce, import, export, recover, recycle and trade f-gases on annual basis until every 31th of March of each year. The inventory team is planning to use the information that shall be gathered in the framework of the Common Ministerial Decision 18694. Since it is a new Decision and considering the scheduled dates for gathering the data, the current improvement is planned for the 2014 submission. It should be mention that any available data will be examined by the inventory team and if they are adequate according to the IPCC GPG, and how this information could be introduced in the next submissions.	Climate Change Emissions inventory Mar 2013 p40
Ireland	The completeness of the inventory has been improved by including combustion emissions from charcoal use for cooking in the energy sector (1.A.4.b) and from waste incineration of clinical and solvent wastes (6.C.a-b). The opportunity has also been taken in this current cycle to improve, wherever possible, the estimates of emissions and removals for all years for LULUCF reported under the Convention in accordance with the requirements of Decision 13/CP.9 in order to achieve consistency with the reporting on Article 3.3 activities under the Kyoto Protocol.	National Inventory Report 2013 Mar 2013 p.27
Italy	Sectoral and background tables of CRF sheets are complete as far as details of basic information are available. For instance, multilateral operations emissions are not estimated because no activity data are available. Allocation of emissions is not consistent with the IPCC Guidelines only where there is no data available to split the information. For instance, for fugitive emissions, CO_2 and CH_4 emissions from oil and natural gas exploration and venting are included in those from oil production because no detailed information is available. CH_4 emissions from other leakage emissions are included in distribution emission estimates. N_2O emissions from oil and natural gas exploration and refining and storage activities are reported under category 1.B.2.C oil flaring. Further investigation will be carried out closely with industry about these figures. For industrial processes, emissions from soda ash use are included in glass production emissions because the use of soda is part of that specific production process.	Italian Greenhouse Gas Inventory 1990-2011 Mar 2013 p.43 f.

MS	Description of the completeness	Source
Luxembourg	CRF table 9(a) on completeness has been filled for every reported year 1990 to 2011. It is expected that this table recapitulates all the explanations given for the notation keys reported in Luxembourg′s GHG inventory for a given year since all the checks included in CRF Reporter were passed successfully by submission 2013v1.2. Hence, if missing information is encountered in CRF table 9(a) for some years, this is not due to a lack of explanations from the side of Luxembourg, but well due to conversion problems in CRF Reporter when the CRF tables were created. In this section, some additional information is presented. An assessment of completeness for each CRF sector is given in the sector overview part of each of the sector chapters 1.8.1.1 Sources and sinks All sources and sinks included in the IPCC Guidelines are covered. With regards to LULUCF, this submission contains new estimations for LULUCF, the three main sub-categories now being covered as well as the sub-categories wetlands, settlements and other lands, which were not estimated in the previous submission. 1.8.1.2 Gases Both direct GHGs as well as precursor gases are covered by Luxembourg′s inventory. However, indirect GHG − NO_x, CO, NMVOCs − and SO_2 need to be re-evaluated in the light of the revision of the inventories Luxembourg is compiling for the UNECE CLRTAP. Generating better emission estimates for these gases are part of our planned improvements. 1.8.1.3 Geographic coverage The geographic coverage is complete. There is no part of the national territory not covered by the inventory. Notation keys The sources and sinks not considered in the inventory, but included in the IPCC Guidelines, are clearly indicated. The reasons for such exclusions are explained. In addition, the notation keys presented below are used to fill in the blanks in all the CRF tables. Notation keys used in the NIR are consistent with those reported in the CRF tables. Notation keys used are those described on page 9 of document FCCC/SBSTA/2006/9 of 18 August 2006. Allocations to categories may differ from Party to Party. The main reasons for different category allocations are different allocations in national statistics, insufficient information in national statistics and/or national methods, and the impossibility to disaggregate emission declarations. IE (included elsewhere) The notation key IE is used for emissions by sources and removals by sinks of GHG that have been estimated but included elsewhere in the inventory instead of the expected source/sink category. Where IE is used in the inventory, CRF table 9 indicates where (in the inventory) these emissions or removals have been included. Such deviation from the expected category is also explained. NE (not estimated) The notation key NE is used for existing emissions by sources and removals by sinks of GHG which have not been estimated. Where NE is used in an inventory for emissions or removals, CRF table 9 indicates why emissions or removals have not been estimated. For emissions by sources and removals by sinks of GHG marked by NE, check-ups are in progress to establish if they actually are NO (not occurring). As part of the improvement programme of the inventory, it is planned that these source or sink categories are either estimated or allocated to NO. C (confidential) The notation key C is used for emissions which could lead to the disclosure of confidential information if reported at the most disaggregated level. In this case, a minimum of aggregation is required to protect business information. So far, no confidential information has been identified in Luxembourg′s GHG inventory. NA (not applicable) The notation key NA is used for activities or processes in a given source/sink category that do not produce emissions or lead to removals of a specific gas. As part of the improvement programme of the inventory, it is planned to revise all the NA notation keys to confirm whether they are indeed NA or rather NE or NO. NO (not occurring) The notation key NO is used for activities or processes in a given source/sink category that do not occur within Luxembourg.	National Inventory Report 1990-2011, May 2013 pp 91-93
Netherlands	The Netherlands' greenhouse gas emission inventory includes all sources identified by the Revised Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 1996) – with the exception of the following very minor sources: • CO_2 from asphalt roofing (2A5), due to missing activity data; • CO_2 from road paving (2A6), due to missing activity data; • CH_4 from enteric fermentation of poultry (4A9), due to missing emission factors; • N_2O from industrial waste water (6B1), due to negligible amounts; • part of CH_4 from industrial waste water (6B1b Sludge), due to negligible amounts; • Precursor emissions (carbon moNO_xide (CO), nitrogen oxide (NO_x), nonmethane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2) from Memo item 'International bunkers' (international transport) have not been included.	Greenhouse gas emissions in the Netherlands 1990-2011 Mar 2013 p 18

MS	Description of the completeness	Source
Portugal	CRF Table 9 (Completeness) gives an overview of the level of completeness of the 2012 submitted inventories to the UNFCCC and EC. Additional information on this issue is given in the subchapters. The inventory covers the 6 gaseous air pollutants included in Annex A to the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), as well as estimates for indirect GHGs, including carbon moNO_xide (CO), nitrogen oxides (NO_x), and non-methane volatile organic compounds (NMVOC). Data are also reported for sulphur oxides (SOx). As a general rule the inventory covers emissions realized in the whole Portuguese territory, i.e., mainland Portugal and the two autonomous regions of Madeira and Azores Islands.	Portuguese National Inventory Report on Greenhouse Gases, 1990-2011 Mar 2013 p1-21
Spain	La exhaustividad se ha evaluado según la tipología de status de estimación recomendada por la metodología IPCC: NO (no ocurren), NE (no estimadas); NA (no se aplica); IE (incluidas en otra parte); C (confidencial), 0 (inferior a la mitad de la unidad utilizada). En la evaluación de la exhaustividad por actividades se ha seguido un criterio conservador en la asignación de las etiquetas NE (no estimadas) en relación con las asignaciones alternativas NO (no ocurren) y NA (no se aplica). Así, NO se ha asignado sólo cuando existe certeza de que la actividad en sí misma no se da en el territorio nacional, y NA se ha reservado para los casos en que existe un conocimiento fundado de que no se da emisión en el cruce seleccionado de actividad emisora y gas emitido; en los restantes casos en que no se ha realizado estimación y no se han asignado otras etiquetas se ha hecho referencia a la situación con la etiqueta NE, aunque en buen número de estos casos pueda no haber emisión positiva (en general son casos en que no consta información sobre factores o algoritmos de estimación de las emisiones). Para una presentación detallada por actividades y gases de las etiquetas de status se remite a las tablas correspondientes del CRF Reporter. Como valoración general puede decirse que el objetivo de exhaustividad se ha conseguido satisfactoriamente, con las siguientes salvedades: - Para los gases fluorados (HFC, PFC, SF_6) no se han podido estimar las emisiones potenciales por carencias de información detallada específica sobre los flujos de comercio exterior (importaciones e importaciones) por tipo de gas. - En las categorías LULUCF: - No se han estimado flujos de emisión/absorción para el depósito de madera muerta y detritus forestales en el bosque, si bien se ha argumentado en el epígrafe 11.3.1.2 que dichos depósitos no resultan en fuente de emisiones. Para el carbono orgánico del suelo se han estimado los flujos en los cambios de uso del suelo de otros usos (cultivos, pastizales) a forestal y de forestal a asentamientos. - No se han estimado flujos de emisión/absorción procedentes de los depósitos de materia orgánica muerta y carbono orgánico de suelos en las conversiones de tierras de cultivo, pastizales y otras tierras a asentamientos. En el caso de los depósitos de los suelos, no consta una especificación clara de metodología adoptada por UNFCCC, y en los restantes depósitos el flujo dependerá de cómo se lleve a cabo la práctica de conversión de las tierras a asentamientos.	Inventario de emisiones de gases de efecto invernadero des Espana anos 1990-2011 Mar 2013 p. 1.58

MS	Description of the completeness	Source
Sweden	GHG inventory The inventory covers emissions and sinks in Sweden. All greenhouse gases arecovered. The general completeness for each sector is discussed below. Detailed information is presented in Annex 5. Energy Estimated emissions are considered to be complete for most sources. Emissions of CH_4 and N_2O from liquid bio fuels used in military transportation are however not estimated. There might also still be some lack in completeness as regards in-house generated fuels in the chemical industry and in smaller companies. Industrial Processes For most sources, and particularly for the most important ones, the estimates are in accordance with the requirements concerning completeness as laid out in the Good Practice Guidance. However, some exceptions do exist. These are primarily in sub-sectors with a large number of smaller facilities with minor emissions. Data is complete for all greenhouse gases, possibly with the exception of CH_4 for a few sources, e.g. within the chemical industry. Solvent and other product use The estimated emissions from solvent and product use are considered to be complete, since a new method was developed during 2005 in order to obtain all activity data concerning the sector from the Products register at the Swedish Chemicals Agency. The estimated emissions of N_2O are also considered to be complete, since national data from the Products register is used in the inventory. Agriculture All relevant agricultural emissions and sources are reported in the inventory. Reindeer, which are normally not considered as a part of the agricultural sector, are included in the inventory. There are, however, some marginal animal groups, which are not included, such as fur-bearing animals (minks, foxes and chinchillas). These groups are very small and there is no methodology developed for estimating their GHG emissions. All sales of fertilizers are included in the inventory, also quantities used in other sectors. N-fixing crops used in temporary grass fields, and sludge used as fertilizer is also included. This means that all anthropogenic inputs to agricultural soils are covered. Land Use, Land Use Change and Forestry All land areas are inventoried in the field except high mountains, military impediments and urban land. We believe that their relative importance for the Swedish GHG inventory is small. The inventory of the LULUCF-sector is complete in the sense that all carbon pools and other sources, defined based on the IPCC GPG for LULCUF, are reported for land use categories that are considered managed. The reporting of woody biomass stocks refers to above and below ground parts of trees taller than 1.3 m. Other vegetation such as shrubs and herbs are not reported. Emissions/removals from below ground biomass of dead stump systems are from this submission included in the dead organic matter pool. Waste The effects of possible leakage of methane and nitrous oxide from the wastewater treatment processes have not been estimated. All other data are complete. KP-LULUCF Sweden has elected the activity Forest management (FM) under Article 3.4 of the Kyoto Protocol (KP). All carbon pools as well as associated mandatory activities (such as fertilization of forest land, biomass burning and conversion to cropland) are reported for activities under article 3.3 and under FM.	National Inventory Report Sweden 2013 Mar 2013 p. 59-60
United Kingdom	The UK GHG inventory aims to include all anthropogenic sources of GHGs. Annex 5 shows sources of GHGs that are not estimated in the UK GHG inventory, and the reasons for those sources being omitted.	UK Greenhouse Gas Inventory, 1990 to 2011 Mar 2013 p.78

1.7.2 Data gaps and gap-filling

The EU GHG inventory is compiled by using the inventory submissions of the EU Member States. If a Member State does not submit all data required for the compilation of the EU inventory by 15 March of a reporting year, the Commission prepares estimates for data missing in collaboration with the relevant Member State. In the following cases gap filling is made:

- To complete specific years in the GHG inventory time-series for a specific Member State
- for the most recent inventory year(s);
- for the base year;
- for some years of the time series from 1990 to the most recent year.

- To complete individual source categories for individual Member States that did not estimate specific source categories for any year of the inventory time series and reported ‘NE’. Gap filling methods are used for major gaps when it is highly certain that emissions from these source categories exist in the Member States concerned;
- To provide complete CRF background data tables for the European Union when some Member States only provided CRF sectoral and summary tables. (In this case, the gap filling methods are used to further disaggregate the emission estimates provided by Member States.)
- To enable the presentation of consistent trends for the EU.

For data gaps in Member States’ inventory submissions, the following procedure is applied by the ETC/ACM in accordance with the implementing provisions under Decision No 280/2004/EC for missing emission data:

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.
- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the ‘Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol’ is used without application of the conservativeness factor.
- If a consistent time series of reported estimates for the relevant source category is not available and if the source category has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, the estimation should be based on the methodological guidance provided in the ‘Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol’ without application of the conservativeness factor.

The Commission prepares the estimates by 31 March of the reporting year, following consultation with the Member State concerned, and communicates the estimates to the other Member States. The Member State concerned shall use the estimates referred to for its national submission to the UNFCCC to ensure consistency between the EU inventory and Member States’ inventories.

The methods used for gap filling include interpolation, extrapolation and clustering. These methods are consistent with the adjustment methods described in UNFCCC Adjustment Guidelines (Table 1) and in the IPCC GPG 2000.(20) On the basis of the general approaches mentioned above concrete methodologies were developed for each sector/gas (**Error! Reference source not found.**).

1.7.2.1 *Gap filling in GHG inventory submissions 2013*

Since 2011 GHG inventory estimates have been complete for all EU Member States, and therefore no gap filling has been needed.

Data basis of the European Union greenhouse gas inventory:

The 2011 EU-15 GHG inventory data consist of GHG submissions of the Member States to the European Commission in 2013; no gap filling was needed. Table 1.21 to

20 ETC ACC technical note on gap filling procedures , December 2006

Table 1.24 show the data basis of the 2013 EU GHG inventory.

Table 1.21 Data basis of CO_2 emissions excluding LULUCF (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	62	64	66	80	77	74	74	67	73	70
Belgium	119	124	125	126	122	117	121	108	115	104
Denmark	53	61	54	51	59	54	51	48	49	44
Finland	57	58	57	57	68	66	58	55	64	56
France	397	396	412	424	414	404	397	379	387	358
Germany	1 042	931	891	865	871	847	846	784	826	798
Greece	83	86	103	113	111	114	110	104	97	95
Ireland	32	35	45	48	47	48	47	42	41	38
Italy	435	445	462	488	484	475	464	415	425	414
Luxembourg	12	9	9	12	12	11	11	11	11	11
Netherlands	159	171	170	176	172	172	175	170	181	168
Portugal	45	54	66	69	65	62	60	57	53	52
Spain	227	254	307	367	357	364	333	297	281	284
Sweden	57	59	54	53	53	52	50	46	52	49
United Kingdom	588	550	552	556	555	546	534	484	501	461
EU-15	**3 367**	**3 298**	**3 373**	**3 484**	**3 467**	**3 408**	**3 332**	**3 067**	**3 155**	**3 003**

Table 1.22 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	8	8	7	6	6	6	6	6	6	5
Belgium	10	9	8	7	7	7	7	6	7	6
Denmark	6	6	6	6	6	6	6	6	6	5
Finland	6	6	5	5	5	5	4	4	4	4
France	60	63	61	56	55	55	55	54	54	53
Germany	110	93	75	59	57	54	54	52	50	49
Greece	10	11	11	10	10	10	10	10	10	10
Ireland	14	14	13	13	13	12	12	12	12	12
Italy	44	44	46	41	40	40	38	38	37	37
Luxembourg	0	0	0	0	0	0	0	0	0	0
Netherlands	26	24	20	16	16	16	16	16	16	15
Portugal	10	12	12	13	12	12	12	12	13	13
Spain	27	29	32	33	34	34	33	34	33	33
Sweden	7	7	6	6	6	5	5	5	5	5
United Kingdom	99	85	65	48	47	46	45	43	43	42
EU-15	**438**	**410**	**369**	**320**	**313**	**308**	**304**	**298**	**296**	**289**

Table 1.23 **Data basis of N_2O emissions in CO_2 equivalents (Tg)**

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	6	7	6	5	6	6	6	5	5	5
Belgium	11	12	11	9	8	8	8	8	8	7
Denmark	10	9	8	6	6	6	6	6	6	6
Finland	7	7	7	7	7	7	7	6	6	5
France	92	91	79	69	66	66	67	63	61	61
Germany	87	80	62	61	60	62	63	63	55	57
Greece	10	9	9	8	8	8	7	7	7	7
Ireland	9	10	10	8	8	8	8	8	8	8
Italy	38	39	40	38	32	32	30	28	27	27
Luxembourg	0	0	0	0	0	0	0	0	0	0
Netherlands	20	20	17	15	15	14	10	9	9	9
Portugal	6	6	6	6	5	6	5	5	5	5
Spain	26	25	31	26	27	27	25	24	25	24
Sweden	8	8	8	7	7	7	7	7	7	7
United Kingdom	68	58	46	41	39	38	37	35	36	35
EU-15	**400**	**379**	**339**	**308**	**295**	**294**	**286**	**275**	**266**	**264**

Table 1.24 **Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)**

Member State		1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	HFC	23	340	647	997	1 004	1 043	1 082	1 134	1 286	1 349
	PFC	1 079	68	67	125	137	184	167	29	64	60
	SF_6	493	1 153	602	517	475	384	391	358	352	322
Belgium	HFC	NA,NO	452	943	1 462	1 559	1 739	1 822	1 883	1 936	1 996
	PFC	1 753	2 335	361	154	159	180	202	116	85	179
	SF_6	1 662	2 205	112	86	75	81	91	97	111	116
Denmark	HFC	NA,NE,NO	218	607	802	823	850	853	799	804	759
	PFC	NA,NO	1	18	14	16	15	13	14	13	11
	SF_6	44	107	59	22	36	30	32	37	38	73
Finland	HFC	0	29	492	863	747	903	993	889	1 164	1 026
	PFC	0	0	22	10	15	8	11	9	1	1
	SF_6	115	71	54	66	71	53	51	50	35	36
France	HFC	3 743	1 730	5 697	11 204	12 014	12 562	13 554	14 339	15 124	15 802
	PFC	4 293	2 562	2 487	1 430	1 167	924	563	365	383	429
	SF_6	2 016	2 239	1 816	1 184	1 035	899	855	711	664	546
Germany	HFC	4 592	7 012	7 623	8 640	8 708	8 742	8 843	9 443	8 963	9 177
	PFC	2 627	1 780	792	695	550	484	472	338	285	230
	SF_6	4 642	6 779	4 269	3 480	3 398	3 334	3 115	3 065	3 194	3 316
Greece	HFC	935	3 290	4 244	3 969	2 134	2 471	2 844	3 227	3 512	3 507
	PFC	163	54	105	70	66	76	89	70	102	78
	SF_6	3	4	4	6	8	10	8	5	6	5
Ireland	HFC	1	55	260	476	549	536	567	523	559	539
	PFC	0	75	305	168	148	131	106	66	37	13
	SF_6	36	83	54	102	63	66	57	38	35	48
Italy	HFC	351	671	1 986	5 401	6 106	6 855	7 513	8 164	8 745	9 306
	PFC	2 487	1 266	1 217	1 715	1 714	1 652	1 501	1 063	1 331	1 455
	SF_6	333	601	493	465	406	428	436	398	373	351
Luxembourg	HFC	12	16	29	53	57	61	63	66	66	67
	PFC	NA,NO	NA,NO	0	0	0	0	0	0	0	0
	SF_6	1	2	2	5	6	6	7	7	7	8
Netherlands	HFC	4 432	6 019	3 892	1 512	1 745	1 864	1 932	2 072	2 260	2 133
	PFC	2 264	1 938	1 581	265	254	319	251	168	209	183
	SF_6	218	287	295	240	199	188	184	170	184	147
Portugal	HFC	NA,NE,NO	66	319	848	962	1 100	1 249	1 379	1 515	1 491
	PFC	NA,NE,NO	NA,NO	0	0	0	0	0	0	0	0
	SF_6	NA,NE,NO	7	10	26	26	37	36	41	44	43
Spain	HFC	2 403	4 646	8 366	5 405	5 973	6 284	7 043	7 369	8 294	8 279
	PFC	883	833	436	288	294	298	315	297	304	313
	SF_6	67	108	205	272	352	368	366	363	379	394
Sweden	HFC	4	132	568	789	818	838	867	869	845	813
	PFC	377	343	241	257	245	248	225	35	158	183
	SF_6	107	127	94	142	111	151	84	81	73	60
United Kingdom	HFC	11 386	15 317	9 282	11 996	12 667	12 969	13 543	13 886	14 237	14 501
	PFC	1 401	462	461	298	302	219	204	145	221	325
	SF_6	1 030	1 239	1 798	1 108	874	792	711	661	689	607
EU-15	HFC	27 882	39 992	44 952	54 418	55 866	58 818	62 768	66 040	69 311	70 745
	PFC	17 329	11 718	8 093	5 490	5 067	4 738	4 120	2 715	3 193	3 461
	SF_6	10 768	15 012	9 867	7 721	7 135	6 828	6 421	6 081	6 184	6 073

1.7.3 Geographical coverage of the European Union inventory

Table 1.25 shows the geographical coverage of the EU-15 Member States' national inventories. As the EU-15 inventory is the sum of the Member States' inventories, the EU-15 inventory covers the same geographical area as the inventories of the Member States.

Table 1.25 Geographical coverage of the EU-15 inventory

Member State	Geographical coverage	EU-territory coverage (UNFCCC and Kyoto)	Party coverage (UNFCCC)	Party coverage (Kyoto Protocol)
Austria	Austria	√	√	√
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region	√	√	√
Denmark	Denmark (excluding Greenland and the Faeroe Islands)	√		
	Denmark, Faroe Islands and Greenland		√	
	Denmark and Greenland			√
Finland	Finland including Åland Islands	√	√	√
France	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas communities (Saint-Barthelemy and Saint-Martin), excluding the French overseas communities (French Polynesia, Wallis and Futuna, Mayotte, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia	√		√
	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion), the overseas communities (French Polynesia, Saint-Barthelemy and Saint-Martin, Wallis and Futuna, Mayotte, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia,		√	
Germany	Germany	√	√	√
Greece	Greece	√	√	√
Ireland	Ireland	√	√	√
Italy	Italy	√	√	√
Luxembourg	Luxembourg	√	√	√
Netherlands	The reported emissions have to be allocated to the legal territory of The Netherlands. This includes a 12-mile zone from the coastline and also inland water bodies. It excludes Aruba and The Netherlands Antilles, which are self-governing dependencies of the Royal Kingdom of The Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.	√	√	√
Portugal	Mainland Portugal and the two Autonomous regions of Madeira and Azores Islands. Includes also emissions from air traffic and navigation bunkers realized between these areas.	√	√	√
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla	√	√	√
Sweden	Sweden	√	√	√
United Kingdom	England, Scotland, Wales and Northern Ireland, and Gibraltar, excluding the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories (except Gibraltar).	√		
	England, Scotland, Wales and Northern Ireland, the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories that have ratified the Kyoto Protocol (the Cayman Islands, the Falkland Islands, Bermuda, Montserrat and Gibraltar).		√	√
EU-15		√		

1.7.4 Completeness of the European Union submission

1.7.4.1 *National inventory report*

The EU NIR follows – as far as posible - the annotated outline of the UNFCCC secretariat with the exception of the annexes. The main reason for this is the nature of the EU inventory being the sum of Member States' inventories. Therefore the main purpose of the annexes is to make transparent the EU emission estimates by providing the basic basic Member States tables for every CRF table. Table 1.26 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.26 Explanations for exclusion of annexes as outlied in the UNFCCC reporting guidelines

Annex required in the UNFCCC reporting guidelines	Comment
Annex 1: Key categories	Key category analyses Tier 1 and Tier 2 are included in Annex 1.2
Annex 2: Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion	Due to the nature of the EU inventory being the sum of Member States' inventories detailed methodologies for estimating CO_2 emissions from fossil fuel combustion are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EU NIR for the EU key categories.
Annex 3: Other detailed methodological descriptions for individual source or sink categories (where relevant)	Due to the nature of the EU inventory being the sum of Member States' inventories detailed methodological descriptions for other source or sink categories are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EU NIR for the EU key categories.
Annex 4: CO_2 reference approach and comparison with sectoral approach, and relevant information on the national energy balance	Information on the reference approach is included in the EU NIR. Due to the nature of the EU inventory being the sum of Member States' inventories there is no national energy balance which could be included in this annex.
Annex 5: Assessment of completeness and (potential) sources and sinks of greenhouse gas emissions and removals excluded	Information on completeness as reported by Member States in CRF Table 9 is included in Annex 1.4.
Annex 6: Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information	The EU considers the Member States CRF and NIR as part fo the EU submission.
Annex 7: Tables 6.1 and 6.2 of the IPCC good practice guidance	Due to the nature of the EU inventory EU uncertainties are not estimated on basis of uncertainties of emission factors and activity data (see chapter 1.7). Therefore no Table 6.1 can be provided for the EU. Information on tier 1 uncertainty analysis is included in chapter 1.6 and in the sector chapters.
Annex 8: Other annexes - (Any other relevant information – optional).	

CRF tables in Annex 1.2

The European Union cannot provide all data in the sectoral background tables. The main reasons for not completing all sectoral background data tables are: (1) limited data availability partly due to confidentiality issues; and (2) the use of different type of activity data by Member States. Latter is due to the fact that the Member States are responsible for calculating emissions. If they use country-specific methods they may also use different types of activity data. At EU-15 level these different types of activity data cannot be simply added up. As at EU-15 level no emissions are calculated directly on the basis of activity data, the documentation of very detailed background data seems to be of lower importance. All the details for the calculation of the emissions are documented in the Member States' CRF tables, as part of their national GHG inventories, which also form part of the EU GHG inventory submission (see Annex 1.12, which is available at the EEA website http://www.eea.europa.eu) and in the sector annexes.

Table 1.27 provides an overview of sectoral report and sectoral background tables available in Annex 1.2, an explanation for each table which is not filled in at EU-15 level and activity data provided for the calculation of implied emission factors. Further information is provided in the relevant sector chapters.

Table 1.27 Inclusion of CRF tables in Annex 1.2

Table	Included in Annex 1.2	Comment
Energy		
Table 1	Yes	
Table 1.A (a)	Yes	
Table 1.A (b)	Yes	
Table 1.A (c)	Yes	
Table 1.A (d)	Yes	

Table	Included in Annex 1.2	Comment
Table 1B1	Yes	
Table 1B2	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview table for 1B2b included in the NIR
Table 1.C	Yes	
Industrial processes		
Table 2(I)	Yes	
Table 2(II)	Yes	
Table 2(I). A-G	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview tables for large key sources included in the NIR
Table 2(II). C,E	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; limited data availability; confidentiality issues
Table 2(II). F	Yes	For those MS which did not provide Table 2(II).F emissions are allocated to the sub-categories according to the aggregated average allocation of those MS which provided Table 2(II).F.
Solvent use		
Table 3	Yes	
Table 3. A-D	No	Type of activity data used by the MS varies
Agriculture		
Table 4	Yes	
Table 4. A	Yes	
Table 4. B(a)	Yes	
Table 4. B(b)	Yes	
Table 4. C	Yes	
Table 4. D	Yes	
Table 4. E	Yes	
Table 4. F	Yes	
LUCF		
Table 5	Yes	
Table 5. A	Yes	
Table 5. B	Yes	
Table 5. C	Yes	
Table 5. D	Yes	
Table 5. E	Yes	
Table 5. F	Yes	
Table 5 (I)	Yes	
Table 5 (II)	Yes	
Table 5 (III)	Yes	
Table 5 (IV)	Yes	
Table 5 (V)	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Waste		
Table 6	Yes	
Table 6. A, C	Partly	Emissions and some activity data are included
Table 6. B	Partly	Emissions are included, activity data is not estimated because of limited data availability
Summary Tables		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Other Tables		
Table 7	Yes	
Table 8(a)	Yes	

Table	Included in Annex 1.2	Comment
Table 8(b)	Partly	It is indicated in which MS recalculations were performed. In addition, the explanations for recalculations are provided in the EU NIR for the EU key sources together with the contribution of every MS to the EU recalculations. Summary information is also provided in Chapter 10 (Tables 10.1 and 10.2).
Table 9	Partly	Annex 1.4 provides a list of all NEs and IEs and includes explanations taken from the Member States' CRF Tables 9. This information is equivalent to CRF Table 9 which cannot be filled-in automatically for the EU-15 due to the amount of information from the Member States. In addition, information on completeness is included in the NIR for the EU key sources explanations for the NE and IE are included in the sector chapters of the NIR, where relevant.
Table 10	Yes	

Table 1.28 provides for specific sectoral background tables an overview of activity data used by Member States in order to explain why this activity data cannot be reported at EU-15 level.

Table 1.28 Activity data reported by Member States in CRF background data tables

Table	Source category		Activity data reported by MS
Table 1B2	1. B. 2. a. Oil (3)	I.Exploration	number of wells drilled
			crude oil
			number of wells drilled/tested
		ii. Production	Oil throughput
			PJ of oil produced
			Crude oil and NGL production
			Crude oil produced
			Oil and gas produced
		iii.Transport	oil loaded in tankers
			PJ Loaded
			Crude oil imports
			Transport of crude oil
			Offshore loading of oil only
		iv.Refining / Storage	Oil refined (SNAP 0401)
			PJ oil refined
			crude oil & products
			kt oil refined
			Refinery input (crude oil and NGL)
			Refery input: crude oil, NGL
			crude oil & products
			Oil refinery throughput
		v. Distribution of Oil Products	Gasoline Consumption (SNAP 0505)
			kt oil refined
			Domestic supply of gasoline
			Oil products
		vi.Other	Transfer loss gas works gas
			onshore loading of oil only
	1. B. 2. b. Natural Gas	i.Exploration	natural gas
			number of wells drilled/tested

		ii. Production (4) / Processing	Gas throughput
			PJ gas produced
			natural gas from crude oil extraction
			Natural gas production
			Mm3 gas produced
		iii.Transmission	Pipelines length (km)
			total amount of gas consumed
			PJ gas consumed
			Length of transmission pipeline
			Mm3 gas transported
			gas transported
			PJ gas (NCV)
			Pressure levelling losses
		iv.Distribution	Distribution network length
			consumption
			distribution net
			PJ gas distributed via local networks
			PJ gas consumed
			Length of distribution mains
			Mm3 gas transported
		v. Other Leakage	PJ gas consumed
			t of natural gas released from pipelines
	1. B. 2. c. Venting(5)	i.Oil	PJ oil produced
			kt oil refined
			Crude oil and NGL production
		ii. Gas	PJ gas produced
			Sour Natural gas production
		iii.Combined	
	Flaring	i.Oil	PJ gas consumption
			kt oil refined
			Consumed
			Crude oil and NGL production
			Mm3 gas consumption
			oil produced
			Refinery gas other liquid fuels
		ii. Gas	PJ gas consumption
			natural gas
			Natural gas production
			quantity of gas flared
		iii.Combined	
Table 2(I)	2.A Mineral products	1. Cement production	Clinker production
			AD confidential
		2. Lime production	Lime produced
			Lime and dolomite production
			Production of lime and bricks

			Limestone consumed
		3. Limestone and dolomite use	Limestone and dolomite used
			Limestone consumption
			Clay, shale and limestone use
			Carbonates input to brick, tiles, ceramic production
		4. Soda ash production	Soda ash production
		4. Soda ash use	Soda ash use
			Use of soda
		5. Asphalt roofing	Roofing material production
			Bitumen consumption
		6. Road paving with asphalt	Asphalt production
			Bitumen consumption
			Asphalt used in paving
			Asphalt liquefied
	2B Chemical industry	1. Ammonia production	Ammonia production
			Natural gas consumption
		2. Nitric acid production	Nitric acid production
			Nitric acid production: Medium pressure plants
Table 2(II) C	2C Metal production	1. Iron and steel production	
		Steel	Steel production
			Crude steel production
			Production of secondary steel
		Pig iron	Iron production
			Production of primary iron
			Pig iron production
		Sinter	Sinter production
			Sinter consumption
		Coke	Coke production
			Coke consumption
			Coke consumed in blast furnace
		2. Ferroalloys production	Ferroalloys production
			Laterite consumption
			Use of coal and coke electrodes
		3. Aluminium production	Aluminium production
			Primary aluminium production
	C.PFCs and SF_6 from MetalProduction	PFCs from aluminium production	Aluminium production
			Primary aluminium production
		SF_6 used in Aluminium and Magnesium Foundries	
		Aluminium foundries	Cast aluminium
			Consumption of aluminium foundries
			SF_6 consumption
		Magnesium foundries	Cast magnesium
			Consumption Mg-Production

			SF_6 consumption
Table 4D	1. Direct soil emissions	3. N-fixing crops	Nitrogen fixed by N-fixing crops
			Dry pulses and soybeans produced
			Area of cultivated soils
		4. Crop residues	Nitrogen in crop residues returned to soils
			Dry production of other crops
Table 5(V)	A. Forest land		Area burned (ha)
			Biomass burned (kg dm)
	B. Cropland		Area burned (ha)
			Biomass burned (kg dm)
	C. Grassland		Area burned (ha)
			Biomass burned (kg dm)
	E. Settlements		Area burned (ha)
			Biomass burned (kg dm)

2 EU-15 GREENHOUSE GAS EMISSION TRENDS

This chapter presents the main GHG emission trends in the EU-15. Firstly, aggregated results are described as regards total GHG emissions and progress towards fulfilling the EU Kyoto target (for EU-15 only). Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EU GHG trends is given. Finally, the trends of indirect GHGs and SO_2 emissions are presented.

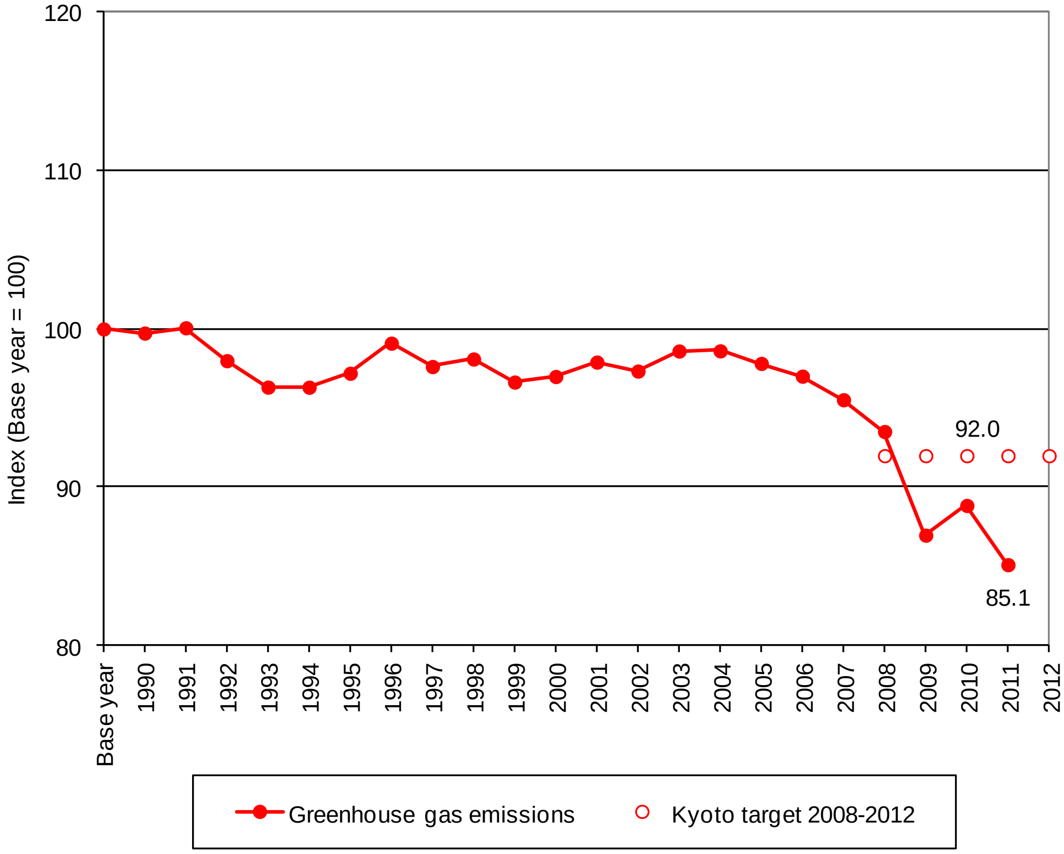
2.1 Aggregated greenhouse gas emissions

In 2011 total GHG emissions in the EU-15, without LULUCF, were 14.7 % (624 million tonnes CO_2 equivalents) below 1990. Emissions decreased by 4.2 % (159.6 million tonnes CO_2 equivalents) between 2010 and 2011.

Under the Kyoto Protocol, the EU agreed to reduce its GHG emissions by 8 % by 2008–12 compared to the'base year'[21]. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms. Since 2009 emissions are below the EU-15 Kyoto target (Figure ES.2).

[21] Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent.

Figure 2.1 **EU-15 GHG emissions 1990–2011 compared with target for 2008–12 (excl. LULUCF)**



Notes: *GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport.* CO_2 *emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.*

2.1.1 Main trends by source category, 1990-2011

Table 2.1 shows the source categories with the largest contributions to changes in greenhouse gas emissions between 1990 and 2011.

Table 2.1 EU-15: Overview of Top decreasing/increasing source categories 1990-2011 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-15
	Million tonnes (CO_2
Road Transportation (CO_2 from 1A3b)	100.3
Consumptions of halocarbons (HFC from 2F)	69.5
Production of halocarbons (HFC from 2E)	-26.7
Nitric Acid Production (N_2O from 2B2)	-29.8
Enteric fermentation (CH_4 from 4A)	-21.4
Manufacture of Solid fuels (CO_2 from 1A1c)	-49.2
Adipic Acid Production (N_2O from 2B3)	-58.2
Solid waste disposal on land (CH_4 from 6A)	-66.4
Agricultural soils (N_2O from 4D)	-37.3
1B Fugitive emissions from fuels (CH_4)	-50.4
Households and servicies (CO_2 from 1A4)	-118.4
Iron and Steel Production (CO_2 from 1A2a +2C1)	-47.8
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-128.4
Public Electricity and Heat Production (CO_2 from 1A1a)	-87.8
Total	**-623.85**

Notes: *As the table only presents sectors whose emissions increased or decreased by at least 20 million tonnes CO_2-equivalents, the sum of the source categories presented does nott match the total change listed at the bottom of the table.*

2.1.2 Main trends by source category, 2010-2011

Table 2.2 shows the source categories contributing the most to changes in greenhouse gas emissions between 2010 and 2011.

Table 2.2 EU-15: Overview of Top decreasing/increasing source categories 2010-2011 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-15
	Million tonnes (CO_2 eq.)
Iron and Steel Production (CO_2 from 1A2a +2C1)	-4.4
Nitric acid production (N_2O from 2B2)	-3.8
Road Transportation (CO_2 from 1A3b)	-8.6
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-10.5
Public Electricity and Heat Production (CO_2 from 1A1a)	-28.9
Households and servicies (CO_2 from 1A4)	-93.9
Total	**-159.6**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2- equivalents, the sum of the source categories presented does nottmatch the total change listed at the bottom of the table*

Main reasons for changes in EU-15 emissions, 2010–2011

In 2011 the winter was also warmer than in the previous year, leading to decreased demand for heating and higher emissions from the residential and commercial sectors.

The 159.6 million tonnes (CO_2 equivalents) decrease in GHG emissions between 2010 and 2011 was mainly due to the following factors:

- A strong emission decrease in households and services (-93.9 million tonnes or -15.3 %) in almost all EU-15 Member States. Milder winter conditions and the lower demand for heating can partly explain lower emissions in 2011 compared to 2010.
- Decreasing emissions in electricity and heat production (-28.9 million tonnes or -3.2 %) in particular in the UK and France. In both countries, reductions in demand for electricity was accompanied by greater use of nuclear power and lower use of gas (UK) and coal (France) for electricity generation.
- Decreasing emissions in road transportation (-8.6 million tonnes or -1.2 %), following a decreasing trend for the forth consecutive year, which was driven by reductions in both passenger and freight transportation.
- Reduced emissions in the category ‘manufacturing industries excluding iron and steel industry ‘ (-10.5 million tonnes or -2.8 %) in particular in the Greece, Italy, Portugal, Spain and the UK. The main reasons were a decline in industrial production (Greece, Spain), a decline in cement production (Greece, Portugal, Spain, and Italy) and a fuel shift from oil to natural gas in the UK manufacturing industry.
- A slight decrease in emissions from iron and steel production (-4.4 million tonnes or -3 %) following a substantial increase in emissions in 2010 (+29.6 million tonnes or +25.8 %) which was caused by a significant increase in crude steel production due to the recovery from the economic crisis.
- A substantial decrease in emissions from nitric acid production (-3.8 million tonnes or -40 %) mainly driven by decreases in Belgium, France and the United Kingdom

No substantial increases took place in GHG emissions between 2010-2011.

2.1.3 Overview of GHG emissions in EU Member States

Table 2.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2011 (million tonnes)	2010-2011 (million tonnes)	Change 2010-2011 (%)	Change 1990-2011 (%)	Change base year–2011 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78.2	79.0	82.8	-2.2	-2.6%	6.0%	4.8%	-13.0%
Belgium	143.1	145.7	120.2	-11.6	-8.8%	-16.0%	-17.5%	-7.5%
Denmark	68.7	69.3	56.2	-5.0	-8.1%	-18.1%	-18.9%	-21.0%
Finland	70.4	71.0	67.0	-7.5	-10.1%	-4.9%	-5.6%	0.0%
France	556.4	563.9	485.5	-28.7	-5.6%	-12.7%	-13.9%	0.0%
Germany	1250.3	1232.4	916.5	-27.0	-2.9%	-26.7%	-25.6%	-21.0%
Greece	104.6	107.0	115.0	-2.2	-1.9%	10.0%	7.5%	25.0%
Ireland	55.2	55.6	57.5	-4.0	-6.5%	4.1%	3.4%	13.0%
Italy	519.0	516.9	488.8	-11.5	-2.3%	-5.8%	-5.4%	-6.5%
Luxembourg	12.9	13.2	12.1	-0.15	-1.3%	-6.2%	-8.1%	-28.0%
Netherlands	211.8	213.0	194.4	-14.8	-7.1%	-8.2%	-8.8%	-6.0%
Portugal	61.0	60.1	70.0	-1.4	-2.0%	14.8%	16.4%	27.0%
Spain	282.8	289.8	350.5	1.8	0.5%	23.9%	21.0%	15.0%
Sweden	72.8	72.2	61.4	-4.0	-6.2%	-15.5%	-14.8%	4.0%
United Kingdom	767.3	776.3	552.6	-41.3	-7.0%	-28.0%	-28.8%	-12.5%
EU-15	**4254.5**	**4265.5**	**3630.7**	**-159.6**	**-4.2%**	**-14.7%**	**-14.9%**	**-8.0%**

([a])The base year under the Kyoto Protocol for each Member State and EU-15 is further outlined in Table 1.4 and 1.5.

2.2 **Emission trends by gas**

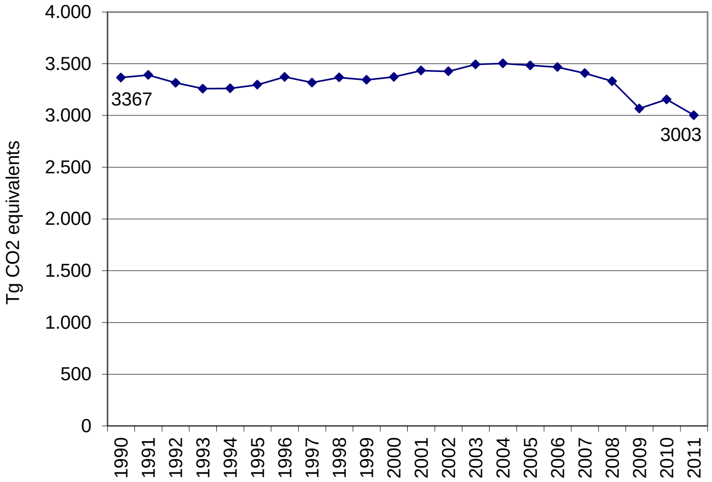


Table 2.4, Figure 2.2 and

Figure 2.3 give an overview of the main trends in EU-15 GHG emissions and removals for 1990–2011. In the EU-15 the most important GHG is CO_2, accounting for 82.7 % of total EU-15 emissions in 2011. In 2011, EU-15 CO_2 emissions without LULUCF were 3 003 Tg, which was 10.8 % below 1990 levels. Compared to 2010, CO_2 emissions decreased by 4.8 %.

Table 2.4 Overview of EU-15 GHG emissions and removals from 1990 to 2011 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Net CO_2 emissions/removals	3 224	3 128		3 319	3 282	3 249	3 143	2 876	2 980	2 823
CO_2 emissions (without LULUCF)	3 367	3 298	3 373	3 484	3 467	3 408	3 332	3 067	3 155	3 003
CH_4	438	410	369	320	313	308	304	298	296	289
N_2O	400	379	339	308	295	294	286	275	266	264
HFCs	28	40	45	54	56	59	63	66	69	71
PFCs	17	12	8	5	5	5	4	3	3	3
SF_6	11	15	10	8	7	7	6	6	6	6
Total (with net CO_2 emissions/removals)	**4 118**	**3 984**	**3 960**	**4 014**	**3 959**	**3 922**	**3 806**	**3 524**	**3 620**	**3 457**
Total (without CO_2 from LULUCF)	**4 261**	**4 154**	**4 144**	**4 179**	**4 144**	**4 081**	**3 995**	**3 716**	**3 796**	**3 636**
Total (without LULUCF)	**4 255**	**4 146**	**4 138**	**4 173**	**4 138**	**4 075**	**3 989**	**3 710**	**3 790**	**3 631**

Figure 2.2 CO_2 emissions without LULUCF 1990 to 2011 in CO_2 equivalents (Tg)

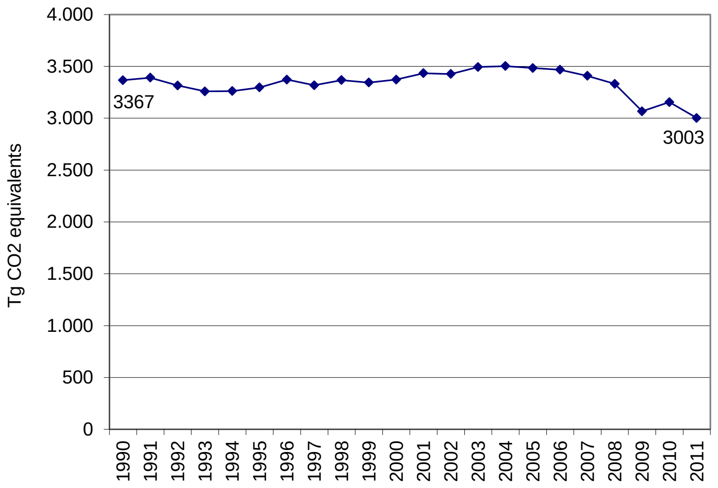
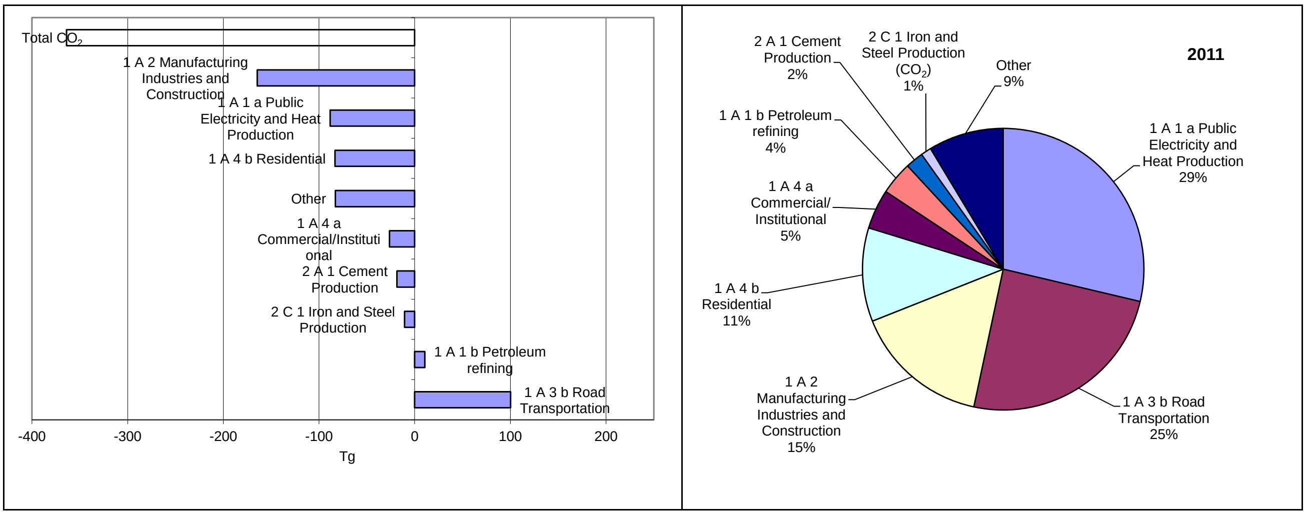


Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2011 in CO_2 equivalents (Tg) for EU-15 and share of largest key source categories in 2011 for EU-15



CH_4 emissions account for 8.0 % of total EU-15 GHG emissions in 2011 and decreased by 34 % since 1990 to 289 Tg CO_2 equivalents in 2011 (Figure 2.4). The two largest key sources account for 57.8 % of CH_4 emissions in 2011. Figure 2.5 shows that the main reasons for declining CH_4 emissions were reductions in managed waste disposal on land and coal mining.

Figure 2.4 **CH_4 emissions 1990 to 2011 in CO_2 equivalents (Tg)**

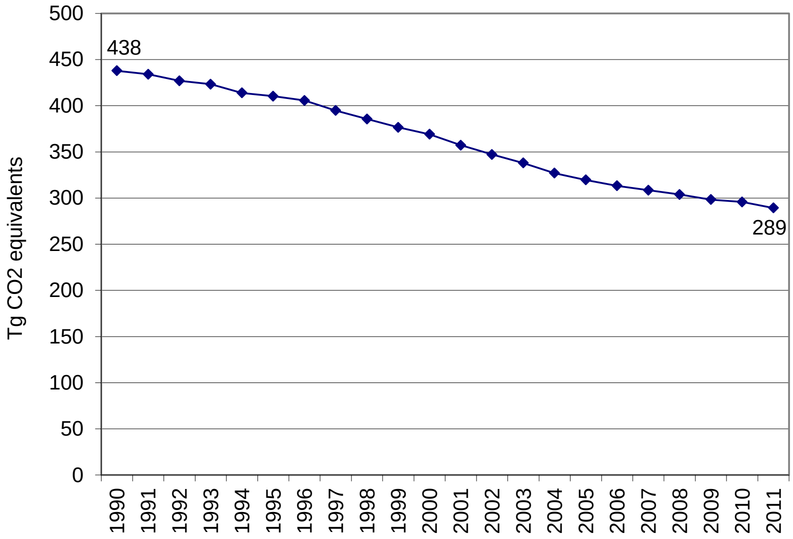
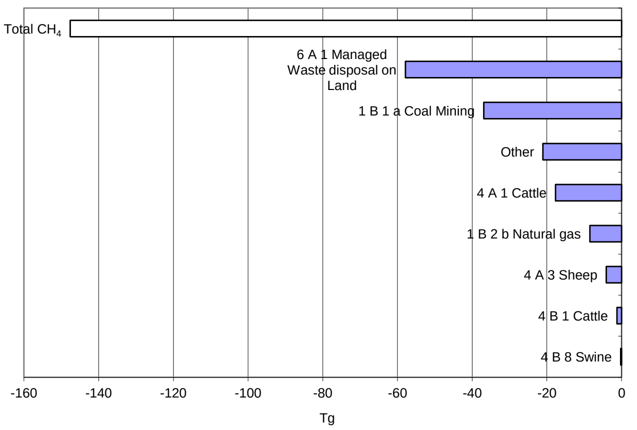
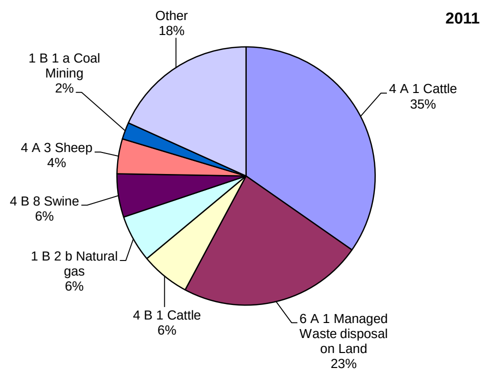


Figure 2.5 **Absolute change of CH_4 emissions by large key source categories 1990 to 2011 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2011 for EU-15**





N_2O emissions are responsible for 7.2 % of total EU-15 GHG emissions and decreased by 34.1 % to 264 Tg CO_2 equivalents in 2011 (Figure 2.6). The two largest key sources account for about 61.5 % of N_2O emissions in 2011. Figure 2.7 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Figure 2.6 **N_2O emissions 1990 to 2011 in CO_2 equivalents (Tg)**

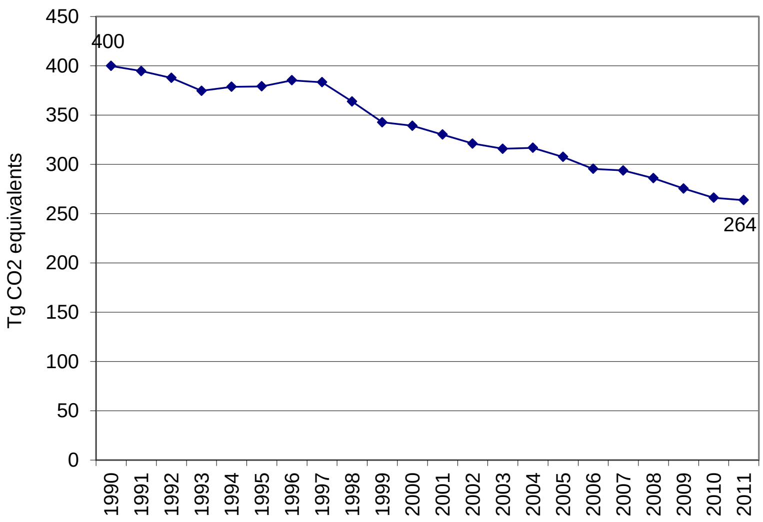
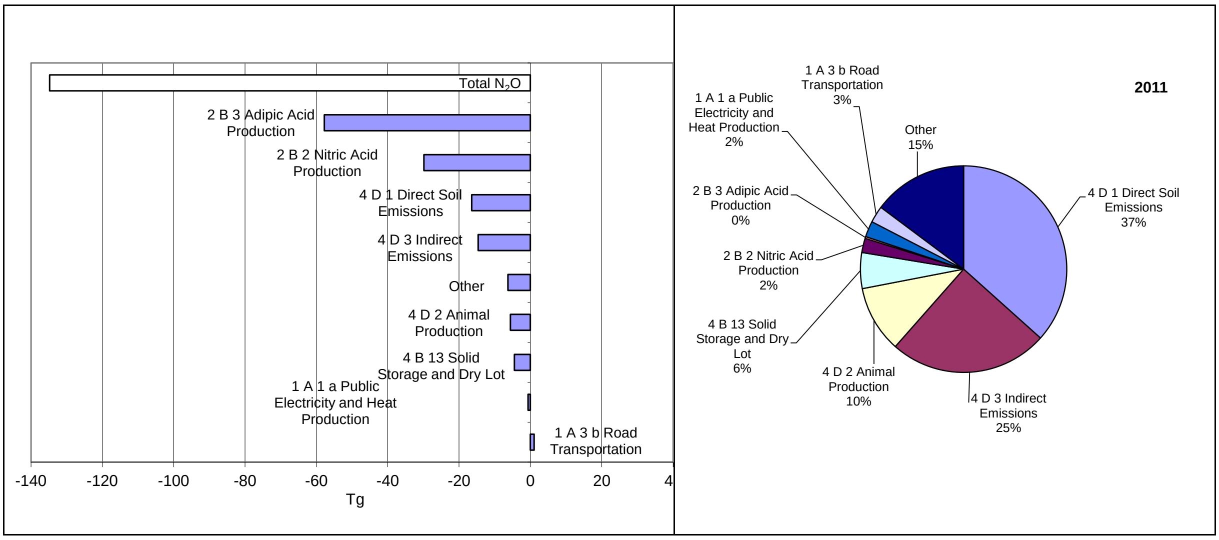


Figure 2.7 **Absolute change of N_2O emissions by large key source categories 1990 to 2011 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2011 for EU-15**



Fluorinated gas emissions account for 2.2 % of total EU-15 GHG emissions. In 2011, emissions were 80 Tg CO_2 equivalents, which was 42.9 % above 1990 levels (Figure 2.8). The two largest key sources account for 94 % of fluorinated gas emissions in 2011. Figure 2.9 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2011. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from production of halocarbons decreased substantially. The decrease started in 1998 and was strongest in 1999 and 2000.

Figure 2.8 Fluorinated gas emissions 1990 to 2011 in CO_2 equivalents (Tg)

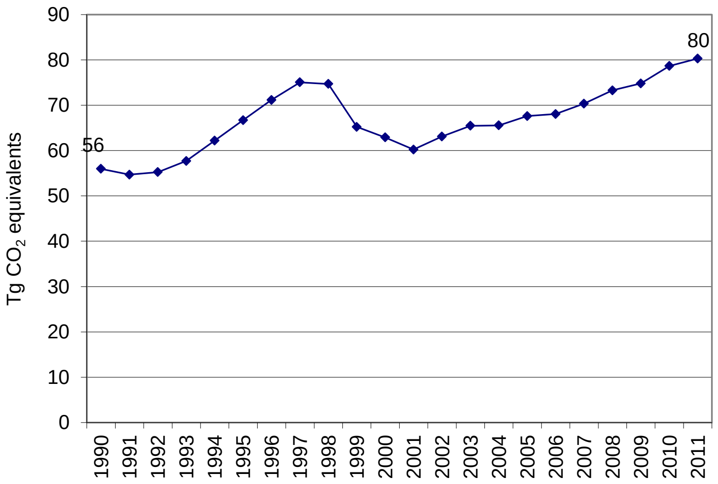
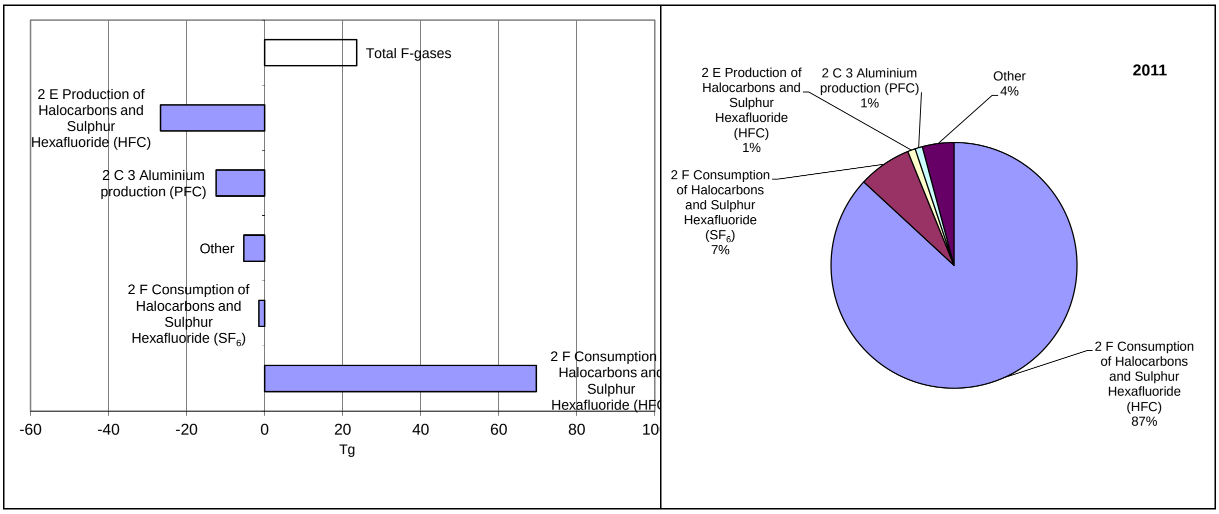


Figure 2.9 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2011 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2011 for EU-15



2.3 Emission trends by source

Table 2.5 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2011. More detailed trend descriptions are included in Chapters 3 to 9.

Table 2.5 **Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2011 in CO_2 equivalents (Tg)**

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
1. Energy	3 282	3 206	3 259	3 348	3 329	3 265	3 200	2 972	3 048	2 898
2. Industrial Processes	353	350	310	311	303	308	292	254	261	253
3. Solvent and Other Product Use	13	12	11	9.667	10	9	9	8	8	8
4. Agriculture	433.9	412	413	385	380	380	379	370	369	370
5. Land-Use, Land-Use Change and Forestry	-137	-163	-177	-159	-180	-153	-183	-186	-170	-174
6. Waste	172	166	144	119	116	113	109	106	104	102
7. Other	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4 118**	**3 984**	**3 960**	**4 014**	**3 959**	**3 922**	**3 806**	**3 524**	**3 620**	**3 457**
Total (without LULUCF)	**4 255**	**4 146**	**4 138**	**4 173**	**4 138**	**4 075**	**3 989**	**3 710**	**3 790**	**3 631**

2.4 Emission trends by Member State

Table 2.6 gives an overview of EU-15 Member States' contributions to the EU GHG emissions for 1990–2011. Member States show large variations in GHG emission trends.

Table 2.6 **Overview of Member States' contributions to EU-15 GHG emissions excluding LULUCF from 1990 to 2011 in CO_2 equivalents (Tg)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	78	80	80	93	90	87	87	80	85	83
Belgium	143	150	146	143	139	134	137	124	132	120
Denmark	69	76	68	64	72	67	64	61	61	56
Finland	70	71	69	69	80	78	70	66	75	67
France	556	552	559	558	546	536	531	508	514	486
Germany	1 250	1 118	1 041	998	1 000	976	975	911	944	916
Greece	105	109	126	135	131	134	130	124	117	115
Ireland	55	59	68	69	69	68	68	62	61	58
Italy	519	530	551	574	564	555	541	491	500	489
Luxembourg	13	10	10	13	13	12	12	12	12	12
Netherlands	212	223	213	209	206	204	203	198	209	194
Portugal	61	72	84	88	83	81	78	75	71	70
Spain	283	313	379	433	424	432	399	363	349	350
Sweden	73	74	69	67	67	66	63	59	65	61
United Kingdom	767	709	674	658	654	644	630	577	594	553
EU-15	**4 255**	**4 146**	**4 138**	**4 173**	**4 138**	**4 075**	**3 989**	**3 710**	**3 790**	**3 631**

The overall EU GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom accounting for 32.3 % of total EU-15 GHG emissions in 2011. These two Member States have achieved total GHG emission reductions of 549 million tonnes CO_2-equivalents compared to 1990[22].

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new Länder after German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in the production of adipic acid.

(*22*) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

France and Italy were the third and fourth largest emitters with a share of 10.7 % each. Italy's GHG emissions were 5.8 % below 1990 levels in 2011. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol refining, however, decreased significantly since 2004. France's emissions were 12.7 % below 1990 levels in 2011. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport and HFC emissions from consumption of halocarbons increased considerably between 1990 and 2011.

Spain is the fifth largest emitter in the EU-15, accounting for 7.7 % of total EU-15 GHG emissions. Spain increased emissions by nearly 24 % between 1990 and 2011. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries.

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2011. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-85 %), followed by CO (-67 %), NMVOC (-57 %) and NO_x (-49 %).

Table 2.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2011 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	(Gg)									
NOx	13 673	12 023	10 490	9 482	9 175	8 866	8 140	7 453	7 246	6 966
CO	53 825	42 345	31 937	23 992	22 568	22 087	20 478	18 419	19 239	17 844
NMVOC	15 270	12 596	10 237	8 385	8 239	7 621	7 178	6 824	6 751	6 549
SO2	16 459	9 986	6 144	4 572	4 353	4 142	3 090	2 668	2 451	2 390

Table 2.8 shows the NO_x emissions of the EU-15 Member States between 1990–2011. The largest emitters, the United Kingdom, Spain, Germany, France and Italy made up 76.9 % of total EU-15 NO_x emissions in 2011. All EU-15 Member States reduced their NO_x emissions between1990 and 2011.

Table 2.8 Overview of Member States' contributions to EU-15 NO_x emissions for 1990–2011 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	195	181	205	236	222	215	203	187	192	181
Belgium	400	388	328	289	272	262	236	205	218	207
Denmark	278	271	205	186	187	173	155	136	133	125
Finland	295	245	211	176	193	184	169	155	167	157
France	1 900	1 775	1 651	1 485	1 409	1 343	1 250	1 171	1 150	1 073
Germany	2 877	2 175	1 925	1 574	1 559	1 481	1 404	1 305	1 329	1 288
Greece	326	329	361	417	413	416	392	379	319	296
Ireland	122	122	134	127	122	119	108	86	78	70
Italy	2 052	1 908	1 446	1 226	1 170	1 153	1 067	1 000	963	943
Luxembourg	0.2	0.5	1	0.4	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	559	464	386	325	316	292	284	263	258	243
Portugal	252	286	284	284	256	248	222	210	198	187
Spain	1 278	1 335	1 370	1 412	1 366	1 360	1 178	1 063	985	1 022
Sweden	271	247	211	180	176	170	163	152	154	146
United Kingdom	2 868	2 296	1 774	1 566	1 515	1 449	1 310	1 140	1 102	1 029
EU-15	**13 673**	**12 023**	**10 490**	**9 482**	**9 175**	**8 866**	**8 140**	**7 453**	**7 246**	**6 966**

Table 2.9 shows the CO emissions of the EU-15 Member States between 1990–2011. The largest emitters, France, Germany, Italy and the United Kingdom that made up 67.6 % of the total CO emissions in 2011, reduced their emissions from 1990 levels substantially. But also all other EU-15 Member States reduced emissions.

Table 2.9 Overview of Member States' contributions to EU-15 CO emissions for 1990–2011 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	1 436	1 272	957	813	772	720	682	636	643	607
Belgium	1 354	1 055	895	717	620	619	614	380	466	385
Denmark	730	651	489	463	455	470	450	422	416	380
Finland	710	634	588	522	508	498	473	462	477	451
France	11 595	9 846	6 970	5 579	5 032	4 762	4 603	4 143	4 636	3 904
Germany	12 402	6 599	4 854	3 695	3 616	3 516	3 433	3 051	3 495	3 304
Greece	1 143	961	961	722	740	751	629	598	527	497
Ireland	400	313	251	189	181	169	157	150	138	126
Italy	7 734	7 172	5 098	3 472	3 214	3 759	2 990	2 819	2 722	2 703
Luxembourg	17	10	7	4	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	1 239	943	817	635	627	605	601	550	548	526
Portugal	962	974	808	743	533	473	448	442	481	421
Spain	3 739	3 217	2 747	2 206	2 295	2 079	1 944	1 777	1 862	1 820
Sweden	1 280	1 127	826	669	629	617	607	606	587	571
United Kingdom	9 085	7 571	5 670	3 563	3 345	3 050	2 844	2 382	2 242	2 151
EU-15	**53 825**	**42 345**	**31 937**	**23 992**	**22 568**	**22 087**	**20 478**	**18 419**	**19 239**	**17 844**

Table 2.10 shows the NMVOC emissions of the EU-15 Member States between 1990–2011. The largest emitters France, Germany and Italy that made up 60.7 % of the total NMVOC emissions in 2011, reduced their emissions from 1990 levels, together with all other EU-15 Member States.

Table 2.10 Overview of Member States' contributions to EU-15 NMVOC emissions for 1990–2011 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	274	222	175	164	174	161	151	122	134	128
Belgium	363	322	236	194	195	177	167	157	156	151
Denmark	164	166	139	114	109	104	99	91	88	81
Finland	229	192	165	140	137	133	119	112	116	107
France	3 881	3 506	3 009	2 608	2 614	2 197	2 089	2 124	2 028	1 973
Germany	3 131	1 808	1 394	1 146	1 134	1 071	1 016	929	1 055	1 006
Greece	269	260	266	221	231	220	228	212	185	159
Ireland	84	79	70	56	54	53	50	47	45	43
Italy	1 955	1 966	1 531	1 260	1 231	1 209	1 125	1 070	1 010	998
Luxembourg	6	6	5	6	5	5	5	5	4	4
Netherlands	475	337	231	167	158	155	153	144	143	143
Portugal	315	305	277	248	214	204	195	186	196	214
Spain	1 075	995	1 022	815	789	770	707	641	639	615
Sweden	359	278	224	199	195	193	189	184	183	177
United Kingdom	2 691	2 156	1 493	1 047	1 000	971	884	797	769	750
EU-15	**15 270**	**12 596**	**10 237**	**8 385**	**8 239**	**7 621**	**7 178**	**6 824**	**6 751**	**6 549**

Table 2.11 shows the SO_2 emissions of the EU-15 Member States between 1990–2011. The largest emitters, the United Kingdom, Spain and Germany, that made up 57 % of the total SO_2 emissions in 2011, reduced their emissions from 1990 levels substantially, together with all other EU-15 Member States.

Table 2.11 Overview of Member States' contributions to EU-15 SO_2 emissions for 1990–2011 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	74	47	32	27	28	24	22	18	19	18
Belgium	363	261	174	145	135	125	98	76	64	55
Denmark	178	140	31	24	28	26	20	15	15	14
Finland	249	105	81	68	85	83	69	59	67	58
France	1 328	998	659	490	465	453	388	330	306	275
Germany	5 292	1 718	653	477	487	469	469	419	444	445
Greece	476	540	496	541	533	538	445	425	265	262
Ireland	182	161	139	71	61	55	45	32	26	23
Italy	1 800	1 326	753	406	383	341	285	233	215	196
Luxembourg	0.2	0.2	0.2	0.2	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	198	139	79	70	81	59	50	38	34	34
Portugal	324	331	263	192	167	160	116	79	70	62
Spain	2 182	1 795	1 514	1 324	1 215	1 209	565	520	488	539
Sweden	105	69	42	36	36	32	30	29	32	30
United Kingdom	3 708	2 357	1 230	700	650	567	488	395	407	378
EU-15	**16 459**	**9 986**	**6 144**	**4 572**	**4 353**	**4 142**	**3 090**	**2 668**	**2 451**	**2 390**

3 ENERGY (CRF SECTOR 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. For each EU-15 key category overview tables are presented including the Member States' contributions to the key category in terms of level and trend, information on methodologies and emission factors. The chapter includes also sections on uncertainty estimates, sector-specific QA/QC, recalculations, the reference approach, and international bunkers.

3.1 Overview of sector (EU-15)

CRF Sector 1 Energy contributes 80 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector decreased by11,7 % from 3282 Tg in 1990 to 2898 Tg in 2011 (Figure 3.1). In 2011, emissions decreased by 5 % compared to 2010.

The most important energy-related gas is CO_2 that makes up 78 % of the total EU-15 GHG emissions. CH_4 and N_2O are each responsible for 1 % of the total GHG emissions. The key categories in this sector are as follows.

- 1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)
- 1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)
- 1 A 1 b Petroleum refining: Liquid Fuels (CO_2)
- 1 A 1 b Petroleum refining: Solid Fuels (CO_2)
- 1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)
- 1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)
- 1 A 2 a Iron and Steel: Liquid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Solid Fuels (CO_2)
- 1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)
- 1 A 2 c Chemicals: Gaseous Fuels (CO_2)
- 1 A 2 c Chemicals: Liquid Fuels (CO_2)
- 1 A 2 c Chemicals: Other Fuels (CO_2)
- 1 A 2 c Chemicals: Solid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)
- 1 A 2 f Other: Gaseous Fuels (CO_2)
- 1 A 2 f Other: Liquid Fuels (CO_2)
- 1 A 2 f Other: Other Fuels (CO_2)
- 1 A 2 f Other: Solid Fuels (CO_2)
- 1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Gasoline (N_2O)
- 1 A 3 b Road Transportation: LPG (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)

- 1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
- 1 A 3 d Navigation: Residual Oil (CO_2)
- 1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Other Fuels (CO_2)
- 1 A 4 b Residential: Gaseous Fuels (CO_2)
- 1 A 4 b Residential: Liquid Fuels (CO_2)
- 1 A 4 b Residential: Solid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)
- 1 A 5 a Stationary: Solid Fuels (CO_2)
- 1 A 5 b Mobile: Liquid Fuels (CO_2)
- 1 B 1 a Coal Mining: (CH_4)
- 1 B 2 a Oil: (CO_2)
- 1 B 2 b Natural gas: (CH_4)
- 1 B 2 c Venting and flaring: (CO_2)

Figure 3.1 CRF Sector 1 Energy: EU-15 GHG emissions in CO_2 equivalents (Tg) for 1990–2011

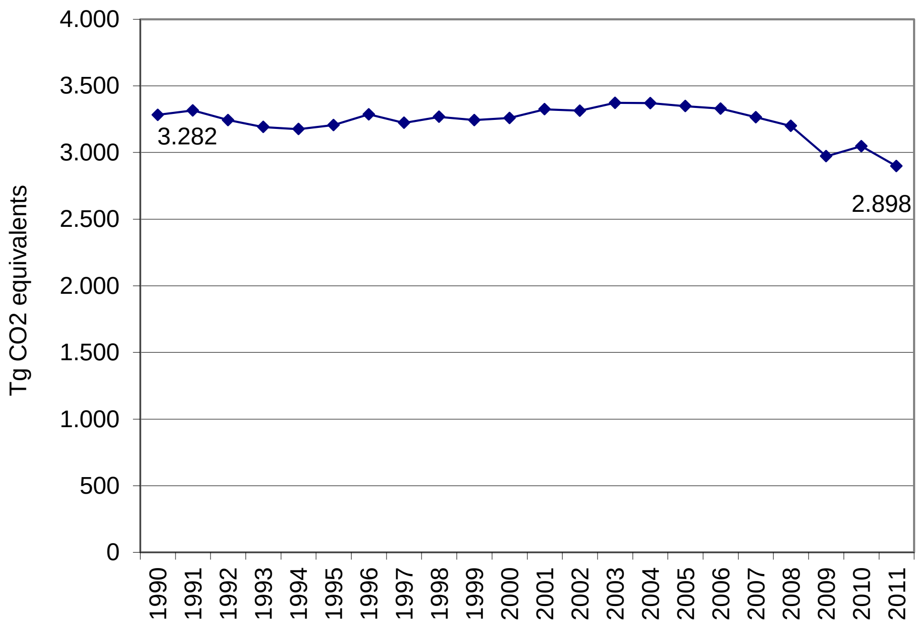
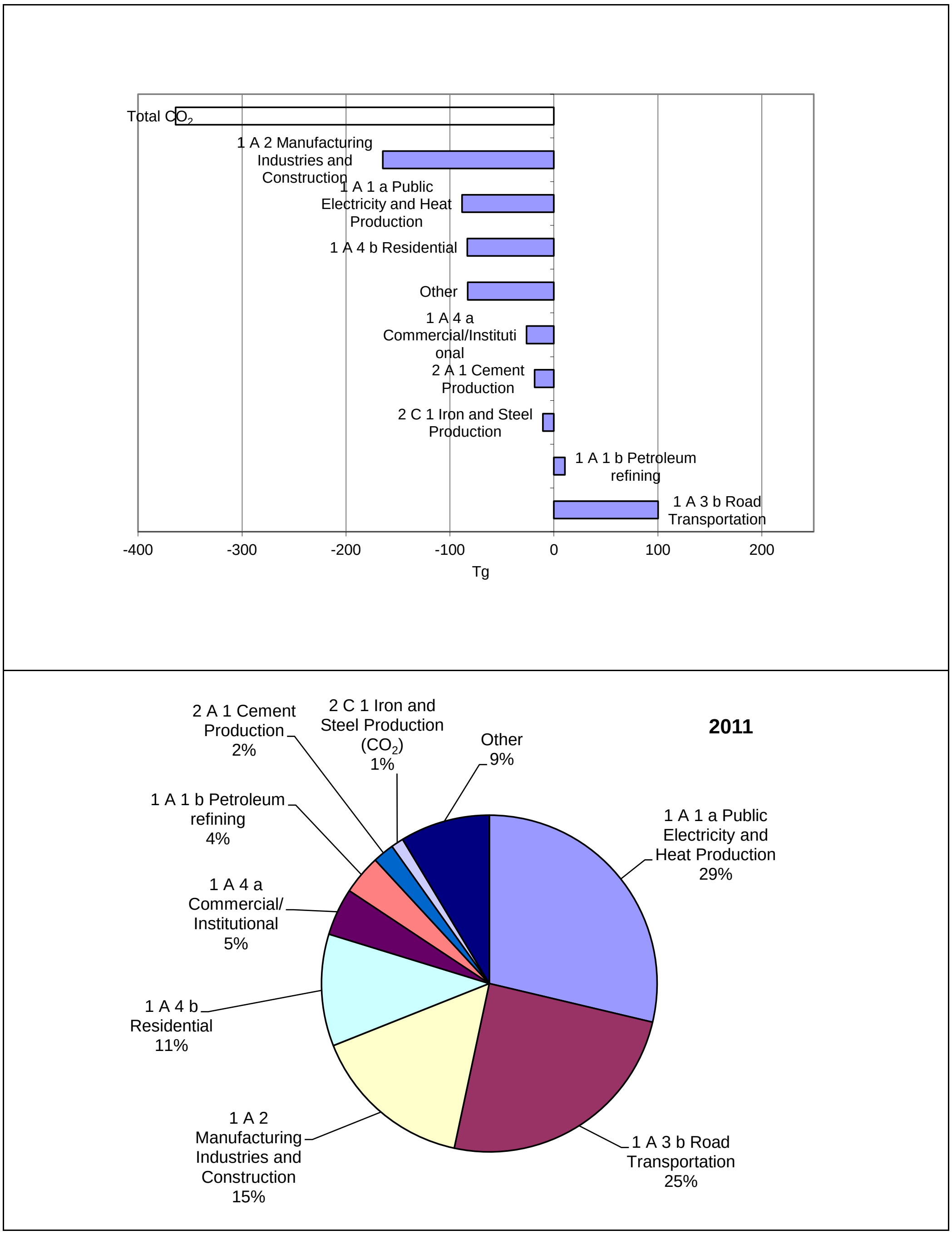


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2011. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 1A1c Manufacture of Solid Fuels and Other Energy Industries are the main reasons for the large absolute emission reductions from Other in Figure 3.2. Figure 3.2 shows that the six largest key categories account for about 90 % of emissions in Sector 1.

Figure 3.2 **CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2011 and share of largest key source categories in 2011**



3.2 Source categories (EU-15)

3.2.1 Energy industries (CRF Source Category 1A1)

Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. For the EU-15, this source category includes three key categories: CO_2 from 'Public electricity and heat production' (CRF 1A1a), CO_2 from 'Petroleum-refining' (CRF 1A1b), and CO_2 from 'Manufacture of solid fuels and other energy industries' (CRF 1A1c).

Figure 3.3 shows the trends in emissions in energy industries for the EU-15 between 1990 and 2011, which was mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 83 % of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 decreased by 11 %, between 1990 and 2011. This was mainly due to a decrease of CO_2 emission from Public Electricity and Heat Production (-88 Tg CO_2 and the manufacturing of solid fuels -49 Tg CO_2). CO_2 emissions from petroleum refining increased by 11 Tg in the period 1990-2011.

Figure 3.3 1A1 Energy Industries: Total GHG, CO_2 and N_2O emission trends and Activity Data

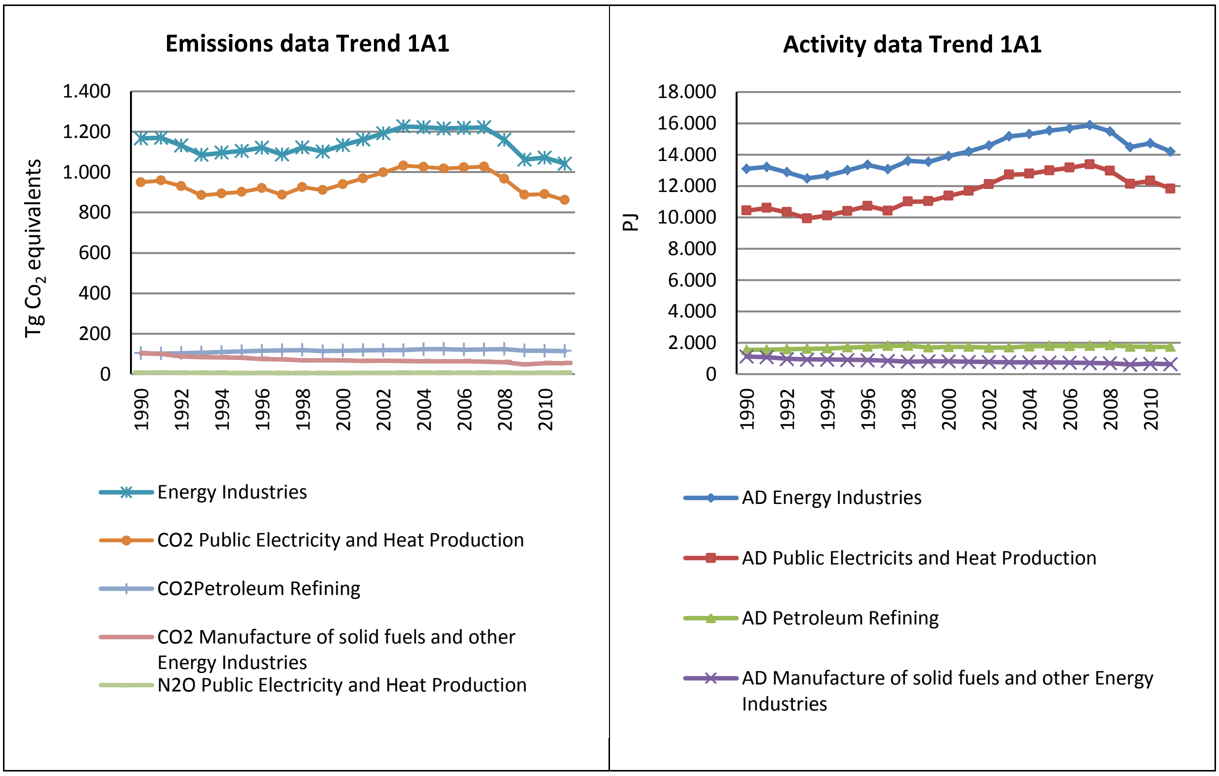


Table 3.1 summarises the information by Member State. Between 1990 and 2011, greenhouse gas emissions from energy industries increased in nine Member States and fell in six. The highest absolute increase was accounted for by Greece, the Netherlands and Spain. Germany and the UK account for the largest part of reductions (-119 Tg).The change in the EU-15 was a net decrease of 66 Tg. The table also shows the emissions of CO_2 and N_2O separately.

Table 3.1 1A1 Energy industries: Member States' contributions to CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	CO2 emissions in 2011 (Gg CO_2 equivalents)
Austria	13 842	13 988	13 792	13 861	46	118
Belgium	29 990	22 049	29 789	21 861	184	151
Denmark	26 246	20 030	26 146	19 738	85	96
Finland	19 187	24 628	19 057	24 272	122	334
France	64 266	52 961	63 542	52 300	593	610
Germany	428 073	354 309	423 418	349 546	4 371	2 879
Greece	43 159	54 026	42 993	53 838	154	172
Ireland	11 239	11 941	11 159	11 798	74	138
Italy	137 214	131 230	136 503	130 565	516	548
Luxembourg	36	995	33	991	2	3
Netherlands	52 699	62 426	52 501	62 061	139	259
Portugal	16 326	16 525	16 261	16 385	61	132
Spain	77 655	86 526	77 354	85 803	277	599
Sweden	10 145	10 662	9 795	10 127	328	449
United Kingdom	236 679	178 829	234 413	177 203	2 063	1 387
EU-15	**1 166 755**	**1 041 127**	**1 156 756**	**1 030 350**	**9 015**	**7 875**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.4 shows the relative contributions of greenhouse gas emissions from energy industries in each Member State, ranging from relatively low shares in Luxembourg and France to relatively high in Finland, Germany, Denmark, and Greece. Figure 3.5 shows the absolute contributions to EU-15 greenhouse gas emissions from energy industries, which are clearly dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from energy industries.

Figure 3.4 Share of greenhouse gas emissions from energy industries in total greenhouse gas emissions by Member State in 2011

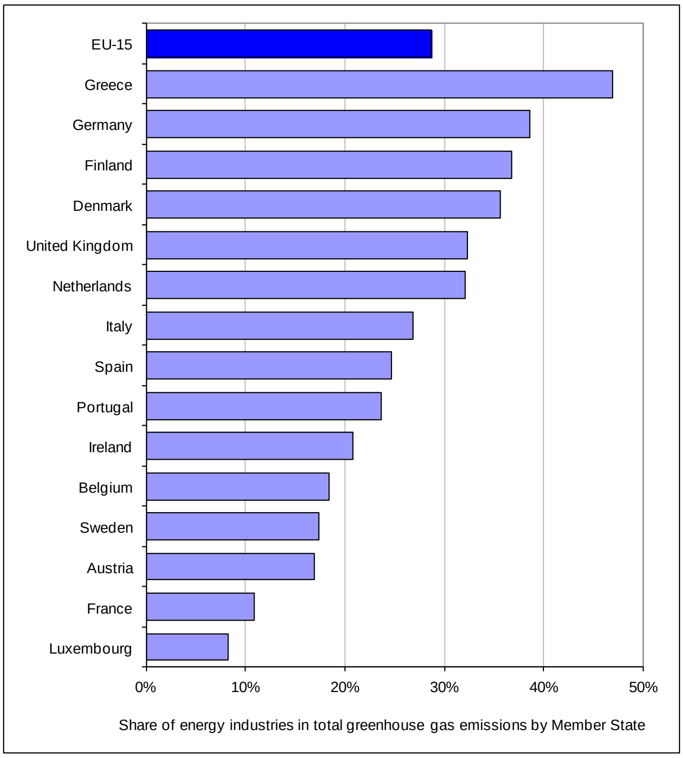
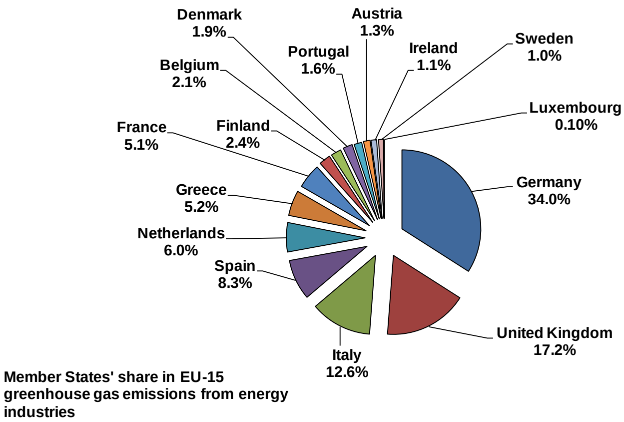


Figure 3.5 Member States' share of greenhouse gas emissions from energy industries in EU-15



Public heat and electricity production is the largest source category in the EU-15, as well as the main source of emissions from energy industries. Differences in the intensity of greenhouse gas emissions of heat and electricity production between the Member States are to a large extent explained by the mix of fuels. The relatively low share of greenhouse gas emissions from energy industries in France can be partly explained by the use of nuclear energy for power generation. Luxembourg is a net importer of electricity from neighbouring countries. Some countries rely more on coal than on gas. At the EU-15 level, 41 % of the fuel used in energy industries comes from solid fuels. Its contribution has been steadily declining in favour of relatively cleaner natural gas, whose share stood at about 33 % in 2011.

Table 3.2 provides information on the Member States' contribution to EU-15 recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2010 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.2 1A1 Energy Industries: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO_2 equiv.	Percent	Gg CO_2 equiv.	Percent	
Austria	0	0.0	-69	-0.5	Energy balance: Revision of CHP statistics and new incineration plants included for gaseous fuels. Energy balance: New waste incineration plants included for other fuels.
Belgium	-37	-0.1	25	0.1	1A1a solid fuels: validation of the emissions for the Flanders region 1A1b: Final energy balance data available
Denmark	0	0.0	19	0.1	Revision of the the energy balance
Finland	0	0.0	-60	-0.2	Corrections in activity data.
France	-506	-0.8	-46	-0.1	Les émissions de CO2, sur 1990-2004, ont été recalculées à partir des FE moyens, par combustible, déterminés sur la période 2005-2011.
Germany	0	0.0	2 677	0.8	Final data available from the national energy balance.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	5	0.0	Refinery now includes Natural Gas use for 2010 and 2011
Italy	0	0.0	-77	-0.1	Update of CO2 emission factor for natural gas and derived gas. Emissions from bioliquid fuel have been added.
Luxembourg	0	0.0	-63	-5.0	Revision of the final consumption (2000-2010) of liquid fuels. For some categories, also the years 1990-2000 were affected, due to calculation methodology to split general IEA AD between Gasoil (heating) and diesel (Transport). Revision of the final consumption of gaseous fuels. (2000-2010, between 686 TJ and 1868 TJ).
Netherlands	0	0.0	0	0.0	
Portugal	-43	-0.3	-38	-0.3	Quantities of MSW incinerated with energy recovery for 2007-2010 have been corrected: an error was found on the sum of quantities for one of the incineration units. Revision of AD concerning quantities of biogas recovery. Revision of ASO, Tail Gas and Off Gas consumption in Refineries.
Spain	0	0.0	129	0.2	1A1c: Revision of natural gas consumption with the updated information provided by facilities of regasification and underground storage of natural gas.
Sweden	0	0.0	0	0.0	
UK	-1 030	-0.4	-463	-0.2	Updated emission factor for combustion at gas separation plant under 1A1c.
EU-15	**-1 616**	**-0.1**	**2 039**	**0.2**	

Table 3.3 provides information on the Member States' contribution to EU-15 recalculations in N_2O from 1A1 Energy Industries for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 3.3 1A1 Energy industries: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	10	9.4	Energy balance: Revision of CHP statistics and revised survey evaluation for gaseous fuels. New waste incineration plants included for other fuels. Energy balance: Revised fuel mix for liquid fuels.
Belgium	-25	-11.8	-20	-12.0	Reallocation of emissions from biomass to 6C1 (Walloon region). Reallocation of emissions from other fuels to 6C2 (Walloon region).
Denmark	-1	-0.8	1	0.8	Revision of energy balance
Finland	0	0.0	3	0.8	Corrections in combustion tecnology. Corrections in activity data.
France	0	0.0	2	0.3	Update AD for waste incineration
Germany	-45	-1.0	-884	-23.7	Revision of N2O emission factors as a result of a research project. Final data available from the national energy balance.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	3	0.7	Addition of bioliquid fuel consumption.
Luxembourg	0	0.0	-0.1	-3.7	Revision of the final consumption (2000-2010) of liquid fuels. For some categories, also the years 1990-2000 were affected, due to calculation methodology to split general IEA AD between Gasoil (heating) and diesel (Transport). Revision of the final consumption of gaseous fuels. (2000-2010, between 686 TJ and 1868 TJ). Revised activity data for biomass due to revised energy balance by national statistics.
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	1.8	1.5	Quantities of MSW incinerated with energy recovery for 2007-2010 have been corrected: an error was found on the sum of quantities for one of the incineration units. Revision of AD concerning quantities of biogas recovery. Revision of ASO, Tail Gas and Off Gas consumption in Refineries.
Spain	-1	-0.4	4	0.7	The consumption of biogas burnt in biomethanation plants with energy recovery (stationary engines and boilers) has been revised, after it was detected the incorrect input of this consumption in the database. The information regarding the fuel consumption of low-power electricity generation plants operating under the ordinary regime has been revised in accordance with the data appearing in Annex V of the Statistics on Electrical Power (prepared by the Ministry of Industry, Tourism and Trade, MINETUR), which were not available at the time of the previous edition of the inventory.
Sweden	0	0.0	0	0.0	
UK	-1	-0.1	-7	-0.5	Updated emission factor for combustion at gas separation plant under 1A1c.
EU-15	**-73**	**-0.8**	**-886**	**-10.0**	

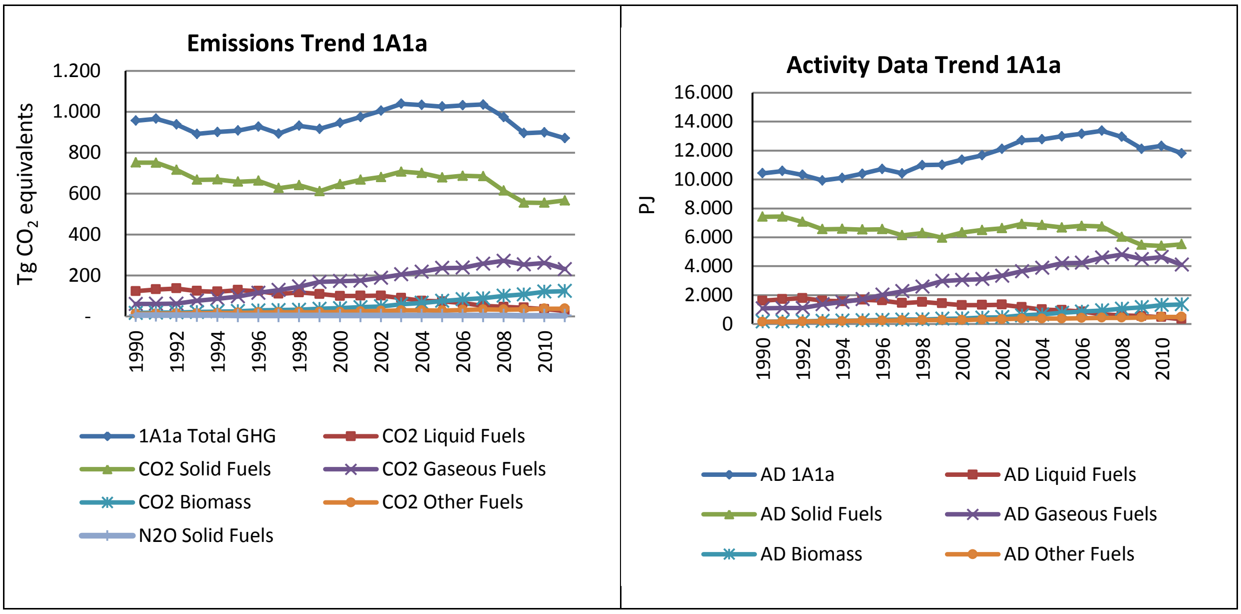
3.2.1.1 *Public Electricity and Heat Production (1A1a) (EU-15)*

According to the IPCC, emissions from public electricity and heat production (CRF 1A1a) should include emissions from main activity producers of electricity generation, combined heat and power generation, and heat plants. Main activity producers (i.e. public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included. Emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) should be assigned to the sector where they were generated and not under 1A1a. Autoproducers may be in public or private ownership.

CO_2 emissions from electricity and heat production is the largest key category in the EU-15 accounting for 24 % of total greenhouse gas emissions in 2011 and for 83 % of greenhouse gas emissions of the Energy Industries Sector. Between 1990 and 2011, CO_2 emissions from electricity and heat production decreased by 9 % in the EU-15.

Figure 3.6 (left) shows the trends in emissions originating from the production of public electricity and heat by fuel in the EU-15 between 1990 and 2011. Figure 3.6 (right) shows the activity data behind the emissions[23].

Figure 3.6 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

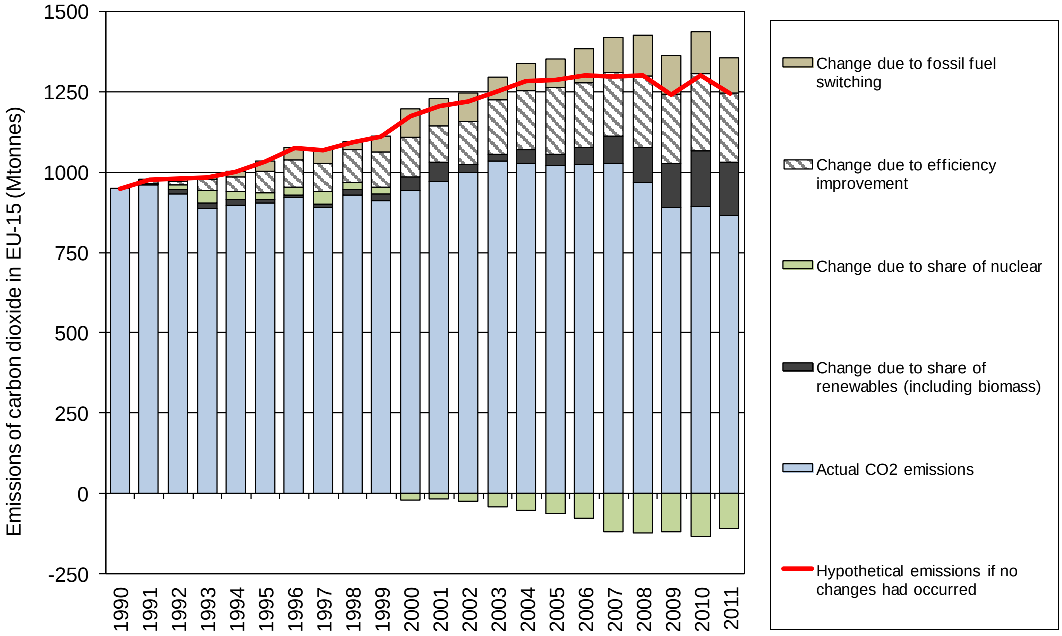


Fuel used for public electricity and heat production increased by 13 % in the EU-15 between 1990 and 2011. Solid fuels still represent almost half of the fuel used in public conventional thermal power plants, although its combustion has been declining (-26 %). Gas has increased very rapidly, by a factor of 3 between 1990 and 2011, and its share stands at 35 % of all the fuel used for the production of heat and electricity in the EU-15. Liquid fuels still account for some 3 % but its use has declined gradually during the past 20 years. The use of biomass has increased even more rapidly than the use of gas, but its share in the fuel mix is relatively small, at around 12 %.

CO_2 emissions from public electricity and heat production did not increase in line with fuel consumption. There are several reasons for this. Figure 3.7 below shows the estimated impact of different factors on the reduction of CO_2 emissions from public heat and electricity generation in the EU-15 between 1990 and 2011. The main explanatory factors at the EU-15 level during the past 21 years have been improvements in energy efficiency and (fossil) fuel switching from coal to gas.

[23] CO_2 emissions from the combustion of biomass fuels are reported as a memo item and are therefore not included in the emissions from public electricity and heat production. The biomass used as a fuel is however included in the national energy consumption (i.e. activity data). The fact that CO_2 emissions from biomass are treated differently from other fuel emissions does not imply emissions from the production of heat and electricity are due to fossil fuel combustion only. Biomass CO_2 emissions are just reported elsewhere. Non-CO_2 emissions from the combustion of biomass (CH_4 and N_2O) are reported under the energy sector.

Figure 3.7 **Estimated impact of different factors on the reduction in emissions of CO_2 from public electricity and heat production in the EU-15 between 1990 and 2011.**



Note: *The chart shows the estimated contributions of the various factors that have affected emissions from public electricity and heat production (including public thermal power stations, nuclear power stations, hydro power plants and wind plants). The top line represents the hypothetical development of emissions that would have occurred due to increasing public heat and electricity production between 1990 and 2011, if the structure of electricity and heat production had remained unchanged since 1990, i.e. if the shares of input fuels used to produce electricity and heat had remained constant, and if the efficiency of electricity and heat production also stayed the same. However, there were a number of changes that tended to reduce emissions. The contribution of each of these changes to reducing emissions is shown by each of the bars. The cumulative effect of all these changes was that emissions from electricity and heat production actually followed the trend shown by the blue bars. This is a frequently used approach for portraying the primary driving forces of emissions. It is based on the IPAT and Kaya identities. The explanatory factors should not be seen as fundamental factors in themselves nor should they be seen as independent from each other. The underpinning energy data is based on Eurostat's energy balances.*

Based on the chart above, CO_2 emissions from public heat and electricity production decreased by 9 % during 1990-2011 (blue bar), but emissions would have risen by over 31 %, had the shares of input fuels used to produce electricity and heat and the efficiency remained constant, an increase which would be in line with the additional amount of electricity and heat produced (37 %). The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2011 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2011, there was an 18 % reduction in the fossil-fuel input per unit of electricity produced from fossil fuels.
- Changes in the fossil fuel mix used to produce electricity, i.e. fuel switching from coal and lignite to natural gas. There was an 11 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2011.
- The higher combined share of nuclear and renewable energy for electricity and heat production in 2011 compared to 1990[24]. During 1990-2011, the share of electricity from fossil fuels in total electricity production decreased by 5 %.

[24] The specific nuclear effect can be separated from the renewable effect in an additive way. These two factors will then be additive to each other and the combined renewable and nuclear effect will remain multiplicative to the already-mentioned fuel-switching and efficiency factors.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.31 (increase in electricity and heat production) X 0.82 (efficiency improvement) X 0.89 (fossil fuel switching) X 0.95 (lower nuclear-renewable share) = 0.91. The combined effect was a decrease of 9 % in CO_2 emissions in 2011 compared to the 1990 level.

Returning to the 2013 inventory, Table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in six Member States and fell in nine. Of the six countries where emissions were higher in 2011 than in 1990, more than 80% of the increase was accounted for by the Netherlands, Greece and Spain. Of the nine countries, where emissions fell, 81% of the total reduction was accounted for by the UK (48%), Germany (20%) and Italy (13%). The change in the EU-15 between 1990 and 2011 was a net decrease of 88 Tg.

Table 3.4 1A1a Public Electricity and Heat Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	10 888	10 884	10 492	1.2%	-392	-4%	-396	-4%
Belgium	23 467	21 277	17 350	2.0%	-3 927	-18%	-6 117	-26%
Denmark	24 695	21 250	17 369	2.0%	-3 881	-18%	-7 326	-30%
Finland	16 450	27 220	21 251	2.5%	-5 968	-22%	4 801	29%
France	46 809	45 885	37 772	4.4%	-8 113	-18%	-9 037	-19%
Germany	339 018	316 843	314 160	36.5%	-2 684	-1%	-24 858	-7%
Greece	40 582	48 319	50 460	5.9%	2 141	4%	9 877	24%
Ireland	10 876	12 745	11 420	1.3%	-1 325	-10%	544	5%
Italy	107 136	92 792	91 400	10.6%	-1 391	-1%	-15 735	-15%
Luxembourg	33	1 203	991	0.1%	-212	-18%	958	2876%
Netherlands	39 932	54 557	50 514	5.9%	-4 043	-7%	10 581	26%
Portugal	14 319	12 120	14 257	1.7%	2 138	18%	-61	0%
Spain	64 331	58 891	72 270	8.4%	13 380	23%	7 939	12%
Sweden	7 718	10 013	7 756	0.9%	-2 257	-23%	38	0%
United Kingdom	203 096	156 430	144 058	16.7%	-12 372	-8%	-59 038	-29%
EU-15	**949 351**	**890 428**	**861 521**	**100.0%**	**-28 908**	**-3%**	**-87 830**	**-9%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Note that German CO_2 emissions from SO_2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

Figure 3.8 shows the relative contributions of greenhouse gas emissions from public electricity and heat production in each Member State, ranging from relatively low shares in France and Luxembourg to relatively high in Finland, Greece, Denmark, and Germany. Figure 3.9 shows the absolute contributions to EU-15 CO_2 emissions from this source category, dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from public electricity and heat production.

Figure 3.8 Share of CO_2 emissions from public electricity and heat production in total greenhouse gas emissions by Member State in 2011

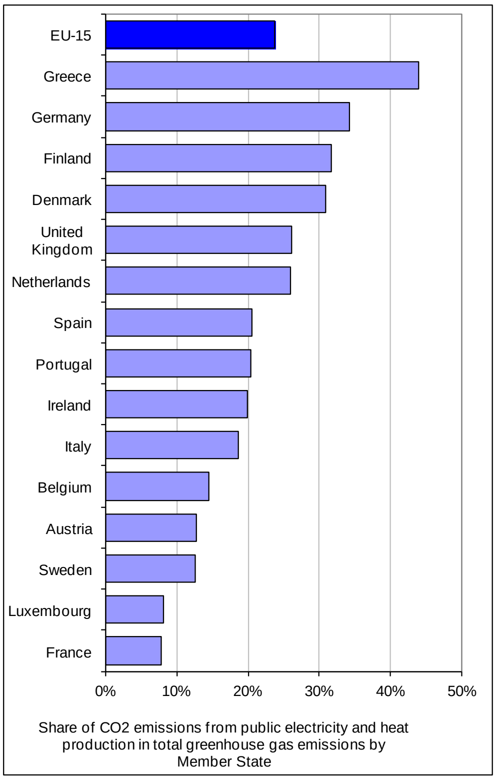
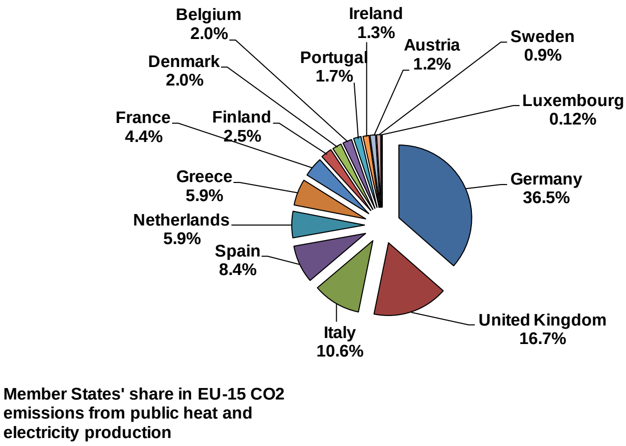


Figure 3.9 Member States' share of CO_2 emissions from public heat and electricity production in EU-15



Finally, N_2O emissions currently represent 0.8 % of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2011, emissions decreased by 9 % (Table 3.5). Emissions from this source category only declined in the United Kingdom, Germany and Italy. The biggest increases occurred in Spain and Finland.

Table 3.5 1A1a Public Electricity and Heat Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	41	116	113	1.7%	-3	-3%	72	174%
Belgium	51	74	78	1.2%	4	5%	27	52%
Denmark	78	99	87	1.3%	-12	-12%	9	11%
Finland	104	334	307	4.7%	-26	-8%	203	195%
France	460	582	497	7.6%	-86	-15%	37	8%
Germany	3 569	2 612	2 632	40.2%	20	1%	-937	-26%
Greece	147	160	163	2.5%	3	2%	16	11%
Ireland	74	151	138	2.1%	-13	-9%	64	87%
Italy	326	277	315	4.8%	39	14%	-11	-3%
Luxembourg	2	2	3	0.0%	0	1%	1	68%
Netherlands	131	246	242	3.7%	-4	-2%	112	85%
Portugal	52	108	120	1.8%	12	11%	68	133%
Spain	197	492	500	7.6%	7	1%	302	153%
Sweden	304	502	423	6.5%	-79	-16%	119	39%
United Kingdom	1 669	925	929	14.2%	3	0%	-741	-44%
EU-15	**7 205**	**6 682**	**6 546**	**100.0%**	**-136**	**-2%**	**-659**	**-9%**

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1A1a Electricity and Heat Production - Liquid Fuels (CO_2)

CO_2 emissions arising from the combustion of liquid fuels for public electricity and heat generation account for about 4 % of all greenhouse gas emissions from 1A1a. Within the EU-15, emissions fell by 79 % between 1990 and 2011 (Table 3.6).

Table 3.6 1A1a Public Electricity and Heat Production, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 229	774	335	1%	-440	-57%	-894	-73%	T2	CS,PS
Belgium	659	192	90	0%	-101	-53%	-569	-86%	CS,T1,T3	CS,D
Denmark	951	789	389	1%	-400	-51%	-562	-59%	CR	CS,D,PS
Finland	1 244	1 125	725	3%	-400	-36%	-518	-42%	T3	CS,D,PS
France	7 875	6 985	4 781	18%	-2 204	-32%	-3 094	-39%	T2, T3	CS
Germany	8 507	3 015	2 457	9%	-558	-19%	-6 050	-71%	CS	CS
Greece	5 375	3 995	3 779	15%	-215	-5%	-1 595	-30%	T2	PS
Ireland	1 087	424	158	1%	-266	-63%	-928	-85%	T3	PS
Italy	63 047	4 042	1 615	6%	-2 427	-60%	-61 432	-97%	T3	CS
Luxembourg	NO	2	2	0%	0	2%	2	-	T2	CS
Netherlands	207	705	909	3%	204	29%	702	339%	T2	CS
Portugal	6 405	1 038	907	3%	-130	-13%	-5 498	-86%	T2	D, CR, PS
Spain	6 007	8 497	7 540	29%	-957	-11%	1 533	26%	T2	CR, PS
Sweden	1 276	1 915	851	3%	-1 064	-56%	-425	-33%	T2	CS
United Kingdom	19 716	2 484	1 444	6%	-1 039	-42%	-18 271	-93%	T2	CS
EU-15	**123 584**	**35 981**	**25 984**	**100%**	**-9 997**	**-28%**	**-97 600**	**-79%**		

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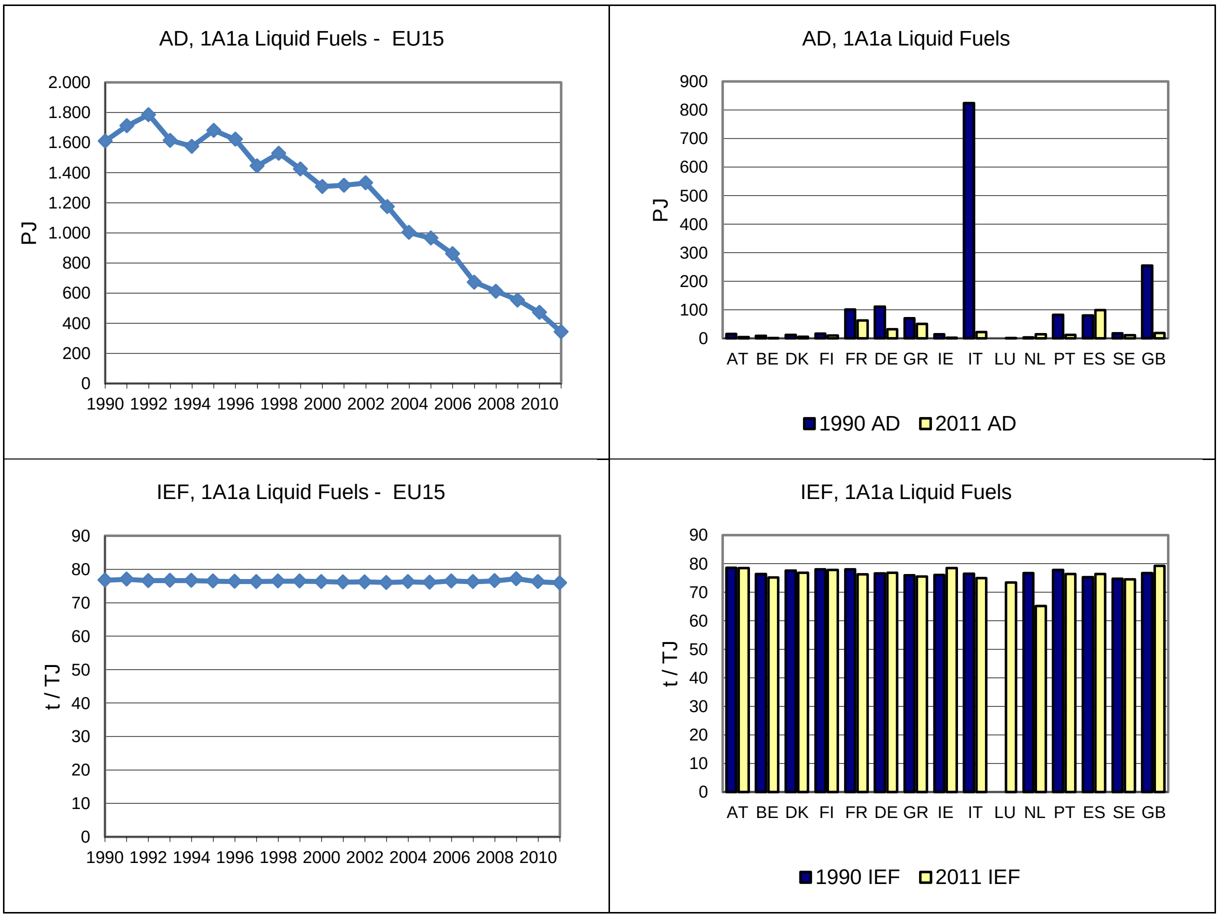
Figure 3.10 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels used in public electricity and heat production. The charts clearly show the importance of liquid fuels has been declining gradually since 1992. The implied emission factor has remained stable for the EU-15 (76 t/TJ in 2011). The largest emitters in 2011 were Spain, France and Greece together responsible for 62 % of the EU-15 emissions; emissions have fallen markedly in Italy compared to 1990.

In the Netherlands, the IEF declined from 71 t/TJ in 1994 to about 60 t/TJ in 1995 and the years thereafter. This is explained by the sharp increase in the use of residual chemical gas. In the Netherlands in this sector, among others, residual gases from the chemical industry are combusted. The implied emission factor is low because these residual gases contain hydrogen gas.

Figure 3.10 **1A1a-Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A1a Electricity and Heat Production - Solid Fuels (CO_2, N_2O)

CO_2 emissions from the combustion of solid fuels represented about two thirds of all greenhouse gas emissions from public electricity and heat production. Within the EU-15, emissions fell by 25 % between 1990 and 2011 (Table 3.7).

Table 3.7 1A1a Public Electricity and Heat Production, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	6 247	3 870	4 252	4.7%	382	10%	-1 995	-32%	T2	CS,PS
Belgium	19 345	7 138	5 916	1.0%	-1 222	-17%	-13 429	-69%	CS,T1,T3	CS,D
Denmark	22 225	14 755	12 308	2.2%	-2 447	-17%	-9 918	-45%	CR	CS,D,PS
Finland	9 281	12 872	9 144	1.6%	-3 728	-29%	-137	-1%	T3	CS,D,PS
France	36 159	24 188	17 962	3.2%	-6 226	-26%	-18 197	-50%	T2, T3	CS
Germany	307 928	261 888	262 533	46.3%	645	0%	-45 395	-15%	CS	CS
Greece	35 207	39 680	40 706	7.2%	1 026	3%	5 499	16%	T2	CS
Ireland	7 909	5 688	5 857	1.0%	169	3%	-2 052	-26%	T3	PS
Italy	28 148	34 626	38 284	6.8%	3 657	11%	10 136	36%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	25 776	24 098	23 333	4.1%	-764	-3%	-2 442	-9%	T2	CS
Portugal	7 913	6 002	8 341	1.5%	2 339	39%	428	5%	T2	D, CR, PS
Spain	57 778	25 536	43 648	7.7%	18 111	71%	-14 130	-24%	T2	PS
Sweden	5 404	4 725	4 126	0.7%	-599	-13%	-1 278	-24%	T2	CS
United Kingdom	183 150	89 832	90 578	16.0%	746	1%	-92 572	-51%	T2	CS
EU-15	**752 470**	**554 898**	**566 986**	**100.0%**	**12 088**	**2%**	**-185 484**	**-25%**		

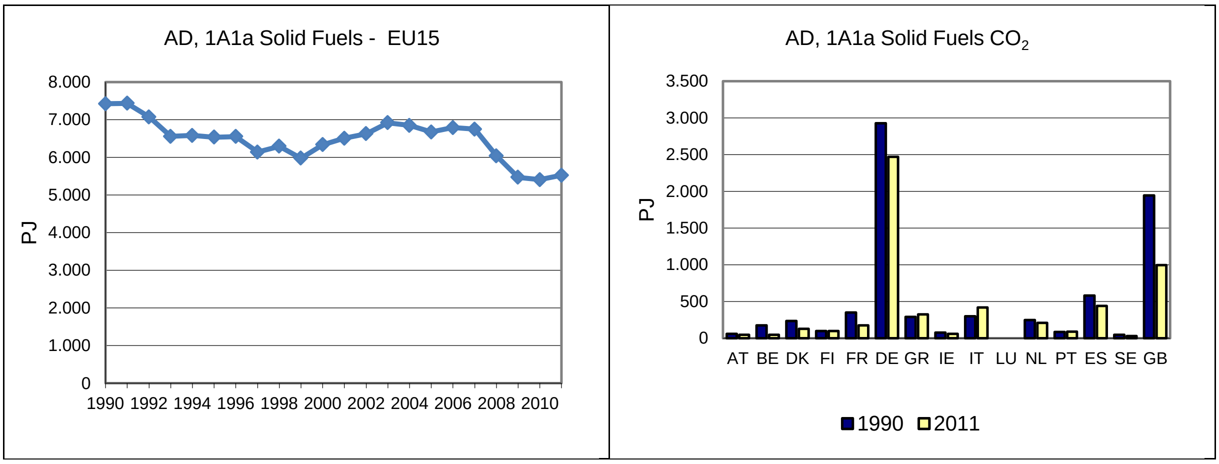
Note that German CO_2 emissions from SO_2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

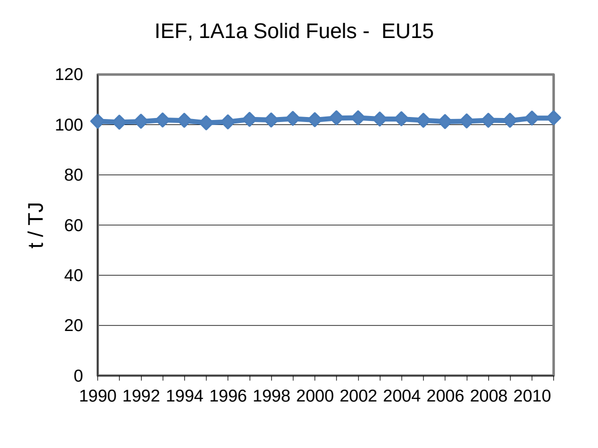
Abbreviations explained in the Chapter 'Units and abbreviations'.

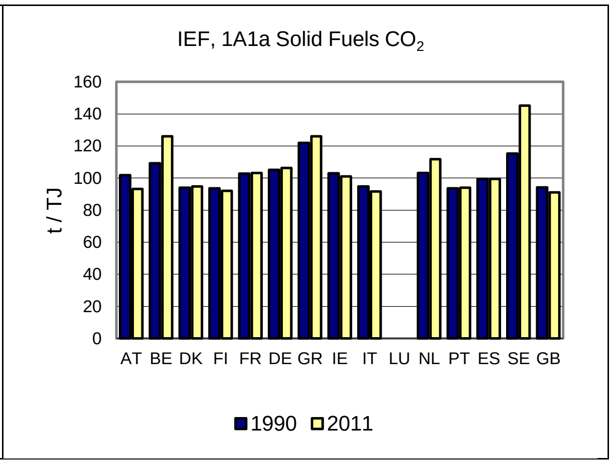
Figure 3.11 shows the relevant activity data and implied emission factors for solid fuels. The amount of solid fuels used decreased gradually until 1999 and has increased again until 2003. In 2003 the upwards trend in solid fuel use in public electricity and heat production has stopped; the trend reversed in 2007. However, in 2010 and 2011 the trend has changed again and coal consumption stayed at the level of 2009. Between 1990 and 2011 coal consumption decreased by 26%, mainly due to decreases in the UK, Germany, France and Spain. The EU-15 implied emission factor has remained fairly stable (103 t/TJ in 2011). The largest emitters in 2011 were Germany and the UK, jointly responsible for 62 % of EU-15 emissions. In both countries, however, emissions have fallen compared to 1990, particularly in the UK where a large shift to gas use in electricity production occurred.

In Belgium and Sweden, the emission factors increased sharply since the late 1990s due to the use of blast furnace gas. The comparatively high IEF of Greece is due to the large importance of domestic lignite use for electricity production.

Figure 3.11 1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2







The related N_2O emissions from the use of solid fuels are responsible for 0.4 % of all greenhouse gas emissions in the heat and power sector. For the EU-15, emissions in 2011 decreased by 39 % between 1990 and 2011 (Table 3.8).

Table 3.8 1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions

Member State	N_2O emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	23	21	23	0.6%	2	10%	0	0%
Belgium	33	6	5	0.1%	-1	-18%	-28	-85%
Denmark	60	39	32	0.8%	-7	-18%	-28	-46%
Finland	43	68	50	1.3%	-18	-26%	8	18%
France	329	259	187	4.8%	-73	-28%	-142	-43%
Germany	3 431	1 970	2 000	51.2%	30	2%	-1 431	-42%
Greece	134	148	150	3.8%	2	2%	16	12%
Ireland	62	49	49	1.3%	0	-1%	-13	-21%
Italy	138	175	194	5.0%	19	11%	56	41%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	101	86	80	2.0%	-6	-7%	-21	-21%
Portugal	36	27	38	1.0%	11	39%	2	5%
Spain	146	194	229	5.9%	35	18%	83	57%
Sweden	232	100	82	2.1%	-19	-19%	-150	-65%
United Kingdom	1 610	785	791	20.2%	7	1%	-819	-51%
EU-15	**6 378**	**3 927**	**3 910**	**100.0%**	**-18**	**0%**	**-2 468**	**-39%**

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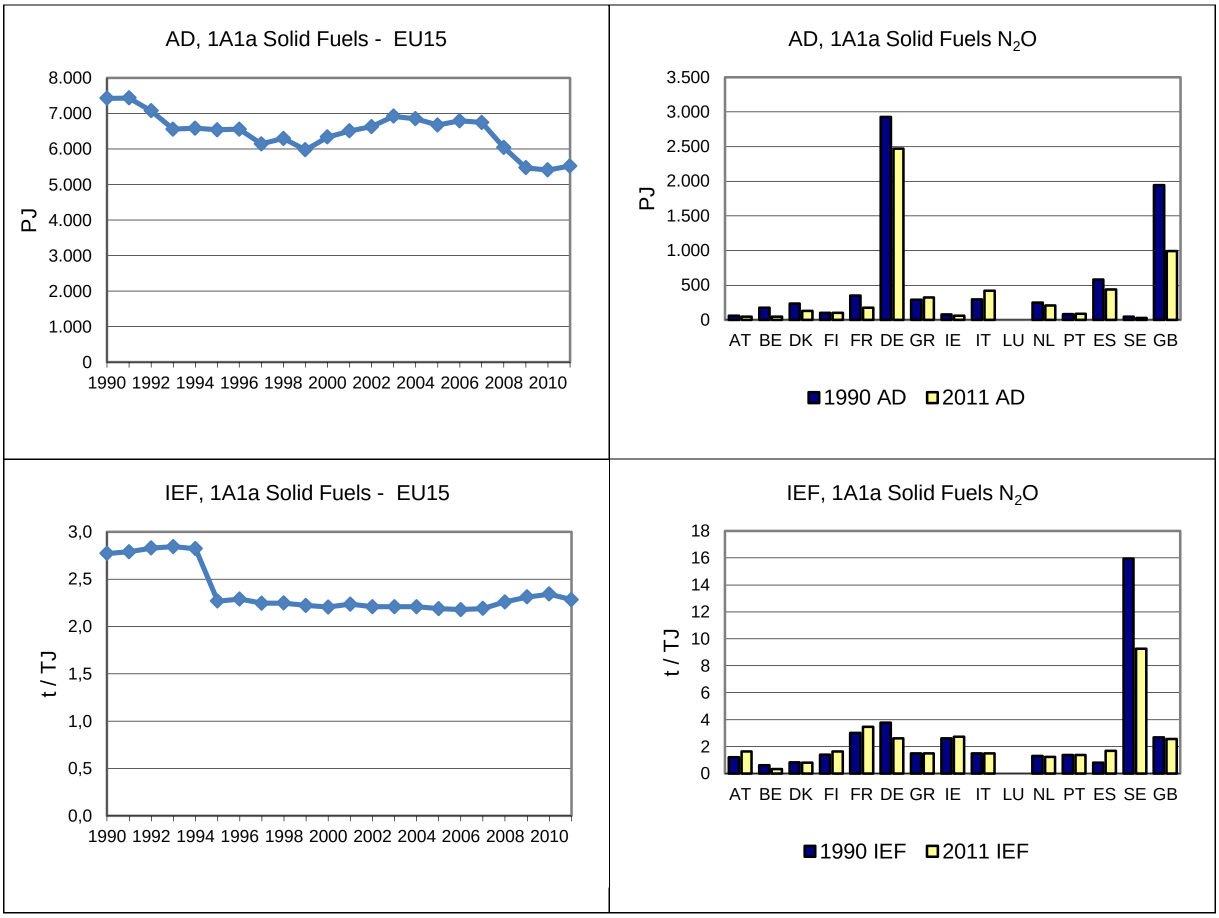
Figure 3.12 shows the related activity data and implied emission factors for N_2O. The EU-15 implied emission factor decreased from 2.8 kg/TJ in 1990 to 2.3 kg/TJ in 2011. The largest emitters in 2011 were Germany and the UK, accounting for 71 % of EU-15 emissions. The EU-15 IEF is dominated by the IEF of Germany. In its latest inventory submission Germany revised the IEF as a result of a research project. This led to a break in the time series for 1994/1995 for the following reasons: Since 1995 the German inventory is based on an estimation procedure for the entire national territory. For the years before 1995 the estimate is based on a two-territory approach for Eastern and Western Germany as result of the German reunification in 1990. Until autumn 1990 Germany was divided into two states with two different statistical systems. There was a transitional period until 1994 with two different statistics in Eastern and Western Germany. The results of the research project cannot be applied to the two different approaches for these years. The integration of N_2O measurement data is always difficult, since N_2O emissions depend on combustion technology and fuel and not on the sector. Great efforts have been made to provide a well documented data set for the base year 1990.

However, it is not possible to do the same work for the years 1991 to 1994 in order to avoid a break in time series.

Sweden has the highest IEF (about 9 kg/TJ in 2011); it declined gradually between 1990 and 2011. This was due to the increased use of blast furnace gas and a lower use of coal. Since the IEF for coal is ten times higher than the IEF for blast furnace gas, the IEF for solid fuels declined overall during the period. This comparatively high implied emission factor is regularly reviewed and found to be correct for Swedish conditions.

Figure 3.12 1A1a Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for N_2O



1A1a Electricity and Heat Production - Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels accounted for 26 % of all greenhouse gas emissions from public electricity and heat generation in 2011. Emissions increased by a factor of three in the EU-15 between 1990 and 2011 (Table 3.9). In all EU-15 Member States the consumption of gas was higher in 2011 than in 1990.

Table 3.9 1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3 294	5 251	4 799	2.1%	-452	-9%	1 505	46%	T2	CS
Belgium	2 751	12 339	9 701	4.2%	-2 638	-21%	6 950	253%	CS,T1,T3	CS,D
Denmark	980	4 375	3 328	1.4%	-1 048	-24%	2 348	240%	CR	CS
Finland	1 976	4 797	3 926	1.7%	-871	-18%	1 950	99%	T3	CS
France	983	9 311	9 541	4.1%	230	2%	8 558	871%	T2, T3	CS
Germany	18 462	38 720	35 949	15.6%	-2 771	-7%	17 487	95%	CS	CS
Greece	NO	4 644	5 974	2.6%	1 330	29%	5974	-	T2	PS
Ireland	1 881	6 633	5 388	2.3%	-1 245	-19%	3 508	187%	T3	PS
Italy	15 787	53 848	51 219	22.2%	-2 630	-5%	35 431	224%	T3	CS
Luxembourg	NO	1 139	923	0.4%	-216	-19%	923	-	T2	CS
Netherlands	13 348	27 281	23 701	10.3%	-3 579	-13%	10 353	78%	T2	CS
Portugal	NO	4 704	4 628	2.0%	-76	-2%	4 628	-	T2	D, CR, PS
Spain	437	23 922	20 111	8.7%	-3 810	-16%	19 674	4501%	T2	CS, PS
Sweden	486	1 930	1 287	0.6%	-643	-33%	801	165%	T2	CS
United Kingdom	16	62 485	50 256	21.8%	-12 229	-20%	50 240	315116%	T2	CS
EU-15	**60 401**	**261 378**	**230 731**	**100.0%**	**-30 647**	**-12%**	**170 330**	**282%**		

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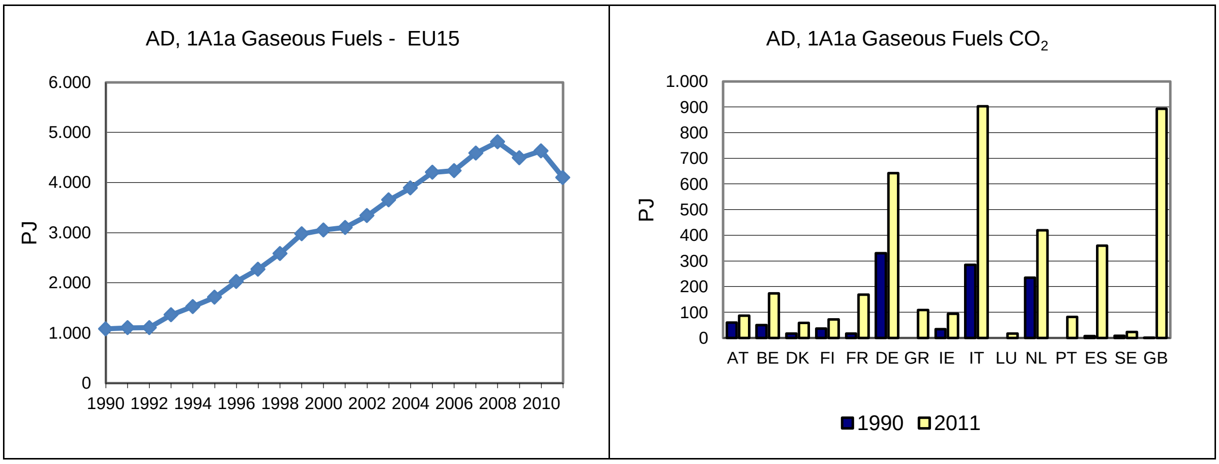
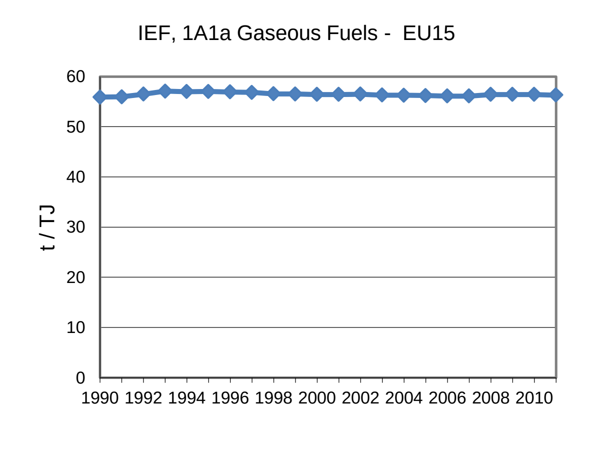
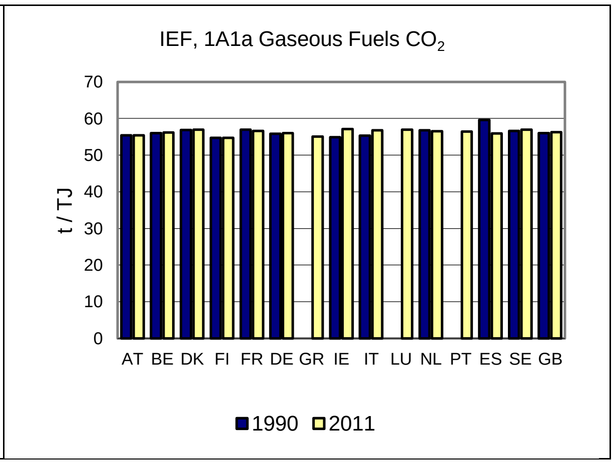
Figure 3.12 shows the activity data and implied CO_2 emission factors from gaseous fuels. Gas use in the power generating sector increased strongly after 1992. The EU-15 implied emission factor has remained fairly stable (56 t/TJ in 2011). The increase in the EU-15 factor observed in the early 1990s can be explained by the higher UK's gas share in the EU-15 and by an increase in the UK's implied emission factor. The latter is the result of the commissioning of the Peterhead power station in Scotland, which uses sour gas, a fuel with a much higher factor than natural gas. The largest emitters in 2011 were the UK and Italy, jointly responsible for 44 % of EU-15 emissions.

Figure 3.13 1A1a-Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2







1A1a Electricity and Heat Production - Other Fuels (CO_2)

In 2011, the share of CO_2 emissions from other fuels stood at about 4 % of total greenhouse gas emissions from public electricity and heat generation. Emissions increased by 193% at EU-15 level between 1990 and 2011 and increased in all countries where 'other fuels' are used in heat and power generation. Other fuels cover the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.10).

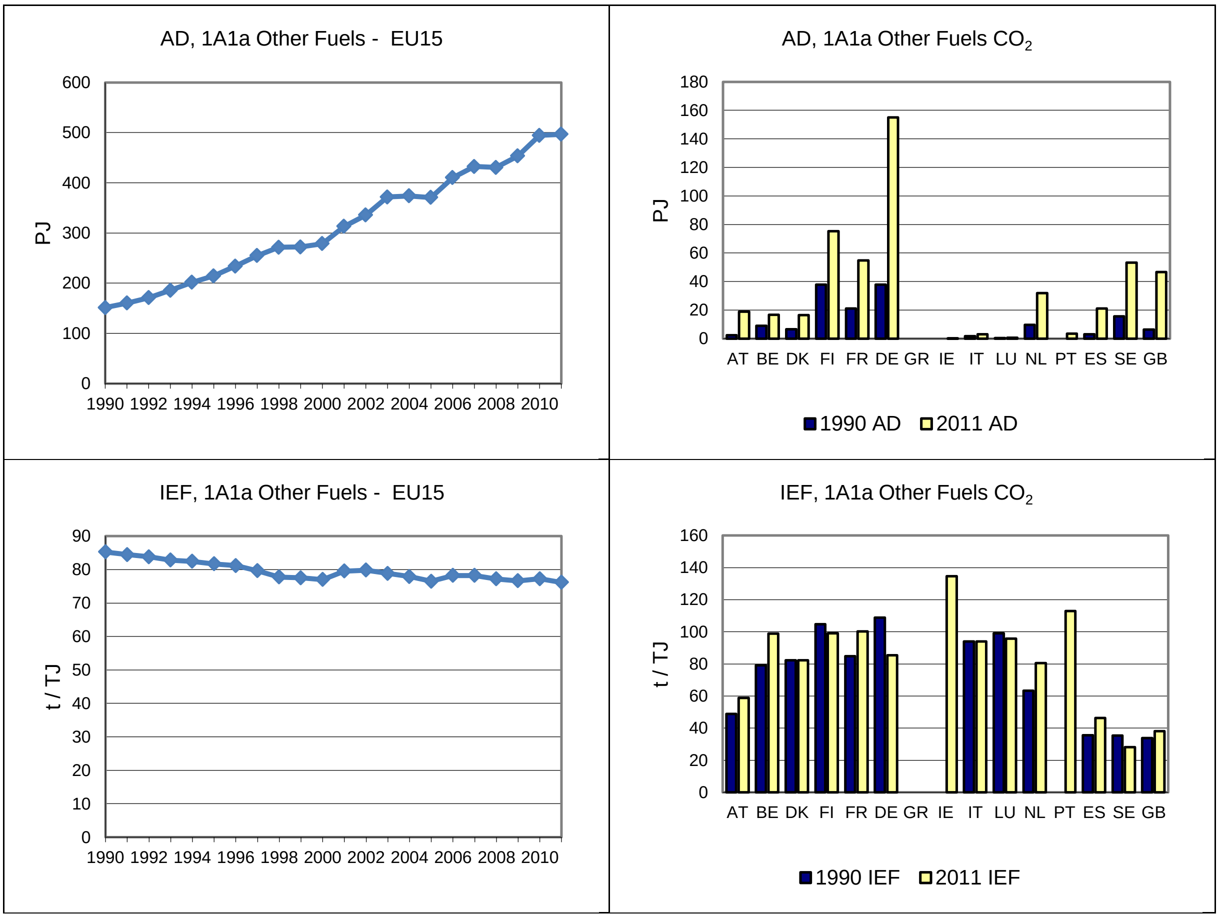
Table 3.10 1A1a Public Electricity and Heat Production, other fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	118	989	1 107	2.9%	118	12%	989	838%	T2	CS,PS
Belgium	712	1 608	1 643	4.3%	34	2%	931	131%	CS,T1,T3	CS,D
Denmark	539	1 331	1 345	3.6%	14	1%	806	150%	CR	CS
Finland	3 950	8 425	7 456	19.7%	-969	-12%	3 506	89%	T3	CS
France	1 792	5 401	5 488	14.5%	87	2%	3 696	206%	T2, T3	CS
Germany	4 121	13 221	13 222	35.0%	0	0%	9 101	221%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	16	0.0%	16	-	16	-	T2	PS
Italy	153	275	283	0.7%	8	3%	130	85%	T3	CS
Luxembourg	33	62	65	0.2%	3	5%	32	96%	T2	D
Netherlands	601	2 473	2 570	6.8%	97	4%	1 969	327%	T2	CS
Portugal	NO	376	381	1.0%	6	2%	381	-	T2	D, CR, PS
Spain	110	936	972	2.6%	36	4%	862	783%	T2	CR, CS, PS
Sweden	553	1 443	1 492	3.9%	49	3%	940	170%	T2	CS
United Kingdom	215	1 630	1 780	4.7%	150	9%	1 566	729%	OTH,T1	CS
EU-15	**12 897**	**38 172**	**37 820**	**100.0%**	**-351**	**-1%**	**24 924**	**193%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the activity data and implied emission factors. The EU-15 implied emission factor has fallen gradually since 1990, standing at 76 t/TJ in 2011. The largest emitters in 2011 were Germany, Finland and France, which together accounted for 69 % of EU-15 emissions.

Figure 3.14 **1A1a Public Electricity and Heat Production, other fuels: Activity Data and Implied Emission Factors for CO_2**



In Germany, the IEF declined continuously between 1990 and 2011 (from 109 to 85 t/TJ). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

Figure 3.14 also shows that the share of Finnish activity in the EU-15 is disproportionally high. This is due to the reporting of 'peat' under 'other fuels' instead of under 'solid fuels' as recommended by the revised 1996 IPCC Guidelines. This apparent misallocation is clearly explained and argued[25] and is consistent with national energy statistics as well as with the IPCC 2006 Guidelines.

In the Netherlands, the IEF increases considerably after 2003 to reach 80 t/TJ in 2011. This was mainly due to the increase in the share of plastics (with a high carbon fraction) in combustible.

Ireland reports for the first time in 2011, municipal solid waste (MSW) used in a waste to energy plant which was commissioned in 2011.

[25] There are several reasons for reporting peat separately from solid fuels in Finland. Solid fuels include hard coal, coke and other fuels derived from coal (BFG, coke oven gas). The origin of these fuels is totally from imported sources, whereas peat is totally a domestic energy source. This categorization follows the practice used in national energy statistics as well as in the IPCC 2006 Guidelines. Moreover, the CO2 IEF of peat is higher than the IEF of hard coal. Combining both fuels would cause significant variation in the IEF of solid fuels. Finally, other properties of peat and hard coal are very different, and would justify the reporting under two different fuel categories. See also the 2008 Finnish NIR to the UNFCCC.

3.2.1.2 *Petroleum Refining (1A1b) (EU-15)*

According to the IPCC, petroleum refining (CRF 1A1b) should include all combustion activities supporting the refining of petroleum products including on-site combustion for the generation of electricity and heat for own use. It does not include evaporative emissions occurring at the refinery. These emissions should be reported separately under 1B2a.

CO_2 emissions from petroleum refining is the ninth largest key category in the EU-15 accounting for 3.0 % of total greenhouse gas emissions in 2011. Between 1990 and 2011, EU-15 CO_2 emissions increased by 10 % (Table 3.11). Emissions in 2011 were above 1990 levels in all Member States, with the exception of the UK, the Netherlands, Belgium, France and Germany.

Table 3.11 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2 394	2 724	2 768	2.4%	44	2%	374	16%
Belgium	4 299	4 710	4 267	3.7%	-442	-9%	-32	-1%
Denmark	906	854	931	0.8%	77	9%	24	3%
Finland	2 260	2 650	2 755	2.4%	105	4%	495	22%
France	11 917	11 627	11 318	9.9%	-309	-3%	-598	-5%
Germany	20 006	19 094	18 380	16.1%	-714	-4%	-1 626	-8%
Greece	2 308	3 669	3 333	2.9%	-336	-9%	1 024	44%
Ireland	182	310	285	0.2%	-25	-8%	103	57%
Italy	16 337	28 035	26 885	23.5%	-1 150	-4%	10 548	65%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	11 041	9 637	9 920	8.7%	283	3%	-1 121	-10%
Portugal	1 867	2 302	2 128	1.9%	-175	-8%	261	14%
Spain	10 906	11 403	11 974	10.5%	571	5%	1 068	10%
Sweden	1 778	2 130	2 022	1.8%	-108	-5%	245	14%
United Kingdom	17 566	16 206	17 449	15.3%	1 243	8%	-118	-1%
EU-15	**103 768**	**115 352**	**114 415**	**100.0%**	**-937**	**-1%**	**10 648**	**10%**

Figure 3.15 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-15 between 1990 and 2011 and the activity data behind the emissions.

Fuel used for petroleum refining increased by 13 % in the EU-15 between 1990 and 2011. Liquid fuels represent 84 % of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part and their use has almost tripled since 1990. There remains a small amount of solid fuels used in petroleum refining in France (blast furnace gas) and Germany (lignite and coke oven gas).

Figure 3.15 **1A1b Petroleum Refining: Total and CO_2 emission trends**

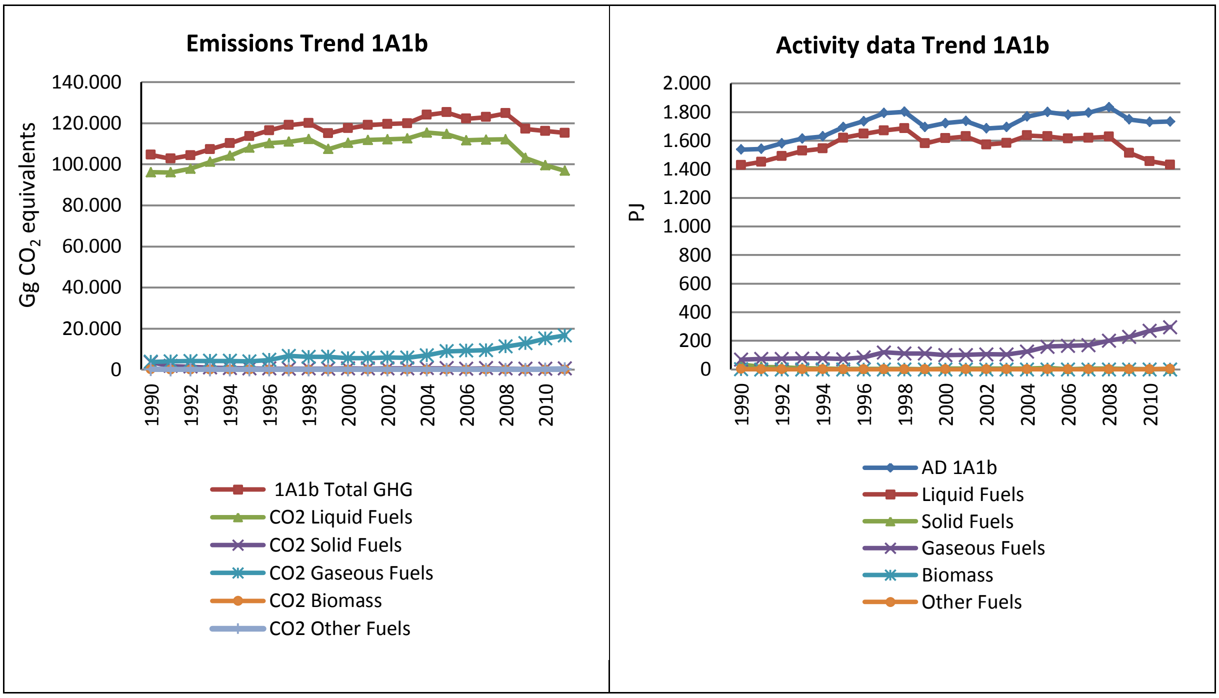


Figure 3.16 shows the relative importance of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State, ranging from the relatively low share in Ireland to relatively high shares in the Netherlands and Italy. Figure 3.17 shows the absolute contributions to EU-15 CO_2 emissions from petroleum refining. Italy was the largest EU-15 emitter in 2011, accounting for more than 20 % of all EU-15 emissions.

Figure 3.16 **Share of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State in 2011**

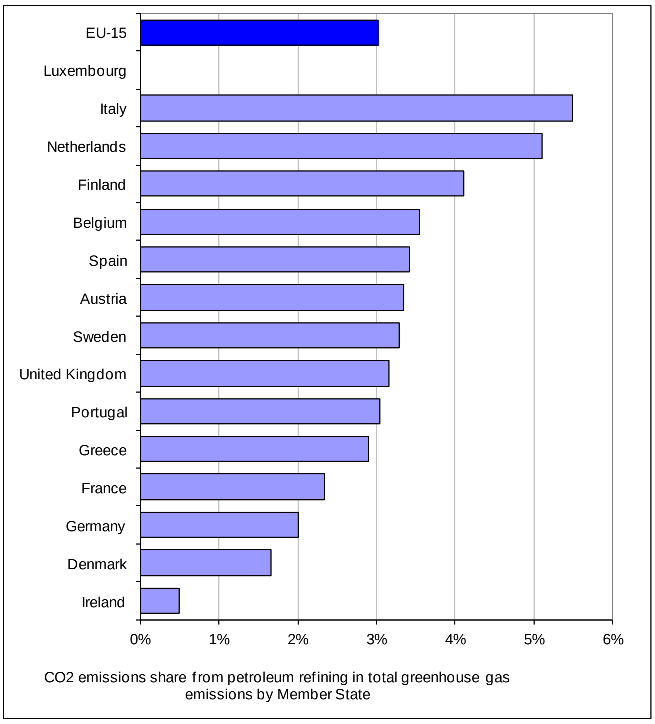
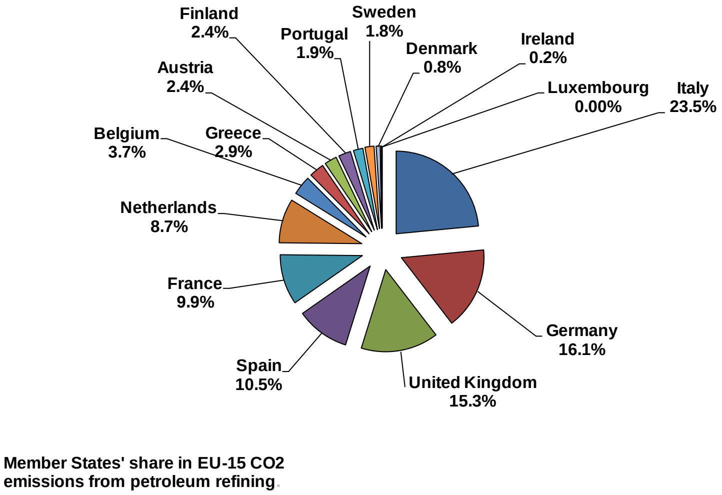


Figure 3.17 Member States' share of CO_2 emissions from petroleum refining in EU-15



1A1b Petroleum Refining - Liquid Fuels (CO_2)

CO_2 emissions from the combustion of liquid fuels used for petroleum refining accounted for 84 % of all greenhouse gas emissions from petroleum refining in 2011. Emissions increased by 1 % between 1990 and 2011 (Table 3.12). Italy had by far the largest emission increase between 1990 and 2011.

Table 3.12 1A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

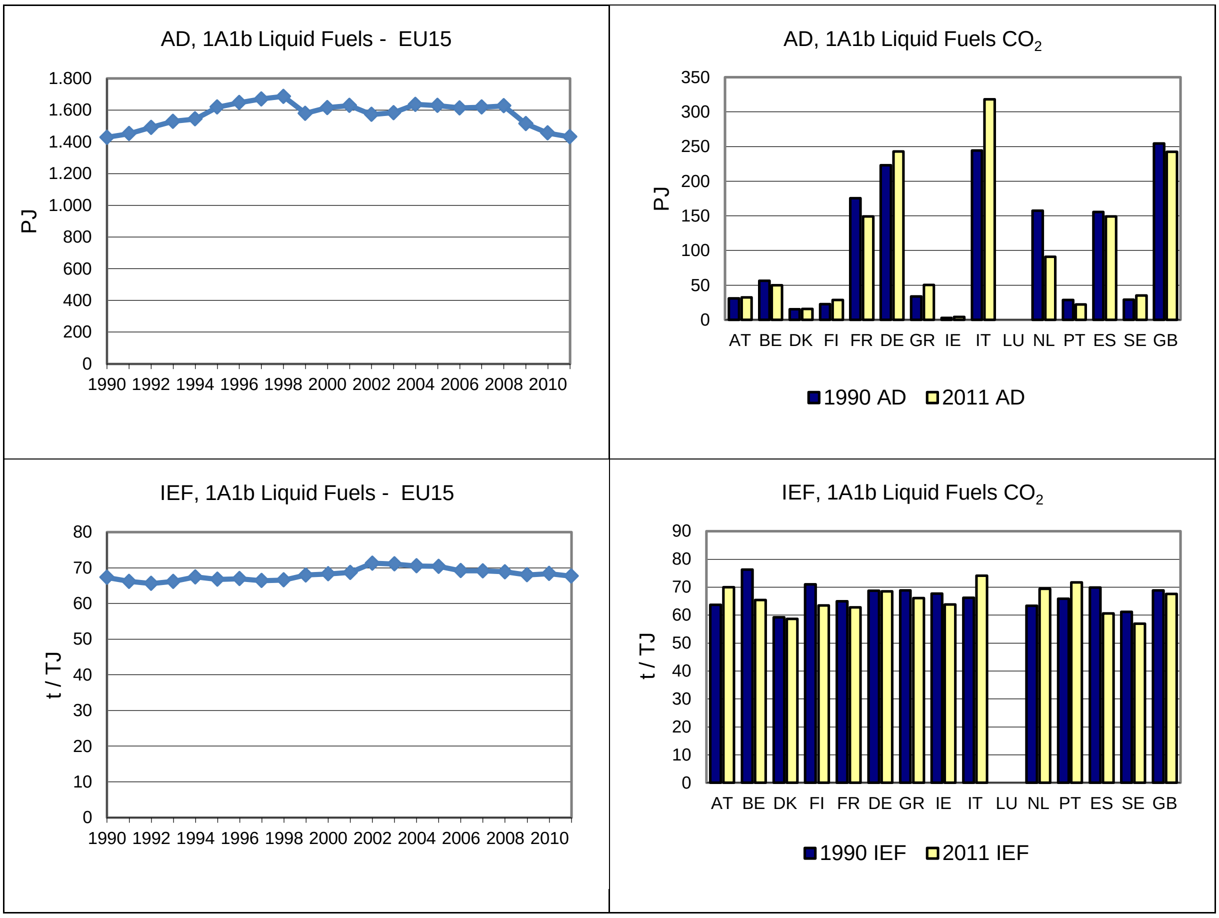
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 958	2 195	2 266	2.3%	71	3%	308	16%	T2	CS
Belgium	4 285	3 640	3 272	3.4%	-368	-10%	-1 013	-24%	CS,T3	PS
Denmark	906	854	931	1.0%	77	9%	24	3%	CR	CS,D,PS
Finland	1 603	1 725	1 810	1.9%	86	5%	207	13%	T3	CS,PS
France	11 393	9 861	9 365	9.7%	-496	-5%	-2 028	-18%	T2, T3	CS
Germany	15 315	17 397	16 669	17.2%	-729	-4%	1 354	9%	CS	CS
Greece	2 308	3 669	3 333	3.4%	-336	-9%	1 024	44%	T2	PS
Ireland	182	305	270	0.3%	-34	-11%	88	49%	T3	PS
Italy	16 178	25 123	23 606	24.4%	-1 517	-6%	7 429	46%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	9 999	6 575	6 320	6.5%	-255	-4%	-3 679	-37%	T2	CS
Portugal	1 867	1 734	1 595	1.6%	-139	-8%	-272	-15%	T2	D, CR, PS
Spain	10 861	9 250	9 027	9.3%	-223	-2%	-1 834	-17%	T2	CR, PS
Sweden	1 778	2 100	1 990	2.1%	-110	-5%	212	12%	T2	CS
United Kingdom	17 517	15 134	16 389	16.9%	1 255	8%	-1 128	-6%	T2	CS
EU-15	**96 150**	**99 563**	**96 843**	**100.0%**	**-2 720**	**-3%**	**693**	**1%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.18 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels. The use of liquid fuels increased rapidly from 1990 to 1998 and had a decreasing tendency thereafter, in particular after 2008. The EU-15 implied emission factor shows small variations between 66 t/TJ and 71 t/TJ. The increase in the EU-15 factor can be partly explained by the growing Italian share in EU-15 activity and emissions and by the increase in Italy's implied emission factor during the period. The largest emitters in 2011 were Italy and Germany, which together contributed 42 % of EU-15 emissions.

In general the fluctuating IEF is due to the annual variations of fuel consumption with different carbon content. In Italy the main fuel used are refinery gases, fuel oil and petroleum coke, which have very different emission factors, and every year their amount used changes resulting in an annual variation of the IEF. The increase in the last years with respect to the nineties of the consumption of fuels with higher carbon content, as petroleum coke and synthesis gas obtained from heavy residual fuels, explain the general growth of the Italian IEF for liquid fuel reported in the CRF for this sector.

Figure 3.18 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A1b Petroleum Refining - Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels in petroleum refining represented less than 1 % of all greenhouse gas emissions from 1A1b in 2011. There are only two countries reporting emissions in the EU-15 in 2011 (Germany and France). EU-15 emissions fell by 84 % on average between 1990 and 2011 (Table 3.13).

Table 3.13 1A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

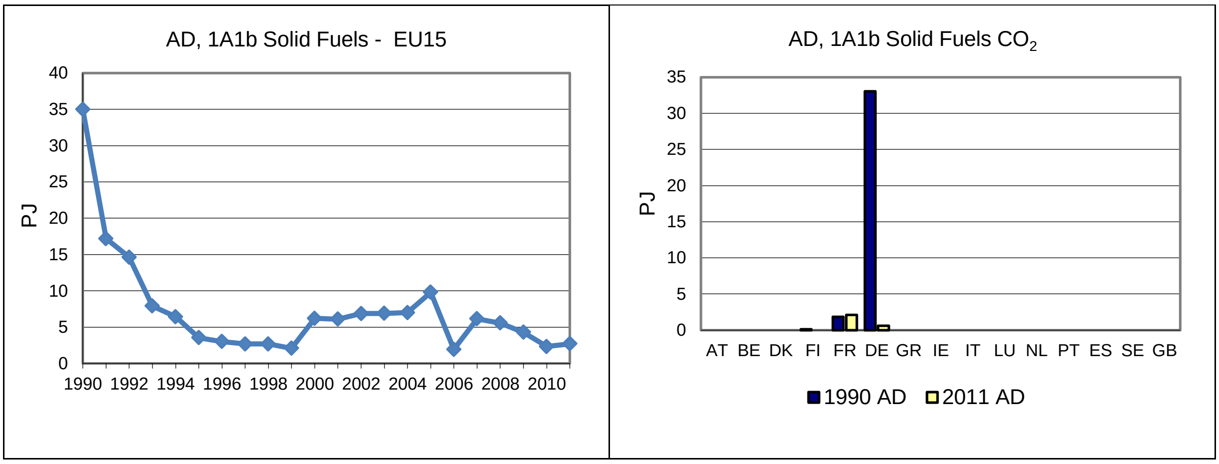
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	12	NO	NO	-	-	-	-12	-100%	NA	NA
France	487	392	551	95.9%	159	40%	64	13%	T2, T3	CS
Germany	3 076	34	24	4.1%	-10	-30%	-3 052	-99%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**3 575**	**426**	**575**	**100.0%**	**149**	**35%**	**-3 000**	**-84%**		

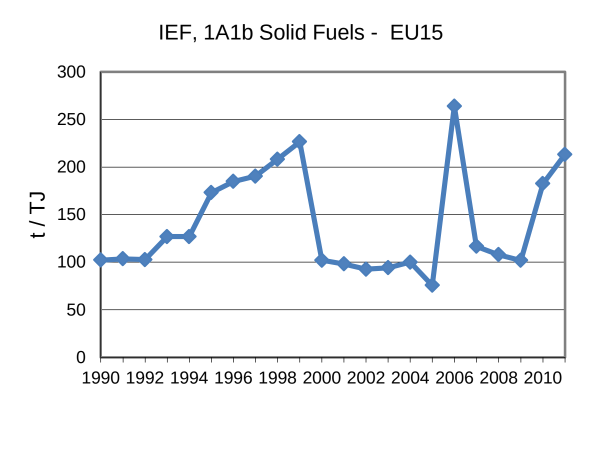
Abbreviations explained in the Chapter 'Units and abbreviations'.

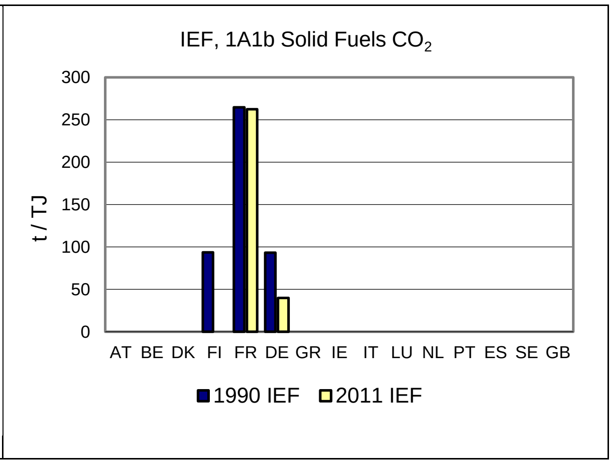
Figure 3.19 shows the relevant activity data and implied emission factors. The use of solid fuels in petroleum refining has declined markedly since 1990. The EU-15 implied emission factor showed strong fluctuations, and stood at 213 t/TJ in 2011. The variation in the EU-15 factor can be partly explained by the declining use of solid fuels in petroleum refining in Germany between 1990 and 1999. This explains the gradual increase of the EU-15 IEF up to 1999 through the growing weight of the much higher implied emission factor of France. The high emission factor in France is due to the use of blast furnace gas in the Dunkerque refinery. In Germany, there was a decline in the IEF in the early 1990s compared to a rather stable IEF since the mid-1990s. The reason is that the use of - mainly - lignite has constantly been reduced in favour of coke oven gas.

The increased EU-15 solid fuel combustion in 2000-2005 and 2007-2009 is due to an increase in fuel combustion in Germany in these years. The higher weight of the German IEF also explains the lower IEF at EU-15 level during these years. For 2006 Germany reports only negligible amounts of solid fuel use in petroleum refining. Therefore, the EU-15 IEF is almost entirely dominated by the French IEF in this year.

Figure 3.19 1A1b-Petroleum Refining, solid fuels: Activity Data and Implied Emission Factors for CO_2







1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2011, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 14 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-15 increased by a factor of three between 1990 and 2011 (Table 3.14). None of the EU-15 Member States reduced their emissions.

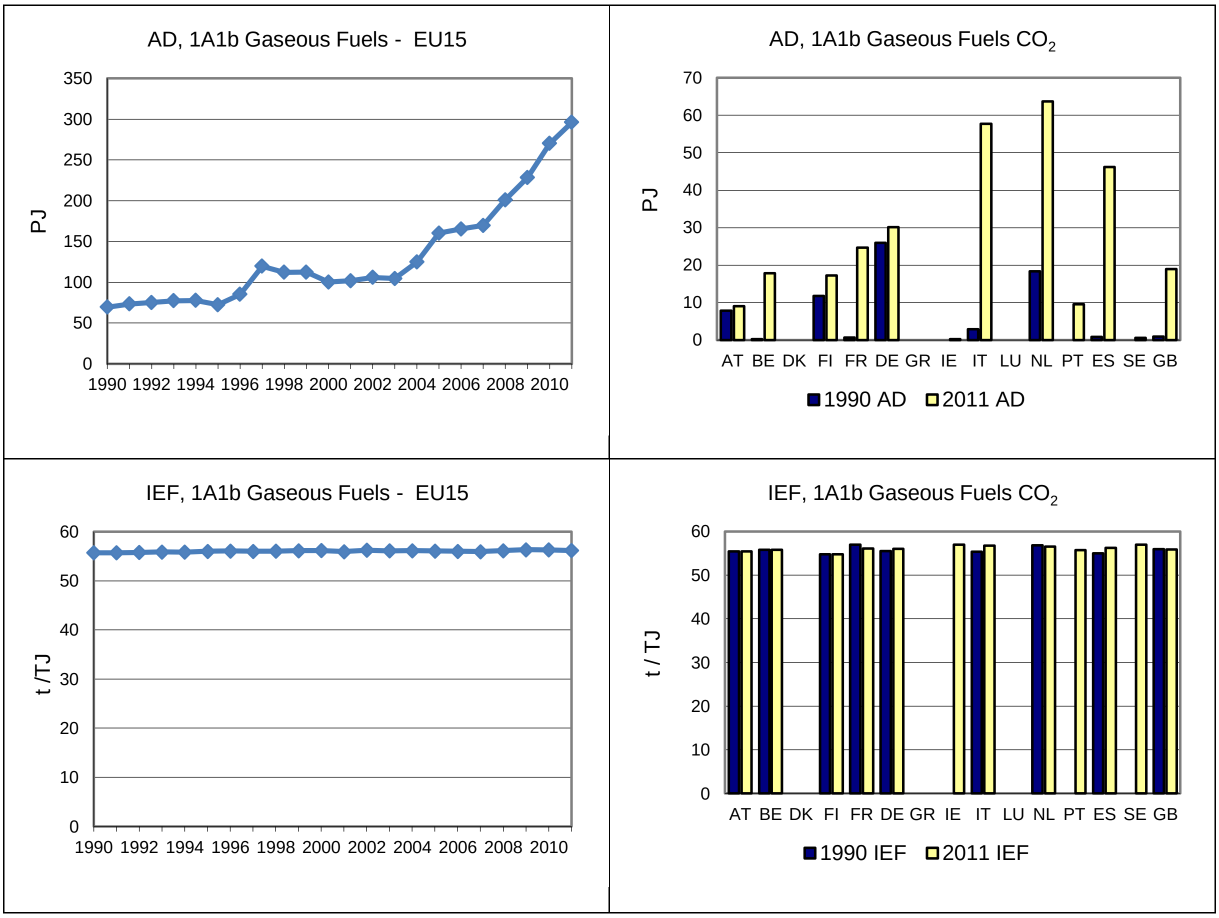
Table 3.14 1A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	437	530	502	3.0%	-28	-5%	65	15%	T2	PS
Belgium	14	1 070	995	6.0%	-74	-7%	982	7101%	CS,T3	PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	644	925	944	5.7%	19	2%	300	47%	T3	CS
France	37	1 356	1 384	8.3%	28	2%	1 347	3657%	T2, T3	CS
Germany	1 441	1 663	1 688	10.1%	25	2%	246	17%	CS	CS
Greece	NO	IE	IE	-	-	-	-	-	NA	NA
Ireland	NO	5	15	0.1%	9	179%	15	-	T3	PS
Italy	159	2 912	3 278	19.7%	367	13%	3 119	1958%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 042	3 062	3 600	21.6%	538	18%	2 558	245%	T2	CS
Portugal	NO	569	533	3.2%	-36	-	533	-	T2	D, CR, PS
Spain	45	2 017	2 598	15.6%	581	29%	2 553	5663%	T2	CS, PS
Sweden	NO	30	32	0.2%	2	7%	32	-	T2	CS
United Kingdom	49	1 072	1 060	6.4%	-12	-1%	1 010	2044%	T2	CS
EU-15	**3 869**	**15 210**	**16 631**	**100.0%**	**1 421**	**9%**	**12 762**	**330%**		

Abbreviations explained in the Chapter 'Units and abbreviations'

Figure 3.20 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. The use of gaseous fuels increased by a factor of more than three between 1990 and 2011. The EU-15 implied emission factor has remained broadly stable, standing at 56 t/TJ in 2011. The largest emitter in 2011 was the Netherlands with 22 % of all EU-15 emissions, followed by Italy and Spain.

Figure 3.20 1A1b Petroleum Refining, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.1.3 *Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-15)*

According to the IPCC, the manufacture of solid fuels and other energy industries includes combustion emissions from fuel use during the manufacture of secondary and tertiary products from solid fuels including production of charcoal. It comprises combustion emissions from the production of coke, brown coal briquettes and patent fuel. It can also cover the emissions from own-energy use in coal mining and gas extraction. Emissions from own on-site fuel use should be included. In addition, this category includes emissions from fuel combustion in oil and natural gas production.

CO_2 emissions from this category accounted for 1.5 % of total greenhouse gas emissions in 2011. Between 1990 and 2011, CO_2 emissions fell by 47 % in the EU-15 (Table 3.15). Emissions from solid fuels fell markedly during the 1990s, since 2000 only gradual annual declines can be observed. The drop in 2009 was due to the drop in iron and steel production triggered by the economic crisis.

Table 3.15 1A1c Manufacture of Solid Fuels and Other Energy Industries: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	510	497	601	1.1%	104	21%	91	18%
Belgium	2 023	259	243	0.4%	-16	-6%	-1 780	-88%
Denmark	545	1 492	1 438	2.6%	-54	-4%	893	164%
Finland	347	237	266	0.5%	29	12%	-81	-23%
France	4 817	3 252	3 210	5.9%	-42	-1%	-1 606	-33%
Germany	64 394	15 800	17 007	31.3%	1 206	8%	-47 387	-74%
Greece	102	49	46	0.1%	-3	-6%	-56	-55%
Ireland	100	121	93	0.2%	-28	-23%	-7	-7%
Italy	13 030	11 730	12 280	22.6%	550	5%	-750	-6%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1 528	2 043	1 627	3.0%	-416	-20%	99	6%
Portugal	75	NO	NO	0.0%	-	-	-75	-100%
Spain	2 117	1 541	1 558	2.9%	17	1%	-559	-26%
Sweden	299	317	348	0.6%	32	10%	49	17%
United Kingdom	13 751	17 448	15 697	28.8%	-1 751	-10%	1 946	14%
EU-15	**103 638**	**54 785**	**54 414**	**100.0%**	**-371**	**-1%**	**-49 224**	**-47%**

Figure 3.21 shows the trends in emissions from this source category by fuel in the EU-15 between 1990 and 2011. About 90 % of greenhouse gas emissions from the manufacture of solid fuels can be accounted for by CO_2 emissions from solid (58 %) and gaseous (34 %) fuels. The figure also shows the activity data behind the emissions.

Fuel used for manufacturing solid fuels fell by 66 % in the EU-15 between 1990 and 2011. In 2011, solid fuels represented 41 % of all fuel use, whereas gaseous fuels took a share of 50%.

Figure 3.21 1A1c-Manufacture of Solid Fuels and Other Energy Industries: Total and CO_2 emission and activity trends

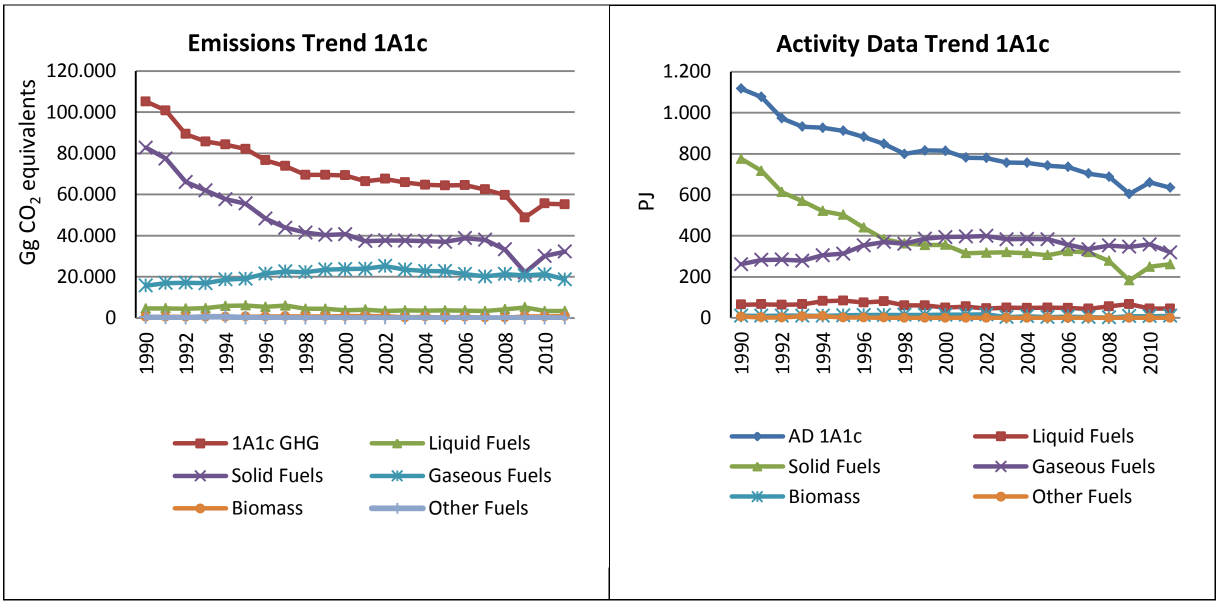


Figure 3.22 shows the relative importance of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State. The country shares range from the highest in the UK to the lowest in Greece (Luxembourg and Portugal do not have emissions from this source category).

Figure 3.23 shows the absolute contributions to EU-15 CO_2 emissions from the manufacture of solid fuels. Italy, Germany and the UK take about 80 % of all EU-15 emissions.

Figure 3.22 Share of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State in 2011

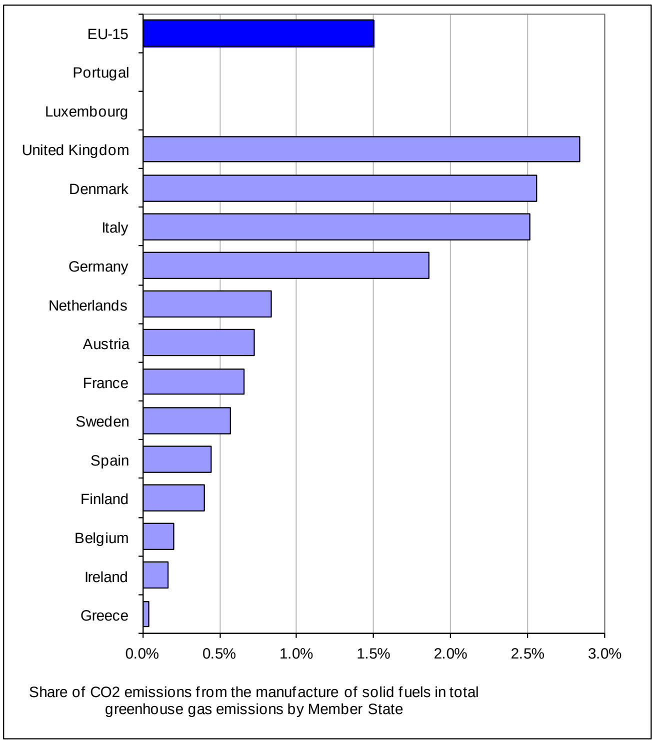
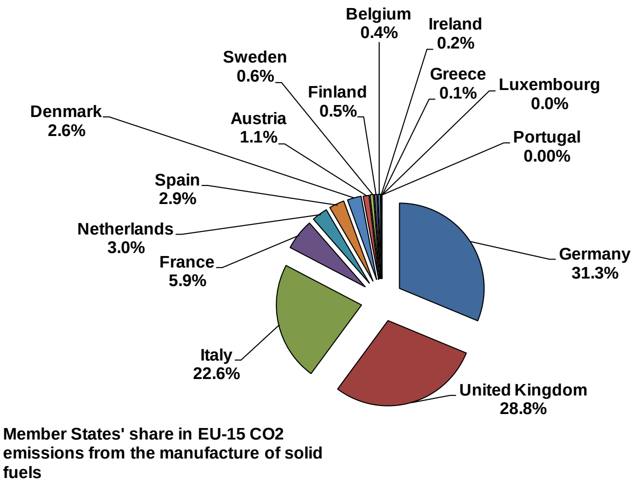


Figure 3.23 Member States' share of CO_2 emissions from the manufacture of solid fuels in EU-15



1A1c Manufacture of Solid Fuels and Other Energy Industries – Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels used in category 1A1c accounted for 34 % of total greenhouse gas emissions from this category in 2011. Emissions in the EU-15 increased steadily by 19 % (Table 3.16) between 1990 and 2000; in the last few years there has been a significant reduction. Almost 50 % of the gross increase in EU-15 emissions between 1990 and 2010 was due to the UK alone. In general, oil and natural gas production are declining since about 2000; therefore also natural gas used in oil and natural gas production is declining.

The decline in 2011 was also due to the UK: there have been reductions in gas use activity across three key sources in 1A1c between 2010-2011: upstream gas production use of gas is down 10.8%, upstream oil production use of gas is down 12.3% and use of gas to drive compressors in the downstream UK gas distribution network is down a reported 19.4%. The first two reductions are driven by a strong decline in UK production of oil and gas (gas production down 21% in one year, oil production down 17%), whereas the reductions in the downstream gas distribution network are due to reduced demand for gas in the UK (2010 had very cold winters at the start and end of the year, so gas use was unusually high in that year).

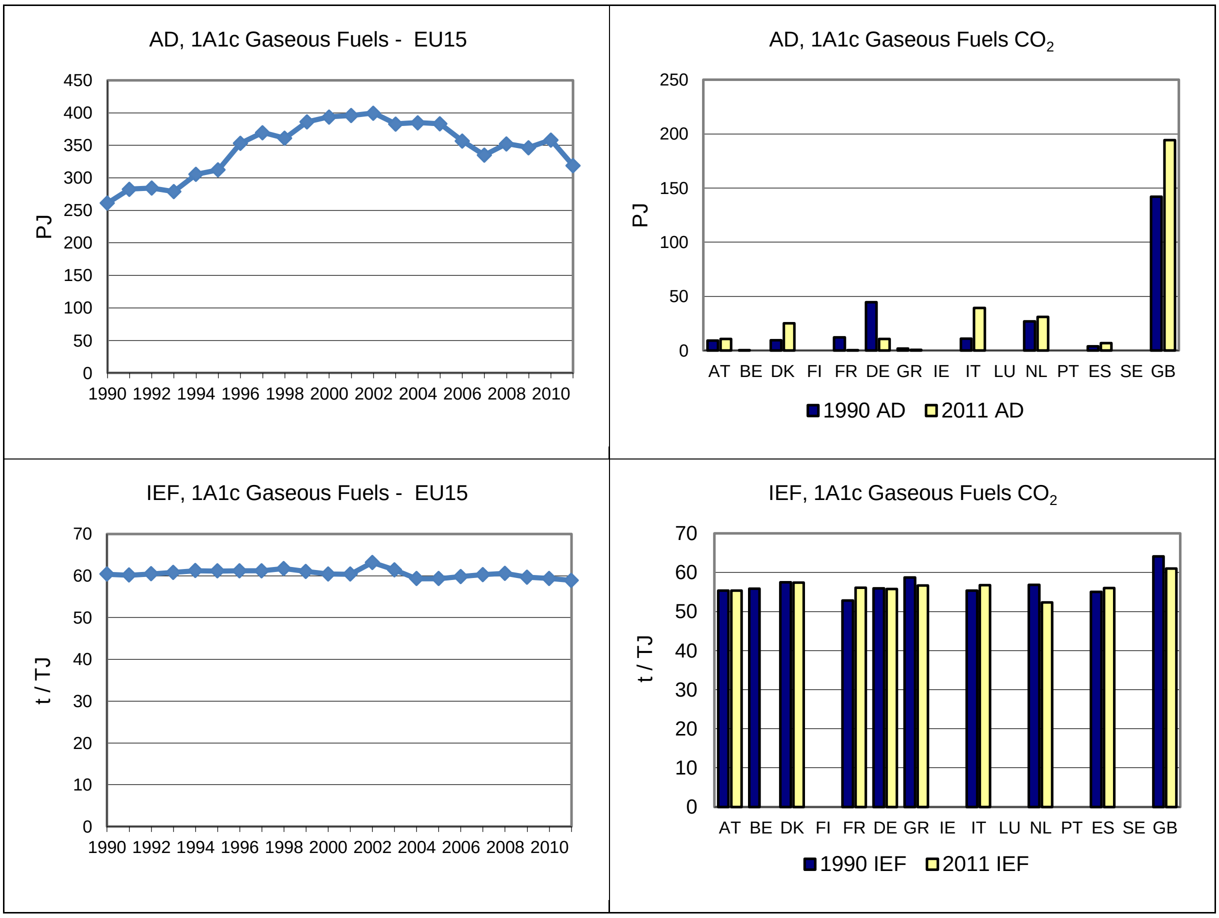
Table 3.16 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	506	497	601	3.2%	104	21%	95	19%	T2	CS
Belgium	3	NO	NO	-	0	-	-3	-100%	NA	NA
Denmark	545	1 492	1 438	7.7%	-54	-4%	893	164%	CR	CS
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	643	35	17	0.1%	-18	-51%	-626	-97%	T2, T3	CS
Germany	2 501	590	598	3.2%	8	1%	-1 903	-76%	CS	CS
Greece	102	49	46	0.2%	-3	-6%	-56	-55%	T2	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	615	2 655	2 227	11.9%	-428	-16%	1 612	262%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 526	2 042	1 627	8.7%	-415	-20%	100	7%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	213	349	386	2.1%	36	10%	173	81%	T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	9 114	13 549	11 846	63.1%	-1 702	-13%	2 732	30%	T2	CS
EU-15	**15 768**	**21 258**	**18 786**	**100.0%**	**-2 472**	**-12%**	**3 018**	**19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows the activity data and implied emission factors for CO_2. The use of gaseous fuels increased by 22 % between 1990 and 2011. The EU-15 implied emission factor is dominated by the UK IEF and is slightly decreasing; it stands at around 60 t/TJ. The reason for the comparatively high IEF in the UK and the explanation for its decrease is as follows: In the UK emissions of gaseous fuels within this sector include colliery methane combustion and natural gas combustion, including offshore own gas use. The carbon emission factor for offshore own gas use is higher than the emission factor for other natural gas combustion, particularly at the start of the time series. This higher emission factor is to be expected, as the unrefined gaseous fuels used in the upstream oil and gas sector will contain heavier hydrocarbons (which are removed in gas treatment prior to injection into natural gas supply infrastructure at onshore terminals). This source is responsible for the majority of the emissions within this sector and is therefore the main driver in the trend in the implied emission factor. The emission factor for this source is based on data supplied by the offshore operators. It decreases across the time series, but remains higher than natural gas consumption in other sectors.

Figure 3.24 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A1c Manufacture of Solid Fuels and Other Energy Industries – Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels used for the manufacture of solid fuels accounted for 58 % of total greenhouse gas emissions from 1A1c in 2011. Emissions in the EU-15 declined by 61%, mainly during the 1990s (

Table 3.17). This was almost-entirely due to a strong decline in emissions in Germany.

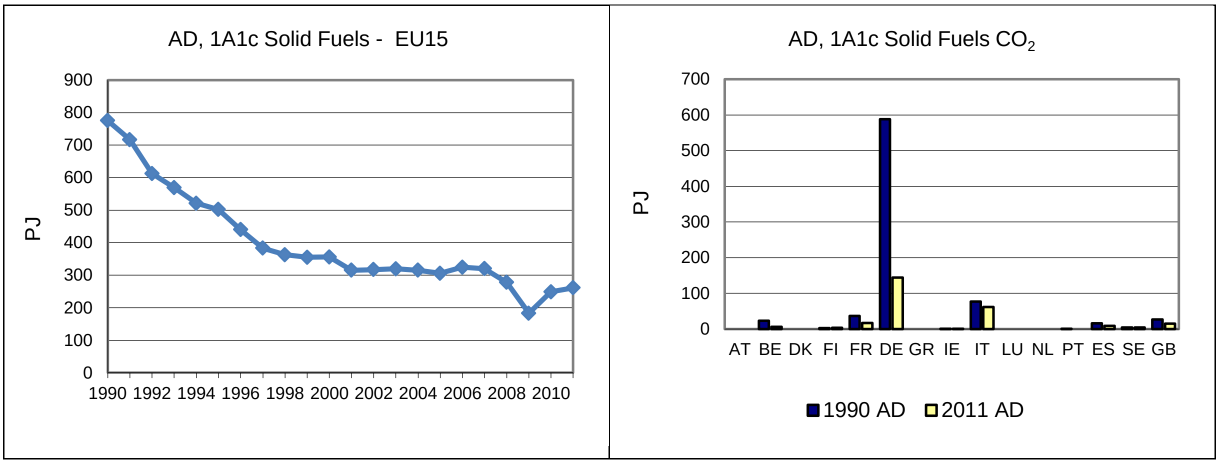
Table 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

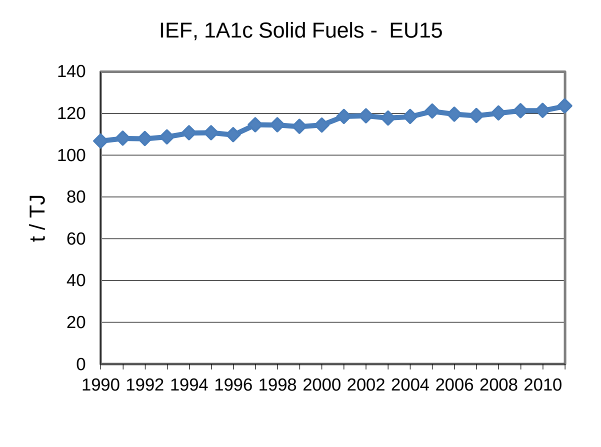
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	2 016	259	243	0.8%	-16	-6%	-1 773	-88%	CS,T3	PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	347	237	266	0.8%	29	12%	-81	-23%	T3	CS
France	4 034	3 217	3 193	9.9%	-24	-1%	-841	-21%	T2, T3	CS
Germany	60 327	14 961	16 137	50.0%	1 176	8%	-44 190	-73%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	100	121	93	0.3%	-28	-23%	-7	-7%	T1	CS
Italy	11 473	9 000	10 042	31.1%	1 042	12%	-1 430	-12%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	IE	NO	NO	-	-	-	-	-	NA	NA
Portugal	26	NO	NO	-	0	-	-26	-100%	NA	NA
Spain	1 847	725	699	2.2%	-25	-3%	-1 148	-62%	T2	CS, PS
Sweden	298	313	345	1.1%	31	10%	47	16%	T2	CS
United Kingdom	2 326	1 333	1 250	3.9%	-83	-6%	-1 075	-46%	T2	CS
EU-15	**82 793**	**30 166**	**32 268**	**100.0%**	**2 102**	**7%**	**-50 525**	**-61%**		

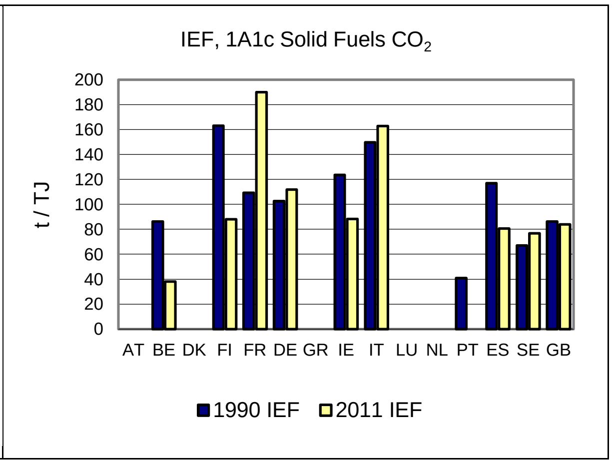
Emissions of the Netherlands are included in 1A2.A
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.25 shows the relevant activity data and implied emission factors. Solid fuels have fallen steadily to less than half of the 1990-level. The EU-15 implied emission factor has increased to reach 124 t/TJ in 2011. This increase is mainly due to a decline in the German share in EU-15 emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The decline in activity data in Germany is mainly due to a large decline in lignite production in the 1990s. Lignite use decreased strongly in the new German Länder from usage levels of the industry of the former GDR. From raw lignite, a range of refined products used to be produced for industry, households and small commercial operations. A comprehensive transition from lignite to other fuels then took place until the end of the 1990s. The high implied emission factor for solid fuels in Italy is due to the large use of derived steel gases and in particular blast furnace gas to produce electricity in the iron and steel plant plants. The largest emitters in 2011 were Italy and Germany, jointly responsible for 81 % of all EU-15 emissions.

Figure 3.25 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Activity Data and Implied Emission Factors for CO_2







3.2.2 Manufacturing industries and construction (CRF Source Category 1A2)

Category 1A2 includes emissions from combustion of fuels in manufacturing industries and construction including fuel use of non public electricity and heat generation (autoproducers). According to the guidelines emissions from fuel combustion in coke ovens are reported under 1A1c except for Austria and the Netherlands, which report on site coke ovens of integrated iron and steel plants under category 1A2a. Some MS report emissions of blast furnace and coke oven gas combustion under categories 1A1a public electricity and heat production or 1A4 other sectors. Emissions from category 1A2 are specified by the sum of subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC, see listing below). Emissions from transport used by industry are reported under category 1A3 Transport. Most MS report emissions arising from off-road and other mobile machinery used in industry (e.g. construction machinery) under category 1A2f. Emissions from non energy fuel use (e.g. reducing agents used in blast furnaces or natural gas used for ammonia production) are reported under category 2 Industrial Processes.

The following enumeration shows the correspondence of 1A2 sub categories and ISIC Rev 3.1 codes:

- 1 A 2 a Iron and Steel: ISIC Group 271 and Class 2731.
- 1 A 2 b Non-Ferrous Metals: ISIC Group 272 and Class 2732.
- 1 A 2 c Chemicals: ISIC Division 24.
- 1 A 2 d Pulp, Paper and Print: ISIC Divisions 21 and 22
- 1 A 2 e Food Processing, Beverages and Tobacco: ISIC Divisions 15 and 16.
- 1 A 2 f Other: Other manufacturing industries: ISIC Divisions 17 to 20, 25, 26, 28 to 37 and 45.

In 2011 category 1A2 contributed to 476,576 Gg CO_2 equivalents of which 98.5% CO_2, 1.2% N_2O and 0.3% CH_4.

Figure 3.26 shows the emission trends within source category 1A2, which is dominated by CO_2 from 1A2f Other contributing by 49 % and 1A2a Iron and steel by 22 %. Some Member States still have difficulties to allocate emissions to all sub-categories under 1A2, which is a main reason for 1A2f being the largest sub-category within 1A2 source category.

Figure 3.26 **1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends**

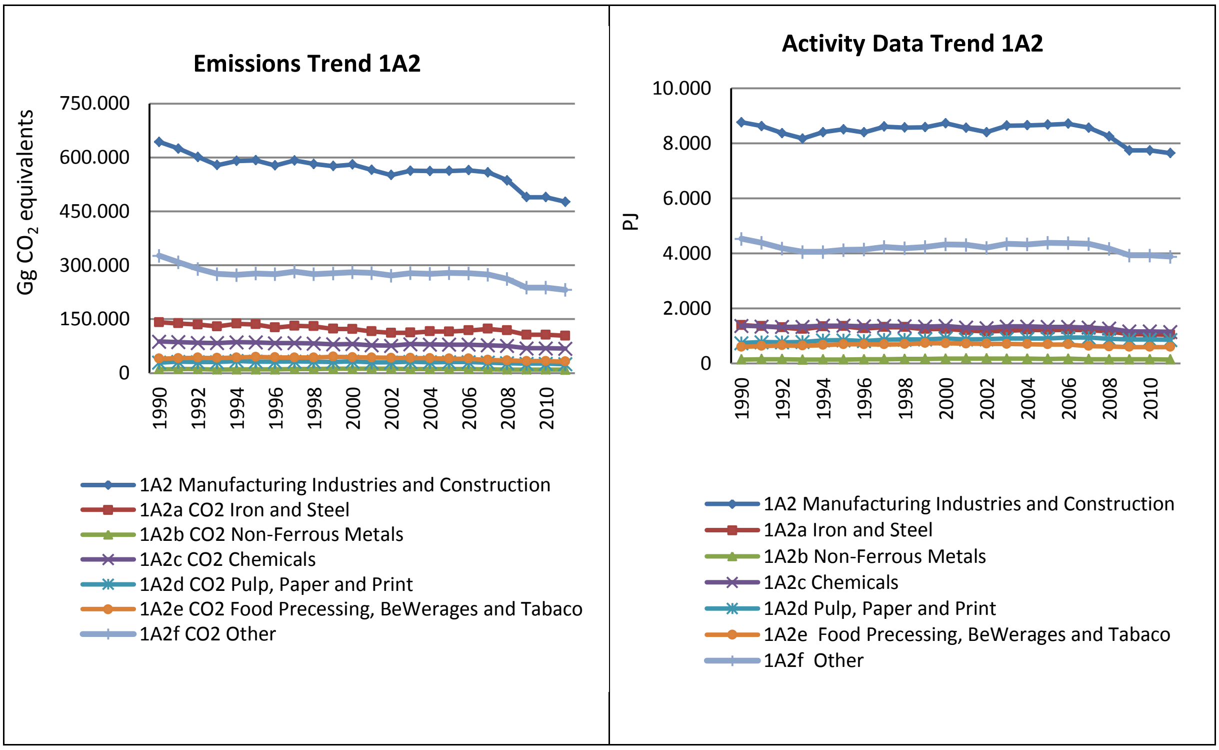


Table 3.18 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.18 **1A2 Manufacturing Industries and Construction: Member States' contributions to total GHG and CO_2 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)
Austria	12 774	14 998	12 685	14 828
Belgium	32 793	23 565	32 605	23 346
Denmark	5 446	4 410	5 385	4 361
Finland	13 357	9 668	13 172	9 515
France	87 434	65 401	86 349	64 448
Germany	177 259	115 291	175 635	114 327
Greece	9 619	5 313	9 566	5 271
Ireland	3 961	4 196	3 943	4 175
Italy	86 948	61 251	85 276	59 854
Luxembourg	6 305	1 293	6 285	1 271
Netherlands	33 098	25 825	33 008	25 744
Portugal	9 854	8 607	9 759	8 477
Spain	46 971	58 677	46 471	57 598
Sweden	12 059	9 515	11 511	8 983
United Kingdom	105 367	68 536	103 414	67 348
EU-15	**643 244**	**476 545**	**635 063**	**469 546**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the fourth largest key source in the EU-15 accounting for 13 % of total GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from manufacturing industries declined by 26 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which was 13 % below 1990 levels in 2011. A shift from solid and liquid fuels to mainly natural gas took place and an increase of biomass and other fuels has been recorded.

Between 1990 and 2011, Germany shows by far the largest emission reductions in absolute terms. Also United Kingdom, France and Italy show emission reductions of more than ten million tonnes CO_2, whereas large emission increases occurred mainly in Spain. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification. Between 2010 and 2011 GHG emissions decreased by 3 % with category 1A2f Other showing the strongest absolute decrease of - 6,181 Gg from all sub categories..

Table 3.19 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A2 Manufacturing Industries for 1990 and 2010 and main explanations for the largest recalculations in absolute terms. The largest recalculations in 2010 were due to Spain, the United Kingdom, France and Germany. The recalculation of Spain in 2010 is dominated by a revision of -3,987 Gg CO_2 from gaseous fuels while the United Kingdom revised liquid fuels by + 3,232 Gg CO_2 as a consequence of a recommendation from the UNFCCC review 2012 (inclusion of liquid products used by petrochemical industries).

Table 3.19 **1A2 Manufacturing Industries and Construction: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

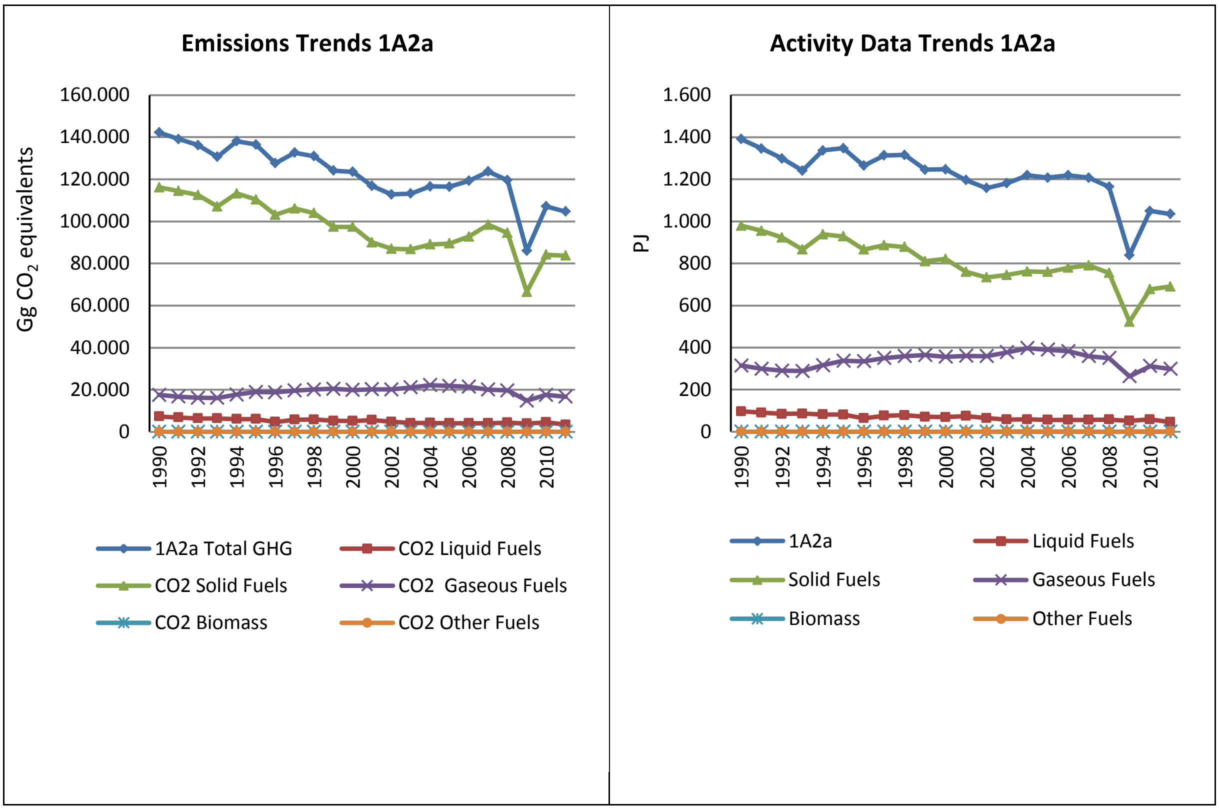
	1990		2010		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0.0	-164	-1.1	Energy balance: Revised survey evaluation.
Belgium	62	0.2	-103	-0.4	Fianl energy balance data available (i.p. large recalculations for chemical industry in the Flemish region) Off-road emissions: Brussels: new off-road figures; Walloon region: reallocation of emissions from 1A4a (off-road of construction sector); Flanders: definitive figures off-road (previous submission: 2010=2009)
Denmark	0	0.0	-30	-0.7	Revision of energy balance
Finland	0	0.0	-18	-0.2	Corrections in activity data.
France	2 489	3.0	912	1.4	La prise en compte des données individuelles pour le calcul des émissions de CO2, CH4 et N2O dans différents secteurs de la combustion pour les procédés énergétiques avec contact, afin d'obtenir des facteurs d'émission rapportés à la consommation de combustibles et non plus à la production. Ce travail nécessite d'être affiné l'année prochaine.
Germany	0	0.0	750	0.7	Final data of activity data available from the national energy balance.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	20	0.4	Revised Energy data from the National Energy Balance.
Italy	-355	-0.4	-1	0.0	Update of CO2 natural gas emission factor. CO2 emission from ferroalloys production reported under the industrial processes sector have been removed from the energy sector because of double counting. CO2 emissions from the use of carbonates in the ferroalloys production, reported in the Industrial processes sector, have been deleted from the energy sector because of double counting.
Luxembourg	-1	0.0	37	2.7	Revision of the final energy consumption (2000-2010). For some categories, also the years 1990-2000 were affected, due to calculation methodology to split general IEA AD between Gasoil (heating) and diesel (Transport).
Netherlands	0	0.0	-13	0.0	Improved method.
Portugal	588	6.4	-202	-2.2	Emission factor update for glass production, due to an in-depth revision of estimation procedures for this sector. Fuel consumption update for glass production, due to an in-depth revision of estimation procedures for this sector. Update for the Natural Gas consumption in a Pulp/Paper installation. Revision of fuel consumption in iron and steel production.
Spain	47	0.1	-3 780	-6.1	El cambio de alcance más relevante es la revisión sistemática que se hace del balance de combustibles que se utiliza específicamente para el inventario de emisiones. Debe reseñarse aquí que para el último año de cada edición del inventario sólo se dispone de los cuestionarios energéticos internacionales, y de éstos a veces sólo un avance, lo que implica en general que en la edición del año siguiente deban ser revisadas las cifras que en el año anterior se habían tomado de dichos cuestionarios al disponerse en este momento posterior de la información de los propios balances energéticos de AIE y EUROSTAT.
Sweden	21	0.2	32	0.3	Minor correction of the emission factor for natural gas. Minor revisions of activity data for construction. Combustion of coke for production of heat used in carbide manufacturing has been included in CRF 1.AA.2.C in submission 2013.
UK	2 212	2.2	3 047	4.6	Liquid fuels: Addition of estimates of emissions from combustion of byproducts at ethylene crackers following UNFCCC review.
EU-15	**5 063**	**0.8**	**485**	**0.1**	

3.2.2.1 *Iron and Steel (1A2a) (EU-15)*

This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. CO_2 emissions from 1A2a Iron and Steel accounted for 22 % of 1A2 source category and 2.9 % of total GHG emissions in 2010.

Figure 3.27 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Between 1990 to 2011 total emissions decreased by 26 %, mainly due to improved efficiency of restructured iron and steel plants and the increased share of gaseous fuels. The strong increase of 25% between 2009 and 2010 correlates with crude steel production which was 25% higher in 2010. Between 2010 and 2011 emissions decreased by 2% while crude steeel production increased by 2%. Between 1990 and 2011 emissions from solid fuels decreased by 28 %, emissions from liquid fuels by 53 % and emissions from gaseous fuels by 5%. Some Member States report emissions from blast furnace gas under categories 1A1a or other sub-categories of 1A2 where it is used for energy recovery in the respective industrial branches. Emissions from coke ovens of integrated iron and steel plants are sometimes not reported in the respective category 1A1c but included in this category. Emissions from blast furnace and coke oven gas flaring without energy recovery are partly reported under category 1B1b. The methodology of splitting emissions from blast furnaces into energy related and process related emissions reported under category 2C1 does not follow a specific standard. E.g. Germany reports 68% of total CO_2 emissions from categories 1A2a and 2C1 under this category and Italy reports 93% in 2011. However, the main driver of category 1A2a CO_2 emissions is blast furnace iron (BFI) production which decreased from about 99 mio tonnes to 80 mio tonnes in 2011 (www.worldsteel.org statistics) whereas total steel production only slightly decreased since 1990 from about 149 mio tonnes to 150 mio tonnes in 2011 (www.worldsteel.org statistics).

Figure 3.27 1A2a Iron and Steel: Total, CO_2 and N_2O emission and activity trends



Between 1990 and 2011, CO_2 emissions from 1A2a Iron and Steel decreased by 26 % in the EU-15 (Table 3.20), mainly due to decreases in Belgium, France, Italy, Luxembourg, Spain and the United Kingdom. Between 2010 and 2011 emissions decreased by 2%.

Table 3.20 1A2a Iron and Steel: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4 944	5 834	5 752	5.5%	-82	-1%	808	16%
Belgium	13 426	6 420	6 191	6.0%	-230	-4%	-7 235	-54%
Denmark	107	88	87	0.1%	-1	-1%	-19	-18%
Finland	2 494	2 994	2 949	2.8%	-45	-2%	455	18%
France	22 248	14 032	12 916	12.4%	-1 116	-8%	-9 332	-42%
Germany	34 742	36 050	34 323	33.0%	-1 727	-5%	-419	-1%
Greece	475	159	148	0.1%	-11	-7%	-327	-69%
Ireland	175	2	2	0.0%	0	0%	-173	-99%
Italy	17 917	14 094	16 382	15.8%	2 288	16%	-1 535	-9%
Luxembourg	5 418	459	387	0.4%	-72	-16%	-5 031	-93%
Netherlands	4 011	4 398	4 280	4.1%	-118	-3%	269	7%
Portugal	1 228	66	72	0.1%	6	10%	-1 155	-94%
Spain	8 526	6 747	6 346	6.1%	-401	-6%	-2 180	-26%
Sweden	1 638	1 773	1 516	1.5%	-256	-14%	-122	-7%
United Kingdom	23 669	13 227	12 571	12.1%	-656	-5%	-11 098	-47%
EU-15	**141 016**	**106 344**	**103 924**	**100.0%**	**-2 420**	**-2%**	**-37 093**	**-26%**

1A2a Iron and Steel - Liquid Fuels (CO_2)

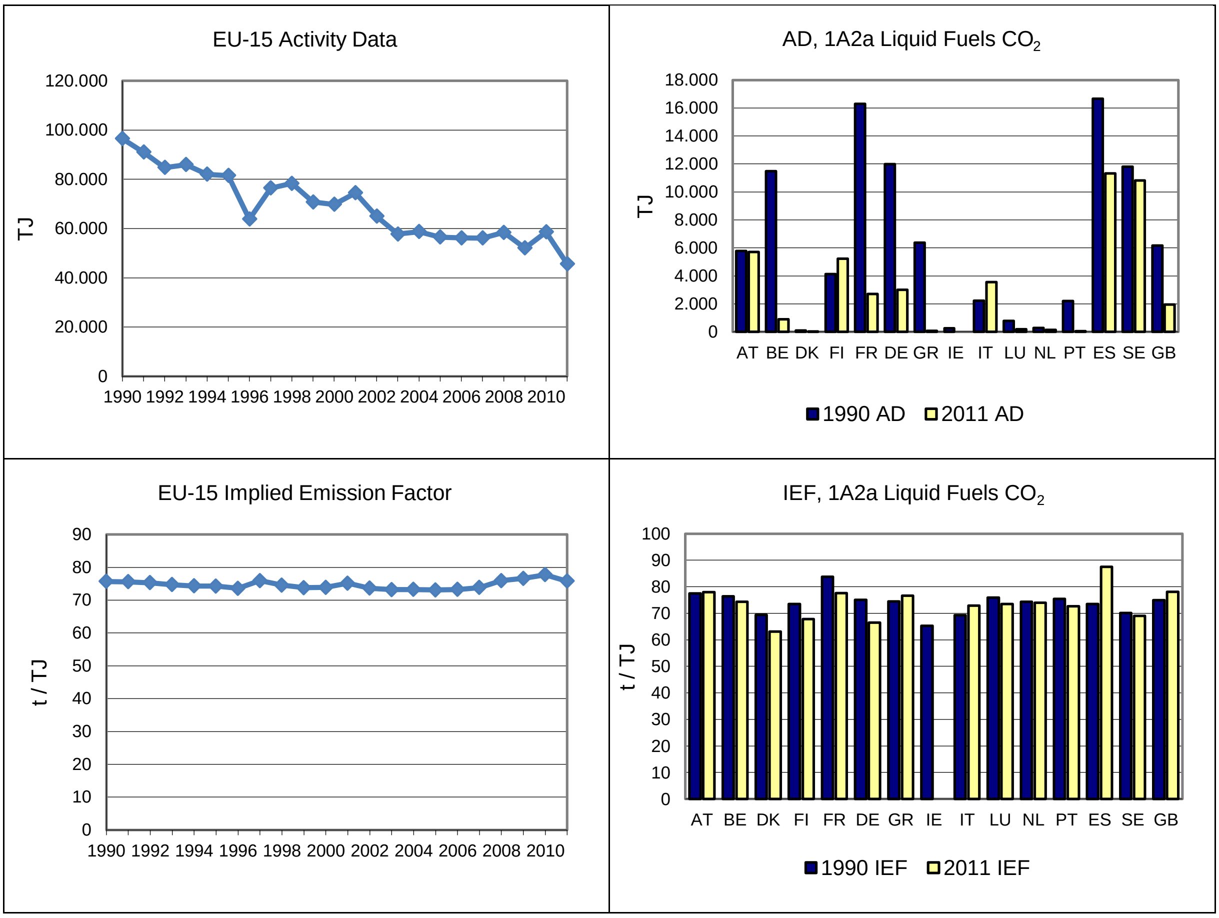
In 2011 CO_2 from liquid fuels had a share of 3 % within this category compared to 5 % in 1990. Between 1990 and 2011 emissions decreased by 53 % (Table 3.21). Significant absolute decreases could be achieved in Belgium, France, Germany and Greece. This activity mainly consists of residual fuel oil used for iron ore reduction in blast furnaces.

Table 3.21 1A2a Iron and Steel, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	448	676	444	12.8%	-231	-34%	-4	-1%	T2	CS,PS
Belgium	878	211	67	1.9%	-144	-68%	-812	-92%	T3	PS
Denmark	7	1	0	0.0%	-1	-73%	-6	-96%	CR	CS
Finland	303	377	354	10.2%	-23	-6%	51	17%	T3	CS
France	1 365	277	210	6.1%	-68	-24%	-1 156	-85%	T2, T3	CS
Germany	900	221	200	5.8%	-21	-9%	-700	-78%	CS	CS
Greece	475	14	6	0.2%	-8	-56%	-469	-99%	T2	PS
Ireland	16	NO	NO	-	-	-	-16	-100%	NA	NA
Italy	153	274	260	7.5%	-14	-5%	106	69%	T2	CS
Luxembourg	59	19	13	0.4%	-6	-31%	-46	-77%	T1,T2	CS,D
Netherlands	21	12	11	0.3%	-1	-8%	-10	-47%	T2	CS
Portugal	167	3	3	0.1%	0	15%	-164	-98%	T2	D, CR, PS
Spain	1 224	1 503	992	28.7%	-511	-34%	-233	-19%	T2	CR, PS
Sweden	828	768	747	21.6%	-20	-3%	-81	-10%	T2, T3	CS, PS
United Kingdom	462	201	152	4.4%	-49	-24%	-310	-67%	T2	CS
EU-15	**7 307**	**4 555**	**3 459**	**100.0%**	**-1 097**	**-24%**	**-3 848**	**-53%**		

Figure 3.28 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Liquid fuel consumption in the EU-15 decreased by 53 % between 1990 and 2011. The CO_2 implied emission factor of EU-15 was 75,78 t/TJ in 2011. The comparatively high IEF of Spain is due to the use of petrol coke.

Figure 3.28 1A2a Iron and Steel, Liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2a Iron and Steel - Solid Fuels (CO_2)

In 2011, CO_2 from solid fuels had a share of 80 % within this category and 82 % in 1990. Between 1990 and 2011 the emissions decreased by 28 % (Table 3.22). Between 1990 and 2011 Belgium, France, Italy, Luxembourg, Spain and the United Kingdom showed major decreases. Between 2010 to 2011, all member states except Italy and Spain show emission decreases.

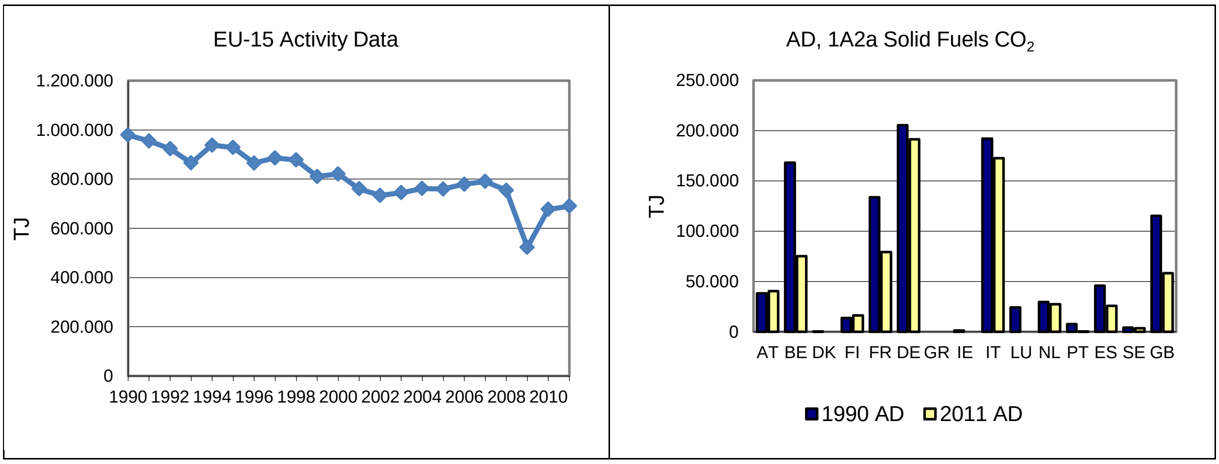
Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

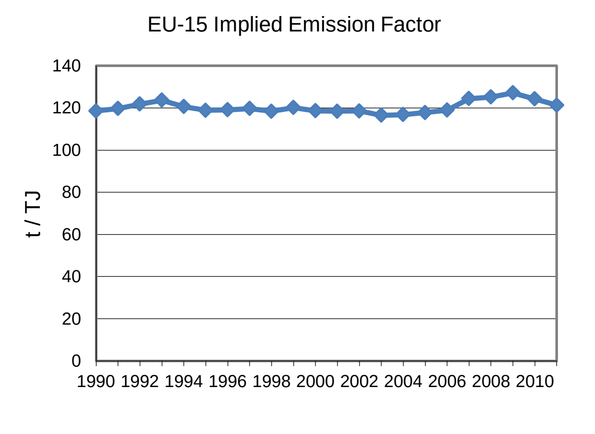
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3 846	4 155	4 143	4.9%	-12	0%	297	8%	T2	CS,PS
Belgium	11 062	4 916	4 793	5.7%	-123	-2%	-6 269	-57%	T3	PS
Denmark	5	NA	NA	-	-	-	-5	-100%	NA	NA
Finland	2 084	2 499	2 476	3.0%	-23	-1%	392	19%	T3	CS,PS
France	18 779	11 734	10 944	13.1%	-790	-7%	-7 835	-42%	T2, T3	CS
Germany	29 396	31 283	30 301	36.2%	-982	-3%	905	3%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	115	NO	NO	-	-	-	-115	-100%	NA	NA
Italy	13 487	9 709	11 913	14.2%	2 205	23%	-1 574	-12%	T2	CS
Luxembourg	4 959	NO	NO	-	-	-	-4 959	-100%	NA	NA
Netherlands	3 323	3 706	3 591	4.3%	-115	-3%	268	8%	T2	CS
Portugal	1 058	16	17	0.0%	2	-	-1 041	-98%	T2	CR,D,PS
Spain	6 515	3 435	3 613	4.3%	178	5%	-2 902	-45%	T2	CR, CS, PS
Sweden	785	948	714	0.9%	-233	-25%	-70	-9%	T2, T3	CS, PS
United Kingdom	20 744	11 762	11 205	13.4%	-557	-5%	-9 539	-46%	T2	CS
EU-15	**116 157**	**84 163**	**83 712**	**100.0%**	**-451**	**-1%**	**-32 445**	**-28%**		

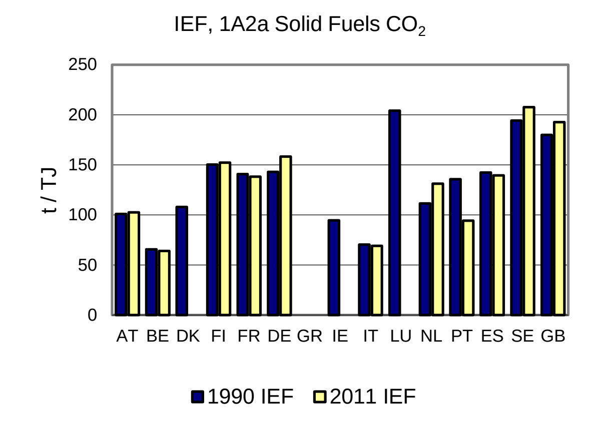
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.29 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emitters are France, Germany, Italy and the UK; together they cause 77 % of the CO_2 emissions from solid fuels in 1A2a. Solid fuel combustion in the EU-15 decreased by 29 % between 1990 and 2011. The implied emission factor in 2011 of EU-15 was 121,3 t/TJ. Belgium and Italy report fuel consumption under this category which was not used for the calculation of the CO_2 emissions and thus results untypically low CO_2 emission factors.

Figure 3.29 1A2a Iron and Steel, solid fuels: Activity Data and Implied Emission Factors for CO_2







1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2011 CO_2 from gaseous fuels had a share of 16 % within source category 1A2a (compared to 12 % in 1990). Between 1990 and 2011 the emissions decreased by 5 % (Table 3.23).

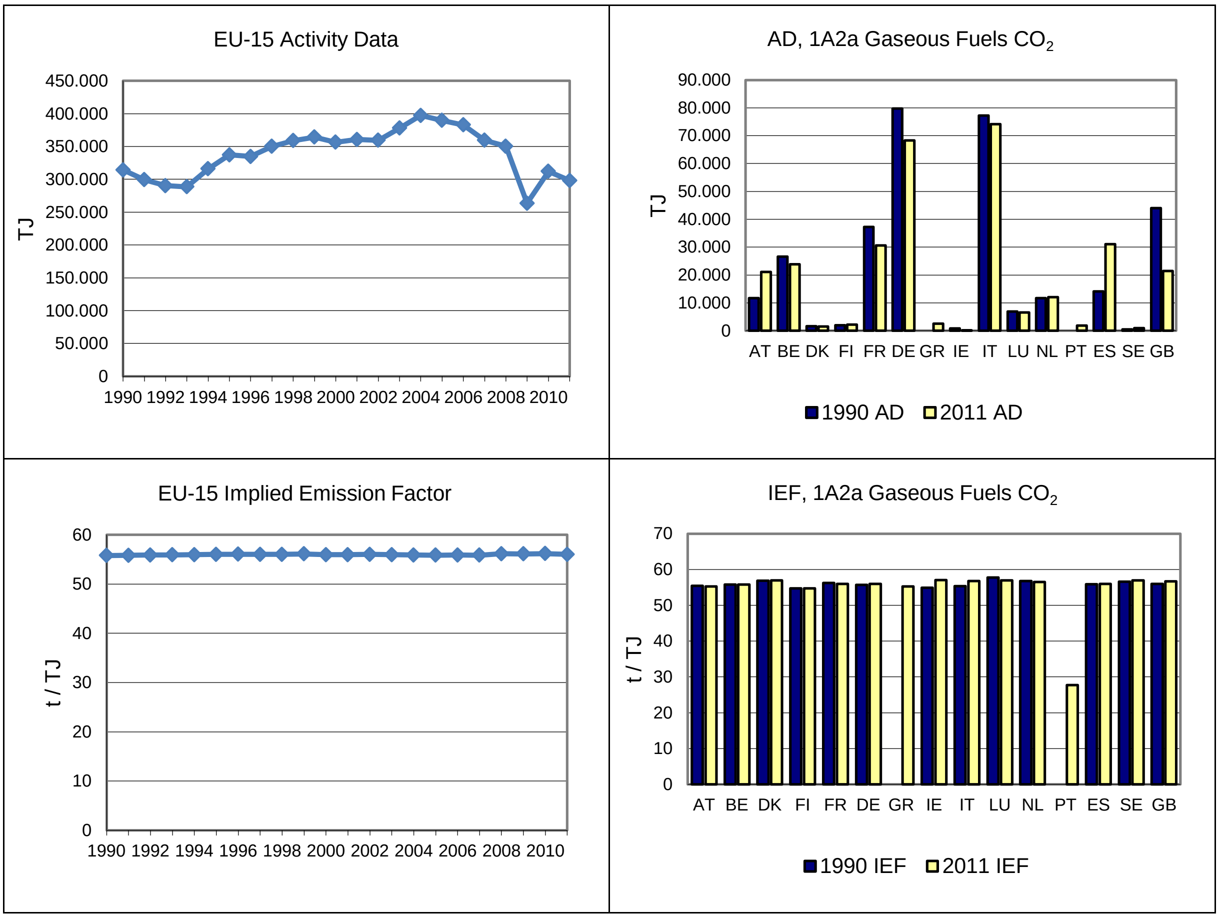
Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	650	1 003	1 165	7.0%	161	16%	515	79%	T2	CS,PS
Belgium	1 485	1 294	1 331	8.0%	37	3%	-154	-10%	T3	PS
Denmark	96	87	87	0.5%	0	0%	-8	-9%	CR	CS
Finland	107	118	119	0.7%	1	1%	11	11%	T3	CS
France	2 097	1 933	1 714	10.3%	-219	-11%	-383	-18%	T2, T3	CS
Germany	4 446	4 546	3 822	22.9%	-724	-16%	-625	-14%	CS	CS
Greece	NO	146	142	0.9%	-3	-2%	142	-	T2	CS
Ireland	44	2	2	0.0%	0	0%	-41	-95%	T1	CS
Italy	4 276	4 111	4 209	25.2%	98	2%	-67	-2%	T2	CS
Luxembourg	400	440	374	2.2%	-66	-15%	-26	-7%	T2	CS
Netherlands	667	680	678	4.1%	-2	0%	10	2%	T2	CS
Portugal	NO	48	52	0.3%	4	9%	52	-	T2	D, CR, PS
Spain	786	1 809	1 741	10.4%	-68	-4%	955	121%	T2	CS
Sweden	25	57	55	0.3%	-3	-5%	29	117%	T2	CS
United Kingdom	2 463	1 264	1 214	7.3%	-50	-4%	-1 249	-51%	T2	CS
EU-15	**17 543**	**17 538**	**16 705**	**100.0%**	**-834**	**-5%**	**-839**	**-5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.30 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain which contribute 69 % to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-15 decreased by 5 % between 1990 and 2011. The implied emission factor of EU-15 was 56 t/TJ in 2011.

Figure 3.30 1A2a Iron and Steel, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

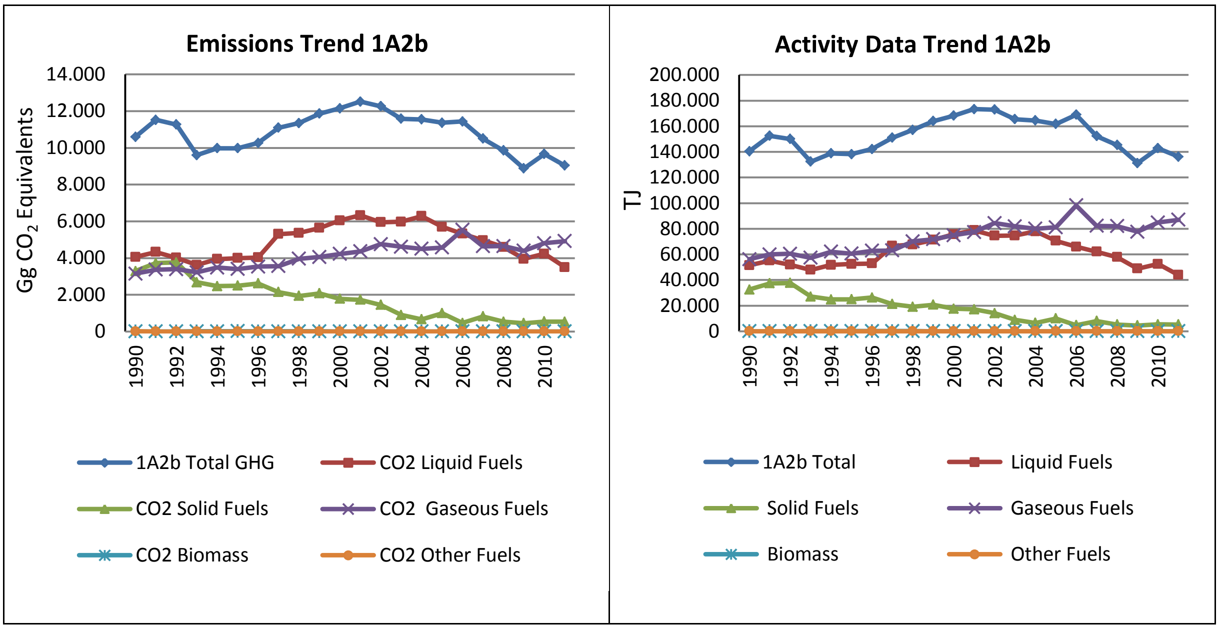


3.2.2.2 *Non Ferrous Metals (1A2b) (EU-15)*

In this chapter information is provided about emission trends, Member States contribution, activity data and emission factors for category 1A2b by fuels. CO_2 emissions from 1A2b Non-Ferrous Metals accounted for 2 % of 1A2 source category and 0.2 % of total GHG emissions in 2011.

Figure 3.31 shows the emission trend within the category 1A2b, which is in 2011 mainly dominated by CO_2 emissions from liquid and gaseous fuels. The share of solid fuels emissions decreased from 31 % in 1990 to 6 % in 2011. In 2011 total GHG emissions were 15 % below 1990 level. Increasing emissions were reported for CO_2 from gaseous fuels (+56 %) while emissions from other fuels decreased.

Figure 3.31 **1A2b Non ferrous Metals: Total and CO_2 emission trends**



EU-15 CO_2 emissions from 1A2b were 15 % below 1990 levels in 2011. In absolute terms, France and Germany reported the highest decreases, while Spain, Ireland and Italy reported substantial increases in this period (Table 3.24).

Table 3.24 **1A2b Non ferrous Metals: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	132	243	242	2.7%	0	0%	111	84%
Belgium	624	436	422	4.7%	-14	-3%	-201	-32%
Denmark	11	8	7	0.1%	-2	-20%	-4	-39%
Finland	336	111	100	1.1%	-11	-10%	-236	-70%
France	2 570	1 060	936	10.4%	-124	-12%	-1 634	-64%
Germany	1 601	166	160	1.8%	-6	-4%	-1 441	-90%
Greece	608	504	462	5.2%	-41	-8%	-145	-24%
Ireland	809	1 516	1 481	16.5%	-35	-2%	672	83%
Italy	738	1 130	1 111	12.4%	-18	-2%	374	51%
Luxembourg	28	53	50	0.6%	-3	-5%	22	81%
Netherlands	216	204	186	2.1%	-18	-9%	-30	-14%
Portugal	IE,NO	IE	IE	0.0%	-	-	-	-
Spain	1 575	3 394	3 074	34.3%	-320	-9%	1 499	95%
Sweden	128	90	83	0.9%	-7	-8%	-44	-35%
United Kingdom	1 143	682	654	7.3%	-28	-4%	-489	-43%
EU-15	**10 518**	**9 595**	**8 968**	**100.0%**	**-627**	**-7%**	**-1 550**	**-15%**

Portugal includes emissions under 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2b Non-Ferrous Metals - Solid Fuels (CO_2)

In 2011 CO_2 from solid fuels had a share of 6 % within source category 1A2b category (compared to 31 % in 1990). Between 1990 and 2011 the emissions decreased by 84 % (Table 3.25). Greece and Portugal reported emissions as 'Included elsewhere' and Ireland, the Netherlands, Luxembourg, Denmark and Sweden as 'Not occurring' or 'Not applicable'. Substantial decreases between 1990 and 2011 were reported by France and Germany.

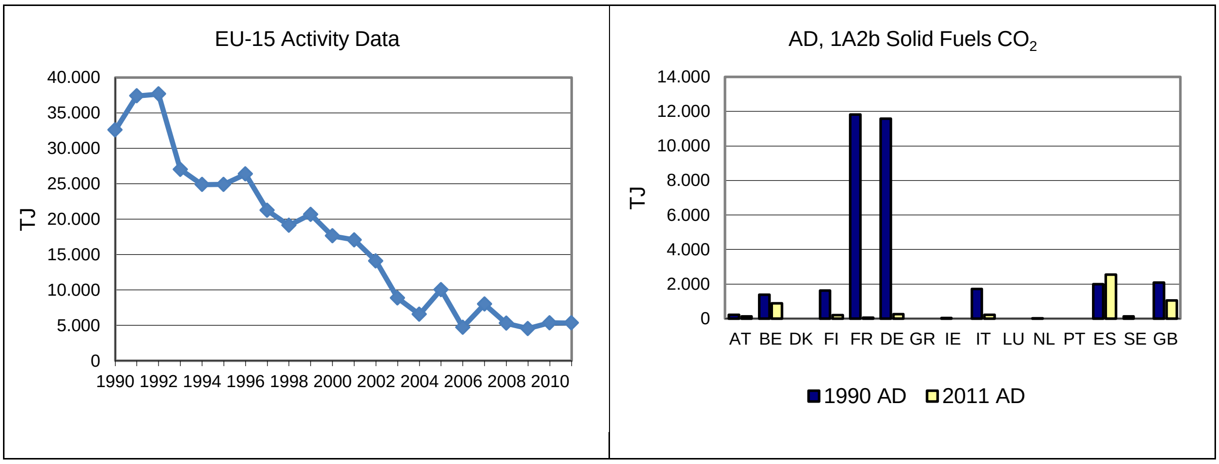
Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

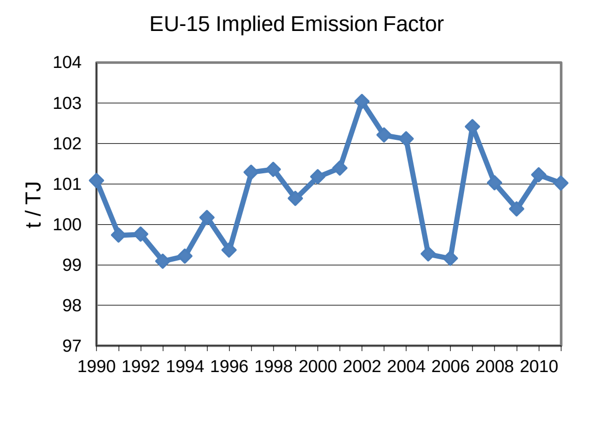
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	22	12	13	2.4%	1	8%	-9	-41%	T2	CS
Belgium	146	84	94	17.5%	10	12%	-52	-35%	T1	D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	155	22	21	3.9%	-1	-6%	-134	-87%	T3	CS
France	1 191	3	4	0.8%	2	72%	-1 187	-100%	T2, T3	CS
Germany	1 206	24	26	4.8%	1	6%	-1 180	-98%	CS	CS
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	4	NA	NA	-	-	-	-4	-100%	NA	NA
Italy	163	23	21	3.9%	-3	-11%	-142	-87%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	0	NO	NO	-	-	-	-0.4	-100%	NA	NA
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Spain	209	274	266	49.4%	-7	-3%	58	28%	T2	CS
Sweden	7	NO	NO	-	-	-	-7	-100%	NA	NA
United Kingdom	191	100	93	17.3%	-7	-7%	-98	-51%	T2	CS
EU-15	**3 295**	**543**	**539**	**100.0%**	**-4**	**-1%**	**-2 756**	**-84%**		

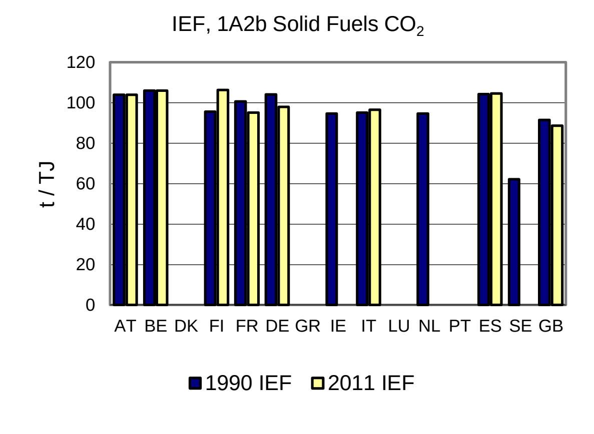
Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry is not available.
Greece includes emissions in the Industrial processes sector (as non-energy use of fuels).
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.32 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Belgium, Spain and the United Kingdom; together they cause 84 % of the CO_2 emissions from solid fuels in 2011. Consumption of solid fuels in the EU-15 decreased by 84 % between 1990 and 2011. The implied emission factor of EU-15 was 101 t/TJ in 2011. The strong decline in 1993 AD is mainly due to a high decrease reported by France.

Figure 3.32 1A2b Non ferrous Metals, solid fuels: Activity Data and Implied Emission Factors for CO_2







1A2b Non-Ferrous Metals - Gaseous Fuels (CO_2)

In 2011 CO_2 from gaseous fuels had a share of 54 % within source category 1A2b (compared to 30 % in 1990). Between 1990 and 2011 the emissions increased by 56 % (Table 3.26). Between 1990 and 2011 the highest absolute increases occurred in Spain, Ireland and Italy.

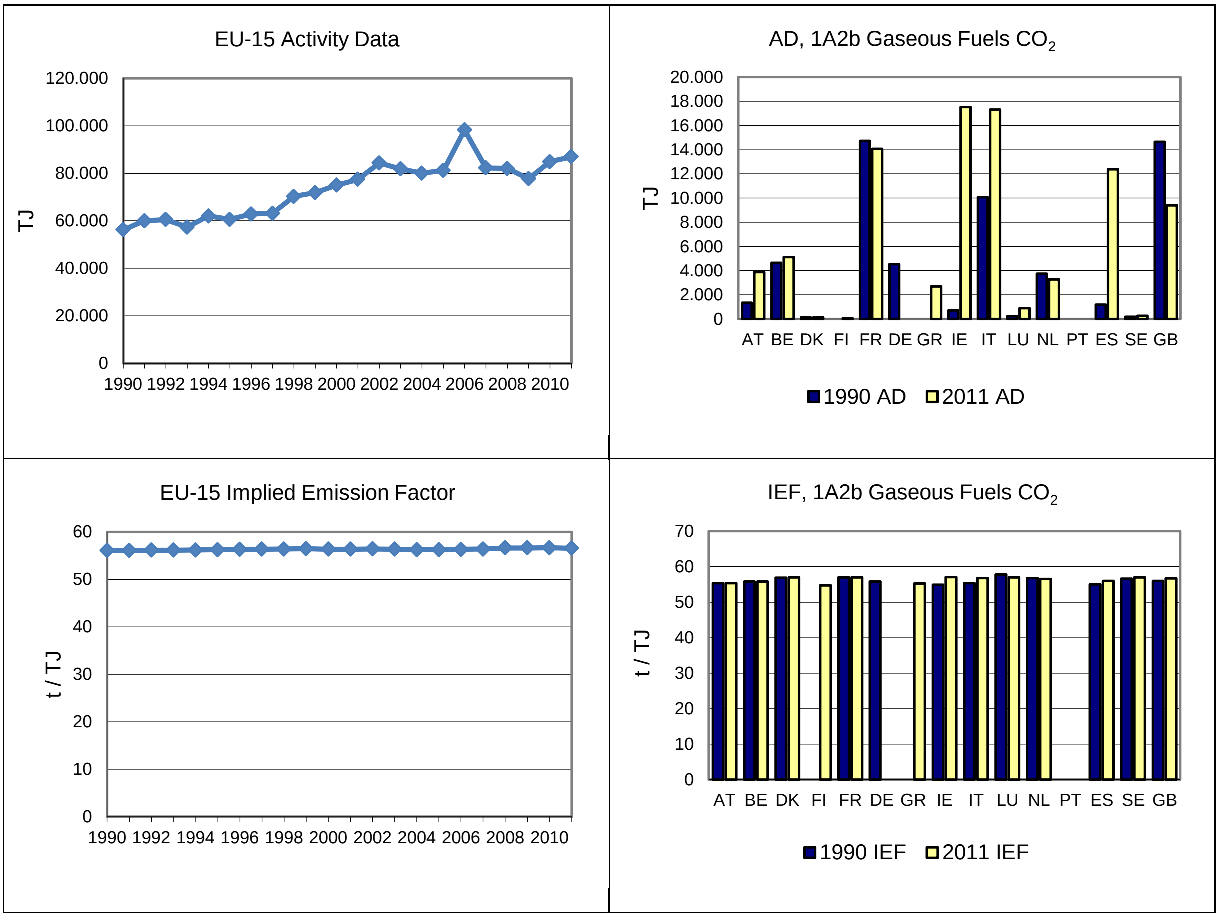
Table 3.26 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	75	211	215	4.4%	3	2%	140	187%
Belgium	260	303	286	5.8%	-17	-6%	27	10%
Denmark	7	7	7	0.1%	0	0%	0	-5%
Finland	NO	3	3	0.1%	0	9%	3	-
France	839	855	802	16.3%	-53	-6%	-37	-4%
Germany	253	IE	IE	0.0%	-	-	-253	-100%
Greece	NO	148	149	3.0%	1	1%	149	-
Ireland	39	806	999	20.3%	194	-	961	2492%
Italy	558	981	982	20.0%	2	0%	425	76%
Luxembourg	13	53	50	1.0%	-3	-5%	37	-
Netherlands	213	204	185	3.8%	-19	-9%	-28	-13%
Portugal	NO	IE	IE	-	-	-	-	-
Spain	66	700	693	14.1%	-7	-1%	628	955%
Sweden	10	18	15	0.3%	-3	-16%	5	45%
United Kingdom	819	522	532	10.8%	10	2%	-287	-35%
EU-15	**3 153**	**4 810**	**4 920**	**100.0%**	**109**	**2%**	**1 767**	**56%**

Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available. Germany reported emissions under 1A2f other (unspecified industrial power plants) because of confidential data. Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 shows activity data and CO_2 implied emission factors for EU-15 and the Member States. The largest emissions are reported by France, Ireland, Italy, Spain and the United Kingdom; together they cause around 81 % of the CO_2 emissions in 2011 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-15 rose by 55 % between 1990 and 2011. The implied emission factor of EU-15 was 56.57 t/TJ in 2011. The jump in 2006 AD is mainly due to Ireland which reports a high increase in 2006 and Spain which reports a high decrease in 2007.

Figure 3.33 **1A2b Non ferrous Metals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**

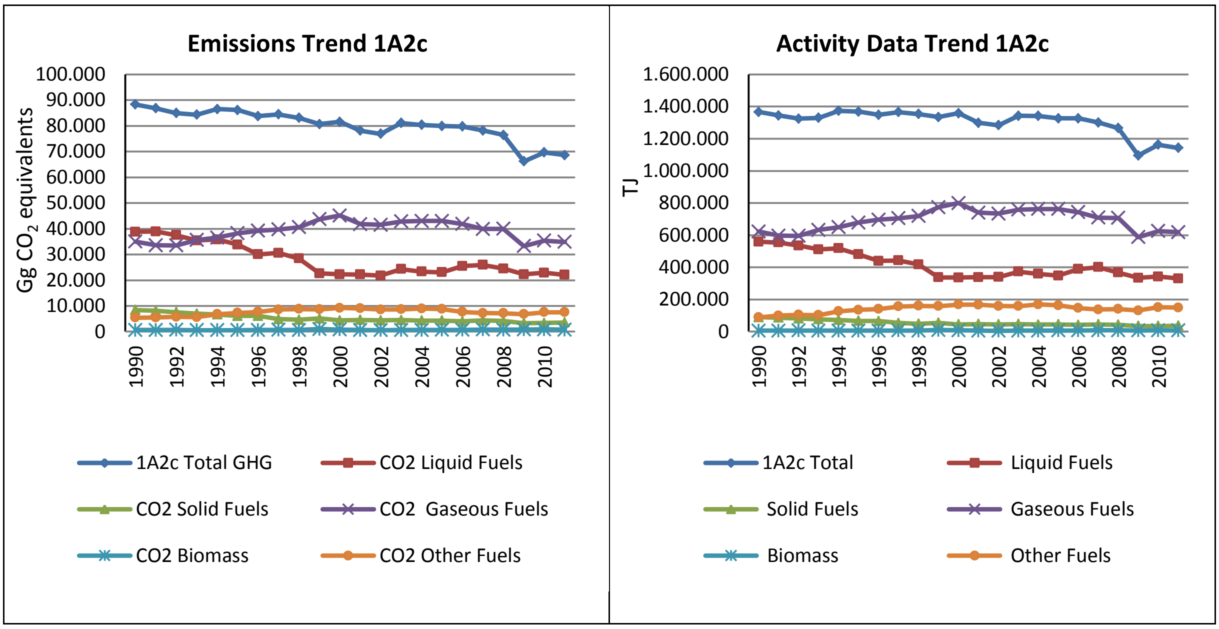


3.2.2.3 ***Chemicals (1A2c) (EU-15)***

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals accounted for 14.3 % of 1A2 category and 1.9 % of total GHG emissions in 2011.

Figure 3.34 shows the emission trend within the category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 22 %, mainly due to decreases in emissions from liquid (-43 %) fuels. Increasing CO_2 emissions were reported for other fuels (+ 107 %).

Figure 3.34 1A2c Chemicals: Total and CO_2 emission and activity trends



Between 1990 and 2011, CO_2 emissions from 1A2c Chemicals decreased by 22 % in the EU-15 (

Table 3.27), mainly due to decreases in Italy, the Netherlands and the United Kingdom; Belgium, France and Spain reported substantial emission increases in this period. Between 2010 and 2011 emissions decreased substantially in Italy and the Netherlands.

Table 3.27 1A2c Chemicals: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	883	1 246	1 264	1.9%	18	1%	381	43%
Belgium	6 585	7 167	7 304	10.7%	136	2%	719	11%
Denmark	282	198	167	0.2%	-31	-15%	-115	-41%
Finland	1 286	777	812	1.2%	35	5%	-474	-37%
France	19 656	20 760	20 548	30.2%	-213	-1%	892	5%
Germany	IE	IE	IE	-	-	-	-	-
Greece	1 153	930	1 196	1.8%	266	29%	43	4%
Ireland	410	285	279	0.4%	-6	-2%	-131	-32%
Italy	19 203	7 777	6 954	10.2%	-824	-11%	-12 249	-64%
Luxembourg	177	167	162	0.2%	-5	-3%	-16	-9%
Netherlands	17 133	13 211	12 401	18.2%	-809	-6%	-4 732	-28%
Portugal	1 480	1 347	1 344	2.0%	-2	0%	-136	-9%
Spain	5 665	6 324	6 783	10.0%	459	7%	1 119	20%
Sweden	1 149	1 289	1 240	1.8%	-49	-4%	91	8%
United Kingdom	12 569	7 644	7 610	11.2%	-34	0%	-4 959	-39%
EU-15	**87 631**	**69 122**	**68 064**	**100.0%**	**-1 058**	**-2%**	**-19 568**	**-22%**

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2c Chemicals - Liquid Fuels (CO_2)

In 2011, CO_2 from liquid fuels had a share of 32 % within source category 1A2c (compared to 44 % in 1990). Between 1990 and 2011, the emissions decreased by 43 % (Table 3.28). Several EU-15 Member States reported decreasing CO_2 emissions from this source category with Italy and the United Kingdom showing the highest reduction in absolute terms. Germany includes emissions under 1A2f.

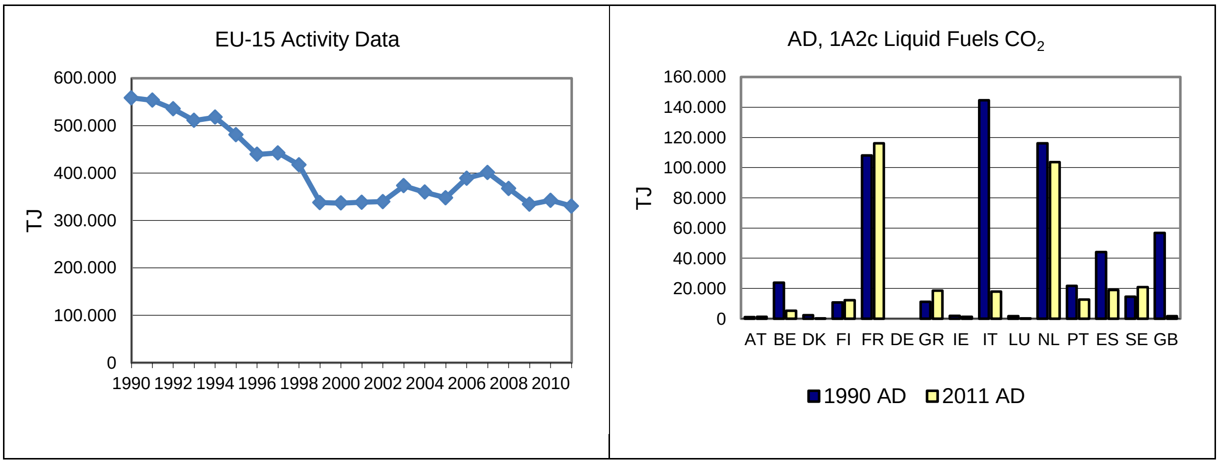
Table 3.28 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

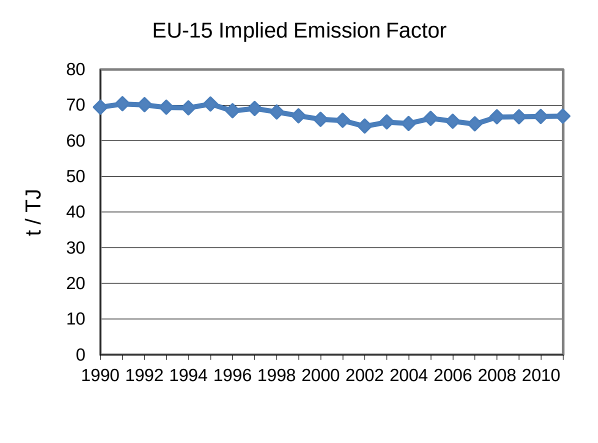
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	82	106	96	0.4%	-10	-9%	13	16%	T2	CS,PS
Belgium	1 835	310	398	1.8%	89	29%	-1 437	-78%	T1	D
Denmark	180	26	0	0.0%	-26	-99%	-179	-100%	CR	CS,D
Finland	772	729	723	3.3%	-6	-1%	-49	-6%	T3	CS
France	7 650	8 048	8 345	37.8%	297	4%	695	9%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	584	633	780	3.5%	147	23%	196	34%	T2	PS
Ireland	131	128	85	0.4%	-43	-33%	-46	-35%	T1	CS
Italy	10 956	1 554	1 178	5.3%	-376	-24%	-9 778	-89%	T2	CS
Luxembourg	120	12	12	0.1%	0	1%	-108	-90%	T1,T2	CS,D
Netherlands	6 570	7 804	7 186	32.5%	-618	-8%	616	9%	T2	CS
Portugal	1 373	778	747	3.4%	-31	-4%	-627	-46%	T2	D, CR
Spain	3 278	1 522	1 419	6.4%	-103	-7%	-1 859	-57%	T2	CR, CS
Sweden	861	1 036	996	4.5%	-40	-4%	134	16%	T2	CS
United Kingdom	4 383	205	128	0.6%	-76	-37%	-4 255	-97%	T2	CS
EU-15	**38 776**	**22 889**	**22 093**	**100.0%**	**-797**	**-3%**	**-16 683**	**-43%**		

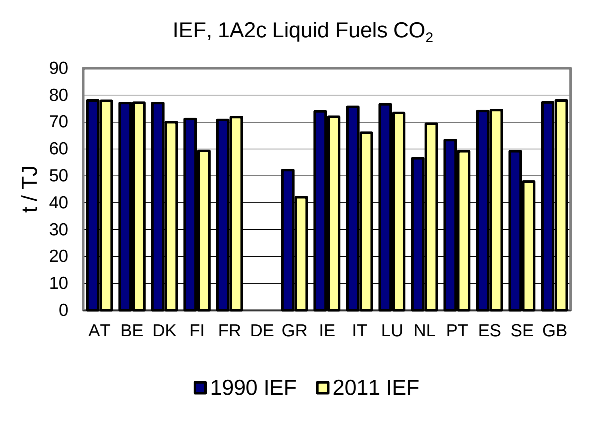
Emissions of Germany are included in 1A2f
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.35 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest contributions are reported by France and the Netherlands; together they cause around 70 % of the CO_2 emissions from liquid fuels in 1A2c. Fuel combustion in the EU-15 decreased by 41 % between 1990 and 2011. The implied emission factor of EU-15 was 66.9 t/TJ in 2011. The low implied emission factor of Greece is because non-energy use is included in activity data. The lower implied emission factor of the Netherlands is because chemical gases are included in liquid fuels. Sweden reports methane and methane based gas mixtures together with liquid fuels which implies a rather low IEF too. The decline in 1999 AD is due to the strong decrease reported by Italy.

Figure 3.35 1A2c Chemicals, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A2c Chemicals - Solid Fuels (CO_2)

In 2011, solid fuels had a share of 5 % within source category 1A2c (compared to 10 % in 1990). Between 1990 and 2011 the emissions decreased by 58 % (Table 3.29). In absolute terms the Netherlands and the United Kingdom reported a significant decrease during this period. Germany includes emissions from this source category in source category 1A2f.

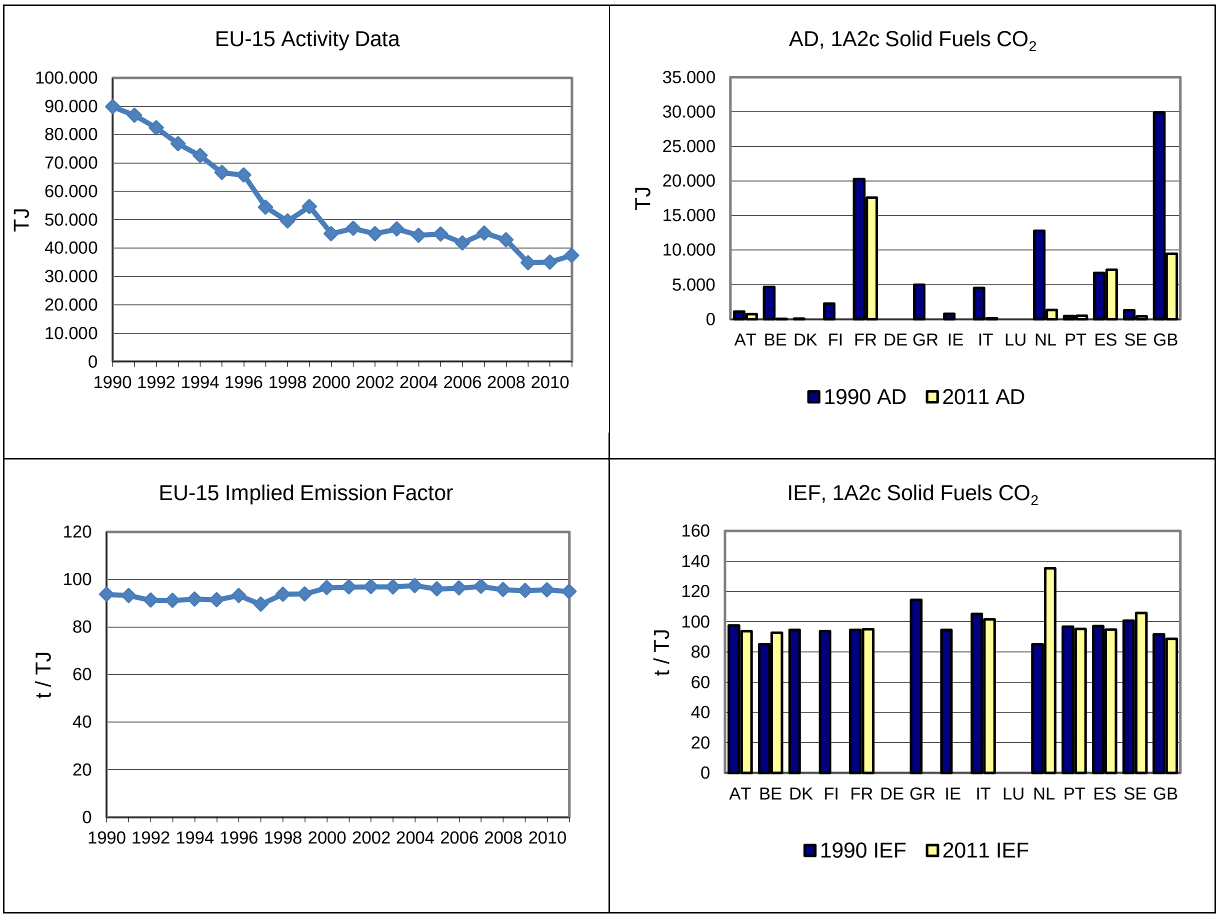
Table 3.29 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	107	76	68	1.9%	-8	-11%	-40	-37%	T2	CS,PS
Belgium	397	0	3	0.1%	3	768%	-393	-99%	T1	D
Denmark	7	NA	NA	-	-	-	-7	-100%	NA	NA
Finland	214	NO	NO	-	0.0	-	-214	-100%	NA	NA
France	1 918	1 574	1 671	47.1%	97	6%	-247	-13%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	569	NO	NO	-	-	-	-569	-100%	NA	NA
Ireland	72	NA	NA	-	-	-	-72	-100%	NA	NA
Italy	478	15	15	0.4%	0	2%	-462	-97%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 087	162	178	5.0%	16	10%	-909	-84%	T2	CS
Portugal	44	49	50	1.4%	1	2%	6	13%	T2	D, CR
Spain	648	557	680	19.2%	123	22%	32	5%	T2	CR, CS, PS
Sweden	127	42	41	1.2%	-1	-2%	-86	-68%	T2	CS
United Kingdom	2 743	876	840	23.7%	-35	-4%	-1 902	-69%	T2	CS
EU-15	**8 412**	**3 352**	**3 548**	**100.0%**	**196**	**6%**	**-4 864**	**-58%**		

Emissions of Germany are inlcuded in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.36 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Spain and the United Kingdom; together they cause 90 % of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion in the EU-15 decreased by -58 % between 1990 and 2011. The implied emission factor of EU-15 was 94.9 t/TJ in 2011. The Netherlands include chemical waste gas within this category which implies the change in their IEF.

Figure 3.36 1A2c Chemicals, solid fuels:Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2011, CO_2 from gaseous fuels had a share of 51 % within source category 1A2c (compared to 40 % in 1990). Between 1990 and 2011, the emissions decreased by 0.3 % (Table 3.30). Between 1990 and 2011 Italy the Netherlands reported substantial decreases. The highest increases occurred in Spain and France and the United Kingdom. Germany includes emissions from this source category in source category 1A2f.

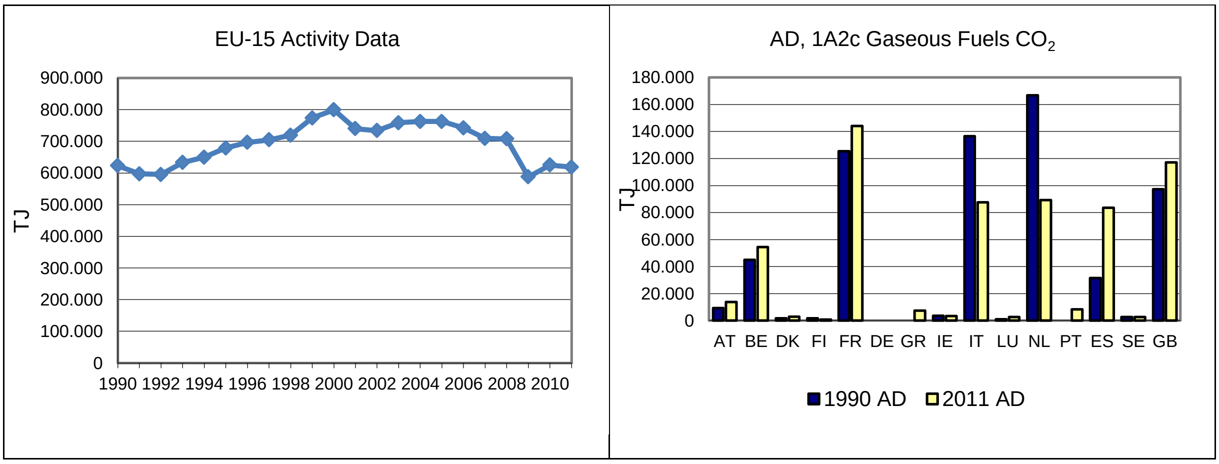
Table 3.30 **1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2 and information on method applied and emission factor**

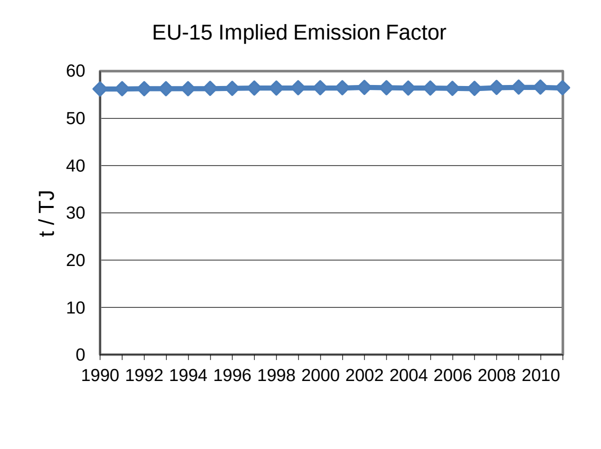
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	519	730	766	2.2%	36	5%	247	48%	T2	CS
Belgium	2 519	3 110	3 047	8.7%	-63	-2%	528	21%	T1	D
Denmark	96	171	167	0.5%	-4	-3%	71	74%	CR	CS
Finland	98	37	46	0.1%	8	22%	-53	-54%	T3	CS
France	7 146	8 731	8 155	23.4%	-576	-7%	1 009	14%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	296	416	1.2%	119	40%	416	-	T2	CS
Ireland	207	158	194	0.6%	37	23%	-13	-6%	T1	CS
Italy	7 561	5 345	4 979	14.3%	-367	-7%	-2 583	-34%	T2	CS
Luxembourg	57	155	150	0.4%	-5	-3%	93	161%	T2	CS
Netherlands	9 476	5 244	5 037	14.4%	-207	-4%	-4 439	-47%	T2	CS
Portugal	NO	422	473	1.4%	50	12%	473	-	T2	D, CR
Spain	1 739	4 246	4 684	13.4%	439	10%	2 945	169%	T2	CS
Sweden	155	159	154	0.4%	-5	-3%	0	0%	T2	CS
United Kingdom	5 443	6 564	6 642	19.0%	77	1%	1 198	22%	T2	CS
EU-15	**35 016**	**35 370**	**34 909**	**100.0%**	**-461**	**-1%**	**-107**	**0%**		

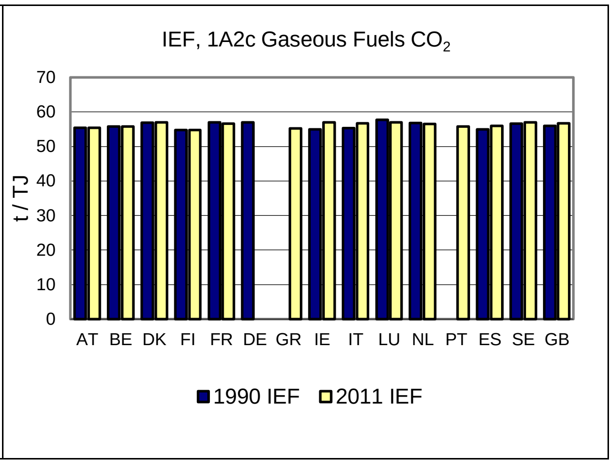
Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.37 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause 84 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-15 decreased by 1 % between 1990 and 2011. The implied emission factor of EU-15 was 56.43 t/TJ in 2011.

Figure 3.37 **1A2c Chemicals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**







1A2c Chemicals - Other Fuels (CO_2)

In 2011, CO_2 from other fuels had a share of 11 % within source category 1A2c (compared to 6 % in 1990). Between 1990 and 2011, the emissions increased by 38 % (Table 3.31). Several Member States reported emissions as 'Not occurring' or 'Not applicable', Germany and the United Kingdom included emissions in 1A2f. The major absolute increase was reported by Belgium between 1990 and 2011. Belgium reports recovered fuels from cracking units or other processes under this category; Italy reports gaseous fuels resulting from the petrochemical production processes.

Table 3.31 1A2c Chemicals, other fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

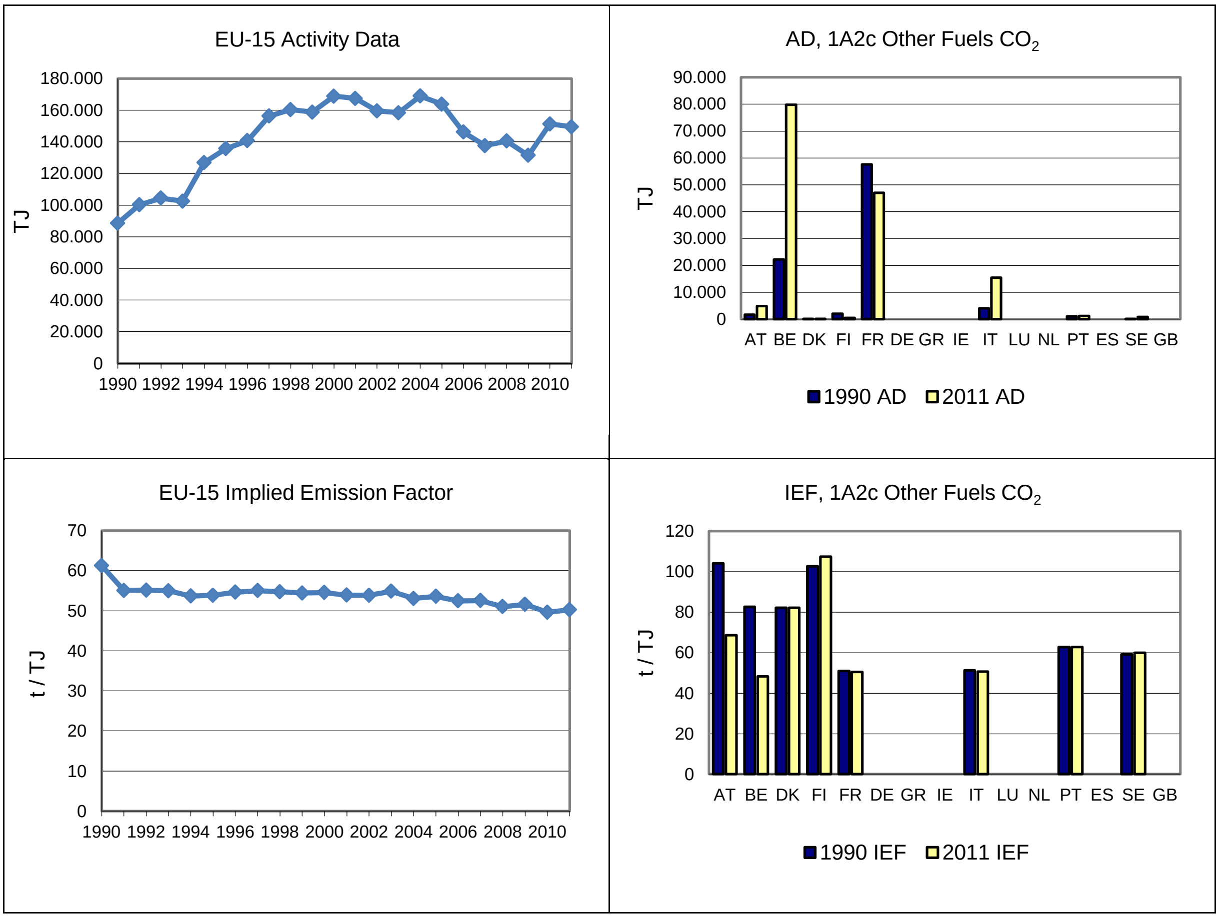
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	174	334	334	4.4%	1	0%	160	92%	T2	D,PS
Belgium	1 834	3 747	3 855	51.3%	107	3%	2 021	110%	T3	PS
Denmark	0	1	1	-	0	0%	0	66%	CR	CS
Finland	202	11	44	0.6%	33	305%	-158	-78%	T3	CS
France	2 941	2 407	2 375	31.6%	-31	-1%	-566	-19%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	208	863	782	10.4%	-81	-9%	574	276%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	63	97	75	1.0%	-22	-23%	12	20%	T2	D, CR
Spain	NA	NA	NA	-	0	-	-	-	NA	NA
Sweden	6	51	48	0.6%	-3	-5%	43	769%	T2	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	NA
EU-15	**5 427**	**7 510**	**7 514**	**100.0%**	**4**	**0%**	**2 087**	**38%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France and Italy; together they cause 93 % of the CO_2 emissions from other fuels in 1A2c. Other fuel consumption in the EU-15 increased by 69 % between 1990 and 2011. The implied emission factor of EU-15 was 50.2 t/TJ in 2011. The increase in activity data 2010 is reported by Italy.

The high implied emission factor 1990 is due to new naphta cracking plants in Belgium which started operation in 1991 and which use recovered fuels with a high share of hydrogen gas. Therefore the IEF of Belgium is much lower for the years after 1990. Because Belgium contributes to 53 % of EU-15 emissions in 2011 it strongly affects the EU-15 IEF.

Figure 3.38 1A2c Chemicals, other fuels: Activity Data and Implied Emission Factors for CO_2

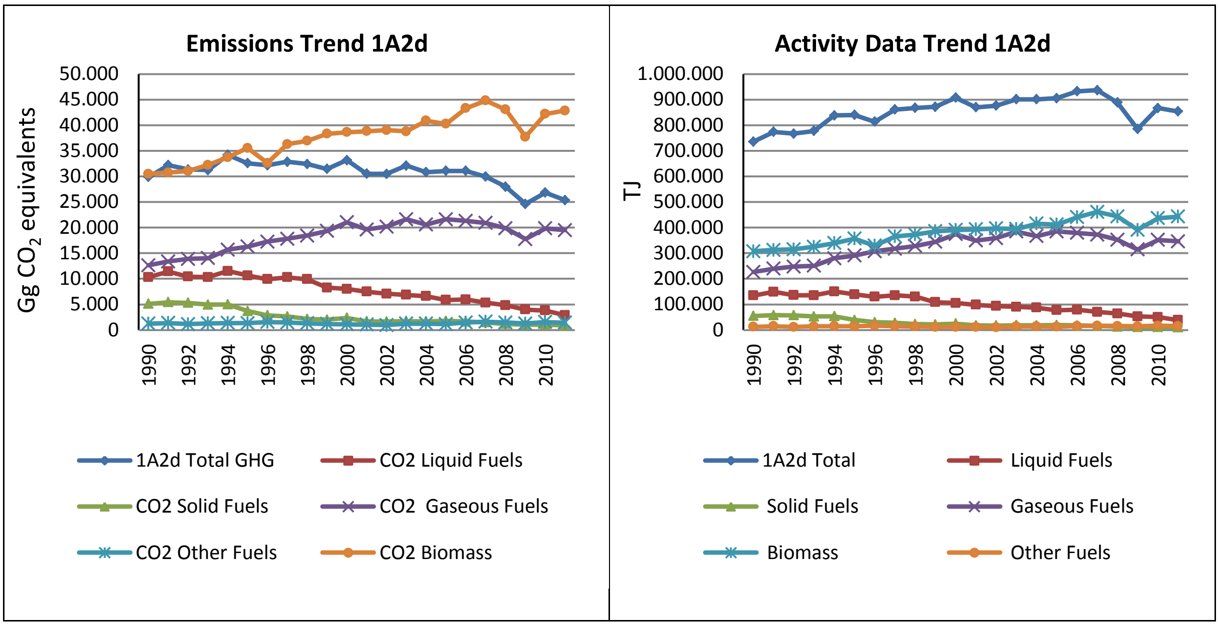


3.2.2.4 *Pulp, Paper and Print (1A2d) (EU-15)*

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print accounted for 5.2 % of 1A2 source category and 0.7 % of total GHG emissions in 2011.

Figure 3.39 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions decreased by 15 %. The share of gaseous fuels (and of biomass) is gradually increasing since 1990.

Figure 3.39 **1A2d Pulp, Paper and Print: Total and CO_2 emission trends**



Between 1990 and 2011, CO_2 emissions from 1A2d Pulp, Paper and Print decreased by 16 % in the EU-15 (Table 3.32), mainly due to decreases in Finland, France, Sweden and the Netherlands. Between 2010 and 2011 emissions decreased by -6 %. Between 1990 and 1999 Luxembourg reported emissions as 'Not occurring' and "Included elsewhere".

Table 3.32 **1A2d Pulp, Paper and Print: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2 213	2 169	2 035	8.2%	-134	-6%	-177	-8%
Belgium	637	620	609	2.5%	-12	-2%	-29	-4%
Denmark	339	152	141	0.6%	-11	-7%	-198	-58%
Finland	5 336	3 648	3 320	13.4%	-328	-9%	-2 016	-38%
France	4 942	3 042	2 372	9.6%	-670	-22%	-2 570	-52%
Germany	4	9	15	0.1%	5	55%	11	302%
Greece	301	179	151	0.6%	-28	-16%	-150	-50%
Ireland	28	19	18	0.1%	-2	-9%	-11	-38%
Italy	3 076	4 578	4 425	17.9%	-153	-3%	1 349	44%
Luxembourg	IE,NO	18	16	0.1%	-3	-14%	16	-
Netherlands	1 743	1 192	1 109	4.5%	-83	-7%	-635	-36%
Portugal	746	1 038	1 035	4.2%	-4	0%	289	39%
Spain	3 211	4 719	4 963	20.1%	244	5%	1 752	55%
Sweden	2 186	1 399	1 115	4.5%	-284	-20%	-1 071	-49%
United Kingdom	4 553	3 427	3 421	13.8%	-6	0%	-1 132	-25%
EU-15	**29 317**	**26 210**	**24 745**	**100.0%**	**-1 465**	**-6%**	**-4 572**	**-16%**

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2d Pulp, Paper and Print - Liquid (CO_2)

In 2011 CO_2 from liquid fuels had a share of 11 % within source category 1A2d (compared to 35 % in 1990). Between 1990 and 2011 the emissions decreased by 72 % (Table 3.33). Between 1990 and 2011 all Member States reported decreasing CO_2 emissions from this source category.

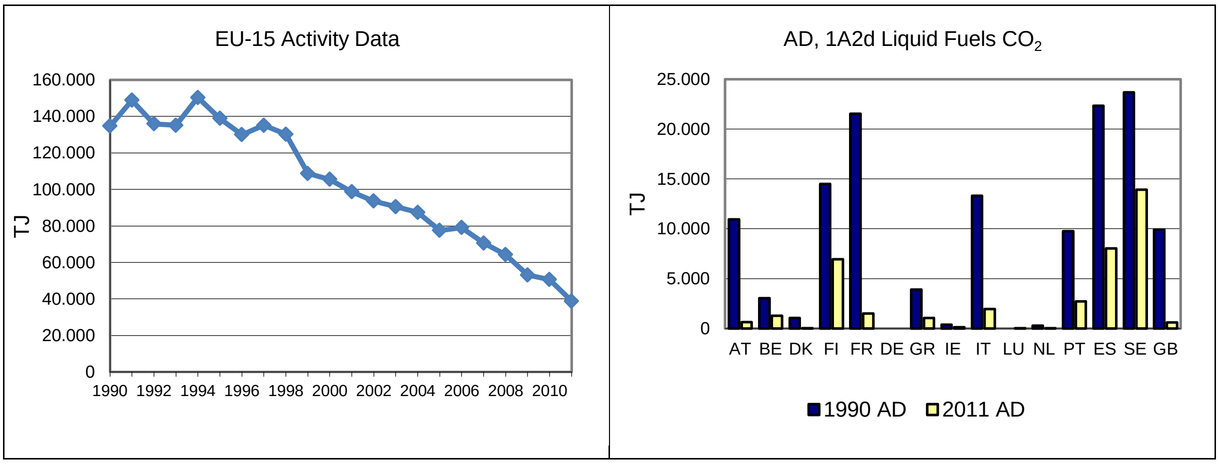
Table 3.33 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

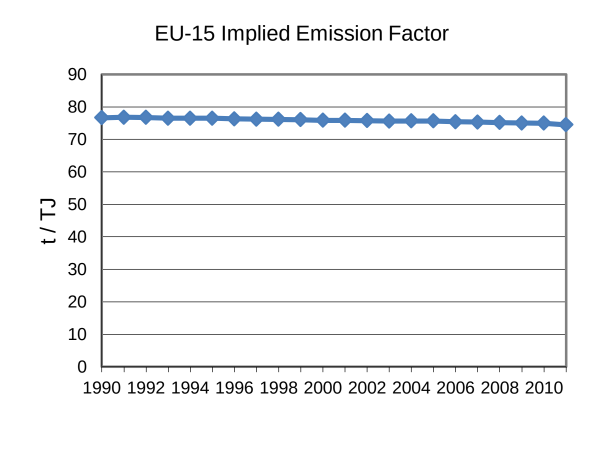
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	853	71	48	1.7%	-23	-33%	-805	-94%	T2	CS,PS
Belgium	232	117	96	3.3%	-21	-18%	-136	-59%	T1	D
Denmark	79	8	1	0.0%	-8	-92%	-79	-99%	CR	CS,D
Finland	1 132	528	518	17.9%	-10	-2%	-614	-54%	T3	CS
France	1 669	368	110	3.8%	-258	-70%	-1 559	-93%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	297	107	76	2.6%	-30	-29%	-221	-74%	T2	PS
Ireland	28	13	9	0.3%	-3	-27%	-19	-68%	T1	CS
Italy	1 015	243	144	5.0%	-99	-41%	-871	-86%	T2	CS
Luxembourg	IE	2	1	0.04%	-1	-33%	1	-	T2	CS
Netherlands	20	1	2	0.1%	2	255%	-18	-89%	T2	CS
Portugal	746	305	207	7.1%	-98	-32%	-539	-72%	T2	D, CR
Spain	1 692	630	598	20.7%	-31	-5%	-1 094	-65%	T2	CR, PS
Sweden	1 786	1 317	1 032	35.7%	-286	-22%	-754	-42%	T2	CS
United Kingdom	767	85	47	1.6%	-38	-44%	-720	-94%	T2	CS
EU-15	**10 317**	**3 795**	**2 890**	**100.0%**	**-905**	**-24%**	**-7 427**	**-72%**		

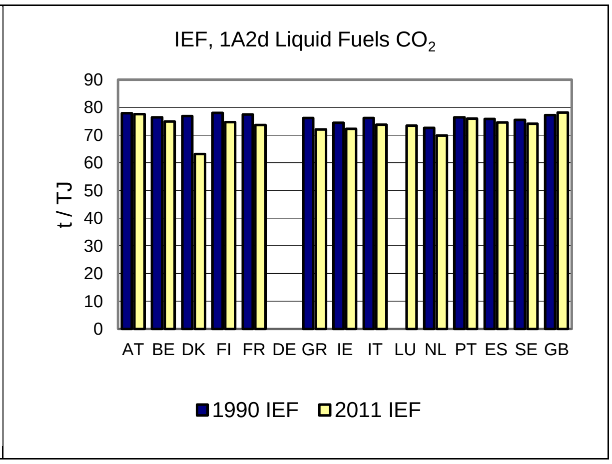
Emissions of Germany and the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.40 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Finland, Portugal, Spain and Sweden; together they cause 81% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-15 decreased by 71 % between 1990 and 2011. The implied emission factor of EU-15 was 74.5 t/TJ in 2011.

Figure 3.40 1A2d Pulp, Paper and Print, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A2d Pulp, Paper and Print - Solid Fuels (CO_2)

In 2011 CO_2 from solid fuels had a share of 4 % within source category 1A2d (compared to 17 % in 1990). Between 1990 and 2011 the emissions decreased by 82 % (Table 3.34). Only seven of the EU-15 Member States reported CO_2 emissions from this source category in 2011.

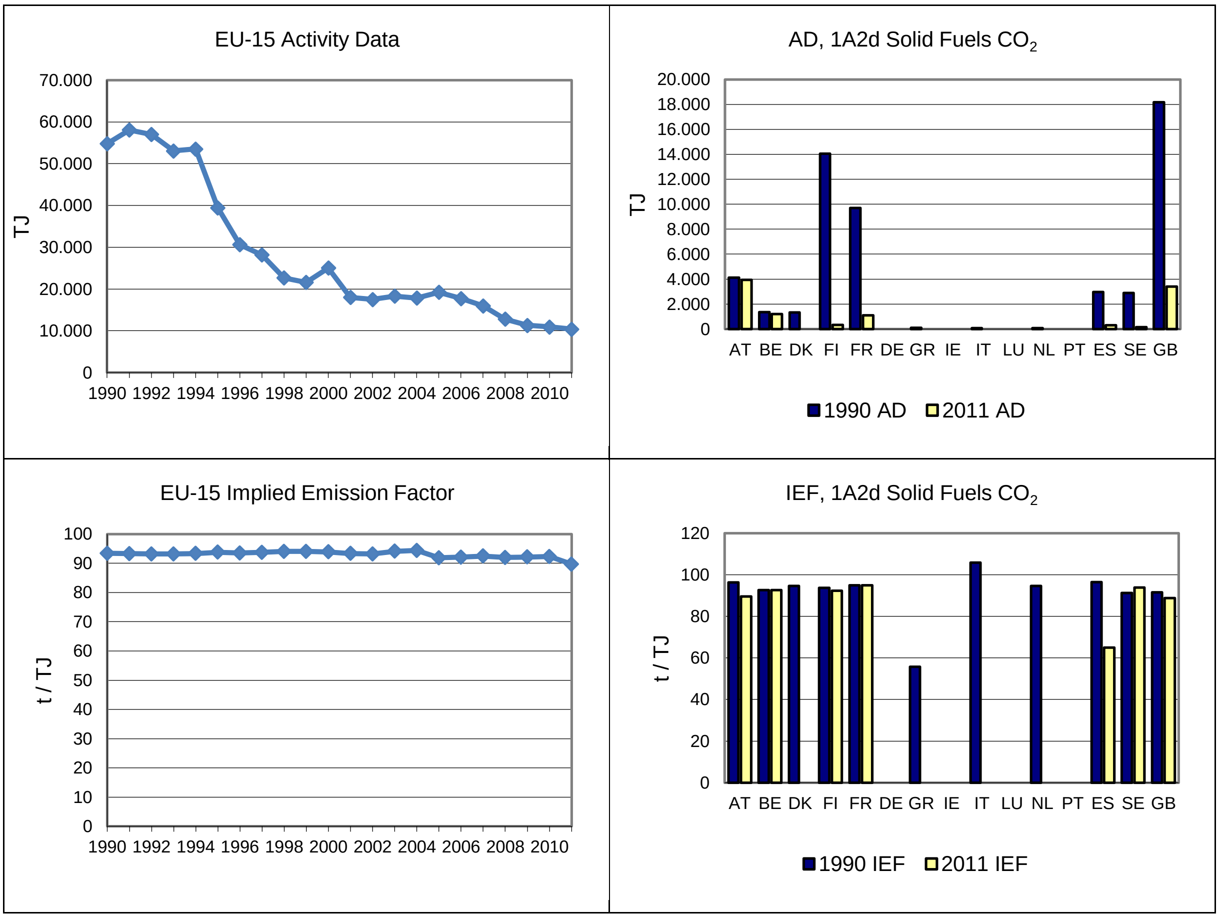
Table 3.34 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	397	326	353	37.8%	27	8%	-45	-11%	T2	CS,PS
Belgium	125	118	111	11.9%	-7	-6%	-14	-11%	T1	D
Denmark	125	NA	NA	-	-	-	-125	-100%	NA	NA
Finland	1 318	80	29	3.2%	-50	-63%	-1 288	-98%	T3	CS
France	922	126	104	11.2%	-22	-17%	-818	-89%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	5	NO	NO	-	-	-	-5	-100%	NA	NA
Ireland	NO	NO	NO	-	-	-	0	-	NA	NA
Italy	6	NO	NO	-	-	-	-6	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	8	NO	NO	-	-	-	-8	-100%	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	286	19	19	2.1%	0	-1%	-267	-93%	T2	CR, PS
Sweden	263	26	14	1.5%	-12	-47%	-249	-95%	T2	CS
United Kingdom	1 664	313	302	32.4%	-12	-4%	-1 362	-82%	T2	CS
EU-15	**5 119**	**1 008**	**931**	**100.0%**	**-76**	**-8%**	**-4 187**	**-82%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.41 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Austria, Belgium, France and the United Kingdom; together they cause around 93 % of the CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption in the EU-15 decreased by 81% % between 1990 and 2011. The implied emission factor of EU-15 was 89.7 t/TJ in 2011. The low IEF of Spain is due to inclusion of gas works gas within this category.

Figure 3.41 1A2d Pulp, Paper and Print, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2d Pulp, Paper and Print - Gaseous Fuels (CO_2)

In 2011, CO_2 from gaseous fuels had a share of 77 % within source category 1A2d (compared to 42 % in 1990). Between 1990 and 2011, the emissions increased by 54 % (Table 3.35). Germany includes emissions in 1A2f.

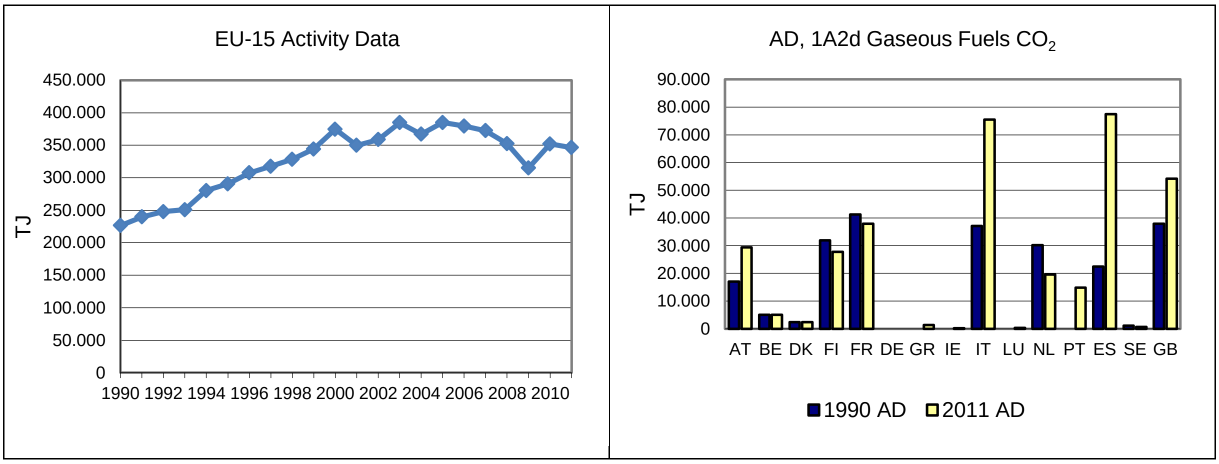
Table 3.35 **1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

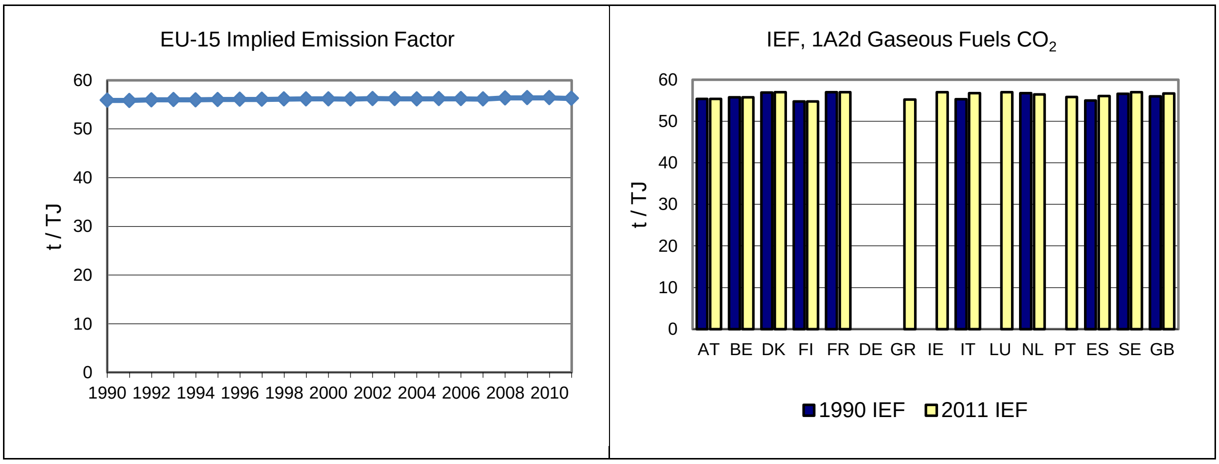
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	943	1 765	1 627	8.3%	-138	-8%	684	73%	T2	CS
Belgium	280	263	281	1.4%	18	7%	0	0%	T1	D
Denmark	134	141	138	0.7%	-3	-2%	5	3%	CR	CS
Finland	1 748	1 649	1 517	7.8%	-132	-8%	-231	-13%	T3	CS
France	2 351	2 548	2 158	11.1%	-390	-15%	-193	-8%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	72	75	0.4%	3	4%	75	-	T2	CS
Ireland	NO	7	8	0.0%	2	-	8	-	T1	CS
Italy	2 055	4 335	4 281	22.0%	-54	-1%	2 226	108%	T2	CS
Luxembourg	IE	17	15	0.1%	-2	-12%	15	-	T2	CS
Netherlands	1 715	1 191	1 106	5.7%	-85	-7%	-609	-36%	T2	CS
Portugal	NO	734	828	4.2%	95	13%	828	-	T2	D, CR
Spain	1 233	4 069	4 345	22.3%	276	7%	3 112	252%	T2	CS
Sweden	66	32	37	0.2%	5	17%	-29	-43%	T2	CS
United Kingdom	2 122	3 029	3 072	15.8%	43	1%	950	45%	T2	CS
EU-15	**12 646**	**19 851**	**19 489**	**100.0%**	**-362**	**-2%**	**6 842**	**54%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.42 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Austria, Finland, France, Italy, Spain and the United Kingdom; together they cause 87 % of the CO_2 emissions from gaseous fuels in 1A2d. Gaseous fuel consumption in the EU-15 rose by 53 % between 1990 and 2011. The implied emission factor of EU-15 was 56.3 t/TJ in 2011.

Figure 3.42 **1A2d Pulp, Paper and Print, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**



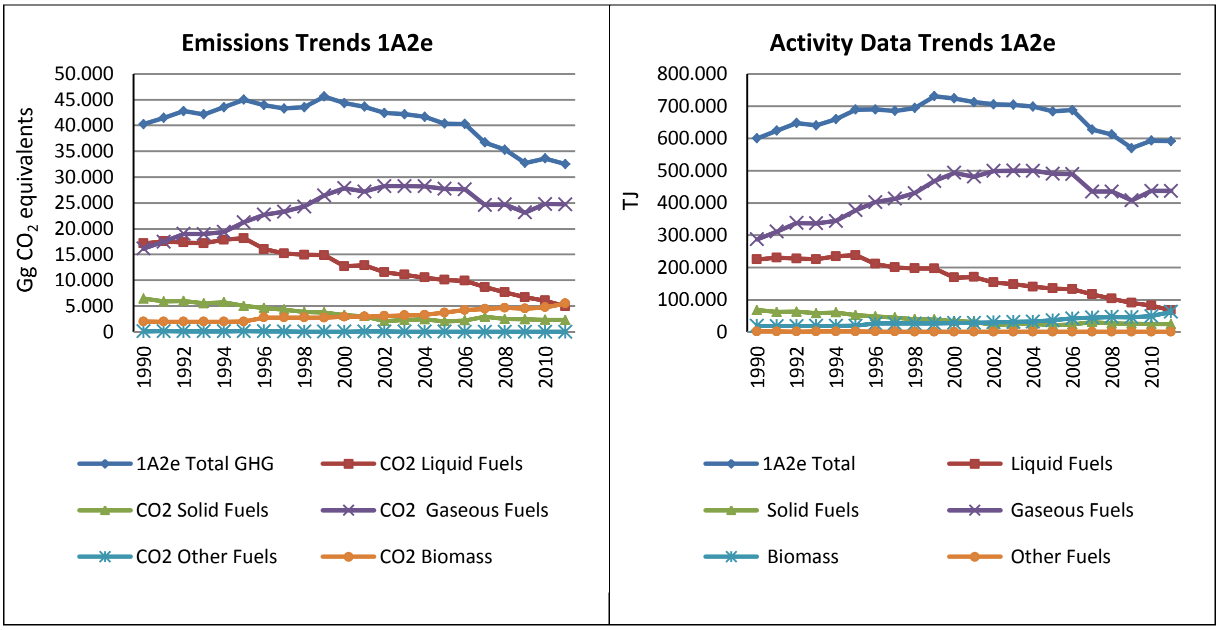


3.2.2.5 ***Food Processing, Beverages and Tobacco (1A2e) (EU-15)***

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 7 % of 1A2 source category and for 0.9 % of total GHG emissions in 2011.

Figure 3.43 shows the emission trend within the category 1A2e, which is dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions decreased by 19 % between 1990 and 2011. Emissions from gaseous fuels increased by 53 %, whereas emissions from all other fossil fuel types decreased.

Figure 3.43 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2011, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco decreased by 20 % in the EU-15 (Table 3.36). Between 2010 and 2011 emissions decreased by 3 %.

Table 3.36 **1A2e Food Processing, Beverages and Tobacco: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	870	957	861	2.7%	-95	-10%	-8	-1%
Belgium	2 990	2 140	2 295	7.2%	155	7%	-695	-23%
Denmark	1 441	1 170	1 210	3.8%	40	3%	-231	-16%
Finland	815	233	238	0.7%	5	2%	-577	-71%
France	9 198	9 506	8 497	26.5%	-1 008	-11%	-701	-8%
Germany	1 989	178	191	0.6%	13	7%	-1 799	-90%
Greece	902	499	401	1.2%	-98	-20%	-502	-56%
Ireland	1 017	993	845	2.6%	-148	-15%	-172	-17%
Italy	3 853	4 397	4 267	13.3%	-131	-3%	413	11%
Luxembourg	16	23	25	0.1%	2	7%	9	54%
Netherlands	4 079	3 447	3 397	10.6%	-50	-1%	-682	-17%
Portugal	822	1 023	945	2.9%	-77	-8%	123	15%
Spain	3 425	3 485	3 693	11.5%	208	6%	268	8%
Sweden	948	484	482	1.5%	-2	0%	-466	-49%
United Kingdom	7 553	4 705	4 751	14.8%	45	1%	-2 802	-37%
EU-15	**39 919**	**33 241**	**32 098**	**100.0%**	**-1 143**	**-3%**	**-7 821**	**-20%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2e Food Processing, Beverages and Tobacco - Liquid (CO_2)

In 2011 CO_2 from liquid fuels decreased to a share of 15 % within source category 1A2e (compared to 43 % in 1990). Between 1990 and 2011, the emissions decreased by 71 % (Table 3.37). Between 1990 and 2011 all Member States showed a reduction of emissions.

Table 3.37 **1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

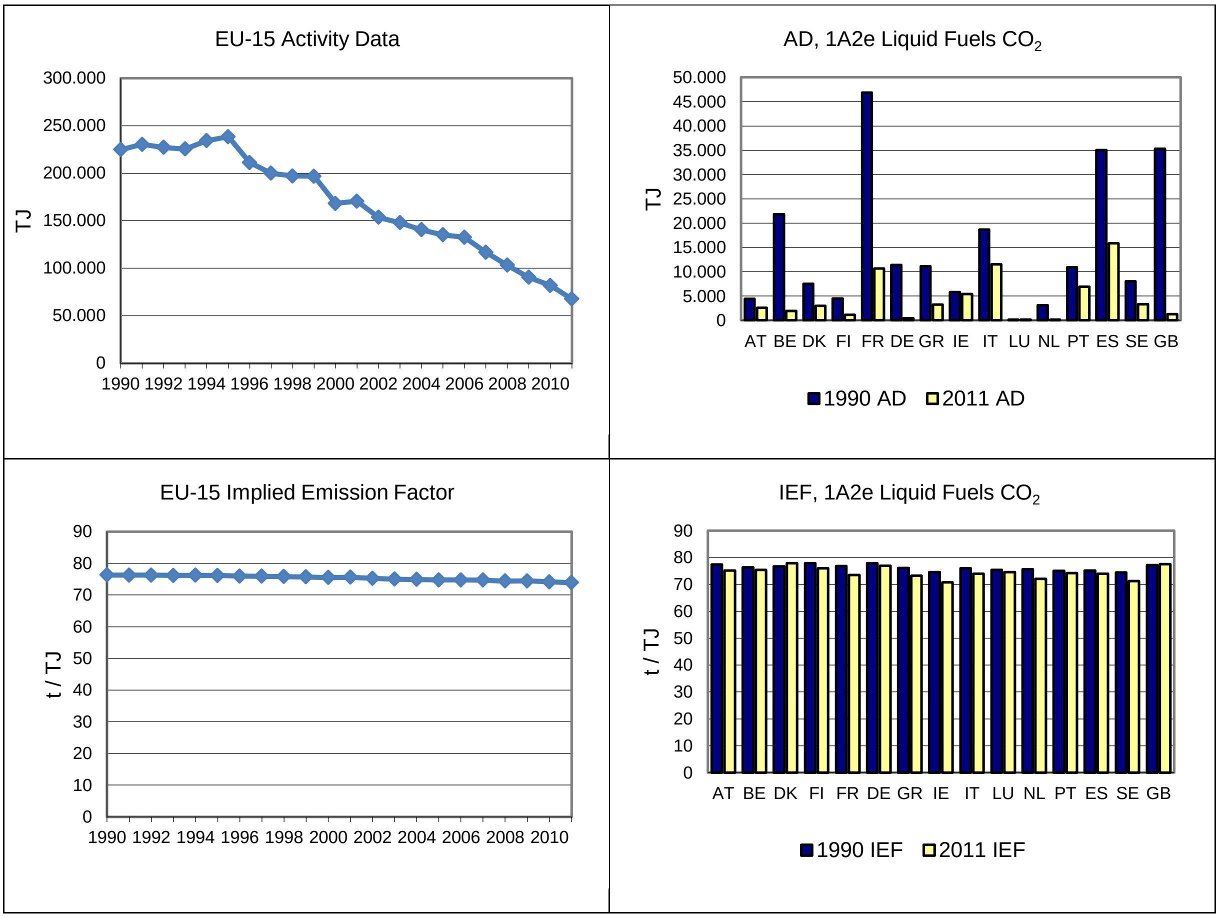
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	345	201	193	3.9%	-8	-4%	-152	-44%	T2	CS,PS
Belgium	1 671	272	147	2.9%	-125	-46%	-1 524	-91%	T1	D
Denmark	576	226	232	4.6%	5	2%	-344	-60%	CR	CS,D
Finland	353	89	89	1.8%	0	0%	-264	-75%	T3	CS
France	3 596	1 047	783	15.7%	-264	-25%	-2 813	-78%	T2, T3	CS
Germany	889	33	32	0.6%	-1	-3%	-857	-96%	CS	CS
Greece	847	294	236	4.7%	-58	-20%	-611	-72%	T2	PS
Ireland	433	565	385	7.7%	-180	-32%	-48	-11%	T1	CS
Italy	1 421	867	855	17.1%	-12	-1%	-566	-40%	T2	CS
Luxembourg	12	9	10	0.2%	1	13%	-2	-17%	T1,T2	CS,D
Netherlands	235	11	10	0.2%	-1	-5%	-225	-96%	T2	CS
Portugal	821	641	513	10.3%	-128	-20%	-308	-37%	T2	D, CR
Spain	2 633	1 386	1 173	23.5%	-213	-15%	-1 460	-55%	T2	CR
Sweden	596	247	235	4.7%	-11	-5%	-361	-61%	T2	CS
United Kingdom	2 727	177	99	2.0%	-78	-44%	-2 628	-96%	T2	CS
EU-15	**17 155**	**6 063**	**4 991**	**100.0%**	**-1 072**	**-18%**	**-12 163**	**-71%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.44 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Italy, Portugal and Spain; together they cause 67 % of the CO_2 emissions from liquid fuels in 1A2e. Fuel consumption in the

EU-15 decreased by 70 % between 1990 and 2011. The implied emission factor of EU-15 was 73.9 t/TJ in 2011.

Figure 3.44 **1A2e Food Processing, Beverages and Tobacco, liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A2e Food Processing Beverages and Tobacco - Solid (CO_2)

In 2011 solid fuels had a share of 7 % within source category 1A2e (compared to 16 % in 1990). Between 1990 and 2011 the emissions decreased by 64 % (Table 3.38) and all Member States reported decreasing CO_2 emissions from this source category.

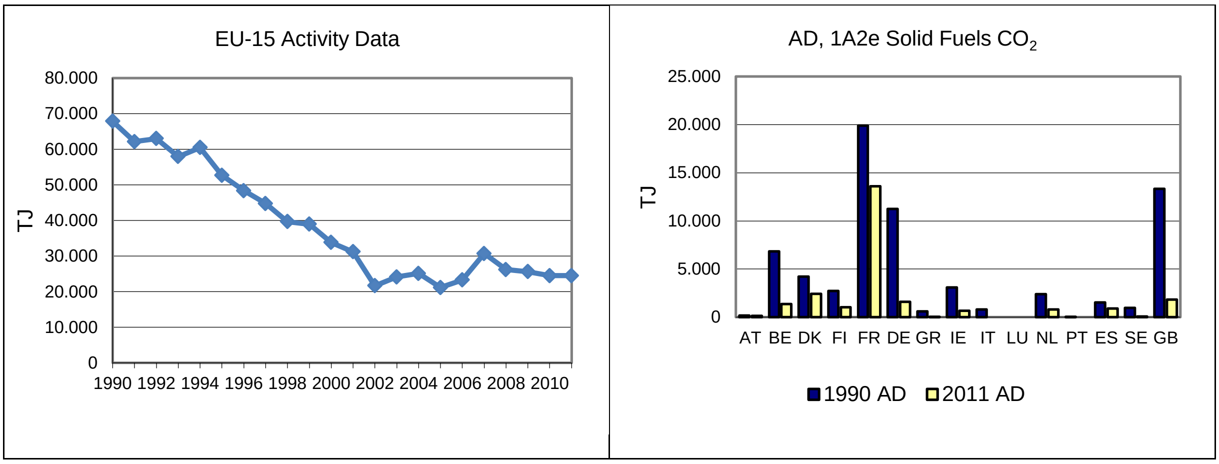
Table 3.38 **1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

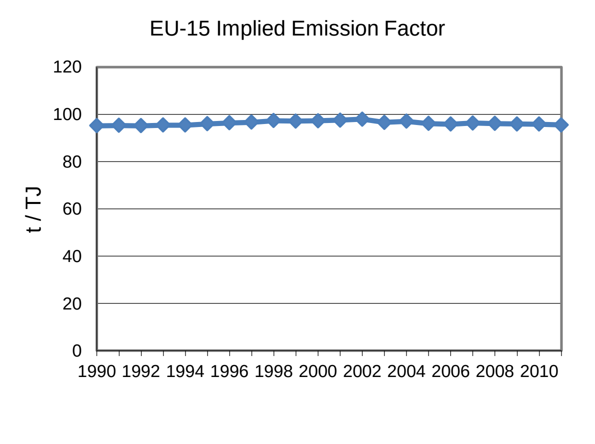
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	18	15	16	0.7%	1	5%	-2	-13%	T2	CS,PS
Belgium	638	143	126	5.4%	-18	-12%	-512	-80%	T1	D
Denmark	402	125	232	9.9%	107	85%	-170	-42%	CR	CS,D
Finland	257	89	96	4.1%	7	8%	-160	-62%	T3	CS
France	1 913	1 329	1 305	55.8%	-25	-2%	-609	-32%	T2, T3	CS
Germany	1 100	145	159	6.8%	14	9%	-941	-86%	CS	CS
Greece	56	15	4	0.2%	-11	-72%	-51	-92%	T2	PS
Ireland	292	62	62	2.7%	0	0%	-229	-79%	T1	CS
Italy	86	NO	NO	-	-	-	-86	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	227	99	77	3.3%	-22	-22%	-150	-66%	T2	CS
Portugal	1	NO	NO	-	-	-	-1	-100%	NA	NA
Spain	161	155	93	4.0%	-61	-40%	-67	-42%	T2	CR
Sweden	90	9	7	0.3%	-2	-23%	-83	-92%	T2	CS
United Kingdom	1 221	160	162	6.9%	2	1%	-1 059	-87%	T2	CS
EU-15	**6 461**	**2 348**	**2 340**	**100.0%**	**-9**	**0%**	**-4 122**	**-64%**		

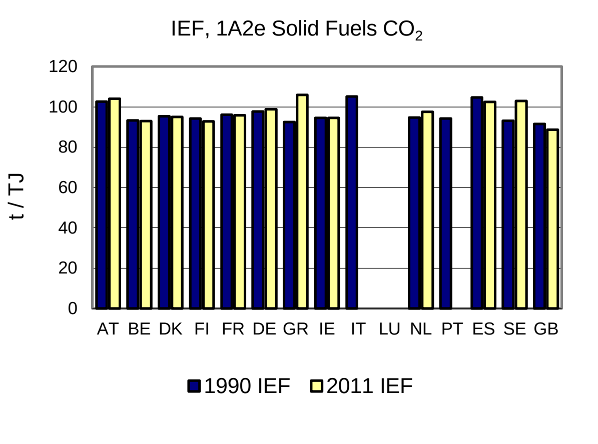
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.45 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France which contributes 56 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 64 % between 1990 and 2011. The implied emission factor of EU-15 was 95.5 t/TJ in 2011.

Figure 3.45 **1A2e Food Processing, Beverages and Tobacco, solid fuels: Activity Data and Implied Emission Factors for CO_2**







1A2e Food Processing Beverages and Tobacco - Gaseous (CO_2)

In 2011 CO_2 from gaseous fuels had a share of 76 % within source category 1A2e (compared to 40 % in 1990). Between 1990 and 2011 the emissions increased by 53 % (Table 3.39). Between 1990 and 2011 most Member States reported increasing CO_2 emissions from this source category. Major absolute increases occurred in Belgium, France, Italy and Spain. With the exception of the years 1995 to 2001 Germany reports emissions in 1A2f.

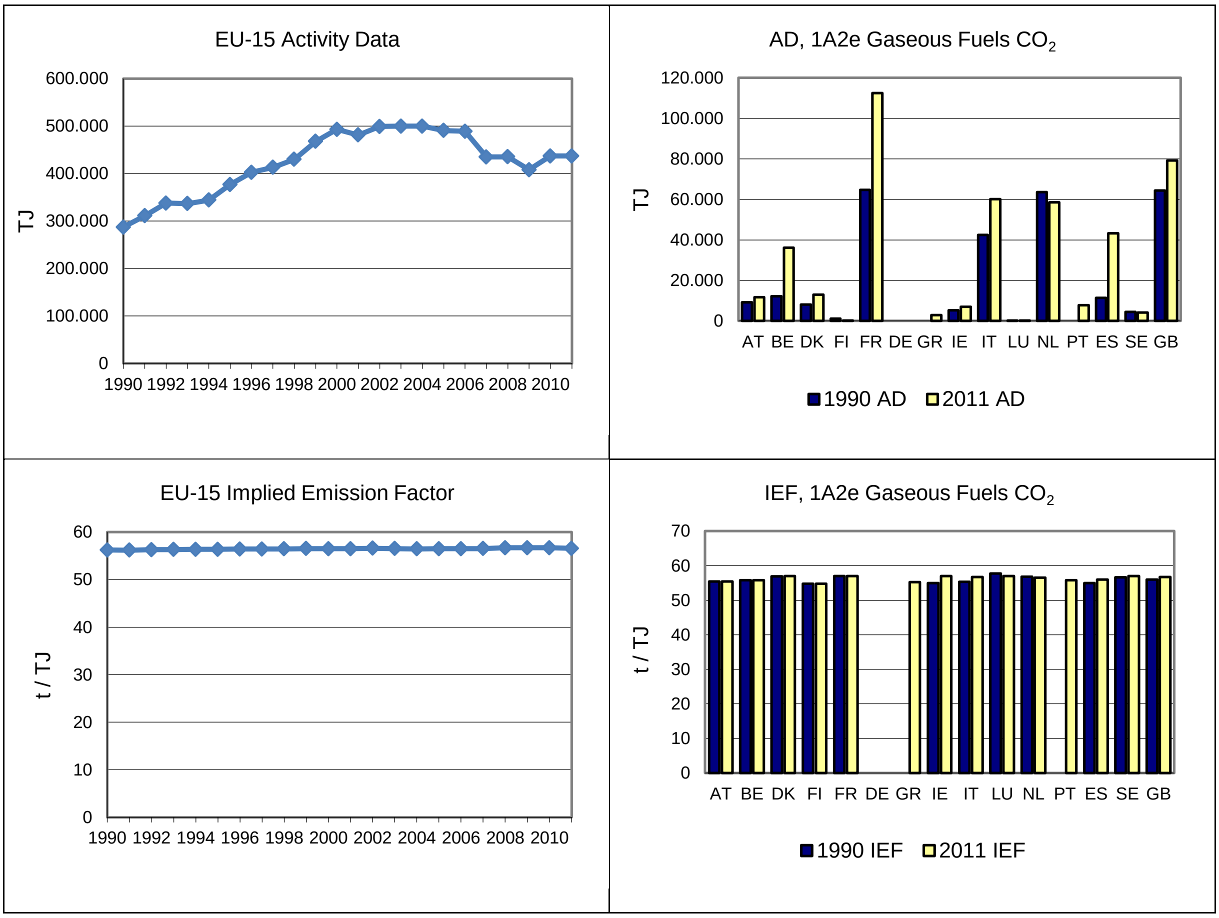
Table 3.39 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	507	741	653	2.6%	-88	-12%	146	29%	T2	CS
Belgium	681	1 725	2 023	8.2%	298	17%	1 342	197%	T1	D
Denmark	463	816	743	3.0%	-72	-9%	280	60%	CR	CS
Finland	67	9	9	0.0%	0	0%	-58	-86%	T3	CS
France	3 688	7 130	6 410	25.9%	-720	-10%	2 722	74%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	189	161	0.6%	-29	-15%	161	-	T2	CS
Ireland	293	366	398	1.6%	32	9%	105	36%	T1	CS
Italy	2 346	3 531	3 412	13.80%	-119	-3%	1 065	45%	T2	CS
Luxembourg	4	14	15	0.06%	0.5	3%	11	286%	T2	CS
Netherlands	3 617	3 337	3 310	13.4%	-28	-1%	-307	-9%	T2	CS
Portugal	NO	382	432	1.7%	50	13%	432	-	T2	D, CR
Spain	631	1 944	2 427	9.8%	483	25%	1 796	285%	T2	CS
Sweden	254	228	240	1.0%	11	5%	-14	-6%	T2	CS
United Kingdom	3 605	4 369	4 489	18.2%	121	3%	885	25%	T2	CS
EU-15	**16 156**	**24 781**	**24 721**	**100.0%**	**-60**	**0%**	**8 565**	**53%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.46 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause about 81 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-15 rose by 52 % between 1990 and 2011. The implied emission factor of EU-15 was 56.6 t/TJ in 2011.

Figure 3.46 **1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**

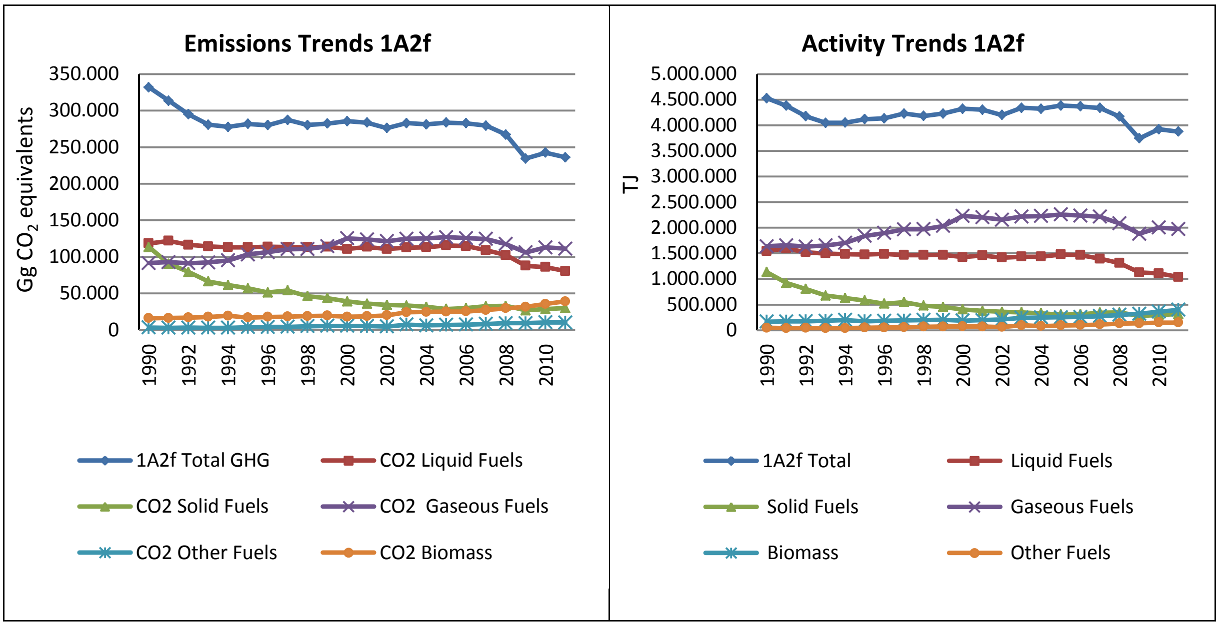


3.2.2.6 *Other (1A2f) (EU-15)*

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Other accounted for 48.6 % for 1A2 source category and for 6.4 % of total GHG emissions in 2011.

Figure 3.47 shows the emission trend within the category 1A2f, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels; the decrease in the early 1990s was mainly due to a decline of solid fuel consumption. Total GHG emissions decreased by 29 %, mainly due to decreases in emissions from solid (-74 %) and liquid (-32 %) fuels.

Figure 3.47 1A2f Other: Total and CO_2 emission trends



Between 1990 and 2011, CO_2 emissions from 1A2f Other decreased by 29 % in the EU-15 (Table 3.40), mainly due to decreases in France(-8,6 Mt) Germany (-57.7 Mt), Italy (-13.8 Mt) and the United Kingdom (-15.6 Mt). The emissions from Spain increased by 8.7 Mt in the same period.

Table 3.40 1A2f Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3 644	4 843	4 673	2.0%	-171	-4%	1 029	28%
Belgium	8 343	6 605	6 526	2.8%	-79	-1%	-1 817	-22%
Denmark	3 205	2 755	2 749	1.2%	-6	0%	-456	-14%
Finland	2 904	1 970	2 095	0.9%	125	6%	-808	-28%
France	27 735	19 970	19 180	8.3%	-790	-4%	-8 555	-31%
Germany	137 299	78 443	79 639	34.4%	1 196	2%	-57 660	-42%
Greece	6 126	4 447	2 913	1.3%	-1 534	-34%	-3 213	-52%
Ireland	1 503	1 730	1 550	0.7%	-179	-10%	48	3%
Italy	40 489	28 038	26 715	11.5%	-1 324	-5%	-13 774	-34%
Luxembourg	646	687	630	0.3%	-57	-8%	-16	-2%
Netherlands	5 826	4 776	4 371	1.9%	-404	-8%	-1 454	-25%
Portugal	5 483	5 664	5 080	2.2%	-584	-10%	-403	-7%
Spain	24 070	33 812	32 738	14.1%	-1 074	-3%	8 669	36%
Sweden	5 462	4 582	4 546	2.0%	-36	-1%	-916	-17%
United Kingdom	53 927	39 605	38 341	16.5%	-1 263	-3%	-15 586	-29%
EU-15	**326 662**	**237 928**	**231 747**	**100.0%**	**-6 181**	**-3%**	**-94 915**	**-29%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2f Other - Liquid Fuels(CO_2)

In 2011 liquid fuels had a share of 34 % within source category 1A2f (compared to 36 % in 1990). Between 1990 and 2011 the emissions decreased by 32 % (Table 3.41). Between 1990 and 2011 the highest absolute decreases were achieved by France, Germany, Italy and the United Kingdom. The highest absolute increases were reported from Austria and Spain.

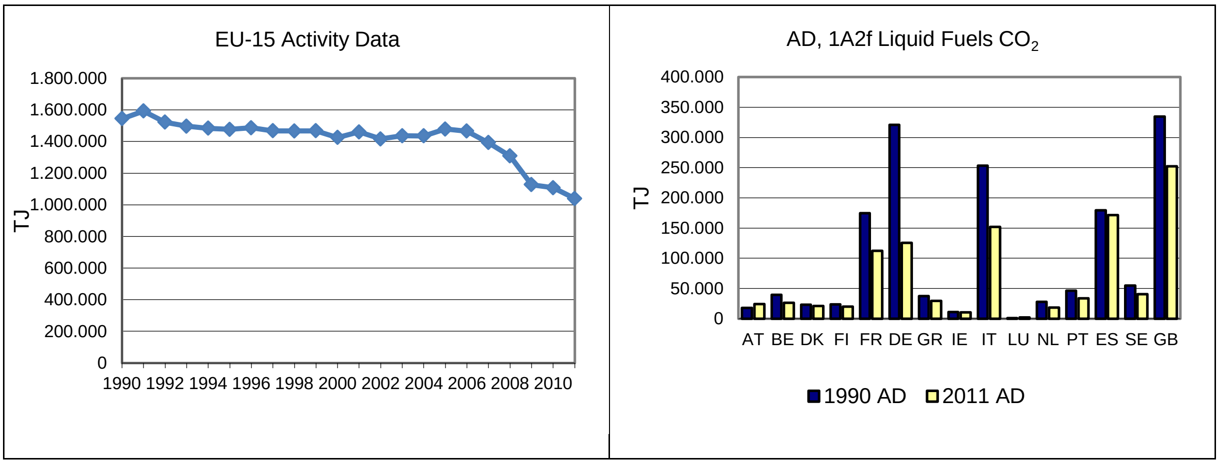
Table 3.41 1A2f Other, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

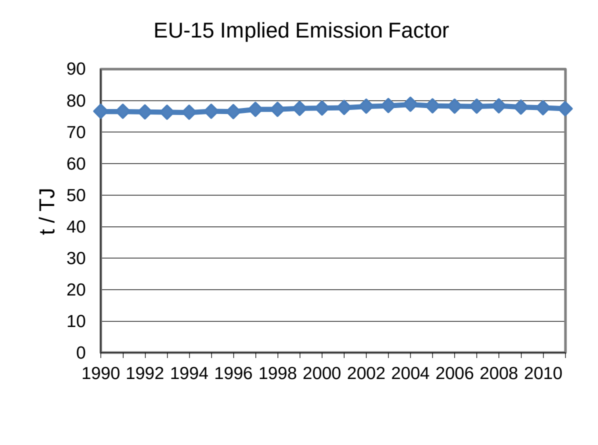
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 376	1 774	1 844	2.3%	70	4%	468	34%	T2,T3	CS,PS
Belgium	3 064	1 903	1 976	2.5%	73	4%	-1 088	-35%	CS,T1	D,PS
Denmark	1 766	1 595	1 653	2.1%	58	4%	-113	-6%	CR	CS,D,PS
Finland	1 809	1 225	1 344	1.7%	119	10%	-465	-26%	CS,M,T3	CS
France	13 772	8 648	8 910	11.1%	262	3%	-4 862	-35%	T2,T3	CS
Germany	24 094	9 842	9 500	11.8%	-342	-3%	-14 594	-61%	CS	CS
Greece	2 828	3 564	2 400	3.0%	-1 163	-33%	-428	-15%	T2	PS
Ireland	824	999	765	1.0%	-234	-23%	-59	-7%	T1	CS
Italy	20 965	13 381	12 978	16.1%	-403	-3%	-7 987	-38%	T2	CS
Luxembourg	88	199	147	0.2%	-52	-26%	58	66%	T1,T2	CS,D
Netherlands	2 107	1 439	1 353	1.7%	-86	-6%	-754	-36%	T2	CS
Portugal	3 345	3 363	2 844	3.5%	-518	-15%	-501	-15%	T2	CR,D,PS
Spain	14 565	16 235	14 842	18.4%	-1 392	-9%	277	2%	T2,T3	CR,CS
Sweden	4 055	3 194	2 992	3.7%	-202	-6%	-1 063	-26%	T1,T2	CS
United Kingdom	23 651	18 749	16 923	21.0%	-1 826	-10%	-6 728	-28%	T2,T3	CS
EU-15	**118 310**	**86 110**	**80 472**	**100.0%**	**-5 638**	**-7%**	**-37 838**	**-32%**		

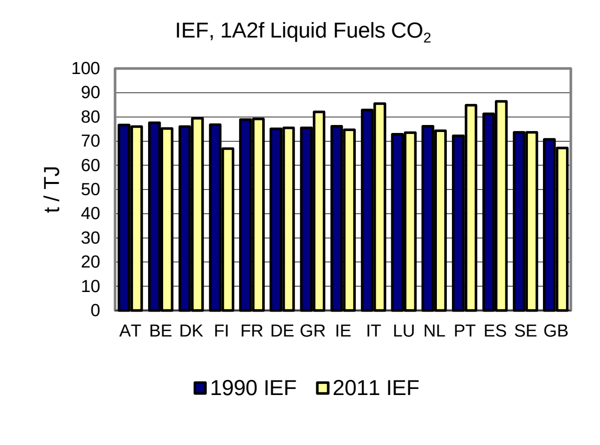
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.48 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, Spain and the United Kingdom; together they cause 55 % of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 33 % between 1990 and 2011. The implied emission factor of EU-15 was 78.3 t/TJ in 2011.

Figure 3.48 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A2f Other - Solid (CO_2)

In 2011 CO_2 from solid fuels had a share of 13 % within source category 1A2f (compared to 34 % in 1990). Between 1990 and 2011 the emissions decreased by 74 % (Table 3.42). Between 1990 and 2011 all Member States reported (partly significant) decreases of emissions; the highest absolute decreases were reported by Germany and the UK. Between 2010 and 2011 EU-15 emissions increased by 5 %.

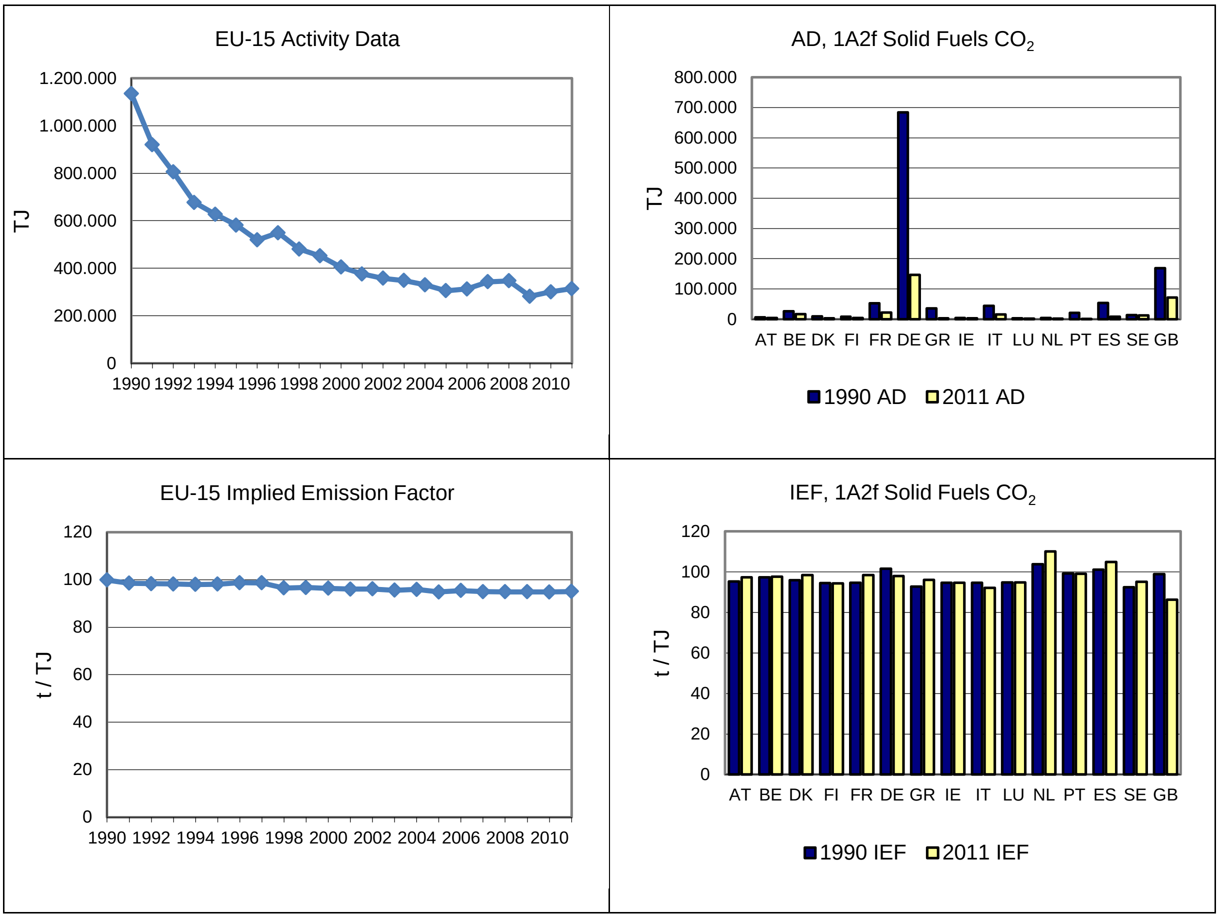
Table 3.42 1A2f Other, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	625	359	350	1.2%	-10	-3%	-276	-44%	T2	CS,PS
Belgium	2 537	1 693	1 648	5.5%	-45	-3%	-889	-35%	CS,T1	D,PS
Denmark	901	327	248	0.8%	-79	-24%	-653	-72%	CR	CS,D,PS
Finland	815	376	336	1.1%	-40	-11%	-479	-59%	T3	CS
France	4 941	1 903	2 141	7.2%	238	13%	-2 800	-57%	T2,T3	CS
Germany	69 494	13 218	14 348	48.1%	1 130	9%	-55 146	-79%	CS	CS
Greece	3 298	655	306	1.0%	-349	-53%	-2 993	-91%	T2	PS
Ireland	389	367	316	1.1%	-51	-14%	-73	-19%	T1	CS
Italy	4 233	1 508	1 444	4.8%	-63	-4%	-2 789	-66%	T2	CS
Luxembourg	333	196	189	0.6%	-7	-4%	-144	-43%	T1	D
Netherlands	388	172	175	0.6%	3	2%	-213	-55%	T2	CS
Portugal	2 126	158	38	0.1%	-121	-76%	-2 088	-98%	T2	CR,D,PS
Spain	5 465	146	875	2.9%	729	501%	-4 590	-84%	T2	CR,CS
Sweden	1 229	1 071	1 208	4.1%	137	13%	-21	-2%	T2	CS
United Kingdom	16 659	6 318	6 211	20.8%	-107	-2%	-10 448	-63%	T2	CS
EU-15	**113 432**	**28 467**	**29 832**	**100.0%**	**1 365**	**5%**	**-83 601**	**-74%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.49 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom; together they cause about 69 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 72 % between 1990 and 2011. The implied emission factor of EU-15 was 95.0 t/TJ in 2011.

Figure 3.49 **1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2**



1A2f Other - Gaseous (CO_2)

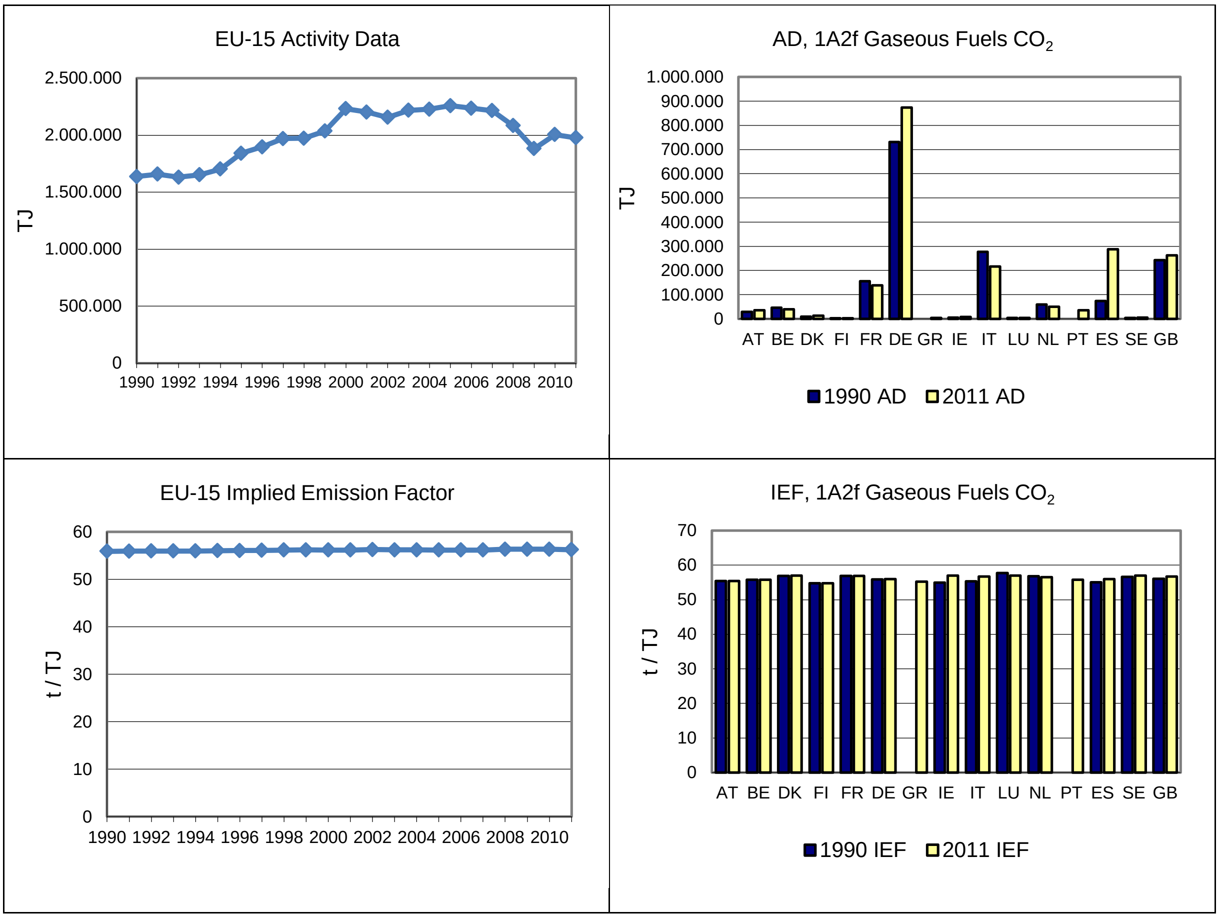
In 2011 CO_2 from gaseous fuels had a share of 47 % within source category 1A2f (compared to 28 % in 1990). Between 1990 and 2011, the emissions increased by 21 % (Table 3.43). Between 1990 and 2011, most Member States showed increasing emissions. Spain, Germany and Portugal showed the highest absolute increases while Italy and France showed the highest absolute decreases.

Table 3.43 **1A2f Other, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 573	2 246	2 001	1.8%	-245	-11%	428	27%	T2	CS
Belgium	2 556	2 371	2 224	2.0%	-147	-6%	-332	-13%	CS,T1	D
Denmark	538	774	768	0.7%	-6	-1%	230	43%	CR	CS
Finland	171	122	132	0.1%	10	8%	-39	-23%	T3	CS
France	8 884	9 173	7 872	7.1%	-1 302	-14%	-1 012	-11%	T2,T3	CS
Germany	40 841	47 947	48 930	44.0%	982	2%	8 089	20%	CS	CS
Greece	NO	210	191	0.2%	-19	-9%	191	-	T2	CS
Ireland	290	347	440	0.4%	92	27%	149	51%	T1	CS
Italy	15 290	13 150	12 292	11.1%	-858	-7%	-2 998	-20%	T2	CS
Luxembourg	225	241	245	0.2%	4	2%	20	9%	T2	CS
Netherlands	3 331	3 165	2 843	2.6%	-321	-10%	-487	-15%	T2	CS
Portugal	NO	1 947	1 990	1.8%	44	2%	1 990	-	T2	CR,D,PS
Spain	4 039	16 768	16 128	14.5%	-640	-4%	12 088	299%	T2	CS
Sweden	178	248	272	0.2%	25	10%	94	53%	T1,T2	CS
United Kingdom	13 616	14 211	14 865	13.4%	654	5%	1 249	9%	T2	CS
EU-15	**91 532**	**112 919**	**111 192**	**100.0%**	**-1 727**	**-2%**	**19 660**	**21%**		

Figure 3.50 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy, Spain and the United Kingdom; together they cause 83 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-15 rose by 21 % between 1990 and 2011. The implied emission factor of EU-15 was 56.2 t/TJ in 2011.

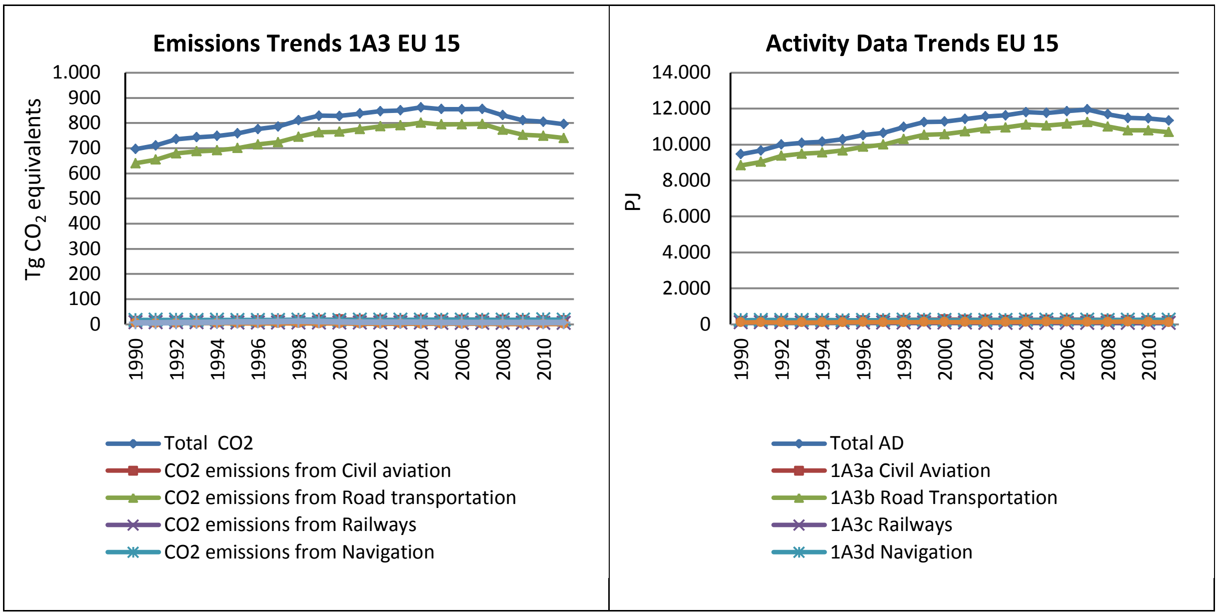
Figure 3.50 **1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**



3.2.3 Transport (CRF Source Category 1A3) (EU-15)

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.51. CO_2 emissions from this source category account for 22%, CH_4 for 0.03 %, N_2O for 0.21 % of total GHG emissions. Between 1990 and 2011, greenhouse gas emissions from transport increased by 14.2 % in the EU-15.

Figure 3.51 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Tg) and Activity Data in TJ



This source category includes ten key categories:

- 1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: LPG (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
- 1 A 3 d Navigation: Residual Oil (CO_2)

Table 3.44 shows total GHG, CO_2 and N_2O emissions from 1A3 Transport.

Table 3.44 **1A3 Transport: Member States' contributions to CO_2 emissions and N_2O emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	CO2 emissions in 2011 (Gg CO_2 equivalents)
Austria	14 029	21 750	13 771	21 523	193	213
Belgium	20 815	27 047	20 427	26 773	261	256
Denmark	10 778	12 865	10 619	12 716	111	136
Finland	12 757	13 228	12 483	13 015	174	176
France	121 215	132 045	119 377	130 457	994	1 398
Germany	164 722	157 179	162 366	155 635	1 236	1 390
Greece	14 544	20 300	14 123	19 961	315	258
Ireland	5 121	11 290	5 022	11 162	62	110
Italy	103 106	117 851	101 269	116 428	1 015	1 129
Luxembourg	2 721	6 849	2 673	6 760	30	82
Netherlands	26 255	35 218	25 994	34 900	103	272
Portugal	10 309	17 550	10 140	17 351	83	170
Spain	55 743	87 385	54 897	86 450	528	845
Sweden	19 301	20 000	18 896	19 787	218	163
United Kingdom	115 212	115 175	113 342	114 166	1 236	940
EU-15	**696 628**	**795 734**	**685 397**	**787 084**	**6 557**	**7 540**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.45 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A3 Transport for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 3.45 1A3 Transport: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-1	0.0	-1	0.0	Rounding difference and revised NVCs.
Belgium	326	1.6	2 858	11.9	Final energy balance available; Liquid Fuels: Copert EFs according ICR.
Denmark	2	0.0	-27	-0.2	The total mileage per vehicle category from 1985-2010 have been updated based on new data prepared by DTU Transport and minor fuel statistical changes from the Danish Energy Agency.
Finland	0	0.0	-140	-1.0	Corrections in activity data (erraneous formula).
France	1	0.0	77	0.1	Pour le transport routier, une mise à jour des facteurs de consommation des poids lourds a entrainé une légère modification des émissions de CH4 et de CO2 sur toute la période. Concernant le CO2, les émissions augmentent de 1 Gg pour 1990 et de 126 Gg pour 2010, en lien avec le changement du taux d'incorporation de biocarburant. De plus, la mise à jour des données d'incorporation des biocarburants a modifié les émissions de CO2 en 2010.
Germany	0	0.0	227	0.1	Revised national energy balance
Greece	-364	-2.5	-910	-4.03	Update of LTO number and average consumption per flight
Ireland	0	0.0	-5	0.0	Minor revision to energy data.
Italy	0	0.0	98	0.1	Update of the COPERT 4 version.
Luxembourg	72	2.8	92	1.5	Following a recommendation by the TERT (during the EU ESD review), the country-specific CO2 emission factor for motor gasoline was set 72'000 kg CO2/TJ for the entire time-series. Revision of the final consumption (2000-2010).
Netherlands	-13	-0.1	163	0.5	Improved method. Improved fuel consumption.
Portugal	0	0.0	-7	0.0	CO2 emission factor correction for gaseous fuel in road transportation; Revision of the 2010 energy balance data by national energy authority for: aviation gasoline and railways.
Spain	759	1.4	529	0.6	A transcription error in the applied figure on total aviation fuel sales has been corrected for 2010, affecting consumption estimates of all fuel types (aviation gasoline and jet kerosene) and all traffic segments (domestic and international aviation). The recalculations for road transportation/gasoline, LPG, natural gas is due to the introduction of the CO2 emissions from lubricant oil consumption. The recalculation for road transportation/diesel oil is due to the introduction of the CO2 emissions from lubricant oil consumption and the change of the activity data. The information reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. The information for navigation/residual oil reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. Revision of fuel consumption with the updated information provided by compressor stations of natural gas
Sweden	-3	0.0	-280	-1.4	Adjustment of activity data for 2009 and 2010 for residual fuel under navigation.
UK	108	0.1	-1 578	-1.3	Liquid fuels: Updated fleet composition and vkm data.
EU-15	**885**	**0.1**	**1 095**	**0.1**	

Table 3.46 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A3 Transport for 1990 and 2010.

Table 3.46 1A3 Transport: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	1	0.3	Transport model update and revised NVCs in liquid fuels.
Belgium	6	2.3	9	3.7	New MIMOSA version in Flanders for liquid fuels. Before 2013, emissions from biomass were included in fossil fuels.
Denmark	-2	-1.8	1	0.5	The total mileage per vehicle category from 1985-2010 have been updated based on new data prepared by DTU Transport and minor fuel statistical changes from the Danish Energy Agency. Also, revisions have been made to the cut-off mileage for N2O emission deterioration for catalyst cars, being in line with the updated version of COPERT IV.
Finland	0	0.0	0	0.0	
France	2	0.2	5	0.4	Pour le N2O, les émissions augmentent de 3,1 en 1990 et de 3,1 en 2010 en raison de la correction du facteur d'émission à froid des véhicules particuliers et des utilitaires légers.
Germany	-6	-0.5	-1	-0.1	Revised national energy balance; recalculation of mileage shares of distinct vehicle types
Greece	-4	-1.3	-10	-2.9	Update of LTO number and average consumption per flight.
Ireland	3	5.5	1	0.6	Change of software versions from COPERT4v8.0 to COPERT4v9.1.
Italy	-13	-1.2	-24	-2.1	Update of the COPERT 4 version.
Luxembourg	3	12.7	8	11.6	Following the use of an updated version of the COPERT model (latest version used is v10.0, previous version used was v9.0) and some minor corrections in the fleet data, the CH4 and N2O emissions were revised.
Netherlands	-185	-64.3	-170.2	-39.0	Improved fuel consumption.
Portugal	0	0.0	0	0.0	
Spain	0	0.1	-45	-5.0	Road transport, diesel oil: The recalculation is due to the change of consumption factors of buses and heavy duty vehicles in the COPERT methodology and the change of the activity data.
Sweden	0	0.0	-3	-1.7	HBEFA: Adjusted fuel consumption considering the use of air conditioning in passengers cars for all years. Corresponding emissions recalculated. Adjusted faulty coding of HDV resulting in a younger vehicle fleet. Corresponding emissions recalculated. Adjusted traffic loads on roads for all vehicles all the way back to 1999. Corresponding emissions recalculated.
UK	-158	-11.4	-249	-21.5	Error corrected for civil aviation/jet kerosine in converting military fuel consumption data by financial year to calendar year. This has lead to reallocations of aviation turbine fuel from other aviation sources. Updated fleet composition and vkm data for road transportation/gasoline and diesel oil. Updated rail model used for railways/liquid fuels.
EU-15	**-353**	**-5.1**	**-477**	**-6.0**	

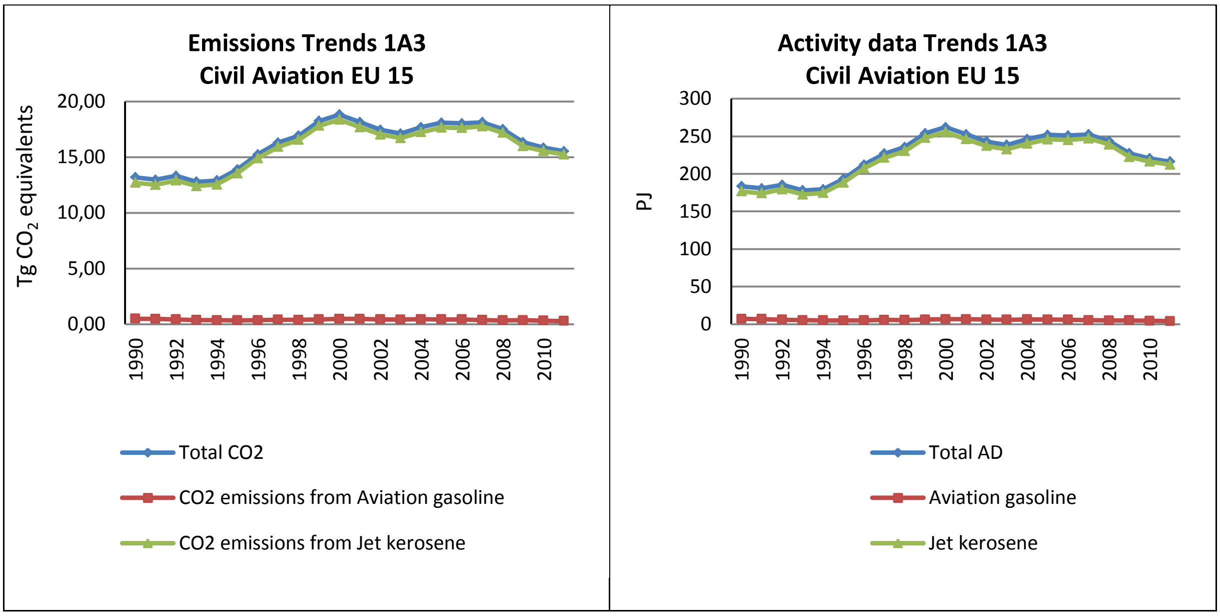
3.2.3.1 *Civil Aviation (1A3a) (EU-15)*

This source category includes emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages.

CO_2 emissions from 1A3a Civil Aviation account for 2% of total transport-related GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from civil aviation increased by 18 % in the EU-15 (Table 3.47, Figure 3.52).

CO_2 emissions from Jet Kerosene account for 98.2 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2010 and 2011, CO_2 emissions from civil aviation decreased by 2 % in the EU-15 (Table 3.47, Figure 3.52).

Figure 3.52 1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Tg) and Activity data in TJ



The Member States France, Germany, Italy and Spain alone contributed 78.5 % to the emissions from this source. Most Member States increased emissions from civil aviation between 1990 and 2011 (Table 3.47).

Table 3.47 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	32	64	62	0.4%	-2	-3%	30	93%
Belgium	13	37	36	0.2%	-1	-2%	23	181%
Denmark	243	156	146	0.9%	-10	-6%	-97	-40%
Finland	385	253	244	1.6%	-9	-4%	-141	-37%
France	4 241	4 477	4 727	30.4%	250	6%	486	11%
Germany	2 309	2 058	1 837	11.8%	-221	-11%	-473	-20%
Greece	353	397	348	2.2%	-49	-12%	-5	-1%
Ireland	51	40	19	0.1%	-21	-53%	-32	-63%
Italy	1 613	2 319	2 299	14.8%	-20	-1%	686	43%
Luxembourg	0.2	1	1	0.004%	0.03	6%	0.4	165%
Netherlands	28	24	22	0.1%	-1	-5%	-5	-19%
Portugal	228	396	354	2.3%	-42	-11%	126	55%
Spain	1 762	3 511	3 338	21.5%	-173	-5%	1 576	89%
Sweden	673	477	525	3.4%	48	10%	-148	-22%
United Kingdom	1 254	1 634	1 568	10.1%	-65	-4%	314	25%
EU-15	**13 185**	**15 843**	**15 526**	**100.0%**	**-317**	**-2%**	**2 341**	**18%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2011 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 98.2 % of CO_2 emissions in 1A3a. Within the EU-15 the emissions increased between 1990 and 2011 by 20 % (Table 3.48). By far the largest absolute increase occurred in Spain. Between 2010 and 2011, the emissions decreased by 2 %.

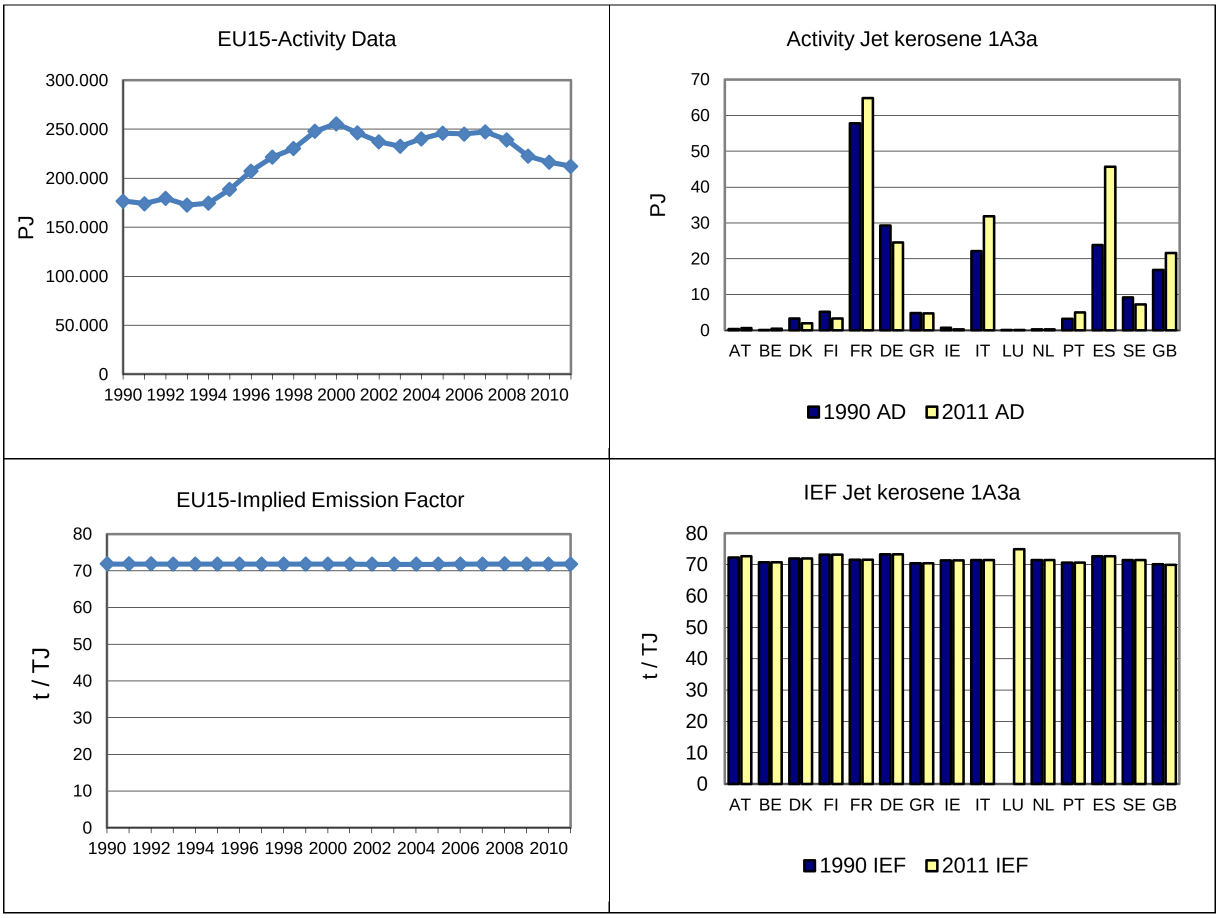
Table 3.48 1A3a Civil Aviation, jet kerosene: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	24	54	48	0.3%	-6	-12%	24	99%	T3	CS
Belgium	5	34	33	0.22%	-1	-3%	29	591%	T1	D
Denmark	234	151	142	0.9%	-9	-6%	-93	-40%	OTH	CS
Finland	377	250	241	1.6%	-9	-4%	-136	-36%	M	CS
France	4 135	4 405	4 643	30.5%	238	5%	508	12%	T2	CS
Germany	2 140	2 018	1 794	11.8%	-224	-11%	-346	-16%	T2,CS	CS
Greece	341	381	333	2.2%	-47	-12%	-8	-2%	T2	D
Ireland	48	38	17	0.1%	-21	-56%	-32	-66%	T2	CS
Italy	1 579	2 261	2 278	14.9%	17	1%	698	44%	T1,T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	16	16	16	0.1%	0	0%	0	0%	T2	CS
Portugal	226	393	352	2.3%	-41	-10%	126	56%	T2	D
Spain	1 727	3 485	3 319	21.8%	-167	-5%	1 592	92%	T2	D
Sweden	658	470	517	3.4%	48	10%	-141	-21%	T1	CS
United Kingdom	1 184	1 580	1 510	9.9%	-70	-4%	326	28%	T3	CS
EU-15	**12 697**	**15 537**	**15 244**	**100.0%**	**-293**	**-2%**	**2 547**	**20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 88.9 % of CO_2 emissions and for 88.8 % of activity data from jet kerosene in 2011 (Figure 3.53). The IEF for the EU-15 is 71.8 t/TJ jet kerosene in 2011. Table 3.48 shows that the majority of emissions from Civil Aviation jet kerosene were calculated using a higher tier method.

Figure 3.53 1A3a Civil Aviation, jet kerosene: Activity data and implied emission factors for CO_2



3.2.3.2 *Road Transportation (1A3b) (EU-15)*

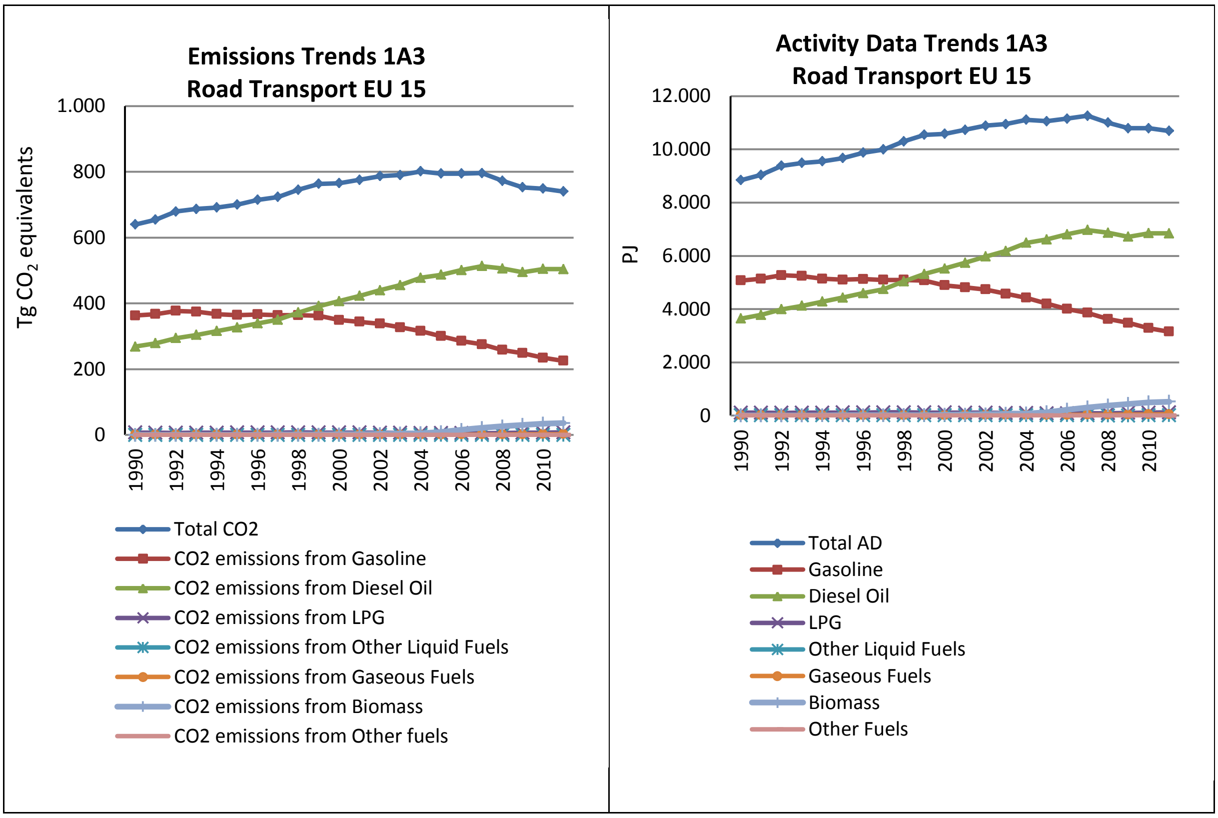
CO_2 emissions from 1A3b Road Transportation

The mobile source category Road Transportation includes all types of light-duty vehicles such as passenger cars and light commercial trucks, and heavy-duty vehicles such as tractors, trailers and buses, and two and three-wheelers (including mopeds, scooters, and motorcycles). These vehicles operate on many types of gaseous and liquid fuels.

CO_2 emissions from 1A3b Road Transportation is the second largest key source of all categories in the EU-15 accounting for 20.4 % of total GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from road transportation increased by 16 % in the EU-15 (Table 3.49). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 16 % between 1990 and 2010.

Figure 3.54 gives an overview of the CO_2 trend caused by different fuels. The trend is mainly dominated by emissions resulting from the combustion of gasoline and diesel oil. The decline of gasoline and the strong increase of diesel show the gradual switch from gasoline to diesel passenger cars in several EU-15 Member States.

Figure 3.54 **1A3b Road Transport: CO_2 Emission Trend and Activity Data**



The Member States Germany, France, Italy, Spain and the United Kingdom contributed most to the CO_2 emissions from this source (76.5 %). All Member States, except for Germany (-2%), increased emissions from road transportation between 1990 and 2011. The Member States with the highest increases in absolute terms were France, Italy, the Netherlands and Spain. The countries with the lowest increase in relative terms were Finland, France, Sweden and the United Kingdom (Table 3.49).

Table 3.49 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	13 323	21 660	20 909	2.8%	-751	-3%	7 586	57%
Belgium	19 595	26 055	25 975	3.5%	-80	0%	6 380	33%
Denmark	9 284	12 081	11 758	1.6%	-323	-3%	2 475	27%
Finland	10 806	11 670	11 487	1.6%	-183	-2%	681	6%
France	112 788	123 982	123 538	16.7%	-443	0%	10 750	10%
Germany	150 358	145 461	147 867	20.0%	2 407	2%	-2 491	-2%
Greece	11 742	18 907	17 260	2.3%	-1 647	-9%	5 518	47%
Ireland	4 690	10 946	10 696	1.4%	-250	-2%	6 006	128%
Italy	93 387	108 678	108 426	14.6%	-253	0%	15 038	16%
Luxembourg	2 647	6 294	6 747	0.9%	454	7%	4 101	155%
Netherlands	25 470	33 900	34 107	4.6%	207	1%	8 637	34%
Portugal	9 476	18 042	16 754	2.3%	-1 288	-7%	7 278	77%
Spain	51 201	83 319	78 890	10.7%	-4 429	-5%	27 689	54%
Sweden	17 308	18 958	18 412	2.5%	-546	-3%	1 105	6%
United Kingdom	108 135	109 174	107 653	14.5%	-1 521	-1%	-482	0%
EU-15	**640 210**	**749 128**	**740 482**	**100.0%**	**-8 647**	**-1.2%**	**100 271**	**16%**

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 68.1 % of CO_2 emissions from 1A3b Road Transport in 2011 (Figure 3.54). All Member States increased emissions from Diesel oil between 1990 and 2011 (Table 3.50). Member States with the highest increase in percent were Austria, Ireland, Luxembourg, Portugal and Spain. Some of these increases are due to fuel bought in the respective countries but consumed abroad (fuel tourism).

Table 3.50 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

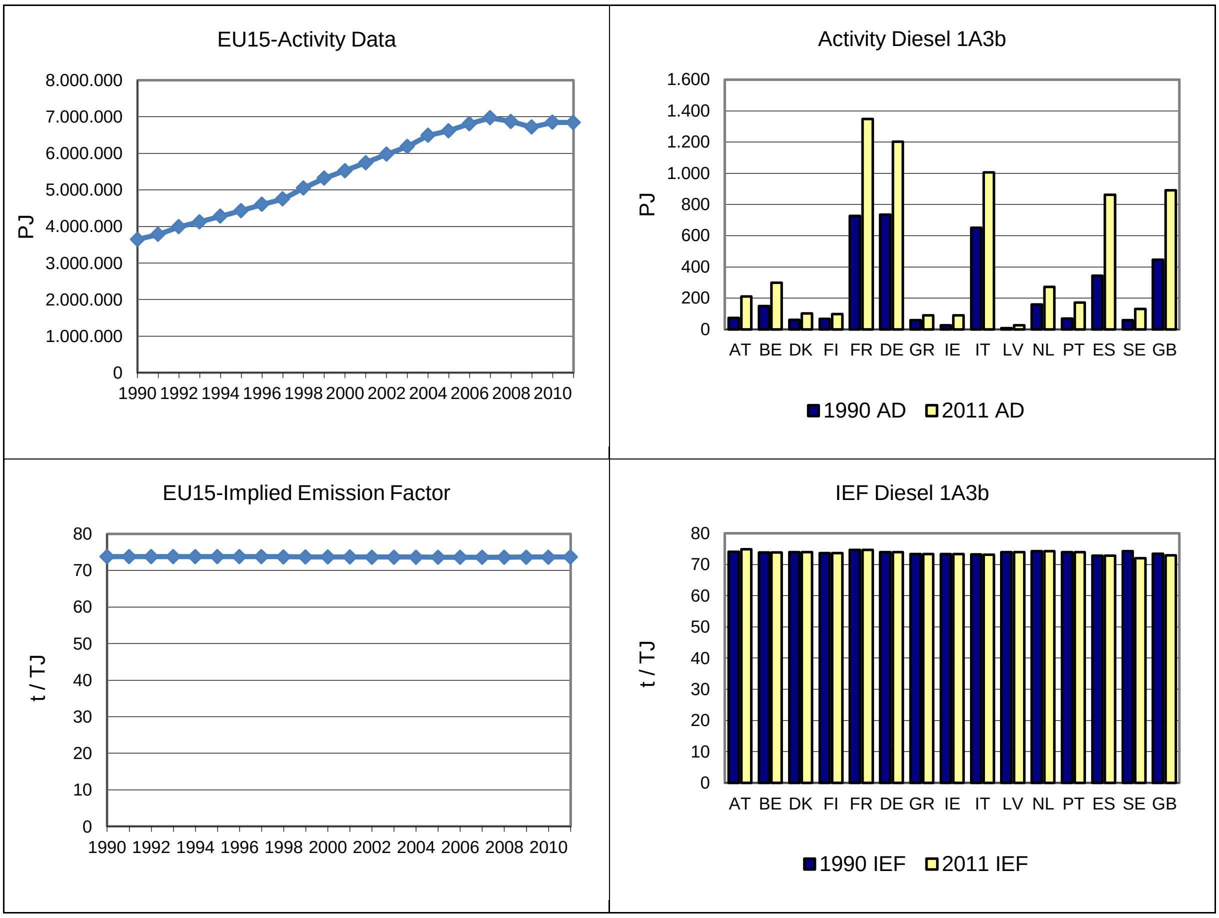
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	5 361	16 279	15 722	3.1%	-556	-3%	10 362	193%	CS,M	CS
Belgium	10 964	22 142	21 980	4.4%	-162	-1%	11 016	100%	T1	CR,CS
Denmark	4 436	7 498	7 523	1.5%	25	0%	3 087	70%	OTH	CS
Finland	4 923	7 135	7 203	1.4%	68	1%	2 280	46%	M	CS
France	54 305	99 649	100 631	20.0%	982	1%	46 326	85%	T3	CS
Germany	54 458	86 437	88 910	17.6%	2 473	3%	34 452	63%	T2,CS	CS
Greece	4 326	7 592	6 582	1.3%	-1 010	-13%	2 256	52%	T1	D
Ireland	1 914	6 541	6 524	1.3%	-17	0%	4 609	241%	T1	CS
Italy	47 776	72 866	73 501	14.6%	636	1%	25 725	54%	M	CS
Luxembourg	1 343	5 195	5 617	1.1%	422	8%	4 274	318%	T3	CS
Netherlands	11 821	20 134	20 170	4.0%	36	0%	8 349	71%	T2	CS
Portugal	5 055	13 497	12 657	2.5%	-840	-6%	7 601	150%	T2	CS
Spain	25 089	66 082	62 814	12.5%	-3 268	-5%	37 725	150%	CR,CS,T3	CR
Sweden	4 404	9 196	9 376	1.9%	180	2%	4 972	113%	T1	CS
United Kingdom	32 754	64 316	65 075	12.9%	759	1%	32 320	99%	T3	CS
EU-15	**268 931**	**504 559**	**504 285**	**100.0%**	**-274**	**-0.1%**	**235 354**	**88%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 77.6 % of CO_2 emissions and for 77.6 % of activity data from diesel oil in 2011 (Figure 3.55). The IEF for the EU-15 is 73.7 t/TJ diesel in 2011. The CO_2 IEF for diesel oil decreased by 0.2 per cent between 1990 (73.81 t/TJ) and 2011 (73.7 t/TJ). The main reason for the decline of the IEF is the changing in fuel specifications of some countries and their contribution to the weighted average. The contribution to diesel consumption of Germany and France, the two largest contributing countries with higher IEFs than the average Member State, declined between 1990 and 2011 (Germany from 20.2 per cent to 17.6 per cent; France from 20 per cent to 19.7 per cent). On the other hand, the contribution to diesel consumption of Spain, which has a low IEF, increased from 9.5 per cent in 1990 to 12.6 per cent in 2011. In addition, a few member States (e.g. Italy, and the United Kingdom) show declining IEFs for the time-series 1990–2011 because of the increased use of diesel blended with biofuels.

Table 3.50 shows that the majority of CO_2 emissions from the combustion of diesel oil in road transportation were calculated using a higher tier method.

Figure 3.55 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for CO_2



1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2011, CO_2 emissions from gasoline decreased by 38 % in the EU-15 (Table 3.51).

Table 3.51 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions and information on method applied and emission factor

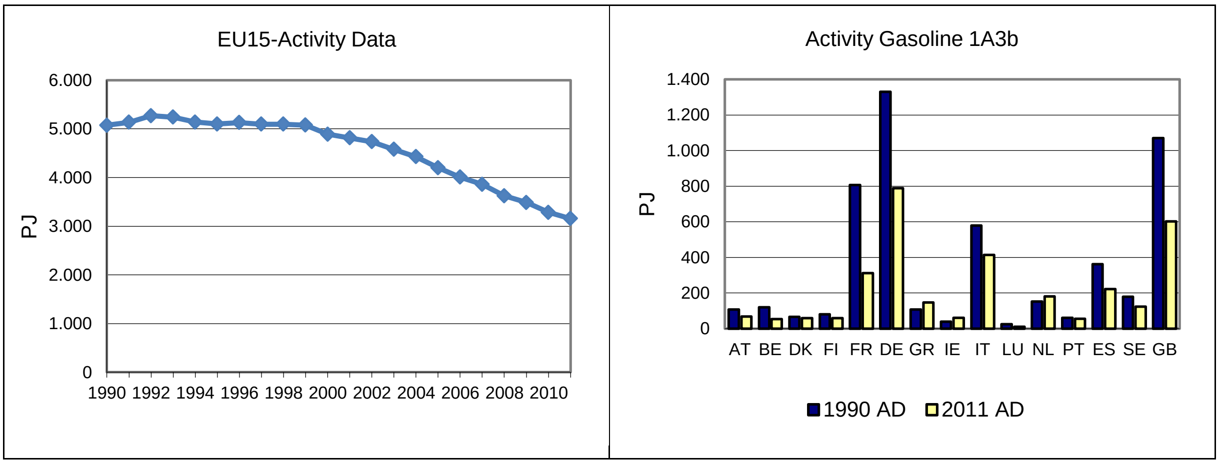
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	7 936	5 270	5 076	2.3%	-194	-4%	-2 860	-36%	CS,M	CS
Belgium	8 469	3 750	3 780	1.7%	30	1%	-4 689	-55%	T1	CR,CS
Denmark	4 838	4 583	4 236	1.9%	-347	-8%	-603	-12%	OTH	CS
Finland	5 883	4 524	4 275	1.9%	-248	-5%	-1 607	-27%	M	CS
France	58 333	23 987	22 528	10.0%	-1 460	-6%	-35 805	-61%	T3	CS
Germany	95 794	56 982	56 745	25.2%	-237	0%	-39 050	-41%	T2,CS	CS
Greece	7 294	11 100	10 038	4.5%	-1 062	-10%	2 744	38%	T1	D
Ireland	2 758	4 404	4 171	1.9%	-233	-5%	1 413	51%	T1	CS
Italy	41 094	30 503	29 406	13.0%	-1 097	-4%	-11 688	-28%	M	CS
Luxembourg	1 277	1 089	1 116	0.5%	26	2%	-162	-13%	T3	CS
Netherlands	10 908	12 855	13 062	5.8%	208	2%	2 154	20%	T2	CS
Portugal	4 420	4 432	3 985	1.8%	-447	-10%	-435	-10%	T2	CS
Spain	26 033	17 028	15 846	7.0%	-1 181	-7%	-10 187	-39%	CR,CS,T3	CR
Sweden	12 900	9 687	8 934	4.0%	-753	-8%	-3 967	-31%	T1	CS
United Kingdom	75 118	44 405	42 171	18.7%	-2 234	-5%	-32 947	-44%	T3	CS
EU-15	**363 056**	**234 599**	**225 369**	**100.0%**	**-9 230**	**-4%**	**-137 687**	**-38%**		

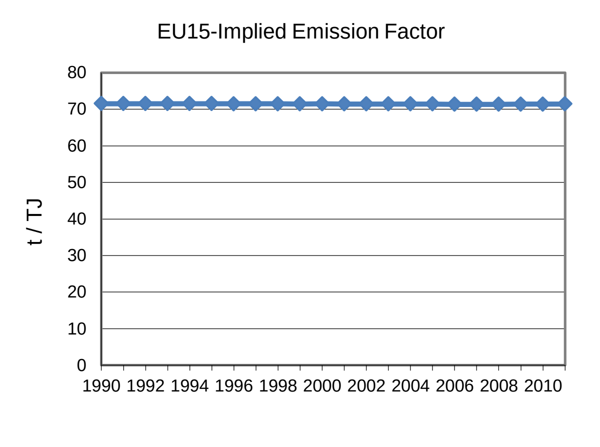
Abbreviations explained in the Chapter 'Units and abbreviations'.

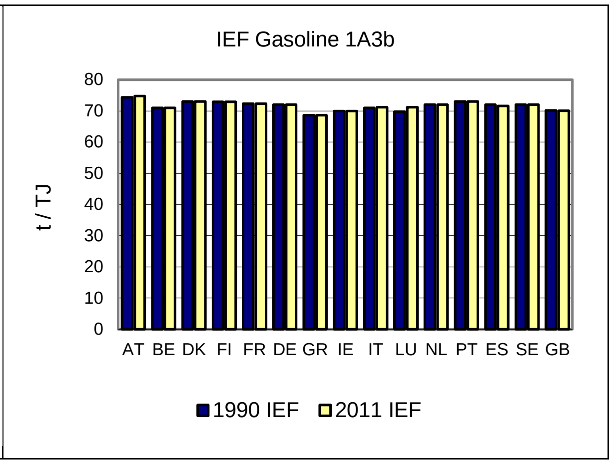
France, Germany, Italy, Spain and the United Kingdom account for 73.9 % for CO_2 emissions and for 74 % of activity data from gasoline in 2011 (Figure 3.56). The IEF for the EU-15 is 71.43 t/TJ gasoline in 2011. The CO_2 IEF for gasoline decreased by 0.2 percent between 1990 (71.55 t/TJ) and 2011 (71.43 t/TJ). The main reason for the decline of the IEF is the changing specifications of gasoline in Germany and France, the two largest contributing countries with higher IEFs than the average Member State. The contribution to gasoline consumption in Germany and France declined between 1990 and 2011 (Germany from 26.2 per cent to 25 per cent; France from 15.9 per cent to 9.9 per cent). On the other hand, the contribution to gasoline consumption of Italy, which has a lower IEF than the average Member State, increased from 11.4 per cent in 1990 to 13.1 per cent in 2011. Also, the United Kingdom, which has a much lower IEF than the average Member State, can be seen here as an influencing factor as the contribution to gasoline consumption amounts to 19.1 per cent in 2011.

Table 3.51 shows that the majority of CO_2 emissions from gasoline combustion in road transportation were calculated using a higher tier method.

Figure 3.56 1A3b Road Transport, gasoline: Activity data and implied emission factors for CO_2







1A3b Road Transportation –LPG (CO_2)

Between 1990 and 2011, CO_2 emissions from LPG increased by 7 % in the EU-15. Two Member States report emissions as 'Not occurring'. Between 2010 and 2011 EU-15 emissions increased by 10 % (Table 3.52) mainly due to emission increases in Italy and Greece.

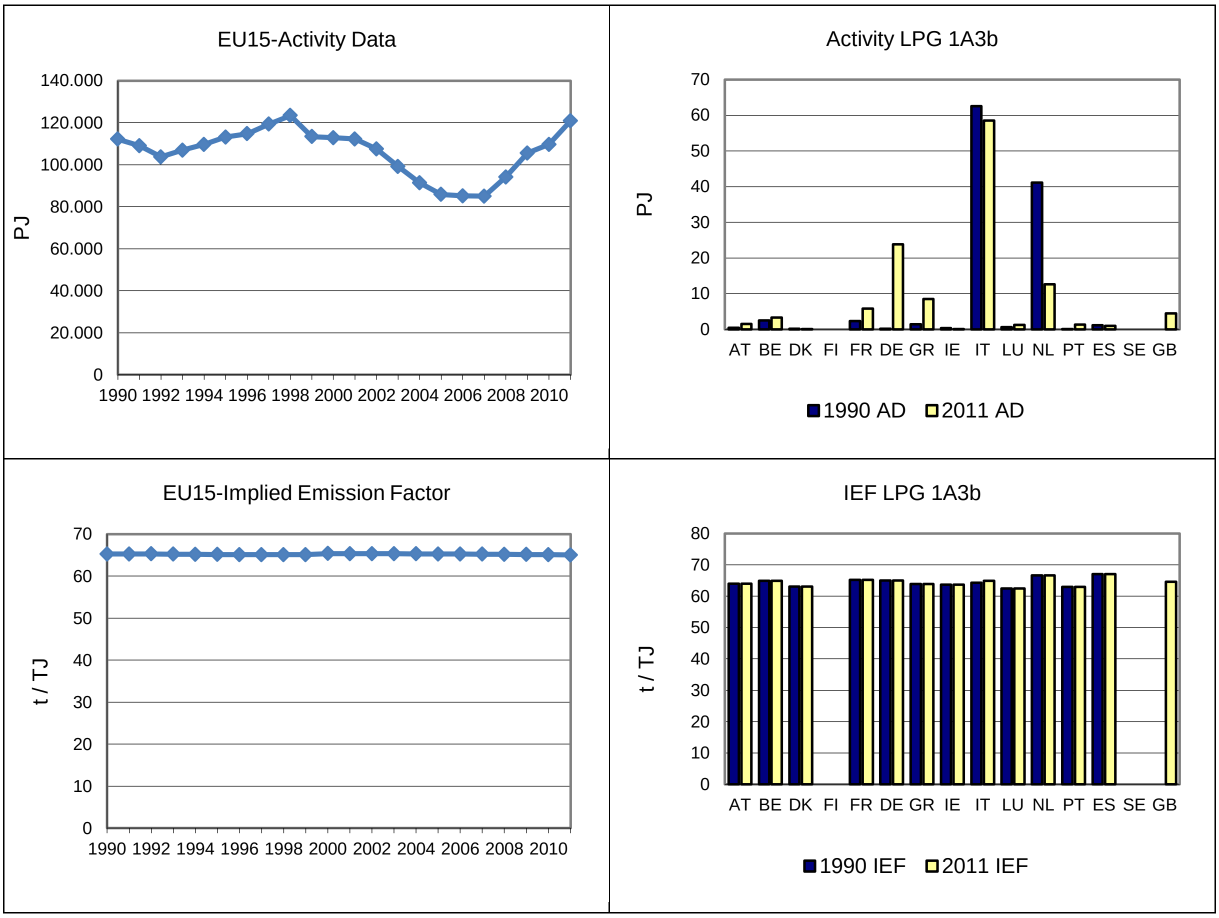
Table 3.52 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	27	100	98	-	-1	-1%	72	270%	CS,M	CS
Belgium	163	163	215	2.7%	52	32%	53	32%	T1	CR,CS
Denmark	9	0.13	0.14	0.0%	0	9%	-9	-98%	OTH	CS
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	150	346	380	4.8%	34	10%	230	153%	T3	CS
Germany	9	1 418	1 550	19.7%	131	9%	1 541	17175%	T2,CS	CS
Greece	91	127	541	6.9%	414	326%	451	497%	T1	D
Ireland	19	1	1	0.0%	0	7%	-17	-92%	T1	CS
Italy	4 026	3 644	3 803	48.3%	159	4%	-223	-6%	M	CS
Luxembourg	11	4	2	-	-2	-54%	-9	-84%	T3	CS
Netherlands	2 740	885	843	10.7%	-42	-5%	-1 898	-69%	T2	CS
Portugal	0	84	83	1.1%	-1	-1%	83	134836%	T2	CS
Spain	79	57	63	0.8%	6	11%	-15	-19%	CR,CS,T3	CR
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	314	290	3.7%	-24	-8%	290	-	T3	CS
EU-15	**7 323**	**7 144**	**7 869**	**100.0%**	**726**	**10%**	**547**	**7%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 77.3 % of CO_2 emission and for 77.4 % of activity data from LPG in 2011 (Figure 3.57). The IEF for the EU-15 is 65.05 t/TJ LPG in 2011. Table 3.52 shows that the majority of CO_2 emissions from LPG consumption in road transportation were calculated using a higher tier method.

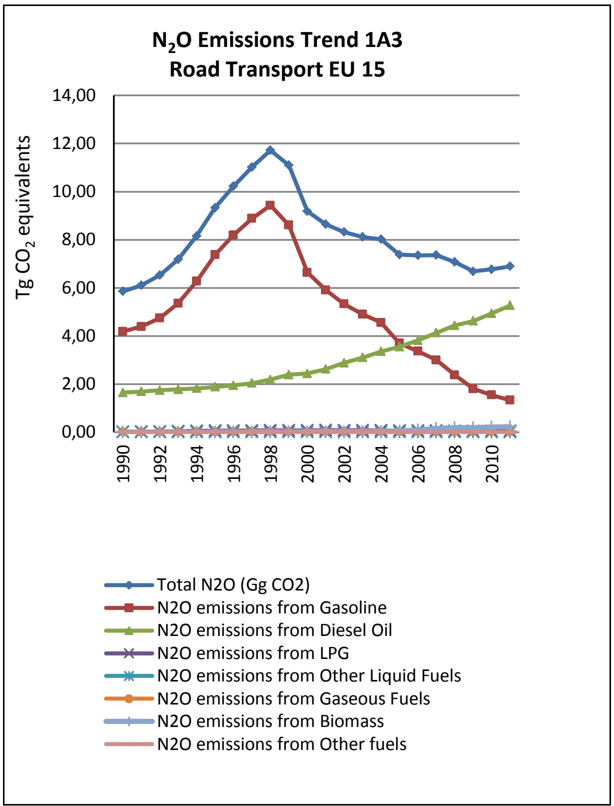
Figure 3.57 1A3b Road Transport, LPG: Activity data and implied emission factors for CO_2



N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.19 % of total EU-15 GHG emissions in 2011. Figure 3.58 gives an overview of the N_2O trend caused by different fuels. The trend is mainly dominated by emissions resulting from gasoline and diesel oil.

Figure 3.58 1A3b Road Transport: N_2O Emissions Trend



N_2O emissions increased between 1990 and 2011 by 18 % (Table 3.55). N_2O emissions increased in the 1990s due to the implementation of the catalytic converter in the early Euro vehicles (mainly Euro 1), but decreased thereafter (for post Euro 2 vehicles). The reason for the existing various trends in N_2O emission are different estimates of N_2O emission factors. In principle, two different models/emission factor sources are being used in EU-15 countries to estimate N_2O emissions: (1) HBEFA - Handbook of emissions factors, (2) COPERT. The Emission Factors Handbook (Austria, Germany, the Netherlands and Sweden) estimates that the N_2O emission factors decrease for every technology generation (Euro 1, Euro 2 etc.). At the moment two versions of the COPERT model are being used in EU-15 countries to estimate emissions, namely COPERT III and COPERT 4. COPERT III was developed in 2000 and incorporated the AEIG methodology that was valid until 2005 (AEIG Chapter rt070100 dated August 2002). COPERT III included rough assumptions on N_2O emission factors, summarised on Table 3.53.

Table 3.53: N_2O Emission Factors in COPERT III/ AEIG Chapter rt070100 – August 2002

Vehicle category	Urban	Rural	Highway
Passenger Cars			
Gasoline Conventional	5	5	5
Gasoline Euro I and on	53	16	35
Diesel CC < 2.0 l	27	27	27
Diesel CC > 2.0 l	27	27	27
LPG	15	15	15
2 - stroke	5	5	5
Light Duty Vehicles			
Gasoline Conventional	6	6	6
Gasoline Euro I and on	53	16	35
Diesel	17	17	17
Heavy Duty Vehicles			
Gasoline > 3.5 t	6	6	6
Diesel < 7.5 t	30	30	30
Diesel 7.5 t < W < 16 t	30	30	30
Diesel 16 t < W < 32 t	30	30	30
Diesel W > 32 t	30	30	30
Urban Buses	30	-	-
Coaches	30	30	30
Motorcycles			
< 50 cm³	1	1	1
> 50 cm³ 2 stroke	2	2	2
> 50 cm³ 4 stroke	2	2	2

These emission factors were fully updated for passenger cars and light commercial vehicles with the launch of the first official COPERT 4 version 3.0 (November 2006) and were introduced in the rt070100 chapter of AEIG dated September 2006. These emission factors introduced reductions in N_2O as the emission technology improved. In particular for gasoline vehicles, these emission factors also introduced an increase in the emission level as the vehicle grows older and a decrease as the fuel sulfur decreased. All emission factors were based on an extensive literature review and synthesis of the findings that was conducted in 2005. Use of the new emission factors over COPERT III should in general lead to reductions of the national N_2O levels.

In 2007, the HDV N_2O emission factors were updated based on a relevant report that was published by the Dutch Institute TNO (Report TNO 03.OR.VM.006.1/IJR). These emission factors were sensitive to vehicle size and driving conditions (urban, rural, highway). Depending on the national stock details, use of the emission factors could lead to both slight increases or slight decreases compared to the previous set. The new emission factors were introduced in COPERT 4 v5.0 (December 2007) but were then introduced in the AEIG with the original GB2009 revision (Technical report 9/2009 – June 2009).

Since June 2009 this basic methodology of N_2O calculation has remained without changes.

The COPERT 4 implementation of the methodology introduced some calculation errors that were fixed in the subsequent software versions. Also a number of slight updates (extension of the methodology to other categories) have been incorporated. A summary of these updates and software fixes is provided in Table 3.54.

Table 3.54: N_2O relevant changes in the COPERT 4 methodology

Version: 3.0	Date: November 2006
METHODOLOGY: Update of the gasoline and diesel passenger car and light duty vehicle N_2O emission factors. Introduction of impact of vehicle technology, vehicle age and fuel sulfur.	
Reference: http://www.emisia.com/versions.html	
Version: 5.0	Date: December2007
METHODOLOGY: Update of the diesel HDV emission factors based on Dutch study	
Reference: http://www.emisia.com/versions.html	
Version: 5.1	Date: February 2008
SOFTWARE CORRECTION: Use of the cumulative mileage instead of annual mileage to calculate N_2O degradation. The correction should lead to an increase in emissions	
Reference: http://www.emisia.com/versions.html	
Version: 6.1	Date: February 2009
METHODOLOGY: The Euro 5 and 6 passenger car and light duty trucks emission factors of CH_4, N_2O, NH_3 have been inherited by default from Euro 4. They were zero in the previous version. The revision will slightly increase total N_2O emissions.	
Reference: http://www.emisia.com/versions.html	
Version: 7.0	Date: December 2009
SOFTWARE CORRECTION: There was a software bug during the calculation of N_2O, NH_3 and CH_4 hot and cold emissions. Because of this bug there was a misallocation between the hot and cold emissions of these pollutants. Furthermore the N_2O cold emissions were stored in place of NH_3 cold emissions and vice versa. This is now corrected. The corrections is expected to lead to MS specific changes	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v7_0.pdf	
Version: 8.1	Date: May 2011
METHODOLOGY: N_2O hot and cold emission factors parameters for Euro 5 and Euro 6 LPG passenger cars are set equal to Euro 5 and Euro 6 gasoline ones. This is estimated to slightly increase N_2O in some MS were LPG vehicles are widespread.	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v8_1.pdf	
Version: 9.0	Date: October 2011
METHODOLOGY: Bioethanol was introduced as a fuel. N_2O emissions are now split to a fossil and a non-fossil (biomass) part (for exporting to CRF).	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v9_0.pdf	
Version: 10.0	Date: November 2012
METHODOLOGY: CH_4 emission factors for Euro 4, 5 and 6 gasoline passenger cars have been updated. This is estimated to slightly increase total CH_4 emissions.	
Reference: http://www.emisia.com/files/COPERT4_v10_0.pdf	

Table 3.56 shows that all Member States use recent N_2O emission factors in 2011. Four MS use different or country specific models or emission factors, as can be seen in Table 3.56.

Table 3.55 1A3b Road Transport: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	173	214	196	2.8%	-18	-9%	22	13%
Belgium	229	233	236	3.4%	4	2%	7	3%
Denmark	91	120	121	1.8%	1	1%	30	34%
Finland	160	164	163	2.4%	-1	0%	3	2%
France	931	1 271	1 328	19.3%	58	5%	398	43%
Germany	1 158	1 243	1 338	19.4%	96	8%	180	16%
Greece	145	190	134	1.9%	-56	-29%	-11	-8%
Ireland	44	94	92	1.3%	-2	-2%	48	107%
Italy	900	1 017	1 044	15.1%	27	3%	144	16%
Luxembourg	27	73	81	1.2%	7	10%	54	201%
Netherlands	101	265	270	3.9%	5	2%	169	166%
Portugal	67	175	162	2.4%	-13	-8%	95	142%
Spain	495	790	779	11.3%	-12	-1%	284	57%
Sweden	157	109	108	1.6%	-1	-1%	-48	-31%
United Kingdom	1 174	815	845	12.2%	29	4%	-329	-28%
EU-15	**5 853**	**6 773**	**6 898**	**100.0%**	**125**	**2%**	**1 045**	**18%**

Table 3.56 Methods/models used for road transport by EU-15 MS

1A3b	**Method/Emission factors**	**Remark**
Austria	CS /HBEFA	
Belgium	CS / COPERT IV	Emissions of CH_4 and N_2O are not calculated based on the Belgian energy statistics, but are the sum of the emissions calculated by the 3 regions using a methodology based on the COPERT-methodology. A region-specific methodology (the so-called MIMOSA-model, also based on COPERT IV) is used in the Flemish region.
Denmark	CS / COPERT IV	An internal NERI model with a structure similar to the European COPERT III emission model (Ntziachristos, 2000) is used to calculate the Danish annual emissions for road traffic. For most vehicle categories, updated fuel use and emission data from new COPERT IV version is incorporated in the NERI model.
Finland	CS / COPERT IV	According to the recommendations in the review the N_2O emission factors have been updated in the LIISA model. Emission factors used in the COPERT IV program have been used as the reference values.
France	COPERT IV	
Germany	CS / HBEFA	
Greece	COPERT IV	
Ireland	COPERT IV	
Italy	COPERT IV	
Luxembourg	COPERT IV	
Netherlands	CS-T2 / HBEFA	
Portugal	COPERT IV	
Spain	COPERT IV	
Sweden	CS / HBEFA	

United Kingdom	COPERT IV	

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 76 % of N_2O emissions from 1A3b "Road Transportation" in 2011. Between 1990 and 2011 N_2O emissions from Diesel oil increased in all Member States, except for Greece which decreased their emissions by 10 %; within the EU-15 the emission increased by 220 %. The smallest increase in absolute terms was reported by Denmark, Finland, Ireland and Luxembourg. Between 2010 and 2011, EU-15 emissions rose by 7 % (Table 3.57).

Table 3.57 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions and information on method applied and emission factor

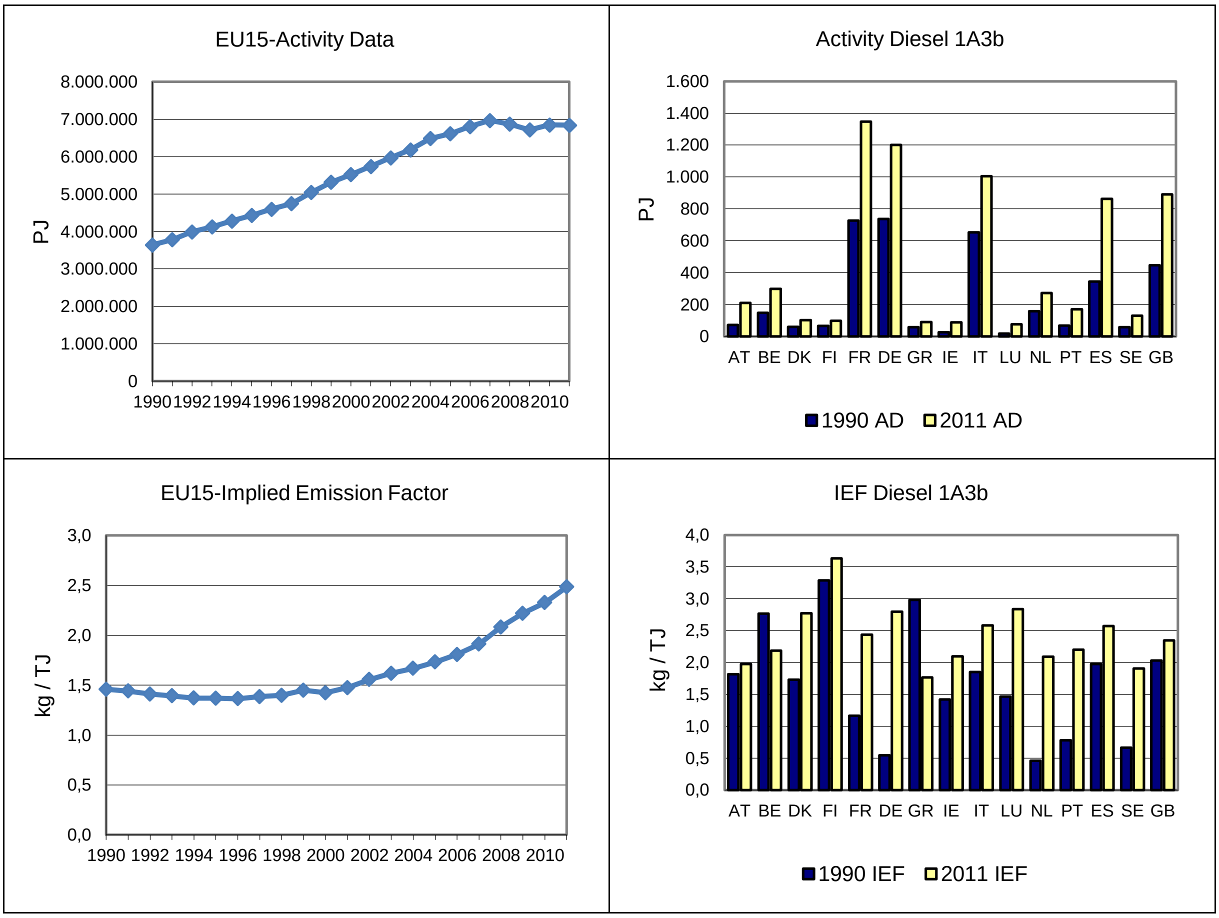
Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	41	133	128	2.4%	-5	-4%	88	215%	CS,M	CS
Belgium	127	197	202	3.8%	5	2%	74	58%	M,T2	CR,CS
Denmark	32	85	87	1.7%	2	3%	55	172%	OTH	OTH
Finland	68	107	110	2.1%	3	3%	42	62%	M	CS
France	263	931	1 017	19.3%	87	9%	754	287%	T3	CS
Germany	124	926	1 041	19.8%	115	12%	917	738%	T3,CS	CS,M
Greece	55	59	49	0.9%	-10	-17%	-5	-10%	M	M
Ireland	11	56	58	1.1%	2	4%	46	403%	T3	M
Italy	374	763	804	15.3%	41	5%	430	115%	M	CS
Luxembourg	8	59	67	1.3%	8	13%	59	710%	T3	D
Netherlands	23	164	176	3.3%	12	7%	153	678%	T2	CS
Portugal	17	123	117	2.2%	-6	-5%	100	605%	T3	CR
Spain	211	687	688	13.0%	1	0%	477	226%	CR,CS,T3	CR
Sweden	12	65	77	1.5%	12	18%	65	530%	M	M
United Kingdom	281	587	648	12.3%	61	10%	368	131%	T3	CS
EU-15	**1 647**	**4 942**	**5 269**	**100.0%**	**327**	**7%**	**3 623**	**220%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 79.7 % of N_2O emissions and for 77.6 % of activity data from diesel oil in 2011 (Figure 3.59). The IEF for the EU-15 is 2.48 kg/TJ Diesel in 2011.

Table 3.57 shows that all N_2O emissions from combustion of diesel oil in road transportation were calculated using a higher tier method.

Figure 3.59 **1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for N_2O emission**



1A3b Road Transportation – Gasoline (N_2O)

N_2O emissions from Gasoline account for 19 % of N_2O emissions from 1A3b Road Transportation in 2011. Between 1990 and 2011, N_2O emissions from gasoline decreased by 68 % in the EU-15. Between 2010 and 2011, all Member States showed a decreasing trend. The EU-15 total N_2O emissions dropped by 14 % (Table 3.58).

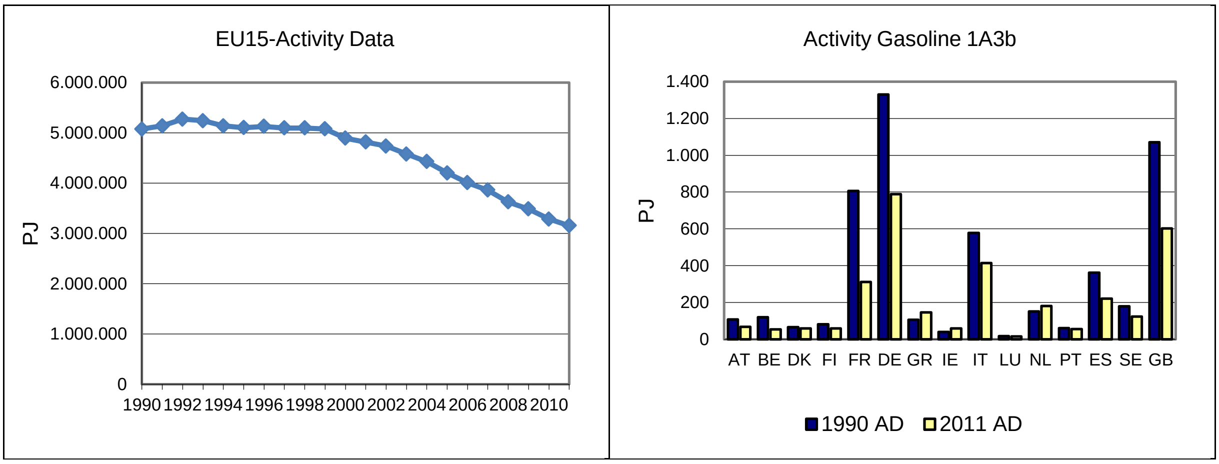
Table 3.58 **1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions and information on method applied and emission factor**

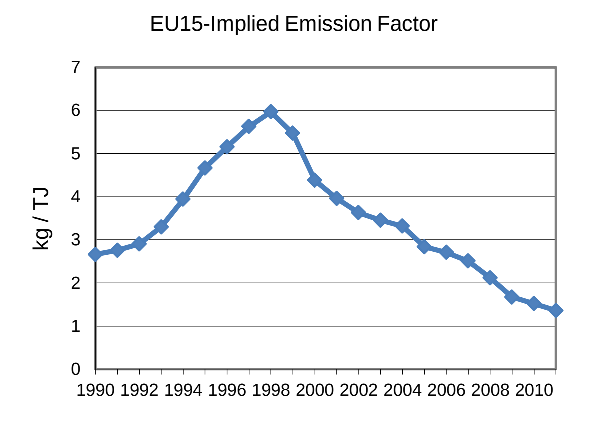
Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	133	81	67	5.1%	-13	-17%	-65	-49%
Belgium	101	23	22	1.6%	-1	-3%	-79	-78%
Denmark	59	34	30	2.2%	-5	-14%	-29	-49%
Finland	92	52	45	3.4%	-6	-12%	-46	-50%
France	668	240	206	15.5%	-34	-14%	-462	-69%
Germany	1 034	226	203	15.3%	-22	-10%	-831	-80%
Greece	91	127	80	6.1%	-46	-37%	-10	-11%
Ireland	33	36	32	2.4%	-4	-11%	-1	-4%
Italy	522	223	208	15.6%	-15	-7%	-314	-60%
Luxembourg	18	12	12	0.9%	-1	-5%	-7	-37%
Netherlands	61	90	82	6.2%	-8	-9%	21	34%
Portugal	50	42	36	2.7%	-6	-15%	-15	-29%
Spain	284	99	87	6.5%	-13	-13%	-198	-70%
Sweden	144	39	26	1.9%	-13	-34%	-118	-82%
United Kingdom	893	226	194	14.6%	-32	-14%	-699	-78%
EU-15	**4 182**	**1 548**	**1 329**	**100.0%**	**-220**	**-14%**	**-2 853**	**-68%**

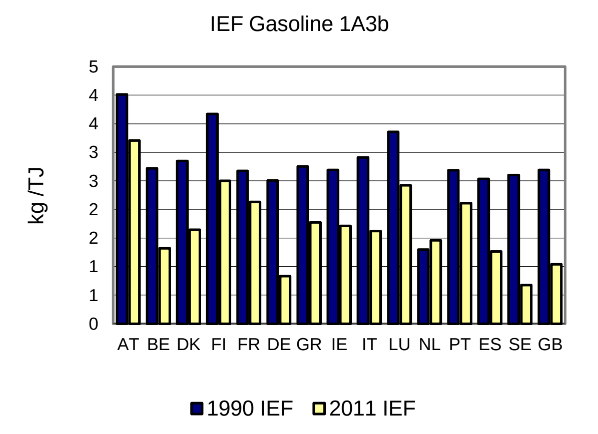
Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom accounted for 67.5 % of N_2O emissions and for 74 % of activity data from gasoline in 2011 (Figure 3.60). The IEF for the EU-15 is 1.36 kg/TJ Gasoline in 2011.

Figure 3.60 **1A3b Road Transport, gasoline: Activity data and implied emission factors for N_2O**





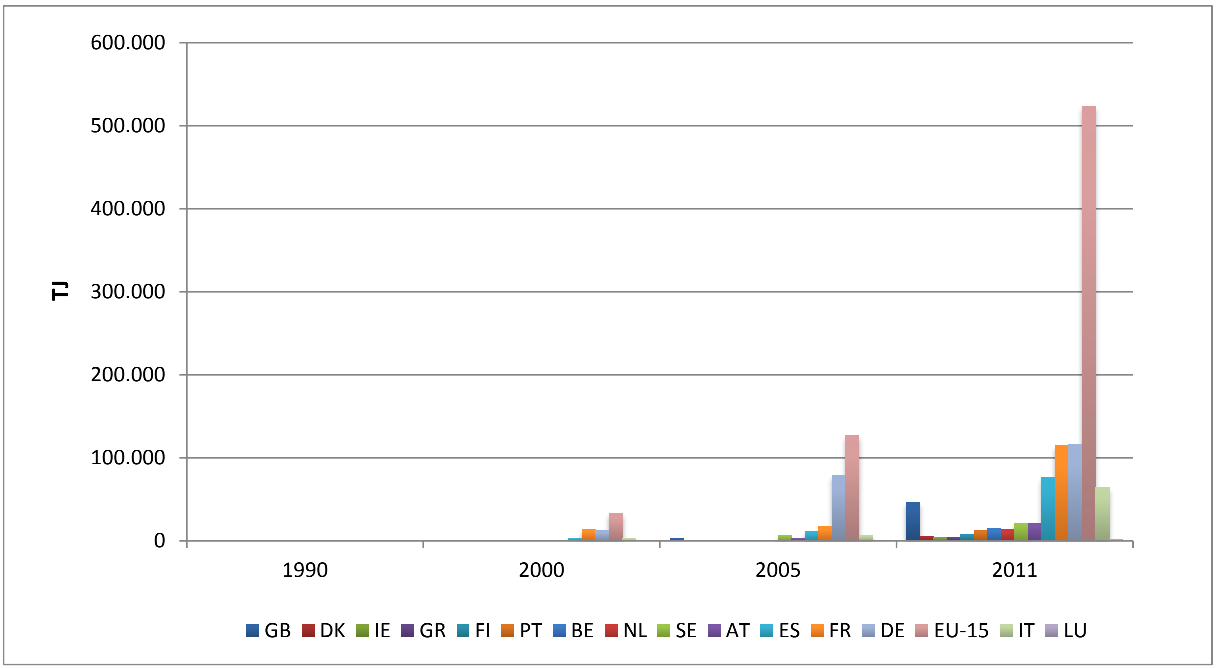


1A3b Road Transportation – Activity Data Biofuels

According to the European Directive on the promotion of the use of biofuels or other renewable fuels for transport (2003/30/EG), Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets, to reduce greenhouse gas emissions. Member States brought into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 2004. A reference value for these targets shall be 2 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2005. A reference value for these targets shall be 5,75 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010. Due to the possibility of different national implementation the MS need to approach partly different targets.

Between 1990 and 2011, activity data of biofuels increased from 17.85 TJ to 523.8 TJ in the EU-15 (Figure 3.61). Germany still reports most of total amount of biofuels (22.1 % of total EU-15 activity in 2011 vs. 23.9 % in 2010) over the last years, followed by France (21.9 %). All Member States except for the UK report biofuels activity data under 1A3b for 2011. Note that some countries might still not report biofuels separately from gasoline or diesel oil (additive) in particular also in other source categories (e.g. 1A2f and 1A4c for other mobile machineries). In this case the use of biofuels is visible in a decreasing trend of the IEFs of gasoline/diesel or liquid fuels.

Figure 3.61 **1A3b Road Transport, biofuels: Trend of Activity data of biofuels**

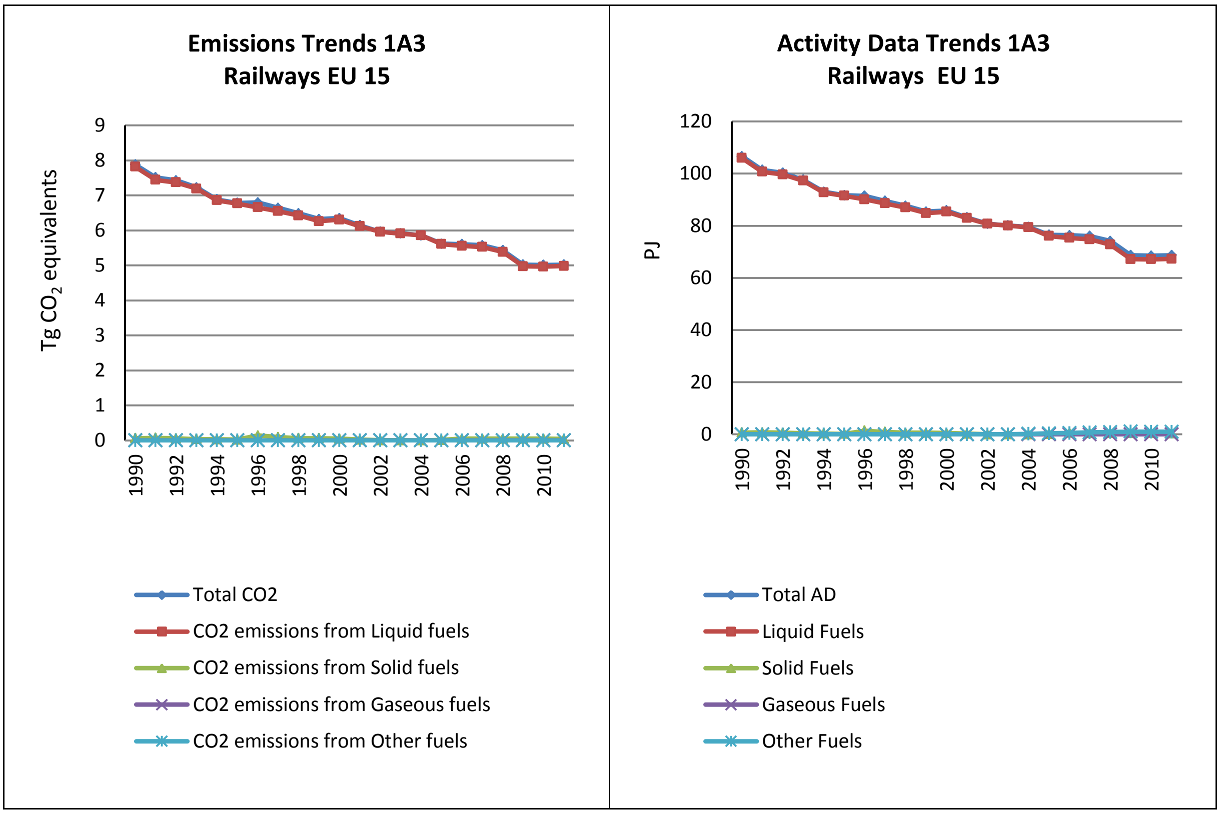


3.2.3.3 *Railways (1A3c) (EU-15)*

Railway locomotives generally are one of these types: diesel, coal, electric, or steam. Diesel locomotives generally use diesel engines in combination with an alternator or generator to produce the electricity required to power their traction motors. Emissions from Railways arise from the combustion of liquid and solid fuels.

CO_2 emissions from 1A3c Railways account for 0.14 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from rail transportation decreased by 36 % in the EU-15. The total trend is dominated by CO_2 emissions from liquid fuels (Figure 3.62). The emissions from this key category are due to fossil fuel consumption in rail transport, which decreased by 36.2 % between 1990 and 2011.

Figure 3.62 1A3c Railways: CO_2 Emission Trend and Activity Data



The Member States France, Germany and the United Kingdom contributed most to the emissions from this source (72.1 %). Between 1990 and 2011, Germany had by far the highest decreases in absolute terms (Table 3.59).

Table 3.59 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	178	149	148	2.9%	-1	0%	-30	-17%
Belgium	224	105	104	2.1%	-1	-1%	-120	-54%
Denmark	297	242	249	5.0%	7	3%	-47	-16%
Finland	191	95	98	2.0%	3	3%	-93	-49%
France	1 070	481	482	9.6%	1	0%	-588	-55%
Germany	2 881	1 083	1 064	21.2%	-19	-2%	-1 817	-63%
Greece	203	63	47	0.9%	-16	-25%	-155	-77%
Ireland	133	122	122	2.4%	0	0%	-11	-8%
Italy	441	197	140	2.8%	-56	-29%	-300	-68%
Luxembourg	25	11	11	0.2%	0	0%	-13	-55%
Netherlands	91	106	102	2.0%	-4	-4%	11	13%
Portugal	176	47	41	0.8%	-6	-13%	-135	-77%
Spain	414	270	278	5.5%	8	3%	-136	-33%
Sweden	101	60	60	1.2%	0	0%	-41	-41%
United Kingdom	1 455	1 984	2 077	41.3%	93	5%	622	43%
EU-15	**7 880**	**5 015**	**5 025**	**100.0%**	**10**	**0%**	**-2 855**	**-36%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2011, CO_2 emissions from liquid fuels decreased by 36 % in the EU-15. Between 2010 and 2011, EU-15 emissions remained stable (Table 3.60).

Table 3.60 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

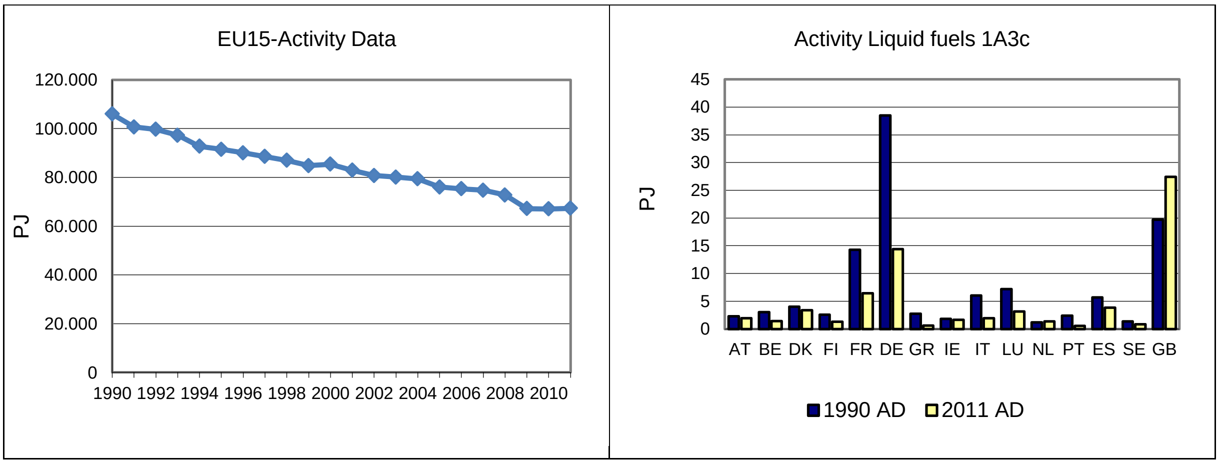
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	171	148	148	3.0%	-1	0%	-24	-14%	CS	CS
Belgium	224	105	104	2.1%	-1	-1%	-120	-54%	CS,M,T1	CS,D
Denmark	297	242	249	5.0%	7	3%	-47	-16%	OTH	CS
Finland	191	95	98	2.0%	3	3%	-93	-49%	M	CS
France	1 070	481	482	9.7%	1	0%	-588	-55%	T1	CS
Germany	2 827	1 083	1 064	21.4%	-19	-2%	-1 763	-62%	CS,T1,T2	CS,D
Greece	200	63	47	0.9%	-16	-25%	-153	-76%	T1	D
Ireland	133	122	122	2.4%	0	0%	-11	-8%	T1	CS
Italy	441	197	140	2.8%	-56	-29%	-300	-68%	D	CS
Luxembourg	25	11	11	0.2%	0	0%	-13	-55%	T2	CS
Netherlands	91	106	102	2.0%	-4	-4%	11	13%	CS	CS
Portugal	176	47	41	0.8%	-6	-13%	-135	-77%	T1	OTH
Spain	414	270	278	5.6%	8	3%	-136	-33%	T2	CR
Sweden	101	60	60	1.2%	0	0%	-41	-41%	T1	CS
United Kingdom	1 455	1 934	2 036	40.9%	102	5%	581	40%	T2	CS
EU-15	**7 817**	**4 964**	**4 984**	**100.0%**	**19**	**0%**	**-2 833**	**-36%**		

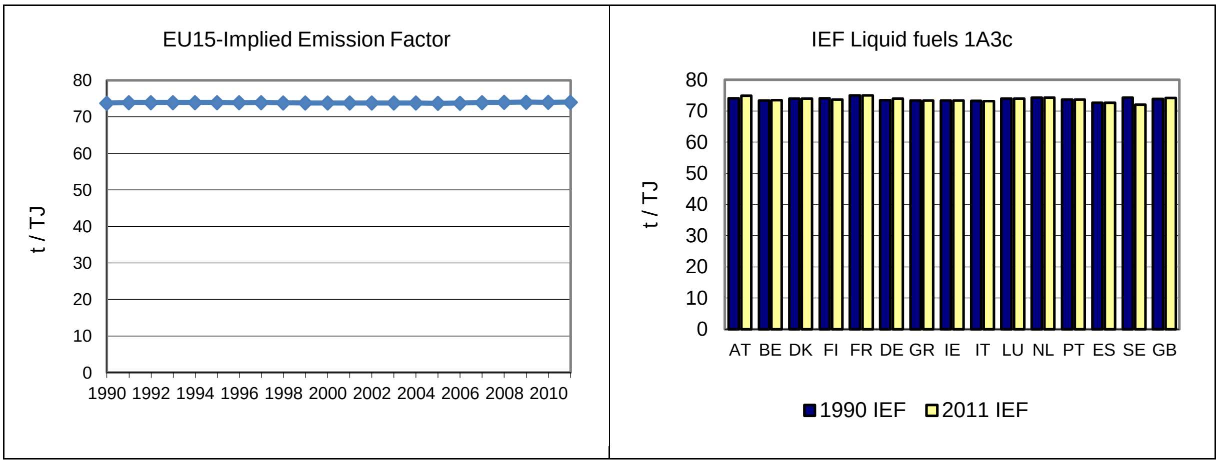
Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 80.4 % of CO_2 emissions and for 80.2 % of activity data from liquid fuels in 2011 (Figure 3.63). The IEF for the EU-15 is 74.03 t/TJ Liquid fuels in 2011.

Table 3.60 shows that the majority of CO_2 emissions from the combustion of liquid fuels in railways were calculated using a higher tier method.

Figure 3.63 1A3c Railways, liquid fuels: Activity data and implied emission factors for CO_2



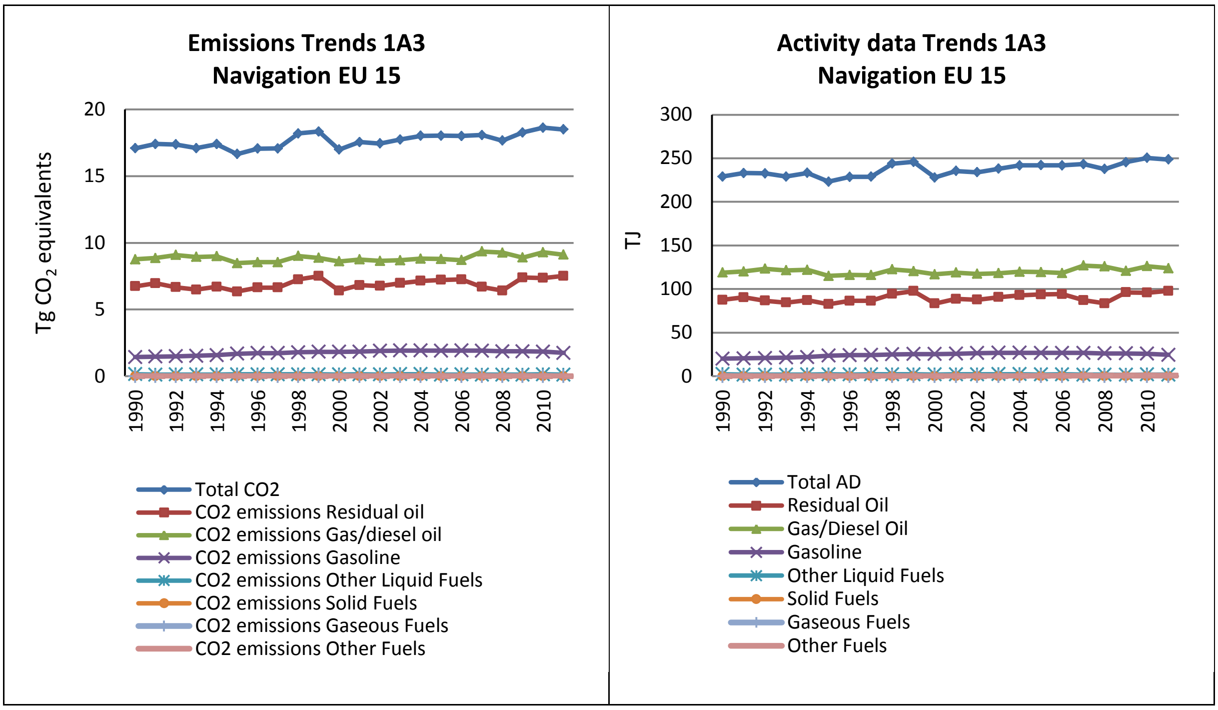


3.2.3.4 ***Navigation (1A3d) (EU-15)***

This source category covers all water-borne transport from recreational craft to large ocean-going cargo ships that are driven primarily by large, slow and medium speed diesel engines and occasionally by steam or gas turbines. Emissions arise from gas/diesel oil, residual oil or other.

CO_2 emissions from 1A3d Navigation account for 0.51 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from navigation increased by 8 % in the EU-15 (Table 3.63). The emissions from this key source are due to fossil fuel consumption in navigation. The total CO_2 emission trend is dominated by emissions from gas/diesel oil and residual oil (Figure 3.64).

Figure 3.64 1A3d Navigation: CO_2 Emission Trend and Activity Data



Five Member States (France, Greece, Italy, Spain and the United Kingdom) contributed the most to the emissions from this source (78.9 %). Most Member States had increasing emissions from navigation between 1990 and 2011. The Member States with the highest increases in absolute terms were Greece, the Netherlands and Spain (Table 3.61).

Table 3.61 **1A3d Navigation: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	14	11	11	0.1%	0	2%	-3	-20%
Belgium	398	469	485	2.6%	16	3%	87	22%
Denmark	796	593	562	3.0%	-31	-5%	-234	-29%
Finland	441	564	537	2.9%	-27	-5%	96	22%
France	1 065	1 219	1 210	6.5%	-8	-1%	145	14%
Germany	2 066	830	769	4.2%	-61	-7%	-1 297	-63%
Greece	1 825	2 286	2 294	12.4%	8	0%	469	26%
Ireland	85	198	172	0.9%	-26	-13%	87	102%
Italy	5 420	5 194	4 873	26.3%	-321	-6%	-547	-10%
Luxembourg	1	1	1	0.0%	0	-7%	0	2%
Netherlands	405	633	669	3.6%	36	6%	264	65%
Portugal	260	227	202	1.1%	-25	-11%	-58	-22%
Spain	1 500	3 546	3 812	20.6%	266	8%	2 313	154%
Sweden	543	442	479	2.6%	37	8%	-64	-12%
United Kingdom	2 273	2 423	2 426	13.1%	4	0%	154	7%
EU-15	**17 091**	**18 635**	**18 502**	**100.0%**	**-133**	**-1%**	**1 411**	**8%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from residual oil account for 40.7 % of CO_2 emissions from 1A3d Navigation in 2011. Between 1990 and 2011, CO_2 emissions from residual oil increased by 12 % in the EU-15. The countries with the highest increase in absolute terms were Greece and Spain. Austria, Germany, Ireland, Luxembourg and the Netherlands reported emissions as 'Not Occurring' (Table 3.62) for 2011, whereas Belgium reported emissions as 'Included Elsewhere' and specifically, the aforementioned emissions are included in gas/diesel oil, since the amounts of residual oil are very small.

Table 3.62 **1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

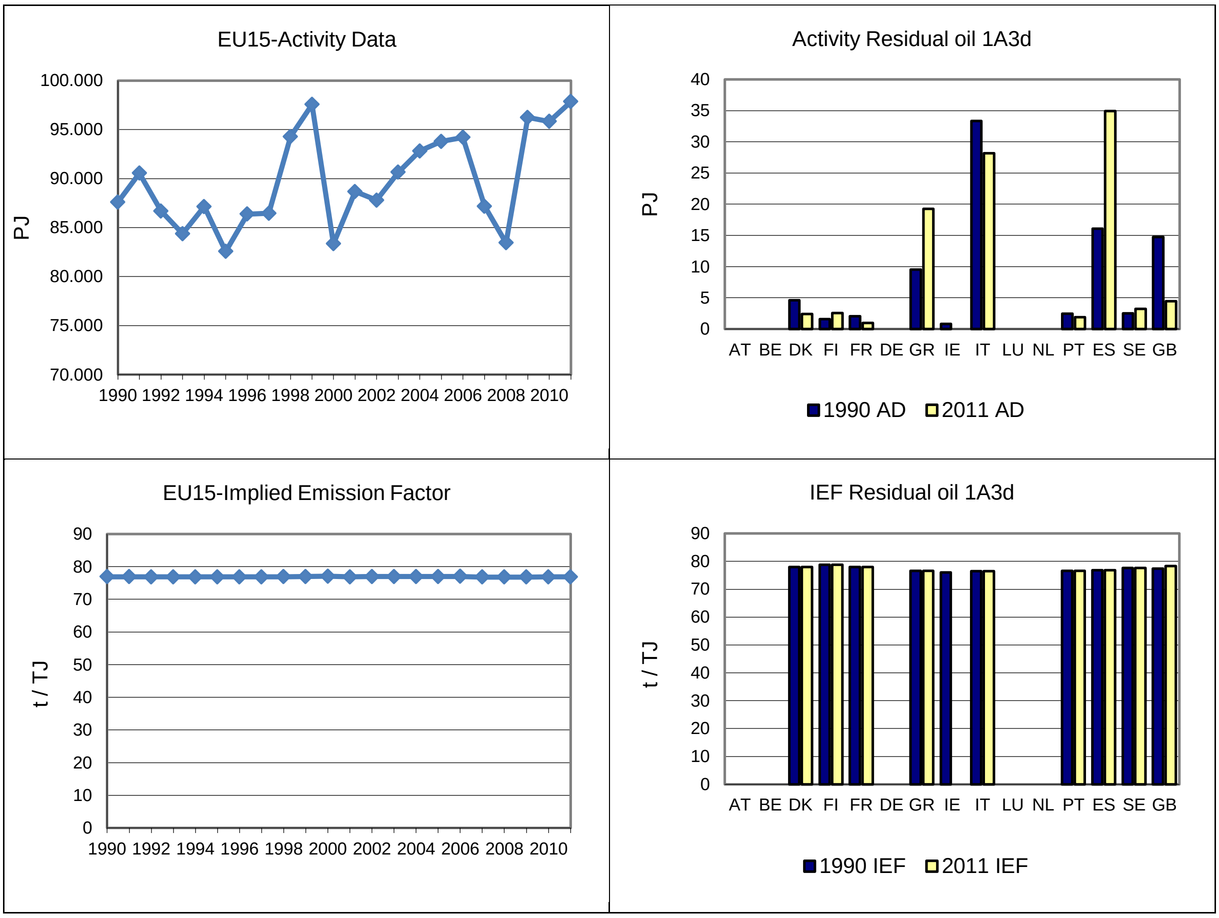
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	IE	IE	IE	-	-	-	-	-	NA	NA
Denmark	357	192	185	2.5%	-6	-3%	-171	-48%	OTH	CS
Finland	123	182	200	2.7%	18	10%	77	62%	M	CS
France	157	59	76	1.0%	17	28%	-81	-51%	T1	CS
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	730	1 422	1 474	19.6%	52	4%	745	102%	T1	D
Ireland	63	NO	NO	-	0	-	-63	-100%	NA	NA
Italy	2 553	2 292	2 158	28.7%	-134	-6%	-395	-15%	T1,T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	188	164	145	1.9%	-18	-11%	-42	-22%	CR	CR
Spain	1 234	2 495	2 682	35.7%	187	8%	1 448	117%	T2	CR
Sweden	194	210	250	3.3%	40	19%	56	29%	T1	CS
United Kingdom	1 140	348	350	4.6%	1	0%	-791	-69%	T2	CS
EU-15	**6 738**	**7 364**	**7 521**	**100.0%**	**157**	**2%**	**783**	**12%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Greece, Italy and Spain account for 84 % of CO_2 emissions and for 84.2 % of activity data from residual oil in 2011 (Figure 3.65). The IEF for the EU-15 is 76.86 t/TJ Residual oil in 2011.

Table 3.62 shows, that the majority of CO_2 emissions from the combustion of residual oil in navigation were calculated using a higher tier method.

Figure 3.65 1A3d Navigation, residual oil: Activity data and implied emission factors for CO_2



1A3d Navigation – Gas/Diesel Oil (CO_2)

CO_2 emissions from Gas/Diesel oil account for 49.3 % of CO_2 emissions from 1A3d Navigation in 2011 (Table 3.63). The CO_2 emissions from Gas/Diesel oil increased by 4 % between 1990 and 2011.

Table 3.63 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

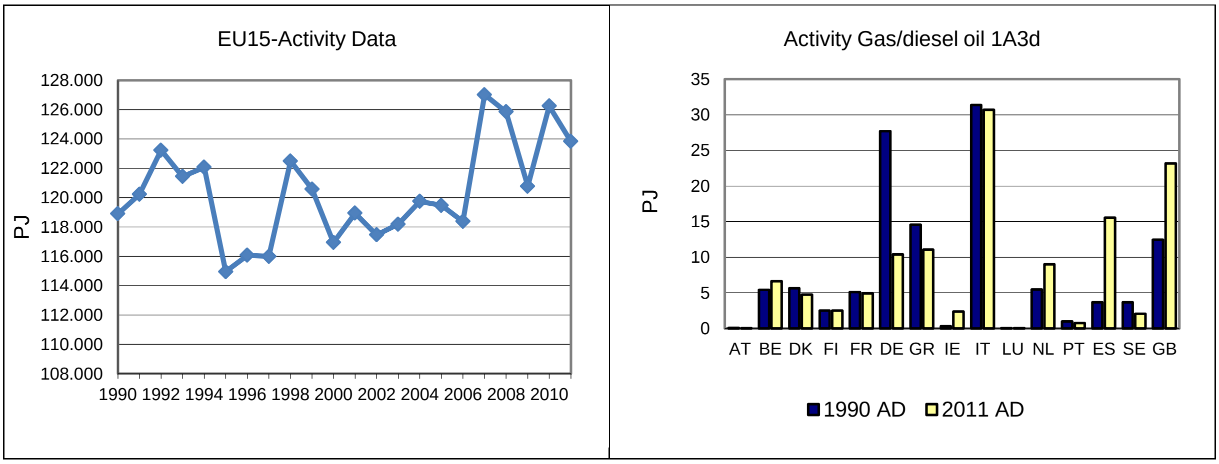
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	4	3	3	0.0%	0	13%	-1	-29%	CS	CS
Belgium	398	469	485	5.3%	16	3%	87	22%	CS,M,T1	CS,D
Denmark	417	375	352	3.9%	-23	-6%	-64	-15%	OTH	CS
Finland	186	191	185	2.0%	-6	-3%	-2	-1%	M,T3	CS
France	382	394	369	4.0%	-25	-6%	-13	-3%	T1	CS
Germany	2 050	827	768	8.4%	-59	-7%	-1 282	-63%	T1	CS
Greece	1 068	854	810	8.9%	-44	-5%	-258	-24%	T1	D
Ireland	22	198	172	1.9%	-26	-13%	150	673%	T1	CS
Italy	2 299	2 374	2 250	24.7%	-124	-5%	-50	-2%	T1,T2	CS
Luxembourg	1	1	1	0.0%	0	-4%	0	24%	T2	CS
Netherlands	405	633	669	7.3%	36	6%	264	65%	T2	CS
Portugal	72	63	56	0.6%	-7	-11%	-16	-22%	CR	CR
Spain	266	1 051	1 130	12.4%	79	7%	864	325%	T2	CR
Sweden	272	155	151	1.7%	-4	-2%	-120	-44%	T1	CS
United Kingdom	921	1 702	1 713	18.8%	11	1%	792	86%	T2	CS
EU-15	**8 762**	**9 291**	**9 112**	**100.0%**	**-178**	**-2%**	**350**	**4%**		

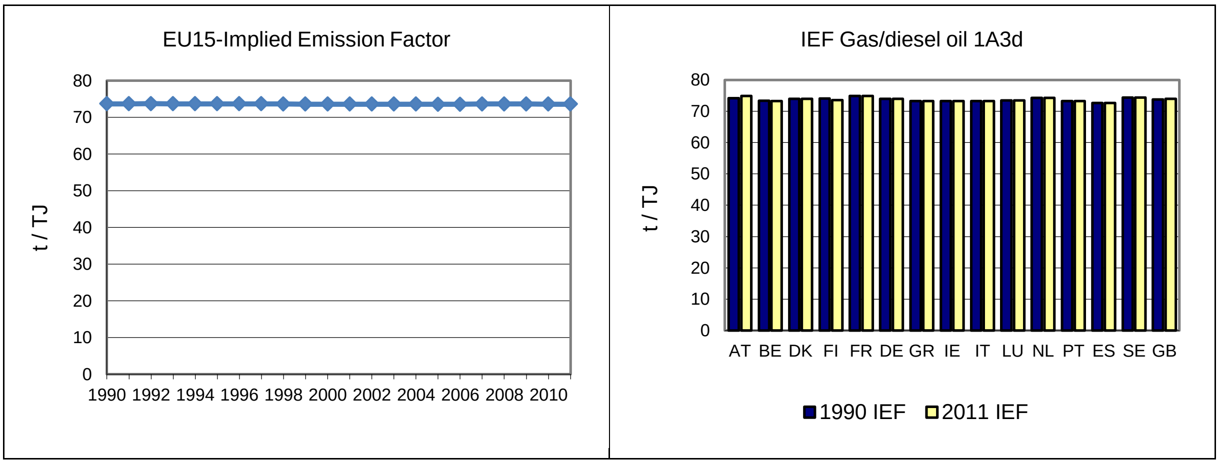
Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Greece, Italy, Spain and the United Kingdom account for 73.2 % of the CO_2 emissions and for 73.4 % of activity data from gas/diesel oil in 2011 (Figure 3.66). The IEF for the EU-15 is 73.58 t/TJ residual oil in 2011.

Table 3.63 shows that the majority of CO_2 emissions from the combustion of gas/diesel oil in navigation were calculated using a higher tier method.

Figure 3.66 1A3d Navigation, gas/diesel oil: Activity data and implied emission factors for CO_2





3.2.3.5 ***Other (1A3e) (EU-15)***

CO_2 emissions from 1A3e Other account for 0.21 % of total EU-15 GHG emissions in 2011. This source includes mainly pipeline transport and ground activities in airports and harbours. The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 7.4 % between 1990 and 2011. A fuel shift occurred from oil to gas.

Germany contributed 54.3 % to the EU-15 emissions from this source in 2011 (Table 3.64). Between 1990 and 2011 the EU-15 emissions increased by 7 %. Denmark, Luxembourg and the Netherlands report emissions as ‘Not occurring’ or ‘Not applicable’. Portugal includes off-road vehicles and machines from manufacturing industries, residential and commercial/institutional with the other combustion equipment of these source categories; emissions from the consumption of jet fuel from military operation in 1 A 5 b (Other Mobile); and emissions from off-road vehicles and machines from agriculture/forestry sector in 1 A 4 c Agriculture/Forestry/Fisheries (see country NIR Portugal, p.149-150).

Table 3.64 1A3e Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	224	321	393	5.2%	73	23%	169	75%
Belgium	197	191	172	2.3%	-18	-10%	-24	-12%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	660	634	648	8.6%	14	2%	-11	-2%
France	213	533	500	6.6%	-33	-6%	287	134%
Germany	4 752	4 068	4 098	54.3%	30	1%	-654	-14%
Greece	NO	9	11	0.1%	2	24%	11	-
Ireland	62	165	153	2.0%	-11	-7%	91	147%
Italy	407	1 093	690	9.1%	-404	-37%	282	69%
Luxembourg	NA	NA	NA	-	-	-	-	-
Netherlands	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	IE	IE	IE	-	-	-	-	-
Spain	20	305	132	1.8%	-172	-57%	112	553%
Sweden	271	304	310	4.1%	7	2%	39	14%
United Kingdom	225	424	441	5.8%	17	4%	216	96%
EU-15	**7 031**	**8 045**	**7 550**	**100.0%**	**-495**	**-6%**	**518**	**7%**

Abbreviations explained in the Chapter 'Units and abbreviation

3.2.4 Other Sectors (CRF Source Category 1A4) (EU-15)

Category 1A4 mainly includes emissions from 'small scale fuel combustion' used for space heating and hot water production in commercial and institutional buildings, households, agriculture and forestry. It includes also emissions from mobile machinery used within these categories (e.g mowers, harvesters, tractors, chain saws, motor pumps) as well as fuel used for grain drying, horticultural greenhouse heating or CO_2 fertilisation and stall heating. Category 1A4c includes emissions from domestic inland, coastal and deep sea fishing whereas emissions from international fishing are included under category 1A3d. Emissions from transportation of agricultural goods are reported under category 1A3 Transport.

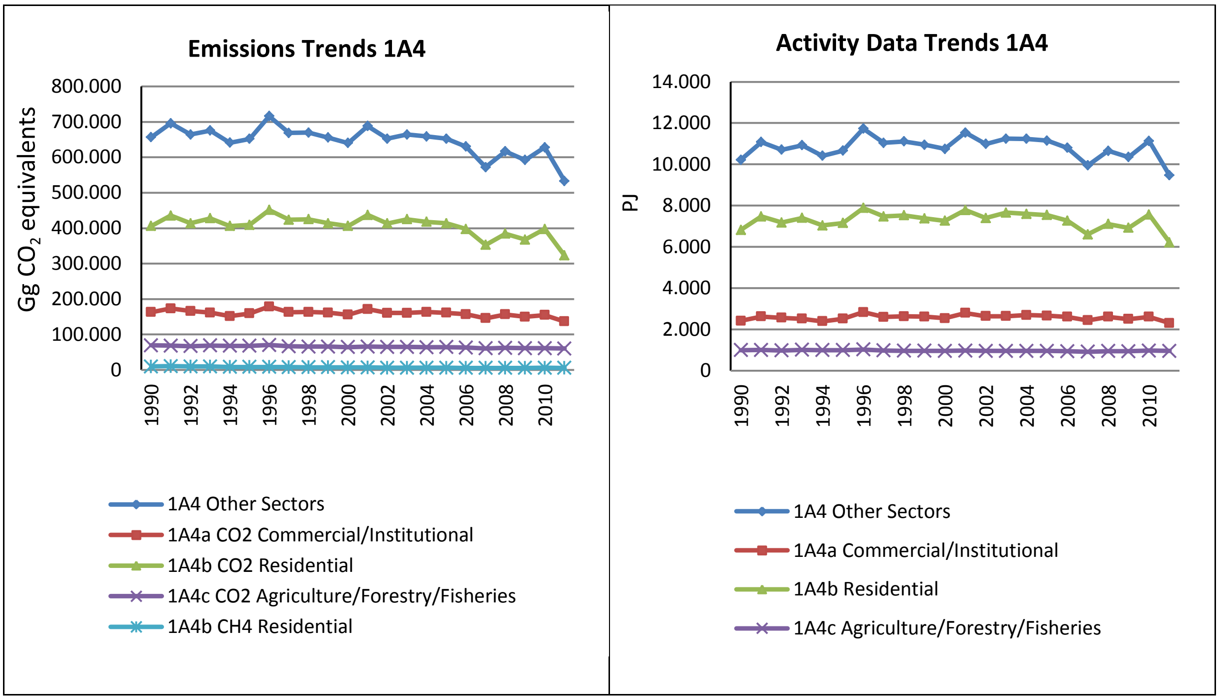
The following enumeration shows the correspondence of 1A4 sub categories and ISIC 3.1 rev codes:

- 1 A 4 a Commercial/Institutional: ISIC categories 4103, 42, 6, 719, 72, 8, and 91-96
- 1 A 4 b Residential: All emissions from fuel combustion in households
- 1 A 4 b Agriculture/Forestry/Fishing: ISIC categories 05, 11, 12, 1302

In 2011 category 1A4 contributed to 533,143 Gg CO_2 equivalents of which 97.5 % CO_2, 1.4 % CH_4 and 1.1 % N_2O.

Figure 3.67 shows the trend of total GHG emissions within source category 1A4 and the dominating sources: CO_2 emissions from 1A4b Residential and from 1A4a Commercial/Residential. The emission trends of the large key sources show larger fluctuations between 1990 and 2011. Between 1990 and 2011 emissions from 1A4 decreased by 18.8 %. Between 2010 to 2011 emissions significantly decreased by 15.1% (95 Mt CO_2 equivalents) which is mainly due to a decline of category 1A4b which decreased by 18.6% (75.6 Mt CO_2 equivalents).

Figure 3.67 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



In 2011 GHG emissions from source category 1A4 accounted for 14 % of total GHG emissions. This source category includes ten key sources which contributed to 97% of total 1A4 GHG emissions. The following list shows the key sources and their contribution to total 1A4 GHG emissions for the year 2011:

- 1 A 4 a Commercial/Institutional: Gaseous Fuels - CO_2 (17 %)
- 1 A 4 a Commercial/Institutional: Liquid Fuels - CO_2 (8 %)
- 1 A 4 a Commercial/Institutional: Solid Fuels - CO_2 (0.4 %)
- 1 A 4 a Commercial/Institutional: Other Fuels – CO_2 (0.8%)
- 1 A 4 b Residential: Gaseous Fuels - CO_2 (38 %)
- 1 A 4 b Residential: Liquid Fuels - CO_2 (20 %)
- 1 A 4 b Residential: Solid Fuels - CO_2 (2 %)
- 1 A 4 b Residential: Biomass - CH_4 (0.8 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels - CO_2 (2 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels - CO_2 (9 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels - CO_2 (0.1 %)

Table 3.65 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2011 CO_2 emissions from 1A4 Other Sectors decreased by 19 %, CH_4 decreased by 37 % and N_2O emissions decreased by 8 %.

Table 3.65 1A4 Other Sectors: Member States' contributions to total GHG, CO_2 and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)
Austria	14 406	10 728	13 786	10 338	386	186
Belgium	27 672	24 486	27 320	24 239	249	153
Denmark	9 152	5 688	8 974	5 447	108	150
Finland	7 176	4 047	6 907	3 744	183	234
France	100 632	89 901	95 599	87 509	3 736	1 147
Germany	208 066	122 726	204 483	121 320	2 595	863
Greece	8 592	11 090	8 126	10 742	84	84
Ireland	10 518	9 483	10 031	9 235	379	153
Italy	78 569	86 179	76 634	83 093	446	1 093
Luxembourg	1 323	1 513	1 310	1 496	9	7
Netherlands	38 291	37 729	37 791	36 253	455	1 435
Portugal	4 658	4 697	4 070	4 333	348	202
Spain	26 454	35 386	25 320	34 314	817	718
Sweden	10 916	3 654	10 385	3 077	243	307
United Kingdom	109 993	85 836	107 499	84 662	1 525	550
EU-15	**656 419**	**533 143**	**638 235**	**519 802**	**11 564**	**7 282**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.66 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A4 Other sectors for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 3.66 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	1	0.0	533	4.9	Gaseous fuels: Energy balance: changes in other sectors increase this 'residual amount'
Belgium	-62	-0.2	-2 208	-6.8	Brussels: new OFFREM run. Flanders: integration of results from a new survey (automn 2012) RBC: update (validation) of the 2010 regional energy balance. Final EB for Wallonia and Flanders (-19,5 PJ for Flanders)
Denmark	20	0.2	-44	-0.7	Revised Energy data from the National Energy Balance; allocation of residual LPG use.
Finland	-254	-3.5	-289	-6.1	Corrections in activity data. Reallocation of one plant.
France	1	0.0	1 844	1.8	Pour tout le secteur, les consommations de combustibles ont été mises à jour. De plus, la répartition des consommations entre les secteurs résidentiel et tertiaire a été modifiée, entrainant un ajustement des émissions de l'année 2010 touchant principalement le CO2 (-1,38 Tg pour le tertiaire, +2,84 Tg pour le résidentiel, +0,39 Tg pour l'agriculture et la pêche).
Germany	0	0.0	4 617	3.2	Gaseous fuels: final data available from the national energy balance.
Greece	0	0.0	0	0.00	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-495	-0.5	Update of waste fuel activity data for 1A4a
Luxembourg	0	0.0	119	7.3	Revision of the final consumption (2000-2010). For some categories, also the years 1990-2000 were affected, due to calculation methodology to split general IEA AD between Gasoil (heating) and diesel (Transport).
Netherlands	0	0.0	13	0.0	Improved method.
Portugal	3	0.1	-14	-0.3	Revision of the 2010 energy balance data.
Spain	0	0.0	-310	-0.8	The estimate of natural gas consumed by the residential sector has been revised taking into account the evolution of natural gas sales to other sectors (commercial-residential sector) registered by the sectoral association (SEDIGAS).
Sweden	2	0.0	-221	-6.1	Correction of consumption of diesel in Fisheries and corresponding emissions recalculated. Revised activity data for stationary combustion.
UK	42	0.0	89	0.1	Additional activity data included for deep sea fishing as a result of the 2012 In Country Review. These activity data reallocated from international shipping.
EU-15	**-248**	**0.0**	**3 634**	**0.6**	

Table 3.67 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1A4 Other sectors for 1990 and 2010.

Table 3.67 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

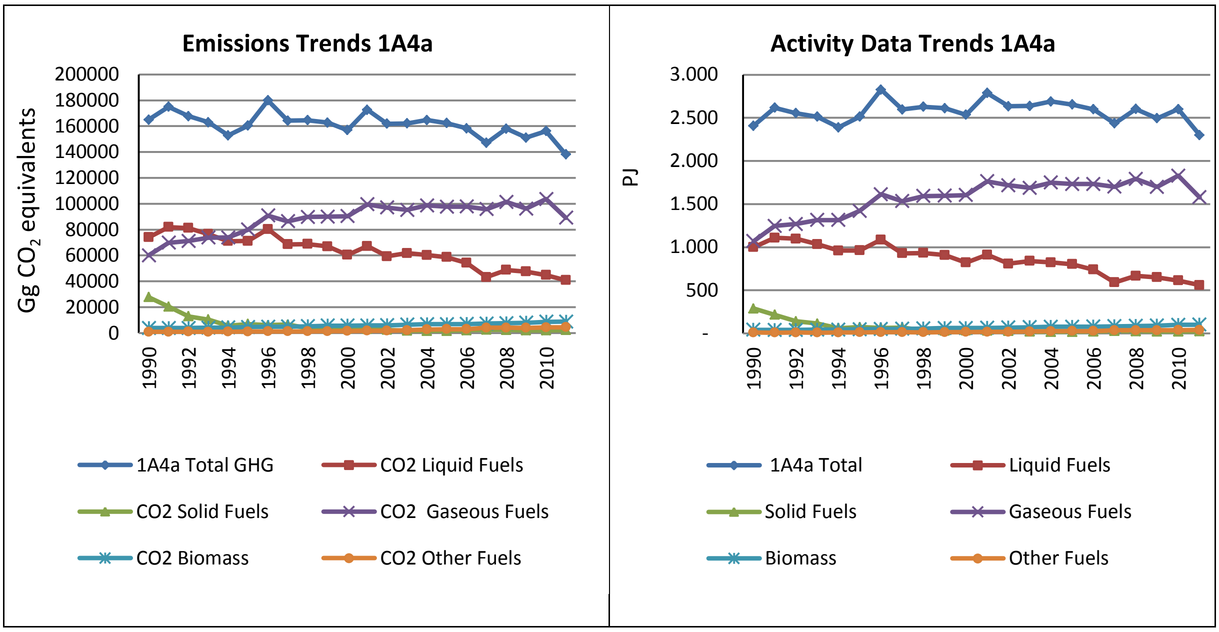
	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	2	0.8	Revised heating split.
Belgium	0	-0.1	-20	-9.2	Reallocation of emissions from the off- road transport in buildings (construction) in Wallonia to category 1A2f instead of 1A4a; corrections in the Flemish region for CH4 emissions in the category 1A4c (sea fishery) as a result of the UNFCCC in-country review; final energy balance data available
Denmark	0	0.0	2	1.0	Revised Energy data from the National Energy Balance; allocation of residual LPG use.
Finland	-1	-0.4	1	0.3	Corrections in activity data. Reallocation of one plant.
France	0	0.0	3	0.2	Updated energy balance data
Germany	0	0.0	144	17.4	Final data available from the national energy balance.
Greece	0	0.0	0.00	0.0	
Ireland	0	0.0	-2	-0.9	Change of software versions from COPERT4v8.0 to COPERT4v9.1.
Italy	137	44.3	0	0.0	Update of activity data: Emission from combustion of pruning biomass have been reallocated from the waste sector to the energy sector.
Luxembourg	2	22.2	0.2	1.9	Revision of the final consumption (2000-2010). For some categories, also the years 1990-2000 were affected, due to calculation methodology to split general IEA AD between Gasoil (heating) and diesel (Transport).
Netherlands	0	0.0	49	3.3	Improved method.
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	-72	-20.6	Improved method.
UK	7	0.4	17	2.9	Additional activity data included for charcoal use.
EU-15	**144**	**1.3**	**124**	**1.6**	

3.2.4.1 *Commercial/Institutional (1A4a) (EU-15)*

In this chapter information about emission trends, Member states' contribution, activity data, and emission factors is provided for category 1A4a by fuels. CO_2 emissions from 1A4a Commercial/Institutional accounted for 3.8 % of total GHG emissions in 2011.

Figure 3.68 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Between 1990 and 2011 GHG emissions decreased by 16.3 %, mainly due to decreases in CO_2 emissions from solid (-92 %) and liquid (-45 %) fuels while CO_2 emissions from gaseous fuels showed an continuous uptrend for the whole time series until 2010. Between 2010 and 2011 the CO_2 emissions decreased by 12 %, mainly driven by a strong decline in gaseous and liquid fuel consumption.

Figure 3.68 **1A4a Commercial/Institutional: Total and CO_2 emission and activity trends**



Between 1990 and 2011, CO_2 emissions from 1A4a decreased by 16 % in the EU-15 (Table 3.68). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of offices, (3) building codes, (4) thermal properties of building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) use of district heating. Fossil fuel consumption in Commercial/Institutional decreased by 4 % between 1990 and 2011, with a fuel switch from coal and oil to gas.

France, Germany, Italy and the United Kingdom contributed the most to the emissions from this source (76 %). The Member States with the highest increases in absolute terms were Spain, Italy and the Netherlands. The Member States with the highest reduction in absolute terms were Germany, the United Kingdom, France and Sweden.

Table 3.68 1A4a Commercial/Institutional: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2 568	2 825	2 577	1.9%	-248	-9%	10	0%
Belgium	4 286	6 566	5 149	3.8%	-1 417	-22%	862	20%
Denmark	1 486	1 052	916	0.7%	-136	-13%	-570	-38%
Finland	1 940	1 067	929	0.7%	-138	-13%	-1 011	-52%
France	28 786	29 323	26 492	19.4%	-2 832	-10%	-2 295	-8%
Germany	63 950	37 453	33 430	24.4%	-4 023	-11%	-30 520	-48%
Greece	527	1 140	1 076	0.8%	-65	-6%	549	104%
Ireland	2 319	2 325	2 090	1.5%	-236	-10%	-229	-10%
Italy	16 144	30 496	28 133	20.6%	-2 363	-8%	11 989	74%
Luxembourg	634	538	537	0.4%	-2	0%	-97	-15%
Netherlands	8 379	13 099	9 620	7.0%	-3 480	-27%	1 241	15%
Portugal	749	1 259	1 097	0.8%	-161	-13%	349	47%
Spain	3 743	8 606	8 120	5.9%	-486	-6%	4 377	117%
Sweden	2 533	693	575	0.4%	-119	-17%	-1 959	-77%
United Kingdom	24 804	18 324	16 011	11.7%	-2 313	-13%	-8 793	-35%
EU-15	**162 847**	**154 766**	**136 750**	**100.0%**	**-18 016**	**-12%**	**-26 097**	**-16%**

1A4 a Commercial/Institutional – Liquid Fuels (CO_2)

In 2011 CO_2 emissions from liquid fuels had a share of 30 % within source category 1A4a (compared to 45 % in 1990). Between 1990 and 2011, the emissions decreased by 45 % (Table 3.69). Only two Member States had increases in this period, with the highest absolute increase in Spain. The highest absolute decrease was achieved in Germany. Between 2010 and 2011 EU-15 total emissions decreased by 45 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oil tanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

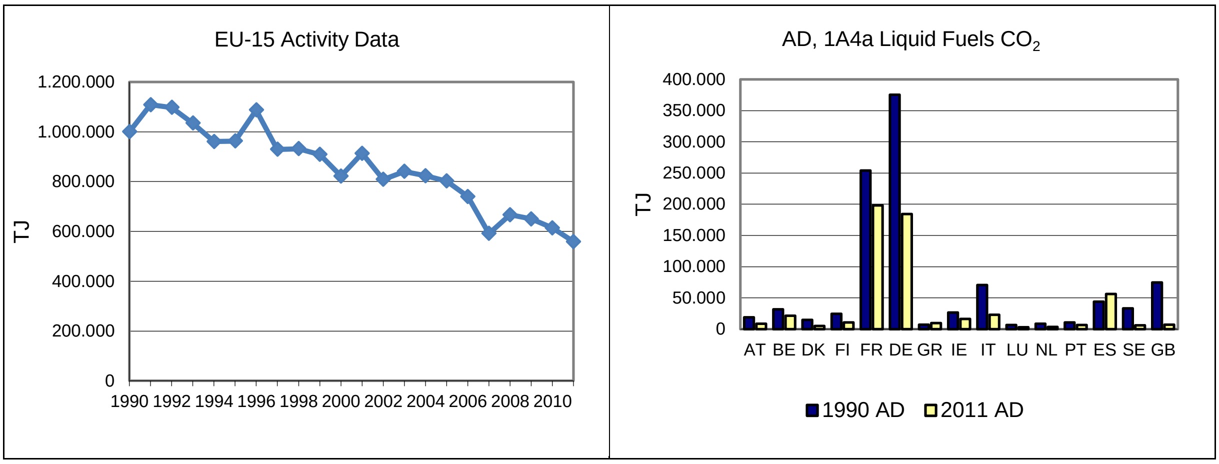
Table 3.69 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

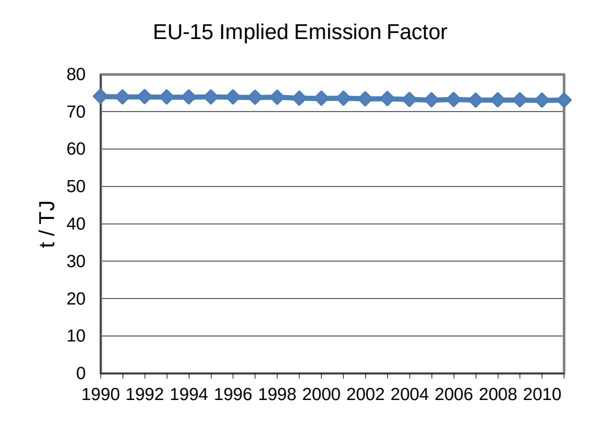
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 421	781	643	1.6%	-138	-18%	-779	-55%	T2	CS
Belgium	2 323	1 930	1 537	3.8%	-392	-20%	-786	-34%	T1	D
Denmark	1 081	396	349	0.9%	-47	-12%	-732	-68%	CR	CS,D
Finland	1 873	941	805	2.0%	-137	-15%	-1 069	-57%	T1	CS
France	18 979	14 928	14 697	36.0%	-231	-2%	-4 282	-23%	T2	CS
Germany	27 633	15 762	13 458	33.0%	-2 304	-15%	-14 175	-51%	CS	CS
Greece	505	819	694	1.7%	-124	-15%	189	37%	T2	D
Ireland	1 957	1 230	1 183	2.9%	-47	-4%	-774	-40%	T1	CS
Italy	5 157	1 689	1 562	3.8%	-127	-8%	-3 596	-70%	T2	CS
Luxembourg	464	171	194	0.5%	23	13%	-270	-58%	T2	CS
Netherlands	619	220	241	0.6%	21	9%	-378	-61%	T2	CS
Portugal	749	694	477	1.2%	-218	-31%	-272	-36%	T2	D, CR
Spain	3 193	4 294	4 050	9.9%	-243	-6%	857	27%	T2	CR
Sweden	2 447	481	400	1.0%	-82	-17%	-2 047	-84%	T1	CS
United Kingdom	5 642	486	546	1.3%	60	12%	-5 096	-90%	T2	CS
EU-15	**74 044**	**44 823**	**40 836**	**100.0%**	**-3 986**	**-9%**	**-33 208**	**-45%**		

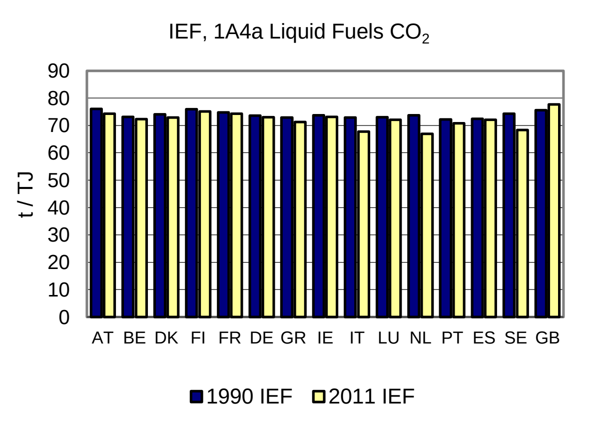
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.69 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany and Spain; together they cause 79 % of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 44 % between 1990 and 2011. The implied emission factor of EU-15 was 73.1 t/TJ in 2011. The dip in activity data 2007 is mainly due to Germany due to reasons explained earlier in this chapter.

Figure 3.69 1A4a Commercial/Institutional, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2011, CO_2 from solid fuels had a share of 2 % within source category 1A4a (compared to 17 % in 1990). Between 1990 and 2011 the emissions decreased by 92 % (Table 3.70). Eight Member States report emissions as 'Not occurring' in 2011; all other Member States reduced emissions between 1990 and 2011 except Spain. Between 2010 and 2011 EU-15 emissions increased by 13 %.

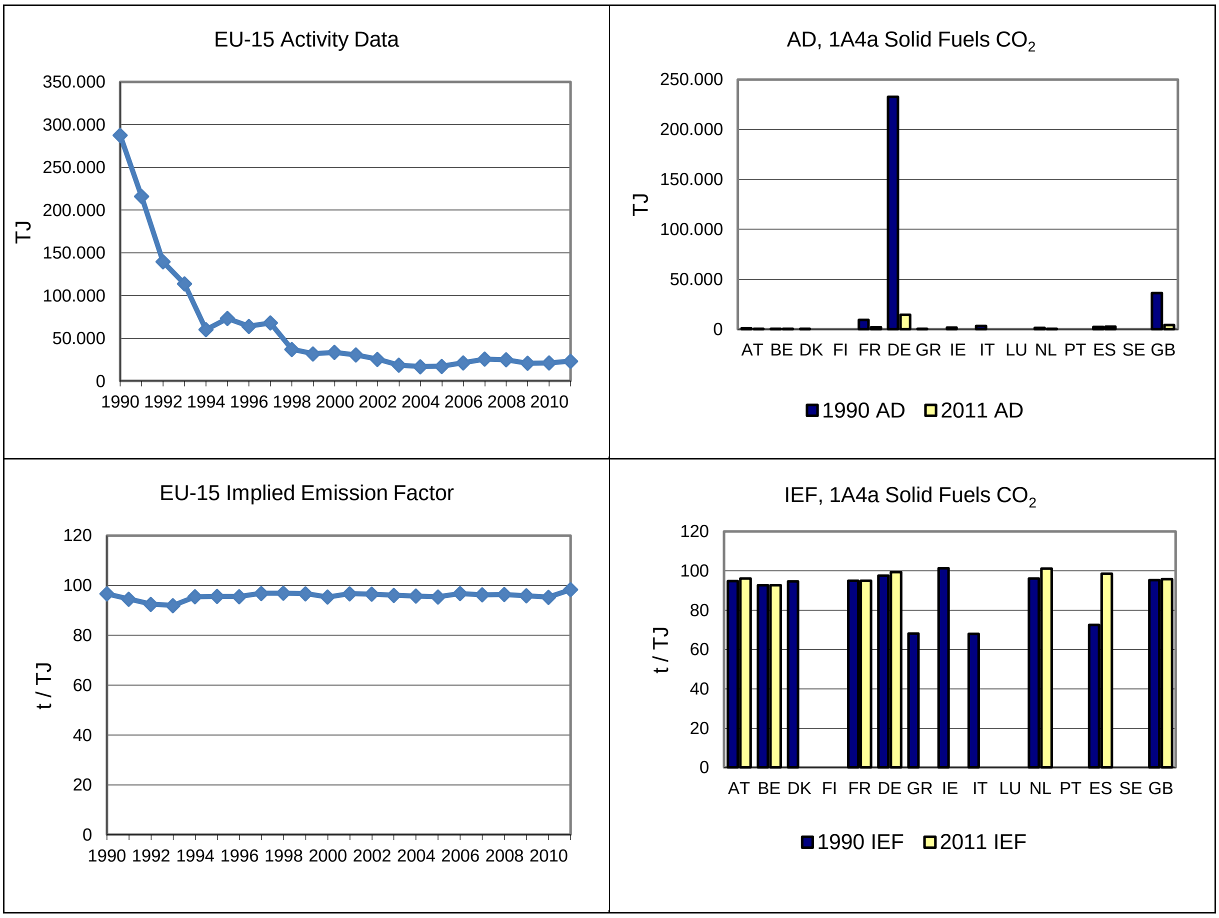
Table 3.70 1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	90	20	17	0.8%	-2	-11%	-73	-81%	T2	CS
Belgium	9	1	1	0.1%	0	14%	-7	-85%	T1	D
Denmark	8	NO	NO	-	-	-	-8	-100%	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	868	204	162	7.1%	-42	-21%	-707	-81%	T2	CS
Germany	22 712	1 107	1 428	62.5%	321	29%	-21 284	-94%	CS	CS
Greece	22	NO	NO	-	-	-	-22	-100%	NA	NA
Ireland	138	NO	NO	-	0	-	-138	-100%	NA	NA
Italy	218	NO	NO	-	-	-	-218	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	128	6	27	1.2%	21	341%	-101	-79%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	154	312	252	11.0%	-60	-19%	98	63%	T2	CR
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	3 441	377	396	17.4%	19	5%	-3 045	-88%	T2	CS
EU-15	**27 789**	**2 027**	**2 283**	**100.0%**	**257**	**13%**	**-25 506**	**-92%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.70 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom in 2011; together they cause 80 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 92 % between 1990 and 2011. The implied emission factor of EU-15 was 98.3 t/TJ in 2011. The implied emission factors of Italy and Spain are comparatively low because of a high share of gas works gas is included.

Figure 3.70 **1A4a Commercial/Institutional, solid fuels: Activity Data and Implied Emission Factors for CO_2**



1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2011 CO_2 from gaseous fuels had a share of 65 % within source category 1A4a (compared to 36 % in 1990). Between 1990 and 2011, the emissions increased by 48 % (Table 3.71). All Member States except the United Kingdom reported increasing emissions. The highest absolute increases occurred in Germany, France; Italy and Spain. Between 2010 and 2011 EU-15 emissions decreased by 14 %.

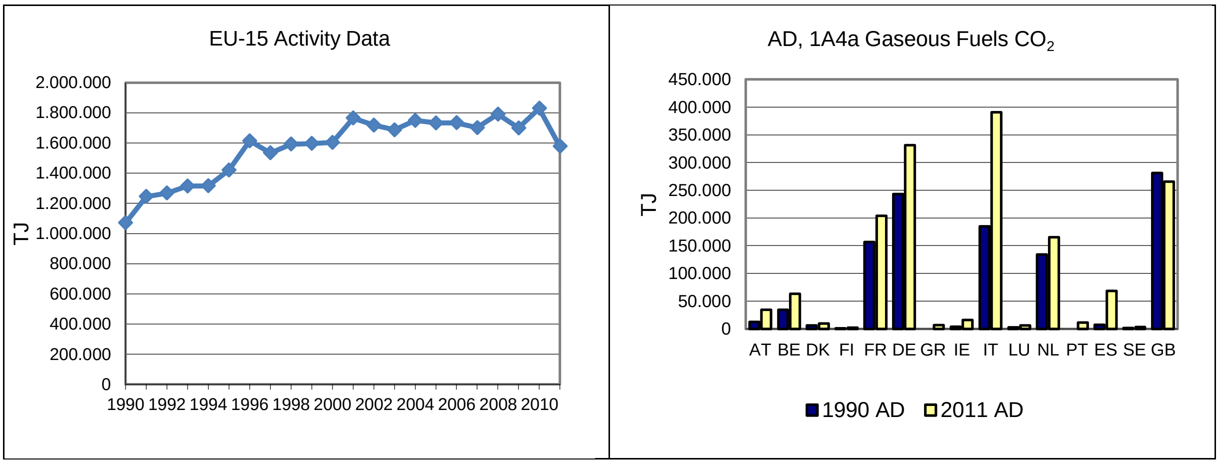
Table 3.71 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

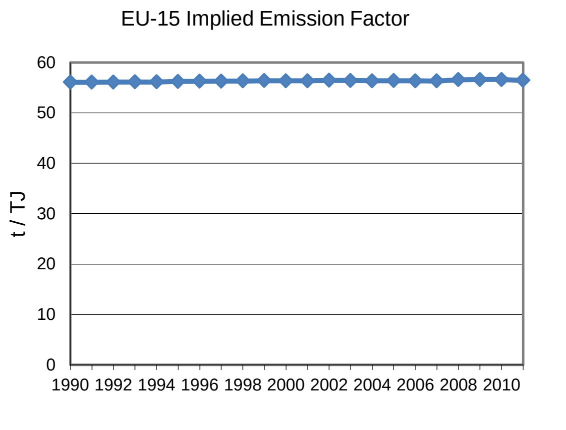
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	707	2 022	1 915	2.1%	-107	-5%	1 208	171%	T2	CS
Belgium	1 924	4 528	3 536	4.0%	-992	-22%	1 612	84%	T1	D
Denmark	363	639	565	0.6%	-74	-12%	202	56%	CR	CS
Finland	50	101	104	0.1%	4	4%	54	108%	T1	CS
France	8 939	14 191	11 633	13.1%	-2 558	-18%	2 694	30%	T2	CS
Germany	13 605	20 584	18 545	20.8%	-2 039	-10%	4 940	36%	CS	CS
Greece	NO	322	381	0.4%	59	18%	381	-	T2	CS
Ireland	223	1 095	906	1.0%	-189	-17%	683	305%	T1	CS
Italy	10 243	24 645	22 166	24.9%	-2 480	-10%	11 923	116%	T2	CS
Luxembourg	170	367	343	0.4%	-24	-7%	173	102%	T2	CS
Netherlands	7 632	12 873	9 352	10.5%	-3 521	-27%	1 719	23%	T2	CS
Portugal	NO	564	621	0.7%	56	10%	621	-	T2	D, CR
Spain	395	4 000	3 818	4.3%	-183	-5%	3 423	867%	T2	CS
Sweden	86	212	175	0.2%	-37	-17%	89	103%	T1	CS
United Kingdom	15 721	17 460	15 068	16.9%	-2 392	-14%	-653	-4%	T2	CS
EU-15	**60 058**	**103 603**	**89 126**	**100.0%**	**-14 478**	**-14%**	**29 068**	**48%**		

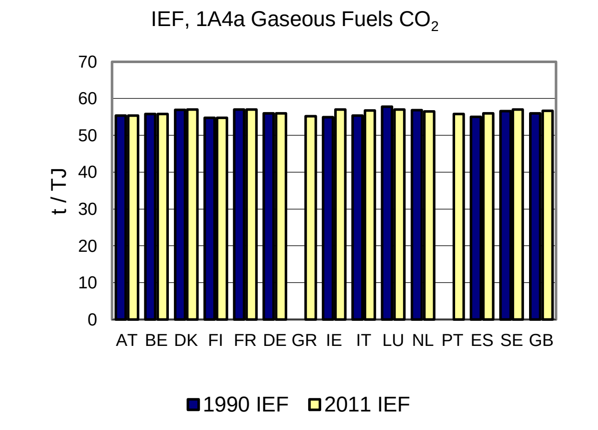
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.71 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, the Netherlands and the UK; together they cause 86 % of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion in the EU-15 rose by 47 % between 1990 and 2011. The implied emission factor of EU-15 was 56.5 t/TJ in 2011.

Figure 3.71 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2







1A4a Commercial/Institutional – Other Fuels (CO_2)

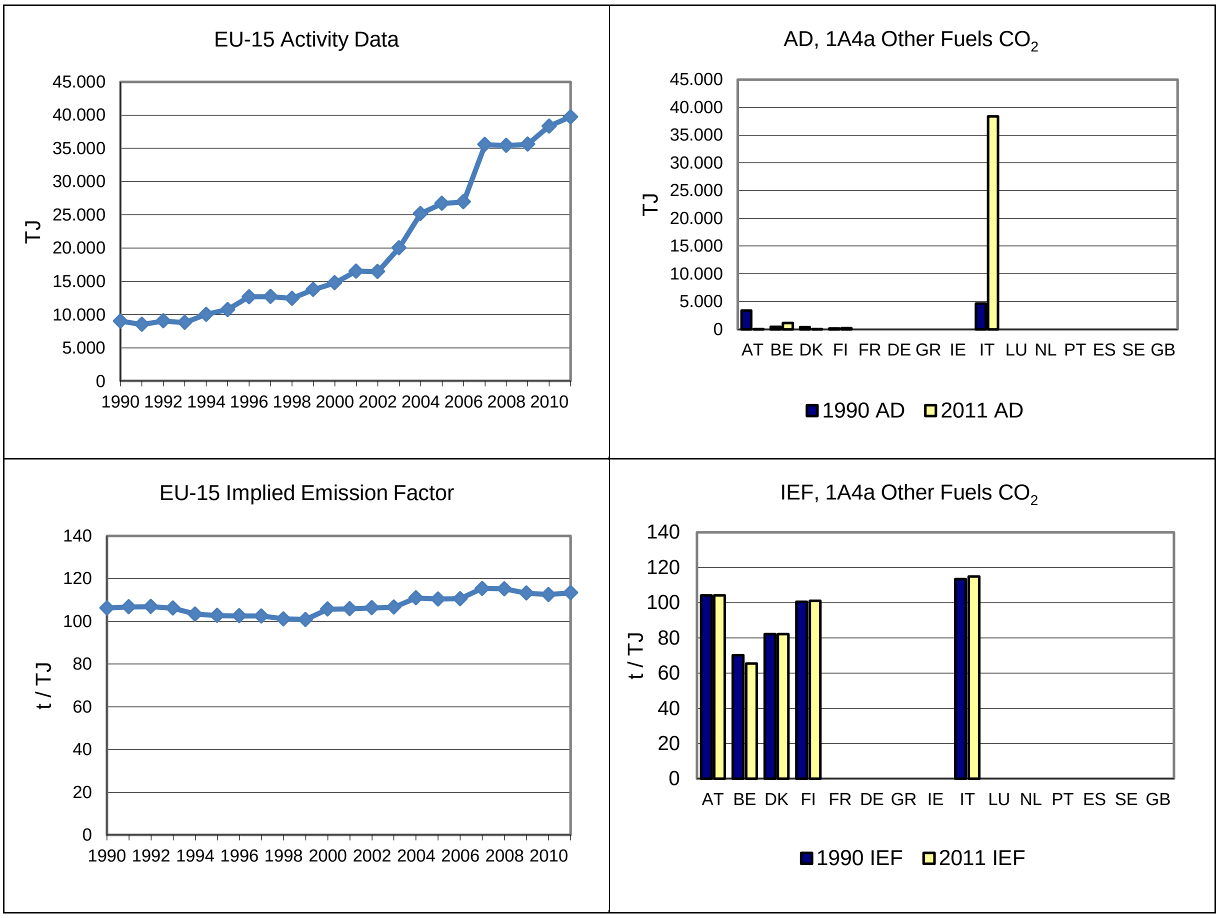
In 2011, CO_2 from other fuels had a share of 0,1 %. Between 1990 and 2011 the emissions increased by 371 % (Table **3.72**). Ten Member States report emissions as 'Not occurring' in 2011; all other Member States reduced emissions between 1990 and 2011 except Italy and Belgium. Between 2010 and 2011 EU-15 emissions increased by 4 %.

Table 3.72: Commercial/Institutional, other fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	350	2	2	0.0%	0	-14%	-347	-99%	T2	D
Belgium	31	107	74	1.6%	-33	-31%	43	141%	T1	D
Denmark	34	17	3	0.1%	-15	-84%	-31	-92%	CR	CS
Finland	16	24	20	0.4%	-5	-19%	4	25%	T1	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	526	4 162	4 406	97.8%	244	6%	3 880	737%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**956**	**4 313**	**4 505**	**100.0%**	**191**	**4%**	**3 549**	**371%**		

Figure **3.72** shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Italy; it causes 97.8 % of the CO_2 emissions from other fuels in 1A4a. The implied emission factor of EU-15 was 113.4 t/TJ in 2011.

Figure 3.72 **1A4a Commercial/Institutional, other fuels: Activity Data and Implied Emission Factors for CO_2**

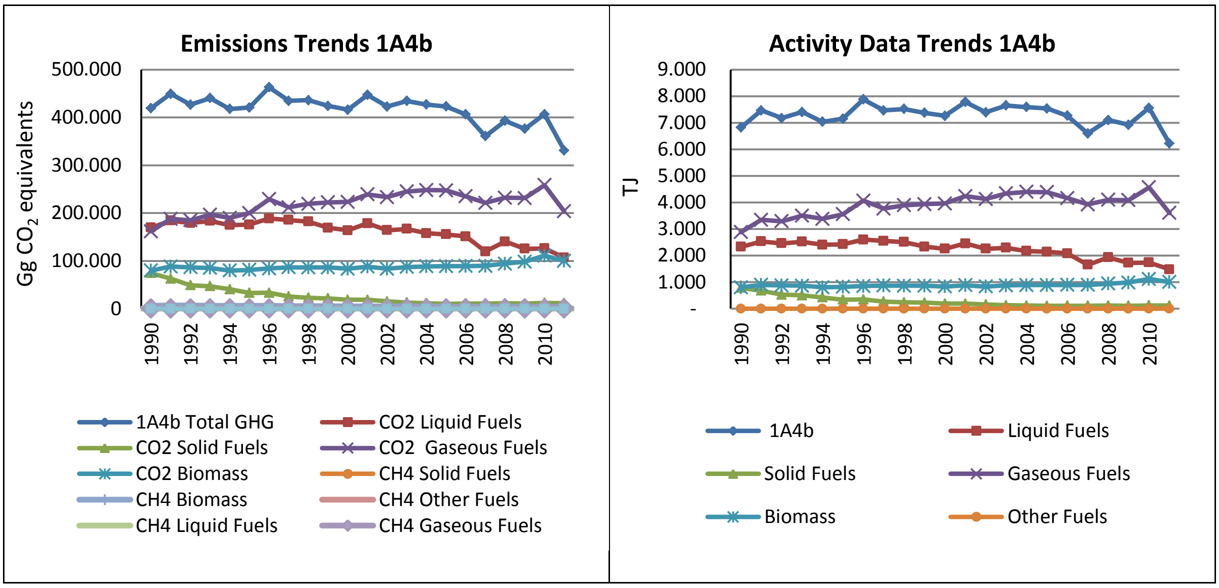


3.2.4.2 ***Residential (1A4b) (EU-15)***

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4b by fuels. CO_2 emissions from 1A4b Residential are the third largest key category of GHG emissions in the EU-15 and account for 8.9 % of total GHG emissions in 2011.

Figure 3.73 shows the emission trend within the category 1A4b, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total GHG emissions decreased by 21% since 1990, although CO_2 emissions from gaseous fuels increased strongly (+26 %) which was counterbalanced by decreasing emissions from other fossil fuels.

Figure 3.73 **1A4b Residential: Total, CO_2 and CH_4 emission and activity trends**



CO_2 emissions from 1A4b Residential

Between 1990 and 2011, CO_2 emissions from households decreased by 20 % in the EU-15 (Table 3.73). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of dwellings, (3) building codes, (4 thermal properties of of building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) use of district heating. Fossil fuel consumption in households decreased by 13 % between 1990 and 2011, with a fuel shift from coal and oil to gas.

Between 1990 and 2011, the largest reduction in absolute terms was reported by Germany reducing emissions by 47.6 million tonnes. Only four Member States show increases in their emissions. One reason for the performance of the Nordic countries and Austria is increased use of district heating. As district heating replaces heating boilers in households, an increase in the share of district heating reduces CO_2 emissions from households (but increases emissions from energy industries if fossil fuels are used). In Germany, efficiency improvements and the fuel switch in eastern German households are two reasons for the emission reductions. Between 2010 and 2011 all member States except Greece show a decrease in emissions.

Table 3.73 1A4b Residential: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	9 965	7 822	6 858	2.1%	-964	-12%	-3 107	-31%
Belgium	20 269	21 355	16 934	5.2%	-4 421	-21%	-3 335	-16%
Denmark	5 003	3 057	2 370	0.7%	-687	-22%	-2 633	-53%
Finland	3 108	1 861	1 373	0.4%	-488	-26%	-1 735	-56%
France	55 987	61 774	50 262	15.6%	-11 512	-19%	-5 726	-10%
Germany	129 474	105 542	81 919	25.4%	-23 623	-22%	-47 555	-37%
Greece	4 671	6 678	7 903	2.4%	1 226	18%	3 232	69%
Ireland	7 052	7 632	6 432	2.0%	-1 200	-16%	-620	-9%
Italy	52 118	52 786	47 840	14.8%	-4 946	-9%	-4 278	-8%
Luxembourg	660	1 139	908	0.3%	-230	-20%	248	38%
Netherlands	19 495	20 812	16 868	5.2%	-3 945	-19%	-2 627	-13%
Portugal	1 660	2 541	2 186	0.7%	-355	-14%	526	32%
Spain	12 979	18 834	15 740	4.9%	-3 094	-16%	2 761	21%
Sweden	6 256	1 051	917	0.3%	-134	-13%	-5 339	-85%
United Kingdom	77 472	84 592	64 407	19.9%	-20 185	-24%	-13 065	-17%
EU-15	**406 168**	**397 477**	**322 917**	**100.0%**	**-74 560**	**-19%**	**-83 251**	**-20%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2011 CO_2 from liquid fuels had a share of 32 % within source category 1A4b (compared to 40 % in 1990). Between 1990 and 2011 the emissions decreased by 37 % (Table 3.74). The highest absolute increases showed Greece, Ireland and the United Kingdom. The highest absolute decreases were reported by Germany, France, Italy and Sweden. Between 2010 and 2011 EU-15 emissions decreased by 15 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oiltanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

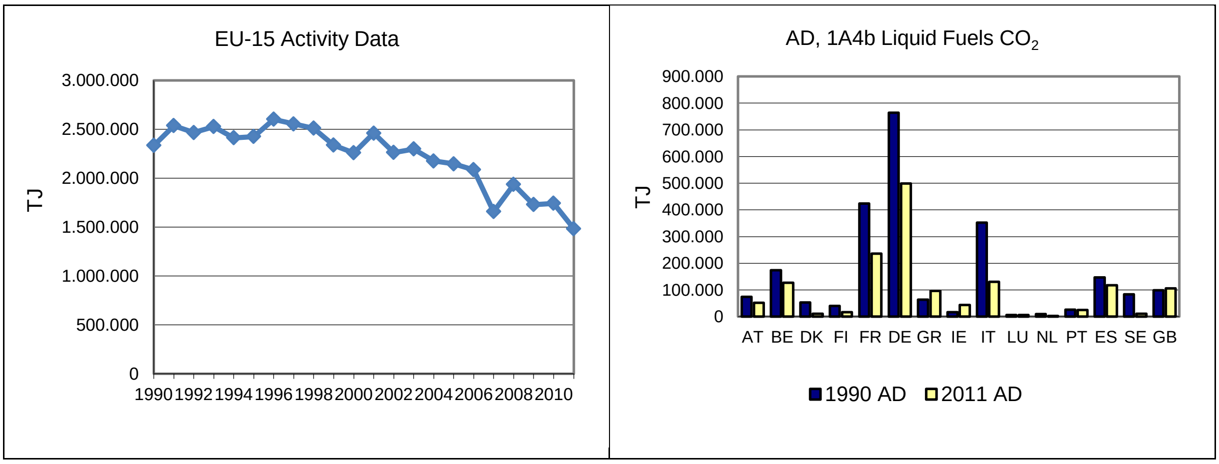
Table 3.74 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

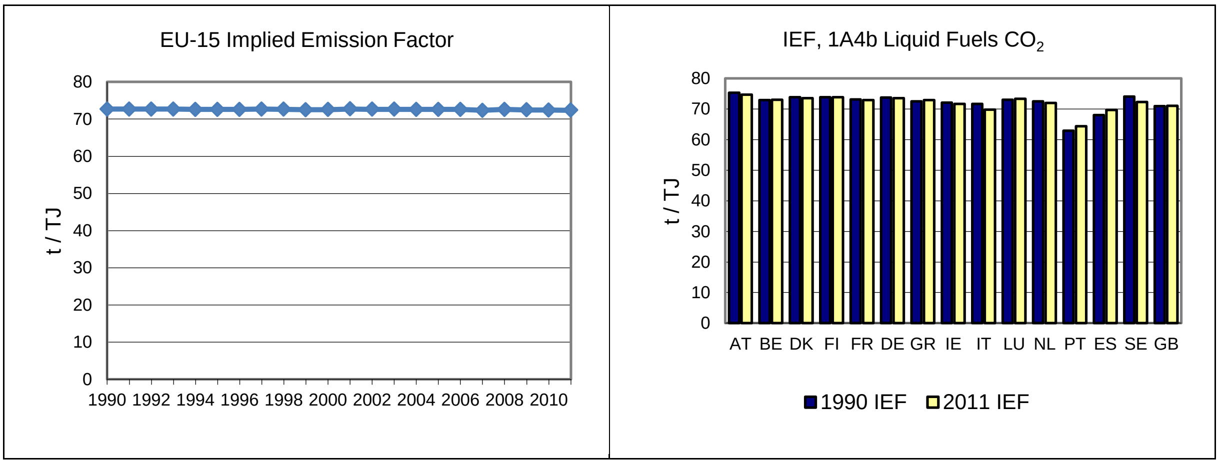
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	5 605	4 461	3 876	3.6%	-584	-13%	-1 729	-31%	T2,T3	CS
Belgium	12 665	11 548	9 298	8.7%	-2 250	-19%	-3 366	-27%	T1	D
Denmark	3 943	1 206	810	0.8%	-396	-33%	-3 133	-79%	CR	CS,D
Finland	2 987	1 698	1 265	1.2%	-433	-26%	-1 722	-58%	T1	CS
France	30 988	21 466	17 246	16.1%	-4 220	-20%	-13 742	-44%	T2	CS
Germany	56 344	43 353	36 727	34.2%	-6 626	-15%	-19 618	-35%	CS	CS
Greece	4 585	6 074	7 080	6.6%	1 006	17%	2 495	54%	T2	D
Ireland	1 175	3 803	3 106	2.9%	-696	-18%	1 931	164%	T1	CS
Italy	25 292	9 873	9 154	8.5%	-719	-7%	-16 138	-64%	T2	CS
Luxembourg	464	592	458	0.4%	-134	-23%	-7	-1%	T2	CS
Netherlands	737	314	222	0.2%	-93	-30%	-516	-70%	T2	CS
Portugal	1 660	1 839	1 581	1.5%	-258	-14%	-79	-5%	T2	D, CR
Spain	9 971	9 463	8 161	7.6%	-1 302	-14%	-1 809	-18%	T2	CR
Sweden	6 170	848	750	0.7%	-99	-12%	-5 420	-88%	T1, T2	CS
United Kingdom	7 015	9 645	7 527	7.0%	-2 118	-22%	512	7%	T2	CS
EU-15	**169 602**	**126 184**	**107 261**	**100.0%**	**-18 923**	**-15%**	**-62 341**	**-37%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.74 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France, Germany, Italy, Spain and the United Kingdom; together they cause 82 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 36 % between 1990 and 2011. The implied emission factor of EU-15 was 72.4 t/TJ in 2011. The implied emission factor of Portugal is lower than for other countries because a high share of city gas and LPG is used by the domestic sector.

Figure 3.74 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2





1A4b Residential –Solid Fuels (CO_2)

In 2011 CO_2 from solid fuels had a share of 4 % within source category 1A4b (compared to 18 % in 1990). Between 1990 and 2011 the emissions decreased by 84 %

Table 3.75). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the United Kingdom, Ireland and France. Between 2010 and 2011 EU-15 emissions decreased by 7 %. Sweden and Portugal report emissions as ‘Not occuring’.

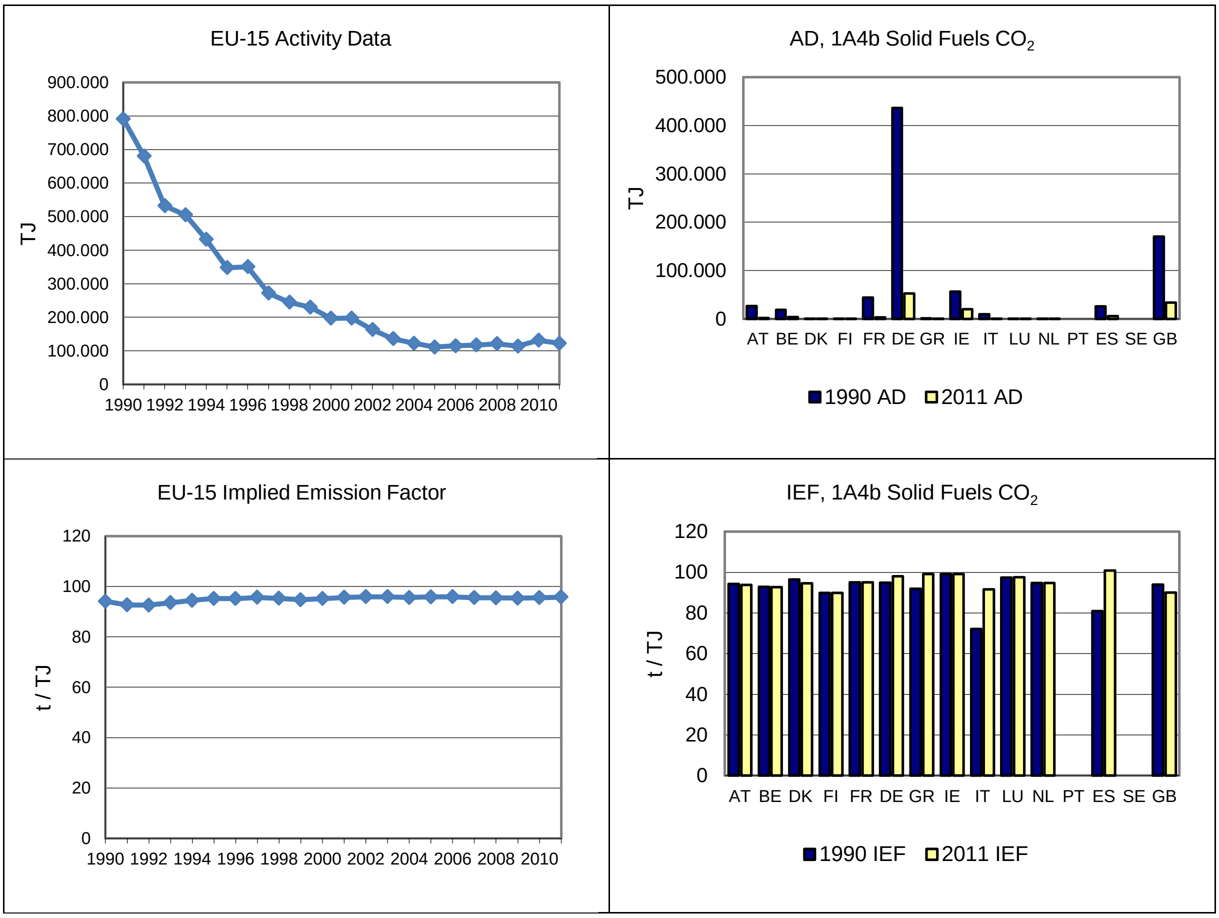
Table 3.75 1A4b Residential, solid fuels: Member States’ contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	2 512	221	192	1.6%	-29	-13%	-2 321	-92%	T2	CS
Belgium	1 759	483	350	3.0%	-133	-28%	-1 409	-80%	T1	D
Denmark	72	3	3	0.0%	0	-7%	-69	-96%	CR	CS,D
Finland	33	1	2	0.0%	1	70%	-32	-95%	T1	D
France	4 168	340	294	2.5%	-46	-14%	-3 875	-93%	T2	CS
Germany	41 415	5 261	5 184	44.2%	-77	-1%	-36 231	-87%	CS	CS
Greece	87	14	19	0.2%	5	33%	-68	-79%	T2	D
Ireland	5 607	2 133	1 966	16.8%	-166	-8%	-3 641	-65%	T1	CS
Italy	702	17	17	0.1%	0	0%	-685	-98%	T2	CS
Luxembourg	26	2	2	0.0%	0	-10%	-24	-92%	T1	D
Netherlands	61	22	15	0.1%	-7	-31%	-46	-75%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	2 091	834	613	5.2%	-221	-26%	-1 477	-71%	T2	CR
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	15 979	3 201	3 060	26.1%	-141	-4%	-12 919	-81%	T2	CS
EU-15	**74 513**	**12 532**	**11 717**	**100.0%**	**-815**	**-7%**	**-62 796**	**-84%**		

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 3.75 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Ireland and the United Kingdom; together they cause 87 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 85 % between 1990 and 2011. The implied emission factor of EU-15 was 95.8 t/TJ in 2011. The 1990 implied emission factors of Italy and Spain are comparatively low because of a high share of gas works gas is included.

Figure 3.75 1A4b Residential, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential – Gaseous Fuels (CO_2)

In 2011, CO_2 from gaseous fuels had a share of 62 % within source category 1A4b (compared to 39 % in 1990). Between 1990 and 2011, the emissions increased by 26 % (Table 3.76). All Member States except the Netherlands and the United Kingdom reported increasing emissions. The highest absolute increase occurred in Germany, France, the United Kingdom, Spain and Italy. Between 2010 and 2011, EU-15 emissions decreased by 21 %.

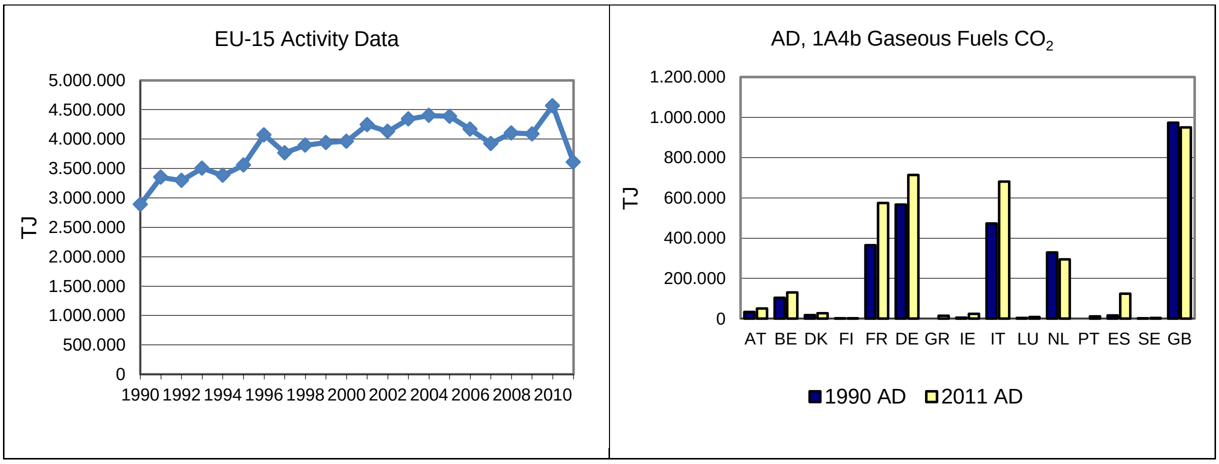
Table 3.76 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

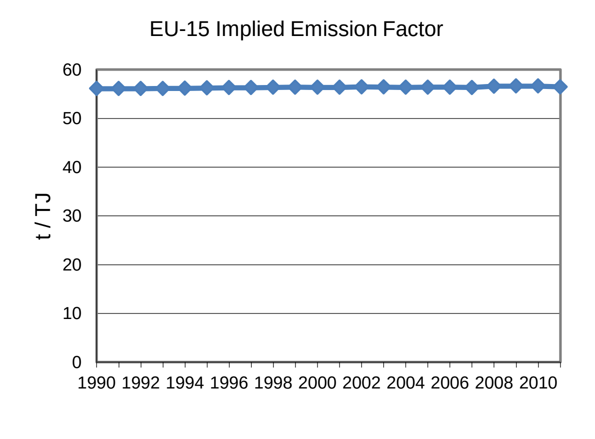
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 847	3 141	2 790	1.4%	-351	-11%	943	51%	T2	CS
Belgium	5 824	9 314	7 276	3.6%	-2 038	-22%	1 452	25%	T1	D
Denmark	988	1 848	1 557	0.8%	-291	-16%	569	58%	CR	CS
Finland	22	108	71	0.0%	-37	-34%	49	225%	T1	CS
France	20 831	39 968	32 722	16.0%	-7 246	-18%	11 891	57%	T2	CS
Germany	31 714	56 928	40 008	19.6%	-16 920	-30%	8 293	26%	CS	CS
Greece	NO	590	805	0.4%	215	36%	805	-	T2	CS
Ireland	270	1 697	1 359	0.7%	-337	-20%	1 089	404%	T1	CS
Italy	26 123	42 896	38 669	19.0%	-4 227	-10%	12 546	48%	T2	CS
Luxembourg	170	544	448	0.2%	-96	-18%	279	164%	T2	CS
Netherlands	18 696	20 476	16 630	8.2%	-3 845	-19%	-2 066	-11%	T2	CS
Portugal	NO	702	606	0.3%	-96	-14%	606	-	T2	D, CR
Spain	918	8 537	6 966	3.4%	-1 572	-18%	6 048	659%	T2	CS
Sweden	86	203	167	0.1%	-35	-17%	81	94%	T1	CS
United Kingdom	54 478	71 746	53 820	26.4%	-17 926	-25%	-658	-1%	T2	CS
EU-15	**161 967**	**258 696**	**203 894**	**100.0%**	**-54 802**	**-21%**	**41 927**	**26%**		

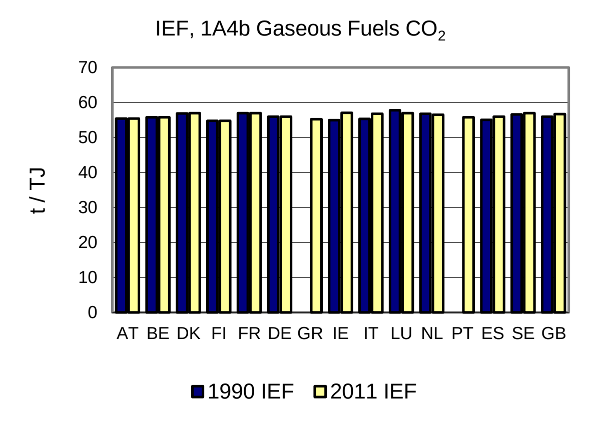
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.76 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and the United Kingdom; together they cause 81 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 rose 25 % between 1990 and 2011. The implied emission factor of EU-15 was 56.5 t/TJ in 2011.

Figure 3.76 1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2







CH_4 emissions from 1A4b Residential

CH_4 emissions from 1A4b Residential accounted for 0.2 % of total GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from households decreased by 31 % in the EU-15 (Table 3.77). In 2011 France was responsible for 23 % of EU-15 CH_4 emissions even though emissions were reduced by 73 % between 1990 and 2011. Italy reported the highest increase in emissions. Between 2010 and 2011 EU-15 emissions decreased by 11 %.

Table 3.77 1A4b Residential: Member States' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	377	194	169	3.1%	-25	-13%	-208	-55%
Belgium	209	150	119	2.2%	-31	-21%	-91	-43%
Denmark	78	123	106	1.9%	-17	-14%	28	36%
Finland	164	251	217	4.0%	-34	-13%	53	33%
France	3 649	1 425	1 069	19.7%	-356	-25%	-2 579	-71%
Germany	1 200	815	703	12.9%	-113	-14%	-498	-41%
Greece	80	68	73	1.3%	5	8%	-7	-9%
Ireland	372	157	143	2.6%	-14	-9%	-229	-62%
Italy	396	933	939	17.3%	6	1%	543	137%
Luxembourg	7	8	6	0.1%	-2	-21%	-1	-20%
Netherlands	361	388	332	6.1%	-57	-15%	-30	-8%
Portugal	344	190	199	3.7%	10	5%	-145	-42%
Spain	775	656	633	11.7%	-23	-4%	-143	-18%
Sweden	234	233	257	4.7%	24	10%	23	10%
United Kingdom	1 450	508	463	8.5%	-45	-9%	-987	-68%
EU-15	**9 699**	**6 098**	**5 428**	**100.0%**	**-670**	**-11%**	**-4 271**	**-44%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2011 CH_4 from biomass had a share of 1.3 % within source category 1A4b (compared to 1.4 % in 1990). Between 1990 and 2011 the emissions decreased by 31 % (Table 3.78). France reported the highest absolute decrease, while Germany's (+117 %) and Italy's (+179 %) CH_4 emissions increased significantly. Between 2010 and 2011, EU-15 emissions increased by 10%.

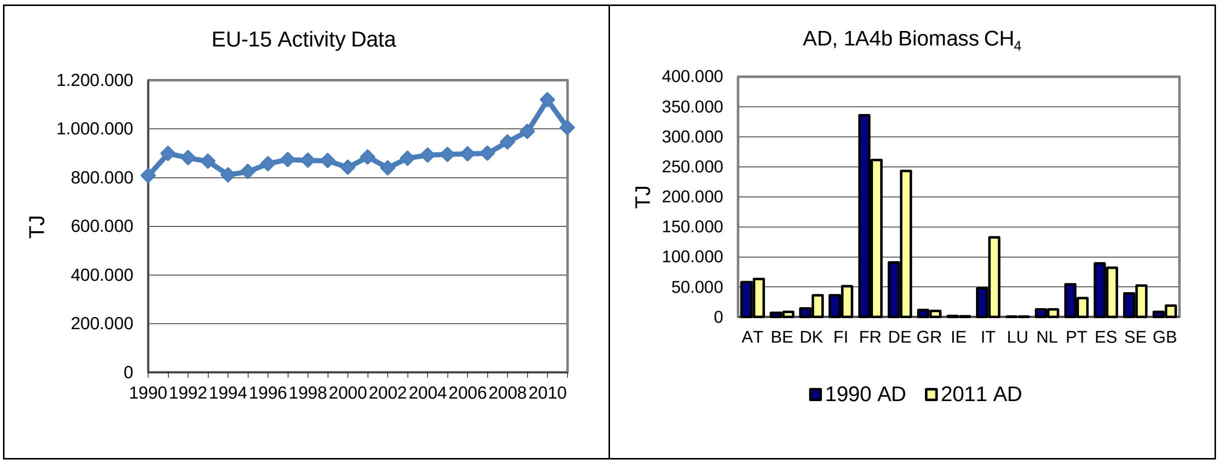
Table 3.78 1A4b Residential, biomass: Member States' contributions to CH_4 emissions and information on method applied and emission factor

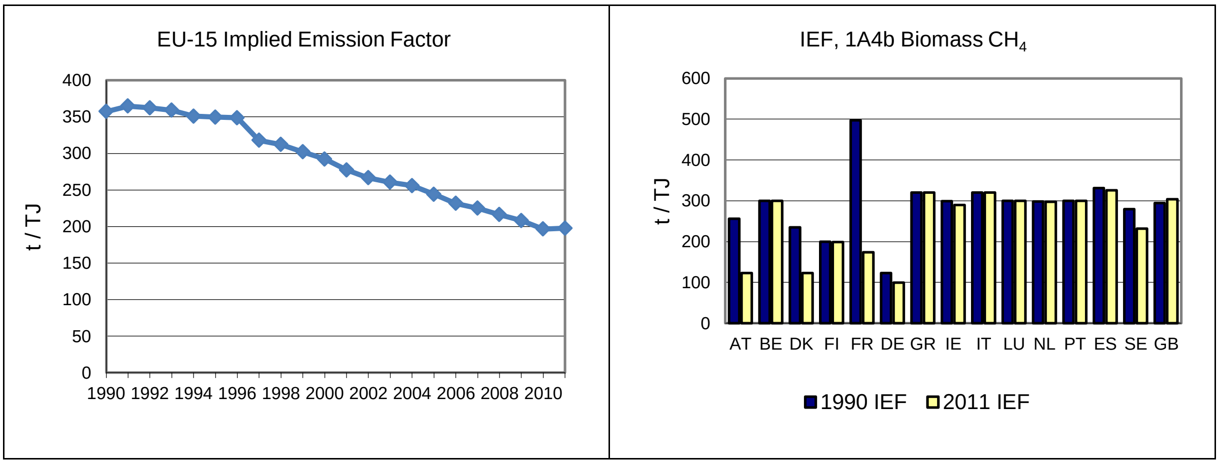
Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	313	188	164	3.9%	-24	-13%	-150	-48%
Belgium	42	66	54	1.3%	-12	-18%	12	28%
Denmark	69	107	93	2.2%	-14	-13%	23	34%
Finland	152	245	213	5.1%	-32	-13%	61	40%
France	3 511	1 285	955	22.9%	-331	-26%	-2 556	-73%
Germany	235	599	509	12.2%	-90	-15%	274	117%
Greece	77	63	67	1.6%	4	7%	-10	-13%
Ireland	12	7	6	0.2%	-1	-12%	-5	-46%
Italy	319	880	890	21.4%	11	1%	571	179%
Luxembourg	4	5	4	0.1%	-1	-22%	0	-10%
Netherlands	79	79	80	1.9%	1	1%	1	1%
Portugal	343	188	198	4.7%	10	5%	-146	-42%
Spain	621	562	562	13.5%	0	0%	-59	-9%
Sweden	229	229	254	6.1%	24	11%	25	11%
United Kingdom	53	117	120	2.9%	4	3%	68	129%
EU-15	**6 059**	**4 618**	**4 168**	**100.0%**	**-450**	**-10%**	**-1 892**	**-31%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.77 shows activity data and implied emission factors for CH_4 from biomass for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause 70 % of the CH_4 emissions from biomass fuels in 1A4b. Biomass fuel consumption in the EU-15 rose by 24 % between 1990 and 2010. The implied emission factor of EU-15 was 197.54 kg/TJ in 2011. The decrease of the IEF is because of improved combustion in new (automated) heating devices and less use of small stoves having higher CH_4 emissions.

Figure 3.77 **1A4b Residential, biomass: Activity Data and Implied Emission Factors for CH_4**



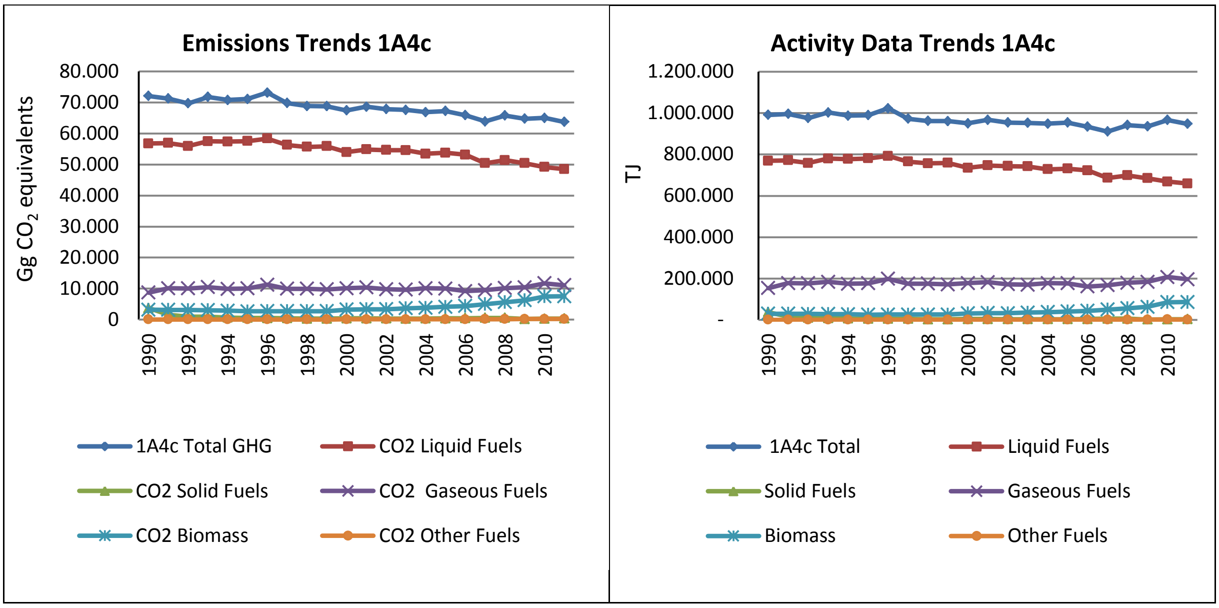


3.2.4.3 *Agriculture/Forestry/Fisheries (1A4c) (EU-15)*

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4c by fuels. CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries accounted for 1.7 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 13 % in the EU-15 (Table 3.79).

Figure 3.78 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 12 %, mainly due to decreases in CO_2 emissions from liquid fuels (-15 %).

Figure 3.78 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



Only five Member States, France, Germany, Italy, the Netherlands and Spain together contributed 73 % to the emissions from this source. Spain was the Member State with the highest increase in absolute terms between 1990 and 2011, while the highest decreases were achieved in Germany, Greece, Italy and the United Kingdom.

Table 3.79 1A4c Agriculture/Forestry/Fisheries: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1 253	855	903	1.5%	47	6%	-350	-28%
Belgium	2 765	2 147	2 157	3.6%	9	0%	-609	-22%
Denmark	2 485	2 179	2 161	3.6%	-18	-1%	-324	-13%
Finland	1 859	1 515	1 442	2.4%	-73	-5%	-417	-22%
France	10 825	10 971	10 756	17.9%	-215	-2%	-69	-1%
Germany	11 060	6 179	5 971	9.9%	-208	-3%	-5 089	-46%
Greece	2 927	1 701	1 763	2.9%	62	4%	-1 164	-40%
Ireland	660	767	714	1.2%	-53	-7%	53	8%
Italy	8 372	7 261	7 120	11.8%	-141	-2%	-1 253	-15%
Luxembourg	16	64	51	0.1%	-13	-20%	36	227%
Netherlands	9 917	10 394	9 766	16.2%	-628	-6%	-151	-2%
Portugal	1 661	1 073	1 049	1.7%	-24	-2%	-612	-37%
Spain	8 598	10 393	10 453	17.4%	61	1%	1 856	22%
Sweden	1 596	1 641	1 586	2.6%	-56	-3%	-11	-1%
United Kingdom	5 223	4 276	4 244	7.1%	-32	-1%	-979	-19%
EU-15	**69 219**	**61 415**	**60 135**	**100.0%**	**-1 280**	**-2%**	**-9 084**	**-13%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4c Agriculture/Forestry/Fisheries – Liquid Fuels (CO_2)

In 2011 CO_2 from liquid fuels had a share of 76 % within source category 1A4c (compared to 79 % in 1990). Between 1990 and 2011 the emissions decreased by 15 % (Table 3.80). Only Ireland, Luxembourg, Spain and Sweden reported increasing emissions with the highest increases in absolute terms in Spain. Between 2010 and 2011 EU-15 emissions decreased by 1 %.

Table 3.80 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

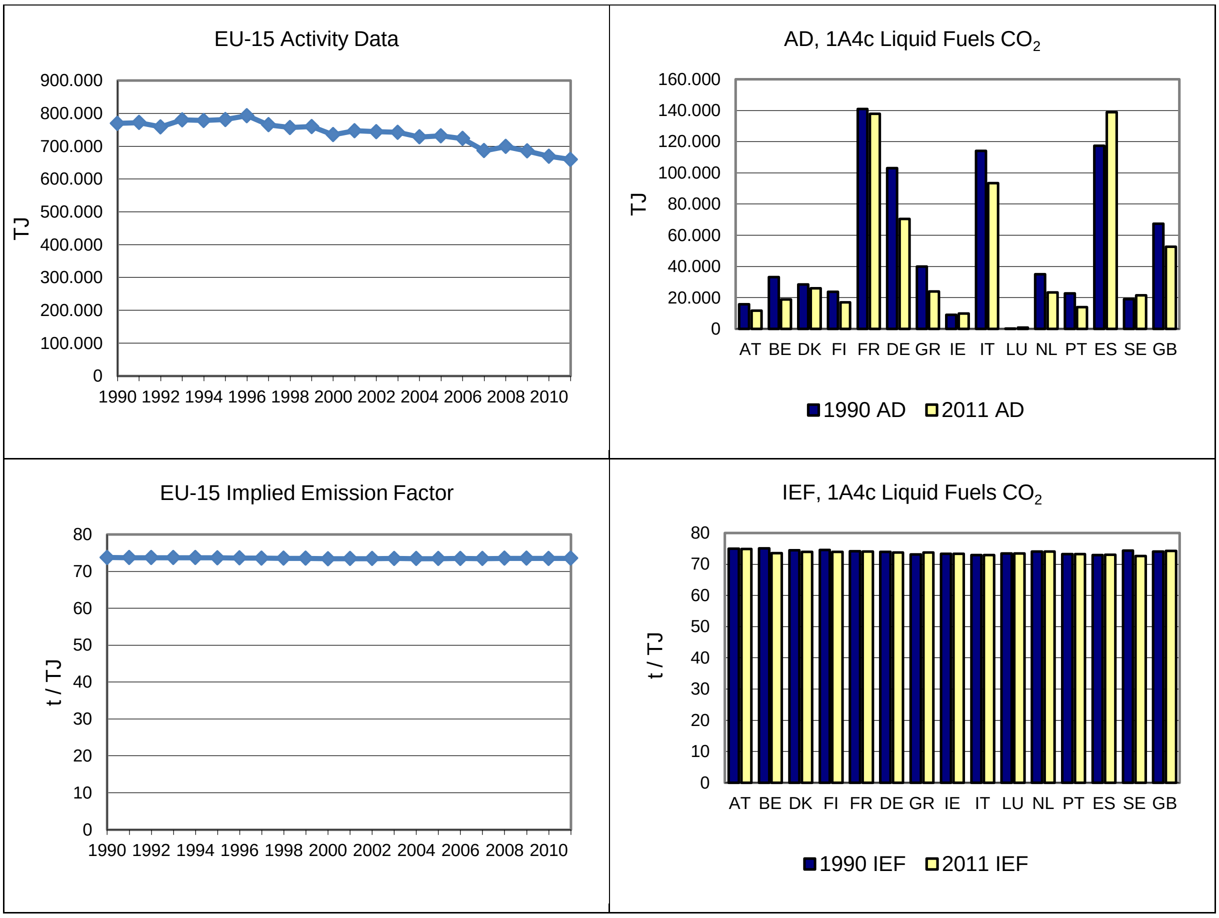
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 181	815	867	1.8%	52	6%	-315	-27%	T2,T3	CS
Belgium	2 490	1 378	1 378	2.8%	0	0%	-1 112	-45%	T1	D
Denmark	2 120	1 921	1 926	4.0%	4	0%	-194	-9%	CR	CS,D
Finland	1 774	1 274	1 245	2.6%	-29	-2%	-529	-30%	M,T1	CS
France	10 442	10 422	10 205	21.0%	-217	-2%	-237	-2%	T2	CS
Germany	7 627	5 396	5 190	10.7%	-205	-4%	-2 436	-32%	CS	CS
Greece	2 917	1 701	1 763	3.6%	62	4%	-1 153	-40%	T2	D
Ireland	660	767	714	1.5%	-53	-7%	53	8%	T1	CS
Italy	8 321	6 919	6 811	14.0%	-109	-2%	-1 510	-18%	T2	CS
Luxembourg	16	64	51	0.1%	-13	-20%	35	226%	T2	CS
Netherlands	2 587	1 797	1 723	3.6%	-74	-4%	-865	-33%	T2	CS
Portugal	1 661	1 049	1 022	2.1%	-27	-3%	-640	-39%	T2	D, CR
Spain	8 555	10 157	10 136	20.9%	-20	0%	1 582	18%	T2, T3	CR
Sweden	1 406	1 614	1 563	3.2%	-51	-3%	157	11%	T1, T2	CS
United Kingdom	4 993	3 910	3 904	8.1%	-5	0%	-1 088	-22%	T2	CS
EU-15	**56 750**	**49 185**	**48 499**	**100.0%**	**-686**	**-1%**	**-8 252**	**-15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.79 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause

67 % of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-15 decreased by 14 % between 1990 and 2011. The implied emission factor of EU-15 was 736 t/TJ in 2011.

Figure 3.79 **1A4c Agriculture/Forestry/Fisheries, liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A4c Agriculture/Forestry/Fisheries – Solid Fuels (CO_2)

In 2011 CO_2 from solid fuels had a share of 0.6 % within source category 1A4c (compared to 5 % in 1990). Between 1990 and 2011 the emissions decreased by 90 % (Table 3.81). Nine member states reported CO_2 emissions from this source category as 'Not occurring' or "Not applicable" in 2011. All other Member States reported decreasing emissions between 1990 and 2011. Between 2010 and 2011 EU-15 emissions increased by 22 %, mainly due to increases reported by Germany. The strong decrease in 1990 to 1992 emissions is due to the reporting of Germany.

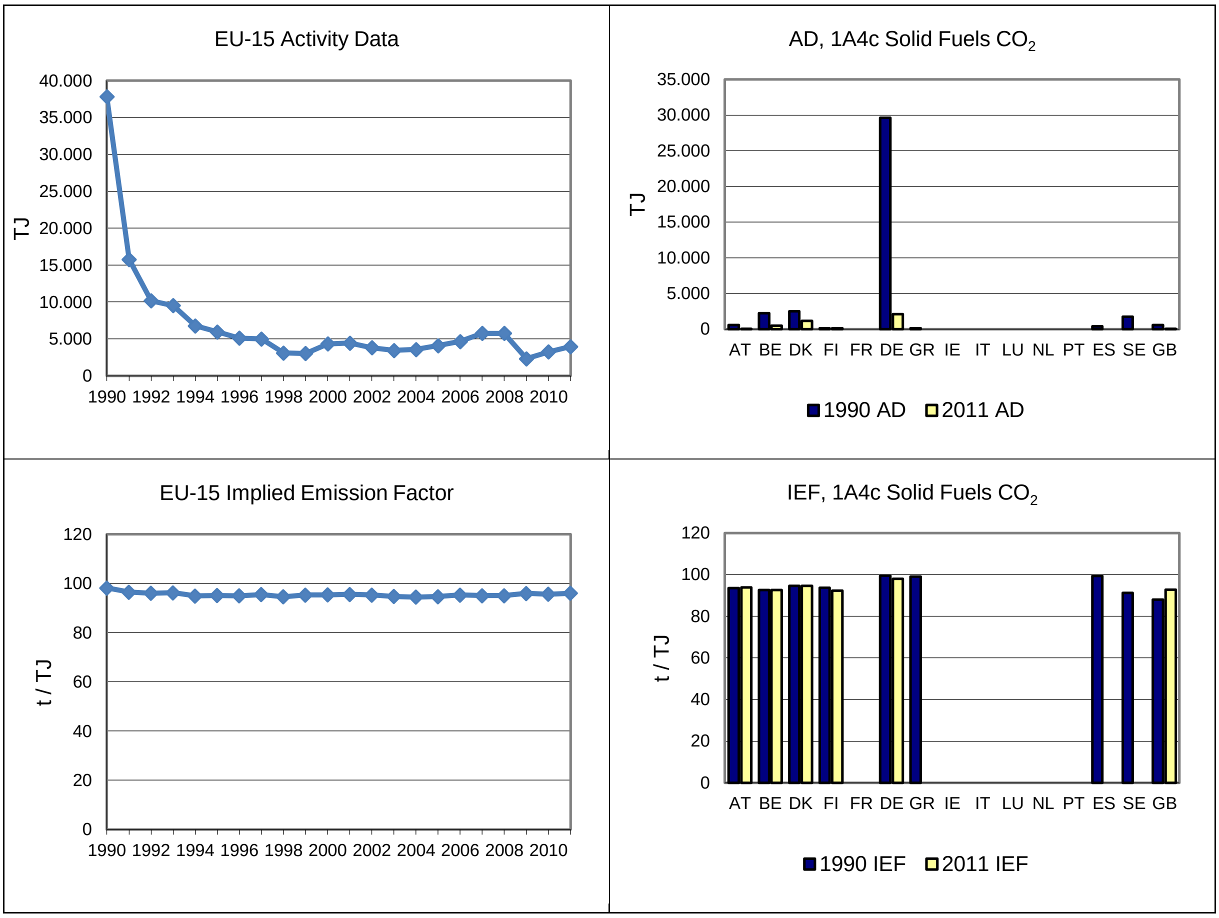
Table 3.81 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	51	5	4	1.1%	-1	-11%	-47	-92%	T2	CS
Belgium	208	46	46	12.1%	0	0%	-162	-78%	T1	D
Denmark	238	101	109	28.9%	9	9%	-129	-54%	CR	CS,D
Finland	13	12	13	3.3%	1	6%	-1	-5%	T3	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	2 948	143	203	53.6%	60	42%	-2 745	-93%	CS	CS
Greece	11	NO	NO	-	0	-	-11	-100%	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	37	NA	NA	-	-	-	-37	-100%	NA	NA
Sweden	157	NO	NO	-	-	-	-157	-100%	NA	NA
United Kingdom	48	3	4	0.9%	0	6%	-45	-93%	T2	CS
EU-15	**3 712**	**309**	**379**	**100.0%**	**69**	**22%**	**-3 334**	**-90%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.80 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Fuel consumption in the EU-15 decreased by 90 % between 1990 and 2011. The implied emission factor of EU-15 was 96.0 t/TJ in 2011.

Figure 3.80 1A4c Agriculture/Forestry/Fisheries, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries –Gaseous Fuels (CO_2)

In 2011, CO_2 from gaseous fuels had a share of 17 % within source category 1A4c (compared to 12 % in 1990). Between 1990 and 2011 the emissions increased by 27 % (Table 3.82). All Member States reported increasing emissions except for Finland, Denmark and Sweden. The highest relative increase occurred in Spain (+5051 %) and the highest increase in absolute terms was reported by the Netherlands. Between 2010 and 2011 EU-15 emissions decreased by 5 %. This source is dominated by the Netherlands were natural gas is used for greenhouse horticulture.

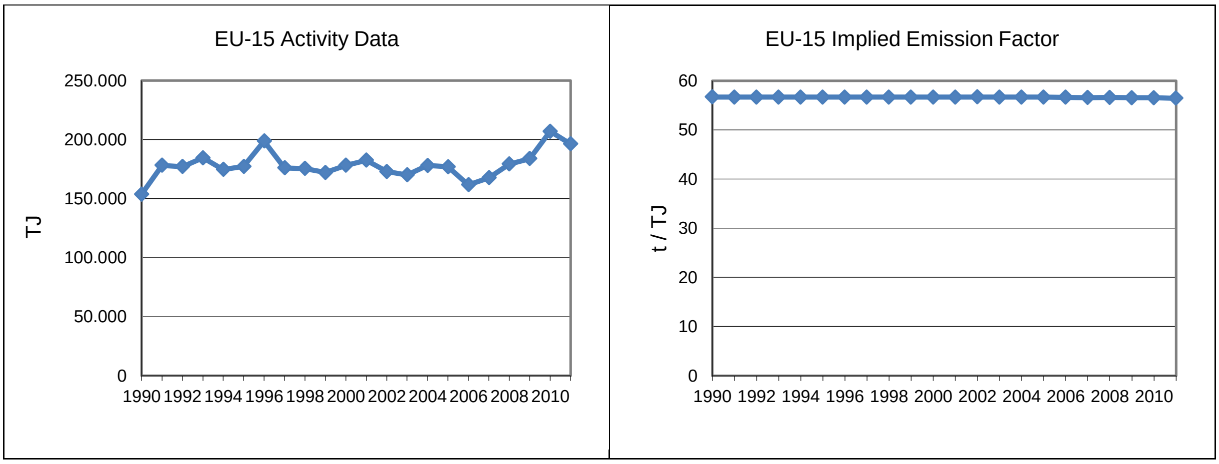
Table 3.82 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

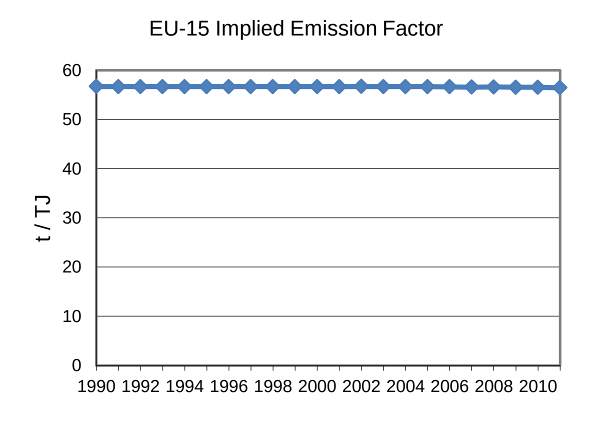
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	20	36	32	0.3%	-4	-11%	11	56%	T2	CS
Belgium	67	723	733	6.6%	9	1%	666	993%	T1	D
Denmark	126	156	126	1.1%	-31	-20%	-1	-1%	CR	CS
Finland	32	14	9	0.1%	-5	-35%	-23	-72%	T1	CS
France	383	548	551	5.0%	2	0%	168	44%	T2	CS
Germany	485	641	577	5.2%	-64	-10%	93	19%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	52	341	309	2.8%	-32	-9%	258	499%	T2	CS
Luxembourg	NO	0	0	-	0	-	0	-	T2	CS
Netherlands	7 330	8 597	8 043	72.6%	-554	-6%	713	10%	T2	CS
Portugal	NO	24	27	0.2%	3	14%	27	-	T2	D, CR
Spain	6	236	317	2.9%	81	34%	311	5051%	T2	CS
Sweden	33	27	22	0.2%	-5	-17%	-11	-33%	T1	CS
United Kingdom	182	363	336	3.0%	-27	-7%	154	85%	T2	CS
EU-15	**8 716**	**11 706**	**11 082**	**100.0%**	**-624**	**-5%**	**2 366**	**27%**		

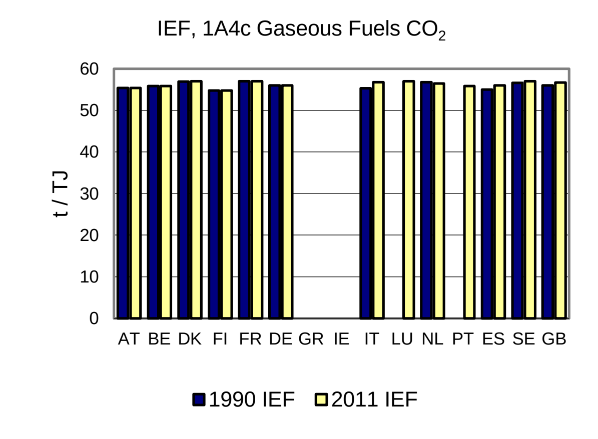
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.81 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by the Netherlands, accounting for 73 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-15 increased by 28 % between 1990 and 2011. The implied emission factor of EU-15 was 56.5 t/TJ in 2011.

Figure 3.81 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2







3.2.5 Other (CRF Source Category 1A5) (EU-15)

Source category 1A5 Other includes emissions from stationary and mobile military fuel use including air craft. In 2011 category 1A5 contributed to 7093 Gg CO_2 equivalents of which 95.3 % CO_2, 0.2 % CH_4 and 4.6 % N_2O.

Table 3.83 provides an overview of Member States' source allocation to Source Category 1A5 Other.

Table 3.83 1A5 Other: Member States' allocation of sources

Member State	Source allocation to 1A5 Other	Source
Austria	Mobile: Military use	CRF Table 1.s.2
Belgium	Mobile: Military use	CRF Table 1.s.2
Denmark	Mobile: Military use	CRF Table 1.s.2
Finland	Stationary: Other non-specified, Non-specified emissions of Fuels from non-energy use, Indirect N_2O emissions from NO_x Mobile: other non-specified	CRF Table 1.s.2
France	Emissions are 'Not occuring'	CRF Table 1.s.2
Germany	Military: stationary and mobile	CRF Table 1.s.2
Greece	Emissions are 'Not occuring'	CRF Table 1.s.2
Ireland	Emissions are 'Not occuring'	CRF Table 1.s.2
Italy	Mobile: other non-specified	CRF Table 1.s.2
Luxembourg	Emissions are 'Included elsewhere' or 'Not occuring'	CRF Table 1.s.2
Netherlands	Mobile: military use	CRF Table 1.s.2
Portugal	Stationary: other non-specified . Emissions are reported for 1990-1994 and 'Not occuring' from 1995 on. Mobile: other non-specified	CRF Table 1.s.2
Spain	Emissions are 'Not occuring'	CRF Table 1.s.2
Sweden	Stationary: other non-specified Mobile: Military use and Other non-specified	CRF Table 1.s.2
United Kingdom	Mobile: military use	CRF Table 1.s.2

Figure 3.82 shows the total trend within source category 1A5 and the dominating emission sources: CO_2 emissions from 1A5b Mobile and from 1A5a Stationary. Total GHG emissions of source category 1A5 decreased by 68 % between 1990 and 2011. Germany has the most influence to the overall trend, it reports minus 90 % CO_2 emissions since 1990 and contributes to 55 % in 1990. The German NIR states that only military sources (incl. aircraft) are included in its inventory. Since 2001 the United Kingdom has a main share and contributes 40 % to CO_2 emissions in 2011. The United Kingdom reports military aircraft and naval vessels within this category.

Figure 3.82 1A5 Other: Total and CO_2 emission and activity trends

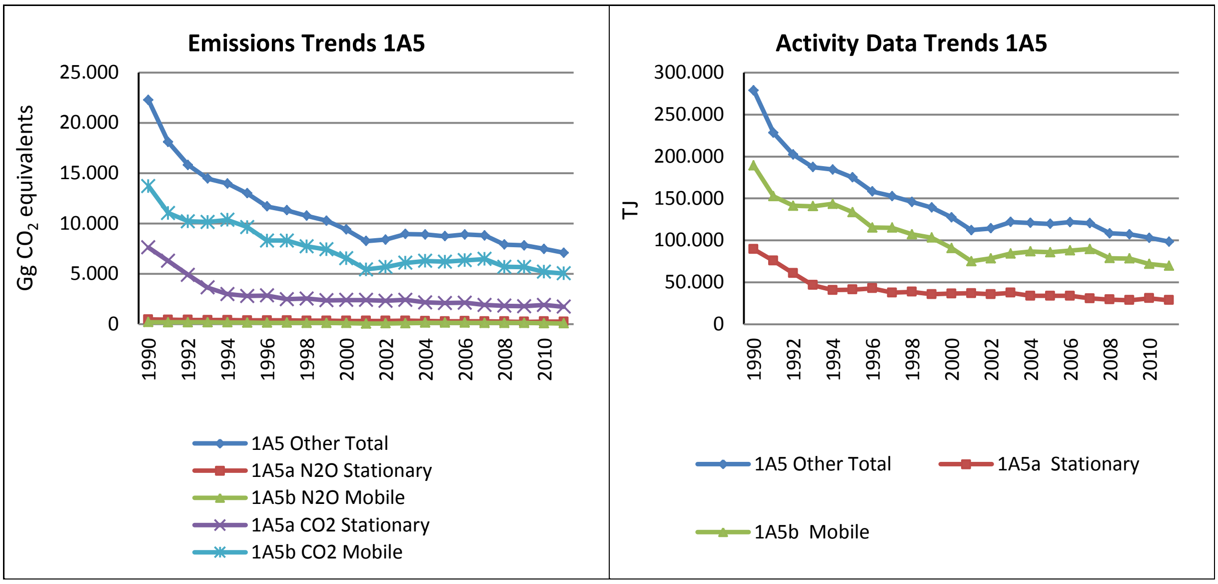


Table 3.84 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.2 % of total GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from this source decreased by 68 % in the EU-15. Between 1990 and 2011, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.84 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)
Austria	36	48	35	47
Belgium	163	50	161	50
Denmark	120	195	119	193
Finland	1 788	1 655	1 334	1 404
France	NO	NO	NO	NO
Germany	12 117	1 216	11 811	1 202
Greece	NO	NO	IE,NO	IE,NO
Ireland	NO	NO	NO	NO
Italy	1 120	527	1 046	495
Luxembourg	29	0	26	NO
Netherlands	577	361	566	355
Portugal	105	78	104	77
Spain	0	0	IE,NA	IE,NA
Sweden	863	186	846	184
United Kingdom	5 337	2 778	5 285	2 751
EU-15	**22 255**	**7 093**	**21 334**	**6 757**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.85 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A5 Other for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

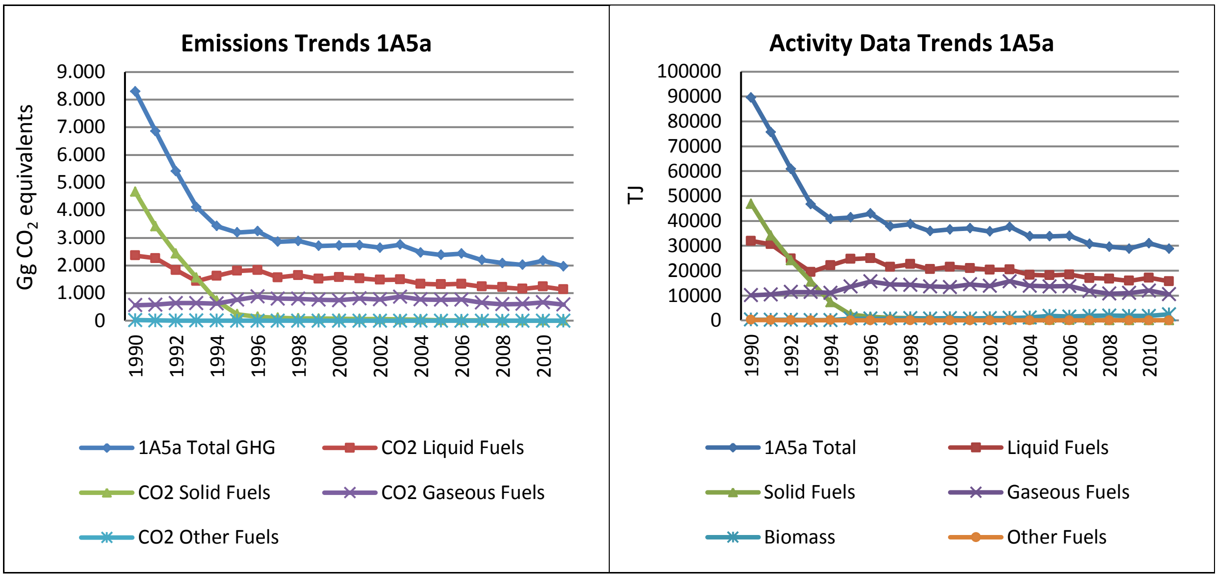
Table 3.85 1A5 Other: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	-12	-19.7	Corrected energy balance.
Denmark	0	0.0	0	0.0	
Finland	254	23.5	401	36.3	Updates in other categories are reflected here.
France	0	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	45	5.6	1	0.5	EF adjusted for jet gasoline. New actitivty data for military navigation. Thermal value adjusted.
UK	0	0.0	-45	-1.5	Added this source in order to maintain consistency with NIR. Emissions included in 1A4a.
EU-15	**299**	**1.4**	**345**	**5.1**	

3.2.5.1 ***Stationary (1A5a) (EU-15)***

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5a Stationary accounted for 0.05 % of total EU-15 GHG emissions in 2011. Figure 3.83 shows the emission trend within the categories 1A5a, which is mainly dominated by CO_2 emissions from solid and liquid fuels for 1990 to 1993 and dominated by liquid and gaseous fuels after from 1994 on. The reduction in the early 1990s was driven by CO_2 from solid fuels. Total emissions decreased by 76 %, mainly due to decreases in emissions from solid fuels (-99.8 %) and liquid fuels (-52.1 %).

Figure 3.83 1A5a Stationary: Total and CO_2 emission and activity trends



Only two Member States (Germany and Finland) reported emissions from this key source in 2011 (Table 3.86). Between 1990 and 2011, Finland had a decrease of 4 % and Germany of 92 %. Portugal reports emissions from 1990 to 1994 only. Luxembourg reports emissions 1990 to 2003 only. This led to an EU-15 decrease of 77 %. Between 2010 and 2011 CO_2 emissions decreased by 10 %.

Table 3.86 1A5a Stationary: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	1 276	1 296	1 224	71.0%	-72	-6%	-52	-4%
France	NO	NO	NO	-	-	-	-	-
Germany	6 329	615	499	29.0%	-115	-19%	-5 830	-92%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Luxembourg	3	NO	NO	-	0	-	-3	-100%
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	9	NO	NO	-	-	-	-9	-100%
Spain	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	0	-
United Kingdom	IE,NO	IE,NO	IE,NO	-	-	-	-	-
EU-15	**7 617**	**1 910**	**1 723**	**100.0%**	**-187**	**-10%**	**-5 894**	**-77%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2011 CO_2 from solid fuels had a share of 0.4 % within source category 1A5a (compared to 56 % in 1990). Between 1990 and 2011, the emissions decreased by nearly 100 % (Table 3.87). In 2011 only Germany reported emissions for this key source.

Table 3.87 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

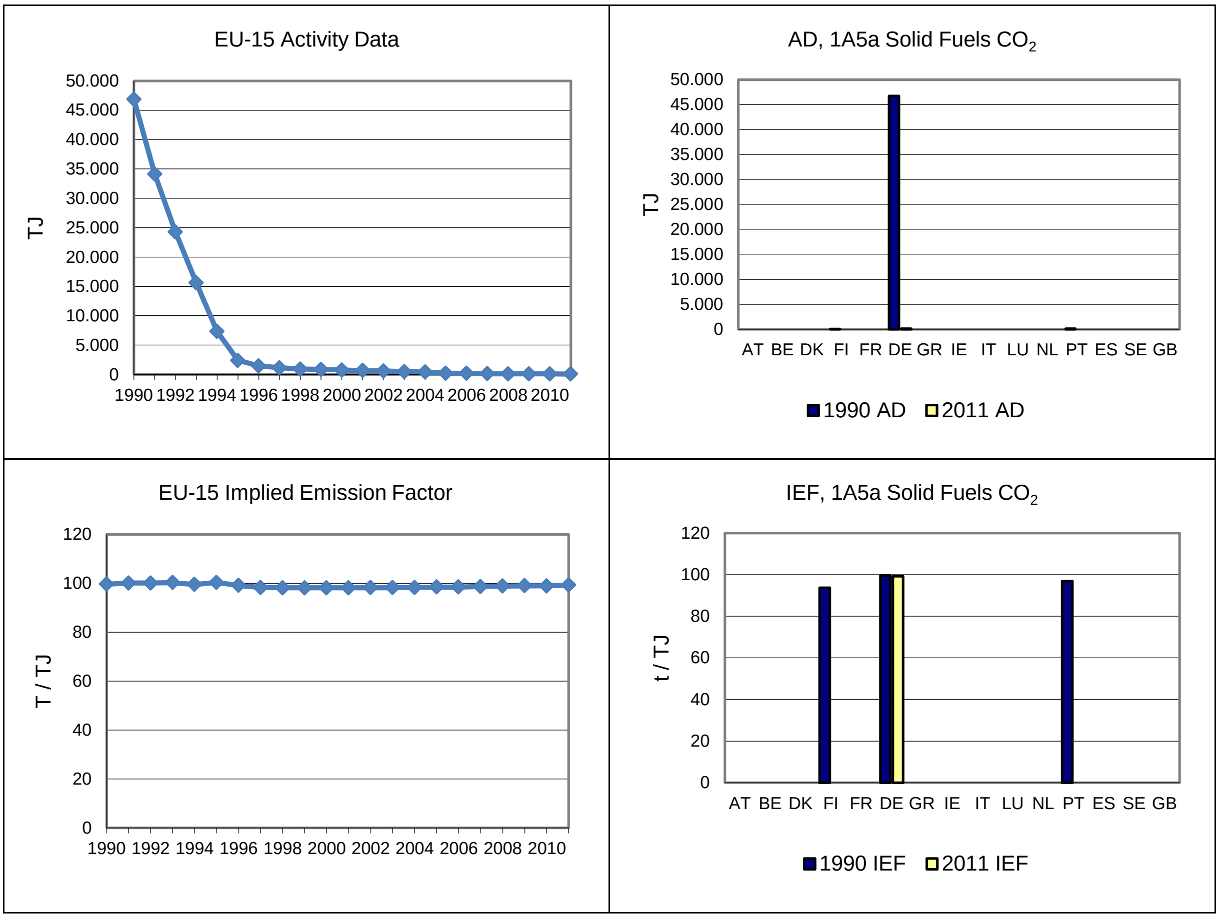
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1	NO	NO	-	-	-	-1	-100%	NA	NA
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	4 657	10	8	100.0%	-2	-20%	-4 650	-100%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NA	NA	NA	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA
Portugal	9	NO	NO	-	-	-	-9	-100%	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	NA
EU-15	**4 667**	**10**	**8**	**100.0%**	**-2**	**-20%**	**-4 659**	**-100%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.84 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Germany accounts for 100 % of EU-15 CO_2 emissions from this source category since 1995.

Fuel combustion in the EU-15 decreased by 99.8 % between 1990 and 2011. The implied emission factor is 99.2 t/TJ in 2011.

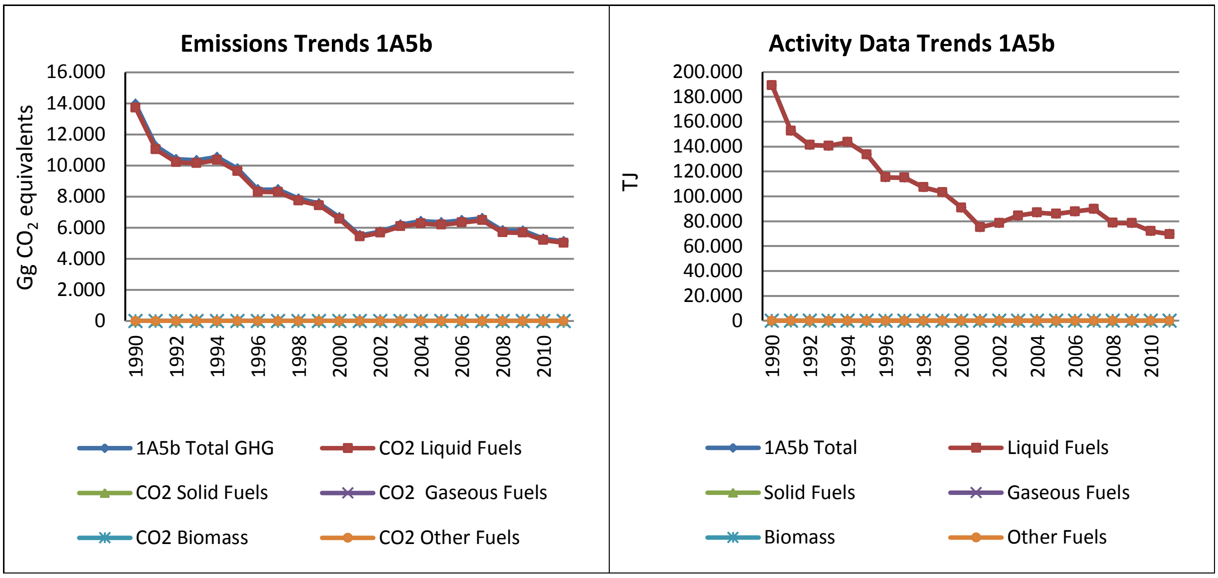
Figure 3.84 1A5a Stationary, solid fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5.2 ***Mobile (1A5b) (EU-15)***

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5b Mobile accounted for 0.1 % of total EU-15 GHG emissions in 2011. Figure 3.85 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 63 %.

Figure 3.85 **1A5b-Mobile: Total and CO_2 emission trends**



Five Member States reported emissions as 'Not occurring' or "Included elsewhere". The United Kingdom had the highest emissions in 2011 and – together with Germany - decreased the most in absolute terms between 1990 and 2011. Finland reported an increase of 210 %. Between 2010 and 2011 Italy and the United Kingdom had the highest absolute decrease. The EU-15 emissions decreased by 3 % between 2010 and 2011 (Table 3.88).

Table 3.88 **1A5b Mobile: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	35	46	47	0.9%	1	1%	12	34%
Belgium	161	47	50	1.0%	2	5%	-112	-69%
Denmark	119	107	193	3.8%	86	80%	74	62%
Finland	58	210	180	3.6%	-30	-14%	122	210%
France	NO	NO	NO	-	-	-	-	-
Germany	5 482	683	703	14.0%	20	3%	-4 779	-87%
Greece	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1 046	627	495	9.8%	-133	-21%	-551	-53%
Luxembourg	23	NO	NO	-	-	-	-23	-100%
Netherlands	566	327	355	7.0%	28	8%	-211	-37%
Portugal	95	86	77	1.5%	-9	-10%	-18	-19%
Spain	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Sweden	846	174	184	3.7%	10	6%	-662	-78%
United Kingdom	5 285	2 893	2 751	54.7%	-142	-5%	-2 534	-48%
EU-15	**13 717**	**5 200**	**5 033**	**100.0%**	**-166**	**-3%**	**-8 683**	**-63%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2011, CO_2 from liquid fuels had a share of 98 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2011 the emissions decreased by 63 % (Table 3.89). France, Greece, Ireland, Luxembourg and Spain report emissions as 'Not occurring', or 'Included Elsewhere'. The highest decrease in absolute terms was achieved in Germany (-87 %) and the United Kingdom (-48%), while Finland had increases by about 210 %.

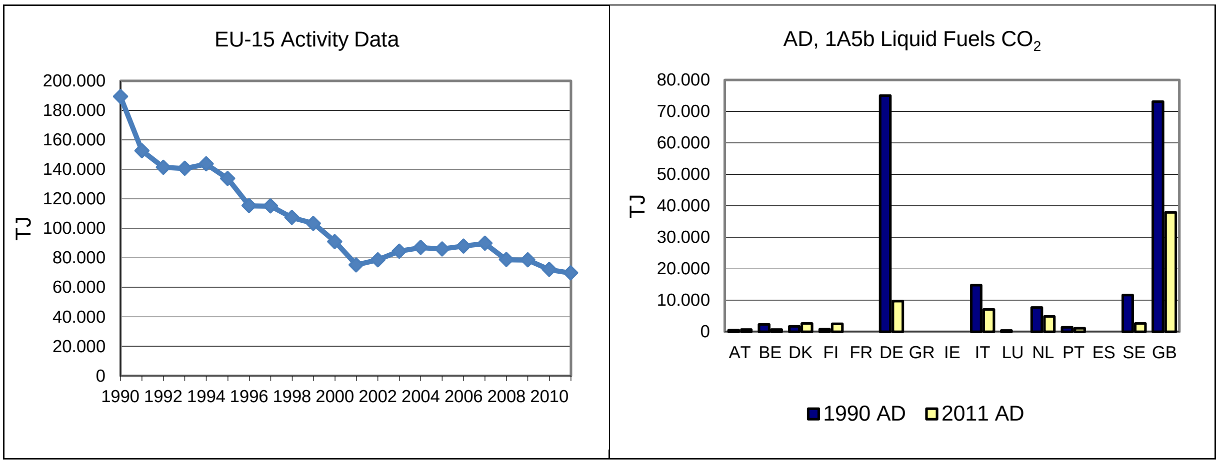
Table 3.89 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

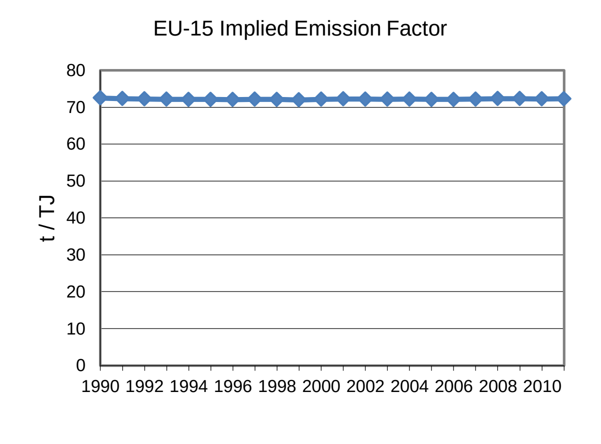
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	35	46	47	0.9%	1	1%	12	34%	CS,M	CS
Belgium	161	47	50	1.0%	2	5%	-112	-69%	T1	D
Denmark	119	107	193	3.8%	86	80%	74	62%	OTH	CS
Finland	58	210	180	3.6%	-30	-14%	122	210%	T1	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	5 482	683	703	14.0%	20	3%	-4 779	-87%	CS,T1	CS,D
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1 046	627	495	9.8%	-133	-21%	-551	-53%	T2	CS
Luxembourg	23	NO	NO	-	-	-	-23	-100%	NA	NA
Netherlands	566	327	355	7.0%	28	8%	-211	-37%	D,T2	D
Portugal	95	86	77	1.5%	-9	-10%	-18	-19%	T1	CR,D
Spain	IE	IE	IE	-	-	-	-	-	NA	NA
Sweden	846	174	184	3.7%	10	6%	-662	-78%	T1	CS
United Kingdom	5 285	2 893	2 751	54.7%	-142	-5%	-2 534	-48%	T2,T3	CS
EU-15	**13 717**	**5 200**	**5 033**	**100.0%**	**-166**	**-3%**	**-8 683**	**-63%**		

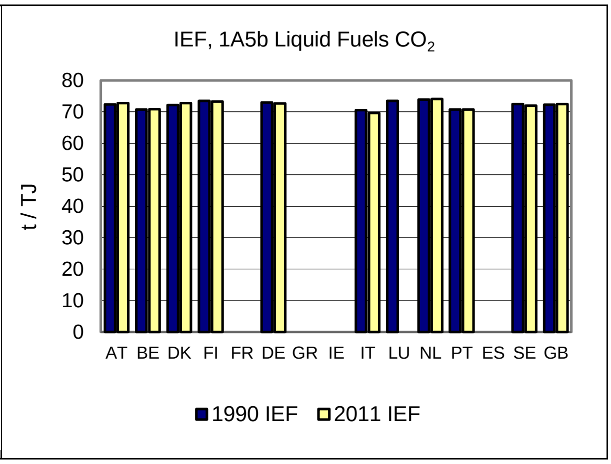
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.86 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy and the United Kingdom; together they cause 78 % of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-15 decreased by 63 % between 1990 and 2011. The implied emission factor of EU-15 was 72.3 t/TJ in 2011.

Figure 3.86 1A5b Mobile, liquid fuels Activity Data and Implied Emission Factors for CO_2




EU-15 Implied Emission Factor
t / TJ
0
10
20
30
40
50
60
70
80
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

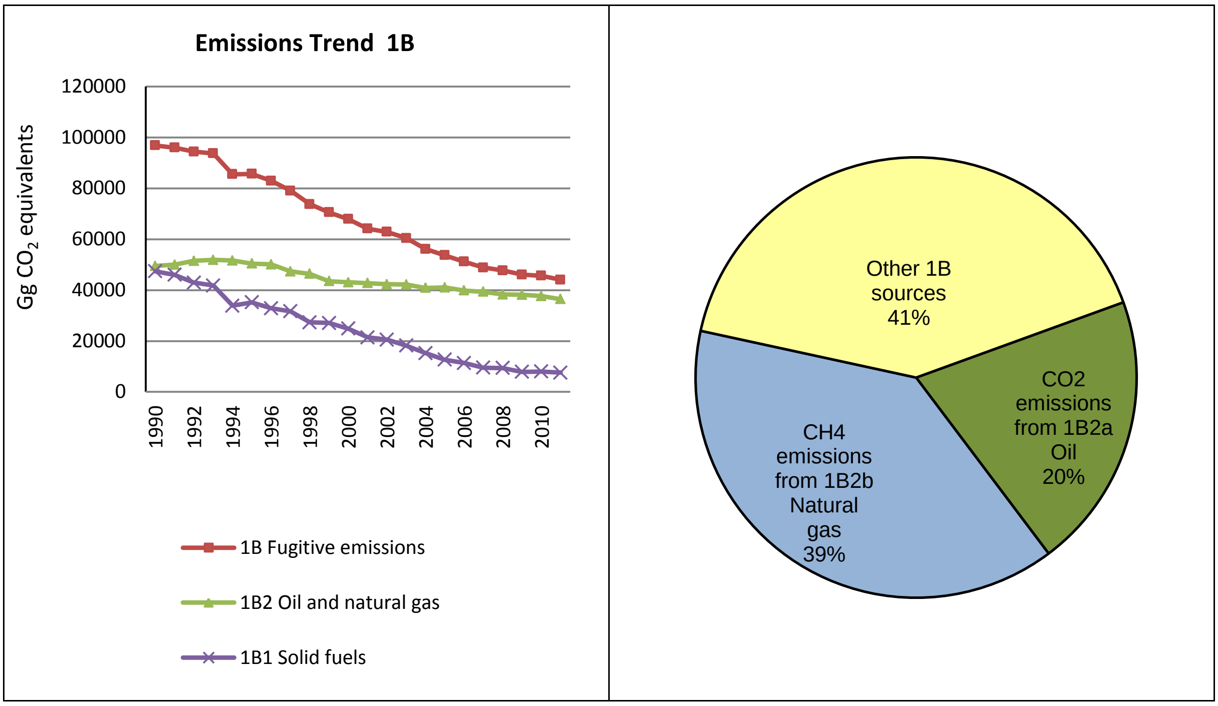

IEF, 1A5b Liquid Fuels CO_2
t / TJ
0
10
20
30
40
50
60
70
80
AT BE DK FI FR DE GR IE IT LU NL PT ES SE GB
1990 IEF
2011 IEF

3.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-15)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions are defined as intentional or unintentional releases of gases from anthropogenic activities that in particular may arise from the production, processing, transmission, storage and use of fuels. Emissions from combustion are only included where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). Evaporative emissions from vehicles are included under Road Transport as Subsection 1A3b v (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2011, in terms of CO_2 equivalents, about 60% of emissions from source category 1B were fugitive CH_4 emissions while about 40% were fugitive CO_2 emissions. Together, they represented 1.2% of total GHG emissions in the EU-15. Fugitive GHG emissions have been steadily declining (Figure 3.87). Between 1990 and 2011, the total fugitive GHG emissions decreased by 55 %. This was mainly due to the decrease in underground mining activities: underground mining activity decreased by 86 % since 1990 (Figure 3.90) and decreases in CH_4 emissions from category 1B1a i underground mines are responsible for 70% of the total decrease of fugitive emissions. Between 1990 and 2011, GHG emissions from 1B1 Solid Fuels decreased by 84 % (Figure 3.88), while emissions from 1B2 Oil and Natural Gas decreased only by 26 % (Figure 3.88). While emissions from these two sources (1B1 Solid Fuels and 1B2 Oil and Natural Gas) each were responsible for roughly 50 % of total fugitive emissions in 1990, fugitive emissions from 1B1 Solid Fuels represented only 17 % of total fugitive emissions in 2011(Figure 3.87).

Figure 3.87 1B Fugitive Emission from Fuel: GHG Emissions trend and proportion of fugitive emissions within source category



Fugitive emissions includes four key sources:

- 1B1a Coal Mining (CH_4)
- 1B2a Oil (CO_2)
- 1B2b Natural Gas (CH_4)
- 1B2c Venting and Flaring (CO_2)

The two largest key sources, i.e. CH_4 emissions from 1B2b Natural Gas and CO_2 emissions from 1B2a Oil account together for 59 % of total fugitive GHG emissions (Figure 3.87).

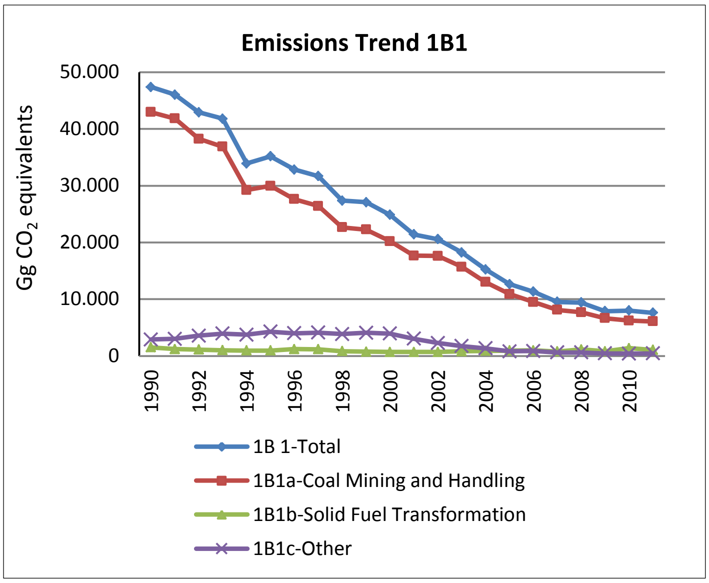
3.2.6.1 *Fugitive emissions from Solid Fuels (1B1) (EU-15)*

In the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions from solid fuels are defined as the total release of methane during coal mining and post-mining activities. Combustion emissions from colliery methane recovered and used are excluded here and reported under Fuel Combustion Emissions. Coal mining data reported to the IEA include also peat extraction, which is not included in the CRF. Three member States part of EU-15 (Finland, Ireland and Sweden) have peat extraction but no coal mining.

In 2011 fugitive emissions from solid fuels accounted for 0.2 % of the total GHG emissions in the EU-15 and 17 % of total fugitive emissions in the EU-15:

- 80 % of these emissions were CH_4 emissions from coal mining. The emissions arise due to the natural production of methane when coal is formed. Methane is partly stored within the coal seam and escapes when mined. Most CH_4 emissions resulted from underground mines; surface mines were a smaller source.
- 12 % of these emissions were CO_2 emissions due to solid fuel transformation
- Since 1990 fugitive CH_4 emissions from 1B1 Solid fuels have been steadily decreasing, caused by the reduction of coal mining

Figure 3.88 1B1 Fugitive Emissions from Solid Fuels: Trend



In 2011 three countries, Germany, the United Kingdom and Greece represented 81 % of total fugitive GHG emissions from solid fuels (Table 3.90).

Table 3.90 1B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)
Austria	11	IE,NA,NO	11	IE,NA,NO	IE,NA,NO	IE,NA,NO
Belgium	330	6	330	6	NO	NO
Denmark	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Finland	NO	NO	NO	NO	NO	NO
France	4 065	44	4 065	44	NA,NO	NA,NO
Germany	20 251	2 639	20 240	2 636	11	3
Greece	1 095	1 238	1 095	1 238	NO	IE,NO
Ireland	NE, NO	NO	NE,NO	NO	NE,NO	NO
Italy	127	71	127	71	0	0
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	436	658	33	21	403	637
Portugal	75	IE, NO	66	IE,NO	9	IE,NO
Spain	1 835	673	1 818	629	18	44
Sweden	5	6	0.0	0.0	5	6
United Kingdom	19 165	2 256	18 306	1 996	856	258
EU-15	**47 395**	**7 592**	**46 091**	**6 642**	**1 301**	**948**

For methodological issues and remarks on completeness see Table 3.91.
Abbreviations explained in the Chapter 'Units and abbreviations'

Between 1990 and 2011 fugitive CH_4 emissions from solid fuels decreased by 86 % (Table 3.90). Large reductions (in absolute terms) were observed in Germany and in the United Kingdom, while emissions actually increased by about 13% in Greece (Table 3.90). Table 3.91 provides information on the methodologies used by EU-15 Member States.

Table 3.91 1B1 Fugitive Emissions from Solid Fuels: Methodological Issues according to NIRs (submitted in 2013) and Member State information of EU-15 Member States

Member State	Methodology
Austria	**General:** This category covers methane emissions from one brown coal surface mine. CH_4 emissions from this category decreased by more than 50% from 1990 to 1999 due to lower mining activities. Before coal mining was stopped in 2007 emissions decreased sharply between 2003 and 2004. **Activity data:** are taken from the national energy balance and statistical year books (e.g. yearbook of the Association of Mining and Steel). **Emission factor:** CORINAIR default emission factor 214g CH_4/Mg coal
Belgium	**General:** *Coal mining and handling (category 1B1a):* During the in-country review in June 2007, the expert review team of UNFCCC detected some missing underground mining activities in the Belgian greenhouse gas emission inventory. In the beginning of the nineties until 1992 there still was some mining activity in the Flemish region. Until 1999 energetic mining activities remained existent. These activities consisted of an auto-producer of electricity that was active until 1996 (the waste of the coal was used to produce electricity) and of energy needed for the sorting machines which were active until 1999. The latter energetic activities are allocated to the category 1A1c. *Solid fuel transformation (category 1B1b):* Emissions during the coke production are caused by the loading of the coal into the ovens, the oven/door leakage during the coking period and by extracting the coke from the ovens. **Activity data:** federal statistics, delivered by corresponding industry, activity data, production data of coke, are directly reported by the companies involved. **Emission factor:** IPCC 2006 guidelines, CITEPA, EMEP/EAA air pollutant emission inventory

Member State	Methodology
	guidebook 2009 (400 g CH_4/ton cokes)
Denmark	**General:** Coal mining does not occur
Finland	**General:** Emissions from the peat production were reported in LULUCF sector (category Wetlands, CRF 5.D 2) as suggested in GPG LULUCF (IPCC 2003) (see chapter 7.5). There were no coal mines in Finland.
France	**General:** closure of surface mines 2002, closure of underground mines 2004, methane emissions after closure are accounted under 1B1c **Activity data:** plant specific for 1B1b, bottom up approach according to site specific data, Tier 2/3 depending on sub-sector, for closed mines: a tier 2 is used **Emission factor:** specific EF for sites, Tier 2/3 depending on site, EMEP/CORINAIR 350 g CH_4/Mg coke
Germany	**General**: hard coal mining Tier 3, brown coal Tier 2 Coal mining (1B1a): mainly emissions from current mining (coalseam methane, CSM) Emissions from hard coal dressing are included in 1B1b. For hard coal emissions from closed coal mines (coalmine methane, CMM) are included in 1B1c. Because of the chosen method of calculation, for brown coal all emissions are included in 1B1a (ii). **Activity data:** Statistik der Kohlenwirtschaft, national statistics **Emission factor**: country specific, study FHG ISI (1993), German lignite-industry association, Deutsche Montan Technologie GmbH. The emission factors for non-greenhouse gases from coking plants were mainly taken from BFI (2012) **Change of methodology**: Sector 1.B.1.b:For CO emissions a change of method was required as the emission factors used in the past overestimated the emissions and did not reflect the emission source correctly. (Up to the resubmission in 2010 higher CO emissions were reported in 1.B.1.b as in1.A.1.c, however according to BFI (2012) emissions from diffuse sources are smaller (by a factor of 55) than emissions from 1.A.1.c Sector 1.B.1.c: recalculations were made based on updated figures provided by the „Gesamtverband Steinkohle (GVSt) “(NIR 2013)
Greece	**General:** only brown coal surface mines **Activity data:** national energy balance **Emission factor:** IPCC Good Practice Guidance (Default)
Ireland	**General:** coal mining does not occur
Italy	**General**: CH_4 emissions from coal mining referred to only two mines with very low production in the last ten years, one of which was underground and produced coal and the other, on the surface, produced lignite. The surface mine stopped the activity in 2001. CH_4 emissions from solid fuel transformation referred to the coke production in the iron and steel industry, which was also decreasing in the last years. CO_2 and N_2O emissions from 1B1 are not occurring. **Activity Data:** National Energy Balance **Emission Factor**: IPCC Guidelines (1997), Corinair Guidebook **Changes NIR 2013:** solid fuel production - the CO_2 emissions have been calculated by mining and post mining activities. Moreover the post mining CH_4 emission factors for underground mine have been revised and post mining CH_4 emissions for surface mine have been calculated.
Luxembourg	**General:** This source category does not exist in Luxembourg.
Netherlands	**General:** The Netherlands currently has only one on-site coke production facility at the iron and steel plant of Tata Steel. A second independent coke producer in Sluiskil discontinued its activities in 1999. The fugitive emissions of CO_2 and CH_4 from both coke production sites are included here. There are no fugitive emissions from coal mining and handling activities (1B1a) in the Netherlands; these activities ceased with the closing of the last coal mine in the early 1970s. **Activity data:** individual company data, national energy statistics (CBS); “IEA Renewable

Member State	Methodology
	Information 2011". **Emission factor:** country specific, IPCC default values. The following emission factors have been used:1990-1997: 0.03 kg CH_4/kg charcoal (IPCC 1996 Guidelines); 1998-2010: 0.0000111 kg CH_4/kg charcoal (Reumermann,P.J Frederiks, B., proceedings 12th European conference on Biomass for Energy, Industry and Climate protection, Amsterdam, 2002).
Portugal	**General:** Since 1990 in Portugal there was extraction of coal at only two coal mines, but both were latter closed down in 1992 and 1994 and did not resume activity since. **Activity data:** General-Directorate for Energy and Geology (DGEG). **Emission factor:** emission factors from IPCC96 (IPCC,1997)
Spain	**Activity Data**: national studies, AITEMIN (Asociación de Investigación Tecnológica de Equipos Mineros) **Emission Factor**: country specific **Changes (NIR 2013):** • A continuación se detallan las principales modificaciones realizadas en la estimación de las emisiones de las categorías de esta fuente clave con respecto a la edición anterior del inventario. • For the years 2008 to 2010 the carbon balances of coke ovens located in integrated steel plants has been revised according to updated information provided by the plants themselves. • Additionally, one of these plants has revised the amount of coke produced in 2008 and 2009
Sweden	**General:** There are no coalmines in Sweden and hence no fugitive emissions from coalmines occur. SO_2 emissions from quenching and extinction at coke ovens are reported in CFR 1B1b. Flaring of coke oven gas from the coke oven is reported in CRF 1B1c since submission 2004. Since submission 2010, flaring of blast furnace gas in the blast furnace and steel converter gas in the steel converter are reported under CRF 2C1.
United Kingdom	**General:** Methane emissions from closed coal mines are accounted for within Sector 1B1a of the UK inventory. Carbon emissions from coke ovens are based on a carbon balance approach. **Activity data:** saleable coal production statistics (national study) **Emission factor:** UK Coal Mining Ltd data, national studies, US EPA **Changes (NIR 2013)::** 1B1a: Improved accuracy and completeness due to revision to emissions from deep-mined coal production to use methane emissions data from a greater share of the UK colliery industry than previously. 1B1b: Improved completeness, due to inclusion of emissions from charcoal production.

CH_4 from Coal Mining (1B1a)

Fugitive emissions from coal mining correspond to the total emissions from:

- underground mining (emissions from underground mines, brought to the surface by ventilation systems),
- surface mining (emissions primarily from the exposed coal surfaces and coal rubble, but also emissions associated with the release of pressure on the coal),
- post-mining (emissions from coal after extraction from the ground, which occur during preparation, transportation, storage, or final crushing prior to combustion).

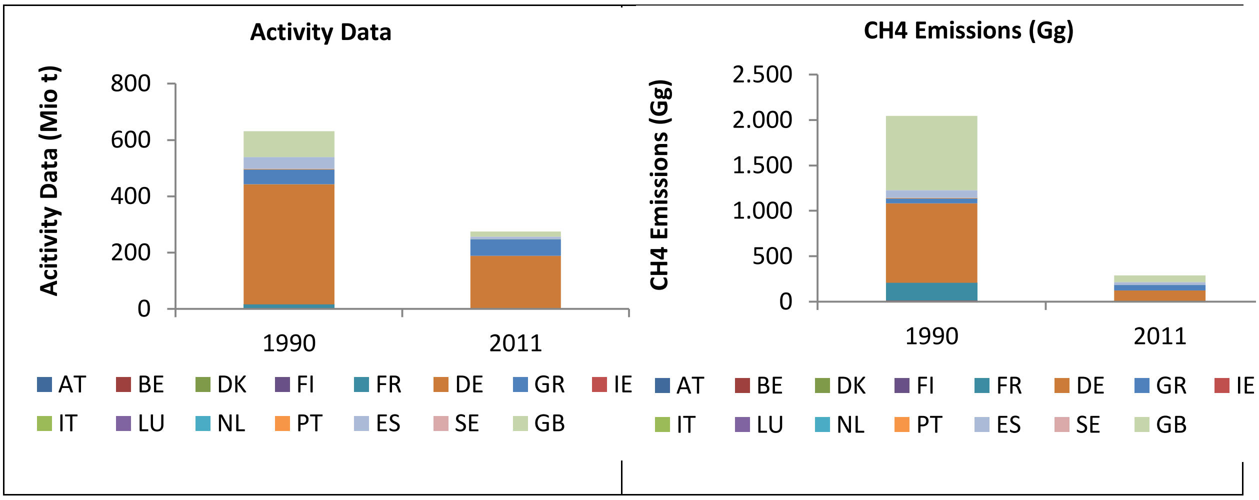
CH_4 emissions from 1B1a coal-mining accounted for 0.2 % of total GHG emissions in 2011 and for 14 % of all fugitive emissions in the EU-15. CH_4 emissions from this source decreased by 86 % in the EU-15 between 1990 and 2011 and by 2 % between 2010 and 2011 (Table 3.92). In 2011 Germany and the United Kingdom accounted together for 69 % of EU-15 CH_4 emissions from 1B1a. They both used higher tier methods for the estimation of emissions from 1B1a and both had substantially reduced their emissions between 1990 and 2011 due to the decline of coal mining (Figure 3.89).

Table 3.92 **1B1a Coal Mining: Member States contribution to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	11	IE,NO	IE,NO	-	-	-	-11	-100%	NA	NA
Belgium	299	NO	NO	-	-	-	-299	-100%	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	4 016	NA,NO	NA,NO	-	-	-	-4 016	-100%	NA	NA
Germany	18 415	2 770	2 612	43.0%	-158	-6%	-15 803	-86%	T2	CS
Greece	1 095	1 193	1 238	20.4%	45	4%	143	13%	T1	D
Ireland	NE,NO	NO	NO	-	-	-	-	-	NA	NA
Italy	60	23	21	0.3%	-2	-9%	-39	-65%	T1	CS,D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA
Portugal	66	IE,NO	IE,NO	-	-	-	-66	-100%	NA	NA
Spain	1 794	521	614	10.1%	93	18%	-1 180	-66%	CS,T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	17 212	1 711	1 595	26.2%	-116	-7%	-15 617	-91%	T3	CS,OTH
EU-15	**42 968**	**6 218**	**6 081**	**100.0%**	**-138**	**-2%**	**-36 887**	**-86%**		

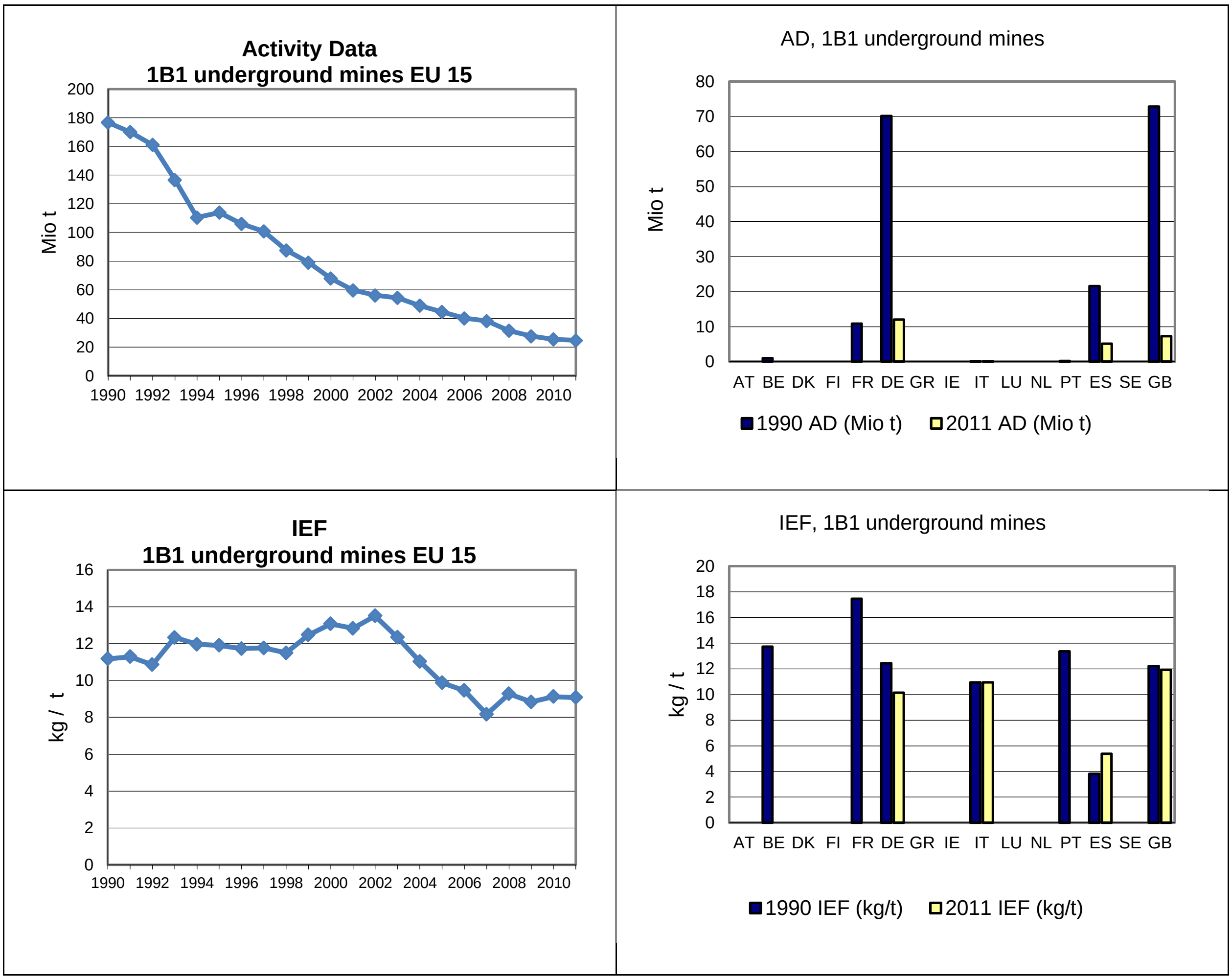
For methodological issues and remarks on completeness see Table 3.88.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.89 **1B1a Coal Mining and Handling: Contribution of MS to CH_4 Emission and Activity Data**



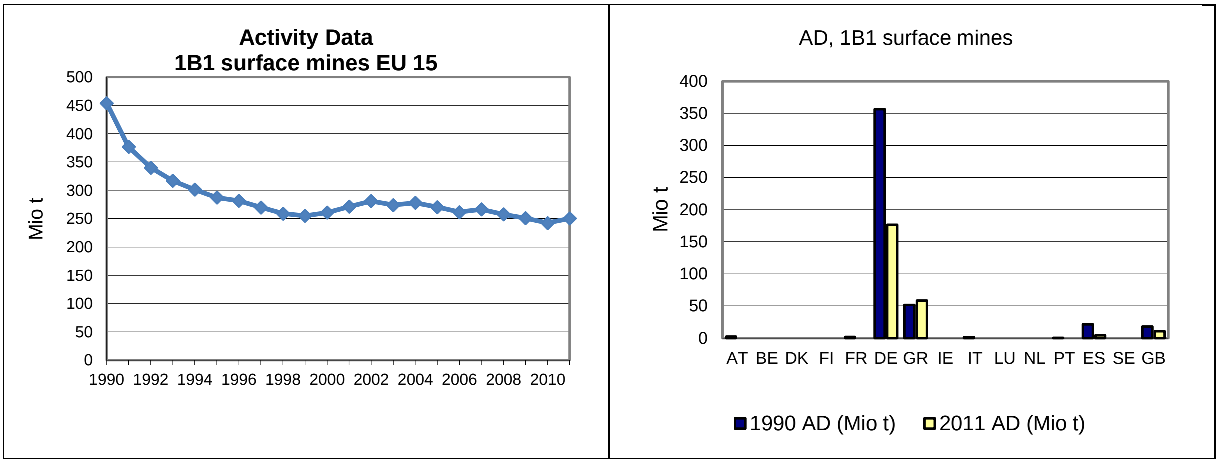
In 2011 most fugitive emissions from coal mines were due to underground mines. Within the EU-15 coal mining in underground mines decreased substantially (86 %) (Figure 3.90). The strong change in underground mining activities is opposed by a moderate change in the implied emissions factor for CH_4 emissions (with a maximum of 13.51 kg/t (2002) and a minimum of 8.17 kg/t (2007)).

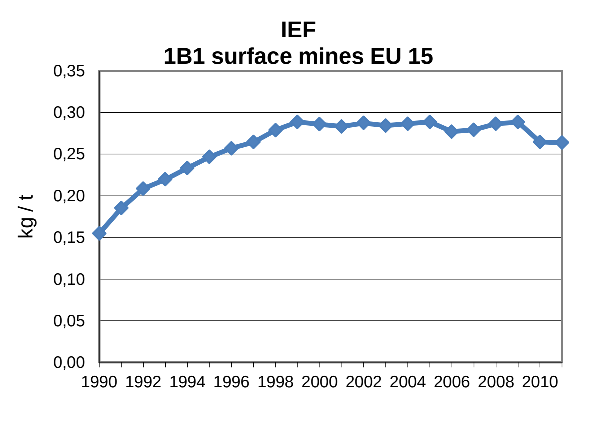
Figure 3.90 **1B1ai Underground Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4**



Overall, in the EU-15 coal production from surface mines decreased by 44.9 % between 1990 and 2011 (Figure 3.91). Coal mining in surface mines decreased in all Member States except in Greece (Figure 3.91).

Figure 3.91 **1B1aii Surface Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4**





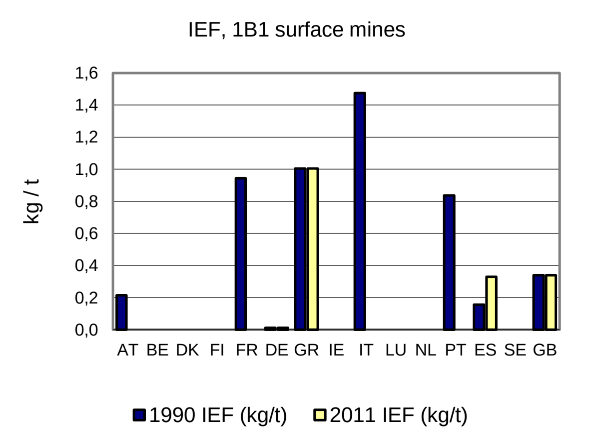


Table 3.93 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2010.

Table 3.93 1B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	5	4.1	1	2.0	Update of emission factor. CH4 emissions from post mining activities in surface mines have been added. Emission from post mining of surface mines have been added.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	24	0.1	291	16.2	Reallocated to Closed Coal Mines.
EU-15	**29**	**0.1**	**293**	**4.5**	

3.2.6.2 *Fugitive emissions from oil and natural gas (1B2) (EU-15)*

Fugitive emissions from oil and natural gas correspond to the total fugitive emissions from oil and gas activities. Fugitive emissions may arise from equipment exhaust (non-combustion), leakages, upsets and mishaps at any point in the chain from production through final use. Emissions from flaring are also included (the combustion is considered a non-productive activity) (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and handling of oil and natural gas. They account for 1.0 % of the total GHG emissions in 2011 and for 83 % (Figure 3.87) of all fugitive emissions in the EU-15.

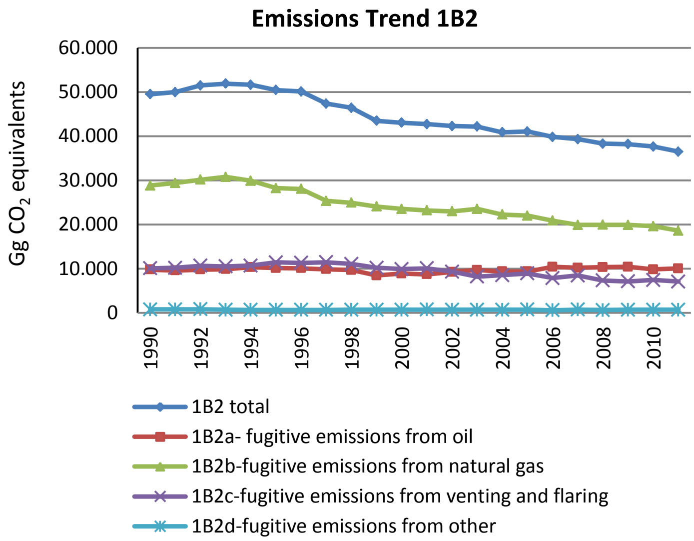
Of all fugitive emissions from oil and natural gas, in 2011:

- 39% were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution)
- 20 % were CO_2 emissions from oil (exploration, production, transport, refining and storage and distribution)
- 12 % were CO_2 emissions due to flaring

This source category includes three key source categories:

- CO_2 from 1B2a Oil
- CH_4 from 1B2b Natural Gas
- CO_2 from 1B2c Venting and Flaring

Figure 3.92 1B2-Fugitive Emissions Oil and Natural Gas: Trend



Fugitive emissions from oil and natural gas arose in all Member States (Table 3.94). Total greenhouse gas emissions from 1B2 decreased by 26 % between 1990 and 2011 ((Figure 3.92). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 33 % over that period.

In 2011, 76% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: France, Germany, Italy and the United Kingdom (Table 3.94). The largest reductions (in absolute terms) were observed in the United Kingdom (mainly CH_4 emissions) and in Italy (both CH_4 and CO_2 emissions), while emissions increased most in Portugal (Table 3.94).

Table 3.94 1B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)
Austria	300	473	102	233	198	240
Belgium	613	495	84	93	528	402
Denmark	369	367	325	256	44	111
Finland	231	158	219	121	11	36
France	5 642	4 043	4 123	2 925	1 484	1 099
Germany	9 835	7 213	1 742	1 393	8 092	5 820
Greece	162	199	70	9	92	189
Ireland	131	28	IE,NO	IE,NO	131	28
Italy	10 654	7 334	3 344	2 315	7 298	5 008
Luxembourg	16	39	0	0	16	39
Netherlands	2 418	1 655	775	900	1 643	754
Portugal	308	1 153	267	988	38	163
Spain	2 270	3 080	1 656	2 537	613	543
Sweden	380	991	304	879	75	109
United Kingdom	16 179	9 267	5 778	4 103	10 358	5 104
EU-15	**49 507**	**36 495**	**18 789**	**16 751**	**30 623**	**19 646**

For methodological issues and remarks on completeness see Table 3.92.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.95 provides information on the methodologies used by EU-15 Member States.

Table 3.95 1B2 –Fugitive Emissions from Oil and Gas: Methodological Issues according to NIRs (submitted in 2013) and Member State information of EU-15 Member States

Member State	Methodology
Austria	**General:** 1 B 2 a i Oil Exploration, 1 B 2 a iii Transport, 1 B 2 b Natural Gas Exploration and 1 B 2 b i Natural Gas Production/Processing, except CO_2 emissions from processing of sour gas, are included in 1 B 2 a ii. CO_2 emissions from 1 B 2 a iv Refining/Storage due to combustion are included in 1 A 1 b Petroleum Refining, fugitive CO_2 emissions are assumed to be negligible. 1 B 2 a v Distribution of oil products also includes storage in storage tanks and refinery dispatch station – only NMVOC emissions are estimated as CH_4 emissions are assumed to be negligible. CO_2 emissions from 1 B 2 c Venting/Flaring are included in 1 A 1 b Petroleum Refining. CH_4 emissions from 1 B 2 c Venting/Flaring are included in 1 B 2 a iv Petroleum Refining **Activity data:** national energy balance, Association of the Austrian Petroleum Industry, Austrian Natural Gas and District Heat Association., E-Control (Austrian Energy Regulator) **Emission factor:** IPCC Reference Manual, country specific; Refining: EF emission factor of 745 kg CH_4/PJ crude oil input;
Belgium	**General**: CO_2 of the refineries were allocated to the sectors 1A1a for the involved combined heat-power installations of the refineries, 1B2c for the flaring emissions and 1A1b for the total emissions excluding the emissions of the combined heat-power installations and excluding the emissions from flaring activities. The emissions of CH_4 reported in 1B2a also contain the emissions of flaring activities, as a consequence these CH_4 emissions are allocated in category 1B2a and not in category 1A1b. 1B2b3: methodology according to GPG 1.B.2.b iv/distribution: emissions are determined on the basis of the length of gas distribution pipelines. 1.B.2.b.iii/transmission: estimation are on the basis of measurements and calculations (taken into account pressure, distance, volume). **Activity data:** Petroleum refineries (category 1B2a and 1B2c): The activity data is the amount of crude oil used in the refineries. 1B2a3: The activity data (import of crude oil in Belgium) derives

Member State	Methodology
	from the federal petroleum balance of the Federal Ministry of Economy in Belgium. he activity data reported in the category 1B2b is the annual total natural gas amount consumed in Belgium. These activity data originate from SYNERGRID, the federation of the grid operators of gas and electricity. **Emission factor:** plant specific, country specific **Methodological changes compared to previous submission (NIR 2013)::** no
Denmark	**General:** 1B2b: Fugitive emissions from natural gas include emissions from transmission and distribution of natural gas. Emissions from gas extraction are included in1B2a. 1B2c: Venting and flaring include activities onshore and offshore. Flaring occur both offshore and onshore in gas treatment and storage plants and in refineries. Venting occurs in gas storage plants. Venting of gas is assumed to be negligible in extraction and in refineries as controlled venting enters the gas flare system. **Activity data:** Activity data used in the calculations of the emissions from oil and gas production and loading of ships are shown in Table 3.5.6. Data are based on information from the Danish Energy Agency (2012a) and from the environmental reports from DONG Oil Pipe A/S (DONG Oil Pipe A/S, 2012). Data on the amount of crude oil processed in the two Danish refineries are given by the refineries in their annual environmental report (A/S Dansk Shell, 2012 and Statoil A/S, 2012). The Danish Energy statistics contains data on the sale of gasoline that are the basis for estimating emissions of NMVOC from service stations. In 1990-1997 transmission rates refer to Danish energy statistics, in 1998 the transmission rate refers to the annual environmental report of DONG Energy, in 1999-2006 emissions refer to DONG/Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). Since 2007 transmission data refer to the annual environmental report by Energinet.dk. Venting and flaring: in DK are two natural gas storage facilities. Both are obligated to make an environmental report on annual basis. **Emission factor:** EMEP/EEA Guidebook (2009), country specific, national studies, UK Emission Factor Database ,Danish EPA
Finland	**General:** There is no exploration or production of oil or natural gas in Finland.CO_2, CH_4 and N_2O emissions from flaring at oil refineries and in the petrochemical industry, fugitive methane emissions from oil refining and methane emissions from gas transmission and distribution were included. Oil refining: The fugitive methane emissions from the refining and storage of oil have been calculated on the basis of 1996 IPCC GL using the default emission factors for oil refining and data from Energy Statistics (Energy Statistics, Yearbook 2011) on oil refining activities. Flaring: Estimates of carbon dioxide emissions from flaring are calculated using data from VAHTI system and emission factors of used fuels in ILMARI calculation system. Natural gas transmission: Fugitive emissions from gas transmission are calculated by Gasum Oy (Huomo A. 2012). Calculations are based on measurements for the years 1996-2011. Emissions of earlier years have been estimated with Gasum Oy (Hyvärinen E. 2000) at Statistics Finland based on the volume of transmitted gas and knowledge of malfunctions and repairing works when gas could have been released. Natural gas distribution: Emissions from gas distribution are also partly based on measurements (1996-2011) made by Helsinkikaasu Oy (Huomo A. 2012) and partly on rough estimates (1991-1994) based on the volume of total distributed gas. This method is close to linear interpolation in accordance with GPG 2000. There were no emissions from gas distribution in 1990. The reason for this is that natural gas has been distributed in the old parts of the distribution network beginning from 1991. So called "town gas", which was earlier distributed in those parts, did not contain substantial amounts of methane. **Activity data:** Energy Statistics (Energy Statistics, Yearbook 2009), flares reported to the VAHTI system **Emission factor:** Emission factors for calculating emissions from the refining and storage of oil are based on the default factor given in 1996 IPCC GL, since country-specific factors are not available. The IPCC Guidelines offer a wide range for the emission factors. Due to lack of knowledge on the applicability of the factors to Finnish circumstances, the mean value of the factors is used (EF = 880 kg methane / PJ oil refined). Plant and fuel specific emission factors are used for calculation emissions from flaring.
France	**General:** Emissions from exploration, production, transport, refining were included. There are 14 refineries in France. The fugitive CO_2 emissions from the gas extraction site 'bassin de Lacq' decreased along with production strongly. The production of petrol emits CO_2 and CH_4, but compared to the transformation of petroleum products much less.

Member State	Methodology
	Activity data: national and plant statistics **Emission factor**: country specific, extraction Tier 1 (liquid) and 3 (gaseous fuel), refining Tier 2/3, pipeline compressors (tier 3), transport Tier 2/3
Germany	**General**: Emissions from 1 B 2 b i are included in 1 B 2 a i Tier-2-Method (IPCC) **Activity data**: Jahresbericht des Wirtschaftsverbandes Erdöl- und Erdgasgewinnung e.V. (WEG), Jahresbericht Mineralöl-Zahlen, Mineralölwirtschaftsverband **Emission factor**: IPCC GPG default emission factors, country specific
Greece	**General**: Extraction, processing, storage, transmission/distribution were included. The introduction of natural gas in the Greek energy system started in 1996. Emissions estimated according to the Tier 1 methodology described in the IPCC Good Practice Guidance (IPCC 2000). Emissions from crude oil transport are reported under venting, while emissions from LPG transport are reported under Other (1.B.2d - Other) **Activity data:** national energy balance, Public Gas Corporation, international institutes and databases **Emission factor:** IPCC Guidelines, IPCC Good Practice Guidancev **Changes (NIR 2013):** No
Ireland	**General:** Ireland has no oil industries and therefore fugitive emissions of greenhouse gases are limited to those associated with natural gas production and distribution. **Activity data:** energy balance, reports to the department of communications energy and natural resources (DCENR) under the OSPARConvention **Emission factor:** country specific
Italy	**General**: Fugitive CO_2 emissions reported in 1B2 referred to fugitive emissions in refineries during petroleum production processes, e.g. fluid catalytic cracking and flaring, and emissions from the production of oil and natural gas. CH_4 emissions reported in 1B2 referred mainly to the production of oil and natural gas and to the transmission in pipelines and distribution of natural gas. CO_2 and CH_4 fugitive emissions from oil exploration are included in those from production because no detailed information is available. N_2O emissions from flaring in oil exploration and in refining activities are reported under oil flaring. Emissions from transport and distribution of oil result as not occurring. CO_2 and CH_4 emissions from gas exploration are also included in those from production while CH_4 emissions from other leakage are included in distribution emission estimates. **Activity Data:** National Energy Balance, specific industry data **Emission factor**: IPCC GPG (2000) **Methodological (NIR 2013)::** CO_2 and CH_4 from 1B2C.1.1. Disaggregation of fugitive emissions from oil among venting, flaring and production. Addition of natural gasoline production; CO_2 and CH_4 from 1B2C.2.1. Disaggregation of fugitive emissions from oil among venting, flaring and production. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Addition of natural gasoline production N_2O from 1B2C.2.1. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D CO_2 and CH_4 from 1B2C.2.2. Disaggregation of fugitive emissions from oil among venting, flaring and production CO_2 from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Reallocation of fugitive emissions from petroleum refining between production processes and flaring CH_4 from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D N_2O from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Addition of N_2O emissions from flaring in refineries **Changes (NIR 2013)** CH_4, CO_2, and N_2O emissions by oil and gas exploration activities have been calculated since 1990 because new information are available on the number of wells for oil and gas exploration. CH_4 and CO_2 emissions by pipeline oil transport have been calculated since 1990. New information has been provided by one gas distribution operator as regards fugitive emissions since 2009. The length of low and medium pressure network for natural gas distribution has been updated since 2009.
Luxembourg	**General:** In Luxembourg, fugitive emissions only occur from natural gas transmission, distribution and leakages (IPCC Sub-categories 1B2b3, 1B2b4 and 1B2b5). Other fugitive emissions are not occurring in Luxembourg. With regards to natural gas, methane emissions from leaks or accidental events are included in IPCC

Member State	Methodology
	sub-categories 1B2b3 – Transmission and 1B2b4 – Distribution, hence notation key IE used in IPCC sub-category 1B2b5 – Other Leakage. **Activity Data:** national natural gas consumption: national statistics **Emission factor**: 2006 IPCC Guidelines default emission factors for natural gas transmission and distribution. (2006 IPCC Guidelines Tier 1 approach has been applied).
Netherlands	**General:** The fugitive emissions – mostly CH_4 – from category 1B2 comprise non-fuel combustion emissions from flaring and venting, emissions from oil and gas production, emissions from gas transport (compressor stations) and gas distribution networks (pipelines for local transport) and oil refining. The fugitive CO_2 emissions from refineries are included in the combustion emissions reported in category 1A1b. In addition, the combustion emissions from exploration and production are reported under 1A1c. From the 2007 submission the process emissions of CO_2 from a hydrogen plant of a refinery (about 0.9 Tg CO_2 per year) are reported in this category. Refinery data specifying these fugitive CO_2 emissions are available from 2002 onwards (environmental report from the plant) and re-allocated from 1A1b to 1B2a-iv for 2002 onwards. **Activity data:** plant and country specific **Emission factor:** country specific Tier 3. Since 2004, the gas distribution sector annually records the number of leaks found per material, and any future possible trends in the emission factors will be derived from these data.
Portugal	**General:** Extraction and production of crude oil did never occur in the Portuguese territory. Therefore, fugitive emissions comprised only those resulting from refining, storage and transport of crude oil, other raw materials, intermediate products and final products - particularly gasoline - from terminal receiving of crude oil and other petroleum products till delivering to final consumer. There is no production of natural gas in Portugal. The use of natural gas in Portugal was initiated only in 1997 (DGEG). All natural gas is imported and received through shipping transport from Algeria and Nigeria as Liquefied Natural Gas (LNG). There are also no major processing operations in Portugal. **Activity data:** plant and country specific, GALP (the company operating all refineries in Portugal), PETROGAL, TRANSGAS, General-Directorate for Energy and Geology (DGEG) **Emission factor:** IPCC Good Practice (IPCC,2000), EMEP/CORINAIR, plant specific, USEPA **Changes NIR 2013:** 1.B.2.a.iii and 1.B.2.a.iv: Double counting related to transport was corrected. 1.B.2.a.v: We start using gasoline sales as AD and not all fuel sales. We have changed emission factors in order to accomplish "Portaria n.º 646/97". We assumed that there is no stage II implementation in service stations in Portugal. 1.B.2.b.: Revision of the 2010 energy balance data (2010); and Revision of pipeline extention made by DGEG (2008-2010). 1.B.2.c: The entire methodology was revised. 1.B.2.d: Revision of the energy production values that resulted from a better activity data desagregation between Ribeira Grande e Pico Vermelho (2000-2010); These new data were provided by the Azores Environmental Authorities; Correction of an error found in the estimation of the CO_2 emission factor for Ribeira Grande (2000-2012).
Spain	**Activity Data:** OILGAS, Enciclopedia Nacional del Petróleo, Petroquímica y Gas, SEDIGAS **Emission factors:** estadística de prospección y producción de hidrocarburos, country specific, EMEP/CORINAR Guidebook, IPCC GPG 2000 **Changes(NIR 2013)**: • For the years 2007-2010, CO_2 emissions from sulfur recovery units reported by a refinery (1B2aiv category) have been reallocated in the category 1A1b (combustion in the oil refining sector) • CH_4 emissions assigned to vacuum distillation processes (in the category 1B2aiv) in two refining plants have been reviewed. • Additionally, the activity variable used in estimating emissions for the vacuum distillation unit (1B2aiv category) of another refinery for the whole period 1990-2010 has been reviewed. • the pipeline length for the distribution of natural gas (1B2biv category) according to operating pressure and material was reviewed (for the year 2010). The new data have changed the estimates of the volume of natural gas leakage in 2010, and, consequently, CO_2 and CH_4 emissions. • The amount of natural gas burned for the years 2009 and 2010 (1B2cii) was reviewed on the basis of the information declared by the company responsible for the management of an underground storage facility.

Member State	Methodology
Sweden	**General:** According to 2006 IPCC Guidelines, emissions from hydrogen production plants should be reported in this sector. Since 2005, one such facility is in operation in Sweden, and another one was taken into operation in 2006. Emissions from these facilities are reported in CRF 1B2ai in accordance with 2006 IPCC Guidelines. In Sweden, crude oil is transported to and from the country by tankers. In response to recommendations from the UNFCCC expert review teams, Sweden estimates for the first time in the 2010 submission inventory emissions of CH_4 from transport of crude oil. **Activity data:** plant specific, report to the EU ETS system, Statistics Sweden, Swedish EPA **Emission factor:** plant specific, country specific and default, IPCC guidelines, 2000 Good Practice Guidance **Changes NIR 2013** Since submission 2012 there has been a smaller revision of the distributed amount of gasoline reported from the used road transport emission model HBEFA3.1. The revision resulted in a decrease of NMVOC emissions in CRF 1.B.2.A.5 of 0.2% (0.03 Gg) in 1990 and 4% (0.12 Gg) in 2011, all compared to submission 2012. • CH_4 and CO_2 emissions from venting activities from natural gas transmission pipelines have been estimated by using the default method in the IPCC Good Practice Guidance. Emissions are allocated to CRF 1.B.2.B.3. In earlier submissions these emissions were not estimated at all. • CH_4 emissions from storage of natural gas have been estimated by applying estimates from the operators of the transmission system. Emissions are allocated to CRF 1.B.2.B.3. In earlier submissions these emissions were not estimated at all. • SO_2 emission corrected for one oil refinery in CRF 1.B.2.A.4. Elementary sulphur was reported instead of SO_2.
United Kingdom	**General:** Emissions occurred from oil and gas production facilities, gas and oil terminals, gas processing facilities, oil refineries, gas transmission networks, and storage and distribution of petrol. Most of the UK's oil and gas production occurs offshore but there are a number of mostly small onshore production sites as well. **Activity data:** Oil and Gas UK trade association (through their annual emissions reporting mechanism to the UK regulatory agency (the Department of Energy & Climate Change), called the Environmental Emissions Monitoring System (EEMS), for years prior to 1995 emission totals are based on an internal Oil and Gas UK summary report produced in 1998, UK Petroleum Industry Association, UK Energy Statistics **Emission factor:** plant specific and aggregated, calculated by UK Institute of Petroleum **Changes NIR 2013**: Review of time series of EEMS-reported data, to address (mainly) outlier IEFs from combustion sources in 1A1c, but this review has also identified some mis-allocations of facilities and emissions between upstream oil and upstream gas and a small number of facility reporting gaps in the 1B2 source categories – now resolved. Review of time series of gas leakage from the UK gas distribution network, leading to revisions in estimates for 1993-2002 inclusive. Improved transparency in reporting of emissions from the gas supply network in the UK, with new separate estimates of leakage from the gas transmission system (1B2biii), which previously was reported with distribution leakage in 1B2biv. Improved completeness of reporting of gas leakage at point of use, including new estimates of leakage from gas use in cooking appliances in residential and commercial sectors.

CO_2 from Oil (1B2a)

Fugitive emissions from oil correspond to fugitive emissions from oil exploration, fugitive emissions from the production of crude oil, fugitive emissions resulting from the loading and unloading of crude oil from tankers, fugitive emissions from the refining of oil and from storage in tanks and emissions (primarily NMVOCs) from transport and handling of oil products. (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CO_2 emissions from 1B2a 'Fugitive CO_2 emissions from oil' account for 0.2 % of total EU-15 GHG emissions in 2011 and for 20 % of all fugitive emissions in the EU-15. Between 1990 and 2011, CO_2 emissions from this source increased by 12 % in the EU-15 (Table 3.93). By contrast, during the same period 1990-2011, CH_4 emissions of this source category were reduced by 38 %.

Together France, Italy and Spain accounted for 68 % of the EU-15 total CO_2 emissions of 1B2a ‘Fugitive CO_2 emissions from oil’ (Table 3.96). All three Member States used higher tier methods for the estimation of 1B2a (Table 3.96). During the period 1990-2011, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Netherlands and in Spain (Table 3.96)..

Table 3.96 1B2a Fugitive CO_2 emissions from oil: Member States’ contributions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	43	145	145	1.6%	0	0%	102	237%	CS	PS
Belgium	0	0	0	0.0%	0	-10%	0	19%	T1	D
Denmark	2	5	4	-	-1	-11%	2	72%	CR	D
Finland	1.0	1.3	1.4	0.0%	0.1	6%	0	43%	CS	D
France	2 795	2 426	2 374	26.5%	-52	-2%	-421	-15%	T1,T2,T3	CS
Germany	1	1	1	0.0%	0	-3%	0	-32%	T1,T2	D
Greece	0	0.04	0.03	0.0%	-0.006	-14%	-0.24	-	T1	D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	2 366	1 447	1 455	16.3%	8	1%	-912	-39%	T1,T2	CS,D
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	0	956	846	9.5%	-110	-12%	846	-	CS,D	CS,D
Portugal	215	805	792	8.8%	-13	-2%	577	269%	D	D
Spain	1 477	1 900	2 246	25.1%	346	18%	769	52%	T1,T2	D,PS
Sweden	234	803	807	9.0%	3	0%	573	245%	T2,T3	CS,PS
United Kingdom	859	306	277	3.1%	-30	-10%	-582	-68%	T2	CS,PS
EU-15	**7 994**	**8 796**	**8 948**	**100.0%**	**152**	**2%**	**954**	**12%**		

For methodological issues and remarks on completeness see Table 3.95.
Abbreviations explained in the Chapter ‘Units and abbreviations’.

CH_4 from Natural gas (1B2b)

Fugitive emissions from natural gas correspond to emissions from the production of gas, gas gathering systems and gas separation plants, emissions from pipelines for long distance and local transport of methane, compressor stations and their maintenance facilities, and the release of gas at point of use, including residential, commercial, industrial and electricity generation users (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CH_4 emissions from 1B2b ‘Fugitive CH_4 emissions from natural gas’ account for 0.5 % of total EU-15 GHG emissions in 2011 and for 39 % of all fugitive emissions in the EU-15. Between 1990 and 2011, CH_4 emissions from this source decreased by 33 % in the EU-15 (Table 3.97).

In 2011, 83% of the EU-15 CH_4 emissions from 1B2b were emitted by three Member States: Germany, Italy and the United Kingdom (Table 3.97). All three Member States used higher tier methods for the estimation of the emissions from 1B2b. The emission decreases between 1990 and 2011 observed in the United Kingdom (-53 %) and in Italy (-32 %) contributed most significantly to the overall reduction in the EU-15 between 1990 and 2011.

Various parameters (e.g. pipelines length, PJ gas consumed, m^3 gas produced, see Table 3.99) were used as activity data for calculation of the sub categories of 1B2b by Member States and thus a meaningful implied emission factor could not be calculated for the EU-15.

Table 3.97 1B2b Fugitive CH_4 emissions from natural gas: Member States' contributions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	96	102	107	0.6%	5	5%	10	11%	T2,T3	CS
Belgium	519	432	395	2.3%	-37	-9%	-124	-24%	CS,M	CS
Denmark	9	4	7	0.0%	3	73%	-2	-24%	CS	CS
Finland	4	30	25	0.1%	-4	-14%	22	609%	T1,T2	CS,D,PS
France	1 334	1 105	1 052	6.2%	-52	-5%	-282	-21%	T1,T2,T3	CS
Germany	6 966	5 321	5 373	31.5%	51	1%	-1 594	-23%	CS,T2,T3	CS,D
Greece	10	124	131	0.8%	6	5%	121	1263%	T1	D
Ireland	131	31	28	0.2%	-4	-12%	-104	-79%	CS	CS
Italy	7 063	4 878	4 774	28.0%	-104	-2%	-2 289	-32%	T1,T2	CS,D
Luxembourg	16	45	39	0.2%	-6	-13%	23	141%	T1	D
Netherlands	373	405	410	2.4%	5	1%	36	10%	T2,T3	CS
Portugal	NO	543	124	0.7%	-419	-77%	124	-	CR,OTH	CR,OTH
Spain	420	473	481	2.8%	7	2%	61	14%	CS,T1	CS,D
Sweden	54	87	87	-	0	0%	33	62%	T1	D
United Kingdom	8 541	4 195	4 016	23.6%	-179	-4%	-4 525	-53%	T2,T3	CS,PS
EU-15	**25 537**	**17 776**	**17 048**	**100.0%**	**-728**	**-4%**	**-8 488**	**-33%**		

For methodological issues and remarks on completeness see Table 3.95.
Abbreviations explained in the Chapter 'Units and abbreviations'.

○ **CO_2 from Venting and Flaring (1B2c)**

Fugitive emissions from venting and flaring correspond to the release and/or combustion of excess gas at facilities for the production of oil or gas and for the processing of gas (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2011 fugitive CO_2 emissions from 1B2c Venting and Flaring accounted for 0.2 % of total GHG emissions in 2011 and for 13 % of all fugitive emissions in the EU-15. The United Kingdom used a higher tier method for the estimation of emissions from 1B2c and was responsible two thirds of the emissions from this source (Table 3.98).

Between 1990 and 2011, CO_2 emissions from this source decreased by 18 % in the EU-15 (Table 3.98).

Table 3.98 1B2c Fugitive CO_2 emissions from venting and flaring: Member States' contributions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	IE	IE	IE	-	-	-	-	-	NA	NA
Belgium	84	103	93	1.7%	-10	-10%	9	11%	T3	PS
Denmark	322	352	251	4.5%	-101	-29%	-71	-22%	CR,CS	CS,PS
Finland	122	98	88	1.6%	-10	-11%	-34	-28%	CS	CS
France	512	438	350	6.3%	-89	-20%	-162	-32%	T1,T2,T3	CS
Germany	337	294	297	5.4%	3	1%	-40	-12%	T1	CS,D
Greece	70	11	9	0.2%	-2	-15%	-60.97	-	T1	D
Ireland	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Italy	293	301	313	5.6%	12	4%	20	7%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	774	65	53	1.0%	-12	-18%	-721	-93%	T2	PS
Portugal	50	38	66	1.2%	28	74%	15	30%	D	D
Spain	179	277	290	5.2%	14	5%	111	62%	CS,T1,T2	CS
Sweden	70	79	72	1.3%	-6	-8%	2	3%	T2	CS,PS
United Kingdom	3 920	3 896	3 659	66.0%	-237	-6%	-261	-7%	T3	CS,PS
EU-15	**6 733**	**5 952**	**5 541**	**100.0%**	**-411**	**-7%**	**-1 192**	**-18%**		

For methodological issues and remarks on completeness see Table 3.95.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.99 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

Member State	GHG source category	1990 Activity data Description	1990 Unit	1990 Value	1990 Implied emission factor (kg/unit)	1990 CH4 emissions (Gg)	2011 Activity data Description	2011 Unit	2011 Value	2011 Implied emission factor (kg/unit)	2011 CH4 emissions (Gg)
Austria	**Natural Gas**					**4.59**					**5.09**
	i. Exploration			1288	IE	IE			1684	IE	IE
	ii. Production (4) / Processing	gas produced	10^6 m^3	1288	IE	IE	gas produced	10^6 m^3	1684	IE	IE
	iii. Transmission	Pipelines length (km)	km	3628	494.56	1.79	Pipelines length (km)	km	6983	385.94	2.69
	iv. Distribution	Distribution network length	km	11672	239.81	2.80	Distribution network length	km	29023	82.42	2.39
	v. Other Leakage	Gas consumed	PJ	NO	NO	NO	Gas consumed	PJ	NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
Belgium	**Natural Gas**					**24.71**					**18.81**
	i. Exploration								NO	NO	NO
	ii. Production (4) / Processing								NO	NO	NO
	iii. Transmission	(e.g. PJ gas consumed)	PJ	341	5979.11	2.04	(e.g. PJ gas consumed)	PJ	599	5599.32	3.36
	iv. Distribution	PJ gas consumed	PJ	341	66474.61	22.67	PJ gas consumed	PJ	599	25793.55	15.46
	v. Other Leakage								NO	NO	NO
	at industrial plants and power stations								NO	NO	NO
	in residential and commercial sectors								NO	NO	NO
Denmark	**Natural Gas**					**0.43**					**0.32**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	Gas produced	10^6 m^3	5137	IE	IE	Gas produced	10^6 m^3	6511	IE	IE
	iii. Transmission	Gas transmission	10^6 m^3	2739	62.03	0.17	Gas transmission	10^6 m^3	6181	27.65	0.17
	iv. Distribution	Gas distributed	10^6 m^3	1905	134.03	0.26	Gas distributed	10^6 m^3	2954	52.02	0.15
	v. Other Leakage	Incl. in transmission		IE	IE	IE	Incl. in transmission		IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Finland	**Natural Gas**					**0.17**					**1.21**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	(e.g. PJ gas produced)		NO	NO	NO	(e.g. PJ gas produced)		NO	NO	NO
	iii. Transmission	PJ gas consumed	PJ	92	1855.49	0.17	PJ gas consumed	PJ	140	1467.61	0.21
	iv. Distribution	PJ gas distributed via local networks	PJ	5	NO	NO	PJ gas distributed via local networks	PJ	8	122833.34	1.00
	v. Other Leakage	t of natural gas released from pipelines		NO	NO	NO	t of natural gas released from pipelines		NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
France	**Natural Gas**					**63.53**					**50.12**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	PJ Production	PJ	309	1040.63	0.32	PJ Production	PJ	78	21.94	0.00
	iii. Transmission	PJ Consumed	PJ	1055	59888.21	63.21	PJ Consumed	PJ	1548	32375.26	50.12
	iv. Distribution			IE	IE	IE			IE	IE	IE
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO

		1990					2011				
Germany	**Natural Gas**					**331.72**					**255.83**
	i. Exploration	numbers of wells drilled	number	IE	IE	IE	numbers of wells drilled	number	IE	IE	IE
	ii. Production (4) / Processing	production and processing	TJ	631232	94.93	59.92	production and processing	TJ	377762	5.53	2.09
	iii. Transmission	high pressure pipelines	km	36760	231.72	8.52	high pressure pipelines	km	62870	246.95	15.53
	iv. Distribution	distribution net	km	245852	813.26	199.94	distribution net	km	433035	430.47	186.41
	v. Other Leakage	gas consumed	TJ	893519	70.89	63.34	gas consumed	TJ	1062217	48.77	51.81
	at industrial plants and power stations		TJ	IE	IE	14.07		TJ	IE	IE	10.14
	in residential and commercial sectors	gas consumed	TJ	893519	55.14	49.27	gas consumed	TJ	1062217	39.23	41.67
Greece	**Natural Gas**					**0.46**					**6.22**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	Natural gas production	10^6 m^3	123	3708.46	0.46	Natural gas production	10^6 m^3	6	415.00	0.00
	iii. Transmission	Length of transmission pipeline	km	NO	NO	NO	Length of transmission pipeline	km	1316	2533.48	3.33
	iv. Distribution	Length of distribution mains	km	NO	NO	NO	Length of distribution mains	km	4686	615.00	2.88
	v. Other Leakage	(e.g. PJ gas consumed)		11567	IE	IE	(e.g. PJ gas consumed)		304140	IE	IE
	at industrial plants and power stations	NG consumption		5783	IE	IE	NG consumption		152070	IE	IE
	in residential and commercial sectors	NG Consumption		5783	IE	IE	NG Consumption		152070	IE	IE
Ireland	**Natural Gas**					**6.24**					**1.31**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	79	14330.75	1.13	PJ of Gas produced	PJ	12	503.34	0.01
	iii. Transmission	(e.g. PJ gas consumed)		IE	IE	IE	(e.g. PJ gas consumed)		IE	IE	IE
	iv. Distribution	PJ of gas consumed	PJ	25	206094.75	5.12	PJ of gas consumed	PJ	74	17666.36	1.30
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	NO	NO	NO	(e.g. PJ gas consumed)	PJ	NO	NO	NO
	at industrial plants and power stations		PJ	NO	NO	NO		PJ	NO	NO	NO
	in residential and commercial sectors		PJ	NO	NO	NO		PJ	NO	NO	NO
Italy	**Natural Gas**					**336.33**					**227.34**
	i. Exploration	0.0%		36	158.15	0.01	0.0%		NO	NO	NO
	ii. Production (4) / Processing	PJ of Gas produced	PJ	17296	2899.60	50.15	PJ of Gas produced	PJ	8339	1600.00	13.34
	iii. Transmission	(e.g. PJ gas consumed)	0	45684	822.12	37.56	(e.g. PJ gas consumed)	0	78300	449.21	35.17
	iv. Distribution	PJ of gas consumed	PJ	20632	12049.80	248.61	PJ of gas consumed	PJ	34736	5148.27	178.83
	v. Other Leakage			NA	IE	IE			NA	IE	IE
	at industrial plants and power stations			NA	IE	IE			NA	IE	IE
	in residential and commercial sectors			NA	IE	IE			NA	IE	IE
Luxembourg	**Natural Gas**					**0.77**					**1.87**
	i. Exploration	gas exploration		NO	NO	NO	gas exploration		NO	NO	NO
	ii. Production (4) / Processing	gas produced		NO	NO	NO	gas produced		NO	NO	NO
	iii. Transmission	gas consumed	TJ	18	13120.17	0.24	gas consumed	TJ	43	13130.51	0.57
	iv. Distribution	gas consumed		17933	30.07	0.54	gas consumed		43219	30.09	1.30
	v. Other Leakage	(specify)		IE	IE	IE	(specify)		IE	IE	IE
	at industrial plants and power stations	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE
	in residential and commercial sectors	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE

		1990					2011				
Netherlands	**Natural Gas**					**17.79**					**19.51**
	i. Exploration	number of wells drilled/tested	number	NA	IE	IE	number of wells drilled/tested	number	NA	IE	IE
	ii. Production (4) / Processing	gas produced	PJ	2300	IE	IE	gas produced	PJ	2419	IE	IE
	iii. Transmission	gas transported	PJ	2648	2137.02	5.66	gas transported	PJ	3223	2091.09	6.74
	iv. Distribution	natural gas distribution network	10^3 km	100	121283.21	12.13	natural gas distribution network	10^3 km	124	103120.19	12.77
	v. Other Leakage			IE	IE	IE			IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Portugal	**Natural Gas**					**NO**					**5.90**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	5842	1009.97	5.90
	iv. Distribution	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	IE	IE	IE
	v. Other Leakage			NO	NO	NO			IE	IE	IE
	at industrial plants and power stations	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
	in residential and commercial sectors	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
Spain	**Natural Gas**					**19.99**					**22.88**
	i. Exploration			IE	IE	IE			NO	NA	NA
	ii. Production (4) / Processing	PJ gas produced (NCV)	PJ	51	70657.76	3.62	PJ gas produced (NCV)	PJ	2	70657.76	0.15
	iii. Transmission	PJ gas (NCV)	PJ	212	782.50	0.17	PJ gas (NCV)	PJ	1182	360.19	0.43
	iv. Distribution	PJ gas consumed (NCV)	PJ	219	73874.23	16.20	PJ gas consumed (NCV)	PJ	1189	18757.70	22.30
	v. Other Leakage	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)		NE	NE	NE
	at industrial plants and power stations			NE	NE	NE			NE	NE	NE
	in residential and commercial sectors			NE	NE	NE			NE	NE	NE
Sweden	**Natural Gas**					**2.57**					**4.16**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	Length of pipeline	km	320	4100.00	1.31	Length of pipeline	km	620	4107.55	2.55
	iv. Distribution	Length of pipeline	km	2050	615.00	1.26	Length of pipeline		2620	615.00	1.61
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
United Kingdom	**Natural Gas**					**406.73**					**191.25**
	i. Exploration			225518	15.66	3.53			12078	45.00	0.54
	ii. Production (4) / Processing			1709	12758.51	21.81			1704	2163.54	3.69
	iii. Transmission			1395830	6.55	9.14			1803198	3.84	6.92
	iv. Distribution	Final gas consumption	GWh	1396	264819.47	369.64	Final gas consumption	GWh	1803	98585.28	177.77
	v. Other Leakage			1385	1885.50	2.61			1350	1724.26	2.33
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			1384768	1.89	2.61			1349908	1.72	2.33

Table 3.100 and Table 3.101 provide information on the contribution of Member States to EU-15 recalculations in CO_2 and CH_4 from 1B2 'Oil and natural gas' for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 3.100 1B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EU recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	-1.8	-1.3	The share of biogenic components in fuels are taken into account in calculation of indirect CO2 emissions.
France	78	1.9	-282	-8.2	Pour la section 1B2a, la densité du pétrole brut a été modifiée. Pour la section 1B2b, une correction a été faite sur certains sites d'extraction qui correspondaient à de l'extraction de pétrole et non de gaz naturel. Pour la section 1B2c, les émissions venting issues de l'extraction du pétrole sont dorénavant inclues sous cette rubrique. Les émissions provenant des torchères sont distinguées entre les torches dans l'extraction de pétrole et celles dans l'extraction de gaz, sites de stockage de gaz naturel et terminaux méthaniers, ces deux derniers ayant été ajoutés cette année.
Germany	51	3.0	8	0.6	Change of a splitfactor.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	124	86.8	306	42.8	Correction of an error found in the estimation of the CO2 emission factor for Ribeira Grande geothermal power plant. Revision of the energy production values that resulted from a better activity data split between Ribeira Grande e Pico Vermelho geothermal power plants. Ultimate CO2 emissions from CH4 and NMVOC process emissions previously not estimated.
Spain	0	0.0	-6	-0.3	CO2 emissions reported by a refinery to the sulphur recovery activity have been reallocated under category 1.A.1.b (These emissions come from the consumption of refinery gas in burners asssociated to the sulphur recovery plant).
Sweden	0	0.0	0	0.0	
UK	0	0.0	36	0.8	Extensive review of offshore oil and gas sector.
EU-15	**253**	**1.4**	**60**	**0.3**	

Table 3.101 1B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-37	-13.3	Revised EFs (new study) for transmission and distribution of natural gas.
Belgium	0	0.0	1	0.2	Reallocation from 1A3e.
Denmark	0	0.0	5	4.6	Natural gas distribution has been recalculated for 2009 and 2010 according to the annual reports from two of the Danish distribution companies.
Finland	0	0.7	0	-0.1	Accuracy of emission figure has been improved.
France	10	0.7	7	0.6	Pour la section 1B2a, la densité du pétrole brut a été modifiée. Pour la section 1B2b, une correction a été faite sur certains sites d'extraction qui correspondaient à de l'extraction de pétrole et non de gaz naturel. Pour la section 1B2c, les émissions venting issues de l'extraction du pétrole sont dorénavant inclues sous cette rubrique. Les émissions provenant des torchères sont distinguées entre les torches dans l'extraction de pétrole et celles dans l'extraction de gaz, sites de stockage de gaz naturel et terminaux méthaniers, ces deux derniers ayant été ajoutés cette année.
Germany	-434	-5.1	-853	-12.9	Improved emission factor for storage of gas.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0.0	0.0	
Italy	0	0.0	90	1.8	Update of CH4 emission factor for gas distribution.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	-13	-25.8	-15.1	-2.5	Process emissions previously not estimated.
Spain	-1	-0.1	0	0.0	CH4 emissions estimate in one the vacuum distillation units at a refinery plant have been revised. According to the information provided by the refinery itself, the existence of a vapour recovery unit associated to the vacuum distillation unit entails that the full current is derived to the refinery gas network, using this gas in the combustion units, so there is no VOC emissions. This is the same case in one of the vacuum distillation units located at another refinery plant. Revision of the activity variable used in the estimation of emissions in the vacuum distillation unit at a refinery plant. In the present edition of the inventory an estimate of the amount of feed to the vacuum distillation unit has been carried out, instead of using the total amount of crude oil processed by the refinery as the activity variable (as it was made in previous editions of the inventory).
Sweden	8	12.0	16	16.6	Emissions from venting and storage of natural gas in the transmission network was added to the already reported fugitive emissions. This is in line with IPCC GPG. Default emision factors from GPG was used to estimate venting emissions. A national method was used to estimate emissions from storage.
UK	36	0.3	8	0.2	Extensive review of offshore oil and gas sector.
EU-15	**-394**	**-1.3**	**-778**	**-3.7**	

3.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States' contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.102 shows the total EU-15 uncertainty estimates for the sector 'Energy' excluding 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. For those emissions for which no split by source category was available, uncertainty estimates were made for stationary combustion as a whole. The highest level uncertainty was estimated for N_2O from 1A2e and the lowest for CO_2 from 1A2f. With regard to trend CH_4 from 1A1a shows the highest uncertainty estimates, CO_2 from 1A1a the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 3.102 Sector 1 Energy (excl. 1A3b and 1B): Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	CO_2	499.597	486.816	-3%	3%	0,0%
1.A.1.a Public electricity and heat production	CH_4	220	1.988	803%	82%	6,6%
1.A.1.a Public electricity and heat production	N_2O	3.976	3.253	-18%	53%	0,1%
1.A.1.b Petroleum refining	CO_2	52.291	51.958	-1%	3%	0,0%
1.A.1.b Petroleum refining	CH_4	16	9	-45%	44%	0,1%
1.A.1.b Petroleum refining	N_2O	281	167	-41%	101%	0,2%
1.A.1.c Manufacture of solid fuels	CO_2	70.597	20.525	-71%	5%	0,0%
1.A.1.c Manufacture of solid fuels	CH_4	92	20	-78%	57%	0,6%
1.A.1.c Manufacture of solid fuels	N_2O	686	190	-72%	17%	0,1%
1.A.2.a Iron and Steel	CO_2	60.789	48.273	-21%	3%	0,0%
1.A.2.a Iron and Steel	CH_4	104	71	-31%	23%	0,3%
1.A.2.a Iron and Steel	N_2O	186	148	-20%	39%	0,1%
1.A.2.b Non-Ferous Metals	CO_2	2.427	2.328	-4%	8%	0,0%
1.A.2.b Non-Ferous Metals	CH_4	2	2	9%	62%	0,1%
1.A.2.b Non-Ferous Metals	N_2O	21	10	-51%	79%	0,3%
1.A.2.c Chemicals	CO_2	10.084	11.150	11%	11%	0,1%
1.A.2.c Chemicals	CH_4	10	13	28%	79%	0,3%
1.A.2.c Chemicals	N_2O	37	35	-6%	376%	1,3%
1.A.2.d Pulp, Paper and Print	CO_2	5.766	4.801	-17%	3%	0,0%
1.A.2.d Pulp, Paper and Print	CH_4	42	58	39%	63%	0,1%
1.A.2.d Pulp, Paper and Print	N_2O	137	151	10%	183%	0,5%
1.A.2.e Food Processing, Beverages and Tobacco	CO_2	7.600	4.759	-37%	5%	0,0%
1.A.2.e Food Processing, Beverages and Tobacco	CH_4	10	7	-27%	91%	0,3%

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.2.e Food Processing, Beverages and Tobacco	N_2O	60	23	-62%	519%	0,7%
1.A.2.f Other	CO_2	161.449	100.239	-38%	3%	0,0%
1.A.2.f Other	CH_4	225	150	-34%	27%	0,2%
1.A.2.f Other	N_2O	1.632	1.190	-27%	79%	0,1%
1.A.3.a Civil aviation	CO_2	9.160	11.062	21%	11%	0,0%
1.A.3.a Civil aviation	CH_4	8	6	-29%	64%	0,2%
1.A.3.a Civil aviation	N_2O	82	80	-2%	173%	0,2%
1.A.3.c Railways	CO_2	4.345	1.856	-57%	6%	0,0%
1.A.3.c Railways	CH_4	6	2	-60%	58%	0,3%
1.A.3.c Railways	N_2O	83	31	-63%	178%	0,7%
1.A.3.d Navigation	CO_2	15.145	16.221	7%	25%	0,1%
1.A.3.d Navigation	CH_4	44	35	-19%	58%	0,1%
1.A.3.d Navigation	N_2O	245	205	-16,4%	245%	0,4%
1.A.3.e Other	CO_2	7.998	6.958	-13%	25%	0,0%
1.A.3.e Other	CH_4	17	12	-31%	29%	0,1%
1.A.3.e Other	N_2O	197	123	-38%	60%	0,4%
1.A.4.a Commercial/Institutional	CO_2	84.654	54.960	-35%	6%	0,0%
1.A.4.a Commercial/Institutional	CH_4	1.244	94	-92%	88%	1,1%
1.A.4.a Commercial/Institutional	N_2O	195	137	-30%	162%	0,3%
1.A.4.b Residential	CO_2	194.044	132.845	-32%	6%	0,0%
1.A.4.b Residential	CH_4	2.663	1.579	-41%	96%	0,3%
1.A.4.b Residential	N_2O	1.091	618	-43%	169%	0,4%
1.A.4.c Agriculture/Forestry/Fisheries	CO_2	30.756	24.069	-22%	9%	0,0%
1.A.4.c Agriculture/Forestry/Fisheries	CH_4	215	164	-24%	62%	0,3%
1.A.4.c Agriculture/Forestry/Fisheries	N_2O	465	438	-6%	156%	0,2%
1.A.5 Other	CO_2	14.933	3.464	-77%	9%	0,0%
1.A.5 Other	CH_4	240	10	-96%	27%	0,3%
1.A.5 Other	N_2O	541	260	-52%	64%	0,2%
1.A (where no subsector data were submitted)	all	861.845	715.967	-17%	2%	1,0%
1.A.1 (where no subsector data were submitted)	all	94.450	90.180	-5%	6%	3,1%
1.A.2 (where no subsector data were submitted)	all	184.621	164.576	-11%	4%	1,3%
1.A.3 (where no subsector data were submitted)	all	128.925	148.189	15%	3%	0,4%
1.A.4 (where no subsector data were submitted)	all	135.361	129.541	-4%	5%	2,1%
Total - 1.A (where no subsector data were submitted)	all	861.845	715.967	-17%	1,8%	0,2%
Total - 1.A.1	all	722.207	655.105	-9%	2,3%	0,6%
Total - 1.A.2	all	435.203	337.985	-22%	2,0%	0,7%
Total - 1.A.3	all	696.573	796.158	14%	3,2%	0,5%
Total - 1.A.4	all	450.689	344.446	-24%	3,3%	1,3%
Total - 1.A.5	all	15.713	3.734	-76%	9,7%	3,3%
Total - 1.A	all	3.182.229	2.853.395	-10%	1,2%	0,4%

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.*

Table 3.103 shows the total EU-15 uncertainty estimates for the sector 1.B 'Fugitive emissions' and the uncertainty estimates for the relevant gases for each source category. The highest level uncertainties were estimated for N_2O from 1B1 and the lowest for CH_4 from 1B2; the highest trend uncertainties were estimated for N_2O from 1B2, the lowest for CH_4 from 1B2.

Table 3.103 1B Fugitive Emissions: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid Fuels	CO_2	419	646	54%	49%	0,3%
1.B.1 Solid Fuels	CH_4	40.174	5.329	-87%	25%	0,2%
1.B.1 Solid Fuels	N_2O	2	2	-18%	113%	0,2%
1.B.2. Oil and Natural Gas	CO_2	12.836	11.557	-10%	13%	0,1%
1.B.2. Oil and Natural Gas	CH_4	29.606	18.627	-37%	9%	0,0%
1.B.2. Oil and Natural Gas	N_2O	61	80	31%	91%	0,3%
1.B (where no subsector data were submitted)	all	8.023	5.825	-27%	75%	7,8%
Total - 1.B	all	91.121	42.066	-54%	12,1%	7,1%

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.104 shows the total EU-15 uncertainty estimates for the sector 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1A3d and the lowest for CO_2 from 1A3b. With regard to trend N_2O from 1A3c shows the highest uncertainty estimates, CO_2 from 1A3b the lowest.

Table 3.104 1A3 Transport: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO_2	9.160	11.062	21%	11%	0,0%
1.A.3.a Civil aviation	CH_4	8	6	-29%	64%	0,2%
1.A.3.a Civil aviation	N_2O	82	80	-2%	173%	0,2%
1.A.3.b Road transport	CO_2	523.030	606.418	16%	4%	0,0%
1.A.3.b Road transport	CH_4	3.165	691	-78%	21%	0,2%
1.A.3.b Road transport	N_2O	4.125	4.267	3%	40%	0,1%
1.A.3.c Railways	CO_2	4.345	1.856	-57%	6%	0,0%
1.A.3.c Railways	CH_4	6	2	-60%	58%	0,3%

1.A.3.c Railways	N_2O	83	31	-63%	178%	0,7%
1.A.3.d Navigation	CO_2	15.145	16.221	7%	25%	0,1%
1.A.3.d Navigation	CH_4	44	35	-19%	58%	0,1%
1.A.3.d Navigation	N_2O	245	205	-16,4%	245%	0,4%
1.A.3.e Other	CO_2	7.998	6.958	-13%	25%	0,0%
1.A.3.e Other	CH_4	17	12	-31%	29%	0,1%
1.A.3.e Other	N_2O	197	123	-38%	60%	0,4%
Total - 1.A.3	all	696.573	796.158	14%	3,2%	0,5%

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

3.4 Sector-specific quality assurance and quality control (EU-15)

There are several activities for improving the quality of GHG emissions from energy: Before and during the compilation of the EU GHG inventory, several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency.

In the second half of the year, the EU internal review is carried out for selected source categories. In 2005, the EU internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production' and 1.B 'Fugitive emissions from fuels'. In 2008, N_2O from road transport were subject to the EU internal review. In 2012 a comprehensive review was carried out for all sectors and all EU Member States in order to fix the base year 2020 under the EU Effort Sharing Decision. (ESD review 2012).

Since the inventory 2005 plant-specific data is available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2). During the ESD review 2012 consistency checks were carried out between EU ETS data and the inventory estimates.

Eurostat energy data

During the initial checks carried out before the compilation of the EU GHG inventory Eurostat energy data is used for cross checking the sectoral and reference approach of the MS submissions. This cross check between the the European energy reporting system and the EU GHG inventory system is an important QA/QC element of the EU GHG inventory compilation.

The quality of the EU GHG inventory is directly affected by the quality of Member States and EU energy statistics systems. EU energy statistics are collected by Eurostat on the basis of the EU energy statistics regulation[26]. The energy statistics regulation was adopted as part of the energy package and

[26] REGULATION (EC) No 1099/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2008 on energy statistics

establishes a common framework for the production, transmission, evaluation and dissemination of comparable energy statistics in the EU.

This regulation aims at collecting detailed statistical data on energy flows by energy commodity at annual and monthly level. It ensures harmonised and coherent reporting of national energy data, which is indispensable for the assessment of EU energy policies and targets. The content and structure of this regulation reflects the essence of the existing European statistical system, a system that is part of the international energy statistical system, and is in direct link with the national statistical structures (classifications) and methodologies. It also has concrete links to other statistical domains, such as economic, environment, trade and business statistics. These links provide an additional dimension in safeguarding data quality assurance.

The European energy statistics system and the quality of the EU inventory is directly affected by this regulation that should:

- ensure a stable and institutional basis for energy statistics in the EU,
- guarantee long-term availability of energy data for EU policies,
- reinforce available resources for the production of the basic energy statistics at national level

The energy statistics regulation should help improving the QA/QC of the EU inventory as it should:

- make available more detailed energy statistics by fuel,
- allow the estimation of CO_2 emissions from energy with the reference and sectoral approach
- assure the quality of the underlying energy statistics
- improve timeliness of energy statistics
- provide a formal legal framework assuring consistency between national and Eurostat data

Moreover, Article 6, paragraph 2 stipulates that:

'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'.

It also foresees the further development of the energy statistics system setting a time frame for the production of more detailed data on renewable energy and final energy consumption, stating:

'With a view to improving the quality of energy statistics, the Commission (Eurostat), in collaboration with the Member States, shall make sure that these statistics are comparable, transparent, detailed and flexible by:

a) reviewing the methodology used to generate renewable energy statistics in order to make available additional, pertinent, detailed statistics on each renewable energy source, annually and in a cost effective manner. The Commission (Eurostat) shall present and disseminate the statistics generated from 2010 (reference year) onwards

b) *reviewing and determining the methodology used at national and Community level to generate final energy consumption statistics (sources, variables, quality, costs) based on the current state of play, existing studies and feasibility pilot-studies, as well as cost-benefit analysis yet to be conducted; and evaluating the findings of the pilot studies and cost benefit analysis with the view to establishing breakdown keys for final energies by sector and main energy uses and gradually integrating the resulting elements in the statistics from 2012 (reference year) onwards.'*

The first annual statistics were submitted to Eurostat on the basis of Energy Statistics Regulation in November 2010. Since then the following improvements were observed:

- Submissions are getting more timely than before 2010, resulting to the availability of complete reference approach tables by the end of February each year;
- More detailed data can be used for the calculation of the reference approach, (e.g. availability of data on international aviation);
- More detailed energy balances are published by Eurostat.

3.5 Sector-specific recalculations (EU-15)

Table 3.105 shows that in the energy sector the largest recalculations in absolute terms in 1990 and 2010 were made for CO_2. In relative terms, the largest recalculations are found in N_2O emissions. They were -1.4 % and -4.6 % in 1990 and 2010, respectively.

Table 3.105 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2010 by gas in Gg (CO_2-eq.) and percentage

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	33 412	1.0%	1 062	0.2%	329	0.1%	3	0.0%	0	0.0%	20	0.2%
Energy	4 647	0.1%	-175	-0.2%	-417	-1.4%	NO	NO	NO	NO	NO	NO
2010												
Total emissions and removals	15 626	0.5%	-8 309	-2.7%	-2 845	-1.1%	67 953	-5.2%	-28	-0.9%	114	1.9%
Energy	7 649	0.3%	-358	-0.9%	-1 348	-4.6%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.106 provides an overview of Member States' contributions to EU-15 recalculations. In absolute terms, Germany and the UK had the most influence on CO_2 recalculations in the EU-15 in 2010. The german and spanish recalculations are due to a variety of changes including revised energy balance data, which are reported in chapter 3.2 in the source categories subchapters. Further explanations for the largest recalculations by Member State are provided in Section 10.1.

Table 3.106 Sector 1 Energy: Contribution of Member States to EU-15 recalculations for 1990 and 2010 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2010					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	299	-35	15	NO	NO	NO
Belgium	289	11	-18	NO	NO	NO	560	-17	4	NO	NO	NO
Denmark	22	-6	-3	NO	NO	NO	-81	9	-1	NO	NO	NO
Finland	0	0	0	NO	NO	NO	-107	3	5	NO	NO	NO
France	2 062	9	71	NO	NO	NO	2 505	19	24	NO	NO	NO
Germany	62	-422	-76	NO	NO	NO	8 280	-628	-786	NO	NO	NO
Greece	-364	0	-4	NO	NO	NO	-910	0	-10	NO	NO	NO
Ireland	0	1	3	NO	NO	NO	20	0	0	NO	NO	NO
Italy	-355	182	75	NO	NO	NO	-475	81	-34	NO	NO	NO
Luxembourg	72	3	3	NO	NO	NO	183	1	8	NO	NO	NO
Netherlands	-13	0	-185	NO	NO	NO	163	45	-170	NO	NO	NO
Portugal	672	-18	0	NO	NO	NO	45	-30	-1	NO	NO	NO
Spain	805	1	0	NO	NO	NO	-3 449	-71	-58	NO	NO	NO
Sweden	64	8	-8	NO	NO	NO	-469	-58	-27	NO	NO	NO
UK	1 331	56	-277	NO	NO	NO	1 085	323	-319	NO	NO	NO
EU-15	**4 647**	**-175**	**-417**	**NO**	**NO**	**NO**	**7 649**	**-358**	**-1 348**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach (EU-15)

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (Eurostat database, February 2013). This submission includes the reference approach tables for 1990–2011.

Energy statistics are submitted to Eurostat by Member States on an annual basis with the five joint Eurostat/IEA/UNECE questionnaires on solid fuels, oil, natural gas, electricity and heat, and renewables and wastes. On the basis of this information Eurostat compiles the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EU-15 as a whole.

The Eurostat data for the EU-15 IPCC reference approach includes activity data and net calorific values as available in the Eurostat database. For the calculation of CO_2 emissions, the IPCC default carbon emission factors are used.

The IPCC reference approach method at EU-15 level is a three-step process.

- **Step 1:** For each Member State, annual data on energy production, imports, exports, international marine bunkers and stock changes are available in the Eurostat database in fuel specific units (kt – 1000 tonnes for oil & petroleum products and TJ – terajoules (GCV – Gross Calorific Value) for natural gas), as these are reported to Eurostat by the reporting countries via the Joint Annual Questionnaires; in these Annual Questionnaires also the calorific values for each and every energy product are reported to Eurostat. Eurostat uses the calorific values provided by each reporting country each year, to transpose the reported in specific units quantities into common energy units (toe – tonnes of oil equivalent and TJ – terajoules (NCV – Net Calorific Value)). Should the reporting country fail to deliver the calorific values, then –and only then- Eurostat applies default calorific values. For the energy products "Patent Fuel", "Coke Oven Coke", "Gas Coke", "Coal Tar", "BKB/PB" fixed calorific values are applied.

- **Step 2:** The EU-15 CRF Table 1.A(b) are calculated by adding the relevant Member State activity and emission data, as calculated under Step 1. The net calorific values provided for the EU-15 in CRF Table 1.A(b) are calculated from dividing apparent consumption in TJ by apparent consumption in fuel-specific units for each fuel. Therefore, these net calorific values are 'implied calorific values'; there are no fuel-specific net calorific values at EU-15 level.

- **Step 3:** For the calculations of carbon stored in Tables 1.A(d), Eurostat data on non-energy use of fuels are used, as reported by Member States in the joint questionnaire. For the fraction of carbon stored and carbon emission factors IPCC default values are taken (IPCC, 1997).

Table 3.107 shows the apparent energy consumption from fossil fuel combustion from 1990 to 2011 as provided in Tables 1.A(b). Total fossil fuel energy consumption was 4 % below 1990 levels in 2011 after a strong decline 2008-2009 due to the economic recession, a small increase 2009-2010 and a decline 2010-2011. Large increases had gas consumption (+54 %), whereas solid fuel combustion declined by 39 %.

Table 3.108 compares EU-15 CO_2 emissions calculated with the IPCC reference approach based on Eurostat data and the sectoral approach available from Member States. The reference approach and the sectoral approach, decreased by 5.3 % and 5.6 % respectively between 1990 and 2011; the percentage differences between the two data sets are below +/-1.0 % for all years.

Table 3.107 Reference Approach: Apparent EU-15 energy consumption (in PJ) (Eurostat data)

Fuel types	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	22,030	23,168	23,402	23,612	23,196	22,570	22,287	21,042	20,955	20,038
Solid Fuels	12,476	9,879	9,020	8,940	9,112	9,222	8,401	7,247	7,517	7,668
Gaseous Fuels	9,352	11,537	14,216	16,146	15,845	15,715	16,096	15,361	16,231	14,438
Total	**43,858**	**44,584**	**46,638**	**48,699**	**48,153**	**47,507**	**46,783**	**43,650**	**44,703**	**42,145**

Table 3.108 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO_2 emissions	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Sectoral approach	3,137	3,074	3,148	3,252	3,236	3,175	3,110	2,886	2,960	2,814
Reference approach	3,126	3,059	3,132	3,238	3,212	3,163	3,107	2,883	2,962	2,806

Table 3.109 provides an overview for EU-15 and by EU-15 Member State on differences between the Eurostat and national reference approach for 2011. The table shows that for EU-15 the differences are very small. However, for some Member States the two data sets show larger differences. The main reasons for diverging energy data are:

- the use of different calorific values (CV);

- differences in the basic energy balance data reported by Member States to Eurostat (in the joint questionnaires) and to the Commission and the UNFCCC (in the CRF tables).

Explanations for significant differences are as follows:

Belgium analysed the differences for soild fuels and concluded that the difference is due to different calorific values. One reason seems to be that the conversion factor sent to Eurostat for `Lignite` seems wrong and will be corrected (8.37 GJ/ton is used by Eurostat and 21.562 GJ/ton by Directorate-General for Energy.

Denmark includes waste under solid fuels in order to make the reference approach more consistent with the sectoral approach.

Sweden informs that the data for the GHG inventory calculations are compiled before the final annual energy balances are ready. Sweden started a project to analyse the differences between CRF and Eurostat data.

Table 3.109 Comparison between Eurostat and national reference approach for apparent consumption for EU-15 for 2011 (CRF 1.A)(27)

MS	Gaseous fuels			Liquid fuels			Solid fuels		
	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %
AT	324,678	327,957	1.0%	491,003	496,943	1.2%	144,644	145,384	0.5%
BE	636,087	640,285	0.7%	914,886	930,369	1.7%	121,815	132,710	8.9%
DE	2,756,188	2,784,786	1.0%	4,311,641	4,216,727	-2.2%	3,228,448	3,275,429	1.5%
DK	155,640	155,640	0.0%	275,551	272,411	-1.1%	135,931	152,722	12.4%
ES	1,213,828	1,216,526	0.2%	2,271,754	2,218,657	-2.3%	521,602	512,794	-1.7%
FI	140,674	140,518	-0.1%	404,774	382,699	-5.5%	238,191	239,742	0.7%
FR	1,550,868	1,482,516	-4.4%	3,241,345	3,278,354	1.1%	430,625	453,725	5.4%
GR	166,310	163,053	-2.0%	535,290	572,599	7.0%	330,203	332,541	0.7%
IE	172,361	172,744	0.2%	257,590	266,186	3.3%	85,046	84,787	-0.3%
IT	2,671,770	2,669,961	-0.1%	2,719,579	2,749,879	1.1%	666,279	667,131	0.1%
LU	43,219	43,219	0.0%	106,710	107,467	0.7%	2,417	2,443	1.1%
NL	1,436,709	1,433,555	-0.2%	1,258,946	1,231,306	-2.2%	312,851	313,166	0.1%
PT	186,884	188,080	0.6%	451,924	432,559	-4.3%	92,464	93,051	0.6%
SE	48,287	48,523	0.5%	580,914	551,425	-5.1%	104,724	96,152	-8.2%
UK	2,939,218	2,931,555	-0.3%	2,510,411	2,562,489	2.1%	1,283,083	1,270,606	-1.0%
EU-15	14,442,719	14,398,916	-0.3%	20,332,317	20,270,069	-0.3%	7,698,323	7,772,384	1.0%

3.7 Responses of EU 15 Member States to UNFCCC Reviews

Table 3.110 provides an overview of EU 15 member state’s response to the UNFCCC Review findings in the Energy sector (excluding transport and fugitive emissions).

Table 3.110 EU 15 member State’s responses to UNFCCC review findings in 2011 or 2012 in the Energy sector (excluding transport and fugitive emissions)

Sector	Gas	Member State	UNFCCC review findings	MS response
Reference approach		AT (2012)	42. The ERT reiterates the recommendation that Austria implement editorial changes in the NIR in order to improve the understanding of the accounting of the biogenic and fossil fuel fractions between the reference and the sectoral approaches, thereby ensuring transparency	Editorial changes were made on page 67 in the 2013 NIR
Feedstocks and non-energy use of fuels		AT (2012	44. Gather additional information regarding the electrode production process and annual production data in order to verify that there is no non-energy use of petroleum coke, reported as non-energy use (which is actually used in a combustion process)	Not yet implemented
Feedstocks and non-energy use of fuels		AT (2012)	45. Exclude the amounts of residual fuel oil used in blast furnaces from the activity data (AD) reported for non-energy use of fuels. Alternatively, Austria should provide an explanation clarifying the issue in its next annual submission.	Implemented; AD is reported only once under non-energy use; see Annex 4 of the 2013 NIR

(27) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

Sector	Gas	Member State	UNFCCC review findings	MS response
Stationary combustion: gaseous fuels – all gases		AT (2012)	46. In cases where the emission factors (EFs) from the European Union emissions trading scheme (EU ETS) are consistently higher than the current country-specific EFs, the ERT recommends that Austria collect additional data regarding the natural gas composition of the domestic production and imports in order to calculate an accurate country-specific EF for natural gas on an annual basis	Unclear if such cases exist, therefore the implementation of this recommendation is unclear
Stationary combustion		AT (2012)	47. Clarify the methodology used in the reporting under the EU ETS for the iron and steel plants and highlight how the distribution losses and fugitive emissions are accounted for in the NIR of the next annual submission	Implemented
Road transportation: liquid fuels	All gases	AT (2012)	48. The ERT reiterates the recommendation from the previous ARR that Austria improve the transparency of its reporting on this category, by providing additional information in the NIR of the next submission regarding the methodology used and the impact of tank fuel exports on the emissions estimates	The NIR 2013 now includes an explanation on GHG emissions from and development of fuel exports.
Navigation: liquid fuels	All gases	AT (2012)	49. Include the additional information provided to the ERT during the review week in the next annual submission in order to improve the transparency of the reporting on emissions from navigation (liquid fuels)	The NIR 2013 now includes a description of the methodology and data used.
Completeness		BE (2011)	37. The ERT noted that, whereas Belgium has reported emissions from oil refining/storage, emissions from transport under fugitive emissions from oil have been reported as "NO". In response to the list of potential problems and further questions raised by the ERT during the review, the Party submitted estimates of CO_2 and CH_4 emissions from oil transport. The ERT accepts the revisions and recommends that Belgium continue to report emissions from this category in the next annual submission and provide detailed documentation on the methodology used in the NIR.	Implemented
Reference approach		BE (2011)	40. The ERT commends Belgium for the efforts undertaken and reiterates the recommendation in the previous review report that the Party further improve the transparency of its reporting on the different approaches, and provide detailed information in the NIR on the progress made in harmonizing the different data sources, and the impact of the measures already undertaken and implemented to reduce the differences between the reference and sectoral approaches in the next annual submission. The ERT encourages Belgium to provide energy balance sheets for the latest inventory year (at the national and regional levels) in the next annual submission, in order to further improve the transparency of its reporting.	Some additional information is provided; regional energy balances are included in the NIR
Feedstocks and non-energy use of fuels		BE (2011)	44. The ERT recommends that Belgium increase the transparency of its reporting by providing additional information in CRF table 1.A(d) to facilitate the tracking of cross-sectoral information.	Implemented
Stationary combustion, solid fuels	CO_2	BE (2011)	45. The ERT recommends that Belgium include further information on the EFs used for 1A2a and on the deviations in the trend in its next annual submission.	Additional information included in the NIR
Stationary combustion, solid fuels	CO_2	BE (2011)	46. The CO_2 IEF reported for 2009 (40.98 t/TJ) for manufacture of solid fuels and other energy industries is 52.6 per cent lower than the value reported for 1990 (86.23 t/TJ). The ERT recommends that the Party improve the transparency of its reporting of information on the trend of the IEF in the next annual submission.	Additional information included in the NIR
Stationary combustion: liquid fuels	N_2O and CH_4	BE (2011)	47. In the category public electricity and heat production, the CH_4 IEF value for liquid fuels used for 2009 (26.99 kg/TJ) is 784.8 per cent higher than the value used for 1990 (2.05 kg/TJ). The ERT recommends that the Party correct this error in the next annual submission and enhance the QC procedures performed prior to submitting the inventory.	Implemented
Reference approach		DK (2011)	52. Denmark indicates, in section 3.4 of the NIR, that the differences for 1998 and 2009 are due to large statistical differences in the official energy statistics for these years, and that the Danish Energy Agency is working on these issues and expects the statistical difference for 2009 to be lower in the next published energy statistics. The ERT commends the efforts that Denmark is making and recommends that the Party include information on the result of these efforts in its next annual submission.	This has been included in the NIR.

Sector	Gas	Member State	UNFCCC review findings	MS response
Feedstocks and non-energy use of fuels		DK (2011)	56. Denmark reports in CRF table 1.A(d) three fuel types used for non-energy purposes: bitumen, white spirit and lubricants. The total non-energy use of fuels is 10,564.31 PJ, and 746.94 Gg CO_2 is not emitted. In the same table, Denmark indicates that some CO_2 emissions are included under the categories mineral products (bitumen), other industrial processes (lubricants) and solvent and other product use (white spirit), but the quantities emitted are not reported (the notation keys NO and included elsewhere (IE) are used) and no explanations are provided either in the NIR or in the CRF tables. The ERT recommends that Denmark provide in the NIR information on how it determines the final carbon storage factors that are reported in CRF table 1.A(d), in order to improve the transparency of the reporting.	Text has been added in the NIR. In addition the implementation of data for associated CO_2 emissions in CRF table 1A(d) is now part of the planned improvements. Chapter 3.4.
Stationary combustion, liquid fuels	N_2O	DK (2011)	62. The N_2O EF for refinery gas used by Denmark for 2009 for the subcategory petroleum refining (0.1 kg/TJ) is low when compared to IPCC defaults for liquid fuels (0.3 - 0.4 kg/TJ). During the review, Denmark informed the ERT that it uses two different N_2O EFs for refinery gas, one when the gas is used in gas turbines and one for its use in boilers. The EF for gas in gas turbines is based on national references, while the EF for gas in boilers is from the Revised 1996 IPCC Guidelines. Denmark states that refinery gas has similar properties to natural gas, namely a similar nitrogen content in the fuel, which means that N_2O formation, as well as that of other nitrogen compounds such as nitrogen oxides (NO_x), is assumed similar under similar combustion conditions. That is the reasoning behind choosing the EFs for natural gas for both turbines and boilers. The ERT recommends that Denmark include the rationale for its selection of this EF in the NIR of its next annual submission.	The rationale for selection of the N_2O emission factor has been added in the NIR. Chapter 3.2
Stationary combustion, liquid fuels	N_2O	DK (2011)	63. For 2008, in Denmark's 2011 annual submission, the N_2O EF for use of liquid fuels in manufacturing industries and construction (2.56 kg/TJ) has decreased by about 16.0 per cent when compared with that reported in the 2010 annual submission (3.05 kg/TJ). The ERT noted that Denmark has moved from the use of the EF from the EMEP/CORINAIR Emission Inventory Guidebook 2007 to the use of the default EF from the Revised 1996 IPCC Guidelines, but that it has not provided the rationale for this change in the NIR. Therefore, the ERT recommends that Denmark provide the rationale for changing the EF used in the NIR of its next annual submission.	The IPCC Guideline values have been preferred for all emission factors that are not nationally referenced. The IPCC Guidelines are considered a better reference for greenhouse gases than the EMEP/EEA Guidebook. Furthermore, the EMEP/EEA Guidebook was revised in 2009, so it no longer contains any guidance on greenhouse gases, therefore the emission factors will never be updated and as such can be considered obsolete.
Uncertainties		DE (2011)	43. Quantitative uncertainties for AD and EFs for several subcategories in manufacturing industries and construction (e.g. iron and steel) are not available in the NIR, but are available only as combined uncertainties reported as per cent of national total emissions. During the review, Germany provided the ERT with the underlying spreadsheets, including category uncertainties for AD and EFs. To increase the transparency of the inventory, the ERT recommends that Germany include this information in its next annual submission, preferably briefly in the category sections, but also as a whole in an annex to the NIR.	Germany included AD and EFs uncertainties in the respective NIR chapter on uncertainties
Stationary combustion		DE (2011)	45. The ERT also noted differences between the inventory data and the corresponding IEA data. The ERT considers that the differences cause no underestimation of emissions, but reiterates the recommendation of the previous review report that Germany explain the reasons for these differences between its inventory data and the corresponding IEA data in its next annual submission.	As the data source for the joint annual questionnaire of the IEA has changed the inventory data and the corresponding ÎEA from 2010 onwards are consistent in the meantime.
Feedstocks and non-energy use of fuels		DE (2011)	47. The ERT commends Germany for its efforts to improve its reporting on feedstocks and non-energy use of fuels (e.g. the use of table 283 in the NIR for verification purposes) and reiterates the recommendation of the previous review report that the Party provide justifications of the methodology used and on any recalculations performed in its next annual submission.	Germany uses the IPCC 1996 default values since the submission 2012. Chapter 20 Annex 4
Comparison of the reference approach with		ES (2011)	68. The ERT notes that the energy balance, and the transparent manner in which it is presented, are key elements for the inventory because the accuracy of inventory estimates in the energy sector mainly reflect the accuracy of the energy balance.	Unclear if this has been implemented

Sector	Gas	Member State	UNFCCC review findings	MS response
the sectoral approach and international statistics			Therefore, the ERT recommends that Spain develop efforts within the national system in order to ensure the consistency between the energy balance used for preparing the inventory and the national official energy balance sent to Eurostat and IEA, in particular by developing actions together with MITYC.	
Comparison of the reference approach with the sectoral approach and international statistics		ES (2011)	69. To aid the transparency of the reporting, the ERT recommends that Spain include the official energy balance (prepared by MITYC and sent to Eurostat and IEA) in the NIR, and explain in the NIR the differences between this energy balance and the energy balance used for the inventory for each category and fuel. In addition, the ERT considers that it may be useful to include, at least in an annex of the NIR, information on fuel quantities expressed in tonnes.	Not implemted
Feedstocks and non-energy use of fuels		ES (2011)	73. During the review week, and in its responses to the list of potential problems and further questions raised by the ERT, the Party provided the ERT with additional information on the use of the natural gas reported in the energy balance as feedstocks and non-energy uses. The ERT considers this has improved the transparency of the reporting. The ERT recommends that the Party include this information in the NIR in its next annual submission and continue its efforts to determine the uses of non-energy-related fuels such as natural gas and petroleum coke.	More detailed information is provided in CRF table 1A(d)
Stationary combustions: all fuels	CO_2; CH_4 and N_2O	ES (2011)	84. The ERT agrees that the revised calculations provided by Spain for 2008 and 2009 mean that there is no longer an underestimation in the inventory for both years and, in accordance with paragraph 82 to the annex to decision 22/CMP.1, decided to replace the adjusted estimate. However, the ERT recommends that Spain continue its efforts to identify and report all uses of natural gas from feedstocks and non-energy use of fuels and allocate any emissions in the appropriate categories, in its next annual submission.	Unclear if this has been implemented
Stationary combustions: all fuels	CO_2; CH_4 and N_2O	ES (2011)	90. The ERT agrees that the revised calculations provided by Spain for 2008 and 2009 mean that there is no longer an underestimation in the inventory for both years and, in accordance with paragraph 82 to the annex to decision 22/CMP.1, decided to replace the adjusted estimate. However, the ERT recommends that Spain continue its efforts to identify and report all uses of petroleum coke from feedstocks and non-energy use of fuels and allocate any emissions in the appropriate categories, in its next annual submission.	Unclear if this has been implemented
Other	CO_2	ES (2011)	101. In previous review reports it was noted that the NIR was not sufficiently transparent on whether fuel consumption for military purposes was included in the energy statistics. During the review week, Spain informed the ERT that those fuel consumptions and emissions are included in the AD and emissions of several categories, in accordance with similarity of uses. However, the ERT noted that in CRF table 1.A(a) the Party reports fuel consumption and emissions in the category other (energy) as "IE" for liquid and gaseous fuels and the NIR does not refer to other emission categories included under other (energy). The ERT considers that the information reported by the Party on this issue is not yet transparent enough to allow it to consider this issue solved and therefore reiterates the recommendations of previous review reports that Spain improve the transparency and consistency of reporting for this category, in its next annual submission.	Unclear if this has been implemented
Transparency		FI (2012, presentati on, ICR)	The ERT recommends to improve the transparency by including more disaggregated information on the activity data used either by further disaggregating the activity data on CRF subcategories or by a more disaggregated fuel list. If data are still presented using categories "other", qualitative information should be provided on which fuels are included	Qualitative information has been added (the lists of the most important fuels included in "other" categories). Tables 3.2-7 and 3.2-8
QA/QC		FI (2012, presentati on, ICR)	The ERT recommends that Finland as part of the continuous improvements of the inventory establishes a system that ensures that all CO_2 emission factors are periodically checked and verified. The ERT notes that priority should be given to the fossil fuels with the highest consumption and hence the largest impact on the CO_2 emissions.	A plan for systematic checking of EFs will be established in 2013. Section 3.2.6
Reference		FI (2012, presentati	The ERT recommends that Finland investigate whether the current practice of excluding all the non-energy fuel use but only	This will be studied for the

Sector	Gas	Member State	UNFCCC review findings	MS response
approach		on, ICR)	part of the carbon is resulting in a correct comparison between the sectoral and reference approach	next submission. Section 3.7
Stationary combustion		FI (2012, presentation, ICR)	The ERT concludes that the current estimates (petroleum refining) are accurate. However, the large drop from 2004 to 2005 is not realistic and could infer an overestimation of the earlier part of the time series including the base year. The ERT recommends that Finland investigate this issue further. Furthermore, the ERT notes that this is not a matter of urgency and that there are other planned improvements that should receive higher priority	This will be studied for the next submission. Section 3.2.6
Feedstocks and non-energy use of fuels		FR (2011)	49. The ERT noted that France has reported associated CO_2 emissions of these fuels as "IE" (except for other petroleum products), their allocation as "NA" and "NO", and the carbon stored and therefore subtracted from emissions from categories in the energy sector as "NA" in CRF table 1.A(d). The ERT therefore recommends that France improve the information reported in CRF table 1.A(d) in its next annual submission.	Not implemented
Stationary combustion: liquid, solid, gaseous and other fuels	CO_2	FR (2011)	53. These revisions have made the AD on fuel use for electricity production in the inventory consistent with the official French energy balance from 1990 to 2009. The ERT welcomes this effort and recommends that France include this explanation in the NIR of its next annual submission.	Not implemented
General transparency		GR (2011)	31. The ERT noted that the Party could further enhance transparency by providing, in the NIR, more background documentation on EFs (e.g. for other fuels in other sectors, and those based on data from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines) and from the core inventory of air emissions (CORINAIR), including an explanation of their appropriateness to the national circumstances of Greece) and disaggregated AD (e.g. other fuels in other (manufacturing industries and construction), waste fuels for combustion by category, lubricant use by category, bituminous coal and lignite by category and biomass in residential). The ERT recommends that Greece enhance the transparency of its reporting by providing the above information in its next NIR.	Annex II was enriched with details of methodology and data for estimating CO_2 and other GHG emissions from fossil fuel combustion, in order toimprove transparency of the energy sector.
Stationary combustion	CO_2	GR (2011)	32. The ERT recommends that Greece provide detailed information (e.g. in an annex to the NIR) on the EU ETS data used, including an analysis of their completeness and consistency with the IPCC methodology, and on the verification procedure applied to ensure conservation of the fuel mass balance and completeness of the data and that the Party report on the progress made with regard to this issue in its next NIR..	Details of the use of ETS reporting in energy sector's inventory calculations are provided in Annex II.
General accuracy		GR (2011)	33. The ERT noticed some errors in the NIR. The ERT recommends that Greece correct these data and enhance its QC procedures for its next annual submission.	Implemented
Non-energy use of fuels		GR (2011)	36. The ERT recommends that Greece exclude all fuels for feedstock and non-energy use from the energy sector and report, in line with the Revised 1996 IPCC Guidelines, in CRF tables 1.A(b) and 1.A(d) all feedstocks and non-energy use of fuels (as identified in the national energy balance), the associated CO_2 emissions and the category/sector under which they are allocated in the inventory. 37. The ERT recommends that Greece report, in line with the Revised 1996 IPCC Guidelines, in CRF tables 1.A(b) and 1.A(d) the feedstocks and non-energy use of solid fuels (as identified in the national energy balance), the associated CO_2 emissions and the category/sector under which they are allocated in the inventory and revise the relevant information in the NIR of the next annual submission.	Inconsistencies in tables 1Ab, 1Ac and 1Ad have been corrected. A description of how "Apparent energy consumption" is calculated has been added in section 3.2.1. Table 3.9 was updated, accordingly. Natural gas used as feedstock for hydrogen production was reallocated to the IP sector.
Stationary combustion		GR (2011)	38. The ERT noted that the net calorific values (NCVs) and carbon EFs for lignite are significantly different for energy industries and for manufacturing industries and construction. In response to a question raised by the ERT during the review, Greece provided detailed information explaining and justifying this difference, including the fact that the lignite is distributed from different mining fields. The ERT recommends that Greece include this information in its next NIR.	Explanation was added in section 3.2.4.2 of the NIR.
Stationary combustion		GR (2011)	39. The ERT noted that the CO_2 IEF for liquid fuels in petroleum refining and in all subcategories under manufacturing industries and construction fluctuates with a general decreasing	Annex II was enriched with details of methodology and data for estimating CO_2 and

Sector	Gas	Member State	UNFCCC review findings	MS response
			trend. The ERT recommends that Greece provide more detailed background information on the AD and EFs for all types of liquid fuels in these subcategories in its next NIR in order to improve the transparency of the reporting.	other GHG emissions from fossil fuel combustion, in order to improve transparency of the energy sector.
Stationary combustion	CO_2	GR (2011)	40. The ERT noted that the carbon content reported for refinery gas (15.42 t C/TJ) is low compared to the IPCC default value (18.2 t C/TJ). In response to a question raised by the ERT during the review, Greece provided more detailed data on refinery gas and explained how the EF (including the carbon content) is computed. The ERT recommends that Greece include this explanation in its next NIR in order to improve the transparency of the inventory.	Table II.10.
Stationary combustion	N_2O	GR (2011)	41. The ERT noted that the N_2O IEF for liquid fuels in agriculture, forestry and fisheries is much lower in 2009 (23.44 kg/TJ) compared with the values in previous years (26.94- 27.70 kg/TJ). In response to a question raised by the ERT during the review, Greece explained that three liquid fuels are used in this category (i.e. diesel and heavy fuel oil for boilers, and diesel and motor gasoline for off-road machinery). In 2009, the IEF decreased due to the reduction in diesel use and the change in the allocation of diesel use between offroad machinery and boilers. The ERT recommends that Greece provide more background information on the N_2O IEF for liquid fuels in agriculture, forestry and fisheries in its next NIR.	NIR section 3.2.4.5.2: An error of the working file of the year 2009 was corrected (concerning AD), and the emissions of CO_2, CH_4 and N_2O from liquid fuels combustion were recalculated for the year 2009. The impact on total emissions was minor (around +33 kt GHG).
Stationary combustion	CO_2	GR (2011)	42. In 2009, the CO_2 IEF for other fuels in other manufacturing industries (32.73 t/TJ) is much lower compared with the value in previous years (89.25-119.13 t/TJ). In response to a question raised by the ERT during the review, Greece explained that the other fuels in this category are alternative fuels (e.g. scrap tyres, cable coating, etc.) used in Greek cement plants and provided the AD and EFs for these fuels for further clarification. The ERT recommends that Greece include this information in its next NIR	Table II.11.
		IE (2011)	39. The ERT recommends that the Party ensure as much consistency as possible between the AD reported in the CRF tables and in its energy balance. 40. The ERT also recommends that the Party investigate the differences between the AD submitted in its CRF tables with the energy balances reported to Eurostat under the EU regulation on energy statistics, which has legal provisions aimed at ensuring the consistency of energy data in the energy balances with AD in the CRF tables.	Differences between the Reference and Sectoral approaches in this submission for the year 2011 are <1.0 %
Reference and sectoral approaches: Feedstocks and non-energy use of fuels: lubricants		IE (2011)	42. The ERT recommends that the Party ensure full consistency between tables 1.A(b) and 1.A(d) in future annual submissions.	Every effort is made to report feedstocks in a consistent manner in the CRF Submission.
Stationary combustion: all fuels	CO_2	IE (2011)	46. During the review, the Party informed the ERT that the issue regarding the energy data in the national energy balance and the corresponding energy data reported through the EU ETS are being harmonized to ensure that both are fully consistent. This would mean that the energy data reported in the next energy balance will be the same as the EU ETS data. The ERT looks forward to this improvement and recommends that Ireland use consistent AD, EFs and emissions in its 2012 annual submission.	Improvements were made in the consistency of data reported under EU ETS and the national energy balance in Submission 2012 (1990-2010 data) and continued in this submission 2013.
Stationary combustion: all fuels	CH_4, N_2O	IE (2011)	47. The ERT recommends that the Party include transparent information, including on how to ensure time-series consistency, about the potential recalculations of emissions of non-CO_2 gases in its future annual submissions.	Energy data reported from EU ETS and the national energy balance are fully harmonised for Energy Industries, CRF 1.A.1.a.
General		IT (2012)	33. The ERT recommends to include the AD and EFs of all biomass fuel consumed in each category of the energy sector and provide more detailed explanations on the estimation of average EFs for biomass fuels in the NIR	Additional information have been supplied in the NIR in the relevant paragraphs, §3.3.3.1, §3.4.3, §3.6.2, §3.6.3.
QA/QC		IT (2012)	34. The eRT recommends to further enhance QA/QC efforts in the NIR, including correcting the share of the energy sector in	Errors and description of trends have been checked and

Sector	Gas	Member State	UNFCCC review findings	MS response
			national GHG emissions, clarifying the driver for recalculations, and correcting the trends in iron and steel production	corrected in the NIR in §3.1, §3.3.3.3, §3.4.2.
Reference and sectoral approaches		IT (2012)	35. Include emissions from category other in the estimation of the reference approach manually in the CRF table 1.A(c) and update the difference between the reference approach and sectoral approach.	Waste production data have been included in the reference approach in the category other and differences have been updated (see §3.8.5 of the NIR)
Reference and Sectoral approaches		IT (2012)	37. Include information on the treatment of refinery feedstocks in the national energy balance, and an explanation on the differences between the inventory data and the IEA data	Refinery feedstocks exports have been properly included in the reference approach updating exports figure of other relevant liquid fuels (see §3.8.5 of the NIR).
Feedstocks and non-energy use of fuels		IT (2012)	40. Add a note in the CRF table 1A(d) explaining that the fuel quantity refers to the "net" fuel quantity and provide an explanation of what "net quantity" means. Provide additional explanation in the NIR as to why the fractions of carbon stored in the NIR are different from those included in CRF table 1.A(d).	Fractions of carbon stored based on gross fuel amount input have been calculated and reported in the CRF table 1.A.(d) (see §3.8.5 of the NIR).
Stationary combustion: liquid fuels	CO_2	IT (2012)	41. The ERT recommends to provide a description of the drivers behind the increasing trend of the CO_2 IEF for consumption of liquid fuels in petroleum refining.	Additional information has been included in §3.3.2.2 of the NIR.
Stationary combustion: solid fuels	CH_4	IT (2012)	42. The ERT recommends to provide in the NIR a rationale for the decreasing trend in the CH_4 IEF in manufacture of solid fuels and other energy industries between 1990 and 2010.	Additional information has been included in §3.3.3.3 of the NIR
Stationary combustion: solid fuels	CH_4	IT (2012)	43. The ERT recommends to transparently document in the NIR the rationale for the relatively high CH_4 IEF for solid fuels in the iron and steel subcategory	Additional information has been included in §3.4.3 of the NIR
Stationary combustion: other fuels	CO_2, CH_4 and N_2O	IT (2012)	44. The ERT recommends to include additional information on which other fuels are used, as well as the quantity of fuel used and their respective EFs in the NIR	Additional information has been included in §3.3.1.1, §3.4.3 , §3.6.2 of the NIR
Comparison of the reference approach with the sectoral approach and international statistics	CO_2	LU (2012)	38. Estimates of CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For 2010, the CO_2 emissions estimated using the reference approach were 2.95 per cent higher than the emissions estimated using the sectoral approach. The ERT noted that the emissions estimated with the sectoral approach are continuously lower than those estimated with the reference approach, with the difference reaching 3.8 per cent (in 1998). Some explanations are provided in the documentation box of CRF table 1.A(c), which are insufficient to explain the difference. In addition, the ERT noted that not all explanations in the documentation box have been updated since the 2011 annual submission and recommends that the Party update these explanations for the next annual submission.	Quantitative estimate of difference not provided (NIR chapter 3.2.1.1)
Comparison of the reference approach with the sectoral approach and international statistics	CO_2	LU (2012)	39. The ERT noticed that the discrepancies in terms of the reported fuel consumption data and emissions between the reference and the sectoral approaches are the highest for other fuels and solid fuels. Thus, for example, although there is a close match in the fuel consumption between the approaches, the emissions from the solid fuels in the reference approach are 22.9 per cent higher. The ERT noted that in CRF table 1.A(d) there is information for non-energy use of solid fuels, but the carbon stored from that table is not subtracted from the reference approach, which would have changed the difference between the approaches. The ERT recommends that Luxembourg consistently report the information between CRF table 1.A(b) and 1.A(d) in the next annual submission. The ERT further encourages the Party to proceed with its plan for improvements and the inclusion of a quantitative estimate of each separate discrepancy between the approaches. The ERT recommends Luxembourg to include thorough explanations for the difference between the approaches in its next annual submission.	Carbon stored is subtracted in the RA.
Comparison of the reference approach with the sectoral	CO_2	LU (2012)	40. The ERT noted that the per cent difference between the two approaches for 2010 had not been included in the NIR and the explanations and tables provided in the NIR had not changed from the previous annual submission. During the review week, Luxembourg provided updated tables 3.7 and 3.8 with corrected	NIR tables 3-7 and 3-8 are still not updated.

Sector	Gas	Member State	UNFCCC review findings	MS response
approach and international statistics			data for the comparison between the approaches. The ERT recommends that the Party improve the QA/QC checks before the submission of the next NIR and make sure that all year-specific information is updated.	
Feedstocks and non-energy use of fuels		LU (2012)	43. The ERT noted that in the 2011 annual submission Luxembourg reported the fraction of carbon stored from lubricants as 50 per cent and indicated that the emissions from motor oil are reported under road transportation. However, in the 2012 annual submission, Luxembourg reports the fraction of carbon stored as having a value of 1, and under planned improvements reports that CO_2 emissions from lubricant oils are used in road transportation and 50 per cent of carbon should be considered as being emitted under this category. In response to the list of potential problems and further questions raised by the ERT during the review week, Luxembourg provided revised estimates using the default fraction of carbon stored for lubricants from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the Revised 1996 IPCC Guidelines) for the entire time series and reported associated emissions under road transportation (see para. 45 below). The ERT welcomes this improvement and recommends that Luxembourg reflect these changes in the NIR of its next annual submission.	Fraction of carbon stored has been changed in table 1.A.(d). NIR chapter *3.2.3.1 Lubricants* provides explanations.
Stationary combustion: biomass	CO_2, CH_4 and N_2O	LU (2012)	The CO_2 IEF for biomass for manufacturing industries and construction was constant (88 t/TJ) between 1998 between 2001 and, after a minor increase between 2001 and 2004 (from 88 t/TJ to 91.86 t/TJ), increased by 17.0 per cent between 2004 and 2005 (107.48 t/TJ). The IEF for CH_4 and N_2O remained constant over the 1998–2010 period. In response to the previous review stage, the Party clarified this with the use of different types of biomass over the time series. The ERT recommends that the Party include further clarification of biomass use and the actual EFs used, in order to clarify the time-series consistency in its next annual submission. In addition, the ERT noted that the discussion in the previous review report on the biomass in the tyres consumed for clinker production and the relevant assumption substantiated during the in-country review, were not reflected in the NIR. The ERT recommends that the Party provide the assumption used and its justification in the next NIR.	NIR chapter *3.2.7.7.2.3 Emission factors* provides explanation about biomass IEFs.
Stationary combustion: solid fuel	CH_4	LU (2012)	49. Luxembourg uses a constant IEF for CH_4 (10 kg/TJ) for solid fuel consumption in the subcategory residential. The IEF is one of the lowest used by the Parties (range: 0.44–443.28 kg/TJ) and below the IPCC default (300 kg/TJ). The ERT considers that the use of an unjustified low CH_4 EF could lead to an underestimation of the emissions from the subcategory residential in the 2012 annual submission and therefore recommended that the Party reconsider the CH_4 EF with a view to justifying it or revising the CH_4 emissions from solid fuel combustion in the subcategory residential for the whole time series. In response to the list of potential problems and further questions raised by the ERT during the review week, Luxembourg explained that it erroneously applied the CH_4 EF for fossil solid fuels from industrial combustion installations to the subcategory residential. This mistake was corrected in the revised information submitted on 12 November 2012 by applying the default EF (300 kg CH_4/TJ) from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines) (Vol. 2, Chap. 2, table 2.5, p. 2.22), which is identical to the default EF in the Revised 1996 IPCC Guidelines. The correction has been applied over the entire time series, which had a minor impact on the national total (less than 0.01 per cent).	The CH_4-IEF for 1A4 biomass has been revised to 300 kg/TJ.
Stationary combustion: all fuels	CO_2	NL (2011)	49. The ERT recommends that the Netherlands provide detailed information on how plant-specific emission factors are used.	Text improved; details are in protocol 13-002; NIR chapters: 3.2.6., 3.2.7., 4.4.4.; details are in protocol 13-002, Annex 1
Stationary combustion		NL (2011)	50. The ERT reiterates the commendation to include accounting of oxidation losses for chemical waste gas during production of ethylene, methanol and carbon black.	This recommendation has not yet been followed up as no resources are available for the necessary study.
Uncertainty estimates		NL (2011)	52. The ERT recommends that the Netherlands describe, in its next annual submission, the process used to derive the uncertainty estimates using expert judgement.	Text improved: NIR chapters 1.7.1. and 3.2.8

Sector	Gas	Member State	UNFCCC review findings	MS response
Reference approach		NL (2011)	53. The ERT recommends that the Netherlands include, in CRF table 1.A(c), the apparent consumption excluding non-energy use and feedstocks in its next annual submission.	Implemented
Stationary combustion: solid fuels	CO_2	NL (2011)	60. The ERT further noted that the Netherlands has reported in the NIR (page 51) that CO_2 emissions from fuel combustion from the on-site coke production in iron and steel plants in the Netherlands including the independent coke production plant, Sluiskil closed in 1990, are reported under the iron and steel category. The ERT noted that this allocation is not consistent with the Revised 1996 IPCC Guidelines which require these emissions to be reported under manufacture of solid fuels and other energy industries. The ERT recommends that the Netherlands correctly allocate these emissions in line with the requirements of the Revised 1996 IPCC Guidelines.	Not possible due to aggregated energy balance of 1990
Stationary combustion: solid fuels	CO_2	NL (2011)	60. In response to the list of potential problems and further questions raised by the ERT during the review, the Netherlands provided a detailed carbon mass balance for 2009 showing all the inputs and outputs in the iron and steel production processes and how these carbon flows are accounted for in the energy and industrial processes sectors. The analysis of the carbon flows by the Netherlands resulted in minor changes to the reported fugitive emissions from coke production, representing an increase in 2009 of 0.2 Gg CO_2 eq (0.03 per cent). The ERT agrees with the revised estimates, the reported carbon mass balance and its carbon flows presented by the Netherlands and recommends that it include this carbon mass balance in its next annual submission.	Emissions calculation is based on a mass balance, which was not be included in the National Inventory Report (due to confidentiality), but can be made available for the UNFCCC review.
Stationary combustion: all fuels	CO_2, CH_4 and N_2O	PT (2011)	38. + 46. The ERT strongly recommends that Portugal report the combustion of landfill gas or biogas fuels under the energy sector and estimate the CH_4 and N_2O emissions from the combustion of these fuels in its next annual submission.	Implemented
Stationary combustion: all fuels	CO_2, CH_4 and N_2O	PT (2011)	43. The ERT recommends that Portugal review and, where appropriate, update the time series using the most up-to-date facility-level data in its next annual submission.	Under Development. More plant specific data has been added to the inventory. This work will be continued.
Stationary combustion: all fuels	CO_2, CH_4 and N_2O	PT (2011)	45. The ERT strongly recommends that the Party include emissions from fuel combustion from lime production under the energy sector in its next annual submission.	Implemented
Comparison of the reference approach with the sectoral approach and international statistics	CO_2	SE(2012)	40. Estimates of CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For 2010, the CO_2 emissions estimated using the sectoral approach were 1.65 per cent higher than the emissions estimated using the reference approach. The ERT noted that the documentation box of CRF table 1.A(c) still contains the incorrect reference to section 3.3.6 of the NIR regarding the explanation of the differences between the two approaches. The ERT therefore reiterates the recommendation made in previous review reports that Sweden correct this reference in the next annual submission. The ERT also noted that the difference between the two approaches fluctuates from –8.2 to +1.6 per cent across the inventory years, and therefore suggests that the Party include a brief explanation for the causes of the differences in the documentation box of CRF table 1.A(c) in the next annual submission. Although the NIR contains some information on the two approaches, the explanation of the reasons for the deviations in the estimates calculated using the two approaches is not sufficiently clear. A study which aims to minimize the difference between the approaches, or to at least identify more detailed explanations for the difference, will be carried out in 2012 and the results will be implemented in the next annual submission. The ERT commends Sweden for undertaking the study and encourages the Party to report on its progress and results and incorporate its conclusions in the next annual submission.	Not clear if the 'new study' has been considered in 2013 submission.
Comparison of the reference approach with the sectoral approach and international statistics	CO_2	SE(2012)	41. The ERT noted that, for the reference approach reported in CRF table 1.A(b), the fuels are reported in energy units and an oxidation factor of 1.0 is used by the Party to convert net carbon emissions to CO_2 emissions. In response to a question raised by the ERT during the review, Sweden explained that the oxidation is accounted for in the EFs used in the reference approach. The ERT strongly recommends that the Party follow the IPCC default reporting method for the reference approach, so that all	Not implemented.

Sector	Gas	Member State	UNFCCC review findings	MS response
			fuels are reported in natural units and the real carbon content of fuels and default oxidation factors are used, in order to further improve the transparency of the Party's reporting.	
Stationary combustion: other fuels	CO_2	SE(2012)	51. The ERT noted that the 2010 value of the CO_2 IEF (27.81 t/TJ) for public electricity and heat production is the lowest reported by all Parties (within the range of 27.81 to 142.29 t/TJ). Sweden explained that the large share of emissions reported under "other fuels" in public electricity and heat production is from the combustion of municipal waste. The CO_2 EFs (32.7 kg/GJ for the period 1990–1995 and 25 kg/GJ for 1996 onwards) account for the fossil-fuel share of the CO_2 emitted. The ERT recommends that Sweden provide more detailed information on the fossil-fuel shares and the EF used by year, and justify the change in the value of the EF in 1996 in the next annual submission.	Not implemented. (NIR 2013ANNEX 2 chapter 1.3.2 states: *"The emission factors for greenhouse gases for waste and other non-specified fuels will be reviewed in 2013"*
Stationary combustion: biomass	CH_4	SE(2012)	52. The CH_4 IEF was constant throughout the period 1990–2005 (30 kg/TJ) but decreased to 18.18 kg/TJ in 2007. The 2010 value (19.47 kg/TJ) is 35.1 per cent lower than the 1990 value. Sweden explained that, in the early years of the time series, wood was the only biogenic fuel used in the chemical industry. Since 2006, the amounts of landfill gas and tall oil used have increased considerably, and these fuels have much lower EFs than wood, which affects the overall IEF for CH_4 emissions from biomass. The ERT recommends that Sweden include this explanation, together with information on the fuel mix in a tabular format, in the NIR of its next annual submission.	Not implemented. (No table about biomass AD by type of fuel found in the NIR)
Recalculation s		UK (2011)	40. The ERT recommends that, in its next annual submission, the United Kingdom ensure and justify that any recalculation performed leads to an improvement of the inventory and strongly recommends that the Party improve the transparency of reporting on recalculations, presenting changes in methods and/or AD and/or EFs in the 2011 submission relative to the 2010 submission, together with any further recalculations for 2012 submission.	Improvements have been made to the text in the 2012 submission. The 2013 full NIR includes more detailed tables explaining recalculations within each of the relevant chapters.
Feedstocks and non-energy use of fuels		UK (2011)	49. The ERT recommends that the Party further improve the quality of the documentation and improve the transparency of the NIR and reiterates the recommendation of the previous review report that additional information be reported in CRF table 1.A(d) indicating from which categories in the energy sector carbon stored is subtracted and where the associated CO_2 emissions are allocated.	Additional text has been included in the 2012 and 2013 submission.
Stationary combustion: all fuels	CO_2, CH_4 and N_2O	UK (2011)	51. The United Kingdom has reported all emissions from fuels used in manufacturing industries and construction under the category other (manufacturing industries and construction), except for emissions from iron and steel. The present ERT therefore reiterates the recommendation of previous review reports, as set out above, and strongly recommends that the United Kingdom allocate these emissions to different subcategories in its next annual submission.	Implemented
Stationary combustion: other fuels	CO_2, CH_4 and N_2O	UK (2011)	53. Emissions from the incineration of MSW for heat generation are currently reported under other sectors, which is not in accordance with the IPCC good practice guidance. The ERT reiterates the recommendation of previous review reports that the United Kingdom reallocate these emissions to the category public electricity and heat production in its next annual submission.	Implemented

Table 3.111 provides an overview of EU 15 member state's response to the UNFCCC Review findings for transport.

Table 3.111 EU 15 member State's responses to UNFCCC review findings in 2011 or 2012 for transport

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
Road transportation: liquid fuels	All gases	AT	The ERT reiterates the recommendation from the previous ARR that Austria improve the transparency of its reporting on this category, by providing additional information in the NIR of the next submission regarding the methodology used and the impact of tank fuel exports on the emissions estimates.	NIR 2013 now includes an explanation on GHG emissions and development of fuel

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
			Austria calculates the energy consumption and associated emissions from road transportation using a bottom-up methodology based on the annual mileage per vehicle category and the specific fuel efficiency. The annual mileage per year in Austria is derived from the national traffic model. The NIR states that the difference between the fuel consumption calculated using the bottom-up methodology and the total fuel sales figures obtained from the national statistics is allocated to fuel exports (i.e. fuel sold in Austria but consumed abroad). The difference is estimated at 30 per cent of the total fuel sales, which was also confirmed by two separate studies conducted by the Party in 2004 and 2009. In response to a question raised by the ERT during the review, Austria confirmed that the emissions resulting from fuel purchased in Austria but exported in vehicle tanks are accounted for under the category road transportation. The ERT concluded that there is no underestimation of emissions, but reiterates the recommendation from the previous review report that, in order to improve the transparency of its reporting in this category, Austria provide additional information in the NIR of its next annual submission regarding the methodology used and the impact of tank fuel exports on the emission estimates.	exports. Section 3.2.10.2 1.A.3.b Road Transport, Fuel Export, pp. 122.
Navigation: liquid fuels	All gases	AT	Include the additional information provided to the ERT during the review week in the next annual submission in order to improve the transparency of the reporting on emissions from navigation (liquid fuels). Austria used a bottom-up model to calculate the national fuel consumption in navigation. The Party did not provide detailed information in the NIR on the methodology, AD and EFs used for the bottom-up assessment; the ERT therefore identified a problem in relation to the transparency of the reporting within this category. The ERT was able to clarify the methodology used and data for the tonne-kilometre, operating hours, other relevant parameters and assumptions used for the calculation of emissions based on additional information provided by Austria during the review. The ERT concluded that there is no underestimation of emissions for this category. The ERT recommends that Austria improve the transparency of its reporting on the methodology and data used for the calculation of emissions from this category, including the provision, in its next annual submission, of the additional information provided to the ERT during the review week.	NIR 2013 now includes a description of the methodology and data used. Section 3.2.10.4 1.A.3.d Navigation, Methodology, pp. 132.
International bunker fuels		IT	Document the split between domestic and international marine bunkers in the NIR. With regard to the reporting on international marine bunkers, the ERT welcomes the improvements made for the Party's 2012 annual submission in response to the recommendation in the previous review report that Italy ensure that there are no discrepancies between CRF tables 1.C and 1.A(b) for residual fuel oil and gas/diesel oil. As identified in the previous review report, the discrepancy was due, in part, to a different split between international and domestic navigation for both residual fuel oil and gas/diesel oil being reported to IEA from that used for the CRF tables. Although the ERT acknowledges that the inconsistency has been resolved, it found that the actual split between domestic and international bunkers used for the reporting has not been documented in the NIR. Therefore, the ERT recommends that the Party document the split between domestic and international marine bunkers in the NIR of its next annual submission.	Additional information have been included in the NIR (§3.5.4.2). Investigation on differences with IEA data are planned for the future.
Bunker fuels		LU	Recheck the assumption for the aviation fuel used for international bunkers and address the inconsistency with IEA figures for jet kerosene. The ERT noted that the per cent difference between the two approaches for 2010 had not been included in the NIR and the explanations and tables provided in the NIR had not changed from the previous annual submission. During the review week, Luxembourg provided updated tables 3.7 and 3.8 with corrected data for the comparison between the approaches. The ERT recommends that the Party improve the QA/QC checks before the submission of the next NIR and make sure that all year-specific information is updated	Tables 3.7 and 3.8 are updated and include also data for years 2010 and 2011.
International		SE	Correct the discrepancies between common reporting format	A study in 2010 showed

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
bunker fuels			(CRF) tables 1.C and 1.A(b) for gas/diesel oil (international marine bunkers) and residual fuel oil (international marine bunkers) for all years of the time series. Further, the ERT noted discrepancies between CRF tables 1.C and 1.A(b) for gas/diesel oil (international marine bunkers) and residual fuel oil (international marine bunkers) for all years of the time series, with the discrepancies being particularly significant for residual fuel oil for the years 2001 and 2007. The ERT reiterates the recommendation made in previous review reports that Sweden correct these discrepancies or explain them in its next annual submission	that the differences between the IEA and the UNFCCC reporting can to some extent be explained by revision policies of the different reporting obligations. Since the UNFCCC has a high demand on consistency of time series, efforts are made to ensure high quality of times series. (NIR, pp. 97-98)
Road transportation		SE	Describe the changes in natural gas consumption by vehicle type across the entire time series. The trend in the CH_4 IEF (103.71–316.68 t/TJ) for gaseous fuels shows large inter- annual fluctuations in recent years as follows: 2006/2007 (–26.3 per cent), 2007/2008 (+12.3 per cent), 2008/2009 (+64.2 per cent) and 2009/2010 (–20.3 per cent). In response to a question raised by the ERT during the review, Sweden explained that country-specific EFs for CH_4 emissions from passenger cars and heavy-duty vehicles are used. The EF differs noticeably between the two vehicle categories as the consumption of natural gas differs between years and vehicles and the IEF is the average for all vehicle categories. The ERT recommends that Sweden describe the changes in natural gas consumption by vehicle type across the entire time series in its next annual submission	No information on natural gas cosumption by vehicle type across the entire time series is included in the NIR.
International bunker fuels		DK	The ERT found that imports of jet kerosene (aviation) and gas/diesel oil (maritime) as reported in the CRF tables are 5–10 per cent higher than according to IEA. Although the inclusion of information for Greenland in the CRF tables explains the existence of small differences in comparison with the IEA data (see para. 54 above), the Party clarified that the difference for gas/diesel oil in marine bunkers was due to an error in the IEA data. Denmark indicated that it will correct the IEA data, which the ERT encourages. Nevertheless, the ERT noted that the data in the CRF tables are in agreement with the data published by DEA, and for jet kerosene the import data in the CRF tables are also in agreement with the DEA data. The ERT encourages Denmark to compare the IEA data with the inventory data and, as a way of improving transparency, to include the reasons for the discrepancies, if any, in the NIR of its next annual submission	NIR, pp. 216, section "Bunkers“
Road transportation, liquid fuels	CO_2, CH_4, N_2O	DK	Denmark has improved the accuracy of the estimates for road transportation by updating the mileage figures per vehicle category and by reclassifying the heavy duty trucks and buses categories according to the COPERT IV model. As a result, recalculations for 2008 resulted in a decrease of 16.7 per cent in the estimate of CH_4 emissions, an increase of 4.5 per cent in the estimate of N_2O emissions and an increase of 0.2 per cent in the estimate of CO_2 emissions. The ERT encourages Denmark to include a brief description of the methods used to obtain the fleet and mileage data necessary for the COPERT IV model in the NIR of its next annual submission	NIR, pp. 217, section "Vehicle fleet and mileage data”
Road transportation, liquid fuels	CO_2, CH_4, N_2O	DK	There are discrepancies between the CO_2 implied emission factors (IEFs) for gasoline and diesel for 2009 and those for 1990: the 2009 IEF for diesel (74.00 t/TJ) is higher than the value for 1990 (73.99 t/TJ), while the 2009 IEF (72.99 t/TJ) for gasoline is lower than the value for 1990 (73.00 t/TJ). Denmark explained to the ERT during the review that these small devia-tions were due to a rounding error made by the reporting software. The ERT recommends that Denmark correct the error and improve its QC procedures for its next annual submission.	It has been checked that the activity data and emissions reported in the CRF and hence the IEFs are correct.
Civil aviation, liquid fuels	CO_2, CH_4, N_2O	DK	Emissions from aviation were calculated using a tier 2 approach for mainland Denmark and a tier 1 approach for	Due to the limited time available from the

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
			Greenland. The ERT rec-ommends that Denmark improve the descrip-tion of the methodology used for estimating emissions from aviation, such as the EF for the representative aircraft types and the number of movements per aircraft type, and additional details on how movements between Green-land and Denmark are considered and provide complementary data on landing and take-off (LTO) and Efs. The CH_4 EF for jet kerosene used in civil aviation has increased by 100.5 per cent, from 1.55 kg/TJ for 2008 to 3.11 kg/TJ for 2009. Denmark explained to the ERT during the review that the reason for the sharp increase in the CH_4 IEF for jet kerosene was a substantial increase in the number of flights using the representative aircraft type Fokker 28. Indeed, the EF proposed for this plane in the Emission Factor Database provided in the EMEP/CORINAIR Emission Inventory Guidebook is very high, especially for taxiing during the LTO cycle. Later during the review, Denmark recognized to the ERT that the use of Fokker 28 as a representative aircraft type was later considered as not appropriate, since it is a old type of aircraft generally no longer in use. Therefore, Denmark plans to select an alternative representative aircraft type which could better represent the real level of emissions. The ERT encourages Denmark in its effort and, in order to improve transparency, also encourages Denmark to include in the NIR of its next annual submission the correspondence between the actual aircrafts used and the representative aircrafts used for the calculations	reception of the draft review report to the deadline for finalisation of the NIR, it was not possible to include this information in the 2012 submission. The requested information will be included in the 2013 submission.
International bunker fuels		FI	Finland reported emissions from international bunker fuels on the basis of fuel sales using country-specific CO_2 EFs and non-CO_2 EFs from the Revised 1996 IPCC Guidelines. Finland indicated the possibility of a minor double counting of emissions with domestic navigation, where ports are used for both national and international shipping purposes (NIR, page 124). The ERT recommends that Finland address this issue and ensure that emissions are not double counted. Finland has agreed to investigate this issue and will provide more information in its 2013 annual submission	The ERT also encouraged Finland to check and remove the small inconsistency caused by the Åland correction in the bunker fuels. This was corrected by subtracting the fuel volume of Åland correction from bunkers and adding it to total domestic fuel consumption. To keep the calculation simple and transparent, the correction was allocated fully to residual fuel oil, which is the most important marine bunker fuel.
Civil aviation, liquid fuels	CO_2, CH_4, N_2O	FI	In its NIR, Finland mentioned that it will start using the data from Eurocontrol starting with the 2012 annual submission to estimate emissions associated with civil aviation, if the work on the Eurocontrol portal advances as planned. The ERT welcomes this plan and encourages Finland to implement this improvement as soon as possible	The use of emission data for aviation from Eurocontrol will be implemented in 2014/2015 (depends on data availability. Alternative sources will also be explored.
International bunker fuel		DE	Germany uses data from Eurocontrol to distinguish international aviation from civil aviation. International marine bunker emissions are based on AD for bunkering ocean- going ships provided in the NEB, which are separated from national navigation data owing to different tax regulations, in line with the IPCC good practice guidance. Deep sea fishing emissions are separated from international marine bunker emissions and reported under national fisheries, as recommended in the previous review report. During the previous review it was concluded that international transport on inland waterways (e.g. on the Rhine) is included in the domestic navigation emission estimates, which is not in line with the IPCC good practice guidance and is a potential overestimation of emissions. During the review week, Germany explained that	Please check NIR report 2012, section 3.2.2, pp.145 and section 3.2.10.1, pp.193

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
			there are no national statistics available to separate the emissions and that the Party has no plans to rectify this possible overestimation at the moment because it has only a small impact, and gathering relevant data would be resource intensive. The ERT appreciated this clarification and noted the difficulty in obtaining data to separate the emissions, but encourages Germany to find a way to separate the emissions from inland navigation activities and report emissions from international navigation activities as a memo item under domestic and international emissions bunker fuels by making appropriate assumptions, and to clearly describe them in the NIR	
Civil aviation		GR	The ERT noted that the data on jet kerosene in the CRF tables are high compared to the data from the International Energy Agency (IEA). Also, the inventory of Greece includes the consumption of aviation gasoline for civil aviation, while no such consumption is included in the IEA data. Greece explained that, since there is a discrepancy between the number of landings and take-offs (LTOs) and the corresponding fuel consumption from the national energy balance, the adjustment applied to the estimate for the base year is continuously applied in the estimation of CO_2 emissions from civil aviation. The ERT recommends that Greece continue its efforts to estimate the country-specific share of LTOs and the corresponding fuel consumption, and report on any progress made in this matter in its next annual submission	Recalculations of the whole time series were performed for both domestic and international aviation. These recalculations are due to a transmission mistake of the LTO number given by the Hellenic Aviation Authority. The mistake was identified during the QC procedure that included cross check with data from EUROCONTROL.
Road transportation: liquid fuels	CO_2	GR	The ERT noted that Greece continues to apply the method used by the ERT in the initial review for calculating the consumption of lubricants for road transportation, which is based on the average lubricant consumption/fuel consumption ratio for the cluster of countries for the whole time series rather than on the data from the national energy statistics. The present ERT reiterates the recommendation in previous review reports that Greece verify the data on lubricants used for road transportation and report thereon in its next annual submission	The lubricants consumption taken from the energy balance was considered as reliable, as the corresponding lubricant consumption per fuel consumption ratio is 0.0035, hence in the range of accepted values (as reported before). Therefore, the calculations were preformed using the statistical lubricants consumption.
Road transportation, liquid fuels	CO_2, CH_4 and N_2O	NL	The ERT noted that the last measurements for the country-specific diesel oil and gasoline CO_2 EFs were conducted in 2004. In response to a question raised by the ERT during the review week, the Netherlands indicated that it intends to assess the currently available data on the carbon content of the different types of fuels used for road transportation to revise its country-specific EFs. The ERT welcomes this initiative and recommends that the Netherlands include the findings of this assessment and use the updated country-specific EFs for this category in its next annual submission. In the previous annual submission, the Netherlands reported that it calculates CO_2 emissions from road transportation using an IPCC tier 2 methodology, using data from domestic fuel sales, which are provided by CBS. The ERT established that the Netherlands actually estimates CO_2 emissions in this category using a tier 1 methodology as the Netherlands uses aggregated fuel sales that may not be disaggregated according to vehicle type. Therefore, the ERT reiterates the recommendation from the previous review report that the Netherlands correct the information in the NIR and in the CRF tables regarding the methodology used to estimate CO_2 emissions from road transportation.	In the NIR 2011, MS stated that tier 1 methodology is used. But in the NIR 2012 it is stated that tier 2 methodology is used.
Civil aviation, liquid fuels	CO_2, CH_4 and N_2O	NL	The ERT noted that there is a 740.6 per cent difference in the jet kerosene for civil aviation reported in the CRF tables (230.20 TJ) and in the data reported to the International Energy Agency (IEA) (1,935.00 TJ) for 2009. The ERT further notes that these data are for the year 2000 but are used to estimate emissions for the whole time series (1990–2009). During the review week, the Netherlands confirmed that the	Text updated, NIR section 3.2.8, pp.74 and pp.79

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
			IEA data on fuel used for domestic aviation originates from CBS. As CBS is the original source for both figures, the discrepancy cannot be understood. In response to the list of potential problems and further questions raised by the ERT during the review, the Netherlands demonstrated that the estimates of emissions for 2009 and 2008 from civil aviation did not result in the underestimation of emissions. A comparison of the fuel consumption data for civil aviation between the IEA data and the data presented in the CRF tables showed that the large difference in the two datasets is as a result of the inclusion of military aviation data in the civil aviation data in the IEA dataset. When the military aviation fuel consumption data are removed from the IEA dataset, the fuel consumption data in the CRF tables are comparable. The ERT agreed with the assessment by the Netherlands and recommends that the Netherlands include this clarification in its next annual submission.	
Road transportation, liquid fuels	CO_2	PT	Portugal updated the CO_2 EFs for gasoline, diesel and liquid petroleum gas for the full time series for the 2010 annual submission. Previously, the EFs used by the Party were based on the EMEP/CORINAIR Emission Inventory Guidebook.6 The revised EFs were sourced from domestic legislation which in turn was sourced from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines). In response to a question raised by the ERT during the review, the Party was unable to provide any country-specific information to justify the change in EFs. As it is good practice to use country-specific data for this category, the ERT recommends that Portugal work with liquid fuel suppliers to develop country-specific EFs for these fuels. The ERT recommends that the Party include the updated EFs together with transparent explanation of the method used to derive them in its next annual submission.	See NIR, section 3.3.3.2.2.7, pp. 179 (EFs are included but no transparent explanation)
Road transportation, liquid fuels	CH_4 and N_2O	PT	Portugal has reported on the differences between the fuel consumption emissions derived from the COPERT IV model and those derived from the energy balance (NIR section 3.3.3.2.6, page 3-124). These differences were 46 per cent for diesel and 31 per cent for gasoline for 2008. To ensure completeness, the fuel consumption emissions derived from the COPERT IV model are corrected to ensure consistency with the data from the energy balance. In response to a question raised by the ERT during the review, Portugal confirmed that these differences have triggered a review of the COPERT IV model inputs, specifically the composition of the vehicle fleet. The Party is taking steps to review and, if appropriate, update these data in future annual submissions. The ERT supports Portugal's use of QA/QC tools to prioritize inventory improvements and recommends that Portugal report on the outcome of this review in the next annual submission.	Differences where found in fuel consumption time series taken as a sum from COPERT 4 compared to total fuel sales data taken from the energy balance. These differences are corrected in COPERT 4 to equal fuel sales in order to ensure full consistency between Energy Statistics and GHG inventory. Corresponding CO_2 emissions are corrected as well. (NIR 2012, pp.3-137)
International bunker fuels		UK	Following the adjustment from the previous review, the Party has implemented some improvements and reallocated fuels from international to domestic aviation for all direct flights between the United Kingdom and its OTs (see para. 54). A reallocation of shipping emissions between international and domestic navigation based on new port movement data was performed, leading to a decrease of fuel allocated to domestic navigation and to an increase for international navigation. Detailed shipping movement data for different vessel types, fuels and journeys has been used to estimate domestic (coastal) shipping emissions. The international marine emissions are derived by the difference between total fuel consumption statistics for marine fuels and fuel consumption by domestic shipping. The new approach is described in annex 3 to the NIR. The ERT encourages the Party to further assess the conformity of bunker definitions between the inventory and national and international statistics, and to provide an explanation on the differences in its next annual submission.	In response to feedback from the ERT, the inventory agency has confirmed with the UK national energy statistics team at DECC that the UK allocations of bunker fuels reported within DUKES are consistent with the data submitted to EUROSTAT and the IEA across the full time-series. The UK inventory memo item estimates for international shipping deviate from the reported data due to reallocation of some of the bunker fuels to military aviation and shipping based on

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
				data from the Defence Fuels Group of the MoD.
Civil aviation, liquid fuels	CO_2, CH_4 and N_2O	UK	Previous ERTs have noted that the geographical coverage of civil aviation estimates leads to an underestimation of the emissions from domestic aviation reported under the energy sector. Since the Party did not officially submit revised estimates as requested by the previous ERT, an adjustment was calculated and applied for this category. For its 2011 submission, the Party has recalculated the full time series (1990–2009) including the emissions for flights between the United Kingdom and the OTs under civil aviation. The ERT noted, however, that the CO_2 emissions from civil aviation in 2008 in the 2011 submission (2,363.65 Gg) are lower than those in the submission 2010 (adjusted value 2,416.37 Gg). In response to questions raised by the ERT during the review, the Party explained that this discrepancy has occurred because preliminary values were used for the 2008 inventory (in the 2010 submission) and also stated that the values were revised in the current submission. This change is not indicated in the CRF table 8(b). The ERT recommends that, where any recalculations are made, the Party present both the previous and actual value of the AD in the NIR, together with the justification and impacts of the various recalculations. In addition, all the information should be included in CRF table 8(b), preferably at the level at which the recalculation takes place	Recalculations are stated in CRF table 8(b).2
International bunker fuels		BE	Information on international bunkers comes from both the regional and the national energy statistics. No international bunker activities take place in the Brussels-Capital Region as Brussels airport belongs to another region (Flemish Region). With regard to the airports in the Flemish Region, the reported kerosene fuel is assigned to bunker fuels and all gasoline for aviation is allocated to domestic aviation. In the Walloon Region, the bunker fuel consumption for international aviation, as well as the AD, are given directly by the two regional airports. During the previous review, Belgium explained that a change in the data collection methodology took place between 2007 and 2008, which resulted in a large discrepancy between the CRF and the IEA data. However, the Party has not provided information on this methodological change in the NIR and no explanations have been provided on how the time-series consistency of the data is ensured. In addition, the recurring issues regarding the discrepancy in the jet kerosene values between the CRF and the IEA data (e.g. 25 per cent in 2007, 40 per cent in 2009) have not been resolved in the 2011 submission and the jet kerosene consumption (international aviation) value reported to the IEA for 2009 (80,754 TJ) is 29.8 per cent higher than the fuel consumption value reported in the CRF tables (62,210 TJ). According to the response provided by Belgium during the review, the difference is caused by the use of temporary data. The ERT noted that a similar explanation was provided by the Party during the previous review, but there was no change to the value for 2008 and no further explanations were provided in the NIR of the 2011 submission. In response to questions raised by the ERT during the review, Belgium explained that the consumption of jet kerosene (international bunkers) was reviewed by the Federal Public Service in April 2011 and the values would be further updated, leading to reduced differences between the IEA and the CRF data (i.e. from +41 per cent to –4.1 per cent for 2008). The ERT recommends that Belgium, in its next annual submission, correct the temporary figures and transparently explain the reasons for the data discrepancies and the follow-up revisions that have taken place, and document how the time-series consistency of the reported data is ensured.	Please check Section 3.2.2 International bunker fuels, pp. 67
Road transportation, liquid fuels	CH_4, N_2O	BE	Belgium has still not implemented the recommendation of the previous review report regarding the use of the same methodology for non-CO_2 emissions from road transportation for all regions and for the entire time series. In the 2011 submission, the Party has used different models to estimate emissions from road transportation (the COPERT IV model for the Brussels-Capital and Walloon Regions for the years	Emissions of CH_4 and N_2O are since the 29th October 2012 submission also based on the amounts of fuel sold of the federal petroleum balance in combination

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 / 2012 submissions	MS comment
			2007–2009 and the COPERT III model for the previous years of the time series and the MIMOSA model for the Flemish Region). In response to questions raised by the ERT during the review, the Party stated that the Flemish Region uses the MIMOSA model in accordance with the mobility policy in the Flemish Region, and explained that the MIMOSA model is similar to the COPERT model but different input data are used. However, for the estimation of CH_4 and N_2O emissions, the functions from the COPERT IV model are used in the MIMOSA model. As a result of the different methods used across the inventory years and regions, the inter-annual changes in the values of the CH_4 and N_2O IEFs for gasoline and diesel oil show large deviations in recent years (e.g. inter-annual changes for gasoline for 2006–2007, 2007–2008 and 2008–2009 of –40.0, –25.3 and 20.0 per cent for CH_4, and –69.8, –15.4 and –5.1 per cent for N_2O; and inter-annual changes for diesel oil for 2006–2007, 2007–2008 and 2008–2009 of –47.0 per cent, –5.9 per cent and –2.2 per cent for N_2O). The ERT recommends that, in addition to the inclusion of information on the methodological changes, Belgium include information explaining the trend in the IEFs across the years of the time series in its next annual submission	with COPERT 4 emission factors. The compiled emissions of each region based on the results of the specific models used in the 3 regions (all of them based on COPERT) are hereby corrected/increased according the ratio between the fuel used(compiled by regional models) and the fuel sold (provided by federal statistics) to get consistency with the methodology used to calculate the emissions of CO_2.
Road transportation, liquid fuels	CH_4, N_2O	BE	With regard to the planned transition to a COPERT IV model for the entire time series in the Walloon Region, the Party has expressed concerns regarding data availability prior to 2003, and alternative ways to ensure time-series consistency at the national level from 1990 are currently under consideration. The ERT notes the efforts made by the Party and recommends that Belgium recalculate the entire time series, in order to ensure the accuracy of the emission estimates for road transportation, and document how time-series consistency is ensured in its next annual submission	During the 2013 submission, the CO_2 emissions from road transport 1A3b were adapted with emission factors from COPERT (instead of IPCC default factors) according to the recommandations of the UNFCCC in-country review. The question was asked specifically for gasoline, but all fuels have been changed.
Road transportation, biomass	CH_4, N_2O	BE	The previous ERT encouraged Belgium to report CH_4 and N_2O emissions from biomass in road transportation even though they were considered negligible. In 2011, the notation key “NE” was replaced by the notation key “IE” (included elsewhere), indicating that the CH_4 and N_2O emissions were included under gasoline and diesel oil for the years 2007–2009. This information has not been further explained in the NIR. The ERT commends the Party for its efforts to improve the completeness of the data; however, in order to improve the transparency of its reporting, the ERT recommends that Belgium provide, in the NIR, background information on the biofuel use in the country and report the emission estimates for CH_4 and N_2O separately in the next annual submission.	Emissions of CH_4 and N_2O from biomass (bio-gasoil and bio-ethanol) are reported separately for the first time during the 2013 submission consistently for the 3 regions. The emission factors are those of equivalent fossil fuels (COPERT does not enable fuel blends).

Table 3.112 provides an overview of EU 15 member state’s response to the UNFCCC Review findings for fugitive emissions.

Table 3.112 EU 15 member State’s responses to UNFCCC review findings in 2011 or 2012 for fugitive emissions

Category	Gas	Member State	UNFCCC review findings for the 2011/2012 submission	MS response
Oil and natural gas	all gases	Austria	Perform more detailed verification of these estimates provided by industry and include ,in the NIR of the next annual submission, information on the methodologies, AD and EFs used to calculate the fugitive emission estimates	The Association of the Austrian Petroleum Industry was consulted and the main outcome of the discussion is given in the NIR to improve transparency. Further, the emission factor that was used to calculate CH_4 emissions is included in the NIR. To ensure time-series consistency it is

Category	Gas	Member State	UNFCCC review findings for the 2011/2012 submission	MS response
				planned to recalculate the complete time series using the same OGP Tier 1 emission factor for the whole time series.
Oil and natural gas	all gases	Austria	Develop a country-specific EF, taking into account the specific technologies in use for oil refining and storage or apply expert judgement to estimate the emissions using a tier 1 method by selecting a more appropriate value within the range 90.1,400 kg CH_4/PJ for refining and 20.250 kg CH_4/PJ for storage	Reasons for the choice of the emission factor for fugitive emissions from oil refining and storage are now explained in the NIR to improve the transparency.
Oil and natural gas	all gases	Austria	Implement its plan (confirmed during the review week) to report the CH_4 emissions from combustion separately in CRF table 1.A.1.b (petroleum refining) using the country-specific EFs described above in the CRF tables and in the NIR of the next annual submission	Reasons for the choice of the emission factor for fugitive emissions from oil refining and storage are now explained in the NIR to improve the transparency.
Oil and natural gas	all gases	Belgium	However, the ERT noted that, whereas Belgium has reported emissions from oil refining/storage, emissions from transport under fugitive emissions from oil have been reported as “NO”. In response to the list of potential problems and further questions raised by the ERT during the review, the Party submitted estimates of CO_2 and CH_4 emissions from oil transport for the period 1990–2009 calculated using the IPCC tier 1 methodology 6 and default IPCC CO_2 and CH_4 EFs for oil transport in pipelines. The revised estimates led to an increase in sectoral emissions by 4.14 Gg CO_2 eq for 2009. The ERT accepts the revisions and recommends that Belgium continue to report emissions from this category in the next annual submission and provide detailed documentation on the methodology used in the NIR.	CH_4 emissions for oil refining/storage included in the inventory, but no comment found in NIR.
-	-	Denmark	No review finding	-
Oil and natural gas	CH_4	Finland	Finland reported CH_4 emissions from natural gas transmission and distribution based on measurements conducted by private companies during the period 1996–2009. During the review, Finland confirmed that the CH_4 emission estimates for the years 1990–1995 were calculated using linear interpolation, which is in accordance with the IPCC good practice guidance, and took into account the increased volume of natural gas transmitted and distributed during 1994 and 1995. The ERT encourages Finland to include further documentation in its next annual submission in order to improve the transparency of its reporting.	Information has been included. (Section 3.6.2.1)
Oil and natural gas	all gases	France	The ERT considers it unclear how France has allocated fugitive emissions from petroleum refining. In its NIR, France has stated that CO_2 emissions from refining processes reported under fugitive emissions are based on the national CO_2 EFs from table 25 of the NIR, which are fuel combustion EFs. For the CH_4 EF, France has used the emissions reported directly by the companies involved, and for the N_2O EF, France has referred to the EFs for fuel combustion. In response to a question raised by the ERT during the review, France explained that the total emissions from petroleum refining are based on plant-specific data, but that there is a problem with the allocation of emissions between fugitive emissions and fuel combustion emissions: some fuel consumption emissions for fluid catalytic cracking or sulphur recovery plants are reported under fugitive emissions from oil and natural gas, but they will be reallocated to the fuel combustion sector in the next annual submission. The ERT recommends that France reallocate the fuel combustion emissions from petroleum refining to fuel combustion and clearly describe the allocation of petroleum refining emissions in the NIR of its next annual submission.	Pour la section 1B2a, les facteurs d‟ émission ont été mis à jour, ainsi que les consommations des FCC dont les consommations de gaz et de fioul ont été transférées au CRF 1A1b (émissions de combustion). De plus, les émissions du torchage ont été transférées au CRF 1B2c.
-	-	Germany	No relevant review finding	-
-	-	Greece	No relevant review finding	-

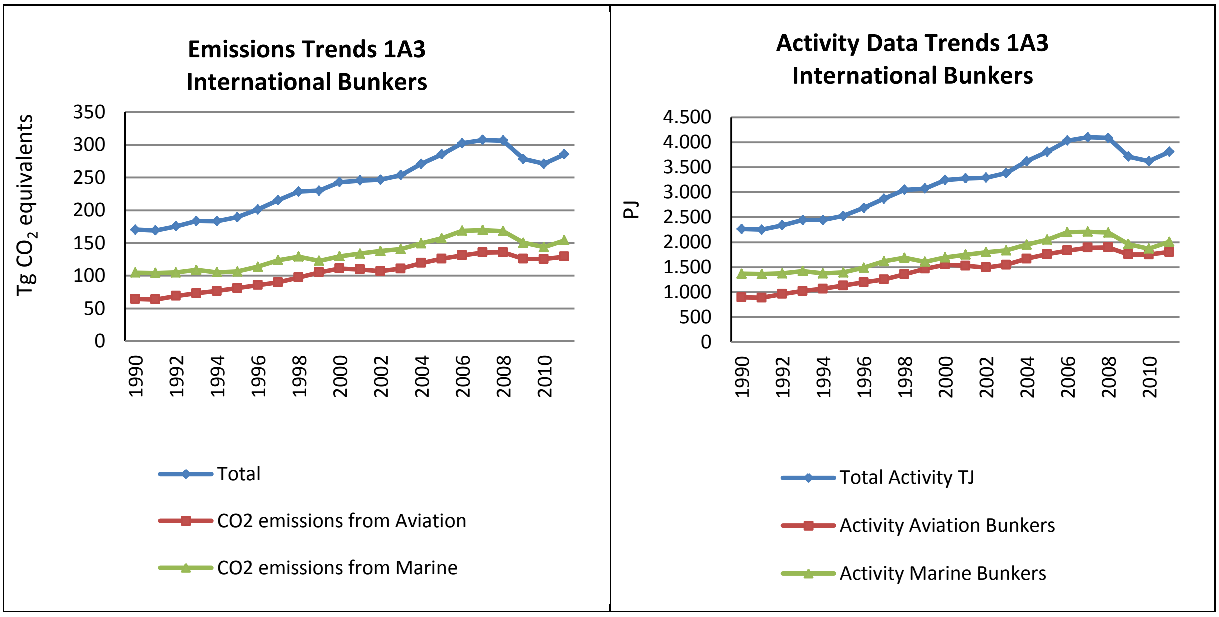
Category	Gas	Member State	UNFCCC review findings for the 2011/2012 submission	MS response
-	-	Ireland	No relevant review finding	-
Oil and natural gas	all gases	Italy	Further disaggregate oil and natural gas exploration and production, and oil transport and refining/storage, if higher-tier data allow.	The ERT recommendation has been fulfilled. Additional information has been provided in the NIR (§3.9.2).
Oil and natural gas	all gases	Italy	Use the correct notation key and provide a description in the NIR and in CRF table 9(a) of where emissions from other leakage are reported.	The notation key has been corrected (§3.9.2 of the NIR).
Solid fuels	CO_2	Italy	The ERT encourages Italy to document the rationale for assuming emissions do not occur and clarify the use of the notation key "NA" for these categories in its next annual submission.	The CO_2 emissions from mines have been estimated (§3.9.2 of the NIR).
-	-	Luxembourg	No relevant review finding	-
Solid Fuels	CO_2	Netherlands	The ERT further noted that the Netherlands has reported in the NIR (page 51) that CO_2 emissions from fuel combustion from the on-site coke production in iron and steel plants in the Netherlands including the independent coke production plant, Sluiskil closed in 1990, are reported under the iron and steel category. The ERT noted that this allocation is not consistent with the Revised 1996 IPCC Guidelines which require these emissions to be reported under manufacture of solid fuels and other energy industries. The ERT recommends that the Netherlands correctly allocate these emissions in line with the requirements of the Revised 1996 IPCC Guidelines. In response to the list of potential problems and further questions raised by the ERT during the review, the Netherlands provided a detailed carbon mass balance for 2009 showing all the inputs and outputs in the iron and steel production processes and how these carbon flows are accounted for in the energy and industrial processes sectors. The analysis of the carbon flows by the Netherlands resulted in minor changes to the reported fugitive emissions from coke production, representing an increase in 2009 of 0.2 Gg CO_2 eq (0.03 per cent). The ERT agrees with the revised estimates, the reported carbon mass balance and its carbon flows presented by the Netherlands and recommends that it include this carbon mass balance in its next annual submission.	Not possible due to aggregated energy balance of 1990
Solid Fuels	CH_4	Netherlands	The ERT noted that fugitive CH_4 emissions from charcoal production have not been reported in the current submission for the whole time series. The NIR indicates that a charcoal production plant has been in operation for the entire time series. The ERT notes that the Revised 1996 IPCC Guidelines provide guidance on the CH_4 EFs for charcoal production. During the review week, the Netherlands informed the ERT that CBS had included the production of charcoal in the statistics on renewable energy and, as a result, AD on charcoal production are now available. The Netherlands further explained that the charcoal production plant was closed in 2010, but it will estimate the historic emissions from 1990 to 2010 based on the production capacity and the EFs from literature sources. During the review week, the ERT recommended that the Netherlands estimate fugitive CH_4 emissions using AD on charcoal production, which the Netherlands confirmed are available, and multiply these AD by a country-specific CH_4 EF or the default CH_4 EF provided in table 1-14 of the Revised 1996 IPCC Guidelines.	No information found
Oil and natural gas	all gases	Portugal	In its 2011 annual submission, Portugal has stated that emissions from compressor stations are included under fugitive emissions from natural gas. In response to a question raised by the ERT during the review, the Party confirmed that there is only one compressor station in Portugal, which is powered by a co-generation plant and, therefore, the emissions are included under stationary combustion. The ERT recommends that Portugal clarify the allocation of these emissions in its next annual submission.	No information found
Oil and	CH_4	Portugal	According to the information provided by Portugal during the review, the time series for fugitive emissions from natural gas	No information found

Category	Gas	Member State	UNFCCC review findings for the 2011/2012 submission	MS response
natural gas			distribution varies significantly. For example, emissions of 26.0 Gg CH_4 are estimated for 2003, no emissions are estimated for 2005 and 2006, while emissions of 23.2 Gg CH_4 are estimated for 2009. This variation is due to the AD, estimated as the difference between the losses of natural gas from the system reported in the energy balance and the estimated losses during transmission and from the regasification plant. To improve the accuracy and time-series consistency of the estimates, the method could be updated so that pipeline length is used as the AD together with an IPCC default EF. A preliminary estimate using publicly available data on pipeline length and default EFs from the IPCC good practice guidance resulted in emission estimates of between 7.5 Gg CH_4 and 10.3 Gg CH_4 for this category. The ERT recommends that Portugal update the method used to estimate emissions from natural gas distribution, as outlined above or using another methodology in accordance with the IPCC good practice guidance.	
Solid Fuels	CH_4	Spain	Previous review reports recommended that Spain undertake a study to determine the extent of degasification activities and CH_4 recovery and flaring in coal mining, and to assess the possible impacts of these activities on GHG emissions for the fugitive emissions and stationary combustion categories. In response to questions raised by the ERT during the review week regarding progress on this issue, Spain stated that the issue is still being analysed and that no definitive results are available yet. The ERT reiterates the previous recommendations that Spain complete the study as soon as possible.	No information found.
-	-	Sweden	No relevant review finding	-
-	-	United Kingdom	No relevant review finding	

3.8 International bunker fuels (EU-15)

International bunker emissions include emissions from Aviation bunkers and Marine bunkers. The emissions of the EU inventory are the sum of the international bunker emissions of the Member States ([28]). Between 1990 and 2011, greenhouse gas emissions from international bunker fuels increased by 67.5 % in the EU-15. CO_2 emissions from “Marine bunkers” account for 54 % of total greenhouse gas emissions from international bunkers in 2011, CO_2 from “Aviation bunkers” accounts for 45.2 % (Figure 3.93).

Figure 3.93 International bunker fuels: GHG emission trend and activity data



3.8.1 Aviation bunkers (EU-15)

This source category includes emissions from flights that depart in one country and arrive in a different country (include take-offs and landings for these flight stages).

CO_2 emissions from Aviation Bunkers equal 3.6 % of total GHG emissions in 2011 but are not included in the national total of GHG emissions (Table 3.113).

The Member States France, Germany, Spain and the United Kingdom contributed more than two thirds to the EU-15 emissions from this source. All Member States, except for Greece, increased emissions from Aviation bunkers between 1990 and 2011.

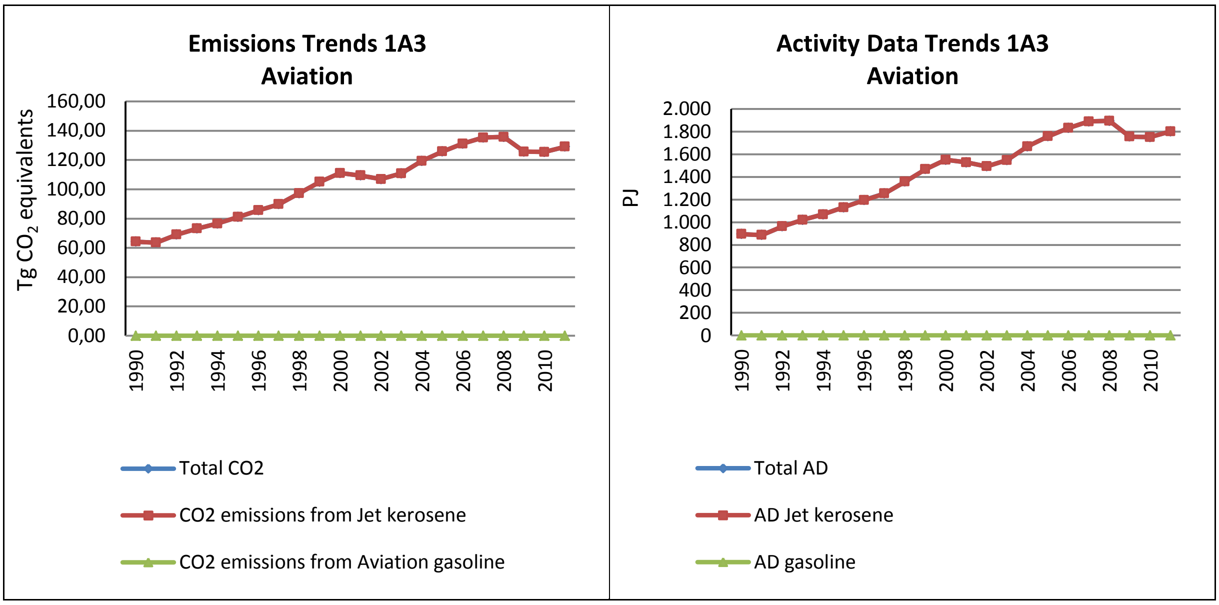
([28]) The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within ‘one country”. This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers ‘national fuel statistics’ for domestic aviation. As the EC is neither a country nor a nation, the EC’s interpretation of the good practice guidance is that the emission estimate at EC level has to be the sum of Member States estimates for domestic air or marine transport as they are the countries or nations addressed in the definition and decision trees of the IPCC good practice guidance.

Table 3.113 Aviation bunkers: Member States' contributions to CO_2

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 1990-2011		Change 2009-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	886	2 050	2 168	1.7%	1 282	145%	119	5%
Belgium	3 095	4 119	4 251	3.3%	1 157	37%	133	3%
Denmark	1 736	2 421	2 492	1.9%	756	44%	71	3%
Finland	1 008	1 654	1 957	1.5%	949	94%	303	15%
France	8 657	16 099	16 714	12.9%	8 057	93%	615	4%
Germany	12 022	24 482	23 561	18.2%	11 539	96%	-921	-4%
Greece	2 439	2 085	2 268	1.8%	-171	-7%	183	8%
Ireland	1 070	2 315	2 074	1.6%	1 005	94%	-241	-12%
Italy	4 161	9 440	9 726	7.5%	5 565	134%	285	3%
Luxembourg	394	1 286	1 219	0.9%	824	209%	-67	-5%
Netherlands	4 540	10 168	10 448	8.1%	5 907	130%	280	3%
Portugal	1 461	2 604	2 709	2.1%	1 248	85%	105	4%
Spain	5 805	13 043	14 310	11.1%	8 505	147%	1 267	9%
Sweden	1 335	2 110	2 274	1.8%	939	70%	164	7%
United Kingdom	15 644	31 611	32 944	25.5%	17 299	111%	1 333	4%
EU-15	**64 253**	**125 486**	**129 115**	**100.0%**	**64 862**	**101%**	**3 628**	**3%**

CO_2 emissions from jet kerosene account for 99,99 % of total emissions from "Aviation bunkers" in 2011 (Figure 3.94**).** All Member States, except for Greece, increased emissions from jet kerosene between 1990 and 2011. Member States with the highest increase between 1990 and 2011 in percent were Austria, Italy, Luxembourg and Spain. On the other hand, Greece was the country with a decrease in CO_2 emissions.

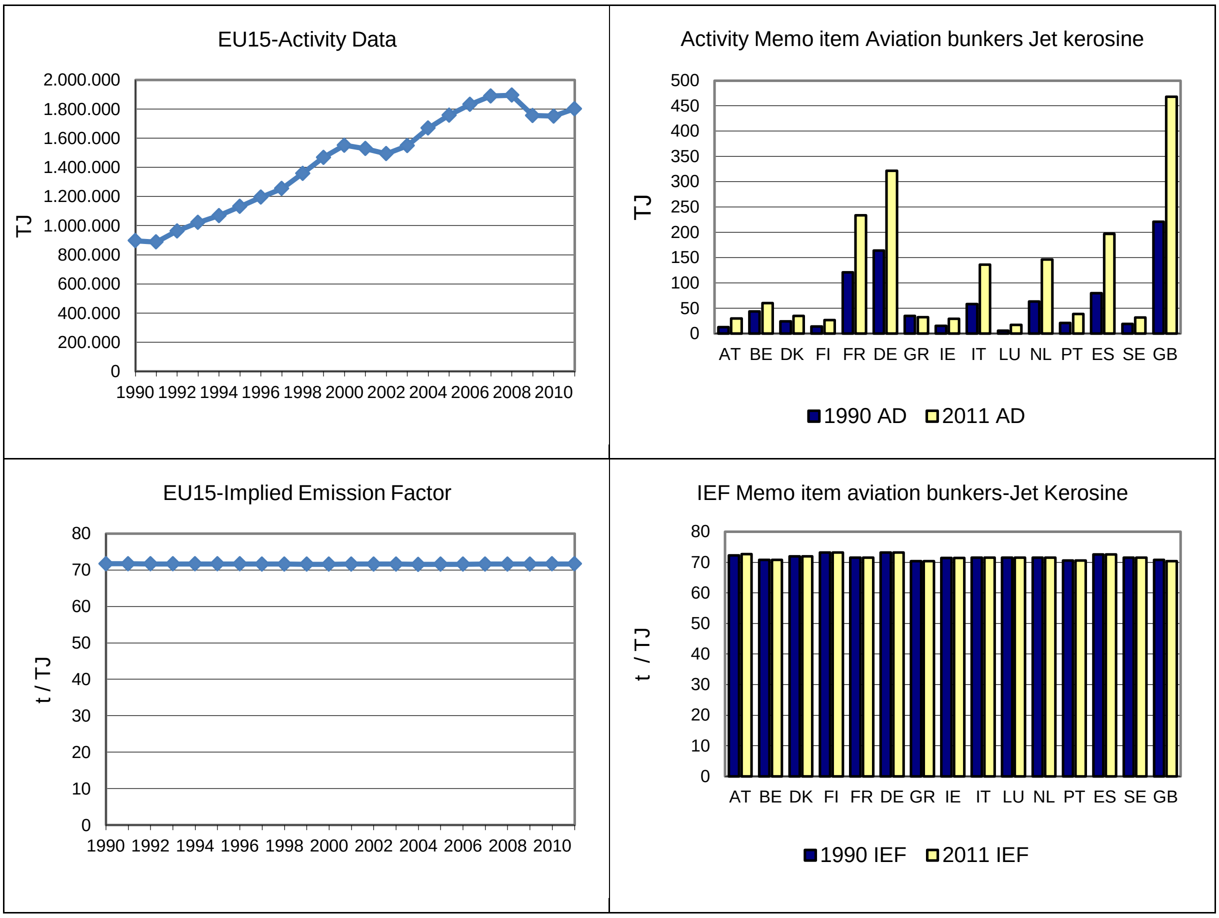
Figure 3.94 Aviation bunkers: Trend of CO_2 Emissions and Activity Data



3.8.1.1 *Aviation Bunkers – Jet Kerosene (CO_2)*

Figure 3.95 provides an overview of activity data and emission factors for EU-15 and those Member States contributing most to EU-15 emissions. Fuel combustion of EU-15 increased by 101 % between 1990 and 2011. The EU-15 implied emission factor was at 71.65 t/TJ in 2011.

Figure 3.95 Aviation bunkers, Jet kerosene: Activity Data and Implied Emission Factors for CO_2



3.8.2 Marine bunkers (EU-15)

This source category includes emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. Marine bunkers include emissions from journeys that depart in one country and arrive in a different country. Marine bunkers exclude consumption by fishing vessels (see Other Sector - Fishing).

CO_2 emissions from "Marine bunkers" equal 4.2 % of total GHG emissions in 2011 and are also not included in the national total of GHG emissions. Between 1990 and 2011, CO_2 emissions from Marine bunkers increased by 47 % in the EU-15 (Table 3.114).

The Member States Belgium, the Netherlands and Spain contributed most to the emissions from this source (65.4 %) in 2011. Between 1990 and 2011, Denmark and Finland decreased emissions from Marine bunkers whereas all the other Member States increased them. The Member States with the highest increase in absolute terms again were Belgium, the Netherlands and Spain.

Table 3.114 Marine bunkers: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 1990-2011		Change 2009-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	39	51	44	0.03%	6	15%	-6	-14%
Belgium	13 303	20 958	25 288	16.4%	11 985	90%	4 331	17%
Denmark	3 005	2 063	2 096	1.4%	-909	-30%	33	2%
Finland	1 835	657	612	0.4%	-1 223	-67%	-45	-7%
France	7 891	7 858	8 430	5.5%	539	7%	572	7%
Germany	7 915	8 883	8 729	5.7%	813	10%	-154	-2%
Greece	8 028	8 643	8 294	5.4%	266	3%	-349	-4%
Ireland	57	430	334	0.2%	277	488%	-96	-29%
Italy	4 389	6 974	7 161	4.6%	2 772	63%	187	3%
Luxembourg	0.1	0.1	0.1	0.0%	0	87%	0	19%
Netherlands	34 357	43 186	48 217	31.3%	13 860	40%	5 031	10%
Portugal	1 386	1 618	1 932	1.3%	546	39%	314	16%
Spain	11 528	26 665	27 276	17.7%	15 748	137%	611	2%
Sweden	2 228	6 710	5 878	3.8%	3 651	164%	-832	-14%
United Kingdom	8 716	8 682	9 781	6.3%	1 065	12%	1 099	11%
EU-15	**104 678**	**143 378**	**154 073**	**100.0%**	**49 396**	**47%**	**10 696**	**7%**

CO_2 emissions from residual fuel oil account for 88.1 % of total emissions from "Marine bunkers" in 2011 (Figure 3.96). Between 1990 and 2011, CO_2 emissions from residual fuel oil increased by 66.9 % in the EU-15. All Member States, except for Denmark and Finland, increased emissions from residual oil between 1990 and 2011. Member States with the highest increase in percent were Spain and Sweden.

CO_2 emissions from gas/diesel oil account for 11.7 % of total emissions from "Marine bunkers" in 2011. Between 1990 and 2011, CO_2 emissions from gas/diesel oil decreased by 20.7 % in the EU-15.

Figure 3.96 Marine bunkers: Trend of CO_2 Emissions and Activity Data

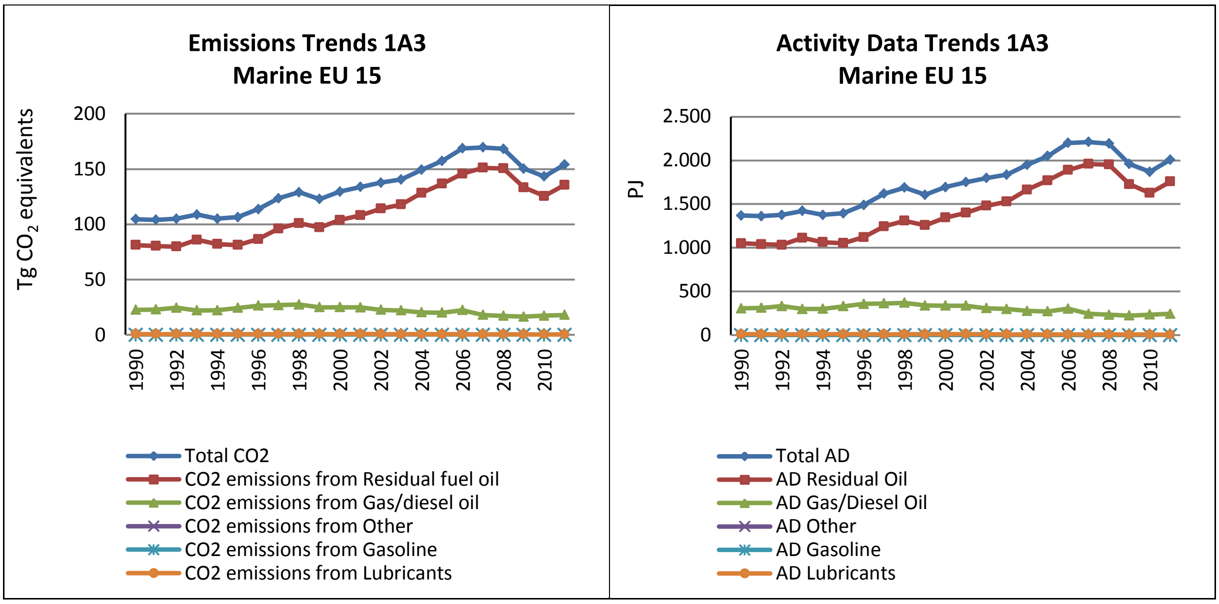
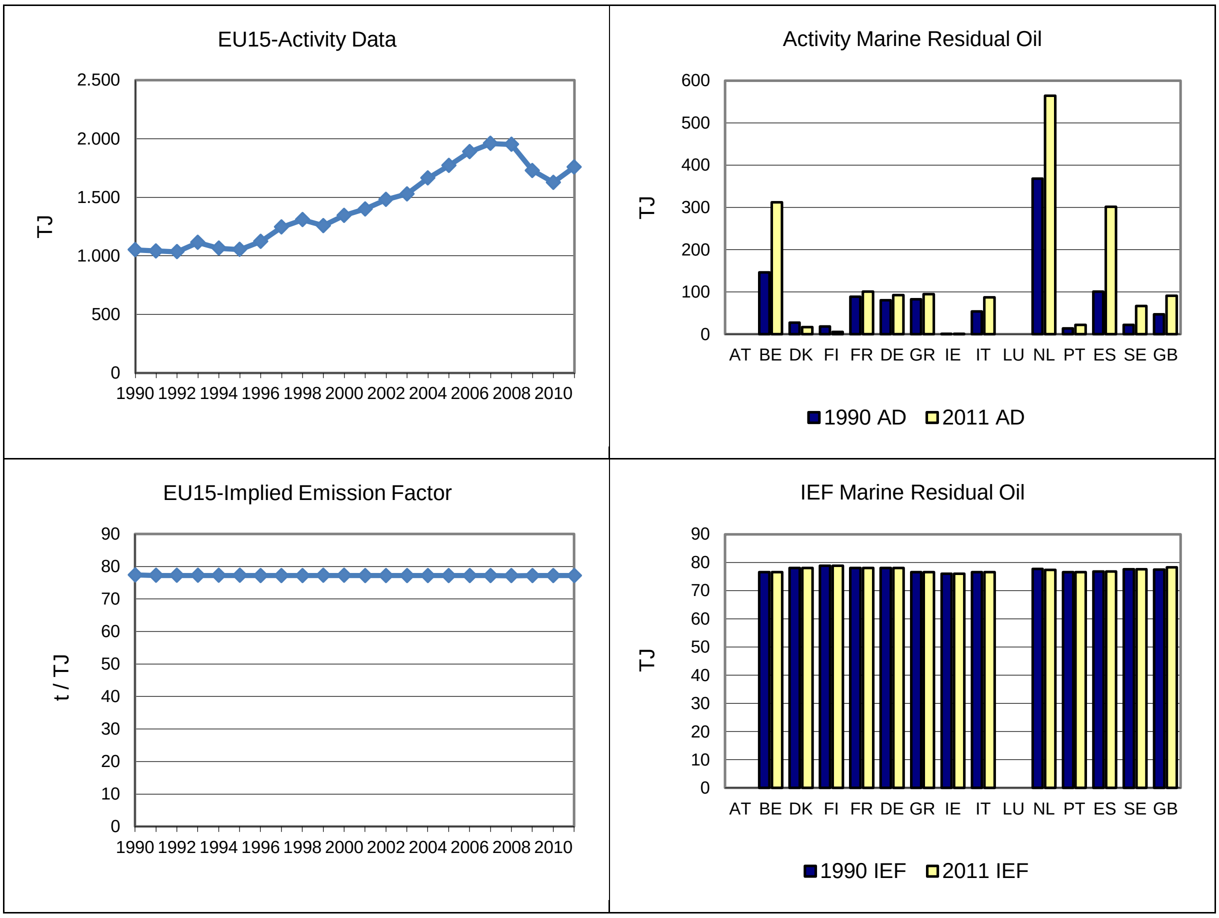


Figure 3.97 and Figure 3.98 provide an overview of activity data and emission factors for residual oil and gas/diesel oil for EU-15 and those Member States contributing most to EU-15 emissions.

3.8.3 Marine Bunkers – Residual Oil (CO_2)

Combustion of residual oil in the EU-15 increased by 66.9 % between 1990 and 2011. The EU-15 implied emission factor was at 77.18 t/TJ in 2011.

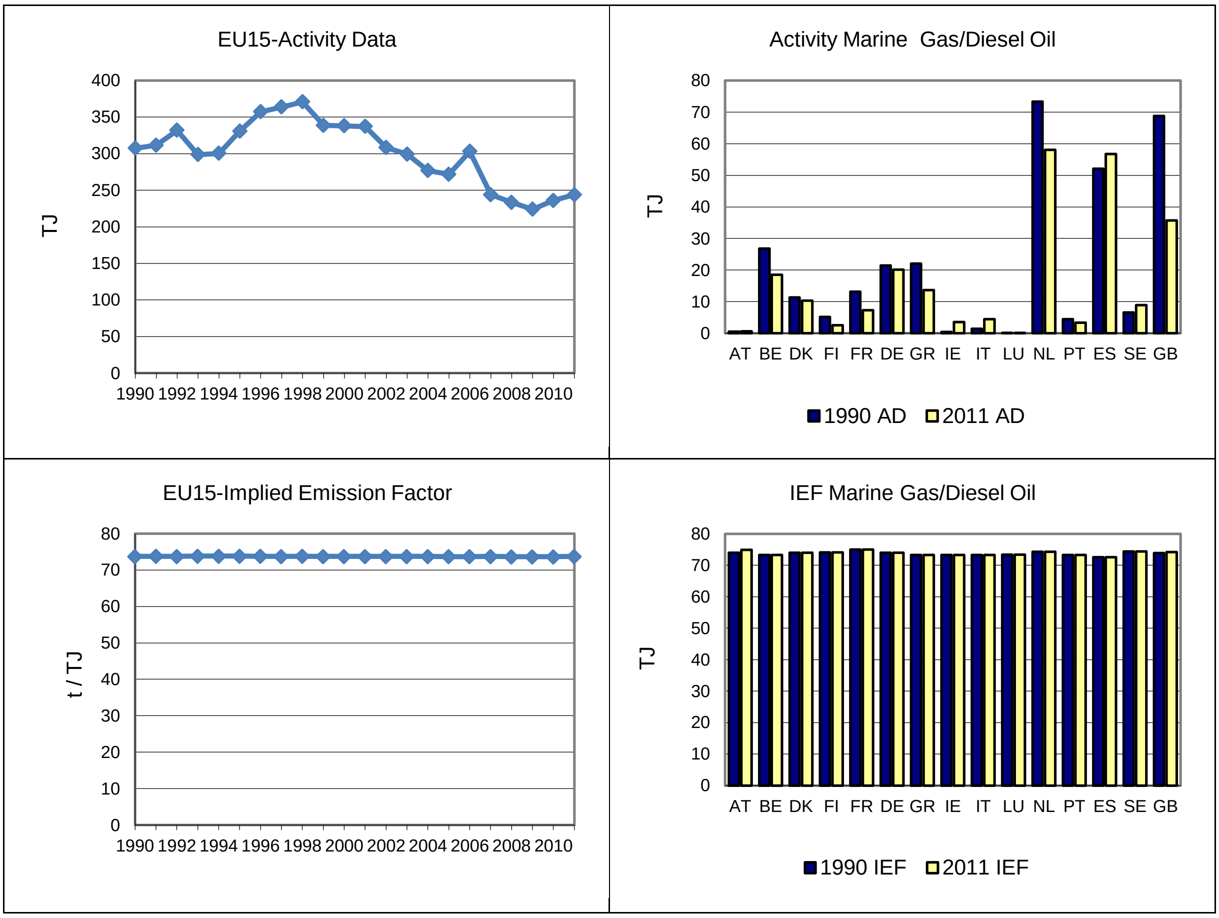
Figure 3.97 Marine bunkers' – Residual Oil: Activity Data and Implied Emission Factors for CO_2



3.8.3.1 *Marine Bunkers – Gas/Diesel Oil (CO_2)*

Combustion of gas/diesel oil in the EU-15 decreased by 20.7 % between 1990 and 2011. The EU-15 implied emission factor was at 73.71 t/TJ in 2011.

Figure 3.98 **Marine bunkers, Gas/Diesel Oil: Activity Data and Implied Emission Factors for CO_2**



3.8.4 QA/QC activities

3.8.4.1 *Collaboration with Eurocontrol - 2007 Study*

The European Topic Centre on Air and Climate Change conducted a study in 2007 based on aviation emission estimates from Member States and calculations by the European Organisation for the Safety of Air Navigation (Eurocontrol). The purpose of the study was to compare emissions reported by Member States with modelling results provided by Eurocontrol to assess the quality of the emissions estimates and help identify areas in need for improvement. The calculations by Eurocontrol are based on flight movement data using an independent data set whereas most Member States use fuel sale statistics. The study assessed three questions: (i) how consistent are estimates for total fuel consumption between the two data sets; (ii) how consistent are estimates for the share of domestic aviation between the two data sets; (iii) does the consistency between the two estimates depend on the type of methodology applied by Member States. The main conclusions of the study were:

Comparing country estimates for fuel burn, CO_2 emissions and NO_x with Eurocontrol calculations is a genuine quality assurance exercise which can help both sides in improving their data. Despite significant uncertainties in the estimates the comparison was able to identify countries for which the differences could not be easily explained and where countries as well as Eurocontrol might need to do further analysis. Especially for the share of domestic aviation Eurocontrol data might be of use to several countries in the future.

The analysis showed that although in theory CO_2 estimates from aviation do not depend on the tier chosen, in practice countries applying higher tiers also had more consistent carbon dioxide emission estimates. One of the reasons might be that the application of higher tiers requires detailed statistics in the aviation sector which might also be reflected in the fuel sale estimates.

The use of bottom-up data for the determination of the split between domestic and international aviation could improve the accuracy of inventory estimates. The small country approach is a good and very easy methodology for countries without domestic IFR/GAT aviation; research projects can produce good estimates for the share of domestic emissions. Out of the 29 countries assessed those applying expert judgement or top-down data had the highest discrepancies compared to Eurocontrol.

In general, the European countries tend to overestimate domestic emissions. This is a conservative approach as it increases the emissions included in the emission reduction commitment under the Kyoto Protocol. For the same reason it would be in the interest of the concerned countries to improve their estimates: greenhouse gas emissions from aviation have increased substantially since 1990 and overestimating the domestic share will exacerbate the efforts for reaching the national targets. Applying the share of domestic aviation as calculated by Eurocontrol to total fuel consumption in the EU-15 leads to an overestimation of domestic emissions from aviation by 6.2 Mt CO_2 in 2005.

3.8.4.2 *Collaboration with Eurocontrol during 2012/13*

At the end of 2010 the European Commission signed a framework contract with Eurocontrol regarding ‘support to the European Commission in relation to climate change policy and the implementation of the EU ETS’. The support project is organised in different Work Packages corresponding to the different areas identified in the framework contract.

One of these Work Packages (WP) pertains to the improvement of GHG and air pollutant emissions inventories submitted by the 27 Member States and the European Union to the UNFCCC and to the UNECE. The main objective of the WP is to assist EU Member States improve the reporting of annual greenhouse gas (and other air pollutant) emission inventories by e.g. estimating the fuel split domestic/international using real flight data from Eurocontrol. The European Environment Agency and its European Topic Centre on Air Pollution and Climate Change Mitigation assist DG CLIMA regarding the technical requirements.

To support the 2013 inventory process, MS recevied fuel and emissions data for the year 2011 as calculated by EUROCONTROL using a TIER 3 methodology applying the Advanced Emisssions Model (AEM) as well as documentation on how these data have been calculated (available upon request). This is a follow up of ERT recommendations made to perform QA exercises and to make data from EUROCONTROL available to member states on a regular basis. The European Environment Agency has made an overview of the methodologies used by MS to calculate emissions from civil and international aviation and made a comparison between EUROCONTROL data and MS data on fuel consumption, CO_2 emissions and implied emission factors. The findings and the EUROCONTROL and MS methodology descriptions results have been shared with MS (documentation available upon request).

Next steps include the evaluation of time series of civil and international aviation emissions. Time series calculated by EUROCONTROL are expected in fall of 2013. Based on the experience gained during this QA/QC process recommendations will be made to EUROCONTROL to safeguard and improve time-series calculations for use by MS.

Under a new framework contract with DG CLIMA, EUROCONTROL could rerun the AEM model to calculate time series for the period 2005-2012. Countries are encouraged to provide feedback on applying these EUROCONTROL data for the year 2011 so that suggestions and questions could be taken into account in the new model run.

As shown in the NIR 2011, comparing emissions reported by Member States with independent modelling results such as performed by EUROCONTROL is a genuine quality assurance exercise and assists in identifying areas in need for improvement of aviation emission calculations. The EU's ARR 2011 report mentions "The ERT again recommends that the European Union continue such QA exercises, that it try to address the issues identified, and that it continue to work on making data from EUROCONTROL available to member States on a regular basis".

3.9 Feedstocks and non-energy use of fuels

Following a recommendation of the expert review team the EU now uses weighted average fractions of carbon stored in order to potentially reduce the differences for apparent consumption between the reference approach and the sectoral approach for those fuels where the IPCC default values (used by the EU up to 2008) are far from the weighted averages of the EU Member States (i.e., for natural gas and lubricants).

Table 3.115 provides an overview of the fraction of carbon stored by fuel as used in the EU GHG inventory 2011. These values are compared with the IPCC default values and the weighted average values of the EU-15 MS.

Table 3.115 Fraction of carbon stored from Table 1A(c) used by the EU-15 Member States compared with IPCC default values and the values used in the EU GHG inventory 2011

	Weighted average based on EU-15 MS GHG inventories 2009	IPCC default (used by the EU before 2009)	Values used in the EU GHG inventory
Naphtha	0,76	0,75	0,75
Lubricants	0,74	0,50	0,75
Bitumen	1,00	1,00	1,00
Coal Oils and Tars	0,78	0,75	0,75
Natural Gas	0,53	0,33	0,50
Gas/Diesel Oil	0,60	0,50	0,50
LPG	0,75	0,80	0,80
Ethane	0,70	0,80	0,80

Table 3.116 provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.116 Information related to feedstocks and non-energy use from Member States' NIRs

MS	Information on feedstocks and non-energy use of fuels	Source
Austria	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount of carbon stored in steel was calculated. **Lubricants** manufacture: emissions are assumed to be included in total emissions from category 1.A.1.b petroleum refinery. use: emissions from the use of motor oil are included in CO_2 emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category 2.C.1. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pressure of lubricants. disposal: emissions from incineration of lubricants (waste oil) are either included in categories 1.A.1.a and 1.A.2 if waste oil is used as fuels or in category 6 C respectively if energy is not recovered. **Bitumen** manufacture: emissions from the production of bitumen are assumed to be included in total emissions of category 1.A.1.b petroleum refinery. use: indirect CO_2 emissions from the use of bitumen for road paving and roofing that should be reported in categories 2.A.5 and 2.A.6 are included in sector 3 solvent and other product use. disposal: CO_2 emissions from the disposal from bitumen are assumed to be negligible. Recycling is not considered. **Natural Gas** manufacture: emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category 2.B.1). use/disposal: not applicable, no CO_2 emissions result from the use or disposal of ammonia. **Coke oven coke** manufacture: emissions from the production of coke are considered in category 1.A.2.a. use: CO_2 emissions from coke used in iron and steel industry are reported under 2.C. disposal: not applicable **Other bituminous coal** In [IEA JQ 2012] non energy use is reported for the manufacture of electrodes. manufacture: No information about emissions from manufacture of electrodes is currently available. Therefore it is not clear if emissions are not estimated or not applicable. use: Emissions from the use of electrodes are considered in category 2.B.4 carbide production and 2.C metal production. disposal: not applicable **Other oil products** manufacture: emissions from the production of ethylene and propylene are included in total emissions of category 1.A.1.b petroleum refinery. CO_2 emissions from solvent use are considered in sector 3 solvent and other product use. use: CO_2 emissions from solvent use are considered in sector 3. disposal: emissions from the disposal of plastics in landfills are considered in 6 A and from the use of plastic waste as a fuel in 1.A.2; emissions from the incineration of plastic in waste without energy recovery is included in 6.C; emissions from incineration of plastics in waste with energy recovery are considered in 1.A.1.a and 1.A.2.	Austria's National Inventory Report 2013, Mar 2013, pp.74-75

MS	Information on feedstocks and non-energy use of fuels	Source
Belgium	The emissions of non-energy use of fuels and related emissions (emissions from recovered fuels from processes) are reported under categories 1A2c, 2B1 and 2B5. In Flanders, a recalculation of the non-energy use and related CO_2 emissions was performed during the 2005 submission, based on the results of a study conducted in 2003 [43]. The default % of carbon stored in the IPCC Guidelines were considered to be inaccurate in the Flemish situation. The default % of carbon stored in the 1996 IPCC guidelines are not well defined: it is not clear what is included or excluded in these default % (f.i. is the waste phase included or not?). Belgium participated in a European network on the CO_2-emissions from non-energy use (see website http://www.chem.uu.nl/nws/www/nenergy/) and one of the conclusions of this network is that the new IPCC guidelines need to give more information on this subject. To our opinion, the guidelines are also not very clear on the allocation of the resulting emissions: in the CRF table 1.A(d), as part of the reference approach, a country should specify in the documentation box where these emissions are allocated. This problem of allocation should be tackled too. The result of the study made a recalculation possible for all years. The effect of the recalculation was greater in the more recent years because the petrochemical industry has expanded its activities in the beginning of the nineties (that's one of the reasons this sector is a key source). Since the petrochemical industry is important in Flanders and Belgium and the emissions from the feedstocks are a key source in the Belgian inventory, the study mentioned above was conducted to get more detailed, country-specific information. A distinction is made between: 1. The use of recovered fuels from cracking units or other processes where a fuel is used as raw material and where part of this fuel (or transformed product) is recovered for energy purposes. These emissions are reported under category 1A2c 'other fuels'. This is the largest source of CO_2 emissions. This includes other fuels in the chemical sector, a result of recovered fuels in the steam cracking units in petrochemical industry (approx. 2/3) and other recovered fuels from the chemical industry (approx. 1/3). These recovered fuels are reported directly in the yearly surveys carried out by the chemical federation in cooperation with the VITO [1]. The choice was made to allocate these fuels under 'other fuels' and not 'liquid fuels' or 'gaseous fuels', for transparency reasons. 2. CO_2 emissions occurring during chemical processes, for example the production of ammonia based on natural gas or the production ethylene oxide (and production of acrylic acid from propene, production of cyclohexanone from cyclohexane, production of paraxylene/metaxylene, etc) where CO_2 is formed in a side reaction (reported respectively under 2B1 and 2B5 other). These CO_2 emissions result from the same surveys in the chemical sector in Flanders as those reported under 1A2c. In the survey, more sources of emissions from chemical processes are reported than are described in the IPCC 1996 guidelines. Emissions of flaring activities in the chemical industry are re-allocated during the 2013 submission to the category 6C instead of the category 2B5 before. 3. Waste treatment of final products is not included in the study. This is practically impossible due to import/export of plastic products, etc. (it is also not clear if the waste phase is included in the default IPCC carbon stored % or not). The emissions of waste incineration are therefore calculated separately and are reported under the sector of waste (category 6C) or under the sector of energy (category 1A1a), whether or not energy recuperation takes place during the process.	Belgium´s Greenhouse Gas Inventory 1990-2011, Mar 2013, pp.63-64
Denmark	The Danish national energy statistics includes three fuels used for nonenergy purposes; bitumen, white spirit and lubricants. The total consumption for non-energy purposes is relatively low, e.g. 12.4 PJ in 2011. The use of white spirit is included in the inventory in Solvent and other product use. The emissions associated with the use of bitumen and lubricants are included in Industrial Processes. The non-energy use of fuels is included in the reference approach for Climate Convention reporting and appropriately corrected in line with the Revised 1996 IPCC Guidelines (IPCC, 1997).	Denmark's National Inventory Report 2013 Mar 2013 p. 152
Finland	To calculate the emissions from the non-specified burning of feedstocks there is a separate module in ILMARI. The ILMARI system includes point source (bottom-up) data on feedstock combustion in the petrochemical industry as well as recycled waste oil combustion in different branches of industry, and they are reported in corresponding subcategories of 1.A 2. These specified energy uses of feedstock and lubricants are subtracted from the corresponding total amounts. For the rest of the feedstock 100% of carbon is estimated to be stored in products (mainly plastics). For the rest of lubricants, 33% of carbon is estimated to be stored in products (recycled lubricants) and 67% of carbon released as CO_2 either in burning of lubricants in motors or illegal combustion of waste oil in small boilers. These non-specified emissions from burning of feedstocks (which are not included in 1.A 2) are included in category 1.A 5. Emissions from natural gas used as feedstock are calculated and reported in sector 2.B 5.	Greenhouse Gas emissions in Finland 1990-2011, Mar 2013 p. 118

MS	Information on feedstocks and non-energy use of fuels	Source
France	Les combustibles fossiles peuvent être consommés pour différents usages tels que la combustion pour des besoins énergétiques ou en tant que matière première, intermédiaire ou agent réducteur. Tous les types de combustibles sont concernés et sont différenciés, en fonction des cas, selon les usages énergétiques et non énergétiques, dans le bilan de l'énergie. Le cas des combustibles solides, liquides et gazeux sont différenciés ci-dessous : En ce qui concerne les consommations de combustibles solides (charbon et coke de charbon), le bilan de l'énergie du SOeS comptabilise tous les usages dans les consommations énergétiques. Quoiqu'il en soit, les usages énergétiques et non énergétiques sont bien distingués dans l'inventaire. Les consommations de combustibles solides en tant que réducteurs ou intermédiaires sont considérées dans le code CRF 2C pour les sites sidérurgiques et de production de ferro-alliages. Voir aussi les méthodologies mises en oeuvre afin de distinguer les consommations et les émissions entre la sidérurgie et les ferro-alliages, au §3.2.7 Industrie manufacturière - figure 23. Les produits pétroliers à usage non énergétique sont essentiellement consommés sur les sites pétrochimiques. Ces usages sont bien connus et font l'objet d'une enquête exhaustive de la part du SOeS10. Selon les résultats de cette enquête, environ 14% de la consommation française de produits pétroliers est utilisée non, comme source d'énergie, mais comme matière première pour la chimie organique. Cette enquête définit les quantités des différentes bases pétrolières consommées ainsi que les productions des vapocraqueurs dont une part de produits autoconsommés par le vapocraqueur (fioul lourd et gaz industriels) à des fins énergétiques. Les consommations de ces produits à usage énergétique sont bien comptabilisées dans les consommations énergétiques de produits pétroliers dans le bilan de l'énergie français et les émissions de GES associées sont prises en compte dans la catégorie CRF 1A2. Seules des émissions de CH_4 sont donc estimées pour les usages non énergétiques des vapocraqueurs et rapportées dans le code CRF 2B5. Les émissions liées à la combustion des huiles moteur sont prises en compte dans la catégorie CRF 1A3. Les émissions des huiles récupérées et brûlées dans les procédés type cimenterie sont prises en compte dans la catégorie CRF 1A2 et celles traitées en incinérateurs de déchets spéciaux en CRF 6. Enfin, les principaux usages non énergétiques du gaz naturel correspondent à la production d'ammoniac, d'hydrogène, et d'acide cyanhydrique. Les émissions de CO_2 associées sont comptabilisées dans le code CRF 2B.	Rapport National D'Inventaire pour la France Mar 2013 p.85-86
Germany	Im Rahmen eines in Zusammenarbeit mit der Universität Utrecht durchgeführten Forschungsvorhabens (UU STS, 2007) wurden die Emissionen aus der nichtenergetischen Verwendung der in der Wirtschaft eingesetzten Energieträger erstmals für die Jahre zwischen 1990 und 2004 berechnet und mit den für das CO_2-Referenzverfahren verwendeten Angaben verglichen. Die Zusammenfassung der Ergebnisse ist in Anhang 2, Kapitel 13.9 des NIR 2007 wiedergegeben.	Nationaler Inventarbericht zum deutschen Treibhausgasinventar 1990-2011 Mar 2013 p. 151

MS	Information on feedstocks and non-energy use of fuels	Source
Greece	Non-energy fuel use concerns the consumption of fuels as raw materials (e.g. in chemical industry, metal production) for the production of other products, or the use of fuels for non-energy purposes (e.g. bitumen). Part of the carbon content of fuels is stored in final products and is not oxidized into carbon dioxide for a certain time period. The fraction of the carbon contained in final products and the time period for which carbon is stored in them, depend on the type of fuel used and of the products produced. The oxidation of the carbon stored in final products occurs either during the use of the product (e.g. solvents) or during their decomposition (e.g. through combustion). It should be noted that emissions during production processes (e.g. ammonia and hydrogen production) should be reported under the sector of industrial processes, while emissions from burning of products should be reported under the waste sector or energy sector (as long as energy exploitation takes place). Non-energy use of fuels in Greece refers to the consumption of: ☐ naphtha, natural gas, and lignite (for the period 1990 – 1991) in chemical industry, ☐ petroleum coke in the production of non-ferrous metals, ☐ lubricants in transport (including off-road transportation), ☐ bitumen in construction and ☐ other petroleum products in the industrial and residential sectors Data on the non-energy consumption of fuels derive from the national energy balance. However, plant specific data derived from verified ETS reports and information provided by specific greek industries resulted to the improvement of reallocation of non-energy use fuels from the energy to the industrial processes sector: ☐ The non-energy use of natural gas for ammonia production has been reallocated to industrial processes sector in the 2012 submission, by using data from ETS reports and plant specific information. Non-energy use of lignite is accounted in the Energy sector and refers only to ammonia production (in one installation for 1990 and 1991) and as a result the fraction of carbon stored is equal to 0. The operation of this installation ended at 1998 while it did not produce ammonia for the period 1992 – 1998. The non-energy use of natural gas for hydrogen production is included in the industrial processes sector, by using data from ETS reports and information from Public Gas Corporation. ☐ No data regarding non-energy use in the iron and steel industry are reported in the national energy balance and, as a result, CO_2 emissions from the use of fuels as reduction agents, are only reported under the industrial processes sector. ☐ Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, by using data from ETS reports and plant specific information, emissions from solid fuels for ferroalloys production are reallocated to the industrial processes sector, as from 2010 submission. ☐ The non-energy use of petroleum coke (see Table 3.9) refers exclusively to the primary aluminium production. Given that the relevant emissions are reported under the industrial processes sector, petroleum coke consumption is not taken into account in the energy sector. On the basis of the above-mentioned clarifications, the possibility to double-count or underestimate CO_2 emissions from the non-energy use of fuels is minor.	Annual Inventory submission to the EC Mar 2013 pp.78-79
Ireland	Naphtha was previously the only petroleum product to be considered in relation to non-energy fuel-use, where the carbon is not fully released as in combustion. The IPCC default value of 0.50, 1.00 and 1.00 are used for the proportion of carbon stored in lubricants, bitumen and white spirit respectively. Ireland's only oil refinery is a small hydroskimming refinery where there is no production of other petroleum products normally used for non-energy purposes, such as bitumen, lubricants, plastics and asphalt. The expanded SEAI energy balance sheets now record the import of some of these products, thereby allowing improved completeness in the Reference Approach estimation of CO_2 emissions and carbon storage. A significant amount of natural gas feedstock was traditionally used in ammonia production in Ireland but the company closed in 2003 and there is consequently no feedstock use of natural gas since then.	Ireland National Inventory Report 2013 Mar 2013 p. 72

MS	Information on feedstocks and non-energy use of fuels	Source
Italy	Data are based on a detailed yearly report available by Ministry of Economic development (MSE, several years [b]). The report summarizes answers from a detailed questionnaire that all operators in Italy fill out monthly. The data are more detailed than those normally available are by international statistics and refer to: • input to plants (gross input); • quantities of fuels returned to the market (with possibility to estimate the net input); • fuels used internally for combustion; • quantities stored in products. National energy balances include only the input and output quantities from the petrochemical plants; so the output quantity could be greater than the input quantity, due to internal transformation. Therefore it is possible to have negative values for some products (mainly gasoline, refinery gas, fuel oil). Consequently for these fuels also the fraction of carbon stored could have negative values. The quantities of fuels stored in products, in percentage on net and gross petrochemical input, are estimated with these data, see Table 3.34 for details by product and Table 3.33 for the overall figure. Specifically, the amount of quantity stored in products for each fuel is calculated as the difference between input (petrochemical input) and output (returns to refinery and internal consumption and losses); carbon stored is therefore calculated from the amounts of fuels stored (in tonnes) multiplied by the emission factors (tC/t) reported in Table 3.34. The fuel quantity reported in Table 1.A(d) of the CRF in TJ is the amount of fuels stored and the fractions of carbon stored are consequently equal to 1. Non-energy products quantity amount stored from refineries are reported in the BEN and the carbon stored is estimated with emission factors reported in Table 3.35. As can be seen from the value reported for the year 2010, there is a sizeable difference of the estimated quantities of fuel stored in product if reference is made to "net" or "gross" input. Moreover the estimation of quantities stored in products are quite different from those reported in the Revised 1996 IPCC Guidelines for National GHG Inventories, Reference Manual, ch1, tables 1-5 (IPCC, 1997). An attempt was made to estimate the quantities stored in products using IPCC percentage values (tables 1-5 of the IPCC Guidelines) and the amount of fuels reported as "petrochemical input" in Table 3.34. The resulting estimate of about 5,523 Gg of products, for the year 2011, is almost 50% bigger than the quantities reported, 3,579 Gg.	Italian Greenhouse Gas Inventory 1990-2011 National Inventory Report 2013, March 2013, pp.102-103

MS	Information on feedstocks and non-energy use of fuels	Source
Luxembourg	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all. Lubricants Manufacturing: manufacturing of lubricants does not occur in Luxembourg. Use: Lubricants are either used in road transportation (motor oil and greases) or in the manufacturing and construction industry (mainly greases). According to the Revised 1996 IPCC Guidelines it can be assumed that 50%of the carbon content of the total quantity of lubricants sold is stored in the product (IPCC default fraction of carbon stored for lubricants). The remaining 50% is considered to be emitted as CO_2. Although the Revised 1996 IPCC GLs recommend to allocate emissions from lubricant uses to the respective categories were uses occur and the IPCC GPG state that "lubricants should be accounted for in other emission categories, as very little is combusted directly in the transportation sector", Luxembourg chose to report CO_2 emissions from lubricant use under category 1A3b - Road transportation - Liquid Fuels - Other Liquid Fuels - Lubricants, as it lacks specific information on lubricant use (i.e. lubricant type, quantities used per category, fraction of lubricant oxidised per lubricant type, etc.). Indeed, when approximating the emissions from lube oil use of Luxembourg's road vehicle fleet, with the COPERT model, emissions are approximately identical to those as estimated with the IPCC default fraction. Carbon stored from lubricant use is reported in CRF Table 1A(d) feedstocks and non-energy use. Activity data reported under 1A(d) feedstocks and non-energy use originates from the energy balance as published from the national statistics institute (STATEC), and represents the total amount of lubricants used in Luxembourg, whereas AD reported under 1A3b - Road transportation – Liquid Fuels - Other Liquid Fuels - Lubricants represents only the amount of lubricants supposed to be oxidised (i.e. 50%). CO_2 emissions from lubricants use were calculated using the default IPCC values (default carbon content of 20.0 kg C/GJ, all carbon assumed to be oxidised). For CH_4 and N_2O emissions from lubricants use, it is assumed that these emissions are included under the 1A3b Road Transportation fuels Diesel, Gasoline and LPG as these emissions are calculated based on real world emission factors (COPERT model), thus including contributions of lubricants, hence notation key IE used. Disposal: incineration of lubricants (waste oil) does not occur in Luxembourg. Waste oil is either recycled or exported. Bitumen Manufacturing: manufacturing of bitumen does not occur in Luxembourg. Coke oven coke Manufacturing: not occurring. All coke used in the iron and steel industry is imported. Use: CO_2 emissions from coke used in iron and steel industry are reported under 2.C.1 − Iron and Steel Production. Other bituminous coal Manufacturing: Manufacturing of electrodes from anthracite used in the electric arc furnaces does not occur in Luxembourg. Use: Emissions from the use of electrodes in the iron and steel production are considered in category 2.C.1 − iron and steel production. Disposal: not applicable. Other oil products Manufacturing: not occurring. All products such as white spirits, etc. are imported. Use: CO_2 emissions from solvent and other products use are considered in sector 3. Disposal: emissions from the disposal of plastics in landfills are considered in 6.A and emissions from incineration, with energy recovery, of waste plastics are considered in 1 A 1 a.	Luxembourg's National Inventory Report 1990-2011 Apr 2013 p. 110f
Netherlands	46% of the gross national consumption of petroleum products is used in non-energy applications. These fuels are mainly used as feedstock (naphta) in the petrochemical industry and in products in many applications (bitumen, lubricants, etc.). Also a fraction of the gross national consumption of natural gas (6%, mainly in ammonia production) and coal (3%, mainly in iron and steel production) is used for non-energy applications and hence not directly oxidised. In many cases, these products will finally be oxidised in waste incinerators or during use (e.g., lubricants in two-stroke engines). In the ReferenceApproach these product flows are excluded from the calculation of CO_2 emissions.	Greenhouse Gas Emissions in the Netherlands National Inventory report 2013 1990-2011 p. 56

MS	Information on feedstocks and non-energy use of fuels	Source
Portugal	Emissions of greenhouse gas emissions from feedstock use are only clearly accounted in the inventory in the following situations: • emission of CO_2 resulting from use of feedstock sub-products as energy sources. That is the case of emissions from consumption of fuel gas in refinery and petrochemical industry; • emission of CO_2 liberated as sub-product in production processes such as ammonia production; • emission of NMVOC from fossil fuel origin, and occurring from solvent use and evaporation. Although in this case it is not possible to establish which part results from feedstock consumption in Portugal in the energy balance; However, some potential emissions are not estimated or are only partly estimated. Those that are estimated in the reference approach but not in sectoral approach are: • emissions from mineral oil use as lubricants; • emissions from wear of bitumen in roads. It is evident that more efforts should be made to estimate other emissions from feedstock use, although it is expected that reporting guidelines should give more clear guidance in the future.	Portuguese National Inventory Report on Greenhouse Gases 1990-2011 Mar 2013 p.3-208
Spain	The consumption of fuel for non-energy use is accounted for in the energy balance. The quantities of each fuel type are included in the reference approach. For each fuel type a split into two parts is given: a) the part that stays in the product and b) the part that is set free and causes the corresponding CO_2 emissions.	Inventario de emissiones de gases de efecto invernadero de Espana años 1990-2006, March 2008,p. 1.23
Sweden	Activity data on feedstocks and non-energy use of fuels is collected from the quarterly fuel statistics. As also noted in Annex 2 section 1.1.1, in the survey form for the quarterly fuel statistics, respondents are among many other things asked to specify whether fuels are used as raw materials or for energy purposes. This facilitates the use of data for CRF table 1.A.d, non-energy use of fuels. As mentioned in section 3.2.1, data on natural gas used as feedstock cannot be reported for the years 2004-2008 due to confidentiality reasons (this activity started in 2004, and for the years 2009 and later, the company using natural gas as feedstock has given permission to publish this data. It is not possible to get a "retroactive" permission to publish data reported in the survey before 2009). Data on carbon from coke, bound in produced ferroalloys is collected directly from the only ferroalloy producer and is added to the remaining data on carbon from coke. Estimates of carbon stored are derived by multiplying given energy amount with emission factors for CO_2 (as given in Annex 2, section 1.2) multiplied by 12/44 (the weight of one atom of carbon is by definition 12/44 the weight of one molecule of CO_2). CO_2 emissions derived from non-energy use of fuels and reported under CRF 1.B and CRF 2 (e.g. flaring of gases and iron and steel process emissions) are added under CRF 1.A.d and linked to the CRF 1.A.b as carbon stored (see Annex 4). The parameter "fraction of carbon stored" has been set to 1.00 for all fuels. This is done because otherwise the emissions corresponding to CRF 2 and 1.B in the sectoral approach would not be accounted for in CRF 1.A.d but in 1.A.b, which would cause systematic differences in the comparison 1.A.c.	National Inventory Report 2013 Sweden Mar 2013 p.99

MS	Information on feedstocks and non-energy use of fuels	Source
United Kingdom	The UK has a large chemical manufacturing sector and emissions of methane, carbon moNO_xide, NO_x, SO_2, and NMVOC in the inventory are treated in some detail to reflect the many different types of process. All of these emission sources are reported under 2B5. CO_2 emissions can occur direct from chemical processes, and estimates are made in the case of production of ammonia (see Section 4.9). It is possible that other chemical processes also result in direct CO_2 emissions but none have been identified. Many chemical processes report CO_2 emissions in the Environment Agency Pollution Inventory and similar data sets, but these emissions are most likely to be due to combustion processes operated as part of those chemical processes (e.g. for steam raising) and so cannot be used as evidence of process-related emissions. Chemical processes can result indirectly in emissions if wastes from the process are subsequently used as fuels and emission estimates for this type of source have been included in the inventory. Emissions can also occur from products from the chemical industry. Sources of emissions include burning of waste products and final products (e.g. flaring and use of wastes as fuels, or burning of candles, firelighters and other products etc.) or degradation of products after disposal resulting in CO_2 emissions (including breakdown of consumer products such as detergents etc.). After considering the magnitude of the sources in relation to the national totals, the uncertainty associated with emissions, and the likely reporting requirements in the 2006 IPCC Guidelines, emissions of carbon from the following sources were included in the 2004 GHG inventory (2006 NIR) and subsequent NIRs: • Petroleum waxes; • Carbon emitted during energy recovery - chemical industry; • Carbon in products - soaps, shampoos, detergents etc; and • Carbon in products – pesticides.	UK Greenhouse Gas Inventory, 1990 to 2011 Mar 2013 pp. 282-283

4 INDUSTRIAL PROCESSES (CRF SECTOR 2)

This chapter starts with an overview on emission trends in CRF Sector 2 Industrial processes. Then for each EU-15 key source overview tables are presented including the Member States (MS)' contributions to the key source in terms of level and trend, and information on methodologies and emission factors. The quantitative uncertainty estimates are summarised in a separate section. Finally, the chapter includes a section on recalculations and on sector-specific QA/QC activities. In addition, overviews of Member States' responses to UNFCCC review findings for industrial processes source categories are provided.

4.1 Overview of sector (EU-15)

CRF Sector 2 Industrial Processes is the third largest sector contributing 7 % to total EU-15 GHG emissions in 2011. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (2 %) and N_2O (0.2 %). The emissions from this sector decreased by 28 % from 353 Tg in 1990 to 253 Tg in 2011 (Figure 4.1). In 2011, the emissions decreased by 2.9 % compared to 2010. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in hydrochlorofluorocarbons (HCFC) production. The large decrease in 2009 was driven by reductions in cement production and a significant drop in the iron and steel production as a consequence of the economic crisis.

The key sources in this sector are:

- 2 A 1 Cement Production: (CO_2)
- 2 A 2 Lime Production: (CO_2)
- 2 A 3 Limestone and Dolomite Use: (CO_2)
- 2 B 1 Ammonia Production: (CO_2)
- 2 B 2 Nitric Acid Production: (N_2O)
- 2 B 3 Adipic Acid Production: (N_2O)
- 2 B 5 Other: (CO_2)
- 2 C 1 Iron and Steel Production: (CO_2)
- 2 C 3 Aluminium production: (PFC)
- 2 E 1 By-product Emissions: (HFC)
- 2 E 1 By-product Emissions: (SF_6)
- 2 E 2 Fugitive Emissions: (HFC)
- 2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)
- 2 F 2 Foam Blowing: (HFC)
- 2 F 3 Fire Extinguishers: (HFC)
- 2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)

Figure 4.1 **CRF Sector 2 Industrial Processes: EU-15 GHG emissions for 1990–2011 in CO_2 equivalents (Tg)**

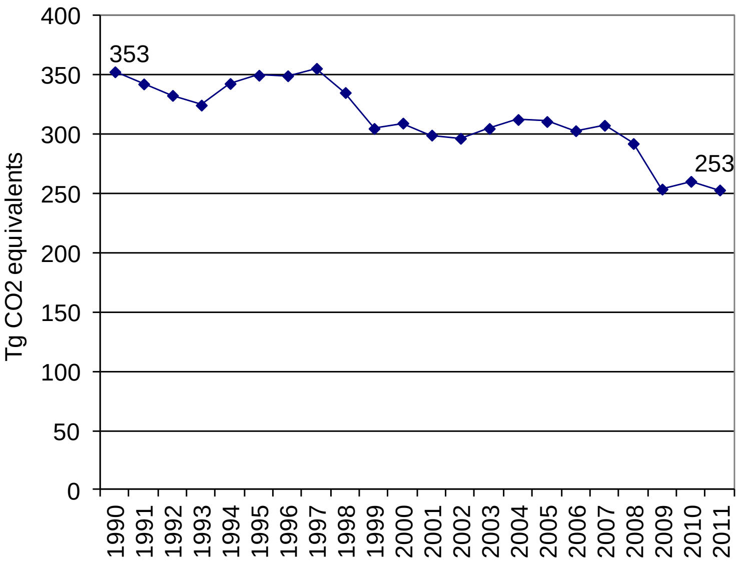
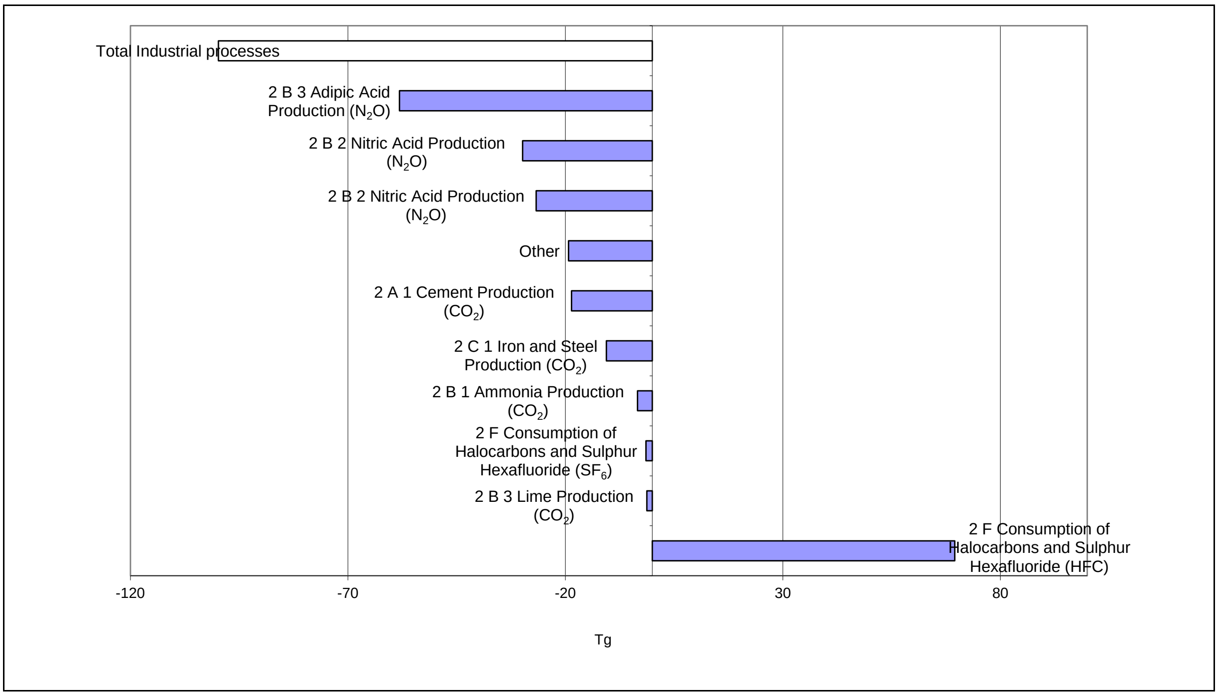
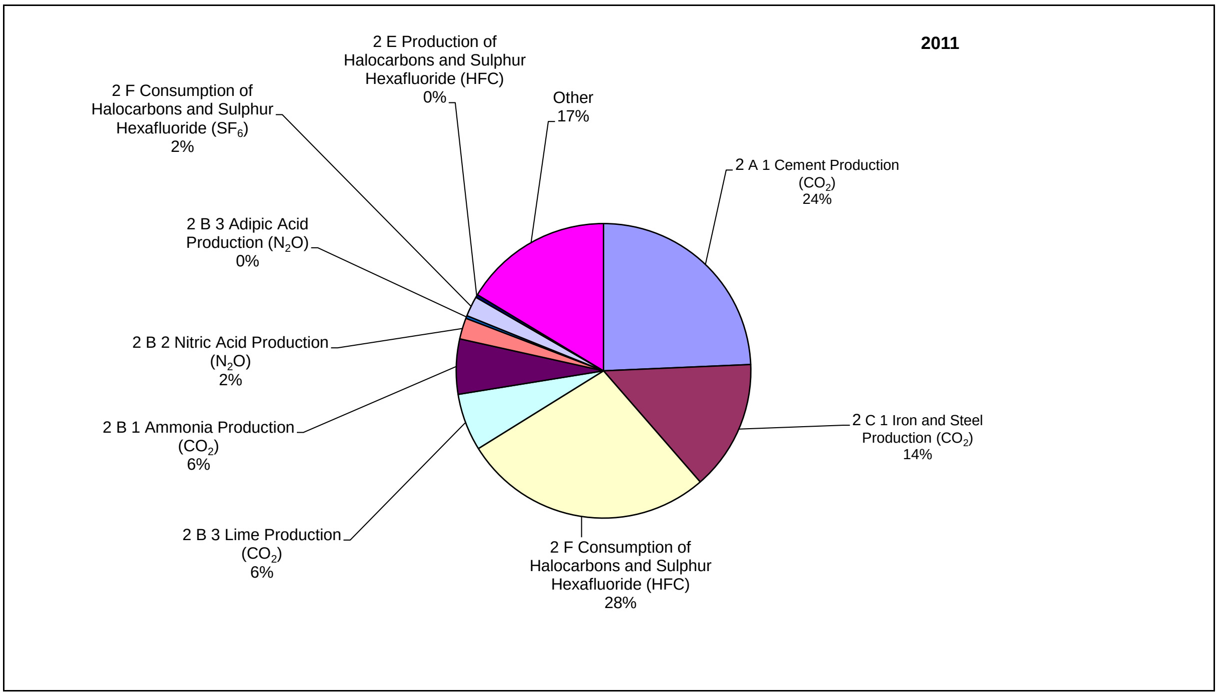


Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs). Additional N_2O emission reductions were achieved in nitric acid production. Large HFC emission increases can be observed from consumption of halocarbons and SF_6. Figure 4.2 shows that the three largest key sources account for about two thirds of total process-related GHG emissions in the EU-15.

Figure 4.2 **CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2011 in CO_2 equivalents (Tg) and share of largest key source categories in 2011**




2011
2 E Production of Halocarbons and Sulphur Hexafluoride (HFC) 0%
Other 17%
2 F Consumption of Halocarbons and Sulphur Hexafluoride (SF_6) 2%
2 A 1 Cement Production (CO_2) 24%
2 B 3 Adipic Acid Production (N_2O) 0%
2 B 2 Nitric Acid Production (N_2O) 2%
2 B 1 Ammonia Production (CO_2) 6%
2 C 1 Iron and Steel Production (CO_2) 14%
2 B 3 Lime Production (CO_2) 6%
2 F Consumption of Halocarbons and Sulphur Hexafluoride (HFC) 28%

4.2 **Source categories (EU 15)**

4.2.1 Mineral products (CRF Source Category 2A) (EU-15)

The source category 2A Mineral Products includes three key categories: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), ceramics production, non-metallurgical magnesia production or environmental pollution control (flue gas desulphurization). Sugar refining, CO_2 emissions from glass production are reported under 2A5 Other.

Table 4.1 summarizes Member States' emissions from Mineral Products in 1990 and 2011. CO_2 emissions from Mineral Products decreased by 19,6 %, especially since 2007 mainly driven by the decrease in cement production due to the economic crisis. Only five EU-15 Member States increased their CO_2 emissions during the period 1990 to2011 (Ireland, Finland, the Netherlands, Portugal and Sweden); Sweden had the largest emission increase in absolute terms and Italy the largest absolute emission reduction in the period 1990-2011.

Table 4.1 2A Mineral Products: Member States total GHG and CO_2 emissions

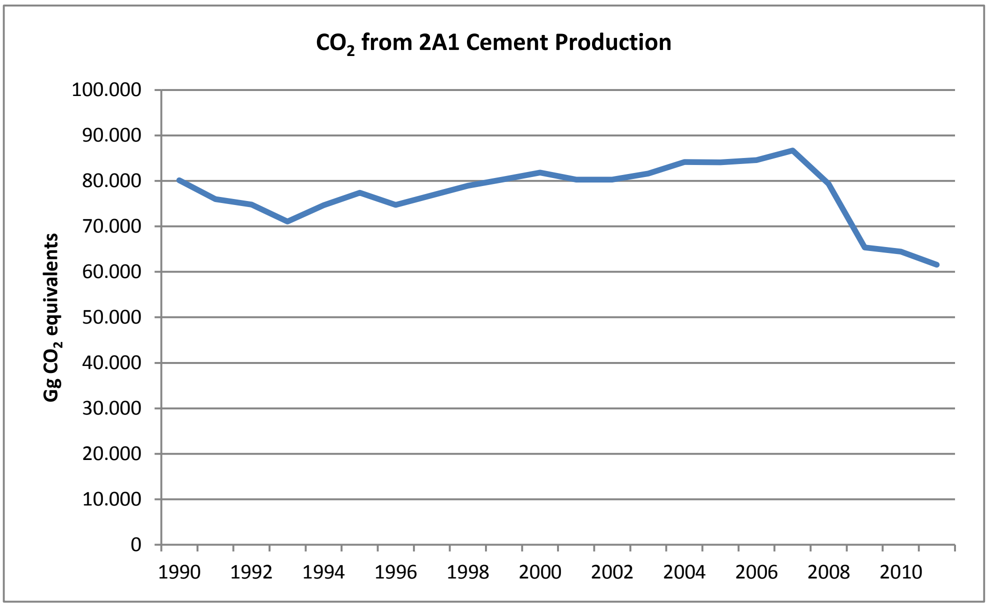
Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)
Austria	3 274	3 030	3 274	3 030
Belgium	5 750	5 096	5 750	5 096
Denmark	1 069	973	1 069	973
Finland	1 268	1 308	1 268	1 308
France	16 525	12 249	16 525	12 249
Germany	22 667	19 498	22 667	19 498
Greece	6 681	3 116	6 681	3 116
Ireland	1 117	1 167	1 117	1 167
Italy	21 303	16 980	21 303	16 980
Luxembourg	623	473	623	473
Netherlands	1 172	1 295	1 172	1 295
Portugal	3 499	3 520	3 493	3 503
Spain	15 427	12 999	15 427	12 999
Sweden	1 722	2 072	1 722	2 072
United Kingdom	10 437	6 645	10 413	6 640
EU-15	**112 533**	**90 422**	**112 504**	**90 400**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.1 ***2A1-Cement Production***

CO_2 emissions from Cement Production account for 2 % of total EU-15 GHG emissions in 2011. In 2011, CO_2 emissions from Cement Production were 23 % below 1990 levels in the EU-15 (**Error! Reference source not found.**).

Figure 4.3 2A1 Cement Production: EU-15 CO_2 emissions



Error! Reference source not found. provides information on emission trends of the key source CO_2 from 2A1 Cement Production by Member State. In 2011, Italy and Germany are the largest emitters accounting for 20.4 % and 21.3 % respectively of EU-15 emissions, followed by Spain (15.5 %). Emissions from 2A1 Cement Production show a significant drop after 2007 in all Member States due to the economic crisis which decreased the construction activities in all countries. In 2011 CO_2 emissions increased again due to a recovery from the economic crisis many Member States (Austria, Belgium, Denmark, Finland, Germany, Luxembourg, Sweden and UK), but continued to further decline in those Member States that are still hurt by a strong economic recession (Greece, Ireland, Italy, Portugal and Spain) which is mirrored by decreasing construction activities in these countries. In Italy, the effects of the global recession period have for example led to two plants closures.

Table 4.2 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	2 033	1 622	1 666	2.7%	44	3%	-368	-18%	CS,T1	PS
Belgium	2 824	2 582	2 762	4.5%	179	7%	-62	-2%	T3	PS
Denmark	882	672	862	1.4%	190	28%	-21	-2%	CS	PS
Finland	734	524	564	0.9%	40	8%	-170	-23%	T2	CS
France	10 937	7 887	8 065	13.1%	178	2%	-2 873	-26%	T2, T3	PS
Germany	15 146	12 188	13 131	21.3%	943	8%	-2 015	-13%	T2	CS
Greece	5 641	4 209	2 430	3.9%	-1 778	-42%	-3 210	-57%	CS	PS
Ireland	884	1 105	966	1.6%	-139	-13%	82	9%	T2	PS
Italy	16 084	13 276	12 583	20.4%	-693	-5%	-3 501	-22%	T2	CS,PS
Luxembourg	570	391	411	0.7%	20	5%	-159	-28%	T2	CS,PS
Netherlands	416	348	351	0.6%	3	1%	-65	-16%	CS	PS
Portugal	3 176	3 376	2 813	4.6%	-563	-17%	-363	-11%	T3	OTH
Spain	12 279	11 197	9 523	15.5%	-1 675	-15%	-2 756	-22%	T2	CS
Sweden	1 272	1 322	1 359	2.2%	37	3%	87	7%	T2	PS
United Kingdom	7 295	3 792	4 096	6.7%	304	8%	-3 200	-44%	T2	CS
EU-15	**80 174**	**64 493**	**61 581**	**100.0%**	**-2 912**	**-5%**	**-18 593**	**-23%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement Production for 1990 and 2011. 97 % of EU-15 emissions are estimated with higher Tier methods and most MS use plant-specific emission factors. In response to the recommendations by the ERT, Denmark used clinker production data as activity data for its 2010 greenhouse gas (GHG) inventory submission, thus harmonization across Member States was achieved (FCCC/ARR/2009/EC, para 49).

The implied emission factors per tonne of clinker produced vary from 0.50 t CO_2/t of clinker produced for Finland to 0.55 t CO_2/t of clinker produced for Belgium. Except for Portugal, all MS use country-specific and plant-specific emission factors. The EU-15 implied emission factor (IEF) (excluding UK that indicated that emission factors and activity data for the production of cement are commercially sensitive and therefore confidential) is 0.53 t CO_2/t of clinker produced.

A noticeable decrease of IEF in the period 1990 to 2011 could only be found for Denmark, Hungary and Latvia. The IEF in the Netherlands shows some fluctuations after 2005, whereas no significant increase or decrease of IEFs during that time could be found for the other MS (IEFs for Hungary and Latvia are explained in the section on new MS).

The EF in Denmark decreased primarily during 1990 and 1996 (-18 %) which is due to the ratio white/grey cement and the ratio rapid cement (GKL-clinker)/basis cement (FHK-clinker)/low alkali cement (SKL-RKL-clinker). The ratio white/grey cement is known from 1990-1997 with maximum in 1990 and thereafter decreasing. The fluctuations of the IEF in the Netherlands are due to the use of an average EF for the earlier years and plant-specific parameters starting from 2005.

Due to a question raised during the Centralized review in 2010, Table 4.3 was corrected for Belgium and Luxembourg, as these MS use a Tier 2 methodology to estimate CO_2 emissions from cement production instead of Tier 3.

Table 4.3 **2A1 Cement Production: Information on methods applied and emission factors for CO_2 emissions**

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2011 Activity data Description	2011 Activity data (kt)	2011 Implied emission factor (t/t)	2011 CO_2 emissions (Gg)
Austria	CS,T1	PS	Clinker production	3 694	0.55	2033	Clinker production	3 176	0.52	1 666
Belgium	T3	PS	Clinker production	5 292	0.53	2824	Clinker production	5 060	0.55	2 762
Denmark	CS	PS	Clinker production	1 406	0.63	882	Clinker production	1 582	0.54	862
Finland	T2	CS	Clinker production	1 470	0.50	734	Clinker production	1 129	0.50	564
France	T2, T3	PS	Clinker production	20 854	0.52	10937	Clinker production	15 229	0.53	8 065
Germany	T2	CS	Clinker production	28 577	0.53	15146	Clinker production	24 775	0.53	13 131
Greece	CS	PS	Clinker production	10 645	0.53	5641	Clinker production	4 569	0.53	2 430
Ireland	T2	PS	Clinker production	1 610	0.55	884	Clinker production	1 805	0.54	966
Italy	T2	CS,PS	Clinker production	29 786	0.54	16084	Clinker production	24 057	0.52	12 583
Luxembourg	T2	CS,PS	Clinker production	1 048	0.54	570	Clinker production	770	0.53	411
Netherlands	CS	PS	Clinker production	770	0.54	416	Clinker production	674	0.52	351
Portugal	T3	OTH	Clinker production	6 128	0.52	3176	Clinker production	5 351	0.53	2 813
Spain	T2	CS	Clinker production	23 212	0.53	12279	Clinker production	18 243	0.52	9 523
Sweden	T2	PS	Clinker production	2 348	0.54	1272	Clinker production	2 603	0.52	1 359
UK	T2	CS	Clinker production	C	C	7295	Clinker production	C	C	4 096
EU15			**EU15 w/o UK (91%)**	**136 839**	**0.53**	**72 878**	**EU15 w/o UK (94%)**	**109 023**	**0.53**	**57 486**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.4 summarizes the methodological information provided by EU-15 Member States in their national inventory reports for cement production. A large number of Member States use data collected from plants under the EU emission trading scheme.

Table 4.4 2A1 Cement Production: Summary of methodological information provided by Member States

Cement Production	
Member State	**Methodology overview**
Austria	Emissions were estimated using a country specific method similar to the IPCC Tier 2 methodology. AD (clinker production) as well as emission were taken from studies from the Austrian cement production industry covering the period from 1995 to 2011. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes. CO2 emissions from the raw meal calcination (decarbonising) were calculated from the raw meal composition determined at every Austrian plant, considering also the MgCO3 content of the raw meal. Based on this data and plant specific production data total emissions from this source were calculated. With the used methodology no cement kiln dust (CKD) correction factor has to be considered. However, in the Austrian plants cement kiln dust is returned back into the process.[NIR 2013].
Belgium	The AD is the clinker production collected directly from individual plants following the Tier 2 method. The calculation of the CO2 process emissions follows the guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC. The emissions are verified each year by an external agency. Since 2002, these emissions have been estimated by using plant-specific emission factors. An average emission factor by plant was estimated in 2002 and is applied on the complete time-series 1990-2001. Since 2002, the emission factor has varied each year and has been calculated directly by the plant. Since 2004, plant data has included information on the CaO and MgO content of the clinker and non-carbonate sources of CaO and MgO. The decarbonisation of the dust re-injected in the furnace is also taking account. The calculation is performed by the operators themselves and subject to independent review in the framework of the Emission Trading Scheme. The same approach cannot be applied to the emission factors for the entire time series because of a lack of plant-specific data on the MgO and CaO content of the clinker and non-carbonate sources of CaO and MgO. That is the reason why an average emission factor by plant was estimated in 2002 and applied on the complete time-series 1990-2001. [NIR 2013]
Denmark	The CO2 emission from the production of cement has been estimated by the company. The emission factor has been estimated from the loss of ignition determined for the different kinds of clinkers produced, combined with the volumes of grey and white cements produced. Determination of loss of ignition takes into account all the potential raw materials leading to release of CO2 and omits the Ca-sources leading to generation of CaO in cement clinker without CO2 release. From the year 2005 onwards CO2 emissions determined by the company for EU-ETS is used in the inventory. The EF depends on the ratio: white/grey cement and the ratio between three types of clinker for grey cement: GKL-clinker/FHK-clinker/SKL-RKLclinker. The ratio white/grey cement is known from 1990-1997 with maximum in 1990 and thereafter decreasing. The ratio: GKL-clinker/FHKclinker/ SKL-RKL-clinker is known from 1990-1997. The individual EF for the different clinker types are respectively: 0.477, 0.459, and 0.610 tonne CO2 per ton. The production of SKL/RKL-clinker peaks in 1991 and decreases hereafter. FKH-clinker is introduced in 1992 and increase to 35 % in 1997. Information on the total production of clinker from 1998-2011 has been provided by the company recently. The company has at the same time stated that data until 1997 cannot be improved as they are not available anymore. [NIR 2013]
Finland	Emissions were calculated using a Tier 2 methodology. The amount of clinker produced annually is used as AD. Data for the years 1990-2006 are received directly from the company and for years 2007-2011 from EU ETS data. EFs used in the calculation of emissions from cement production are plant-specific provided by the industry for the whole time series (except for plant 3 where the mean of the two other plant is applied) and are corrected for CaO and MgO contents. The cement kiln dust data was available from the companies for years 1996 - 2005 (plant 1) and 1996 - 2006 (plant 2). For plant 3, no data was available. Missing data was imputed using means of the data available. The clinker production data is complete and no imputation was necessary. Data for the years 1990-2006 are received directly from the company and for years 2007-2011 from EU ETS data. [NIR 2013]
France	France uses a Tier 2 method for the earlier year and Tier 3 method for more recent years. The methodology based on national statistics (clinker statistics) from cement association and national EFs from industry. Since 2004 detailed plant-specific data with plant-specific EF and emissions reported under the EU-ETS are used. Since 2008, annual data considering all three sources (calcination of carbonates in the raw materials used to produce the clinker, the partial calcination of cement kiln dust or bypass dust, the non-carbonate carbon in raw materials) is used. Before 2004 an average EF and data that became available in 2009 was used [NIR 2013]
Germany	Activity data from BDZ were used until 1994. As of 1995, following improvement of data collection within the association, activity data were compiled by the VDZ, and by its cement-industry research institute, via surveys of German cement plants. The emission factor used is 0.53 t CO2 / t cement clinker, which is based on mass-weighted EFs for individual plants, i.e. the VDZ determined the emission factor by aggregating plant-specific data relative to fractions of CaO and other metal oxides (MgO; in raw materials, and containing carbonate) in clinker. A research project confirmed this EF (VdZ, 2009). Cement kiln dust is recycled into the kiln. [NIR 2013]
Greece	For the years 2005-2011 detailed data have been accessed via the verified EU ETS reports of the plants. These data refer to the quantities of carbonate raw material (CaCO3, MgCO3) used for the production of clinker. In the recent years (2008 – 2011) the plants report also emissions from non-carbonate carbon (organic carbon). As regards to the emissions from the non-calcined CKD not recycled to the kiln, these have already been included in the emissions from carbonates reported by the plants. Emissions prior to 2005 in the past were calculated using the Tier 2 methodology, based on clinker production. Following the change of the methodology to Tier 3, and according to the IPCC GPG, the overlap method has been used in order to ensure the consistency of the time-series. [NIR 2013]

Cement Production	
Member State	**Methodology overview**
Ireland	In 2004, plant-specific information relating to CO2 emissions in 2002 and 2003 was obtained by the EPA for all cement plants for the development of Ireland's First National Allocation Plan. This method is fully consistent with the Tier 2 method in the IPCC good practice guidance and its application employs reliable data on clinker production, corrected as appropriate for CKD, and CaO content of the clinker. The reported process CO2 emissions for each plant in 2002 and 2003 were calculated using the Tier 2 method. As the EU ETS subsequently became operational, plant specific CO2 emissions and corresponding clinker production data are also available for all cement plants for the years 2004 through 2010 and these data are used directly to report emissions for category 2.A.1 in Ireland. The plant-specific emission factors for process CO2 emissions in 2011 ranged from 0.516 to 0.536 t CO2/ t clinker with a weighted average of 0.535 t CO2/ t clinker, which is very similar to the 2010 values. [NIR 2013]
Italy	CO2 emissions from cement production are estimated by the IPCC Tier 2 approach. Activity data comprise data on clinker production provided by ISTAT (ISTAT, several years). Emission factors are estimated on the basis of information provided by the Italian Cement Association (AITEC, several years) and by cement facilities in the framework of the European pollutant emission register (EPER, now E-PRTR) and the European emissions trading scheme. For the years from 1990 up to 2003 the resulting emission factor for cement production was equal to 540 kg CO2/t clinker, based on the average CaO content in the clinker and taking into account the contribute of carbonates and additives. In lack of specific data from the plants, this value was suggested to the operators by AITEC (AITEC, 2004) on the basis of a tool provided by the World Business Council for Sustainable Development. From 2004, emission factors are based on the data reported within the frame of the EPER/EPRTR and of the European Emissions Trading scheme. The EF resulted in 518 kg CO2/t clinker in 2008, in 528 kg CO2/t clinker in 2009 (EF value for this year has been checked and revised in the present submission) and in 523 kg CO2/t in 2011 based on the average CaO content in the clinker and taking into account the contribute of carbonates and additives. The average emission factor varies year per year as a consequence of the different circumstances (e.g. quality of the raw materials and operating conditions) at the about 54 clinker facilities. [NIR 2013]
Luxembourg	In Luxembourg, one clinker production plant is operating. During the production of clinker, limestone, which is mainly calcium carbonate (CaCO3), is calcined to produce lime (CaO) and CO2 as a by-product. Activity data, i.e. clinker production, is obtained annually from the plant operator. For the estimation of CO2 emissions, the Tier 2 method of 2000 IPCC-GPG using clinker production data is applied. According to the operator of the plant, there is no calcined Cement Kiln Dust (CKD) to be lost from the system. Hence, the CKD Correction Factor equals 1.00. According to 2007 ETS Tier 3 method, the emission factor is based on the CaO and MgO content of the clinker. It is assumed that all the CaO and MgO are from carbonate source (e.g. CaCO3 and MgCO3 in limestone). Plant-specific CaO and MgO contents are available (chemical analysis done by the plant operator). [NIR 2013]
Netherlands	For cement clinker production the environmental reports (AER) of the single Dutch company are used. The CO2 process emissions from this source category are from 2002 based on (measured) data reported by the single company in the Netherlands that produces clinkers. The methodology for measurements and for calculating emissions can be described as follows: The first carbonate input in the kiln is the raw material. The CO2 emission is calculated on a monthly basis by multiplying the amount of raw material by a derived process EF. From every batch in a month a sample is taken just before the raw material is fed into the kiln. The process EFs and composition data for batches of raw material are determined in a laboratory. The EF is determined by measuring the weight loss of the sample (excluding the amount of organic carbon). The monthly EF is set as the average of all sample EFs determined that month. The second carbonate input in the kiln is sewage sludge. The CO2 emission from this source is also calculated monthly by multiplying the amount of sewage sludge by the monthly derived process EF. Besides the CO2 emissions resulting from calcination of the carbonate input in the kiln, the company considers the CO2 emission from burning off the small amount of organic carbon in the raw material as a process emission. As a result, the total yearly process emissions of the company are the sum of all monthly emissions of the following sources: A. CO2 from the calcination of the carbonate input of the raw material; B. CO2 from the calcination of the carbonate input of sewage sludge; C. CO2 from the burning of organic carbon in the raw material.[NIR 2013]
Portugal	EU-ETS method A from Annex VII of Decision 2007/589/EC is used from 2005 onwards. Calculation is based on the carbonate content of process inputs (including fly-ash or blast furnace slag) with cement kiln dust (CKD) and bypass dust deducted from raw material consumption (Tier 3). It is assumed a complete calcination (conversion factor = 1). For the period 1990-2004, emissions were estimated based on clinker production time series. The CO2 emission factors were estimated by converting kiln input materials composition data, using the following stoichiometric ratios. EU-ETS data on consumption of raw materials is used from 2005 onwards. Clinker production since 2005 was received directly from each industrial plant. [NIR 2013]

Cement Production	
Member State	**Methodology overview**
Spain	The estimation of CO2 emissions for this activity has been performed by using the Tier 2 method and by applying an emission factor per quantity of clinker produced. Clinker production data and the applied EF are obtained from associations of cement production (OFICEMEN). The EF was derived from data on ton of clinker produced for the period 2005-2009 as provided by OFICEMEN. The original source of the EFs are the data provided by the cement plants under the EU ETS. For the years prior to the start of the EU ETS, the average EF for 2005 was used. [NIR 2013]
Sweden	Emissions have been estimated based on ETS data as well as direct information from the company based on clinker production. In line with the Good Practice Guidance Tier 2 methodology, plant-specific CO2 emission estimations in Sweden are based on clinker production and include emissions from by-pass dust and cement kiln dust (CKD) as well as emissions from organic carbon of raw meal. For 1990-2004, information from the company on CO2 emissions is based on clinker production and default EF from GHG protocol, CKD correction factor and organic carbon in raw meal. From 2005, the company reports plant-specific data on CO2 emissions to the EU ETS. The CO2 emissions are based on production of clinker and CaO content of clinker, but also include CO2 contained in released non-recycled dust (CKD and by-pass) as prescribed by the national guidelines for reporting to the EU ETS 92. Also CO2 emissions from organic carbon of raw meal are included in the CO2 emissions reported in the EU ETS. [NIR 2013]
United Kingdom	The methodology used for estimating CO2 emissions from calcination is to use data provided by theMineral Product Association (2011), which in turn is based on data generated by UK cement clinker producers for the purposes of reporting to the EU Emission Trading Scheme. The data are available for 2005 to 2011 only, and so the value for 2005 has been applied to earlier years as well. [NIR 2013]
According to the analysis presented in Table above 97.5% of MS estimate emissions with higher tier methods.	

Source: NIR 2013.

According to the analysis presented in Table 4.5, 5% of MS estimate emissions with higher tier methods. **Error! Reference source not found.** summarizes the recommendations from the 2011 and 2012 UNFCCC inventory reviews in relation to the category 2A1 Cement Production. The overview shows that reports from the centralized and in-country reviews conducted in 2012 are still lacking for most Member States until now and were only available for Austria, Estonia, Italy, Lithuania, Luxembourg, Malta, Poland, Romania and Sweden. Recommendations from the 2011 UNFCCC inventory review are included for those MS for which no 2012 review reports are available.

Table 4.5 2A1 Cement Production: Findings of the 2011 and 2012 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2013 inventory submissions

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2011/2012 submission	**Status in 2013 submission**
Austria	Improve transparency by including information on the composition of raw meal and on the calcium carbonate and magnesium carbonate content for all years of the time series, including additional information on the use of EU ETS data and provide an explanation of how time-series consistency is ensured across the time series.(FCCC/ARR/2012/AUT)	Composition of raw meal is provided in 2013 NIR. The methodology is based on the same methodology over the time seires, no additional justification of time series consistency seems necessary.
Belgium	As indicated in the previous review report, it is not clear whether the impact of the magnesium oxide (MgO) content in clinker on the CO2 EFs has been considered for the whole time series. In response to questions raised by the ERT during the review, Belgium provided an additional description of the methodology used to determine the EFs and confirmed that the MgO content in clinker has been considered for the estimates since 2004. The ERT recommends that the Party apply the same approach to the EFs for the entire time series, in order to improve time-series consistency, and improve the documentation on the EF in the NIR, in order to improve the transparency of the next annual submission (FCCC/ARR/2011/BEL). Review report 2012 not yet available.	Ib the NIR it is explained that since 2004, plant data had included information on the CaO and MgO content of the clinker and non-carbonate sources of CaO. (p. 84)
Denmark	The ERT questioned the Party, during the review, as to whether it accounts for imports and exports for the early years of the time series, which are required to be taken into account when using a tier 1 approach. The Party responded to the ERT that it believes that clinker production at that time was solely for the company's own use, but that it will research this further and confirm in its next annual submission. The ERT recommends that Denmark conduct this research to ensure that the tier 1 approach is being implemented in accordance with the IPCC good practice guidance for estimating emissions for the early years of the time series. The ERT further questioned Denmark on its consideration of cement kiln dust (CKD) in the time series of emission estimates, in particular for the earlier years. Denmark responded that, although it is known that the emission estimates are based on the different types of clinker used, there is no information to indicate whether CKD is included in the emission estimates. The ERT recommends that Denmark continue to pursue any information that could clarify whether CKD is included in the emission estimates for all years of the time series. (FCCC/ARR/2011/DNK). (2012 ARR not yet available).	The ERT has been informed that no further information is available for the years1990-1997. The work with including CKD in the emission estimates is on-going.
Finland	The ERT recommends that Finland explain the increasing trend in CO2 emissions from 1993 onwards and provide the total rated clinker production capacity of cement plants in Finland in the next annual submission. For cement production Finland applies a correction factor of 0.92 to account for non-carbonate sources of calcium oxide (CaO) in the raw materials. This factor causes Finland to have one of the lowest IEFs (0.50 t/t for 2009) of all reporting Parties (0.49–0.56 t/t). The source of the IEF is mentioned; however, it is not included in the list of references in the NIR. The ERT recommends that Finland include this information in the NIR of the next annual submission. (FCCC/ARR/2011/FIN)	Finland explained that the decrease was due to the economic recession and the closing of a plant in 1993, while the increase in the latter period of the time series is due to an increase in clinker production. Finland also clarified that the production capacity is not relevant in this respect, and that it would increase the resources needed for data collection unduly.The reference related to the correction factor is included in the NIR.
France	The ERT recommends that France report the exact number of plants applying a tier 3 method and those still applying a tier 2 method, with the corresponding AD and EFs used, in order to increase transparency. The ERT reiterates the recommendation in the previous review report that France recalculate the previous emission estimates for the plants now using a tier 3 methodology for the entire time series in its next annual submission. To increase transparency, the ERT reiterates the recommendation of the 2009 review report that France report the EF and AD used to estimate emissions from this category disaggregated by cement type. In the previous review report it was recommended that France provide more information on the consideration of cement kiln dust (CKD) and the dust collection and recycling systems in the 33 cement plants in the country. France has not provided additional information in its 2011 annual submission on this issue. The ERT reiterates the recommendation in the previous review report that France clarify the dust collection and recycling systems in the cement plants and the related consideration of CKD in the estimation of emissions in its next annual submission.(FCCC/ARR/2011/FRA). (2012 ARR not yet available).	CKD has been considered and included for the entire time series. Tier 3 plant specific data are not available before 2004, therefore France has used IPCC methodologies to achieve time-series consistency, but tier 3 methods annot be produced for earlier years. Data for different cement types are reported for two different cement types.

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2011/2012 submission	Status in 2013 submission
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DEU). 2012 ARR not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	Ireland uses plant-specific data and EFs reported under the EU ETS to estimate emissions from cement production. Estimates include the consideration of the cement kiln dust factor. However, the Party still does not report information on the CaO and MgO content of the clinker, which is used to derive the country-specific estimates. The ERT, therefore, reiterates the recommendation in the previous review report, in accordance with the IPCC good practice guidance, that Ireland include information on the CaO and MgO content of the clinker in its future annual submissions. (FCCC/ARR/2011/IRL) (2012 ARR not yet available).	Information on CaO and MgO content of clinker is not published in this inventory report as the cement producers deem it to be confidential. The data are available to the expert review teams for annual GHG inventory reviews upon request.
Italy	In response to a question raised by the ERT during the review about the decreasing trend, the Party responded that the national cement facilities association (Associazione Italiana Tecnico Economica Cemento) confirmed that for the last decade operators have been committed to the reduction of CO2 emissions from their production by producing the types of cement that have a lower clinker demand. The operators have achieved this by partially replacing clinker with different materials (e.g. fine ground carbonates and fly ash). In addition, Italy indicated that the IEF for each plant depends on the quality of the raw material input. The ERT noted that altering the fraction of clinker in cement, while reducing total CO2 emissions, should not have an impact on the decreasing IEF, which is based on emissions/t clinker produced. However, the ERT agrees that the quality of the raw material input (e.g. carbonate content) could result in a fluctuating IEF. Therefore, the ERT recommends that the Party further explore the fluctuating IEF and provide information thereon in its next annual submission. (FCCC/ARR/2012/ITA).	Italy already provided a satisfying answer to the ERT. It is unclear what they should further explore, if the explanation has already been provided.
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/LUX).	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD). 2012 ARR not yet available.	No follow-up necessary
Portugal	However, for the period 1990–2004, the emissions were estimated based on a simple backcasting methodology using the clinker production time series provided directly by the cement production plants as a driver, but the Party has not provided a clear explanation of this methodology in the NIR. The ERT recommends that Portugal provide additional descriptions of the estimation methodologies used for the period 1990–2004, in order to improve the transparency of its next annual submission. (FCCC/ARR/2011/PRT). (2012 ARR not yet available).	Information on the AD data used for the period 1990-2004 is provided in the NIR 2013.
Spain	During the review week, the Party's inventory team informed the ERT that Spain performed QC checks to AD and IEFs taking into consideration that the procedures implemented for the EU ETS to estimate emissions are in accordance with the IPCC good practice guidance. The ERT recommends that Spain include a brief description of the EU ETS-based QC measures in the NIR of its next annual submission (FCCC/ARR/2011/ESP).(2012 ARR not yet available.)	No specific description of ETS-based QC measures are provided in the methodological description of the NIR apart from the fact that Efs and AD were compared.
Sweden	Sweden reported CO2 emission estimates for the organic carbon content of the raw meal for the period 1990–2010. For the period 2005–2010, the CO2 emissions from the raw meal were estimated using information from the facilities for 2004 and added to the estimated CO2 emissions from clinker production. In response to questions raised by the ERT during the review, Sweden clarified that, for the period 2005–2010, the EU ETS data already included CO2 emissions from the organic carbon content of the raw meal, and that the reported emissions are therefore overestimated. The Party indicated that it plans to remove the reported CO2 emissions from the organic carbon content of the raw meal in its next annual submission. The ERT recommends that Sweden reconsider the estimates of emissions from cement production for the entire time series in its next annual submission (FCCC/ARR/2012/SWE).	Recalculations are performed and explained in the 2013 submission.
UK	During the review, based on the aggregated clinker production figures provided by the United Kingdom, the ERT concluded that the decline in emissions in recent years was a result of a decline in clinker production, while the implied emission factors (IEFs) remain quite stable across the whole time series. The ERT recommends therefore that the United Kingdom explain the trend of cement production in its next annual submission. (FCCC/ARR/2011/GBR). (2012 ARR not yet available).	No further information on the trend for cement production is provided.

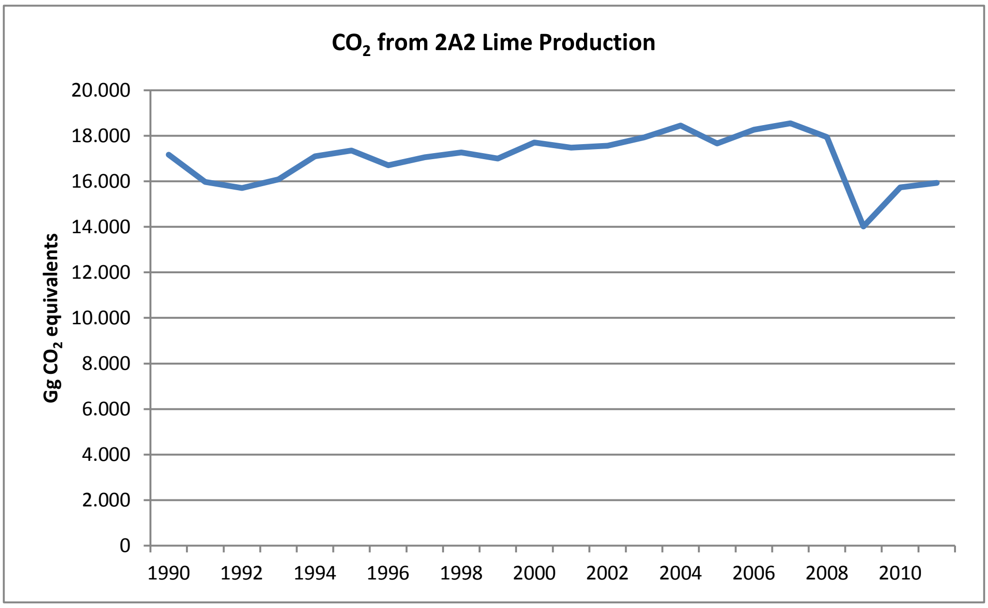
Source: NIR 2013, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.1.2 *2A2 Lime Production*

CO_2 emissions from 2A2 Lime Production account for 0.4 % of total GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from this source decreased by 7 % in the EU-15. Germany and France are the largest emitters accounting for 30.9 % and 13.2 % of EU-15 emissions respectively, followed by Italy (13.0 %). Compared to 2010, emissions remained almost stable with a small increase of 1.2 % for the EU-15. The decrease of CO_2 emissions in the early nineties was dominated by emission reductions in Germany, Belgium, France and the UK due to a decreased production of lime and dolomite.

The emissions in the EU-15 increased by 6 % in the period 1993 to 1994. This increase was caused by a raised production rate of lime in Germany and France in that period (Figure 4.4). In 2009, lime production decreased sharply due to the economic crisis in all MS, many MS also showed decreasing lime production in 2007 and 2008. In 2011 lime production increased again slightly by 1.2 % compared to the previous year due to the improved economic situation in most MS, however emissions continued to decrease in Denmark, France, Greece, Italy, Spain and Sweden.

Figure 4.4 2A2 Lime Production: EU-15 CO_2 emissions



Germany was responsible for 30.9 % of the emissions from this source in 2011. The decrease of emissions in the early nineties was dominated by the drop in German lime production due to the sector's restructuring following German reunification, as well as of economic factors and development of competing and substitute products. In 2011, 7 MS reduced their emissions since 1990 and 6 MS increased their emissions from this source category.

Table 4.6 2A2 Lime Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	396	574	605	3.8%	30	5%	209	53%	CS	CS,PS
Belgium	2 097	1 648	1 741	10.9%	93	6%	-356	-17%	T3	PS
Denmark	116	46	35	0.2%	-10	-23%	-80	-69%	CS	D
Finland	383	412	438	2.7%	26	6%	55	14%	T2	CS
France	2 587	2 256	2 106	13.2%	-150	-7%	-482	-19%	T2, T3	PS
Germany	5 868	4 768	4 927	30.9%	158	3%	-941	-16%	T2	CS
Greece	404	230	193	1.2%	-37	-16%	-211	-52%	CS	PS
Ireland	214	192	199	1.2%	7	3%	-15	-7%	T2	PS
Italy	2 042	1 969	2 069	13.0%	100	5%	27	1%	T2	CS,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	IE	IE	IE	-	-	-	-	-	NA	NA
Portugal	197	431	501	3.1%	69	16%	303	154%	T3	OTH
Spain	1 146	1 584	1 468	9.2%	-116	-7%	322	28%	D	D, PS
Sweden	295	527	513	3.2%	-14	-3%	219	74%	D	D
United Kingdom	1 436	1 096	1 135	7.1%	39	4%	-301	-21%	T2	D
EU-15	**17 181**	**15 735**	**15 930**	**100.0%**	**195**	**1%**	**-1 250**	**-7%**		

Emissions of the Netherlands are included in 2D2 Food industries.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.6 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A2 Lime Production for 1990 to 2011. The table shows that 95 % of EU-15 MS use lime production as activity data for calculating CO_2 emissions, except for the UK that uses limestone consumption.

The EU-15 IEF (excluding the UK) in 2011 is 0.72 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.62 for France and 0.78 for Belgium and Finland. The table also suggests that 86 % of the EU-15 emissions are estimated using higher tier methodologies (country-specific, Tier 2 and Tier 3).

The IEFs during 1990 and 2011 in the inventories submission 2013 mostly due not fluctuate strongly. The IEF decreased in 2011 compared to the previous year in France, Greece and Spain. Italy's IEF decreased most during 1990 and 2009 (-11 %), and the IEF in Portugal showed fluctuations in 2006 and 2007. Explanations for the development of the recent changes in implied emission factors are given in the following overview:

Implied Emission Factor Lime production, Italy

The consistent trend of IEF was interrupted in 2004, when the IEF decreased by 11 % between 2004 and 2005. This break is caused by the use of data based on times series supplied in the framework of the EU ETS. An average emission factor that was supplied for the years 2000 to 2004 was also used for previous years. Data from the ETS submission for the first allocation plan was used for the years 2005 onwards.

Implied Emission Factor Lime production, Greece

The fluctuations in the IEF can be attributed to the fact that activity data reported are calculated using ElStat data for hydrated, non-hydrated and hydraulic lime, as described in the IPCC GPG, although the emissions are calculated according to the verified ETS reports, as provided by the plants. These fluctuations can also be attributed to the carbonates content of the raw material. Especially, for 2010 the CaCO3 content of the raw material was 94.09%, while for 2011 the calcium carbonate content was 95.41%.

Implied Emission Factor Lime production, France

Small fluctuations of the IEF arise from the contribution of different lime types with different carbonate contents of the raw materials that lead to some fluctuations in the implied emission factors, in particular the EF for hydraulic lime can vary between 335 et 568 kg/t which impacts the IEF.

Implied Emission Factor Lime production, Spain

The variations of IEF (0.753 t CO_2/t in 1992 to 0.877 t CO_2/t in 1997, reaching the second highest IEF among EU-15 MS in 1997) is caused by reporting of different activity data by the lime manufacturers in the past as the activity data is partly referred to limestone raw material on the one hand and partly to lime production data on the other. For recent years no significant variations of the IEF could be found; the implied emission factor for aggregated lime production was 0.69 t CO_2/t lime in 2011, which is very similar to that for the other years for which ETS data is available.

Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. Draft 2006 IPCC Guidelines define three tiers, an output-based approach that uses default values (Tier 1), an output-based approach that estimates emissions from CaO and CaO·MgO production and country-specific information for correction factors (Tier 2) and an input-based carbonate approach (Tier 3), the latter requiring plant-specific data. Lime production is covered under the EU emissions trading scheme and monitoring guidelines under the EU ETS (Commission Decision of 29/01/2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council) allow methods equivalent to either Tier 2 or Tier 3 above. The use of plant-specific data reported and verified under the EU ETS by Member States therefore can be considered as equivalent to Tier 2 or Tier 3 as defined in draft 2006 IPCC Guidelines.

Table 4.7 2A2 Lime Production: Information on methods applied, activity data, emission factors for CO_2 emissions

			1990				2011			
Member State	Method applied	Emission factor	Activity data		Implied emission factor	CO_2 emissions	Activity data		Implied emission factor	CO_2 emissions
			Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS	CS,PS	Lime Production	513	0.77	396	Lime Production	810	0.75	605
Belgium	T3	PS	Lime production	2 661	0.79	2 097	Lime production	2 236	0.78	1 741
Denmark	CS	D	Lime production	156	0.74	116	Lime production	49	0.72	35
Finland	T2	CS	Lime Production	488	0.78	383	Lime Production	558	0.78	438
France	T2, T3	PS	Lime Production	3 587	0.72	2 587	Lime Production	3 377	0.62	2 106
Germany	T2	CS	Lime Production	7 772	0.76	5 868	Lime Production	6 550	0.75	4 927
Greece	CS	PS	Lime Production	491	0.82	404	Lime Production	260	0.74	193
Ireland	T2	PS	Lime Production	255	0.84	214	Lime Production	261	0.76	199
Italy	T2	CS,PS	Lime Production	2 583	0.79	2 042	Lime Production	2 939	0.70	2 069
Portugal	T3	OTH	Lime Production	276	0.72	197	Lime Production	695	0.72	501
Spain	D	D, PS	Lime Production	1 601	0.72	1 146	Lime Production	2 135	0.69	1 468
Sweden	D	D	Lime Production	389	0.76	295	Lime Production	685	0.75	513
UK	T2	D	Limestone consumption	3 223	0.45	1 436	Limestone consumption	2 548	0.45	1 135
EU15			**EU15 w/o UK (93%)**	**20 772**	**0.76**	**15 745**	**EU15 w/o UK (95%)**	**20 554**	**0.72**	**14 796**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.8 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category.

Table 4.8 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production	
Member State	**Methodology comment**
Austria	Emissions were estimated using a country specific method based on detailed production data. Activity data and emission values were reported by the Association of the Stone & Ceramic Industry. For 2005-2010 verified CO_2 emissions reported under the ETS were used for the inventory. These data cover the whole lime producing industry in Austria. The methodology for this emission calculation is the same like in the years before. The reported CO_2 emission data is based on data of each lime production plant in Austria, including production volumes and the respective CaO and MgO contents of lime produced in the respective plant. For the years from 2005 onwards detailed, verified data from the ETS is available: some plants calculate emissions based on data of the raw material, most calculate emissions from data of produced lime; thus the activity data reported under the ETS for some plants is production volumes, for others the amount of used raw materials. For the calculation of an overall IEF the overall value of Austrian lime production as reported by the Association of the Stone & Ceramic Industry is used. The IEF depends on the quality (CaCO3/MgCO3 content) of the used limestone; it ranges between 0.73 and 0.77 tonnes CO_2 per tonne lime produced – which corresponds to the default range for purity of high calcium lime from 93-98%. [NIR 2013]
Belgium	From 1990 to 2002, these emissions of lime production were estimated by using default emission factors (790 kg CO_2/T lime and 910 kg CO_2/T dolomite lime) in three different plants and a plant-specific emission factor (754 kg CO_2/T lime) in the three others plants. This plant-specific emission factor was coming from analyses performed in 2002. Since 2003, all the emission factors are plant-specific (except for the dolomite lime in 2003 and 2004). The activity data are the lime and dolomite lime production and are collected directly from individual plants. The variations of the global emission factors are mainly due to the different proportions of lime and dolomite lime production over the years. A part of the lime production is coming from the kraft pulping process: the CO_2 liberated during the conversion of calcium carbonate to calcium oxide in the lime kiln in the kraft pulping process contains carbon which originates in wood. This CO_2 is not included in the net emissions (CO_2 biomass in table 4.2). It explains the low IEF lime (750-760 kg CO_2/t) as the lime production coming from the kraft pulping process is included in the lime production. [NIR 2013]
Denmark	The CO_2 emission from the production of burnt lime (quicklime) as well as hydrated lime (slaked lime) has been estimated from the annual pro-duction figures, registered by Statistics Denmark, and emission factors. The EFs applied are 0.785 kg CO_2/kg CaO as recommended by IPCC (IPCC (1996), vol. 3, p. 2.8) and 0.541 kg CO_2/kg hydrated lime (calculated from company information on composition of hydrated lime (Faxe Kalk, 2003)).One Danish company – Faxe Kalk – is covered by the EUETS, however, the company do only account for approximately 75 % of the Danish production of lime and hydrated lime (average from 1999-2008). A number of small companies accounts for the remaining of the Danish production. [NIR 2013]
Finland	Emissions were calculated using a Tier 2 methodology. Emissions from lime production are calculated by multiplying emission factors with lime output. Activity data are collected mainly directly from the industry but industrial statistics have also been used for earlier years. Emissions from 2005 onwards have been calculated using production data reported to the EU ETS data. The total amount of produced lime has also been checked from industrial statistics. The calculation method was slightly updated for the latest submission due to new information of activity data in EU ETS, as only pure lime (=CaO+MgO amounts) are used as activity data (impurities have been written off the amount of lime). For all other years (1990-2004) production amount was then recalculated using the assumption (Emissions permit, 2010) that about 6 per cent of the product is impurities. There are two emission factors used in Finland to calculate emissions of lime production. There is an emission factor for all five plants of a company and it is based on the actual CaO and MgO contents of lime derived from measurements of those five plants in Finland. It is a calculated mean value from emission and production data for the years 1998-2002. This emission factor has been used for the whole time series for those five plants. After the exclusion of impurities of produced lime, the mean value was also recalculated and used to calculate emissions of those five plants for the whole time series. Emissions of another company, plant was founded in 2003, are calculated using emission factors which are based on the yearly average of actual CaO and MgO contents in lime (GHG emissions permit, 2011). [NIR 2013]
France	Higher tier methodology considering three types of lime. AD from industrial associations are used until 2005 (plant-specific data were available for a subset of plants), since 2004 plant-specific AD for all installations are available. Stochiometric EF for lime, and CS EF for hydraulic lime used based on national data. Average EFs for the three lime types are used until 1995 which were gradually replaced by plant-specific EF. To take into account impurities corrections have been undertaken to be in accordance with the methodology applied in the EU ETS. Lime production in sugar industry is estimates and a specific EF was derived [NIR 2013]
Germany	Country-specific EFs have been replaced default- EF based on stochiometric relationships in the 2012 submission (EFlime 0.746 CO_2/t lime and EFdolomitic lime 0.867 t CO_2/t dolomitic lime). The approach conforms to the specifications in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000). The German Lime Association (BV Kalk) collects the production data for the entire time series, on a plant-specific basis, and makes them available for reporting purposes. The quantities produced by plants that are not included in the German Lime Association's association statistics are estimated on the basis of existing information (such as operator figures, data published in the framework of emissions trading) and then added to the German Lime Association's figures. This ensures that all of German lime production is taken into account. [NIR 2013]
Greece	For years 2005 – 2011, the calculation of carbon dioxide emissions from lime production is based on the collection of plant-specific data on the type (s) and quantity(ies) of carbonate(s) consumed to produce lime, as well as the respective emission factor(s) of the carbonates consumed. The principal carbonates detected in the Greek lime industry were CaCO3 and MgCO3. The activity data resulted in 447.90 kt of CaCO3 eq for the production of lime in

Lime Production	
Member State	**Methodology comment**
	2011. The emission factor for CaCO3 is 0.44 and for MgCO3 0.522. As regards to the emissions from the non-calcined carbonate remaining in LKD, they have already been included in the emissions from carbonates reported by the plants, therefore an assumption of Fd=1 has been used to avoid double counting.The lime production of Greece refers to high-calcium and hydraulic lime. Both values are provided by the NSSG for the years 1993-2011, whereas for the years 1990-1993 the missing data have been calculated using the trend extrapolation method as described in the IPCC GPG. Hydraulic lime data for 2008 - 2011 are provided directly by the sole plant producing it in Greece.Lime production in the national statistics is reported as non hydrated lime, hydrated lime and hydraulic lime. The hydrated lime production data are converted to non hydrated lime using the correction for the proportion of hydrated lime as described in the IPCC GPG, using a water content of 28%.The average proportion of hydrated lime to non-hydrated and hydraulic is 55.01%. According to the data provided by the El.Stat. and the relevant plant, hydraulic lime for 2011 was not produced. [NIR 2013]
Ireland	Statistical data on lime production in Ireland are obtained annually from the lime manufacturers. Lime producers provided their own estimates of CO_2 emissions from lime manufacture for the development of NAP1. These were calculated in accordance with the methods providing detailed information on emission estimates and activity data. The CO_2 estimates for lime production in 2010 have been obtained from the ETS returns to the Climate Change Unit of the EPA. The implied emission factor for aggregated lime production was 0.762 t CO_2/t lime in 2011, which is very similar to that for the other years for which ETS data are available. Data provided by the lime producers form the basis for emissions over the period 1990-2004. The implied emission factors for the 1990-2004 time-series indicated by the information supplied by the lime producers are in the range 0.753 to 0.877 t CO_2/t lime produced with an average of 0.82 t CO_2/t lime. EU ETS data for the years 2005 to 2011 are used to confirm the estimates for the years 1990-2004. [NIR 2013]
Italy	CO_2 emissions from lime have been estimated on the basis of production activity data supplied by ISTAT (ISTAT, several years) and by operators in the frame of the ETS reporting obligations adding the amount of lime produced and used in the sugar and iron and steel production sectors; emission factors have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association (CAGEMA, 2005). In particular since 2009, information available in the frame of the ETS reporting obligation has allowed us having the lime productions at facility level together with CO_2 emissions data (both activity data and CO_2 emissions are certified). [NIR 2013]
Luxembourg	Not occuring. [NIR 2012]
Netherlands	Lime production only occurs in sugar industry which is reported under category 2D2 Food and drink. [NIR 2013]
Portugal	EU-ETS method A from Annex VIII of Decision 2007/589/EC from 2005 onwards. Calculation is based on the amount of calcium carbonate and magnesium carbonate in the raw materials consumed (Tier 3). For the period 1990-2004, emissions were estimated based on lime production time series. Data on consumption of raw materials, was obtained for the period 2005-2011 from EU-ETS. Lime production for the period 1990-2011, was obtained from National Statistics (INE) IAPI industrial survey. Lime production in the iron and steel industry was available from information received from the industry for the period 1991-1994. For the remaining years 1990 and 1995-2001 annual lime production, which data was unavailable, was forecasted using energy consumption as surrogate indicator. After year 2002 production of lime in this unit was interrupted and the production line dismantled. All lime produced in the iron and steel plant was high calcium lime. In the case of the paper pulp industry the IAIT/IAPI surveys have no available information in lime production but only of limestone and dolomite consumption. Lime production had to be estimated from consumption of those carbon bearing materials and assuming the stoichiometric ratios of limestone and dolomite rock. Consumption of limestone and dolomite materials is available for the period 1989-2000 from National Statistics (INE): for the period 1989-1991 from IAIT industrial survey, and for 1992-2011 from the IAPI industrial survey.[NIR 2013]
Spain	Higher tier methodology considering different types of lime. AD are obtained from lime producer association ANCADE. AD from non-commercial lime production was gathered by individual questionnaires from plants for lime production in steel industry, sugar production and production of calcium carbonates. Emissions from lime production in integrated steel plants are included in this category for the years 1990-1992. Emission factors are derived from IPCC guidelines depending on the quantities of the final product and the degree of purity. The purity degrees are derived from plant-specific data for each year and if such data was not available for individual plants, it was derived from adjacent years for which such information was available and in few cases from default parameters provided by WBSCD/WRI "The GHG Protocol: a corporate accounting and reporting standard." For dolomite in sinter emissions were estimates based on plant-specific information on CO_2 content in primary matter was used and for lime production in other industries the default EF from 1996 IPCC Guidelines. Separate EFs have been derived for the non-commercial lime production. [NIR 2013]
Sweden	The emissions of CO_2 from the production of lime are based on activity data on produced amounts of quicklime and hydraulic lime and dolomitic lime. As CO_2 emissions also depend on the production process, the methods for collecting activity data and estimating CO_2 emissions are described by data source. Activity data on used amounts of limestone for production of lime for sugar production are obtained directly from the sugar producing company. In earlier submissions the whole amount of lime produced and used within the sugar industry was reported as activity data without taking into account that a large amount of the produced lime is precipitated as CaCO3 in the carbonation process. Since submission 2010, only the part of CaO which is not recovered as CaCO3 is reported as activity data. Since the 2011 submission, detailed data on the quantities of lime used as make-up lime in the pulp and paper industry, and quantities of limestone and dolomite used for production of make-up lime, have been obtained from the Swedish Lime Association and The Swedish Lime Industry from 1995. Based on 2006 IPCC Guidelines, the purity of the limestone is set to 95% for the production of lime within the pulp and paper industry. The corresponding figure for dolomite is 100%. For all other production of quicklime, hydraulic lime and dolomite (mainly used in iron and steel production), detailed data from 1990 are obtained from the Swedish Lime Association. To avoid double counting of emissions, activity data for produced quicklime, hydraulic lime and dolomite lime in the sugar industry and the pulp and paper industry has been deducted. Based on 2006 IPCC Guidelines, the purity of the limestone is set to 95% for the production of lime in

Lime Production	
Member State	**Methodology comment**
	conventional lime mills. The corresponding figure for dolomite is 100%. The produced amounts of quick lime and dolomitic lime in conventional lime mills was very low in 2009 which led to a reduced amount of emitted CO_2 in 2009 compared to previous years. [NIR 2013]
United Kingdom	The UK previously based estimation of lime production emissions on limestone and dolomite consumption data, which were readily available (British Geological Survey, 2012). However, site-specific data from EU ETS and other sources have suggested a much higher production of lime in recent years, and so the activity data used in the UK inventory have now been revised to take into account this alternative information. The EU ETS data consist of CO_2 emission estimates and activity data from 2005 onwards. For limestone, an emission factor of 120 t carbon/kt limestone is assumed, based on the stoichiometry of the chemical reaction, and for dolomite, the corresponding emission factor of 130 t carbon/kt dolomite is used. The calculated activity data excludes carbonates calcined in the chemical industry since this is all used in the Solvay process, which does not release CO_2. The calcination of limestone in the sugar industry is also excluded for the same reason. Prior to 2005 there are no EU ETS data, and data are also missing for 2005-2006 for some lime kilns because of UK exemptions from the EU ETS for some sites in those years. So, between 1994 and 2004, CO_2 emission estimates for lime production are based on emissions data published in the Pollution Inventory (PI). For the period 1994-1997, there is less reporting of CO_2 in the PI and so site-specific CO_2 emissions are estimated based on other site-specific data such as emissions data for particulate matter from those sites in the relevant years. The PI-based data, like the EU ETS data, suggest that the BGS activity data, previously used in the UK inventory, are too low. [NIR 2013]

Source: NIR 2013.

Table 4.9 summarizes the recommendations from the 2011 and the 2012 UNFCCC inventory reviews in relation to the category 2A2 Lime Production as well as the status of the review finding in the 2013 inventory submission.

Table 4.9 **2A2 Lime Production: Findings of the 2011 and 2012 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2013 inventory submissions**

Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC report of the review of the 2011/2012 submission	Status in 2013 submission
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/AUT).	No follow-up necessary
Belgium	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/BEL). 2012 ARR not yet available.	No follow-up necessary
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK). 2012 ARR not yet available.	No follow-up necessary
Finland	The ERT recommends that Finland explore the use of plant-specific data for the five plants for which an IEF is currently used, and use interpolation or other ways of ensuring time-series consistency. (FCCC/ARR/2011/FIN)	Average EFs derived from plant-specific data are used.
France	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FRA). 2012 ARR not yet available.	No follow-up necessary
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DEU). 2012 ARR not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/IRE). 2012 ARR not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ITA). 2012 ARR not yet available.	No follow-up necessary
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/LUX).	No follow-up necessary
Netherlands	the Netherlands demonstrated that there are no emissions of lime production in the paper industry. In the Netherlands, paper and cardboard are mainly produced from recycled fibres, while new pulp is mainly imported from abroad. The production of wood pulp is minimal and amounts to only a few per cent of total production. In the Netherlands, pulp production only takes place by mechanical or thermo-mechanical processes. The kraft (sulphate) pulping process, the only source for CO2 emissions (originating from biomass), is not used in the Netherlands. The ERT agreed with this explanation and recommends that the Netherlands include this information in its next annual submission. (FCCC/ARR/2011/NLD). 2012 ARR not yet available.	Information is not included in the NIR. It is unclear how much information should be included in the NIR about activities that do not occur. The main purpose of the NIR is to explain the emissions estimated.
Portugal	According to page 4-9 of the NIR, it is possible that there is some double counting of CO2 emissions in this category, if part of the quicklime that is produced in an industrial unit is sold and used again to produce slacked lime or hydraulic lime in a different industrial plant. The ERT recommends that Portugal make further efforts to address this issue and avoid any possible double counting of emissions in this category in its next annual submission. (FCCC/ARR/2011/PRT). (2012 ARR not yet available).	This issue is still included in the planned improvements in the NIR 2013.

Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC report of the review of the 2011/2012 submission	Status in 2013 submission
Spain	The ERT found that the time series of the IEF show one apparent inconsistency: the average IEF in the period from 1990 to 2005 (0.767 t/t lime produced on average) is 2.8 per cent larger than the value for the period from 2006 to 2009 (0.748 t/t lime produced, on average), and a drop of 5.1 per cent between 2005 (0.770 t/t lime produced) and 2006 (0.731 t/t lime produced). During the review week, the ERT noted that this difference is explained by data on the purity of lime. Spain does not present information about the purity of lime in the NIR, or any discussion of the apparent inconsistency in the time series. Therefore, the ERT recommends that Spain improve the transparency of its reporting, by including data on the purity of lime for the whole time series, in its next annual submission. During the review week, the Party's inventory team informed the ERT that Spain also produces lime in sugar mills, but does not account for the corresponding emissions under the category lime production because all of the CO2 produced is captured into a subproduct that is used as a soil amelioration product. The ERT notes that sufficient information is not included in the NIR and, in particularly, that it is insufficient to conclude whether the total flow of CO2 produced is captured or whether a portion is emitted. In the latter case the associated emissions would not be accounted for in the inventory, which would therefore be underestimated. The ERT strongly recommends that Spain ensure that its inventory is fully complete by including, in the NIR of its next annual submission, information about the production of this soil product and the reasons that all the CO2 is stored; otherwise Spain is recommended to calculate and report on the percentage of the CO2 that is not captured and estimate the corresponding emissions.(FCCC/ARR/2011(ESP). 2012 ARR not yet available.	The ERT's recommendation is strongly exaggerated. These small changes in IEFs do not represent time-series inconsistencies and it is not a reporting requirement to report on purity of lime in each submission. It would be wroing to include a discussion of time series inconsistency in the NIR as the time series is not inconsistent.
Sweden	Sweden reported that the CO2 emission estimates are calculated based on lime production by type of lime and using the EF and data on the purity of lime from the 2006 IPCC Guidelines. The AD were obtained from the sugar industry, the Swedish Lime Association and the Swedish Lime Industry. The Party reported that more than 99 per cent of the lime used in the sugar and in the pulp and paper industries is quicklime, with a 95 to 97 per cent CaO content. For other lime production, the Party reported that the data on the production of quicklime, hydraulic lime and dolomitic lime were obtained from the Swedish Lime Association. In response to questions raised by the ERT during the review, Sweden indicated that about 90 to 96 per cent of the lime produced in conventional lime mills is quicklime and 4 to 10 per cent is dolomitic lime. The ERT recommends that Sweden improve the transparency of the next NIR by providing information on the ratio of limestone to dolomite used in other lime production and by clarifying the use of hydraulic lime. (FCCC/ARR/2012/SWE). .	Transparency of the NIR was considerably improved. However, the ratio of limestone to dolomite use is not included but does not seem to be the relevant information to explain the IEFs and emission trends in Sweden. It is explained for which production types hydraulic lime is used, but no quantitative figures are provided.
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR). 2012 ARR not yet available.	No follow-up necessary

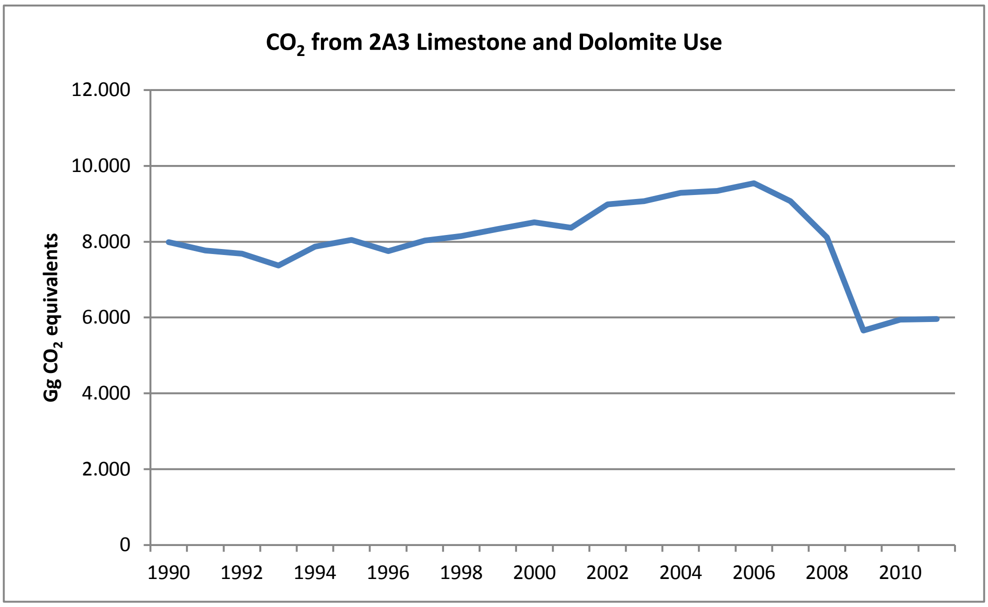
Source: NIR 2013, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

To the review in 2011 an issue related to a potential underestimation of the CO_2 emissions from lime production in the UK was raised and it was recommended that the European Union continue its efforts together with the United Kingdom in order to prepare estimates using the country-specific information that the Party is preparing. The UK recalculated CO_2 emissions from lime production resulting in a considerable increase in emissions of 862.3 Gg CO_2 in 2010 and 515 Gg CO_2 in 1990. The revised methodology is based on EU ETS emission estimates and activity data from 2005 onwards. As the activity data is reported in various forms, e.g. feedstock or product from different plants, the UK still reports limestone consumption as activity data in the CRF which is different to other MS. However, the improved methodology increased the 2010 emissions by 15% and the underlying problem in the 2011 review – the lack of accounting for dolomite consumption – was improved.

4.2.1.3 *2A3 Limestone and Dolomite Use*

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total GHG emissions in 2011. Between 1990 and 2006, CO_2 emissions from this source increased by 24 % in the EU-15 and decreased by 25.4 % until 2011 (Figure 4.5). In 2011, Italy was responsible for 24.8 %, the UK for 15.4 % and France for 14.2 % of the emissions from this source. Emissions from this source category increased in seven MS in the period 1990 to 2011 (Austria, Denmark, Finland, Ireland, the Netherlands, Portugal and Sweden), whereas in five Member States emissions decreased during that time period (Belgium, France, Greece, Italy, Spain and UK). In absolute terms, the decrease in emissions was larger than the increase, with the largest absolute reduction in Italy.

Figure 4.5 **2A3 Limestone and Dolomite Use: EU-15 CO_2 emissions**



The increase of CO_2 emissions by 6 % in 1993-1994 was dominated by the increase of emissions in the Netherlands, the UK, Spain and Finland. The increase of emissions was mainly due to changes of activity (Netherlands, the UK). Reverse emissions trends and thus offsetting the increases of emissions to some extent could be found for Italy and Greece for that period.

CO_2 emissions decreased by 27 % in EU-15 during 2008-2009. Italy (the country's share in EU change of emissions 2008-2009 was 34 %) and Spain (the country's share in EU change of emissions 2008-2009 was 28 %) were the main contributors to this reduction. The decrease of CO_2 emissions in Spain in that time is mainly due to decrease of brick and tiles production as a consequence of the impact of the economic recession. Additionally, there was a decrease in the carbonates content in the clay used for brick and tiles manufacturing. For Italy, the emissions reduction is related to a decrease in carbonates input to brick, tiles, ceramics, pulp and paper production at country level equal to 30 % during 2008 and 2009. Between 2009 and 2010 emissions increased slightly in the EU-15 due to a better economic situation. In those MS that are still strongly hit by the financial crisis (Ireland, Italy, Spain, Portugal) emissions kept decreasing in this period while all other MS showed slightly raising emissions.

Table 4.10 2A3 Limestone and Dolomite Use: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	203	294	268	4.5%	-27	-9%	64	32%	T1	D,PS
Belgium	428	212	206	3.5%	-6	-3%	-222	-52%	T3	CS,PS
Denmark	14	41	38	0.6%	-3	-8%	24	176%	CS,T1	CS,D
Finland	97	260	281	4.7%	22	8%	185	191%	T2	CS
France	1 392	923	849	14.2%	-74	-8%	-543	-39%	T2, T3	PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	583	458	462	7.7%	5	1%	-121	-21%	CS,T1	CS,D
Ireland	0	1	1	0.0%	0	1%	1	590%	T2	PS
Italy	2 540	1 546	1 481	24.8%	-65	-4%	-1 059	-42%	T2	CS,D,PS
Luxembourg	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	481	574	600	10.1%	25	4%	119	25%	CS	D
Portugal	33	57	56	0.9%	-1	-2%	22	67%	D	D
Spain	1 005	499	667	11.2%	168	34%	-338	-34%	D	D, PS
Sweden	90	135	136	2.3%	0	0%	45	50%	CS	D
United Kingdom	1 125	948	922	15.4%	-26	-3%	-204	-18%	T2	CS,D
EU-15	**7 992**	**5 948**	**5 966**	**100.0%**	**18**	**0%**	**-2 026**	**-25%**		

Belgium reports emissions in the source category 2A7.
Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).
Luxembourg reports emissions in the source category 2A1 and 2A7.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.10 provides information on methods applied, activity data, emission factors for CO_2 emissions from 2A3 Limestone and Dolomite Use for 1990 to 2011. The table shows that almost all MS (except Italy) use limestone and dolomite consumption as activity data for calculating CO_2 emissions. In 2011 the EU-15 IEF is 0.46 t CO_2/t of limestone and dolomite consumption. The implied emission factors per tonne of limestone and dolomite consumption vary between 0.41 t CO_2/t for Belgium and Spain and 0.72 t CO_2/t for the UK. Different EFs arise from the occurrence and the allocation of different activities under 2.A.3. Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. The use of plant-specific data reported and verified under the EU ETS by Member States can be considered as equivalent to a Tier 2 or Tier 3 method. It is difficult to calculate a specific share of EU emissions calculated with higher tier methods in the absence of such IPCC definitions and due to the fact that MS's estimates are mostly composed by several sources with independent estimation methods, using partly higher tiers, partly default methods.

Table 4.11 **2A3 Limestone and Dolomite Use: Information on methods applied, activity data, emission factors for CO_2 emissions**

Member State	Method applied	Emission factor	1990				2011			
			Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
			Description	(kt)			Description	(kt)		
Austria	T1	D,PS	Limestone and Dolomite Use	462	0.44	203	Limestone and Dolomite Use	620	0.43	268
Belgium	T3	CS,PS	Limestone and Dolomite Use	114	3.75	428	Limestone and Dolomite Use	505	0.41	206
Denmark	CS,T1	CS,D	Limestone and Dolomite Use	42	0.33	14	Limestone and Dolomite Use	91	0.42	38
Finland	T2	CS	Limestone and Dolomite Use	226	0.43	97	Limestone and Dolomite Use	655	0.43	281
France	T2, T3	PS	Limestone and Dolomite Use	3 152	0.44	1 392	Limestone and Dolomite Use	1 931	0.44	849
Germany	NA	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Greece	CS,T1	CS,D	Limestone Consumption	1 249	0.47	583	Limestone Consumption	1 040	0.44	462
Ireland	T2	PS	Limestone Consumption	0	0.44	0	Limestone Consumption	2	0.43	1
Italy	T2	CS,D,PS	Carbonates input to brick, tiles, ceramic production	5 773	0.44	2 540	Carbonates input to brick, tiles, ceramic production	3 366	0.44	1 481
Netherlands	CS	D	Limestone and Dolomite Use	1 093	0.44	481	Limestone and Dolomite Use	1 370	0.44	600
Portugal	D	D	Limestone consumption	74	0.45	33	Limestone consumption	121	0.46	56
Spain	D	D, PS	Limestone and Dolomite Use	2 285	0.44	1 005	Limestone and Dolomite Use	1 618	0.41	667
Sweden	CS	D	Limestone and Dolomite Use	194	0.47	90	Limestone and Dolomite Use	298	0.46	136
UK	T2	CS,D	Limestone and Dolomite Use	2 689	0.42	1 125	Limestone and Dolomite Use	1 276	0.72	922
EU15			**EU15**	**17 354**	**0.46**	**7 992**	**EU15**	**12 893**	**0.46**	**5 966**

Belgium reports emissions in the source category 2A7.
Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).
Abbreviations explained in the Chapter 'Units and abbreviations'.

A considerable increase of IEFs during 1990 and 2011 in the inventory submission 2013 could be observed for Denmark and the UK, whereas no significant increase or decrease of the IEF occurred for any other MS recently. Explanations for the development of the implied emission factors are given in the following overview:

Implied Emission Factor Limestone and Dolomite Use, Denmark

The increase of the IEF is caused by the consideration of the occurrence and relevance of different activities included in this category: The activity data comprises the consumption of carbonates for production of mineral wool, consumption of CaCO3 for wet flue gas cleaning at waste incineration plants and combined heat and power plants. In the production of stonewool a number of raw materials contributing to CO_2 emission are used: bottom ash from coal-fired CHP, stonewool binder, stonewool waste, limestone, and dolomite. Activity data for production of mineral wool is not reported due to confidentiality reasons, therefore the total emissions are divided by the other activities only resulting in the increasing IEF. EU-ETS data for some years (1998-2002) combined with energy consumption has been used for extrapolation of the CO_2 emission from 1990-1997 and interpolation from 2003-2005. For wet flue gas cleaning at combined heat and power plants statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2005; from 2006 onwards consumption of limestone has been used. Waste incineration plants: statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2010. For wet flue gas cleaning at waste incineration plants produced amount of gypsum has been used as activity data for the period 1990-2010. The change in applied statistics explains the increasing IEF from 2005 to 2006. Regarding fluegas cleaning at combined heat and power stations, Denmark investigates to use statistics concerning consumption of limestone at waste incineration plants for the next inventory submission.

Implied Emission Factor Limestone and Dolomite Use, UK

The comparable high IEF (2010) is due to the inclusion of CO_2 emissions from gypsum produced in the flue gas desulphurisation process. The activity data does not reflect this particular process, and therefore the IEF is higher than might otherwise be expected. The increase of the IEF is caused by including CO_2 emissions from gypsum produced in the flue gas desulphurisation process but excluding this item in its activity rate.

CO_2 emissions occur when limestone and/or dolomite is used in wet flue gas desulphurization (FGD) of flue gases in power generation. With its report of the review of the initial report of the European Union, the ERT recommends that the EU encourage member States which do not mention this category in their NIR to report where this category is included (FCCC/IRR/2007/EC, para 68). In response to the recommendation by the ERT, Table 4.11 provides an overview about the reporting of this category.

Table 4.13 provide a more detailed overview on methods used in EU-15 Member States and the coverage of this source category.

Table 4.12 **2A3 Limestone and Dolomite Use: Information of wet flue gas desulphurization provided by Member States**

Limestone and dolomite use		
Member State	**FGD included**	**Further information on wet flue gas desulphurization**
Austria	2.A.3	In this category CO_2 emissions from decarbonising of limestone in the iron and steel industry, limestone use for desulphurization and in chemical industry are considered. Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. The time series was constructed with the help of plant specific SO_2 emission declarations from the annual steam boiler database. [NIR 2013]
Belgium	2.A.3	After receiving the ETS-data and consultation of these ETS-data the emissions due to the use of limestone in pollution control were completed for the 2012 submission in the category 2A3 and accounts for +/- 10-15 kton of CO_2 (from 1999 on). The limestone and dolomite use (category 2A3) includes the process CO_2 emissions in the flue-gas desulphurisation in electric power installations (2 in the Flemish region) [NIR 2012 and 2013]
Denmark	2.A.3	The CO_2 emission from consumption of limestone for flue gas cleaning has been estimated from statistics on generation of gypsum (wet flue gas cleaning processes) and the stoichiometric relations between gypsum and release of CO_2. Statistics on the generation of gypsum from power plants are compiled by Energinet.dk. However, for 2006 - 2011 information on consumption of $CaCO_3$ at the relevant power plants has been compiled (from environmental reports) and used in the calculation of CO_2- emission from flue gas cleaning. Information on the generation of gypsum at waste incineration plants does not explicitly appear in the Danish waste statistics (Miljøstyrelsen, 2012). However, the total amount of waste products generated can be found in the statistics. The amount of gypsum is calculated by using information on flue gas cleaning systems at Danish waste incineration plants (Illerup et al., 1999; Nielsen & Illerup, 2002) and waste generation from the different flue gas cleaning systems (Hjelmar & Hansen, 2002). However, for 2011 information of $CaCO_3$ at the relevant plants has been compiled from environmental reports and used in the calculation of CO_2 emission from flue gas cleaning. [NIR 2013]
Finland	2.A.3	Limestone and dolomite use comprises the use in the energy industry for sulphur dioxide control. One energy production plant started to use dolomite for sulphur reduction in 2008 and emissions of that use are now reported for the first time for 2008-2011. [NIR 2013]
France	2.A.3	The category of limestone and dolomite use (2A3) includes the following sub-sectors: [...] the use of carbonates for the desuplphurization of industrial stires (3 heat plants and 4 power plants) and the use as neutralizer for acidic substances (une chemical plant). [NIR 2013]
Germany	1.A.1.a	Flue gas emissions are reported under 1A1a instead of 2A3. Limestone is used for the refining of sugar as well as for wet flue gas cleaning at power plants and waste incineration plants. CO_2 emissions from flue-gas desulphurisation are included in 1.A.1.a Limestone use in flue-gas desulphurisation in public power stations. In the inventory, these CO_2 emissions were assigned to emissions from use of solid fuels, because such use is the reason for operation of the flue-gas desulphurisation systems and for the systems' CO_2 emissions. For calculating the volume of gypsum in years 2008 and 2009 the volume of gypsum was used as preliminary input value. [NIR 2013]
Greece	2.A.3	The operation of flue gas desulphurization systems in Greece started in 2000. The estimation of emissions is based on data collected during the formulation of the NAP for the period 2005 – 2007. For years 2005-2011 data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. [NIR 2013]
Ireland	2.A.3	The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone ($CaCO_3$) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to $CaCO_3$. [NIR 2013]
Italy	2.A.3	CO_2 emissions deriving from the treatment of flue gases have been accounted for the whole time series in source categorie 2.A.3. [NIR 2013]
Luxembourg		No information available [NIR 2013]
Netherlands	2.A.3	The CO_2 emissions from this source category are based on consumption figures for limestone use – derived from plaster production figures – for flue gas desulphurisation (FGD) with a wet process by coal-fired power plants and for apparent dolomite consumption (mostly used for road construction). [NIR 2013]
Portugal	1.A.1.a	CO_2 emissions from wet flue gas desulfurization are estimated for large point sources in the sector of public electricity and heat production. Since there is no CRF category specific for desulfurization, total CO_2 emissions from this abatement system were included together with combustion emissions. [NIR 2013]

Limestone and dolomite use		
Member State	**FGD included**	**Further information on wet flue gas desulphurization**
Spain	2.A.3	Category 2A3 includes emissions from the decarbonization of carbonates consumed for bricks and tiles as well asfor the desulphurization of flue gas of power plants. Emissions from desulfurization are estimated based on specific questionnaires on the consumption of limestone for the desulphurization process that are sent to power stations in which such a technique for reducing emissions is used. [NIR 2013]
Sweden	2.A.3	Activity data and CO2 emissions from the use of limestone and dolomite within facilities producing glass and mineral wool, iron pellets and chemical products, and also use of limestone and dolomite for flue gas purification in energy producing facilities are reported in CRF category 2A3. The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite. [NIR 2013]
UK	2.A.3	Limestone is also used in flue-gas desulphurisation (FGD) plant used to abate SO2 emissions from combustion processes. The limestone reacts with the SO2 present in flue gases, being converted to gypsum, with CO2 being evolved. Emissions are calculated using emission factors of 120 t carbon/kt limestone and 130 t carbon/kt dolomite, in the case of glass processes involving calcination, and 69 t carbon/kt gypsum produced in the case of FGD processes. [NIR 2013]

Source: NIR 2013.

Table 4.13 2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States

Limestone and Dolomite Use	
Member State	**Methodology comment**
Austria	In this category CO_2 emissions from decarbonising of limestone in the iron and steel industry and from limestone use for desulphurization in power plants, chemical and other industry are considered. CO_2 emissions from decarbonising of limestone and dolomite in glass industry are accounted for in 2.A.7.c Glass Production. Emissions were estimated using the methodology and the IPCC default EF for the years 1990-2004. AD for limestone used in blast furnaces for the years 1998 to 2002 was reported directly by the plant operator of the two integrated iron and steel production sites that operate blast furnaces. For the years before and after AD was estimated using the average ratio of limestone used per ton of pig iron produced of the years 1998-2002. For 2005-2010 verified CO_2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. Under ETS plant operators are calculating the emissions on the basis of the Austrian Ordinance(45) regarding monitoring, reporting and verification of GHG emissions. The important part is §8(2) which defines the calculation-based approach as the methodology to be used. Annex 2 (7) provides the relevant TIERs for this approach. Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. The time series was constructed with the help of plant specific SO_2 emission declarations from the annual steam boiler database. For calculation of CO_2 emissions the IPCC default emission factors of 440 kg CO_2/t limestone and 477 kg CO_2/t dolomite were used. Since 2005 ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values. [NIR 2013]
Belgium	The limestone and dolomite use (category 2A3) includes the process CO_2 emissions in the sinter plants, the flue-gas desulphurisation in electric power installations (2 in the Flemish region) and the sugar plants (2 installations in the Walloon region). This category doesn't include the following source categories in which CO_2 emissions are produced via limestone use in glass production (limestone fraction in the relevant raw materials and ceramic production (limestone fraction in the relevant raw materials). The allocation of these emissions in the category 2A7 is made to improve the harmonisation of reporting across EU Member States. Since 1990, sinter production has declined sharply in Wallonia. In 1990, there were 4 sinter plants and in 2011, the last sinter plant was closed. Until 2002, these emissions are calculated by using an IPCC 1996 emission factor of 200 kg CO_2/ton sinter. The emissions calculated involved combustion and process emissions. As the fuel consumption was known, combustion emissions were calculated and reported in the energy sector (fuel consumption x emission factor (table 3.1) and the remaining emissions were reported in the process sector ((200 kg CO_2/ton sinter) X (production of sinter) – (combustion emissions). These process emissions are originating from additive in the furnace as limestone. From 2005 on, CO_2 emissions (process and combustion emissions) have been obtained directly by the obliged reporting of the plants under the emission trading scheme. The total IEF in 1990 and 1991 differs from 200 kg CO_2/t as the production of one pelletization plant is taking into account with no process emissions. In the Flemish region, the process emissions originates from (1) production of fluid pig iron (category 2C1), (2) amount of lime used directly in the sinter factory to fix the alkalinity of the slags and (category 2A3) (3) the amount of lime used (indirectly) in the grinded mixture (mixture of ores, recovery products, MgCO3, CaCO3, …) in the sinter factory as well (category 2A3). [NIR 2013]
Denmark	The reported emissions include the use of limestone and dolomite for fluegas cleaning as well as for the production of stonewool. No activity data is reported for production of stonewool. This means that the IEF varies with the ratio: flue gas cleaning/stonewool production. A detailed description of stonewool production will be included in the next NIR. In the production of stonewool a number of raw materials contributing to CO_2 emission are used: bottom ash from coal-fired CHP, stonewool binder, stonewool waste, limestone, and dolomite. The shares of the different CO_2 sources will be analysed and a new classification (CRF code) will be considered. Regarding flue gas cleaning: CHP: statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2005; from 2006- consumption of

Limestone and Dolomite Use	
Member State	**Methodology comment**
	limestone has been used. Waste incineration plants: statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2010. The change in applied statistics explain the increasing IEF from 2005 to 2006. From next year application of statistics concerning consumption of limestone at waste incineration plants will be investigated and implemented if possible. [EU QA/QC 2012]
Finland	Emissions were calculated using a Tier 2 methodology. Emissions from limestone and dolomite use are calculated by multiplying emission factors with activity data. Activity data are collected mainly directly from the industry but industrial statistics have also been used to calculate emissions at the beginning of the time series. Emission factors for calculating emissions from limestone and dolomite use are based on the IPCC default factors. The emission factors are modified by multiplying default emission factor with correction factors (0.93-1.00, based on information from the producers, Slioor, 2004), because not all limestone and dolomite are calcinated completely in the various processes. Different factors have been used then more detailed information on the composition of limestone is available for some of the plants. If no information of composition has been received the correction factor 0.97, which is based on GPG for lime production, is used. (Default value for CaO or CaO and MgO content is 0.95, Table 3.4 Basic Parameters for the Calculation of Emission Factors for Lime Production). The average for the correction factor for the whole time series is 0.96 (range 0.95-0.98). The consumption of limestone and dolomite has been used as activity data when calculating emissions from limestone and dolomite use. Most of the data for the whole time series have been received from individual companies and EU ETS and only a small part data of earlier years have been estimated using industrial statistics. Also data on limestone and dolomite uses for which it was previously not clear if they produce emissions or not have been checked using industrial statistics and the web sites of companies. It was confirmed that these uses do not cause CO_2 emissions as limestone has been used for instance as coating and filler pigments in paper and cardboard, paint and plastic industry. [NIR 2013]
France	The reported emissions in this category include the following subsectors: - decarbonization in the production of enamel production (3 plants in France): AD is taken from anual declarations and an average EF is used. - the use for desulphurization for flue gas cleaning (2 heat plants and 4 power plants): AD is taken from annual declarations for recent years and interpolated based on certain years for which data is available. EF are available since 1999 and before an avergae EF is used . - the use of limestone to neutralize acidic substances (one chemical plant): AD is taken from annual declarations for recent years and interpolated based on certain years for which data is available. EF are available since 1997 and before an average EF is used. - the use of limestone as primary material and additive (which ceased after the year 2008). Activity data and EFs are derived from plant-specific reporting since 2000 and is based on production data and an EF based on stociometric relationships for the years before . A production plant for magnesium was active from 1990 to 2002 and production data is available for this period and an EF is taken from literature [NIR 2013]
Germany	Limestone consumption is reported in the sectors that use limestone and in 2A7 Other. The Section on 2A3 in the NIR presents a lime balance to ensure complete reporting [NIR 2013]
Greece	Estimate includes limestone use in metal production (steel, aluminium), magnesia, ceramics production and SO_2 scrubbing. AD and plant-specific EF from operators under EU ETS are used. Steel production: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005-2011) and the reporting performed for the NAP formulation in the previous years. For 2011, the total CaCO3 equivalent amounts to 18.52kt. Primary aluminium production: Data on primary aluminium production are plant specific and confidential (there is only one plant in Greece). The emission factor used is 0.44, whereas the single carbonate estimated is CaCO3. Plant specific data on limestone consumption cover the years 1990 and 1998 – 2011. The specific limestone consumption has been used for filling in missing data. Ceramics production: Carbonates consumption data (in the context of the ETS reports) have been used to estimate emissions in the years 2005-2011. Activity data refer to CaCO3 and MgCO3 consumption (emission factors 0.44 and 0.522 respectively). Limestone consumption data are available also for the period 2000-2004 (questionnaires of the plants under the NAP formulation). Missing data for the period 1990 – 1999 were filled in on the basis of the ceramics production trend reported by the ElStat for the same period. SO_2 scrubbing: The operation of flue gas desulphurization systems in Greece started in 2000. The estimation of emissions is based on data collected during the formulation of the NAP for the period 2000 – 2003 and concern limestone consumption in two power plants. Limestone consumption for 2004 was estimated assuming that the specific limestone consumption per electricity produced in those two power plants is kept constant at 2003 levels. For years 2005-2011 data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. Magnesia production: Emissions are estimated using information for the single plant operating in Greece for the years 1999-2011 and the produced quantities of magnesia that have been provided by the Hellenic Statistical Authority for the years 1990-1998. [NIR 2013]
Ireland	The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone (CaCO3) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to CaCO3. A further minor use of limestone relevant to 2.A.3 Limestone and Dolomite Use in Ireland is its application in the purification of sugar produced from sugar beet. However, sugar production ceased in 2006 and the only information on emissions is that obtained under ETS in respect of 2005 and 2006. Since 2008, when the last brick and tile manufacturing plants closed, the only source of emissions in this sub-category is the use of limestone for flue gas desulphurisation at peat fired power plants [NIR 2013]
Italy	CO_2 emissions from limestone and dolomite use are related to the use of limestone and dolomite in bricks, tiles and ceramic production, paper production and also in the treatment of flue gases from power plants. In general about 86% of the total Limestone&Dolomite is used in the production processes of bricks and tiles; about 6.9% is used for the fine ceramic material; 6.9% is used in the treatment of flue gases in the power plants and about 0.1% is used in the

Limestone and Dolomite Use	
Member State	**Methodology comment**
	paper industry. CO_2 emissions have been estimated for the whole time series; the overall CO_2 emission time series being mainly driven by the CO_2 emissions from the use of Limestone and Dolomites in the Bricks and Tiles sector (the same percentages are observed in the distribution of CO_2 emissions among the contributing sectors as for the Limestone&Dolomite used amounts). In the CRFs the total amount of limestone and dolomite used in these processes is reported, as activity data, and it has been estimated on the basis of the average content of CaCO3 in the different products. Detailed production activity data and emission factors have been supplied in the framework of the European emissions trading scheme and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations (ANDIL, 2000; ANDIL, several years; ASSOPIASTRELLE, several years; ASSOPIASTRELLE, 2004). The activity data for 2010 have been updated in the present submission. Additional information will be available from 2013, in the context of the EU ETS with the entry of new plants for sectors not previously included, which will be used to verify emission estimates. [NIR 2013]
Luxembourg	The use of limestone and dolomite is accounted for in IPCC Sub-categories 2A1 – Cement Produc-tion and 2A7 – Other – Glass Production [NIR 2013]
Netherlands	The CO_2 emissions from this source category are based on consumption figures for limestone use for flue gas desulphurisation (FGD) with coal-fired power plants and in Iron- and steel production and for apparent dolomite consumption (mostly used for road construction). From 2000 onwards, data reported in the annual environmental reports of Tata Steel (Corus) are used to calculate the CO_2 emissions from the limestone use. For the period 1990–2000 the CO_2 emissions were calculated by multiplying the average IEF (107.9 kg CO_2 per ton of crude steel produced) over the 2000–2003 period by the crude steel production. CO_2 from limestone use = limestone use * f(limestone) * EFlimestone , where f is the fractional purity. No activity data are available to estimate other sources of limestone and dolomite use. [NIR 2013]
Portugal	Presently, in the inventory of GHG emissions, only CO_2 emissions resulting from production of calcium and magnesium nitrates and consumption of sodium carbonates in paper pulp production are reported in source category 2A3. CO_2 emissions are estimated from the quantification of carbon in original raw materials, and making a mass balance for the quantities of CO_2 that are liberated in the conversion process. Carbon content of materials consumed in Portugal was set from molecular stoichiometry. The consumption of sodium carbonate in the paper and pulp industry was determined from the statistical information from INE from 1990 to 2010 and estimated for 2011 based on Gross Domestic Product. Due to the unavailability of statistical information concerning consumption of carbonaceous materials in the fertilizer industry – for the production of calcium and magnesium nitrates – they had to be estimated from fertilizer production data and considering that stoichiometrically two moles of nitrogen require one mole of either CaCO3 or MgCO3. Fertilizer production data was also available from INE database from 1990 to 2010 and estimated for 2011 based on Gross Domestic Product. The ceramic industry, more particularly the brick and tile industry and the pavement industry, consumes limestone, dolomite and the carbonates of sodium and barium, and all these substances were considered to result in decarbonization. For this industry sector, although the consumption of carbonate bearing materials is not known for the whole period, a consumption factor was developed based on the information received under the European Emission Trading Scheme (EU-ETS), and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series. In 2011 there is a strong decrease in limestone and dolomite consumption related to a decrease in calcium nitrate production. [NIR 2013]
Spain	Includes emissions from dolomite and lime use in bricks and tiles production and from flue gas desulphurization in power plants. AD for bricks and tiles are based on data from the industrial association (HISPALYT) and from plant-specific data from power plants. Data on desulphurization are derived from questionnaires directly send by the power plants. An EF based on the stechiometric relation was used for bricks and tiles production. Plant-specific parameters for the EF are available for the emissions from desulphurization in power plants. [NIR 2013]
Sweden	This source category comprises of activity data, CO_2 emissions from the use of limestone and dolomite within facilities producing iron sinter, glass wool and mineral wool, chemical products, but also use of limestone and dolomite for flue gas purification. Activity data and CO_2 emissions from the use of limestone and dolomite within facilities producing glass and mineral wool, iron pellets and chemical products, and also use of limestone and dolomite for flue gas purification in energy producing facilities are reported in CRF 2A3. The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite. Data on the use of limestone and dolomite have been acquired from environ-mental reports, the ETS and through direct contacts with the companies. Sweden has chosen to not include in 2.A.3 (but in corresponding categories): · CO_2 emissions from the use of limestone and dolomite in primary and secondary production of steel (2.C.1.1, 2.C.1.2), · CO_2 emissions from the use of limestone and dolomite in other metal production (2.C.5), · CO_2 emissions from the use of limestone and dolomite in production of clay based products (2.A.7) and · CO_2 emissions from the use of limestone and dolomite in glass production (2.A.7.1). [NIR 2013]
United Kingdom	The category includes limestone and dolomite use in iron and steel industry, for sinter production and for desulphurization of flue gases in power plants. Data on the usage of limestone and dolomite for steel production are available from the Iron & Steel Statistics Bureau (2012). Corus UK Ltd has provided analytical data for the carbon content of limestone and dolomite used at their steelworks (Corus, 2005), and these have been used to generate emission factors of 111 t carbon/kt limestone and 123 t carbon/kt dolomite for sintering and basic oxygen furnaces. Emissions are calculated using an emission factor of 69 t carbon/kt gypsum produced in the case of FGD processes. This factor is based on the stoichiometric relationship between gypsum and carbon dioxide formed in the FGD plant. Data on gypsum produced in FGD plant has previously been taken from the British Geological Survey (2012),, but these data are not always consistent with site-specific emissions data available from EU ETS, and so now a composite series of activity data is used with BGS data for 1994-2004, and EU ETS data for 2005-2011. BGS data for 2005 are in very good agreement with EU ETS data for that year, and so it has been assumed that BGS data for 1994-2004 are

Limestone and Dolomite Use	
Member State	**Methodology comment**
	also comparable with the later EU ETS data. [NIR 2013]

Source: NIR 2013.

Table 4.14 summarizes the recommendations from the 2011 and 2012 UNFCCC inventory reviews in relation to the category 2A3 Limestone and Dolomite Use.

Table 4.14 2A3 Limestone and Dolomite Use: Findings of the 2011 and 2012 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2013 inventory submissions

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2011/2012 submission	**Status in 2013 submission**
Austria	Provide information on the limestone use for each industry and provide an explanation for the calculation of the estimates for limestone use in chemical industry prior to 2005 in the next annual submission (FCCC/ARR/2012/AUT)	Recommendation was implemented in 2013 NIR.
Belgium	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/BEL). 2012 ARR not yet available.	No follow-up necessary
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK). 2012 ARR not yet available.	No follow-up necessary
Finland	For limestone and dolomite use Finland applies correction factors to the IPCC default EFs to account for impurities. While the percentages of impurities assumed by Finland seem reasonable in comparison with available international literature, the ERT recommends that Finland include in its next annual submission more information verifying the assumptions it made in establishing the correction factors. The correction factors vary between 0.93 and 0.97 according to the NIR. No key category. (FCCC/ARR/2011/FIN)	In response to questions raised during the review, Finland stated that if the plant-specific correction factors were available they were used in the inventory, and in other cases a correction factor of 0.97 was used. Furthermore, Finland informed the ERT that a master thesis from Helsinki University of Technology was used as reference; however, the thesis is written in Finnish. Finland also stated that plant-specific information cannot be included in the NIR for reasons of confidentiality.
France	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FRA). 2012 ARR not yet available.	No follow-up necessary
Germany	Germany continues to report CO2 emissions from limestone and dolomite use as "included elsewhere" ("IE") and explained the merits of category-specific calculation and reporting of emissions (e.g. under iron and steel production or flue gas desulphurization). In view of the fact that Germany's approach is not fully in line with the Revised 1996 IPCC Guidelines, the ERT reiterates the recommendation in the previous review report to the effect that Germany report CO2 emissions in accordance with the Revised 1996 IPCC Guidelines, or make efforts to do so by giving further analysis and consideration to this issue. Also, the ERT encourages Germany to present a table showing the aggregated CO2 emissions from the major components of the category limestone and dolomite use (namely, flue gas desulphurization in public power stations as well as iron and steel production) for information purposes in the relevant chapter in the NIR, even if it continues to include those emissions under the respective end-use categories in the actual inventory reporting (i.e. in the CRF tables and in the key category analysis). (FCCC/ARR/2011/DEU).(2012 ARR not yet available)	An overview of limestone and dolomite use is included in the 2012 submission already.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	During the review, Ireland did not provide an explanation regarding the sharp fall of CO2 emissions from 2008 to 2009, but referred to the AD contained in annex E of the NIR. The ERT recommends that the Party include an explanation of the emissions variation from year to year either in the introduction part of the industrial processes sector or under the category-level section in order to improve the transparency of the NIR. The ERT also recommends a more detailed explanation regarding the IEF used (it currently represents the average of the two consumers) in order to improve transparency. (FCCC/ARR/2011/IRL).(2012 ARR not yet available).	The NIR explaines that the trend since 2008 is entirely due to the amount of desulphurisation required at these power plants. AD and Efs are provided in Annex F of the NIR 2013.
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/ITA).	No follow-up necessary
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/LUX). 2012 ARR not yet available. No NIR 2012 available.	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD). 2012 ARR not yet available. No NIR 2012 available.	No follow-up necessary
Portugal	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/PRT). 2012 ARR not yet available.	No follow-up necessary
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ESP). 2012 ARR not yet available.	No follow-up necessary

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2011/2012 submission	Status in 2013 submission
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/SWE).	No follow-up necessary
UK	The United Kingdom reported CO2 emissions from the flue gas desulphurization processes at thermal power stations, which has resulted in higher IEFs than other Parties. The United Kingdom explained that this is because the estimated emissions include emissions from flue gas desulphurization at power stations, but the gypsum produced is excluded from the AD. The ERT recommends that the United Kingdom update the AD value used and improve the comparability of the IEF with other reporting Parties for the next submission. (FCCC/ARR/2011/GBR).(2012 ARR not yet available)	AD not updated , but related explanation os provided in the NIR.

Source: NIR 2013, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

In the 2011 inventory review, the ERT recommended continue to focus on improving comparability with other Parties and the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. In addition, the ERT notes that the allocation of emissions in this category can affect the key category analysis, which could have implications for resource prioritization on inventory improvements. Therefore, the ERT recommended that the European Union strengthen its efforts to achieve comparable reporting by Member States. Further, the ERT recommended that the Party consider whether the more detailed information on limestone and dolomite use reported under the EU ETS could help in achieving this objective. The previous tables show that in the past further harmonization of the reporting on emissions from limestone consumption for flue gas desulphurization took place. Table 4.13 shows that there is a large variety of single emission sources under this category. The reporting of diverse sources under 2A3 therefore will not lead to comparability within the EU or with other countries as the different underlying processes are not comparable. The comparability of emission sources will however improve with the use of 2006 IPCC Guidelines in the UNFCCC reporting where glass production will be a separate category and where specific subcategories for other process uses of carbonates are provided. The EU has discussed the issue of allocation of specific sources under limestone and dolomite use again in WG1 under the Climate Change Committee in February 2013. While completeness of the emissions in this source category could be further enhanced, MS still have different emission sources that are allocated under 2A3 and there are valid reasons for the choices of allocation of emissions from limestone and dolomite use in MS inventories.

4.2.1.4 *2A7 Other Mineral Products*

Table 4.15 provides an overview about the emission sources reported in the category 2A7 Other Mineral Products in 2011 as well as total emissions in this category. Following respective recommendations from the UNFCCC review of the EU inventory, several attempts were made to harmonize the allocation of emissions in a more transparent way across MS. 1996 IPCC Guidelines recommend to “inventory all other uses of limestone and dolomite which produce CO_2 emissions”, including glass manufacture and to allocate emissions from soda ash use in glass manufacture under 2A4. However, it is considered as a significant increase in transparency if all MS would report CO_2 emissions from glass production in a separate category under 2A7 which is an emission source in most MS. If a harmonized subcategory for emissions from glass production is reported by MS, this would allow a comparison of IEFs across countries for glass production as well as quality checks with EU ETS data. IEFs for a multitude of different activities reported under 2A3 are not really comparable due to the different nature of processes allocated under this category. Respective guidance was provided to MS, however UNFCCC ERTs to individual MS recommended to report different emission sources under 2A3 instead of a more transparent and comparable separation under 2A7 Other Glass production. In our view the recommendation of the 1996 IPCC Guidelines to “inventory all other uses of limestone and dolomite which produce CO_2 emissions” is not contradicting a separation under 2A7 ‘other mineral products’ if such allocation enhances the transparency and comparability across Parties. In 2013 all 15 MS reported CO_2 emissions from glass production as a separate category under 2A7. . In addition, several MS separate emissions from bricks and tiles and ceramics production in this category (Austria, Belgium, Denmark, France, Germany, Ireland, Spain, Sweden, UK) and emissions from sinter production (Austria), Germany is the largest contributor to this category with 20.5 %, followed by Spain (17.9 %) in 2011.

Table 4.15 2A7 Other Mineral Products: Emission sources reported for the year 2011

Member State	2.A.7 Other Mineral Products	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 total
Austria	Glass production, sinter production, bricks and tiles (decarbonizing)	480	NA	NA	480	9%
Belgium	Glass Production, ceramics	387	NA,NO	NA,NO	387	7%
Denmark	Glass Production, Yellow bricks. Expanded clay	37	IE,NA	IE,NA	37	1%
Finland	Glass production	2	NO	NO	2	0%
France	Glass Production, Brick and Tile Production	734	NA	NA	734	14%
Germany	Glass Production, Ceramics, Bricks and Tiles (decarbonizing)	1080	NA	NA	1.080	20%
Greece	Glass Production	11	NA,NO	NA,NO	11	0%
Ireland	Glas production, Bricks and Tiles (decarbonizing)	1	NO	NO	1	0%
Italy	Glass production	584	NA	NA	584	11%
Luxembourg	Glass production	62	NO	NO	62	1%
Netherlands	Glass production	248	NO	NO	248	5%
Portugal	Glass Production	131	1	NO	146	3%
Spain	Glass production, Magnesite production, Porous Tiles, Non-porous Tiles	942	NA	NA	942	18%
Sweden	Glass production, Light expanded clay aggregate, Glass and mineral wool production	62	NA	NA	62	1%
UK	Fletton Brick Production	488	0	NE	493	9%
EU-15 Total		**5.247**	**1**	**0**	**5.268**	**100%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 4.16 provides information on the contribution of Member States to EU recalculations in CO_2 from 2A Mineral products for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 4.16 2A Mineral products: Contribution of MS to EU recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	413	7.7	196	4.2	Because of ICR 2012, CO2 emissions of Limestone and Dolomite use previously allocated in sector 2C1 and 2A7 are reallocated in 2A3 since 2013 submission on.
Denmark	0	0.0	-4	-0.5	Company specific information on consumption of CaCO3 for flue gas cleaning has been included for 2011. In the calculations of CO2 emission from production of lime one plant has been treated separately.
Finland	9	0.7	10	0.8	A new plant using dolomite in energy production started in 2008 and emissions were included to the calculations. Emissions from ceramics production and neutralisation were included to the inventory.
France	124	0.8	44	0.4	Pour la production de chaux (2A2), les émissions de CO2 ont été augmentées d'environ 2% sur toute la période suite à la prise en compte des émissions de CO2 induites par l'utilisation de roche calcaire en sucrerie. Pour l'utilisation de calcaire (2A3), les émissions induites par l'utilisation de la dolomie pour la production de magnésium ont été ajoutées jusqu'en 2001. Pour la production de carbonate de soude (2A4), le facteur d'émission de CO2 lié à la production de carbonate de soude a été corrigé en 1990 pour un des sites en activité.
Germany	-309	-1.3	-276	-1.5	Methods: correction with factor for impurities in 2.A.2 lime production Update of Activity Data due to recalaculation of glass production in 2.A.4.2 soda ash use Update of Activity Data for former years in 2.A.7.1 glass production.
Greece	-28	-0.4	0	0.0	Overlap methodology was applied throughout the time series to improve consistency between the different methods used. Tier 3 methodology is applied for the recent years according to the IPCC guidelines.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-122	-0.7	Update CO2 emission factor for soda ash production. Update of soda ash production data.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	6	0.2	-83	-2.0	Recalculations were made based on EU-ETS data concerning raw materials consumption, fuels consumption and cullet incorporation. Recalculations are particularly relevant in CH4 emissions.
Spain	23	0.2	12	0.1	Revision of lime production as non-marketed intermediate in the sugar production process; CO2 emissions (decarbonizing) from lime production at a calcium carbide production plant, which were previously included as part of the calcium carbide manufacturing process (category 2.B.4), have been reallocated under category 2.A.2.
Sweden	0	0.0	-27	-1.3	Cement production: CO2 emissions from organic carbon in the raw material excluded
UK	247	2.4	843	15.4	Activity data revised for lime production . Now consistent with ETS data. Revision to AD for limestone and dolomite use for 2005 onwards to use EU ETS data since BGS data is incomplete. Review of notation keys for soda ash production, asphalt roofing and road paving with asphalt. Updated activity data time series from British Glass for glass production.
EU-15	**484**	**0.4**	**592**	**0.6**	

4.2.2 Chemical industry (CRF Source Category 2B) (EU-15)

Chemical industry includes the following key categories: CO_2 from 2B1 Ammonia Production, N_2O from 2B2 Nitric Acid Production and from 2B3 Adipic Acid Production and CO_2 and N_2O from 2B5 Other Chemical Industry.

Source category 2B1 Ammonia Production covers CO_2 emissions that occur during the production of ammonia, a chemical used as a feedstock for the production of several chemicals. In most instances, anhydrous ammonia is produced by catalytic steam reforming of natural gas (mostly CH_4) or other fossil fuels. CO_2 at plants using this process is released primarily during regeneration of the CO_2 scrubbing solution, with additional but relatively minor emissions resulting from condensate stripping. Source category 2B2 Nitric Acid Production accounts for N_2O emitted as a by-product of the high temperature catalytic oxidation of ammonia (NH_3) in the production of nitric acid. Adipic Acid Production (2B3) also emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid.

Table 4.17 summarises information on Member States' emissions from chemical industry in 1990 and 2011 for total GHG, CO_2 and N_2O. Between 1990 and 2011, CO_2 emission from 2B Chemical Industry increased by 2.1 %. The absolute increase in CO_2 emissions was largest in Germany and Belgium; the absolute reductions were largest in Italy, France and Ireland. Between 1990 and 2011, N_2O emission from 2B Chemical Industry decreased by 91.2 %. The absolute decreases in N_2O emissions were largest in UK, France and Germany.

Table 4.17 2B Chemical Industry: Member States' contributions total GHG and CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)	N_2O emissions in 1990 (Gg CO2 equivalents)	CO2 emissions in 2011 (Gg CO2 equivalents)
Austria	1 509	698	583	632	912	48
Belgium	4 588	3 346	645	1 944	3 943	1 400
Denmark	1 044	2	1	2	1 043	NA,NO
Finland	1 807	848	151	713	1 656	135
France	27 814	3 250	3 186	1 955	24 551	1 244
Germany	35 496	20 138	13 076	16 680	22 420	3 457
Greece	1 350	1 059	240	583	1 109	475
Ireland	2 026	NO	990	NO	1 035	NO
Italy	9 982	1 886	3 254	1 585	6 676	295
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	11 095	4 768	3 744	3 409	7 096	1 113
Portugal	1 159	184	633	109	518	65
Spain	3 626	1 067	785	763	2 800	258
Sweden	969	193	126	136	835	49
United Kingdom	27 805	2 839	2 994	2 560	24 641	207
EU-15	**130 269**	**40 278**	**30 407**	**31 070**	**99 236**	**8 747**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.18 provides information on the contribution of Member States to EU recalculations in CO_2 from 2B Chemical industry for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

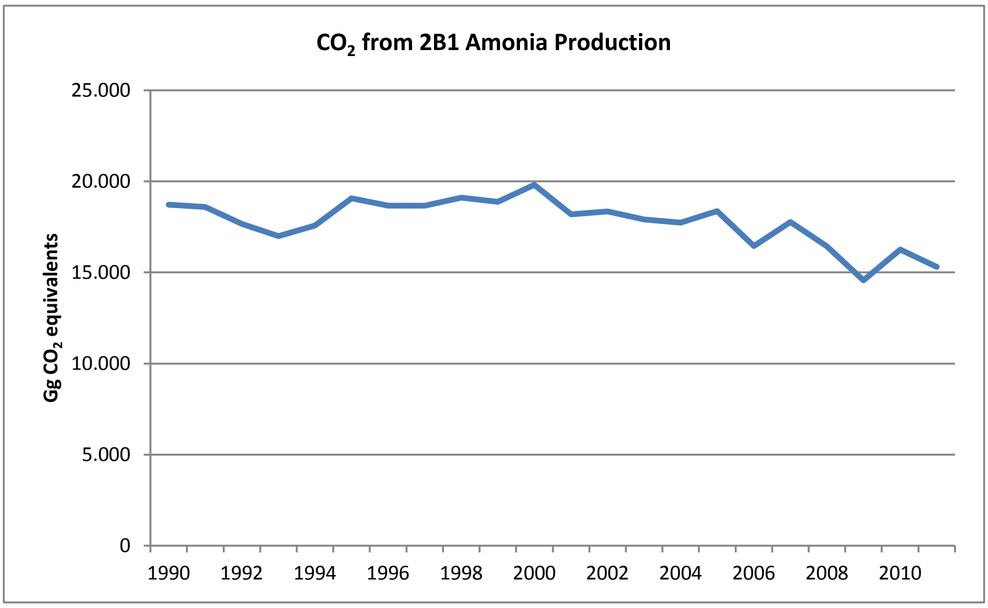
Table 4.18 **2B Chemical Industry: Contribution of MS to EU recalculations of CO_2 emissions for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	-1 387	-44.0	Flanders: optimization emissions 2010 for cat. 2B5/other (completed survey by the industry). Flanders: re-allocation of some emission to flaring from 2B5 to 6C2 flaring (complete timeseries, 592 kton CO2 in 2010).
Denmark	0	0.0	0	0.0	
Finland	1	0.7	-7	-0.9	Emissions of three plants have been recalculated due to new knowledge of production process. The activity data of a plant have been corrected due to new data of raw material use.
France	-380	-10.7	415	24.6	Ammoniac(2B1): Le calcul des émissions de CO2 liées à la production d'ammoniac a été entièrement revu afin de ne prendre en compte que les émissions de CO2 liées au procédé de production d'ammoniac (CO2 procédé). Pour ce faire, les émissions de CO2 sont calculées à partir des consommations des vaporeformeurs. Hydrogène (2B5): L'estimation des émissions de CO2 liées à la production d'hydrogène a été intégrée dans cette nouvelle édition de l'inventaire. La méthodologie d'estimation est la même que celle employée pour estimer les émissions de CO2 de la production d'ammoniac : consommation de gaz naturel des vaporeformeurs.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-1	-0.9	Correction of low and high density polyethylene production with data from INE.
Spain	-11	-1.4	-23	-3.2	Revision of CO2 emissions estimate as a result of the corresponding revision of carbon balance in one calcium carbide production plant. CO2 emissions (decarbonizing) from lime production at a calcium carbide production plant, which were previously included as part of the calcium carbide manufacturing process, have been reallocated under category 2.A.2.
Sweden	0	0.0	0	0.0	
UK	0	0.0	-26	-0.9	Correction to split between process and fuel use emissions for ammonia production based on operator data. Reallocation between 2B1 and 1A2c.
EU-15	**-391**	**-1.3**	**-1 029**	**-3.2**	

4.2.2.1 *2B1 Ammonia Production*

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from this source decreased by 18.2 % (Figure 4.6). Germany, the Netherlands and France are responsible for 73 % of these emissions in the EU-15. Italy, Ireland and France had large reductions in absolute terms between 1990 and 2011. The reasons for these reductions were a change to low emitting technology in France and production decreases in the other two countries and the cessation of production in Ireland. The largest growth in emissions had Germany, followed by Belgium.

Figure 4.6 2B1 Ammonia Production: EU-15 CO_2 emissions



The raise of CO_2 emissions by 10 % in 1993-1995 was dominated by the increase of emissions in Belgium, Germany, Portugal and the Netherlands, whereas Italy showed a reverse trend in CO_2 emissions. The emissions in Belgium increased noticeably from 1993 to 1994 because new production installations started in the Flemish region. For Germany, production decreased during 1991-1993 due to closure of production sites in Eastern Germany, whereas in 1995 the market had stabilized again. The contribution to the EU-15 emission change 1993-1994 was dominated by activity data rather than implied emission factors.

The decrease in EU-15 CO_2 emissions by 10 % in 2006, which was followed by an increase of emissions by 9 % was mainly caused by France and the UK.. National statistics in France show a drop in production for 2006.

The largest reduction in CO_2 emissions in 2008-2009 could be observed for Portugal, as the only fertilizer industrial plant manufacturing ammonia has stopped its activity in 2009; the ammonia production has been relocated to India. CO_2 emissions in Germany (country's share in change of EU-15 emissions in 2011 is 48.6 %), the UK (country's share: 5.5 %) and Italy (country's share: 4.2 %) decreased considerably in absolute terms during 2008 and 2009. These reductions were mainly due to a drop in ammonia production that could be observed for nearly all Member States, but with highest rates among EU-15 MS for the UK (-28 %), Italy (-21 %) and Germany (-8 %) . Despite the decrease in the French production rate, France increased its CO_2 emissions from Ammonia production in the period 2008 to 2009, which was caused by a non-optimal process caused by a drop of production due to the economic crisis. Between 2009 and 2011, CO_2 emissions increased again in all EU-15 MS except France due to a consolidation of the economy. The emission reduction in France is due to the fact that one plant does no longer produce hydrogen, but buys hydrogen from an adjacent ammonia production plant and is therefore no longer emitted, due to a reduced ammonia production and a slight decrease of the EF because of an improvement of the catalysts. In the Netherlands and the UK emissions increased between 2009 and 2010 and decreased again from 2010 to 2011.

Germany – representing the highest share of CO_2 emissions from Ammonia Production –estimated these emissions based on plant-specific information (Tier 3 approach) and thus improved the accuracy of estimates for this category, as recommended by the ERT (FCCC/ARR/2009/EC, para 50).

Table 4.19 2B1 Ammonia Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	514	538	556	3.6%	18	3%	42	8%	CS	CS,PS
Belgium	420	1 015	1 103	7.2%	88	9%	683	162%	T3	D,PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	44	NO	NO	-	-	-	-44	-100%	NA	NA
France	2 205	1 216	1 083	7.1%	-133	-11%	-1 122	-51%	T2	PS
Germany	5 745	7 437	7 450	48.7%	13	0%	1 705	30%	T3	PS
Greece	240	301	261	1.7%	-40	-13%	21	-	T1a	CS
Ireland	990	NO	NO	-	-	-	-990	-100%	NA	NA
Italy	2 765	959	839	5.5%	-120	-13%	-1 925	-70%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 096	3 156	2 681	17.5%	-476	-15%	-415	-13%	T1b	CS
Portugal	569	NO	NO	-	0	-	-569	-100%	NA	NA
Spain	709	661	697	4.6%	35	5%	-12	-2%	D	PS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	1 431	969	643	4.2%	-327	-34%	-789	-55%	T1	CS
EU-15	**18 729**	**16 253**	**15 312**	**100.0%**	**-941**	**-6%**	**-3 417**	**-18%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.19 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia Production for 1990 to 2011. The table shows that all MS (except for Ireland and the UK) report Ammonia Production as activity data. The implied emission factors per tonne of ammonia produced for 2011 vary between 1.1 t CO_2/t ammonia for Austria and 2.4 t CO_2/t ammonia for Germany (excluding the UK). In 2011 the EU-15 IEF (excluding the UK) is 1.78 t CO_2/t of ammonia produced. The table also suggests that about 65 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.20 **2B1 Ammonia Production: Information on methods applied, activity data, emission factors for CO_2 emissions**

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2011 Activity data Description	2011 Activity data (kt)	2011 Implied emission factor (t/t)	2011 CO_2 emissions (Gg)
Austria	CS	CS,PS	Ammonia Production	461	1.12	514	Ammonia Production	502	1.11	556
Belgium	T3	D,PS	Ammonia Production	360	1.17	420	Ammonia Production	954	1.16	1 103
Finland	NA	NA	Ammonia Production	28	1.55	44	Ammonia Production	NO	NO	NO
France	T2	PS	Ammonia Production	1 928	1.14	2 205	Ammonia Production	902	1.20	1 083
Germany	T3	PS	Ammonia Production	2 705	2.12	5 745	Ammonia Production	3 165	2.35	7 450
Greece	T1a	CS	Ammonia Production	313	0.77	240	Ammonia Production	158	1.66	261
Ireland	NA	NA	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	NO	NO	NO
Italy	T2	PS	Ammonia Production	1 455	1.90	2 765	Ammonia Production	476	1.76	839
Netherlands	T1b	CS	Ammonia Production	C	C	3 096	Ammonia Production	C	C	2 681
Portugal	NA	NA	Ammonia Production	C	C	569	Ammonia Production	C	NO	NO
Spain	D	PS	Ammonia Production	573	1.24	709	Ammonia Production	560	1.24	697
UK	T1	CS	Natural gas consumption PJ net	1 328	1.08	1 431	Natural gas consumption PJ net	800	0.80	643
EU15			**EU15 w/o IE, NL, PT and UK (69%)**	**7 823**	**1.62**	**12 642**	**EU15 w/o NL, PT and UK (76%)**	**6 718**	**1.78**	**11 989**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factor for 2011 was lower than in 1990 for Italy and the United Kingdom and slightly lower for Austria and Belgium and France whereas the IEF increased for all other EU-15 MS during that period. The implied emission factor decreased between 2011 and 2010 for the following Member States: France, Germany, Greece, Italy and UK. Explanations for the recent development of the implied emission factors and for outliers in IEFs are given in the following overview:

Implied Emission Factor Ammonia Production, Austria

Activity data (ammonia production) and natural gas input represent plant specific data. The composition of the synthesis gas is measured regularly. CO_2 emissions are calculated from the natural gas input – Tier 2 method of the IPCC guidelines with a standard emission factor (55.4 t/TJ) minus reported fugitive CH_4 emissions during start-ups of the ammonia production, minus reported CO_2 and CH_4 emissions from urea production that both derive directly from ammonia minus carbon stored in melamine. The resulting CO_2 IEF (with respect to ammonia) is decreasing over time, because of the increasing melamine production.

Implied Emission Factor Ammonia Production, France

One plant stopped production in 2009. The sites reduced their specific emissions since 1990 due to improved efficiencies of catalysts. This was in particular the case for one site with 40% of the production for which the EF decreased from 2 kg CO_2 /t NH_3 produced to 1.5 kg CO_2/ t NH_3 in 2010. Deviating values occur for specific years, such as for 2009 when the IEF increased by 14% during 2008 and 2009 due to a non-optimal process in one plant due to lower process efficiency. In 2010, this site recovered its efficiency and that`s why the IEF decreased by 17 % and is around 2008 IEF.

Implied Emission Factor Ammonia Production, Germany

The growth of German IEF during 1992 and 1993 of 14% contributed most to the overall increase of the IEF during 1990 and 2009 (17%). The underlying reason is a gap in the emissions reported to the UBA from 1990 to 1992. Since its resubmission in 2010 and to correspond to recommendations from the In Country Review in 2010, Germany adds the CO_2 captured for other uses to total CO_2 emissions from 2B1. This results in an IEF results of 2.38 t CO_2/t NH_3 in 2010. The reason for the higher CO_2

IEF is that in Germany not only natural gas is used as fuel input, but also heavy fuel oil which leads to higher emissions. The fluctuations in the ratio of heavy fuel oil related to natural gas lead to changes in the IEF.

Implied Emission Factor Ammonia Production, Greece

The Greek IEF increased especially during the years 1990-1993 and 1998-2001 which is due to the different fuels used in the two plants operating in Greece. The first plant has been operating since 1990, with an interruption between 1994-1997 using natural gas provided by the Public Gas Company SA (DEPA) since 1998. During 1990-1993 natural gas has been provided by the Kavala Oil Corporation. Imported natural gas was introduced to the Greek energy system by DEPA in 1996. Until 1996 natural gas consumption in Greece corresponded to small amounts of domestic natural gas explored by the company Kavala Oil. The second plant has been operating since 1990 up to 1999 with intervals. This plant used lignite as feedstock until 1991, and liquid fuels until its closure.

During the Centralized Review of the Greek inventory in 2010, Greece recalculated and resubmitted all its estimates of CO_2 emissions from ammonia production reported under the industrial processes sector and the part that was allocated to the energy sector. The MS also used, for calculating its resubmitted estimates, updated AD compiled in consultation with external data providers, in order to have more accurate data on the natural gas used as feedstock for ammonia production. Thus, to correspond to recommendations raised during the EU Centralized Review in 2010, time-series consistency for ammonia production was improved. The decrease of the CO_2 implied emission factor in 2011 is due to a lower carbon content of the imported natural gas.

Implied Emission Factor Ammonia Production, UK

The IEF of the UK (2010) is not comparable with other IEFs, because it is based on the activity data which is natural gas consumption in PJ for this source and not on ammonia production as for other MS and the fluctuations therefore represent changes in the carbon content of the natural gas.

Implied Emission Factor Ammonia Production, Italy

The CO_2 emission factor has been calculated on the basis of information reported by the production plants for 2002 and 2003 in the framework of the national EPER/E-PRTR registry and considering also the amounts of CO_2 recovered since the beginning of the recovery operations. CO_2 reported to the national EPER/E-PRTR registry has been used for the previous years in consideration that, as communicated by the operators, no modifications to the production plants have occurred along the period (YARA, 2007). Since 2002, the average emission factors result also from data reported by the plants in the national EPER/E-PRTR and they account for the recovered CO_2 data too.

Table 4.20 provides a more detailed overview of the methodologies and data sources used by Member States for this source category as reported in the NIR 2013.

Table 4.21 2B1 Ammonia Production: Summary of methodological information provided by Member States

Ammonia Production	
Member State	**Methodology overview**
Austria	AD since 1990 and CH_4 emission data from 1994 onwards were reported directly by the only ammonia producer in Austria and thus represent plant specific data. The composition of the synthesis gas is measured regularly at the only ammonia producer in Austria. CO_2 emissions are calculated from the natural gas input with a standard emission factor (55.4 t/TJ). CH_4 emissions are calculated from the measured synthesis gas composition and the number and duration of start-ups. The implied emission factor for CH_4 that was calculated from activity and emission data from 1994 was applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years. CH_4 emission factors of ammonia plants depend largely on the number of shutdowns and startups during the year. Especially a start up after a turn around with exchange of catalyst in some of the reactors of the plant needs a prolonged start up procedure resulting in an increase of the IEF. CO_2 emissions are calculated from the natural gas input – Tier 2 method of the IPCC guidelines – with a standard emission factor (55.4 t/TJ) minus reported fugitive CH_4 emissions during start-ups of the ammonia production, minus reported CO_2 and CH_4 emissions from urea production that both derive directly from ammonia and minus carbon stored in melamine. The resulting CO_2 IEF (with respect to ammonia) is decreasing over time, because of the increasing melamine production. [NIR 2013]
Belgium	In Flanders the emissions of CO_2 originating from the production of ammonia are obtained as a result of the yearly surveys carried out by the chemical federation in cooperation with the Vito. Last years this information (activity data and emissions) comes directly from the plant via their annual integrated environmental reporting obligation. The estimation of the emissions is based on the consumption of natural gas. The consumption is multiplied with the default IPCC emission factor for CO_2 for natural gas (55,8 kton CO_2/PJ) and the caloric value (variable per month). A part of the CO_2 (recovery part) is transported internally to the nitro-phosphor-installation and effectively measured by flow measurements. This amount of measured CO_2 is obviously subtracted from the overall CO_2 emissions from ammonia production. This part of CO_2 is afterwards sold as lime product. In the Walloon region, the same methodology is used. The amount of natural gas used in the process is given directly by the plant. There is a flow meter on the duct. The CO_2 process emissions are calculated based on this amount of natural gas. 100% per cent of the carbon content of the natural gas is presumed to be emitted and the default IPCC emission factor for CO_2 for natural gas (55,8 kton CO_2/PJ) is used. A part of the process CO_2 emissions is used by two other plants. The uses of these process CO_2 emissions are Ammonium carbonate production as intermediate, inert agent and food production. All the CO_2 emissions are allocated to the ammonia plant as it is assumed that all gas carbon will be emitted to the atmosphere in Belgium. [NIR 2013]
Denmark	Not occuring. [NIR 2013]
Finland	The tier 1 IPCC methodology was applied. CO_2 emissions from ammonia production are calculated by multiplying the amount of produced ammonia with the emission factor. Activity data have been received directly from the company and the emission factor is the default factor from the IPCC.All ammonia currently used in Finland is imported. In 1990-1992 small amounts (4 - 30 Gg per year) were produced using mainly peat and heavy oil as feedstock for the needed hydrogen. From 1993 on there has been no ammonia production in Finland [NIR 2013]
France	There are currently four ammonia producing plants in France. Emissions, activity data (natural gas consumption) and EFs are obtained directly from plants, CS EF calculated on this basis. [NIR 2013]
Germany	Tier 3 methodology has been applied since the 2011 submission. Companies report all information to Industrieverband Agrar (IVA) where data is aggregated and forwarded to UBA. [NIR 2013]
Greece	CO_2 emissions have been estimated using Tier 1a methodoloy. AD concerning fuel consumption for the years 1998-2009 have been provided by the plant using natural gas and by DEPA. Activity data concerning fuel consumption for the years 1998-2009 have been provided by the plant using natural gas and by DEPA. Data for 2010 and 2011 they are plant specific and provided by the sole plant operating in Greece. National ammonia production for the whole time-series has been provided by the El Stat and for the years 1998-2011 by the one plant still operating in Greece. The country specific carbon content of fuel (natural gas) is estimated as described: The CC of domestic NG is 16.20 t C/TJ (it is the mean value of CC of NG from the different reservoirs that NG was extracted). This value has been used for years 1990-1993. The CC of imported NG is calculated basing on the chemical composition data of natural gas provided by DESFA (Hellenic Gas Transmission System Operator S.A.) [NIR 2013]
Ireland	Carbon dioxide emissions from ammonia production are estimated from the natural gas feedstocks to the plant as indicated in the national energy balance provided by SEI. In accordance with the 1996 IPCC guidelines, it is assumed that no feedstock carbon is sequestered in urea and the emission factor is 54.94 kg CO_2/TJ, the value for indigenous natural gas, which equates to 2.3 tonne CO_2/tonne natural gas. Ammonia production was closed in 2003. [NIR 2013]
Italy	Ammonia production data are published in the international industrial statistical yearbooks (UN, several years), national statistical yearbooks (ISTAT, several years) and from 2002 they have been checked with information reported in the national EPER/E-PRTR registry. Since 2009 only one facility has been producing ammonia in Italy and reporting data to the national PRTR. Recovered CO_2 has been investigated with the cooperation of the operators and the resulting information has been used to revise the whole CO_2 emission time series and the emission factors as reported in the last submissions. The analysis has allowed understanding that CO_2 emissions recovered from ammonia production are used to produce urea and technical gases. According to IPCC Guidelines this CO_2 recovered should be accounted for emission and included in the estimate. Differently from the previous submissions the resulting average CO_2 emission factors were found to be higher than the IPCC defaults. In particular, for the years 1990-2001, CO_2 emission factor has been calculated on the basis of information reported by the production plants for 2002 and 2003 in the framework of the national EPER/E-PRTR registry and considering also the amounts of CO_2 recovered since the beginning of the recovery operations. CO_2 reported to the national EPER/E-PRTR registry has been used for the previous years in consideration that, as communicated by the operators, no modifications to the production plants have occurred along the period (YARA, 2007). Since 2002, the average emission factors result also from data reported by the plants in the national EPER/E-PRTR and they account for the recovered CO_2 data too. [NIR 2013]

Ammonia Production	
Member State	**Methodology overview**
Luxembourg	Not occuring. [NIR 2012, NIR 2013 not yet available]
Netherlands	A method equivalent to IPCC Tier 1b has been applied. The amount of natural gas used as feedstock and a country-specific emission factor are used to estimate CO2 emissions. Activity data on use of natural gas are obtained from Statistics Netherlands (CBS). One of the ammonia/urea producers in the Netherlands operates also a melamine plant, where a part of the produced urea is used as input. For that reason the C stored in the melamine is subtracted from the CO2 emissions from the Ammonia production. Until last year, an average storage factor, 17% of the total CO2 emissions from the Ammonia production, have been used. From this year the Dutch inventory team has access to the produced urea data, used as input in the melamine plant. [NIR 2013]
Portugal	In 2008 only one fertilizer industrial plant manufactures ammonia in Portugal, using Vacuum Residual Fuel Oil (VRF) as source of hydrogen (feedstock). Total production of ammonia in Portugal is available from the only existing facility for the period 1990-2008. In 2009, this plant has stopped activity and the ammonia production has been relocated to India. The quantity of VRF that was used was set from data collected at the only industrial plant in Portugal for a limited number of years – 1990 till 1994 – and a strong linear relation between feedstock consumption and ammonia production could be established from available data [NIR 2013]
Spain	From 4 plants in 1990, only 2 plants still exist in 2011. In one plant that existed from 1990 to 1996, the production process was based on direct synthesis of ammonia in closed circuits with pure hydrogen and N which did not produce CO2 emissions. Use of production data and country-specific EF from some plants and IPCC default factors and production statistics for the other plants. In 2009 only two plants were producing ammonia. Plant specific data (production of ammonia, consumption of natural gas and refinery gas, CO2 produced, directly emitted, sold) is available. Emission factors are in the range 1.009-1.294 kg CO2/tonne ammonia when using natural gas as input and in the range 1.420-1.430 kg CO2/tonne ammonia when using naphtha / gas refinery as input. [NIR 2013]
Sweden	There is an annual production of about 5 Gg of ammonia in Sweden, according to UN statistics . This ammonia is however not intentionally produced, but is a by-product in one chemical industry producing various chelates and chelating agents, such as EDTA, DTPA and NTA . Emissions from this industry are included in CRF code 2B5 Other. Ammonia production, 2B1, is thus reported as NO in the CRF-tables. [NIR 2013]
UK	Emissions of CO2 from feedstock use of natural gas are calculated by combining reported data on CO2 produced, emitted and sold by the various ammonia processes. Where data are not available, they have been calculated from other data such as plant capacity or natural gas consumption. The ammonia plant utilising hydrogen by-product from chemicals manufacture does not need to be included since there are no process emissions of CO2. [NIR 2013]

Source: NIR 2013.

Table 4.22 summarizes the recommendations from the 2011 and 2012 UNFCCC inventory reviews in relation to the category 2B1 Ammonia Production.

Table 4.22 2B1 Ammonia Production: Findings of the 2011 and 201 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2013 inventory submissions

Member State	**Review findings and responses in relation to 2B1 Ammonia Production**	
	Comment UNFCCC report of the review of the 2011/2012 submission	**Status in 2013 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/AUT).	No follow-up necessary
Belgium	The ERT reiterates the recommendation from the previous review report that Belgium provide clearer information in the NIR on the methodology used, including justification for the oxidation factor applied. The ERT further recommends that Belgium develop plant-specific EFs for this key category and further update the description in the NIR on the development of the EFs for the next annual submission. (FCCC/ARR/2011/BEL)(2012 review report not yet available)	A plant-specific methodology is used, but no information on oxidation factors or EFs is provided in the NIR:
Denmark	NO	No follow-up necessary

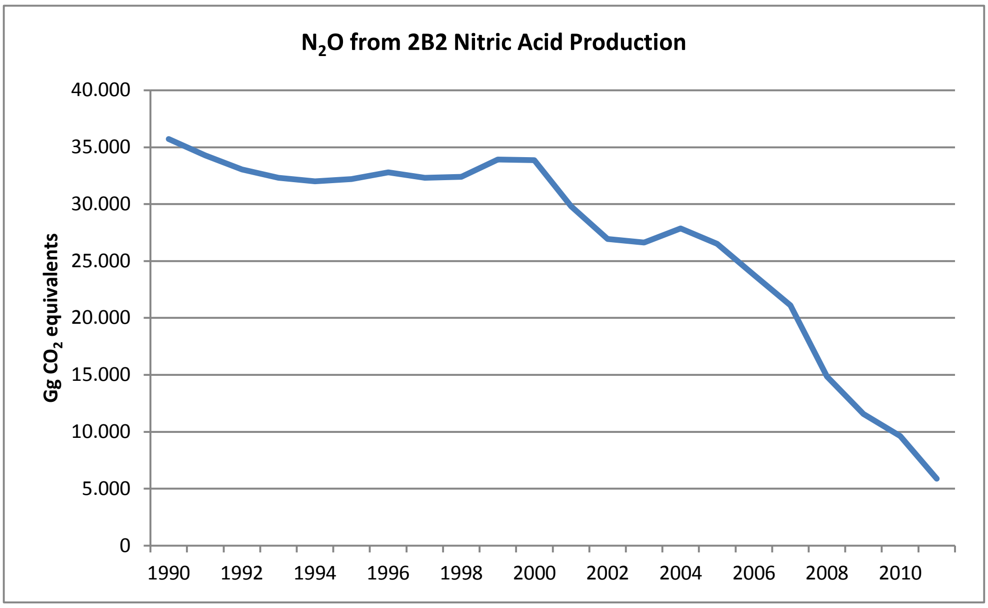
Member State	Review findings and responses in relation to 2B1 Ammonia Production	
	Comment UNFCCC report of the review of the 2011/2012 submission	Status in 2013 submission
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FIN) 2012 ARR not yet available.	No follow-up necessary
France	In response to a question raised by the ERT during the review, France responded that AD and emissions are reported by each plant, and that the increase in the value of the CO2 IEF between 2008 and 2009 is due to the decrease in the efficiency of the process as a result of the lower load factor of the plants. To increase transparency, the ERT recommends that France include this information in its next annual submission. (FCCC/ARR/2011/FRA).(2012 ARR not yet available)	Information is not included in the NIR.
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DEU). 2012 ARR not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/IRE). 2012 ARR not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/ITA).	No follow-up necessary
Luxembourg	NO	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD). 2012 ARR not yet available.	No follow-up necessary
Portugal	The NIR indicates that the only plant still manufacturing ammonia ceased production in 2009. In CRF table 2(I).A–G, Portugal has reported the AD as confidential (“C”) but has reported the CO2 emissions. New data provided by the plant led to recalculations of the emissions for the period 1990–2008: for 2008, the CO2 emissions decreased by 78.54 Gg (by 12.0 per cent for the category). The ERT recommends that Portugal report additional information on this recalculation in its next annual submission. (FCCC/ARR/2011/PRT). (2012 ARR not yet available).	The production of the single plants stopped in 2009, it may be difficult to gather more information after the plant closed.
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ESP). 2012 ARR not yet available.	No follow-up necessary
Sweden	NO	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR). 2012 ARR not yet available.	No follow-up necessary

Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.2.2 *2B2 Nitric Acid Production*

N_2O emissions from 2B2 Nitric acid production account for 0.2 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source decreased by 83.5 % (Table 4.23). Germany (49.9%), France (11.4 %) and Belgium (10.6 %) account for 71.9 % of EU-15 emissions. All Member States had reductions from this source between 1990 and 2011. The Netherlands and France had the greatest reductions in absolute terms, due to the implementation of technical measures at all Dutch nitric acid plants in the third quarter of 2007 and due to the improvement of the process and catalyst efficiency in France. Production stopped in Denmark (middle of 2004) and Ireland (in 2002 due to the liquidation of Irish Fertilizer Industries).

Figure 4.7 **2B2 Nitric acid production: EU-15 N_2O emissions**



The decrease in N_2O emissions by 12 % in 2000-2001 and further 10 % 2001-2002 was dominated by the drop in emissions in France, UK and the Netherlands. The decrease of N_2O emissions of minus 11 % during 2006 and 2007 was dominated by Belgium (contributing with 27 % to the EU-15 emission change), the Netherlands (contributing with 48 % to the EU-15 emission change due to technical measures that have been implemented at all nitric acid plants in the third quarter of 2007) and France (contributing with 10 % to EU-15 emission change due to improved catalyst efficiency). The N_2O emissions further decreased significantly by minus 30 % between 2007 and 2008 and by minus 23 % during 2008 and 2009. Emissions reductions in 2009 were achieved especially in Germany, Finland and France. In Finland all existing Finnish nitric acid plants have started to use special catalyst to decrease emissions during 2009 whereas in Germany and France further implementation of reduction techniques and improvement of the process efficiency led to a continuation of the trend in emissions since 2007. This trend of declining N_2O emissions continued between 2010 and 2011 for all Member States except for Greece and Italy which reported emission increases in this period.

Table 4.23 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	912	63	48	0.8%	-16	-25%	-864	-95%	CS	PS
Belgium	3 562	1 865	625	10.6%	-1 240	-66%	-2 937	-82%	T3	PS
Denmark	1 043	NO	NO	-	-	-	-1 043	-100%	NA	NA
Finland	1 656	167	135	2.3%	-32	-19%	-1 521	-92%	T2	PS
France	6 570	1 191	670	11.4%	-521	-44%	-5 901	-90%	T2	PS
Germany	3 384	3 030	2 936	49.9%	-95	-3%	-449	-13%	T3	PS
Greece	1 109	428	475	8.1%	47	11%	-634	-57%	D	D
Ireland	1 035	NO	NO	-	-	-	-1 035	-100%	NA	NA
Italy	2 086	157	179	3.0%	22	14%	-1 907	-91%	T2	D,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	6 330	301	243	4.1%	-58	-19%	-6 087	-96%	T2	PS
Portugal	518	297	65	1.1%	-233	-78%	-453	-87%	D	PS
Spain	2 800	504	258	4.4%	-246	-49%	-2 542	-91%	T3	PS
Sweden	814	312	41	0.7%	-271	-87%	-773	-95%	T2	PS
United Kingdom	3 904	1 317	207	3.5%	-1 110	-84%	-3 697	-95%	CS	CS
EU-15	**35 723**	**9 633**	**5 881**	**100.0%**	**-3 752**	**-39%**	**-29 842**	**-84%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.23 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric Acid Production for 1990 to 2011. The table shows that all MS report Nitric Acid Production as activity data; for some MS this information is confidential (Netherlands and Portugal). The implied emission factors per tonne of nitric acid produced vary for 2011 between 0.0003 t N_2O/t of nitric acid produced for Austria and 0.0070 t N_2O/t of nitric acid produced for Greece. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0017 t N_2O/t of nitric acid produced. The decrease of the EU-15 IEF during 1990 and 2010 is mainly due to the implementation of improved abatement technologies in the different MS and the closure of older plants in some MS. The table also suggests that about 97.7 % of EU-15 emissions are estimated with higher tier methods for 2011.

Table 4.24 2B2 Nitric Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 N_2O emissions (Gg)	2011 Activity data Description	2011 Activity data (kt)	2011 Implied emission factor (t/t)	2011 N_2O emissions (Gg)
Austria	CS	PS	Nitric Acid Production	530	0.0056	2.9	Nitric Acid Production	542	0.0003	0.2
Belgium	T3	PS	Nitric Acid Production	1 436	0.0080	11.5	Nitric Acid Production	2 051	0.0010	2.0
Denmark	NA	NA	Nitric Acid Production	450	0.0075	3.4	Nitric Acid Production	NO	NO	NO
Finland	T2	PS	Nitric acid production medium pressure plants	549	0.0097	5.3	Nitric acid production medium pressure plants	542	0.0008	0.4
France	T2	PS	Nitric Acid Production	3 200	0.0066	21.2	Nitric Acid Production	2 156	0.0010	2.2
Germany	T3	PS	Nitric Acid Production	1 698	0.0064	10.9	Nitric Acid Production	2 473	0.0038	9.5
Greece	D	D	Nitric Acid Production	511	0.0070	3.6	Nitric Acid Production	219	0.0070	1.5
Ireland	NA	NA	Nitric Acid Production	339	0.0099	3.3	Nitric Acid Production	NO	NO	NO
Italy	T2	D,PS	Nitric Acid Production	1 037	0.0065	6.7	Nitric Acid Production	437	0.0013	0.6
Netherlands	T2	PS	Nitric Acid Production	C	C	20.4	Nitric Acid Production	C	C	0.8
Portugal	D	PS	Nitric Acid Production	C	C	1.7	Nitric Acid Production	C	C	0.2
Spain	T3	PS	Nitric Acid Production	1 329	0.0068	9.0	Nitric Acid Production	667	0.0012	0.8
Sweden	T2	PS	Nitric Acid Production	374	0.0070	2.6	Nitric Acid Production	263	0.0005	0.1
UK	CS	CS	Nitric Acid Production	2 408	0.0052	12.6	Nitric Acid Production	1 084	0.0006	0.7
EU15			**EU15 w/o NL and PT (81%)**	**13 861**	**0.0067**	**93**	**EU15 w/o NL and PT (95%)**	**10 433**	**0.0017**	**18**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factors for 2011 are significantly lower than in 1990 for all MS except for Greece. Explanations for the development of the implied emission factors are therefore given in the following overview. Besides implementing abatement measures, also the closure of older plants in Belgium, Denmark, Ireland, Italy and Sweden resulted in reduced emissions.

Implied Emission Factor, Belgium

The decrease in IEF was due to further introduction of catalysts in the different installations in the Flemish region. Since 2000 only one plant with 4 installations is still involved in this sector. From 2003 on lower emission factors in this plant are reported because of the gradually extension of the use of catalysts. This producer in the Flemish region has nowadays 4 installations involved and produces nitric acid via the dual pressure process (medium/high pressure) with SCR (emission of N_2O). In 2011 the lowest emission factor for the complete time series of 1,17 kg N_2O/ton HNO3 was registered in the Flemish region In the Walloon region, there is only one producer of nitric acid (one plant with 3 installations). Each year, this plant provides the N_2O emissions based on their production and on monitoring. The global emission factor used was 4,93 kg/t in 2008, 6,34 kg/t in 2009, 6,46 kg/t in 2010 and 0,62 kg/t in 2011. This drop of the emissions in 2011 is explained by the placement of new catalysts on two installations at the end of 2010. The increase of the IEF in 2009 and 2010 is explained by an explosion in the plant in 2009 resulted in higher emissions in 2009 and 2010 as the control unit was out of order.

Implied Emission Factor, Austria

In Austria there is only one producer of nitric acid which operates two different dual pressure plants at one site. So called weak nitric acid is produced with a concentration of 59.6% HNO3 by oxidation of ammonia produced in the same location (Umweltbundesamt 2001(53)). There is no production of concentrated nitric acid in Austria. Nitric acid is mainly used for the production of fertilisers. The decrease of the IEF is due to the introduction of emission reduction measures: In 2001 a new catalyst was installed (IEF decreased from an average of 5.7 kg N_2O/t nitric acid, to about 5.0 kg N_2O/t nitric acid) and in 2004 a N_2O decomposition facility called Uhde process (EnviNO$_x$® process) was installed for the combined removal of N_2O and NO_x from the tail gas of nitric acid plants. (the IEF decreased from an average of 5.0 kg N_2O/t nitric acid, to about 1.6 kg N_2O/t nitric acid). In May 2009 a second catalyst in the nitric acid plant was installed which fully operated in 2010 and in 2011 the production process was further optimized.

Implied Emission Factor, France

IEF is calculated with activities and N_2O emissions reported under the E-PRTR. Between 2007 and 2008, reported N_2O emissions decreased due to improved processes and catalyst efficiency. In 2009 one older plant producing nitric acid was closed. Since 2002 the introduction of catalysts significantly reduced the IEF.

Implied Emission Factor, Finland

The decrease of the IEF after 2008 is due to the first joint implementation project in Finnish territory. This project aims on cutting down N_2O emissions of nitric acid plants and was started in 2009. A new N_2O abatement technology - a pelleted catalyst - was installed directly in the ammonia oxidation reactor underneath the ammonia oxidation catalyst (Pt-Rh) in all the three existing nitric acid plants which reduced emissions by 90 %.

Implied Emission Factor, Germany

A new plant started production that was build with the best available technology in 2002 and thus IEF significantly decreased from 2002 onwards. An additional decrease of the IEF is due the use of reduction techniques from 2006 onwards, partly catalytic destruction is used.

Implied Emission Factor, Italy

In 2008 the implementation of catalyst N_2O abatement technology in one of the major production plants (i.e. in one unit of that plant) has led to a significant decrease in total N_2O emissions from nitric acid production, consequently a relevant reduction in the IEF can be observed too (YARA, several years) the implied emission factor for 2008 is in fact 2.29 kg N_2O/Mg nitric acid production (the abatement rate in one plant was 82% so far); in 2010 the implied emission factor is 1.21 kg N_2O/Mg nitric acid production; the relevant decrease is due to the installation of the abatment technology in the other unit of the same producing facility (Radici Chimica, 2011) and to the technical improvements implemented in 2011 (Radici Chimica, 2013).

Implied Emission Factor, Spain

The emission reduction since 2010 is due to the installation of secondary reduction technologies in three of the four plants with medium pressure. The effective implementation of the technologies was in 2010 for two plants and in 2009, 2010 and 2011 for the third plant. Therefore a further decrease of the IEF can be observed in 2011. The reduction technologies consist in additional catalysts that were installed in the reactors for ammonia oxidation which allows a catalytic destruction of N_2O.

Implied Emission Factor, Sweden

The IEF of Sweden decreased from 2006 to 2007, then emissions increased again until 2009 followed by a sharp decrease between 2010 and 2011. The decrease is due to the implementN_2O reduction catalysts. However, these catalysts were taken out of operation during 2009. In 2010 they were used again, but not during all months of the year. In 2011 the catalysts were again fully operational.

Implied Emission Factor, United Kingdom

The larger of the two remaining UK plants fitted control equipment to reduce N_2O emissions in early 2011, leading to the large decreases in the aggregate EFs for both pollutants in 2011 compared with the previous year.

Table 4.25 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from Nitric Acid Production.

Table 4.25 2B2 Nitric Acid Production: Summary of methodological information provided by Member States

Nitric Acid Production	
Member State	**Methodology comment**
Austria	Following the IPCC Guidelines plant specific measurement data was collected. Activity and emission data of N_2O emissions was obtained directly from the plant operator. Since 1998, emissions are measured continuously. Based on the analysed emission data of 1998 and due to the fact that the production technology has not changed between 1990 and 1998 emission factors per ton of product were calculated for the used technologies. With these estimates of plant specific emission factors and the production volume of the individual plants the total emission of N_2O per year was calculated. [NIR 2013]
Belgium	The N_2O emissions from the production of nitric acid are estimated in Flanders until 2002 by using an emission factor of 8 kg N_2O/ton HNO3 from CITEPA [2]. The three plants involved in Flanders agreed with this factor of 8 kg N_2O/ton HNO3 since 1990 and give their nitric acid production figures each year. Since 2000 only one plant with 4

Nitric Acid Production	
Member State	**Methodology comment**
	installations is still involved in this sector. From 2003 on lower emission factors in this plant are reported because of. the gradually extension of the use of catalysts. The emissions are monitored since 2003. This producer in the Flemish region has nowadays 4 installations involved and produces nitric acid via the dual pressure process (medium/high pressure) with SCR (emission of N_2O). Although the closure of 2 plants in the Flemish region, in 1995 and in 2000 respectively, the production of nitric acid stabilized more or less after 2000, until 2008 and the emissions of N_2O decreases in time due to undertaken measures. The year 2009 was an exception due to the economic crisis and in the year 2010 a real boost took place in nitric acid production (an increase of 37% compared to 2009). In 2011 the lowest emission factor for the complete time series of 1,17 kg N_2O/ton HNO3 was registered in the Flemish region. In the Walloon region, there is only one producer of nitric acid (one plant with 3 installations). Each year, this plant provides the N_2O emissions based on their production and on monitoring. The global emission factor used was 4,93 kg/t in 2008, 6,34 kg/t in 2009, 6,46 kg/t in 2010 and 0,62 kg/t in 2011. This drop of the emissions in 2011 is explained by the placement of new catalysts on two installations at the end of 2010. The increase of the IEF in 2009 and 2010 is explained by an explosion in the plant in 2009 resulted in higher emissions in 2009 and 2010 as the control unit was out of order. [NIR 2013]
Denmark	The N_2O emission from the production of nitric acid/fertiliser is based on measurement for 2002. For the previous years, the N_2O emission has been estimated from annual production statistics from the company and an emission factor of 7.5 kg N_2O/tonne nitric acid, based on the 2002 emission measured. The production of nitric acid ceased in the middle of 2004. [NIR 2013]
Finland	Statistics Finland co-operates with the nitric acid manufacturers to produce the annual emission estimates. For emissions in 1990–2004 the procedure was as follows: the manufacturers provided the activity data and emission factors, and Statistics Finland carried out the calculations using an agreed methodology that corresponds to the IPCC Good Practice Guidance equation 3.9. Starting from the inventory year 2005 both emissions and activity data have been received from the Vahti system. Currently it is the specific emission factors rather than emissions that are calculated by the inventory unit. Since 2009 all existing nitric acid plants have been equipped with automatic systems according to EU standards to measure the project key parameters. The plant-specific project emission factor representing the average N_2O emissions per tonne of nitric acid over the respective verification period is derived by dividing the total mass of N_2O emissions by the total output of 100% concentrated nitric acid for that period. Before 2009, only one of the three plants was equipped with a continuous N_2O emission measurement unit. From 2005 the company used also a portable measurement device at the other two plants. A consultant made periodically measurements at the plants in 1999–2004. No measurements are available prior to 1999. The annual nitric acid and fertiliser production figures have been obtained from the production plants or from the Vahti system [NIR 2013]
France	L'UNIFA reported emissions for each plant for the years 1990, 1998 , and 2001.For the year in between, only a global balance for all plants was provided. These data were compared with data reported in environmental declarations of industry. Since 2002 annual plant-specific data is available and good practice guidance for the estimation was adopted by AFNOR . the emissions are based on measurements and are annually verified by competent authorities. [NIR 2013]
Germany	Tier 3 methodology has been applied since the 2011 submission. Companies report all information to Industrieverband Agrar (IVA) where data is aggregated and forwarded to UBA. [NIR 2013]
Greece	Estimation is based on IPCC default methodology. Estimates are based on activity data from El.Stat and the individual industrial units for 1990-2010 and average IPCC default EF (IPCC GPG 2000). Actually in the recent years there is only one unit producing nitric acid in Greece therefore, data are sent directly to the inventory team by the unit. No N_2O abatement technologies are used. [NIR 2013]
Ireland	Nitric acid production ceased in 2002 with the liquidation of Irish Fertilizer Industries. For the years 1990-1995, the inventory agency received direct correspondence from the plant operator specifying the quantities of nitric acid produced and the company‟ s estimates of N_2O emitted during the production process. The emissions were estimated from nitrogen loading and the type of catalyst used in the process. [NIR 2013]
Italy	"With regard to nitric acid production (2B2), production figures at national level are published in the national statistical yearbooks (ISTAT, several years), while at plant level they have been collected from industry (Norsk Hydro, several years; YARA, several years; Radici Chimica, several years). In 1990 there were seven production plants in Italy; three of them closed between 1992 and 1995, and another one closed in 2004, one more closedown in 2008 has left two plants still operating. The N_2O average emission factors are calculated from 1990 on the basis of the emission factors provided by the existing production plants in the national EPER/E-PRTR registry, applied for the whole time series, and default IPCC emission factors for low and medium pressure plants attributed to the plants, now closed, where it was not possible to collect detailed information. Thus, N_2O emissions are estimated at plant level also considering the operating unit level, if necessary. Activity data have been collected at plant level for the whole time series. Unit specific default IPCC EFs have been used for plants closed in the nineties because it was not possible to collect more detailed information. For the other plants, data supplied in the framework of the EPER/EPRTR registry have been used from 2001 onwards, while for the years 1990-2000 EFs at unit level have been calculated as an average of 2001-2004 data provided by operators in the EPER/EPRTR register. The implied emission factor varies year by year depending on the production levels of the different plants and it was equal to 6.49 and 7.07 kg N_2O/Mg nitric acid production, in 1990 and in 2007 respectively. Relevant reductions in N_2O emissions have been observed since 2008, specifically: In 2008 the implementation of catalyst N_2O abatement technology in one of the major production plants(i.e. in one unit of that plant) has led to a significant decrease in total N_2O emissions from nitric acid production, consequently a relevant reduction in the IEF can be observed too (YARA, several years) the implied emission factor for 2008 is in fact 2.29 kg N_2O/Mg nitric acid production (the abatement rate in one plant was 82% so far); the, in 2010 the implied emission factor is 1.21 kg N_2O/Mg nitric acid production; the relevant decrease is due to the installation of the abatment technology in the other unit of the same producing facility (Radici Chimica, 2011) and to the technical improvements implemented in 2011 (Radici Chimica, 2013). [NIR 2013]
Netherlands	Activity data are confidential. An IPCC Tier 2 method is used to estimate N_2O emissions. The emission factors are

Nitric Acid Production	
Member State	**Methodology comment**
	based on plant-specific measured data which are confidential. The emissions are based on data reported by the nitric acid manufacturing industry and are included in the emission reports under EU ETS and the national Pollutant Release and Transfer Register (PRTR). [NIR 2013]
Portugal	Only three industrial plants did produced nitric acid in Portugal between 1990 and 2011. In all weak nitric acid (60 percent) is produced from ammonia, using catalytic (Platinum-rhodium alloy catalysts) oxidation of ammonia with air to NO2 at medium pressure, and subsequent absorption with water to form nitric acid in a dualstage process. EFs were estimated based on monitoring data from the facilities and are confidential. Activity Data is obtained directly from the facilities. One of the plants was shutdown during year 2010 and replaced by a new facility.[NIR 2013]
Spain	In 1990 13 plants existed while in 2011 only 4 plants still exist. Plant-specific production data for the years 1990 and 2008-until the most recent year and for the entire time series from industrial association FEIQUE (the Business Federation of the Chemical Industry in Spain) and the ministry of industry, energy and tourism (MITYC). AD differentiates data per plant, production types and processes. CS EF from plant-specific questionnaires are used taking into account technologies installed . Pleant specific measurements are used for the N_2O emissions since 2008 which are gathered via questionnaires from the plants. Before 2008 plant-specific EFs for each plant are used. For the plants that closed an EF of 7 kg N_2O/t nitric acid was used based on information from the association from 1998. N_2O emission reduction technologies were implemented in the remaining plants in 2009, 2010 and 2011 [NIR 2013]
Sweden	Activity data, such as the produced amount of nitric acid, has been obtained from the facilities and from official statistics. Emission estimates of N_2O have been reported in the companies' environmental reports or have been provided by the facilities directly. Emission data are not available for all facilities for 1991-1993. Since two plants have been shut down, it is no longer possible to acquire this information. Calculations have therefore been made based on production statistics and an assumed emission factor. [NIR 2013]
United Kingdom	Across the 1990-2009 time-series, the availability of emissions and production data for UK Nitric Acid (NA) plant is inconsistent, and hence a range of methodologies have had to be used to provide estimates and derive emission factors for this sector. Where possible, emission estimates are based on site-specific data provided by process operators. Over the period covered by the UK inventory, there have been nitric acid plants operating in England, Northern Ireland, and Scotland, although all production in Scotland ceased in the early 1990s. For plant in England, emissions data from plant operators are available for all sites from 1998 onwards from the EA's Pollution Inventory. For the single plant (now closed) in Northern Ireland, emissions data from plant operators became available from 2001. There is no site-specific data for any Scottish plants. Site-specific production estimates are largely based on production capacity reported directly by the plant operators. This approach may overestimate actual production. No data are available for three sites operating between 1990 and 1993, and production at these sites is calculated based on the difference between estimates of total production and the sum of production at the other sites. Emission estimates for N_2O are derived for each NA site using: a) Emissions data provided by the process operators directly or via the Pollution Inventory (1998 onwards for plant in England, 2001 onwards for plant in N Ireland); b) Site-specific emission factors derived from reported emissions data for the same site for another year (1990-1997 for some plant in England, 1994-1997 for other plant in England, 1990-2000 for plant in N Ireland); and c) A default emission factor of 6 kt N_2O /Mt 100% acid produced in cases where no emissions data are available for the site (some sites in England, Scotland, 1990-1993). This default factor is the average of the range quoted in IPCC Guidelines (IPCC, 1997) for medium pressure plant [NIR 2013]

Source: NIR 2013.

Table 4.26 summarizes the recommendations from the 2011 and 2012 UNFCCC inventory reviews in relation to the category 2B2 Nitric Acid Production.

Table 4.26 2B2 Nitric Acid Production: Findings of the 2011 and 2012 UNFCCC inventory reviews in relation to N_2O emissions and responses in 2013 inventory submissions

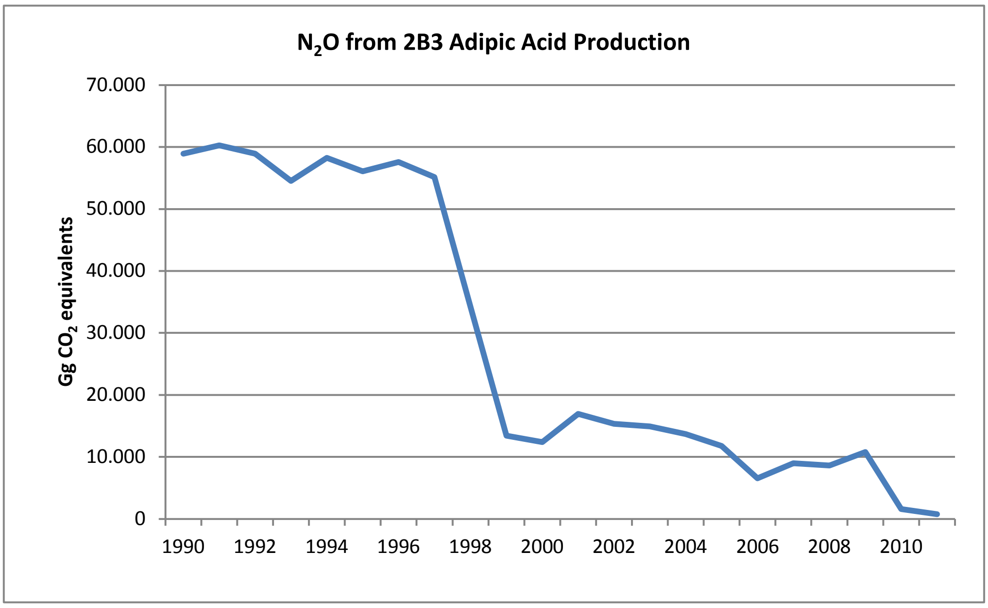
Member State	Review findings and responses related to 2B2 Nitric Acid Production	
	Comment UNFCCC report of the review of the 2011 submission	Status in 2012 submission
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/AUT).	No follow-up necessary
Belgium	During the review, the Party clarified that the decline was mainly due to strengthened abatement measures adopted in the Flemish Region where four dual-pressure process plants have been installed with a selective catalytic reduction process, and one single-pressure process plant has been installed with a non-selective catalytic reduction process. The ERT recommends that Belgium include this explanation in the NIR of its next annual submission, in order to improve transparency. (FCCC/2011/ARR/BEL). 2012 ARR not yet available.	The information on the reduction technologies was incorporated in the NIR.
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK). 2012 ARR not yet available.	No follow-up necessary
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FIN) 2012 ARR not yet available.	No follow-up necessary
France	The ERT considers, similarly to the previous review report, that France is not reporting information on how it calculates the country-specific EFs in a transparent manner. The ERT therefore reiterates the recommendation in the previous review report that France report in the NIR on the process technology used for each plant and the EFs aggregated by the two groups of plants (with and without N2O destruction technology) in order to increase transparency in its next annual submission. The ERT also reiterates the recommendation in previous review reports that France report the production share of the seven plants where continuous measurements are made separately and indicate their share in the total nitric acid production in France. The ERT therefore reiterates the recommendation in the previous review report that France report in the NIR on the process technology used for each plant and the EFs aggregated by the two groups of plants (with and without N2O destruction technology) in order to increase transparency in its next annual submission. The ERT also reiterates the recommendation in previous review reports that France report the production share of the seven plants where continuous measurements are made separately and indicate their share in the total nitric acid production in France. (FCCC/ARR/2011/FRA).(2012 ARR not yet available)	Process technologies by plant and production shares by plant are not reported (likely to be confidential information). There seem to be no plants without destruction technologies left, therefore the suggested grouping may be difficult to implement.
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DEU). 2012 ARR not yet available.	No follow-up necessary
Greece	During the review, the Party provided relevant information regarding the data sources used for the verification of plant-specific AD used to estimate these emissions. The ERT recommends that Greece include this information in its next annual submission, in order to improve transparency. No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/IRE). 2012 ARR not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ITA). 2012 ARR not yet available.	No follow-up necessary
Luxembourg	NO	No follow-up necessary
Netherlands	The Netherlands uses a plant-specific EF of 7.4 kg N2O/t nitric acid to estimate emissions for the period 1990–1998. The plant-specific EF is based on measurements taken in 1998 and 1999. From 1999 onwards, the emission estimates are based on measurements taken annually. The results of the measurements taken in 1998 and 1999 which have been used to determine the country-specific EF for the period 1990–1998 could not be provided to the ERT by the Netherlands as they had not been archived correctly. Therefore, the emissions for the period 1990–1999 and the time-series consistency could not be assessed by the ERT. The ERT recommends that the Netherlands retrieve the results of the 1998 and 1999 measurements in order to demonstrate time-series consistency in its next annual submission and that the Netherlands archive all such results properly and, when necessary, make them available for ERTs in the future. (FCCC/ARR/2011/NDL). (2012 ARR not yet available)	Detailed information on abatement technologies and efficiences at each plant provided in the NIR
Portugal	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ESP). 2012 ARR not yet available.	No follow-up necessary
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ESP). 2012 ARR not yet available.	No follow-up necessary
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/SWE). .	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR). 2012 ARR not yet available.	No follow-up necessary

Source: NIR 2013, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.2.3 *2B3 Adipic Acid Production*

N_2O emissions from 2B3 Adipic Acid Production account for 0.02 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source decreased by 98.7 % (Figure 4.8). Only France, Germany and Italy (the UK produced adipic acid until 2009) produce adipic acid and all three countries were able to decrease emissions from this source category significantly due to the retrofitting of installations with abatement technologies.

Figure 4.8 2B3 Adipic Acid Production: EU-15 N_2O emissions



During 1997 and 1999, N_2O emissions for EU-15 decreased significantly by 76 %. The country's share in this change of emission trend was 43 % for Germany ,31 % for France and 28 % for the UK, whereas Italy increased its emissions during that time period and reduced its emissions significantly during 2005 and 2006 (-77%).

In Germany decomposition takes place nearly completely. At the end of 1997, both producers have put a catalytic reactor system into operation that, in constant operation, achieves an N_2O-decomposition rate of 96-98 %. A N_2O abatement system was fitted to the single plant that produces adipic acid in 1998. The abatement system is a thermal oxidation unit and is reported by the operators to be 99.99 % efficient at N_2O destruction.

The only plant that produces adipic acid in France installed an abatement technique in 1998. A strong reduction was observed between 2003 and 2004 (more than 70 %) when a new treatment system was installed. Changes in the IEF after this period are due to the halt of the treatment system for maintenance or when it is out of order.

The decrease of N_2O emissions in Italy between 2005 and 2006 is the result of the application of the best available technique to reduce emission in the only existing adipic acid production plant. In 2004, the N_2O catalytic decomposition abatement technology has been tested so that the value of emission factor has been reduced taking into account the efficiency and the time, one month, hat the technology operated. From the end of 2005 the abatement technology is fully operational; the average emission factor in 2006 is equal to 0.05 kg N_2O/kg adipic acid produced and the abatement system had been operating continuously for 9 months; since 2007 the average emission factor has been 0.03 kg N_2O/kg adipic acid produced and the operating time of the abatement system has been 11 months. Technical improvements in operating the production process and the abatement system have allowed achieving significant reduction in N_2O emissions since 2009 (Radici Chimica, 2013): in 2010 the average emission factor was 0.019 kg N_2O/kg adipic acid produced while in 2011 the average EF is 0.005 kg N_2O/kg adipic acid produced with the abatement rate exceeding 98%. (Table 4.27).

The increase of N_2O emissions between 2000 and 2001 and between 2006 and 2007 was dominated by the raise of emissions in Germany due to damaged abatement systems. During 2008 and 2009 German N_2O emissions increased by 56 % because the exhaust air cleaning system of one producer in Germany was not working for a longer period of time. In 2008-2009, the largest reduction of emissions could be found for the UK. The UK's only remaining adipic acid plant closed during early 2009 - therefore emissions are much lower than in previous years.

Table 4.27 2B3 Adipic Acid Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	14 806	380	126	16.5%	-255	-67%	-14 680	-99%	T2	PS
Germany	18 805	716	522	68.3%	-195	-27%	-18 283	-97%	T3	PS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4 579	490	116	15.2%	-374	-76%	-4 463	-97%	T2	D,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	20 737	NO	NO	0.0%	0	-	-20 737	-100%	NA	NA
EU-15	**58 927**	**1 587**	**764**	**100.0%**	**-823**	**-52%**	**-58 163**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.28 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic Acid Production for 1990 to 2011. The table shows that in 2011 adipic acid was produced in three MS only. All three MS use adipic acid production as activity data but the information is confidential in France, Germany and the UK. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.005 t/t for 2011. The table suggests that in 2011 100 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.28 2B3 Adipic Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

			1990					2011				
Member State	Method applied	Emission factor	Activity data		Implied emission factor	N_2O emissions		Activity data		Implied emission factor	N_2O emissions
			Description	(kt)	(t/t)	(Gg)		Description	(kt)	(t/t)	(Gg)
France	T2	PS	Adipic acid production	C	C	47.8		Adipic acid production	C	C	0.4
Germany	T3	PS	Adipic acid production	C	C	60.7		Adipic acid production	C	C	1.7
Italy	T2	D,PS	Adipic acid production	49	0.30	14.8		Adipic acid production	83	0.00	0.4
UK	NA	NA	Adipic acid production	C	C	66.9		Adipic acid production	NO	C	NO
EU15			**EU15**			**190**		**EU15**			**2.5**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.29 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from adipic acid production.

Table 4.29 2B3 Adipic Acid Production: Summary of methodological information provided by Member States

Adipic Acid Production	
Member State	**Methodology comment**
France	There is only one production site in France. Emissions are based on plant-specific data. Good practice guidance for the emissions measurement and estimation at plant level have been developed and approved by AFNOR. Since 1998 an abatement system is installed that destroys N_2O using absorption which is synthesizing nitirc acid. The plant is equiped with a catylytic treatment of NO_x before the exhaust is emitted in the atmosphere. In regular situations emissions are continuously measured, in irregular situations, emissions are estimated based on a material balance [NIR 2013]
Germany	"Until around the mid-1990s, producers provided data only on amounts produced. The IPCC default emission factors have been used to calculate nitrous oxide emissions for that period. For the subsequent period, in addition to reporting their production figures, producers also confidentially reported their N_2O emissions, along with necessary background information. This fact is highly significant with regard to the precision of the reported data; without data on technically unavoidable N_2O production, and – especially – without information as to the operating period of the relevant decomposition facilities, estimates of the reduction in nitrous oxide emissions would have been so imprecise that it would have been necessary to continue using the default EF. [NIR 2013]"
Italy	Italian production figures and emission estimates for adipic acid have been provided by the process operator (Radici Chimica, several years) for the whole time series. Emissions estimates provided by the operator are based on the IPCC default EF. More specifically, N_2O emissions from adipic acid production (category 2B3) have been estimated using the default IPCC emission factor equal to 0.30 kg N_2O/kg adipic acid produced, from 1990 to 2003. Since 2004 the operator has started to study how to introduce an abatement system; although emission estimates provided by the operator have still been based on the IPCC default emission factor (0.30 kgN_2O/kg adipic acid produced), the operating hours of the abatement system and the abatement rates have also been included in the estimation process. The abatement system is generally run together with the adipic acid production process. In 2004, the N_2O catalytic decomposition abatement technology has been tested so that the value of emission factor has been reduced taking into account the efficiency and the time, one month, that the technology operated. From the end of 2005 the abatement technology is fully operational; the average emission factor in 2006 is equal to 0.05 kg N_2O/kg adipic acid produced and the abatement system had been operating continuously for 9 months; since 2007 the average emission factor has been 0.03 kg N_2O/kg adipic acid produced and the operating time of the abatement system has been 11 months. Technical improvements in operating the production process and the abatement system have allowed achieving significant reduction in N_2O emissions since 2009 (Radici Chimica, 2013): in 2010 the average emission factor was 0.019 kg N_2O/kg adipic acid produced while in 2011 the average EF is 0.005 kg N_2O/kg adipic acid produced with the abatement rate exceeding 98%. [NIR 2013] Thus, both for the period 1990-2005 and from 2006 onwards the estimates are provided according to the GPG (default EF has been used when no abatement system was operational; abatement rates have been considered in estimating emission values since 2006). The operator reports also under EPER/E-PRTR both adipic acid production and the N_2O emissions related to this production; adipic production and N_2O emissions have been also reported by the operator to the national competent authoritiy for the ETS (because the facility will join the ETS system in 2013) together with additional information such as abatement rates and operating times. Based on information from the national PRTR EFs are calculated for the plant, the resulting value is checked and verified by the formula included in the following box (based on the IPCC default EFs for adipic acid production, abatement rate and operating time of the abatement technology at the facility). In the formula the average emission factor is calculated subtracting from the default EF (0.300 kgN_2O /kg adipic acid produced) the default EF multiplied by the abatement technology rate and by the operating time factor, parameters and resulting EF values are indicated for the years 2005 to 2011. The EFs submitted for the adipic acid production in the CRF and the EFs calculated for the plant in the following box are practically the same. [NIR 2013]
United Kingdom	There was only one company manufacturing adipic acid in the UK, but this closed in early 2009. Production data and

Adipic Acid Production	
Member State	**Methodology comment**
	emission estimates have been estimated based on data provided by the process operator (Invista, 2010). The emission estimates are based on the use of plant-specific emission factors for unabated flue gases, which were determined through a series of measurements on the plant, combined with plant production data and data on the proportion of flue gases that are unabated. In 1998 an N_2O abatement system was fitted to the plant. The abatement system is a thermal oxidation unit and is reported by the operators to be 99.99% efficient at N_2O destruction. In 2004 it was operational 92.6 % of the time (when compared to plant operation). Variation in the extent to which this abatement plant is operational, account for the large variations in emission factors for the adipic acid plant since 1999. A small nitric acid plant is associated with the adipic acid plant that also emits N_2O. From 1994 onwards this emission is reported as nitric acid production but prior to 1994 it is included under adipic acid production. This will cause a variation in reported effective emission factor for these years. This allocation reflects the availability of data. [NIR 2013]

Source: NIR 2013

Table 4.30 summarizes the recommendations from the 2011 and 2012 UNFCCC inventory reviews in relation to the category 2B3 Adipic Acid Production.

Table 4.30 2B3 Adipic Acid Production: Findings of the 2011 and 2012 UNFCCC inventory reviews in relation to N_2O emissions and responses in 2013 inventory submissions

Member State	Review findings and responses related to 2B3 Adipic Acid Production	
	Comment UNFCCC report of the review of the 2011/2012 submission	**Status in 2013 submission**
France	The NIR (page 130) reports an increase in the value of the CO2 EF for 2009 by 50.0 per cent, but the corresponding CO2 emissions increased by only 19.6 per cent between 2008 and 2009 (i.e. not following the same growth rate as the EF).The ERT cannot find a reason why the value of the CO2 EF should increase when the production of adipic acid decreases, as the oxidation of feedstock decreases in parallel. In addition, adipic acid production has been decreasing since 2006 without any similar impact on the EFs, which remained constant until 2009. The ERT recommends that France confirm whether there is any change in the industrial process or in the methodology and parameters used to estimate the emissions, or any miscounting of CO2 emissions, and to report in detail on its findings in its next annual submission. 75. The ERT noted that the methodology used to estimate the N2O emissions from adipic acid production is not described in the NIR. In response to a question raised by the ERT during the review, France provided documentation on the methodology used (methodology BP X30-330 of the French Association of Normalization). The ERT considers that the methodology is in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, but recommends that France include a description of this methodology in its next annual submission. (FCCC/ARR/2011/FRA). (2012 ARR not yet available).	Methodological description is included in the NIR 2013
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DEU). 2012 ARR not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/ITA).	No follow-up necessary
UK	NO	No follow-up necessary

Source: NIR 2013, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.2.4 *2B5 Other Chemical Industry*

CO_2 emissions from 2B5 Other account for 0.43 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from this source increased by 42.9 % (Figure 4.8, Table 4.32). Germany is responsible for 59.3 % of these emissions in the EU-15, followed by the UK (12.3 %), Belgium (5.4 %), France (5.3 %), the Netherlands (4.8%) and Italy (4.8 %). Germany had the largest growth of emissions in absolute terms due to the increased production of methanol in the past and a new producer for carbon black. Additionally emissions of the conversion loss increased with further development of the production. Belgium, Finland, Greece, Italy, Netherlands, Portugal and the UK also show an increase of emissions.

Figure 4.8 2B5 Other: EU-15 CO_2 emissions

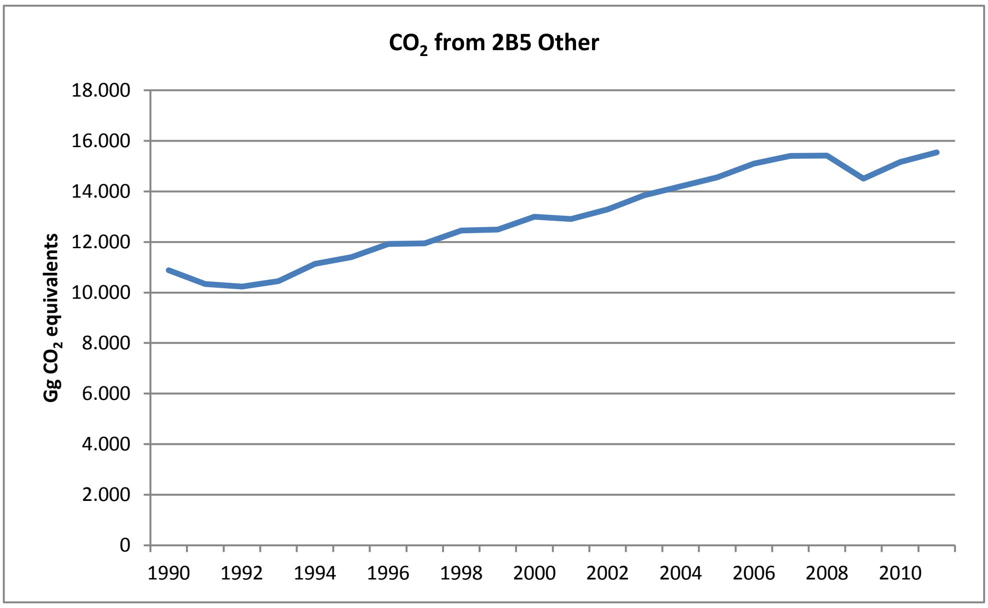


Table 4.31 2B5 Other: EU-15 CO_2 emissions – emission trends between 1990 and 2011 and MS contribution

Member State	2.B.5 Other	CO_2 emissions [Gg] 1990	CO_2 emissions [Gg] 2011	CH_4 emissions [Gg] 1990	CH_4 emissions [Gg] 2011	N_2O emissions [Gg] 1990	N_2O emissions [Gg] 2011
AT	5. Other (please specify)	31.0	26.4	0.6	0.8	NA,NO	NA,NO
	CO2 from nitric acid production	0.4	0.4	NO	NO	NO	NO
	Other Chemical Industry	30.5	26.0	0.3	0.3	NA	NA
BE	Other non-specified	224.2	841.0	NA	0.1	0.0	0.1
DK	5. Other (please specify)	0.8	2.2	NA,NO	NA,NO	NA,NO	NA,NO
	Catalysts/Fertilizers	0.8	2.2	NA	NA	NA	NA
FI	5. Other (please specify)	106.9	712.7	NO	NO	NO	NO
	chemicals production	24.4	7.6	NO	NO	NO	NO
	Hydrogen	57.9	668.3	NO	NO	NO	NO
	Phosphoric Acid Production	24.5	36.7	NO	NO	NO	NO
FR	5. Other (please specify)	805.4	826.9	3.7	2.5	10.2	1.4
	Ethylene	IE	IE	2.2	1.5	NA	NA
	2.B.5.6 Glyoxylic Acid Production	NA	NA	NA	NA	8.6	1.1
	2.B.5.7 Anhydrid Phtalic Production	30.1	20.0	NA	NA	NA	NA
	2.B.5.8 Other non-specified	775.3	806.9	1.5	1.0	1.6	0.4
DE	Calcium Carbide	443.2	18.6	NO	NO	0.0	0.0
	5. Other (please specify)	6 888.2	9 211.8	0.0	0.0	0.7	C,IE,NA,NO
	Carbon Black	786.7	1 779.2	0.0	0.0	0.0	0.0
	Methanol	848.4	692.9	NO	NO	0.0	0.0
	Caprolactam	NA	NA	NA	NA	0.7	NO
	Catalytic Burning	2 553.1	2 964.0	NA	NA	NA	NA
	Conversion loss	2 700.0	3 775.7	NO	NO	NO	NO
GR	5. Other (please specify)	NA,NE,NO	321.9	0.0	NA,NO	NA,NO	NA,NO
	Hydrogen Production	NA	321.9	NA	NA	NA	NA
	Organic chemicals production	NE	NE	0.0	NO	NA	NA
IE	5. Other (please specify)	NO	NO	NO	NO	NO	NO
IT	5. Other (please specify)	474.9	744.1	2.5	0.3	0.0	NA,NO
	Carbon Black	422.1	691.3	1.8	0.1	0.0	0.0
	Propylene	NA	NA	0.1	0.1	NA	NA
	Titanium Dioxide Production	52.8	52.8	NA	NA	NA	NA
LU	Carbon Black	0.0	0.0	NO	NO	0.0	0.0
NL	Calcium Carbide	NO	NO	NO	NO	0.0	0.0
	5. Other (please specify)	648.5	727.6	11.4	11.0	2.5	2.8
	Carbon Black	0.0	0.0	1.5	0.8	0.0	0.0
	Ethylene	IE	IE	2.9	4.4	NO	NO
	Styrene	0.0	0.0	5.3	5.3	0.0	0.0
	Methanol	0.0	0.0	1.7	0.6	0.0	0.0
	Carbon electrodes	54.6	99.6	NO	NO	NO	NO
	Ethene oxide production	127.7	178.0	NO	NO	NO	NO
	Graphite	33.0	20.6	NO	NO	NO	NO
	Other Chemical Industry	433.2	429.4	NO	NO	NO	NO
PT	Carbon Black	50.6	95.8	0.2	0.3	0.0	0.0
	Ethylene	7.2	8.3	0.2	0.2	NO	NO
	Ammonium sulphate	0.1	0.0	NO	NO	NO	NO
	Monomer and polymer production	2.0	1.3	NO	NO	NO	NO
	Production of Explosives	3.6	3.6	NO	NO	NO	NO
ES	Silicon Carbide	41.0	42.1	0.2	0.2	0.0	0.0
	Calcium Carbide	35.3	23.9	NA	NA	0.0	0.0
	5. Other (please specify)	NA	NA	1.8	2.0	NA	NA
	Carbon Black	0.0	0.0	0.7	0.7	0.0	0.0
	Ethylene	NA	NA	1.0	1.3	NA	NA
	5. Other (please specify)	NA	NA	1.8	2.0	NA	NA
	Carbon Black	0.0	0.0	0.7	0.7	0.0	0.0
	Ethylene	NA	NA	1.0	1.3	NA	NA
	Dichloroethylene	0.0	0.0	NA	NA	0.0	0.0
SE	4. Carbide Production	54.2	32.5	NA,NO	NA,NO		
	Calcium Carbide	54.2	32.5	NA	NA	0.0	0.0
	5. Other (please specify)	71.9	103.9	0.4	0.4	0.1	0.0
	Base chemicals for plastic industry	NA	NA	NE	NE	0.0	0.0
	Other inorganic chemical prod	34.2	63.9	0.3	0.3	0.0	0.0
	Other non-specified	NA	NA	NE	NE	NE	NE
	Other organic chemical prod	37.7	40.0	0.0	0.0	NA	NA
	Pharmaceutical industry	NA	NA	NE	NE	0.1	0.0
GB	Calcium Carbide	NO	NO	NO	NO	0.0	0.0
	5. Other (please specify)	1 562.9	1 917.2	8.1	3.5	NA,NO	NA,NO
	Ethylene	IE	IE	0.6	0.5	NO	NO
	Methanol	0.0	0.0	0.0	NO	0.0	0.0
	Carbon from NEU products	1 562.9	1 917.2	NA	NA	NA	NA
	Chemical Industry (Other)	NA	NA	7.4	2.9	NA	NA

For an overview of sources and MS trend developments at disaggregate level for source 2B5 see Table 4.32. This overview shows that due to the heterogeneity of emission sources in this category, it is difficult to interpret the EU 15 trend in a general way.

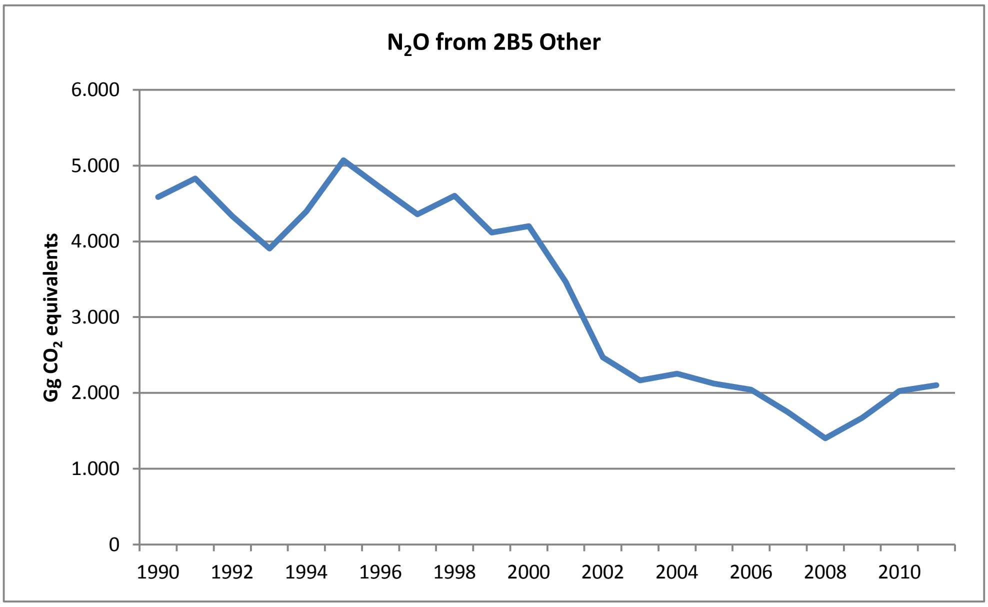
Table 4.32 2B5 Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	31	27	26	0.2%	-1	-2%	-5	-15%	T3	PS
Belgium	224	753	841	5.4%	88	12%	617	275%	T3	PS
Denmark	1	2	2	0.0%	0	4%	1	174%	CS	D
Finland	107	773	713	4.6%	-61	-8%	606	567%	CS,T2	CS,PS
France	805	840	827	5.3%	-13	-2%	21	3%	T2	PS
Germany	6 888	8 827	9 212	59.3%	385	4%	2 324	34%	CS,T2	CS,D
Greece	NA,NE,NO	362	322	2.1%	-40	-11%	322	-	T1	CS
Ireland	NO	NO	NO	-	-	-	0	-100%	NA	NA
Italy	475	702	744	4.8%	42	6%	269	57%	D	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	649	725	728	4.8%	2	0%	79	12%	CS,T1	CS,D,PS
Portugal	63	108	109	0.7%	1	1%	46	72%	D	CS
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	72	99	104	0.7%	5	5%	32	45%	CS	PS
United Kingdom	1 563	1 953	1 917	12.3%	-36	-2%	354	23%	CS	CS,OTH
EU-15	**10 878**	**15 171**	**15 545**	**100.0%**	**374**	**2%**	**4 667**	**43%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.06 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source decreased by 54.2 % (Table 4.33). The Netherlands, Belgium and France are responsible for almost all of these emissions in the EU-15. Emissions decreased especially in France – besides the Netherlands – and had the largest influence on the reductions in the EU-15, whereas Belgium increased its N_2O emissions in the period 1990 to 2011.

Figure 4.9 2B5 Other: EU-15 N_2O emissions



N_2O emissions in France decreased strongly between 1998 and 2003 and again from 2005 onwards. The first decline in emissions can be explained by the closing of one of the two sites which produced glyoxylic acid until 2001 and the installation of an abatement technique for the other site in 1998. The second decrease is due to the efficiency improvement of the abatement technique for glyoxylic acid production and by the decrease of the production of PTTB and industrial and medical N_2O. During 2008 and 2009, N_2O emissions again increased, which is caused by an increase of Uranium tetrafluoride production which emits N_2O, and by an increase of glyoxilic acid production. From 2009 to 2010 N_2O emissions increased again by 21%. This increase is on the one hand due to the increase of industrial and pharmaceutical production of N_2O (and consequently N_2O emissions). Secondly, it is due to the modification of N_2O measurements for UF4 production. Before 2010, N_2O measurements were done annually and extrapolated so as to determine N_2O emissions for the whole year whereas since 2010, the N_2O emissions are measured on a continuous basis.

In response to the recommendations by the ERT (FCCC/ARR/2009/EC, para 53), additional explanations of the trends or inter-annual fluctuations of N_2O emissions are given. For the Netherlands, N_2O emissions derive from the production of caprolactam; these emissions decreased by 48 % during 2004 and 2008. During the period 1990 to 2004, the Dutch emissions are based on production-indexes; as a result of an increasing production level the emissions increased, too. A better process control and a lower production level resulted in an emission reduction during 2004 and 2008. Plant-specific N_2O emission factors are used for caprolactam production. Emission factors as well as activity data on caprolactam production are confidential. Only emissions are reported by the companies.

N_2O emissions in Belgium increased during 1990 and 2009, especially during 2003 and 2007. Emissions of N_2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out. N_2O emissions increased again by 31% between 2009 and 2010 in the Flemish region due to strong increase of production of caprolactam in that period.

In Italy, N_2O emissions from caprolactam production have been estimated and emissions arise from only one producing plant, which closed in 2003.

Table 4.33 2B5 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	381	731	775	36.9%	44	6%	394	103%
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3 175	609	449	21.4%	-160	-26%	-2 726	-86%
Germany	231	IE,NA,NO	IE,NA,NO	-	-	-	-231	-100%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	11	NA,NO	NA,NO	-	-	-	-11	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	766	681	870	41.4%	189	28%	104	14%
Portugal	0.03	0.1	0.1	0.0%	0	1%	0	89%
Spain	NA	NA	NA	-	-	-	-	-
Sweden	22	7	8	0.4%	1	13%	-14	-64%
United Kingdom	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-15	**4 586**	**2 028**	**2 102**	**100.0%**	**74**	**4%**	**-2 484**	**-54%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.34provides an overview of all sources reported under 2B5 Other Chemical Production by EU-15 Member States for the year 2011. The largest contributor to the total EU-15 emissions is Germany, followed by the Netherlands and the UK. A detailed overview of the estimated emission sources and the methodologies used is provided in Table 4.33.

During the centralized review of the 2009 annual submission of the European Union, the ERT recommended EU to improve the completeness of its inventory by providing emission estimates for categories that have not currently been estimated, e.g. CH_4 from chemical industries such as the production of ethylene and dichloroethylene (FCCC/ARR/2009/EC, para 45). For these emissions only France reported 'NE' and in response to the recommendations by the ERT during the centralized review of the 2007 and 2008 greenhouse gas (GHG) inventory submissions of France (FCCC/ARR/2008/FRA), the Member State provided estimates of CH_4 from the production of ethylene and dichloroethylene with its 2010 greenhouse gas (GHG) inventory submission that was included in the European GHG inventory, thus improving the completeness for this source categories, independent from the fact that no methodologies are provided for these sources in 1996 IPCC Guidelines

Table 4.34 2B5 Other: Overview of sources reported under this source category for 2011

Member State	2.B.5 Other Chemical Industry	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Ethylene, Other chemical industry, CO2 from nitric acid production	26.4	0.8	NA,NO	43.2	0.2%
Belgium	Caprolactam Production, Other chemical production	841.0	0.1	2.5	1 618.0	8.9%
Denmark	Catalysts/Fertilizers, Pesticides and Sulphuric acid	2.2	NA,NO	NA,NO	2.2	0.0%
Finland	Hydrogen, chemicals production	712.7	NO	NO	712.7	3.9%
France	Ethylene, Styrene, Glyoxylic acid production, Anhydrid Phtalic Production, Other chemical production	826.9	2.5	1.4	1 327.4	7.3%
Germany	Carbon Black, Methanol, Caprolactam, Catalytic Burning, Conversion loss, N-Dodecandiacid	9 211.8	0.0	C,IE,NA,NO	9 212.4	50.9%
Greece	Organic chemicals production	321.9	NA,NO	NA,NO	321.9	1.8%
Ireland		NO	NO	NO	-	-
Italy	Carbon Black, Ethylene, Dichloroethylene, Styrene, Titanium Dioxide Production, Propylene, Caprolactam	744.1	0.3	NA,NO	750.4	4.1%
Luxembourg		NO	NO	NO	-	-
Netherlands	Carbon Black, Ethylene, Styrene, Methanol, Graphite, Caprolactam, Other chemical industry, Carbon electrodes, Ethene oxide production	727.6	11.0	2.8	1 829.2	10.1%
Portugal	Carbon Black, Ethylene, Ammonium sulphate, Monomer and polymer production, Production of explosives	109.0	0.5	0.0	119.6	0.7%
Spain	Carbon Black, Ethylene, Styrene	NA	2.0	NA	41.9	0.2%
Sweden	Pharmaceutical industry, Other inorganic chemical production, Other organic chemical production, Base chemicals for plastic industry	103.9	0.4	0.0	119.4	0.7%
UK	Ethylene, Methanol, Chemical Industry (All), Carbon from NEU products	1 917.2	3.5	NA,NO	1 990.0	11.0%
EU-15 Total		**15 545**	**21**	**7**	**18 088**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In response to the recommendation by the ERT in its review report, the methodologies for the largest emission sources in this category are provided (FCCC/ARR/2008/EC, para 53). Table 4.35 gives an overview on the coverage of source categories and methodologies and data sources used by Member States for other chemical production.

Table 4.35 **2B5 Other Chemical Production: Summary of methodological information provided by Member States**

Other Production	
Member State	**Methodology comment**
Austria	**Production of Fertilizers and Urea**: No IPCC methodology is available for these sources. Data for urea production were directly reported by the Austrian producer of urea and thus represent plant-specific data. The CH_4 emissions are calculated from the ammonia input in the urea production process and the methane content of the ammonia. CH_4 emissions from the production of urea were reported for the years 2002–2010. For the years before no data is available; therefore the implied emission factor for the year 2002 was used for all years. CO_2 emissions are reported by the operator since 1995. The IEF from this year was applied to calculate emissions from the previous years. Data for fertilizer production for 1990 to 1994 were taken from national statistics (STATISTIK AUSTRIA), for 1995 to 2009 production data were reported directly by the main producer of fertilizers in Austria. CH_4 emissions from the production of fertilizers were reported for the years 2002–2010; these data became available due to a measurement programme for CH_4 at the plant starting in 2002. Before no data is available; therefore the IEF for the year 2002 was used for all years. [NIR 2013]
	Ethylene Production: Emissions were estimated using the IPCC default methodology. Activity data are the capacity of the only ethylene producing plant in Austria and amount to 350 000 t Ethylene per year until 2005. In 2006 the capacity of the ethylene plant was expanded to 500 000 t. The IPCC default emission factor of 1 g CH_4/kg Ethylene production was used to calculate the emissions that amount to 350 tonnes CH_4 until 2005 and 500 tonnes CH_4 since 2006.[NIR 2013]
Belgium	The emissions of N_2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out (monthly measurements-gas analysing by using the gas chromatography - ECD method to determine the concentration of N_2O in the gas and estimate the emissions of N_2O.). This company estimated the emissions of the previous years from 1990 on as accurate as possible. There is a strong increase of emissions of N_2O between 2009 and 2010 due to strong increase of production of caprolactam in that period (+20%). [NIR 2013]
	Other process CO_2 emissions are reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclo-hexane, production of paraxylene/meta-xylene production of carbon black etc). These CO_2 emissions result from surveys in the chemical sector in Flanders. The emissions of this category are reported by the companies to the chemical federation (about 15 to 20 companies involved). The data fluctuate, since the processes included can fluctuate. The data are reported in an aggregated way by the chemical federation and need to be treated confidential; Since there is only one producer of carbon black in Belgium (Flemish region), emitting below the threshold value of 100 kton CO_2 and not (yet) obliged to report under the ETS-directive, no individual emissions of this plant are reported because of confidentiality. These emissions are consequently integrated in the category 2B5/other. [NIR 2013]
	The emissions of CO_2 originate from the production of 1,2 dichloromethane and vinychloride in the Walloon region. The CO_2 emissions decreases between 2008 and 2010 as the production of anhydride maleic and phtalic was stopped in 2009 in the Walloon region. The emissions are estimated by the chemical industry. [NIR 2013]
	Some small process emissions of N_2O (maximum 25 kton CO_2 eq) and CH_4 (maximum of 11 kton CO_2 eq) mainly in the chemical industry in the Flemish region. These emissions are reported by the industry via their annual environmental emission reporting obligations and are small process emissions from 1) for N_2O: a naphtha cracker, emissions from waste gas combustion (containing NH_3 from the production process), emissions from purging of bottles and purifying of bulk product N_2O, and from 2) for CH_4: emissions from an adsorption system of an oxidation unit, process emissions of naphtha cracker and leak losses from a relax station of natural gas. [NIR 2013]
Denmark	The CO_2 emission from the production of catalysts/fertilisers is based on information in an environmental report from the company (Haldor Topsøe, 2011), combined with personal communication. In the environmental report, the company has estimated the amount of CO_2 from the process and the amount from energy conversion. Based on information from the company, the emission of CO_2 has been calculated from the composition of raw materials used in the production (for the years 1990 and 1996-2004). For 2005 to 2011 the EF is assumed to be the same as in 2004 based on the same activity (produced amount). For the years 1991-1995, the production, as well as the CO_2 emission, has been assumed to remain the same as in 1990. [NIR 2013]
Finland	**Hydrogen Production:** Emissions from hydrogen production are calculated by multiplying activity data with emission factors. Activity or emission data have been received directly from companies, a minor part of earlier years' data having been estimated. There are no default emission factors for hydrogen production in the 1996 IPCC GL, for which reason the stoichiometric ratio of chemical reactions is used. One company has a system to capture formed carbon dioxide for recovery and use. The transferred CO_2 is bottled and according to present knowledge is used in applications from which it is released to the atmosphere immediately or within a timeframe of some years after the transfer and therefore the transferred CO_2 is not deducted from the total emissions of this sub-category. The emission factor for calculating emissions from hydrogen production is based on the stoichiometric ratios of chemical reactions. The consumption of hydrocarbons is used as activity data in calculating emissions from hydrogen production. The feedstocks used are natural gas, naphtha and propane. Activity data are collected directly from individual companies. [NIR 2013]
	Phosphoric acid production: The total amount of CO_2 released from phosphoric acid plant has been calculated multiplying the use of apatite and calcite with CO_2 content of defined yearly average of daily samples. Emission factors, used amount of apatite and calcite and calculated CO_2 emissions were received from the phosphoric acid producing company. Emission factors for apatite and calcite have been defined as a yearly average of daily samples. Emission factors are received directly from the phosphoric acid producing company. The activity data are the used amount of apatite and calcite. The amounts of them are received from the company. [NIR 2013]
	Indirect CO_2 emissions from NMVOC emissions from chemical industry: NMVOC emissions from chemical industry are estimated by the Finnish Environment Institute based on emission data from the VAHTI system.

Other Production	
Member State	**Methodology comment**
	Documentation of the calculation is presented in the Finnish IIR 2013. Indirect CO_2 emission was calculated using the equation below. It was assumed that the average carbon content is 80% by mass for years 1990-2011 for all categories under the sector Industrial Processes based on 2006 IPCC Guidelines. The fraction of fossil carbon in the NMVOCs is based on the NMVOC speciation profile provided in the EMEP/EEA Emission Inventory Guidebook under NFR Sector 2A5 Asphalt Roofing. [NIR 2013]
France	**N_2O from Glyoxylic Acid Production**: Emissions are taken from annual declarations of the two plants. Catalytic treatment was installed in 1998 which reduced emissions. Emissions are continuously measured and in times when measurement units do not function properly they are calculated with a mass balance approach based on measured data for glyoxylic acid (an average this occurs during 6 days per year) [NIR 2013]
	Medical N_2O: AD and emissions are delivered directly from one production plant [NIR 2013]
	Uranium tetrafluoride: Emissions data is taken directly from annual statements of pollutant emissions since 1990 and emissions are derived from continuous measurements since the 2012 submission. [NIR 2013]
	Carbon Black: National production of black carbon is available from national statistics. Since 2001 CO_2 and CH_4 emissions are dtermined using a balance for each production site, for the years before an average factor for 2011 is applied. [NIR 2013]
	Ethylene-Propylene: The national production is reported by the association for the years 1990 to 2003, in national statistics from 2004-2005 and in the publication "Pétrole" from CPDP since 2006. The CH_4 EF is taken from IPCC guidelines. [NIR 2013]
	Hydrogen: Natural gas consumption is provided by the plants and the EF for natural gas of 57 $kgCO_2/GJ$ is used [NIR 2013]
Germany	**Carbon Black**: Estimation of CO_2 emissions is based on IPCC default CO_2-EFs from IPCC-Guidelines 2006 and AD, which were provided by the Federal Statistical Office. the three German producers of carbon black report an emission factor of 0.027 kg methane per tonne of carbon black. Since relevant technology has been in service since the 1970s, this EF is rounded off to 0.03 kg/t and applied to the entire time series.[NIR 2013]"
	Coke burn-off for catalyst regeneration in refineries: With regard to refineries, only catalyst regeneration is taken into account. Reviews to date indicate that other emissions sources from refineries (heavy-oil gasification, calcination and hydrogen production) are already covered as part of refineries' own consumption [NIR2013]
Greece	"CH_4 and NMVOC emissions from the production of ethylene and 1,2 dichloro-ethane, as well as NMVOC emissions from the production of polyvinylchloride and polystyrene are included in this category. CO_2 emissions from Hydrogen production are also included in this category. In 2011 submissions these emissions were included in the Energy Sector, but in 2012 they have been reallocated in the IP sector, in line with the ERT recommendations. Hydrogen production: CO_2 emissions for H2 production are estimated on the basis of the natural gas consumed for the process. Hydrogen production emissions refer to years after 1997, as natural gas consumption refers to the imported Natural Gas that was introduced in1996 to the Greek energy system Data are provided by the Public Gas Company (DEPA) for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2011. CH_4 emissions from the production of ethylene and 1,2 dichloro-ethane are estimated according to the equation: (Emissions) = (Production) * (Emission factor). The following are noted in relation to the application of the above equation: Default emission factors (IPCC Guidelines) are used. Activity data (production of ethylene and 1,2 dichloro-ethane) are confidential and provided by the ElStat. The available data cover the period 1990 – 2007, whereas the ethylene and 1,2 dichloro-ethane production has ceased in 1998 and 2000 respectively. [NIR 2013]"
Italy	**Caprolactam:** N_2O emissions from caprolactam have been estimated on the basis of information supplied by the only plant present in Italy, production activity data published by ISTAT (ISTAT, several years), and production and emission data reported in the national EPER/E-PRTR registry. The average emission factor is equal to 0.3 kg N_2O/Mg caprolactam production. The plant closed in 2003. [NIR 2013]
	Carbon Black: CO_2 and CH_4 emissions from carbon black production process have been estimated on the basis of information supplied by the Italian production plants in the framework of the national EPER/EPRTR registry and the European emissions trading scheme. In 1996 a change in the production technology in the existing plants caused a reduction of CH_4, NMVOC, NO_x, SOx and PM10 emissions. In 2005, the CO_2 implied emission factor is 2.55 t CO_2/t carbon black production, in 2008 it is equal to 2.59 t CO_2/t carbon black production, in 2009 the IEF is 2.49 t CO_2/t carbon black production, while in 2010 the IEF is 3.06 t CO_2/t carbon black production and in 2011 3.19 t CO_2/t carbon black. [NIR 2013]
	Calcium Carbide: CO_2 emissions from calcium carbide production process have been estimated on the basis of the activity data provided by the sole Italian producer and referred to the years from 1990 to 1995 when the production stopped. The default IPCC CO_2 emission factor (IPCC, 2006) has been used to estimate the emissions. [NIR 2013]
Netherlands	**Caprolactam production**: Plant-specific N_2O emission factors are used for Caprolactam production (confidential). [NIR 2013]
	Industrial gases: CO_2 emissions are estimated based on use of fuels (mainly natural gas) as chemical feedstock. An oxidation fraction of 20% is assumed, based on reported data in environmental reports from the relevant facilities. [NIR 2013]
	Carbon electrodes: CO_2 emissions are estimated based on fuel use (mainly petroleum coke and coke). A small oxidation fraction – 5% – is assumed, based on reported data in the environmental reports.[NIR 2013]
	Activated carbon: CO_2 emissions are estimated on the basis of the production data for Norit and by applying an emission factor of 1 t/t Norit. The emission factor is derived from the carbon losses from peat uses reported in the environmental reports. As peat consumption is not included in the national energy statistics, the production data since 1990 have been estimated based on an extrapolation of production level of 33 Tg reported in 2002. This is considered

Other Production	
Member State	**Methodology comment**
	to be justified because this source contributes relatively little to the national inventory of greenhouse gases. [NIR 2013]
	Ethylene oxide: CO_2 emissions are estimated based on capacity data by using a default capacity utilisation rate of 86% and applying an emission factor of 0.45 t/t ethylene oxide. [NIR 2013]
Portugal	The major organic chemical plant in Portugal is BOREALIS unit, a petrochemical unit. The basic process in this unit is Ethylene production by Thermal Steam Cracking of petroleum feedstock. A specific and detailed inventory survey was made for BOREALIS Petrochemical Plant in Sines unit in 1993-1994. Emissions estimated for this period where used to determine plant-specific process emission factors that were used to estimate emissions for all time series from 1990 to 2001 and using ethylene production as activity rate indicator. For BOREALIS Petrochemical Plant in Sines - produced quantities are available from 1990 to 1997 and were forecasted thereafter. [NIR 2013]
	The second chemical industry LPS is the sole Carbon Black plant in Portugal. In the case of carbon black, where CO_2 emissions result from liberation of carbon in tail gas to atmosphere, emissions were estimated using a simple mass balance. Production of carbon black and explosives is available from 1990 to 2010 from INE Statistical Database (IAIT and IAPI surveys). Emissions from flares and flue gas combustor where included in the emission factors. Statistical information for all emissions sources other than Sines industrial Plants were obtained from the National Statistical Institute (INE). In the case of carbon black, where CO_2 missions result from liberation of carbon in tail gas to atmosphere, emissions were estimated using a simple mass balance [NIR 2013]
	"Finally the last individualized unit (LPS) is an industrial plant located in Lisbon producing Phthalic Anhydride from aromatic compounds. Apart from those individualized industrial plants other chemical industrial activities were included as area sources in this sub-source sector: Vinyl Chloride Monomer (VCM); - Low Density Poly-ethylene (LDPE); Poly Vinyl Chloride (PVC); Poly propylene (PP); Poly styrene (PS); Formaldehyde; Explosives. Emission factors for the Phtalic Anhydride Plant are from US-EPA (1983) [NIR 2013]"
Spain	Methodologies for 2B5 not explained in the NIR while small amouints of CH_4 emissions are reported in the CRF [NIR 2013]
Sweden	This sub-category includes various chemical industries, such as sulphuric acid production, the pharmaceutical industry, production of base chemicals for plastic industry, various organic and inorganic chemical productions and other non specified chemical production, which are not covered elsewhere. The primary information on emissions of CO_2, CH_4, N_2O, NO_X, CO, NMVOC and SO_2 is as reported by the companies in their environmental reports. In the IPCC Guidelines, methods for estimating CH_4 emissions for several chemical products are presented and consequently the CRF Reporter is divided on those products (2B5.1-5). Since several plants in Sweden produce several chemicals products each but report emissions aggregated by plant, it is not possible to report emissions in accordance with the suggested split in the CRF Reporter. In Sweden there is one company producing carbon black. CH_4 emissions are included from 1990 and onwards based on production data from the company" s environmental reports and IPCC Guidelines default EF (11 g CH_4/kg production). [NIR 2013]
United Kingdom	"It is possible that other chemical processes also result in direct CO_2 emissions but none have been identified. Emissions of carbon from the following sources were included in the 2004 GHG inventory (2006 NIR) and subsequent NIRs: • Petroleum waxes; • Carbon emitted during energy recovery - chemical industry; • Carbon in products - soaps, shampoos, detergents etc; and • Carbon in products – pesticides. [NIR 2013]"
	"Methane emissions are reported separately for production of ethylene and production of methanol, these chemicals being suggested as sources by the IPCC Guidelines for National Greenhouse Gas Inventories. Ethylene was manufactured on four sites at the end of 2011 while the only methanol plant closed in 2001. The IPCC Guidelines also suggested that methane might be emitted from manufacture of carbon black, styrene and dichloroethylene, however no evidence of any emissions of methane from these processes in the UK has been found and no estimates have been made. However, methane is emitted from other UK chemical processes and these emissions are reported as third, general, source category. [NIR 2013]"

Source: NIR 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.36 summarizes the recommendations from the 2010 and 2011 UNFCCC inventory reviews in relation to the category 2B5 Other Chemical Production.

Table 4.36 2B5 Other Chemical Production: Findings of the 2011 and 2012 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2013 inventory submissions

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2011/2012 submission	**Status in 2013 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/AUT).	No follow-up necessary
Belgium	Belgium has reported emission estimates for some categories without providing AD that are either confidential or impossible to attribute to one specific activity under the category other (chemical industry). The ERT commends the Party for this effort, which has improved the completeness of the emission estimates, and recommends that Belgium include information on the coverage of the category in the documentation box of CRF table 2(I)A-G and try to attribute these emissions to specific activities, where applicable, by gas, for the next annual submission, in order to improve the transparency of its reporting. (FCCC/ARR/2011/BEL). 2012 ARR not yet available.	Belgium continues to report some CO2 emissions from other chemical industries in an aggregate way.
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK). 2012 ARR not yet available.	No follow-up necessary
Finland	For the production of hydrogen under other (chemical industry) Finland applies a correction factor to the stoichiometric factors to account for the incompleteness of the chemical reactions. During the review, the ERT enquired about the use of pressure swing adsorption (PSA) units and whether the off-gas from the PSA containing unreacted CH4 and CO is recycled to the fired reformer as fuel and provided further information. In response, Finland informed the ERT that there are five hydrogen production plants in Finland and all plants produce hydrogen with steam-reforming and the produced hydrogen is refined in PSA units. The ERT recommends that Finland include the information provided to the ERT in the next annual submission. (FCCC/ARR/2011/FIN, para 53)	In response, Finland informed the ERT that there are five hydrogen production plants in Finland and all plants produce hydrogen with steam-reforming and the produced hydrogen is refined in PSA units. Furthermore, Finland explained that when off-gases are used only for preheating of processes, the correction factor has been applied; if off-gases are recycled and combusted no correction factor has been used. Finland also informed the ERT that the combusted off-gas emissions are included in the energy sector and emissions are calculated using the composition of the offgas to determine the EF. During the review, Finland informed the ERT that in its opinion emissions are not double counted and that the off-gas emissions reported in the energy sector are corrected taking the emissions reported under hydrogen production into account. [NIR 2012, p.165, 166, 398]
	The recycling and combustion of off-gases could potentially result in a double counting of emissions. During the review, Finland informed the ERT that in its opinion emissions are not double counted and that the off-gas emissions reported in the energy sector are corrected taking the emissions reported under hydrogen production into account. The ERT recommends that Finland ensure that there is no double counting of emissions and improve the description of this in its next annual submission. (FCCC/ARR/2011/FIN, para 54)	
France	In response to a question raised by the ERT during the review, France provided additional information on the methodology used by the plants to estimate N2O emissions from the production of N2O. The ERT considers that the methodology used by France is in line with the IPCC good practice guidance. The ERT recommends that France report this information on the methodology used by the plants to estimate N2O emissions in its next annual submission. The NIR does not provide information on why these N2O emissions have not been recycled since 2001 or whether they are destroyed. In response to a question raised by the ERT during the review, France indicated that the emissions are currently emitted directly into the atmosphere, but the plant has plans to destroy these emissions in the future. To improve transparency, the ERT recommends that France include, in its next annual submission, all the explanations provided to the ERT during the review and report on the plans of the plant to destroy these N2O emissions. There is only one phthalic anhydride plant in the country. France has reported the production in the CRF tables under other (chemical industry) as confidential. To improve transparency, the ERT recommends that France report additional information on the methodology, AD and EFs used to estimate emissions from this category in its next annual submission. (FCCC/ARR/2011/FRA). (2012 ARR not yet available).	As it is unclear which additional material was made available to the review, it cannot be assessed whether the information is included in the NIR. It is unclear why France should report potential future plans to destroy N2O emissions in the NIR when this is not yet implemented. This seems confusing as it is not relevant until such technologies are implemented. For Phthalic anhydride France reported that the production data and EF are confidential and FR has aggregated the data to another category. For the EF an index-based development is indciated in the NIR.

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2011/2012 submission	Status in 2013 submission
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DEU). 2012 ARR not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC). 2012 ARR not yet available.	No follow-up necessary
Ireland	NO	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/ITA).	No follow-up necessary
Luxembourg	NO	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD). 2012 ARR not yet available.	No follow-up necessary
Portugal	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ESP). 2012 ARR not yet available.	No follow-up necessary
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/ESP). 2012 ARR not yet available.	No follow-up necessary
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/SWE). .	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR). 2012 ARR not yet available.	No follow-up necessary

Source: NIR 2013, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php
Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.5 *Non-key sources*

2B4 Carbide Production

The ERT identified that the NIR does not include a section on 2B4 Carbide Production (FCCC/ARR/2008/EC, para 55). This is due to the fact that carbide production is not a key source in the sector 2 Industrial processes. An overview of Member States' methodologies, emission factors, quality estimates and emission trends is only provided in this report if identified with the key category analysis at EU-15 level.

In response to a recommendation raised during the EU Centralized Review in 2010, information on the trend of EU-15 CO_2 emissions from Carbide Production that was provided during the review is given in this NIR: The EU-15 CO_2 emissions trend from carbide production is mainly influenced by Germany and France. In Germany, emissions dropped by 79 % in 1991 compared to 1990. During the reunification period, calcium carbide production took place primarily in former East Germany. Shortly after reunification, production discontinued in former East Germany, while only one producer remained in former West Germany. In the period 1990 to 2008, this producer cut production by about half. In France, carbide production occurred in one plant up to 2003, and since 2003 there has been no carbide production in that MS any more.

4.2.3 Metal production (CRF Source Category 2C) (EU-15)

This source category includes the following key sources: CO_2 from 2C1 Iron and Steel Production, PFC from 2C3 Aluminium Production.

Table 4.37summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2011, CO_2 emission from 2C Metal Production decreased by 23 %. The absolute decrease was largest in Luxembourg, Belgium, Italy and Portugal.

Table 4.37 2C Metal Production: Member States' contributions to total GHG, CO_2, PFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2011 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO2 equivalents)	SF6 emissions in 2011 (Gg CO2 equivalents)
Austria	4 786	5 789	3 725	5 789	1 050	NO	253	0
Belgium	2 022	550	2 022	540	NO	NO	NO	NO
Denmark	30	0	28	NA,NO	NO	NO	31	NO
Finland	1 941	2 368	1 936	2 359	NO	NO	NO	C,NO
France	7 591	3 909	4 524	3 813	3 032	86	809	205
Germany	26 682	17 051	24 153	16 947	2 489	82	189	58
Greece	1 104	1 169	940	1 129	163	39	NA,NO	NA,NO
Ireland	0	0	NO	NO	NO	NO	NO	NO
Italy	5 608	1 743	3 878	1 610	1 673	81	NA,NO	NA,NO
Luxembourg	985	124	985	124	NA,NO	NA,NO	NA,NO	NA,NO
Netherlands	4 907	1 630	2 661	1 548	2 246	82	NO	NO
Portugal	175	85	170	72	NE	NO	NE	NO
Spain	4 290	3 137	3 384	3 060	883	62	NA	NA
Sweden	3 457	3 433	3 078	3 252	377	180	24	26
United Kingdom	3 687	1 577	2 309	1 384	1 333	162	426	74
EU-15	**67 265**	**42 565**	**53 794**	**41 625**	**13 247**	**776**	**1 732**	**363**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.38 provides information on the contribution of Member States to EU recalculations in CO_2 from 2C Metal production for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 4.38 2C Metal Production: Contribution of MS to EU recalculations in CO_2 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0.9	0.02	Revised data of the energy balance resulted in a change of split in process and energy related CO2 emissions in several years throughout the time series, thus a shift from or to 1.A.2.a to 2.C.1.
Belgium	-428	-17.5	-189	-17.4	Reallocation emissions CO2 from limestone use in iron & steel (from 2C1 to 2A3) and for Flanders: re-allocation emissions from 2C1/pig iron
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	147	3.4	1 170	34.0	Les consommations d'énergie et matière fournies par la FFA ont été mises à jour pour 2010. De plus, une modification des teneurs en carbone des combustibles et matières premières, à partir de la moyenne 2001-2008 calculée grâce aux bilans de la Fédération Française de l'Acier, entrainent des modifications des émissions de CO2 sur toute la période (+0,15 Tg CO2 en 1990, +1,25 Tg CO2 en 2010).
Germany	0	0.0	-903	-4.8	Final activity data available from national energy balance in 2.C.1.1 steel. Updated statistical data in 2.C.2 Ferroalloys Production.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	154	967.8	46	259.7	Electric Arc Furnace EF correction based on EU-ETS data.
Spain	-2	-0.1	98	2.9	Revision of CO2 emissions estimate as a result of the corresponding revision of carbon balance in intregrated iron and steel plants. The latter is in turn a consequence of: i) The revision of estimates for fugitive emissions from coke ovens in such plants according to the new carbon balance from coke production provided by the plants themselves; ii) The revision of characterisitcs (lower heating value, carbon content) of the coke oven gas burnt at the integrated iron and steel plants (this revision affects the overall carbon balance in these plants).
Sweden	0	0.0	1	0.0	Slightly increased CO2 emissions due to an additional raw material CO2 source.
UK	0	0.0	-65	-3.7	Revised steel production statistics. Revised EF for blast furnace gas.
EU-15	**-129**	**-0.2**	**159**	**0.4**	

Error! Reference source not found. provides information on the contribution of Member States to EU recalculations in PFC from 2C Metal Production for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 4.39 2C Metal Production: Contribution of MS to EU recalculations in PFC for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.2	Revisions to operator reported emissions data.
EU-15	**0**	**0.0**	**0**	**0.0**	

4.2.3.1 *Iron and steel production*

This source category includes emissions from the iron and steel industry. Crude iron is produced by the reduction of iron oxide ores mostly in blast furnaces, generally using the carbon in coke or charcoal (sometimes supplemented with coal or oil) as both the fuel and reductant. In most iron furnaces, the process is aided by the use of carbonate fluxes (limestone). Additional emissions occur as the limestone or dolomite flux gives off CO_2 during reduction of pig iron in the blast furnace, but this source category is covered as emissions from limestone use. Carbon plays the dual role of fuel and reductant. Member states use different methods for the allocation of emissions that are described in **Error! Reference source not found.**

CO_2 emissions from 2C1 Iron and Steel Production account for 1% of total EU-15 GHG emissions (w/o LULUCF) in 2011. Germany is responsible for 45% of these emissions in the EU-15. Germany had the largest decreases in absolute terms between 1990 and 2011 while increases were encountered in Austria, Finland, Sweden and to a lesser extent also in Greece. Between 1990 and 2011 emissions are fluctuating. The emission trend follows mainly the emissions from Germany that are fluctuating due to varying production figures. Overall, between 1990 and 2011, CO_2 emissions from this source decreased by 23 % (**Error! Reference source not found.**), however, emissions from this source category increased by 31% between 2009 and 2010 following the recovery of the industry after the economic recession in 2009. Between 2010 and 2011 emissions decreased again by 5%.

Figure 4.10 **2C1 Iron and Steel Production: EU-15 CO_2 emissions**

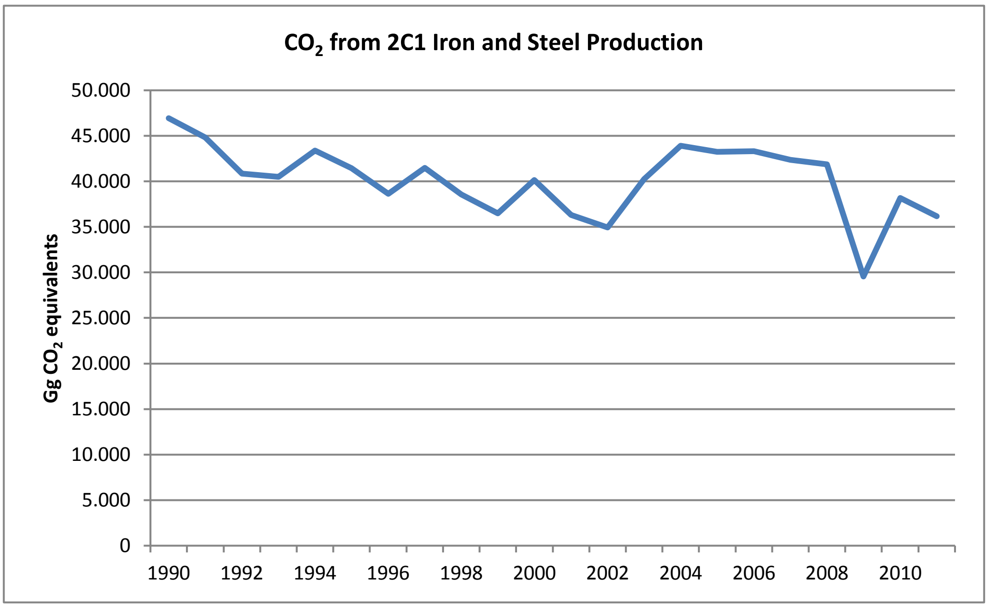


Table 4.40 **2C1 Iron and Steel Production: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor**

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3 546	5 461	5 769	15.9%	308	6%	2 224	63%	CS,T2	D,PS
Belgium	2 022	899	540	1.5%	-359	-40%	-1 483	-73%	CS,D,T3	PS
Denmark	28	NA,NO	NA,NO	-	-	-	-28	-100%	NA	NA
Finland	1 935	2 408	2 358	6.5%	-50	-2%	423	22%	,T1,T2,T3	CS,D
France	3 298	3 781	3 053	8.4%	-728	-19%	-245	-7%	T2	CS
Germany	22 712	17 304	16 350	45.2%	-954	-6%	-6 362	-28%	T2	CS
Greece	93	116	126	0.3%	10	9%	33	35%	CS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	3 124	1 139	1 297	3.6%	158	14%	-1 827	-58%	D,T2	CR,CS,PS
Luxembourg	985	134	124	0.3%	-10	-7%	-861	-87%	CS,T2	CS
Netherlands	2 267	687	1 110	3.1%	423	62%	-1 156	-51%	T2	CS
Portugal	170	64	72	-	-	-	-98	-58%	T2	PS
Spain	2 428	2 081	1 539	4.3%	-542	-26%	-889	-37%	T2	CS,PS
Sweden	2 465	2 701	2 793	7.7%	93	3%	329	13%	CS,T2	PS
United Kingdom	1 859	1 395	1 056	2.9%	-340	-24%	-803	-43%	T2	CS
EU-15	**46 932**	**38 168**	**36 187**	**100.0%**	**-1 981**	**-5%**	**-10 745**	**-23%**		

Error! Reference source not found. shows information on activity data, emission factors for CO_2 emissions from 2C1 Iron and Steel Production for 1990 and 2011. For 2C1 Iron and Steel Production it is not useful to give an average IEF for the EU-15 because the allocation of emissions (the split between process and combustion related emissions for pig iron production, which is the most important sub category) is differing between MS. The table and the method descriptions included in **Error! Reference source not found.** suggest that for 2011 more than 90% of the reported emissions are estimated using higher tier methods.

Table 4.41 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

Member State	1990 Activity data: Description	1990 (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2011 Activity data: Description	2011 (kt)	2011 Implied emission factor (t/t)	2011 CO_2 emissions (Gg)
Austria	**Iron and steel production**		**0.26**	**3 546**	**Iron and steel production**	**0**	**0.33**	**5 769**
	Steel Production [kt]	3 921	0.12	484	Steel Production [kt]	6 786	0.12	817
	Iron Production [kt]	3 444	0.88	3 043	Iron Production [kt]	5 822	0.84	4 904
	Sinter Production [kt]	4 384	NA	NA	Sinter Production [kt]	3 528	NA	NA
	Coke Production [kt]	1 725	NA	NA	Coke Production [kt]	1 316	NA	NA
	Other			20	Other	0	0.00	49
Belgium	**Iron and steel production**		**0.07**	**2 022**	**Iron and steel production**	**0**	**0.03**	**540**
	Steel	11 570	0.17	2 022	Steel	8 151	0.07	534
	Pig Iron	9 415	IE	IE	Pig Iron	4 671	IE	IE
	Sinter	5 267	IE	IE	Sinter	5 349	IE	IE
	Coke	4 542			Coke	1 940	IE	IE
	Other				Other	0	0.00	5
Denmark	**Iron and steel production**		**0.05**	**28**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	Steel	614	0.05	28	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Finland	**Iron and steel production**		**0.58**	**1 935**	**Iron and steel production**	**0**	**0.49**	**2 358**
	Produced steel	2 861	0.68	1 931	Produced steel	3 989	0.59	2 355
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Produced coke	487	0.001	1	Produced coke	852	0.001	1
	Other			3	Other	0	0.00	2
France	**Iron and steel production**		**0.10**	**3 298**	**Iron and steel production**	**0**	**0.12**	**3 053**
	Steel: kt Production	19 073	0.09	1 643	Steel: kt Production	16 030	0.07	1 117
	Pig Iron: kt Production	14 088	0.09	1 324	Pig Iron: kt Production	9 632	0.16	1 549
	Sinter: kt Production	IE	IE	IE	Sinter: kt Production	IE	IE	IE
	Coke: kt Production	IE	IE	IE	Coke: kt Production	IE	IE	IE
	Other			331	Other	0	0.00	387
	2.C.1.5.1 Rolling mills, blast furnace charging	16 848	0.02	331	2.C.1.5.1 Rolling mills, blast furnace charging	16 030	0.02	387

	1990				2011			
Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Germany	**Iron and steel production**		**0.19**	**22 712**	**Iron and steel production**	**0**	**0.23**	**16 350**
	Steel	87 878	0.26	22 712	Steel	44 284	0.37	16 350
	Pig Iron	32 263	IE	IE	Pig Iron	27 944	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NO	Other	0	0.00	NO
Greece	**Iron and steel production**		**0.09**	**93**	**Iron and steel production**	**0**	**0.06**	**126**
	steel production in EAF	999	0.09	93	steel production in EAF	1 993	0.06	126
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Ireland	**Iron and steel production**		**NO**	**NO**	**Iron and steel production**	**0**	**NO**	**NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Italy	**Iron and steel production**		**0.05**	**3 124**	**Iron and steel production**	**0**	**0.02**	**1 297**
	Steel: Production	25 467	0.05	1 346	Steel: Production	28 735	0.02	658
	Pig Iron: Production	11 852	0.15	1 778	Pig Iron: Production	9 837	0.06	638
	Sinter: Production	13 577	NA	NA	Sinter: Production	10 286	NA	NA
	Coke: Production	6 356	NA	NA	Coke: Production	4 788	NA	NA
	Other			NA	Other	0	0.00	NA
Luxembourg	**Iron and steel production**		**0.09**	**985**	**Iron and steel production**	**0**	**0.05**	**124**
	steel production	3 506	0.12	404	steel production	2 526	0.05	124
	pig iron production	2 645	0.08	200	pig iron production	NO	NO	NO
	sinter production	4 804	0.08	380	sinter production	NO	NO	NO
	coke production in non-integrated plants	NO	NO	NO	coke production in non-integrated plants	NO	NO	NO
	Other			NA	Other	0	0.00	NA

Member State	1990 Activity data Description	(kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)	2011 Activity data Description	(kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)
Netherlands	**Iron and steel production**		**0.44**	**2 267**	**Iron and steel production**	**0**	**0.16**	**1 110**
	Crude steel production	5 162	0.01	43	Crude steel production	6 927	0.00	22
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NA	NA	Sinter	NO	NA	NA
	See 1B1b	IE	IE	IE	See 1B1b	IE	IE	IE
	Other			2 224	Other	0	0.00	1 088
	Limestone equiv. use	IE	IE	IE	Limestone equiv. use	IE	IE	IE
	Carbon loss	12	190.21	2 224	Carbon loss	16	66.33	1 088
Portugal	**Iron and steel production**		**0.11**	**170**	**Iron and steel production**	**0**	**0.04**	**72**
	Steel	621	0.08	50	Steel	1 942	0.04	72
	Pig Iron	308	0.00	0	Pig Iron	NO	NO	NO
	Sinter	338	0.24	80	Sinter	NO	NO	NO
	Coke	230	0.18	40	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Spain	**Iron and steel production**		**0.18**	**2 428**	**Iron and steel production**	**0**	**0.10**	**1 539**
	Steel production	13 163	0.07	979	Steel production	15 655	0.05	791
	Pig iron production	C	C	246	Pig iron production	C	C	378
	Sinter production	C	C	538	Sinter production	C	C	285
	Coke production	IE	IE	IE	Coke production	IE	IE	IE
	Other			666	Other	0	0.00	84
Sweden	**Iron and steel production**		**0.16**	**2 465**	**Iron and steel production**	**0**	**0.10**	**2 793**
	Production of secondary steel	1 743	0.09	156	Production of secondary steel	1 675	0.11	187
	Production of primary iron	2 845	0.81	2 306	Production of primary iron	3 357	0.77	2 600
	Sinter	10 977	0.00	3	Sinter	22 861	0.00	6
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NA	Other	0	0.00	NA
UK	**Iron and steel production**		**0.08**	**1 859**	**Iron and steel production**	**0**	**0.09**	**1 056**
	Electric Steel Production	4 316	0.01	37	Electric Steel Production	2 444	0.01	19
	Iron Production (blast furnace)	12 463	IE	IE	Iron Production (blast furnace)	6 625	IE	IE
	Sinter	NA	IE	IE	Sinter	NA	IE	IE
	Coke consumed in blast furnaces	5 180	IE	IE	Coke consumed in blast furnaces	2 645	IE	IE
	Other			1 822	Other	0	0.00	1 037
	Blast furnace gas flared	2 824	0.64	1 805	Blast furnace gas flared	1 541	0.67	1 028
	Basic Oxygen Steel Production	13 169	0.00	17	Basic Oxygen Steel Production	6 946	0.00	9

According to the IPCC methodology, processes including auto-producers - power and heat production facilities located in iron and steel plants excluding heating of coke ovens (where usually coke oven gas is combusted) and fuel combustion (gaseous fuels and coke) in sinter plants (agglomeration of iron ores) should be taken into account in 1A2a; while processes including consumption of carbonaceous reducing agents, especially in blast furnaces, oxidation of carbon contained in a pig iron or scrap and the burning off carbonaceous electrodes should be taken into account in 2C1. Additionally, emissions coming from limestone and dolomite use in iron and steel plants should be included under 2A3 and Emissions coming from heating of coke ovens should be reported under 1A1c.

However, some EU-15 Member States do not keep this boundary for different reasons (local traditions used in history and in this context an attempt to keep consistency in data series). E. g. some Member States report emission from blast furnace gas and from converter gas under 1A2a instead of under 2C1, because they interpret it as emissions from energy supply.

Thus, for an overview of EU-15 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU-15 Member States in the combined category 1A2a + 2C1 are given in **Error! Reference source not found.**.

Table 4.42 CO_2 Emissions of EU-15 Member States in 1A2a and 2C1 Iron and Steel

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Share 2C1
	1A2a	2C1	Combined		
Austria	5 752	5 769	11 521	8.2%	50%
Belgium	6 191	540	6 730	4.8%	8%
Denmark	87	NA,NO	87	0.1%	0%
Finland	2 949	2 358	5 307	3.8%	44%
France	12 916	3 053	15 969	11.4%	19%
Germany	34 323	16 350	50 673	36.2%	32%
Greece	148	126	274	0.2%	46%
Ireland	2	NO	2	0.0%	NA
Italy	16 382	1 297	17 679	12.6%	7%
Luxembourg	387	124	511	0.4%	24%
Netherlands	4 280	1 110	5 390	3.8%	21%
Portugal	72	72	144	0.1%	-
Spain	6 346	1 539	7 885	5.6%	20%
Sweden	1 516	2 793	4 310	3.1%	65%
United Kingdom	12 571	1 056	13 626	9.7%	8%
EU-15	**103 924**	**36 187**	**140 110**	**100.0%**	**26%**

It is obvious, that the ratio 2C1 / (1A2a + 2C1) entitled as "Share 2C1" differs significantly for individual Member States. Therefore, boundary between 1A2a and 2C1 is not uniformly interpreted in individual Member States. The seven Member States that are significant CO_2 emitters from iron and steel production (accounting together for 90% of EU-15) allocate emissions in the following ways:

- **Germany**: About 32 % of emissions is reported under 2C1. To calculate process specific emissions the Tier 2 approach is used (using a carbon / tonne pig iron factor for the ideal blast furnace process) and emissions are subtracted from total emissions calculated by the total fuel input to obtain energy related emissions. Process emissions include furthermore electrode combustion in the electric steel production. Emissions from carbonates used in metal production are reported in sector 2C1 instead of 2A3.

- **United Kingdom:** Major share of emissions (92 %) is reported under 1A2a. Emissions from pig iron, sinter and coke production are allocated in 1A2a (or 1A1) instead of 2C1.
- **France:** Major share of emissions (81 %) is reported under 1A2a. In the CRF tables it is specified that emissions from sinter are reported under 1A2a and emissions from coke are included in 1B1b.
- **Italy:** Major share of emissions (93 %) is reported under 1A2a. CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector. In the sector 2C1 emissions are reported from: the carbonates used in the sinter plant and in basic oxygen furnaces to remove impurities and to the steel and pig iron scraps, instead of sector 2A3; and graphite electrodes consumed in electric arc furnaces.
- **Austria:** Half of the emissions (50 %) are reported under 2C1. Process specific emissions are calculated according to the IPCC good practice guidance Tier 2 approach (using a fix percentage of coke used as reducing agent); these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1A2a Iron and Steel. Emissions from sinter and coke production are included in 1A2a. Emissions from limestone and dolomite use are reported under 2A3. Process emissions include furthermore electrode combustion in the electric steel production.
- **Belgium:** Major share of emissions (92 %) is reported under 1A2a. Emissions from coke are included in the energy sector. Emissions from carbonates used in metal production are reported in sector 2C1 instead of 2A3.
- **Spain:** More than three quarters of emissions (80 %) is reported under 1A2a. Emissions from coke are included in the energy sector.

Error! Reference source not found. summarises information by Member State on methods used for estimating CO_2 emission from 2C1 Iron and Steel Production.

Table 4.43 2C1 Iron and Steel Production: Information on activity data and methods used for CO_2 emissions for 1990 and 2011

Member states	Description of methods
Austria	Total CO_2 emissions from the two main integrated iron and steel production sites in Austria were reported directly by industry until 2002. They are calculated by applying a very detailed mass balance approach for carbon. For the years 2003 and 2004 total CO_2 emissions were not reported by industry, thus they were estimated using information from the national energy balance and from the years before. For 2005–2011 verified CO_2 emissions, reported under the ETS, were taken for the inventory, which is a similar – slightly more detailed - approach as for the years before. The ETS data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel. Process specific emissions are calculated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1 A 2 a Iron and Steel. CO_2 emissions from pig iron production were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG. For 2005- 2011 CO_2 emissions from non-carbonatious ore– calculated by its C content – and other additives – including plastics and coal fines used as reducing agents –were taken into account additionally. This information became available from background data reported under the ETS. Again it has to be stressed that this additional accounting does not affect total CO_2 emissions, but only improves the accuracy of the split made between process and combustion specific emissions. CO_2 emissions from steel production (which corresponds to steel production at the two integrated sites operating basic oxygen furnaces) were calculated following the IPCC GPG guidelines Tier 2 approach. CO_2 emissions from electric steel production were estimated using a country specific methodology. All CO_2 emissions from electric arc furnaces are allocated in 2.C.1 according to IPCC guidelines.
Belgium	The category 2C1 includes the emissions of CH_4 from sinter production (Flemish region) and the process emissions of CO_2 from the iron and steel sector (Flemish and Walloon regions). As a result of the UNFCCC in-country review in September 2012, the process emissions originating from the use of limestone during the sinter manufacturing, are re-allocated to the category 2A3 instead of 2C1 before. Other emissions from the iron and steel sector are allocated to the category 1A2a (energy emissions) and category 1A1c (emissions of production of coke).

Member states	Description of methods
	All activity data recorded in this sector (fluid steel, pig iron, sinter and cokes) originate directly from the companies involved. During the 2011 submission the emissions of CO_2 in the iron and steel sector are completely revised in the Flemish region and based on the ETS-methodology instead of C-balance-approach in previous emissions. One company produces rust-free steel. The process emissions in this company are rather small and calculated on the basis of the production of fluid steel on one side. An emission factor of 1.11 – 1.17 %C is still used, being the C-amount blown off in the convertor. On the other hand, the consumption of electrodes is also taken into account. The sum of both emissions of CO_2 are total process emissions in this company. The 2nd company involved in this category in the Flemish region produces stainless steel. Until the submission of 2012 the process emissions in this company were calculated on the basis of the production of fluid steel on the one hand with an overall emission factor of 1.11 – 1.17 %C , being the C-amount blown off in the convertor. On the other hand, the consumption of electrodes is taken into account. The sum of both emissions of CO_2 is total process emissions in this company. During the 2013 submission this methodology is optimized and made consistent with the ETS-reporting data. This more accurate methodology takes into account the consumption and the C-amount of all raw materials used and the C-amounts that remain in by- and end-products. In the Walloon region, iron is produced through the reduction of iron oxides (ore) with metallurgical coke (as the reducing agent) in a blast furnace to produce pig iron. Steel is made from pig iron and/or scrap steel using electric arc or basic oxygen furnace. During the production of iron and steel, coke and coal are used as reducing agents in the blast furnace, resulting in the production of the by-product blast furnace gas. A small part of these gases are emitted by flaring and the rest are subsequently used as fuels for energy purposes in the integrated plant. To estimate CO_2 emissions from the blast furnace and the basic oxygen furnace, an energy balance and a CO_2 balance are performed of the blast furnace. All the carbon in the coke and the coal brought in the blast furnace is supposed to be converted to CO_2 and in C in the pig iron. All the C in the pig iron is supposed to be emitted by the basic oxygen furnace. Since 2005, CO_2 emissions have been obtained directly by the obliged reporting of the plants under the emission trading scheme. In 2010 recalculation of emissions in the electrical arc furnaces sector by using plant specific data in the Walloon region led to a change of emission factors.
Denmark	The CO_2 emission from the consumption of metallurgical coke at steelworks has been estimated from the annual production of steel sheets and steel bars combined with the consumption of metallurgical coke per produced amount (Stålvalseværket, 2002). The carbon source is assumed to be coke and all the carbon is assumed to be converted to CO_2 as the carbon content in the products is assumed to be the same as in the iron scrap. The emission factor (3.6 tonnes CO_2/ton metallurgical coke) is based on values in the IPCC-guideline (IPCC (1997), vol. 3, p. 2.26). Emissions of CO_2 for 1990-1991 and for 1993 have been determined with extrapolation and interpolation, respectively.
Finland	The calculation method of CO_2 emission from iron and steel industry is country specific. Both fuel based emissions and process emissions are calculated in connection with the ILMARI calculation system (see chapter 3.2 Emissions from fuel combustion) using plant/process level (bottom-up) data. The methodology is slightly plant-specific, because all plants are different from each other. The main common feature for all plants is, that fuel-based emissions for each installation are calculated in ILMARI system from the use of fuels, excluding coke and heavy bottom oil used in blast furnaces, and subtracted from total CO_2 emissions (described below). Fuel-based emissions are allocated to CRF 1A 2a and CRF1A 1c (coke ovens) The rest of emissions are allocated to process emissions in CRF 2C 1 (and CRF 2.A 1 in the case of lime kilns). Total CO_2 emissions for each installation (coke oven, sinter plant, blast furnace, lime kiln, steel converter, rolling mills, power plants/boilers) in each plant are mostly taken from VAHTI database. These emissions are basically calculated by plant operators using carbon inputs (fuel inputs and reducing materials) and they are reported by installations separately. From 2005 on, all four iron and steel plants in Finland report to the ETS. Starting from 2007 submission, the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation. Recalculation in 2010 submission: coke consumption time series data were updated
France	Country specific based on carbon mass balance approach Data sources: Annual pollutant emission reports; French Steel Association. Recalculations (2013 submission): Modification des teneurs en carbone des combustibles et matières première, à partir de la moyenne 2001-2008 calculée grâce aux bilans de la Fédération Française de l'Acier. / Mise à jour du bilan énergétique de la FFA en 2010
Germany	The total process-related emissions to be reported under 2.C.1 consist of the following: 1. The CO_2 emissions resulting from use of reducing agents in primary steel production, where the relevant top gas and converter gas is not used in other source categories and thus reported under other categories as CO_2 emissions 2. The CO_2 emissions from limestone inputs in pig iron production, and 3. The CO_2 emissions from electrode consumption in electrical steel production Die aus dem Reduktionsmitteleinsatz resultierenden CO_2-Emissionen werden über das Aufkommen an Gichtgas und Konvertergas (Kohlenstoffaustrag) berechnet.

Member states	Description of methods
	Die CO_2-Emissionen aus dem Kalksteineinsatz werden nach Tier 1 bestimmt (UBA 2006, FKZ 20541217/02). Elektrostahlerzeugung: Die Emissionen werden aus der Menge des produzierten Elektrostahls über einen in 2009 neu ermittelten Emissionsfaktor (7,4 kg/t) berechnet, der auf dem spezifischen Elektrodenverbrauch pro t Elektrostahl (2,06 kg/t), dessen Kohlenstoffgehalt (98%) sowie dem stöchiometrischen Faktor (3,667 t CO_2/t C) basiert.
Greece	Steel production in Greece is based on the use of electric arc furnaces (EAF). There are no integrated iron and steel plants for primary production as no units for primary production of iron exist, but there are several iron and steel foundries. The methodology used for the estimation of emissions is based on tracked carbon oxidation throughout the production processes in electric arc furnace operation.
Ireland	NO – There is no iron and steel production in Ireland
Italy	CO_2 emissions from iron and steel production refer to the carbonates used in sinter plants, in blast furnaces and in steel making plants to remove impurities; they are also related to the steel and pig iron scraps, and graphite electrodes consumed in electric arc furnaces. Basic information for this sector derives from different sources in the period 1990-2011. Activity data are supplied by official statistics published in the national statistics yearbook (ISTAT, several years) and by the sectoral industrial association (FEDERACCIAI, several years) .For the integrated plants, emission and production data have been communicated by the two largest plants for the years 1990-1995 in the framework of the CORINAIR emission inventory, distinguished by sinter, blast furnace and BOF, and by combustion and processes emissions. From 2000 CO_2 emissions and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. For 2002-2006 data have also been supplied by all the four integrated iron and steel plants in the framework of the European EPER/E-PRTR registry not distinguished for combustion and processes. Concerning the electric arc furnaces, additional information on the consumption of scraps, pig iron, graphite and electrodes and their average carbon content has been supplied together with the steel production by industry for a typical plant in 2004 (FEDERACCIAI, 2004) and checked with other sectoral study (APAT, 2003). On the basis of these figures an average emission factor has been calculated.CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector, including fuel consumption of derived gases. Emissions from lime production in steel making industries are reported in 1A2 Manufacturing Industries and Construction. CO_2 average emission factor in electric arc furnaces, equal to 0.035 t CO_2/t steel production, has been calculated on the basis of equation 3.6B of the IPCC Good Practice Guidance (IPCC, 2000) taking into account the pig iron and graphite electrodes used in the furnace and the amount of carbon stored in the final product. The same emission factor has been used for the whole time series. Implied emission factors for steel production reduced from 0.053 to 0.023 t CO_2/t steel production, from 1990 to 2011, due to the reduction in the basic oxygen furnaces. CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector, including fuel consumption of derived gases. The amount of carbon stored in steel produced in integrated plants has been considered and subtracted from the carbon balance. The amount of carbon contained in steel has been estimated on the basis of EN standard and, from 2005, with emission trading data.
Luxembourg*	Sinter Plant (SP): The emissions in 1990 are calculated from the mass of carbon in the ore. It is therefore a country specific methodology. The data were collected directly from the operator. Blast furnace (BF) and basic oxygen furnace steel production (BOF): The 2000 IPCC-GPG Tier 2 methodology is applied for calculating the emissions in 1990. The emissions from iron production in BF and from steel production in BOF are calculated separately based on a carbon balance over the production processes. Electric arc furnace steel production (EAF): The 2000 IPCC-GPG Tier 2 methodology has been applied for calculating the emissions from the year 2004 onward. The emissions are calculated based on a carbon balance over the production process. [NIR 2008]
Netherlands	CO_2 emissions are estimated using a Tier 2 IPCC method and country-specific carbon contents of the fuels. Carbon losses are calculated from coke and coal input used as reducing agent in blast and oxygen furnaces, including other carbon sources such as limestone and the carbon contents in the iron ore (corrected for the fraction that ultimately remains in the steel produced). Only the net carbon losses are reported in category 2C1. The carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuels for energy purposes is subtracted from the carbon balance and is included in the Energy sector (1A1a and 1A2a, see Sections 3.2.2 and 3.2.3).
Portugal	Emissions are simply calculated from multiplication of activity levels by a suitable emission factor. To avoid double counting, carbon dioxide emissions in coquerie and blast furnace, from oxidation of the carbon that was used as a reducing agent were not estimated from steel or coke production data but simply from use of coke derivative fuels (coke gas and blast furnace gas) in all combustion equipments. Methodology to estimate emissions from combustion of coke gas and blast furnace gas were already discussed in chapter 3.2A – Energy Industries and emissions are included in source sector 1A.2 - manufacturing industries and construction - and 1A.1.c.1 - Manufacture of Solid Fuels. Emissions factors for production process where set mostly from CORINAIR/EMEP also with contributions from IPCC96 and US-EPA AP42. The CO_2 emission factors for Electric Arc Furnace, and that were used for each one of the two iron and steel plants

Member states	Description of methods
	that are included in the European Union Emission Trading Scheme (EU-ETS), were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke for years 2002 and 2003. It was assumed that the same carbon content exists in both scrap and final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives. Scrap use for the period 2005-2011 was obtained from EU-ETS data. Recalculations for the 2013 submission were made from 2002 onwards, assuming that since then there is only secondary steel production in Portugal, We implemented EU-ETS methodology both for fuel consumption and process related CO_2 emissions.
Spain	La estimación de las emisiones de CO_2 en los procesos de fabricación de sínter, arrabio y acero se ha realizado utilizando el método de nivel 2 de IPCC según el cual se rastrea el carbono a través del proceso de producción, evitándose de esta manera la contabilidad por partida doble de las emisiones. La elección de este método ha sido posible debido a que se ha podido disponer de balances de masa de carbono en las materias de entrada y salida correspondientes para cada uno de los procesos encuadrados dentro de esta categoría, tal y como se describe más adelante en este mismo apartado, con distinción entre las tecnologías utilizadas en la fabricación de acero (acerías eléctricas vs acerías de oxígeno básico), dadas las diferencias sustanciales en cuanto a la tecnología y las materias primas utilizadas. En cuanto a las antorchas, la estimación de las emisiones de CO_2 se basa en el contenido de carbono de cada gas incinerado y en los factores de oxidación, tal y como se detalla más adelante en este mismo epígrafe. Incorporación a la categoría 2C1 de la estimación de las emisiones originadas en antorchas en coquerías. 2013: Revisión de las emisiones de CO_2 en las categorías 2C2 (Ferroaleaciones) y 2C5 (Silicio metal), pasando a utilizar balances de masa de carbono entre las entradas y salidas a cada uno de los procesos realizados en estas actividades, con información obtenida vía cuestionario individualizado a cada una de las plantas de estas dos categorías. NIR Capítulo 4, Sección 4.6.
Sweden	Process emissions arising from reducing agents in the primary steel works and secondary iron and steel works are reported in CRF 2C1. As the plants also generate emissions from fuel combustion (CRF 1A1c and CRF 1A2a) and fugitive emissions (CRF 1B1c), the text in this section is closely connected to the text in the corresponding section in the energy chapter. In the Swedish inventory, emissions from primary iron and steel production and secondary steel production are reported separately and fed into the CRF Reporter under 2C1.2 Pig iron and 2C1.1 Steel, respectively. This enables process emissions from the two integrated iron and steel production plants in Sweden to be reported together (2C1.2 Pig iron), and thus not introducing further sources of uncertainty due to additional data handling. Steel: The reported CO_2 emissions include emissions from reducing agents such as coke, coal and electrodes in electric arc furnaces in secondary steel plants. Reported CO_2 emissions also include emissions from the use of limestone and dolomite in secondary steel industry. In most cases data from the Swedish inquiry for the Swedish national allocation plan (NAP) for the EU emissions trading scheme could be used for the years 1998-2002. Data for remaining years (1990-1997 and 2003-2004) has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, environmental reports and through contacts with the companies. Data in the ETS also includes information on other sources for process-related CO_2 emissions as well as information concerning carbon bound in products, slag, etc., Reported CO_2 emissions are for all facilities except the one which closed down in 2004 based on data in the ETS, and reported CO_2 emissions can therefore be classified to follow the Good Practice Guidance method Tier 2. According to the ETS guidelines, reported emissions shall be based on all carbon input to and carbon output from the process. For the remaining facility plant specific methods are applied Iron powder: In Sweden there is one producer of iron ore based iron powder. The emissions of CO_2 are calculated by using the Good Practice Guidance method Tier 2. The method includes plant specific activity data on emissions from carbon-containing input materials such as coke and anthracite and also specific carbon-contents of output iron and rest products for all years. Pig iron: The recommended Tier 2 method according to the IPCC Guidelines is applied: calculations of CO_2 emissions are based on carbon mass-balances in order to reduce the risk of double counting or omitting CO_2 emissions. The carbon contents of external input materials such as coking coal, coke, injection coal, limestone, etc., are balanced against final output materials; coke86, pig iron86, steel, tar, sludge, slag, etc. The remaining carbon contents are accounted for as CO_2 emissions. In the previous submission, CO_2 emissions from organic carbon in the raw material were double-counted for the years 2005 – 2010. (For these years CO_2 emissions from organic carbon are included in emissions reported in EU ETS.)
United Kingdom	The methodology for the prediction of carbon dioxide emissions from fuel combustion, fuel transformation, and processes at integrated steelworks is based on a detailed carbon balance. Carbon emissions from integrated steelwork are reported under 1A1c, 1B1b, 1A2a, 2A3 and 2C1, depending upon the emission source. Only carbon emissions from flared blast furnace gas and basic oxygen furnace gas are reported under 2C1. Carbon emissions from electric arc furnaces and ladle arc furnaces are calculated using emission factors provided by Corus (2005). Energy related emissions from foundries are included in category 1A2a but any process emissions from foundries of direct GHGs are likely to be very small and are not estimated.

*Source: NIR 2013 unless stated otherwise, *source: NIR 2012*

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Table 4.44 2C1 Iron and Steel Production : Findings of the latest UNFCCC review of the inventory report in relation to CO_2 emissions and responses in 2012 inventory submissions

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	**Status in 2013 submission**
Austria	The ERT recommends that Austria provide an explanation on how the electric arc furnace plant operators in Austria calculate the emissions under the EU ETS.	Resolved (NIR 2013 p. 203.)
Belgium	No 2012 review report available at the time of the compilation of this NIR	Follow up required
	Recommendation in ARR 2011: CO_2 emissions from electric arc furnaces: ERT recommends that Belgium provide a justification for the applicability of the plantspecific EFs for the early years and conduct recalculations, in order to ensure the timeseries consistency of the emission estimates in the next annual submission.	a re-allocation of the process emissions took place for the part originating from the use of lime(stone) in the sinter plants from the category 2C1 to 2A3. (NIR p114) not resolved
Denmark	No 2012 review report available at the time of the compilation of this NIR	follow-up necessary
	There were no recommendations in the ARR 2011 for this sector	
Finland	No 2012 review report available at the time of the compilation of this NIR	follow-up necessary
	ARR 2011: No recommendations for this sector	
France	No 2012 review report available at the time of the compilation of this NIR	follow-up necessary
	ARR 2011: the ERT recommends that France report on the exact number of plants producing ferroalloys, the types of ferroalloys produced (if applicable, in percentage terms because of the confidentiality of this activity) and the production trend and AD for each type of ferroalloy since 1990 in its next annual submission.	not resolved
Germany	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR2011: Germany further informed the ERT that there is an ongoing discussion with the Federal Statistical Office and the steel industry to improve the data. Having noted this information, the ERT recommends that Germany use the data improved through this discussion when calculating and reporting CO_2 emissions from this category in its next annual submission. The ERT also recommends that, in its next NIR, Germany provide a transparent explanation of the recalculation, namely what was wrong with the data previously used and how the data have been improved.	not resolved
Greece	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR 2011: No recommendations for this sector	
Ireland	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR 2011: No recommendations for this sector	

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	**Status in 2013 submission**
Italy	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
Luxembourg	No 2012 review report available at the time of the compilation of this NIR ARR 2011: The ERT recommends that Luxembourg include a carbon mass balance for the entire time series and more information on the country-specific methodology in order to increase transparency in the NIR of its next annual submission.	follow-up necessary for all issues as the NIR 2013 had not been submitted at the time of compilation of this report
Netherlands	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR 2011: Allocate emissions 1990 from coke production according to 1996 IPCC GL The ERT agrees (category other- iron and steel production) with these estimates and recommends that the Netherlands include information about the methods used and the emission estimates in its next NIR.	resolved
Portugal	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR 2011: Portugal clarified that all ferroalloys production ceased before 1990 and, accordingly, the Party reported its CO_2 emission estimates for ferroalloys production as “NO” for every year in the period 1990–2009 in its revised estimates submitted on 24 October 2011. The ERT recommends that Portugal explain this update in its next annual submission.	resolved in NIR 2013
	The ERT noted that AD for estimating emissions from iron and steel production is mainly based on interpolated or proxy data. The ERT encourages Portugal to make efforts to find appropriate statistical data for the whole time series or to use plantspecific data and report its emission estimates accordingly in its next annual submission.	partly resolved (NIR 2013)
	The recalculations resulted in an increase in CO_2 emissions from iron and steel production of 8.13 Gg (or 60.6 per cent) for 2008. To increase transparency, the ERT recommends that Portugal report additional information on this recalculation, including how the Party ensures the consistency of the time series 1990–2009, in its next annual submission.	follow-up necessary
Spain	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR 2011: The ERT recommends that Spain improve the transparency of reporting by presenting separately emissions, AD and EFs from integrated and electric arc furnace plants emissions, in the NIR of its next annual submission.	on going
Sweden	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary
	ARR 2011: According to the Revised 1996 IPCC Guidelines, emissions of CO_2 from the use of limestone in iron and steel plants should be reported separately, as process emissions from limestone and dolomite use. However, Sweden has reported these emissions under pig iron. The ERT reiterates the recommendation of the previous review report that Sweden report these emissions in accordance with the Revised 1996 IPCC Guidelines in its next annual submission.	not resolved (no change in reporting) in NIR 2013 p. 194
UK	No 2012 review report available at the time of the compilation of this NIR	follow- up necessary

Sources: Review Reports 2011 and 2012 unless stated otherwise; NIR 2013 unless stated otherwise

4.2.3.2 *Aluminium production and magnesium foundries*

This category includes PFC and SF_6 emissions from aluminum production and magnesium foundries. Two PFCs, tetrafluoromethane (CF4), and hexafluoroethane (C2F6) are known to be emitted from the process of primary aluminum smelting. These PFCs are formed during the phenomenon known as the anode effect (AE), when the aluminum oxide concentration in the reduction cell electrolyte is low. In the magnesium industry, SF_6 is used as a cover gas in foundries to prevent oxidation of molten magnesium. It is assumed that all SF_6 used as cover gas is emitted to the atmosphere.

Error! Reference source not found. summarizes information by Member State on emission trends for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.02 % of total EU-15 GHG emissions (w/o LULUCF) in 2011. Between 1990 and 2011, PFC emissions from this source decreased by 94 % (**Error! Reference source not found.**). The UK and Sweden are responsible for 44 % of these emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2011. France, Germany, the Netherlands and Italy had the largest decreases in absolute terms, in Austria, aluminium production ended in 1992. The decreasing trend of PFC emissions from this key source between 1990 and 2010 is due to production stop (AT, 90-92) or decline (DE, ES) and due to process improvements (FR, DE, ES, NL). The peak in 2002 is due to technological changes and not well optimized operations (NL, FR). The small increase in 2011 still reflects the recovery of the industry after the economic crisis in 2009.

Figure 4.11 2C3 Aluminium Production: EU-15 PFC emissions

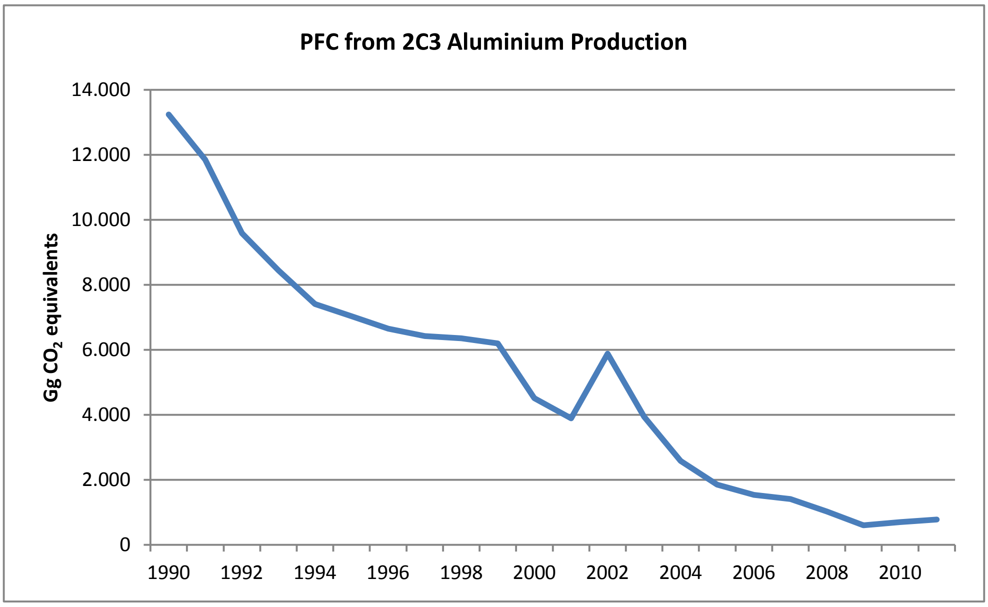


Table 4.45 **2C3 Aluminium Production: Member States' contributions to PFC emissions and information on method applied, activity data and emission factor**

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 050	NO	NO	-	-	-	-1 050	-100%	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	3 032	46	86	11.1%	40	89%	-2 946	-97%	CR	PS
Germany	2 489	135	82	10.5%	-53	-39%	-2 408	-97%	T3	CS
Greece	163	34	39	5.1%	5	16%	-124	-76%	T3	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1 673	85	81	10.5%	-4	-4%	-1 592	-95%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2 246	58	82	10.6%	24	42%	-2 164	-96%	T2	PS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA
Spain	883	70	62	8.1%	-8	-11%	-820	-93%	T2	PS
Sweden	377	156	180	23.3%	24	15%	-196	-52%	T2	D
United Kingdom	1 333	113	162	20.9%	49	43%	-1 170	-88%	CS	CS,PS
EU-15	**13 247**	**697**	**776**	**100.0%**	**79**	**11%**	**-12 471**	**-94%**		

Error! Reference source not found. shows information on activity data and emission factors for PFC emissions from 2C Metal Production for 1990 to 2011. The table shows that in 2011 aluminium production was reported by all MS, except Austria, as activity data; for some MS this information is confidential. The implied emission factors for CF4 per tonne of aluminium produced vary for 2011 between 0.02 kg/t for Germany and 0.21 kg/t for Sweden. The EU-15 IEF (excluding Greece, France and Spain) is 0.06 kg/t. The implied emission factors for C2F6 per tonne of aluminium produced vary for 2011 between less than 0.004 kg/t and 0.01 kg/t. The EU-15 IEF (excluding Greece, France and Spain) is 0.01 kg/t. The table suggests that for 2011 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions. The EU-15 IEFs generally decrease due to reduced durations and frequencies of the anode effects.

Table 4.46 **2C Metal Production: Information on methods applied, activity data, emission factors for PFC emissions**

Member State	Method applied	Emission factor	Gas	1990				2011			
				Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
				Description	(kt)			Description	(kt)		
Austria	NA	NA	CF_4	Aluminium production	88	1.56	137	Aluminium production	NO	NO	NO
			C_2F_6	Aluminium production	88	0.19	17	Aluminium production	NO	NO	NO
France	CR	PS	CF_4	Aluminium production	C	C	369	Aluminium production	C	C	12
			C_2F_6	Aluminium production	C	C	69	Aluminium production	C	C	1
Germany	T3	CS	CF_4	Aluminium production	740	0.45	336	Aluminium production	433	0.02	11
			C_2F_6	Aluminium production	740	0.05	34	Aluminium production	433	0.003	1
Greece	T3	PS	CF_4	Aluminium production	150	0.14	21	Aluminium production	165	0.03	5
			C_2F_6	Aluminium production	150	0.02	3	Aluminium production	165	0.004	1
Italy	T2	PS	CF_4	Aluminium production	232	0.86	198	Aluminium production	142	0.075	11
			C_2F_6	Aluminium production	232	0.18	42	Aluminium production	142	0.01	1
Netherlands	T2	PS	CF_4	Aluminium production	272	1.02	277	Aluminium production	303	0.04	11
			C_2F_6	Aluminium production	272	0.18	48	Aluminium production	303	0.004	1
Spain	T2	PS	CF_4	Aluminium production	C	C	122	Aluminium production	C	C	9
			C_2F_6	Aluminium production	C	C	10	Aluminium production	C	C	1
Sweden	T2	D	CF_4	Aluminium production	96	0.56	54	Aluminium production	113	0.21	23
			C_2F_6	Aluminium production	96	0.03	3	Aluminium production	113	0.03	3
UK	CS	CS,PS	CF_4	Aluminium production	290	0.60	174	Aluminium production	213	0.10	21
			C_2F_6	Aluminium production	290	0.08	22	Aluminium production	213	0.01	3
EU-15			**CF_4**	**EU-15 w/o FR, GR; ES (97%)**	**1 718**	**0.68**	**1 176**	**EU-15 w/o FR, GR; ES (78%)**	**1 204**	**0.06**	**77**
			C_2F_6	**EU-15 w/o FR,GR, ES (98%)**	**1 718**	**0.10**	**165**	**EU-15 w/o FR,GR, ES (83%)**	**1 204**	**0.01**	**10**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. provides key information on methods used for 2C3 by the EU15 Member States.

Table 4.47 **2C3 Aluminium Production: Description of national methods used for estimating PFC emissions**

Member States	Description of methods
Austria	PFC emissions were estimated using the IPCC Tier 3b methodology. The specific CF4 emissions (and C2F6 emissions respectively) of the anode effect were calculated by applying the following formula (BARBER 1996), (GIBBS & JACOBS 1996), (TABERAUX 1996): kg CF4/tAl = (1.7 x AE/pot/day x F x AEmin)/CE For the aluminium production in Austria the rate of C2F6 is about 8% and the current efficiency (CE) about 85.4%. Activity data were taken from national statistics (1990 to 1992). Primary aluminium production in Austria was terminated in 1992.
Belgium	NO – there is no aluminium production in Belgium
Denmark	NO – there is no aluminium production in Denmark
Finland	NO – there is no aluminium production in Finland
France	Deux types de technologies sont employées sur les sites, la plus ancienne, dénommée SWPB correspondant à une alimentation mécanisée sur les côtés des cuves, et la plus récente, dénommée PFPB correspondant à une alimentation ponctuelle automatique au centre de la cuve. Emission declarations from plants are used that follow a tier 2 approach. Recalculations: Modification des émissions 2005-2010 à la suite de la prise en compte des données transmises par l'exploitant. Ces données distinguent vraiment les émissions provenant du procédé (production et cuisson des anodes in situ - coke de pétrole et brai entant que matière première + consommation d'anodes en carbone) de celles provenant de la combustion. Ces données fournissent des résultats plus précis que GEREP où chaque atelier de production est représenté par une fiche de calcul, mais où les émissions liées à la combustion et au procédé sont rassemblées.
Germany	The production figures for the year 2009 were taken from the aluminium-industry monitoring report for the year 2009 [GDA, 2009]. Emission data is available for PFC emissions from primary aluminium foundries, thanks to a voluntary commitment on the part of the aluminium industry. Since 1997, the aluminium industry has reported annually on the development of PFC emissions from this sector. The measurement data is not published, but it is made available to the Federal Environmental Agency. The measurements conducted in all German smelters in the years 1996 and 2001 form the basis for calculation of

Member States	Description of methods
	CF_4 emissions. In this context, specific CF_4 emission factors per anode effect were calculated, in keeping with the technology used. The number of anode effects is recorded and documented in the smelters. The total CF_4 emissions were calculated by multiplying the total anode effects for the year by the specific CF_4 emissions per anode effect determined in 2001. The total emission factor for CF_4 is obtained by adding the CF_4 emissions of the smelters and then dividing the sum by the total aluminium production of the smelters. C_2F_6 and CF_4 occur in a constant ratio of about 1:10. The above-described method was applied to the entire time series, and the emissions for the years 1990 to 1996 were filled in via recalculations.
Greece	PFC emissions estimates are based on anode effect performance by calculating the anode effect overvoltage statistic (Overvoltage method). This methodology concerns measurements and recordings that are being performed concerning the parameters of the equation used for the CF_4 emission's calculation, namely the overvoltage and the aluminium production process current efficiency. The estimations are provided directly by the plant to the inventory team.
Ireland	NO – there is no aluminium production in Ireland
Italy	PFC emissions from aluminium production have been estimated using both Tier 1 and Tier 2 IPCC methodologies. The Tier 1 has been used to calculate PFC emissions from 1990 to 1999, while Tier 2 has been used since 2000. These emissions, specifically CF_4 and C_2F_6, have been calculated on the basis of information provided by national statistics (ENIRISORSE, several years; ASSOMET, several years) and the national primary aluminium producer (ALCOA, several years),, with reference to the document drawn up by the International Aluminium Institute (IAI, 2003) and the IPCC Good Practice Guidance (IPCC, 2000). Tier 1 method has been used to calculate PFC emissions related to the entire period 1990-1999. The emission factors for CF_4 and C_2F_6 were provided by the main national producer (ALCOA, 2004) based on the IAI document (IAI, 2003). PFC emissions for the period from the year 2000 result from the more accurate IPCC Tier 2 method, based on default technology specific slope factors and facility specific anode effect minutes. The EFs for PFCs were then calculated by ALCOA as weighted arithmetic mean values of EFs for the different technologies (IAI, 2003), the weights representing the technologies implemented.
Luxembourg*	NO – there is no aluminium production in Luxembourg
Netherlands	PFC emissions from primary aluminium production reported by the two facilities are based on the IPCC Tier 2 method for the complete period 1990-2011. Emission factors are plant specific and are based on measured data.
Portugal	NO – there is no aluminium production in Portugal
Spain	Para el cálculo de las emisiones de PFC, se ha optado por utilizar el método de nivel 2 referido en la Guía de Buenas Prácticas 2000 IPCC en el epígrafe 3.3 (ecuación 3.10 y Box 3.3 "Tabereaux approach"). Para la aplicación de la fórmula anterior se han utilizado los valores por defecto de la variable "pendiente" (slope = 1,698 (p/CE)) de la Guía de Buenas Prácticas 2000 IPCC (epígrafe 3.3.1, tabla 3.9), y de la información sobre las variables "AEF" y "AED" facilitadas por las plantas productoras mediante un cuestionario específico diseñado al efecto, distinguiendo por planta y series el método de fabricación seguido (ánodos precocidos picado lateral o central y proceso Söderberg de agujas verticales). Dentro de cada serie se recibe información del número de efectos ánodos por cuba y día y de la duración en minutes del efecto ánodo.
Sweden	Tier 2: Activity data used for the PFC emission calculations, anode effects in min/oven day and production statistics, were provided by the company, and specified for the Prebaked and Söderberg processes.
United Kingdom	The estimates were based on actual emissions data provided by the aluminium-smelting sector. There are two main aluminium smelting operators in the UK. One operator uses a Tier 2 methodology Smelter-specific relationship between emissions and operating parameters based on default technology-based slope and over-voltage coefficients, using the default factors for the CWPB (Centre Worked Prebaked) plant. The other operator uses a Tier 3b methodology (as outlined in the IPCC guidance) Smelter-specific relationship between emissions and operating parameters based on field measurements. Emissions estimates were based on input parameters, including frequency and duration of anode effects, and number of cells operating. Emission factors were then used to derive the type of PFC produced. All emissions occur during manufacturing. These emissions were provided directly by the operators.

*Source: NIR 2013 unless stated otherwise, *source: NIR 2012*

Error! Reference source not found. summarizes the recommendations from the latest UNFCCC reviews of the inventory report in relation to the category 2C3 Aluminium Production. The overview shows that few recommendations were made, some could be implemented, however for several Member States the review report 2012 had not been available at the compilation of this NIR.

Table 4.48 2C3 Aluminium Production: Findings of the latest UNFCCC review of the inventory report in relation to PFC emissions and responses in 2012 inventory submissions

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	Status in 2013 submission

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	**Status in 2013 submission**
Austria	Not relevant as there is no Aluminium production in Austria	No follow-up necessary
Belgium	Not relevant as there is no Aluminium production in Belgium	No follow-up necessary
Denmark	Not relevant as there is no Aluminium production in Denmark	No follow-up necessary
Finland	Not relevant as there is no Aluminium production in Finland	No follow-up necessary
France	No 2012 review report available at the time of the compilation of this NIR	Follow- up necessary
	In ARR 2011: no recommendations for this sector	
Germany	No 2012 review report available at the time of the compilation of this NIR	Follow- up necessary
	In ARR 2011: no recommendations for this sector	
Greece	No 2012 review report available at the time of the compilation of this NIR	Follow- up necessary
	ARR: 2011: The ERT commends Greece for performing additional QC procedures on the plant-specific data by comparing it with publicly available data.	Resolved in NIR 2013 (p183)
Ireland	Not relevant as there is no Aluminium production in Ireland	No follow- up necessary
Italy	No 2012 review report available at the time of the compilation of this NIR	Follow- up necessary
	ARR 2011: The ERT recommends that Italy provide, in the NIR of its next annual submission, improved information clarifying the methodological approaches used, in accordance with the IPCC good practice guidance.	Resolved in NIR 2013
Luxembourg	Not relevant as there is no Aluminium production in Luxembourg	No follow- up necessary
Netherlands	No 2012 review report available at the time of the compilation of this NIR ARR 2011: During the review, the ERT recommended that the Netherlands provide revised estimates for this category using the CO_2 EF of 1.45 t CO_2/t aluminium for 2007–2009.	Follow- up necessary for both issues
Portugal	Not relevant as there is no Aluminium production in Portugal	No follow- up necessary
Spain	No 2012 review report available at the time of the compilation of this NIR ARR 2011: The ERT concluded that the information provided explains the trend, and recommends that the Party include information related to the relative use of the technologies in the NIR of its next annual submission. The ERT recommends that Spain improve the transparency of reporting of CF4 and C2F6 emissions from aluminium production, in particular the technology shifts that explain the trend in the IEF time series.	Follow- up necessary for all issues
Sweden	No 2012 review report available at the time of the compilation of this NIR	Follow- up necessary

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	Status in 2013 submission
	ARR 2011: no recommendations for this sector	
UK	No 2012 review report available at the time of the compilation of this NIR	Follow- up necessary

Sources: Review Reports 2011 and 2012 unless stated otherwise; NIR 2013 unless stated otherwise

Error! Reference source not found. summarise information by Member State on emission trends and methodologies for the source category SF_6 from 2C Metal Production.

Table 4.49 2C-Aluminium and Magnesium Foundries: Description of national methods used for estimating SF_6 emissions

Member states	Description of methods
Austria	Emissions were estimated following the IPCC methodology using annual consumption data of SF_6. Information about the amount of SF_6 used was obtained directly from the aluminium and magnesium producers in Austria and thus represents plant-specific data (for verification data was checked against data from SF_6 suppliers). Actual emissions of SF_6 equal potential emissions and correspond to the annual consumption of SF_6 for magnesium casting, by two companies that used SF_6 as fire-extinguishing cover gas until 2006. SF_6 has not been used in magnesium casting since 2006. From the six secondary aluminium smelters only one stated the use of SF_6 as a cleaning gas from 2006 onwards. For these recent years an EF of 1.5% of SF_6 consumed was applied. This EF is based on measurements in a German aluminium plant that have shown significant destruction of SF_6 (decomposition into sulphur and fluorine) during the process. From 1990 to 2011 the emissions decreased by nearly 100%. This decreasing trend is explained by technological advances and the replacement of SF_6 by other substances used for surface protection
Belgium	NO – there are no aluminium and magnesium foundries in Belgium
Denmark	The emission of SF_6 has been decreasing in recent years due to the fact that activities under Magnesium Foundry no longer exist
Finland	Direct reporting method, Tier 1a. Tier 1b is not applicable to this category because all SF_6 used is imported in bulk. Emissions from this source are not reported separately due to confidentiality (Included in 2 F).
France	Les émissions de SF_6 sont déterminées par bilan matière à partir de l'estimation des consommations annuelles et de certaines informations communiquées par les industriels. Les quantités consommées sont considérées totalement relarguées à l'atmosphère.
Germany	Aluminium production: All of the SF_6 used in Germany to purify molten aluminium is emitted completely upon use (consumption = emission; EF = 1). The practice of assuming the equivalence between consumption (AR) and emissions conforms to the IPCC method (IPCC, 1996a: 2.34). SF_6 consumption was determined via direct surveys, regarding sales, of the few providers of the SF_6-containing gas mixture. The survey for the report year 2000 revealed that the gas mixture has no longer been sold since 2000. For the report year 2002, a first survey of gas providers' SF_6 sales figures was carried out, and these figures were compared with data obtained from a first survey of amounts consumed by industry. This made it possible to identify SF_6 users, in the area of aluminium casting, who use pure SF_6. Since 2007, data on the sale of SF_6 gas are obtained from the central bureau of statistics. Magnesium production: Until 2006, SF_6-input quantities have been determined via direct surveys of foundries' annual consumption levels. In 2006, thusly determined input data were cross-checked for the first time against sales quantities as determined via surveys of gas sellers in this sector. The described procedure has been applied to all report years other than 1996 and 1999, for which lacking yearly data was obtained via interpolation. Good agreement was found, and thus since then, data on gas sales are obtained from the central bureau of statistics. In 2010 emission factors and respectively emissions were concretised due to plant specific measurements
Greece	NO – there are no aluminium and magnesium foundries in Greece
Ireland	NO – there are no aluminium and magnesium foundries in Ireland
Italy	For SF_6 used in magnesium foundries, according to the IPCC Guidelines (IPCC, 1997), emissions are estimated from consumption data made available by the company (Magnesium products of Italy, several years), assuming that all SF_6 used is emitted. In 2007, SF_6 has been used partially, replaced in November by HFC 125, due to the enforcement of fluorinated gases regulation (EC, 2006). This regulation allows for the use of SF_6 in annual amounts less than 850 kg starting from 1 January 2008, that's why in 2008 SF_6 was still reported together with HFC125 emissions. HFC125 emissions have been reported in the CRF sector 2G OTHER. and, in 2010, were equal to 605 kg while in 2011 are equal to 0 because HFC134 was used (2,994 kg) also reported under category 2G.
Luxembourg	NO – there are no aluminium and magnesium foundries in Luxembourg
Netherlands	NO – there are no aluminium and magnesium foundries in the Netherlands
Portugal	NO – there are no aluminium and magnesium foundries in Portugal

Member states	Description of methods
Spain	NO – there are no aluminium and magnesium foundries in Spain
Sweden	The total annual amount of SF_6 used in the magnesium foundries is reported as emissions, according to the IPCC Guidelines and Good Practice Guidance. Data is obtained from companies using SF_6. In Sweden, no SF_6 is used in aluminum foundries (CRF 2C4.1) as far as known, and thus reported as not occurring (NO).
United Kingdom	For magnesium alloy production an IPCC Tier 2 methodology is used to estimate emissions. Emissions from 1998-2008 were estimated based on the emission data reported by the company to the UK's Pollution Inventory. These data are considered reasonably robust whilst earlier data (pre-1998) are estimated based on consultation with the manufacturer. In 2004, for the first time, one of the main industry users has implemented a cover gas system using HFC134a as a cover gas for some of its production capacity. There has not been a complete switch to HFC 134a, although the operator is considering this on an ongoing basis depending on suitability for the different alloys produced. In addition to having a significantly lower GWP than SF_6 (and thus reducing emissions on a CO_2 equivalent basis), use of HFC134a is further advantageous in that a significant fraction of it is destroyed by the high process temperatures thus reducing the fraction of gas emitted as a fugitive emission. It is assumed 90% of the used HFC cover gas is destroyed in the process (CSIRO 2005). In 2008, for the first time, emissions of HFCs have been reported in the Pollution Inventory, and therefore this figure has been used for 2008. Note that actual emissions of SF_6 for this sector are reported for practical reasons under 2C5 'Other metal production'. This is because the CRF Reporter does not allow reporting of HFC emissions under the 2C4 sector category. No emissions of SF_6 are currently reported by any of the aluminium foundries in the Pollution Inventory. Emissions from the use of SF_6 in the UK are therefore reported as Not Occurring.

4.2.3.3 *Other metal production*

Error! Reference source not found. provides an overview of all sources reported under 2C5 Other Metal Production by EU-15 Member States for the year 2011. Four Member States report emissions from silicium, magnesium or non-ferrous metals: the largest contributors to emissions are Sweden with 40.5 % and Spain with 40.1%.

Table 4.50 2C5 Other: Overview of sources reported under this source category for 2011

Member State	2.C.5 Other Metal Production	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	NA, NO	NA	NA	NA	NA,NO	NA,NO	NO	-	0.0%
Belgium	NA	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Denmark	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Finland	Non-ferrous metals	0.2	NO	NO	NA,NO	NA,NO	NO	0.2	0.0%
France	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Germany	Magnesium production	NA,NO	NA,NO	NA,NO	C,NA,NO	NA,NO	IE,NA,NO	-	0.0%
Greece	NA, NO	NO	NO	NA	NA,NO	NA,NO	NA	-	0.0%
Ireland	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Italy	Magnesium Foundries	NA	NA	NA	NA	NA	NA	-	0.0%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Netherlands	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Portugal	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Spain	Silicium production	180.9	NA	NA	NA	NA	NA	181	40.1%
Sweden	Non-ferrous metals	182.6	NE,NO	NA,NO	NA,NO	NA,NO	NA,NO	183	40.5%
UK	Non-ferrous metals	NO	NO	NO	13.2	NA,NO	0.0031	87.6	19.4%
EU-15 Total		**364**	**0**	**0**	**13**	**0**	**0.0031**	**451**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-15)

Emissions related to the production of halocarbons as well as SF_6 are reported under this source category. This includes chemical by-products of processes related to the production of these substances that may be released into the atmosphere as well as fugitive emissions of the chemicals that occur during the production and distribution of the chemical.

Error! Reference source not found. summarise information by Member State on emission trends for the key source HFCs from 2E Production of Halocarbons and SF_6.

Table 4.51 2E Production of Halocarbons and SF_6: Member States' contributions to total GHG and HFC emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2011 (Gg CO_2 equivalents)
Austria	NA, NO	NA,NO	NA	NA
Belgium	3 313	172	NO	NA,NO
Denmark	0	0	NO	NA,NO
Finland	0	0	NA,NO	NA,NO
France	4 691	103	3 635	100
Germany	4 529	143	4 409	41
Greece	935	0	935	NA,NO
Ireland	NA, NO	NA, NO	NA,NO	NA,NO
Italy	1 284	1 266	351	NA,NO
Luxembourg	0	0	NA,NO	NA,NO
Netherlands	4 432	205	4 432	205
Portugal	NE, NO	NE, NO	NE,NO	NA,NO
Spain	2 403	397	2 403	397
Sweden	0	0	NO	NA,NO
United Kingdom	11 385	160	11 374	73
EU-15	**32 971**	**2 446**	**27 539**	**816**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. provides information on the contribution of Member States to EU recalculations in HFC from 2E Production of Halocarbons for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 4.52 **2E Production of Halocarbons and SF_6: Contribution of MS to EU recalculations in HFC for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	43	4.9	Revision of HFC-23 emissions estimate according to the new information provided by the only HFC-32 production plant. Revision of HFC-32 emissions estimate according to the new information provided by the only HFC-32 production plant. Revision of HFC-143a emissions estimate according to the new information provided by the only HFC-143a production plant.
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**0**	**0.0**	**43**	**2.4**	

HFC emissions from 2E1 By-Product Emissions account for 0.01 % of total EU-15 GHG emissions (w/o LULUCF) in 2011. In 2011 the Netherlands and the United Kingdom together account for about 69 % of these emissions in the EU-15. Between 1990 and 2011, HFC emissions from this source decreased by 98 % (**Error! Reference source not found.**). The initial increase of emissions from 1990 to 1997 by 54 % is due to increased production in UK, Spain, Greece and the Netherlands. Since 1997 emissions decreased in nearly all Member States strongly; in UK due to the installation of thermal oxider pollution abatement equipments; in the Netherlands due to the installation of a thermal afterburner; in Spain due to the installation of a condensation equipment; and in Greece due to production stop in 2006. In contrast to the trend described above, emissions in France decreased already between 1990 and 1997 due to the installation of a thermal afterburner and remained stable since then.

Figure 4.12 **2E1 By-Product Emissions: EU-15 HFC emissions**

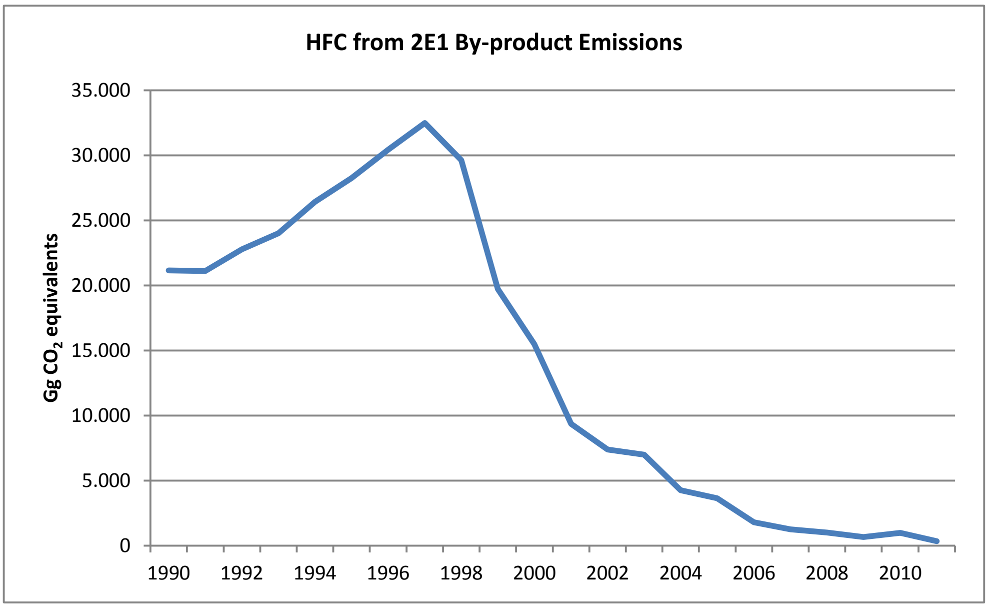


Table 4.53 **2E1 By-Product Emissions: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
France	1 663	110	55	15.9%	-54	-50%	-1 607	-97%	T2	PS
Germany	C,NA	C,NA	C,NA	-	-	-	-	-	NA	NA
Greece	935	NA,NO	NA,NO	-	-	-	-935	-100%	NA	NA
Ireland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Italy	351	NA,NO	NA,NO	-	-	-	-351	-100%	NA	NA
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	4 432	391	166	47.8%	-224	-57%	-4 266	-96%	T2	PS
Portugal	NE,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Spain	2 403	395	54	15.4%	-342	-86%	-2 350	-98%	T2	PS
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
United Kingdom	11 374	82	73	20.9%	-9	-11%	-11 301	-99%	T2	PS
EU-15	**21 158**	**977**	**348**	**100.0%**	**-629**	**-64%**	**-20 810**	**-98%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. shows information on methods used for HFC emissions from 2E1 By-Product Emissions for the years between 1990 and 2011. For 2E1 By-Product Emissions it is not possible to give an average IEF for the EU-15 because for most countries activity data is confidential. Except for Greece, all reported emissions are estimated with higher Tier methods. This means that for the latest inventory year (2011) all reported emissions are estimated using higher tier methods (based on plant specific data).

Table 4.54 **2E1 By-Product Emissions: Description of national methods used for estimating HFC emissions and abatements applied**

Member States	Description of methods
Austria	NO – there is no production of Halocarbons and SF_6 in Austria

Member States	Description of methods
Belgium	NO – there is no production of Halocarbons and SF_6 in Belgium
Denmark	NO – there is no production of Halocarbons and SF_6 in Denmark
Finland	NO – there is no production of Halocarbons and SF_6 in Finland
France	La méthode appliquée est de rang GIEC 2. Toutes les émissions sont déterminées à partir d'une approche bottom-up à partir des données communiquées directement par les sites industriels conformément aux déclarations annuelles faites aux DREAL. Pour les émissions de HFC et de PFC, les sites industriels distinguent les émissions dues aux sous-produits (HFC-23, HFC-125 et CF4) des émissions fugitives (HFC-32, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-365mfc, PFC-116 et C4F8). Il existe un site en France, producteur de HCFC-22, émetteur de HFC-23. Les émissions ont été réduites de façon importante depuis 1992 après l'introduction d'un incinérateur. Les émissions sont déterminées à partir d'une approche bottum-up à partir des données communiquées directement par les sites industriels conformément aux déclarations faites aux DRIRE/DREAL. Parmi les activités de la chimie du nucléaire, la réalisation d'électrolyses de HF occasionnent des émissions de fluor. Ces émissions sont neutralisées par des pots à soufre pour transformer le fluor en sous-produit SF_6 (neutre chimiquement). Ce procédé a été modifié fin 2006 afin de recycler le fluor : les émissions de SF_6 sont ainsi évitées. Les émissions sont communiquées annuellement par le site. Les HFC sont distingués en fonction de leur composition et de leur provenance (i.e. « sous-produit » ou émission « directe »). Ces émissions sont communiquées par les contacts avec les sites concernés et les déclarations annuelles des rejets. Les émissions ont été considérablement réduites depuis 1990 suite à l'installation d'unités de traitement des produits fluorés par oxydation thermique dans les différentes usines. Seules les émissions résiduelles subsistent. De même que pour les HFC, les PFC sont distingués en fonction de leur origine.
Germany	Since 1995 emissions have been calculated (via mass balance) on the basis of the amount of H-CFC-22 produced, of annual measurements of HFC-23 concentrations in the facility's waste gas, of amounts of HFC-23 sold and of the amounts of HFC-23 delivered to the cracking facility; for the 1995 report year, emissions reduction measures (cracking facility) have been taken into account, as of the middle of the year, for the first production facility. Since produced quantities of H-CFC are not reported, no emission factor can be determined and compared with the IPCC standard emission factor. The producer reports only emissions of HFC-23. These are reported in aggregated form, together with emissions from the CRF sub - source category 2.E.2, since they are confidential. In 1995, in Frankfurt, a CFC cracking plant went into operation that cracks, at high temperature, excess HFC-23 produced during production of H-CFC-22 and that recovers hydrofluoric acid; i.e. no significant emissions are produced. HFC-23 produced at the second German production facility is captured in large amounts at the production system itself; the substance is then sold as a refrigerant or – following further distillative purification – as an etching gas for the semiconductor industry. The HCFC-22 production was terminated in mid 2010. From 2011 there are no emissions from HFC-23.
Greece	According to the IPCC Good Practice Guidance, the analytical methodology (Tier 2) should be applied for the calculation of HFC-23 emissions from HCFC-22 production, as it constitutes a key source. This methodology is based on the collection and elaboration of on site measurement data. However, due to the lack of such data, calculation of emissions is based on production statistics and a reference emission factor. It should be noticed that data on the production of HCFC-22 are confidential and therefore are not presented in the current report. The reference emission factor used is suggested by the IPCC GPG. HFC-23 emissions from HCFC-22 manufacture do not occur since 2006, since the plant manufacturing HCFC-22 has stopped operating since.
Ireland	NO – there is no production of Halocarbons and SF_6 in Ireland
Italy	For source category "By-product emissions", the IPCC Tier 2 method is used, based on plant-level data communicated by the national producer (Solvay, several years). Also for source category "Fugitive emissions", emission estimates are based on plant- level data (Tier 2) communicated by the national producer (Solvay, several years). [NIR 2013] In 2010 the operator has provided the time series for the activity data from 2002 (HCFC22 and TFM). Recalculation of the whole Total F-gas emissions time series for category 2E has occurred, because CF4 emissions as a by product of HCFC22 production process have been accounted.
Luxembourg*	NO – there is no production of Halocarbons and SF_6 in Luxembourg
Netherlands	Production of HCFC-22(2E1): To comply with the IPCC Good Practice Guidance (IPCC, 2001) an IPCC Tier 2 method is used to estimate emission of this source category. HFC-23 emissions are calculated using both (measured) data on the mass flow of HFC23 produced in the process and a destruction factor to estimate the reduction of this HFC 23 flow by the thermal afterburner. Handling activities (HFCs) (2E3): Tier 1 country-specific methodologies are used to estimate the handling emissions of HFCs. The estimations are based on emissions data reported by the manufacturing and sales companies.
Portugal	NO – there is no production of Halocarbons and SF_6 in Portugal

Member States	Description of methods
Spain	The information on HFC-23 emissions is based on the estimates made by the centres themselves, complemented for the years 1990-1998 by a default emission factor. Therefore, the estimation methodology applied in this case is a combination of Tier 1 and Tier 2 in the IPCC's terminology. No se presenta aquí la información sobre variables de actividad y parámetros de proceso por ser de carácter confidencial al corresponder actualmente la propiedad de las plantas únicamente a dos empresas. Cabe asimismo mencionar que en una de las plantas existe un descenso de la emisión a partir del año 2001 debido a la construcción y puesta en servicio de una instalación para disminuir la emisión de HFC-23 mediante su compresión, condensación, licuación y almacenamiento. El HFC-23 licuado se carga en cisternas y se envía a un gestor exterior para su tratamiento. Por último, el descenso que se observa en las emisiones en el año 2011 tiene su origen en el correspondiente descenso de la producción de HCFC-22 en la única planta de fabricación existente en este año.
Sweden	NO – there is no production of halocarbons and SF_6 in Sweden
United Kingdom	A full description of the emission model and associated methodology used for this sector is contained in AEA (2008). Within the model, manufacturing emissions from UK production of HFCs, PFCs and HFC 23 (by-product of HCFC 22 manufacture) are estimated from reported data from the respective manufacturers. Manufacturers have reported both production and emissions data, but only for certain years, and for a different range of years for different manufacturers. Therefore the emissions model is based on implied emission factors, and production estimates are used to calculate emissions in those years for which reported data was not available. Two of the three manufacturers were members of the UK greenhouse gas Emissions Trading Schemes. All three now report their emissions to the Environment Agency's Pollution Inventory and these reported emissions have been used to calculate total emissions in later years for two of the operating plant, where full speciated emissions data were provided by one of the operators for most of the time series. Emissions from the production of HCFC-22 are reported under 2E1.2 and are combined with fugitive emissions from HFC and manufacture, to protect commercial confidential data.

*Source: NIR 2013 unless stated otherwise, *source: NIR 2012*

Table 4.55 provides an overview of Member States' contributions to HFC emissions from sector 2E2, Fugitive Emissions. Only 3 Member States report emissions from this sector. Spain accounts for 80 % of all emissions, France for 10.4 % and Germany for 9.6 %.

Table 4.55 2E2 Fugitive Emissions: Member States' contributions to HFC emissions

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
France	1 972	57	44	10.4%	-12	-21%	-1 927	-98%	T2	PS
Germany	4 409	166	41	9.6%	-124	-75%	-4 368	-99%	T3	PS
Greece	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Ireland	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Italy	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Portugal	NE	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Spain	NA	529	343	80.0%	-186	-35%	343	-	T2	PS
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
United Kingdom	NA	NA	NA	-	-	-	-	-	NA	NA
EU-15	**6 381**	**751**	**429**	**100.0%**	**-322**	**-43%**	**-5 952**	**-93%**		

Error! Reference source not found. shows that only one Member State reports GHG emissions under 2E3 Other for the year 2011. The Netherlands include HFC emissions from handling activities, like repackage HFCs from large units (e.g. containers) into smaller units (e.g. Cylinders).

Table 4.56 2E3 Other: Overview of sources reported under this source category for 2011

Member State	2.E.3 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total	Information from NIR-2008
Austria	NA	NA	NA	NA	-	0.0%	
Belgium	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Denmark	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Finland	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
France	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Germany	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	Includes confidential HFC emissions from 2E1 and 2E2
Greece	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Ireland	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Italy	NA	NA	NA	NA	-	0.0%	
Luxembourg	NA	NA	NA	NA	-	-	
Netherlands	Not specific attributable due to Confidential Bussiness Information	38.5	NA,NO	NO	38.5	100.0%	2E3 Handling activities: emissions of HFCs. There is one company in the Netherlands that repackage HFCs from large units (e.g. containers) into smaller units (e.g. Cylinders) and in addition trading with HFCs. Besides this company there are a lot of companies in the Netherlands which are importing small units with FCs and sell them in the trading areas.
Portugal	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Spain	NA	NA	NA	NA	-	0.0%	
Sweden	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
UK	Other non-specified	NA	NA	NA	-	0.0%	
EU-15 Total		**38**	**0**	**-**	**38**	**100.0%**	

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. summarizes the recommendations from the latest UNFCCC reviews of the inventory report in relation to the category 2E Production of Halocarbons.

Table 4.57 2E Production of Halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2012 inventory submissions

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2013 submission
Austria	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Belgium	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Denmark	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Finland	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
France	No 2012 review report available at the time of the compilation of this NIR ARR 2011: no recommendations for this sector	Follow – up necessary
Germany	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary
	ARR 2011: The ERT recommends that, in the next NIR, Germany improve the explanation of the emission trend by including the information on the cessation of HCFC-22 production and any other relevant new information.	Resolved in NIR 2013
Greece	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2013 submission
	ARR 2011: no recommendations for this sector	
Ireland	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Italy	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary
	ARR 2011: no recommendations for this sector	
Luxembourg	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Netherlands	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary
	ARR 2011: The ERT recommends that the Netherlands explore ways to allow the reporting of sufficient data to the Dutch inventory experts, in order to ensure completeness, consistency and adequate QC of the emission estimates, while maintaining the confidentiality of the data.	follow – up necessary
Portugal	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Spain	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary
	ARR 2011: no recommendations for this sector	
Sweden	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary
	ARR 2011: no recommendations for this sector	
UK	No 2012 review report available at the time of the compilation of this NIR	Follow – up necessary
	ARR 2011: The ERT recommends that the United Kingdom correct the errors, improve QC for the sector and appropriately report these emissions in the CRF tables for its next annual submission.	On going

Sources: Review Reports 2011 and 2012 unless stated otherwise; NIR 2013 unless stated otherwise

4.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-15)

Emissions related to the consumption of Halocarbons (HFCs, PFCs) and Sulphur Hexafluoride (SF_6) are reported under this source category. These substances are serving as alternatives to ozone depleting substances (ODS) that are being phased out under the Montreal Protocol. The main applications for Halocarbons include refrigeration and air conditioning, fire suppression and explosion protection, aerosols, solvent cleaning, and foam blowing, as well as some other applications. Primary uses of SF_6 include gas insulated switch gear and circuit breakers, fire suppression and explosion protection, and other applications.

Error! Reference source not found. summarises information by Member State on emission trends of total GHG emissions and for the two key sources (HFCs and SF_6) from 2F Consumption of Halocarbons and SF_6.

Table 4.58 2F Consumption of Halocarbons and SF_6: Member States' contributions to total GHG, HFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2011 (Gg CO_2 equivalents)	SF_6 emissions in 1990 (Gg CO_2 equivalents)	SF6 emissions in 2011 (Gg CO_2 equivalents)
Austria	292	1 730	23	1 349	240	321
Belgium	103	2 119	NO	1 996	103	116
Denmark	13	843	NA,NO	759	13	73
Finland	115	1 063	0	1 026	115	36
France	1 520	16 383	108	15 702	1 070	341
Germany	4 511	12 274	40	8 970	4 333	3 156
Greece	3	3 551	NA,NO	3 507	3	5
Ireland	37	600	1	539	36	48
Italy	213	9 761	NO	9 302	213	351
Luxembourg	13	75	12	67	1	8
Netherlands	237	2 175	NO	1 928	218	147
Portugal	0	1 534	NE	1 491	NE	43
Spain	67	8 528	NA	7 882	67	394
Sweden	88	850	4	813	84	34
United Kingdom	674	15 024	12	14 416	604	533
EU-15	**7 886**	**76 512**	**200**	**69 747**	**7 101**	**5 608**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2F Consumption of Halocarbons and SF_6 account for about 2 % of total EU-15 GHG emissions (w/o LULUCF) in 2011. HFC emissions in 2011 were 349 times higher than in 1990. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). France, Italy, UK, Spain and Germany had the most significant absolute increases from this source between 1990 and 2011.

SF_6 emissions from 2F Consumption of Halocarbons and SF_6 account for 0.15 % of total EU-15 GHG emissions (w/o LULUCF) in 2011. Between 1990 and 2011, SF_6 emissions from this source decreased by 21 %. Germany, France, Italy, UK, Austria and Spain are responsible for 91 % of total EU-15 emissions (w/o LULUCF) from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2011.

Error! Reference source not found. provides information on the contribution of Member States to EU recalculations in HFC from 2F Consumption of Halocarbons for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 4.59 2F Consumption of halocarbons: Contribution of MS to EU recalculations in HFC for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-4	-14.3	125	10.8	In the refrigeration and air conditioning equipment sub category (2.F.1; namely the sub categories "supermarkets" and "other commercial" both reported under "commercial refrigeration"), "industrial refrigeration" and "stationary air conditioning" (excluding room AC and heating pumps) which are estimated in a top down model), where inconsistencies have also already been identified by the ESD review, it was necessary to completely rework the estimation from the basic input data. The new model is now fully consistent over the whole time series (which the old model was not as it only fully covered the years 2000/2004/2007/2010). For the other subcategories of 2.F.1 minor changes were made.
Belgium	0	0.0	134	7.4	For refrigeration "installations" (commercial and industrial refrigeration and stationary air conditioning), the emission rate has been revised for the period since 1997 (a constant reduction percentage, instead of linear decrease, now being considered for the yearly loss rate from the refrigerant bank). Thereby, the existing stock, the Amount charged into new systems, Amount of systems at time of disposal and the emissions have changed for these years, for the various gase
Denmark	0	0.0	4	0.5	A few corrections have been made in the CRF for consumption of HFC-134a to hard foam – IEF and stock, however, no methodological changes have been implemented.
Finland	0	0.0	0	0.0	
France	6	6.3	-1 784	-10.7	Toute la période d'inventaire a été revue suite à l'étude de EReIE réalisée en 2012. Un nouveau type de HFC, le HFC-245fa, est rapporté. Celui-ci apparait sous l'appellation « Unspecified mix of HFCs » dans la Table2(II).Fs1. D'importantes modifications ont eu lieu suite à la mise en place d'une nouvelle méthodologie de calcul des émissions d'aérosols techniques et à de nouvelles données de ventes pour les aérosols pharmaceutiques.
Germany	0	0.0	-2 634	-23.4	Implementation of an improved calculation method with new data sources and changed EFs.
Greece	0	0.0	-46	-1.3	Introduction of recycling; error correction
Ireland	0	0.0	-4	-0.7	Revised activity data for mobile air conditioning
Italy	0	0.0	-11	-0.1	Update of activity data of Mobile Air Conditioning.
Luxembourg	0	0.0	0.0	0.0	
Netherlands	0	0.0	-23	-1.3	New improved activity data. Addition of emission data which were excluded in the former submission.
Portugal	0	0.0	283	23.0	AD revision on MDI based on new data provided by Infarmed.
Spain	0	0.0	106	1.5	2F3 Fire extingushers: Revision of the stock in operating systems, after it has been detected an error in the estimation algorithm (the amount already decommissioned was not discounted)
Sweden	0	0.0	-4	-0.5	Due to a recurring one year lag in the updating of the data from the Products Register from the Swedish Chemicals Agency, data on bulk import and export in 2010 were updated.
UK	0	0.0	2	0.0	Emissions for overseas territories updated to be consistent with data and methods in UK GHG inventory.
EU-15	**3**	**1.3**	**-3 851**	**-5.4**	

Error! Reference source not found. provides information on the contribution of Member States to EU recalculations in SF_6 from 2F Consumption of Halocarbons for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 4.60 **2F Consumption of halocarbons and SF_6: Contribution of MS to EU recalculations in SF_6 for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-1	-0.4	6	1.9	Revised model
Belgium	0	0.0	6	6.0	Recalculation according to the recommendations of the Saturday Paper
Denmark	0	0.0	0.4	1.1	A few corrections have been made in the CRF for consumption of HFC-134a to hard foam – IEF and stock, however, no methodological changes have been implemented.
Finland	21	21.8	4	12.2	Improved activity data in the 2.F.8 EE sector.
France	0	0.0	100	30.9	Les recalculs des émissions de SF6 sont dues à l'ajout des émissions provenant d'EDF qui n'étaient pas comptabilisées jusqu'à présent.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0.0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	36	511.8	Electrical Equipment AD revision. Start estimating actual SF6 emissions from the manufacture of switch-gears and circuit breakers. Start estimating actual SF6 emissions from the manufacture of switch-gears and circuit breakers.
Spain	0	0.0	18	4.8	Revision of the amount of fluid filled in new manufactured products as a result of the Volunteer Agreement for limiting emissions of sulphur hexafluoride Revision of the amount of fluid in operating system as a result of the Volunteer Agreement for limiting emissions of sulphur hexafluoride Revision of the amount of fluid remained in products at decommissioning
Sweden	0	0.0	-1	-1.8	Due to a recurring one year lag in the updating of the data from the Products Register from the Swedish Chemicals Agency, data on bulk import and export in 2010 were updated. In addition, updated data from one company changed the estimate for SF6 in Stock.
UK	0	0.0	0	0.0	
EU-15	**20**	**0.3**	**170**	**3.1**	

Error! Reference source not found. shows the sub-categories of HFC emissions from 2F Consumption of Halocarbons and SF_6 by Member State. It shows that 2F1 Refrigeration and Air Conditioning Equipment is by far the largest sub-category accounting for 81 % of HFC emissions in this source category; 2F4 Aerosols/Metered Dose Inhalers and 2F2 Foam Blowing account for 9% and 5 % respectively.

Table 4.61 **2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2010 (Gg CO_2 equivalents)**

Member State	Consumption of Halocarbons and SF_6	Refrigeration and Air Conditioning Equipment	Foam Blowing	Fire Extinguishers	Aerosols/ Metered Dose Inhalers	Solvents	Other applications using ODS substitutes	Semiconductor Manufacture	Electrical Equipment	Other (please specify)
Austria	**1 349**	1 304	12	12	18	NO	NO	2	NO	NA,NO
Belgium	**1 996**	1 820	96	10	68	NO	NO	1	NO	NA,NO
Denmark	**759**	661	78	NO	16	NO	NO	NO	NO	4
Finland	**1 026**	977	7	C,NO	38	NO	NO	C,NA,NO	NO	3
France	**15 702**	11 675	1 397	136	2 102	379	NO	14	NO	NA,NO
Germany	**8 970**	7 810	680	29	440	C,NO	NO	10	NO	NA,NO
Greece	**3 507**	3 389	32	42	44	NA,NO	NO	NO	NO	NA,NO
Ireland	**539**	340	28	74	93	NO	NO	2	NO	NA,NO
Italy	**9 302**	8 218	513	174	389	NO	NO	8	NO	NA,NO
Luxembourg	**67**	63	2	NO	2	NO	NO	NO	NA	NA,NO
Netherlands	**1 928**	1 562	IE	IE,NO	IE	IE,NO	NO	NO	NO	366
Portugal	**1 491**	1 432	47	6	6	NO	NO	NO	NO	NA,NO
Spain	**7 882**	5 584	64	2 164	70	NA	NA	NA	NA	NA
Sweden	**813**	743	37	6	28	NO	NO	NO	NA	NA,NO
UK	**14 416**	11 087	310	206	2 706	107	NA	IE	IE	NA,NO
EU-15	**69 747**	**56 666**	**3 303**	**2 860**	**6 022**	**486**	**0**	**38**	**0**	**373**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. shows MS contribution to EU-15 HFC emissions from the two most important sub-sources 2F1 and 2F4.

Table 4.62 **2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	1 224	1 304	2.3%	80	7%	1 304	-	CS	CS
Belgium	NO	1 750	1 820	3.2%	70	4%	1 820	-	T2	CS,D,PS
Denmark	NO	696	661	1.2%	-35	-5%	661	-	CS	CS
Finland	0	1 090	977	1.7%	-113	-10%	977	7754940%	T2	D
France	85	11 209	11 675	20.6%	465	4%	11 589	-	M	CS
Germany	NA,NO	7 452	7 810	13.8%	358	5%	7 810	-	T2	CS,D
Greece	NO	3 374	3 389	6.0%	15	0%	3 389	-	T2	D
Ireland	IE,NO	369	340	0.6%	-28	-8%	340	-	T1,T3	CS
Italy	NO	7 685	8 218	14.5%	533	7%	8 218	-	T2	CS
Luxembourg	0	62	63	0.1%	0	1%	63	2414220%	CS	CS
Netherlands	NO	1 534	1 562	2.8%	28	2%	1 562	-	T2	CS
Portugal	NE	1 455	1 432	2.5%	-23	-2%	1 432	-	T2	CS,D
Spain	NA	5 123	5 584	9.9%	460	9%	5 584	-	T1,T2	D
Sweden	3	780	743	1.3%	-37	-5%	740	25948%	CS,T2	CS,D
UK	NO	10 840	11 087	19.6%	247	2%	11 087	-	T3	CS
EU-15	**88**	**54 644**	**56 666**	**100.0%**	**2 022**	**4%**	**56 578**	**64094%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2011, HFC emissions from 2F1 were about 644 times higher than in 1990 (**Error! Reference source not found.**). France, Germany, Italy and the UK are responsible for 69% of total EU-15 emissions from this source. Between 2010 and 2011 EU-15 emissions increased by 4 %. The largest increase of HFC emissions from 2F1 between these years was in Spain. Sweden, Finland, Denmark, Ireland and Portugal reported decreasing emissions from this source in the latest years.

Figure 4.13 **2F1 Refrigeration and Air conditioning: EU-15 HFC emissions**

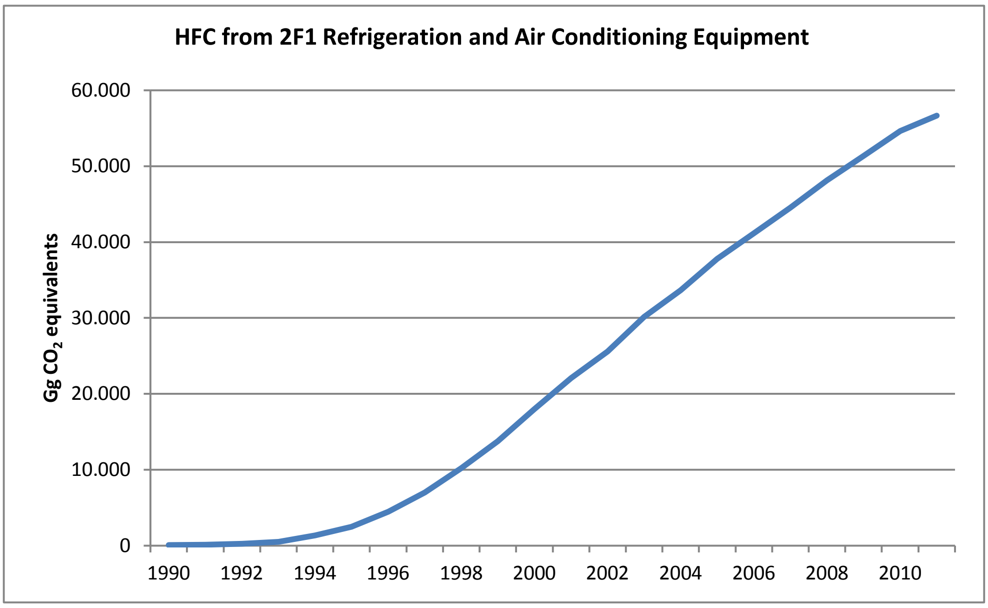


Table 4.63 **2F2 Foam Blowing: Member States# contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	31	12	0.4%	-19	-60%	12	-	CS	CS
Belgium	NO	103	96	2.9%	-7	-6%	96	-	T2	CS,D,PS
Denmark	NA,NO	87	78	2.3%	-10	-11%	78	-	CS	CS
Finland	NO	8	7	0.2%	0	-5%	7	-	T2	D
France	NO	1 255	1 397	42.3%	142	11%	1 397	-	CR,T2	CS,PS
Germany	C,NO	670	680	11.3%	10	2%	680	-	T2	CS,D
Greece	NO	34	32	0.5%	-3	-8%	32	-	T2	D
Ireland	NO	28	28	0.9%	1	3%	28	-	T1	CS
Italy	NO	496	513	15.5%	17	3%	513	-	T2	D
Luxembourg	12	2	2	0.1%	0	1%	-10	-85%	CS	CS
Netherlands	NO	IE	IE	-	-	-	-	-	NA	NA
Portugal	NE	48	47	1.4%	-1	-2%	47	-	T2	D
Spain	NA	68	64	1.9%	-3	-5%	64	-	T2	D
Sweden	NA	32	37	1.1%	4	13%	37	-	CS	PS
UK	NO	299	310	9.4%	11	4%	310	-	T3	CS
EU-15	**12**	**3 160**	**3 303**	**100.0%**	**142**	**5%**	**3 291**	**27408%**		

In 2011, HFC emissions from 2F2 **Error! Reference source not found.** increased by 5% compared to 2010 – and by 27 408% compared to 1990. The biggest contributors to this sector are France (42.3%), Italy (15.5%) and Germany (11.3%), those three countries account for 69.1% of the share in EU15 emissions in this sector. All countries but France, Germany, Ireland, Italy, Luxembourg, Sweden and the UK reported a decrease in emissions compared to 2010.

Table 4.64 **2F3 Fire extinguishers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	0	10	12	0.4%	2	21%	12	-	CS	CS
Belgium	NO	12	10	0.4%	-2	-17%	10	-	T2	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	C,NO	C,NO	-	-	-	-	-	NA	NA
France	NO	130	136	4.7%	5	4%	136	-	CR,T2	CS
Germany	NO	24	29	0.5%	5	23%	29	-	CS	CS,D
Greece	NA,NO	41	42	0.7%	1	3%	42	-	CS	D
Ireland	0	65	74	2.6%	9	13%	74	33837%	T3	CS
Italy	NO	160	174	6.1%	14	9%	174	-	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Portugal	NE	6	6	0.2%	0	-2%	6	-	T2	CS
Spain	NA	2 080	2 164	75.7%	84	4%	2 164	-	T1,T2	D
Sweden	NA	6	6	0.2%	0	0%	6	-	CS	CS
UK	NO	204	206	7.2%	2	1%	206	-	T2	CS
EU-15	**0**	**2 739**	**2 860**	**100.0%**	**121**	**4%**	**2 859**	**1308191%**		

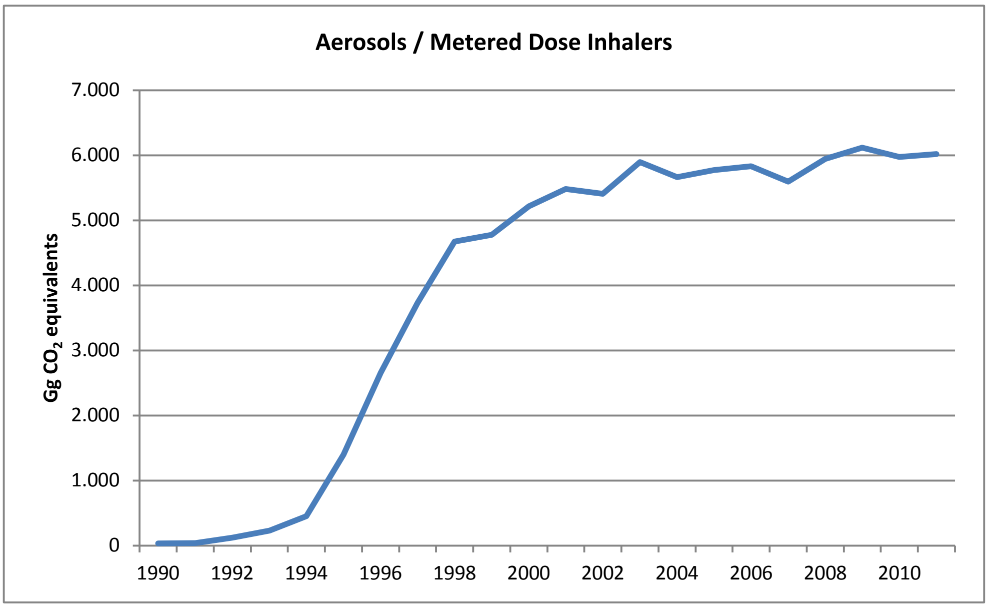
In 2011, HFC emissions from 2F3 **Error! Reference source not found.** increased by 4% compared to 2010 – and by 1 308 191% compared to 1990. The biggest contributors to this sector are Spain (75.7%), UK (7.2%), and Italy (6.1%), those three countries account for 88.9% of the share in EU15 emissions in this sector. Belgium and Portugal reported a decrease in emissions (-17% and -2% respectively) compared to 2010.

Table 4.65 **2F4 Aerosols/ Metered Dose Inhalers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	20	18	18	0.3%	0	0%	-2	-9%	CS	CS
Belgium	NO	69	68	1.1%	-1	-2%	68	-	T1,T2	D
Denmark	NA,NO	17	16	0.3%	0	-3%	16	-	CS	CS
Finland	NA,NO	63	38	0.6%	-25	-39%	38	-	T2	D
France	IE,NO	1 974	2 102	34.9%	127	6%	2 102	-	CR,T2	CS
Germany	C,NO	457	440	7.3%	-16	-4%	440	-	CS,T2	CS,D
Greece	NO	63	44	0.7%	-18	-29%	44	-	T2	D
Ireland	1	94	93	1.5%	-1	-1%	92	14880%	T1,T2	CS
Italy	NO	393	389	6.5%	-4	-1%	389	-	T2	CS
Luxembourg	NA,NO	2	2	0.0%	0	2%	2	-	CS	CS
Netherlands	NO	IE	IE	-	-	-	-	-	NA	NA
Portugal	NE	7	6	0.1%	0	-2%	6	-	RA	CS
Spain	NA	100	70	1.2%	-29	-30%	70	-	D	D
Sweden	1	27	28	0.5%	1	4%	27	2048%	CS,T2	D
UK	12	2 691	2 706	44.9%	14	1%	2 694	22779%	T2	CS
EU-15	**34**	**5 975**	**6 022**	**100.0%**	**47**	**1%**	**5 988**	**17661%**		

In 2011, HFC emissions from 2F4 were more than 177 times higher than in 1990 (**Error! Reference source not found.**). France and UK are responsible for 79.8 % of total EU-15 emissions from this source. Between 2010 and 2011 EU-15 emissions increased by 1 %. The relative decrease between these years was largest in Finland, Spain and Greece, the biggest increase was reported in France (**Error! Reference source not found.**).

Figure 4.14 2F4 Aerosols/Metered Dose Inhalers: EU-15 HFC emissions



Error! Reference source not found. provide descriptions on methods used for estimating HFC, PFC and SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.66 2F Consumption of halocarbons and SF_6: General description of national methods used for estimating emissions

Member States	Description of methods
Austria	Methodologies have been developed in general in different studies contracted by the Umweltbundesamt: • (Umweltbundesamt 2001b) – 1990-2000 total sector • (Obernosterer et al 2004) – re-evaluation of sub category foam blowing • Austrian estimates of emissions from the sources 2.F.4 Aerosols and 2.F.5 Solvents are based on a European evaluation of emissions from this sector (Harnisch & Schwarz 2003), subsequently disaggregated to provide a topdown estimate for Austria. • (Leisewitz & Schwarz 2010/2011) – covered the years 2000-2007 and 2010 for the total sector Emissions for all subcategories were estimated using a country specific methodology, emission factors are based on information of experts from the respective industries. For most sources emissions are calculated from annual stocks using emission factors. Data about consumption of HFC, PFC and SF_6 were determined from the following sources: data from national statistics data from associations of industry direct information from importers and end users Since 2004 there is also a reporting obligation under the Austrian FC-regulation for users of FCs in the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols.
Belgium	For estimating the emissions of the F-gases a country-specific methodology was developed by 2 consultancies (ECONOTEC and ECOLAS) in 1999 based on the IPCC Guidelines and updated every year and further optimised by ECONOTEC in collaboration with the VITO Emissions of fluorinated greenhouse gases are mainly estimated on the basis of the consumption of the different substances for each application, the consumption of products containing such substances, figures on external trade in substances or products containing substances, as well as on emission modelling by application and

Member States	Description of methods
	assumptions on leakage rates.
Denmark	The data for emissions of HFCs, PFCs, and SF_6 has been obtained in continuation on work on inventories for previous years. The determination includes the quantification and determination of any import and export of HFCs, PFCs, and SF_6 contained in products and substances in stock form. This is in accordance with the IPCC-guideline (IPCC (1997), vol. 3, p. 2.43ff) as well as the relevant decision trees from the IPCC Good Practice Guidance (GPG, IPCC (2000) p. 3.53ff). For the Danish inventories of F-gases basically a Tier 2 bottom up approach is used. As for verification using import/export data a Tier 2 top down approach is applied. In an annex to the F-gas inventory report 2008 (DEPA, 2010), there is a specification of the approach applied for each sub-source category. The following sources of information have been used: Importers, agency enterprises, wholesalers, and suppliers Consuming enterprises, and trade and industry associations Recycling enterprises and chemical waste recycling plants Statistics Denmark Danish Refrigeration Installers' Environmental Scheme (KMO) Previous evaluations of HFCs, PFCs, and SF_6 Suppliers and/or producers provide consumption data of F-gases. Emission factors are primarily defaults from GPG, which are assessed to be applicable in a national context. In an annex to the F-gas inventory report 2010 (Poulsen & Werge, 2012)), there is a specification of the approach applied for each subsource category
Finland	Detailed sector-specific approach. Emissions from each category are quantified using 2 or 3 different methods given in IPCC GPG (2000).
France	IPCC Tier 2 methodology is applied for all subsectors Methodological changes (2013 Submission) in 2.F.1 Les évolutions des émissions de gaz fluorés sont en grande partie liées à la mise à jour annuelle de l'inventaire du CEP des MINES ParisTech. Elles ont notamment été engendrées par des corrections suite à de nouvelles sources et résultats d'enquêtes. De plus, les émissions correspondant aux quantités perdues lors de la récupération des quantités restant dans les bouteilles de fluides retournées aux distributeurs sont dorénavant comptabilisées. Methodological changes (2013 submission) 2.F.2: Toute la période d'inventaire a été revue suite à l'étude de EReIE réalisée en 2012. Un nouveau type de HFC, le HFC-245fa, est rapporté. Celui-ci apparait sous l'appellation « Unspecified mix of HFCs » dans la Table2(II).Fs1. Methodological changes in Semiconductor manufacture 2.F.7 (2013 submission:) Les émissions sont attribuées à la charge et non pluså la banque comme dans l'édition précédente. Methodological changes in 2.F.4 Aerosols (2013 submission): Transféré du 2.F.4.2.TB(iia), la baisse constatée après transfert est due à une nouvelle méthode de calcul. D'importantes modifications ont eu lieu suite à la mise en place d'une nouvelle méthodologie de calcul des émissions d'aérosols techniques et à de nouvelles données de ventes pour les aérosols pharmaceutiques.
Germany	A detailed country specific approach (Tier 2) is applied for all subsectors.
Greece	In order to obtain a reliable estimation of F-gases emissions, collection of detailed data for all activities mentioned above (e.g. number of refrigerators, type and amount of refrigerant used by each market label, substitutions of refrigerants that took place the late years etc.) is required. The availability of official data in Greece is limited and, therefore, the estimations presented hereafter involve the application of country specific methodologies. In order to resolve any remaining completeness issues, and given the fact that there has not been any opposite indication for the use of the PFCs in Fire Extinguishers and f-gases in Solvent Uses up to now, in September 2010 Greece has decided to use information from inventories of neighbouring countries. To this end, the inventory of Italy has been used, on the grounds that the climatic and socio-economic conditions between Greece and Italy are quite similar.
Ireland	Emission calculation is based on special studies by sub-contractors. Where data allowed, emission estimates were calculated following the guidance for individual sub-categories provided by IPCC good practice guidance.
Italy	Methodology used is IPCC Tier 2a, except for SF_6 emissions from electrical equipment (2F7), where it is IPCC Tier 3c. The IPCC Tier 1a method has been used to calculate potential emissions, using production, import, export and destruction data provided by the national producer (Solvay, several years; ST Microelectronics, several years; MICRON, several years). As regard PFC potential emissions, since no production occurs in Italy, export has been reasonably assumed negligible, whereas import correspond to consumption of PFCs by semiconductor manufacturers, that use these substances. Regarding HFCs there was an update in 2011 of import export data reported by operators .
Luxembourg*	A re-evaluation of the emission sources and the emissions of HFCs, PFCs and SF_6, taking into account the 2000 IPCC-GPG Guidelines as well as country specific considerations has been done in 2011.
Netherlands	To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary refrigeration, Mobile airconditioning, Aerosols, Foams and Semiconductor manufacturing. The country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3 method and the country-specific methods for the sources Sound-proof windows and Electron

Member States	Description of methods
	microscopes are equivalent to IPCC Tier 2 methods. For 2007 and 2008 the country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3b method and from 2009 onwards to the IPCC Tier 3a method.
Portugal	For those sources with sufficient available data, actual emissions where estimated with a Tier 2 (advanced or actual method) approach which is considered Good Practice in accordance with GPG. This approach allows the quantification of emissions in the year in which they actually occurred accounting for the time lag between consumption and emissions. On the contrary, the Tier 1, or potential approach, allocates emissions in the year that the chemical is sold into a particular end-user. As a general rule, bottom-up methodologies were used, and thus overall methodology should be classified as Tier 2a. This approach departs from the knowledge of the number of equipments using Fluorinated compounds and estimates emissions to atmosphere from charge (amount of chemical used in the equipment), service life, emission rate during the various periods of the equipment life and possible recovery of emissions. Whenever possible emission estimates include: - assembly emissions - when equipment is first filled; - operation emissions - occurring during equipment lifetime or usage and resulting mainly from leaks; - disposal emissions - the remaining charge that is released to the atmosphere at end of equipment life and where the remaining charge is neither recycled or destroyed. Due to update of AD time series were revised 2011.
Spain	No general description, see sub-category specific descriptions • equipos de refrigeración y aire acondicionado La metodología de estimación de las emisiones se ha basado en la expuesta en la Sección 2.17.4.2 del Manual de Referencia 1996 IPCC y en las secciones 3.7.4 y 3.7.5 de la Guía de Buenas Prácticas 2000 IPCC. • Espumado de plásticos: Para estimar las emisiones de esta sub-categoría se ha aplicado el método de nivel 2 de IPCC con factores de emisión por defecto que figuran en la Tabla 7.6 de la Guía 2006 IPCC. • Equipos de extinción de incendios: la información sobre cantidades consumidas de gases fluorados en el mantenimiento y nueva instalación de equipos de extinción se ha obtenido por cuestionario remitido a las principales empresas del sector, con distinción entre equipos fijos y equipos portátiles. A partir de la información anterior (cantidades declaradas o estimadas de HFC y PFC incorporadas) se ha calculado el stock existente en cada año de cada tipo de gas almacenado en el conjunto de equipos utilizados en esta actividad. • Aerosoles: La estimación de la emisión puede realizarse multiplicando la serie de producción nacional (gases introducidos en fabricación) por los factores de emisión mencionados, agregando las emisiones producidas en la fase de producción a las emisiones en la vida útil de los equipos.
Sweden	In estimating the actual emissions, as far as possible, a Tier 2 approach has been used. A model is used for calculating the actual emissions. Changes in accumulated amounts each year resulting from additional amounts of HFC, PFC and SF_6 imported and used within the country, as well as the decline in accumulated stock caused by exports or emissions from operating systems, have been taken into consideration. Potential emissions: Data on bulk imports and exports are obtained from the Products register hosted by the Swedish Chemicals Inspectorate, which did not register these substances until 1995. Estimates of potential emissions for imports and exports were, however, made for all years in the time series, 1990-2004 in a special study in 2005. The method of estimating potential emissions for 2005 was made accordingly. A SMED study carried out in 2011 (Gustafsson T. 201. Fluorinated Greenhouse Gases in Sweden. Review of Methodology and Estimated Emissions Reported to the UNFCCC and the EU monitoring Mechanism) led to recalculation of emissions Data on bulk import and export in 2010 were updated. It mainly affected emissions of HFC-134a and HFC-152 in commercial refrigeration
United Kingdom	No general description, see sub-category specific descriptions

*Source: NIR 2013 unless stated otherwise, *source: NIR 2012*

Error! Reference source not found. provide descriptions on methods used for estimating HFC emissions from 2F1 Refrigeration and Air-Conditioning Equipment.

Table 4.67 2F1 Refrigeration and Air-conditioning equipment: Description of national methods used for estimating HFC emissions

Member States	Description of methods
Austria	Refrigeration and Air Conditioning: Consumption data was obtained directly from the most important importers, retailers and service companies of refrigerants. The stocks of the different subcategories were estimated using information from the most important refrigerant retailers/ importers and experts from the refrigeration branch. A detailed model was used to calculate emissions from passenger cars. This includes figures on new registered cars, MAC quota and the average charge. The stocks were calculated accordingly. For the sector 2.F.1; (sub categories “supermarkets” and “other commercial”) a new fully consistent model over the whole time series was developed. A top down model was used for the subcategories: Industrial refrigeration, Supermarkets (Part of CRF category

Member States	Description of methods
	commercial refrigeration), Other commercial refrigeration (Part of CRF category commercial refrigeration), Stationary air conditioning (part of CRF category stationary air conditioning) For the rest of the sector 2F1 including parts that are, for the most part, not filled in Austria (or at least not filled on site), emissions are estimated using a bottom up approach: Room air conditioning (part of the CRF category stationary air conditioning), Heat pumps (part of CRF category stationary air conditioning, Commercial stand alone refrigeration equipment manufacturing (part of CRF category commercial refrigeration) Domestic refrigeration, Transport refrigeration, Mobile air conditioning.
Belgium	For the refrigeration sector, emissions have been estimated separately for the following source categories: industrial and commercial installations, household refrigerators, air conditioning of private cars, air conditioning of buses and coaches, and refrigerated transport. In accordance with the IPCC guidelines, the assembly emissions, the operation emissions and the disposal emissions are being determined separately. The assembly emissions are calculated as a function of the estimated amount charged into new systems and the percentage assembly losses, the operation emissions as a function of the amount stocked in existing systems and assumptions on annual leakage rates, and the disposal emissions in function of the amount in systems at time of disposal and the estimated recovered fraction. An annual inquiry is made on the consumption of the major F-gas containing product manufacturers, among which the 4 car manufacturers. These data are used for calculating the potential emissions as well as the assembly emissions. Industrial and commercial "installations" represent all on-site assembled systems for industrial & commercial refrigeration as well as stationary air-conditioning applications, which is the largest single source of F-gas emissions. The consumption and emission of refrigerants are modelled on the basis of an annual inquiry among refrigerant distributors on their national supply by refrigerant mixture, as well as on assumptions on average loss rates, from which the estimated supply for refilling vehicles is subtracted. No distinction is made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it is not possible to disaggregate the consumption data between these sub-sectors, because of the presence of intermediary wholesalers, and the fact that no inventory of installations is available. For refrigeration "installations" (commercial and industrial refrigeration and stationary air conditioning), the emission rate has been revised for the period since 1997 (a constant reduction percentage, instead of linear decrease, now being considered for the yearly loss rate from the refrigerant bank). Thereby, the existing stock, the Amount charged into new systems, Amount of systems at time of disposal and the emissions have changed for these years, for the various gases. The refrigerant consumption and emissions of the transportation sector are estimated by modelling the evolution of the vehicle stock, on the basis of the number of new vehicle registrations and of the percentage of new vehicles equipped with air conditioning., by category of vehicles (cars, buses and coaches). The emissions from refrigerated transport are calculated on the basis of the annual number of new registrations of refrigerated trucks and trailers by gross / net weight categories, the average quantity of refrigerant (by type of refrigerant) contained in each vehicle (by vehicle category) and emission factors taken from the literature.
Denmark	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. In case of commercial refrigerants and Mobile Air Condition (MAC), national emission factors are defined and used. Import/export data for sub-source categories where import/export is relevant (MAC, fridge/freezers for household) are quantified on estimates from import/export statistics of products + default values of the amount of gas in the product. The estimates are transparent and described in the annex to the report referred to above. applied. In an annex to the F-gas inventory report 2010 (Poulsen & Werge, 2012)), there is a specification of the approach applied for each subsource category. Detailed information on the amount of HFCs used for refilling of mobile A/C has been available for 2009 and 2011, and therefore, a new approach has been implemented in the calculation of emissions. HFCs for mobile A/C are only used for refilling, and therefore the amount used for mobile A/C is assumed to be the same as the amount emitted during use (Poulsen & Werge,2012):Consumption of HFC for MAC = refilled stock = emission
Finland	Refrigeration and air conditioning (CRF 2.F.1) Top-down Tier 2, Tier 1a, Tier 1b The Tier 2 top-down method is used for all sources in this category, both stationary and mobile. Data are not collected for separate subcategories because such statistics are either not available or the preparation of such statistics would entail a very high reporting burden on companies. There is also some evidence that simpler questionnaires lead to better response activity. HFC-23 emissions from this source are not reported separately due to confidentiality.
France	IPCC Tier 2. Les émissions de HFC sont déterminées à l'aide du modèle « RIEP » développé par l'Ecole des Mines de Paris qui utilise une méthode de rang 2 du GIEC avancée.
Germany	IPCC Tier 2a. This category is divided into the sub-categories of household refrigeration, commercial refrigeration, transport refrigeration, industrial refrigeration, stationary air-conditioning systems and room air-conditioners, and mobile air-conditioning systems. For calculation of HFC emissions from the sub-categories of refrigeration and stationary airconditioning systems, individual data are collected, or refrigerant models used. Any refrigerant models used are described in connection with the relevant method. The emission factors used are the result of surveys of experts. For some sub - source categories, disposal emissions occurred for the first time in 2003. The application of new refrigerant models with different calculation steps and new data sources in the subsectors commercial refrigeration 2.F.1.b, industrial refrigeration 2.F.1.d, stationary refrigeration (2.F.1.e) as well as mobile refrigeration (2.F.1.f) as well as the first-time collection of data for heat pumps led to multiple

Member States	Description of methods
	recalculations in the 2013 submission of the inventory.
Greece	Refrigeration and air-conditioning: F-gases emissions are estimated according to the Tier 2a methodology described in the IPCC Good Practice Guidance. It is a bottom-up approach based on detailed equipment data and emission factors representing various types of leakage per equipment category. It should be noted that the application of the Tier 1 methodology (calculation of potential emissions based on imports, exports and domestic consumption of each gas) and Tier 2b is not possible, as the available information is not reported in the way required by these methodologies. Total emissions are calculated as the sum of assembly emissions, operation emissions that include annual leakage from equipment stock in use as well as servicing emissions and disposal emissions that include the amount of refrigerant released from scrapped systems. In the 2013 submission the calculation in this sector was revised: More specific, the amount of the equipment sold in Greece each year (produced equipment+imported equipment-exported equipment), was considered to derive only from the equipment produced in country. However, the penetration of equipment in F-gases is different for those that are produced in Greece and those imported. This error has been corrected in the whole time series, and a ratio between produced and imported equipment has been calculated and used to calculate the total amount of F-gases consumed each year.
Ireland	In terms of stationary refrigeration data on the quantities of industrial gases supplied to the refrigeration sector is obtained from chemical suppliers and manufacturers of refrigeration units. Sales data is provided for a range of HFCs and blends corresponding to the individual HFC species. A bottom-up approach is not feasible for estimating actual emissions from stationary refrigeration and air conditioning in Ireland due to the lack of data available on equipment types and HFC sales data into equipment sub-categories. Therefore emissions are estimated using a top-down approach based on reported sales data and information on market shares, which are applied to calculate estimates of total HFC sales into the Irish stationary refrigeration and air-conditioning sectors. Emissions of HFCs from sub-category 2.IIA.F.1.6 Mobile Air-Conditioning are estimated using a Tier 3b bottom-up analysis which utilises national vehicle fleet statistics from the Department of the Environment, Heritage and Local Government and assumed rates of air conditioning unit penetration in the national vehicle fleet. The methodology used takes account of vehicle lifetime, the percentage of vehicles having HFC in their air-conditioning systems, average charge per unit, product manufacturing emissions, effective lifetime leakage rates (incorporating emissions from normal operating losses and accidental releases arising from collision damage) and decommissioning losses. HFC emissions from Mobile Air Conditioning (2F1) have been revised for 2005-2009. This is due in part to the use of a revised disposal factor of 10 per cent for end of life vehicles (AEA, 2011). In addition the assumed penetration of air conditioning units containing HFC's in vehicles is now assumed to reach 90 per cent by 2010 (AEA, 2011). The result of this recalculation is an increase in HFC emissions from Mobile Air Conditioning of 2.7 per cent in 2009. HFC emissions from Refrigeration and Air Conditioning (2F1) have been revised for 2009 due to the provision of revised manufacturing loss emissions by one of the installations that provide information to the inventory agency. The result of this recalculation is a reduction of 13.7 per cent in HFC emissions from Refrigeration and Air Conditioning in 2009.
Italy	Refrigeration and air-conditioning: IPCC Tier 2a Basic data and have been supplied by industry: specifically, for the mobile air conditioning equipment the national motor company and the agent's union of foreign motor-cars vehicles have provided the yearly consumptions; for the other air conditioning equipment the producer supply detailed table of consumption data by gas. Losses rates have been checked with industry and they are distinguished by domestic equipment, small and large commercial equipment, industrial chillers, mobile air conditioning equipment. Refrigeration activities, such as commercial, transport, industrial and other stationary, are all reported under domestic refrigeration because no detailed information is available to split consumptions and emissions in the different sectors. Anyway appropriate losses rates have been applied for each gas taking in account the equipment where refrigerants are generally used. Therefore implied product life factors, especially for HFC 134a, result from the weighted average of different losses rates, from 0.7% for domestic refrigeration to 10% for large chillers. As for HFCs an update of import export data reported by operators was made in 2011.
Luxembourg*	Emissions from industrial and commercial installations have been calculated on the basis of a life-cylce approach and on the basis of an inquiry among the refrigerant distributors on their national supply by refrigerant mixture on the year 2006. The evolution in time of the total supply by refrigerant has been assumed to be the same as in Belgium. No distinction has been made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it was not possible to disaggregate the consumption data between these sub-sectors because of the presence of intermediary wholesalers. The emissions are calculated on the basis of the assumption of 3% assembly losses, the annual losses (10.0% in 2010), the average equipment lifetime of 20 years and an end-of-life recovery rate of 50%. Emissions from domestic refrigeration have been estimated to be negligible. In fact, HFCs are very rarely used in domestic refrigeration. Furtheron there are very low quantities (< 100 g) used in these applications and the systems are always hermetically sealed. Moreover Luxembourg has a very efficient recycling technology for domestic refrigeration equipments (Superfreonskescht). Emissions from the manufacturing of refrigerators are based on figures provided by the only manufacturer and are very small (below 0.1 kt CO_2-eq "actual").

Member States	Description of methods
	Emissions from cars have been calculated on the basis of a life-cylce approach and on the basis of the evolution of the national car fleet. Assumptions have been taken for the percentage of new cars equipped with air conditioning (96% in 2010), the average quantity of HFC 134a in a new car (0.61 kg in 2010), the percentage of annual losses (6.9% regular losses and 1.9% accidentally losses in 2010) and the annual refilling rate (3% in 2010). Moreover it is assumed that there is no dismantling of end-of-life cars in Luxembourg since all old cars are exported. Emissions from buses have been calculated on the basis of a life-cylce approach and on the basis of the evolution of the national bus fleet. Assumptions have been taken for the percentage of new buses equipped with air conditioning (100% in 2010), the average quantity of HFC 134a in a new bus (10.6 kg in 2010) and the percentage of annual losses (15% in 2010). Moreover it is assumed that there is no dismantling of end-of-life buses in Luxembourg since all old buses are exported. Emissions from transport refrigeration are calculated on the basis of the emissions reported by Germany (Schwarz, 2009) expressed per capita with the relative population in Luxembourg.
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary Refrigeration and Mobile air conditioning (For HFC134a a more accurate split on the usage figures(PWC, 2012) into Stationary refrigeration , Mobile airconditioning and the seagoing shipping sector came available for the period 2006-2010. As for mobile air-conditioning detailed data about delivery vans and lorries per year became available for the period 2000-2010 hence leading to recalculations in 2012.)
Portugal	CFC, HCFC and F-Gases emissions from operation and disposal of Domestic Refrigeration Equipments, Commercial Refrigeration (non domestic Refrigeration Equipments), transport refrigeration equipments, Stationary and Industrial Air conditioning equipments and Mobile Air Conditioning were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.4 of the GPG. F-Gases emissions for each particular compound were estimated from total Refrigeration Fluid emissions and considering the percentage of F-Gas use in total Refrigeration Fluid use in each year. The stock of domestic refrigeration equipments was estimated from the number of households and from the percentage of households with refrigeration equipments, available for years 1990, 1995 and 2000, according to an unpublished report from INE.From year 2000 onward the percentage of equipments per household was forecasted by APA based on gross domestic product behaviour. The number of households refers to INE-Family Survey. There are no available national statistics concerning the number and dimension of non-domestic refrigeration equipments used in commerce, industry, tourism, services and institutional activities. A survey to Hotels, Hostels and Camping Parks was conducted with the support of “Turismo de Portugal, ip” and “AHP – Associação da Hotelaria de Portugal”, in order to obtain real data concerning the number and dimension of non-domestic refrigeration equipments. Data pertaining to other commerce and services activities was estimated with the technical support of APIRAC, Importers and DGE (Enterprise and Industry General Directorate). Calculations for Hypermarkets were made separately. CFC, HCFC and F-gases emissions from operation and disposal of Mobile Air Conditioning (MAC) systems were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.5.1 of the GPG. Estimates for Road Transportation and Railways were made separately. The number of light vehicles with MAC was estimated from the total number of light vehicles sold each year, using the same information used to establish the time series of car sales and fleet in chapter 1A3, and the percentage of new cars sold with MAC at each year was estimated according to data provided by manufacturers.
Spain	Para estos sectores se ha contado con información suministrada para algunos años por las asociaciones empresariales del frío y climatización y, por lo que respecta a su uso en la industria de automoción, con información obtenida vía cuestionario a las plantas de fabricación de automóviles. Para los equipos estacionarios de refrigeración y climatización, el equipo de trabajo del inventario ha extendido las tasas de variación interanual para completar los últimos años de la serie al no haberse podido disponer de otra información en esta edición del inventario. La información para el desglose según tamaños (pequeños o stand-alone y medios/grandes) de los equipos de refrigeración comercial, se ha tomado de un estudio sectorial sobre equipamiento de las superficies comerciales, clasificadas según tipología y tamaño, y que contenía datos sobre metros lineales de equipos de refrigeración. Los factores de emisión son, por lo que respecta a la producción nacional de automóviles, datos derivados de la información de cuestionarios a las plantas fabricantes, y para los demás sub-sectores se han tomado de las guías de IPCC.
Sweden	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. Refrigeration and air conditioning equipment: Input data for the calculation of actual emissions consists of information from various sources. For heat pumps, air conditioning, mobile air conditioning, refrigeration and freezing equipment, the equipment producers and importers were contacted and have provided information of varying quality. Estimates have been checked with trade associations (KYS and SVEP) and with experts at the Swedish EPA (Ujfalusi, Bernekorn, Björsell). The information on refrigerant-related imported amounts of fluorinated gases from the Products register is compared to calculations made in the model, based on assumptions and information from other sources. A SMED study carried out in 2011 (Gustafsson T. 201. Fluorinated Greenhouse Gases in Sweden. Review of Methodology and Estimated Emissions Reported to the UNFCCC and the EU monitoring Mechanism) was based on contacts with the Swedish road vehicles manufacturers. Several factors were modified for MAC for 2010 onwards to be more in line with the present

Member States	Description of methods
	status of the Swedish road vehicle fleet.
United Kingdom	The calculation methodology within the model is considered to provide a relatively conservative approach to the estimation of emissions.The bank of fluid is estimated by considering the consumption of fluid in each sector, together with corrections for imports, exports, disposal and emissions.Once the size of the bank in a given year is known, the emission can be estimated by application of a suitable emission factor.Emissions are also estimated from the production stage of the equipment and during disposal.The methodology corresponds to the IPCC Tier 2 -'bottom-up'- approach.Data are available on the speciation of the fluids used in these applications; hence estimates were made of the global warming potential of each fluid category. Emissions from the domestic refrigeration sector were estimated based on a bottom-up approach using UK stock estimates of refrigerators, fridge-freezers, chest-freezers and upright freezers from the UK Market Transformation Programme (MTP, 2002). For the commercial and industrial refrigeration sub-sectors, emission estimates are now based on refrigerant fluid sales data, from the British Refrigeration Association. This allowed the previous estimates within the model to be verified against real data, and adjusted accordingly. Emissions of HFCs from mobile air conditioning systems were also derived based on a bottom-up analysis using UK vehicle statistics obtained from the UK Society of Motor Manufacturers and Traders, and emission factors determined in consultation with a range of stakeholders. A full account of the assumptions and data used to derive emission estimates for the MAC sub-sector is in AEAT (2004) and AEA (2008). The previous version of the refrigeration/air conditioning inventory model developed by AEA (2010) was updated by ICF International in the summer/autumn of 2011 based on revised industry input and a more transparent, robust Tier 2 modelling approach.

*Source: NIR 2013 unless stated otherwise, *source: NIR 2012*

Error! Reference source not found. provides an overview of all sources reported under 2F9 Other by EU-15 Member States for the year 2011. The largest contributor to emissions is Germany with 59.3 %. Most Member States report emissions from double glaze windows in this source category.

Table 4.68 2F9 Other: Overview of sources reported under this source category for 2011

Member State	2.F.9 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Double glaze windows, Research and other use	NA,NO	NA,NO	0.0105	249.9	5.8%
Belgium	Double glaze windows	NA,NO	0.4	0.0041	97.5	2.2%
Denmark	Double glaze windows, Laboratories, Fibre optics	4.2	4.8	0.0025	68.0	1.6%
Finland	Grouped confidential data	3.0	1.2	0.0012	32.0	0.7%
France	Shoes application, Closed application, Open application	NA,NO	184.7	NO	184.7	4.3%
Germany	Car Tyres, Shoes, Trace gas, Double glaze windows, Coating, AWACS maintenance, Optical Glass Fibre, Solar Technology, Welding	NA,NO	0.1	0.1076	2 572.5	59.3%
Greece	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Ireland	Medical Applications, Tracer in Leak Detection, Double glaze windows, Sporting goods	NA,NO	NA,NO	0.0001	3.4	0.1%
Italy	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Luxembourg	Noise reduction windows	NA,NO	NA,NO	0.0003	6.6	0.2%
Netherlands	No specific allocation due to confidentiality of data	365.7	NA,NO	0.0061	512.3	11.8%
Portugal	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	-	0.0%
Sweden	Shoes, Double glaze windows	NA,NO	1.0	0.0002	5.3	0.1%
UK	Semiconductors, Electrical and production of trainers, One Component Foams, Gibraltar F Gas Emissions	NA,NO	75.5	0.0223	608.3	14.0%
EU-15 Total		**373**	**268**	**0.1548**	**4 341**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. summarise information by Member State on emissions for the key source SF_6 from 2F9 Other sources of SF_6. The emission trend is mainly driven by the emission trend in Germany.

Figure 4.15 **2F9 Other: EU-15 SF_6 emissions**

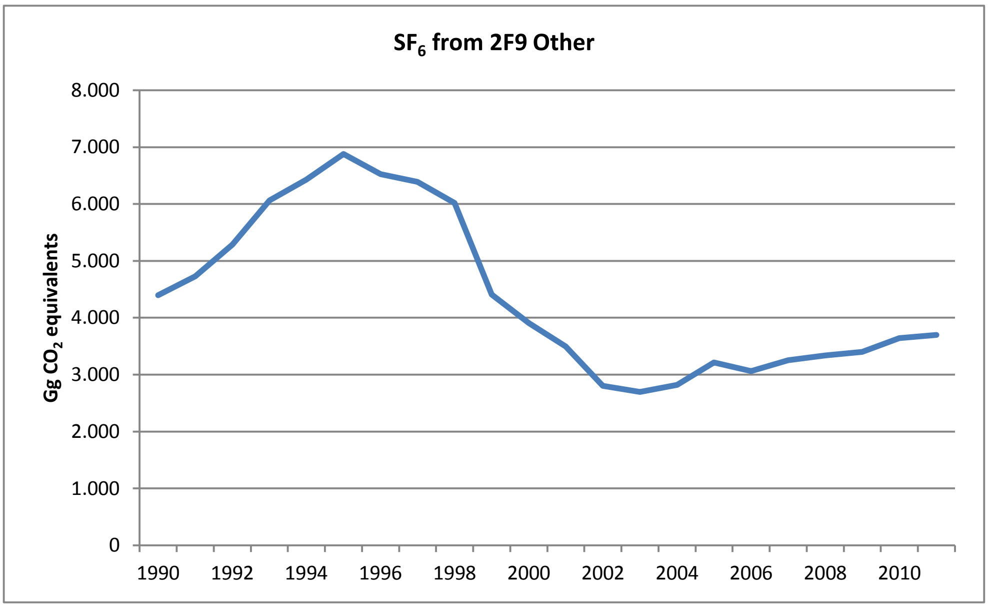


Table 4.69 **2F9 Other: Member States' contributions to SF_6 emissions**

Member State	SF_6 emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	127	253	250	6.8%	-3	-1%	123	98%
Belgium	84	90	97	2.6%	7	7%	13	16%
Denmark	12	24	59	1.6%	35	145%	47	394%
Finland	8	23	28	0.7%	5	20%	20	253%
France	118	NO	NO	-	-	-	-118	-
Germany	3 211	2 489	2 572	69.5%	83	3%	-639	-20%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	14	3	3	0.1%	0	1%	-10	-75%
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	1	6	7	0.2%	0	6%	6	1043%
Netherlands	218	184	147	4.0%	-37	-20%	-72	-33%
Portugal	NE	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	2	8	4	0.1%	-3	-43%	2	78%
United Kingdom	604	559	533	14.4%	-26	-5%	-71	-12%
EU-15	**4 397**	**3 640**	**3 700**	**100.0%**	**60**	**2%**	**-697**	**-16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Error! Reference source not found. provide descriptions on methods used for estimating SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.70 2F6-2F9 Consumption of halocarbons and SF_6: Description of national methods used for estimating SF_6 emissions

Member States	Description of methods
Austria	Semiconductors: All consumption data and data about actual emissions from semiconductor manufacture are based on direct information from industry. Emissions are calculated by the companies themselves from the annual consumption of each fluid by plant and the effectiveness of the respective abatement technologies (Tier 2a according to IPCC 2006). Electrical Equipment: Information on SF_6 stocks in electrical equipment from 2003 onwards was obtained from energy suppliers and industrial facilities (as mentioned above, there is a reporting obligation for operators of SF_6 filled equipment since 2004). Data 2000-2002: estimation based on an annual growth rate 2003-2007 of 16.9% for MV-GIS and 4,1% for HV-GIS. 2% was added to the reported stock to account for equipment used in industry that is not reported otherwise. For 1990-1999 the stock was calculated from consumption data of this sector.The EFop of HV- and MV-GIS correspond to the default emission factors of the IPCC GL 2006 with 0.7% (HV) and 0.1% (MV) per year, respectively. Manufacturing emissions from first filling were estimated to 1% according to reported data, the EFdisp is assumed to equal 2%. Noise insulating windows: Activity data were estimated based upon information from experts from industry. Approximately one-third of the total amount of SF_6 used for filling of the double glass windows is released during assembly. For the stock of gas remaining inside the window (bank), an annual leakage rate of 1 percent is assumed. At the end of the lifetime, about 75% of the initial stock remains and is lost by disposal. As of 2003, the Austrian F-gas regulation stopped by legal prohibition the usage of SF_6 as filling gas for soundproof glazing.. Emissions at disposal became relevant in 2005, because the average life time is estimated to be 25 years and the first SF_6 filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of SF_6 in windows produced in 1980 is emitted this year. Tyres: SF_6 used as filling gas for tyres was supplied by only one SF_6 importer, who reported on the amount of SF_6 sold to the Austrian tyre and automotive trade. Due to the Austrian F-gas regulation this use has been legally prohibited. According to IPCC GL 2006 it is assumed that SF_6 completely emits from car tyres with their disposal three years after filling. Filling emissions are regarded to be insignificant. Shoes: Operating emissions during the use of the footwear are not considered. The lifetime of sport shoes is estimated with 3 years. At the disposal of old shoes 100% of the initial filling is released to the atmosphere (i.e. EFdisp = 100%). Emissions of year 3 are treated to be equal to the amount of F-gas filled in sport shoes put on the market in the year n-3. Research: Manufacturers and operators provided the number of devices operating in Austria. Data on filling volume and refilling have been collected from the institutions and companies operating the equipment, from manufacturers and from service companies. The annual F-gas consumption (first filling of new products) normally is very small (order of kg) and reached only one year about 400 kg. The stock is for all years below 1 t. The implied EF is in the order of 6%, but there is a wide difference between the several types of equipment.The emissions from bank are equalized with the company reports for refilling of losses.
Belgium	The SF_6 emissions originating from the production and the stock of soundproof double-glazing are calculated from the SF_6 consumption data, which have been obtained from the main manufacturers. The stock of SF_6 contained in existing glazing in Belgium is evaluated on the basis of a balance between production, import and export of this glazing , as well as emissions from the stock, over the years. From information obtained from the double glazing producers we assessed a specific export rate for each of them. The import of acoustic double glazing was estimated to be around 10% of the Belgian consumption. The emission rate of glazing from the bank is assumed to be 1% /year, as previously. The emission from production of acoustic double glazing is assumed to be 33% of the SF_6 consumption. The disposal emissions are based on an assumed unique lifetime of 25 years. SF_6 emissons from the electricity sector are based on stock and emission factor data obtained from the SYNERGRID association. Manufacturing emissions have been estimated for SF_6 of Electrical Equipment, using an emission factor of 1%. For the semiconductor industry, the emission figures are those directly obtained from the relevant companies of the sector. Category 2F9 “Other non-specified” corresponds to small laboratory uses of C6F14, for which it has been assumed that emissions equal consumption.
Denmark	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Finland	Electrical equipment (CRF 2.F. 8) Tier 3c (country-level mass-balance), Tier 1b Tier 1a estimates can not be calculated for this source because of lack of historical data. Tier 1b estimates have been calculated, however, based on survey and emissions data, cf. section 3.1 of Oinonen (2003). Running shoes (CRF 2.F. 9) Method for adiabatic property applications, Tier 1b Tier 1a is not applicable to this category because all SF_6 used is imported not in bulk, but in products (i.e. shoes). Emissions from this source are not reported separately due to confidentiality. The emissions from running shoes ended in 2007.
France	IPCC Tier 2. Fabrication de semi-conducteurs (2F7) : Les émissions de PFC, HFC-23 et SF_6 sont calculées selon la méthode de rang 2c du GIEC à partir des consommations de gaz déclarées par les sites. Equipements électriques (2F8) : La méthode de calcul distingue les émissions à la charge des équipements à

Member States	Description of methods
	l'usine selon les quantités déclarées par les industriels à leur syndicat et les émissions du parc installé estimées par EDF qui distingue les fuites à l'usage, la maintenance et la fin de vie.
Germany	Semiconductor manufacture: The emissions cannot be determined solely on the basis of input quantities (sales by gas vendors), because the difference between consumption and emissions depends on a number of factors, including only partial chemical transformation in plasma reactors and the effects of downstream exhaust-gas-scrubbing systems. Furthermore, a residue of approximately 10 % per gas bottle must be taken into account as non-consumption. During the etching process, only about 15 % of the added CF4 react chemically. The emission factor, an inverse reaction quota, thus amounts to 85 % of the CF4 consumption. Electrical equipment: The emissions figures are based largely on a mass balance. Increasingly, they are also being combined with emission factors for sub-areas in which the technical measurement limits for mass-balancing have been reached or in which mass-balancing would necessitate unreasonably high costs. The methods used are based on the new "2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 3", Chapter 8. For further information, the reader is referred to "Tier 3, Hybrid Life-Cycle Approach" in sub-chapter 8.2. Noise insulating windows: The EF production is 33 %, with respect to new annual consumption. The emission factor Euse of 1 % with respect to the average SF_6 stocks that have accumulated since 1975 and that are in place in year n. Disposal losses are incurred at the end of windows' service lifetimes (utilization periods), or an average of 25 years after being filled. Tyres and Shoes: The emissions are calculated using equation 3.23 of IPCC-GPG (2000).
Greece	Electrical equipment The available information is not sufficient in order to apply the methodologies suggested by the IPCC Good Practice Guidance. In the context of the present inventory emissions are estimated on the basis of information provided by PPC regarding losses in the transmission and in the distribution system. The data provided cover the period 1995 – 2008. Emissions estimates are being performed on the basis of the quantity of SF_6 consumed during the year, by the Directorate of Strategy and Planning of the PPC. Emissions for the period 1990 – 1994 are estimated (by the inventory team) by mean of a linear extrapolation.
Ireland	Semiconductor manufacture 2F7: There are two main semiconductor manufacturers in Ireland, both of which provide data on the annual use and estimated emissions of HFCs, PFCs and SF_6 in their plants over the full time series 1990-2008. SF_6 emissions from Semiconductor Manufacture have been revised for 2009 as a result of revised data supplied to the inventory agency by one of the installations in the this sector Electrical equipment: The Electricity Supply Board (ESB) is the owner of both the high and low voltage distribution systems and the owner and operator of the medium and lower voltage distribution systems in Ireland. The company has supplied an estimate of SF_6 emissions from their equipment using a Tier 1 approach based on an analysis of opening and closing stocks of SF_6. Other Emission Sources (2.F.9): This category includes emissions of SF_6 from minor uses within Ireland including emissions from double glazed windows, medical applications, sporting goods and as a gas-air tracer in leak detection. Double glazed windows were first introduced in Ireland in 1978, thus there is a bank of SF_6 in windows manufactured and installed prior to 1990 which will contribute to the emissions from leakage in the period 1990-2011. Emissions of SF_6 from Sporting Goods (2F7) have been revised for 1998-2009 as a result of revised estimates submitted by the UK to the UNFCCC.
Italy	SF_6 emissions from electrical equipment have been estimated according to the IPCC Tier 2a approach from 1990 to 1994, and IPCC Tier 3c from 1995. SF_6 leaks from installed equipment have been estimated on the basis of the total amount of sulphur hexafluoride accumulated and average leakage rates; leakage data published in environmental reports have also been used for major electricity producers (ANIE, several years). Additional data on SF_6 used in high voltage gas insulated transmission lines have been supplied by the main energy distribution companies.
Luxembourg*	F7 – Electrical Equipment - A country specific methodology is applied: Emissions= EF● AR The activity rate (AR) is based on the installed capacity with the total nameplate capacity from the largest operator (CREOS) in Luxembourg (80% coverage). The yearly emissions are assumed to vary between 0.1 and 0.9% depending on the type of switchgear according to the EF's applied in Germany.
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Portugal	SF_6 emissions from electrical equipment: different estimates methodologies for electricity distribution at: (a) Very High Voltage (>110 kV): a methodology based on "Correspondent States Principle" was used (b) distribution at Low (≤1 kV), Medium (>1 kV and ≤45 kV) and High Voltage (>45 kV and ≤110 kV): estimated with a tier T3b, based on data provided by "EDP Distribuição", excluding the details in life-cycle and using a country-specific emission factor. Separate estimates were made for Gas Circuit Breakers; Outdoor Gas Insulated Switchgears; Gas Insulated Switchgears; High and Medium Voltage Sectioning Posts;
Spain	Tier 2. Category 2F8 includes the SF_6 emissions from electrical equipment. In the case of Spain, this is the only source generating emissions of this gas. De una forma general, las emisiones se pueden generar en cada uno de los siguientes puntos del ciclo de vida de los equipos eléctricos que incorporan SF_6 como aislante: 1) En la fase de fabricación del equipo (lo que incluye las operaciones de prueba y la carga de los equipos). 2) Durante la instalación en el lugar de funcionamiento del equipo. 3) Durante la fase de funcionamiento del equipo. 4) En la retirada de funcionamiento del equipo. Estos cuatro puntos o fases del ciclo vida que dan origen a las emisiones se corresponden con los respectivos cuatro términos que figuran en el segundo miembro de la ecuación siguiente, y que es la trascripción de la

Member States	Description of methods
	Ecuación 3.16 de la Guía de Buenas Prácticas de IPCC correspondiente al método de nivel 2a, que es el que se ha adoptado para la estimación de las emisiones de esta actividad: ET = EF + EI + EO + ERdonde: ET = Emisiones totales; EF = Emisiones en fabricación; EI = Emisiones en instalación; EO = Emisiones en operación de los equipos; ER = Emisiones en la retirada de los equipos
Sweden	Semiconductor manufacture: Information concerning the annually used amounts of various fluorinated substances has been provided by the company, and as far as possible been compared to information from the Products register at the Swedish Chemicals Agency. Emissions are calculated by using the IPCC Good practice Guidance Tier 1 method. Electrical equipment: SF_6 emissions from electrical equipment have been estimated according to the IPCC Tier 2a approach from 1990 to 1994 because facility level specific data are not available, IPCC Tier 3c has been used since 1995 (for both medium and high voltage electrical equipment). The SF_6 emissions from production have decreased in later years due to measures taken at the production facility. These estimates, obtained from industry, are of medium to high quality, with better quality in later years. For the early 1990s, assumptions on the emitted amounts of SF_6 from GIS manufacture were made in cooperation with industry. Industry has also provided information concerning the used amount of SF_6 for GIS manufacture, as well as the share of products that are exported from the country, which exceeds 90 % of the production. Emissions from installed amounts of SF_6 for insulation purposes in operating systems have previously contributed less to the actual annual emissions. In 2001- 2002, a questionnaire was sent out to power companies from the trade association Swedenergy102 (Svensk Energi) asking for the installed amounts of SF_6 in operating equipment, and the replaced amounts of SF_6 during service. The results showed an installed accumulated amount of approximately 80 Mg and an annual leakage rate of 0.6 % (equals the amount replaced from the questionnaire) and these were used as input data in the inventory. For later years, data on replaced amounts of SF_6 in operating systems results in a calculated annual leakage rate of 0.5 % (Swedenergy and power distribution companies). For jogging shoes, a more or less rough estimate has been made. It has not been possible to obtain any national data, so a Norwegian estimate was scaled to the Swedish population. According to the results from a study performed in early 2004 a phasing out of SF_6 and replacement with PFC-218 was started in 2003. Manufacturers of windows have provided data on the amount of SF_6 used in the manufacture of barrier gas windows. The manufacturers have also provided estimates of the share of SF_6 emitted in production. These estimates vary considerably between manufacturers, from 5-50%. Calculating a weighted average of the emission factor at production results in a national figure in the order of 30%, which is in line with the point estimate of 33% given in the IPCC Good Practice Guidance.
United Kingdom	Emissions of SF_6 from semiconductor manufacturing and from electrical equipment are combined with emissions from training shoes in source category 2F8b for reasons of commercial confidentiality. SF_6 emission from electrical transmission and distribution were based on industry data from BEAMA (for equipment manufacturers) and the Electricity Association (for electricity transmission and distribution), who provided emission estimates based on Tier 3b, but only for recent years. Tier 3a estimates were available for the electricity distribution and transmission industry for 1995. In order to estimate a historical time series and projections, these emission estimates together with fluid bank estimates provided by the utilities were extrapolated using the March study methodology (March, 1999).This involved estimating leakage factors based on the collected data and using the March model to estimate the time series. Emissions prior to 1995 used the March SF_6 consumption data to extrapolate backwards to 1990 from the 1995 estimates. Emissions of PFC and SF_6 emissions from electronics are based on data supplied by UK MEAC – the UK Microelectronics Environmental Advisory Committee.UK MEAC gave total PFC consumption for the UK electronics sector based on purchases of PFCs as reported by individual companies. Emissions were then calculated using the IPCC Tier 1 methodology, which subtracts the amount of gas left in the shipping container (10%), the amount converted to other products (between 20% and 80% depending on the gas) and the amount removed by abatement (currently assumed to be zero).Emissions for previous years were extrapolated backwards assuming an annual 15% growth in the production of semiconductors in the UK up until 1999.

*Source: NIR 2013 unless stated otherwise, *source: NIR 2012*

Error! Reference source not found. summarizes the recommendations from the latest UNFCCC reviews of the inventory report in relation to the category 2F Consumption of Halocarbons. The overview shows that some recommendations have been implemented. For several Member States the review report 2012 had not been available at the time of the compilation of this NIR.

Table 4.71 2F Consumption of halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2012 inventory submissions

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2013 submission**
Austria	Use the notation key included elsewhere (“IE”) to indicate that the emissions from manufacture and disposal are included under the emissions “from stocks”	Resolved: in CRF Tables

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2013 submission
Belgium	No 2012 review report available at the time of the compilation of this NIR	Follow up necessary
	ARR 2011: However, the ERT noted that some emissions are still reported as "NE", such as HFC emissions from the disposal of commercial refrigeration equipment and some categories for which there are no default methods and/or EFs provided in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the Revised 1996 IPCC Guidelines) and/or the IPCC good practice guidance. Potential SF_6 emissions from electrical equipment and double-glazed windows are reported as "NE" and "NO", although the actual emissions are reported.	Not resolved: As for HFC emissions from the disposal of comm. Refrigeration and equipment the notation key in the actual CRF (Tab2(II)FS1 is reported "NO". As for the potential emissions from el. Equipment (still "NE") and double glazed windows (still "NO") (Tab 2(I)s2 no changes have been made in the actual CRF
	ARR 2011: The ERT commends Belgium for the improvement with regard to the HFC-134a emissions from the disposal of domestic refrigeration equipment. Belgium explained that the disposal of refrigeration and air-conditioning equipment has not yet occurred, assuming a 15-year lifespan of the equipment. The ERT recommends that Belgium include this information in the NIR of the next annual submission and revise the notation key used in CRF table 2(II) accordingly.	Resolved BE NIR 2013, p.123 For refrigeration "installations" (commercial and industrial refrigeration and stationary air conditioning), the emission rate has been revised for the period since 1997 (a constant reduction percentage, instead of linear decrease, now being considered for the yearly loss rate from the refrigerant bank).
	Estimates of SF_6 emissions from electrical equipment: The ERT recommends that the Party justify, in the next annual submission, the applicability of the EFs to the whole time series and make appropriate updates in order to maintain time-series consistency, supported by appropriate documentation in the NIR.	NIR 2013: Manufacturing emissions have now also been estimated for SF_6 of Electrical Equipment, using an emission factor of 1%.
Denmark	No 2012 review report available at the time of the compilation of this NIR	Follow up necessary
	ARR 2011: The ERT concluded that Denmark has provided complete estimates for these disposal emissions. However, the ERT recommends that Denmark be more transparent and provide the rationale for this determination in the NIR of its next annual submission.	Partly resolved, on going work
	The Party also observed some inconsistencies earlier in the time series that it intends on investigating further and, as appropriate, correcting in its next annual submission. The ERT welcomes the improvements in the estimates for the later years of the time series and recommends that the Party recalculate the time series for the next annual submission, if additional errors are identified through the intended QC process.	Corrections have been made for activity data for consumption of HFCs for hard foam. Chapter 4.7.3
	Previous review reports have provided recommendations on cross-cutting issues related to this category, in particular related to improving QA/QC and transparency in the NIR.14 The ERT reiterates these recommendations: with respect to QA/QC, the ERT continues to recommend that Denmark develop QA/QC procedures for the F-gas emission calculations; while, regarding transparency, the ERT reiterates previous recommendations that the Party improve the documentation of methods and assumptions for the F-gas model in the NIR, recognizing that not all model documentation needs to be included for transparency.	The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going. Chapter 4.7.2, 4.7.3, 4.7.4 and 4.7.5
Finland	No 2012 review report available at the time of the compilation of this NIR	Follow – up required
	The ERT recommends that the improvement of the time-series consistency for SF_6 emissions from electrical equipment be implemented, as planned	

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2013 submission**
	by Finland for its 2013 annual submission	Resolved (recalculations) in NIR 2013
France	No 2012 review report available at the time of the compilation of this NIR	Follow up required
	ARR 2011: As the NIR does not provide an explanation for the recalculations performed in the subcategories electrical equipment and other (open application), the ERT recommends that France include clear explanations for all recalculations in NIR of its next annual submission.	Partly resolved ajout d'émissions provenant de EDF (2F8)
	The ERT reiterates the recommendation in the previous review report that France improve the transparency of the NIR by providing more recent information on the model used, including information on the assumptions used, data collection, QA/QC checks, model validation, and peer reviews in its next annual submission.	Partly resolved - ajout des émissions des quantités perdues lors de la récupération des quantités restantes dans les bouteilles de fluides (2F1) - utilisation des résultats de l'étude EReIE. Ajout du HFC-245fa (dans HFC-mix) (2F2) - nouvelle méthodologie de calcul des émissions d'aérosols techniques et nouvelles données de ventes pour les aérosols pharmaceutiques (2F4)
Germany	No 2012 review report available at the time of the compilation of this NIR.	Follow up required
	ARR 2011: The ERT recommends that Germany improve the documentation in the NIR of the trilateral review and its results with respect to the German fluorinated gases (F-gases) inventory in its next annual submission.	
Greece	No 2012 review report available at the time of the compilation of this NIR.	Follow up required
	ARR 2011: The ERT notes that the information on HFC emissions from imported foams is not reflected in the NIR and recommends that Greece include a transparent explanation on the assumptions, methodologies, AD and EFs used to estimate HFC emissions from foam blowing in the next annual submission. The ERT also notes that the import of foams containing HFCs can be covered not only by companies producing foams and recommends that the Party further investigate the import of HFC-containing foam products in Greece for the next annual submission.	Partly resolved – both issues are addressed in the NIR 2013 (p.200)
Ireland	No 2012 review report available at the time of the compilation of this NIR	Follow up required
	ARR 2011: In addition, the Party is also recommended to correct some uses of notation keys, such as the substitution of "NO" to "IE" for aerosols disposal emissions and the insertion of "IE" in industrial refrigeration for the identified HFCs, in order to bring consistency to the NIR and CRF tables	Irelands response: cannot find the inconsistency of IE and NO but have altered Table 4.1 to be consistent with CRF Table2(I)s
	As raised in previous review reports, the ERT noted that Ireland is still not presenting transparent information on the time series of AD and EFs for each category separately […]The ERT considers that the approach adopted by Ireland impairs transparency, and reiterates the recommendation in the previous review report of increasing the level of disaggregation of the above-mentioned issues in its future annual submissions by providing additional information for the following categories: aerosols and metered dose inhalers.	EFs have been presented in fully disaggregated form in the 2013 NIR

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2013 submission
	The ERT also recommends that the Party fill the CRF tables with the percentage of manufacture, in life and disposal factors regarding F-gases consumption categories, instead of the proportions currently reported.	Follow up required
	The ERT also noted that the recommendation in the previous review report for the provision of more information on the share of new vehicles was not addressed in the 2011 annual submission. The ERT reiterates this recommendation for the future annual submissions. In addition, the ERT reiterates the recommendation in the previous review report for the correction of mobile air-conditioning IEFs for product manufacturing, lifetime and disposal losses in the future annual submission.	Follow up required
	Ireland reports emissions of HFC-23 and HFC-227ea from fire extinguishers in the 2011 submission. However, the ERT notes that only sectoral background data is provided for HFC 227ea in CRF table 2(II).F. The ERT reiterates the recommendation from the previous review that Ireland provides background data on HFC-23 from fire extinguishers in the future annual submissions	Follow up required
Italy	No 2012 review report available at the time of the compilation of this NIR.	Follow up required
	ARR 2011: The ERT recommends that Italy enhance the transparency of its reporting by explaining the reasons for the changes in the methodology used throughout the time series in its next annual submission.	Not resolved
Luxembourg	No 2012 review report available at the time of the compilation of this NIR.	Follow up necessary for all issues as the NIR 2013 had not been submitted at the time of compilation of this report
	ARR 2011: The ERT recommends that Luxembourg provide a more detailed explanation in the NIR on the AD, EFs, methodologies and assumptions applied to the category consumption of halocarbons and SF_6, in order to increase the transparency of its reporting. Luxembourg did not fill in any notation keys or numeric values in the background tables for F-gases (e.g.CRF sectoral background table 2(II).F) for all reporting years. The transparency and completeness of the CRF tables could be improved by providing completed background tables for emissions of F-gases.	
	75.Luxembourg has reported actual HFC and SF_6 emissions based on the new study on the estimation of HFCs, PFCs and SF_6 (Econotec, 2010). The ERT concluded that Luxembourg's estimation level was appropriate. The ERT commends the Party for conducting the new study and applying the results of the study to the estimation of HFC and SF_6 emissions.	
	76 The ERT recommends that Luxembourg provide a description of the trend in the NIR and maintain the time-series consistency of these categories in accordance with the IPCC good practice guidance.	
	77The ERT reiterates the recommendation from the previous review report that Luxembourg make efforts to collect and use country-specific data in the calculation of HFC emissions for the entire time series.	
	78. The ERT noted that Luxembourg has information that tracks the flow and amount of HFC, PFC and SF_6 emissions (in bulk and equipment). The ERT recommends that Luxembourg provide this information in the NIR and in the relevant CRF tables in its next annual submission.	
Netherlands	No 2012 review report available at the time of the compilation of this NIR.	Follow up necessary

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2013 submission
	The ERT recommends that the Netherlands calculate potential emissions of all ODS substitutes according to the tier 1 method contained in the IPCC good practice guidance. This calculation method will contribute to the completeness of the inventory and to the transparency and comparability of the emissions.	Not resolved
	The ERT recommends that the Netherlands report the SF_6 emissions under semiconductor manufacture instead of under the sub-category other for transparency reasons.	resolved
Portugal	No 2012 review report available at the time of the compilation of this NIR. ARR 2011: The ERT recommends that Portugal assess the completeness of its reporting of actual HFC emissions for consumption of halocarbons and SF_6 and either provide estimates or justify why the emissions do not occur in its next annual submission. CRF table summary 3 does not include information on methods and emission factors (EFs) used for the estimation of HFC, PFC and SF_6 emissions from the consumption of halocarbons and SF_6. The ERT recommends that Portugal provide this information in its next annual submissions.	Follow up necessary for all issues
Spain	No 2012 review report available at the time of the compilation of this NIR. ARR 2011: The ERT recommends that the Party describe the assumptions that it used to prepare the estimates in the NIR of its next annual submission.	Follow up necessary for all issues
Sweden	No 2012 review report available at the time of the compilation of this NIR.	Follow up necessary
	ARR 2011: Sweden indicated that it has not been able to estimate the amount of F-gas emissions from solvents but that this is expected to be minor. The ERT recommends that Sweden, in its next annual submission, estimate these emissions, explain any recalculations and improve the consistency between the NIR and the CRF tables.	Not resolved (NIR 2013 p.219)
UK	No 2012 review report available at the time of the compilation of this NIR.	Follow up necessary
	The ERT recommends that the United Kingdom provide the necessary information of the model in the NIR of its next submission to ensure transparency of the emission estimates.	On going

Sources: Review Reports 2011and 2012 unless stated otherwise; NIR 2013 unless stated otherwise

4.2.6 Other (CRF Source Category 2G) (EU-15)

Error! Reference source not found. shows that only four Member States report GHG emissions under 2G Other for the year 2011. The Netherlands include CO_2, CH_4 and N_2O emissions from fireworks and candles, degassing drinking water from groundwater and process emissions in other economic sectors; Germany reports due to confidentiality reasons aggregated HFC emissions from shoes, AWACS maintenance and welding; Denmark include CO_2 emissions from lubricants in this category and Italy does not specify the origin of the HFC emissions.

Table 4.72 2G Other: Overview of sources reported under this source category for 2011

Member State	2.G Other	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Belgium	NA,NE	NA	NA	NA	NA	NA	NA	-	0.0%
Denmark	Lubricants	33.2	NA	NA	NA	NA	NA	33.2	6.0%
Finland	NA	NA	NA	NA	NA	NA	NA	-	0.0%
France	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Germany	Other non-specified Confidential SF6-emissions of the use in AWACs, Sport shoes and for Welding are reported in "Unspecified mix of HFCs" to keep confidentiality of these data.	NO	NO	NO	165.3	IE,NA,NO	IE	165	29.8%
Greece	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Ireland	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Italy	NA	NA	NA	NA	3.9	NO	NO	3.9	0.7%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Netherlands	Fireworks and candles, Degassing drinkwater from groundwater, Process emissions in other economic sectors	305.9	1.7	0.04	NA,NO	NA,NO	NO	353	63.5%
Portugal	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Sweden	NA	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
UK	NA	NA	NA	NA	NA	NA	NA	-	0.0%
EU-15 Total		**339**	**2**	**0**	**169**	**0**	**-**	**555**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.73 shows the total EU-15 uncertainty estimates for the sector 'Industrial processes' and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for PFC from 2F (96 %) and the lowest for N_2O from 2F (0 %). With regard to trend PFC from 2F shows the highest uncertainty estimates, CO_2, CH_4, and N_2O from 2E and CO_2 from 2F and CO_2, and N_2O from 2A the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.73 **Sector 2 Industrial processes: Uncertainty estimates for the EU-15**

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A Mineral Products	CO_2	109 702	87 394	-20%	3%	0.0%
2.A Mineral Products	CH_4	29	22	-25%	59%	0.7%
2.A Mineral Products	N_2O	0	0		0%	0.0%
2.B Chemical Industry	CO_2	30 944	31 392	1%	10%	0.0%
2.B Chemical Industry	CH_4	186	94	-50%	25%	0.1%
2.B Chemical Industry	N_2O	99 006	8 747	-91%	7%	0.2%
2.C Metal Production	CO_2	51 973	40 079	-23%	5%	0.0%
2.C Metal Production	CH_4	26	46	76%	21%	0.2%
2.C Metal Production	N_2O	39	22	-44%	69%	0.3%
2.C Metal Production	HFC	0	0		0%	
2.C Metal Production	PFC	6 716	465	-93%	16%	0.1%
2.C Metal Production	SF_6	474	88	-81%	29%	0.1%
2.D Other Production	CO_2	5	2	-54%	15%	0.1%
2.D Other Production	CH_4	5	6	22%	21%	0.0%
2.D Other Production	N_2O	66	81	22%	21%	0.0%
2.E Production of Halocarbons and SF_6	HFC	11 695	259	-98%	12%	0.1%
2.E Production of Halocarbons and SF_6	PFC	2 567	1 437	-44%	12%	0.1%
2.E Production of Halocarbons and SF_6	SF_6	1 846	102	-94%	10%	0.2%
2.F Consumption of Halocarbons and SF_6	HFC	3 024	54 947	1717%	40%	3.5%
2.F Consumption of Halocarbons and SF_6	PFC	266	1 227	361%	96%	4.3%
2.F Consumption of Halocarbons and SF_6	SF_6	7 931	4 345	-45%	7%	0.0%
2.G Other	CO_2	354	358	1%	19%	0.0%
2.G Other	CH_4	297	281	-5%	51%	0.0%
2.G Other	N_2O	3	11	273%	71%	1.9%
Total - 2	all	347 030	250 674	-28%	9.0%	7.0%

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories

4.4 Sector-specific quality assurance and quality control (EU-15)

There are two main activities for improving the quality of GHG emissions from industrial processes: (1) Before and during the compilation of the EU GHG inventory several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency. (2) In the second half of the year the EU internal review is carried out for selected source categories. In 2006 the following source categories have been reviewed by Member States experts: 2A Mineral Products, 2B Chemical Industry, 2C Iron and Steel Production and Fluorinated Gases, 2E Production of Halocarbons and SF_6 and 2F Consumption of Halocarbons and SF_6. In 2008, completeness and allocation issues have been reviewed by Member States experts for all source categories in Industrial Processes. In 2012 a comprehensive review was carried out for all sectors and all EU Member States in order to fix the base year 2020 under the EU Effort Sharing Decision. (ESD review 2012).

For the inventory 2005 for the first time plant-specific data was available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2). During the ESD review 2012 consistency checks were carried out between EU ETS data and the inventory estimates.

4.5 Sector-specific recalculations (EU-15)

Table 4.74shows that in the industrial processes sector the largest recalculations in absolute terms were made for CH_4 and HFCs in 1990 and 2010.

Table 4.74 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2010 by gas (Gg CO_2 equivalents) and percentage)

1990	**CO_2**		**CH_4**		**N_2O**		**HFCs**		**PFCs**		**SF_6**	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	33 412	1.0%	1 062	0.2%	329	0.1%	3	0.0%	0	0.0%	20	0.2%
Industrial Processes	-35	0.0%	10	1.3%	-1	0.0%	3	0.0%	0	0.0%	20	0.2%
2010												
Total emissions and removals	15 626	0.5%	-8 309	-2.7%	-2 845	-1.1%	67 953	-5.2%	-28	-0.9%	114	1.9%
Industrial Processes	-278	-0.2%	36	5.5%	0	0.0%	-3 808	-5.2%	-28	-0.9%	114	1.9%

Table 4.75 provides an overview of Member States' contributions to EU-15 recalculations.

Table 4.75 Sector 2 Industrial processes: Contribution of Member States to EU-15 recalculations for 1990 and 2010 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2010					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	-4	0	-1	1	0	0	125	-6	6
Belgium	-15	0	0	NA,NO	0	0	-1 381	0	0	134	1	6
Denmark	0	0	0	NA,NO	NA,NO	0	-4	0	0	4	0	0
Finland	10	0	0	0	0	21	3	0	0	0	0	4
France	-109	0	-1	6	0	0	1 629	0	0	-1 784	0	100
Germany	-309	0	0	0	0	0	-1 179	0	-1	-2 634	-23	-55
Greece	-28	0	0	0	0	0	0	0	0	-46	0	0
Ireland	0	0	0	0	0	0	0	0	0	-4	0	0
Italy	0	0	0	0	0	0	-122	0	0	-11	0	0
Luxembourg	0	0	0	0	NA,NO	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0	0	0	-23	0	0
Portugal	160	10	0	NE,NO	NE	0	-38	26	1	283	0	36
Spain	10	0	0	0	0	0	87	0	0	150	0	18
Sweden	0	0	0	0	0	0	-25	0	0	-4	0	-1
UK	247	0	0	0	0	0	752	10	0	2	0	0
EU-15	**-35**	**10**	**-1**	**3**	**0**	**20**	**-278**	**36**	**0**	**-3 808**	**-28**	**114**

5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

This chapter provides sections on emission trends, methods and on recalculations in CRF Sector 3 Solvent and Other Product Use. In response to the UNFCCC review findings this report for the second time includes more detailed descriptions of methods used by Member States.

The IPCC 2006 Guidelines summarize the most important background information on solvents and other product use as follows: “The use of solvents manufactured using fossil fuels as feedstocks can lead to evaporative emissions of various non-methane volatile organic compounds (NMVOC), which are subsequently further oxidised in the atmosphere. Fossil fuels used as solvent are notably white spirit and kerosene (paraffin oil). White spirit is used as an extraction solvent, as a cleaning solvent, as a degreasing solvent and as a solvent in aerosols, paints, wood preservatives, lacquers, varnishes and asphalt products. In Western Europe about 60 percent of the total white spirit consumption is used in paints, lacquers and varnishes. White spirit is the most widely used solvent in the paint industry.” (IPCC, 2006).

A comprehensive methodology for estimating NMVOC emission for all sources is provided neither in the IPCC guidelines nor in the EMEP/EEA Air pollutant emission inventory guidebook 2009. The current methodology for estimating NMVOC from solvents lacks comparability between countries transparency and uncertainty quantification.[29]

The EMEP/EEA Air pollutant emission inventory guidebook 2009 is structured according to the Nomenclature for Reporting (NFR), which is the reporting format of the Guidelines for Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (LRTAP). This nomenclature closely resembles the IPCC source nomenclature developed for reporting under the UN Framework Climate Change Convention. Cross-referencing to the Selected Nomenclature for reporting of Air Pollutants (SNAP) 97 developed by the EEA's European Topic Centre (ETC/AE) is presented in the following overview (Table 5.1). (EMEP/EEA, 2009)

Table 5.1 Cross-referencing to the Selected Nomenclature for reporting of Air Pollutants (SNAP) 97 developed by the EEA's European Topic Centre (ETC/AE)

CRF	SNAP	Description	CRF	SNAP	Description
3 A	0601	Paint application	3 B	0602	Degreasing, dry cleaning and electronics
	060101	Paint application: manufacture of automobiles		060201	Metal degreasing
	060102	Paint application: car repairing		060202	Dry cleaning
	060103	Paint application: construction and buildings		060203	Electronic components manufacturing
	060104	Paint application: domestic use (except 060107)		060204	Other industrial cleaning
	060105	Paint application: coil coating	3 D	0604	Other use of solvents and related activities
	060106	Paint application: boat building		060401	Glass wool enduction
	060107	Paint application: wood		060402	Mineral wool enduction

29 See http://www.tfeip-secretariat.org/assets/Meetings/Documents/CI-Feb-2010-Meeting-Documents/MeetingReportCIWorkshop17Feb2010final.pdf

CRF	SNAP	Description	CRF	SNAP	Description
	060108	Other industrial paint application		060403	Printing industry
	060109	Other non industrial paint application		060404	Fat, edible and non edible oil extraction
3 C	0603	Chemical products manufacturing or processing		060405	Application of glues and adhesives
	060301	Polyester processing		060406	Preservation of wood
	060302	Polyvinylchloride processing		060407	Underseal treatment and conservation of vehicles
	060303	Polyurethane processing		060408	Domestic solvent use (other than paint applicat.)
	060304	Polystyrene foam processing		060409	Vehicles dewaxing
	060305	Rubber processing		060411	Domestic use of pharmaceutical products
	060306	Pharmaceutical products manufacturing		060412	Other (preservation of seeds,...)
	060307	Paints manufacturing		0605	Use of HFC, N_2O, NH_3, PFC and SF_6
	060308	Inks manufacturing		060501	Anaesthesia
	060309	Glues manufacturing		060505	Fire extinguishers
	060310	Asphalt blowing		060506	Aerosol cans
	060311	Adhesive, magnetic tapes, films &photographs		060508	Other
	060312	Textile finishing	NOT included in this sector		
	060313	Leather tanning	2 F 1	060502	Refrigeration and air conditioning equipments
	060314	Other	2 G	060503	Refrigeration and air conditioning equipments using other products than halocarbons
			2 F 2	060504	Foam blowing (except 060304)
			2 F 6	060507	Electrical equipments (except 060203)

5.1 Overview of sector (EU-15)

CRF Sector 3 Solvent and Other Product Use contributes 0.22 % to the total EU-15 GHG emissions in 2011 (Table 5.5). The EU-15 Member states jointly achieved an emissions reduction of about 40 % from 13.21 Tg in 1990 to 7.97 Tg in 2011 (Figure 5.1 and Table 5.2).

This emission reduction was achieved by

- Germany (2 683 Gg CO_2eq; -59 %);
- France (948 Gg CO_2eq; -46 %);
- The Netherlands (387 Gg CO_2eq; -71 %);
- Italy (798 Gg CO_2eq; -33 %);
- Austria, Belgium Finland, Sweden, Luxembourg, Ireland and Portugal (together 421 Gg CO_2eq; -25 %)

The GHG emission of the Member States Denmark and Greece increased slightly (together 59 Gg CO_2eq; 14 %) in the same period (Table 5.2 and Figure 5.2).

Figure 5.1 **Sector 3 Solvent and Other Product Use: EU-15 GHG emissions for 1990–2011 in CO_2 equivalents (Tg)**

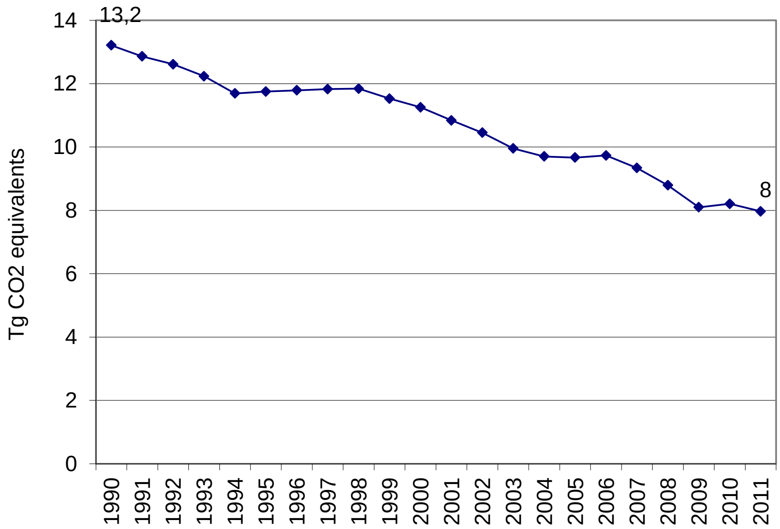
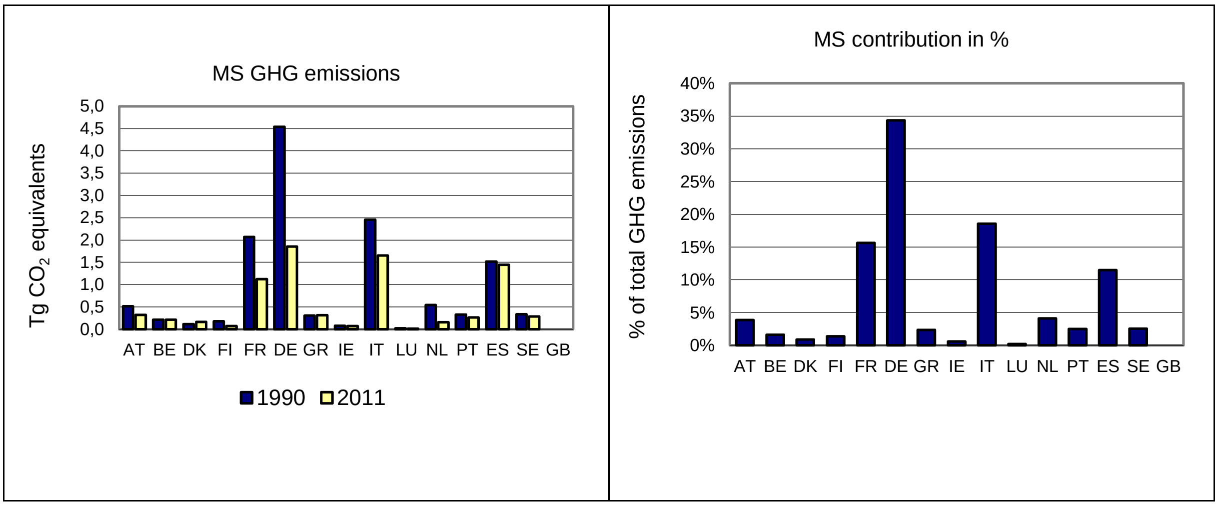


Figure 5.2 **Sector 3 Solvent and Other Product Use: GHG emissions of EU-15 MS for 1990 and 2011 as well as Member States' contributions to GHG emissions for 2011 in percentage**



In 2011, the emissions decreased by 3 % compared to 2010 (Table 5.2). In this period the highest emission reduction in absolute terms was achieved by Spain (-144 Gg CO_2eq; -9 %), Germany (-89 Gg CO_2eq; -5 %) and Netherlands (-27 Gg CO_2eq; -15 %). Notable emission increases between 2010 and 2011 occurred in the Member States Portugal (41 Gg CO_2eq; +18%) and France (26 Gg CO_2eq; +2 %).

The Member States France, Germany, Italy and Spain are jointly responsible for 76 % of the total EU-15 GHG emissions in this sector in 2011 (Table 5.2). The United Kingdom does not estimate emissions from this sector, as there is no clear guidance provided in the 1996 Guidelines on estimating CO_2 from NMVOC. N_2O emissions are believed to be negligible (GB NIR, 2013).

Table 5.2 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emissions

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	512	327	324	4.1%	-3	-1%	-188	-37%
Belgium	213	211	211	2.6%	0	0%	-2	-1%
Denmark	116	187	167	2.1%	-21	-11%	51	44%
Finland	178	74	70	0.9%	-4	-5%	-109	-61%
France	2 068	1 094	1 120	14.1%	26	2%	-948	-46%
Germany	4 539	1 944	1 856	23.3%	-89	-5%	-2 683	-59%
Greece	308	316	316	4.0%	0	0%	8	3%
Ireland	80	72	72	0.9%	1	1%	-8	-9%
Italy	2 455	1 677	1 656	20.8%	-20	-1%	-798	-33%
Luxembourg	24	14	16	0.2%	1	10%	-8	-34%
Netherlands	541	181	154	1.9%	-27	-15%	-387	-71%
Portugal	330	226	267	3.3%	41	18%	-63	-19%
Spain	1 516	1 593	1 449	18.2%	-144	-9%	-67	-4%
Sweden	332	289	289	3.6%	0	0%	-44	-13%
United Kingdom	0	0	0	0.0%	0	-	0	-
EU-15	**13 212**	**8 205**	**7 969**	**100.0%**	**-237**	**-2.9%**	**-5 244**	**-40%**

In the Sector 3 Solvent and Other Product Use in addition to CO_2 emission NMVOC and N_2O emission are identified. The most important GHG from Solvent and Other Product Use is CO_2. In 2011 the CO_2 emissions had a share of 0.19 % of the 'Total EU-15 CO_2 Emissions and Removals' and a share of 0.15 % of the 'Total EU-15 GHG emissions' (Table 5.3). In 2011 the N_2O emissions had a share of 0.91 % of the 'Total EU-15 N_2O emissions' and a share of 0.07 % of the 'Total EU-15 GHG emissions' (Table 5.4). The sector Solvent and Other Product Use does not contain a key source.

Table 5.3 Sector 3 Solvent and Other Product Use: EU-15 CO_2 emissions as well as their share

	Unit	1990	2011
CO_2 emission in 'Solvent and Other Product Use'	[Gg]	8 845	5 571
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 212	7 968.6
Share of CO_2 emission in Total GHG in 'Solvent and Other Product Use'		*67%*	*70%*
Total National CO_2 Emissions and Removals (excluding net CO_2 from LULUCF)	[Gg]	3 367 101	3 002 815
Share of CO_2 emission from 'Solvent and Other Product Use' in Total CO2 Emissions and Removals		*0.26%*	*0.19%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4 254 504	3 630 657
Share of CO_2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.21%*	*0.15%*

Table 5.4 Sector 3 Solvent and Other Product Use: EU-15 N_2O emissions as well as their share

	Unit	1990	2011
N_2O emission in 'Solvent and Other Product Use'	[Gg]	14.1	7.7
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 212	7 969
Share of N_2O emission in Total GHG in 'Solvent and Other Product Use'		*33%*	*30%*
Total National N_2O Emissions	[Gg]	1 290	851
Share of N_2O emission from 'Solvent and Other Product Use' in Total National N_2O Emissions		*1.09%*	*0.91%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4 254 504	3 630 657
Share of N_2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.10%*	*0.07%*

Table 5.5 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions as well as their share

	Unit	1990	2011
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 212	7 969
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4 254 504	3 630 657
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.31%*	*0.22%*

In Table 5.6 the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-15 and for all EU-15 Member States are listed as recommended in IRR 2007 (para 78).

Table 5.6 **Sector 3 Solvent and Other Product Use: EU-15 emissions of CO_2, N_2O, NMVOC and GHG**

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
		Gg			Gg CO_2 eq		Gg			Gg CO_2 eq
AT	A. Paint Application	54.14		20.36	54.14	B. Degreasing and Dry Cleaning	26.34	NA	9.96	26.34
BE		NA		15.99	NA		NA	NA	3.41	NA
DK		7.26		2.87	7.26		0.00	NA	0.00	0.00
FI		19.18		8.72	19.18		0.52	NO	0.24	0.52
FR		370.69		118.94	370.69		17.26	NA	5.54	17.26
DE		560.49		254.77	560.49		88.50	NO	40.23	88.50
GR		35.66		11.44	35.66		8.92	NA	2.86	8.92
IE		19.41		6.23	19.41		3.67	NA	1.18	3.67
IT		543.68		174.43	543.68		61.59	NA	19.76	61.59
LU		2.53		1.15	2.53		3.06	NA	1.03	3.06
NL		51.82		17.98	51.82		1.97	NO	3.41	1.97
PT		66.03		21.19	66.03		7.68	NO	2.46	7.68
ES		371.94		119.34	371.94		79.93	NA	25.65	79.93
SE		27.27		10.12	27.27		0.16	NA	0.15	0.16
GB		NE		72.44	NE		NE	NE	21.11	NE
EU15		2 130.10		855.97	2 130.10		299.60	0.00	136.98	299.60
AT	C. Chemical Products, Manufacture and Processing	11.61		6.15	11.61	D. Other	81.09	0.49	36.05	232.11
BE		NA		3.77	NA		NA	0.68	19.64	211.13
DK		12.02		4.81	12.02		131.35	0.05	19.31	147.68
FI		7.72		3.51	7.72		15.78	0.09	7.17	42.41
FR		95.23		30.55	95.23		549.76	0.28	176.39	637.21
DE		118.94		54.06	118.94		738.12	1.13	335.51	1087.98
GR		NA		IE	NA		117.18	0.50	40.05	271.83
IE		7.89		2.53	7.89		41.52	NA,NE	13.32	41.52
IT		NA		59.91	NA		474.26	1.86	152.15	1051.01
LU		1.40		0.53	1.40		3.81	0.02	1.77	8.78
NL		NA		IE	NA		68.77	0.10	35.44	100.70
PT		63.39		20.34	63.39		81.24	0.16	26.07	129.59
ES		NA		87.35	NA		383.53	1.98	123.06	997.25
SE		0.92		0.37	0.92		135.33	0.40	67.08	260.59
GB		NE		11.66	NE		NE	NE,NO	237.81	0.00
EU15		319.10		285.56	319.10		2 821.75	7.74	1 290.84	5219.79
AT	Total Solvent and Other Product Use	173.19	0.49	72.53	324.20					
BE		NA	0.68	42.81	211.13					
DK		150.62	0.05	27.00	166.95					
FI		43.19	0.09	19.63	69.83					
FR		1 032.93	0.28	331.42	1 120.38					
DE		1 506.05	1.13	684.57	1 855.90					
GR		161.75	0.50	54.36	316.41					
IE		72.49	NA,NE	23.26	72.49					
IT		1 079.53	1.86	406.25	1 656.28					
LU		10.81	0.02	4.48	15.77					
NL		122.56	0.10	56.83	154.50					
PT		218.34	0.16	70.06	266.69					
ES		835.40	1.98	355.40	1 449.12					
SE		163.68	0.40	77.73	288.93					
GB		NE	NE,NO	343.02	0.00					
EU15		5 570.55	7.74	2 569.34	7 968.59					

5.2 Methodological issues and uncertainties (EU-15)

This sector does not contain any key source. An overview of methodologies used by the Member States to estimate emissions from this sector is given in Table 5.7. The methodologies used by the Member States are very different. Generally they are based on:

- Methodology provided by IPPC Guidelines and CORINAIR Guidebook;
- Bottom up and top down approach / consumption-based emissions estimating;
- Chemical approach

- mass balance for single substances or groups of substances
- plant specific surveys / expert judgment.

No additional overview of qualitative uncertainty estimates is provided. Altogether it can be noted that very high uncertainties are reported because of lack of information and rough assumptions.

The following overview (Table 5.7) consists mainly of excerpts of Member State NIRs. In some cases the information given in Member State NIRs is summarised. The references given in the following overview are taken directly from the Member State NIRs. The full reference can be found in the list of references in the respective NIR.

Table 5.7 Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

<table>
<tr><th colspan="4">Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions</th></tr>
<tr><th colspan="4">Austria (NIR AT 2013)</th></tr>
<tr><td>GHG & pollutant:</td><td>CO_2, NMVOC, N_2O</td><td>GHG Key Category:</td><td>CO_2</td></tr>
<tr><td>Uncertainties:</td><td>CO_2: 11 %, N_2O: 20 %</td><td>Completeness:</td><td>yes</td></tr>
<tr><td>Time series consistency:</td><td>yes</td><td rowspan="2">Planned improvements:</td><td rowspan="2">no</td></tr>
<tr><td>Recalculation:</td><td>no</td></tr>
<tr><td colspan="2">Sector specific QA/QC and verification:</td><td colspan="2">Tier 1 & 2 QA/QC activities</td></tr>
</table>

Methodology (CO_2 emissions):

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. Emission estimates only based on the top-down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE, ETBE, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector. Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

Activity:

The top-down approach is based on (A) import-export statistics, (B) production statistics on solvents in Austria, (C) survey on non-solvent-applications in companies, and regularly questionnaires (D) survey on the solvent content in products and preparations at producers & retailers. The bottom up approach is based on an extensive survey on the use of solvents in the year 2000 and 2008. In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected. Information about the type of application of the solvents was gathered, divided into the three categories 'final application', 'cleaner' and 'product preparation' as well as the actual type of waste gas treatment, which was divided into the categories 'open application', 'waste gas collection' and 'waste gas treatment'.

Emission factor:

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. In a second step a survey in 1800 households was made for estimating the domestic solvent use. Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O Emissions in CRF 3: 3 D 1 Use of N_2O for anaesthesia and 3 D 3 Use of N_2O in aerosol cans: A specific methodology for these activities has not been prepared yet. 100 % of N_2O used for anaesthesia/ aerosol cans is released into atmosphere, which means that activity data = emission (1.00 Mg N_2O/ Mg product use)

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Belgium (NIR BE 2013)			
GHG & pollutant:	NMVOC, N_2O	**GHG Key Category:**	no
Uncertainties:	N_2O: AD: 3 %, EF: 100%	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	no
Recalculation:	yes		
Sector specific QA/QC and verification:		Tier 1 quality control checks are performed in the 3 regions for the Belgian key source categories only.	

In Belgium the emissions of NMVOC in the source category 'Solvent and other product use' include paint application (building industry, households and road markings), production of medicines, paints, inks and glues, domestic use of other products (incl. glues and adhesives), coating processes in general (incl. assembly of automobiles), printing industry, wood conservation, treatment of rubber, recuperation of solvents, extraction of oil, cleaning and degreasing and dry cleaning.

No estimation of the CO_2 equivalent emissions of the solvent consumption is carried out in Belgium.

The greenhouse gas emissions in this category 3 are related in Belgium to the use of N_2O as anesthetics.

Methodology (NMVOC):

The regions in Belgium are using comparable methodologies to estimate the emissions of solvent and other product use in their region.

The emissions of NMVOC in Flanders are estimated by using the results of a study started by the University of Gent in 1998 and continued by the Flemish Environment Agency (VMM).

In Wallonia, the calculation is based on a methodology established by Econotec.

In the Brussels region, the emissions are calculated by using the results of the research projects.

Because of the less importance of these emissions in the greenhouse gas story, only a general view of how these emissions are calculated in Belgium is given below.

Broadly speaking, emissions of NMVOC are estimated in Belgium based on:

- Production figures that are given by the specific industry or professional federations. The emission factors used, are mainly the solvent content of the product.
- Information gathered in the industrial databases mainly originating from the yearly reporting obligations of the industrial companies.

More information is provided in the IIR.

- The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of hospital beds in Belgium and the average consumption of anaesthetics per bed. The emission factor is 10,3 kg N_2O/bed/year. This factor was determined by inquiries carried out in 1995 by the independent consultant agency Econotec.

It has been assumed that all of the nitrous oxide used for anaesthetics will eventually be released to the atmosphere. The number of beds used for the emissions calculations was obtained from the DGASS (General Directorate for Health and Social Action) and from the Health Public Federal Service.

- There is no estimation carried out in Belgium of the CO_2 equivalents calculated out of the emissions of NMVOC of the solvent consumption because of the unreliability of this factors proposed in literature.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Denmark (NIR DK 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	no
Uncertainties:	CO_2 equiv: total emissions 19 %, trend: 10 %	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	yes
Recalculation:	yes		
Sector specific QA/QC and verification:		provided	

Methodology (CO_2 emissions):

Until 2002 the Danish solvent emission inventory was based on questionnaires, which were sent to selected industries and sectors requiring information on solvent use. In 2003 it was decided to implement a method that is more complete, accurate and transparent with respect to including the total amount of used solvent, attributing emissions to industrial sectors and households and establishing a reliable model that is readily updated on an annual basis.

Emission modelling of solvents can basically be done in two ways: 1) By estimating the amount of (pure) solvents consumed, or 2) By estimating the amount of solvent containing products consumed, taking account of their solvent content (EMEP/EEA, 2009).

In 1) all relevant solvents must be estimated, or at least those together representing more than 90 % of the total pollutant emission, and in

2) all relevant source categories must be inventoried or at least those together contributing more than 90 % of the total pollutant emission. A simple approach is to use a per capita emission for each category, whereas a detailed approach is to get all relevant consumption data (EMEP/EEA, 2009).

The detailed method 1) is used in the Danish emission inventory for solvent use, thus representing a chemicals approach, where each pollutant is estimated separately. The sum of emissions of all estimated pollutants used as solvents equals the pollutant emission from solvent use.

Method 2) is used for determining emissions from fireworks, tobacco, candles and charcoal for barbeques included in 3D Other Use.

Pollutant list

NMVOC is the most abundant chemical group in relation to Solvent and Other Product Use. Additionally there is also some use and/or emissions of NO2 and CO_2.

The definitions of solvents and VOC that are used in the Danish inventory (Nielsen et al., 2012) are as defined in the solvent directive (Directive 1999/13/EC) of the EU legislation: “Organic solvent shall mean any VOC which is used alone or in combination with other agents, and without undergoing a chemical change, to dissolve raw materials, products or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dissolver, or as a dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or a plasticiser, or as a preservative”. VOCs are defined as follows: “Volatile organic compound shall mean any organic compound having at 293.15 K a vapour pressure of 0.01 kPa or more, or having a corresponding volatility under the particular condition of use”.

This implies that some NMVOCs, e.g. ethylenglycol, that have vapour pressures just around 0.01 kPa at 20 °C, may only be defined as VOCs at use conditions with higher temperature. However, use conditions under elevated temperature are typically found in industrial uses. Here the capture of solvent fumes is often efficient, thus resulting in small emissions (communication with industries).

The Danish list of NMVOCs comprises approx. 30 pollutants or pollutant groups representing more than 95 % of the total emission from solvent use.

Activity data

For each pollutant or product a mass balance is formulated:

Consumption = (production + import) – (export + destruction/disposal + hold-up) (Eq. 1)

Data concerning production, import and export amounts of solvents and solvent containing products are collected from StatBank DK (2012), which contains detailed statistical information. Manufacturing and trading industries are committed to reporting production and trade figures to the Danish Customs & Tax Authorities in accordance with the Combined Nomenclature.

Import and export figures are available on a monthly basis from 1990 to present and contain trade information from approx. 200 countries worldwide. Production figures are reported quarterly as industrial commodity statistics by commodity group and unit from 1990 to present.

Destruction and disposal of solvents lower the pollutant emissions. In principle this amount must be estimated for each pollutant in all industrial activities and for all uses of pollutant containing products. At present the solvent inventory only considers destruction and disposal for a limited number of pollutants. For some pollutants it is inherent in the emission factor, and for others the reduction is specifically calculated from information obtained from the industry or literature.

Hold-up is the difference in the amount in stock in the beginning and at the end of the year of the inventory. No information on solvents in stock has been obtained from industries. Furthermore, the inventory spans over several years so there will be an offset in the use and production, import and export balance over time.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Denmark (NIR DK 2013)

In some industries the solvents are consumed in the process, e.g. in the graphics and plastic industry, whereas in the production of paints and lacquers the solvents are still present in the final product. These products can either be exported or used in the country. In order not to double count consumption amounts of pollutants it is important to keep track of total solvent use, solvents not used in products and use of solvent containing products. Furthermore some pollutants may be represented as individual pollutants and also in chemical groups, e.g. “o-xylene”, “mixture of xylenes” and “xylene”. Some pollutants are better inventoried as a group rather than individual pollutants, due to missing information on use or emission for the individual pollutants. The Danish inventory considers single pollutants, with a few exceptions.

Activity data for pollutants are thus primarily calculated from Equation 1 with input from StatBank DK (2012). When StatBank (2012) holds no information on production, import and export or when more reliable information is available from industries, scientific reports or expert judgements the data can be adjusted or even replaced.

Emission factors

For each pollutant the emission is calculated by multiplying the consumption with the fraction emitted (emission factor), according to:

Emission = consumption * emission factor

The present Danish method uses emission factors that represent specific industrial activities, such as processing of polystyrene, dry cleaning etc. or that represent use categories, such as paints and detergents. Some pollutants have been assigned emission factors according to their water solubility.

Higher hydrophobicity yields higher emission factors, since a lower amount ends in waste water, e.g. ethanol (hydrophilic) and turpentine (hydrophobic).

Emission factors for solvents are categorised in four groups in ascending order:

(1) Lowest emission factors in the chemical industry, e.g. lacquer and paint manufacturing, due to emission reducing abatement techniques and destruction of solvent containing waste, (2) Other industrial uses, e.g. graphic industry, have higher emission factors, (3) Non-industrial use, e.g. auto repair and construction, have even higher emission factors, (4) Diffuse use of solvent containing products, e.g. painting, where practically all the pollutant present in the products will be released during or after use.

For a given pollutant the consumed amount can thus be attributed with two or more emission factors; one emission factor representing the emissions occurring at a production or processing plant and one emission factor representing the emissions during use of a solvent containing product. If the chemical is used in more processes and/or is present in several products more emission factors are assigned to the respective chemical amounts.

Emission factors can be defined from surveys of specific industrial activities or as aggregated factors from industrial branches or sectors. Furthermore, emission factors may be characteristic for the use pattern of certain products.

The emission factors used in the Danish inventory also rely on the work done in the joint Nordic project (Fauser et al., 2009).

D1 Other: Use of N_2O for Anaesthesia, 3D4 Other: Other Use of N_2O & 3D5 Other: Other

Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans, use in laboratories, racing cars and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount. Sold amounts are obtained from the respective companies and the produced amount is estimated from communication with the company.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Finland (NIR FI 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	yes
Uncertainties:	NMVOC: AD: ±100; EF: ±20% N_2O: ±10%;	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	Check of activity data
Recalculation:	yes		
Sector specific QA/QC and verification:	The bilateral quality meeting, which function as Tier 1 QA audit, is held annually between the inventory unit and the sectoral expert. TIER 1 QC according to GPG 2000, Table 8.1.		

Methodology (CO_2 emissions):

NMVOC emissions from printing industry are based on the emission data from the VAHTI system (detailed information in Annex 2 to the Finnish NIR 2013), a questionnaire to presses and oil mills that do not report their emissions to the VAHTI system, activity data from the Finnish Safety and Chemicals Agency's (Tukes) database (Kotiranta, S. 2012), Finnish Food Safety Authority (Hynninen, E-L. 2012) and Finnish Cosmetics, Toiletry and Detergents Association. The detailed description of these calculations is included in the Finnish IIR (Finnish Environment Institute, 2013).

Indirect CO_2 emissions from solvents and other product use have been calculated from NMVOC emissions for the time series 1990-2011 using the equation below. It was assumed that the average carbon content is 60% by mass for all categories under the sector of solvents and other products use in accordance with the 2006 IPCC Guidelines. As described in the Guidelines, the used fossil carbon content fraction of NMVOC is based on limited published national analyses of speciation profile.

$Emissions_{CO2} = Emissions_{NMVOC} *$ Percent carbon in NMVOCs by mass * 44 /12

Methodology (N_2O Emissions):

The N_2O emissions are calculated by Statistics Finland. The country-specific calculation method is consistent with a Tier 2 method. In the estimation of the N_2O emissions sales data are obtained from the companies delivering N_2O for medical use and other applications in Finland. For the years 1990 to 1999 the emissions have been assumed constant based on activity data obtained for the years 1990 and 1998. Since 2000 annual and more precise data have been received from the companies. The emission estimation is based on the assumption that all used N_2O is emitted to the atmosphere in the same year it is produced or imported to Finland. A very small part of emissions is estimated due to non-response.

Activity: For the estimation of N_2O emissions production or importation data are obtained from companies for the years 1990, 1998 and all years starting from 2000. In 2011 one company reported that they have continued to export and that has been also taken into account in the calculations

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Germany (NIR DE 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	yes
Uncertainties:	CO_2: 7,9% N_2O: 47%	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	no
Recalculation:	no		
Sector specific QA/QC and verification:	TIER 1 & 2 QC checks		

Methodology (CO_2 emissions):

NMVOC emissions are calculated in keeping with a product-consumption-oriented approach. In this approach, the NMVOC input quantities allocated to these source categories, via solvents or solvent-containing products, are determined and then the relevant NMVOC emissions (for each source category) are calculated from those quantities via specific EFs. This method is explicitly listed, under "consumption-based emissions estimating", as one of two methods that are to be used for emissions calculation for this source category. Use of this method is possible only with valid input figures – differentiated by source categories – in the following areas:

1. Quantities of VOC-containing (pre-) products and agents used in the report year,
2. The VOC concentrations in these products (substances and preparations),
3. The relevant application and emission conditions (or the resulting specific EF).

To take account of the highly diverse structures throughout the sub-categories 3A – 3D, these input figures are determined on the level of 37 differentiated source categories, and the calculated NMVOC emissions are then aggregated. The product/substance quantities used are determined at the product-group level with the help of production and foreign-trade statistics. Where possible, the so-determined domestic-consumption quantities are then further verified via cross-checking with industry statistics.

The values used for the average VOC concentrations of the input substances, and the EFs used, are based on experts' assessments (expert opinions and industry dialog) relative to the various source categories and source-category areas. Not all of the necessary basic statistical data required for calculation of NMVOC emissions for the most current relevant year are available in final form; as a result, the data determined for the previous year are used as an initial basis for a forecast for the current report. The forecast for NMVOC emissions from solvent use for the relevant most current year is calculated on the basis of specific activity trends. As soon as the relevant basic statistical data are available for the relevant most current year, in their final form, the inventory data for NMVOC emissions from solvent use will be recalculated.

For the 2013 report, indirect CO_2 emissions from NMVOC have been calculated. According to Chapter 7 Precursors and Indirect Emissions of the 2006 IPCC Guidelines the following relationship was used for pertinent conversion: $EM_{indirect\ CO2} = EM_{NMVOC}$ * molar mass CO_2 / molar mass C * 60%.

Methodology, Activity & Emission factor (N_2O Emissions):

Anaesthesia: The 1990 figure for N_2O emissions from medical applications is based on an extrapolation of a statistical plant survey conducted in 1990 in the territory of the former GDR. N_2O emissions of 6,200 t were estimated, as a rough approximation, for Germany in 1990. The N_2O figure for 2001 was obtained via a written memorandum, dating from 2002, of the Industriegaseverband e.V. (IGV) industrial-gas association. That figure was tied to a range of 3,000 ~ 3,500 t/a. The mean value from that range (3,250 t/a) was then used for generation of an N_2O-emissions time series. Since 2005, the Industriegaseverband (IGV) industrial-gas association has carried out surveys of N_2O sales for all applications in Germany. In addition, the IGV has made the data from those surveys available to the Federal Environment Agency for reporting purposes. In 2010, the IGV entered into a voluntary agreement, with the Federal Ministry of Economics and Technology (BMWi), regarding annual provision of N_2O-sales data for purposes of emissions reporting. The gaps in the data relative to uses in anaesthesia are closed via interpolation and extrapolation. The pertinent emission factor is 100%.

Whipped-cream aerosol cans: Use of N_2O in aerosol cans for whipped cream, in Germany, has to be carefully differentiated. In Germany, there is one maker of aerosol cans for whipped cream. That maker also fills the cans in Germany. In emissions calculations, it is assumed, on the basis of the above described research, that that company accounts for a share of about 3 % of the laughing-gas sales of the IGV industrial-gas association. The majority of the companies who deal with such aerosol cans has them filled abroad and then imports them into Germany. The relevant sales of such companies are thus not included in the data of the IGV industrial-gas association. The MIV dairy-industry association has reported to the Federal Environment Agency the results of a one-time survey that showed that 50.2 million units of whipped-cream aerosol cans were sold in 2008. At the same time, the MIV association reported that the units involved vary in size, and that it is not possible to break the figures down by can sizes. Internet research showed that pressurized cartridges for this area are sold in Germany: cartridges with 8g of N_2O, for 0.5l cans, and cartridges with 16g of N_2O, for 1.0l cans. Comparison calculations have shown that 8g of N_2O is a safe approximation, for purposes of calculation, for the amount of laughing gas contained per sold unit (whipped-cream aerosol can). That, in turn, leads to an input figure of 401.6 t N_2O for whipped-cream aerosol cans in 2008 in Germany. Since no pertinent data are available for the years prior to 2008, that value is assumed to be constant. The emission factor for whipped-cream aerosol cans is assumed to be 100%.

Semiconductor manufacturing: On a one-time basis, the German Electrical and Electronic Manufacturers' Association (ZVEI) has provided information on quantities of laughing gas sold in the years 1990, 1995, 2000, 2001 and 2008. Values

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Germany (NIR DE 2013)
between those points are obtained via interpolation. In addition, the ZVEI estimated the emission factor for 2008 to be about 40 %, in keeping with conversion of laughing gas within the pertinent process and with downstream treatment processes. The ZVEI was unable to provide any figures for 1990. But since it can be assumed that levels of waste-gas treatment in 1990 were not nearly as high as they were in 2008, an emission factor of 100 % is used as a conservative estimate for 1990. The emission factor for the period between 1990 and 2008 was obtained via interpolation. **Explosives:** In 2003, a total of 59 kt of explosives was produced in Germany. Of that figure, 13 kt were exported abroad, and 5.8 kt were imported into Germany. Those figures, in turn, yield a figure of 51.8 kt for the amount of explosives used in Germany. Of that amount, ANFO accounts for a share of 60 %, emulsion explosives account for 25 % and dynamite explosives account for 15 %. ANFO explosives consist of 94 % ammonium nitrate and 6 % fuels. The corresponding relationship for emulsion explosives is 80 % to 20 %; for dynamite explosives, it is 50 % to 50 %. At present, nitrous oxide amounts in detonation clouds are not determined, while amounts of NO and NO2 are determined. […]The emission factor for use of explosives is 0.1036 kg N_2O/t explosives. That emission factor was determined, via measurement, by the BAM in February 2010. As a result, the emission factor has been corrected downward, considerably, with respect to the Submission 2010.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Great Britan (NIR GB 2013)			
GHG & pollutant:	NMVOC	**GHG Key Category:**	no
Uncertainties:	no	**Completeness:**	NMVOC CO_2: NE N_2O: NE
Time series consistency:	yes (for NMVOC)	**Planned improvements:**	General QA/QC
Recalculation:	no		
Sector specific QA/QC and verification:	TIER 1 & 2 QC checks		

No direct GHG emissions are reported in this category.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Greece (NIR GR 2013)			
GHG & pollutant:	CO_2, NMVOC	**GHG Key Category:**	yes
Uncertainties:	CO_2: 300%	**Completeness:**	NMVOC, CO_2, 2O: NE
Time series consistency:	yes	**Planned improvements:**	Not provided
Recalculation:	no		
Sector specific QA/QC and verification:		Not provided	

Methodology (CO_2 emissions):

The calculation of NMVOC emissions requires a very detailed analysis of the use of solvents and other products containing volatile organic compounds. There are two basic approaches for the estimation of emissions from Solvent and Other Product Use, which depend on the availability of data on the activities producing emissions and the emission factors.

Production-based. In cases that solvent or coating use is associated with centralised industrial production activities (e.g. automobile and ship production), it is generally possible to develop NMVOC emission factors based on unit of product output. Next, annual emissions are estimated on the basis of production data.

Consumption-based. In many applications of paints, solvents and similar products, the end uses are too small-scale, diverse, and dispersed to be tracked directly. Therefore, emission estimates are generally based on total consumption (i.e. sales) of the solvents, paints, etc. used in these applications. The assumption is that once these products are sold to end users, they are applied and emissions generate relatively rapidly. Emission factors developed on the basis of this assumption can then be applied to data from sales for the specific solvent or paint products.

The application of both approaches needs detailed activity data, concerning either e.g. the amount of pure solvent consumed or the amount of solvent containing products consumed. The availability of such activity data in Greece is limited and as a result the default CORINAIR methodology is applied for the estimation of NMVOC emissions. Carbon dioxide emissions are calculated from NMVOC emissions, assuming that the carbon content of NMVOC is 85%.

Paint application: Data availability concerning the use of products containing solvents for "Vehicle manufacture and Vehicle refinishing" is limited and as a result the respective emissions are not estimated. Emissions from "Domestic use and construction" are estimated on the basis of population figures and default emission factors from CORINAIR (0.5 kg / capita).

Metal Degreasing and Dry Cleaning: Emission estimates are given only for the dry cleaning sector. These estimates are based on population figures and default emission factors from CORINAIR (0.25 kg /capita) that is applicable to all types of dry cleaning equipment.

Other Use of Solvents and Related Activities: The emission factors used for some of the activities defined in CORINAIR and for which it was possible to obtain the corresponding activity data from the Hellenic Statistical Authority, are:

- Production and processing of PVC: 40 kg / t of product produced or processed.
- Production of pharmaceutical products: 14 g /capita.
- Ink production: 30 kg / t of product.
- Glue production, applied emission factor: 20 kg /t of product
- For the wood preservation: 24 kg / t of wood preserved
- For fat edible and non edible oil extraction: 14 kg NMVOC/ t of seed processed
- For domestic solvent use (except paint application): 2.6 kg NMVOC/capita/year

In the case of printing industry, the estimation of emissions was based on the consumption of ink. Printing ink is mostly used for the publishing of newspapers, books and various leaflets. According to the estimations of one publishing organisation, the amount of ink used for the printing of a daily newspaper is approximately 3.7 g of ink. The quantity of ink used for printing books etc. was calculated by subtracting the total quantity used for the newspapers from the total ink consumed.

The emission factor applied (260 kg / t ink) is the average of emission factors for newspaper printing (54 kg /t ink) and for books and other leaflets printing (132-800 kg / t ink).

N_2O emissions (source categories 3D1 & 3D3)

For source categories 3D1 and 3D3, neither national activity data nor IPCC methodology are available for the estimation of N_2O emissions. The inventory team in order to provide emissions for these source categories proceeded as follows:

1. The inventory team started by investigating the NIRs and ERT audit reports of other Annex I parties, as concerns the estimation of emissions for the 3D1 and 3D3 source categories.

2. The ratio of N_2O emissions per population (ktN_2O/1000s capita) for a cluster of Annex I parties was computed. Four European countries were selected: Italy and Spain (which have similarities with Greece as concerns climate etc), Austria and Netherlands (in order to be conservative in the estimation of emissions).

3. The mean value of the above mentioned ratios was calculated.

4. By using the population of Greece as a driver (activity data) and the above calculated ratio as “Emission factor”, the emissions for the whole time series 1990-2011 of the 3D1 and 3D3 were estimated.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Irelandd (NIR IE 2013)			
GHG & pollutant:	CO_2, NMVOC	**GHG Key Category:**	no
Uncertainties:	AD: 30%; EF: 5%	**Completeness:**	NMVOC, CO_2, 2O: NE
Time series consistency:	Yes	**Planned improvements:**	Not provided
Recalculation:	Yes		
Sector specific QA/QC and verification:		TIER 1 QC	

Methodology (CO_2 emissions):

The levels of solvent use and the emissions from solvents have changed substantially in response to product replacement and reformulation and emission controls being implemented under Integrated Pollution Prevention Control (IPPC) and the Solvents Directive (CEC, 1999). Given these developments, the inventories of NMVOC emissions from solvent use were assessed in 2005 when a project was commissioned to carry out an in-depth analysis of the specified NMVOC source categories (CTC, 2005). This work enabled the best possible estimates of emissions for the period 1990- 2004 to be derived, and built upon earlier commissioned work in 1998 (Finn et al, 2001). The revised estimates for the time series 1990-2003 indicated lower NMVOC emissions than had been previously reported and used as the basis for estimating CO_2 in the sector Solvent and Other Product Use. In 2011, further improvements were undertaken which focussed on the appropriateness of activity data and emission factors and the consistency of emission estimates for the time series 1990-2008.

CTC (2005) developed a bottom-up approach for estimating NMVOCs from activities that are subject to IPPC licensing in the four source categories (3.A Paint Application, 3.B Degreasing and Dry Cleaning, 3.C Chemical Products and 3.D Other Solvent Uses). Relevant data on emissions and solvent use were extracted from their electronic or paper Annual Environmental Reports (AERs) or Pollution Emissions Registers (PERs). Where such information was not available, European PERs were assessed.

Top-down methods were used for activities (i.e. the use of paints and the use of domestic solvents) that are not covered by the IPPC licensing system. For these activities, Irish statistics such as vehicle stock, population and housing stock were used.

Input, usage and emissions data for each individual activity is collated into IPPC and non-IPPC spread sheets. Emissions are estimated by applying EMEP/CORINAIR methods, using default, UK and literature emission factors and general guidance as appropriate. Interpolation and extrapolation are used to elaborate a time series where no annual specific data is available. These are combined with Irish statistics for the number of vehicles, population, housing stock and a range of other activity data. In some instances activity data is currently not available in Ireland and where this occurs emission estimates are undertaken using Irish and UK population statistics and UK emission data. In other instances, emissions are estimated using GDP as a surrogate activity data.

The estimates of CO_2 emissions from Solvent and Other Product Use for the period 1990-2011 are presented in Table 5.1. The largest contributor to overall emissions is the source category 3D Other Use of Solvents which accounts for 57% of NMVOC emissions in 2011. It is estimated that approximately two thirds of emissions from this source category are attributable to domestic solvent use. Emissions from domestic solvent use have increased in recent years, while those from the majority of other sub-categories have decreased due in general to reduced solvent contents in paints and coatings and the economic downturn in recent years. The main drivers for the increasing emissions from domestic solvent use are considered to be the increased per-capita consumption of cosmetics, toiletries and household products.

Source category 3A Paint Application is a significant source of NMVOC, accounting for 27 per cent of total NMVOC emissions in 2011. Emissions from this source category have substantially fallen since 2002 as the solvent content of paint (both water and solvent based paints) has decreased. This trend has primarily been driven by legislation such as the Deco Paints Directive (EP and CEU, 2004b; DEHLG, 2007) and the Solvents Directive (CEC 1999). Both Directives have had a substantial impact on the solvent content of paints, coatings and other products. Integrated Pollution Prevention and Control has also impacted on the industrial users of solvents, requiring solvent management plans and improvements to working practices and the implementation of abatement techniques.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Netherlands (NIR NL 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	no
Uncertainties:	NMVOC: 30%; C-content: 10%; CO_2: 27%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	No		
Sector specific QA/QC and verification:		general QA/QC procedures	

Methodology (CO_2 emissions):

Detailed information on the activity data and emission factors of NMVOC estimates can be found in the monitoring protocol 13-014 on the website www.nlagency.nl/nie.

Activity data: consumption data and NMVOC contents of products are mainly provided by trade associations, such as the VVVF (for paints), the NCV (for cosmetics) and the NVZ (for detergents). Consumption of almost all solventcontaining products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the last years, resulting in a steady decline in NMVOC emissions since 1990 (see section 2.4). Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly in 0recent years. It is assumed that the NMVOC contents of these products have remained stable. Emission factors: it is assumed that all NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which are partly broken down in sewerage treatment plants after use, or used as fuel in BBQs or fondue sets (methylated spirit). The carbon contents of NMVOC emissions are documented in the monitoring protocol on the website www.nlagency.nl/nie.

Methodological issues: Country-specific carbon contents of the NMVOC emissions from 3A Paint application, 3B Degreasing and dry cleaning and 3D Other product use are used to calculate indirect CO_2 emissions. Monitoring of NMVOC emissions from these sources differs per source. Most of the emissions are reported by branch organisations (e.g., paints, detergents and cosmetics). The indirect CO_2 emissions from NMVOC are calculated from the average carbon contents of the NMVOC in the solvents: 3A: 0.72 C-content NMVOC (%); 3B: 0.16 C-content NMVOC (%); 3D: 0.69 C-content NMVOC (%)

The carbon content of degreasing and dry cleaning is very low due to the high share of chlorinated solvents (mainly tetra chloro-ethylene used for dry cleaning). The emissions are then calculated as follows:

CO_2 (in Gg) = {NMVOC emission in subcategory i (in Gg) x C-fraction subcategory i} x 44/12

The fraction of organic carbon (of natural origin) in the NMVOC emissions is assumed to be negligible.

Methodology (N_2O emissions):

Activity data and implied emission factors: Detailed information on the activity data and emission factors of N_2O estimates are found in the monitoring protocol 13-014 on the website www.nlagency.nl/nie.

Activity data: The major hospital supplier of N_2O for aesthetic use reports the consumption data of aesthetic gas in the Netherlands annually. The Dutch Association of Aerosol Producers (NAV) reports data on the annual sales of N_2Ocontaining spray cans. Missing years are then extrapolated on the basis of this data. Domestic sales of cream in aerosol cans have shown a strong increase since 1990. The increase is reflected in the increased emissions. Emission factors: the emission factor used for N_2O in anaesthesia is 1 kg/kg. Sales and consumption of N_2O for anaesthesia are assumed to be equal each year. The emission factor for N_2O from aerosol cans is estimated to be 7.6 g/can (based on data provided by one producer) and is assumed to be constant over time.

Methodological issues: Country-specific methodologies are used for the N_2O sources in Sector 3. Since the emissions in this source category are from non-key sources for N_2O, the present methodology complies with the IPCC Good Practice Guidance (IPCC, 2001). A full description of the methodology is provided in the monitoring protocol 13-014 on the website www.nlagency.nl/nie.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Portugal (NIR PT 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	Yes – CO_2
Uncertainties:	CO_2 3A - AD: 6%; EF 21% 3B EMI: 7% 3C AD: 5%; EF 26% 3D AD: 6%; EF 81% N_2O 3D EMI: 10%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	Yes
Recalculation:	Yes		
Sector specific QA/QC and verification:		general QA/QC procedures	

Methodology, Activity data & Emission factor (CO_2 emissions):

NMVOC emissions estimates must be converted in CO_2 emissions whenever the carbon that is present in organic compounds has fossil fuel origin (originated from feed-stocks from petroleum, coal or natural gas), and being assumed that NMVOC compounds are fully oxidized in air to carbon dioxide contributing thence to the atmospheric pool.

Ultimate CO_2 emissions were calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory as CO_2e. U_{CO2} = NMVOC * 0.85 * (44/12). Where U_{CO2} - Ultimate CO_2 (ton/yr); MVOC - Global emissions of NMVOC (ton/yr).

Paint Application (CRF 3A): NMVOC emissions from use of coating materials are estimated in a simple manner using the following formulation: $Emi_{NMVOC(a,p,y)} = \Sigma_a \Sigma_p [EF_{(p)} * Coating_{CONS(a,p,y)}] * 10\text{-}3$; where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from use/application of coating substances during year y; $Coating_{CONS(a,p,y)}$ – Use of coating substance p in economic activity a during year y; $EF_{(p)}$ – NMVOV EF (solvent content) resulting from application of substance;

For specific sectors were more detailed activity data and emissions factors were available a product base methodology was used. This is the case for: (a) Cars manufacturing; (b) Truck cabin coating; (c) Leather finishing. The product based methodology can be described as following: $Emi_{NMVOC(p,y)} = \Sigma_a \Sigma_p [EF_{(p)} * Coating_{CONS(a,p,y)}] * 10\text{-}3$. Where $Emi_{NMVOC(p,y)}$ – NMVOC emissions resulting the production of product p during year y (t/yr); Product(p,y) – Production units of product p during year y (cars/yr, truck cabins/yr, kg leather/yr); $EF_{(p)}$ – NMVOV emission factor for production of product p (kg/car, kg/truck cabin, kg/kg leather) p – product (cars, truck cabin, leather). Emission factors were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA. Default emission factors and abatement technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner.

$EF_{NMVOC(y)} = CS_{(t,y)}$ *10^-2 * 1 - $AT_{(t)}$ – *10^-2 $EF_{NMVOC(default)}$ – Default NMVOC emission factor.

Where: $EF_{NMVOC(y)}$ – NMVOC emission factor in year y (t/yr); $CS_{(t,y)}$ – Control strategy, share of abatment technology t during year y (%); $AT_{(t)}$ – Efficiency of abatement technology t (%); t – abatement technology; $EF_{NMVOC(default)}$ – Default NMVOC emission factor.

In cases where industrial detailed information was not available, Tier 1 emission factors for industrial paint application were used. This emission factor is based on the quantity of coating applied.

Activity data: The available and reliable information concerning the use of paints is restricted to a small number of activities in Portugal. From IAIT and IAPI industrial surveys, compiled by national statistics, it is only possible to determine consumption of paint in industrial activities, but the remaining, and larger part of consumption, is not known. Therefore total consume of paint and varnish in Portugal had first to be estimated from internal production, importation and exportation according to: TotalCons(y)=Production(y)+Imports(y)–Exports(y); Where: TotalCons(y)- Consumed paint and varnish of type p in year y; Production(y) - National Produced paint and varnish of type p in year y; Imports(y) - Imported paint and varnish of type p in year y; Exports(y) - Exported paint and varnish of type p in year y.

Degreasing and dry cleaning (CRF 3B): Assuming that all solvents consumed during degreasing and dry-cleaning evaporate, NMVOC emission will be equal to the amount of solvents used. If it is considered that annual consumption of solvents in an economic activity is used to replenish the quantity of solvent that was lost, then annual NMVOC emissions may be estimated from the annual consumption of solvent. This methodology overcomes the need of being aware of the portion of solvent that is recovered. In the case of the dry-cleaning activity it was assumed that either the solvent is lost directly to atmosphere, or if it is conveyed to water or retained in clothes, but it will eventually reach atmosphere by evaporation. For the dry cleaning sector other methodologies, based on quantities of washed cloths, are recommended by several sources (USEPA, 1981; EMEP/CORINAIR). However, in Portugal there is no sufficient information to use this other approach.

Activity Data Statistical information concerning total solvent use, from the National Statistics Institute (INE), was used to estimate VOC emissions. Consumption of solvents, presented in Table 5.29, was based on consumption of volatile organic materials in the metal and plastic industries, from IAIT statistical survey. There is no available statistical information concerning consumption of solvents and other materials in dry-cleaning activity, because this activity is not included under IAIT and IAPI industrial surveys. Therefore, it was assumed that all PER (Tetra-chloro-ethylene)79 consumed in Portugal is used in dry-cleaning80 activity and that all PER used is imported (no national production). Annual apparent consumption was estimated from INE's statistical databases on external trade from 1990 to 2009 and assumed as equal to solvent use.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Portugal (NIR PT 2013)

Chemical products, manufacture and processing (CRF 3C): Emissions were estimated by the use of emission factors that are multiplied by the quantity of material produced: $EMI_{NMVOC} = EF * Activity_{Rate} * 10^{-3}$ where EMI_{NMVOC} - annual emission of NMVOC (ton/yr); $Activity_{Rate}$ - Indicator of activity in the production process. Quantity of product produced per year as a general rule for this emission source sector (ton/yr); EF - emission factor (kg/ ton); It was assumed that NMVOC result mostly from solvents with fossil origin, therefore contributing fully to ultimate carbon dioxide emissions.

Polyester processing: Emissions from polyester processing were estimated according with the EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). A tier 2 approach was used as activity data and emissions factors were stratified for polyester processing. The technology specific emission factor was obtained from EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). The emissions factor was assumed constant for all covered period. Data on polyester is available from the IAPI industrial surveys from INE.

Polyvinylchloride processing: Emissions from polyvinylchloride processing were estimated according with the EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). A tier 1 approach was used as specific emissions factors from the EEA/EMEP guidebook were not available for polyvinylchloride processing. The default emission factor was obtained from EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). The emissions factor was assumed constant for all covered period. Data on polyvinylchloride is available from the IAPI industrial surveys from INE.

Polyurethane and polystyrene foam processing: Emissions from polyurethane and polystyrene foam processing were estimated according with the EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). A tier 2 approach was used as activity data and emissions factors were stratified for polyurethane and polystyrene foams. Data on polyurethane and polystyrene foam is available from the IAPI industrial surveys from INE.

Rubber processing: Emissions from rubber processing was estimated according with EMEP/CORINAIR Guidebook. Rubber processed for tyre production is not included in this sector. Statistical information for year 2008 was not yet available, therefore emissions were estimated according with a forecast based on historical emissions from the last five year period. The emission factor used for rubber processing was obtained from EMEP/CORINAIR guidebook. The same emission factor was used for year 1990 to 2008. Production data of rubber artefacts was available from the IAIT and IAPI industrial surveys from INE.

Paints, Inks and Glues Manufacturing: Emissions from paints, inks and glue manufacturing were estimated according with EMEP/CORINAIR Guidebook. Emission factors were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA (http://gains.iiasa.ac.at). Default emission factors and abatement technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner. Production data of paints, inks and glue was available from the IAIT and IAPI industrial surveys from INE. Production data of paints, inks and glue was available from the IAIT and IAPI industrial surveys from INE.

Manufacture of Tyres: Emissions from tyre manufacturing were estimated according with EMEP/CORINAIR Guidebook. Emission factors were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA (http://gains.iiasa.ac.at). Default emission factors and abatement technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner. Since the final emission factor is expressed in g/kg tyre, a conversion factor was used to obtain emission factor expressed in g/tyre in order to use the activity data provided by INE. A conversion factor of 15kg/tyre was used. Production data for tyres was available from the IAIT and IAPI industrial surveys from INE.

Other use of solvents and related activities (CRF 3D):

Use of N_2O for Anaesthesia (3.D.1) The N_2O consumed in Portugal is primarily for medical use as anaesthesia. The new 2006 guidelines propose that emissions be estimated from supply "It is good practice to estimate N_2O emissions from data of quantity of N_2O supplied that are obtained from manufacturers and distributors of N_2O products". There will be a time delay between manufacture, delivery and use but this is probably small in the case of medical applications because hospitals normally receive frequent deliveries to avoid maintaining large stocks. Therefore, it is reasonable to assume that the N_2O products supplied will be used in one year. It is assumed that none of the administered N_2O is chemically changed by the body, and all is returned to the atmosphere. It is reasonable to assume an emission factor of 1.0. Consumption of N_2O emissions are calculated from statistics obtained from INE (1990 to 2009).

Fire Extinguishers (3.D.2), N_2O from Aerosol Cans (3.D.3) and Other Use of N_2O (3.D.4) are included under 3D1.

Other (3.D.5)

Printing: Emissions from printing industry was estimated according with Tier 1 methodology from EMEP/CORINAIR Guidebook. $EMI_{NMVOC(y)} = EF_{(i)} * INK_{CONS(y)} \times 10^{-3}$ where $EMI_{NMVOC(y)}$ – NMVOC emissions resulting from printing activities during year y (t/yr); $Ink_{CONS(y)}$ – Use of printing ink during year y (t/yr); EF(i) – NMVOC emission factor (solvent content) for ink use (g/kg ink). The emission factor used for printing activities was obtained from EMEP/CORINAIR guidebook. The same emission factor was used for year 1990 to 2010. Consumption of inks in printing industry according to printing product is available from the INE's statistical database

Edible and non edible oil extraction Emissions of NMVOC were estimated considering that the annual hexane consumption by the industrial plant, hexane make-up, is due to losses to the air, and hence: $EMI_{NMVOC(y)} = MakeUp_{Solvents(y)}$ where: $EMI_{NMVOC(y)}$ - Emissions of NMVOC (ton/yr); $MakeUp_{Solvents(y)}$ - annual consumption of solvent in edible and non-edible oil industry, to replenish losses (ton/yr). The national emission factor for NMVOC was calculated as the ratio of the amount of solvents consumed during manufacture processes to the quantities of edible and non edible oil manufactured. However, from the available data from INE, this emission factor could be only estimated from IAIT industrial survey, i.e. from 1989 to 1991, because solvent consumption is not available from IAPI survey. Statistical information used in actual calculations of annual emission factor are presented in Table 5.52, together with the average emission factor in 1989- 1991, value that was used to

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Portugal (NIR PT 2013)
estimate annual NMVOC emissions for the whole covered periodOil refining data was available from INE's industrial surveys: IAIT for 1990 and 1991 and IAPI thereafter until 2000. ***Industrial application of glues and adhesives*** NMVOC = $Cons_{Nat}$ x FE_{Nat} + Imp x FE_{imp} where: NMVOC = Global emissions of NMVOC (ton); ConsNat = Domestic consumption of glues and adhesives produced in Portugal (ton) FE_{Nat} = Emission factor for glues and adhesives produced in Portugal (kg NMVOC/ton Ink) Imp = Imported glues and adhesives (ton) FE_{imp} = Emission factor associated with the use of imported glues and adhesives. $Cons_{Nat}$ = $Prod_{Nat}$ - Exp where: $Cons_{Nat}$ = Consumed glues and adhesives produced in Portugal (ton) $Prod_{Nat}$ = National production of glues and adhesives (ton) Exp = Exported glues and adhesives (ton). To estimate the emission factor applied for the use of national glues and adhesives, the ratio of the amount of solvents consumed during manufacture processes with the amount of glues and adhesives manufactured was computed, and an average emission factor obtained. The emission factor for VOC emission from the manufacture of glue and adhesives was subtracted from this value to obtain the emission factors for use of national produced glue and adhesives. ***Wood Preservation*** $EMI_{NMVOC\ (y)}$ = Consumption(y) * $FE_{Consumption}$ where: $EMI_{NMVOC(y)}$ - Emissions of NMVOC associated to consumption of wood preservation products (ton) Consumption(y) - Consumption of wood preservation products (ton) $FE_{Consumption}$ - Emission factor associated to the consumption of wood preservation products. CORINAIR90 Emission Factor Handbook proposes three emission factors for VOC emission from wood preservation, depending on the type of product used. The emission factor is 100 kg/ton of product applied for creosote; 900 kg/ton for solvent based products and 0 for water based products. The available data do not discriminate the share of the several types of preservation products, therefore, it was assumed that the main product used in Portugal is creosote. Activity Data (Wood Preservation products Consumption) were obtained from National Statistics Institute (INE) ***Domestic solvent use including fungicides*** This secotr addresses emissions from the use of solvent containing products by the public in their homes. This sector does not include the use of decorative paints which is covered by source category 3.A. Paint Application. MVOC's are used in a large number of products sold for use by the public. These include: - Cosmetics and toiletries; Products for the maintenance or improvement of personal appearance, health or hygiene. - Household products; Products used to maintain or improve the appearance of household durables. - Construction/Do-It-Yourself; Products used to improve the appearance or the structure of buildings such as adhesives and paint remover. - Car care products; Products used for improving the appearance of vehicles to maintain vehicles or winter products such as antifreeze. Pesticides such as garden herbicides and insecticides and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this section. Emission from this sector were calculated using a Tier 1 approach. This approach uses a single emission factor expressed on a person basis which was multiplied by the population to derive emissions from domestic solvent use. $NMVOC_i$ = Population i x EF_{NMVOC} where: $NMVOC_i$ - Emissions of NMVOC, Population i – inhabitants in year i; EF_{NMVOC} - Emission factor associated with the use of domestic products containing solvents [kg/person/year] Emission Factors Emission factor for NMVOC was obtained from EMEP/CORINAIR Guidebook, 2009. This default emission factor has been derived from an assessment of the emission factors presented in GAINS model developed by IIASA. Activity data were obtained from National Statistics Institute (INE).

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Luxembourg (NIR LU 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	no
Uncertainties:	-	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	No		
Sector specific QA/QC and verification:		Source specific QA/QC procedures	

Methodology (CO_2 emissions):

As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used, in Luxembourg, in the various applications, a bottom up and a top down approach were combined.

The top down approach provides total quantities of solvents used in Luxembourg. The share of solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. It was based on the economic structure in Luxembourg, applying solvent use and emission factors from the Austrian survey by linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. This model has been developed for Austria (WINDSPERGER et al. 2002a, 2004) and was in the meantime applied for different European countries within the network "non-energy use of fossils and CO_2 emissions" (WINDSPERGER & STEINLECHNER, 2006). The application for Luxembourg is suitable as both countries show similar situation regarding economic and technical structure, and moreover as members of the EU similar legal framework conditions.

A study compiled for Austria (WINDSPERGER et al. 2002a) showed huge overestimation of NMVOC emissions when emission estimates are based on a top down approach only because a large amount of substances is used for "non-solvent-applications". "Non-solvent applications" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE/ETBE, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE/ETBE which is used as fuel additive and finally combusted; these emissions are considered in the transport sector. Additionally, the comparison of the top-down and the bottom-up approaches helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, de-icing agents of aeroplanes, tourism, which were not considered in the top-down approach.

***Top down Approach is based** on:*

1) import-export statistics on solvent substances and solvent containing products (foreign trade balance) (STATEC);

2) production statistics on solvents in Luxembourg;

3) a survey on non-solvent-applications in companies in Austria (Windsperger et al. 2004a);

4) survey on the solvent content in products and preparations at producers and retailers in Austria (Windsperger et al. 2002a).

ad (1) and (2): Total quantity of solvents used in Luxembourg were obtained from import-export statistics and production statistics provided by STATEC. Nearly a full top down investigation of substances of the import-export statistics from 1993 to 2008 was carried out (data 1990 – 1992 were interpolated). One problem is that the methodology of the import-export statistics changed over the years. In case of severe deviations between some years smoothing the time series with the mean values was used. In Luxembourg, there are only few facilities producing solvents. The production of solvents considerably decreased, especially in the last years.

ad (3): In a study on the comparison of top down and bottom up approach in Austria (WINDSPERGER et al. 2002a), the amount of solvents used in "non-solvent-applications" was identified. The most important companies in Austria were identified and asked to report the quantities of solvents they used over the considered time period in „non-solvent-applications". In combination with import-export statistic for these solvent substances the percentages of „non-solvent-applications" were calculated. For Luxembourg, these percentages of "non-solvent-applications" were adapted to the country's specific situation according to information from companies in Luxembourg.

ad (4): Relevant producers and retailers provided data on solvent content in products and preparations in Austria. These data were also adapted to Luxembourg due to the country specific situation.

5.2.1 Bottom up Approach

In a first step, an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this extensive survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

Furthermore, information was gathered on:

1) type of application of the solvents:"final application", "cleaner" and "product preparation" as well as

2) actual type of waste gas treatment: "open application", "waste gas collection" and "waste gas treatment".

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. The survey in 1 300 Austrian companies in the year 2000 was carried out at all industrial branches with solvent applications at NACE-level-4. Within these NACE-levels data on solvent use distinguished in substance categories was collected from the companies and a factor of "solvent use per employee" was calculated. For the calculation of the total amounts within the SNAP-digit (level 3) the number of employees in the respective NACE-levels in 2000 was used (WINDSPERGER et al. 2002b). In accordance with statistics in other European countries the structural business statistics (number

Luxembourg (NIR LU 2013)

of employees (NACE Rev.1.1)) were taken from Eurostat 2008. In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002a) for estimating the domestic solvent use (37 categories in 5 main groups: cosmetic, do-it-yourself, household cleaning, car, fauna and flora). Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated. The comparison of top down and bottom up approach helped to identify several additional applications that make an important contribution to the total amount of solvents used. Thus in a third step the quantities of solvents used in these applications such as windscreens wiper fluids, antifreeze, hospitals, de-icing agents of aeroplanes, tourism were estimated in surveys.

The outcome of these three steps was the total amount of solvents used for each application in the year 2000 (at SNAP level 3) in Austria (WINDSPERGER et al. 2002a).

To adapt the values for Luxembourg coefficients of the solvent consumption per employee (respective inhabitant) were used and applied to the employees of the industry sectors in Luxembourg (resp. Inhabitants). The outcome was the total amount of solvents for every application in the year 2000 in Luxembourg.

To achieve a time series, the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between “general aspects” and “specific aspects”. The information about these defined aspects were collected for two pillar years (1990 and 1995) and were taken from several studies (SCHMIDT et al. 1998, BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the two pillar years was estimated. For the years in between, data was linearly interpolated. Since 2000, no new survey has been conducted so that the data remain constant since then.

Because of unavailability of data of employees in 1990 in the European database, the number of employees was taken out from 1995.

5.2.2 Combination Top-down – Bottom-up approach and updating

To verify and adjust the data, the solvents given in the top down approach and the results of the bottom up approach were differentiated in the pillar years (1995, 2000, 2003, 2005). The differences between the quantities of solvents from the top down approach and bottom up approach respectively are lower than 10%.

As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That’s why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach.

5.2.3 Calculation of CO_2 emissions from Solvent Emissions

The basis for the calculation of the carbon dioxide emissions were the quantities of solvent emissions differentiated by the 15 groups of substances (acetone, methanol, propanol, solvent naphtha, paraffins, alcohols, glycols, ester, aromates, ketones, aldehydes, amines, organic acids, cyclic hydrocarbons, and others). Substance specific carbon dioxide factors for these 15 substance groups have been created in Austria on the basis of the carbon content and the stoichiometrically formed CO_2.

5.2.4 N_2O emissions from Anaesthesia (3D1)

For the period 1990-2002, no data from the hospitals on the consumption of N_2O could be obtained. Hence, N_2O emissions from anaesthesia usage were estimated by combining reported emissions in Germany with the relative population in Luxembourg. From 2003 to 2010, the use of N_2O in hospitals for anaesthesia was directly obtained from the “Entente des hôpitaux luxembourgeois”. Thus, country-specific data was used. It was assumed that all the N_2O used for anaesthesia is completely released to the atmosphere.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Italy (NIR IT 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	Yes
Uncertainties:	CO_2: AD: 30%; EF: 50%; N_2O: AD: 50%; EF: 10%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	Yes		
Sector specific QA/QC and verification:	Source specific QA/QC procedures including an independent review was organized in October 2012 between Italy and Spain, in which the solvents sector was analysed.		

Methodology (CO_2 emissions):

Emissions of NMVOC from solvent use have been estimated according to the methodology reported in the EMEP/CORINAIR guidebook, applying both national and international emission factors (Vetrella, 1994; EMEP/CORINAIR, 2007). Country specific emission factors provided by several accredited sources have been used extensively, together with data from the national EPER Registry; in particular, for paint application (Offredi, several years; FIAT, several years), solvent use in dry cleaning (ENEA/USLRMA, 1995), solvent use in textile finishing and in the tanning industries (TECHNE, 1998; Regione Toscana, 2001; Regione Campania, 2005; GIADA 2006). Basic information from industry on percentage reduction of solvent content in paints and other products has been applied to EMEP/CORINAIR emission factors in order to evaluate the reduction in emissions during the considered period. Emissions from domestic solvent use have been calculated using a detailed methodology, based on VOC content per type of consumer product.

As regards household and car care products, information on VOC content and activity data has been supplied by the Sectoral Association of the Italian Federation of the Chemical Industry (Assocasa, several years) and by the Italian Association of Aerosol Producers (AIA, several years [a] and [b]). As regards cosmetics and toiletries, basic data have been supplied by the Italian Association of Aerosol Producers too (AIA, several years [a] and [b]) and by the national Institute of Statistics and industrial associations (ISTAT, several years [a], [b], [c] and [d]; UNIPRO, several years); emission factors time series have been reconstructed on the basis of the information provided by the European Commission (EC, 2002). The conversion of NMVOC emissions into CO_2 emissions has been carried out considering that carbon content is equal to 85% as indicated by the European Environmental Agency for the CORINAIR project (EEA, 1997), except for CO_2 emissions from the 3C sub-sector which are not calculated to avoid double-counting. These emissions are, in fact, already accounted for in sectors 1A2c and 2B.

Methodology, Activity data & Emission factor (N_2O emissions):

Emissions of N_2O have been estimated taking into account information available by industrial associations. Specifically, the manufacturers and distributors association of N_2O products has supplied data on the use of N_2O for anaesthesia from 1994 to 2011 (Assogastecnici, several years). For previous years, data have been estimated by the number of surgical beds published by national statistics (ISTAT, several years [a]). Moreover, the Italian Association of Aerosol Producers (AIA, several years [a] and [b]) has provided data on the annual production of aerosol cans. It is assumed that all N_2O used will eventually be released to the atmosphere, therefore the emission factor for anaesthesia is equal to 1 Mg N_2O/Mg product use, while the emission factor used for aerosol cans is 0.025 Mg N_2O/Mg product use, because the N_2O content in aerosol cans is assumed to be 2.5% on average (Co.Da.P., 2005).

For the estimation of N_2O emissions from explosives, data on the annual consumption of explosives have been obtained by a specific study on the sector (Folchi and Zordan, 2004); as stated in the document, this figure is believed to be constant for all the time series with a variation within a range of 30%. As for the emission factor, the estimated N_2O emissions represent the theoretically maximum emittable amount; in fact, no figures are available on the amount of N_2O emissions actually emitted upon detonations and the value of 3,400 Mg N_2O/Mg explosive use is provided by a German reference (Benndford, 1999) which corresponds to the assumption of 68 g N_2O per kg ammonium nitrate. N_2O emissions have been calculated multiplying activity data, total quantity of N_2O used for anaesthesia, total aerosol cans and explosives, by the related emission factors.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Spain (NIR ES 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	No
Uncertainties:	AD: 50%; EF: 25%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	Yes
Recalculation:	Yes		
Sector specific QA/QC and verification:		Source specific QA/QC procedures.	

Methodology (CO_2 emissions):

Este sector comprende un grupo heterogéneo de categorías en cuyos procesos lo que prima es la utilización de compuestos orgánicos volátiles excepto metano (COVNM) que se traducen en emisiones finales de CO_2, así como otros productos que tienen un potencial de calentamiento directo (N_2O y eventualmente emisiones inmediatas de CO_2, si bien estas últimas no se ha constatado hasta ahora en esta categoría del inventario).

En relación con los COVNM son relevantes las emisiones originadas en las categorías siguientes: 3A Aplicación de pintura ; 3B Limpieza en seco y desengrasado ; 3C Fabricación y tratamiento de otros productos químicos ; 3D Otros - Usos de disolventes y N_2O y actividades relacionadas.

Es importante reseñar que de acuerdo con la metodología unificada de IPCC y EMEP/CORINAIR, se incluyen en el cálculo de las emisiones de gases de efecto invernadero de este sector, además del cómputo inmediato de las emisiones de CO_2 y N_2O, las emisiones finales de CO_2 provenientes de la oxidación de las emisiones (inmediatas) de COVNM correspondiente a las categorías 3A, 3B y 3D.

Para los COVNM, la metodología aplicada para la estimación de las emisiones es esencialmente la de EMEP/CORINAIR, complementada con aportaciones y consultas realizadas con IIASA y EGTEI3.

Como especificidades cabe destacar que, para algunas fuentes emisoras de especial relevancia, la información se ha recabado y procesado a nivel de planta individualizada (caso de las plantas de fabricación de automóviles). Para las restantes fuentes emisoras, la información sobre las variables de actividad procede en su inmensa mayoría de las asociaciones empresariales correspondientes, entre las que cabe destacar las siguientes: (1) Asociación Española de Fabricantes de Pinturas y Tintas de Imprimir (ASEFAPI); (2) Federación Empresarial de la Industria Química Española (FEIQUE); (3) Confederación Española de Empresarios de Plástico (ANAIP); (4) Asociación Técnica del Poliuretano Aplicado (ATEPA); (5) Asociación Nacional de Poliestireno Expandido (ANAPE); Asociación de la Industria del Poliuretano Rígido (IPUR); (6) Consorcio Nacional de Industriales del Caucho (COFACO); (7) Asociación Nacional de Empresas para el Fomento de las Oleaginosas y su Extracción (AFOEX); (8) Asociación Nacional de Empresas de Protección de la Madera (ANEPROMA). Asimismo, se ha utilizado en el caso de algunas actividades información de estadísticas generales, tales como la población del Instituto Nacional de Estadística (INE), la Encuesta Industrial (INE) o la publicación "La Industria Química en España" del Ministerio de Industria, Energía y Turismo (MINETUR).

En cuanto a los factores de emisión, la metodología utilizada trata de cuantificar el contenido de COVNM en los disolventes y otros productos que contienen estas sustancias. En su caso, se incorporan los coeficientes reductores correspondientes a las distintas técnicas de aplicación y de abatimiento de las emisiones resultantes. En particular, y para el caso de aplicación de pinturas, es especialmente relevante la diferenciación entre los distintos tipos de pinturas (al agua, al disolvente, etc.). En la medida que se dispone de información de la evolución de estas técnicas en el tiempo, los factores aparecen diferenciados para cada año.

Especial mención merece el caso de las fábricas de automóviles, para las cuales se ha realizado un tratamiento individualizado en cada planta, recabando la información sobre cantidades de concentrado y disolvente utilizadas y sus contenidos en COV en las distintas fases de las líneas de pintado del proceso productivo, así como de los procesos de recuperación y eliminación implantados en cada centro, de manera que la emisión se estima por balance de masas.

Una vez que se han determinado las emisiones inmediatas de COVNM su conversión a CO_2 final se realiza utilizando el siguiente algoritmo: Emisión CO_2 = Emisión COVNM · 0,85 · 44/12 ; donde 0,85 es el coeficiente para pasar la masa de COVNM a masa de carbono, y 44/12 para expresar la masa de carbono en masa de CO_2.

Methodology, Activity data & Emission factor (N_2O emissions):

En cuanto al uso de N_2O, cabe mencionar que en el inventario español sólo se ha identificado como fuente emisora la utilización de este gas en anestesia, actividad que se encuadra dentro de la categoría 3D.

Por lo que al N_2O se refiere, las emisiones consideradas en el inventario se circunscriben, tal y como se ha mencionado anteriormente, al uso de este gas con fines anestésicos. El óxido nitroso, con su característica de mayor solubilidad en grasas que en el agua, es transportado en forma gaseosa por la sangre hasta el sistema nervioso central a través de los líquidos contenidos en este último, donde se produce un estado de completa inconsciencia o narcosis. Como muchos otros productos anestésicos volátiles, el N_2O sale del organismo sin experimentar cambios, es decir, es refractario al catabolismo de los procesos biológicos. Debido a esta propiedad la emisión de N_2O se considera igual al consumo que de dicho gas se hace para este uso. Dicho consumo se ha estimado a partir de la información facilitada por el Ministerio de Sanidad, Servicios Sociales e Igualdad para los años 2000-2011, habiéndose estimado los consumos correspondientes a los años 1990-1999 mediante procedimientos de extrapolación, utilizando como información complementaria los datos suministrados para dicho periodo por una de las grandes empresas del sector.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
France (NIR FR 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	Yes (TIER2)
Uncertainties:	AD: 20%; EF: 20%	**Completeness:**	Yes
Time series consistency:	Yes	**Planned improvements:**	Yes
Recalculation:	No		
Sector specific QA/QC and verification:		Generale QA/QC procedures.	

Methodology (CO_2 emissions):

Les émissions de CO_2 traduisent la transformation du carbone contenu dans les émissions de COVNM en CO_2 ultime. Cette conversion se fait sur la base d'un contenu moyen en carbone de 85%. Au total pour cette catégorie, les émissions ultimes de CO_2 ont été réduites de 1992 Gg à 1037 Gg de 1990 à 2011. Les principales réductions ont eu lieu dans le secteur de l'application de peinture (grâce à une baisse de l'activité et une réduction de la teneur en solvant des peintures), du dégraissage et du nettoyage à sec (amélioration du recyclage et renouvellement des matériels).

Les émissions de CO_2 traduisent la transformation du carbone contenu dans les €missions de COVNM provenant de l'application de peintures en CO_2 ultime. Cette conversion se fait sur la base dÅun contenu moyen en carbone de 85%.

3.A. AD: Mix top-down (provenant des statist. du secteur) et bottum-up lorsque les informations par usine sont disponibles. EF : Estimés au niveau national en concertation avec la profession dans le cas général. Recalcul sé partir des facteurs d'émission spécifiques chaque installation si ceux-ci sont disponibles.

3.B. AD: Estimation des consommations totales de solvants EF: Pour le dégraissage des métaux, directement dé éduits des émissions de COVNM. Pour le nettoyage à sec, estimé à partir des données des industriels

3.C. AD: Traitement des statistiques de consommation au niveau national ou bottom-up suivant les secteurs. EF : Spécifiques aux secteurs. Valeurs nationales par dé€ faut ou spécifiques à chaque installation si elles sont disponibles

3.D. AD: des statistiques de consommation au niveau national ou bottom-up suivant les secteurs ; EF: Spécifiques aux secteurs. Valeurs nationales par défaut ou informations par installation lorsquÅelles sont disponibles

Methodology, Activity data & Emission factor (N_2O emissions):

3.D. AD: Population ; EF Valeur par défaut

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Sweden (NIR SE 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	No
Uncertainties:	CO_2 3A - AD: 11%; EF: 15% 3B - AD: 15%; EF: 20% 3C - AD: 15%; EF: 20% 3D - AD: 14%; EF: 19% N_2O 3D - AD: 10%; EF: 10%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	Yes
Recalculation:	yes		
Sector specific QA/QC and verification:		General QA/QC procedures.	

Methodology (CO_2 emissions):

3.A: All activity data from 1995 has been obtained from the Products register at the Swedish Chemicals Agency. Emissions from 1988 are taken from a time series that was compiled in a special study concerning NMVOC emissions, carried out by SMED in 2002133. The emissions for 1990-1994 have been interpolated based on the information from the late 1980´s and known data for 1995.

3.B: All activity data from 1995 has been obtained from the Products Register at the Swedish Chemicals Agency. Emission data for 1988 is based on reported quantities of tetrachloroethylene from the Swedish Chemicals Agency. After 1995 also other substances for degreasing and dry cleaning are included. Of the total amount of NMVOC used within CRF 3B these "non tetrachloretylene" substances contribute approximately 30%. As not only tetrachloroethylene is included in the time series after 1995, the NMVOC emissions reported 1988 is recalculated using a correction factor based on the proportion of other NMVOCs of the total NMVOC for 1995 (tetrachloroethylene plus 30 %). Emissions between 1990 and 1994 have been interpolated based on the information from the late 1980´s and known data for 1995. The solvents used within CRF 3B includes a lower carbon share compared to the solvents used in the other sub-codes within CRF 3.

3.B: The category includes emissions from car manufacturing, paint industry and from rubber industry. Emissions from car manufacturing contributed in 2005 by approximately 50%, paint industry by 35 % and rubber industry by 15 % of the reported emissions in CRF 3C. The corresponding figures for 2011 are 35 %, 45 % and 20 %, respectively. Emission data for car manufacturing has been compiled from environmental reports for 1990 and data for 1991-1994 has been interpolated. For paint industry emission data for 1990-1994 has been taken from the old time series given in a special study concerning NMVOC emissions, carried out by SMED in 2002133. Emission data for the rubber industry is known for 1988133 and data for 1990-1994 have been interpolated based on the information from the late 1980´s and known data for 1995.

3.D : Solvents used in printing industry, for preservation of wood, in leather industry and in textile industry have been estimated separately. The code also includes solvents used by other industries not reported separately, and also solvents for domestic use. The printing industry contributes to totally reported CO_2 and NMVOC in CRF 3.D by around 8 %. The corresponding figure for preservation of wood and leather and textile industry is below 1%, while general solvent use represents over 90% of the total reported emissions in CRF 3D. Emission data for 1988 is known for most industries included in CRF 3D and in most cases the emissions for 1990-1994 have been interpolated based on information from the late 1980´s and known data for 1995.

Methodology, Activity data & Emission factor (N_2O emissions):

There are two companies in Sweden selling N_2O in gas cylinders. Information on sold amounts was obtained from one of the companies (1990 - 1991) and from the Products Register at the Swedish Chemicals Agency (1992 - 2010). The time series of use of N_2O in Sweden are reported in Other use of N_2O (3.D.4) since no background data is available to separate between the source categories Use of N_2O for Anaesthesia (3.D.1) and N_2O from Aerosol cans (3.D.3). Consequently CRF codes 3.D.1 and 3.D.3 are both reported as IE. Activity data for the latest year, 2011, is not yet official and hence Sweden has chosen to report data from 2010 also for 2011. Data for 2011 will be updated in the next submission.

5.3 Sector-specific quality assurance and quality control (EU-15)

This year for the first time sector specific quality assurance and quality control was implemented for the sector Solvents and other product use. Before and during the compilation of the EU GHG inventory, Member States data was checked. The checks focused on completeness (including the use of the notation keys “NE”, “NO” and “NA”), time series consistency and plausibilty of emission data, comparison of data across Member States and checks of internal consistency. The findings were communicated to Member States. It is planned to extend this procedure in the next years.

5.4 Sector-specific recalculations (EU-15)

Table 5.8 shows that in the solvent sector recalculations were made for CO_2 and N_2O.

Table 5.8 Sector 3 Solvent and Other Product Use: Recalculations of total GHG emissions and recalculations of GHG emission for 1990 and 2010 by gas ($GgCO_2$-equivalents and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
		percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	33 412	1.0%	1 062	0.2%	329	0.1%	3	0.0%	0	0.0%	20	0.2%
Solvent and other product use	97	1.1%	0	0.0%	-367	-7.8%	NO	NO	NO	NO	NO	NO
2010												
Total emissions and removals	15 626	0.5%	-8 309	-2.7%	-2 845	-1.1%	67 953	-5.2%	-28	-0.9%	114	1.9%
Solvent and other product use	-165	-2.8%	0	0.0%	-1 198	-32.2%	NO	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 5.9 provides an overview of Member States’ contributions to EU-15 recalculations:

- Denmark, France, Portugal and Spain provided recalculations of CO_2 emissions for 1990;
- Spain provided recalculations of N_2O emissions for 1990;
- Denmark, France, Italy, Netherlands, Portugal, Spain and Sweden provided recalculations of CO_2 emissions for 2010.
- Belgium, Netherlands, Spain and Sweden provided recalculations of N_2O emissions for 2010.

Table 5.9 Sector 3 Solvent and Other Product Use: Contribution of Member States to EU-15 recalculations for 1990 and 2010 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2010					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Belgium	NA	0	0	NO	NO	NO	NA	0	-3	NO	NO	NO
Denmark	23	0	0	NO	NO	NO	111	0	0	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	3	0	0	NO	NO	NO	-130	0	0	NO	NO	NO
Germany	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	18	0	0	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	26	0	-16	NO	NO	NO
Portugal	-2	0	0	NO	NO	NO	-2	0	0	NO	NO	NO
Spain	74	0	-367	NO	NO	NO	-149	0	-1 196	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	-39	0	17	NO	NO	NO
UK	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
EU-15	**97**	**0**	**-367**	**NO**	**NO**	**NO**	**-165**	**0**	**-1 198**	**NO**	**NO**	**NO**

5.5 Responses of EU-15 Member States to UNFCCC Reviews for findings in the Sector Solvents and other Product Use

Table 5.10 provides an overview of EU-15 member state's responses to the UNFCCC Review findings in the sector Solvents and other product use. For the following Member States the ARRs 2012 (reviewing the 2012 submission) were considered: Austria, Italy, Luxembourg and Sweden. For all other Member States the ARRs 2011 were considered. The choice was based on the date when the ARRs were published.

Table 5.10 EU 15 member State's responses to UNFCCC review findings for Fugitive Emissions

Gas	**Member State**	**UNFCCC review findings for the 2011/2012 submission**	**MS response**
-	Austria	No review finding	-
-	Belgium	No review finding	-
all gases	Denmark	The current ERT detected no evident implemented changes in the 2011 annual submission, but Denmark indicated during the review that the data sources and methods used to estimate emissions for the years 1990–1994 will be made consistent with the methods used to estimate emissions for after 1994 and that information thereon will be provided in the 2012 annual submission. The ERT welcomes this improvement and recommends that Denmark reflects the planned changes in its next annual submission.	This improvement was carried out in the 2012 submission.
-	Finland	No review finding	-
-	France	No review finding	-
-	Germany	No review finding	-
-	Greece	No review finding	-
-	Ireland	No review finding	-
-	Italy	No review finding	-
all gases	Luxem-bourg	Ensure time-series consistency by recalculating the emissions for the period 1990–2002	No information found
-	Netherla nds	No review finding	-
-	Portugal	No review finding	-
-	Spain	No review finding	-

Gas	Member State	UNFCCC review findings for the 2011/2012 submission	MS response
-	Sweden	No review finding	-
-	United Kingdom	No review finding	-

6 AGRICULTURE (CRF SECTOR 4)

Half the European Union's land is farmed. This fact alone highlights the importance of farming for the EU's natural environment. Farming and nature exercise a profound influence over each other. Farming has contributed over the centuries to creating and maintaining a variety of valuable semi-natural habitats. Today these shape the majority of the EU's landscapes and are home to many of the EU's richest wildlife. Farming also supports a diverse rural community that is not only a fundamental asset of European culture, but also plays an essential role in maintaining the environment in a healthy state[30].

The links between the richness of the natural environment and farming practices are complex. While many valuable habitats in Europe are maintained by extensive farming, and a wide range of wild species rely on this for their survival, agricultural practices can also have an adverse impact on natural resources. Pollution of soil, water and air, fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices and land use.

Agriculture in Europe is determined by the Common Agriculural Policy (CAP) of the European Union. The CAP dates from 1957, and its foundations are entrenched in the Treaty of Rome. Initially, the emphasis of the CAP was to increase agricultural productivity, partly for food security reasons, but also to ensure that the EU had a viable agricultural sector and that consumers had a stable supply of affordable food (Gay et al., 2005). With the MacSharry reform of 1992 several steps were taken by the EU to shift CAP subsidies away from price and market support towards direct support for farmers. This was further pursued with the Agenda 2000 reform, as signified by the shift in focus towards the maintenance and enhancement of the rural environment and the growing recognition of agriculture as a multifunctional activity. In environmental terms, the focus is on

- less-favoured areas and areas with environmental restrictions, and
- on agricultural production methods designed to protect the environment and to maintain the countryside.

However price support and income payments, together with milk quotas, remained the dominant support measures. The 2003 CAP reform made further progress in the direction initiated by the Agenda 2000 reform, by aiming to make European agriculture more market oriented and giving a stronger focus to environmental protection. With the CAP reform, cross-compliance became an obligatory element of the CAP. Cross-compliance establishes a link between the granting of income support to the farmers and the compliance by the beneficiary with specified requirements of public interest (Oenema, 2008). These are given in

- "Statutory management requirements" (SMR, (Annex III of Regulation (EC) No 1782/2003) which are set in 19 community legislative acts on environment, food safety, animal health and welfare, as well as
- the obligation to maintaining land in good agricultural and environmental conditions (GAECs) and maintaining permanent pasture at level at 1.5.2004. Definitions of GAEC are specified at national or regional level and should warrant appropriate soil protection, ensure a minimum level of maintenance of soil organic matter and soil structure and avoid the deterioration of habitats.

The *Nitrates Directive* (Council Directive 91/676/EEC) is the SMR with the largest impact on greenhouse gas emissions from agriculture. The directive aims at reducing and preventing water

[30] http://europa.eu.int/comm/agriculture/envir/index_en.htm

pollution caused by nitrates from agricultural sources with the goal that nitrate concentrations in groundwater will not exceed 50 mg NO3 L^{-1} and listing codes of good practice (Annex II A) to be implemented by the farmers on a voluntary basis. Nitrate vulnerable zones must be designated on the basis of monitoring results which indicate that the groundwater and surface waters in these zones are or could be affected by nitrate pollution from agriculture. The action program must contain mandatory measures relating to: (i) periods when application of animal manure and fertilisers is prohibited; (ii) capacity of and facilities for storage of animal manure; and (iii) limits to the amounts of animal manure and fertilisers applied to land.

This has affected emissions in most countries, for example in Belgium, manure Action Plans (based on the Nitrate directive) in Flanders affected NH_3 volatilization from manure application. The first action plan in 1991 regulated the reduced in which manure can be spread and foresees low-emission techniques for the application of manure on land. The MAP2bis in 2000 focuses on the reduction of the manure surplus and manure processing in order to reduce the NH_3 emissions from manure application on land. Other MAP's followed.

In Denmark, the environmental policy has introduced a series of measures to prevent loss of nitrogen from agricultural soil to the aquatic environment. The measures include improvements to the utilisation of nitrogen in manure, a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals per hectare and maximum nitrogen application rates for agricultural crops. All farmers are obliged to do N-mineral accounting a a farm and field level with the N-excretaion data from FAS (Faculty of Agricultural Sciences). The N figures also include the quantities of mineral fertilisers bought and sold. Suppliers of mineral fertilisers are required to report all N sales to commercial farmers to the Plant Directorate. An active environmental policy has brought about a decrease in the N-excretion and a decrease of emission per produced animal, because of more efficient feeding. As a result of increasing requirements to reduce the nitrogen loss to the environment, the consumption of nitrogen in synthetic fertiliser has more than halved from 1990 to 2007.

In the Netherlands, manure and fertiliser policy influences livestock numbers. Especially young cattle, pigs and poultry numbers decreased by the introduction of measures like buying up part of the so-called pig and poultyr production rights (ceilings for total animal numbers) by the government and lowering the maximum nutrient application standards for manure and fertiliser.

However, greater compliance to standards and requirements for animal welfare and the housing of animals may contribute to increasing emissions (so-called pollution swapping).

Beside the environmentally-targeted directives, also the so-called first pillar of the CAP (dealing with market support in contrast to pillar two covering rural development measures) had a strong impact on the greenhouse gas emissions from agriculture in Europe, namely through the milk quota system, which lead to a strong reduction of animal numbers in the dairy sector to compensate for the increasing animal performance during the last decades.

Other important policies affecting greenhouse gas emissions from agriculture, particularly by addressing the abatement of air pollution through the control of NO_x and NH_3 emissions include, under others,

- the 1999 *Gothenburg Protocol* under the *Convention on Long Range Transboundary Air Pollution (CLRTAP)* to 'Abate Acidification, Eutrophication and Ground-level Ozone', which entered into force on 22 June 2006;
- the National Emission Ceilings Directive (NEC - Directive 2001/81/EC), which sets upper

limits for each Member State for the total emissions in 2010 of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution;

- the *Integrated Pollution Prevention and Control* (IPPC) Directive, which was established in 1996 (http://ec.europa.eu/environment/ippc/index.htm), and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2000 fattening pigs; more than750 sows or more than 40,000 head of poultry). These are required under the directive to apply control techniques for preventing NH_3 emissions according to Best Available Technology (BAT).

Structural changes are caused also by the general development of countries. For example, in Finland, the membership in the EU resulted in changes in the economic structure followed by an increase in the average farm size and a decrease in the number of small farms (Pipatti 2001), causing also a decrease in the livestock numbers for most animal types. Swedish agriculture has undergone radical structural changes and rationalisations over the past 50 years. One fifth of the Swedish arable land cultivated in the 1950s is no longer farmed. Closures have mainly affected smallholdings and those remaining are growing larger. In 1999, some 31,000 agricultural holdings were livestock farms, 14,000 were purely crop husbandry farms, and only 5,000 were a combination of the two. Livestock farmers predominately engage in milk production and the main crops grown in Sweden are grain and fodder crops. The decrease of agricultural land area has continued since Sweden joined the European Union in 1995 and the acreages of land for hay and silage has increased. Organic farming has increased from 3 % of the arable land area in 1995 to 17 % in 2007.

6.1 Overview over the sector

Figure 6.1 EU-15 GHG emissions for 1990–2011 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg)

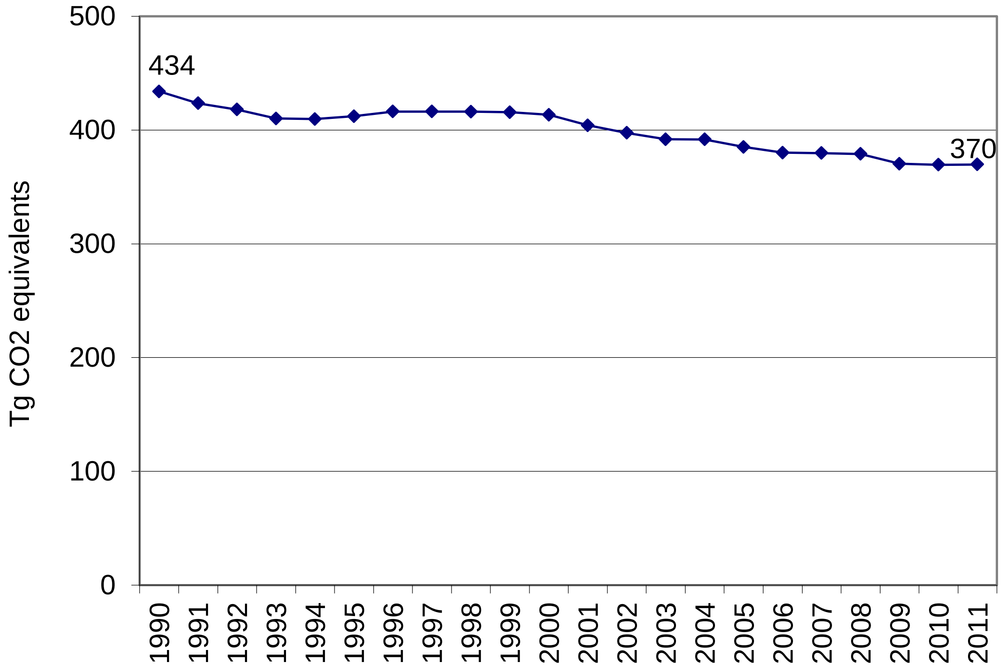
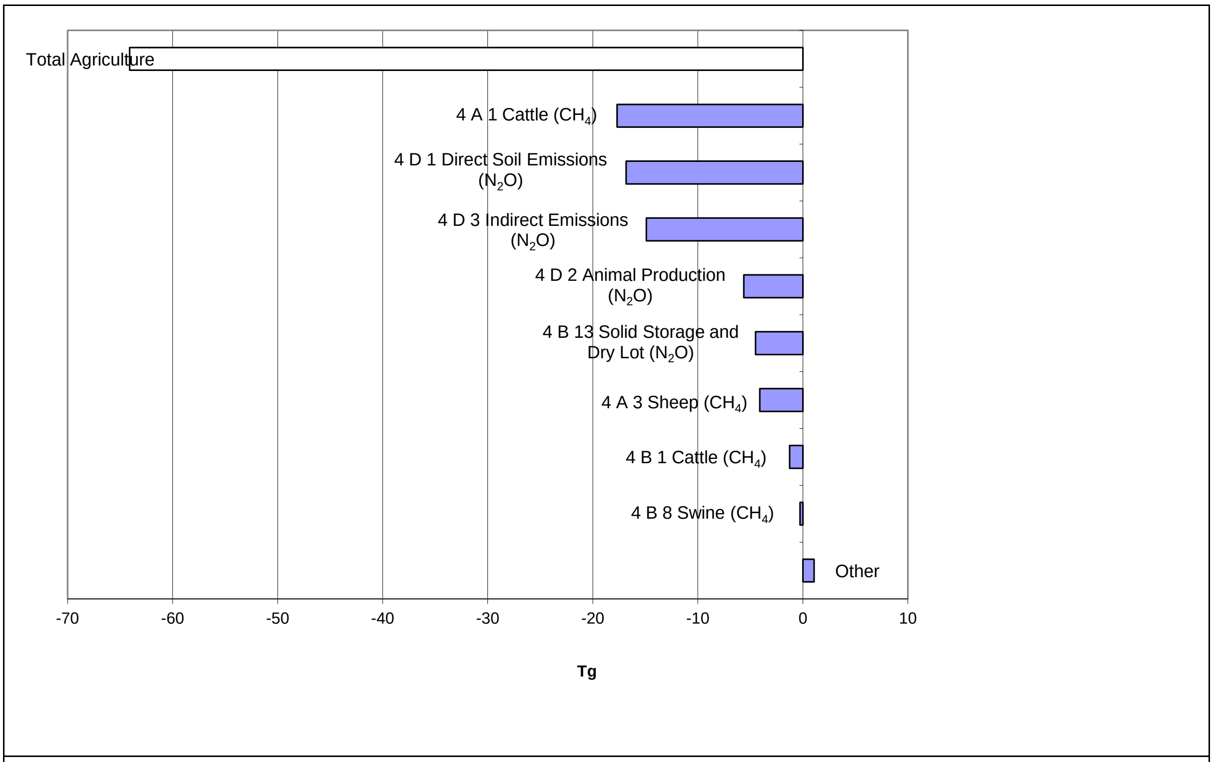
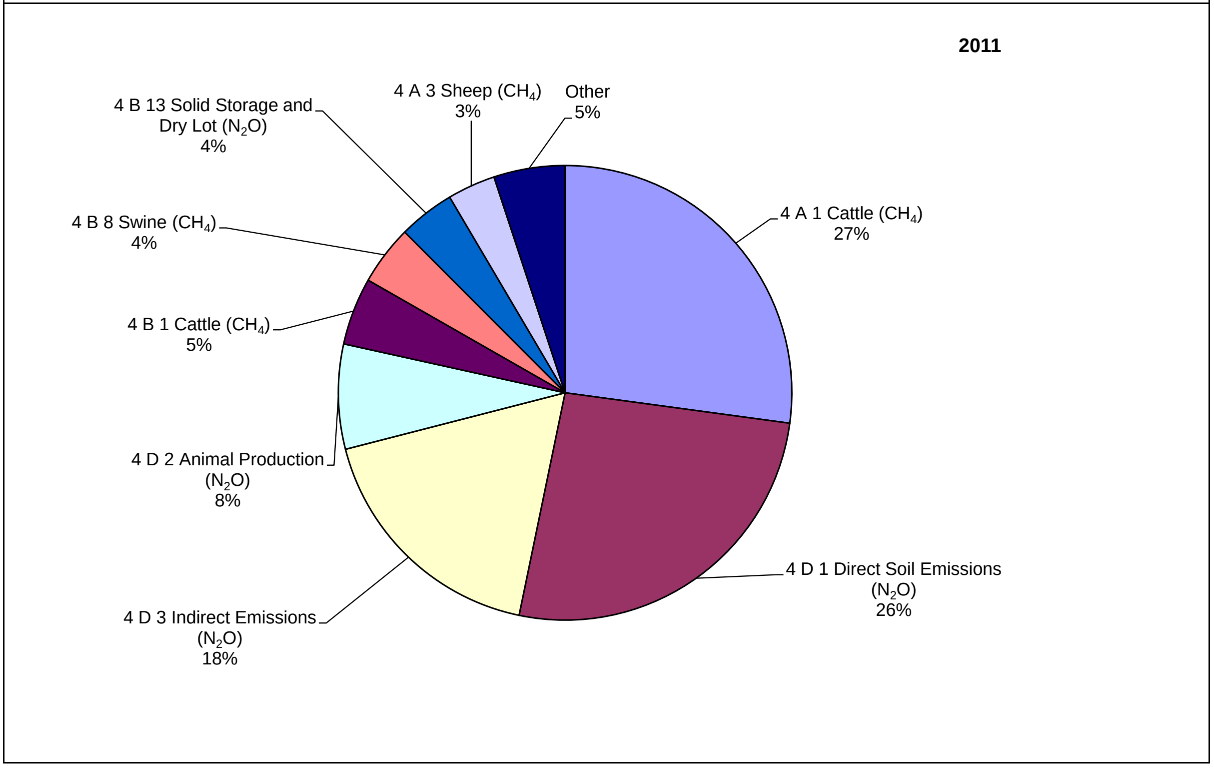


Figure 6.2 shows that large reductions occurred in the largest key sources N_2O from 4.D.1: ‘Direct soil emissions’, 4.D.3: ‘Indirect emissions’ and CH_4 from 4.A.1: ‘Cattle’. The main reasons for this are decreasing use of fertiliser and manure and declining cattle numbers in most Member States.

Figure 6.2 Absolute change of GHG emissions by large key source categories 1990–2011 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture' and share of largest key source categories in 2011





6.2 Source Categories

Table 6.1 shows total GHG and CH_4 emissions by Member State from 4A Enteric Fermentation. Between 1990 and 2010, CH_4 emission from 4A Enteric fermentation decreased by 12 %. The absolute decrease was largest in Germany, the absolute increase was largest in Spain.

Table 6.1 4A Enteric Fermentation: Member States' contributions to total GHG and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)
Austria	3 753	3 215	3 753	3 215
Belgium	4 118	3 483	4 118	3 483
Denmark	3 247	2 840	3 247	2 840
Finland	1 933	1 594	1 933	1 594
France	30 611	28 133	30 611	28 133
Germany	29 561	20 693	29 561	20 693
Greece	3 246	3 224	3 246	3 224
Ireland	9 574	8 439	9 574	8 439
Italy	12 278	10 761	12 278	10 761
Luxembourg	261	244	261	244
Netherlands	7 653	6 545	7 653	6 545
Portugal	2 709	2 784	2 709	2 784
Spain	11 120	10 515	11 120	10 515
Sweden	2 951	2 578	2 951	2 578
United Kingdom	18 593	15 190	18 593	15 190
EU-15	**141 610**	**120 238**	**141 610**	**120 238**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from cattle is the largest single source of CH_4 emissions in the EU-15 accounting for 3.3 % of total GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from enteric fermentation from cattle declined by 15 % in the EU-15 (Table 6.2). In 2011, the emissions decreased by 1% compared to 2010. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 18 % below 1990 levels in 2011. The Member States with most emissions from this source were France and Germany (together 45,3 %). All Member States except Spain, Portugal and Greece reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2011.

Table 6.2 **4A1 Cattle: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3 551	3 045	3 007	3.0%	-38	-1%	-544	-15%	T1,T2	CS,D
Belgium	3 865	3 292	3 235	3.2%	-57	-2%	-631	-16%	T2	CS,D
Denmark	2 929	2 442	2 428	2.4%	-14	-1%	-502	-17%	T2	CS
Finland	1 011	778	767	0.8%	-11	-1%	-245	-24%	T2	CS
France	27 804	26 102	25 750	25.7%	-352	-1%	-2 055	-7%	T3	CS
Germany	28 232	19 919	19 674	19.6%	-246	-1%	-8 558	-30%	CS,T2	CS
Greece	929	941	949	0.9%	8	1%	20	2%	T2	CS,D
Ireland	8 485	7 908	7 793	7.8%	-115	-1%	-692	-8%	CS,T2	CS
Italy	10 138	8 332	8 361	8.3%	30	0%	-1 776	-18%	T2	CS
Luxembourg	257	245	237	0.2%	-7	-3%	-19	-8%	T2	CS
Netherlands	6 783	5 870	5 765	5.7%	-104	-2%	-1 017	-15%	T2	CS
Portugal	1 860	2 219	2 215	2.2%	-4	0%	355	19%	T2	CS
Spain	6 026	6 507	6 405	6.4%	-102	-2%	380	6%	CS,T2	CS,D
Sweden	2 578	2 204	2 184	2.2%	-20	-1%	-395	-15%	CS	CS
United Kingdom	13 597	11 707	11 593	11.6%	-114	-1%	-2 004	-15%	T2	D
EU-15	**118 045**	**101 509**	**100 363**	**100.0%**	**-1 147**	**-1%**	**-17 683**	**-15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from sheep is the forth largest single source of CH_4 emissions in the EU-15 and accounts for 0.35 % of total GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from enteric fermentation of sheep declined by 25 % in the EU-15 (Table 6.3). In 2010, the emissions were 3 % lower compared to 2010. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 27 % below 1990 levels in 2011. The Member States with most emissions from this source were Spain and the United Kingdom (50,9%). Most Member States reduced CH_4 emissions from enteric fermentation of sheep.

Table 6.3 **4A3 Sheep: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	52	60	61	0.5%	0	1%	9	17%	T1	D
Belgium	32	18	16	0.1%	-1	-6%	-16	-49%	T1	D
Denmark	33	40	34	0.3%	-6	-16%	1	2%	T2	D,CS
Finland	15	22	23	0.2%	1	3%	8	54%	T2	CS
France	2 048	1 578	1 523	12.0%	-56	-4%	-526	-26%	T3	CS
Germany	549	351	279	2.2%	-72	-21%	-270	-49%	T1	D
Greece	1 656	1 680	1 678	13.3%	-2	0%	22	1%	T2	CS,D
Ireland	1 032	560	571	4.5%	11	2%	-461	-45%	T1	D
Italy	1 468	1 327	1 334	10.6%	7	1%	-134	-9%	T1	D
Luxembourg	1	2	2	0.0%	0	-1%	0	23%	T1	D
Netherlands	286	190	183	1.4%	-7	-4%	-103	-36%	T1	D
Portugal	579	453	409	3.2%	-44	-10%	-170	-29%	T2	CS
Spain	4 269	3 422	3 109	24.6%	-314	-9%	-1 160	-27%	T2, CS	D, CS
Sweden	68	95	105	0.8%	10	10%	36	53%	T1	D
United Kingdom	4 662	3 286	3 322	26.3%	36	1%	-1 340	-29%	T1	CS
EU-15	**16 752**	**13 084**	**12 647**	**100.0%**	**-436**	**-3%**	**-4 105**	**-25%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.1 Manure management (CRF Source Category 4B) (EU-15)

Table 6.4 shows total GHG, CH_4 and N_2O emissions by Member State from 4B Manure Management. Between 1990 and 2011, CH_4 and N_2O emissions from 4B Manure Management decreased by 4 % and 17 % respectively.

Table 6.4 **4B Manure Management: Member States' contributions to total GHG emissions, CH_4 and N_2O emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N2O emissions in 2011 (Gg CO2 equivalents)
Austria	1 365	1 250	431	325	934	925
Belgium	2 391	2 155	1 429	1 385	962	770
Denmark	1 593	1 711	993	1 308	600	403
Finland	734	726	247	300	487	426
France	14 429	14 611	8 284	9 914	6 145	4 697
Germany	10 617	7 795	6 698	4 983	3 919	2 812
Greece	656	600	352	326	304	274
Ireland	2 789	2 570	2 354	2 133	435	438
Italy	7 383	5 830	3 462	2 114	3 921	3 716
Luxembourg	120	121	79	96	41	25
Netherlands	4 235	3 686	3 053	2 634	1 183	1 052
Portugal	1 711	1 341	1 185	1 044	526	296
Spain	6 517	8 265	5 172	6 611	1 345	1 654
Sweden	967	747	234	301	733	446
United Kingdom	5 388	4 167	3 429	2 522	1 958	1 645
EU-15	**60 894**	**55 577**	**37 401**	**35 997**	**23 493**	**19 579**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B1 Cattle account for 0.49 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from this source decreased by 7 % (Table 6.5). Germany and France are responsible for 49,7 % of the total EU-15 emissions from this source. Six Member States had reductions between 1990 and 2011. In absolute terms, Ireland, Germany and Italy had the most significant decreases from this source.

Table 6.5 **4B1 Cattle: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	283	228	224	1.3%	-3	-1%	-59	-21%	T1,T2	CS,D
Belgium	341	287	283	1.6%	-5	-2%	-59	-17%	T2	CS,D
Denmark	519	596	593	3.3%	-3	-1%	74	14%	CS,T2	CS
Finland	71	91	90	0.5%	-1	-1%	18	26%	T2	CS
France	4 501	5 604	5 591	31.5%	-13	0%	1 090	24%	T2	D
Germany	4 516	3 352	3 224	18.2%	-128	-4%	-1 291	-29%	T2	D
Greece	62	58	58	0.3%	0	1%	-4	-6%	T2	CS,D
Ireland	1 888	1 606	1 581	8.9%	-24	-2%	-307	-16%	T2	CS
Italy	1 636	908	708	4.0%	-200	-22%	-929	-57%	T2	CS
Luxembourg	47	61	59	0.3%	-2	-3%	12	25%	T2	CS
Netherlands	1 593	1 735	1 795	10.1%	59	3%	201	13%	T2	CS
Portugal	48	79	78	0.4%	-1	-1%	30	63%	T2	CS
Spain	1 715	1 570	1 582	8.9%	12	1%	-133	-8%	CS,T2	CS,D
Sweden	142	211	214	1.2%	3	1%	72	51%	T2	CS
United Kingdom	1 650	1 668	1 667	9.4%	-1	0%	17	1%	T2	CS,D
EU-15	**19 012**	**18 053**	**17 746**	**100.0%**	**-307**	**-2%**	**-1 266**	**-7%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B8 Swine account for 0.43 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from this source decreased by 2 % (Table 6.6). France and Spain are responsible for 55 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source.

Table 6.6 **4B8 Swine: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	123	77	74	0.5%	-3	-3%	-49	-40%	T1	D
Belgium	1 065	1 079	1 072	6.8%	-6	-1%	7	1%	T2	CS,D
Denmark	423	619	629	4.0%	10	2%	206	49%	CS,T2	CS
Finland	IE	IE	IE	-	-	-	-	-	NA	NA
France	3 281	3 856	3 790	24.1%	-66	-2%	509	16%	T2	D
Germany	2 063	1 641	1 623	10.3%	-18	-1%	-441	-21%	T2	CS
Greece	146	129	128	0.8%	-1	-1%	-18	-13%	T1	D
Ireland	332	406	414	2.6%	8	2%	82	25%	T2	D
Italy	1 432	1 151	896	5.7%	-255	-22%	-536	-37%	T2	CS
Luxembourg	31	34	37	0.2%	2	6%	6	18%	T1	D
Netherlands	1 154	1 076	770	4.9%	-307	-28%	-384	-33%	T2	CS
Portugal	1 088	857	854	5.4%	-4	0%	-234	-22%	T2	CS
Spain	3 264	4 811	4 851	30.9%	39	1%	1 587	49%	T2, CS	D, CS
Sweden	57	45	45	0.3%	0	1%	-12	-21%	T2	CS
United Kingdom	1 496	516	512	3.3%	-3	-1%	-984	-66%	T2	CS,D
EU-15	**15 956**	**16 297**	**15 695**	**100.0%**	**-602**	**-4%**	**-261**	**-2%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B13 Solid Storage and Dry Lot account for 0.4 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source decreased by 23 % (Table 6.7). Italy and France are responsible for 52.4 % of the total EU-15 emissions from this source.All counties but Ireland decreased their emissionsbetween 1990-2011. In absolute terms, France had the most significant decrease from this source.

Table 6.7 **4B13 Solid Storage and Dry Lot: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	750	690	684	4.6%	-6	-1%	-66	-9%	T1	D
Belgium	894	726	712	4.8%	-14	-2%	-182	-20%	T1	D
Denmark	314	89	76	0.5%	-13	-15%	-238	-76%	CS,D	D
Finland	420	339	335	2.3%	-4	-1%	-85	-20%	D	D
France	5 989	4 589	4 499	30.4%	-90	-2%	-1 489	-25%	T2	D
Germany	2 512	1 691	1 654	11.2%	-37	-2%	-858	-34%	T1,T2	D
Greece	283	251	254	1.7%	2	1%	-29	-10%	D	D
Ireland	371	383	375	2.5%	-9	-2%	3	1%	T1	D
Italy	3 728	3 248	3 258	22.0%	10	0%	-470	-13%	T2	D,CS
Luxembourg	40	23	23	0.2%	-1	-3%	-17	-43%	T1	D
Netherlands	947	844	891	6.0%	47	6%	-56	-6%	T2	D
Portugal	509	278	276	1.9%	-2	-1%	-233	-46%	D	D
Spain	348	335	316	2.1%	-19	-6%	-32	-9%	D, T2, CS	D
Sweden	654	329	313	2.1%	-17	-5%	-342	-52%	T2	D
United Kingdom	1 548	1 154	1 140	7.7%	-13	-1%	-408	-26%	T1	D
EU-15	**19 307**	**14 970**	**14 805**	**100.0%**	**-164**	**-1%**	**-4 501**	**-23%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B14 Other account for 0.08 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source increased by 50 % (Table 6.8). Spain and the UK are responsible for 63,9% of the total EU-15 emissions from this source.

Table 6.8 **4B14 Other: Member States' contributions to N_2O emissions**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	151	217	214	7.7%	-3	-1%	64	42%
Belgium	57	49	49	1.7%	0	0%	-8	-15%
Denmark	192	258	250	8.9%	-8	-3%	58	30%
Finland	55	68	72	2.6%	4	6%	17	31%
France	NA	NA	NA	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	13	13	13	0.5%	0	0%	0	3%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	300	304	10.9%	4	1%	304	-
Luxembourg	0.02	0.32	0.31	0.01%	0	-2%	0	1176%
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	997	1 319	1 338	47.8%	19	1%	341	34%
Sweden	64	107	110	3.9%	2	2%	46	72%
United Kingdom	343	455	450	16.1%	-5	-1%	107	31%
EU-15	**1 871**	**2 787**	**2 800**	**100.0%**	**13**	**0%**	**929**	**50%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.2 Agricultural soils (CRF Source Category 4D) (EU-15)

N_2O emissions from this source category account for 5 % of total GHG emissions. Table 6.9 shows total GHG and N_2O emissions by Member State for N_2O from 4D Agricultural Soils. N_2O emissions from this source decreased by 16 % between 1990 and 2011. All EU-15 Member States decreased emissions.

Table 6.9 4D Agricultural Soils: Member States' contributions to total GHG and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N2O emissions in 2011 (Gg CO_2 equivalents)
Austria	3.437	3.112	3.430	3.102
Belgium	4.808	3.728	4.808	3.728
Denmark	7.702	5.118	7.702	5.118
Finland	3.990	3.541	3.990	3.541
France	54.374	48.262	54.374	48.262
Germany	47.785	41.872	47.785	41.872
Greece	7.452	4.980	7.452	4.980
Ireland	7.271	6.682	7.271	6.682
Italy	19.484	15.372	19.484	15.372
Luxembourg	362	298	362	298
Netherlands	10.669	5.798	10.669	5.798
Portugal	3.461	2.884	3.461	2.884
Spain	18.807	17.728	18.807	17.728
Sweden	5.080	4.447	5.080	4.447
United Kingdom	33.431	27.000	33.431	27.000
EU-15	**228.110**	**190.823**	**228.104**	**190.814**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.10 provides information on emission trends and information on methods applied and emissions factor of the key source from 4D1 Direct soil emissions by Member State. Direct N_2O emissions from agricultural soils is the largest source category of N_2O emissions and accounts for 2.7 % of total EU-15 GHG emissions in 2011. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2010, emissions declined by 15 % in the EU-15. The Member States with most emissions from this source were France and Germany. All Member States reduced N_2O emissions from agricultural soils.

The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 24 % and 11 % below 1990 levels in 2011, respectively. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001)

Table 6.10 **4D1 Direct soil emissions: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 909	1 739	1 862	1.9%	124	7%	-47	-2%	T1	D
Belgium	2 567	2 044	2 093	2.2%	48	2%	-475	-18%	T1a	CS,D
Denmark	4 466	3 106	3 168	3.3%	62	2%	-1 297	-29%	CS,D,T1b	D
Finland	3 032	2 804	2 756	2.9%	-48	-2%	-276	-9%	T1,T2	CS,D
France	24 712	20 516	21 634	22.4%	1 118	5%	-3 079	-12%	CR,T1,T2	CS,D
Germany	29 141	24 730	26 361	27.3%	1 631	7%	-2 780	-10%	CR,T1,T2	CR,D
Greece	2 761	1 591	1 423	1.5%	-168	-11%	-1 338	-48%	T1,T1a,T1b	CS,D
Ireland	3 022	2 882	2 762	2.9%	-120	-4%	-260	-9%	T1a,T1b	D
Italy	9 607	7 222	7 350	7.6%	128	2%	-2 257	-23%	CS,T1	CS,D
Luxembourg	161	130	126	0.1%	-3	-3%	-35	-22%	T1a,T1b	D
Netherlands	4 137	3 286	3 236	3.4%	-50	-2%	-901	-22%	T1b,T2	CS
Portugal	1 440	1 003	1 000	1.0%	-3	0%	-440	-31%	T1a	D
Spain	9 285	9 036	8 513	8.8%	-523	-6%	-772	-8%	CS,T1a,T1b	D
Sweden	2 793	2 481	2 493	2.6%	12	0%	-299	-11%	CS,T1a,T1b	CS,D
United Kingdom	14 343	11 616	11 785	12.2%	169	1%	-2 558	-18%	T1,T1a	D
EU-15	**113 376**	**94 188**	**96 563**	**100.0%**	**2 375**	**2.5%**	**-16 813**	**-15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D2 Pasture, Range and Paddock Manure account for 0.76 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source decreased by 17 % (**Error! Not a valid bookmark self-reference.**). France and the United Kingdom are responsible for 51.4 % of the total EU-15 emissions from this source. The Netherlands had the greatest reduction in absolute terms while Portugal had the largest increases.

Table 6.11 **4D2 Pasture, Range and Paddock Manure: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	169	96	95	0.3%	-1	-1%	-74	-44%	T2	D
Belgium	992	778	761	2.8%	-17	-2%	-231	-23%	T1a	D
Denmark	334	215	208	0.8%	-7	-3%	-127	-38%	CS,D	D
Finland	191	188	188	0.7%	0	0%	-3	-1%	D	D
France	9 599	8 907	8 711	31.6%	-196	-2%	-888	-9%	T2	D
Germany	2 104	1 349	1 315	4.8%	-33	-2%	-789	-37%	CR	CR
Greece	1 821	1 760	1 753	6.4%	-7	0%	-68	-4%	D	D
Ireland	2 868	2 640	2 611	9.5%	-29	-1%	-257	-9%	T1a	D
Italy	1 736	1 544	1 549	5.6%	4	0%	-187	-11%	T1	CS,D
Luxembourg	59	58	56	0.2%	-2	-3%	-3	-5%	T1	D
Netherlands	3 150	1 307	1 108	4.0%	-199	-15%	-2 042	-65%	T1b	CS
Portugal	687	820	814	3.0%	-7	-1%	127	18%	T1a	D
Spain	2 473	2 632	2 502	9.1%	-130	-5%	29	1%	`1a, T1b, CS	D
Sweden	436	445	440	1.6%	-6	-1%	4	1%	T2	CS
United Kingdom	6 572	5 495	5 455	19.8%	-40	-1%	-1 118	-17%	T2	CS
EU-15	**33 191**	**28 233**	**27 565**	**100.0%**	**-668**	**-2%**	**-5 626**	**-17%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D3 Indirect Emissions account for 1.8 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source decreased by 19 % (**Error! Not a**

valid bookmark self-reference.). France, the UK, Spain, Germany and Italy are responsible for 83.3 % of the total EU-15 emissions from this source.

Table 6.12 4D3 Indirect Emissions: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1 352	1 099	1 145	1.7%	46	4%	-207	-15%	T1a,T1b	D
Belgium	1 249	880	873	1.3%	-6	-1%	-375	-30%	T1a	CS,D
Denmark	2 902	1 705	1 742	2.7%	37	2%	-1 161	-40%	CS,D,T1b	D
Finland	767	625	602	0.9%	-22	-4%	-165	-21%	T1	D
France	20 062	17 004	17 917	27.3%	914	5%	-2 145	-11%	T1	D
Germany	16 540	13 275	14 196	21.6%	921	7%	-2 344	-14%	CR,D,T1	CR,D
Greece	2 869	1 937	1 804	2.7%	-133	-7%	-1 065	-37%	T1a	CS,D
Ireland	1 381	1 330	1 309	2.0%	-22	-2%	-72	-5%	T1b	CS
Italy	8 141	6 373	6 473	9.9%	100	2%	-1 668	-20%	T1	CS,D
Luxembourg	142	118	115	0.2%	-2	-2%	-26	-19%	T1b	D
Netherlands	3 358	1 491	1 450	2.2%	-41	-3%	-1 908	-57%	T1,T3	D
Portugal	1 333	1 081	1 076	1.6%	-5	0%	-257	-19%	T1a	D
Spain	7 049	7 143	6 713	10.2%	-430	-6%	-336	-5%	CS,T1a,T1b	D
Sweden	1 133	828	828	1.3%	0	0%	-304	-27%	CS,T1	D
United Kingdom	12 251	9 461	9 378	14.3%	-82	-1%	-2 873	-23%	T1	D
EU-15	**80 529**	**64 349**	**65 623**	**100.0%**	**1 273**	**2%**	**-14 907**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.3 Methodological issues and uncertainty

All Member States consider their greenhouse gas inventories in the agricultural sector for complete for those categories that are reported to occur in the countries. For categories 4.A, 4.B (both methane and nitrous oxide) and 4.D (nitrous oxide) emissions in all relevant sub-categories are considered (CRF Tables 7s2). CH_4 emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain.

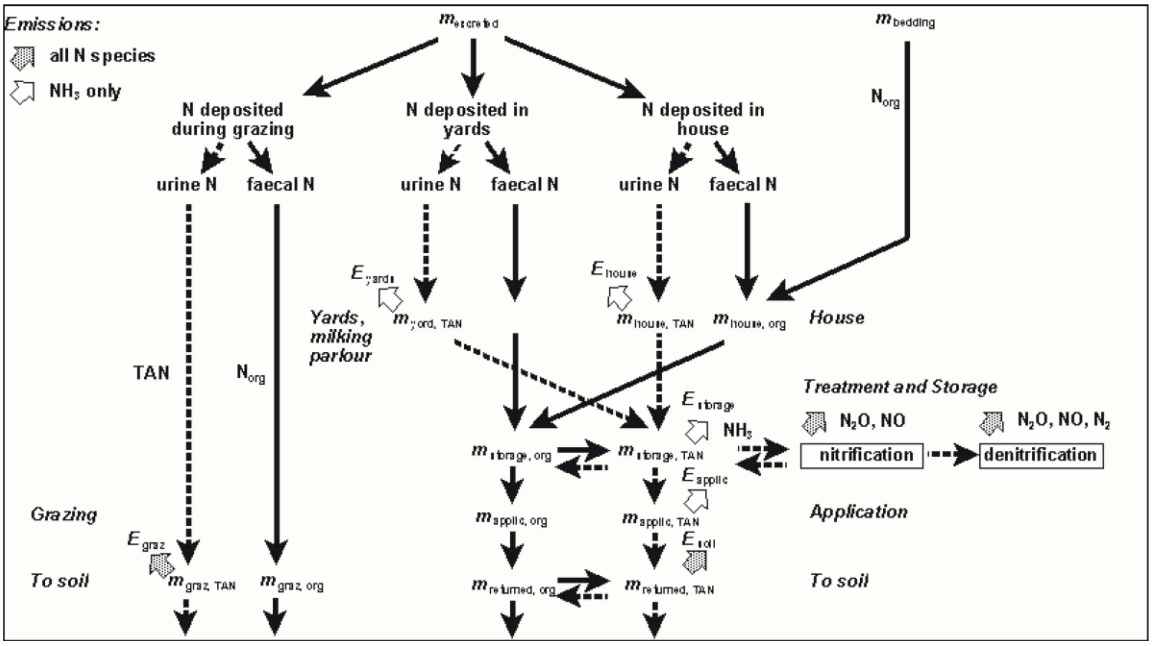
Many countries recognise that in the agriculture sector the emissions from the different categories are inherently linked and are best estimated in a comprehensive model that covers not only greenhouse gases (CH_4 and N_2O) in a consistent manner, but also ammonia. Estimations of ammonia emissions are required for reporting under the Convention on Long-Range Transboundary Air Pollution and are needed to estimate indirect N_2O emissions. Hence, some countries have developed comprehensive models covering consistently different source categories and different gases.

- Austria: For the calculation of the losses of gaseous N species the mass-flow procedure pursuant to EMEP/CORINAIR is used. A detailed emission model for NH_3, NMVOC and NO_X has been integrated into the national inventory (Amon and Hoertenhuber 2008, unpublished).
- Germany: Germany uses the emission inventory model GAS-EM (see Figure 6.3) to calculate consistently emissions of CH_4, NH_3, N_2O, and NO from agricultural sources. It is based on IPCC methodologies and has been developed in recent years with a comprehensive description found in Roesemann et al. (2013). Basis of the model is the feed intake which determine emissions in category 4A and which determines N and C excretion rates relevant for category 4B and also 4D. Data are available at district (Landkreis, livestock characterisation, housing systems, manure management systems) and regional (Bundesland, soil management) level. N-emissions are considered within a N-flow concept (Daemmgen and Hutchings, 2005). In the N-flow concept, only remainin N in manure is transferred to storage systems, after subtraction

of emissions in housing systems. Emissions are subtracted from the total N-pool.

- Denmark: The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called IDA (Integrated Database model for Ag-ricultural emissions). The model complex is designed in a relational data-base system (MS Access). Input data are stored in tables in one database called IDA_Backend and the calculations are carried out as queries in anoth-er linked database called IDA. This model complex, is implemented in great detail and is used to cover emissions of NH_3, particulate matter and greenhouse gases. Thus, there is a direct coherence between the NH_3 emission and the emission of N_2O.
- Finland: Finland uses a nitrogen mass flow model (except for N-fixing, crop residue and sewage sludge) accounts for nitrogen losses as ammonia and nitrous oxide emissions during manure management in animal houses, during storage and application; the calculation method was developed in order to avoid double-counting.

Figure 6.3 Flow of nitrogen in manure management systems (Dämmgen et al., 2007)



6.3.1 Enteric Fermentation (CRF source category 4.A)

6.3.1.1 *Source category description*

Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. The amount of methane that is released depends on the type of digestive tract, age, and weight of the animal and on the quality and quantity of the feed consumed. Ruminant livestock (e.g., cattle, sheep) are major sources of methane, but there are also moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). The ruminant gut structure fosters extensive enteric fermentation of their diet. Generally, higher feed intake induces also higher methane emission, but the extent of methane production may also be affected by the composition of the diet. Feed intake is positively related to animal size, growth rate, and production (e.g., milk production, wool growth, or pregnancy).

CH_4 emissions in the source category Enteric Fermentation stem for 8 Member States to over 85% from the sub-category "Cattle". Substantial emissions from the sub-category "Sheep" (up to 52% of emissions in category 4.A. for Greece) are reported by Greece, Italy, Portugal, Spain, and United Kingdom. Emissions accounting for more than 5% of the total emissions in this category are further reported by 4 countries for the sub-category "Goats" (Greece, 17%) and for the sub-category "Swine" (Belgium, Denmark, and Netherlands, with a maximum of 11%).

An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EC-level) and also goats and swine are given in Table 6.13. Data are given for 2011 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe.

Table 6.13: Total CH_4 emissions in category 4A and implied Emission Factor at EU-15 level for the years 1990 and 2011

1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2692	2930	798	75	136
Animal population [1000 heads]	26211	65018	114170	12805	113536
Implied EF (kg CH_4/head/yr)	103	46	7.0	5.9	1.2

2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2140	2640	602	67	139
Animal population [1000 heads]	17402	57231	83784	11350	118374
Implied EF (kg CH_4/head/yr)	123	47	7.2	5.9	1.2

2011 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	79%	90%	75%	90%	102%
Animal population [1000 heads]	66%	88%	73%	89%	104%
Implied EF (kg CH4/head/yr)	120%	102%	103%	101%	98%

Information source: CRF for 1990 and 2011, submitted in 2013

6.3.1.2 *Methodological Issues*

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in Table 6.14. In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category "enteric fermentation", the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States.

The table indicates also the Tier level of the source category and of the emission estimates for the animal types considered. For this purpose we compare the implied emission factor for dairy cattle, non-dairy cattle and sheep with the IPCC default values for Western Europe of 100 kg CH_4 head^{-1} year-1, 48 kg CH_4 head^{-1} year-1 and 8 kg CH_4 head^{-1} year-1, respectively. For a detailed description on the methodology used to estimate the "Tier-level" for the EC, see Section 6.4.1. Within the EU-15, only Greece uses Tier 1 for non-dairy cattle, taking the default values of Eastern European countries of 56 kg CH_4 head^{-1} year-1 for non-dairy cattle. A value of 56 kg CH_4 head^{-1} year-1 was also used by

Austria for non-dairy cattle, however, according to the national inventory report it was derived on the basis of a Tier 2 calculation. For cattle, all emissions are calculated with the help of country-specific data, while for sheep still 29% of the emissions are estimated with a Tier 1 approach.

Even though several Member States did not report disaggregated key source categories for category 4A, emission values show that sheep is not a key source category for most countries. However, considerable emissions from this category with more than 10% of total emissions in this category are reported by 5 countries. Therefore, most countries are applying Tier 1 methodology. Those Member States where sheep emissions are belonging to the key source categories have indeed developed a Tier 2 approach. In the case of the United Kingdom, where the default value was used, but it is adjusted for lambs, considering also the lifetime of lambs. Thus we assigned a Tier level of 1.5.

On EU-15 level, 97% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach. Overall, a Tier level between Tier 1.6 and Tier 2.0 can be derived in all EU-15 countries for the source category 'enteric fermenation' with a Tier level of Tier 1.95 for EU-15. This estimate includes also the Tier level for goat (Tier 1.3), swine (Tier 1.6) and reindeer (estimated by Finland and Sweden with national emission factors). The thus aggregated Tier level accounts for 98% of the emissions in category 4A and has been complemented with 'other emissions' assuming that these are estimated with a Tier 1 approach giving overall a quality of Tier 1.93.

Table 6.14: Total emissions, contribution of the main sub-categories to CH_4 emissions in category 4A, methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and sheep. Data for the year 2011.

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	3,215	Tier 1.9	40%	Tier 2.0	53%	Tier 2.0	y	2%	Tier 1.0
Belgium	3,483	Tier 1.9	36%	Tier 2.0	57%	Tier 2.0	y	0%	Tier 1.0
Denmark	2,840	Tier 2.0	56%	Tier 2.0	30%	Tier 2.0	y	1%	Tier 2.0
Finland	1,594	Tier 1.8	48%	Tier 2.0	28%	Tier 2.0	y	1%	Tier 1.0
France	28,133	Tier 2.0	33%	Tier 2.0	58%	Tier 2.0	y	5%	Tier 2.0
Germany	20,693	Tier 2.0	56%	Tier 2.0	39%	Tier 2.0	y	1%	Tier 1.0
Greece	3,224	Tier 1.6	11%	Tier 2.0	19%	Tier 1.0	y	52%	Tier 2.0
Ireland	8,439	Tier 2.0	30%	Tier 2.0	62%	Tier 2.0	y	7%	Tier 2.0
Italy	10,761	Tier 1.8	41%	Tier 2.0	37%	Tier 2.0	y	12%	Tier 1.0
Luxembourg	244	Tier 2.0	42%	Tier 2.0	56%	Tier 2.0	y	1%	Tier 1.0
Netherlands	6,545	Tier 1.9	61%	Tier 2.0	28%	Tier 2.0	y	3%	Tier 1.0
Portugal	2,784	Tier 2.0	26%	Tier 2.0	54%	Tier 2.0	y	15%	Tier 2.0
Spain	10,515	Tier 2.0	17%	Tier 2.0	44%	Tier 2.0	y	30%	Tier 2.0
Sweden	2,578	Tier 1.9	38%	Tier 2.0	47%	Tier 2.0	y	4%	Tier 1.0
United Kingdom	15,190	Tier 1.9	28%	Tier 2.0	48%	Tier 2.0	y	22%	Tier 1.5
EU-15	**120,238**	**Tier 1.93**	**37%**	**Tier 2.0**	**46%**	**Tier 2.0**	**y**	**11%**	**Tier 1.7**
EU-15: Tier 1	3%		0%		0%			29%	
EU-15: Tier 2	97%		100%		100%			71%	

a Contribution to CH_4 emissions from enteric fermentation
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 6.15: Available background information on the methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	Methodology

Member State	Methodology
Austria	IPCC Tier 1 for Swine, Sheep, Goats, Horses and Other Animals (Deer). For Cattle Tier 2. For the calculation of emissions from category Poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. The agricultural practices related to poultry in Switzerland are very similar to those in Austria: Both countries have a small structured agriculture due to similar alpine conditions, comparable traditions and culture. In both countries more than 60% of the farms manage less than 20ha. In Austria, the animal category 'other' (4.A.10) corresponds to furred game. This category includes mainly deer, but no further data on the exact composition of this animal category is available. As the contribution to the overall emissions is very small, a simple approach has been chosen by applying the default emission factor of sheep because sheep is the most similar ani-mal category to deer.
Belgium	Tier 2 approach is in both regions (harmonized), Flanders and Wallonia for key-source animal types (cattle). Tier 1 for cattle is in Brussels (low animal numbers). CH_4 emissions from enteric fermentation from the other, non-key source, animal categories (sheep, goats, swine, horses and mules and asses) are estimated using the Tier 1 methodology.
Denmark	The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called IDA (Mikkelsen, 2006; Mikkelsen and Gyldenkærne 2006). IDA operates with 38 different livestock categories, according to livestock category, weight class and age. These categories are subdivided into housing type and manure type, which results in 247 different combinations of live-stock subcategories and housing types. For each of these combinations, information on e.g. feed intake, digestibility, excretion and methane conversion factors is attached. The emission is calculated from each of these subcategories and then aggregated in accordance with the IPCC livestock categories given in the CRF. The implied emission factors for all animal categories are based on the Tier 2 or country-specific approach with the exception of poultry, ostrich and pheasants. Emissions from fur management is considered to be not applicable (Hansen, 2010).The category Non-Dairy Cattle includes Calves, Heifer, Bulls and Suckler Cows and the implied emission factor is a weighted average of these different subcategories. Data given for Non-Dairy Cattle covers data for heifer older than ½ year. The category Swine includes the subcategories Sows, Piglets and Slaughtering Pigs. The feed intake for sows and piglets has increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy.
Finland	Tier 1 for Horses, Swine, Goats and Fur animal (Norway EFs). Tier 2 method for Cattle. CH_4 emissions from enteric fermentation of Reindeer have been calculated by estimating the GE on the basis of literature (McDonald, 1988) by using national data for estimating dry matter intake and its composition (hay and lichen) and calculating the respective emission factor. The same methodology has been used for estimating GE and EF for Sheep. Cattle's are not used for work in Finland. Piglets are included in the category 'sows with piglets'.
France	Tier 2 or 3; national emission factors based on methodologies slightly different to IPCC.
Germany	Tier 3 for dairy cows; Tier 2 for other cattle and swine. Tier 1 for other animals.
Greece	Dairy and non-dairy cattle and sheep by tier 2 methodology. Other animals by tier 1.
Ireland	Cattle: Tier 2. For Dairy cows and Suckler Cows, the country was divided into three regions: (1) south and east, (2) west and midlands, and (3) north west, coinciding with regions used for implementing the Nitrates Directive based on slurry storage requirements of local planning authorities. The cattle production systems in each region are defined in terms of calving date, the dates of winter housing and spring turn-out to grass, milk yield and composition, forage and concentrate feeding level, cow live-weight and live-weight change and lactation period. Emission factors for the beef cattle categories were determined by calculating lifetime emissions for the animal and by partitioning between the first, second and third years of the animal's life. This approach allows the published CSO animal populations for June to be used directly as the activity data most representative of the inventory year for enteric fermentation while taking into account the movement of cattle from one category to another (i.e. from 0-1 year old to 1-2 year old to over 2 years old), as enumerated by the June census, up to two times in their three-year lifetime (O'Mara, 2006). Other animals: Tier 1 Methodology, EFs IPCC default.
Italy	The Tier 2 IPCC GPG approach has been followed for Dairy, Non-Dairy and Buffalo. Country-specific emission factor suggested by the Research Centre on Animal Production for rabbits have been use. A Tier 1 approach, with IPCC default emission factors, has been used to estimate methane emissions from swine, sheep, goats, horses, mules and asses.
Luxembourg	The IPCC Tier 1 method has been applied to all farm animal categories with the exception of cattle for which a Tier 2 method has been used (option B).
Netherlands	For mature dairy cattle a country-specific method based on a Tier 3 using dynamic modelling (Tier 3; Smink, 2005), employing the model of Mills et al. (2001), including updates (Bannink et al., 2005a,b). This model is based on the rumen model of Dijkstra et al. (1992). It has been developed for dairy cows and is therefore not suitable for all cattle categories. The model calculates the gross energy intake and methane production per cow per year on the basis of data on the share of feed components (grass silage, maize silage, wet by-products and concentrates) and their chemical nutrient composition (sugars, NDF, etc).
Portugal	Tier 2 for all animal types, with an enhanced characterization of livestock, with subdivision per age, sex and management conditions for most animal types. Milk yield was estimated dividing the annual production of milk cow over the number of cows in production101, both of which are published by the National Statistical Institute (INE). Three different cattle types were considered: (1) Imported breeds; (2) Traditional breeds on pasture; (3) Traditional breeds on range. The methodology used by the French I.N.R.A. (INRA, 1984) was used to estimate feed intake for each

Member State	Methodology
	swine and rabbit.
Spain	**Sheep: Tier 2. Cattle and swine: Tier 3. Other animal categories: Tier 1. For sheep, national literature on the main animal breed present in Spain is used to estimate parameters which are not given by IPCC.**
Sweden	**Significant Cattle subgroups: national emission factor (Tier 1). Reindeer: according to Tier 2 methodology using a Finnish value of gross energy requirements. Other animal categories: Tier 1. The national methodology for Dairy Cows, Beef Cows and Other Cattle.**
United Kingdom	**Tier 2 method for dairy and beef cows, lambs and deer. Tier 1 for other animal types. The UK sheep production sector has a complex structure, with many different breeds of sheep and a range of hill, upland and lowland rearing and finishing systems. The UK is currently undertaking a programme of work to improve methodology for calculating emissions from this sector, which will include derivation of monthly sheep and lamb population models and country-specific emission factors.**

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2011 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Luxembourg and the Netherlands have chosen to use the option B of the CRF for the classification of cattle. In order to allow the calculation of an EC implied emission factor for the categories listed under option A, these numbers were “converted” using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Other animal types with population data reported in Table4.A are reindeers (Finland, Sweden), deer (Austria, Denmark, Luxembourg, and UK), fur farming (Finland, Denmark), rabbits (Italy, Luxembourg, and Portugal), and other poultry (Denmark).

Some information on the source of the animal numbers for the different Member States is given in Table 6.17.

Table 6.16: Animal population [1000 heads] in 2011.

Member State 2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	527	1,449	361	72	3,005	14,644
Belgium	460	2,109	98	33	6,583	32,280
Denmark	565	1,003	94	13	12,932	19,319
Finland	286	629	129	5	1,335	10,236
France	3,661	15,454	7,636	1,397	14,031	290,517
Germany	4,190	8,338	1,660	150	22,788	132,344
Greece	137	519	8,822	5,113	869	29,048
Ireland	1,086	5,323	4,430	10	1,551	14,658
Italy	1,755	4,143	7,943	960	9,351	200,718
Luxembourg[1)]	40	152	9	6	89	102
Netherlands[1)]	1,470	2,416	1,088	380	12,429	98,925
Portugal	247	1,244	2,255	419	1,947	34,134
Spain	817	5,169	17,003	2,693	25,540	159,844
Sweden	346	1,165	623	6	1,483	17,299
United Kingdom	1,814	8,119	31,634	94	4,441	162,551
EU-15	17,402	57,231	83,784	11,350	118,374	1,216,620

Information source: CRF for 1990 and 2011, submitted in 2013

[1)] Numbers for cattle have been calculated using the figure given under option B.

Table 6.17: Available background information on the source of animal population data

Member State	Activity Data
Austria	**The Austrian official statistics (Statistic Austria, 2006) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 swine numbers were fluctuating due to a high elasticity to market prices. The animal numbers of Young Swine were not taken into account because the emission factors for Breeding Sows already includes nursery and growing pigs (Schechtner 1991). Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS database (Kirner and Schneeberger, 1999). From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green Reports' of the ministry of agriculture (BMLFUW 2007) was used. The Austrian inventory does not distinguish between horses and mules and asses. As mules and asses are only of very little importance in Austria,The Austrian official statistics (Statistic Austria, 2006) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 swine numbers were fluctuating due to a high elasticity to market prices. The animal numbers of Young Swine were not taken into account because the emission factors for Breeding Sows already includes nursery and growing pigs (Schechtner 1991). Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS database (Kirner and Schneeberger, 1999). From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green Reports' of the ministry of agriculture (BMLFUW 2007) was used. The Austrian inventory does not distinguish between horses and mules and asses. As mules and asses are only of very little importance in Austria,**
Belgium	**"Statistics Belgium" (Statbel) publishes the livestock figures, agricultural land area and edible crop production of N-fixing and non-N-fixing crops yearly in its agricultural census. These data are available for and used by the three regions: Flanders, Wallonia, and Brussels. In Flanders, livestock figures from 2000 on are obtained by the Manure Bank of the Flemish Land Agency. Concerning the agricultural census, since 2008 this inquiry has changed slightly. 75% (before 2008 this was 100%) of all agricultural businesses (including the biggest farms) have to fill in a form each year about the situation at the farm on the 1st of May of that year. Mules and Asses are included in the category Horses. "Other" includes Horses, Mules and Asses, Goats and Rabbits.**
Denmark	Livestock production is primarily based on the agricultural census from Statistics Denmark. The emission from slaughter pigs and poultry is based on slaughter data. Approximate numbers of horses, goats and sheep on small farms are added to the number in the Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares, where many of these animals are placed. Animal numbers of sheep, goats, ostriches and deer are based on the Central House animal farm Register (CHR). Pheasant numbers are based on expert judgement from NERI and the pheasant breeding association. **Statistics Denmark – Agricultural Statistics www.dst.dk (DSt) provide data on livestock production, milk yield, slaughtering data, export of live animal (poultry), land use, crop production, and crop yield. The Danish Centre for Food and Agriculture, Aarhus University (DCA) provides data on N-excretion, feeding situation, animal growth, N-fixed crops, crop residue, N-leaching/runoff, and - NH_3 emissions factor. The Danish Agricultural Advisory Service www.lr.dk (DAAS) provides data on housing type (until 2004), grazing situation, manure application time and methods, estimation of extent of field burning of agricultural residue. The Danish Environmental Protection Agency www.mst.dk (EPA) provides data on sewage sludge used as fertiliser, industrial waste used as fertiliser. The Danish AgriFish Agency http://naturerhverv.fvm.dk (DAFA) provides data on synthetic fertiliser (consumption and type), housing type (from 2005), sewage sludge used as fertiliser (from 2005 based on the register for fertiliza-tion), number of animals from the Central Husbandry Register. The Danish Energy Agency www.ens.dk (DEA) provides data on manure used in biogas plants.**
Finland	**The number of cattle, sheep, swine, poultry and goats was received from the Matilda-database maintained by the Information Centre of the Ministry of Agriculture and Forestry (http://www.mmmtike.fi/en/) as well as from the Yearbook of Farm Statistics published annually by the Ministry of Agriculture and Forestry. The number of animals describes the number of animals in 1st of May (cattle, swine, and poultry) and it has been reported consistently over the time series. Cattle category has been divided into the following sub-categories: Dairy cows, suckler cows, bulls, heifers and calves for which separate emission factors have been calculated. Animal numbers are harmonized with the Nitrogen mass flow model used by the Finnish Environment Institute.The number of cattle, sheep, swine, poultry and goats was received from the Matilda-database maintained by the Information Centre of the Ministry of Agriculture and Forestry (http://www.mmmtike.fi/en/) as well as from the Yearbook of Farm Statistics published annually by the Ministry of Agriculture and Forestry. The number of animals describes the number of animals in 1st of May (cattle, swine, and poultry) and it has been reported consistently over the time series. Cattle category has been divided into the following sub-categories: Dairy cows, suckler cows, bulls, heifers and calves for which separate emission factors have been calculated. Animal numbers are harmonized with the Nitrogen mass flow model used by the Finnish Environment Institute.**
France	**Agricultural statistics are issued by the ministry of agriculture (SCEES/AGRESTE). Activity data is a one year average. Heifers are included in Other Cattle, but heifers more than 2 years old (40% of the total heifer livestock) are considered as Dairy cattle.**
Germany	**Animal types are disaggregated, if significant differences exist between emission factors. For example, dairy cattle are grouped into sub-categories in each district on the basis of animal performance and feeding indicators. Other cattle include calves, heifers, bulls (beef), suckler**

Member State	Activity Data
	cowws and mature males. Sows, suckling pigs and fattening pigs are calculated separately, as well as sheep and lambs, and the results are aggregated and IEFs covering both sub-categories are reported. The category 'poultry' is differentiated into the sub-categories laying hens, broilers, pullets, geese and ducks and turkey hens and cocks. The category horses is differentiated in large and small horses. Animal numbers are reported as 'animal places' referring to the average number of livestock over a complete year. A complete animal census at the "Kreise" level is available for every second year in the official agricultural statistics with the exception of goats, mules and asses, and buffalo. For the other years, animal numbers are available at the "Länder" level. Cattle numbers are obtained from the data base http://www.hi-tier.de. Pig numbers are lower than official statistics, as piglets up to 8 kg are considered with sows. For sheep numbers were estimated; the first census on sheep in 2010 showed that numbers were over-estimated, but the numbers were maintained. The number of horses is partly interpolated. Since 2010 numbers are aggregated to 'equides' including mules and asses; those are included in the category 'horses' but lead only to a small over-estimation due to the low number of mules and asses. Buffalo numbers are not published and obtained from the buffalo organisation; numbers are extrapolated for the years before 2000, resulting on no buffaloes for the years 1990-1995.
Greece	**Animal population except Sheep, is a 3-year average. The data for population of dairy cattle was updated in the current submission following the results of a survey of ELSTAT. Milk yield derives from data of the annual Agricultural Statistics. Portion of female cattle, >2 year old, giving birth is estimated at 0.9 while milk production yield estimated at 0.1 kg/day (estimated for 365 days) and milk production yield during suckling estimated at 1.0 kg/day (estimated for 365 days). The average bodyweight of sheep at weaning is estimated at 15 kg while the average weights of female and male mature sheep (>1 year) are estimated at 53 kg and 70 kg respectively.**
Ireland	Statistical data are compiled and published by the Central Statistics Office. Ireland uses one annual average population characterisation. For both dairy cows and suckler cows, the country is divided into three regions: (1) south and east, (2) west and midlands, and (3) north-west, coinciding with the regions used for the implementation of regulations on Good Agricultural Practices for the protection of Waters. The number of cows in each category, given by CSO statistics, is allocated to the three regions identified above using the Cattle Movement Monitoring System (CMMS) and Animal Identification and M ovement (AIM) system reports published by the Department of Agriculture, Fisheries and Food (DAFF) and the Department of Agriculture Food and the Marine (DAFM). The CSO produces two censuses of animal numbers per year, one reflecting the number of animals nationally in June and the other referring to populations in December. For the purposes of calculating emissions from breeding cattle, an average of the number in each category of breeding animals present in the national herd in June and December is used. The publication of separate census data for June and December annually and the application of these statistics in order to achieve the most representative annual average population related to cattle and some other livestock explains differences that are often seen between national and FAO statistics for agriculture. The Irish cattle herd is now characterised by 11 principal animal categories for which annual census data are published by CSO. The number of Cows in each category given by CSO statistics was allocated to the regions using CMMS reports published by the Department of Agriculture and Food (DAF).
Italy	Figures from the Farm Structure Survey 2007 (FSS 2007). Livestock data are collected from the National Institute of Statistics (ISTAT) and are based on specific national surveys carried out every 10 years. ISTAT collects comprehensive data through different surveys (Greco and Martino, 2001): • Structural surveys (Farm Structure Survey, survey on economic results of the farm, survey on the production means); • Interim surveys (survey on the area and production of the cultivation, livestock number, milk production, slaughter, etc.); **• General Agricultural Census, carried out every 10 years (1990, 2000, 2010).**
Luxembourg	**The activity data are the livestock data reported in the national statistics.**
Netherlands	Taken from the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (e.g., Van der Hoek and Van Schijndel, 2006). For cattle, three categories are distinguished: • mature dairy cattle: adult cows for milk production; • mature non-dairy cattle: adult cows for meat production; **• young cattle: mixture of different age categories for breeding and meat production, including adult male cattle.**
Portugal	**Activity data are 3-years average except for last year. Annual livestock numbers were available from the statistical databases of the National Statistics Institute (INE) for Cattle, Swine, Sheep, Goats, Horses, Mules and Donkeys, disaggregated per region, age and sex. For the 2010 inventory, new activity data was obtained from the Survey of the Agriculture Explorations Structure (INE, bi-annual) concerning number of broilers, hens, turkeys, ducks and rabbits. Data provided comprises total livestock in Portugal, and RGA 99 regional values were used for disaggregation purposes; gaps in time series were corrected with linear interpolation; disaggregation between hens for industrial egg production and for production of chicks had to be made since the new INE data reported only total hens. All original figures in statistical database represent stock numbers at a particular time of the year (usually December); for some species with strong seasonal reproducing periods, such as goat and sheep, these numbers had**

Member State	Activity Data
	to be corrected and converted in average annual population, using statistics on the number of slaughtered lambs and kids.
Spain	**Animal numbers are from the "Anuario de Estadistica Agroalimentaria" and from the "Encuestas Ganaderas" published by the ministry of agriculture, food and environment (MAGRAMA). Data are used at higher disaggregation. For cattle and swine numbers, statistics are available for May and November, so both data are used to calculate an annual average. Swine number are differentiated for extensive ('iberica' strain) and total swine ('iberica'+'blanca'), at the province level.**
Sweden	**The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.**
United Kingdom	**Livestock population data are reported annually as statistical outputs of the four Devolved Administrations of the UK (i.e. England, Wales, Scotland and Northern Ireland), based on the annual June Agricultural Survey for each country. These data are summed to provide UK population data for the livestock categories and subcategories as used in the inventory compilation. Data for earlier years are often revised so information was taken from the England and the Devolved Administrations' agricultural statistics databases. Dairy cows - quoted assumes animal lives for a year; emission calculation assumes animal lives for 6 months. The average lifespan of lambs is estimated by Wheeler et al. (2012) as 8.1 months.**

Emission Factors and other parameters

Considerable variation is found in the Implied Emissino Factor (IEF) for dairy and non-dairy cattle with values between 104 kg CH_4 head^{-1} yr^{-1} (Spain) and 137 kg CH_4 head^{-1} yr^{-1} (Portugal) for dairy cattle, and 36 kg CH_4 head^{-1} yr^{-1} (Netherlands2)) and 64 kg CH_4 head^{-1} yr^{-1} (Finland) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production. The slightly lower Dutch IEF compared to the default IPCC IEF for adult dairy cattle at a comparable milk production rate (at a milk production rate of 6 700 kg per cow per year) can be explained by the higher feed digestibility in the Netherlands. The IEF for the EU-15 Member States and the CH_4 conversion factors used are given in Table 6.18. For EU-15, the implied emission factor in 2011 was 123 kg CH_4 head^{-1} yr^{-1} for dairy cattle.

For non-dairy cattle, the low IEF reported by the Netherlands (36 kg CH_4 head^{-1} yr^{-1} in 2011) is explained by the fact that the Netherlands has a considerable population of white veal calves. Because of the low roughage intake MCF is 4% instead of 6% for these animals. This results in a lower average methane conversion rate for total cattle. In Denmark, the IEF is 40 kg CH_4 head^{-1} yr^{-1} in 2011. The IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed. Also in Germany the IEF is lower than IPCC default which is due to large share of cattle with low EF. The level of IEF seems to be comparable to that given by a number of other countries (comparison based on 2007 submissions, including Option B). Further, the low IEF is consistent with a low animal weight for non-dairy cattle in Germany.

The IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH_4 head^{-1} yr^{-1} and 13.1 kg CH_4 head^{-1} yr^{-1} considerably higher than the IPCC default values and the numbers used in other Member States. This is explained by the Danish normative data, which operate with sheep including lamb and goats including kids. The emissions of lamb and kids are therefore included in the numbers for sheep and goats, respectively. On the other hand, the IEF for sheep for UK is with 5.0 kg CH_4 head^{-1} yr^{-1} the lowest from EU and is similar to the IEF for developing countries according to the IPCC 2006 GL. The emission factor was fixed by Tier 1 with the assumption that IEF for lambs is 40% of that for adult sheep (breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year).

For horses, Germany makes a distinction for large and small horses, whereby the IEF for large horses was taken from IPCC (2006) and the IEF for small horses used was smaller with 12 kg $head^{-1}$ yr^{-1}. The overall IEF for horses is thus smaller than the IPCC value.

The CH_4 conversion factor is IPCC default for most Member States.

More detailed information on the development of the emission factors for category 4A is given in Table 6.19.

Table 6.18: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory. Data for the year 2011.

Member State	Implied EF (kg CH_4/head/yr) [1]					CH_4 conversion (%) [1]				
2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	117	56	8.0	5.0	1.5	6.0	6.0	6.0	5.0	0.6
Belgium	129	45	8.0	5.0	1.5	6.0	6.0	NE	NE	NE
Denmark	133	40	17.2	13.1	1.1	6.0	6.0	6.0	5.0	0.6
Finland[1]	128	64	8.4	5.0	1.5	6.0	6.0	NA	NA	NA
France	121	51	9.5	11.9	0.8	NA	NA	NA	NA	NA
Germany	133	46	8.0	5.0	1.2	6.3	6.1	6.0	5.0	0.6
Greece	119	56	9.1	5.0	1.5	6.0	6.0	6.6	NE	NE
Ireland	113	47	6.1	5.0	1.1	6.5	6.5	7.0	NE	NE
Italy	119	46	8.0	5.0	1.5	6.0	4.3	NA	NA	NA
Luxembourg[2]	120	42	8.0	5.0	1.5	6.0	6.0	6.0	5.0	0.6
Netherlands[2]	128	36	8.0	5.0	1.5	5.9	5.8	NE	NE	NE
Portugal	137	58	8.6	7.5	1.4	6.0	5.9	6.0	5.0	0.6
Spain	104	43	8.7	5.0	0.9	5.1	4.7	6.6	NA	82.2
Sweden	133	50	8.0	5.0	1.5	6.2	7.0	6.0	5.0	0.6
United Kingdom	111	43	5.0	5.0	1.5	6.0	NE	NE	NE	NE
EU-15	123	46.7	7.2	5.9	1.2	6.1	5.7	6.6	5.0	31.3

Information source: CRF for 1990 and 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1] Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. The IEF has been calculated as a weighted average. [2] The IEF for Luxembourg and the Netherlands has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

Table 6.19: Available background information for CH_4 emissions in category 4.A. Emission Factor and other parameters

Member State	Emission Factor and other parameters
Austria	Country specific emission factors for cattle calculated from the specific gross energy intake and the methane conversion rate (IPCC for "all other cattle" because there are few if any feedlot cattle with a high-energy diet). Austrian energy intake data were recalculated by from the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (Poetsch et al. 2005, Gruber and Poetsch, 2006). Gross energy intake for all other cattle categories were calculated from typical Austrian diets by animal nutrition expert Andreas Steinwidder (AMON et al. 2002). These livestock categories show distinct differences in organic and conventional diets. The time series of average milk yields per dairy cow was taken from national statistics, milk yield of suckling cows is from Hausler (2009). Data for suckling cows are from the study 'Mutterkuh und Ochsenhaltung 2003: in which 56 holdings in Styria, Lower Austria, Carinthia and Salzburg were investigated. In a study with Austrian suckling cows (Simmental) carried out from 2004 to 2008, the influence of duration of suckling period (180 days and 270 days) on milk yield and body weight of cows and weight gain of calves was determined (STEINWIDDER et al. 2006). As no major changes in diets of Non-Dairy Cattle occurred in the period since 1990, methane emissions from enteric fermentation of Non-Dairy Cattle are calculated with a constant gross energy intake for the whole time series. **For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. The animal category Other livestock**

Member State	Emission Factor and other parameters
	corresponds to deer with default EF used for sheep.
Belgium	**The EFs for dairy cattle are different in both regions based on milk production. The average animal weight and weight gain originate in Flanders from the Department Agriculture and Fishery and in Wallonia from average weights published by the federal finance department. In Flanders, data for feed digestibility (DE%) originate from a report [http://www.rivm.nl/bibliotheek/rapporten/680125001.html] from the Netherlands, a neighbouring country with comparable feeding situations. In both regions a methane conversion rate (Ym) of 6% is used to calculate the emission factor for each cattle type. The emission factors for all categories with exception for dairy cows stay constant over the entire time series. For dairy cows the emission factor increases with increasing milk production.**
Denmark	Feed consumption for all animal categories is based on the Danish normative figures. The Tier 2/CS equation for EF of enteric fermentation is the sum of the feed-ing situation in winter and summer. The EF is based on actual feeding plans, which is provided from data for feed units (FU) for each livestock category. Feeding with sugar beets is taken into account because sugar beet feeding gives a higher methane production rate compared to grass and maize due to the high content of easily convertible sugar. However, it is only dairy cattle and heifers which have sugar beets in the feed. To calculate the total gross energy (GE) intake, the GE per feed unit needs to be estimated. A feed unit in Denmark is defined as the feed value in 1.00 kg barley with a dry matter content of 85 %. For other cereals e.g. wheat and rye one feed unit is 0.97 kg and 1.05 kg, respectively. The calculation of GEFU, winter and GEFU, summer is based on the composition of feed intake and the energy content in proteins, fats and carbohydrates based on actual efficacy feeding controls or actual feeding plans at farm level, col-lected by DAAS or DCA. For dairy cows, the energy intake comes out at 18.3 MJ pr. FU in a standard winter feed regardless of whether the animal grazes or not, which is based on information from DCA. Ym default, but a national factor is used for dairy cattle and heifers. The estimation of the national values of Ym is based on model “Karoline” developed by DCA based on average feeding plans for 20 % of all dairy cows in Denmark obtained from the Danish Agricultural Advisory Service DAAS (Olesen et al.; 2005). Sheep include lamb and an average Ym value for mother sheep and lamb is used. **Tier 1 EFs are from Wang and Huang (2005).**
Finland	**IPCC gives no default emission factor for reindeer, thus it has been calculated by using national methodology for estimating gross energy intake of reindeer from the basis of their forage. The same equation has been used for sheep also. Emission factors for cattle are updated annually. EF´s for other animal groups will be updated if more national data will become available. Average daily weight gain for cattle was estimated to remain constant.**
France	**Emissions factors were used for enteric fermentation from a study published in 2008 by the French National Institute of Agronomy. These emission factors are based on parameters equivalent to Ym and GE, and they have been updated based on the results of MONDFERENT project (INRA). Results for cattle have been included in this report, but for the monogastric and for the small ruminants calculations are still being updated and the former values from Vermorel 2008 have been maintained. For dairy cattle, emission factors are dependent of milk production. For non-dairy cattle, emission factors are constant in time and changes in total emissions will depend on the number of animals.**
Germany	**The calculation of the EF for Dairy Cattle (Daemmgen etal, 2012) is based on the approach from Kirchgessner et al. (1994) and based on the intake of fibres, N-free extracts, proteins and fat calculating total GE intake. For cows, heifers, bulls and male cattle > 2 years a MCF of 0.065 is used according to IPCC (2006) which is higher than IPCC default, but matches better German feed quality. MCF for calves is 0.02 after Kirchgessner (2008). MCF for swine is IPCC default.**
Greece	**The average milk production for domestic and in flock and for nomadic sheep was considered equal to 0.22 kg/day and 0.20 kg/day. For the estimation of net energy for dairy cattle activity, it was considered that they are confined to a small area thus no energy is required to acquire feed (Ca = 0). For the estimation of net energy for other cattle activity, it was considered that they are confined in areas with sufficient forage requiring modest energy expense to acquire feed. (Ca = 0.17)**
Ireland	The Tier 2 emission factors for the 11 animal categories for 1990 and the years since 2003; interpolation was used to complete the time series. Substantial further subdivision was incorporated for dairy and beef cattle to adequately describe the wide range of cattle rearing and finishing systems applicable in Ireland (dairy cows: 12 systems ; suckler cows: 18 system types; male and female beef cattle: up to 30, O’Mara et. al., 2006).There is little statistical information on the live weight gain of the different types of Cattle in the Irish Cattle herd, but the weight of carcasses of all slaughtered cattle is recorded by the Department of Agriculture and Food. In the approach outlined by O’Mara (2006), the daily energy requirement of cows in each region is calculated by month or part thereof based on maintenance requirements, milk yield and composition, requirements for foetal growth and gain or loss of bodyweight (INRA, 1989). In this system, net energy requirement is defined in terms of unites fourragere lait (UFL), where 1 UFL is the net energy value of 1 kg of barley at 86 per cent dry matter and is equal to 7.11 MJ net energy for lactation (NEl). This international energy system, which is well established and used locally in Ireland, was considered more appropriate to the local conditions than the system and equations used by the IPCC guidelines and IPCC good practice

Member State	Emission Factor and other parameters
	guidance. The energy gains and losses refer to intra-annual changes for the animal and do not mean that average body weight for animals in the dairy herd is increasing from year to year. The live -weight of 535 kg for dairy cows is an indicative weight supplied by the Department of Agriculture, Food and the Marine, as dairy cow live-weights are not in general monitored on farms. The live-weight is adopted as the reference point for the annual emission factor der ivation for the herd and is chosen to be consistent with other parameters relevant to the estimation of emissions from cattle, e.g. manure production. For beef cattle, analysis is undertaken for a total of 11 separate production systems covering the three groups of male and female beef cattle. Important parameters such as housing dates (expert opinion and Hyde et al., 2008), turnout dates (expert opinion and Hyde et al., 2008) and live-weight gains (expert opinion reconciled with actual national carcass weights) during winter housing periods and grazing seasons are defined for each system (O'Mara, 2006). Using data for the average carcass weight of male and female cattle, appropriate live -weight gains are applied to the various life stages of each animal category, such that when all categories are combined, that data is consistent with the national statistics for carcass weight (plus or minus 10 kg difference). Given data for liveweight and liveweight gain, energy requirements of animals were estimated during the winter housing periods and grazing seasons of the animal's lifetime using the INRAtion computer programme, version 3.0 (incl. adaptions to Irish conditions). This programme is devised by the French research organisation INRA, and is based on the net energy system for Cattle. Bulls for breeding are mostly of continental breeds, and their emission factors are based on those for late maturing male beef ca ttle of suckler origin in their second year. In-calf heifers are assigned the same emission factors as female beef cattle in their second year (i.e. corresponding to the category 1–2 years old). In-calf heifers only require emissions associated with the period March – December of their second year to be accounted for, as they are subsequently enumerated as dairy or suckler cows in the CSO animal census thereafter. **Other livestock: default EF adjusted on the basis of animal weight (resulting on lower values for sheep and swine than IPCC default).**
Italy	**Data to calculate the emission factor from dairy and non-dairy cattle are national (ISTAT, Centro Ricerche Produzioni Animali, Reggio Emilia - CRPA). This information has been discussed in a specific working group in the framework of the MidetAIRaneo project (CRPA, 2006; CRPA, 2005). The emission factor for buffalo has been calculated by Condor et al. (2006). The emission factor for rabbits is national.**
Luxembourg	**For the Tier 1 method, default GE are usually provided in the IPCC Guidelines. For the Tier 2 method, GE is the combination of various feed intake – or net energy – estimates relating to maintenance, activity, growth, etc. of the animals.**
Netherlands	**Country specific tier 2 for cattle. The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively). For swine, sheep, goats and horses, default IPCC emission factors are used. The increased milk production per cow is the result of both genetic changes (due to breeding programmes for milk yield) as well as the increase in feed intake and higher feeding quality of cattle diets. Specific model predicts the methane emission factor for mature dairy cattle (Bannink, 2011).**
Portugal	**Default EF for horses, mules and asses, due to the unavailability of a more detailed livestock characterization and specific characterization of national populations. In accordance with the unavailability of emissions factors in IPCC96 for broilers, laying hens, turkeys, ducks, geese, guinea fowl and other poultry, emissions from these classes were not estimated and were assumed as negligible.**
Spain	**Animal characterization and digestibility are obtained according to UPV (2006). Milk and wool production and number of births obtained from statistics by breed. For cattle and swine a Tier 3 methodology has been developed (MAGRAMA, 2010) on the basis of the feed and energy requirement balances defining a typical feed composition. Similar tier 3 approach for poultry, but the lack of reliable data for Ym parameter has prevented the calculation of emissions of these animals.**
Sweden	**A national methodology based on feed energy requirements expressed as metabolisable energy is used in the Swedish inventory to estimate emission factors for dairy cows, beef cows and other cattle. The calculations for dairy cows were revised some years ago. The emission factors for other cattle groups were also re-evaluated, using the same methodology. The initial step in estimating emission factors for cattle according to the Swedish method is enhanced characterisation of feed intake estimates (Tier 2 methodology). The energy requirements for maintenance, growth, lactation and pregnancy are estimated, but expressed as metabolisable energy (MJ/day) instead of as net energy. The metabolisable energy requirement is then recalculated to digestible energy. A lactation period of 305 days and a non-lactating period of 60 days was used (Bertilsson, 2002; Nieminen, 1998). The default values in the IPCC Guidelines are used for the less significant animal groups. Reindeer: according to IPCC GPG (Tier 2) and using a Finnish value of gross energy requirements.**
United Kingdom	**Apart from cattle, lambs and deer, the methane emission factors are IPCC Tier 1 defaults. The emission factor for Lambs is assumed to be 40% of that for adult Sheep (Sneath, 1997). The UK emission factor for deer is based on Sneath et al. (1997). A country-specific value (75%) for the digestibility of feed (DE), value is based on typical diets for cows over the lactating and non-lactating period, combining forage and concentrates, with energy values for the various feeds according to MAFF (1990) (Bruce Cottrill, ADAS, pers. comm.). The forage component represents 62% of annual dietary dry matter intake (consist of fresh grass (grazed), grass silage and maize silage, in the ratio 4:4:1, with a weighted average DE value of approximately 72%). The constituents of the concentrate**

Member State	Emission Factor and other parameters
	feed are assumed to be barley grain, sugar beet pulp (molasses), wheat feed, wheat grain, rapeseed meal, soya bean meal and sunflower meal, with a weighted average DE value of approximately 82%. The overall weighted average DE value for the diet is therefore estimated as 75%.

Milk productivity is one of the most important factors determining the level of CH_4 emissions from dairy cattle. Several countries have reported milk productivity, which are reproduced in Table 6.20 and Table 6.21 beside information on feed intake, animal weight, and feed digestibility. The data show clearly that a strong intensification of cattle husbandry occurred, with increases in the milk yield ranging from 29% (Ireland) to 120% (Spain). This is thus more than the increase in the CH_4 emission factor. The increased production was only partly achieved by increased energy intake (up to a maximum of 45%, but some countries report also a stable feed intake), and partly by an improved feed efficiency. This is expressed in the feed digestibility, which for some countries increased by up to 6%, however it must be kept in mind that most countries do not estimate a time-varying feed digestibility (only 4 do, compared to 14 countries which report a time-dependent milk productivity). Higher feed digestibility reduces the portion of carbon intake that is transformed to methane in ruminants. As the feed intake increase is smaller than the increase in milk productivity (for EU15 the numbers are 25% and 53%, respectively), the feed quality and consequently also the feed digestibility increase most probably in more countries. Given that emission calculations are based on milk production, this suggests that these countries tend to overestimate the increase in methane emissions from enteric fermentation of dairy cattle. Calculating the average for those countries which have reported data, the milk yield was higher by 11% than the default value for Western Europe (11.5 kg/day) in 1990, and increased to a level which was 69% above IPCC default in 2011. Even though feed digestibility for dairy cattle was not separately estimated for each year by all countries, the level is 18% to 20% above IPCC default digestibility (60%).

Table 6.20: Additional background information for calculating CH_4 emissions from enteric fermentation from dairy cattle. Data for the year 2011.

Member State	Dairy Cattle			
2011	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	298	700	17	70
Belgium	324	600	20	75
Denmark	341	580	23	71
Finland	325	649	22	70
France	NA	NA	19	NA
Germany	320	648	20	74
Greece	302	600	15	60
Ireland	246	535	15	75
Italy	303	603	18	65
Luxembourg	305	650	20	70
Netherlands	334	NA	NA	NA
Portugal	349	NE	21	60
Spain	312	647	22	70
Sw eden	329	NA	25	69
United Kingdom	282	646	21	75
EU-15	309	627	19	72

Member State	Dairy Cattle			
1990	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	247	700	10	66
Belgium	253	600	11	75
Denmark	278	550	17	71
Finland	250	520	16	70
France	NA	NA	13	NA
Germany	260	608	13	73
Greece	224	600	7	60
Ireland	222	535	11	75
Italy	240	603	12	65
Luxembourg	247	650	13	70
Netherlands	280	NA	NA	NA
Portugal	241	NE	12	60
Spain	225	598	10	69
Sw eden	276	NA	19	69
United Kingdom	221	572	14	75
EU-15	248	595	13	71

Information source: CRF for 1990 and 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Table 6.21: **Additional background information for calculating CH_4 emissions from enteric fermentation from non-dairy cattle. Data for the year 2011.**

Member State 2011	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	143	425	NO	73
Belgium	115	409	NE	76
Denmark	130	320	NO	71
Finland	124	577	NA	70
France	NA	NA	NA	NA
Germany	109	327	NE	73
Greece	141	419	NO	60
Ireland	130	341	8	75
Italy	139	378	NA	NA
Luxembourg[2)]	108	357	NA	64
Netherlands[2)]	110	NE	NE	NE
Portugal	153	411	3	62
Spain	126	440	4	72
Sweden	181	NE	NE	69
United Kingdom	NE	NE	NE	NE
EU-15	126	373	5	72

Member State 1990	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	123	364	NO	74
Belgium	106	381	NE	76
Denmark	107	290	NO	71
Finland	103	442	NA	70
France	NA	NA	NA	NA
Germany	106	300	NE	73
Greece	136	382	NO	60
Ireland	132	349	8	75
Italy	141	376	NA	NA
Luxembourg[2)]	104	322	NA	64
Netherlands[2)]	113	NE	NE	NE
Portugal	138	355	2	62
Spain	124	395	4	67
Sweden	181	NE	NE	69
United Kingdom	NE	NE	NE	NE
EU-15	120	340	6	72

Information source: CRF for 1990 and 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head. 2) Numbers calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

Trends

Animal population. In all countries, the numbers of cattle and sheep are considerably reduced since 1990, on the average by 34% for dairy cattle and 12% for non-dairy cattle, and by 27% for sheep. An increase in the number of cattle has only been observed in the category of non-dairy cattle in Greece (8%), Sweden (2%), Portugal (27%) and Spain (49%). Largest decrease of the number of dairy cattle occurred in Luxembourg (2011 at 34% of the 1990 level). For non-dairy cattle, largest decrease occurred in Netherlands (2011 at 40%).

The picture is a little bit different for the categories goats and swine, as some countries have encountered a significant increase of the populations, for example the goat population in Belgium in 2011 has increased by 275% compared to 1990; in the Netherlands this figure amounts to 526%. However, due to a decrease of the goat number in other countries with a high population (mainly Spain with 2,693,000 heads in 2011), the goat population at EU15 level was rather stable (2011 at 89% of 1990-level).

The swine population was increased especially in Denmark (36%), Spain (56%), and Ireland (27%), but this was balanced from reductions in other countries. Poultry numbers saw a slight increase of 15% in EU15; only Austria and Luxembourg reported CH_4 emissions from enteric fermentation of poultry.

The trend in animal numbers is to a large extent influenced by EU policy such as suckler cow premia, milk quota, but also environmental legislation linked to agricultural policy through cross-compliance and the rural development. Animal development is also determined by epidemics such as the avian flu (reducing e. g. the number of poultry in the Netherlands in 2003), the BSE crisis between 2001 and 2003, to name just the most important. Further examples for driving forces of the observed trends are given in Table 6.22 below.

Implied emission factor. At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 102.7 kg CH_4 head^{-1} yr^{-1} to 123 kg CH_4 head^{-1} yr^{-1} while at the same time the animal number of dairy cattle decreased by 34%, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by dairy cattle.

Changing IEFs, however, are not necessarily due to a changing (assumed) productivity of non-dairy cattle sub-categories, but can rather be the consequence of a different composition of non-dairy cattle (e. g. ratio of heifers to young cattle) with different implied emission factor. Nevertheless, the IEF for non-dairy cattle was more stable than that for dairy cattle and changed only by 2% between 1990 and 2011 from 45.6 kg CH_4 head^{-1} yr^{-1} to 46.7 kg CH_4 head^{-1} yr^{-1}.

For sheep, the implied emission factors changed since 1990 in 5 countries, but stayed close to the 1990-value for EU15 aggregate. Finland, France, Portugal and Spain saw a substantial increase of the IEF for sheep between by 2% and 23%.

Figure 6.4 through Figure 6.16 show the trend in the activity data for the key source in the category of enteric fermentation as well as the trend of one important indicator for animal productivity, the average daily gross energy intake for dairy and non-dairy cattle and sheep. The trend of the populations of swine, goat, and poultry are included as well. Table 6.22 gives additional information on the trend in category 4A as reported in the national inventory reports.

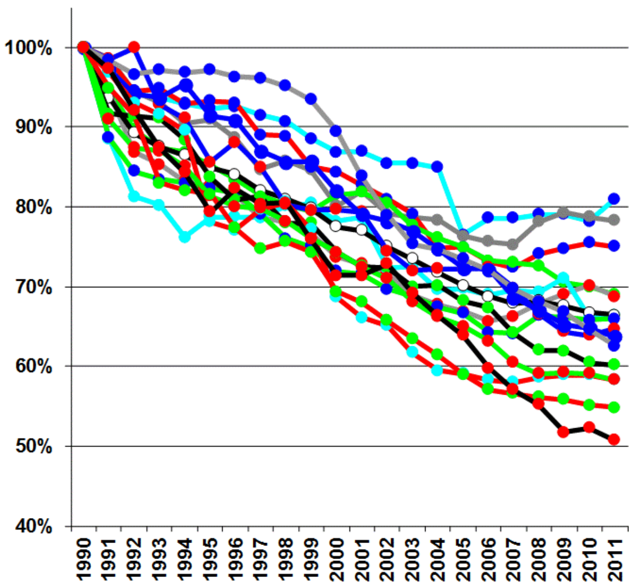
Table 6.22: Available background information on the trend for CH_4 emissions in category 4.A.

Member State	Trend in category 4A
Austria	**Up to the early 1990ies Austrian dairy husbandry was determined by traditional Austrian green feeding and traditional Austrian races. From the mid 1990ies onwards milk production has been intensified: diets with higher energy concentration were fed and the share of high yield breeds (e.g. Holstein Friesian) in dairy farming was increased.** ***Cattle:* From 1990 onwards: The continuous decline of dairy cattle numbers is connected with the in-creasing milk yield per cow: For the production of milk according to Austria's milk quota every year a smaller number of cows is needed. 1995: The financial support of suckling cow husbandry increased significantly in 1995 when Austria became a Member State of the European Union. The husbandry of suckling cows is used for the production of veal and beef; the milk yield of the cow is only pro-vided for the suckling calves. Especially in mountainous regions with unfavourable farming conditions, suckling cow husbandry allows an extensive and economic reasonable utilisation of the pastures. Suckling cow husbandry contributes to the conservation of the traditional Austrian alpine landscape. 1996–1998: The market situation affected a decreasein veal and beef production, resulting in a declining suckling cow husbandry. Farmers partly used their former suckling cows for milk production. Thus, dairy cow numbers slightly increased at this time. Reasons are manifold: Changing market prices, BSE epidemic in Europe and change of consumer behaviour, milk quota, etc.** ***Swine:* 1998–2000; 2006–2008: increasing/ decreasing swine numbers: The production of swine has a high elasticity to prices: Swine numbers are changing due to changing market prices very rapidly. Market prices change due to changes in consumer behaviour, saturation of swine production, epidemics, etc.**
Belgium	**In Belgium, there is the trend of disappearance of small businesses, also reinforced by the BSE crises. This affected only swine in 2001 and 2002, but in 2003 also bovine animals and poultry. Additionally in Flanders, this partly can be explained due to the subsidized cut down of the number of Cattle. Nevertheless the land area used for agricultural purposes remained identical during this period. In 2005 Wallonia has 55% of the land used for agriculture, but 67% of agricultural businesses are situated in Flanders. The land area used for farming is on average 19 ha per farm in the Flemish region and 47 ha per farm in the Walloon region.**
Denmark	
Finland	**Following the inclusion of Finland in the EU, emissions from the agricultural sector have decreased by 12% (period 1990-2011) due to changes in the economic structure of the sector. There was a decrease in the number of farms, and increase of their size and a reduction in livestock numbers except for horses. Inter-annual variations on animal numbers are due to the agricultural policy and subsidies.**
France	
Germany	Cattle: since 2008 data are from HIT; which showed to be 2.9% higher than previous numbers. As a consequnce, the emissions for the years before 2008 are slightly under-estimated. There is some inconsistency in the time series of animal numbers in Germany due to the modification of

Member State	Trend in category 4A
	the "Agrarstatistikgesetzes" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an approach for correction has been developed and applied (Daemmgen, 2006). **Buffalo: Buffalo have been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series**
Greece	
Ireland	**Increased beef population is explained by the earlier finishing time for male beef cattle since the BSE crisis that affected agriculture during the 1990s.** **2010 was a particularly good year for Irish agriculture. Milk yield per cow increased by 8% from 4946 kg milk per cow to 5322 kg per cow. As a consequence, the IEF of methane EF dairy cattle increased between 2009 and 2010 by 3%.**
Italy	**The average daily milk production increased from 2009 to 2010 (from 17.4 to 18.7 kg/head/day) and leading thus to a significant increase of the IEF for dairy cattle by 4%.**
Luxembourg	
Netherlands	**Decreases in emissions from cattle the decrease in numbers is mainly explained by an increase in milk production per dairy cow combined with an unchanged total milk production. Milk production per cow increased significantly since 1990, a development which has resulted from both genetic changes in cattle (due to breeding programmes) and the change in amount and composition of feed intake. Total milk production in the Netherlands is determined mainly by EU policy on milk quota. Milk quota remained unchanged in the same period. In order to comply with the unchanged milk quota, animal numbers of (dairy) cattle had to decrease to counteract the effect of increased milk production per cow. The numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease. (Van Schijndel and Van der Sluis, 2008). Goat numbers increased by a factor 5 and horse numbers nearly doubled in this period. The increase in the number of goats might be explained as an effect of the milk quota for cattle.** **The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year. In areas where this disease was present, the transportation of pigs, sows and piglets to the slaughterhouse was not allowed, so the animals had to remain on the pig farms for a relatively long period (accumulation of pigs).** **An increase in the number of poultry is observed between 1990 and 2002. In 2003 however, poultry numbers decreased by almost 30% as a direct result of the avian flu outbreak. In the years afterwards the population recovered, reaching a level only slightly below the 2002 number in 2011.**
Portugal	**Decrease in dairy cows, consistent with the increase in productivity and the limits imposed by the EU on milk quotas.** **Data from National Statistics show a decrease in net stripped weight per animal from 2007 to 2008 causing an inter-annual decrease in emission factor for sheep by 5%.**
Spain	**Inter-annual variation in the emissions from enteric fermentation of sheep due to changes in the composition of the herd; the IPCC sheep categories correspond to 8 different categories in the Spanish livestock inventory, and for each of those categories an emission factor has been calculated. Inter-annual variations in sheep emissions are due to these different categories and how weights are assigned from the national EFs to meet the categories defined by the IPCC.**
Sweden	**Decrease of agricultural land since Sweden joined the EU. Livestock is mainly focused on milk production and crops are grain and fodder crops. Increase of organic farming from 6% in 1995 to 17% in 2010.**
United Kingdom	

Figure 6.4: Trend of activity data (population) for dairy cattle.

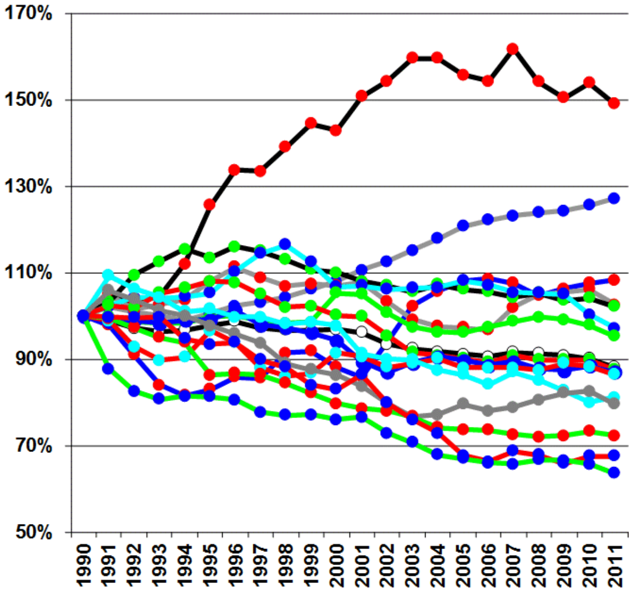
Dairy cattle: Population (1000 head)



	1990	Trend (%) 1990-2011	2011
Ireland	1,341	81%	1,049
Netherlands	3,755	78%	2,957
Denmark	753	75%	568
France	5,310	69%	3,716
Luxembourg	118	69%	83
Italy	2,642	66%	1,746
EU-15	26,211	66%	17,494
Germany	6,355	66%	4,183
Greece	212	65%	135
United Kingdom	2,848	64%	1,847
Portugal	394	63%	255
Sweden	576	60%	348
Austria	905	58%	533
Finland	490	58%	289
Belgium	839	55%	462
Spain	1,611	51%	841

Figure 6.5: Trend of activity data (population) for non-dairy cattle.

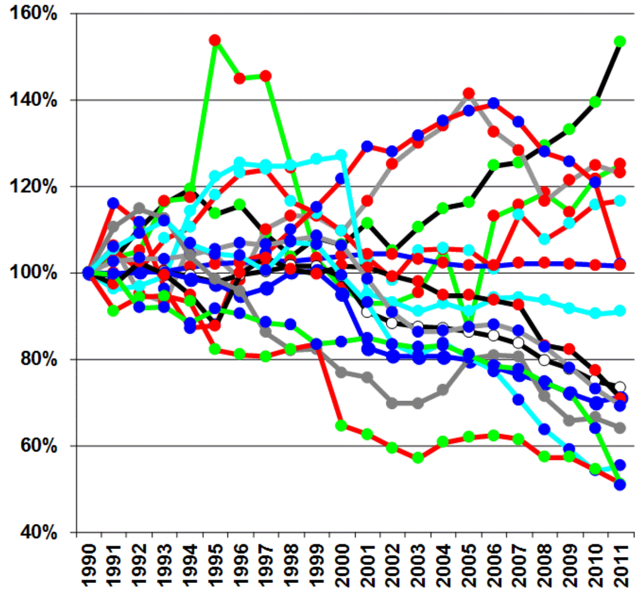
Non-dairy cattle: Population (1000 head)



	1990	Trend (%) 1990-2011	2011
Spain	3,471	149%	5,336
Portugal	978	127%	1,228
Greece	479	108%	515
Luxembourg	186	102%	197
Sweden	1,142	102%	1,189
Ireland	5,481	97%	5,494
France	16,227	95%	15,871
EU-15	65,018	88%	58,546
Belgium	2,410	88%	2,165
United Kingdom	9,344	87%	8,262
Austria	1,679	86%	1,481
Italy	5,110	81%	4,086
Netherlands	3,168	80%	2,612
Finland	870	72%	636
Denmark	1,486	67%	1,003
Germany	13,133	63%	8,626

Figure 6.6: Trend of activity data (population) for sheep

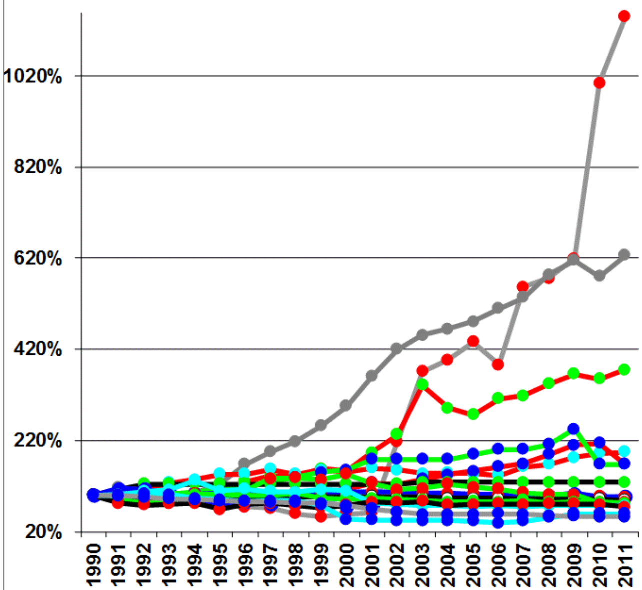
Sheep: Population (1000 head)



	1990	Trend (%) 1990-2011	2011
Sweden	406	153%	565
Finland	103	125%	126
Luxembourg	7	123%	9
Austria	310	117%	358
Denmark	92	102%	111
Greece	8,692	102%	8,832
Italy	8,739	91%	7,900
EU-15	114,170	73%	85,505
United Kingdom	44,469	71%	31,086
Spain	24,037	71%	18,552
Portugal	3,262	69%	2,384
Netherlands	1,702	64%	1,130
Ireland	8,021	55%	4,336
Belgium	192	51%	105
Germany	3,266	51%	2,089
France			

Figure 6.7: Trend of activity data (population) for goats

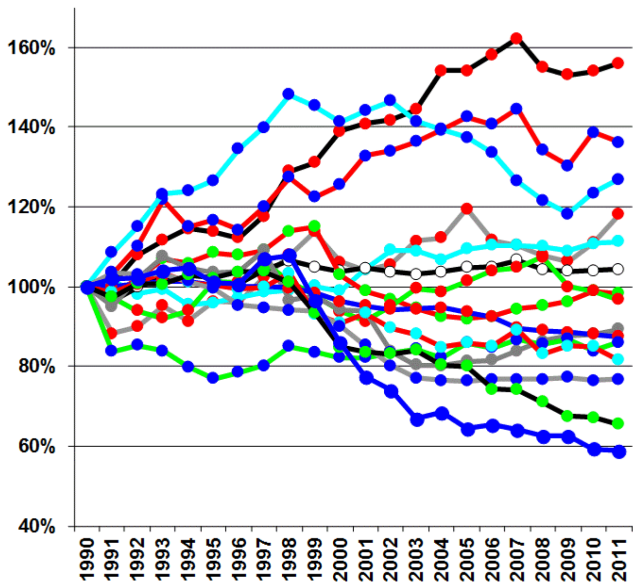
Goats: Population (1000 head)



	1990	Trend (%) 1990-2011	2011
Luxembourg	1	1150%	5
Netherlands	61	626%	353
Belgium	9	375%	31
Austria	37	194%	72
Denmark	7	167%	16
Germany	90	167%	150
Sweden	4	128%	6
United Kingdom	98	97%	93
Greece	5,339	96%	5,155
EU-15	12,805	89%	11,656
Finland	6	83%	5
France	3,688	81%	3,134
Italy	1,259	76%	983
Spain	3,663	74%	2,904
Ireland	17	58%	10
Portugal	810	52%	426

Figure 6.8: Trend of activity data (population) for swine

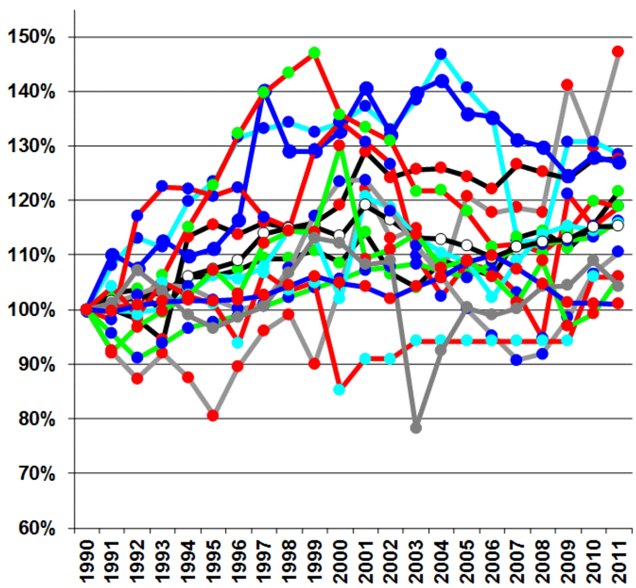
Swine: Population (1000 head)



	1990	Trend (%) 1990-2011	2011
Spain	16,371	156%	25,203
Denmark	9,497	136%	13,173
Ireland	1,222	127%	1,509
Luxembourg	75	118%	84
Italy	8,407	111%	9,321
EU-15	113,536	104%	118,046
Belgium	6,700	98%	6,626
Finland	1,381	97%	1,367
Netherlands	13,915	89%	12,255
Greece	994	87%	875
Germany	26,502	86%	22,244
Austria	3,688	81%	3,134
Portugal	2,535	77%	1,938
Sweden	2,264	65%	1,520
United Kingdom	7,548	59%	4,468
France			

Figure 6.9: Trend of activity data (population) for poultry

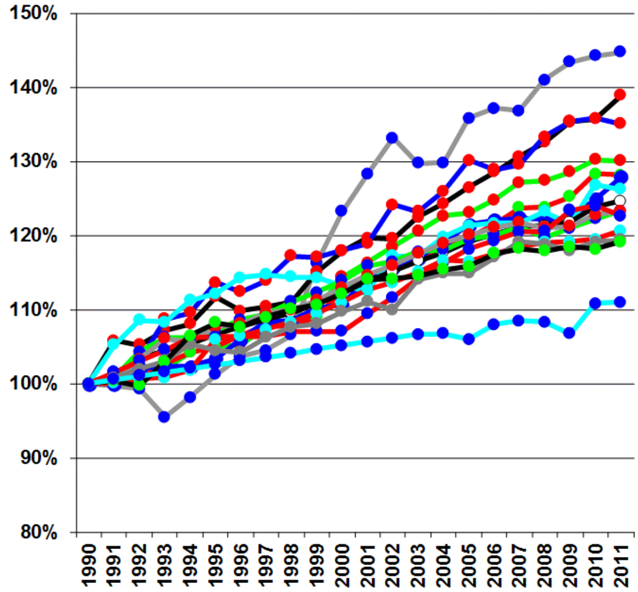
Poultry: Population (1000 head)



	1990	Trend (%) 1990-2011	2011
Luxembourg	69	147%	90
Ireland	11,413	128%	14,923
Spain	125,292	128%	159,706
United Kingdom	127,952	127%	163,842
Sweden	14,222	122%	16,403
Denmark	16,249	119%	18,731
Belgium	27,167	119%	32,577
Germany	113,879	116%	128,900
Italy	173,342	116%	198,347
EU-15	1,055,766	115%	1,215,392
Portugal	30,891	110%	32,897
Austria	13,821	106%	14,644
Finland	9,663	106%	9,587
Netherlands	94,902	104%	103,371
Greece	28,747	101%	29,079
France			

Figure 6.10:. **Trend of activity data (gross energy intake) for dairy cattle.**

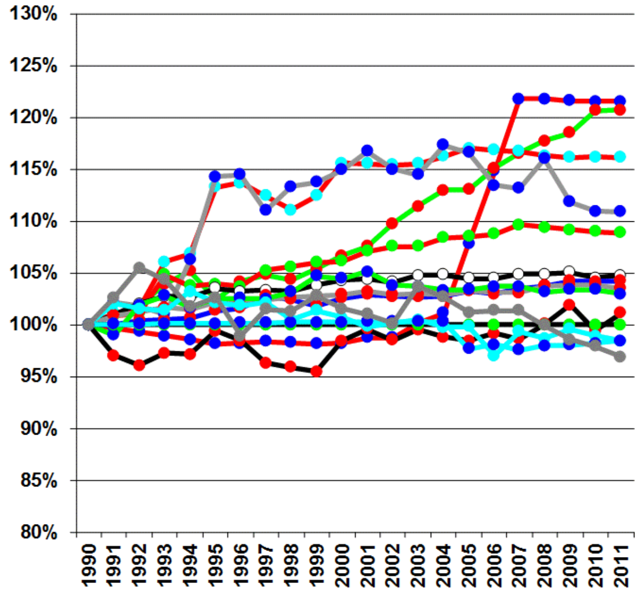
Dairy cattle: Average gross energy intake (GE) (MJ/head/day)



	1990	Trend (%) 1990-2011	2011
Portugal	241	145%	348
Spain	225	139%	305
Greece	224	135%	304
Finland	250	130%	325
Belgium	253	128%	325
United Kingdom	221	128%	275
Italy	240	126%	305
EU-15	248	125%	307
Germany	260	123%	318
Luxembourg	247	123%	304
Denmark	278	123%	345
Austria	247	121%	295
Netherlands	280	119%	333
Sweden	276	119%	326
Ireland	222	111%	246
France			

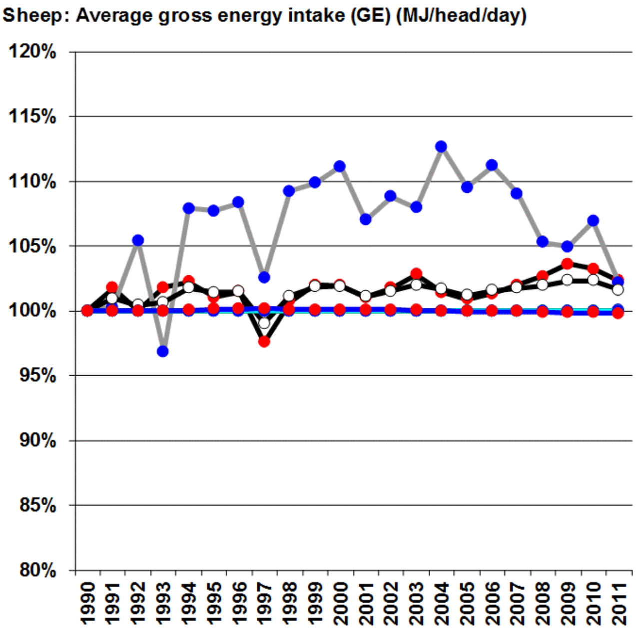
Figure 6.11: **Trend of activity data (gross energy intake) for non-dairy cattle.**

Non-dairy cattle: Average gross energy intake (GE) (MJ/head/day)



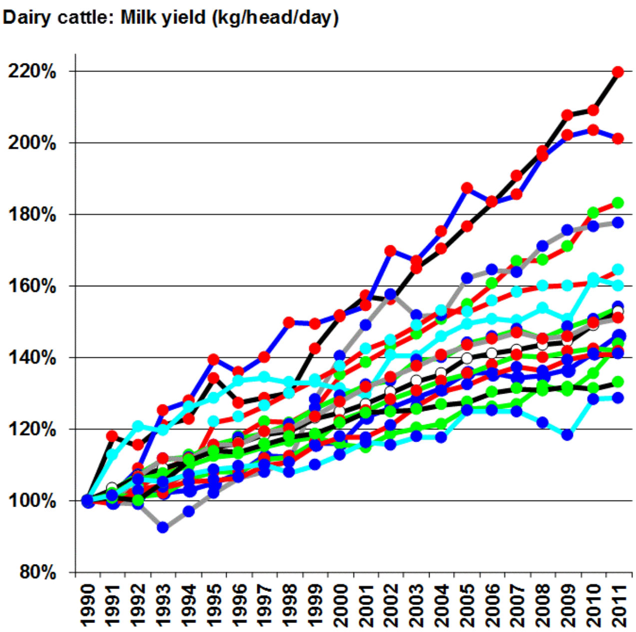
	1990	Trend (%) 1990-2011	2011
Denmark	107	122%	130
Finland	103	121%	124
Austria	123	116%	143
Portugal	138	111%	153
Belgium	106	109%	115
EU-15	120	105%	126
Greece	136	104%	141
Luxembourg	104	103%	108
Germany	106	103%	109
Spain	124	101%	123
Sweden	181	100%	181
Italy	141	98%	139
Ireland	132	98%	129
Netherlands	113	97%	111
United Kingdom			
France			

Figure 6.12: Trend of activity data (gross energy intake) for sheep



	1990	Trend (%) 1990-2011	2011
Spain	19	102%	20
Portugal	21	102%	23
EU-15	20	102%	20
Denmark	44	100%	44
Austria	20	100%	20
Luxembourg	20	100%	20
Germany	20	100%	20
Sweden	20	100%	20
Ireland	20	100%	20
Greece	21	100%	21
Finland			
Belgium			
Italy			
Netherlands			
United Kingdom			
France			

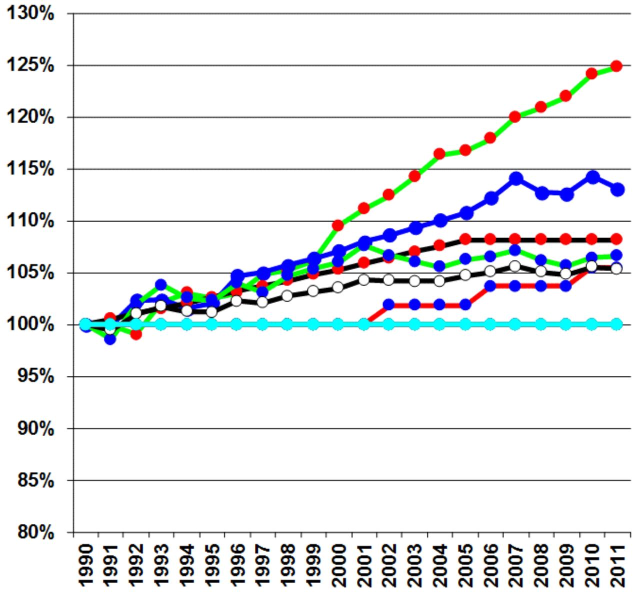
Figure 6.13: Trend of activity data (milk productivity) for dairy cattle



	1990	Trend (%) 1990-2011	2011
Spain	9.9	220%	20.7
Greece	7.5	201%	15.2
Belgium	11.2	183%	20.1
Portugal	11.9	178%	21.0
Austria	10.4	164%	16.7
Italy	11.5	160%	18.7
Germany	12.9	154%	19.4
EU-15	12.7	153%	19.0
Luxembourg	13.1	151%	19.6
United Kingdom	14.1	146%	19.9
France	13.1	144%	17.7
Finland	15.7	142%	22.3
Denmark	16.5	141%	23.3
Sweden	18.6	133%	24.4
Ireland	11.5	129%	14.7
Netherlands			

Figure 6.14: Trend of livestock characterisation: animal mass for dairy cattle

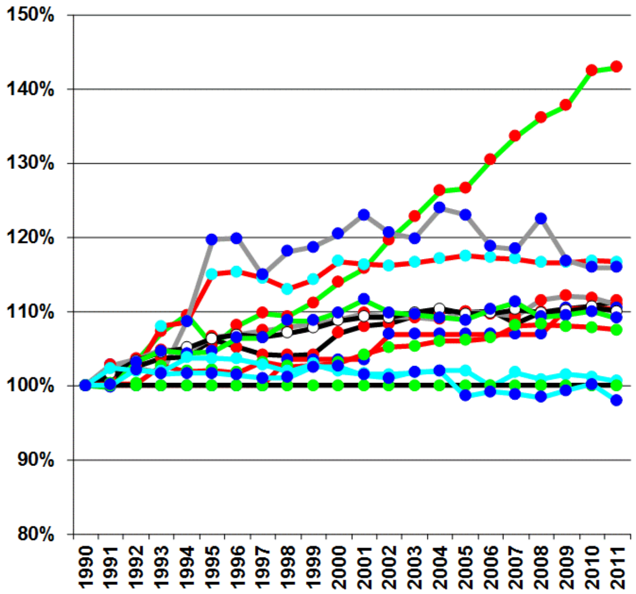
Dairy cattle: Typical animal mass (kg dm/head/day)



	1990	Trend (%) 1990-2011	2011
Finland	520	125%	645
United Kingdom	572	113%	653
Spain	598	108%	647
Germany	608	107%	647
Denmark	550	105%	580
EU-15	595	105%	627
Sweden	600	100%	600
Belgium	600	100%	600
Luxembourg	650	100%	650
Ireland	535	100%	535
Austria	700	100%	700
Italy	603	100%	603
France			
Portugal			
Greece			
Netherlands			

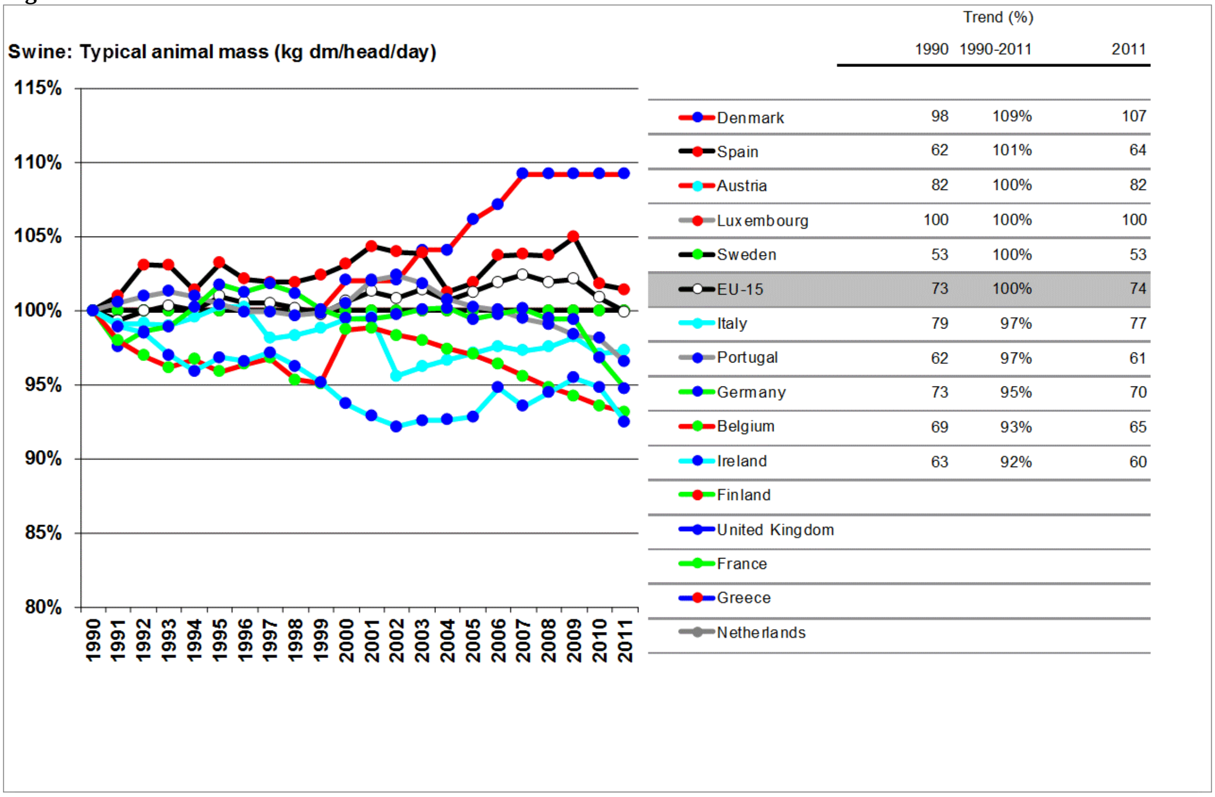
Figure 6.15: Trend of livestock characterisation: animal mass for non-dairy cattle

Non-dairy cattle: Typical animal mass (kg dm/head/day)



	1990	Trend (%) 1990-2011	2011
Finland	278	143%	396
Austria	364	117%	425
Portugal	355	116%	412
Spain	395	111%	437
Luxembourg	322	111%	360
Denmark	290	110%	320
EU-15	345	110%	381
Germany	300	109%	330
Belgium	381	107%	410
Italy	376	101%	381
Sweden	550	100%	550
Ireland	349	98%	350
United Kingdom			
France			
Greece			
Netherlands			

Figure 6.16: Trend of livestock characterisation: animal mass for swine



6.3.1.3 *Uncertainty and time series consistency*

CH_4 emissions from enteric fermentation belong to the source categories in agriculture, which are less uncertain. Animal numbers are assumed to be correct with a maximum uncertainty of 10% (with the exception of Portugal), and also the emission factor, which is calculated to a large extent with the Tier 2 methodology, is estimated to be known with a precision better than 20% for most countries, with 40% being the highest uncertainty estimate (Belgium and France) for cattle and 50% (Portugal) for other animal types. One exception is the high uncertainty assigned to some animal types (mules and asses, poultry and rabbit) in Portugal. The absence of statistic numbers for poultry, the need to estimate a time-series based on surrogate drivers, and the prevalence of dispersed animals in small farms, naturally causes higher uncertainty values for these animals. Finally, animals that are usually not considered as meat, such as equines, are less controlled and numbers tend to be known with less rigour.

The contribution of enteric fermentation to the overall inventory uncertainty is 1% or less for all countries. For the EU-15 aggregate its contribution is 0.3%.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.43 and Table 6.44. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4. Note that some countries (Finland) are using Tier 2 methodology for combining uncertainty estimates in agriculture at a much finer level of disaggregation and thus do not report AD and EF uncertainty estimates separately. Instead, due the combined uncertainty estimate is reported also in the cells for the EF uncertainty and the AD uncertainty is set to zero.

Table 6.25 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from enteric fermentation.

Table 6.23: Relative uncertainty estimates for activity data in category 4A

Member State	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Swine	Poultry	Other
Austria		10.0						
Belgium	5.0		5.0	5.0		5.0		
Denmark	2.0							
Finland	12.6							
France	5.0							
Germany			4.0	2.5	3.6			
Greece	5.0							
Ireland			1.0	1.0				1.0
Italy	20.0							
Luxembourg		2.0						
Netherlands			5.0	5.0		5.0		5.0
Portugal	6.5							
Spain	3.0							
Sweden	2.3							
United Kingdom	0.1							

Table 6.24: Relative uncertainty estimates for implied emission factors in category 4A

Member State	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Swine	Poultry	Other
Austria		20.0						
Belgium	20.0		20.0	20.0		20.0		
Denmark	20.0							
Finland	12.5							
France	15.0							
Germany			40.0	24.5	25.0			
Greece	30.0							
Ireland			15.0	15.0				30.0
Italy	20.0							
Luxembourg		20.0						
Netherlands			15.0	20.0		50.0		30.0
Portugal	12.2							
Spain	9.0							
Sweden	11.3							
United Kingdom	20.0							

Table 6.25: Available background information for the uncertainty estimates in category 4.A

Member State	Background information to uncertainty estimates
Austria	Activity Data: Animal numbers, in accordance to (Winiwarter 2008) were estimated at 10% uncertainty and considered statistically independent. Emission Factor: Uncertainties of emission factors for CH_4 emissions of enteric fermentation, according to Amon et al. (2002) were considered 20% for cattle and sheep (representing ruminants) and 30% for all other animals. EFs are correlated. Uncertainties of CH_4 emissions from Enteric Fermentation were estimated with a "Monte Carlo" simulation. Assuming a normal probability distribution, the calculated standard deviation is 4%. This indicates there is a 95% probability that CH_4 emissions are between +/- 2 standard deviations. Uncertainties considered are Gross Energy Intake, Methane Conversion Factor, Livestock, Share of oragnic farming, emission factor. The emission factors for the Tier 2 method are determined by the uncertainty of the gross energy intake and the CH_4 conversion rate.
Belgium	Activity Data: The only activity data here is the national livestock census. The uncertainty is judged small taken into account the features of the monitoring (census twice a year, individual earmarks and registration for all bovines, …),. Emission Factor: The emission factors are mainly the IPCC default values, using Tier 1 methodology. Consequently, the IPCC uncertainty estimate of 40% is used for the emission factor.
Denmark	Activity Data: Due to the large number of farms included in the norm figures, the arithmetic mean can be assumed as a very good estimate,with a low uncertainty. All cattle have theyr own ID-number (ear tags) and, hence, the uncertainty in this number is almost non-existent. The Danish Plant Directorate, as the controlling authority, performs analysis of feed sold to farmers. Onaverage, 1600 to 2000 samples are analysed every ear. Uncertainty in the data is seen as negligible. The combined effect of low uncertainty in actual animal numbers, feed consumption and excretion rates gives a very low uncertainty in the activity data. The major uncertainty, therefore, relates to the emission factors.
Finland	Activity Data: Uncertainty estimates of animal numbers were based on knowledge on the reliability and coverage of data collection. Cattle has individual earmarks that enable very accurate assessment of animal numbers (uncertainty of ±3%), but uncertainty in animal numbers for other species in farms is higher (±5%). The uncertainty in animal numbers is estimated to be the highest for reindeer (±10%). Emission Factor: IPCC default uncertainties for emission factors were used excluding reindeer, for which the national emission factor has been used. The uncertainty in the Tier 2 method for evaluating emissions from enteric fermentation of cattle was assessed by estimating uncertainty in each calculation parameter (except coefficients, whose importance was expected to be minor) and combining uncertainties using

Member State	Background information to uncertainty estimates
	Monte Carlo simulation. Uncertainty in CH_4 emissions from enteric fermentation of domestic livestock were estimated at -20% to +30% in 2007.
France	
Germany	**Activity Data: For the IEF for swine, a comparison shows that those countries with an explicit calculation use higher IEF than IPCC default; this suggests that IPCC (1996 and 2006) are not suitable to represent mid-European conditions for swine.** **Emission Factor: The uncertainties in the methane emission factors are on the order of 30 % (EMEP, 2000: Chapter B1040-6). The primary sources of inaccuracy in these figures include the methane conversion factor (for cattle, 0.06 ± 0.005, i.e. 10 %, cf. IPCC, 2006) and the actual federation composition, especially that for cattle.**
Greece	
Ireland	
Italy	
Luxembourg	**Activity Data: Animal numbers' uncertainty is estimated between 2% (for cattle, which are extremely well covered due to their inclusion in a register) and 10% for animals distributed over many small farms (sheep, horses, chicken).** **Emission Factor: The uncertainty in CH_4 emission factors for livestock categories (sheep, goats, horses) is reported to be ±20%.**
Netherlands	**Activity Data: For cattle, uncertainty in animal numbers 5% (Olivier et al.,2009),** **Emission Factor: For cattle, uncertainty in emission factor 15% (Bannink, 2009).The uncertainty in the emission factor for swine and other animals is estimated to be 50% and 30%, respectively (Olivier et al.,2009)**
Portugal	
Spain	
Sweden	
UK	

The following issues related to time-series consistency are identified for population and IEF data:

- *Austria*

  The FAO agricultural data base provides worldwide harmonized data (FAO Agr. Statistical System 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets.

  1991: A minimum counting threshold for poultry was introduced. Farms with less than 11 poul-try were not considered any more. However,the contribution of these small farms is negligible, both with respect to the total poultry number and to the trend. The increase of the soliped population between 1990 and 1991 is caused by a better data collection from riding clubs and horse breeding farms. 1993: New characteristics for swine and cattle categories were introduced in accordance with Austria's entry into the European Economic Area and the EU guidelines for farm animal population categories. This shift is considered to be insignificant. In the same year "Young swine < 50 kg" were shifted to "Fattening pigs > 50 kg" (before 1993 the limits were 6 months and not 50 kg which led to the shift) causing distinct in-consistencies in time series. Following a recommendation of the Centralized Review 2003, the age class split for swine categories of the years 1990–1992 was adjusted us-ing the split from 1993.

- *Belgium*

  In Flanders from 2000 on another source for animal numbers is used, but a consistency check has been performed. The animal number between Statbel and the manure bank is not exact the same. Statbel collects data on the 1st of May, which means that farmers give the animal number present at the farm at the 1st of May. For the manure bank farmers give the average animal population of the past year.

- *Denmark*

  Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. Statistics Denmark is the source for the database kept by FAO (Food and Agriculture Organization of the United Nations). This explains why the number of sheep, goats and horses in FAO and the Danish emission inventory disagree. The largest difference is found for horses. Improvements to the documentation of number of horses, sheep and goats on small farms, in cooperation with DAAC, are planned for the 2010 reporting. Since the year 2007, a decision was taken to improving methodology in estimation of animal number to add number of sheep, goats and horses on small farms less than 5 ha.

- *Germany*

  Cattle: since 2008 data are from HIT; which showed to be 2.9% higher than previous numbers. As a consequnce, the emissions for the years before 2008 are slightly under-estimated.

  There is some inconsistency in the time series of animal numbers in Germany due to the modification of the "Agrarstatistikgesetzes" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an approach for correction has been developed and applied (Daemmgen, 2006).

  Buffalo: Buffalo have been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series

- *Sweden*

  The time series in the agricultural sector in Sweden are calculated consistently but the data needed are not always available for every year covered by the inventory. In cases where statistics are not produced annually, interpolation and extrapolation are necessary tools for the imputation of estimates. Methane from enteric fermentation may be a bit more certain with an error of about 30 %.

- *United Kingdom, AD general*

  In the United Kingdom, the time-series consistency of these activity data is very good due to the continuity in data provided. There is an increase in slaughter weight from 2004 (238kg) to 2005 (343kg). This increase was a result of the lifting of the Over Thirty Month rule, which is a measure to control the exposure of humans to the disease BSE.

6.3.2 Manure Management CH_4 (CRF source category 4.B(a))

6.3.2.1 *Source category description*

During storage and management of manure, CH_4 can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term ‘manure’ is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. Source category 4.B(a) excludes emissions that originate from burning of manure. The decomposition of manure generates CH_4 under anaerobic conditions (i.e., in the absence of oxygen). These conditions occur most readily when large numbers of animals are managed in a confined area (e.g., dairy farms, beef feedlots, and swine and poultry farms), and where manure is disposed of in liquid-based systems. If manure is managed or treated in liquid systems, it decomposes anaerobically and can produce a significant quantity of CH_4. The temperature and the retention time of the storage unit greatly affect the amount of methane produced.

Table 6.26 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (49% and 44% of total emissions in category 4B(a), respectively). For cattle, the contributions of non-dairy cattle are prevailing with percentages of total emissions in this category amounting to 20% and 29%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Ireland (74%) and the United Kingdom (66%); the lowest in Portugal and Spain, where cattle contribute with only 7%. This is compensated with the emissions from swine manure with 82% of the total CH_4 from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 14% and 5.9% of total CH_4 from manure management, respectively. Greece has also the highest contribution of poultry to CH_4 emissions from manure management with 22%.

At the EU-15 level, CH_4 emissions from manure management have decreased for cattle and sheep, but have increased for swine, which is mainly due to an intensification of swine production resulting in a higher IEF. Emissions from goats and poultry remained more or less stable.

Table 6.26: Total CH_4 emissions in category 4B(a) and implied Emission Factor at EU-15 level for the years 1990 and 2011

	Dairy Cattle	Non-dairy cattle	Swine
	1990		
Total Emissions of CH_4 [Gg CH_4]	516	389	760
Total Population [1000 heads]	26211	65018	113536
Implied Emission Factor [kg CH_4 / head / year]	19.7	6.0	6.7

	Dairy Cattle	Non-dairy cattle	Swine
	2011		
Total Emissions of CH_4 [Gg CH_4]	494	351	747
Total Population [1000 heads]	17402	57231	118374
Implied Emission Factor [kg CH_4 / head / year]	28.4	6.2	6.4

	Dairy Cattle	Non-dairy cattle	Swine
	2011 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	96%	90%	98%
Total Population [1000 heads]	66%	88%	104%
Implied Emission Factor [kg CH_4 / head / year]	144%	103%	95%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2011, submitted in 2013
Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

6.3.2.2 *Methodological Issues*

Methods

CH_4 emissions from manure management are a key source category for cattle and swine at EU-15 level. This is true also for many Member States. Table 6.27 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reported whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management implies the need to estimate for each animal category the excretion of volatile organic solids (VS) and a maximum methane producing capacity (B_0); furthermore, for each animal category and manure management system, a methane conversion factor must be determined, which is dependent on the climate region. Each country must determine the fractions of the manure managed in all AWMS-climate region combinations. A weighted average of the methane conversion factor over all occurring climate regions must then be calculated for each animal waste management system. The IPCC *Guidelines* list default values for all these parameters. In Table 6.27, we report also the Tier that has been used by the Member States to estimate CH_4 emissions from manure management according to the approach described in section 6.4.1 (see Table 6.87 through Table 6.90).In the case of CH_4 emissions from manure management, a Tier 2 approach was assigned according to the "median-rule" with the weighting factors 0.75, 0.13, and 0.13 for VS, B_0, or MCF, respectively (see Section 6.4.1.2 for details). For the methane conversion factor, we calculated the default value by using the allocation to the different climate regions reported by the countries and multiplying with the respective IPCC value. For the Netherlands, no background data are given, so the level of the method could not be calculated. However, according to the NIR of the Netherlands, a country-specific Tier 2 method has been applied.

Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.3 and Tier 2.0 with a Tier level for EU-15 of Tier 1.8 (corresponding to 86% of the emissions being calculated with country-specific data). This relatively low quality for this source category is due to the fact that countries with a high number of animals have intermediate quality (Tier 1.5, e.g. because no country-specific estimation of VS has been done).

Some additional information on the methodological approaches for some Member States is given in Table 6.28.

Table 6.27: Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine. Data for the year 2011.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	325	Tier 1.8	31%	Tier 1.9	38%	Tier 1.9	y	23%	Tier 1.9
Belgium	1,385	Tier 1.9	12%	Tier 1.9	9%	Tier 1.9	y	77%	Tier 1.9
Denmark	1,308	Tier 1.9	30%	Tier 1.9	16%	Tier 1.9	y	48%	Tier 1.9
Finland	300	Tier 1.6	30%	Tier 1.9	15%	Tier 1.9	y	35%	Tier 1.2
France	9,914	Tier 1.8	31%	Tier 1.8	25%	Tier 1.8	y	38%	Tier 1.8
Germany	4,983	Tier 2.0	36%	Tier 2.0	29%	Tier 2.0	y	33%	Tier 2.0
Greece	326	Tier 1.3	12%	Tier 1.9	6%	Tier 1.9	y	39%	Tier 1.2
Ireland	2,133	Tier 1.8	22%	Tier 1.8	52%	Tier 1.8	y	19%	Tier 1.9
Italy	2,114	Tier 1.8	15%	Tier 2.0	18%	Tier 2.0	y	42%	Tier 2.0
Luxembourg	96	Tier 1.8	33%	Tier 1.8	29%	Tier 1.8	y	38%	Tier 1.8
Netherlands	2,634	Tier 2.0	51%	Tier 2.0	18%	Tier 2.0	y	29%	Tier 2.0
Portugal	1,044	Tier 1.9	4%	Tier 1.8	4%	Tier 1.8	y	82%	Tier 1.9
Spain	6,611	Tier 1.8	19%	Tier 1.8	5%	Tier 1.8	y	73%	Tier 1.8
Sweden	301	Tier 1.9	22%	Tier 1.9	49%	Tier 1.9	y	15%	Tier 1.9
United Kingdom	2,522	Tier 1.5	48%	Tier 1.8	18%	Tier 1.8	y	20%	Tier 1.0
EU-15	**35,997**	**Tier 1.8**	**29%**	**Tier 1.9**	**20%**	**Tier 1.9**	**y**	**44%**	**Tier 1.8**
EU-15: Tier 1	14%		12%		12%			16%	
EU-15: Tier 2	86%		88%		88%			84%	

a Contribution to CH_4 emissions from manure management
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 6.28: Available background information for the calculation of CH_4 emissions in category 4.B(a)

Member State	Methods
Austria	**Cattle and swine: Tier 2 (key sources); Sheep, Goats, Horses and Other Soliped, Chicken, Other Poultry and Other animals: Tier 1.**
Belgium	**Tier 2 methodology is used for both cattle and swine in Flanders and in Wallonia. Tier 1 is used in Brussels region. Although sheep, goats, poultry, horses, mules and asses are no key sub-source categories, however a region specific approach is used. EF used in de current methodology are close to the IPCC value. Because of the availability of detailed statistics on livestock composition in Flanders, including data on e.g. slaughter weights, a more extended variant of the IPCC methodology has been applied. Accounting for the fact that the weight of the cattle over the whole lifetime is not the same as the slaughter weight, the weight is integrated from birth to slaughtering. A study performed by the Flemish Institute for Technological Research (Vito), indicates that CH_4 emissions during manure processing are negligible.**

Member State	Methods
Denmark	**The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen, 2006). The IPCC Tier 2 approaches are used for the estimation of the CH_4 emission from manure management. The amount of manure is calculated for each combination of livestock subcategory and stable type. A significant share of cattle and pig slurry are treated in biogas plants (DEA 2010). Treated slurry in biogas plants has a lower emission of both CH_4 and N_2O. No description on how to include biogas treated slurry in the inventories is provided in the IPCC guidelines. Therefore, the Danish inventory uses data based on a Danish study (Sommer et al., 2001). The lower CH_4 emission as a consequence of biogas treated slurry is calculated as the difference between non-treated slurry and treated slurry. Based on results from Sommer et al. (2001) it is assumed that the emission from treated cattle slurry is reduced by 23% compared with untreated slurry and results from treated pig slurry show a 40 % lower emission than for untreated slurry.**
Finland	**Methane emissions from manure management are calculated in the same generic way as emissions from enteric fermentation, i.e. by multiplying the number of the animals in each category with the emission factor for each category. In Finland the Tier 2 method is used for all animal categories. The national emission factor for each cattle subcategory has been calculated by using the IPCC Tier 2 methodology.**
France	**Tier 1 or 2. The AWMS, the nitrogen excretion factors and the volatile organic solids (VS) come from national data. For the other parameters, IPCC defaults are considered.**
Germany	Tier 2 for all animal categories with the exception of gooses.
Greece	**Dairy cattle, non-dairy cattle and sheep: Tier 2. Other animals: Tier 1.**
Ireland	**Cattle: Tier 2. Other livestock: Tier 1.**
Italy	**IPCC Tier 2 approach has been used for estimating CH_4 EFs for manure management from cattle, buffalo and swine. For estimating slurry and solid manure EFs and the specific conversion factor, a detailed methodology (Method 1) has been applied at a regional basis (cattle and buffalo categories). Then, a simplified methodology, for estimating EFs time series, has been followed (Method 2). Since the 2006 submission, a reduction of CH_4 emissions because of biogas production has been considered.**
Luxembourg	**Tier 1 method has been applied to estimate methane emissions from manure management – i.e. for all animal categories except cattle. Population and methane emission growths are exactly the same as in enteric fermentation. What distinguishes one tier from the other is the fact that, for cattle, the average gross energy intake – as a component of the volatile solid daily excretion – is not a default value but, rather, the value obtained when estimating enteric fermentation methane related emissions with a Tier 2 method.**
Netherlands	**Tier 2 approach is used based on country specific data on animal manure production per animal, on manure characteristics (like organic matter (OM) content) and (liquid) manure storage conditions.**
Portugal	**All animal types: Tier 2. Emission factors by animal type and climatic conditions.Emissions factors for each animal type were established according to the tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produced per animal and the share of each Manure Management System that is used for each animal type. Results differ considerably from the ones obtained using the IPCC defaults, due to: swine manure in Portugal is treated in anaerobic lagoons (which have the highest MCF); management of wasted form dairy cows kept in stalls is split among solid storage and short retention pits; dairy cows in pasture are more common in Portugal than the default assumption of IPCC; non-dairy cows with milking calves are usually kept on pasture, but fattening animals are usually grown in confined areas and solid storage is the prevalent method; daily spread and usage as fuel are rare; there is a small percentage of traditional swine kept outdoors and foraging in pastures; some poultry is kept outside; and there are no substantial seasonal variations in the share of management systems**
Spain	**Tier 3 for cattle, swine and poultry; Tier 1 for other animal categories.VS is estimated using a national methodology based on the digestible energy and the type of diet for cattle, swine and poultry. Smooth functions for the MCF and the FE for tier 1 approaches are used (modification accepted by IPCC). It has been calculated by interpolating IPCC default factors for the three climatic regions (with mid-point mean annual temperature of 10, 20, and 28°C) using the formula: MCF(T)=MCF(10°C) + b (10-T)^m, where b and m are parameters that vary with animal waste management system.**
Sweden	**Include emissions from grazing animals. Tier 2 for Cattle and Swine, Tier 1 methodology is used for other animal groups.**
United Kingdom	**Tier 2 for cattle and deer, tier 1 for other animals.**

Activity Data

Table 6.29 and Table 6.30 summarize the allocation of the produced manure over the animal wastes management systems ‘liquid systems’, ‘solid storage and dry lot’ and ‘pasture, range and paddock’ for the animal categories dairy and non-dairy cattle and swine in 2011 and 1990, respectively. The table shows, that in all countries more manure is managed in liquid systems for swine than for cattle, whereby in Italy, Ireland and the Netherlands, 100% of the swine manure is managed in liquid systems. Only in the UK more manure is managed in solid than in liquid systems. In the category cattle, generally more manure is managed in liquid systems for dairy cattle than for non-dairy cattle, expressed in relative numbers, with the exception of Italy.

Substantial changes in the allocation of manure to manure management systems are reported for Sweden, Germany, Finland, and Denmark, however, with different signs of the direction of the changes. For example, liquid systems were more frequently used to manage manure from dairy cattle in Sweden (from 23% in 1990 to 62% in 2011).

Table 6.29: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2011

Member State	Dairy Cattle - Allocation of AWMS (%)					Non-Dairy Cattle - Allocation of AWMS (%)				
2011	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	32%	NO	49%	3%	16%	23%	NO	44%	5%	28%
Belgium	12%	NO	25%	43%	21%	4%	NO	38%	45%	13%
Denmark	88%	NO	2%	5%	5%	30%	NO	1%	29%	40%
Finland	46%	NO	27%	26%	1%	NO	NO	NO	NO	NO
France	41%	NO	20%	39%	NO	27%	NO	30%	42%	NO
Germany	74%	NO	16%	11%	NO	42%	NO	38%	19%	NO
Greece	6%		86%	8%			3%	62%	33%	2%
Ireland	29%	NO	2%	70%	NO	32%	NO	6%	62%	NO
Italy	38%	NO	57%	5%	NO	56%	NO	41%	3%	NA
Luxembourg	34%	NO	16%	45%	5%	26%	NO	19%	50%	5%
Netherlands	90%			10%		81%		2%	17%	
Portugal	20%	NO	50%	30%	NO	13%	NO	NO	87%	NO
Spain	NO	NO	NO	NO	100%	NO	NO	NO	85%	15%
Sweden	62%	NO	13%	24%	1%	18%	NO	19%	46%	17%
United Kingdom	38%	13%	4%	45%	NO	4%	14%	21%	62%	NO
EU15	50%	1%	19%	24%	6%	27%	2%	24%	43%	4%

Member State	Swine - Allocation of AWMS (%)					Poultry - Allocation of AWMS (%)				
2011	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	78%	NO	4%	NO	18%	NO	NO	NO	NO	NO
Belgium	6%	3%	6%	NO	85%	19%	NO	62%	0%	18%
Denmark	97%	NO	3%	0%		2%	NO	NO	1%	97%
Finland	60%	NO	35%		5%	1%	NO	37%	NO	62%
France	93%	NO	6%	1%	NO	4%	NO	89%	7%	NO
Germany	92%	NO	8%	NO	NO	NO	NO	100%	NO	NO
Greece	90%		10%						72%	28%
Ireland	100%	NO	NO	NO	NO	10%	NO	88%	2%	NO
Italy	100%	NO	NA	NA	NA	4%	NO	67%	NO	30%
Luxembourg	90%	NO	5%	NO	5%	NO	NO	75%	NO	25%
Netherlands	100%					1%		99%		
Portugal	92%	NO	2%	6%	NO	52%	NO	47%	1%	NO
Spain	NO	NO	NO	NO	100%	NO	NO	NO	NO	100%
Sweden	82%	NO	15%	NO	3%	25%	NO	55%	NO	20%
United Kingdom	24%	26%	38%	12%	NO	NO	38%	NO	2%	60%
EU15	66%	1%	5%	1%	27%	4%	5%	57%	4%	30%

Source of information: CRF 4.B(a) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system.

Table 6.30: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 1990

Member State	Dairy Cattle - Allocation of AWMS (%)					Non-Dairy Cattle - Allocation of AWMS (%)				
1990	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	33%	NO	49%	11%	7%	25%	NO	46%	9%	20%
Belgium	10%	NO	27%	43%	20%	3%	NO	37%	45%	15%
Denmark	70%	NO	13%	15%	2%	36%	NO	3%	28%	33%
Finland	23%	NO	51%	25%	2%	NO	NO	NO	NO	NO
France	26%	NO	34%	39%	NO	21%	NO	37%	42%	NO
Germany	55%	NO	27%	18%	NO	58%	NO	26%	15%	NO
Greece	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Ireland	32%	NO	2%	66%	NO	31%	NO	5%	63%	NO
Italy	38%	NO	57%	5%	NO	58%	NO	40%	2%	NA
Luxembourg	23%	NO	32%	45%		19%	NO	31%	50%	
Netherlands	70%			30%		66%		2%	32%	
Portugal	35%	NO	35%	30%	NO	NO	NO	27%	73%	NO
Spain	NO	NO	NO	27%	73%	NO	NO	NO	82%	18%
Sw eden	23%	NO	52%	25%	1%	17%	NO	32%	42%	8%
United Kingdom	30%	17%	7%	45%	NO	3%	14%	22%	62%	NO
EU15	38%	2%	26%	29%	6%	30%	2%	26%	39%	3%

Member State	Sw ine - Allocation of AWMS (%)									
1990	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	70%	NO	9%	NO	21%	NO	NO	NO	NO	NO
Belgium	3%	3%	6%	NO	87%	21%	NO	71%	0%	8%
Denmark	89%	NO	11%	NO	NO	3%	NO	NO	0%	96%
Finland	36%	NO	58%	0%	5%	NO	NO	64%	NO	36%
France	83%	NO	17%	1%	NO	2%	NO	93%	5%	NO
Germany	80%	NO	20%	NO	NO	NO	NO	100%	NO	NO
Greece	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Ireland	100%	NO	NO	NO	NO	12%	NO	86%	2%	NO
Italy	100%	NO	NA	NA	NA	32%	NO	68%	NO	NO
Luxembourg	90%	NO	5%	NO	5%	NO	NO	75%	NO	25%
Netherlands	100%					58%		42%		
Portugal	95%	NO	3%	2%	NO	NO	NO	100%	0%	NO
Spain	NO	NO	NO	NO	100%	NO	NO	NO	NO	100%
Sw eden	44%	NO	52%	NO	5%	25%	NO	55%	NO	20%
United Kingdom	43%	28%	27%	2%	NO	NO	50%	NO	1%	50%
EU15	65%	2%	12%	0%	21%	13%	6%	59%	1%	21%

Source of information: CRF 4.B(a) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Anaerobic lagoon + Liquid system.

For some countries, background information on in addition to what is reported in Table 6.17 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 6.31.

Table 6.31: Available background information on the allocation to animal waste management systems used for the calculation of CH_4 and N_2O emissions in category 4.B(a)

Member State	Activity data
Austria	**AWMS distribution was taken from the research project "Animal husbandry and manure management systems in Austria" (Amon et al. 2007) which was a a comprehensive survey on the agricultural practice in Austria. As a result of TIHALO, for 2005 new representative data on animal husbandry and manure management systems all over Austria is available. Firstly, a questionnaire was developed to assess animal housing, manure storage and manure application on typical Austrian farms. In November 2005, the questionnaire was sent to 5 000 Austrian farms. The statistical sampling plan was set up with the assistance of the Statistics Austria to guarantee the selection of a representative sample of Austrian farms. A questionnaire return of about 40% had to be achieved to receive representative data on animal husbandry and manure management systems in Austria. The returned questionnaires were manually fed into a data template by the Statistics Austria. On the basis of this template, a data base was created that contained the questionnaire information. Anonymity of the farms that supplied data is guaranteed. The data base was checked for representativeness and plausibility. For the year 1990 AWMS data based on (Konrad 1995) is available. The AWMS data from 2005-2008 were derived by linear extrapolation. From 2008 onwards the AWMS distribution is held constant in order to prevent implausible trends by the end**

Member State	Activity data
	of the commitment period. It is not planned to have another survey before the end of the commitment period. In the 2008 inventory, the following new systems have been taken into account: yard, deep litter, composting, aerobic treatment and anaerobic digester; these AWMS have been summarised under "Other". Manure management systems are distinguished for Dairy Cattle, Suckling Cows and Cattle 1–2 years in "summer situation" and "winter situation". For poultry and horses in addition the treatment of manure in anaerobic digesters is been considered. The amount of manure treated in anaerobic digersters is obtained on data from the the Austrian Energy Regulator E-Control (E-CONTROL 2011) on the basis of reports from biogas plants operators.
Belgium	**The fraction manure handled in each management system (MS%) is region-specific and can differ slighlty. The allocation of animals to AWMS originate in Flanders from the Manure Bank of the Flemish land Agency (VLM). In Wallonia, the allocation of animals to each animal waste management system (AWMS) comes from the STATBEL agricultural census of 1992 and 1996, where those data were published by animal type. Those data are not collected yearly by the STATBEL given their slow pace of change. In all three regions swine and poultry stay 100% of their lifetime in house. Cattle (with exception of slaughter calves) spend more or less 50% of their lifetime on pasture. The amount (net export) is inventoried by the Manure Bank of the VLM and yearly published as the 'manure balance' in the following progress reports: http://www.vlm.be/lijsten/publicaties/Pages/MB_Voortgangsrapporten.aspx**
Denmark	From 2005, all farmers have to report to the Danish AgriFish Agency (DAFA) information concerning the use of housing type. Before 2005 there exist no official statistics which cover the distribution of animals according to housing type. The distribution is, therefore, based on an expert judgement from the Danish Agricultural Advisory Service (DAAS) and DCA. Approximately 90-95 % of Danish farmers are members of DAAS, which regularly collects statistical data from the farmers on different issues, **as well as making recommendations with regard to farm buildings. Hence, have DAAS a very good feeling of which housing types that are currently in use.**
Finland	**Distribution over animal systems (slurry, solid storage, pasture) is country-specific from literature (MKL, 1993; Seppänen and Matinlassi, 1998) and expert judgement. Anaerobic lagoons and daily spread not used in Finland.**
France	**Surveys on the distribution of national animal housing systems have been carried out in 1994, 2001, and 2008 and allow thus to cover the evolution of the systems in time. Distribution of manure over AWMS takes into account the time the animal spent within the housing and outside (pasture or yard) as well as the share of solid and liquid systems. As only days which were spent entirely in the housing systems were counted, 4 hours/day during the grazing period were added for dairy cattle to account for time they spent in the housings. Distribution over AWMS is interpolated between the years 1994, 2001 and 2008 and has been kept constant after 2008.**
Germany	Information on feeding and stable types are taken from the agricultural model 'RAUMIS' available at vTI (Regionalisiertes Agrar- und UmweltInformationsSystems fuer Deutschland). The model is based on national statistics at district level, description of standard production methods from KTBL, information from the ministry for agriculture and results from surveys. Data gaps are filled by expert knowledge. RAUMIS could not be updated after 1999 and values between 1999 and 2010 were interpolated using new data from the 2010 Survey on Agricultural Production Methods (SAPM). Some assumptions were taken for missing data, e.g. regarding calves systems until 2002, solid systems for dairy cows are assumed to be deep litter which is most common in Germany etc. Also biogas installations are considered. **Data on activity data of cattle and swine slurry in biogas installation as well as the storage of the digesters are from KTBL. No differentiated data on animal sub-categories is available, therefore it is assumed that cattle slurry is from dairy cows and swine slurry from fattening pigs. There is an increasing trend of slurry treated in biogas installation, which in some occasions exceeded the available quantity of slurry so that the trend (and emission reduction) is slightly under-estimated. The shares of cattle vs. swine slurry are known for the year 2010 and have been used to extrapolate back to 1990.**
Greece	**Values referring to Near East and Mediterranean category for the allocation of manure to animal waste management systems per animal species was followed. However, in some cases country-specific data was used based on the judgement of experts from several institutes, including the Agricultural University of Athens, the Ministry of Rural Development and Food, the Department of Animal Production at the School of Agricultural Technology (the Technological Educational Institute of Epirus) and the Office of Rural Development of the Prefecture of Thessaloniki. Greece continues efforts to improve the country-specific data. Country-specific data for dairy cattle, other cattle, buffalo and swine was considered. Dairy cattle are mainly stall or housed and they are used for milk production. Only for a small share of their life they are in pasture. The manure produced from them is mainly managed in Solid storage and dry lot systems. Liquid management systems, which is a practise in some new units, manure separation of liquid-solid is performed. Most of the solid produced is stored to piles and is treated with solid practices, while 15% of solid is drifted by the liquid, stored to tanks and it is treated according to liquid practices. The percentage of dairy cattle farms that use liquid-solid separation systems is about the 40% of the total dairy cattle.The majority of swine in Greece remain in properly designed building infrastructures and their manure is managed with liquid systems according to Greek legislation. A small share of swine's manure, about 10%, is managed with solid systems. This share mainly represents the manure produced by swine live in small production units. Sheep and goats are in pasture in Greece.**
Ireland	**The allocation to animal waste management system is based on the farm facilities survey. The same values are used for all years. The bulk of animal wastes in housing are managed in liquid storage systems. New information obtained from a national farm facilities survey (Hyde et al., 2008). The Farm Facilities Survey was conducted on a representative sample of farms, the results of which are available**

Member State	Activity data
	at both national level and for each of the three designated Nitrates Directive regions. The proportioning of Animal Waste Management Systems within the model is undertaken on an individual subsystem basis (dairy cows: 12 systems, suckler cows: 18 system types, beef cattle: up to 30 systems). The partitioning of the year into pasture and housing periods is based on expert opinion in conjunction with the results of the Farm Facilities Survey (Hyde et al., 2008) for each particular subsystem. Having derived the time spent at pasture and the time spent in housing for cattle, the Farm Facilities Survey is used to determine the partitioning of liquid and solid manures to AWMS within the housing period, and the estimation of the number of animals that are out-wintered (i.e. at pasture all year round). Approximately two-thirds of animal manure nitrogen is excreted at pasture annually, reflecting the relatively short period that cattle and sheep are housed in Ireland.
Italy	Liquid system, solid storage and other management systems (chicken-dung drying process system) are considered according to their significance and major distribution in Italy. Since 2006 submission, several parameters have been updated: average weight, production of slurry and solid manure and the nitrogen excretion rates. The source for updating these parameters was the Nitrogen Balance Inter-regional Project. A national census on biogas production/technology can be found in CRPA and CRPA/AIEL (CRPA, 2008; CRPA/AIEL 2008). Biogas production data are collected every year by the National Electric Network (TERNA, 2011).
Luxembourg	The allocation of AWMS for dry lot is included in solid storage.The activity data are the livestock data reported in the national statistics.
Netherlands	In the Netherlands animal manure is stored in cellars under the slatted floors of animal houses, and when full pumped into outside storage facilities. Anticipating the ban on battery cage systems effective from 2012, farmers are changing their management towards ground housing or the aviary system. In the process they switch from solid manure without bedding (on which birds do not walk), to solid with bedding on which the birds do walk. A growing portion of the manure N is exported.
Portugal	Livestock numbers per animal type were available at Concelho level from two detailed agriculture surveys: RGA89 and RGA99. Livestock numbers in each Concelho area were allocated to each climate region, for year 1999, according to the land are percentage, and always assuming an homogeneous distribution of animals in the Concelho territorial area. Number of animals was summed at each Administrative Region (Região). Livestock population in each climate region and by Região was estimated annually from total livestock population in Região and considering the constant share and, finally, the total national livestock population for each region was calculated. Fraction of manure handled in each manure management system is established using expert opinion, and was last updated in 2010.
Spain	Data for waste management systems for cattle, swine and poultry are from national surveys. For other animal types the values are from expert judgement (UPV 2006). Within manure management systems, "others" has the highest share because most of the manure from cattle, swine and poultry is managed following a chain of connected processes which makes it difficult to associate them to any of the systems considered by IPCC.
Sweden	Information on waste management systems is collected from the surveys published in the biannual statistical report on the use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). Three manure management systems are considered apart form grazing animals: liquid systems (including semi-liquid manure), solid storage and deep litter (sometimes categorised as "other" in the national inventory). National estimates of stable periods are collected from the statistical report on use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990. Since dairy cows are often stabled at night, the data on stable periods for this animal category is combined with an assumption that 38% of its manure was produced in the stable during the grazing period (calculated according to the STANK model, Swedish Board of Agriculture, 2005)The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.
United Kingdom	Country-specific data on the proportion of manure managed in the different AWMS data derive from a number of sources, including published ad-hoc surveys (e.g. Smith et al., 2000a, 2001b, 2001c; Sheppard 1998, 2002; Webb et al., 2001) and, more recently, relevant data from the Farm Practices Surveys for England and a time series is included to reflect changes in practice over time.Livestock population data are reported annually as statistical outputs of the four Devolved Administrations of the UK (i.e. England, Wales, Scotland and Northern Ireland), based on the annual June Agricultural Survey for each country. These data are summed to provide UK population data for the livestock categories and subcategories as used in the inventory compilation. Data for earlier years are often revised so information was taken from the England and the Devolved Administrations' agricultural statistics databases. Dairy cows - quoted assumes animal lives for a year; emission calculation assumes animal lives for 6 months. The average lifespan of lambs is estimated by Wheeler et al. (2012) as 8.1 months.

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the Member States, as shown in Table 6.32. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, which is more than the range proposed in the IPCC *Guidelines* for different climate regions (for dairy cattle in Western Europe, for example, an emission factor of 14 kg CH_4 head^{-1} y^{-1} is proposed for cool climate regions and a factor of 81kg CH_4 head^{-1} y^{-1} of warm climate regions), but less than the ratio of the methane conversion factors of liquid (39% - 72%) and solid (1% – 2%) manure.

As mentioned above, the two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-15 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

The ratio of the highest and the smallest IEF used by the Member States is 9 for dairy cattle, and 7 for non-dairy cattle and 24, 21, and 18 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Spain with 43.1 kg CH_4/head/year and the smallest by Portugal with 7.8 kg CH_4/head/year.

For dairy cattle, the low IEF used in Portugal is explained by the fact that part of dairy cattle is managed in "Fossas" (Pits), which corresponds best to the IPCC class "Pit storage below animal confinements". The storage time is very short, less than one month. Therefore, Portugal set the MCF to zero. In 2006 guidelines the MCF is revised to 3%, but no clear distinction is made between pits and liquid/slurry system. A more detailed assessment would require a country-specific study. Germany uses higher CH_4-IEF for dairy cattle then neighbouring countries. This might partly be caused by the use of MCF values from IPCC (2006), while most countries use data from IPCC (1996).

A very low IEF has been used for non-dairy cattle by Spain. Spain uses a Tier 2 approach. Gross energy is calculted using tier 2 methodology of enteric fermentation whilst percentages of manure management systems are taken from national references. The dominant systems for non-dairy cattle are solid storage and pasture, both of which have very a low MCF at 10ºC. The reason for high IEF used by France is high values for the MCF. This is due to the climate region, which is "temperate" in the metropolitan territory and "warm" in DOM and COM. In Denmark, non-Dairy Cattle" includes calves, heifers, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. The Danish IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed.

Table 6.32: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2011

Member State	Implied EF (kg CH_4/head/yr)					
2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	9.0	4.1	0.19	0.12	1.2	0.074
Belgium	16.8	2.7	0.64	0.77	7.8	0.036
Denmark	32.7	9.7	2.82	2.45	2.3	0.027
Finland1)	15.0	3.3	0.19	0.12	3.8	0.223
France	40.2	7.7	0.19	0.12	12.9	0.079
Germany	20.1	8.3	0.27	0.22	3.4	0.036
Greece	13.8	1.7	0.25	0.18	7.0	0.117
Ireland	20.8	9.9	0.16	0.12	12.7	0.388
Italy	8.7	4.5	0.22	0.15	4.6	0.080
Luxembourg	37.3	8.7	0.19	0.12	19.5	0.088
Netherlands	43.1	9.2	0.16	0.33	2.9	0.020
Portugal	7.8	1.4	1.76	1.70	20.9	0.014
Spain	73.5	3.0	0.23	0.16	9.0	0.010
Sweden	8.9	6.1	0.19	0.12	1.4	0.078
United Kingdom	31.8	2.7	0.12	0.12	5.5	0.075
EU-15	28.4	6.2	0.22	0.23	6.4	0.062

Source of information: CRF 4.B(a) for 2011, submitted in 2013 Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. Swine is reported under "other" in the categories: fattening pigs, sows with piglets and weaned pigs. The IEFs have been calculated as a weighted average. The IEF for the Netherlands and Luxembourg has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

The parameter of interest are the allocation of manure to climate regions (Table 6.33) and methane conversion factor used (Table 6.34). Most of Europe falls into the cool climate region with average annual temperatures below 15°C. Accordingly, most countries are allocating 100% of the animal population to the cool climate region, with Italy and Portugal allocating a part of the population into the temperate region (for dairy cattle for example 8% and 61%, respectively) and only Greece allocating 100% of the animals to the temperate climate region. France assumes 0.1% of the dairy cattle and 0.9% of the non-dairy cattle in the warm climate region, which is due to the extra-territorial regions; the remaining manure is allocated to the temperate climate region. The distribution of the animals over the climate regions is somewhat different for different animal types; in Portugal, for example, the portion of animals living in the temperate region increases from dairy cattle over non-dairy cattle to swine.

For the categories dairy cattle, non-dairy cattle and swine, only in few cases is the allocation of animal population to climate regions reported to be dynamic. However, in Portugal, for example, a general shift of livestock production to warmer climate regions has been observed increasing the percentage of manure managed in the temperate region by 9%, 18%, and 6% for dairy cattle, non-dairy cattle, and swine, respectively.

The potential methane producing factor is IPCC default or close to IPCC default for most countries (Table 6.35); the amount of volatile organic solid excreted per animal (Table 6.36) and year varies across the countries on the basis of the animal characterization with a ratio of highest to lowest average VS excretion rate between 2.3 (Non-dairy cattle) and 3.8 (Goats).

Table 6.33: Member State's allocation of dairy cattle, non-dairy cattle and swine to the climate regions "cool", "temperate" and "warm" in 2011

Member State	Dairy Cattle - Allocation by climate region[1)]			Non-Dairy Cattle - Allocation by climate region[1)]			Swine - Allocation by climate region[1)]		
2011	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)
Austria	100%	NO	NO	100%	NO	NO	100%	NO	NO
Belgium	100%	NO	NO	100%	NO	NO	100%	NO	NO
Denmark	100%	NO	NO	100%	NO	NO	100%	NO	NO
Finland	100%	NO	NO	NO	NO	NO	100%	NO	NO
France	100%	NA	0.1%	99%	NA	0.9%	99%	NA	1.1%
Germany	100%	NO	NO	100%	NO	NO	100%	NO	NO
Greece		100%			100%			100%	
Ireland	100%	NO	NO	100%	NO	NO	100%	NO	NO
Italy	92%	8%	NO	87%	13%	NO	97%	3%	NO
Luxembourg	100%	NA	NA	100%	NA	NA	100%	NA	NA
Netherlands	100%			100%			100%		
Portugal	39%	61%	NO	24%	76%	NO	16%	84%	NO
Spain	83%	17%		62%	38%		54%	46%	
Sweden	100%	NO	NO	100%	NO	NO	100%	NO	NO
United Kingdom[1)]	100%	NO	NO	100%	NO	NO	100%	NO	NO
EU-15	97%	3%	0%	93%	7%	0%	88%	12%	0%

Source of information: CRF 4.B(a) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] The portion lacking for 100% are reported as daily spread (only UK) and 'other'.

Table 6.34: Member State's Methane Conversion Factor used for dairy cattle, non-dairy cattle and swine for the different animal waste management systems in 2011

Member State	Dairy Cattle - Methane Conversion Factor (%) [1)]				Non-dairy Cattle - Methane Conversion Factor (%) [1)]				Swine - Methane Conversion Factor (%) [1)]			
2011	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock
Austria	NO	9%	1.00%	1.00%	NO	8%	1.00%	1.00%	NO	3%	1.00%	100.00%
Belgium	NO	19%	2.00%	1.00%	NO	19%	2.00%	1.00%	NO	19%	2.00%	NO
Denmark	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%
Finland	NA	10%	1.00%	1.00%	NA	1000%	100.00%	100.00%	NA	10%	1.00%	100.00%
France	NO	39%	1.00%	1.00%	NO	39%	1.01%	1.01%	NO	39%	1.01%	1.01%
Germany	NO	14%	2.00%	1.00%	NO	14%	7.63%	1.00%	NO	22%	7.96%	100.00%
Greece												
Ireland	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	NA	NA
Italy	NO	14%	2.15%	1.06%	NO	15%	2.25%	1.06%	NO	22%	NA	NA
Luxembourg	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	1.00%	NA
Netherlands		17%		1.00%		16%	0.07%	1.00%		39%		
Portugal	43%	NA	1.30%	1.30%	NA	NA	NA	1.39%	44%	NA	1.42%	1.42%
Spain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden	NO	4%	1.00%	1.00%	NO	4%	1.00%	1.00%	NO	4%	1.00%	NO
United Kingdom	NO	39%	1.00%	1.00%	NO	39%	1.00%	1.00%	NO	39%	1.00%	1.00%
EU15	43%	24%	1.62%	1.01%	NA	28%	2.25%	1.06%	44%	25%	3.37%	1.07%

Source of information: CRF 4.B(a) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Anaerobic lagoon + Liquid system.

Table 6.35: Member State's methane producing potential for emissions from manure management for the main animal types in 2011

Member State 2011	CH4 producing potential (Bo) (CH_4 m^3/kg VS)					
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	0.24	0.17	NA	NA	0.45	NA
Belgium	0.24	0.17	0.19	0.17	0.45	0.32
Denmark	0.24	0.17	0.19	0.17	0.45	0.32
Finland	0.24	0.17	0.19	0.17	0.45	0.32
France	0.24	0.17	0.19	0.17	0.45	0.32
Germany	0.23	0.23	0.19	0.18	0.30	0.37
Greece	0.24	0.17	0.19	NE	NE	NE
Ireland	0.24	0.24	0.19	0.17	0.45	0.32
Italy	0.14	0.13	0.19	0.17	0.46	0.32
Luxembourg	0.24	0.17	0.19	0.17	0.45	0.32
Netherlands	0.25	0.25	0.25	0.25	0.34	0.34
Portugal	0.24	0.17	0.19	0.17	0.45	0.32
Spain	0.24	0.17	NA	NA	0.45	0.32
Sweden	0.24	0.17	0.20	0.20	0.45	0.30
United Kingdom	0.24	0.17	0.19	0.17	0.45	0.32
EU-15	0.23	0.19	0.19	0.18	0.41	0.33

Source of information: CRF 4.B(a) for 2011, submitted in 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.36: Member State's volatile solid excretion from managed manure for the main animal types in 2011

Member State 2010	VS excretion (kg dm/head/day)				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	4.2	1.9	0.4	0.3	0.3
Belgium	4.0	1.4	0.5	0.5	0.5
Denmark	6.2	2.8	1.1	1.1	0.2
Finland	4.9	1.9	0.4	0.3	0.5
France	5.1	2.7	0.4	0.3	0.5
Germany	4.0	1.5	0.4	0.3	0.3
Greece	6.6	2.8	0.4	NE	NE
Ireland	3.0	1.3	0.4	0.3	0.3
Italy	6.4	2.8	0.4	0.3	0.3
Luxembourg	4.5	1.9	0.4	0.3	0.5
Netherlands	4.6	1.1	0.5	0.6	0.2
Portugal	7.0	2.7	0.5	0.4	0.5
Spain	4.1	2.4	NA	NA	0.3
Sweden	5.3	1.5	0.4	0.3	0.3
United Kingdom	3.7	2.3	0.4	0.3	0.5
EU-15	4.6	2.2	0.4	0.3	0.3

Source of information: CRF 4.B(a) for 2010, submitted in 2012 Abbreviations explained in the Chapter 'Units and abbreviations'.

Some additional background information on the factors and parameters used by the Member States is given in Table 6.37.

Table 6.37: Available background information on the emission factors and other parameters used for the calculation of CH_4 emissions in category 4.B(a)

Member State	Emission Factors and other parameters
Austria	Austrian specific values for dairy cows were calculated in dependency of annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content). **The default MCF values for 'cool climate regions' were used. For liquid systems a national value is used based on measurements. For yard (which is not included in the GPG2000, the MCF of pasture, range and paddock has bee taken. For deep litter the MCF of the 2006 IPCC Guidelines (17%) have been taken because the MCF of the GPG 2000 (39%) is not applicable to Austria's cold climate conditions. In Austria manure from deep litter systems is usually removed twice a year - in spring and in au-tumn. The bedding is continuously added, there is no mixing. Austrian measurements showed that CH_4 emissions from farmyard manure were always lower than CH_4 emissions from liquid manure. It would contradict latest scientific results to apply a higher MCF to deep litter systems than to liquid manure systems. Hence, for Austria the chosen MCF of 17% (IPCC 2006) is a conservative estimate. MCF for liquid systems are obtained from peer reviewed publications (AMON et al. 2002a, 2006, 2007a) based on a three-year measurement campaign on emissions from manure stores. The extensive emission measurements under field conditions showed, that an increase in methane emissions during slurry storage was only observed during the summer season. The low temperature in all other seasons in Austria reduces significantly methane formation during slurry storage. Emission measurements were carried out in one of the warmest Austrian region and therefore may tend to overestimate MCF values. Following the results of a Germam study (FNR, 2010), CH_4 losses of biogas plants are about 1-2% of the gas produced under cold climate conditions. Following these results and expert judgement, the MCF was set to 2% for manure treated in anaerobic digesters. B_0 is default.** National values for dairy cows depend on milk yield and corresponding feed intake data. For the calculation of VS excretion of suckling cows an average milk yield of 3 000 kg was applied. Austrian specific values on VS excretion for all other cattle categories were calculated from typical Austrian diets under organic and conventional management. As no major changes in diets of Non-Dairy Cattle occurred, methane emissions from manure management of Non-Dairy Cattle are calculated with a constant gross energy intake and thus constant VS excretion rate. Constant value for the whole time series for swine (SCHECHTNER1991). From Manure Management for Sheep, Goats, Horses, Poultry and Other Livestock / Deer are estimated with Tier 1 approach. **For biogas digesters data show a leakage rate of 2%.**
Belgium	**Emission factors for each animal category have been developed by Siterem 2001. Those factors take into account the type and volume of manure produced during the time spent in stables, its density and carbon content, and its carbon volatilisation ratio. The resulting EF are comparable to the default IPCC for cool climate.**
Denmark	B_0 and MCF IPCC default. For liquid systems, the MCF of 10 % in the Reference Manual (IPCC, 1997) is used. All data required to calculate VS excretion are based on Danish Normative data except of grazing days for dairy cattle and heifers. The Revised 1996 IPCC guidelines (IPCC, 1997) provide a default MCF of 10 % for liquid/slurry, which is based on research of Hashimoto & Steed (1993) and Woodbury & Hashimoto (1993). This MCF value was changed to 39% in the IPCC Good Practice Guidance (IPCC, 2000), without any scientific argumentation, documentation or specific references. It has to be remarked that the 2006 IPCC Guidelines (IPCC, 2006) return to a MCF val ue of 10% for Danish conditions referenced to "Judgement of IPCC Expert Group in combination with Mangino et al. (2001) and Sommer et al. (2000)" (IPCC, 2006). The methane emission from liquid systems is very sensitive to temperature effects. Basically most of the manure is stored in Denmark under cold conditions (<5-10 degrees) .The CH_4 formation practically stops at 4°C and therefore there are no plausible arguments that 39% of total CH_4 capacity should be released under Danish conditions. Danish studies confirm this assumption (Husted, 1994 and Sommer et al., 2000). Furthermore, investigations based on measurements in Canada, which conditions are similar to Denmark, support this value (Massé et al., 2003). Support of this value is also found from a Swedish review (Dustan, 2002), taking both the cold climate and the fact that the slurry containers usually have a surface cover, in to account. Considering the agricultural conditions in Denmark and the present scientific knowledge as described above a MCF of 10 % for liquid/slurry is more appropriate under the Danish conditions. The Danish decision of using a MCF of 10 % is as demonstrated above backed by several scientific papers as well as both the revised 1996 IPCC Guidelines and the IPCC 2006 Guidelines. Therefore Denmark intends to continue using a MCF value of 10 % until scientific knowledge become available. The IEF for sheep and goats includes lambs and kids, which corresponds the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value. Swine: typical animal mass is based on slaughter pigs. Old-style tethering systems with solid manure have been replaced by loose housing with slurry-based systems. For non-dairy cattle, the opposite development has taken place. An increasing proportion of bull-calves are raised in stables with deep litter, where the MCF is lower than for liquid manure.

Member State	Emission Factors and other parameters
Finland	**Cattle: EF per subcategory calculated with IPCC tier 2 methodology. National values for digestible energy (DE %), fraction of animal´s manure managed annually in each manure management system (MS), average milk production and animal weight. For Reindeer it is assumed that all manure is deposited on pastures and for fur animals it is assumed that all manure is managed as solid. For fur animals, VSi value is based on expert judgement being 0.17 kg/head/day.**
France	**Data regarding manure management systems and excretion factors, and for cattle also VS, from national sources. For other parameters, default IPCC. For cattle, VS is estimated from the results of MONDFERENT project, based on energy needs (fodder units), which are transformed into net energy, then in digestible energy and finally in digestible organic matter ingested. From this, VS is deduced. VS is constant in time for non-dairy cattle, but for dairy cattle the calculation of VS is based on milk production and can vary with time. For animals other than cattle, IPCC defaults are taken. MCFs used correspond to cold climate.**
Germany	**According to the calculation at district level, IEF are varying with time and space due to differences in AWMS distribution and climate. Emissions reductions due to biogas digesters are considered. The emission factors represent the general situation in Germany. Calculations are done at the district level. VS is obtained from dry matter intake using a national method (Daemmgen et al., 2011). Feed digestibility and ash content of the feed components are given from feed producers and Roesemann et al. (2013). For sheep and goats, horses and buffaloes IPCC default VS values. For B_0 for cattle and pigs a national factor is used (Daemmgen et al., 2012). Other animals default. For pullets a conservative value of 0.39 m3 CH_4/kg is taken from IPCC (2006). MCF values for cattle and swine are according to Daemmgen et al. (2012) according to IPCC (2006) for annual mean temperature of less than 10 degree Celsius; for liquid manure with cover the conservative MCF for liquid manure without cover was taken; for deep litter and pasture/range/paddock IPCC (2000) default. MCF for other animals IPCC default, taking for consistency reasons IPCC (2006). In Germany, in regions with annual mean temperature above 10ºC (Rheintal, Ruhrgebiet) livestock production is less significant. The MFC of biogas installations is obtained from leakage rate of the fermenter, the residual amount and the MCF of the storage of the digested manure based on IPCC 2000 (Roesemann et al. 2013). Leakage rate is set to 1%; for the calculation of the residual CH_4 see Roesemann et al. (2013). The share of digested manure stored gas tight (MCF=0) or in liquid systems is from KTBL. For gooses an EF of 0.78 kg/animal/yr is used according to IPCC (1996) for poultry.**
Greece	
Ireland	**New information obtained from a national farm facilities survey (Hyde et al., 2008) and the work on emission factors for enteric fermentation in cattle is the basis of the CH_4 emission factors for manure management. The emission factors for manure management are derived using the quantified organic matter excretion as volatile solids (VS), a BO (the methane production potential of animal waste), the allocation to animal waste management system based on the farm facilities survey and the corresponding values of MCF (methane conversion factor) given for the cool climate zone. Ireland uses the value of 0.24 m3 CH_4/kg VS (the value for dairy cattle in the IPCC good practice guidance) for BO for all cattle based on input from agricultural experts who advise that the methane potential of dairy cattle manures and non-dairy cattle manures in Ireland is the same, given the similarity of their grass -based feeding systems. Volatile solids values for dairy cows and non-dairy cattle are estimated using the information provided in O'Mara (2006). These values differ from the default values provided in the IPCC Good Practice Guidance due to the higher digestibility of feeds in Ireland. The default digestibility of 60 per cent is very low in comparison to the digestibility of silage (70 per cent), grazed grass (80 per cent) and concentrates (80 per cent). Grazed grass and silage make up the majority of feed intake of cattle in Ireland due grass based production systems.**
Italy	**Housing systems in Italy, which will be updated with information coming from the 2010 Agricultural Census. Emission factors for slurry and solid manure (g CH_4 $head^{-1}$ $month^{-1}$) are calculated for each month. The average methane conversion factors (MCF), for each manure management system (classified by climate), was estimated with data coming from the Agriculture Census from 1990 and 2000 and the FSS 2005 (ISTAT, 2007[a]). Average MCFs were not used for estimating manure management EF, but they are useful to verify the EF accuracy. Country-specific methane emission rate for swine was experimentally determined by the Research Centre on Animal Production (CRPA, 1996).**
Luxembourg	**For cattle, the IEF has been calculated by combining the country specific activity data, coefficients and parameters according to the Tier 2 methodology.**
Netherlands	Country-specific CH_4 emission factors are calculated for all three manure management systems for every animal category on a Tier 2 level. These calculations are based on country-specific data on: • manure characteristics: organic matter (OM) and maximum CH_4 producing potential (B_0) • manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF). MCF of 1.5% for all animal categories; for manure production in the meadow, it uses the IPCC default MCF value. New measurements on organic matter content of manure (Commissie Bemesting Grasland en Voedergewassen, 2012) have given rise to most of the shifts, since these reflect directly in the EFs being calculated. Lower values are seen for pigs and horses, and higher for rose veal (as a part of young stock) and fur-bearing animals (as part of other animals). **For dairy cattle, the energy requirement expressed as net energy value of lactation (or VEM in Dutch) is calculated based on total milk production and feed composition. For young cattle the energy requirement is calculated on the basis of total weight gain and feed composition. The intake of grass silage, maize silage, wet by-products, concentrates and grass products is estimated from national statistics found at www.cbs.nl. More information on the Netherlands VEM system is presented in**

Member State	Emission Factors and other parameters
	Smink et al. (2005) and Tamminga et al. (2004).
Portugal	**Emissions factors for each animal type were established according to the tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produced per animal and the share of each Manure Management System that is used for each animal type. Results differ considerably from the ones obtained using the IPCC defaults, due to: swine manure in Portugal is treated in anaerobic lagoons (which have the highest MCF); management of wasted form dairy cows kept in stalls is split among solid storage and short retention pits; dairy cows in pasture are more common in Portugal than the default assumption of IPCC; non-dairy cows with milking calves are usually kept on pasture, but fattening animals are usually grown in confined areas and solid storage is the prevalent method; daily spread and usage as fuel are rare; there is a small percentage of traditional swine kept outdoors and foraging in pastures; some poultry is kept outside; and there are no substantial seasonal variations in the share of management systems**
Spain	**VS is estimated using a national methodology based on the digestible energy and the type of diet for cattle, swine and poultry. Smooth functions for the MCF and the FE for tier 1 approaches are used (modification accepted by IPCC). It has been calculated by interpolating IPCC default factors for the three climatic regions (with mid-point mean annual temperature of 10, 20, and 28°C) using the formula: MCF(T)=MCF(10°C) + b (10-T)^m, where b and m are parameters that vary with animal waste management system.**
Sweden	**The B_0i and MCF factors used are the default values in the Good Practice Guidance, except for the MCF for liquid manure, where the value of 3.5 % is used. This value was developed by Rodhe et al. 2008 and is considered to be more appropriate for Swedish conditions.**
United Kingdom	**The emission factors for manure management are calculated following IPCC Tier 2 methodology using default IPCC data for volatile solids (VS) and methane producing potential (Bo) parameters for each livestock type (except for dairy and beef cows and deer) where a Tier 2 calculation is used to determine VS. Country-specific data for the proportion of manure from each livestock type managed according to the different animal waste management systems (AWMS) and IPCC default methane conversion factors for the different AWMS.**

Allocation to climate regions

An independent estimate of the allocation of livestock to IPCC climate regions was performed by JRC for the inventory in 2013. The assessment was based on AGRI4CAST interpolated meteorological data (AGRI4CAST, 2012), available on a 50km by 50km grid for Europe. A climate map distinguishing the regions according to the definition in IPCC (1996) was created; obviously the "warm" climate region is not present in the EU area. The analysis of annual data between the years 1990 and 2010 (see Figure 6.17) show that the delineation of the climatic zones in Europe does not change to a large extent from year to year. This justified basing the analysis of livestock distribution within the climatic zones for each country in EU25 on the climate map derived from annual mean average temperature in the period 1990 – 2010 (lower right map of Figure 6.17).

Livestock data at grid level (1 km x 1 km) are obtained from Leip et al. (2008)[31]. The data are obtained from an ex-post simulation of the CAPRI model (Britz & Witzke, 2012)[32] for the base year 2002 (average 2001-2003), available at NUTS2. Disaggregation of animal number was done for two groups (i) land-based animals: cattle, sheep and goats (ruminants) and (ii) non land-based animals: pig and poultry (monogastrics).

Figure 6.18 shows the distribution of IPCC climate zones in Europe using meteorological information averaged over the years 2000-2010, and the distribution of livestock (as livestock units). Additional information is given in Table 6.38. 89% of the surface are in Europe – as EU25[33] – falls into the cold climate zone with an annual mean temperature below 15ºC. Only 11% fall into the temperate zone[34].

31 http://afoludata.jrc.ec.europa.eu/index.php/dataset/detail/243

32 The simulation was carried out in 2009

33 EU27 without Malta and Cyprus

34 This value would not change if Cyprus (9251 km^2) and Malta (316 km^2) would be included in the assessment – they together make about 0.2% of the continental surface area of EU27.

Out of the 25 countries in the analysis, only five countries have a part of their **surface area** within the temperate climate zone (mean annual temperature between 15º and 25ºC): France (4%), Greece (56%), Italy (37%), Portugal (75%), and Spain (61%). Both Malta and Cyprus are in the temperate zone.

Over-sea territory of France (included in the European Union: Guadeloupe, Martinique, Guyane, La Réunion, Saint-Barthélemy and Saint-Martin) have a total surface area of 88,869 km^2 which is 14% of the total French surface area part of the European Union (CITEPA, 2012).

According to the CAPRI data used, there were about 100 million LU in EU25, whereof 76% were ruminants and 24% were monogastric animals. The share of ruminant LU ranges between 39 and 94% with the lowest share in Denmark and the highest share in Ireland.

Livestock density (LU km^{-2}) varies strongly within each country (Figure 6.18, Table 6.38). In France, hot-spots such as the Bretagne and the Auvergne lead to a mean LU-density of 33 LU km^{-2} in the cool climate zone, while the density in the temperate climate zone is only 5 LU km^{-2} (coastal areas of Provence-Alpes-Cote d'Azur and Languedoc-Roussillon). The animals in the temperate zone are all ruminants, with less than 0.5 LU km^{-2} of monogastric animals in that area. The situation is similar in Italy, where also mainly the coastal areas are classified as 'temperate' with lower livestock density, in particular for monogastric animals. In Greece and Spain, the livestock density is very similar in the area belonging to the cool and temperate climate zones, as also inland areas are part of the temperate zone, as Andalucía, Extremadura, and Western Castilla-la-Mancha in Spain. Finally, only a part of Northern Portugal belongs to the cool climate zone, with a higher livestock density in the Southern area and thus almost double LU in the temperate zone of Portugal than in the cool climate zone, with a larger difference for monogastric animals with respect to ruminants.

As a consequence, the **share of livestock units per climate zone** (Table 6.39) gives higher shares in the cool climate zone for France (99%), Italy (75%) and Spain (58%), while more LU are calculated for the temperate climate zone for Greece (63%) and Portugal (84%). Large differences between the two groups of livestock assessed are found for Italy (71% versus 92% of ruminants and monogastrics in the cool climate zone, respectively) and Portugal (19% versus 9% of ruminants and monogastrics in the cool climate zone, respectively).

The comparison of the data with information obtained from the national greenhouse gas inventory reports (Table 6.40) reveals substantial differences for several countries.

France. France is almost entirely in the cool climate zone (with the exception of the extra-territorial area), for both CAPRI and national data.

Greece. Greece allocates 100% of manure in the temperate climate zone (Ministry of Environment Energy and Climate Change, 2012), while CAPRI-MARS data suggest that more than one third of the livestock units are in the cool climate zone.

Italy. Both the national inventory (ISPRA, 2012) and CAPRI-MARS give a very high share of monogastric animals for the cool climate zone, while there is some disagreement for ruminants, with a higher share of ruminants in the temperate climate zone (29%) in the CAPRI-MARS data than in the national inventory data (range 7-41%). Depending on the method of aggregating ruminant data, the average allocation of cattle, sheep and goat to the cool climate zone is 79%, 86% or 88%, depending on whether animal numbers, N excretion, or VS excretion is used. The aggregation on the basis of animal numbers appears to be quite in agreement with the CAPRI-MARS data, considering considerable uncertainty in the downscaling process.

Portugal. According to the National Inventory Report of Portugal, the distribution of poultry and swine is very different with 42% of poultry being in the cool climate zone, but only 19% of swine. Both values are considerably higher than the CAPRI-MARS estimate of only 9%. Such a large difference is astonishing as – in contrast to most of the other countries – in Portugal not only coastal areas are classified as 'temperate' and thus the downscaling of CAPRI-NUTS2 data to the pixel scale (which is most uncertain) is less relevant. A similar difference between the two estimates is found for ruminants, at higher shares in the cool climate zone in both data sets.

Spain. While the CAPRI-MARS data estimate about the same share of ruminants and monogastric animals in the cool (almost 60%) and temperate climate (about 40%) zones, the share of animals in the cool climate zone on the basis of national data is higher for ruminants (52%-67%), depending on the aggregation method, than for monogastric animals (46%).

Differences between the CAPRI analysis and national data are caused by differences in the methodology (e.g. aggregation method) and data sources used. Available information on the national methodologies are summarized in Table 6.41.

Livestock data are obtained from statistical sources at high resolution; this is in contrast to the CAPRI data which were available only at NUTS2 level and were dis-aggregated to the pixel scale. In several countries, the temperate climate zone is located in coastal areas, such as in Italy, France, and Eastern Spain, and also Greece (see Figure 6.17). These are often narrow stripes, which adds considerable uncertainty of the spatial distribution of animals within NUTS2 regions. However, often this is overlaid with a gradient across different NUTS2 such as for example in Italy (intensive production systems concentrated in Northern Italy, higher share of extensive systems in Southern Italy) and France (concentration of animal production systems in a few regions).

Depending on the methodology used by the MS, the time series of the allocation to climate region reflects weather conditions or only shifts in animal population. The trend of the allocation is shown in Figure 6.19.

Figure 6.17: Climate zones – cool, temperate, warm - , according IPCC (1996) derived from AGRI4CAST interpolated meteorological data for different years and longterm average 1990 – 2010

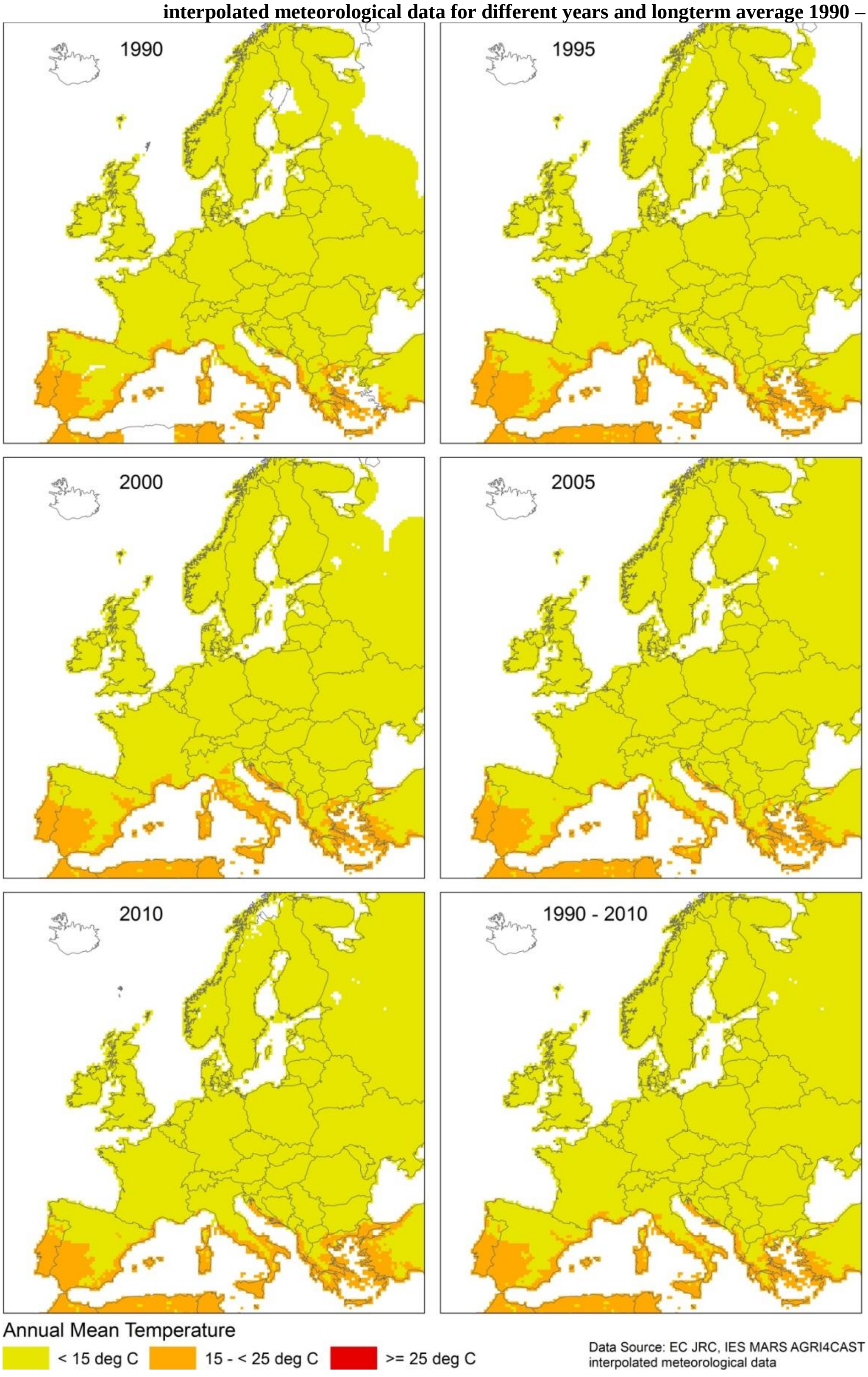


Figure 6.18: **Distribution of livestock (livestock units km^{-2}) in Europe in relation with climate zones as defined by IPCC (1997). Maps are given for monogastric animals (upper left), ruminants (upper right) and total livestock units (lower left).**

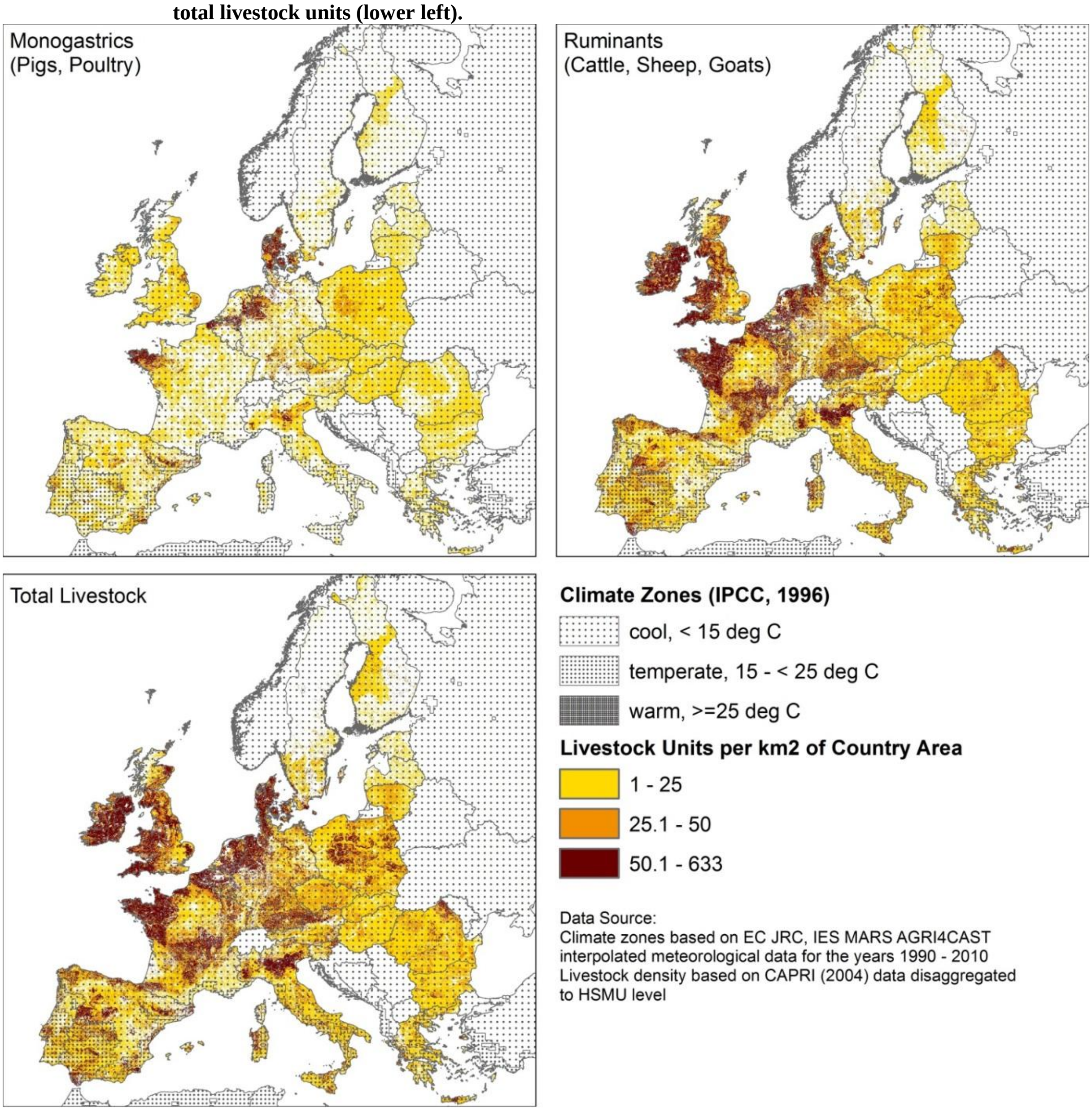


Table 6.38: **Information on country area by climate zones, livestock units for ruminants and monogastrics, and livestock unit density by Climate Zones. Data sources: climate zones definition according to in IPCC (1997), climate data for the years 2000-2010 from AGRI4CAST (2012), Livestock Unit distribution from Leip et al. (2008).**

	Country	Area		Livestock Units			Livestock Units Density in Climate Zones					
Country	Area	Share of climate zone		Total	Ruminants	Mono-gastrics	Total Livestock		Ruminants		Monogastric animals	
	(km^2)	(% of country total)		1000 LU	(%)	(%)	(number of Livestock Units per km^2)					
Country		Cool	Temp				Cool	Temp.	Cool	Temp.	Cool	Temp.
Austria	83920	100	0	2057	77	23	25		19		6	
Belgium	30666	100	0	2835	65	35	92		60		33	
Bulgaria	110213	100	0	1423	83	17	13		11		2	

Country	Country	Area		Livestock Units			Livestock Units Density in Climate Zones					
	Area	Share of climate zone		Total	Ruminants	Mono-gastrics	Total Livestock		Ruminants		Monogastric animals	
	(km^2)	(% of country total)		1000 LU	(%)	(%)	(number of Livestock Units per km^2)					
Czech Rep.	78869	100	0	1528	65	35	19		13		7	
Denmark	43338	100	0	3498	39	61	81		32		49	
Estonia	45357	100	0	234	80	21	5		4		1	
Finland	337889	100	0	960	76	23	3		2		1	
France	549161	96	4	17677	85	15	33	5	28	5	5	0
Germany	357590	100	0	13848	72	28	39		28		11	
Greece	131997	44	56	2018	88	12	13	17	11	15	2	2
Hungary	93011	100	0	1294	52	48	14		7		7	
Ireland	69939	100	0	5074	94	6	73		68		4	
Italy	301315	63	37	8236	84	16	32	19	26	18	7	1
Latvia	64599	100	0	334	87	13	5		4		1	
Lithuania	64882	100	0	862	87	12	13		12		2	
Luxembourg	2596	100	0	146	93	7	56		52		4	
Netherlands	37357	100	0	4394	59	41	118		70		48	
Poland	311927	100	0	6673	64	36	21		14		8	
Portugal	89635	25	75	1642	68	32	12	21	9	14	2	7
Romania	238456	100	0	3958	85	14	17		14		2	
Slovakia	49014	100	0	510	57	43	10		6		4	
Slovenia	20280	100	0	382	85	15	19		16		3	
Spain	505553	61	39	11970	70	30	23	25	16	17	7	8
Sweden	449765	100	0	1419	77	23	3		2		1	
UK	244514	100	0	10469	89	11	43		38		5	
EU25	**4311843**	**89**	**11**	**103440**	**76**	**24**	**24**	**21**	**19**	**16**	**6**	**5**

Table 6.39: **Distribution of total livestock units, and livestock units of ruminants and monogastric animals by Climate Zone. Data sources: climate zones definition according to in IPCC (1997), climate data for the years 2000-2010 from AGRI4CAST (2012), Livestock Unit distribution from Leip et al. (2008)**

	Share of Livestock Units in Climate Zones					
Country	Total Livestock		Ruminants		Monogastric animals	
	(% of country total)					
	Cool	Temperate	Cool	Temperate	Cool	Temperate
Austria	100	0	100	0	100	0
Belgium	100	0	100	0	100	0
Bulgaria	100	0	100	0	100	0
Czech Republic	100	0	100	0	100	0
Denmark	100	0	100	0	100	0
Estonia	100	0	100	0	100	0
Finland	100	0	100	0	100	0
France	99	1	99	1	100	0
Germany	100	0	100	0	100	0
Greece	37	63	37	63	37	63
Hungary	100	0	100	0	100	0

Country	Share of Livestock Units in Climate Zones					
	Total Livestock		Ruminants		Monogastric animals	
	(% of country total)					
	Cool	Temperate	Cool	Temperate	Cool	Temperate
Ireland	100	0	100	0	100	0
Italy	75	25	71	29	92	8
Latvia	100	0	100	0	100	0
Lithuania	100	0	100	0	100	0
Luxembourg	100	0	100	0	100	0
Netherlands	100	0	100	0	100	0
Poland	100	0	100	0	100	0
Portugal	16	84	19	81	9	91
Romania	100	0	100	0	100	0
Slovakia	100	0	100	0	100	0
Slovenia	100	0	100	0	100	0
Spain	58	42	58	42	57	43
Sweden	100	0	100	0	100	0
United Kingdom	100	0	100	0	100	0
EU25	**90**	**10**	**90**	**10**	**91**	**9**

Table 6.40: Comparison between the allocation of livestock to the cool and temperate climate zones as reported in the National Inventory Reports (EEA, 2012) and as calculated on the basis of CAPRI dis-aggregated livestock data (Britz & Witzke, 2012; Leip et al., 2008) and MARS meteorological data (AGRI4CAST, 2012)

	France		Greece		Italy		Portugal		Spain	
	Cool	Temp.	Cool	Temp.	Cool	Temp.	Cool	Temp.	Cool	Temp.
Allocation of manure as reported in National Inventory Reports										
Dairy cattle	100%	0%	0%	100%	93%	7%	44%	56%	78%	22%
Non-dairy cattle	99%	0%	0%	100%	89%	11%	28%	72%	63%	37%
Sheep	100%	0%	0%	100%	72%	28%	30%	70%	52%	48%
Goats	94%	0%	0%	100%	59%	41%	49%	51%	18%	82%
Swine	99%	0%	0%	100%	97%	3%	19%	81%	47%	53%
Poultry	100%	0%	0%	100%	96%	4%	42%	58%	45%	55%
Allocation of livestock units as calculated from CAPRI and MARS data										
Total livestock	99%	1%	37%	63%	75%	25%	16%	84%	58%	42%
Ruminants	99%	1%	37%	63%	71%	29%	19%	81%	58%	42%
Monogastrics	100%	0%	37%	63%	92%	8%	9%	91%	57%	43%

Table 6.41: Available background information regarding animal allocation to climate regions

Member State	Emission Factors and other parameters
Greece	The selection of EFs for our emission calculations are based on the 100% allocation of animals to the "temperate" zone". This consideration is based on annual mean temperature (MAT) values provided by the Greek Meteorological Service, measured at meteorological stations around Greece. According to the 5th national communication, for the high majority of Greece, MAT is higher than 15 C, with some small exceptions, like Ioannina and Tripoli, where MAT was measured to be around 14 C. Moreover, in regions like Thessaly (Larisa) and Alexandroupoli, where the highest percentage of animals (cows, sheep etc) is located, MAT is measured to be higher than 16 C.

Member State	Emission Factors and other parameters
	Based on measured MAT values provided by the Greek Meteo Service and geographical allocation of animal's data from Hellenic Statistical Authority, we will re-examine the allocation to climate zones and reported associated emissions. However, the effect of possible recalculations on total emissions is expected to be minor, given that this is not a key category for Greece. For example, if we conclude to similar results as the JRC assessment, the impact to total GHG emissions will be less than 0.05 %.
Portugal	Portugal estimates the allocation to climate regions in 5 steps. Climate data refer to the climatological normals for the period 1931-60 referring to the average values of annual air temperature. The network of climatological stations was constituted by 52 stations complemented by 93 other climatological stations with more than 10 years but less than 30 years of observations.The interpolation was done based on data from the referred 145 monitoring stations using physiographic factors. The equivalent scale is 1:1000000. Additional information can be obtained here **http://sniamb.apambiente.pt/webatlas/** Step 1: For each Concelho territorial area in mainland Portugal and Madeira archipelago the percentage of land area above and below 15ºC was determined using the annual average air temperature map. All area in Azores islands were considered to be in temperate region. This information was obtained cross-referencing Concelho areas with the average air temperature map in a GIS software. Step 2: Using data from INE (national statistics) 1999 Agriculture Census, which has information at Concelho level, we determine the number of animals, for each animal type, that are managed in cool or temperate conditions. With this information we can characterize the management condition for 1999. Step 3: We then aggregate this information into NUTs II and determine the shares, for each animal type, of animals in cool or temperate condition. This procedure is needed because livestock numbers for years not covered by the census are given by INE aggregated in NUTSII level. We used the 1999 NUTSII shares to characterize temperature condition for all time series (we assume equal). Step 4: With the shares for each animal type and year we now applied those values to the yearly livestock numbers given by INE (at NUTSII level). Step 5: VS values are determined for each animal type according to the methodologies discussed in the NIR. We assume these values are representative of 1998. For most animal types we use weight at slaughter (from INE) to propagate VS from 1998 to other years. Following recommendations made by the 2012UNFCCC incountry review team, in future inventories we will try to update livestock information concerning number of animals by Concelho with new information gathered by the 2009 Agriculture census. We will also try to implement a new system that incorporated more recent temperature data.
Spain	The Spanish Inventory does not use directly IPCC climate regions (see Table 6.28). The Spanish Inventory is performed at regional level (NUTS3), comprising 50 provinces. In some regions, annual temperature means are close to 15ºC. Therefore, slight interannual changes in temperature would lead to large differences in emission estimates, as these regions may be assigned to different climate regions depending on the year. Additionally, the IPCC climate division of the provinces by climate region would give rise to substantial differences among provinces with similar climate conditions, which would be assigned to different climate regions. In order to avoid these distortions, it was decided to smooth the stepped function shown in the IPCC Reference Manual (pp. 4.36 and 4.37)35. **Climate data**: 6-hourly data provided by meteorological stations and synoptic reports of the National Weather Institute (AEMET). The possible gaps in these data are filled using temperature curves, specifically fitted for each station based on available data. After that, these temperatures are aggregated to estimate an annual mean. Provincial annual mean temperature is estimated using every weather station available and applying a lapse rate (0.6ºC / 100 m altitude) to correct for altitude variations. It is assumed that the provincial mean altitude is the mean altitude of the weather stations. **Livestock data**: Livestock numbers are gathered from the National Annual Directory of the Ministry of Agriculture, Food and Environment. The information is provided annually at regional level and comprises different subcategories within each type of livestock. This sub-categorization is further disaggregated into the Inventory animal categories (currently around 80)

[35] This revision deemed sound according to IGES-IPCC communication (September 2001).

Member State	Emission Factors and other parameters

Aggregation: Information required in table 4.B(a) for each animal aggregate categories that are not very similar, such as suckling pigs and hogs within Swine. A weighted mean was calculated using N excretion as weighting parameter. Therefore, numbers reported in table 4.B(a) are obtained, for each year, using: i) mean annual provincial temperatures; ii) number of heads by category for each province; and, iii) N excretion by category.

Smoothing of the MCF and default emission factors: Smoothed functions take the temperatures 10ºC, 20ºC and 28ºC as the class mark for each climate region. For each class mark, the default MCF provided by IPCC is taken and the linear function thus obtained is smoothed to provide the above-mentioned values. The smoothed function proposed by the Inventory Working Party is as follows:

$$Factor(t) = Factor(10) + b \cdot (10 - t)^m$$

where:

Factor(t) = Emission factor at temperature t.

Factor(10) = Emission factor at a temperature of 10ºC (known).

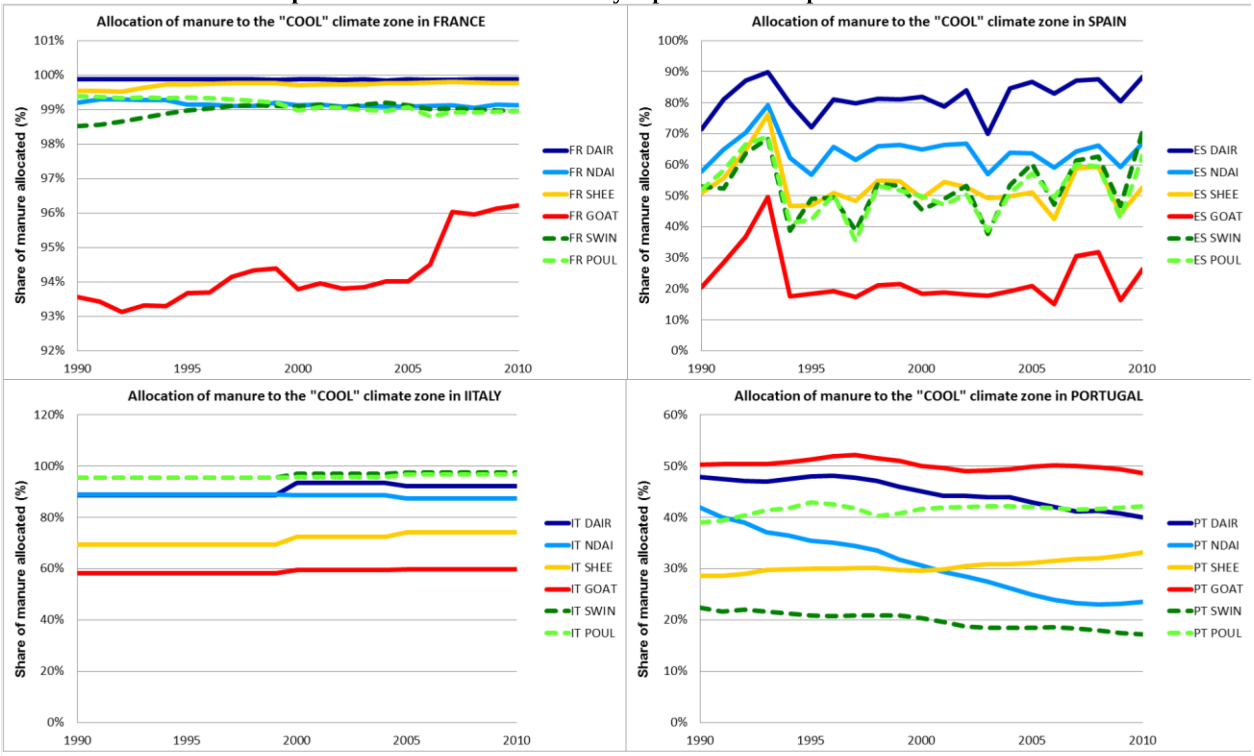
b, m = Parameters depending on the manure management system.

The following table shows the functions for each of the management systems:

System	***MCF***$_{jK}$
Pasture/Range/Paddock	• $MCF=1.000+0.033x(T^a-10)^{1.179}$
• Daily spreading	• $MCF=0.100+0.017x(T^a-10)^{1.380}$
• Solid Storage	• $MCF=1.000+0.033x(T^a-10)^{1.179}$
• Liquid/Slurry	• $MCF_{crust}=39+0.008x(T^a-10)^{2.900}$
	• $MCF_{no\ crust}=39+0.008x(T^a-10)^{2.900}$
• Pit storage below animal confinements	• Two step function:
	• Si T^a <20ºC. $MCF_{<1\ month}=0$
	• Si $T^a \geq 20$ºC. $MCF_{<1\ month}=1.000x(T^a-20)^{1.636}$
	• $MCF_{>1\ month}=39+0.008x(T^a-10)^{2.900}$
Anaerobic digester	• MCF=0
Cattle and swine deep litter	Same as Pit storage below animal confinements
Compost – Static stack	• MCF=0.5
Intensive compost	• MCF=0.5
Poultry manure with bedding	• MCF=1.5
• Poultry manure without bedding	• MCF=1.5
• Aerobic treatment	• MCF=0.1

Member State	Emission Factors and other parameters
	For Tier 1 animals, IPCC also takes into account the climatic region they belong to and varies the default emission factor appropriately. Analogously to the actions carried out with the MCFs in Tier 1, functions that are continuous with temperature have been obtained from the default values of the emission factor provided by the IPCC.

Figure 6.19: Trend of allocation of manure to the cool (Portugal, Italy, Spain) or the temperate (France) climate zone as reported in the National Inventory reports of the respective countries



Trends

Shifts in emission factors are partly explained by the increasing milk yield for dairy cows and by changes in the use of manure management systems. For example, in Denmark, an increasing IEF for dairy cattle results from an increasing milk yield and a shift to liquid manure systems. For pigs, there has been a similar development with a move from solid manure to slurry-based systems. For non-dairy cattle, the opposite development has taken place; an increasing proportion of bull-calves is raised in stables with deep litter, where the MCF is lower than for liquid manure. A similar effect is seen for Finland. The fluctuations underlying the general increase in emissions in Finland are related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture. In the Netherlands, liquid manure systems were replaced for poultry by solid manure systems which explain the decreasing emissions for poultry.

Figure 6.20: through Figure 6.25 show the trend of the development of animal productivity in terms of volatile solid excretion for dairy and non-dairy cattle and swine, and the IEF for CH_4 emissions from manure management. These figures show how the different development of the animal sectors in

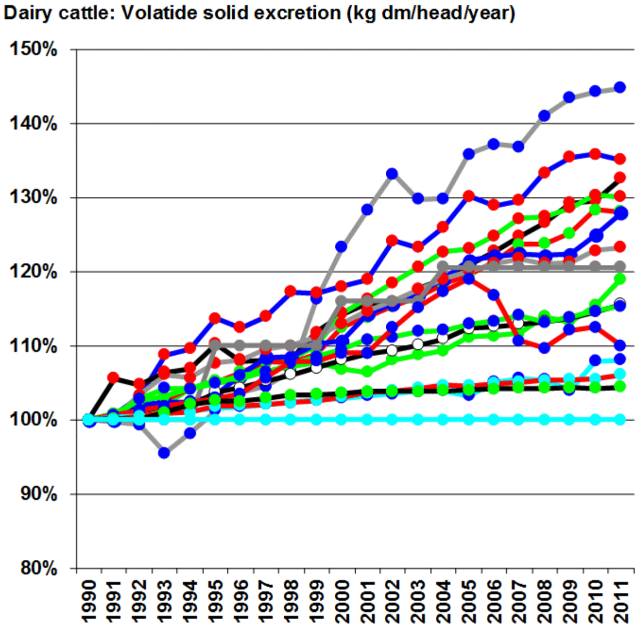
the various countries affects the average characteristics at EU level. Spain is the country with the largest increase in the Swine population and also the country which estimates the highest estimated volatile solid excretion rate. Thus the trend observed at EU-15 level (steepest increase in volatile solid excretion) can entirely be explained by a shift of the weight towards Spanish conditions.

Table 6.42 gives additional information on the trend in category 4B(a) as reported in the national inventory reports.

Table 6.42: Available background information on the trend for CH_4 emissions in category 4.B(a).

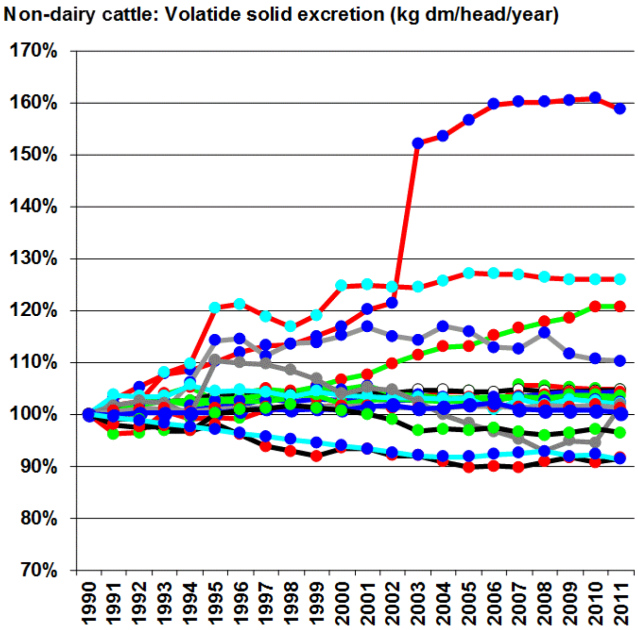
Member State	Trend in category 4B(a)
Denmark	The emission from manure management has increased due to a change towards greater use of slurry-based stable systems, which have a higher emission factor than systems with solid manure. By coincidence, the decrease and the increase almost balance each other out and the total CH_4 emission from 1990 to 2007 has decreased by 5%. For pigs, there has been a similar development as for dairy cattle with a move from solid manure to slurry-based systems. Updated stable type data for 2007 shows fewer animals on slurry systems than previous estimated by the expert judgement from the Danish Agricultural Advisory Centre. An increase of the EF for swine has been observed between 2007 and 2008 (6%). This is due to changes in the allocation between the subcategories sows, slaughter pigs and piglets. Looking at the time series for EF similar changes is seen, for example between 1993 and 1994 (increase by 7%), 2000-2001 (decrease by 5%) and 2004-2005 (decrease by 6%).
Finland	Some inter-annual variation between the years can be noticed from the time series but overall there is an increase in the emissions since 1990. This is mainly caused by fluctuation in activity data between the years because of changes in animal numbers, for example, which is largely affected by agricultural policy and subsidies. Manure management is affected by the fluctuation in animal numbers as well as the proportion of manure managed in different manure management systems which vary depending on animal species. The number of animals kept in a slurry-based system is increasing.
Germany	Between 1993 and 1994 there has been a shift in German dairy cattle housing systems from straw based systems to slurry based systems (1993: 33 % straw based systems, 1994: 19 % straw based systems). As the MCFs for slurry systems (10 and 17 %) are much higher than the MCF for solid systems (2 %), this leads to a comparably high increase of overall methane EF. (TI - Claus Roesemann)
Ireland	A decrease of the IEF for non-dairy cattle between 2005 and 2006 (by 5%) is explained by the strong increase of recovery of biogas from the animal waste storage for energy purposes in 2006.
Italy	Strong increase in biogas recovery in affected significantly CH_4 emissions from manure management.
Luxembourg	Methane emissions from manure management are increased by more than 22% for the period 1990-2006. Animals who did contribute the most of these emissions are cattle, swine and chicken. Beside livestock population developments, the methane emission increase is mainly driven by the changes in the AWMS for cattle: the liquid system share in AWMS went from 23% to about 38% for dairy cattle and from 18.9% to 28.9% for non-dairy cattle. As liquid systems have the highest methane conversion factor, this explains why, despite a decreasing cattle population, related CH_4 emissions did rise over the period 1990-2006.
Netherlands	The interannual increase of methane emissions is 13% and methane IEF for dairy cattle in 2008/2009 is 11%. This is not due to shorter grazing periods but the result of a shift from day and night grazing towards during the daytime only. Methane emissions from the stable are far higher than during grazing thus explaining the difference. Lower values are seen for pigs and horses, and higher for rose veal (as a part of young stock) and fur-bearing animals (as part of other animals). In poultry three effects lead to lower emissions, i.e. decrease in organic matter content of broiler manure, less laying hens kept and the on-going shift to solid manure within the latter category.
Spain	Increase of methane emissions from manure management in the period 1990-2011 due to the increase of number of heads of non-dairy cattle and, above all, of swine. (The interannual increase of CH_4 emissions for Swine 2005/2006 by 11% is due to several factors: a) an increase of 5% in the numbers of animals that superimposes to an increase in the per animal weight, and b) to an increase of the annual average temperatures (based on annual meteorological - not climatic - data for temperature).) There is also an increase of emissions from poultry, but this has a lower impact in the total.

Figure 6.20: Trend of volatile solid excretion for dairy cattle



	1990	Trend (%) 1990-2011	2011
Portugal	4.8	145%	6.9
Greece	4.5	135%	6.1
Spain	3.9	133%	5.1
Finland	3.7	130%	4.9
Belgium	3.1	128%	4.0
United Kingdom	2.7	128%	3.4
Luxembourg	3.7	123%	4.5
Netherlands	3.8	121%	4.6
France	3.5	119%	4.0
EU-15	3.8	116%	4.4
Germany	3.5	115%	4.0
Denmark	5.5	110%	6.2
Ireland	2.8	108%	3.0
Austria	4.0	106%	4.2
Sweden	5.1	104%	5.3
Italy	6.4	100%	6.4

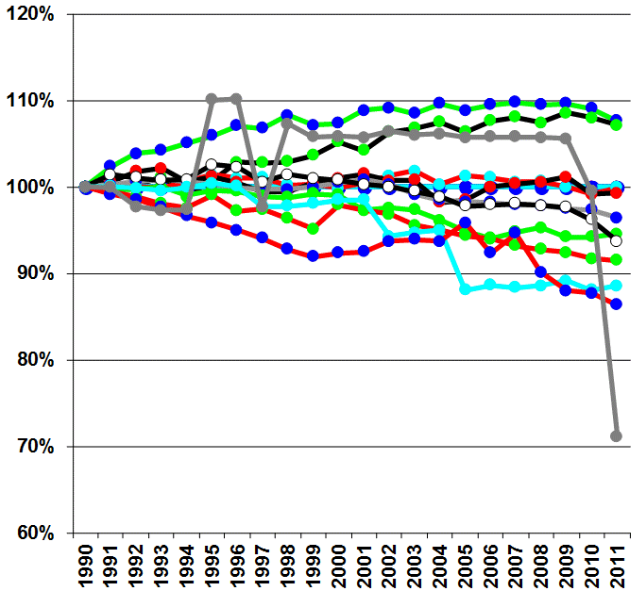
Figure 6.21: Trend of volatile solid excretion for non-dairy cattle



	1990	Trend (%) 1990-2011	2011
Denmark	1.7	159%	2.8
Austria	1.5	126%	1.9
Finland	1.5	121%	1.9
Portugal	2.6	110%	2.9
Belgium	1.3	105%	1.4
EU-15	1.9	105%	2.0
Greece	2.7	104%	2.8
France	1.9	103%	2.0
Germany	1.4	102%	1.5
Italy	2.8	102%	2.8
Netherlands	1.2	102%	1.1
Luxembourg	1.9	101%	1.9
United Kingdom	2.3	100%	2.3
Sweden	1.5	96%	1.5
Spain	2.5	91%	2.3
Ireland	1.4	91%	1.3

Figure 6.22: Trend of volatile solid excretion for swine

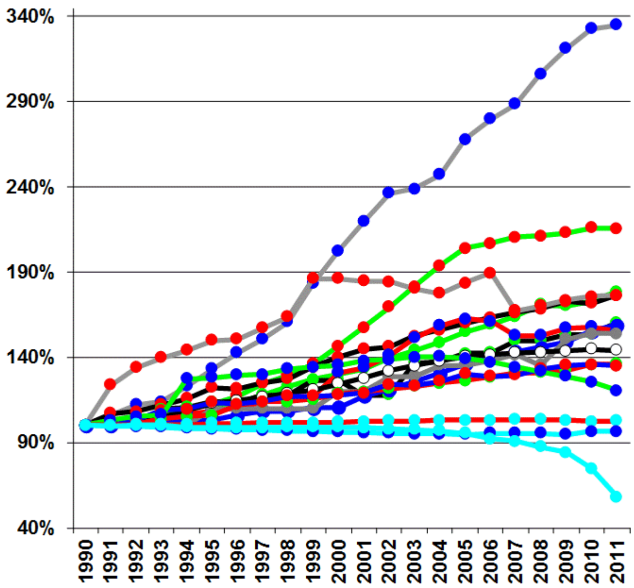
Swine: Volatide solid excretion (kg dm/head/year)



	1990	Trend (%) 1990-2011	2011
Germany	0.2	108%	0.3
Sweden	0.3	107%	0.3
Finland	0.5	100%	0.5
Luxembourg	0.5	100%	0.5
United Kingdom	0.5	100%	0.5
Ireland	0.3	100%	0.3
Austria	0.3	100%	0.3
Spain	0.3	99%	0.3
Portugal	0.5	96%	0.5
France	0.3	95%	0.3
EU-15	0.3	94%	0.3
Belgium	0.4	91%	0.4
Italy	0.4	89%	0.3
Denmark	0.2	86%	0.2
Netherlands	0.2	71%	0.2
Greece			

Figure 6.23: Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle

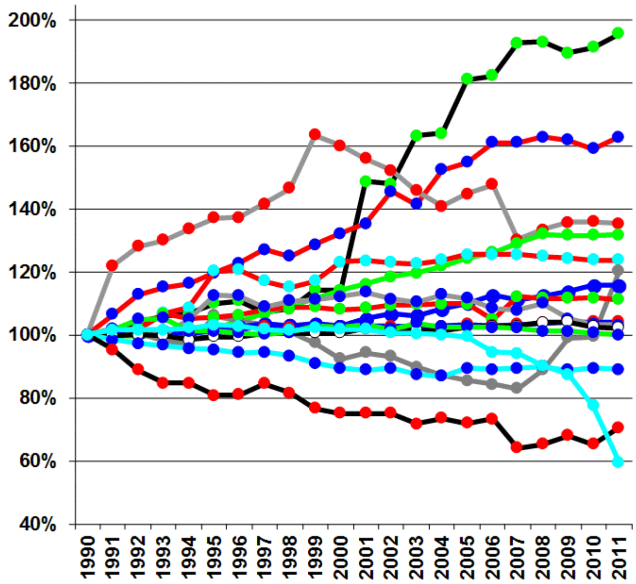
Dairy cattle: CH4 from manure management (kg dm/head/day)



	1990	Trend (%) 1990-2011	2011
Portugal	2.3	335%	7.7
Finland	6.9	215%	15.0
France	22.5	179%	38.9
Spain	41.7	176%	71.5
Luxembourg	21.1	176%	37.2
Sweden	5.6	160%	8.5
United Kingdom	20.0	159%	31.1
Denmark	21.1	155%	33.2
Netherlands	28.0	154%	43.1
EU-15	19.7	144%	28.5
Belgium	12.4	136%	16.8
Greece	10.2	135%	13.9
Germany	16.7	121%	21.0
Austria	8.7	103%	8.9
Ireland	21.6	96%	20.8
Italy	15.0	58%	11.2

Figure 6.24: Trend of IEF for CH_4 emissions from category 4B(a) for non-dairy cattle

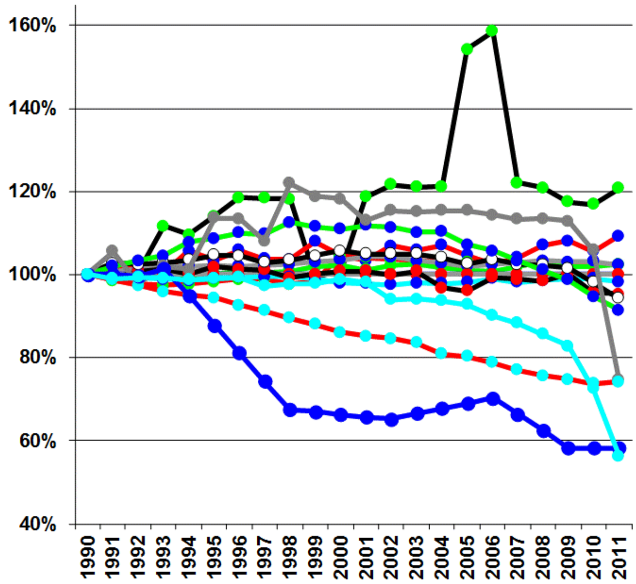
Non-dairy cattle: CH4 from manure management (kg dm/head/day)



	1990	Trend (%) 1990-2011	2011
Sweden	3.1	196%	5.9
Denmark	6.0	163%	9.5
Luxembourg	6.4	135%	8.7
France	5.9	132%	7.7
Austria	3.3	124%	4.1
Netherlands	7.6	120%	7.6
United Kingdom	2.3	116%	2.7
Belgium	2.4	111%	2.7
Greece	1.6	104%	1.7
Portugal	1.4	103%	1.4
EU-15	6.1	102%	6.2
Germany	8.3	100%	8.3
Ireland	11.1	89%	9.9
Spain	4.2	70%	2.7
Italy	7.5	60%	5.8
Finland			

Figure 6.25: Trend of IEF for CH_4 emissions from category 4B(a) for swine

Swine: CH4 from manure management (kg CH4/head/yr)



	1990	Trend (%) 1990-2011	2011
Sweden	1.2	121%	1.4
Denmark	2.1	109%	2.2
Belgium	7.6	102%	7.8
France	12.6	102%	12.8
Portugal	20.4	102%	21.1
Greece	7.0	100%	7.0
Luxembourg	19.5	100%	19.5
Ireland	13.0	98%	12.8
Spain	9.5	95%	9.1
EU-15	6.8	94%	6.7
Germany	3.7	91%	3.5
Netherlands	3.9	75%	4.2
Austria	1.6	74%	1.2
United Kingdom	9.4	58%	5.5
Italy	8.1	56%	5.9
Finland			

6.3.2.3 *Uncertainty and time series consistency*

As for enteric fermentation, the activity data in the category 4B(a) are considered to be relatively certain with uncertainty estimates around 10% for most countries. Highest uncertainty for the activity data are estimated by Italy and Sweden (20%). Portugal assigns a high uncertainty to the population data of several animal types.

The uncertainty estimate for the emission factors is higher and ranges between 10% (Spain) and 100% (Italy).

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.43 and Table 6.44. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in section 6.4

Table 6.45 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from manure management. The table lists only information on activity-data uncertainty that is not covered in category 4A.

Table 6.43: Relative uncertainty estimates for activity data in category 4B(a)

Member State	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Swine	Poultry	Other
Austria		10.0						
Belgium	10.0		10.0	10.0		10.0		
Denmark	5.0							
Finland	12.1							
France	5.0							
Germany		6.4			4.6	2.9		
Greece	5.0							
Ireland	1.0		1.0	1.0				
Italy	20.0							
Luxembourg		2.0						
Netherlands	10.0	10.0				10.0	10.0	
Portugal	8.4							
Spain	3.0							
Sweden	7.0							
United Kingdom	0.1							

Table 6.44: Relative uncertainty estimates for implied emission factors in category 4B(a)

Member State	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Swine	Poultry	Other
Austria		50.0						
Belgium	40.0		40.0	40.0		40.0		
Denmark	20.0							
Finland								
France	30.0							
Germany		64.1			18.6	28.9		
Greece	50.0							
Ireland	30.0		15.0	15.0				
Italy	100.0							
Luxembourg		70.0						
Netherlands	100.0	100.0				100.0	100.0	
Portugal	74.6							
Spain	8.0							
Sweden	17.6							
United Kingdom	30.0							

Table 6.45: Available background information for uncertainty estimates in category 4.B(a)

Member State	Background information to uncertainty estimates
Austria	Emission Factor: "AWMS distribution for the years 1989–1992 could be estimated with low uncertainty (± 10%) due to the survey of (KONRAD1995). It must be assumed that AWMS distribution changed after 1992. Uncertainty increases the longer the time lag between the sur-vey and the respective inventory year. Uncertainty of AWMS distribution in 2001 was estimated at 30%. TIHALO (AMON et al 2007) carried out a

Member State	Background information to uncertainty estimates
	comprehensive survey on AWMS distribution on representative Austrian farms. The inventory revision integrated TIHALO data into the emis-sion estimates. Uncertainty of AWMS distribution has therefore been reduced again to ± 10%. Following the uncertainties of N_2O emission factors, we estimate MCF values to be –50 to +100% uncertain. The country specific MCFs reflect the agricultural practice and the climate conditions in Austria better than the default values. Thus, uncertainties could be reduced to ± 20% (AMON & HÖRTENHUBER 2010). Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 50%(expert judgement Barbara Amon, spring 2010), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000. "
Belgium	Activity Data: The activity data are the livestock census, but also the type of animal housing. The type of housing is more difficult to assess than the number of animals. Consequently the uncertainty on the activity data is estimated at 10 %. Emission Factor: The CH_4 emission factors are based on a regional-specific study. However, given that many assumptions were necessary to calculate these emission factors, the uncertainty on these emission factors is estimated to be similar to the uncertainty on enteric fermentation emission factor.
Denmark	Emission Factor: The emission factor for CH_4 from manure management is 10%. This figure may be underestimated and the uncertainty is, therefore, increased to 100 % until further investigations reveal new data.
Finland	Emission Factor: The uncertainty estimate of the CH_4 emission factor for manure management for all species (±30%) was based on uncertainty estimates of other countries, i.e. Norway, the Netherlands, the USA (Rypdal & Winiwarter 2001) and the UK (Charles et al. 1998), complemented with expert judgement. Uncertainty could be reduced by collecting more information about the distribution of manure management systems and by gathering data from gas flux measurements in order to study the suitability of IPCC default to Finnish boreal climate.
Germany	Emission Factor: 30 % for emission factors for CH_4 and NH_3. The errors for the other emission factors are not known. Figures for N_2O, NO and N2 are taken from IPCC (2006).
Netherlands	Activity Data: The uncertainty in the annual CH_4 and N_2O emissions from manure management from cattle and swine is estimated to be approximately 100%. The uncertainty in the amount of animal manure (10%) is based on a 5% uncertainty in animal numbers and a 5–10% uncertainty in excretion per animal. The resulting uncertainty of 7–11% was rounded off to 10%. Emission Factor: The uncertainty in the CH_4 emission factors for Manure management, based on the judgments of experts, is estimated to be 100% (Olivier et al.,2009). Of the three factors that together make up the emission factor (emission per amount of manure), MCF (Methane Conversion Factor) is the most uncertain. The factor captures for instance assumptions on temperature (temperature is important to the rate of methane production) on technology of manure systems (e.g., sometimes methane (biogas) is col-lected and used) and on the actual management (e.g. whether a tank is directly cleaned after its use). The microbiology of methane formation itself is relatively well known. Most of the uncertainty is created by the assumptions about 'average' manure manage-ment (Olsthoorn and Pielaat, 2003)
Portugal	Activity Data: Territorial units under each climate class could easily change as much as 30% in either direction, value that was assumed as representative of uncertainty for this factor. Emission Factor: Uncertainty for the quantity excreted, VS parameter, was set at 20%, considering the use of an enhanced livestock characterization. Uncertainty values vary from 10% for horses up to 22% for dairy cows. The uncertainty of the biogas density was assumed not to be determinant of the overall uncertainty value.

The following issues for time-series consistency have been identified:

- *CH_4 Emissions – Dairy cattle, Non-Dairy cattle, Greece*

  The inter-annual decrease in methane emissions of dairy cattle in 2004/2005 is 22% and increase in 2005/2006 is 30%. The inter-annual increase in methane emissions of non-dairy cattle in 2004/2005 is 46% and decrease in 2005/2006 is 27%. Not satisfactory explained.

- *CH_4 Emissions – Dairy cattle, Non-Dairy cattle, Luxembourg*

  An unexpected interannual increasing of methane emissions in 2004-2005 is 412%.

- *Activity data, Sweden*

  Information on waste management systems is collected from the surveys published in the biannual statistical report on the use of fertilisers and animal manure in agriculture and the interpolated values are used for the intermediate years. National estimates of stable periods for cattle are collected from the statistical report on use of fertilisers and animal manure in agriculture. This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990.

6.3.3 Manure Management N_2O (CRF source category 4.B(b))

6.3.3.1 *Source category description*

During storage and management of manure, N_2O can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. As for methane emissions, source category 4.B(b) excludes emissions that originate from burning of manure. Also excluded are emissions from manure deposited on pastures by grazing animals, which are reported under category 4.D2.

Direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure, and depend on the availability of nitrogen and carbon. As nitrification requires the presence of oxygen, N_2O emissions are favoured by aerobic conditions, which are favoured in solid manure storage and treatment systems. Denitrification is an anaerobic process and yields molecular nitrogen next to N_2O. Under conditions of reduced moisture, high nitrate concentrations and acidic medium, the emissions of N_2O relative to N_2 increase. Losses of other forms of nitrogen (NH_3, NO_x) are possible and will potentially lead to N_2O emissions once they re-deposit on the surface. These 'indirect' N_2O emissions are reported in source category 4.D3.

Generally, GHG emissions (in CO_2-equivalents) from manure management are predominantly as CH_4 rather than as N_2O. At the EU-15 level, this ratio is at about a factor of 2.8, ranging from 0.5 (Austria) to 7.3 (Ireland). Values close or smaller to unity are found for example for Italy (0.9).

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.46.

Table 6.46 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 2011 with an -1% increase of the IEF for solid systems and of -7% for liquid systems.

Table 6.46: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-15 level for the years 1990 and 2011

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	7	62
Total Nitrogen excreted [Gg N]	20	2688	2226
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.18%	1.78%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2011		
Total Emissions of N_2O [Gg N_2O-N]	0	6	48
Total Nitrogen excreted [Gg N]	20	2456	1729
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.16%	1.76%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2011 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	99%	85%	77%
Total Nitrogen excreted [Gg N]	99%	91%	78%
Implied Emission Factor [kg N2O-N / kg N]	100%	93%	99%

6.3.3.2 Methodological *Issues*

Methods

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems; the percentage of emissions from solid storage systems thus varies between 70% in Sweden and 93% in Portugal.

Table 6.47 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that ‘solid storage’ is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. This is done by most Member States at a higher disaggregation level than categories that are reported in the CRF. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates is calculated from the Nex factor for the each manure management system (assigning Tier 1 or Tier 2 when comparing to IPCC default), combined with the MEAN-rule (see section 6.4.1.5, Table 6.91 through Table 6.94) and then further combined with the Tier level of the emission factor for the manure storage system by using the MEDIAN rule with weighting factors for Nex and the IEF being 2/3 and 1/3 (for details see Section 6.4.1.3).

As most countries use country-specific nitrogen excretion rates for most animals but use default emission factors, the Tier level of Tier 1.8 is assigned. The combined uncertainty of solid, liquid, and other systems (14% of total emissions, for which a Tier 1 was assumed) range between Tier 1.2 and Tier 2.0. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used. Netherland does not report nitrogen excretion rates and no allocation of animal waste to manure management systems could be done. However, according to the national inventory report, a Tier 2 approach can be assumed for the Nex values.

For EU-15, the overall Tier level is Tier 1.8 (76% of emissions estimated using country-specific information). This value is somewhat lower for solid systems (Tier 1.7) than for liquid systems (Tier 1.9). A compilation of national methodologies for the estimation of nitrogen excretion can be found in Table 6.53; most data are based on country-specific information. This is important if we assess the uncertainty of the EU15 emission estimate: given that nitrogen excretion is largely controlling N_2O emissions from manure management, the error of the estimates of the different countries can be assumed to be largely independent one from another. Only two countries are relying on IPCC default values, i.e. Greece using values reported for the Mediterranean region and France (for dairy cattle) using the value for Western Europe.

Additional background information on the methodology, if available, is summarised in Table 6.48.

Table 6.47: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems. Data for the year 2011.

2011	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Austria	925	Tier 1.8	74%	Tier 1.7	y	3%	Tier 1.7
Belgium	770	Tier 1.7	92%	Tier 1.7	y	1%	Tier 1.7
Denmark	403	Tier 1.9	19%	Tier 1.7	y	19%	Tier 1.9
Finland	426	Tier 1.2	79%	Tier 1.5	y	4%	Tier 1.1
France	4,697	Tier 1.7	96%	Tier 1.7	y	4%	Tier 1.7
Germany	2,812	Tier 2.0	59%	Tier 2.0	y	41%	Tier 2.0
Greece	274	Tier 1.6	92%	Tier 1.4	y	3%	Tier 1.6
Ireland	438	Tier 1.7	86%	Tier 1.7	y	14%	Tier 1.7
Italy	3,716	Tier 1.7	88%	Tier 1.6	y	4%	Tier 1.7
Luxembourg	25	Tier 2.0	91%	Tier 2.0	y	8%	Tier 2.0
Netherlands	1,052	Tier 1.8	85%	Tier 2.0	y	15%	Tier 1.7
Portugal	296	Tier 1.7	93%	Tier 1.6	y	4%	Tier 1.7
Spain	1,654	Tier 1.8	19%	Tier 1.1	y	0%	Tier 1.0
Sweden	446	Tier 1.7	70%	Tier 1.7	y	5%	Tier 1.7
United Kingdom	1,645	Tier 1.8	69%	Tier 1.7	y	3%	Tier 1.7
EU-15	**19,579**	**Tier 1.8**	**76%**	**Tier 1.7**	**y**	**10%**	**Tier 1.9**
EU-15: Tier 1	24%		26%			11%	
EU-15: Tier 2	76%		74%			89%	

a Contribution to N_2O emissions from manure management; b Quality level (between Tier 1 and Tier 2); c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 6.48: Available background information on the methodology for estimating N_2O emissions in category 4.B(b)

Member State	Methods
Austria	**For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. For the calculation of the losses of gaseous N species (NH_3-N and NO_x-N) the mass-flow pro-cedure pursuant to EMEP/CORINAIR (EEA 2007) has been applied. In 2009 new data on agri-cultural practice in Austria (AMON et al. 2007) has been integrated to the ammonia emission model (AMON & HÖRTENHUBER 2008).**
Belgium	**The method used in the three regions is fully in compliance with the IPCC GPG 2000. N_2O emissions from manure produced by grazing animals are not taken into account into category 4.B but are included in the category 4.D, agricultural soils.**
Denmark	**Emissions from manure management are calculated in with the model IDA. Investigation indicates a lower N_2O emission from biogas treated slurry compared to untreated slurry (Sommer et al., 2001 and Sommer et al., 2004). The lower emission is a**

Member State	Methods
	result of displacement in allocation between the fraction of degradable and non-degradable VS. Biogas treated slurry increase the fraction of non-degradable VS, which promote the oxygen content in soil. These conditions will reduce the potential risk for N_2O emission, because N_2O emission takes place in environments without oxygen or with very low concentrations of oxygen (Sommer et al., 2001). In practice this effect of a lower N_2O emission will takes place in the manure applied on soil. However, it is chosen, in the inventory, to incorporate the lower N_2O-emission as a subtracting from the manure management emission. The biogas treatment is accomplished before the slurry is applied to soil. It is assumed that the lower emission of biogas treated slurry compared to untreated slurry is 64% for cattle slurry and 59% for pig slurry (Sommer et al., 2001).
Finland	**N_2O emissions from manure management are calculated with a national calculation model (Gronroos et al. 2009). The nitrogen mass flow model takes into account the volatilisation of ammonia in each step of manure management (animal shelter, filling storage, storing) and the effect of possible abatement measures to volatilisation. This enables to calculate indirect nitrous oxide emissions from AWMS. Urine stored separately is a small adjustment to solid storage emissions (and has EF of liquid). Direct N_2O emissions from manure managements are calculated in the model using the IPCC methodology, with default EF.**
France	
Germany	**Calculation of N-excretion is calculated with the GAS-EM model and based on the concept of nitrogen-flow in agriculture which considers all nitrogen losses including molecular nitrogen (EMEP, 2003; Daemmgen and Hutchings, 2005; Daemmgen et al., 2007). It considers a differentiation between organic nitrogen and easily decomposable nitrogen (total ammoniacal nitrogen, TAN). TAN is present in the urine of mammals, while poultry excrete uric acid nitrogen (UAN), which is considered as TAN in the calculations. In a first step, both the excretion of total nitrogen and of total ammoniacal nitrogen (TAN) is estimated. Consistently with the definition of the EFs,emissions of NH_3 are calculated in proportion to the TAN content, while N_2O, NO, and N2 emissions are proportional to the total N content, weighted by the share of TAN and organic N. Emissions of all N-gases on pasture, range and paddock occur simultaneously, while volatilization in housing systems are subtracted from available TAN for the calculation of emissions from manure management systems. For solid storage systems, the N in bedding material is considered with a N-content of 0.58% of dry weight straw. All calculations are done on the district level using the agricultural model RAUMIS.**
Greece	**Default**
Ireland	**Tier 1**
Italy	**For sheep and goat, a detailed analysis has been carried out with information from ASSONAPA, the National Association for Sheep Farming. For slurry and solid manure production parameters, specifically for the cattle and buffalo category, updated data have been incorporated, according to new country specific data available.**
Luxembourg	
Netherlands	**Activity data are collected in compliance with a Tier 2 method. The method used is fully in compliance with the IPCC Good Practice Guidance (IPCC, 2001). Ther N-flows from animal production are assessed by the National Emission Model for Ammonia (NEMA). Results include emissions of ammonia (NH_3), nitric oxide (NO), laughing gas (N_2O) and nitrogen gas (N2) from stable and storage. IPCC 2000 methodology with country specific parameters.**
Portugal	
Spain	**IPCC 2000 methodology with country specific parameters.**
Sweden	**The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.**
United Kingdom	**It is assumed that 20% of the total N emitted by livestock volatilises as NO_x and NH_3 and does not contribute to N_2O emissions. This is because in the absence of a more detailed split of NH_3 losses at the different stages of the manure handling process it has been assumed that NH_3 loss occurs prior to major N_2O losses. Emission estimates are made with 20% smaller Nex factors than those reported in the CRF. The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.**

Activity Data

In EU-15, a total of 7,872 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2011. The largest share of this manure-nitrogen was excreted by grazing animals, followed by manure managed in liquid and solid storage systems. Compared with 1990, this was a decrease of manure-nitrogen by 13%. The decreases were similar for the different manure management systems with a smallest decrease for liquid systems (-9%). The decrease of nitrogen was particularly pronounced in the Netherlands, where total nitrogen decreased by 31%. At the same time, the manure managed on solid storage systems increased by 8% indicating a strong shift from pasture to solid systems in the Netherlands. This is a consequence of the increase of the time period dairy cattle are kept indoors. Firstly this is done to increase cost-effectiveness of milk production and secondly to increase the efficiency of manure application as an effect of Dutch manure-policy.

The nitrogen managed in the various manure management systems in 2011 is given in Table 6.49. Background information on the allocation to manure management systems is given in Table 6.31. Nitrogen excretion data per head will be discussed below.

Table 6.49: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2011 [Gg N yr-1]

Member State 2011	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Austria		54		70	33	10	166
Belgium		19	2	73	86	78	258
Denmark		199		8	32	21	260
Finland		38		42	7	19	106
France		406		462		894	1,761
Germany		761		369		135	1,265
Greece		15	1	26	5	180	227
Ireland		129		38		268	435
Italy		316		334	31	159	841
Luxembourg		4		2	1	6	13
Netherlands		329		94		69	492
Portugal	20	22		28		84	154
Spain		2	3	32	428	308	773
Sweden		50		32	11	45	138
United Kingdor		113	139	117	53	560	982
EU-15	20	2,456	145	1,729	688	2,835	7,872

Information source: CRF Table 4.B(b) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As most countries are using IPCC default values for the IEF or values that are close to it, these numbers apply also for the EC-N_2O inventory for manure management. An overview of the implied emission factors is given in Table 6.50.

Table 6.50: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory 2011

Member State	Implied EF (kg N_2O-N / kg N)			
2011	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Austria	NO	0.10%	2.0%	1.3%
Belgium	NO	0.10%	2.0%	0.1%
Denmark	NO	0.08%	2.0%	1.6%
Finland	NO	0.10%	1.6%	2.0%
France	NA	0.10%	2.0%	NA
Germany	NO	0.31%	0.9%	NO
Greece	NA	0.10%	2.0%	0.5%
Ireland	NO	0.10%	2.0%	NO
Italy	NO	0.10%	2.0%	2.0%
Luxembourg	NO	0.10%	2.0%	0.1%
Netherlands	NO	0.10%	1.9%	NO
Portugal	0.10%	0.10%	2.0%	NO
Spain	NO	0.10%	2.0%	0.6%
Sw eden	NO	0.10%	2.0%	2.0%
United Kingdom	NO	0.10%	2.0%	1.7%
EU-15	0.10%	0.16%	1.8%	0.8%

Information source: CRF Table 4.B(b) for 2011, submitted in 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is the nitrogen excretion rate per head and year, which is given in Table 6.51 for EU15-countries and for the main animal types. The table shows a range by a factor of up to 3.3 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range of about 40 kg N head^{-1} y^{-1} from 99 (Austria) to 138 kg N head^{-1} y^{-1} (Denmark). Large ranges are found for non-dairy cattle with values between 41 (Netherlands) and 59 kg N head^{-1} y^{-1} (France) and sheep with values between 5.1 kg N head^{-1} y^{-1} (Spain) and 17.0 kg N head^{-1} y^{-1} (Luxembourg). In the German inventory, the IEF for the category solid storage and dry lot is country specific and higher than default. Nitrogen in bedding material is considered when calculating N_2O emissions from solid manure. The IEF is therefore higher than each partial EF by management system.

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.52. Additional background information on the calculation of nitrogen excretion rates is summarised in Table 6.53.

Table 6.51: Total Nitrogen excretion by AWMS [kg N head-1 yr-1] for dairy and non-dairy cattle, sheep, swine, and poultry in 2011

Member State 2011	Dairy	Non-Dairy	Sheep	Swine	Poultry
Austria	98.5	46.6	13.1	9.6	0.5
Belgium	116.8	54.2	7.6	10.0	0.6
Denmark	138.5	44.1	17.0	8.0	0.6
Finland	129.6	51.7	10.0	IE	0.6
France	115.6	59.1	16.7	7.0	0.5
Germany	116.6	44.3	8.4	11.7	0.8
Greece	100.0	46.2	10.7	16.0	0.6
Ireland	102.1	48.3	6.9	8.4	0.5
Italy	116.0	49.5	16.2	11.7	0.5
Luxembourg	102.0	46.9	17.0	11.4	0.7
Netherlands	127.6	41.4	6.5	8.6	0.6
Portugal	117.1	50.5	8.0	9.1	0.6
Spain	111.2	43.6	5.1	9.1	0.4
Sweden	127.2	41.9	6.2	9.0	0.4
United Kingdom	121.2	53.9	5.2	10.4	0.6
EU-15	117.0	50.5	8.2	9.4	0.6

Information source: CRF Table 4.B(b) for 2011, submitted in 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.52: Available background information on the emission factor for calculation of N_2O emissions in category 4.B(b)

Member State	Emission Factors
Austria	Default with exception of 'deep litter' for which IPCC (2006) is taken. In the IPCC guidelines no emission factor for yard is available. It is assumed, that the storage of the yard manure equals the average waste management systems distribution in Austria. Thus, the implied N_2O emission factor of all systems (except pasture) has been used. Scientific background: N_2O emissions result from the interaction of manure N with organic carbon that is present in soils and in straw. This explains higher EF for pasture, solid systems or composting compared to liquid systems. In yards, there is neither soil-C nor straw-C.
Belgium	In Belgium, the local excretion factors are more or less comparable to the IPCC 1996 default value, especially if the principle of table 4.14 of the IPCC GPG 2000 is taken into account.
Denmark	
Finland	IPCC default. For dung and deep litter, EF is the same as for solid storage, and urine's is the same as for slurry
France	
Germany	Liquid slurry - the higher EF from IPCC (2006) is used as a conservative estimate. For artificial cover the EF for natural crust is used (0.5%) instead of the EF of 0% following a 'worst-case' assumption; however, these artificial covers are not significant in Germany. For anaerobic digesters IPCC (2000) is used. A differentiation between deep litter and solid storage is made. EF for solid storage is 1.3% (Vandre et al., 2012), for deep litter the EF from IPCC (2006) had to be used, similar to poultry litter, for which no EF is available from IPCC (1996). Studies from Denmark (Sommer, 2001) and UK (Sneath et al., 1997) show that EFs from IPCC (2006) do not lead to an underestimation of emissions. Emissions of NO and N2 are linked to N_2O emissions, using an EF for NO of 10% and for N2 of 300% of the N_2O-EF.
Greece	Default
Ireland	Default
Italy	Liquid system, solid storage and other management systems (chicken-dung drying process system) are considered according to their significance and major distribution in Italy
Luxembourg	
Netherlands	IPCC default.

Member State	Emission Factors
Portugal	IPCC 1996 defaults
Spain	IPCC 2000 defaults
Sweden	Default values from the IPCC Guidelines. IEFs may change over the years, depending on the relative size of the respective subgroups aggregated.IPCC 1996 defaults
United Kingdom	Calculations were performed with the N_2O Inventory of Farmed Livestock to compare housing and storage phases (Sneath et al. 1997). For pigs and poultry, the emission factor for housing is the same as or greater than that of storage. For dairy and non-dairy cattle, the emission factor for the housing phase is around 10% of the storage phase, so the non-stored FYM has been split between SSD and DS to account for this. Emissions from the combustion of poultry litter for electricity generation are reported under power stations. Emissions occurring during storage of poultry litter that will later be used for energy generation are included in the agricultural inventory.IPCC 2000 defaults

Table 6.53: Available background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)

Member State	Nitrogen excretion rates
Austria	N-excretion data are calculated following the guidelines of the European Commissions according to the requirements of the European Nitrate Directive based on feed rations which are estimated on the basis of the following parameters: Cattle: Feed rations represent data of commercial farms consulting representatives of the working groups “Dairy production”. These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogenand energy uptake, efficiency, duration of livestock keeping etc. Sheep and goats:life weight, daily gain of weight, degreeof pregnancy or lactating, feeding rations. Pigs: breeding pigs, piglets, boars, fattening pigs: number and weight of piglets, daily gain of weight, energy content of feeding, energy and nitrogen uptake, N-reduced feeding. Poultry: feeding ration, duration of keeping, nitrogen uptake, nitrogen efficiency. Horses: feeding ration per horse category, weight of horses.
Belgium	In Wallonia N-excretion factors were first determined for the implementation of the CE Nitrates Directive 91/676 (see annexes of the decree downloadable on http://www.nitrawal.be/upload_files/3.1.1%20PGDA/AGW%20PGDA%2031%2003%2011.pdf) but were representing the nitrogen after deduction of the atmospheric losses, so new factors were calculated on this basis for the purposes of estimating atmospheric emissions. For Flanders, nitrogen excretion factors are from the Manure Bank of the Flemish Land Agency (www.vlm.be) and are based on the regional situation. The N-excretion factors of cattle, sheep, goats, horses, mules and rabbits used in 2011 are described in the manure decree of December 2006 (or MAP3): http://www.vlm.be/SiteCollectionDocuments/Publicaties/mestbank/bemestingsnormen_2013.pdf. For dairy cows, in MAP3, these N-excretion factors depend on the average milk production per cow. Till 2006 the N-excretion factors of the manure action plan (MAP2bis) is used. For the N-excretion factors of swine and poultry, a farmer can choose to use the standard excretion factors. Or they can choose (or in some cases are obliged) to use the other systems (regression, animal feed covenant, input-output balance).
Denmark	N-excretion (kg N/head/yr) is weighted values from the following categorisation: Non-dairy cattle: Calves, Bulls, Heifers and Suckling Cattle, Sheep, Goats, Swine: Piglets, Slaughtering pigs, Fur animals, Poultry: Broilers, Hens, Ducks, etc. The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories. The Danish N-excretion levels are generally lower than IPCC default values. This is due to the highly skilled, professional and trained farmers in Denmark, with access to a highly competent advisory system.
Finland	Annual N excretion per animal for cattle, sheep, swine, horses, poultry and fur animals has been calculated by animal nutrition experts of MTT Agrifood Research Finland (Nousiainen, J. pers.comm.). Values for annual N excretion (Nex) are based on calculations on N intake-N retention for typical animal species in typical forage system. Annual nitrogen excretion per animal and in the case when animals are kept less than one year in farms (swine, poultry), replacement of animals with new ones has been taken account in the calculations. For reindeer, values for goats have been used. N-excretion for Fur animals is average of two sub-categories: Minks and Fitches and Fox and Racoon.
France	Data related to manure management systems based on national studies. Country-specific excretion factors but IPCC default volatilisation factors. (For cattle, N-excretion is calculated on the basis of animal physiology, milk production, and feed consumption. While feed consumption of dairy cattle is known, it has been estimated for non-dairy cattle. For swine, N-excretion has been calculated from animal physiology data and the share of swine under phase-feeding. N-excretion factors for poultry are available for 78 animal types, which have been aggregated to the 10 animal types in the national statistics based on data obtained on the survey on animal housing systems from 2008. N-excretion for goats are from Schmideley et al. (2002). N-excretion data is from

Member State	Nitrogen excretion rates
	expert judgement (Rosset).
Germany	Dairy cattle: N-excretion factors are calculated on the basis of milk productivity, protein content of the milk, the weight, number of births and the composition of the rations. Non-dairy cattle: feed composition, daily weight gain and live weight. Swine and hens: N-excretion is calculated on the basis of productivity (number of births or weight gain), the weight and the feed composition. For Dairy cattle and national data for other animals. Country-specific data for other animal categories. Values for the content of total ammoniacal nitrogen (TAN) were estimated for Cattle, Swine, Sheep, Horses, and Poultry. Other parameter required for the estimation of N_2O emission (the effective surface area, the ventilation conditions and the temperature during storage) are not available. N-excretion for other livestock are taken from national studies (see Roesemann et al., 2013). For the detailed calculation the mean N-content in feed is checked with national feeding recommendations. N-excretion is obtained by subtracting N-retention, N-export in products (milk/eggs/offspring) from N-intake.
Greece	N excretion for dairy cattle value referring to West Europe countries was used taking into account that the dairy milk production in Greece has increased to levels similar to those of Western Europe. Moreover, for other cattle and buffalo N excretion values for dairy cattle referring to West Europe countries were used. For the rest of the animals N excretion value referring to Mediterranean countries was used. Finally, for the estimation of other cattle and sheep N excretion, the adjustment factors for young animals proposed by IPCC guidelines (Table 4.14, IPCC 1997) were used.
Ireland	For Cattle, the excretion rates are consistent with the nitrogen content of cattle feeds and the quantities excreted by the animal, as analysed in conjunction with the determination of Tier 2 CH_4 emission factors for Cattle. The published nitrogen excretion rates are used along with the information on the allocation of animal manures to each applicable animal waste management system from the Farm Facility Survey.
Italy	Since 2006 submission, with results obtained from the Nitrogen Balance Inter-regional Project, country-specific annual nitrogen excretion rates have been incorporated. This project involved Emilia Romagna, Lombardia, Piemonte and Veneto regions, where animal breeding is concentrated. The nitrogen balance methodology was followed, as suggested by IPCC. N-excretion rates are time-dependent for cattle, buffalo, and pigs.
Luxembourg	The nitrogen excretion per AWMS cannot be calculated since the nitrogen excretion per head of animal is not yet estimated for Luxembourg. The default factors suggested for Western Europe in the IPCC Guidelines have to be further investigated to decide whether or not they might be applied to Luxembourg's situation as regards manure management of animals.
Netherlands	Standard factors for manure production and manure N-excretion per animal per animal category and per manure management system are calculated by the Netherlands Statistics and decided on by WUM (Working group for Uniform calculations on Manure- and minerals) annually, based on specific data such as milk yield. More specified data on manure management are based on statistical information on management systems and is documented (Van der Hoek, 2006). http://www.greenhousegases.nl/documents/4B_N$_2$O_manure.pdf
Portugal	Country-specific nitrogen excretion factors. The nitrogen excretion rates result from expert information provided by the Ministry of Agriculture. The pattern used allows different rates according to age and sex. After 2009 reports' review, N excretion rates were revised, in coordination with the Ministry of Agriculture, including: analysis of new nitrogen excretion rates proposed in the revision of the Agricultural Good Practice Code (CBPA), compliance of nitrogen excretion rates from CBPA with livestock information used in the inventory, and resort to expert guesses when animal types are not covered in CBPA by comparing with similar animal types. Results are considered to be more representative of the national conditions than those formerly submitted. For dairy cattle, CBPA defines nitrogen excretion rate as a function of milk production.
Spain	National N-excretion factors for cattle, sheep, swine and poultry. For the other animal types IPCC facotr for the "Near East & Mediterranean" climate region and applying age-related correction factors.
Sweden	The Swedish Board of Agriculture publishes data on manure production from most of the animal subgroups included in the inventory. The given values are according to the STANK model, which is the official model for input/output accounting on farm level (Linder, 2001). They are a function e. g. of milk productivity for dairy cattle, age and number of production cycles for pigs etc.
United Kingdom	Country-specific values for nitrogen excretion per head for the different livestock types were derived from the report of Defra project WT0715NVZ (Defra, 2006) with interpretation by Cottrill and Smith (ADAS) .

Trends

The decreases in total N_2O emissions of 17% (total; 15% in liquid systems and 23% for solid systems) are mainly due to decreases in nitrogen excretion. For liquid systems, the implied emission factor decreases by 7% (a decrease by 19%, 14% and 2% is estimated for Denmark, the Netherlands and Germany, respectively). For solid systems, a change in the IEF between 1990 and 2011 has been reported for Finland (increase of 9%), Germany (decrease of 14%), and the Netherlands (increase of 2%).

Figure 6.26 through Figure 6.32 show the trend of the nitrogen excretion rate per head and the nitrogen managed in solid storage and dry lot systems. The trend in emissions is driven by animal numbers, animal performance (nitrogen excretion) and the distribution of manure over the manure management systems, which have been discussed above. The effect of the AWMS is contrary to that observed for the methane emissions.

The category "other" animal waste management systems for Italy is reported for the years 1995 onwards only in the Italian inventory. This nitrogen excretion refers to poultry manure that is undergoing a drying-process. This system has been widely used from 1995 (CRPA, 2000).

Nitrogen excretion for buffalo is reported for Germany (occurring from 1996 onwards), Italy and Greece only. While Greece and Germany use a constant excretion factor of 70.0 and 82.0 kg N head^{-1} year-1, respectively, the N excretion of buffalo varies significantly in time in Italy with values between 92 and 107 kg N head^{-1} year-1. The N-excretion values result from the weighted average of cow buffalo and other buffaloes and the variability is due to the interannual variation of the proportion of the two livestock number as published by the National Institute of statistics. Cow buffaloes have a higher N excretion, comparable with dairy cows, because they are prevalently bred for milk production (mozzarella di bufala).

Table 6.54 gives additional information on the trend in category 4B(b) as reported in the national inventory reports.

Table 6.54: Available background information on the trend for N_2O emissions in category 4B(b).

Member State	Trend in category 4B(b)
Austria	Emissions of cattle dominate the trend. The reduction of diary cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of dairy cattle since 1990).
Belgium	
Denmark	This reduction in the total amount of nitrogen in manure despite the increasing production of pigs and poultry is particularly due to an improvement in fodder efficiency, especially for slaughter pigs. An increase of the EF for swine has been observed between 2007 and 2008 (6%). This is due to changes in the allocation between the subcategories sows, slaughter pigs and piglets. Looking at the time series for EF similar changes is seen, for example between 1993 and 1994 (increase by 7%), 2000-2001 (decrease by 5%) and 2004-2005 (decrease by 6%).
Finland	The fluctuation in N_2O emissions is related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture.
France	
Germany	
Greece	
Ireland	
Italy	N-excretion in the category Other has been not reported in 1990-1994. The chicken-dung drying process system has been widely used only since 1995 onwards.
Luxembourg	
Netherlands	The relatively large decrease in N_2O emissions of solid manure in 2003 is a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004 and 2005, N_2O emissions increased once again following the recovery of poultry animal numbers, while in 2006 the emission decreased as a consequence of lower poultry numbers. In 2007 emissions increased as a result of increasing animal population and higher N excretion per animal. The slightly increase N_2O emissions from manure management over the whole time series is explained by a higher IEF partly counteracted by a decrease in N excretion in the stable. The interannual decrease of N-excretion in 2008/2009 is 6%. Technical information on the composition of rations and their mineral content are taken into consideration, and therefore N-excretion can vary from year to year. In 2009 considerably more maize silage was available, filling in almost equal energy requirements replacing grass (which has more than double the N-content of maize).

Member State	Trend in category 4B(b)
	Anticipating a ban on battery cage systems for laying hens effective from 2012, farmers start changing their management towards ground housing or the aviary system in 2011. In the process they switch from solid manure without bedding on which birds do not walk, to solid manure with bedding on which birds do walk. Following the GPG 2000, emission factor increases from 0.5 to 2% in this case, thus explaining the overall increase.
Portugal	
Spain	
Sweden	The N_2O emissions have decreased since 1990, mainly because of a change from solid manure management to slurry management in dairy and pork production. An increase in the production cycles per year from 2.5 to 3 for pigs for meat production causes an increase in the nitrogen excretion for swine in 2001-2002 by 16%.
United Kingdom	

Figure 6.26: **Trend of nitrogen excretion rates for dairy cattle**

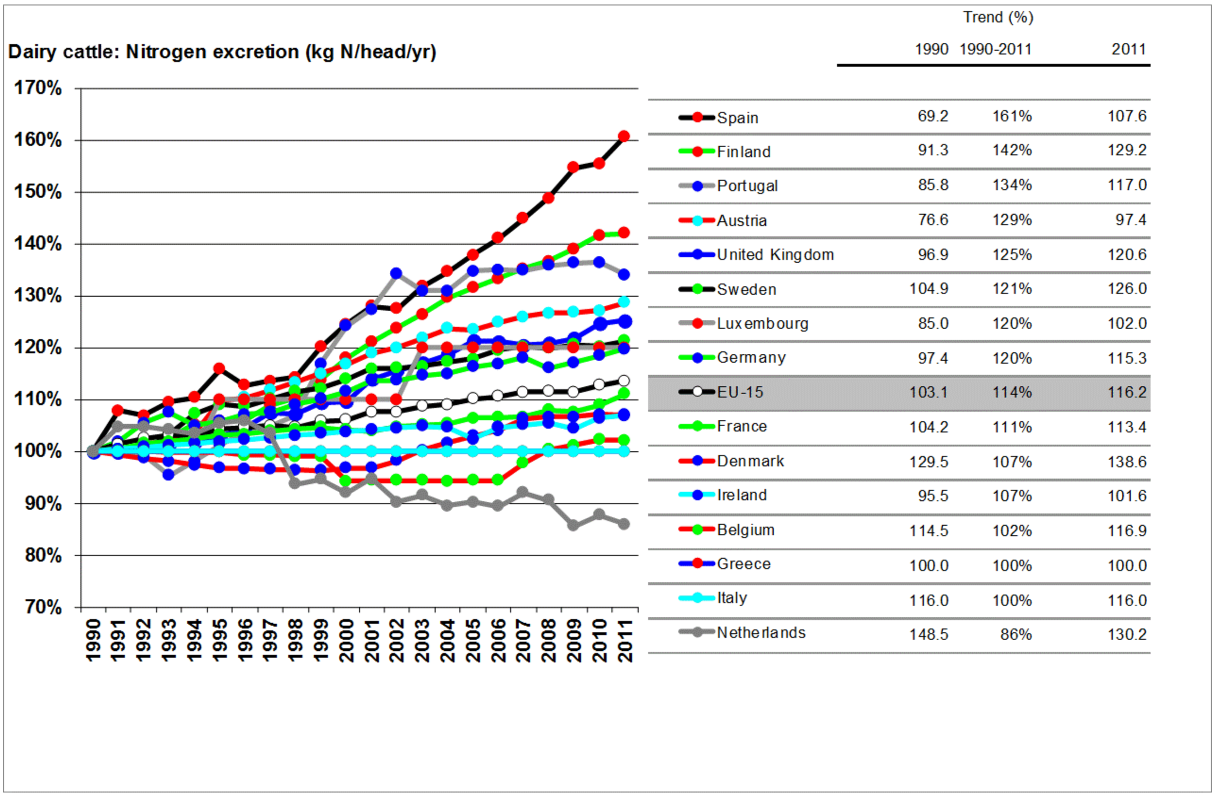
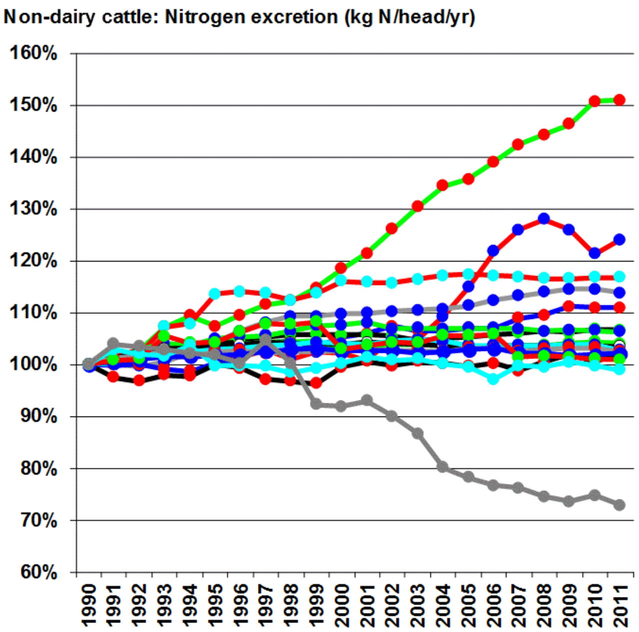
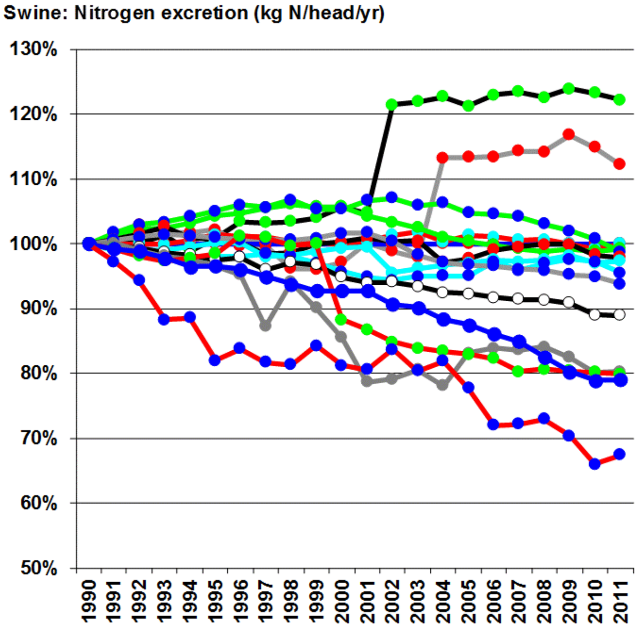


Figure 6.27: Trend of nitrogen excretion rates for non-dairy cattle:



	1990	Trend (%) 1990-2011	2011
Finland	34.3	151%	51.7
Denmark	35.6	124%	43.1
Austria	40.0	117%	46.7
Portugal	44.4	114%	50.8
Greece	41.7	111%	46.2
Sweden	39.3	107%	42.0
Germany	41.8	106%	44.5
France	56.8	104%	59.3
EU-15	48.8	103%	50.6
Ireland	47.0	103%	48.8
Luxembourg	45.8	102%	47.2
Spain	42.7	102%	43.0
United Kingdom	52.9	102%	53.8
Belgium	53.7	101%	54.2
Italy	50.0	99%	49.8
Netherlands	56.9	73%	42.5

Figure 6.28: Trend of nitrogen excretion rates for swine

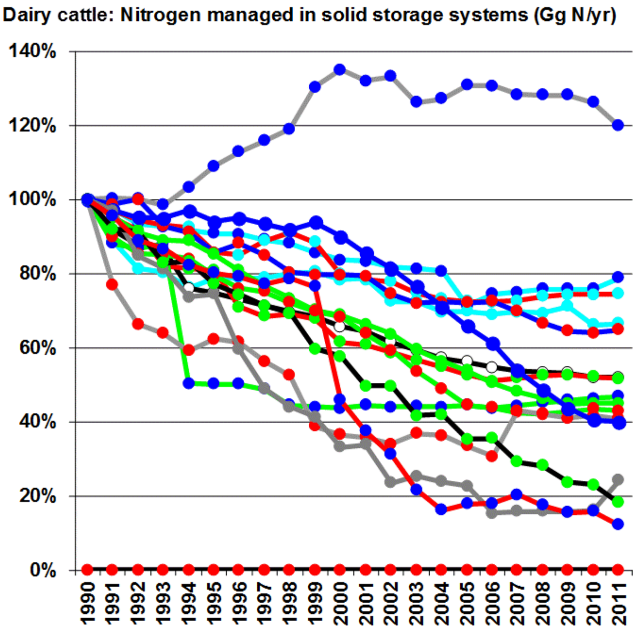


	1990	Trend (%) 1990-2011	2011
Sweden	7.4	122%	9.1
Luxembourg	10.2	112%	11.7
Greece	16.0	100%	16.0
Austria	9.6	100%	9.5
France	7.0	99%	7.0
Germany	11.8	99%	11.9
Spain	9.3	98%	9.1
Italy	12.0	97%	11.7
Ireland	8.8	95%	8.6
Portugal	9.8	94%	9.3
EU-15	10.6	89%	9.4
Netherlands	10.8	80%	8.6
Belgium	12.5	80%	10.0
United Kingdom	13.2	79%	10.4
Denmark	11.8	67%	7.8
Finland			

- Remark Sweden: Due to more intense swine production the nitrogen production for sows and pigs for meat production were updated in 2002. This led to an increase in N-excretion of 16% between 2001 and 2002.
- Remark Luxembourg: Nex is calculated as a population-weighted average of constant Nex values

for 4 swine sub-categories: pigs < 20kg- pigs from 20 to 50 kg- fattening pigs > 50 kg and breeding pigs. From 2004 onwards the two first sub-categories were changed to pigs < 10 kg and pigs from 10 to 50 kg. Unfortunately the published table does not record these changes as a footnote but they are clearly visible in the series. Since this modification increases the Nex it was not corrected because it does not lead to an underestimation of the emissions for the `Kyoto` years.

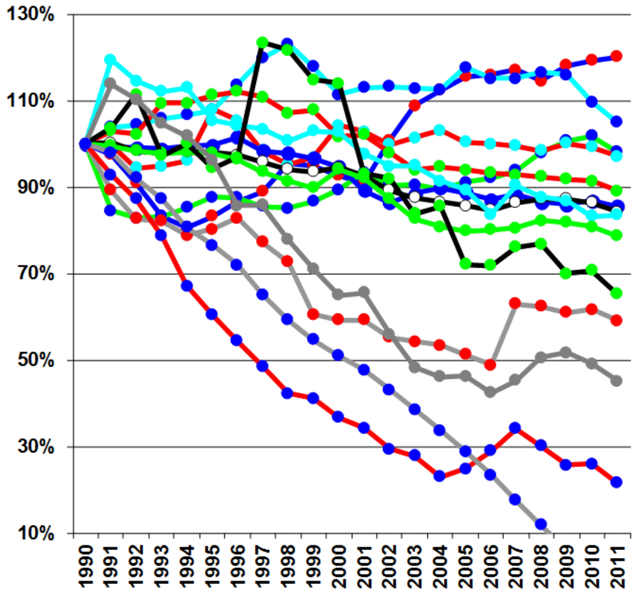
Figure 6.29: Trend of N managed in solid storage and dry lot, dairy cattle



	1990	Trend (%) 1990-2011	2011
Portugal	11.8	120%	14.9
Ireland	2.6	79%	2.0
Austria	34.3	74%	25.5
Italy	174.9	66%	115.6
Greece	15.0	65%	9.6
EU-15	696.5	52%	361.4
Belgium	25.9	52%	13.5
Germany	166.4	47%	77.0
France	163.4	45%	73.3
Finland	22.9	43%	9.9
Luxembourg	1.6	41%	0.7
United Kingdom	19.7	40%	8.0
Netherlands	13.6	24%	2.2
Sweden	31.4	18%	7.2
Denmark	13.0	12%	2.0
Spain			

Figure 6.30: Trend of N managed in solid storage and dry lot, non-dairy cattle

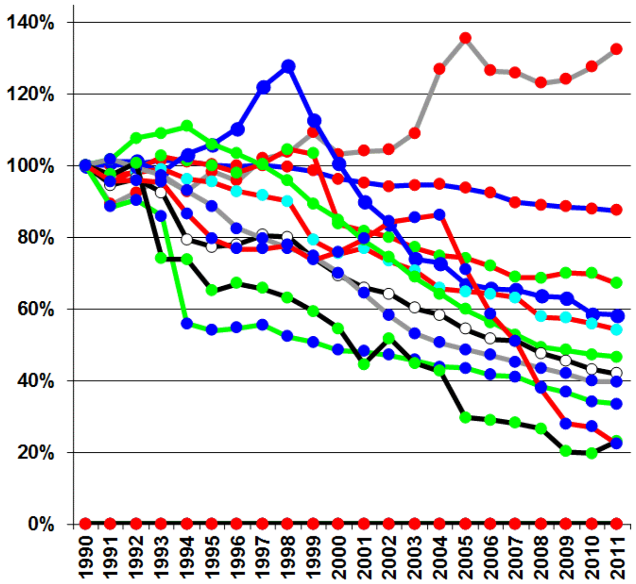
Non-Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2011	2011
Greece	12.4	120%	14.7
Ireland	25.0	105%	27.4
Germany	144.3	98%	146.8
Austria	29.9	97%	29.6
Belgium	48.2	89%	44.1
United Kingdom	98.3	86%	85.3
EU-15	755.1	84%	652.3
Italy	101.8	83%	84.8
France	239.9	79%	194.0
Sweden	15.0	65%	10.6
Luxembourg	2.3	59%	1.4
Netherlands	26.5	45%	13.0
Denmark	1.8	22%	0.5
Portugal	9.7	0%	0.0
Finland			
Spain			

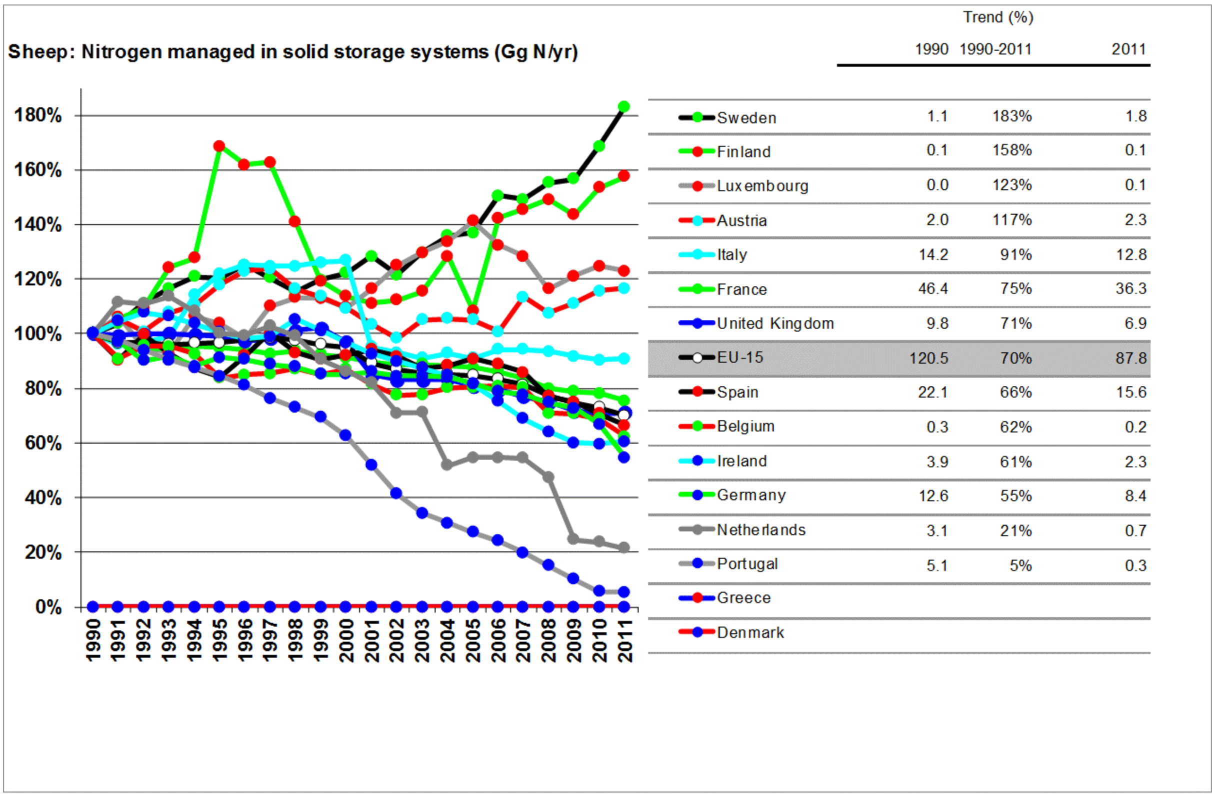
Figure 6.31: Trend of N managed in solid storage and dry lot, swine

Swine: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2011	2011
Luxembourg	0.0	133%	0.0
Greece	1.6	87%	1.4
Belgium	5.4	67%	3.8
United Kingdom	30.9	58%	18.1
Austria	3.9	54%	2.2
France	14.9	47%	7.1
EU-15	141.2	42%	60.8
Portugal	0.7	40%	0.3
Germany	62.8	33%	21.4
Sweden	8.6	23%	1.7
Denmark	12.3	22%	3.3
Ireland			
Italy			
Netherlands			
Finland			
Spain			

Figure 6.32: Trend of N managed in solid storage and dry lot, sheep



6.3.3.3 Uncertainty *and time series consistency*

Activity data used for the estimation of N_2O emissions from manure management are generally analogous to those used for the estimation of CH_4 emissions, and consequently also the uncertainty estimates are similar. The uncertainty of the emission factor is much higher than the uncertainty of the activity data, and only Sweden has estimated an uncertainty lower than 50%. Generally an uncertainty of 100% is assumed, the United Kingdom assume high uncertainty with a 414% value.

Nevertheless, N_2O emissions from manure management are representing only a small fraction in most inventories, so that the contribution to the overall uncertainty remains in most cases small, i.e. 0.5% of total emissions or less. Only Austria and United Kingdom report a higher contribution of N_2O emissions from manure management to the overall uncertainty with 1.1% and 1.2% of total emissions, respectively.

An overview of the uncertainty estimates for activity data and emission factors is given in Table 6.55. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in section 6.4

Table 6.56 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from manure management.

Table 6.55: Relative uncertainty estimates for activity data and implied emission factors in category 4B(b)

Member State	AD	EF
Austria	10.0	100
Belgium	10.0	90
Denmark	22.4	50
Finland	66.8	0
France	5.0	50
Germany	3.9	102
Greece	50.0	100
Ireland	11.2	100
Italy	20.0	100
Luxembourg		
Netherlands	10.0	100
Portugal	36.5	93
Spain	16.0	100
Sw eden	14.9	37
United Kingdom	1.0	414

Table 6.56: Available background information for uncertainty estimates in category 4.B(b)

Member State	Background information to uncertainty estimates
Austria	Emission Factor: Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 70% (AMON et al. 2002), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.
Belgium	Emission Factor: The IPCC emission factors are used to calculate the emissions of N_2O. Consequently, the IPCC uncertainty in combination with information of the Finnish emission inventory, are used in the uncertainty calculation.
Denmark	Activity Data: The normative figures (Poulsen et al. 2001) are arithmetic means. Based on the feeding plans, the standard deviation in N-excretion rates between farms can be estimated to ±20 % for all animal types (Hanne D. Poulsen, FAS, pers. comm).
Finland	Activity Data: Uncertainty in nitrogen excretion values varies between animal species, from 2 to 15%, except for reindeer and poultry (25%). The amount of N excreted annually by the reindeer is very uncertain. Currently, because of lack of data, the value for goats has been used. Emission Factor: The uncertainty estimate for N_2O emissions from manure management used a negatively skewed distribution based on different studies (Amon et al., 2001; Huether, 1999). The uncertainty of the N_2O emission factor could probably be reduced by gathering more national data from gas flux measurements. Uncertainties in manure management are estimated using Tier 2 Monte Carlo simulaiton to the emission calculation models. For nitrous oxide from manure management, it has been estimated at -43...+66%. For direct nitrous oxide emission factors, it's -60...+100%, in line with the IPCC 2006 uncertainty range
Portugal	Activity Data: The uncertainty in N-excretion rate was set at 37.5 per cent, considering an intermediate situation between the uncertainty values recommended by GPG for default N-excretion rates (50 per cent) and the lower uncertainty when country-specific values are based on accurate national statistics (25 per cent). Emission Factor: The uncertainty in N_2O emission factors was set in accordance with the maximum values, 100 per cent for all MMS.

6.3.4 Rice Cultivation

6.3.4.1 Source *category description*

Anaerobic decomposition of organic material in flooded rice fields produces methane (CH_4), which escapes to the atmosphere primarily by transport through the rice plants. The annual amount emitted from an area of rice acreage is a function of rice cultivar, number and duration of crops grown, soil type and temperature, water management practices, and the use of fertilisers and other organic and inorganic amendments.

Rice cultivation is occurring in five EU-15 countries: France, Greece, Italy, Portugal, and Spain. All these countries but Italy are reporting rice production under a continuously flooding regime, while in Italy the practice of multiple aeration is predominant. In Italy rice paddies are flooded with 15-25 cm of water usually from April-May to August. During this field submersion time two or three water drainage periods, of 2 to 4 days each, can happen in 85% of rice paddies, a clearly uninterrupted submersion in 13-14% and about one month delayed submersion in 1-2%.

At EU-15 level, the implied emission factors amounts to 23 g m^{-2} in 2011 for continuous flooded rice fields, which represents an increase in the implied emission factor by 27% since 1990 (see Table 6.57), which can be explained by the higher contribution of Portugal with an implied EF of 69.1 g CH_4 m^{-2} in 2011 compared to 31.9 g CH_4 m^{-2} in 1990 . Note that the implied emission factors for intermittently flooded field are stemming from the Italian inventory only. Here emissions are smaller than the emissions from continuously flooded fields. At the EU-15 level and with the given choices of emission factors by the different countries, however, the average emission from continuous flooded fields appears to be only half of those from single-aerated rice fields.

Table 6.57: Total CH_4 emissions, area harvested and implied Emission Factor for category 4C at EU-15 level for 2011 and 1990.

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	29.7	0.6	74.5
Total Area harvested [10^9 m^2 y^{-1}]	1.64	0.02	2.13
Implied Emission Factor [g CH4 / m^2]	18	27	35

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2011		
Total Emissions of CH4 [Gg CH4]	47.0	17.6	56.2
Total Area harvested [10^9 m^2 y^{-1}]	2.05	0.73	1.73
Implied Emission Factor [g CH4 / m^2]	23	24	32

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2011 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	158%	2927%	75%
Total Area harvested [10^9 m^2 y^{-1}]	125%	3263%	81%
Implied Emission Factor [g CH4 / m^2]	127%	90%	93%

6.3.4.2 Methodological ***Issues***

Methods

A summary of the methodologies used for the calculation of CH_4 emissions from rice cultivation is given in

Table **6.58**. More detailed data are given in the section on the emission factors.

Table 6.58: Additional information in the methodology used for the calculation of CH_4 emissions in category 4.C in 2011

Member State	Method
France	**Default EF, as it is not a key source, IPCC methodology. Statistic from the Ministry of Agriculture.**
Greece	**Continuously flooded fields and the default methodology suggested by the IPCC Good Practice Guidance was followed. The cultivated areas provided by the NSSG and the default emission factor (20 g CH_4 / m^2) were used for the emissions calculation. Rice cultivated in Greece is grown in continuously flooded fields without the use of organic amendments and one cropping period is considered annually.**
Italy	**In Italy, three types of rice cultivation are distinguished: Wet-seeded "classic" cultivation, Wet-seeded "red rice control" cultivation and dry-seeded with delayed flooding. The wet-seeded cultivation methods fall into the IPCC category of 'multiple aeration' while the dry-seeded cultivation method is intermittently aerated one once. A detailed description of the management is given in the national inventory report. Estimated only for an irrigated regime. Expert group on rice cultivation together with the C.R.A. – Experimental Institute of Cereal Research – Rice Research Section of Vercelli was established to improve methodology. The quality of the Italian rice emission inventory was verified with the Denitrification Decomposition model (DNDC) model. Initial results have found a high correspondence between the EFs used for the Italian inventory and those simulated with DNDC model (Leip and Bocchi, 2007). Methane emission factor has been adjusted with the following parameters: daily integrated emission factor for continuously flooded fields without organic fertilisers, scaling factor to account for the differences in water regime in the rice growing season (SFw), scaling factor to account for the differences in water regime in the preseason status (SFp) and scaling factor which varies for both types and amount of amendment applied (SFo) (Yan et al., 2005). Following national circumstances: cultivation period of rice (days) and annual harvested area under specific conditions. In Italy, rice is sown from mid-April to the end of May and harvested from mid-September to the end of October; the only practised system is the controlled flooding system, with variations in water regimes (Tossato and Regis, 2002; Mannini, 2004; Confalonieri and bocchi, 2005; Regione Emilia Romagna ,2005)**
Portugal	**Methane emissions from rice production were estimated following the GPG, but simplified because there are no appreciable differentiation in Portugal in what concerns water management regimes or any other conditions that are known to affect emissions from this source sector. A regional specific seasonally integrated emission factor for continuously flooded fields without organic amendments (Efc) of 31.9 g/m^2/yr was used, based on Schutz (1989). Rice culture in Portugal is almost homogeneous, in what concerns hydrologic management regime and characterized by cultivation being done under irrigated continuous flooded areas (SFw is set to 1). Traditionally, stubbles and straw were burnt between crops, the use of rice straw as fodder or bedding is not significant (Portuguese Ministry of Agriculture). More recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by ploghing. This is the only procedure allowed for rice cultivation subject to the "Techniques of Integrated Production and Protection"), which occupied about 60 per cent of rice paddies in 2004. A time series for the scaling factor reflecting organic amendments S0 was developed assuming that, in 1990, 100% of rice paddies were burnt and no organic amendments were added to soil. In 2008 the area subjected to burning was reduced to only about 33 per cent.**
Spain	**The rice cultivation is not key source, EFs: IPCC default, default methodology.**

Activity Data

Italy is by far the largest producer of rice in Europe, with 2465 km^2 of rice cultivation, followed by Spain with an area of 1192 km^2 (2011 data). The other three countries have rice producing areas of around 200 km^2, as shown in Table 6.59 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aerations.

Table 6.59: Rice Harvested Area in the Member States in 2011 and 1990

Member State 2011	Harvested area [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.27	NO	NO
Greece	0.28	NO	NO
Italy	NO	0.73	1.73
Portugal	0.31	NO	NO
Spain	1.19	NO	NO
EU-15	2.05	0.73	1.73

Member State 1990	Harvested area [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.24	NO	NO
Greece	0.16	NO	NO
Italy	NO	0.02	2.13
Portugal	0.34	NO	NO
Spain	0.90	NO	NO
EU-15	1.64	0.02	2.13

Information source: CRF Table 4.C for 2011 and 1990, submitted in 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

A summary of the implied emission factors used by these countries is given in Table 6.60. France and Greece are using IPCC default emission factors presented in the IPCC *Good Practice Guidance*. This value is the arithmetic mean of the seasonally integrated emission factors presented in Table 4-13 of the IPCC *Guidelines*. In this Table, a value from Schuetz et al (1989) is also presented (36 g m^{-2}, range 17-54 g m^{-2}, representing a seasonally averaged emission factor). In Italy, a daily integrated emission factor for continuously flooded fields without organic fertiliser (Schuetz et al., 1989; Leip et al., 2002) have been adjusted to account for differences for three different cultivation types (see

Table **6.58**) Spain uses a seasonal emission factor of 12 g m^{-2}, which has been obtained from Table 4-9 of the IPCC *Guidelines* reporting a study carried out in Spain (Seiler et al., 1984); the value used by Portugal in 1990 and 2011 is the above-mentioned value of 36 g m^{-2} measured by Schuetz et al. (1989).

Table 6.60: Implied Emission factors for CH_4 emissions from rice cultivation used in Member State's inventory. Data for the year 2011.

Member State 2011	Implied EF (g $CH_4 \cdot m^{-2}$)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.00	NO	NO
Greece	20.00	NO	NO
Italy	NO	24.07	32.40
Portugal	69.1	NO	NO
Spain	12.00	NO	NO
EU-15	22.88	24.07	32.40

Member State 1990	Implied EF (g $CH_4 \cdot m^{-2}$)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.00	NO	NO
Greece	20.00	NO	NO
Italy	NO	26.84	34.92
Netherlands	NO	NO	NO
Portugal	31.9	NO	NO
Spain	12.00	NO	NO
EU-15	18.06	26.84	34.92

Information source: CRF Table 4.C for 2011 and 1990, submitted in 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trend

The trend in rice growing areas in these countries is divers: while in Italy, the area cultivated with rice fluctuated since 1990, its level in 2011 was 14% larger than in 1990. The harvested area in Spain increased from 1990 to 2011 by 32%, but around 1993-1995 rice production was only half of the area reported in 1990; also Greece increased its rice production since 1990 by 70%. The trend was opposite in France with peaks in rice production during 1993-1995 and in 2011 the level was about 12% lower than in 1990. Finally, Portugal saw a decline in rice production by 7% since 1990.

There was a considerable increase in the implied emission factor used by Portugal from 31.9 g CH_4 m^{-2} yr^{-1} in 1990 to 69.1 g CH_4 m^{-2} yr^{-1} in 2011. The reason is the increase of organic amendment to rice paddies in this time period. In 1990 it can be assumed that 100% of the rice paddies were burned and no organic amendment was added to the soils. However, the "Techniques of Integrated Production and Protection" allow only incorporating the straw by ploughing. In 2004, 60% of the rice cultivation area was subject to these "Techniques".

Figure 6.33 through Figure 6.38 show the area harvested and the implied emission factors for the different rice management systems.

Figure 6.33: Trend of continuous flooded rice cultivation – area harvested

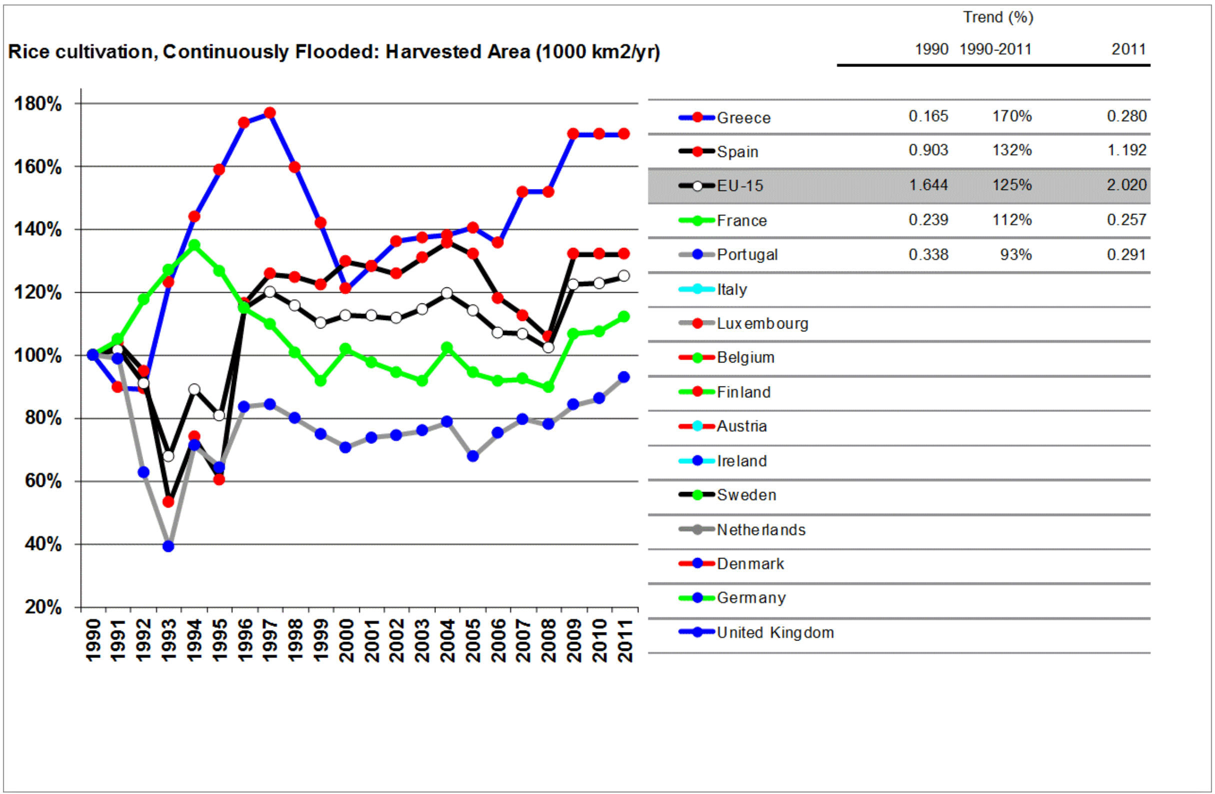


Figure 6.34: Trend of intermittently flooded (single aeration) rice cultivation – area harvested

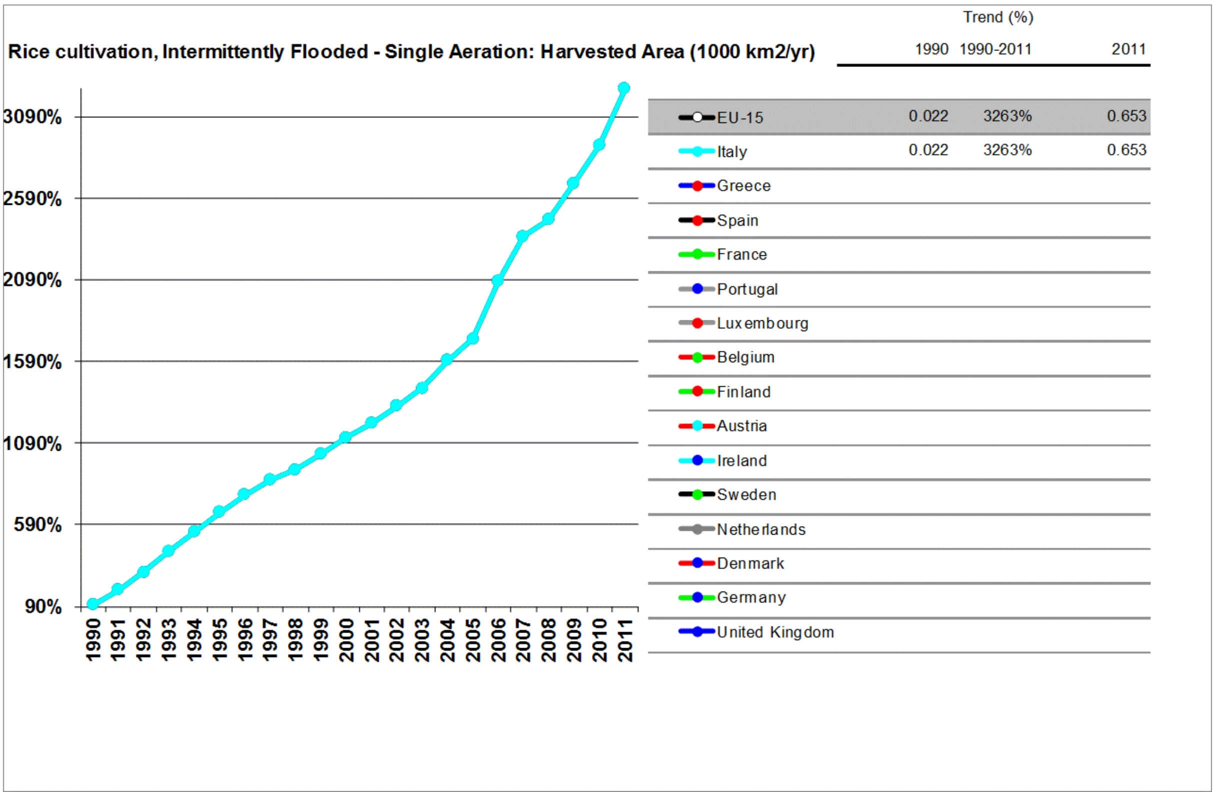


Figure 6.35: Trend of intermittently flooded (multiple aeration) rice cultivation – area harvested

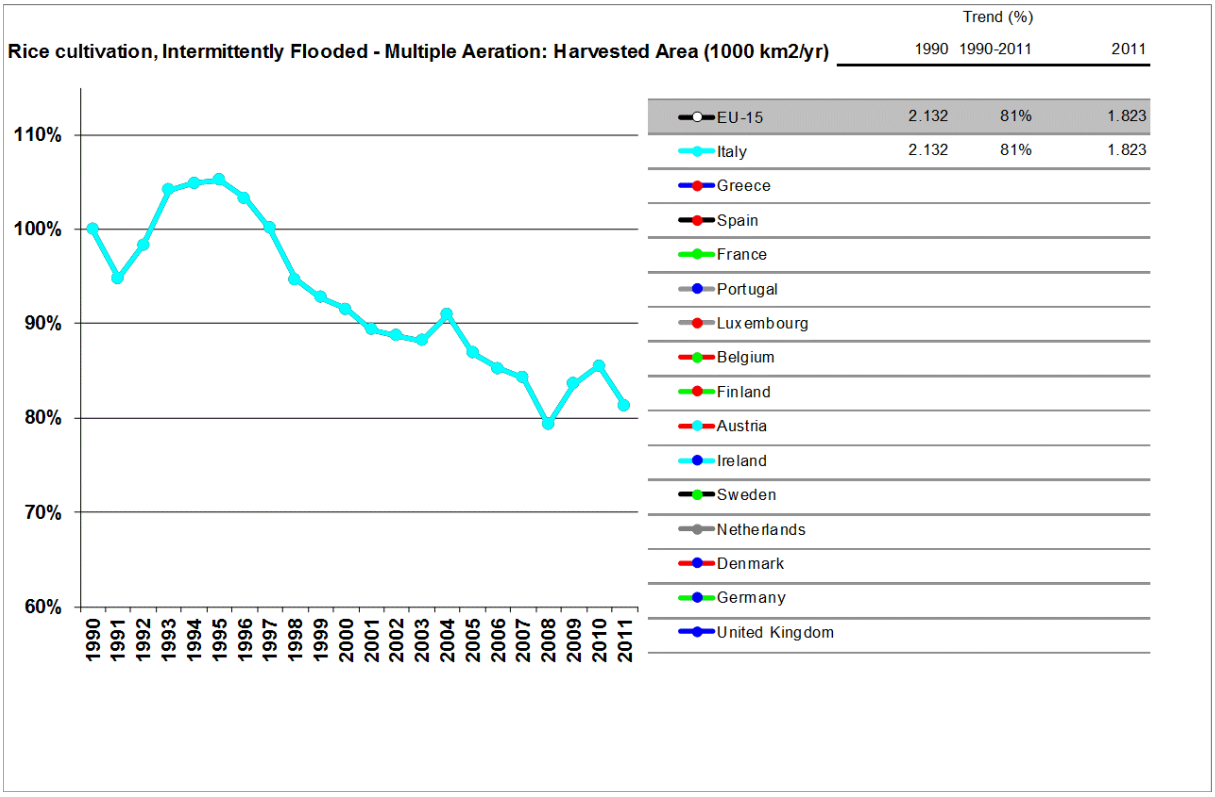


Figure 6.36: Trend of continuous flooded rice cultivation – implied emission factor

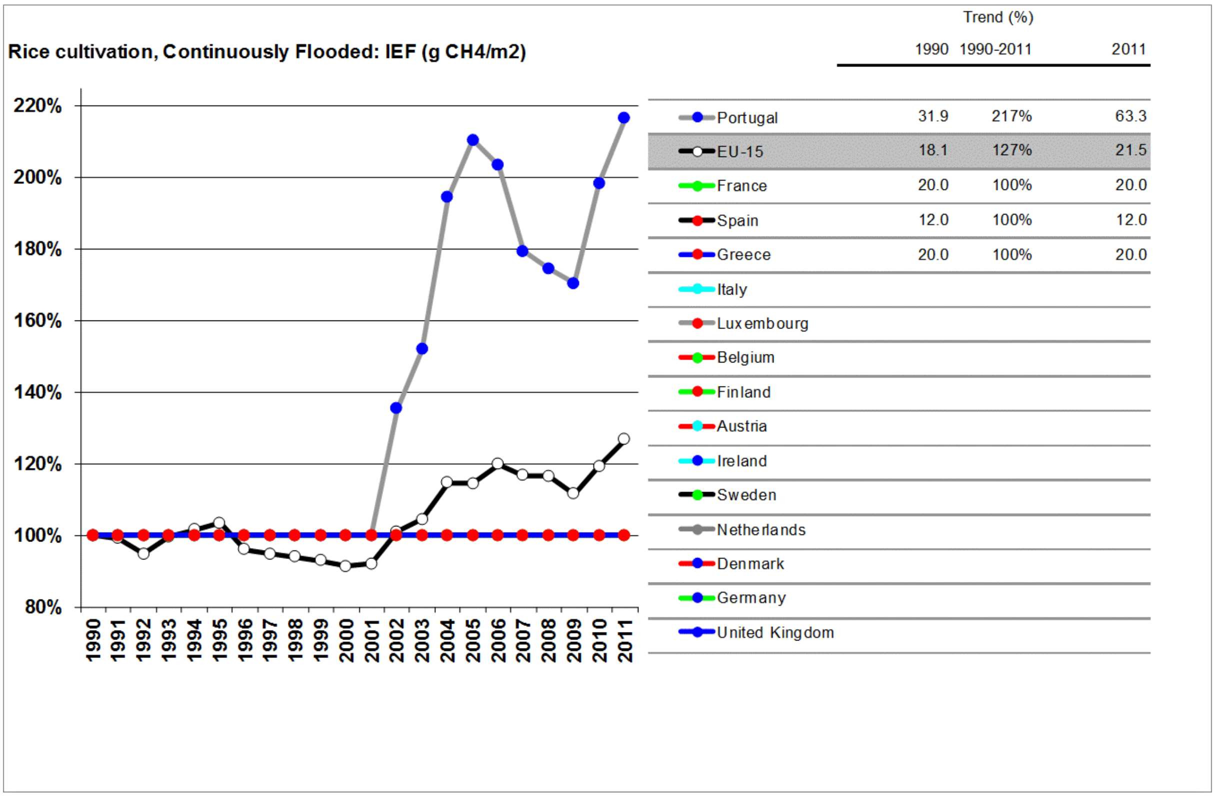


Figure 6.37: Trend of intermittently flooded (single aeration) rice cultivation – implied emission factor

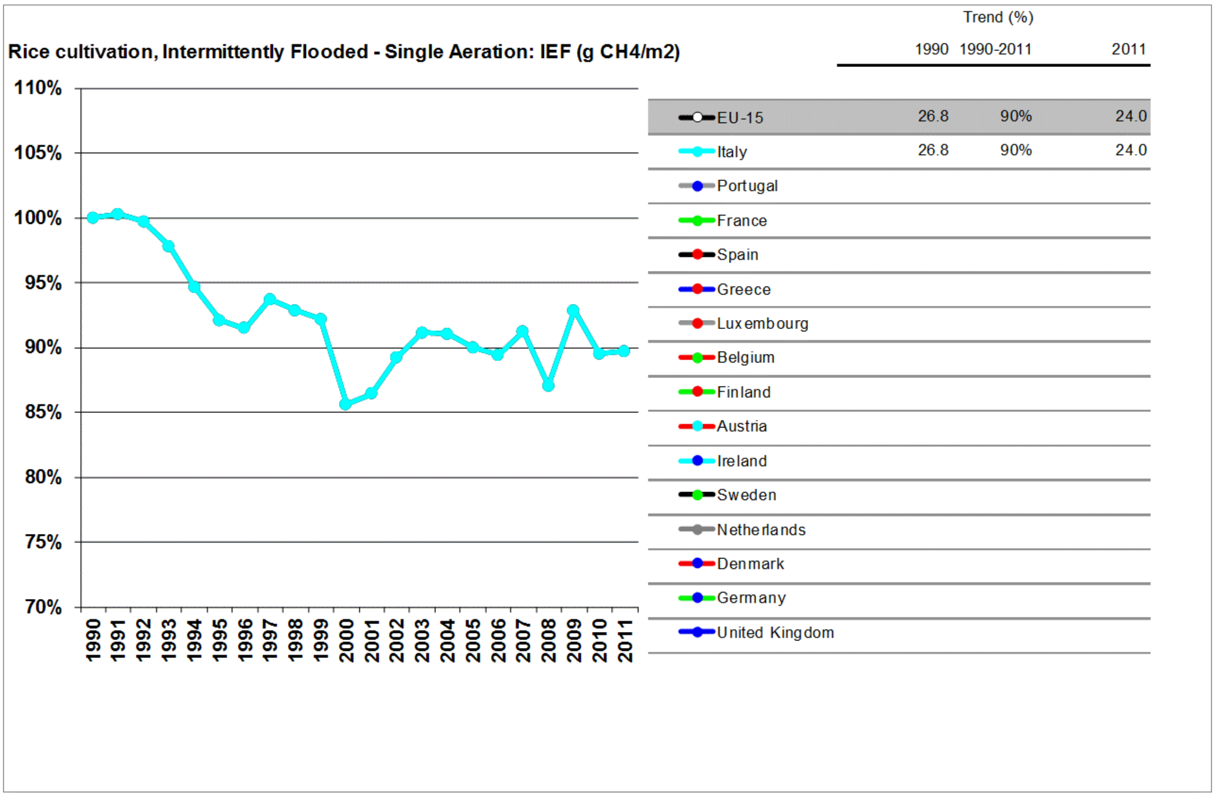
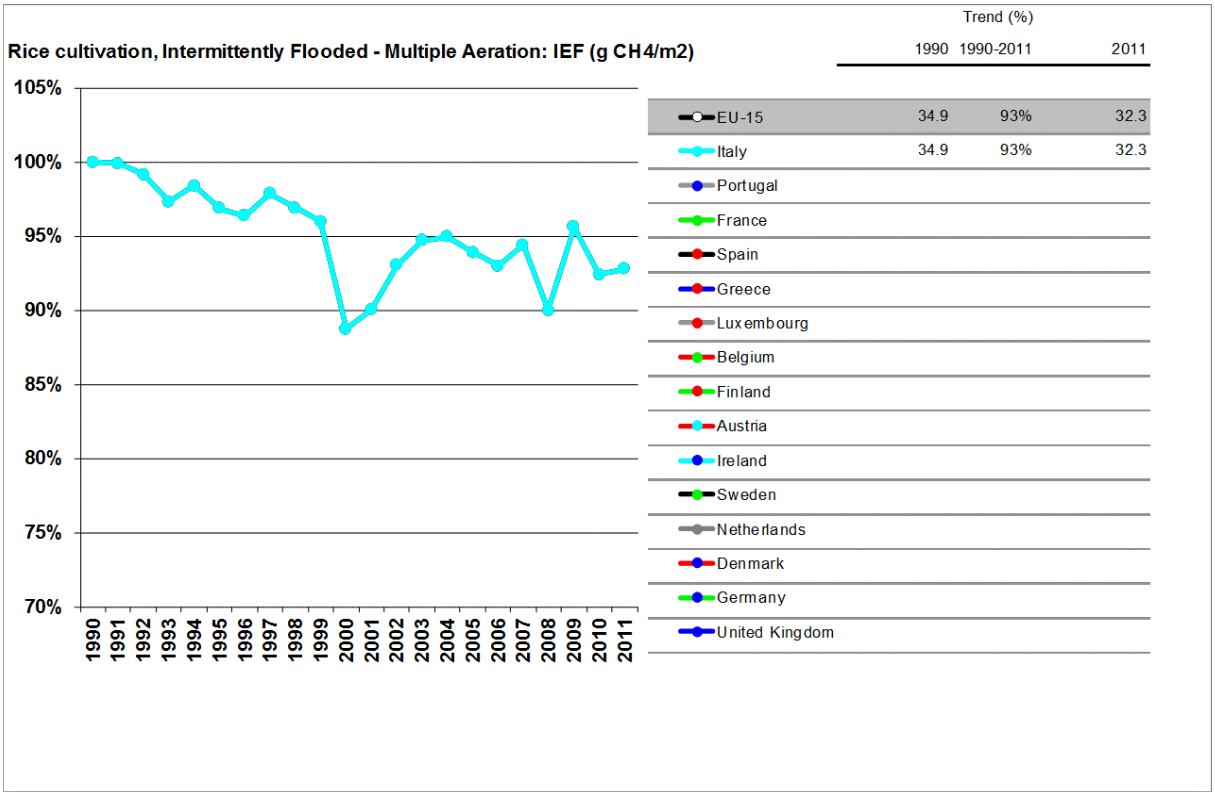


Figure 6.38: Trend of intermittently flooded (multiple aeration) rice cultivation – implied emission factor



6.3.4.3 Uncertainty *and time series consistency*

Uncertainty estimates for CH_4 emissions from rice cultivation are reported by three countries (Greece, Italy, and Portugal). The area used for the cultivation of rice is generally well known, only Portugal reports an uncertainty of 37.2% for this variable. The uncertainty of the implied emission factor is 40%, except for Italy, which uses a national methodology and estimates an uncertainty of 20%. An overview of the estimates is given in Table 6.61.

Table 6.62 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from rice cultivation.

Table 6.61: Relative uncertainty estimates for activity data and implied emission factors in category 4C

Member State	**AD**	**EF**
Greece	2.0	40.0
Italy	3.0	20.0
Portugal	33.6	40.0

Table 6.62: Available background information for uncertainty estimates in category 4.C

Member State	Background information to uncertainty estimates
Italy	**Uncertainty of emissions from rice cultivation has been estimated equal to 20% as a combination of 3% and 20% for activity data and emissions factor, respectively.**
Portugal	**The uncertainty in the adjusted seasonally integrated emission factor was considered to be 40 per cent, according to the range proposed in table 4.22 of the GPG. For activity data, the standard deviation of inter-annual area under rice cultivation was considered, also 40 per cent.**

6.3.5 Agricultural Soils - N_2O (Source category 4.D)

6.3.5.1 *Source* category *description*

Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification. Nitrification is the aerobic microbial oxidation of ammonium to nitrate, and denitrification is the anaerobic microbial reduction of nitrate to nitrogen gas (N2). Nitrous oxide is a gaseous intermediate in the reaction sequence of denitrification and a by-product of nitrification that leaks from microbial cells into the soil and ultimately into the atmosphere. One of the main controlling factors in this reaction is the availability of inorganic N in the soil. Therefore, N_2O emissions are reported separately for the main anthropogenic input pathways of nitrogen to the soil, i.e., application of mineral nitrogen fertiliser nitrogen or nitrogen contained in applied manure, biological nitrogen fixation and nitrogen returned to the soil by the process of mineralistion of crop residues. Additionally, the emissions of N_2O from manure deposited by grazing animals on pasture, range and paddock are reported here. The emissions of N_2O that result from anthropogenic N inputs or N mineralisation occur through both a direct pathway (i.e., directly from the soils to which the N is added/released), and through two indirect pathways: (i) following volatilisation of NH_3 and NO_x from manure management and managed soils, and the subsequent redeposition of these gases and their products NH4 + and NO3 - to soils and waters; and (ii) after leaching and runoff of N, mainly as NO3 -, from managed soils.

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.63). This was most significant for direct emissions from the application of synthetic fertiliser

(-24%), followed by indirect emissions from leaching and run-off (-18%) and volatilisation of NH_3+NO_x (-22%). In the latter two cases, the reduction of emissions can be explained by a reduction of nitrogen input, as the implied emission factor was not or, in the case of leaching+runoff, only slightly changing during the reporting period. The reduction of animal manure applied to soils more than counterbalanced the increase in the implied emission factor for animal wastes application so that emission decreased by 7%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 5%, caused by strong increase by 117% of the implied emission factor for this source in the Netherlands during 1990 to 2011. This increase is explained by a shift from surface spreading of manure to the incorporation of manure into the soil. In the inventory of the Netherlands, incorporation of manure into soils is accounted for with a higher emission factor of N_2O. Incorporation into the soil reduces NH_3 emissions.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 24% for synthetic fertiliser application, 11% for application of manure, 0% (on average) of the area of cultivated histosols and 15% for nitrogen excreted by grazing animals. This was translated to a reduction of volatilized and re-deposited nitrogen by 22% and of the amount of nitrogen leached by 18%.

Table 6.63: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-15 level in 2011 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	197	74	26	107	48	211
Total Nitrogen input [Gg N]	10110	3992	21526	3277	3072	5450
Implied Emission Factor [kg N_2O-N / kg N]	1.24%	1.18%	7.6	2.08%	1.00%	2.47%

2011	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	149	69	26	89	38	174
Total Nitrogen input [Gg N]	7637	3552	21481	2784	2386	4467
Implied Emission Factor [kg N_2O-N / kg N]	1.24%	1.24%	7.7	2.03%	1.00%	2.48%

2011 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	76%	93%	101%	83%	78%	82%
Total Nitrogen input	76%	89%	100%	85%	78%	82%
Implied Emission Factor	100%	105%	102%	98%	100%	100%

Source of information: Tables 4.D for 1990 and 2011, submitted in 2013

[1)] Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

6.3.5.2 Methodological ***Issues***

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many

Member States use country-specific methodologies, linking the N_2O inventory with the CORINAIR NH_3 inventory or using simulation models. A more specific discussion of emission factors and parameters used is presented below.

Table 6.64 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. For direct N_2O emissions from the application of fertiliser and for emissions from animal production activity data are multiplied by the emission factor, which is for most countries the IPCC default factor. Thus, the vast majority of the emissions are calculated with the Tier 1 approach for the emission from synthetic fertiliser. However, emissions depend also the fraction of nitrogen that volatilises is subtracted from the applied nitrogen for the calculation of N_2O emissions and – for manure applied – also from the method that is used to estimate nitrogen excretion, which has already been discussed above. Additionally, nitrogen in crop residues and nitrogen fixed by biological nitrogen fixation might be estimated using country-specific data.

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology described in 6.4.1.5 (Table 6.95 through Table 6.98, for details see section 6.4.1.5).

- The Tier level for direct N_2O emissions is calculated from the Tier level for emissions from mineral fertiliser input, manure application, crop residues and N-fixing crops on the basis of the MEAN rule. The Tier level for the estimation of N_2O emissions from mineral fertiliser is done by comparing the IEF with the IPCC default value. For emissions from manure applications, the Tier level of the nitrogen excretion rates estimated for N_2O emissions from manure management are combined with the Tier level of the IEF using the MEDIAN rule. The Tier level for N_2O emissions from crop residues and N-fixing crops are combined from the quality level of the emission factor used and the Tier level of the N-input, which is done by expert judgement on the basis of the information contained in the national inventory reports (see Table 6.72 and Table 6.73). A "Tier 2" level has been assigned only if country-specific data have been used; the use of Tier 1b with default IPCC parameters counted as Tier 1 level. An analogue approach is followed to determine the Tier level for N_2O emissions from the cultivation of histosols.
- The Tier level of N_2O emissions from grazing animals is derived from the quality of N excretion factors, the implied emission factor, and a factor based on the information given in the national inventory report on the fraction of manure deposited to grazing land. The share of nitrogen that is deposited on pasture/range and paddock was only considered to be "Tier 2" if the estimate is based on a more is based on a more elaborate approach than purely the length of the grazing season.
- The Tier level for indirect N_2O emissions is a combination of the Tier levels for N_2O emissions from volatilised NH_3+NO_x and from leached/run-off nitrogen. In either case the Tier level is derived from the emission factor used and the respective fraction of nitrogen with weighing factors being 1/3 and 2/3. In the case of N-volatilization the Tier level of the amount of nitrogen is derived from both volatilization of mineral nitrogen and manure nitrogen (MEAN rule), whereby the quality of the latter is obtained from $Frac_{GASM}$ and from nitrogen excretion factors (equal weights) using the MEDIAN rule.

As a result, we estimate that a minimum of 33% of the emissions reported in category 4D are estimated with country-specific information. Highest quality was obtained for emissions from volatilised nitrogen (45%), which reflects the direct impact of the calculation of N-excretion rates and the fact that several countries link this calculation to the NH_3 inventory, where fertiliser-specific volatilisation fractions are given.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.65. Note however, that most information will be summarized in specific tables on the emission factors and parameters used.

Table 6.64: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year 2011.

2011	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Austria	3,102	Tier 1.3	60%	Tier 1.3	y	3%	Tier 1.4	y	37%	Tier 1.2	y	8%	Tier 1.6	29%	Tier 1.1
Belgium	3,728	Tier 1.4	56%	Tier 1.2	y	20%	Tier 1.4	y	23%	Tier 2.0	y	7%	Tier 2.0	17%	Tier 2.0
Denmark	5,118	Tier 1.5	62%	Tier 1.3	y	4%	Tier 1.4	y	34%	Tier 1.9	y	6%	Tier 1.6	28%	Tier 2.0
Finland	3,546	Tier 1.5	78%	Tier 1.5	y	5%	Tier 1.1	y	17%	Tier 1.5	y	4%	Tier 1.6	13%	Tier 1.5
France	48,262	Tier 1.2	45%	Tier 1.1	y	18%	Tier 1.7	y	37%	Tier 1.1	y	6%	Tier 1.0	31%	Tier 1.1
Germany	41,872	Tier 1.4	63%	Tier 1.4	y	3%	Tier 1.7	y	34%	Tier 1.3	y	5%	Tier 1.6	28%	Tier 1.2
Greece	4,980	Tier 1.2	29%	Tier 1.1	y	35%	Tier 1.4	y	36%	Tier 1.1	y	6%	Tier 1.0	30%	Tier 1.1
Ireland	6,682	Tier 1.3	41%	Tier 1.1	y	39%	Tier 1.4	y	20%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
Italy	15,372	Tier 1.3	48%	Tier 1.3	y	10%	Tier 1.4	y	42%	Tier 1.2	y	10%	Tier 1.6	33%	Tier 1.1
Luxembourg	298	Tier 1.2	42%	Tier 1.2	y	19%	Tier 1.4	y	39%	Tier 1.2	y	6%	Tier 1.0	32%	Tier 1.2
Netherlands	5,798	Tier 1.9	56%	Tier 2.0	y	19%	Tier 1.7	y	25%	Tier 2.0	y	8%	Tier 2.0	17%	Tier 2.0
Portugal	2,890	Tier 1.4	35%	Tier 1.1	y	28%	Tier 1.4	y	37%	Tier 1.6	y	6%	Tier 1.6	31%	Tier 1.6
Spain	17,728	Tier 1.2	48%	Tier 1.2	y	14%	Tier 1.4	y	38%	Tier 1.2	y	5%	Tier 1.6	32%	Tier 1.1
Sweden	4,447	Tier 1.7	56%	Tier 1.8	y	10%	Tier 1.7	y	19%	Tier 1.6	y	4%	Tier 1.6	15%	Tier 1.6
United Kingdom	27,000	Tier 1.3	44%	Tier 1.1	y	20%	Tier 1.4	y	35%	Tier 1.6	y	6%	Tier 1.6	29%	Tier 1.6
EU-15	**190,824**	**Tier 1.3**	**51%**	**Tier 1.3**	**y**	**14%**	**Tier 1.5**	**y**	**34%**	**Tier 1.3**	**y**	**6%**	**Tier 1.5**	**28%**	**Tier 1.3**
EU-15: Tier 1	67%		72%			46%			69%			55%		71%	
EU-15: Tier 2	33%		28%			54%			31%			45%		29%	

a Contribution to N2O emissions from agricultural soils

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n)

Table 6.65: Available background information for the calculation of N_2O emissions in category 4.D

Member State	Methods
Austria	**Emissions are estimated within an N-flow model for agriculture. The IPCC Tier 1a and – where applicable – Tier 1b with Austria specific consideration of nitrogen losses (NH_3-N, NO_x-N, N_2O-N). These losses are subtracted from the amount of mineral fertiliser N sales in the CRF table.**
Denmark	**The IPCC Tier 1b. Emissions of N_2O are closely related to the nitrogen balance. Indirect emissions from atmospheric deposition includes all emission sources of ammonia, i.e., livestock manure, use of synthetic fertiliser, crops, ammonia-treated straw used as feed, field burning of crop residues and sewage sludge and sludge from industrial production applied to agricultural soils.**
Finland	**Tier 1 approach for all N_2O emissions from soils, except for cultivation of organic soils (Tier 2). Emissions are estimated within a mass-flow approach in order to avoid double-counting. The nitrogen mass flow model (except for N-fixing, crop residue and sewage sludge) accounts for nitrogen losses as ammonia and nitrous oxide emissions during manure management in animal houses, during storage and application; for NH_3 volatilisation of pasture manure, urine and dung volatilisation are now taken into account separately; for synthetic fertilisers fertiliser type field type and placement fertilisation are considered; atmospheric deposition from manure is calculated from the ammonia volatilised during the whole management/application process. Activity data are national, mainly from the annual agricultural statistics of the Ministry of Agriculture and Forestry; other data from the Finnish Environment Institute and Finish Forest Research Institute. Emission factors are IPCC default, except for organic soils, for which it is calculated based on national data.**
Germany	**Nitrogen emissions are calculated with the mass-flow approach. A national approach is used for calculating N_2O emissions from atmospheric deposition of NH_3+NO_x taking into consideration total volatilization fluxes of NH_3 and NO_x, including those from mineral fertiliser, applied and deposited manure and NH_3 emissions from leguminous crops. As there is a small net export of manure, this has been ignored following a conservative approach. Emission factors of NH_3 are according to EMEP. NO emissions from housing and manure storage are assumed to be 10% of N_2O emissions.**
Ireland	**Direct Soil Emissions: calculated in a Tier 1 approach take into account the nitrogen inputs from all these sources, except that due to the cultivation of organic soils. For N_2O emissions from manure application, also N_2O emissions during housing and storage are subtracted from the N-input.**
Italy	**IPCC default Tier 1 methodology.**

Member State	Methods
Luxembourg	Nitrous oxide emissions from agricultural soils are estimated by using emission factors in relation with the mass of fertilisers used. For fallows (cultures without fertiliser use) an area-based emission factor is used in relation with the respective agricultural surface areas.
Netherlands	Full description of the methodologies is provided in Van der Hoek et al. (2007), with more details in Kroeze (1994). An IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions from soil. An IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions from animal production. An IPCC Tier 1 method is used to estimate indirect N_2O emissions from atmospheric deposition. From 2010 calculations are made on gross instead of net nitrogen flows in order to make them more transparent. At the same time, emission factors were updated based on laboratory and field experiments towards the effect of manure application technique on N_2O emission (Velthof et al., 2010; Velthof en Mosquera, 2011; Van Schijndel en Van der Sluis, 2011). For a description of the methodologies and data sources used, see the monitoring protocols on www.nlagency.nl/nie.
Portugal	Manure managed as liquid systems and solid storage is fully applied to agricultural soil as a fertiliser, irrespective of the animal species considered, whereas only 80% of manure handled in anaerobic lagoons is placed in soil (Bicudo & Albuquerque, 1995). The remaining 20 per cent wastewater flow and nitrogen is rejected directly to water systems. This fraction, however, is included in the determination of N_2O indirect emissions from agricultural soils. For the estimation of N_2O emissions from agricultural soils other than animal production, Tier 1a approach is used, with the same emission factor for all nitrogen sources (EF1 IPCC default, equal to 0.0125). For indirect N_2O emissions from soils, Tier 1a with default emission factors.
Spain	Tier 1 with national parameters. The activity data for applied organic nitrogen is obtained after subtracting not only NH_3 and NO_x volatilization from housing and manure management systems, but also N_2O emissions in manure management systems. Sources of information: "Anuario de Estadistica" (MAGRAMA) for mineral fertiliser applied and crop production (surface and yield per crop, by year and province).
Sweden	Background emissions from agricultural soils are reported both for organic and mineral soils in the Swedish inventory. For mineral soils, a national emission factor has been developed (Kasimir-Klemedtsson, 2001), considering 0.5 kg N_2O/ha. N_2O emissions from animal manure applied to soils are calculated using default IPCC methodology with national estimates of N content in manure. For indirect emissions, default emission factors from IPCC 2000 are used, but values for losses of nitrogen as ammonia and nitrogen leakage are national.
United Kingdom	IPCC default Tier 1 methodology.

Activity Data

For the estimation of N_2O emissions from N-fixing crops and crop residues, most Member States use the amount of N input (in Gg N) as activity data in the CRF table; but some countries give the emission factor in kilogram of nitrogen emitted per kilogram of dry crop production (N-fixing crop or other crops, respectively). Therefore, the data given in Table 6.66 in the respective columns are not comparable.

Additional background information on the source of the data used in the Member States's inventories is given in Table 6.67.

Table 6.66: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D. Data for the year 2011.

Member States 2011	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Sewage Sludge	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
	Direct							Indirect	
Austria	100	110	23	71	NO	10	1	49	74
Belgium	144	127	5	66	25	78	0	51	51
Denmark	194	192	42	52	527	21	6	59	153
Finland	144	60	0.9	25	3,315	19	0	29	38
France	2,108	691	229	507	NO	894	17	588	1,236
Germany	1,702	764	80	969	12,280	135	28	470	978
Greece	163	38	1	27	67	180		64	123
Ireland	333	106	1	12	NO	268		88	72
Italy	468	437	167	119	90	159	9	303	411
Luxembourg	12	6	0	3	NO	6	0	4	8
Netherlands	214	290	4	26	2,230	69	1	96	80
Portugal	94	43	2	25	NO	84		36	74
Spain	770	298	169	110	NO	257	40	198	472
Sweden	168	62	36	47	1,448	45	2	37	53
United Kingdom	1,023	326	25	465	1,500	560	34	316	644
EU-15	7,637	3,552	785	2,524	21,481	2,784	139	2,386	4,467

Source of information: Tables 4.D for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviat

Table 6.67: Available background information on the activity data used for the calculation of N_2O emissions in category 4.D. Data for the year 2011.

Member State	Activity data
Austria	"Mineral fertiliser consumption: Grüne Berichte (BMLFUW); urea application in Austria: expert judgement based on sales data (RWA). Detailed data about the use of different kind of fertilisers are available until 1994, because until then, a fertiliser tax („Düngemittelabgabe“) had been collected. Data about the total mineral fertiliser consumption are available for amounts (but not for fertiliser types) from the statistical office (Statistik Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). Annual sales figures about urea are available for the years 1994 onwards from a leading fertiliser trading firm (RWA). These sources were used to get a time series of annual fertiliser appli-cation distinguishing urea fertilisers and otherN-fertilisers ("mineral fertilisers"). High inter-annual variations in N_2O emissions of sector 4.D mineral fertiliser use. These variations are caused by the effect of storage: fertilisers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertiliser tax intensified this effect at the beginning of the 1990ies. Considering this effect, the arithmetic average of each two years is used as fertiliser application data. Cropped area legume production and harvested amount of agricultural crops: (BMLFUW). Agriculturally applied Sewage sludge data were taken from Water Quality Report, 2000 (Philippitsch, 2001), For 2001 to 2006 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used. "
Belgium	Data of crop production (area and yield) originate from 'Statistics Belgium'. The cultivated area for each crop originates from the agriculture census of the 1st of May. Data of crop production (area and yield) originate from 'Statistics Belgium'. The cultivated area for each crop originates from the agriculture census of the 1st of May. The crop production originates from an additional survey performed in December.
Denmark	The amount of nitrogen (N) applied on soil by use of synthetic fertiliser is estimated from sale estimates by the Danish AgriFish Agency, which is source to the FAO database. The use of synthetic fertiliser includes fertiliser used in parks, golf courses and private gardens. 1 % of the synthetic fertiliser can be related to these uses outside the agricultural area. Data for crop yield is based on Statistics Denmark. For nitrogen content in the plants the data is taken from Danish feed stuff tables (Danish Agricultural Advisory Centre).
Finland	The amount of synthetic fertilisers sold annually has been received from the annual agricultural statistics of the Ministry of the Agriculture and Forestry. The amount of sewage sludge applied annually has been received from the VAHTI database of Finland's environmental administration. Area of cultivated organic soils are from MTT Agrifood Research Finland. Crop yields of cultivated plants have been received from agricultural statistics.

Member State	Activity data
France	National statistics of fertiliser consumption are from UNIFA. Crop production statistics are obtained from the Ministry of agriculture (SCEES/ AGRESTE). For animal production, the difference between table 4.D and table 4B(b) is due to the overseas territories that are accounted separately in table 4D.
Greece	Confirmed data for the quantities of synthetic fertilisers applied in soils derive for the first time from the Pan-Hellenic Association of Professional fertilisers Producers & Dealers (PHAPFPD). Agricultural production data were derived from the Hellenic Statistical Authority (ELSTAT).
Ireland	The annual statistics on nitrogen fertiliser use (Nfert) are obtained from the Department of Agriculture, Food and the Marine.
Italy	Italian fertiliser Association (AIF) the use of fertilisers is determined by their cost and particularly by the price of agricultural products. In the last years, prices have decreased and, as a result, farmers need to save costs, consequently, less fertilisers is being used (Perelli, 2007; De Corso 2008). The Italian National Statistical System (SISTAN) revises every year the National Statistical Plan that covers three years and includes, among others, the system of agricultural statistics. In this framework, the Agriculture, Forestry and Fishing Quality Panel has been established under coordination of the Agriculture service of ISTAT where those who produce and use agricultural statistics (mainly public institutions) meet every year in order to monitor and improve national statistics. Information of the cultivated surface is collected 100% from rice farmers. Every year, data are collected on time by the National Rice Institute (ENR, 2011[b]).
Luxembourg	AD from national statistical data (Statistical Yearbook, tables C.2100 and C.2104) and ASTA (Administration des Services Techniques de l'Agriculture)
Portugal	No available statistics on annual quantity of N used for agricultural soils, not even on sales of synthetic fertilisers.The National Statistical Institute, in collaboration with Laboratorio Quimico Agricola Rebelo da Silva and ADP (main fertiliser producer), produced a methodology that estimates the Apparent Consumption of fertilisers in the Agriculture activity (ACFA) by a simple mass balance, from sales and international market information data not accounting for losses and stock changes. The data are compared to the more complete time-series that is available at FAO (http://faostat.fao.org), with sales information for “Nitrogenous fertilisers” from 1961 up to 2002. However, and although its completeness, the Ministry of Agriculture and the National Statistical Institute, shown concerns about the origin of the information behind the final time series, and consider that it did not reflect clearly the situation that existed in Portugal in the period. Nevertheless, both series agree quite well near the base year, although the values in this series appear to be over-estimating the rate of decrease of synthetic fertilisers in Portugal.
Spain	Mineral fertiliser statistics are obtained from 'Anuario de Estadistica Agroalimentario' (MARM)
Sweden	Sales of fertilisers, recalculated into nitrogen quantities, are published annually by Statistics Sweden and the national estimates are considered to be accurate, according to the quality declaration in the statistical report. The fertiliser sales values are however a bit higher than the estimated use of fertilisers, which is estimated from telephone interviews with farmers. The difference can partly be explained by the use of fertiliser in other sectors such as in horticulture. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in the current submission of the GHG inventory. Estimated standard yields for different crops are published annually by the Swedish Board of Agriculture/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years. The area of arable land in the agricultural sector is taken from the National Forest Inventory to harminize the Swedish National Forest Inventory with the agricultural sector.
United Kingdom	Annual consumption of synthetic fertiliser is estimated based on crop areas from the England and the Devolved Administrations. Production data of crops are provided by Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI

Emission Factors and other parameters

Table 6.68 and Table 6.69 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2011. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. In addition, while the emission factors are static in the time series, some parameters are dynamically calculated on the basis of national input data, for example the mix of mineral fertiliser types with different volatilization fractions associated.

In the following, country-specific elements in the calculation of N_2O emissions from agricultural soils as reported in the National Inventory Reports are given in Table 6.71 for direct N_2O emissions from fertiliser application, Table 6.72 and Table 6.73 for N_2O emissions from N-fixing crops and crop residues, Table 6.74 for the N_2O emissions from animal production and Table 6.75 for N_2O emissions from cultivated histosols.

Furthermore, background information on the development of national parameters is given in Table 6.76 for $Frac_{GASF}$, Table 6.77 for $Frac_{GASM}$ and Table 6.78 for $Frac_{LEACH}$.

Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands and by Sweden.

The Swedish EF for synthetic fertiliser is lower than the IPCC default and is based on a study on N_2O emissions in Sweden and other countries of northern Europe and Canada (Kasimir-Klemedtsson, 2001). This study is supported by another study carried out in Norway, suggesting a lower emission factor for emitted fertiliser N than the IPCC default value (Laegreid and Aastveit, 2002). The EF for applied manure is higher than IPCC default and is a country specific EF derived from a literature study requested by the Swedish EPA (Klemedtsson, 2001).

The Netherlands distinguish between mineral fertiliser application on mineral soils and on organic soils, with the EFs being twice as high for the application on organic soils.; For the application of manure, differentiation is made between surface spreading and incorporation of the fertiliser. As more nitrogen is locally available if the fertiliser is incorporated into the soil, this application system is assumed to result in higher emissions of N_2O in mineral soils. For organic soils, the same, higher EF is applied for both application systems. An overview of the Dutch emission factors is given in Table 6.70. Additional background information on the emission factors used is given in Table 6.71.

All countries are reporting N_2O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2% N_2O-N per kg N excreted and year, except of the emission inventories of the Netherlands, which use an EF of 3.3%.

Table 6.68: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2011.

Member States 2011	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
	Direct						Indirect	
Austria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Belgium	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Denmark	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	1.96%
Finland	1.25%	1.25%	1.25%	1.25%	8.4	2.0%	1.00%	2.50%
France	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Germany	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Greece	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Ireland	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Italy	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Luxembourg	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Netherlands	1.30%	0.87%	1.00%	1.00%	4.7	3.3%	1.00%	2.50%
Portugal	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Spain	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Sweden	0.8%	2.50%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
United Kingdom	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
EU-15	1.24%	1.24%	1.25%	1.25%	7.7	2.0%	1.00%	2.48%

Source of information: Tables 4.D for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.69: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2011

Member States 2011	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0.18%		3.8%	27%	6%	30%	2.6%	0.9%	34%
Belgium	NO	NO	3.8%	21%	30%	13%	2.0%	0.9%	50%
Denmark	0.77%	NO	1.6%	19%	8%	33%	3.9%	1.7%	86%
Finland	0.12%	NA	1.5%	25%	18%	15%	NA	0.6%	NA
France	0.54%	NO	10.0%	20%	46%	30%	3.0%	0.8%	NA
Germany	NO	NO	4.8%	30%	11%	30%	4.4%	2.4%	66%
Greece	10%		10.0%	20%	79%	30%	1.4%	0.5%	52%
Ireland	NO	NO	3.6%	17%	62%	10%	1.4%	1.1%	NO
Italy	10%	NO	9.4%	29%	19%	30%	3.0%	1.5%	45%
Luxembourg	NO	NO	10.0%	20%	45%	30%	3.0%	1.5%	50%
Netherlands	NO	NO	5.4%	17%	14%	12%	NE	NE	NE
Portugal	4.4%	NO	5.7%	19%	54%	32%	2.2%	1.3%	71%
Spain	19.7%	NO	9.0%	16%	40%	30%	2.4%	0.5%	NA
Sweden	NO	NO	0.9%	33%	33%	20%	1.3%	1.0%	64%
United Kingdom									
EU-15 1)	NA	NA	5.7%	22%	33%	25%	2.6%	1.2%	57%

Source of information: Tables 4.D for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Arithmetic average over the MS that reported.

Direct emissions from application of fertiliser

Only few countries use country-specific emission factors to estimate N_2O emissions caused by the application of mineral fertiliser. The reason is the extreme high spatial and temporal variability of this emission source, which makes the generation of a robust database with observations, based on which national emission factors can be derived, extremely difficult. National methodologies are summarized in Table 6.71. Table 6.72 through Table 6.74 give additional information on the methodologies used to estimate N_2O emissions from crop residues, biological N-fixation, and animal production.

Table 6.70 shows the methodology used in the Netherlands in detail.

Table 6.70: N_2O emission factors for agricultural soils used in Netherlands' inventory (from the NL protocol for direct N_2O emissions; www.greenhousegases.nl)

Supply source	EF (kg N_2O–N per kg N supply)		Reference
	Mineral soil	Organic soil	
Using fertiliser			
- ammonia-retaining (no nitrate)	0.005	0.01	2
- other types of fertiliser	0.01	0.02	1
Using animal manure			
- above-ground usage	0.01	0.02	1
- low-emission use	0.02	0.02	1
Grazing agricultural pets			
- faeces	0.01	0.01	1
- urine	0.02	0.02	1
Nitrogen fixation	0.01		1
Remaining crop residues	0.01		2
Agricultural use of histosols		0.02	2

references: 1= Kroeze, 1994; 2= Van der Hoek et al., 2005

Table 6.71: Available background information for the calculation of N_2O emissions from the application of fertiliser in category 4.D

Member State	Direct emissions from fertiliser application
Finland	IPCC default with the exception of emission factors for organic soils on grass and other crops which are based on national data (Monni et al. 2007) (cereals 11.08 kg N_2O-N ha-1 y^{-1}, grass 5.7 kg N_2O-N ha-1 y^{-1}).
Germany	IPCC default. For emissions from leaching, default factor from IPCC 2006. The IPCC 1996 factor represents poor knowledge available at the time. The new data set used for the development for the IPCC 2006 guidelines agrees with the German situation (Weymann et al., 2008).
Netherlands	Distinction is made between fertiliser type (ammonia-retaining-no nitrate fertiliser and other fertiliser), application to mineral or organic soils, and manure incorporation. The country specific emission factors for mineral soils are lower than IPCC defaults and for organic soils they are higher. A fixed distribution of the total amount of nitrogen in fertiliser and animal manure is used over the Netherlands areas of mineral and organic agricultural soils. For fertiliser use, 90% is attributed to mineral soils, and 10% to organic soils; for animal manures this is 87% and 13% respectively (Kroeze, 1994). For incorporation into soil also a higher emission factor than the IPCC default is used. A recent survey on N_2O emission factors for the field-scale application of animal manure (Kuikman et al., 2006) showed that on the basis of available data it was not possible to make an update of the N_2O emission factors applied in the past (Kroeze et al., 1994). Very few comparative trials between surface spreading and incorporation have been carried out in The Netherlands to date, resulting in very low emission rates for both techniques. Field-scale comparative experiments carried out in other countries show that, in most cases, N_2O emissions increased and seldom were lower in comparison with surface application. However, it was not possible to deduce long-term average N_2O emission factor from these findings and to translate these to the Dutch circumstances. Therefore, it was not possible to underpin an update of the N_2O emission factor for the application of animal manure. More research is needed in order to be able to take the specific circumstances of The Netherlands into account.
Sweden	National emission factor for direct emissions based on a study by (Klemedtsson, 2001). For nitrogen supply from fertilisers, a national emission factor, 0.8% N_2O-N of N-supply, is used. For nitrogen supply from manure, a national emission factor of 2.5% emissions of N-supply is used. The background emissions from the cultivation of mineral soils have also been included in the inventory with the national emission factor of 0.5 kg N_2O-N ha-1. For other direct soil emissions, default values from the IPCC Guidelines are used. The background emissions from organic soils vary with different crops. They are considered to be higher from ploughed soils than from pasture or lay lands and the suggested emission factors are 1 and 6 kg N_2O-N ha-1, respectively. The IPCC guidelines' default value is implemented in the inventory since a Swedish/Finnish research group concluded that not enough data exists to generate different emission factors for different management and soil types (Klemedsson et al., 1999).

Table 6.72: Available background information for the calculation of N_2O emissions from crop residues in category 4.D

Member State	Direct emissions from crop residues
Austria	Country-specific data for average crop residues/crop products ratio, dry matter fraction, N in crop residues (Goetz, 1998) and fraction of crop residues removed (Loehr 1990). Emissions from field burning have been calculated on a crop by crop basis.
Belgium	The dry matter content of the crops in Flanders is region specific.
Denmark	Tier 1b. N_2O emissions from crop residues are calculated as the total above-ground amount of crop residues returned to soil. For cereals the aboveground residues are calculated as the amount of straw plus stubble and husks. The total amount of straw is given in the annual census and reduced with the amount used for feeding, bedding and biofuel in power plants. Straw for feeding and bedding is subtracted in the calculation because this amount of removed nitrogen returns to the soil via manure. Data for nitrogen content in stubble and husks are provided by the Danish Institute of Agricultural Sciences (Djurhuus,and Hansen, 2003). Burning of plant residues has been prohibited since 1990 and may only take place in connection with continuous cultivation of seed grass. It is assumed that the emissions are insignificant. The fractions FracNCRO, $Frac_{NCRBF}$ and FracR are calculated for all years by us-ing the definitions given in the IPCC Reference Manual. A higher $Frac_{NCRBF}$ could be explained that Denmark includes fields with clover grass, which has a high N-content. The higher national FracNCRO could be a consequence of the relatively large part of straw that is harvested and used for feeding, bedding and fuel. The national FracR is significantly higher than the IPCC default. The national value express, that 84 % to 87 % of the total N in crops above ground is re-moved from the field. The remaining is the N-content in straw and tops from beets and potatoes, which are left on the field. From 1990 to 2011 the FracR is increased as a consequence of a fall in cultivated area of feeding beets.
Germany	Germany makes use of statistically available nitrogen contents in crop residues from the Duengerverorndung (DuV, 2007) and IGZ (2007). Factors used in the Tier 2 calculation for emissions from crop residues is given in (Daemmgen et al., 2007).
Italy	Country-specific methodology; N-content in crop residues calculated using the protein content in dry matter, and dividing by the factor 6.25. The FCR parameter is obtained by adding the nitrogen content of cultivars crop residues.
Netherlands	A fixed country specific value in kg N per hectare is used for the nitrogen content of the above-ground crop residues (Velthof and Kuikman, 2000). Country-specific values for removal of crop residues show that during the period 1990-2003, only grains and corn were removed (90%) from the fields (Van der Hoek et al., 2005).
Portugal	Tier 1b approach from IPCC 2000. Crop residues returned to soils include all crops (N fixing and non N fixing crops, and also including permanent crops). Calculations similar to N-fixing crops; N added to soil is estimated from the ration residue/crop mass, fraction of dry matter in product and fraction of N in dry matter. Values for the estimation of N in residues for leguminous are the same as for N fixed by crops. For non-leguminous, IPCC defaults. For the estimation of FCR, FracFUEL, FracCNST and FracFOD were set to zero for all crops, because those uses are negligible in Portugal.
Spain	Regulations on burning of cereal residues vary between regions (zones A and B). Data are listed by year, crop category and zone. Calculation of emissions from crop residues following IPCC 2000 default methodology (considering FracFUEL-CR, FracCNST-CR and FracFOD equal to zero, because these uses do not take place in Spain).
Sweden	Methodology recommended in IPCC 2000 is followed, combined with national activity data on removed residues and other parameters. Emission factors used are the default. N-content in crop residues from cereals is based on national measurement data (Mattson, 2005). For other crops, a combination of national factors and IPCC default values was used (Swedish EPA/SMED, 2005).
United Kingdom	Production data of crops are provided by Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI.

Table 6.73: Available background information for the calculation of N_2O emissions from N-fixing crops in category 4.D

Member State	Direct emissions from N-fixing crops
Austria	Values for biological fixation for peas, soya beans and horse/field beans (120 kg N/ha) and clover-hey (160 kg N/ha) are country-specific (Goetz, 1998); these values are constant over the time series.
Denmark	Tier 1b. The estimates for the amount of fixed nitrogen in crops are estimated by Danish Institute of Agricultural Science (Swedish Board of Agriculture, 2005) from literature (Kristensen, 2003; Høgh-Jensen et al, 1998; Kyllingsbæk, 2000). Emissions from clover-grass are included (not mentioned in IPCC). Area with grass and clover cover now 20% of the total agricultural area and represent thus a

Member State	Direct emissions from N-fixing crops
	significant part of N-fixing crops emissions.
Finland	Vegetables grown in the open have been included into the emission estimate of crop residues for the first time in 2005 submission. Vegetable yields have been received from literature (Yearbook of Farm Statistics, 2006). Values for the residue/product fraction, dry matter content and nitrogen fraction are IPCC with amendments where appropriate values were missing (turnip rape/rape; sugar beet; clover seed) or where more values based on expert judgement were used (N-fraction for peas of 3.5%; DM and residue/product fraction from sugar beet used for vegetables).
Germany	The quantity of N fixes by leguminous crops is estimated on the basis of cultivated area and national average N-fixing rates of 250 kg N ha-1 (pulses), 300 kg N ha-1 (alfalfa), and 200 kg N ha-1 (mixed alfalfa, clover; improved grassland) (DÄMMGEN et al., 2007).
Greece	Tier1b. The cereal production of Greece consists mainly of wheat (36 per cent of cereal production) and maize (52 per cent of cereal production) crops, whose FRACNCRO is significant lower than IPCC default, 0.0028 of wheat and 0.0081 of maize.
Ireland	Tier1b
Italy	Nitrogen input from N-fixing crops (FBN, kg N yr^{-1}) is calculated with a country-specific methodology. Peculiarities that are present in Italy were considered: N-fixing crops and legumes forage. FBN is calculated with two parameters: cultivated surface and nitrogen fixed per hectare (Erdamn 1959 in Giardini, 1983).
Netherlands	For emissions from crop residues and N-fixing crops, only crops from arable farming and horticulture in the full soil (not in tubs) are included. Country-specific value for nitrogen fixation per hectare (Mineralen Boekhouding, 1993) (Lucerne: 422 kg N per hectare; Green peas (harvested dry) and field peas, marrowfat peas en grey peas, brown beans, peas (harvested green): 164 kg N per hectare; Field beans: 325 kg N per hectare; Stem beans (harvested green), scarlet runner-/salad-/common beans: 75 kg N per hectare; Broad beans: 164 kg N per hectare.
Portugal	Tier 1b approach of IPCC 2000: use of crop-specific residue to product ratio and dry matter content. Quantity of N fixation estimated from INE data on crop production (regional level), including permanent crops. N fixed is estimated from the ration residue/crop product mass, the fraction of dry matter in product and the fraction of N in dry biomass. These parameters are calculated by crop, using default IPCC values.
Spain	Two methods are used: a specific national methodology to calculate non-cultivated agricultural land, and IPCC methodology with national parameters for cultivated land. A literature review was made to obtain N-fixing parameters relevant for cultures grown in Spain. This resulted in a detailed list containing data on crop residue/yield fraction, dry matter, carbon and nitrogen content for more than 100 crop types.
Sweden	To estimate nitrogen fixation from the atmosphere, a model according to Høgh-Jensen has been used since submission 2006 The model covers fixation from root and stubble as well as transmission to other plants. It has been adapted to Swedish conditions (Frankow-Lindberg, 2005). According to the model, the amount of fixed nitrogen is estimated as a part of the total amount of N in the plant's biomass, which varies depending on the kind of leguminous plant, the age of the pasture, the number of harvests and, to some extent, the amount of fertiliser applied.
United Kingdom	Crop production data were provided by Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI.

Table 6.74: Available background information for the calculation of N_2O emissions from animal production in category 4.D

Member State	Grazing animals
Austria	During the summer months, 14.1% of Austrian Dairy cows and Suckling cows are on alpine pastures 24 hours a day. 43.6 % are on pasture for 4 hours a day and 42.3 % stay in the housing for the whole year (Konrad, 1995).
Belgium	The nitrogen from grazing is estimated, taking into account the number of days in pasture and the nitrogen excreted by each animal category. Available nitrogen is the difference between the manure nitrogen content and the manure nitrogen volatilisation in NH_3 and NO form.
Denmark	$Frac_{GRAZ}$. The amount of nitrogen deposited on grass is based on estimations from the NH_3 inventory. Grazing days is based on expert judgement from the Danish Agricultural Advisory Centre.
Finland	Calculating manure excreted on pasture requires data of length of pasture season and time spent outside. For dairy cattle, it has been estimated that 25% of cows spend nights inside (14h) during

Member State	Grazing animals
	pasture season. The length of pasture season is 140 days for suckler cows, heifers, horses and ponies, 125 days for dairy cows, 100 for calves, 130-140 for sheep and goats, 365 for reindeer and 0 for bulls, swine, poultry and fur animals.
Germany	Grazing animals: N input calculated with the mass-flow approach taking into consideration all relevant housing systems occurring in Germany and is based on the length of the grazing period, the average time per day spent grazing and in milking yards. The share of grazing varies with subcategory, region, and time.
Ireland	Default
Netherlands	National emission factor. A distinction is made between nitrogen in urine and in faeces. The distribution of nitrogen over faeces and urine depends on the nitrogen content in the meadow grass, and in turn this depends on the fertilisation level. For the period 1990-1999 a distribution of 30/70 was assumed, and for the period from 2000 onwards, a ratio of 35/65 is used (calculated on the basis of Valk et al., 2002). For the calculation of N_2O emissions, the nitrogen excreted is corrected for NH_3 volatilization.
Portugal	Emissions of N_2O due to the input of nitrogen to soils from pasture, range and paddock were estimated with a methodology similar to that used to estimate emissions of N_2O from Manure Management. The emission factor of N_2O for Pasture, Range and Paddock (EF3) was set at 0.02 kg N_2O-N/kg N which is the default IPCC96 emission factor.
Sweden	2% default emission factor for all animal groups (although it is probably an overestimation of emissions in a cold climate, but no better empiric information is available)
United Kingdom	The fraction of livestock N excreted and deposited onto soil during grazing in UK is much larger (0.54) than the IPCC default value (0.23), as cattle in particular spend more time grazing at pasture in the UK than is the case in many other countries.

Direct emissions from the cultivation of histosols.

N_2O emissions from the cultivation of histosols reported as not occurring in Austria, France, and Spain, and as not estimated in Portugal. Additionally, no emissions from the cultivation of histosols are reported by Ireland, because tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the middle and western part of the country. Consequently, nitrogen inputs due to the cultivation of organic soils have been taken as negligible.

The cultivation of histosols represents the biggest share of emissions from agricultural soils in Finland (38%), Sweden (15%) and a substantial source for N_2O emissions in Germany (11% - almost as large as emission from application of manure) and the Netherlands (9%). The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used in most countries. The Netherlands uses 4.7 kg N_2O-N ha^{-1}; national emission factors are further used in Denmark (8.0 kg N_2O-N ha^{-1}) and Finland (8.4 kg N_2O-N ha^{-1}).

On absolute terms, the estimated emissions of N_2O from the cultivation of histosols are largest for Germany (15.4 Gg N_2O), followed by Finland (4.4 Gg N_2O) and Sweden (1.8 Gg N_2O).

Table 6.75: Available background information for the calculation of N_2O emissions from the cultivation of histosols in category 4.D

Member State	Histosols
Austria	Cultivation of Histosols is not occurring in Austria. There are no annually cultivated organic soils in the Austrian grassland area.
Belgium	The cultivation of organic soils only represents Flanders. The area of histosols in Flanders has been estimated using region specific data based on an intersection between the CORINE Land Cover Geo dataset from 1990 and the Belgian 'Soil association map'. The area of cultivated organic soils is obtained by the University of Leuven (KUL). Given the slow pace of change the area is taken constant

Member State	Histosols
	over the entire time series.
Denmark	
Finland	The area of cultivated organic soils has been received from MTT Agrifood Research Finland and has been updated for the 2006 submission on the basis of (Myllys, 2004; Kähäri, 1987). The area of cultivated organic soils is poorly known in Finland. Current area estimate is based on the results of soil analysis. The emission factors for organic soils on grass and other crops are based on national data (Monni et al. 2007). The emission factors were calculated on the basis of published results on annual fluxes measured with flux chambers on five different peat fields.
Germany	Estimation of the area of cultivated histosols consistent with estimates from the LULUCF sector. It includes the classes arable land and grassland (not woody grassland) whereby un-drained grassland is subtracted.
Greece	Data for the areas of organic soils cultivated area (6.7 kHa, constant for the entire period examined in North Greece) derive from a relevant research conducted by the Soil Science Institute of Athens (SSIA, 2001).
Ireland	Not estimated. Tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the midlands and west. Consequently, nitrogen inputs due to the cultivation of organic soils can be taken as negligible.
Italy	The area of organic soils cultivated annually (histosols) is estimated to be 9,000 hectares for the whole time series (CRPA, 1997[b]). The data for surface area, reproduced in the national soil map of the year 1961, were supplied by the Experimental Institute for the study and protection of soil in Florence (ISSDS). These values have been verified with related data for Emilia Romagna region, where this type of soil is most prevalent.
Netherlands	A fixed country-specific emission factor of 0.02 kg N_2O-N per hectare is used for this calculation (largely taken from Dutch research projects conducted in the first half of the 1990s and reported in Kroeze, 1994).
Portugal	Histosols represent at most a negligible emission quantity in Portugal, and they may be reported as not occurring for all practical purposes.
Sweden	The area of organic soils has only been estimated intermittently. The latest survey in 2009 concluded that approximately 5 % of the total area of arable land consists of organic soils (Berglund, Berglund & Sohlenius, 2009). That fraction has then been used for all years.
United Kingdom	The area of cultivated histosols is estimated at 1500 km^2. It is assumed to be equal to that of eutric organic soils in the UK and is based on a FAO soil map figure supplied by SSLRC (now NSRI).

Indirect emissions.

All Member States report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH_3 and NO_x volatilised and nitrate leached to the groundwater using the default IPCC emission factors. Only Denmark uses a smaller emission factor for N_2O from nitrogen leached or run-off (1.96%).

Country-specific methodologies, however, are used by most Member States for the calculation of nitrogen volatilisation and nitrate leaching, with only 3 Member States using the IPCC default values for the volatilisation fractions of mineral and organic fertiliser ($Frac_{GASF}$ and $Frac_{GASM}$), respectively, and 7 countries are using the default IPCC values for the leaching fraction ($Frac_{LEACH}$). The Netherlands reports the fractions as NE.

The EMEP/EEA Emission Inventory Guidebook (EMEP/EEA, 2009) gives in the section ‘4.D Crop production and agricultural soils’ the emission factors for NH_3 volatilization from mineral fertilisers if the Tier 2 ‘technology specific approach’ can be used (Table 3-2). The method considers soil pH and the mean spring temperature as factors influencing the magnitude of NH_3 volatilizations. For example, the application of ammonium nitrate on soils with a pH≤7 and a mean spring temperature of 6ºC would lead to a NH_3 volatilization of 0.014 or 1.4%, which is considerably lower than the IPCC default factor. Volatilizations higher than the IPCC default factor of 10% are only achieved when using this methodology for the application of urea, nitrogen solutions at high temperatures, or ammonium sulphates or ammonium phosphates on soils with a high pH>7. Accordingly, the estimates volatilization fraction of NH_3 and NO_x from the application of mineral fertiliser is considered by all Member States to be lower as the IPCC default values (range of national factors 1.5% to 10%, with 3 countries using the default value of 10%).

In contrast, most of the Member States with country-specific volatilisation rates for organic fertiliser are estimating larger losses of NH_3 + NO_x than proposed by the IPCC (range 21% to 33%) with 3 countries using the default $Frac_{GASM}$ of 20% and the lowest volatilization fraction used being 16.1%. The country-specific methodology for the estimation of NH_3 volatilization is in some cases based on the NH_3 inventory using the CORINAIR methodology thus differentiating between different kinds of synthetic fertilisers.

Also, model-based estimations for the fraction of nitrogen volatilised from applied animal wastes have been used. The fraction of nitrogen lost by leaching ranges from 12.0% to 33% with 7 countries using the default FracLEACH of 30% and 6 countries using a smaller value. They are in some cases based on a nitrogen-leaching model (e.g., Denmark, Sweden) and in some cases based on national studies (e.g., Finland, Ireland).

Table 6.76: Available background information on the fraction of NH_3 and NO_x volatilized from applied mineral fertiliser, FracGASF for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASF}$
Austria	$Frac_{GASF}$ NH_3 emissions are 2% for mineral fertilisers and 15% for urea fertilisers; NO_x emissions 0.3% (CORINAIR)
Belgium	$Frac_{GASF}$ 2.3% in Wallonia (recommended by IIASA for different fertiliser types); in Flanders an average rate for NH_3 volatilisation is calculated by the model that estimates the NH_3 emissions from synthetic fertiliser as developed by ILVO. The rate for NO volatilisation in Flanders is 1.5%.
Denmark	The Danish value for the $Frac_{GASF}$ is an average of national estimates of NH_3 emissions from each fertiliser type (Sommer and Christensen, 1992; Sommer and Jensen, 1994; Sommer and Ersbøll, 1996) in accordance with the CLRTAP guidebook. The major part of the Danish emission is related to the use of calcium ammonium nitrate and NPK fertiliser, where the emission factor is 0.01 kg NH_3-N/kg N. The low Danish $Frac_{GASF}$ is also probably due to a small consumption of urea (<1%), which has a high emission factor.
Finland	Nitrogen volatilised as NH_3-N and NO_x-N from synthetic fertilisers ($Frac_{GASF}$) is calculated and used for calculating indirect emissions from atmospheric deposition and subtracted from the amount of N remaining which is used for calculating direct emissions form synthetic fertiliser application.
Germany	$Frac_{GASF}$ dynamically calculated using default emission factors for the application of mineral fertilisers (EMEP/CORINAIR, 2003).
Ireland	The volatilization rates for Ireland are however determined from an elaborate new NH_3 inventory for agriculture and it is assumed that nitrogen lost as NO_X is negligible in comparison to NH_3.
Italy	$FRAC_{GASF}$ parameter is estimated for the whole time series, following the IPCC definition
Netherlands	Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions. The extent of the NO_x emission as a result of fertiliser and animal manure is estimated at 15% of the ammonia emission (De Vries et al., 2003). The supply source, deposits of NO_x as a result of using fertiliser and animal manure, is not (yet) included in the annual calculations under the framework of the Emission Registration, and is therefore not included when determining the nitrogen balance.
Portugal	Country specific, determined from an estimate of the share of N synthetic fertilisers used in Portugal, based on statistical information from INE on exports, imports and national production of each individual fertiliser. Values vary between 0.053 and 0.064 kg NH_3-N/kgN, almost half the default IPCC value
Spain	$Frac_{GASF}$ from national inventories, calculated according to the EMEP/CORINAIR methodology.

Member State	$Frac_{GASF}$
Sweden	**The proportions of emitted N-content of fertilisers sold in different years vary because of changes in the sold quantities of different types of fertilisers. Values for ammonia emission fractions from EMEP/EEA emission inventory guidebook 2009 and calculated using the mean spring temperature of 5.9 Celsius degrees.**

Table 6.77: Available background information on the fraction of NH_3 and NO_x volatilized from applied manure, FracGASM for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASM}$
Austria	The amount of manure left for spreading was calculated within source category 4B (Amon et al., 2002). With regard to a comprehensive treatment of the nitrogen budget, the emission inventory of N_2O is linked with the Austrian inventory of NH_3. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASM}$. Nitrogen left for spreading is calculated subtracting the following losses: N-excreted during grazing, NH_3-N losses from housing, NH_3-N losses during manure storage and N_2O-N losses from manure management. NH_3 emissions from housing: according to CORINAIR using EFs for Switzerland where similar management strategies and geographic structure between the countries, or default EFs for Germany if no Swiss factor is available; NH_3 emissions from manure management: TAN content according to Schlechtner 1991 (cattle and pigs) + emissions factors default CORINAIR; correction factors are applied for different manure treatment systems from the Swiss inventory model DYNAMO (Menzi et al., 2003; Reidy et al., 2007;2009); for example composted solid manure has a correction factor of 1.2 with respect to uncomposted solid manure, and covered liquid systems have correction factors between 0.2 (solid cover) to 1.1 (aerated open tank) compared to uncovered tank. Other animals CORINAIR simple methodology; NH_3 emissions during manure application: CORINAIR default factors; NO_X-emissions during manure application: a conservative emission factor for NO_x-N of 1% was used (Freibauer & Kaltschmitt, 2001).
Belgium	**In Wallonia and Flanders no animal manure is burned. In Flanders the animal manure nitrogen used as fertiliser is also corrected for the amount of manure transported outside Flanders or to a fertiliser processing company.**
Denmark	**Emissions of NH_3 are linked to the national NH_3 emission inventory (Mikkelsen et al. 2011). The $Frac_{GASM}$ is estimated as the total N-excretion (N ab animal) minus the ammonia emission in stables, storage and application. They are based on national estimations and are calculated in the ammonia emission inventory. The $Frac_{GASM}$ has decreased since 1990 as a result of an active strategy to improve the utilization of the nitrogen in manure. It is assumed that 1.9% of the N-input from sewage sludge or industrial sludge applied to soil volatilises as ammonia.**
Finland	**The amount of N volatilised as NH_3-N from total manure N ($Frac_{GASM}$) is calculated in the N calculation model for the whole manure management chain and is used for calculating indirect N_2O emissions from atmospheric deposition.**
Germany	**$Frac_{GASM}$ is calculated considering also the input of nitrogen with straw. Therefore, it is not possible to deduce $Frac_{GASM}$ on the basis of the data available in the CRF.**
Ireland	**The volatilization rates for Ireland are determined from an elaborate NH_3 inventory for agriculture (Duffy et al. 2012). It is assumed that nitrogen lost as NO_X is negligible in comparison to NH_3. In addition, $Frac_{GASM}$ is split into $Frac_{GASM}$1 and $Frac_{GASM}^2$ with $Frac_{GASM}$1 referring to NH_3-N losses from animal manures in housing, storage and landspreading and $Frac_{GASM}^2$ being the proportion of nitrogen excreted at pasture that is volatilised as NH_3. These modifications have been made to achieve more accurate accounting of nitrogen and to maintain consistency with Ireland's inventory of NH_3. There is no contribution to N_2Oindirect-dep from FS, the nitrogen input from sludge spreading, but FS increases N 2Oindirect -leach through its inclusion in FAM.**
Italy	**$Frac_{GASM}$ country-specific, FAM (t yr^{-1}) value is estimated by summing the FAM for each livestock category**
Netherlands	**Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions (estimated at a tier 3 level; LEI-MAM).**
Portugal	**$Frac_{GASM}$ equals the sum of $EFNH_3$(i,s) and $EFNH_3$SD. The use of emission factors of ammonia volatilisation from EMEP/UNECE results, therefore, in obtaining a value for $Frac_{GASM}$ that is different and slightly higher than the default value for $Frac_{GASM}$. The resultant implied $Frac_{GASM}$ oscillates between 0.22 to 0.23 kg N-NH_3 + N-NO_x/ kg of N excreted.**

Member State	$Frac_{GASM}$
Spain	$Frac_{GASM}$ from national inventories, calculated according to the EMEP/CORINAIR methodology.
Sweden	The estimates of the fraction of nitrogen supply in emitted as ammonium-N are model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage. $Frac_{GASM}$ varies from year to year.

Table 6.78: Available background information on the fraction of nitrogen input leached or run-off, FracLEACH for the calculation of N_2O emissions in category 4.D

Member State	FracLEACH and EF5
Austria	Default value applied to nitrogen inputs from synthetic fertiliser use, livestock excretion, and sewage sludge application.
Belgium	FracLEACH is estimated from local studies (Pauwelyn, 1997) and falls into the IPCC range (0.17 kg N / kg N available). In Flanders, the nitrogen leaching (N_2O model) comes from the SENTWA model (System for the Evaluation of Nutrient Transport to Water) that is yearly updated.
Denmark	The calculation of N to the groundwater is based on two different models– SKEP/Daisy and N-LES (Børgesen & Grant, 2003) carried out by DJF and NERI. SKEP/DAISY is a dynamical crop growth model taking into account the growth factors, whereas N-LES is an empirical leaching model based on more than 1500 leaching studies performed in Denmark during the last 15 years. The models produce rather similar results for nitrogen leaching on a national basis (Waagepetersen et al., 2008). Data concerning the N-leaching to rivers and estuaries is based on data from NOVANA (National Monitoring program of the Water Environment and Nature) received from NERI the department of Freshwater Ecology. NOVANA is a monitoring program which includes monitoring of the ecologic, physic and chemical condition of water areas and transport of water and a range of substances, including N, to lakes and the sea (Wiberg-Larsen et al., 2010). These studies include measurements from 223 monitoring stations in all parts of Denmark and have been going on from the early 1990'ies.
Finland	It is estimated that nitrogen leaching is less than IPCC default value in Finnish conditions (Rekolainen, 1993) value is 15% and this has been used in the inventory).
Germany	For the calculation of indirect emissions from leaching, the following sources of N are considered: (i) fertiliser application, net of losses as NH_3, NO, and N2; (ii) sewage sludge application, net of emissions of N_2O only; (iii) N-fixation, net of losses of N_2O, NH_3 and N2; crop residues, net of emissions of N_2O and N2. Estimation of N2 losses according to Roesemann et al. (2013). FracLEACH default.
Ireland	Estimates of the nitrogen loads in Irish rivers reported under the OSPAR Convention (NEUT, 1999) suggest that approximately 10 percent of all applied nitrogen in Irish agriculture is lost through leaching. More recent research (Ryan et al., 2006; Del Prado et al., 2006 and Richards et al., 2009) also suggest an average value of 10%. The value of 0.1 is considered to be a more realistic estimate of FracLEACH than the default value of 0.3.
Netherlands	Tier 3 approach (Velthof and Mosquera, 2011) has been adopted, while keeping the IPCC default EF of 0.025 in place. Specific characteristics of the Netherlands' agricultural soils, with relatively high water tables. A model (STONE) was adopted to assess this fraction as described in Velthof and Mosquera (2011).
Portugal	Default FracLEACH for nitrogen applied to soil. For 20% of manure managed in anaerobic lagoons, which are directly discharged to the wastewater system, with agreement of the ERT, the N_2O emissions are calculated directly from the total amount of manure discharged, without considering volatilization losses are a leaching fraction, and using the default IPCC emission factor.
Sweden	The national estimates of nitrogen leaching are calculated from the SOILNDB model , which is a part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). The simulation model SOIL/SOILN was developed during the 1980s in order to describe nitrogen processes in agricultural soils. Since then the model has been developed and tested on data from controlled leaching experiments, and these tests show that the model estimates leaching from soils with good precision (Swedish EPA, 2002b). By using national data on crops, yields, soil, use of fertiliser/manure and spreading time, the leaching is estimated for 22 regions. These regions are based on similarities in agricultural production. For calculating nitrogen leaching in the inventory, the average N leaching per hectare, calculated by the SOILNDB model, is multiplied by the total Swedish area of agricultural soil. To estimate the implied FracLEACH,the leached nitrogen, according to the national model, is divided by the sum of nitrogen in fertilisers and animal production. This quotient varies between 0.2 and 0.25.
United Kingdom	Indirect emissions of N_2O from leaching and runoff are estimated according the IPCC methodology but with corrections for N_2O emissions to avoid double counting N. The sources of nitrogen considered, are synthetic fertiliser application and animal manures applied as fertiliser.

N_2O emissions from other sources.

Seven countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in six cases the IPCC default factor for direct N_2O emissions, one Member States used a different value. An overview of the emissions from sewage sludge and the specified other 'other' sources in category 4D is given in Table 6.79. Furthermore, other N_2O emissions are reported but the Netherlands, Portugal and the United Kingdom. Note that for better overview, the activity data on sewage sludge application are also included in Table 6.66.

Table 6.79: Member State's emissions from "other" sources in category 4D. Data for the year 2011.

Member States 2011	Description	Value kg N/yr	IEF kg N2O-N / kg N	EM N2O (Gg)	Value kg N/yr	IEF kg N2O-N / kg N	EM N2O (Gg)
		1990			2011		
Austria	Sew age Sludge Spreading	1,034,480	0.0125	0.020	1,384,467	0.0125	0.027
Belgium	Sludge Spreading	75,274	0.0125	0.001	72,265	0.0125	0.001
Denmark	Industrial w aste used as fertilizer	1,528,720	0.0125	0.030	3,942,000	0.0125	0.077
Denmark	Use of sew age sludge as fertilizers	3,056,918	0.0125	0.060	2,543,400	0.0125	0.050
Finland	Municipal sew age sludge applied to soils	1,644,651	0.0125	0.032	199,281	0.0125	0.004
France	4.D.1.6.1 Sew age Sludge Spreading	15,411,141	0.0125	0.303	17,162,807	0.0125	0.337
Germany	Sew age sludge on agricultural fields	27,415,232	0.0125	0.539	28,423,199	0.0125	0.558
Italy	Sew age sludge applied to soils	4,057,125	0.0125	0.080	9,486,486	0.0125	0.186
Luxembourg	Sew age Sludge Spreading	377,061	0.0125	0.007	247,105	0.0125	0.005
Netherlands	Sludge application on land	5,000,000	0.0100	0.079	900,000	0.0100	0.014
Spain	Domestic Wastew ater Sludge	8,296,042	0.0125	0.163	39,725,219	0.0125	0.780
Sw eden	Use of sew age sludge as fertilizers	826,000	0.0125	0.016	1,556,994	0.0125	0.031
United Kingdom	Municipal sew age sludge applied to fields	14,371,200	0.0125	0.282	33,606,893	0.0125	0.660
EU-15	**Total sewage sludge**	**83,093,844**	**0.0123**	**1.613**	**139,250,114**	**0.0125**	**2.732**
France	4.D.1.6.2 Compost Spreading	21,033	0.0125	0.000	182,527	0.0125	0.004
Spain	Municipal Solid Wastes Compost	8,480,979	0.0125	0.167	10,852,984	0.0125	0.213
EU15	**Total compost**	**8,502,011**	**0.0125**	**0.167**	**11,035,511**	**0.0125**	**0.217**
Sw eden	Cultivation of mineral soils	2,951,000	0.5001	2.319	2,815,000	0.5001	2.212
United Kingdom	Improved Grassland	29,005,584	0.0125	0.570	29,182,857	0.0125	0.573

Additional information on N_2O emissions estimated from the application of sewage sludge it given in Table 6.80.

Table 6.80: Available background information on N_2O emissions estimated under the category 'other' in category 4.D

Member State	
Austria	**Country-specific data on N-content (Scharf et al., 1997).**
Belgium	**In Wallonia, the data on sludge spreading on agricultural soils are available on the website of DGARNE (http://www.environnement.wallonie.be/). It is considered a fixed contribution of 0,1kg N/ha.yr and an emission factor equal to 0,0125 kg N_2O-N/kg N from sludge is used. In Flanders, the use of sewage sludge on agricultural soils is forbidden. This is described in the manure decree. In Brussels sludge spreading does not take place.**
Denmark	**The category, "Other", includes emission from sewage sludge and sludge from the industrial production applied to agricultural soils as fertiliser. Information about industrial waste, sewage sludge applied on agricultural soil and the content of nitrogen is provided by the Danish Environmental Protection Agency.**
Germany	**Data on sewage sludge application is from Umweltbundesamt and since 2009 from the Statistical Office.**
Greece	**?2? direct emissions from the sewage sludge used in agriculture, the default emission factor of 1.25% N_2O-N per kg N was applied while the annual amount of sewage sludge used in agriculture in Greece was provided by the Waste Management Sector of the Ministry of Environment, Energy and Climate Change (MEECC). Since 2004 and it remains limited, mainly in the frame of research projects and pilot studies. The N content of sewage sludge (dry matter) used in agriculture is assumed to be 3.0%. This value was obtained from the report 'Disposal and recycling routes for sewage sludge Part 3 – Scientific and technical report', Table 3, Page 24, European Commission, 2001.**
Ireland	**Published estimates of sludge production (Monaghan eta l. 2009) and the proportion applied on agricultural lands are used to estimate FS on the basis of 3 percent nitrogen content in sewage sludge with typical dry solids content of 25 percent (Fehily Timoney, 1985). The estimate of FS is included in N_2Odirect without deduction for volatilisation and the value is added to FAM for reporting purposes.**

Member State	
Italy	Published estimates of sludge production (Monaghan eta l. 2009) and the proportion applied on agricultural lands are used to estimate FS on the basis of 3 percent nitrogen content in sewage sludge with typical dry solids content of 25 percent (Fehily Timoney, 1985). The estimate of FS is included in N_2Odirect without deduction for volatilisation and the value is added to FAM for reporting purposes.
Spain	28% increase of emissions from sewage, compared to 1990, due to the increase in the sewage activity and to the spread of wastewater treatment. Data on the application of sewage sludge are available for the years 1989, 1993 and 1997. For the other years these data are linearly interpolated.
Sweden	N_2O from sewage sludge used as fertiliser is a part of the N_2O emissions from agricultural soils and may be reported, according to the IPCC Good Practice Guidance, if sufficient information is available. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in submission 2006 of the GHG inventory.
Sweden	N_2O from sewage sludge used as fertiliser is a part of the N_2O emissions from agricultural soils and may be reported, according to the IPCC Good Practice Guidance, if sufficient information is available. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in submission 2006 of the GHG inventory.
United Kingdom	Data sources for the annual production of sewage sludge (as dry matter) were obtained from OFWAT, the Water Commissioner for Scotland and the Northern Ireland regulator, UREGNI. The amounts for the missing years were derived by interpolation/extrapolation of the available data.

Trends

Trends in N_2O emissions from agricultural soils are consistent with the decrease of animal numbers in Europe and with the decrease of nitrogen in manure (see above). The input of nitrogen to agricultural soils also decreased considerably between 1990 and 2011, as shown in Table 6.66. The input of manure decreased by 24%, and the input of mineral fertiliser decreased even more, by EU-15. Accordingly, also the amount of nitrogen volatilized or leached decreased by 15% and , respectively.

Figure 6.39 through Figure 6.52 show the trend of direct N_2O emissions from the source categories mineral and organic fertiliser application and indirect emissions from atmospheric deposition and nitrogen leaching and run-off.

In several countries the fraction of mineral fertiliser that volatilises as NH_3 or NO_x is showing considerable fluctuation (see for example Sweden and Ireland). This is a direct consequence of the varying composition of the types of mineral fertiliser used and the NH_3 emission factors taken from the more detailed ammonia-inventory.

The fraction of livestock N excretion that volatilises as NH_3 or NO_x is reported to be more stable. A decreasing trend can be observed for Denmark and Belgium.

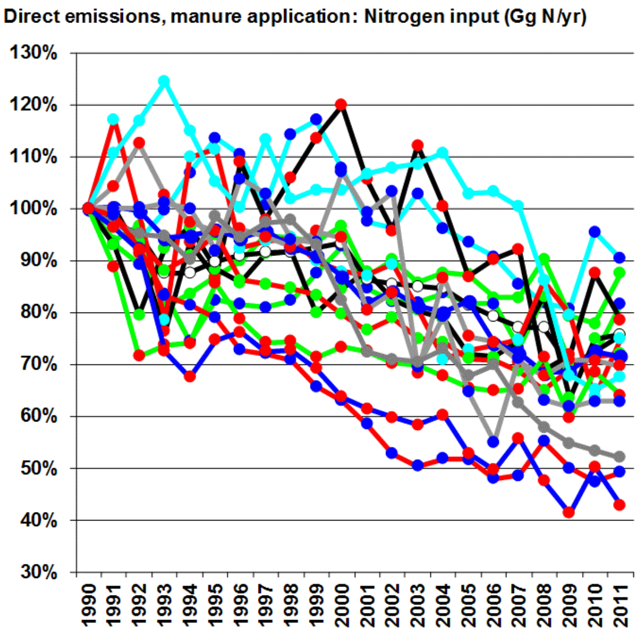
General observations include:

- Denmark: Reduction of total N_2O emissions since 1990 is due to a proactive national environmental policy over the last twenty years to prevent loss of nitrogen from agricultural soil to the aquatic environment. These measures includes among other things a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals per hectare (ha) and maximum nitrogen application rates for agricultural crops. Due to the combination of these increasing environmental requirements and the efforts to obtain economic advantage, the farmers have been forced to improve the utilisation of nitrogen in manure. The improvement of feed efficiency has been one of the most important drivers to reach those objectives. This has led to a halving of nitrogen use in synthetic fertiliser and to a decrease of emission per produced kg of meat, all of which has reduced the overall GHG emission. The national emission from crop residues has decreased as result of a decrease in the cultivated area of beetroot for feeding, which has been replaced by the cultivation of forage maize.
- Finland: N_2O emissions from agricultural soils have decreased since 1990, mainly due to the decrease in animal numbers. Annual changes in some parameters, like crop annual yield and crop

residues, cause the fluctuation in the time series, but the share of these emissions is minor compared to total emissions and it does not affect much the overall trend. Since Finland joined the EU, there has been a reduction in the use of nitrogen fertilisers and an improvement in manure management resulting from agri-environmental programmes. However, the number of cultivated organic soils has increased, leading to an increase in N_2O emissions.

Additional information on the trend in category 4D as reported in the national inventory reports are given below the respective figures.

Figure 6.39: Trend of N_2O emissions for mineral fertiliser – N-input



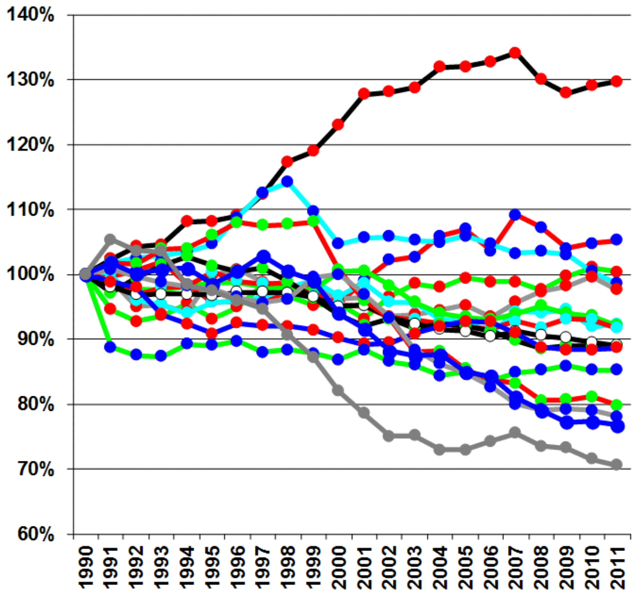
	1990	Trend (%) 1990-2011	2011
Ireland	368.7	90%	351.8
France	2,409.9	87%	1,875.2
Germany	2,089.3	81%	1,499.3
Spain	981.6	78%	858.5
Sweden	222.6	76%	166.5
EU-15	10,109.7	76%	7,324.1
Austria	133.3	75%	84.8
Belgium	200.5	72%	143.2
United Kingdom	1,431.1	71%	1,036.0
Luxembourg	17.0	70%	12.0
Italy	691.7	68%	450.0
Finland	225.1	64%	154.2
Portugal	149.9	63%	94.1
Netherlands	412.4	52%	219.5
Denmark	395.0	49%	187.1
Greece	381.6	43%	191.7

- Austria: High inter-annual variations in N_2O emissions are caused by fluctuations in mineral fertiliser sales. These variations are caused by the effect of storage. As fertilisers have a high elasticity to prices, sales data are changing due to changing market prices very rapidly. Not the whole amount purchased is applied in the year of purchase. The fertiliser tax intensified this effect at the beginning of the 1990s. In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertiliser use in accordance with the IPCC good practice guidance. Investigations showed that data on the actual fertiliser use are not available in Austria. Therefore it has been decided to continue to use the official fertiliser sales data as input data for the emission inventory.
- Greece: The steep decrease observed for the years 1993 and 1994 is due to the cut backs in public incentives for the use of synthetic fertilisers. The decrease in the use of synthetic nitrogen fertilisers could probably be attributed to an increase in organic farming, the price of fertiliser and the impact of initiatives to promote good practice in fertiliser use.
- Portugal: Time series shows an abrupt decrease until 1992 and thereafter a lighter reduction: total synthetic nitrogen fertiliser use in 2003 is 22% less than in 1990. Nitrogen in fertilisers is the first source of nitrogen to soils in Portugal just above nitrogen in animal manure applied to soil. Interannual changes of emissions (2002/2003 16%, 2003/2004 6%, 2004/2005 8%, 2005/2006 11%, fluctuation from 2003) can be explained from variations of emissions from N applied as

synthetic fertilisers. During this period a severe drought occurred which caused reduction in the sales and use of fertilisers.

Figure 6.40: Trend of N_2O emissions for organic fertiliser – N-input

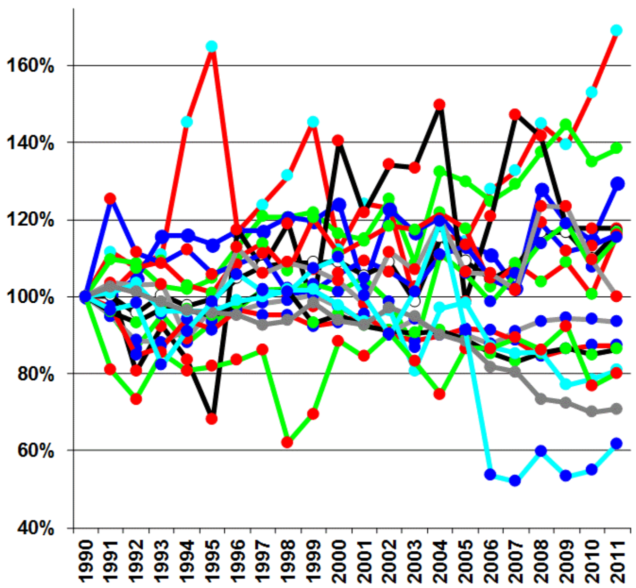
Direct emissions, manure application: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2011	2011
Spain	229.9	130%	296.7
Denmark	182.6	105%	191.1
Finland	60.1	100%	60.7
Ireland	107.3	99%	107.8
Luxembourg	5.9	98%	5.9
Italy	473.9	92%	435.2
France	751.0	92%	702.7
Austria	120.5	92%	112.0
Sweden	70.0	89%	62.3
EU-15	3,992.2	89%	3,572.2
Greece	42.9	89%	37.9
Germany	897.4	85%	764.5
Belgium	159.8	80%	129.6
Portugal	55.0	78%	43.5
United Kingdom	425.6	77%	329.0
Netherlands	410.3	71%	293.4

Figure 6.41: Trend of N_2O emissions from crop residues – N-input

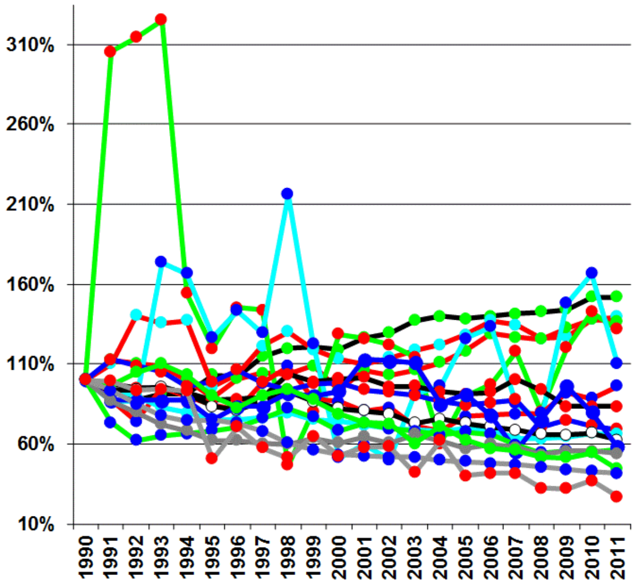
Crop residues: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2011	2011
Austria	41.9	169%	64.0
France	366.2	138%	494.5
United Kingdom	359.5	129%	412.1
Spain	93.4	118%	109.9
EU-15	2,158.8	117%	2,370.9
Belgium	56.3	117%	56.5
Greece	23.6	116%	26.7
Germany	840.3	115%	905.2
Luxembourg	2.9	100%	3.1
Portugal	26.6	93%	25.0
Denmark	59.3	87%	51.8
Sweden	54.5	86%	46.3
Italy	147.5	81%	115.9
Finland	30.7	80%	23.6
Netherlands	36.4	71%	25.5
Ireland	19.7	62%	10.8

Figure 6.42: Trend of N_2O emissions from N-fixing crops – N-input

N-fixing crops: Nitrogen input (Gg N/yr)

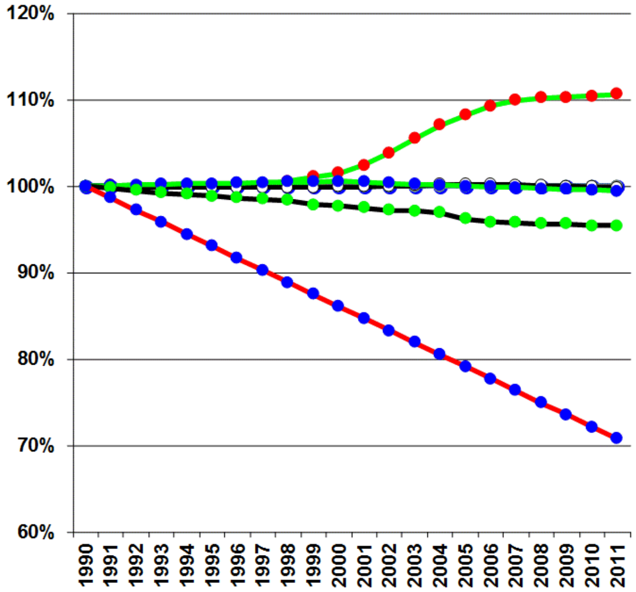


	1990	Trend (%) 1990-2011	2011
Sweden	23.6	152%	35.8
Austria	16.8	140%	23.2
Belgium	3.5	137%	4.8
Finland	0.7	132%	1.0
Ireland	0.5	110%	0.9
Denmark	44.3	96%	39.1
Spain	203.1	83%	169.0
Greece	1.1	69%	0.8
Italy	254.7	66%	170.2
EU-15	1,260.9	62%	842.4
United Kingdom	43.2	58%	34.5
Germany	140.4	57%	77.0
Netherlands	7.8	54%	4.4
France	515.8	44%	279.4
Portugal	5.0	42%	2.1
Luxembourg	0.3	27%	0.1

- Finland: Some parameters, such as the annual crop yields affecting the amount of crop residues produced, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.

Figure 6.43: Trend of N_2O emissions from cultivated histosols – Cultivated area

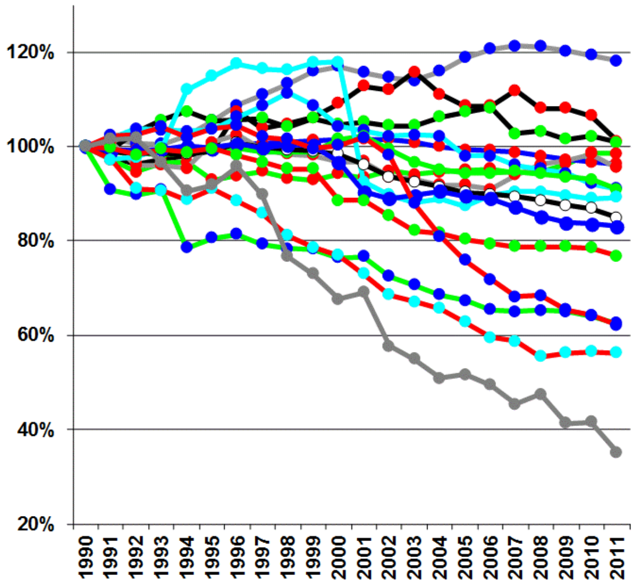
Cultivation of histosols: Cultivated area (km2/yr)



	1990	Trend (%) 1990-2011	2011
Finland	2,997	111%	3,310
United Kingdom	1,500	100%	1,500
Belgium	25	100%	25
Greece	67	100%	67
Italy	90	100%	90
Netherlands	2,230	100%	2,230
EU-15	21,526	100%	21,500
Germany	12,354	99%	12,293
Sweden	1,518	95%	1,448
Denmark	745	71%	537
Austria			
France			
Spain			
Luxembourg			
Portugal			
Ireland			

Figure 6.44: Trend of N_2O emissions from pasture, range, and paddock – N-input

Nitrogen deposited during grazing: Nitrogen input (Gg N/yr)

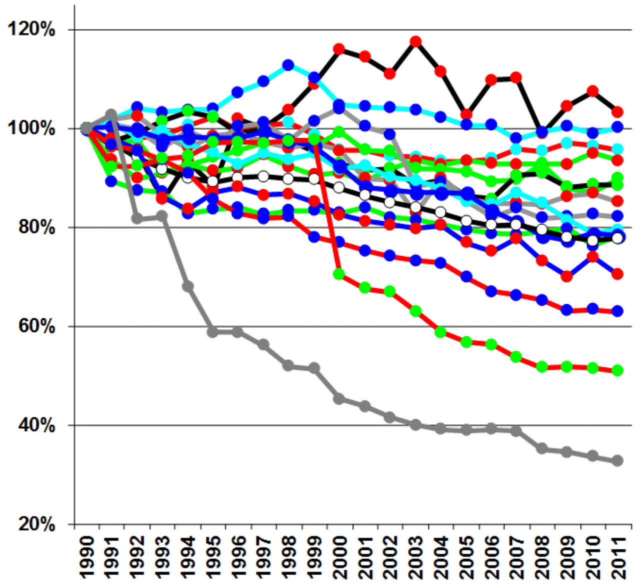


	1990	Trend (%) 1990-2011	2011
Portugal	70.5	118%	84.2
Spain	253.8	101%	270.1
Sweden	44.7	101%	45.7
Finland	19.6	99%	19.3
Greece	186.9	96%	180.6
Luxembourg	6.0	95%	5.9
Ireland	294.4	91%	271.0
France	982.9	91%	913.6
Italy	178.2	89%	158.5
EU-15	3,277.0	85%	2,844.4
United Kingdom	674.6	83%	564.0
Belgium	101.8	77%	79.8
Germany	216.0	63%	138.4
Denmark	34.3	62%	22.0
Austria	17.3	56%	9.8
Netherlands	195.9	35%	81.3

- Netherlands: The decrease of N_2O emissions from meawdoes is caused by a relatively high decrease in N-input to soil (from manure and chemical fertilizer application and animal production in the meadow) partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy driving a shift from surface spreading of manure to the incorporation of manure into the soil. The decrease in indirect N_2O emissions is fully explained by the decrease in N lost by atmospheric deposition and by leaching and run-off. Tendency is to keep grazing animals indoors more, thus decreasing the amount of manure excreted in the meadow. Emissions therefore shift towards category 4B Manure management, but increase there only partially offsets the decrease here, as associated EFs are lower (for CH_4 the opposite is true).

Figure 6.45: Trend of N_2O emissions for atmospheric deposition – N-input

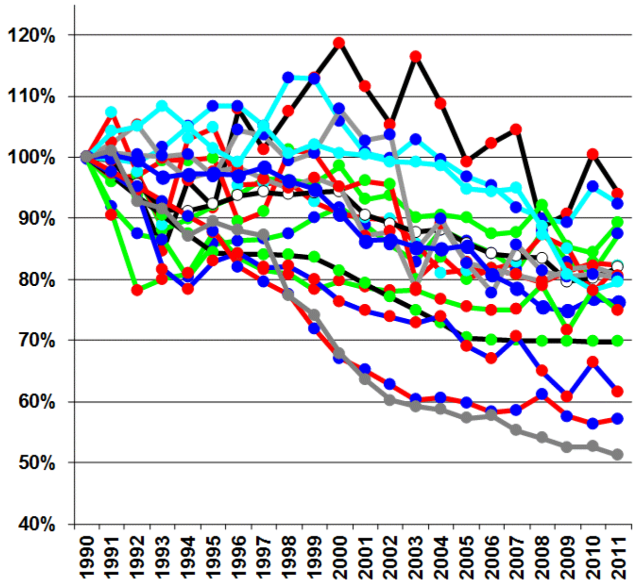
Nitrogen volatilised as NH3+NOx: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2011	2011
Spain	191.7	103%	205.6
Ireland	88.2	100%	87.3
Austria	51.8	96%	49.9
Finland	31.0	93%	29.4
France	654.3	90%	568.8
Sweden	41.7	88%	36.9
Luxembourg	4.6	85%	4.0
Portugal	43.2	82%	35.7
Italy	380.9	79%	299.7
Germany	600.3	78%	457.4
United Kingdom	403.9	78%	318.0
EU-15	3,072.5	78%	2,369.8
Greece	90.5	70%	66.9
Denmark	93.4	63%	59.2
Belgium	100.5	51%	51.7
Netherlands	296.6	33%	99.5

Figure 6.46: Trend of N_2O emissions for nitrogen leaching and run-off – N-input

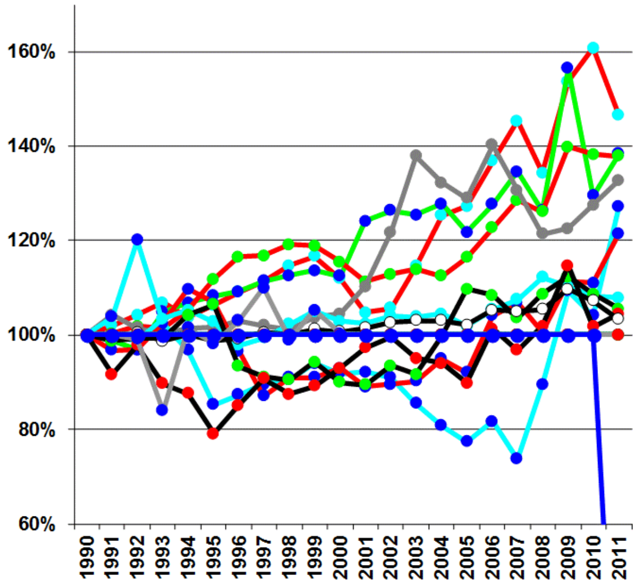
Nitrogen leached/run-off: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2011	2011
Spain	502.1	94%	504.3
Ireland	78.1	92%	74.3
France	1,385.7	89%	1,168.7
Germany	1,118.0	87%	907.0
Belgium	62.3	82%	51.6
Austria	90.3	82%	70.3
EU-15	5,449.7	82%	4,370.2
Luxembourg	9.8	81%	8.0
Portugal	92.2	80%	74.5
Italy	516.1	80%	403.4
United Kingdom	844.4	76%	649.6
Finland	50.6	75%	39.6
Sweden	76.3	70%	53.3
Greece	199.4	62%	132.3
Denmark	267.2	57%	150.6
Netherlands	157.1	51%	82.7

Figure 6.47: Trend of $Frac_{GASF}$

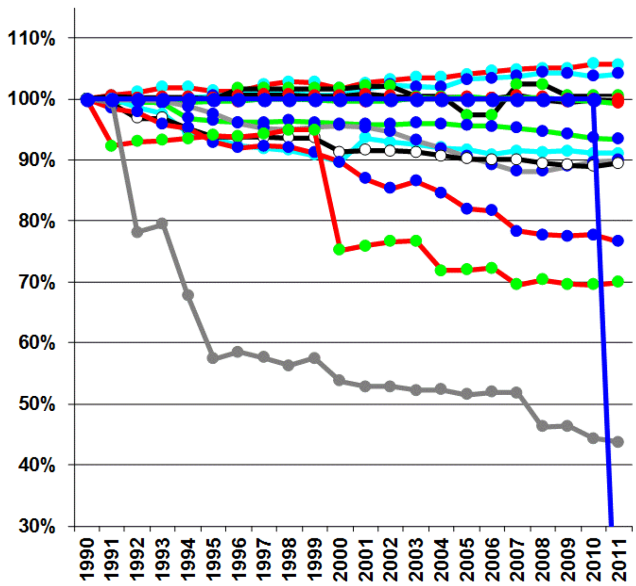
Indirect emissions: FracGASF (%)



	1990	Trend (%) 1990-2011	2011
Austria	0.03	147%	0.04
Germany	0.03	138%	0.04
Belgium	0.03	138%	0.04
Netherlands	0.04	133%	0.05
Ireland	0.03	127%	0.03
Denmark	0.01	121%	0.02
Italy	0.09	108%	0.09
Sweden	0.01	106%	0.01
Spain	0.09	104%	0.09
EU-15	0.05	103%	0.06
Finland	0.01	100%	0.01
Greece	0.10	100%	0.10
Portugal	0.06	100%	0.06
France	0.10	100%	0.10
Luxembourg	0.10	100%	0.10
United Kingdom	0.10	0%	0.10

Figure 6.48: Trend of $Frac_{GASM}$

Indirect emissions: FracGASM (%)

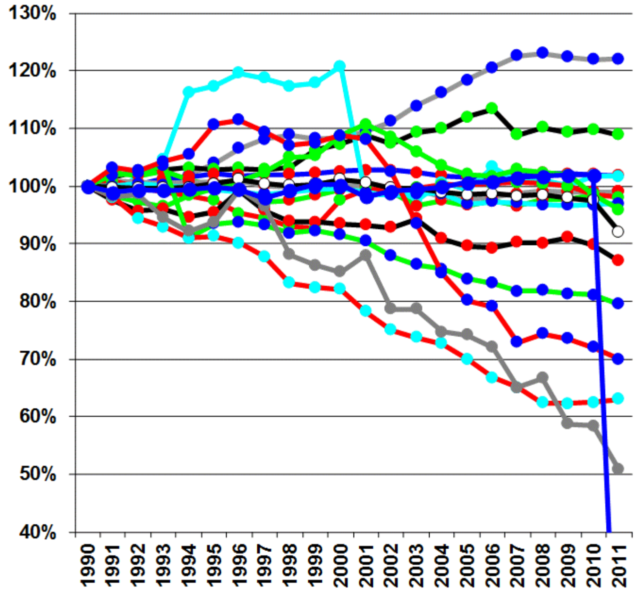


	1990	Trend (%) 1990-2011	2011
Austria	0.26	106%	0.27
Ireland	0.17	104%	0.17
Sweden	0.33	100%	0.33
Greece	0.20	100%	0.20
France	0.20	100%	0.20
Luxembourg	0.20	100%	0.20
Spain	0.16	100%	0.16
Finland	0.25	99%	0.25
Germany	0.32	93%	0.30
Italy	0.32	91%	0.29
Portugal	0.22	90%	0.19
EU-15	0.25	89%	0.22
Denmark	0.25	77%	0.19
Belgium	0.30	70%	0.21
Netherlands	0.39	44%	0.17
United Kingdom	0.20	0%	0.20

- Sweden: Variations in $Frac_{GASF}$ are a direct consequence of the varying composition of types of mineral fertilisers (Swedish Board of Agriculture, Statistics Sweden) and the NH_3 emission factors from CORINAIR (1998).

Figure 6.49: Trend of $Frac_{GRAZ}$

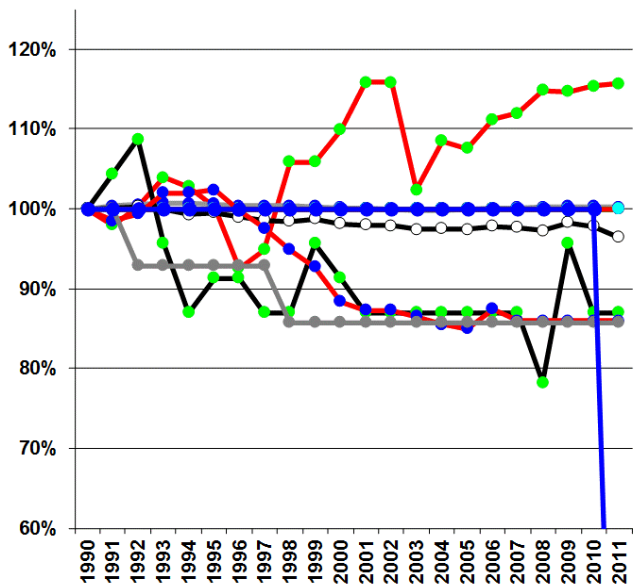
Pasture, range and paddock: FracGRAZ (%)



	1990	Trend (%) 1990-2011	2011
Portugal	0.45	122%	0.54
Sweden	0.30	109%	0.33
Greece	0.78	102%	0.79
Italy	0.19	102%	0.19
Finland	0.18	99%	0.18
Luxembourg	0.45	99%	0.45
Belgium	0.31	98%	0.30
Ireland	0.64	97%	0.61
France	0.48	96%	0.47
EU-15	0.36	92%	0.35
Spain	0.46	87%	0.41
Germany	0.13	79%	0.11
Denmark	0.12	70%	0.08
Austria	0.09	63%	0.06
Netherlands	0.28	51%	0.16
United Kingdom	0.56	0%	0.57

Figure 6.50: Trend of FracLEACH

Indirect emissions: FracLEACH (%)



	1990	Trend (%) 1990-2011	2011
Belgium	0.12	116%	0.13
Portugal	0.32	100%	0.32
Greece	0.30	100%	0.30
Italy	0.30	100%	0.30
Finland	0.15	100%	0.15
Luxembourg	0.30	100%	0.30
Ireland	0.10	100%	0.10
France	0.30	100%	0.30
Spain	0.30	100%	0.30
Germany	0.30	100%	0.30
Austria	0.30	100%	0.30
EU-15	0.26	96%	0.25
Sweden	0.23	87%	0.20
Denmark	0.38	86%	0.33
Netherlands	0.14	86%	0.12
United Kingdom	0.30	0%	0.30

- Denmark: FracLEACH is decreasing since the 1990s, when manure was often applied in autumn. The decrease in FracLEACH over time is caused by sharpened environmental requirements, banning manure application after harvest. The major part of manure application is made in spring and summer, where there is a precipitation deficit. This is due to a decrease in the emission from leaching and run off, which is decreased because of a decrease in N-input mainly from synthetic fertilizer. The annual fluctuating is due to climatic changes and especially the precipitation conditions.

- Sweden: Regarding the leach factor (4d3), there is an important decrease between 1999 and 2005, believed to be consequence of an increase in the area of catch crops. However, other factors such as an increased concern of eutrophication problems may have led to a changed fertilising patterns.

Figure 6.51: Trend of direct emissions from the cultivation of histosols - IEF

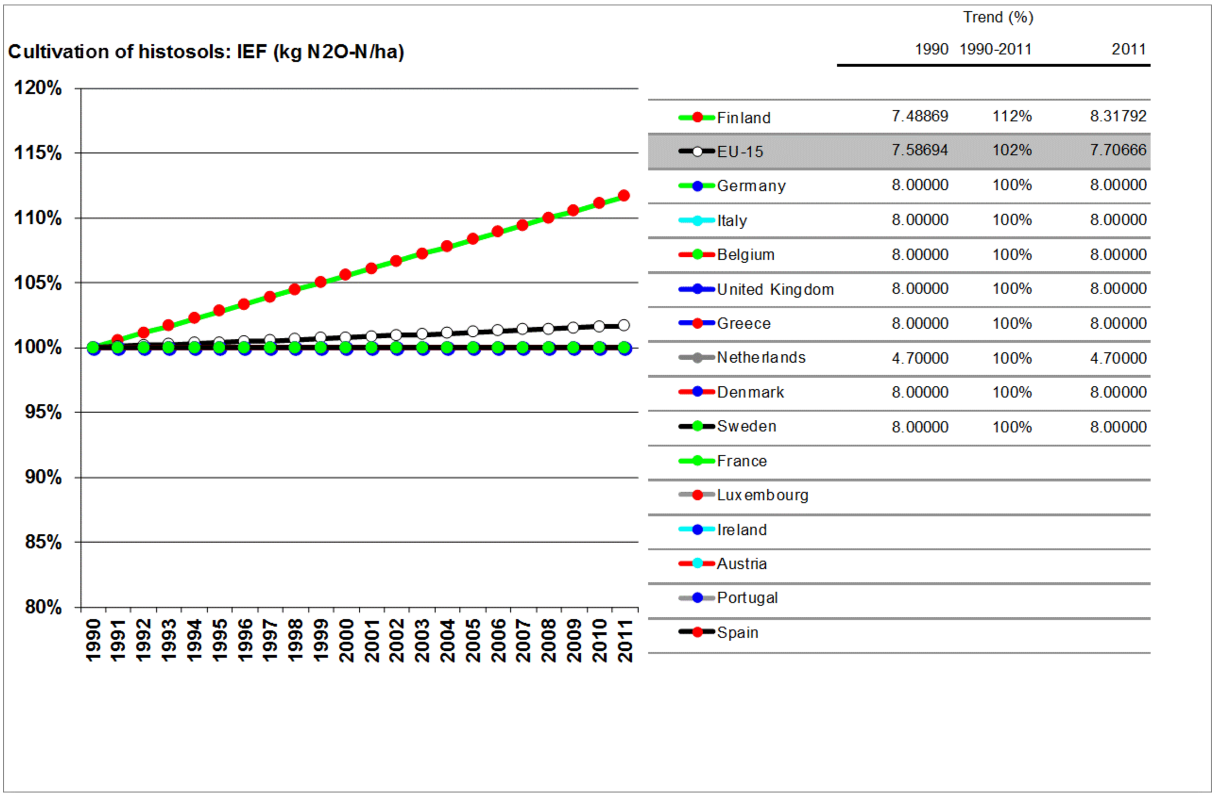
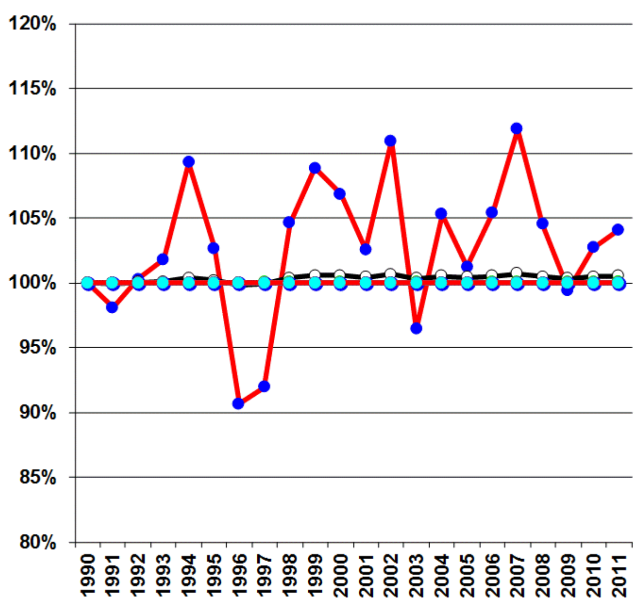


Figure 6.52: Trend of indirect emissions from leaching/run-off - IEF



	1990	Trend (%) 1990-2011	2011
Denmark	0.01880	104%	0.01930
EU-15	0.02470	100%	0.02480
France	0.02500	100%	0.02500
Sweden	0.02500	100%	0.02500
Spain	0.02500	100%	0.02500
Netherlands	0.02500	100%	0.02500
Greece	0.02500	100%	0.02500
Belgium	0.02500	100%	0.02500
Germany	0.02500	100%	0.02500
Portugal	0.02500	100%	0.02500
Italy	0.02500	100%	0.02500
Ireland	0.02500	100%	0.02500
Finland	0.02500	100%	0.02500
United Kingdom	0.02500	100%	0.02500
Luxembourg	0.02500	100%	0.02500
Austria	0.02500	100%	0.02500

6.3.5.3 Uncertainty *and time series consistency*

As described above, N_2O emissions from agricultural soils are among the most uncertain source categories of national GHG inventories. For direct N_2O emissions, the highest uncertainty is attributed to the emission factor, which ranges up to 400% relative uncertainty in Greece (expressed in 2•standard_deviation) and even up to 500% for each sub-category in Portugal. For indirect emissions, both the activity data and the emission factors are considered equally uncertain, which stems from the fact that a most uncertain parameter, the fraction of nitrogen leached, must be applied to determine the activity data. Thus, uncertainties of indirect N_2O emissions are estimated as up to more than 200% (Finland, Netherland, Portugal).

This large difference of the uncertainty estimates does not reflect real differences in the uncertainties of the emission estimates. Rather, the differences are caused by different interpretation of the available data:

- In the United Kingdom, the uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (per. comm.).
- The estimate of Portugal is based on the Good Practice Guidance that presents a possible variation from one-fifth to 5 times the default emission factor of 1.25 per cent. From that range an uncertainty of 500 per cent was assumed in uncertainty analysis.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.81 and Table 6.82. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in section 6.4

Table 6.83 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from agricultural soils.

Table 6.81: Relative uncertainty estimates for activity data in category 4D

Member State	Total	Direct	Animal Production	Indirect
Austria		5.0		5.0
Belgium		30.0	30.0	30.0
Denmark			25.5	
Finland		118.1	196.3	296.5
France		15.0	20.0	120.0
Germany		15.4	20.0	142.8
Greece		20.0	50.0	20.0
Ireland		11.2	11.2	11.2
Italy		20.0	20.0	20.0
Luxembourg		10.0	10.0	20.0
Netherlands		10.0	10.0	50.0
Portugal	19.7			
Spain		18.0	16.0	190.0
Sweden		15.0	35.0	28.4
United Kingdom	1.0			

Table 6.82: Relative uncertainty estimates for implied emission factors in category 4D

Member State	Total	Direct	Animal Production	Indirect
Austria		150.0		150.0
Belgium		250.0	250.0	250.0
Denmark			100.0	
Finland				
France		140.0	200.0	430.0
Germany		53.2	200.0	319.1
Greece		400.0	100.0	50.0
Ireland		100.0	100.0	50.0
Italy		100.0	100.0	100.0
Luxembourg		150.0	150.0	150.0
Netherlands		60.0	100.0	200.0
Portugal	181.1			
Spain		400.0	100.0	50.0
Sweden		65.8	150.0	121.9
United Kingdom	424.0			

Table 6.83: Available background information for uncertainty estimates in category 4.D

Member State	Background information to uncertainty estimates
Austria	Mineral Soils – EF: Revision of the uncertainty estimate of N_2O from soils. A detailed investigation reveald that the source of the 48% uncertainty presented was a statement in an IPCC report (2000) referring to a measurement uncertainty. Here we have to deal with an emission factor uncertainty, which is estimated much higher, at an order of magnitude (IPCC, 2006). This higher number is still much smaller than the two orders of magnitude recommended by IPCC (2000). The latter was considered in part systematic uncertainty, however (the random uncertainty was considered smaller than the range now used) - this is still in part true, but only reflects our lack of knowledge on soil processes. Choosing to apply a quasi-standardized value conforms to the claim of (Winiwarter, 2007) that application of similar parameters between countries allows for a smaller error in an inter-comparison, even if the difference to a "true value" might be larger.In the latest Austrian study (WINIWARTER 2008) for the emission factor of N_2O from soils an uncertainty of 150% was applied. Uncertainty contributions of the activity (combined from agricultural area and average N-fertiliser

Member State	Background information to uncertainty estimates
	input) at about 5% is almost negligible in this context. It is virtually N_2O alone that determines the uncertainty. Uncertainties of emission factors of indirect emissions are not significantly different from those of direct emissions, and the underlying processes (microbial nitrification/denitrification) are identical. Thus it was decided to treat the uncertainties of directand indirect emissions as being correlated.
Belgium	Mineral soils - AD: N_2O emissions from soils involves the use of more AD (mineral fertilisers, atm. deposition and runoff, manure application, ...) Consequently the uncertainty on AD is estimated at 30% , which seems in line with the values applied by other parties. Mineral soils – EF: The uncertainty of N_2O from agricultural soils is crucial for the determination of the overall uncertainty. Although most countries use the IPCC default values, the uncertainty on emission factors varies widely : 2 orders of magnitude (Norway), 509 % (UK, in IPCC Good Practice Guidance), 200 % (France and the Netherlands, NIR 2003), 100 % (Ireland, NIR 2003), 75 % (Finland, overall uncertainty for AD*EF, [40]), 24 % (Austria, NIR 2003). For the time being, a more or less average value of 250 % is used for this uncertainty calculation.
Denmark	Mineral soils – AD: Both farmers and suppliers of mineral fertilisers are obliged to report to the Plant Directorate. The total sold to farmers is very close to the amount imported by the suppliers, corrected by storage. The total amount of mineral fertiliser in Denmark is, therefore, a very precise estimate for the mineral fertiliser consumed. This is also valid for N-excretion in animal manure.
Finland	The uncertainty estimate for N_2O emissions from agricultural soils is very high due to both lack of knowledge of emissions generating process and high natural variability and was estimated at -60 to +170% (direct) and -60 to +240% (indirect). For the 2005 inventory submission, uncertainty estimates were revised based on measurements data. The range of annual average emission factors obtained from different soils reveal that uncertainty may be larger than previously estimated. Mineral soils - AD: Uncertainties in N_2O emissions from agricultural soils are estimated by applying Tier 2 Monte Carlo simulation to the emission calculation models. The most effective way to reduce uncertainty would be case D, i.e., the use of the climate-specific emission factors for N_2O from agricultural soils (Monni et al., 2007). On the basis of this study, at this stage the national field data does not enable the development of a reliable national emission factor for mineral soils. The national emission factor for N_2O emission from cultivated organic soils would be 7.9 kg ha-1 a-1 with an uncertainty of -114 to +187%, which is very close to the IPCC default value... These results from the field monitoring indicated that even if large national measurement campaigns are introduced, this source will still remain very uncertain. (Monni et al., 2007) Organic soils: The accuracy of the emission estimate for organic soils could be further improved by adopting separate emission factors for grass and cereals since emissions from grass fields are consistently lower due to less frequent tillage of the soil and a longer period of nitrogen uptake of the grass compared to cereals (Monni et al., 2007)
Germany	The detailed discussion in this source indicates that the error for relevant areas is on the order of 10 % and that the error for emissions is on the order of 50%.
Ireland	Large uncertainties still remain in relation to the N_2O emissions from the agricultural sector. These uncertainties are the main determinant behind uncertainty in total national emissions
Italy	Montecarlo analysis was also applied to estimate uncertainty of the two key categories Direct N_2O emissions from agricultural soils and Indirect N_2O emissions from nitrogen used in agriculture. Normal and lognormal distributions have been assumed for the parameters; at the same time, whenever assumptions or constraints on variables were known this information has been appropriately reflected on the range of distribution values.
Luxembourg	Arable land crops, used to estimate soil emissions, are on the high end at 10%, just the “fallows” (which is the basis for calculating indirect soil emissions) is considered statistically dependent, but twice as high. Most similar analyses of uncertainties of national GHG inventories have already shown previously that N_2O emissions from soils are poorly understood and are the highest priority for methodological improvement. Mineral soils – EF: Manure application emission factor follow a 70% uncertainty for CH_4 and a range from 50% to 200 % (lognormal distribution) for N_2O. The CH_4 emission factor for soil emissions is considered uncertain by +/-100%, the N_2O emission factor is within a factor of 10 (lognormal distribution, from 30% to 300% of the best estimate) following IPCC (2006).
Netherlands	The uncertainty in direct N_2O emissions from Agricultural soils is estimated to be approximately 60%. The uncertainty in indirect N_2O emissions from N used in agriculture is estimated to be more than a factor of 2 (Olivier et al.,2009).
Portugal	Mineral soils – AD: Comparing the values of nitrogen in synthetic fertilisers form these independent data sources between 1995 and 2000 a maximum uncertainty value of 17 per cent was obtained. For nitrogen in animal manure applied to soil and animal grazing, we take 100%, due to the uncertainty in the percentage of manure that ends up in soil. For crop production, the IPCC 2000 default (25%). For indirect N_2O emissions from soils, uncertainty in activity data is considered 50% higher than for direct emissions, in order to incorporate the error of the volatilisation and leaching fractions (in line with IPCC 2000); final uncertainty value is 63%. Mineral soils – EF: From that range an uncertainty of 500 per cent was assumed in uncertainty analysis for nitrogen applied as synthetic fertilisers, manure, crop residues and nitrogen fixed by n-fixing crops. Considering that in the cases of nitrogen added to soil from n-fixing crops and crop residues, an additional 100 per cent uncertainty was added to take into account errors in the determination of nitrogen content of crops and residues from production. For indirect N_2O emissions from soils, default uncertainty level from IPCC 2000.

Member State	Background information to uncertainty estimates
Sweden	**Mineral soils – EF: Direct N_2O emissions from agricultural fields are calculated with an error of about 80% in the emission factor. The disaggregating of direct emissions from manure and mineral fertilisers, respectively, in the Swedish inventory may reduce some of the variability but direct emissions from agricultural soils are still one of the most uncertain in the inventory.**
United Kingdom	**Emissions from agricultural soils were correlated. The uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (pers. comm.).** **Mineral soils – EF: The overall uncertainty quoted is calculated using the first method in order that uncertainties should not be underestimated in sectors showing a skewed distribution such as agricultural soils and N_2O as a whole.**

6.3.6 Agricultural Soils – CH_4

CH_4 fluxes from agricultural soils are reported only by Austria. In Austria, CH_4 emissions from Agricultural Soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions. The average carbon content of sewage sludge amounts to 300 kg C/t (Detzel et al., 2003; Schaefer 2002), 52% of the carbon is emitted to the air from which 5% as methane. Emissions of 0.44 Gg CH_4 yr^{-1} are calculated.

In Germany, fluxes of CH_4 from agricultural soils are not considered for the first time in the inventory for the year 2008. CH_4 is taken up in aerobic soils, and N-application reduces this sink for CH_4. In former inventories, the estimation was based on the approach of Boeckx and Van Cleemput (2001), compiling the available observations in Europe, differentiating emissions from grassland ($EFCH_4$ = - 2,5 kg ha-1 a-1CH_4) and from cropland ($EFCH_4$ = - 1,5 kg ha-1 a-1 CH_4). In the course of the development of the IPCC(2006) guidelines, however, no consensus could be found how this CH_4 sink in agricultural soil could be considered (A. Freibauer, pers. comm.).

6.3.7 Field burning of crop residues – CH_4 and N_2O (CRF source category 4.F)

Burning of crop residues on the field gives rise to emissions of various compounds, including aerosols and trace gases. Field burning of crop residues is forbidden in Europe. Most countries therefore do not report CH_4 and N_2O emissions from this source category. Also at European level, this source category contributes only insignificantly to total emissions from agriculture. We therefore present only limited information, including total CH_4 and N_2O emissions and emissions from the two most important crop groups (cereals and 'other') (Table 6.84) and methodological information as described in the national GHG inventory reports (Table 6.85). The trend of CH_4 and N_2O emissions from field burning of crop residues is shown in

Figure 6.53 and Figure 6.54. In many countries, field burning of crop residues has become illegal since 1990 so that the emissions show a significant decline by almost one order of magnitude. Only Greece and Italy report stable emissions from this source category.

Table 6.84: CH_4 and N_2O Emission from burning of crop residues in 2011

2011	Total Gg CO2-eq		Cereals Gg CO2-		Other Gg CO2-eq	
	CH4	N2o	CH4	N2o	CH4	N2o
Austria	0.9	0.0	0.5	0.0	0.4	0.0
Belgium						
Denmark	2.6	0.1	0.2	0.0	2.4	0.1
Finland	0.6	0.0	0.6	0.0		
France	21.0	0.6	17.1	0.4	2.0	0.1
Germany						
Greece	26.9	0.7	25.9	0.7		
Ireland						
Italy	12.8	0.3	12.8	0.3		
Luxembourg						
Netherlands						
Portugal	21.7	1.1	8.3	0.2	13.5	0.9
Spain	368.5	4.5			368.5	4.5
Sw eden						
United Kingdom						
EU-15	**455.2**	**7.3**	**65.5**	**1.6**	**386.8**	**5.6**

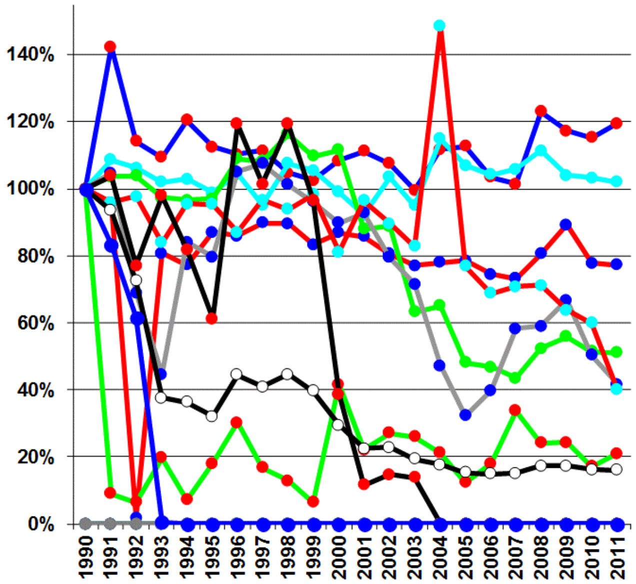
Table 6.85: Methodologies used to calculate CH_4 and N_2O Emission from field burning of crop residues in 2010

Member States	
Austria	**Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale.**
Denmark	**Field burning of agricultural residues has in Denmark been prohibited since 1990 and may only take place in connection with production of grass seeds on fields with repeated production and in cases of wet or broken bales of straw. The amount of burnt straw from the grass seed production is estimated as 15 % of the total amount produced. The amount of burnt bales of or wet straw is estimated as 0.1 % of total amount of straw. Both estimates are based on an expert judgement by the Danish Agricultural Advisory Service. The total amounts are based on data from Statistics Denmark. The fraction value FracBURN is calculated by using the definitions as given in IPCC Reference Manual.**
Finland	**Default. The share of straw burned in 2007 (0.25%) is an estimate made by several experts on crop cultivation in different parts of Finland. The trend of residue burning is assumed to follow the trend of rye crop yield as rye is the most common straw burned on fields. The share of burned residue from total cereal residue on the fields for the years 1990-2006 is estimated on the basis of the annual rye yield.**
France	**IPCC default**
Greece	**The fraction of residues that is burned on-site in fields, which needs to be subtracted, was assumed to be 10%.**
Italy	**Country-specific methodology is used for estimating emissions from field burning of agriculture residues. Emissions from fixed residues, stubble (stoppie), burnt on open fields, are reported in this category (4F) while emissions from removable residues (asportabili) burnt off-site, are reported under the waste sector. The following data are used: (a) annual crop production, removable residues/product ratio, and “fixed” residue/removable residues ratio; (b) dry matter fraction; (c) fraction of the field where “fixed” residues are burned, and fraction of residues oxidized during burning; (d) fraction of carbon and nitrogen from the dry matter of residues; (e) default emissions rates for C-CH_4 and N-N_2O.**
Netherlands	**Open fires/burning in the field is prohibited by law and therefore negligible in practice.**
Spain	**Despite the new regulations prohibiting the burning agricultural residues for most crops, these regulations are not the main reason for changes in this category of emissions. The main driver for trends in the emissions from burning of agricultural residues is the burning of rests of pruning of olive trees and vines, which have not been reduced.**
Portugal	**In-site burning of agricultural residues is still practiced nowadays in Portugal, being however forbidden by law-decree during the Forest Fire Season from May to September. Burning of residues from vineyards and olive oil are the most significant sources. Methodology according**

Member States	
	to IPCC, except for the fact that residue biomass is not estimated from crop production but from residue production quantities by cultivated area. Quantity of residues and actually burnt fraction from expert opinion from the Agriculture Ministry (Seixas et al., 2000). Only for rice a detailed and time-series could be developed following the information received from the agriculture experts from the Portuguese Ministry of Agriculture: (i) traditionally, stubbles and straw were burnt between crops, as the use of rice straw as fodder or bedding is not significant, and is not removed from field; (ii) more recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by ploghing (only procedure allowed in the area subject to the "Techniques of Integrated Production and Protection", which is about 50 per cent of rice paddies in 2004). It may be assumed that, in 1990, 100 per cent of rice paddies were burnt and no organic amendments were added to soil. Today the area subjected to burning is between 30 and 40%.
United Kingdom	**Field burning has largely ceased in the UK since 1993. For years prior to 1993, field-burning data were taken from the annual MAFF Straw Disposal Survey (MAFF, 1995). The estimates of the masses of residue burnt of barley, oats, wheat and linseed are based on crop production data (Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI) and data on the fraction of crop residues burnt (MAFF, 1995; ADAS, 1995). Field burning ceased in 1993 in England and Wales. Burning in Scotland and Northern Ireland is considered negligible, so no estimates are reported from 1993 onwards. The carbon dioxide emissions are not estimated because these are part of the annual carbon cycle.**

Figure 6.53: Trend of CH_4 emissions from field burning of crop residues

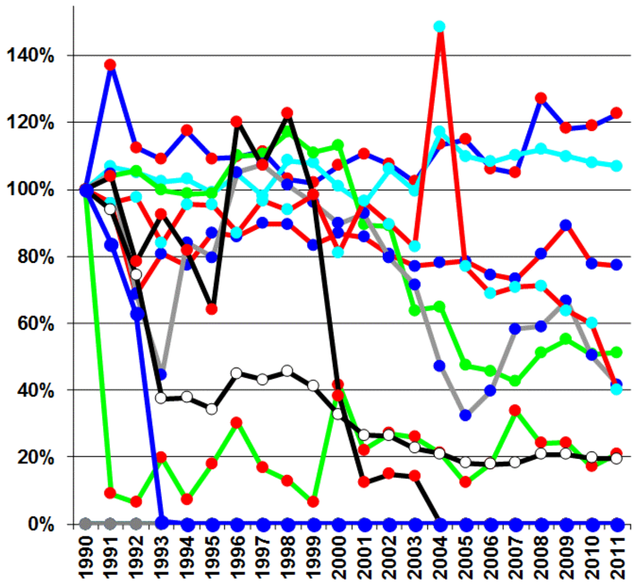
Field burning of crop residues: CH4 emissions (Gg CH4/yr)



	1990	Trend (%) 1990-2011	2011
Greece	1.218	119%	1.403
Italy	0.623	102%	0.643
Denmark	0.015	77%	0.011
France	1.853	51%	0.954
Portugal	0.676	42%	0.340
Austria	0.035	40%	0.021
Finland	0.090	21%	0.015
EU-15	20.939	16%	3.388
Germany			
Belgium			
Luxembourg			
Sweden			
Ireland			
Spain	3.767	0%	0.000
Netherlands			
United Kingdom	12.662	0%	0.000

Figure 6.54: Trend of N_2O emissions from field burning of crop residues

Field burning of crop residues: N2O emissions (Gg N2O/yr)



	1990	Trend (%) 1990-2011	2011
Greece	0.031	123%	0.036
Italy	0.013	107%	0.014
Denmark	0.000	77%	0.000
France	0.046	51%	0.023
Portugal	0.018	42%	0.009
Austria	0.001	40%	0.000
Finland	0.002	21%	0.000
EU-15	0.428	20%	0.084
Germany			
Belgium			
Luxembourg			
Sweden			
Ireland			
Spain	0.062	0%	0.000
Netherlands			
United Kingdom	0.256	0%	0.000

6.4 Sector-specific quality assurance and quality control

The following sections describe a methodology to estimate the uncertainty of Member States and the EC's emission estimates in the sector agriculture. The method involves several additions to the approaches described in the IPCC guidelines (IPCC 2000, 2006). This includes:

(1) a quantitative assessment of the Tier level of the emission estimate based on the individual factors and parameters used for all member states and for the EU;
(2) consistent aggregation of the available uncertainty information to the level of the categories including gap filling where necessary. This is done using both Tier 1 and Tier 2 methodology for both level and trend uncertainty;
(3) aggregation of categorical uncertainty estimates to the EU level using quantitative information on the level of independence. As a proxy for the level of independence, the Tier level is used and is defined as follows: Tier 1 if only default IPCC data are used in the estimation equation and Tier 2 if the emissions estimate is based on country-specific data. Through the aggregation of emission data by categories and countries, intermediate values between Tier 1 and Tier 2 become possible.

The methodology has been published in the Journal Climatic Change in the year 2010 (open access: http://dx.doi.org/10.1007/s10584-010-9915-5).

The following section describe the methodology and update the tables to the last inventory year of 2010.

6.4.1 Determination of the Tier level

The IPCC methodology estimates emissions Es from a certain source category s as

$$E_s = IEF_s \cdot AD_s \qquad (1)$$

where ADs are the activity data for the source category s and IEFs is the implied emission factor for this category. There are three levels for estimating the emissions, called Tier 1, Tier 2, and Tier 3, moving from the use of default values over the inclusion of national information to the application of modelling tools. In order to define an EU-wide Tier level per source category and sector, two criteria must be met:

- For each source category and Member State a Tier level must be assigned.
- To assess the Tier level of aggregated emissions derived at different quality, the Tier levels must be measured on an interval scale, allowing 'intermediate' Tier levels.

To do so, we developed standard procedures for each source category. These are based on the following principles:

(i) The flow of nutrients in agriculture implies that the emission in one category can serve as activity level in another. For example, nitrogen excretion can be regarded as an emission of nitrogen in livestock production systems. According to the IPCC the amount of nitrogen excreted is an activity data for estimating N_2O emissions from manure management. Thus, in contrast to the IPCC definitions, we define as activity data only this information that must be obtained using statistical surveys (e.g., population data, distribution of animal manure systems etc.) and regard everything else as parameters (emission factors and other factors).

(ii) A Tier level is assessed for each parameter by comparing the IPCC default value with the value used by the countries. If the default IPCC value is used, the Tier level is set to Tier 1 and otherwise the Tier level is set to Tier 2. Caution must be taken if country-specific data are identical to the default values.

(iii) An appropriate estimation of the basic activity data (animal numbers, mineral fertiliser consumption, allocation of manure to the manure management systems) is regarded as basic requirement for the estimation of the source strength and is not considered in the calculation of the overall Tier level.

Note however, that Tier levels are aggregated applying different aggregation rules:

1. The MEDIAN-rule should be applied where the Tier level of a product of different parameters Pi is to be evaluated. For example the emission factor for CH_4 emissions from manure management is calculated from the CH_4 production potential, the methane conversion factor, and the volatile solid excretion. The aggregation of the Tier level of these parameters to estimate the level of quality of the emission factor should follow the following principles. (i) If parameters with very different quality are multiplied, the higher quality should get more weight; (ii) if parameters with different uncertainty are multiplied, it should be good practice to estimate the parameter which is associated with the higher uncertainty at a higher Tier level. Thus, the aggregation rule should reward if efforts have been made to improve uncertain parameters. However, with the lack of a comprehensive set of relative uncertainty estimates for the individual parameters, in the following equation an arbitrary weighting factors $w_{p,j}$ has been introduced, based on expert judgment.

$$Q_{\prod_i P_i} = 3 - \prod_i \left(3 - Q_{P_i}\right)^{\frac{w_{p,i}}{\sum_j w_{p,j}}} \qquad (2)$$

   with *i* and *j* indicating the individual parameters to be multiplied. The term (3-Q_i) assures that a higher weight is given to the parameter estimated with the higher Tier.

   In some cases, when there is clear domination of one multiplicative parameter, the median rule simplified and the Tier level of the product is approximated with that Tier level. This simplified rule has been applied to estimate the Tier level of CH_4 emissions from enteric fermentation, which is in many cases based or validated with direct measurements.

2. The MEAN-rule if an emission estimate is calculated as the sum of two or more sub-categories. In this case, the Tier levels of the individual estimates are aggregated using an emission-weighted average. E.g., the Tier level of indirect N_2O emissions from agriculture Q4D3 is calculated from the Tier levels calculated for indirect emissions through volatilization of nitrogen gases Q4D3a and leaching/run-off of nitrate Q4Db according to:

$$Q_{A+B} = \frac{Q_A \cdot E_A + Q_B \cdot E_B}{E_{A+B}} \qquad (3)$$

It must be noted, however, that a higher Tier-level does not automatically mean that also the emission estimate is more accurate. The relationship only holds, if (i) inherent links between processes are reflected in the methodology; (ii) parameters are based on statistically representative sample of measurements or carefully with experimental data validated models.

6.4.1.1 *CH_4* emissions ***from enteric fermentation***

The Tier level for CH_4 emissions from enteric fermentation is determined by comparison of the Implied Emission Factor with the IPCC default emission factors. The Tier level for cattle, sheep, goats, swine, and reindeer is shown in Table 6.86

Table 6.86: Tier level of IEFs for CH_4 emissions from enteric fermentations in 2011.

2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Reindeer
Austria[1)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	
Greece	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Netherlands	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Portugal[1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.5	Tier 1.0	Tier 1.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 1.7**	**Tier 1.3**	**Tier 1.6**	**Tier 2.0**

1) Dairy-cattle for Spain and Non-dairy cattle for Austria and Portugal: IEF equals default IPCC EF, however Tier 2 has been used according to the national inventory reports.

6.4.1.2 *CH_4* emissions ***from manure management***

The determination of the Tier level for the estimation of CH_4 emissions from manure management is done in four steps

1. "Default" CH_4 conversion factors for each manure management system are calculated on the basis of the allocation of manure to the different AWMS
2. The results are compared with the used MCF and a Tier 2 level assigned if the two numbers differ (see Table 6.87).
3. The final Tier level is obtained using the MEDIAN rule from the Tier levels of MCF, B_0, and VS, using the following weigths: w_{MCF}=0.13; wB_0=0.13; w_{VS}=0.75 (see Table 6.88, Table 6.89, and Table 6.90). The highest weight is given to the Volatile solid excretion factor because it can and should be based on the detailed characterization of the animal performance.

Table 6.87: Tier level of MCF for CH_4 emissions from manure management in 2011.

2011 MCF	Dairy	Non-dairy	Sheep	Goats	Sw ine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Denmark	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Greece	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg [1)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.4**	**Tier 1.4**	**Tier 1.0**	**Tier 1.0**	**Tier 1.4**	**Tier 1.0**

Sheep and goats get Tier 1 for MCF!

The data used for B_0 and VS are compared with IPCC default values.

Table 6.88: Tier level of B0 for CH_4 emissions from manure management in 2011.

2011 B0	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.3**	**Tier 1.3**	**Tier 1.0**	**Tier 1.1**	**Tier 1.2**	**Tier 1.1**

Table 6.89: Tier level of VS for CH_4 emissions from manure management in 2011.

2011 VS	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Netherlands [2]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 1.5**	**Tier 1.4**	**Tier 2.0**	**Tier 1.5**

Table 6.90: Tier level of the IEFs for CH_4 emissions from manure management in 2011.

2011 IEF	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.9	Tier 1.0
Belgium	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Denmark	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Finland	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.8
France	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.9	Tier 2.0	Tier 1.9
Greece	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.0	Tier 1.2	Tier 1.0
Ireland	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0
Netherlands [1]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Spain	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.8
Sweden	Tier 1.9	Tier 1.9	Tier 1.2	Tier 1.9	Tier 1.9	Tier 1.9
United Kingdom	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.9**	**Tier 1.9**	**Tier 1.4**	**Tier 1.4**	**Tier 1.8**	**Tier 1.4**

[1] Netherlands does not give background data in Table 4B(a), however according to the national inventory report a Tier 2 methodology is used.

6.4.1.3 *N_2O emissions from manure management*

The determination of the Tier level of the estimate of N_2O emissions from manure management is done in four steps

1. The comparison of the N-excretion rates used with the IPCC default values (see Table 6.91)
2. The determination of the Tier level of manure allocated to the manure management systems based on the Tier level of the N-excretion rate by animal type and the allocation of manure-nitrogen to the manure management systems reported in Table 4B(b) (see Table 6.92)

3. The comparison of the N_2O emission factor used with the IPCC default values (see Table 6.93)
4. The calculation of the overall Tier level on the basis of the MEDIAN rule by using the Tier level of the IEF (with a weight of 0.33) and the Tier level of the allocated manure nitrogen to the manure management systems (with a weight of 0.67).

Table 6.91: Tier level of the N-excretion rates for N_2O emissions from manure management in 2011.

2011 Nex	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Austria	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0		Tier 2.0	Tier 2.0	
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Italy	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**

[1)] Netherlands does not give N-excretion data in Table 4B(b), however according to the national inventory report a Tier 2 methodology is used.

Table 6.92: Tier level of the allocation of manure-nitrogen to the manure management systems for N_2O emissions from manure management in 2011.

Member State	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.8		Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 1.1		Tier 1.2	Tier 0.8	Tier 1.9
France	Tier 2.0		Tier 2.0	Tier 2.0	
Germany	Tier 2.0		Tier 2.0	Tier 2.0	
Greece	Tier 1.8	Tier 2.0	Tier 1.6	Tier 1.9	Tier 1.1
Ireland	Tier 2.0		Tier 2.0	Tier 2.0	
Italy	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands	Tier 2.0		Tier 2.0	Tier 2.0	
Portugal	Tier 2.0		Tier 1.8	Tier 2.0	
Spain	Tier 1.0	Tier 1.0	Tier 1.2	Tier 2.0	Tier 2.0
Sweden	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
EU15	**Tier 2.0**	**Tier 2.0**	**Tier 1.9**	Tier 2.0	**Tier 2.0**

[1)] including anaerobic lagoon

Table 6.93: Tier level of the IEFs for N_2O emissions from manure management in 2011.

2011	Liquid system[1)]	Solid storage and dry lot	Other
Austria	Tier 1	Tier 1	Tier 2
Belgium	Tier 1	Tier 1	Tier 1
Denmark	Tier 2	Tier 1	Tier 2
Finland	Tier 1	Tier 2	Tier 1
France	Tier 1	Tier 1	NA
Germany	Tier 2	Tier 2	NO
Greece	Tier 1	Tier 1	Tier 1
Ireland	Tier 1	Tier 1	NO
Italy	Tier 1	Tier 1	Tier 1
Luxembourg			Tier 1
Netherlands	Tier 1	Tier 2	NO
Portugal	Tier 1	Tier 1	NO
Spain	Tier 1	Tier 1	Tier 2
Sw eden	Tier 1	Tier 1	Tier 1
United Kingdom	Tier 1	Tier 1	Tier 2
EU15	**Tier 1.1**	**Tier 1.7**	**Tier 1.8**

Table 6.94: Tier level of the estimation of N_2O emissions from manure management in 2011.

2011	Liquid system[1)]	Solid storage and dry lot	Other	Total
Austria	Tier 1.7	Tier 1.7	Tier 2.0	Tier 1.8
Belgium	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
Denmark	Tier 1.9	Tier 1.7	Tier 2.0	Tier 1.9
Finland	Tier 1.1	Tier 1.5	Tier 1.7	Tier 1.2
France	Tier 1.7	Tier 1.7	NA	Tier 1.7
Germany	Tier 2.0	Tier 2.0	NO	Tier 2.0
Greece	Tier 1.6	Tier 1.4	Tier 1.1	Tier 1.6
Ireland	Tier 1.7	Tier 1.7	NO	Tier 1.7
Italy	Tier 1.7	Tier 1.6	Tier 1.7	Tier 1.7
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.7	Tier 2.0
Netherlands	Tier 1.7	Tier 2.0	NO	Tier 1.8
Portugal	Tier 1.7	Tier 1.6	NO	Tier 1.7
Spain	Tier 1.0	Tier 1.1	Tier 2.0	Tier 1.8
Sw eden	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
United Kingdom	Tier 1.7	Tier 1.7	Tier 2.0	Tier 1.8
EU15	**Tier 1.9**	**Tier 1.7**	**Tier 1.9**	**Tier 1.8**

1) including anaerobic lagoon

6.4.1.4 *CH_4 emissions from rice cultivation*

No combination of information is required.

6.4.1.5 *N_2O emissions from agricultural soils*

The determination of the Tier level of N_2O emissions from agricultural soils is done in three steps:

1. The comparison of the used emission factors (for direct N_2O emissions induced by the application of synthetic fertiliser, animal wastes, nitrogen from crop residues and N-fixing crops and by the cultivation of histosols; for N_2O emissions from manure deposited by grazing

animals; for indirect N_2O emissions induced by volatilization of NH_3+NO_x from synthetic fertiliser and from applied manure, and induced by leaching/run-off of nitrogen from the fields) with the respective IPCC default values.

2. With the exception of direct N_2O emissions induced by the application of mineral fertiliser, a Tier level has been considered for the nitrogen input data.
   (a) For the application of animal waste the Tier levels of N allocation to liquid systems (incl. anaerobic lagoons), solid storage and dry lot, and other systems have been combined using the MEAN rule.
   (b) For N-fixing crop, crop residues and cultivated area of histosols, the Tier level has been estimated from the information reported in the national inventory reports
   (c) For nitrogen deposited by grazing animals, the Tier level calculated under category 4B(b) for pasture, range, and paddock is used.
3. The Tier level of the N_2O emission estimate is calculated on the basis of the above-obtained information:
   (d) Application of synthetic fertiliser the Tier level of the emission factor is used
   (e) Direct emissions from other nitrogen sources using the MEDIAN rule with equal weights for the Tier level of the nitrogen input and the emission factor
   (f) N_2O emissions from grazing animals using the MEDIAN rule for N-input, $Frac_{GRAZ}$, and the emission factor using equal weights. The Tier level for $Frac_{Graz}$ has been determined on the basis of the information given in the national inventory reports
   (g) N_2O emissions from volalised nitrogen using the MEDIAN rule for the amount of volatilised nitrogen, which is calculated from the Tier levels for volatilised synthetic fertiliser and manure nitrogen using the MEAN rule, and the emission factor using equal weights. The Tier level for volatilised synthetic fertiliser is obtained by comparing $Frac_{GASF}$ with the IPCC default value. The Tier level for volatilised manure nitrogen is obtained using the MEDIAN rule on the basis of $Frac_{GASM}$ (comparing with the IPCC default value) and the Tier level of applied nitrogen manure using equal weights.
   (h) N_2O emissions from leached/run-off nitrogen using the MEDIAN rule for N-input, FracLEACH and the emission factor giving higher weight to FracLEACH and the emission factor (0.43 each) than to the N-input (0.14)

Table 6.95: Tier level of the estimation of direct N_2O emissions from agricultural soils in 2011.

Member States	Synthetic fertilizer	Animal Wastes appl.			N-fixing crops			Crop Residues			Cultivation of Histosols		
	N2O emis.	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions
Austria	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	NO	NO
Belgium	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 0.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
Finland	Tier 1.0	Tier 1.2	Tier 1.0	Tier 1.1	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
France	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Germany	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.3	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Ireland	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Italy	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Netherlands	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Spain	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Sweden	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
United Kingdom	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
EU-15	**Tier 1.0**			**Tier 1.5**			**Tier 1.4**			**Tier 1.3**			**Tier 1.9**

Table 6.96: Tier level of the estimation of N_2O emissions from pasture, range and paddock in 2011.

Member States	Animal Production			
	N-input	FracGRAZ	EF	N2O emissions
Austria	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.4
Belgium	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Finland	Tier 0.8	Tier 1.0	Tier 1.0	Tier 1.1
France	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.7
Greece	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.4
Ireland	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Italy	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Netherlands	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Spain	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Sweden	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.7
United Kingdom	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
EU-15				**Tier 1.5**

Table 6.97: Tier level of the estimation of indirect N_2O emissions from nitrogen volatilised from agricultural soils in 2011.

Member States	$Frac_{GASF}$	Manure application	$Frac_{GASM}$	Volatilized Manure	Volatili-zation	Emission Factor	N2O emissions from volatilised nitrogen
Austria	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Belgium	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Denmark	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Finland	Tier 2.0	Tier 1.2	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.0	Tier 1.6
France	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Greece	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.3	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Italy	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Portugal	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Spain	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Sweden	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
United Kingdom	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
EU-15							**Tier 1.4**

Table 6.98: Tier level of the estimation of indirect N_2O emissions from nitrogen leached/run-off from agricultural soils in 2011.

Member States	N input	$Frac_{LEACH}$	Emission factor
Austria	Tier 1.8	Tier 1.0	Tier 1.0
Belgium	Tier 1.7	Tier 2.0	Tier 1.0
Denmark	Tier 1.9	Tier 2.0	Tier 2.0
Finland	Tier 1.2	Tier 2.0	Tier 1.0
France	Tier 1.7	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 1.0	Tier 1.0
Greece	Tier 1.6	Tier 1.0	Tier 1.0
Ireland	Tier 1.7	Tier 2.0	Tier 1.0
Italy	Tier 1.7	Tier 1.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0
Netherlands	Tier 1.8	Tier 2.0	Tier 1.0
Portugal	Tier 1.7	Tier 2.0	Tier 1.0
Spain	Tier 1.8	Tier 1.0	Tier 1.0
Sweden	Tier 1.7	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.8	Tier 2.0	Tier 1.0
EU-15			

6.4.2 Uncertainty

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.104. These data are calculated from the information on the uncertainty of activity data and implied emission factors (see sections above and Table 6.100 through Table 6.102 summarizing all categories in agriculture) and the emissions data. For several countries,

N_2O emissions from agricultural soils are by far dominating the uncertainty of national inventory. The uncertainty estimate for this source category of the submission in 2013 ranges from 22.0% of total national GHG emissions (excl. LULUCF, Ireland) to 247.0% of total national GHG emissions (United Kingdom). Overall, the estimate for the uncertainty range is relatively stable since the last years (see Table 6.99).

Table 6.99: Range of contribution of category 4D to overall GHG uncertainty. Minimum and maximum values since 2005 submission

	Minimum uncertainty	Maximum uncertainty
2005	0.7% (Austria)	20.9% (France)
2006	1.5% (Austria)	17.6% (France)
2007	1.9% (Denmark)	19.9% (France)
2008	1.7% (Denmark)	20.1% (France)
2009	2.0% (Denmark)	17.9% (France)
2011	2.4% (Netherlands)	18.7% (United Kingdom)
2012	1.2% (Portugal)	19.0% (United Kingdom)
2013	1.9% (Netherlands)	20.7% (United Kingdom)

The contribution of the whole agricultural sector to the overall uncertainty is very similar to the contribution of agricultural soils (23.0% to 247.5%), highlighting again the dominance of this category.

Some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N_2O. For example, the uncertainty of direct N_2O emissions is estimated in the Greece inventory of being ±400% (63.9% of the national total) versus ±54% (10.9% of the national total) of the indirect emissions. On the other hand, the Netherlands estimate an uncertainty of ±61% and ±206% for direct and indirect N_2O emissions agricultural soils, respectively (corresponding to 12.3% and 18.6% of the national total uncertainty, respectively).

CH_4 emissions from enteric fermentation are less uncertain (2.7% to 11.0% of total national GHG emissions) and manure management contributes with less than 16.5% uncertainty.

Table 6.104 gives an overview of: (1) the estimated total GHG uncertainty, carried out with the Tier 1 methodology, and (2) the contribution of the agricultural sector to the overall uncertainty, calculated from reported relative uncertainties for activity data and emission factors and from reported emissions. The corresponding uncertainties for activity data and emission factors are given in Table 6.100 and Table 6.101, and the combined uncertainty (Tier 1 approach) is given in Table 6.102. The data for the combined uncertainty are "gap-filled" at the category-level, if required, to allow a meaningful comparison of the uncertainty estimates at EU-level, using information reported at the level below the categories.

A table summarizing background information on the uncertainty estimates is given in Table 6.103.

It is interesting to note that combined relative uncertainty of agriculture in some cases is higher than the overall uncertainty of the greenhouse gas inventory (for example in Austria and Spain). This is due to the fact that the combined uncertainty is calculated neglecting any other contribution to the uncertainty. As uncertainties are assumed to be uncorrelated between the different sectors, the consideration of more sectors can thus lead to the partial compensation of the individual uncertainties.

Some countries have carried out also a Monte Carlo uncertainty assessment. In most cases, both the input data and also the results do not deviate much from the Tier 1 analysis. Main differences between both methods are (i) the possibility to assess emission sources where the distribution of the uncertainty is non-normal and (ii) the consideration of correlation between source categories, which tends to reduce the compensation effect.

Table 6.100: Member States' uncertainty estimates for Activity Data used in the agriculture sector [%]

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	**CH_4**	**N_2O**	**N_2O**	**N_2O**	**N_2O**	**N_2O**
Austria	*(1)	*(1)	10		5		5
Belgium	5	10	10		30	30	30
Denmark	2	5	22			25	
Finland	13	12	67		118	196	297
France	5	5	5		15	20	120
Germany	*(2)	*(6)	4		15	20	143
Greece	5	5	50		20	50	20
Ireland	*(3)	*(7)	11		11	11	11
Italy	20	20	20		20	20	20
Luxembourg	*(4)	*(4)			10	10	20
Netherlands	*(5)	*(8)	10		10	10	50
Portugal	6	8	37	20			
Spain	3	3	16		18	16	190
Sw eden	2	7	15		15	35	28
United Kingdom	0	0	1	1			

*(1)- AT: Cattle: 10%

*(2)- DE: Dairy cattle 4% and non-dairy cattle 2%. Buffalo 4%

*(3)- IE: Dairy and non-dairy cattle and other animals: 1%

*(4)- LU: Cattle: 2%

*(5)- NL: Dairy and non-dairy cattle, swine and other animals: 5%

*(1)- Cattle and swine: 10%

*(6)- DE: Dairy cattle 6% and swine 3%. Buffalo 5%

*(3)- IE: Dairy and non-dairy cattle and other animals: 1%

*(4)- LU: Cattle: 2%

*(7)- NL: Cattle, swine and other animals: 10%

Table 6.101: Member States' uncertainty estimates for Emission Factors used in the agriculture sector [%]

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(6)	100		150		150
Belgium	20	40	90		250	250	250
Denmark	20	20	50		0	100	
Finland	13	0	0		0		
France	15	30	50		140	200	430
Germany	*(2)	*(7)	102		53	200	319
Greece	30	50	100		400	100	50
Ireland	*(3)	*(8)	100		100	100	50
Italy	20	100	100		100	100	100
Luxembourg	*(4)	*(9)			150	150	150
Netherlands	*(5)	*(10)	100		60	100	200
Portugal	12	75	93	181	0		
Spain	9	8	100		400	100	50
Sweden	11	18	37		66	150	122
United Kingdom	20	30	414	424	0		

*(1)- AT: Cattle: 20%

*(2)- DE: Dairy cattle 40% and non-dairy cattle 25%. Buffalo 25%

*(3)- IE: Dairy and non-dairy cattle 15, other animals: 30%

*(4)- LU: Cattle: 20%

*(5)- NL: Dairy cattle 15%, non-dairy cattle 20%, swine 50% and other animals: 30%

*(6)- AT: Cattle: 50%

*(7)- DE: Cattle 64% and swine 29%. Buffalo 19%

*(8)- IE: Dairy and non-dairy cattle 15, other animals: 30%

*(9)- LU: Cattle: 70%

*(10)- NL: Cattle, swine and other animals: 100%

Table 6.102: Member States' uncertainty estimates for agriculture (combined uncertainty calculated from the given uncertainty of AD and EF) [%]

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	22	51	100	109	150		150
Belgium	21	41	91	162	252	252	252
Denmark	20	21	55	103		103	
Finland	18	12	67	105	118	196	297
France	16	30	50	181	141	201	446
Germany	26	43	102	124	55	201	350
Greece	30	50	112	123	400	112	54
Ireland	11	11	101	58	101	101	51
Italy	28	102	102	66	102	102	102
Luxembourg	20	43	0	91	150	150	151
Netherlands	12	75	100	65	61	100	206
Portugal	14	75	100	182			
Spain	9	9	101	207	400	101	196
Sweden	12	19	40	56	67	154	125
United Kingdom	20	30	414	424			

Table 6.103: **Available background information on the uncertainty estimates in the sector of agriculture**

Member State	Uncertainties
Austria	Separate uncertainty calculations, albeit with the same (as much as possible) input information was performed using a spread sheet prepared specifically according to the Tier 1 approach (IPCC 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data (Tier 2). Since the first detailed uncertainty analysis (Winiwarter and Rypdal, 2001) the Austrian inventory compilers have spent considerable effort to also obtain uncertainties from individual contributors to the inventory. Studies on methane emissions reported also uncertainty in emission factors (Amon et al. 2002, Gebetsroither et al. 2002).
Belgium	In Flanders, a complete study of the uncertainty was conducted in 2004 by an independent consultant, Det Norske Veritas, both on Tier 1 and Tier 2 level. The uncertainties were determined for the emission level 2001 and for the 1990-2001 trend in emissions for all source categories comprising emissions of CO_2, CH_4 and N_2O. These results are available in the technical report 'Quantification of Uncertainties – Emission Inventory of Greenhouse Gases of the Flemish Region of June 2004'.
Denmark	The uncertainty estimates are based on the Tier 1 methodology in the IPCC Good Practice Guidance (GPG) (IPCC, 2000). Uncertainty estimates for the all sectors are included in the current year. The estimated uncertainties for some of the emission sources, based on expert judgement (Olesen et al. 2001, Gyldenkærne, pers. comm., 2005). The uncertainties for the number of animals and the number of hectares with different crops under cultivation are very small.
Finland	Uncertainty is quantified with a Tier 2 approach (KASPER model, developed by VTT Technical Research Centre of Finland). A simulation model was constructed for uncertainty analysis using Monte Carlo simulation and sensitivity analysis using an extended version of Fourier Amplitude Sensitivity Test (FAST, Saltelli et al. 2005). In agriculture, an uncertainty estimate was given for each calculation parameter of the calculation model at a detailed level. A detailed description of the uncertainty analysis has been presented in Monni & Syri (2003), Monni (2004) and Monni et al. (2007).
France	Uncertainty calculation according to Tier 1 methodology. Strongest impact on total uncertainty arises from the category of N_2O emissions from agricultural soils.
Ireland	Tier 1 method. In some of the most important emissions sources in Agriculture (such as enteric fermentation and agricultural soils) and Waste (solid waste disposal, for example) the activity data or emission factors ultimately used are determined by several specific component inputs, which are all subject to varying degrees of uncertainty. The uncertainty estimates used for both activity data and emission factor for these sources have been derived by assigning uncertainties to the key component parameters and combining them at the level of activity data or emission factors, as appropriate, for each activity for input to the Tier 1 uncertainty assessment.
Italy	Tier 1 approach. In addition, a Tier 2 approach, corresponding to the application of Monte Carlo analysis, has been applied to specific categories of the inventory but the results show that, with the information available at present, applying methods higher than the Tier 1 does not make a significant difference in figures. For N_2O emissions from agricultural soils, a Montecarlo analysis was applied assuming a normal distribution for activity data and two tests one with a lognormal and the other with a normal for emission factors; the results with the normal distribution calculated an uncertainty figure equal to 32.44, lower than the uncertainty by the Tier 1 approach which was 102; in the case of the lognormal distribution there were problems caused by the formula specified in the IPCC guidelines which is affected by the unit and needs further study before a throughout application.
Luxembourg	In December 2007, the Environment Agency contracted Austrian Research Centres GmbH - ARC28 for performing a detailed uncertainty analysis of Luxembourg's GHG inventory. Monte-Carlo approach was used to calculate overall uncertainty. Within this project, we use the software "@RISK" from Palisade Co. (www.palisade.com).
Netherlands	Tier 1 method for base year and last reported year – for both the annual emissions and the emission trend for the Netherlands. All uncertainty figures should be interpreted as corresponding to a confidence interval of 2 standard deviations (2?), or 95%. In cases where asymmetric uncertainty ranges were assumed, the largest percentage was used in the calculation. Furthermore, a Tier 2 uncertainty assessment was carried out in 2006 (Ramirez, 2006). The study used the same uncertainty assumption as the Tier 1 study but accounted for correlations and non-Gaussian distributions. Results are at the same order of magnitude for the level assessment, although a higher uncertainty is found for the trend analysis. As part of the above mentioned study, the expert judgments and assumptions made for uncertainty ranges in emission factors and activity data for the Netherlands have been compared to the uncertainty assumptions (and their underpinnings) used in Tier 2 studies carried out by other European countries.
Sweden	During 2005, a SMED study was carried out to improve transparency and quality in the uncertainty estimates of the Swedish National Greenhouse gas inventory (Gustafsson, 2005). Although much activity data in the agricultural sector is estimated from extensive surveys, with high quality estimates at national level, the sector contributes to a large part of the total estimated uncertainty.
United Kingdom	Both the Tier 1 and Tier 2 uncertainty estimates. The Tier 2 approach provides estimates according to GHG (1990, base year and latest reporting year) and has now been extended to provide emissions by IPCC sector and is based on a background paper (Eggleston et al., 1998). An internal review was completed of the Monte Carlo analysis was completed in 2006 (Abbott et al., 2006). The uncertainty of the majority of the sectors was assumed to be normally distributed; for certain sectors where data are highly correlated or the distributions non-normal, custom correlations or functions have been used (landfill, sewage sludge distributions calculated from a known data series; agricultural soils lognormal distribution with the 97.5%il being 100 times the 2.5%il). Calculations are carried out using the @RISK software.

The uncertainty estimates are combined to the EU-15 level for source categories in the agriculture sector. For the sector as a whole, uncertainties are combined with a Tier 1 approach considering an assumed degree of dependence between each pair of countries. The quantitative assessment of the quality-levels outlined above helps to derive a reasonable estimate for the correlation coefficient ρ_{XY} between two countries X and Y. To this purpose, the Tier levels Q_X and Q_Y are transformed with the following equation:

$$\rho_{X,Y} = \sqrt{(2 - Q_X) \cdot (2 - Q_Y)} \qquad (4)$$

Equation (4) leads to the situation of no correlation $(\rho_{X,Y} = 0)$ for two countries with a Tier 2 approach and full correlation $(\rho_{X,Y} = 1)$ if both countries used a Tier 1 approach. A correlation coefficient can be calculated for any intermediate situation. This information is further processed within the standard IPCC Tier 1 method for both level and trend uncertainty.

Table 6.104: Member States' uncertainty estimates for agriculture expressed in percent of total GHG emissions. The table shows three "scenarios" for the uncertainty at EU-15 level, i.e., (i) with the correlation between MS uncertainty estimates as quantified with equation (4); (ii) under the assumption of no correlation and (iii) under the assumption of full correlation between the uncertainty estimates of MS. Scenario (i) is considered to be the most realistic case, and scenarios (ii) and (iii) are giving the range of uncertainty at EU-15 level.

Member State	Total agriculture	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
		CH_4	CH_4	N_2O	total N_2O	direct N_2O	animal prod. N_2O	indirect N_2O
	uncertainties expressed as % of total GHG emissions							
Austria	47.4	9.5	2.2	12.3	44.7	36.9		22.7
Belgium	65.5	7.7	6.1	7.4	64.3	56.3	20.5	23.5
Denmark	55.1	5.9	2.8	2.3	54.6		2.2	
Finland	64.0	4.8	0.6	4.9	63.6	55.5	6.3	30.5
France	96.2	4.9	3.3	2.6	95.9	33.4	19.2	87.8
Germany	74.2	7.6	3.0	4.1	73.6	20.8	3.8	70.5
Greece	69.4	11.0	1.8	3.4	68.4	63.9	22.0	10.9
Ireland	22.8	5.4	1.3	2.5	22.0	15.7	14.9	3.8
Italy	34.1	9.1	6.4	11.3	30.2	22.4	4.7	19.7
Luxembourg	43.7	7.4	6.3		40.9	28.6	12.7	26.3
Netherlands	27.7	5.0	12.2	6.6	23.4	12.3	6.9	18.6
Portugal	71.6	5.2	10.5	4.0	70.5			
Spain	100.5	2.7	1.5	4.6	99.5	92.6	6.9	35.8
Sweden	32.1	3.8	0.7	2.3	31.8	21.6	8.7	13.3
United Kingdom	247.5	6.6	1.6	14.7	247.0			
EU15	**6.7**	**0.3**	**0.2**	**0.3**	**7.8**			
EU15 no corr	**4.2**	**0.2**	**0.1**	**0.2**	**4.2**			
EU15 full corr	**9.0**	**0.6**	**0.3**	**0.6**	**9.0**			

Uncertainties calculated from information contained in NIR on uncertainty of activity data and emission factors, and emission data, using the Tier 1 approach.

6.4.3 Improvements since last submission

A major revision of the present chapter on methodological issues and uncertainty in the sector agriculture was done for the submission in 2006. The chapter gives now a complete overview of all relevant parameters required for the estimation of GHG emissions in this sector. This has been done in parallel to the calculation of all background parameter in the CRF tables for agriculture.

The changes were partly due to a "natural evolution" of the inventory generation over the years and partly motivated by recommendations made by the UNFCCC review team on the occasion of the in-country review in 2005. The main issues raised by the Expert Review Team in 2005 and the major changes include (i) more transparent overview tables on methodological issues; (ii) better presentation of trend development; (iii) streamlining information contained in CRF and NIR; (iv) continuous working with Member States in order to improve the inventory and allowing the quantification of all background data; (v) including a summary of workshops.

For the submission in 2007, few improvements were added, mainly regarding the calculation of the quality of the EC estimate. Several errors that were identified in the background tables of the Member States could be eliminated, such as the inconsistent use of units or implied emission factors. These corrections did not have an impact on the calculated emissions, but made the aggregation of background information difficult and the comparison impossible.

For the submission in 2008, based on recommendations by the Expert Review Team of the in-country review in 2007, several improvements were implemented, including higher transparency in describing the aggregation of animal numbers presented under Option B into Option A (which is used at EU level), time series consistencies and trends (including epidemic diseases and issues raised by the ERT, such as the buffalo population in Germany and the goat population in Luxembourg, manure managed in 'other' systems in Italy, or $Frac_{GASM}$ used in Sweden), and outliers. A discussion on the main policies driving the level of GHG emissions in Europe was introduced.

Further a novel approach to calculate uncertainties at the EU level including the assessment of the quality of the emission estimates at MS and EU level has been implemented and described in the NIR. This method was presented during the in-country-review in 2007 and its implementation in the EC-IR was suggested by the ERT. This has been complemented by a series of tables giving background information for the estimates of the uncertainty levels for activity data and emission factors.

Emission sources reported by a few MS only (such as CH_4 emissions from enteric fermentation of poultry, reported by Austria and Luxembourg only) still still lead to a discrepancy between the IEF for EU-15 reported in the CRF-tables and the NIR. This is because our principle to not change the category MS report emissions (with the above-mentioned exception of the shift from Option B to Option A for cattle). In the annex to the NIR a weighted average of the IEF for poultry is calculated instead giving the IEF of those animals for which emissions have been quantified and included into the EU total. This is documented also in the CRF tables in a transparent way.

For the submissions in 2008 through 2013, background information was further developed, in particular with regard to the general development and policy drivers in the countries. A new section was introduced giving most important information on the source category 'Field Burning of Agricultural Residues' and information on the methodology and trends of emissions in this category has been added. For the submission in 2011, a new section was added summarizing the findings of the GGELS project (Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS); **http://afoludata.jrc.ec.europa.eu/index.php/dataset/detail/236**).

Additional work on the comparison of GHG emission estimates from agriculture with the CAPRI model using different methodologies (IPCC 1997, IPCC 2006, IPCC 1997 with country-specific information as provided by MS IRs) is on-going but not yet finalised.

The JRC is cooperating with EUROSTAT on a methodology to use the CAPRI model for the regionalisation of the Gross Nutrient Budget (GNB) indicators (nitrogen and phosphorus) that needs to be reported regularly by countries to EUROSTAT and OECD. The GNBs are identified as one of the key agro-environmental indicators. Current reporting occurs at the national level. For policy making, a higher resolution, matching with legislative and environmental boundaries (NVZ, watershed) rather than administrative boundaries (country) is required. The CAPRI model is an economic model for agriculture, which has an environmental accounting model integrated. It has a spatial resolution of NUTS2 and reports, a.o. Nitrogen Balances at this level. The CAPRI model has a down-scaling module integrated which estimates land use shares and environmental indicators at the pixel level (1 km by 1 km). The use of the CAPRI model is motivated in view of the lack of methodology for regionalisation of the GNB and the high costs associated with building up such systems in the countries at one hand, and the thrive to harmonise the conceptual approaches.

For the submission 2013, the discussion of the share of manure excretion by IPCC climate zones was extended and amended with an independent Europe-wide estimation of shares, together with additional background-information on the methodologies used by the MS. This project is of high relevance also for the submission of the EC GHG inventories, because

- The project might help identifying data gaps which will be discussed in the Working Group on Agri-environmental indicators at EUROSTAT and could lead to improvements of data collection, such as the Survey on Agricultural Production Methods (SAPM) which was carried out in 2010[36]
- The project aims at enhancing cooperation between countries and for various reporting obligations. The EUROSTAT/OECD methodology and handbook on Nutrient Budgets explicitly mentions the link to GHG inventory systems.

Continuous work with MS helps to identify and correct errors; and justifications for un-documented national emission factors have been requested (for example, for the use of IPC2006 default values) and are now also included in national inventory reports (Germany). Even though **the number of errors could be significantly reduced with regard to previous submissions,** a few errors remain and have been requested to be corrected by the MS, such as for example a few (remaining) mistakes in the units reported.

The MS CRF tables are carefully checked on these errors and corrected before calculating the background data for the European Union.

The generation of the chapter on agriculture is now highly automated in order to reduce the risk of inconsistencies between NIR and CRF.

36 http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Survey_on_agricultural_production_methods_%28SAPM%29

6.4.4 Activities to improve the quality of the inventory in agriculture

As a first activity to assure the quality of the inventory by Member States, a workshop on “Inventories and Projections of Greenhouse Gas Emissions from Agriculture” was held at the European Environment Agency in February 2003. The workshop focused on the emissions of methane (CH_4) and nitrous oxide (N_2O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH_3). The consideration of ammonia emissions allows the validation of the N_2O emission sources and it further strengthens the link between greenhouse gas and air pollutant emission inventories reported under the UNFCCC, the EC Climate Change Committee, the UNECE Long-Range Transboundary Air Pollution Convention, and the EU national emission ceiling directive. Objectives of the workshop were to compare the Member States’ methodologies and to identify and explain the main differences. The longer term objective is to further improve the methods used for inventories and projections in the different Member States and to identify how national and common agricultural policies could be integrated in EU-wide emission scenarios.

Information on the workshop and the recommendations can be downloaded at the following website:

http://ccupeople.jrc.ec.europa.eu/leip/expmeetcat4d_2004/recommendations.htm

6.4.5 Comparison of national inventories with EU-wide calculations with the CAPRI model

The GGELS-project on the "Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions" was commissioned by the Directorate-General for Agriculture and Rural Development to the Joint Research Centre and run from 09/2008-12/2010. The study included the implementation of an LCA (life-cycle assessment) approach into the CAPRI model including update of GHG-calculation modules, as well as an ex-ante according to the latest CAPRI projections for the year 2020 and an explorative assessment of technological and policy mitigation options. Ancillary assessments were made on a description of livestock systems in Europe, the GHG emissions related to imported meat product and livestock's impact on biodiversity.

For the LCA-approach, activity-based emissions according to the emissions source categories in the IPCC (2006) guidelines are converted to product-based emission intensities, using well-defined allocation rules. Additional emissions that are generated during the life-cycle of a product are estimated as well and included in the estimated emission intensities. The GGELS report include also a detailed comparison of activity-based emissions estimates calculated with the CAPRI model with those reported in the greenhouse gas inventory report of the European Communities in 2010 for the year 2004, which is the base year for the version of the CAPRI model used.

The report, executive summary and the data tables are available at:

http://afoludata.jrc.ec.europa.eu/index.php/dataset/files/236

A detailed description of the methodology used in the study is given in section 4.2. (Activity-based GHG emissions from the European livestock system considered in the sector ‘agriculture’ of the IPCC guidelines) of the report with additional data tables provided in the Annex to Chapter 4 (Quantification of greenhouse gas and ammonia emissions from the livestock sector in the EU – Methodology). Section 5 (Comparison of EU livestock GHG emissions derived by CAPRI with official GHG inventories) provides a detailed comparison between the emissions estimates.

In the following, a summary of this comparison is provided as given in the executive summary of the report:

The objective of the GGELS project was to provide an estimate of the net emissions of GHGs and ammonia (NH_3) from livestock sector in the EU-27 according to animal species, animal products and livestock systems following a food chain approach.

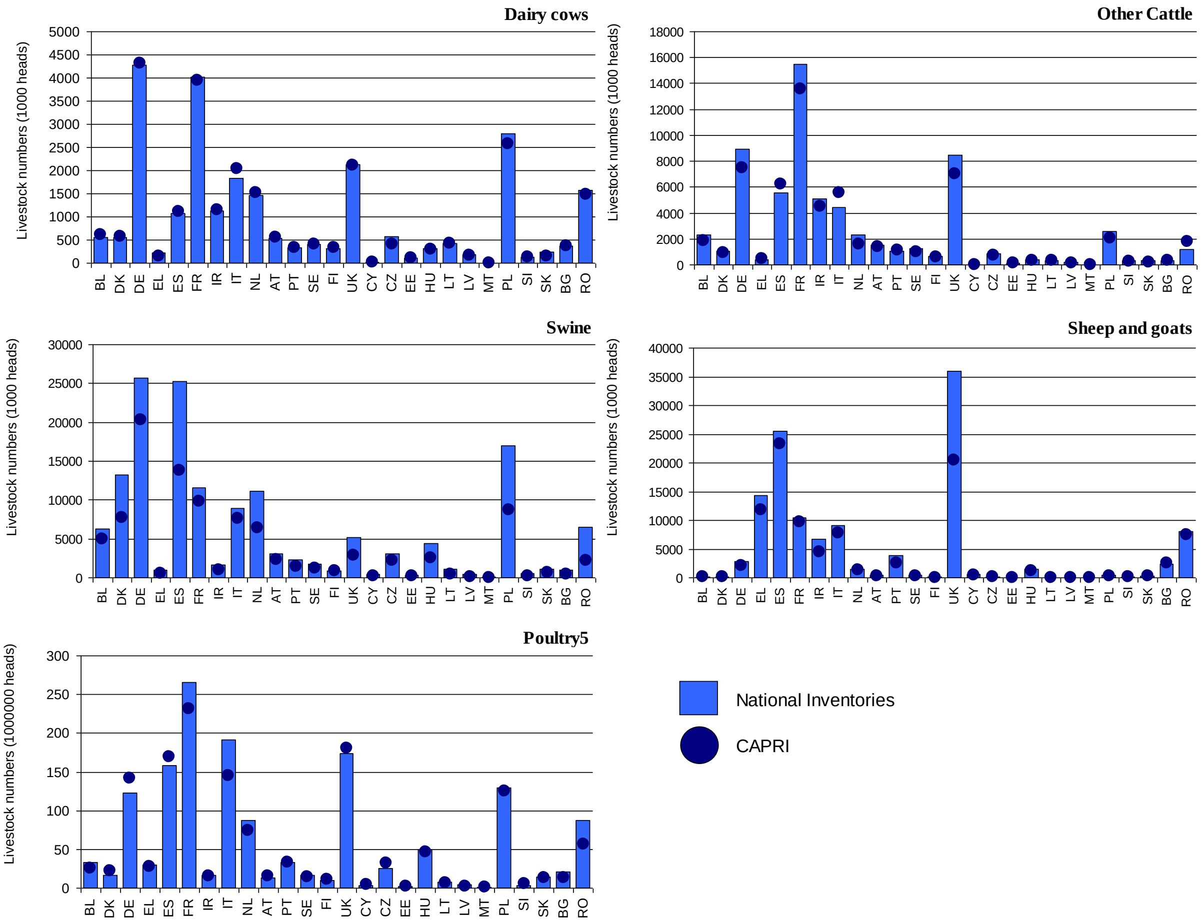
For the comparison of activity-based GHG emissions calculated in the GGELS project (taking into account only emissions directly created during the agricultural production process) with official national GHG emissions submitted to the UNFCCC, we selected the latest inventory submission of the year 2010 (EEA, 2010), using the data reported for the year 2004, the base year selected also for the CAPRI calculations.

Differences in basic input parameters, such as animal numbers and mineral fertiliser application rates are limited, since both are based on the official numbers of livestock statistics. However, on the one hand EUROSTAT data are not always in line with national statistical sources used by national inventories, and on the other hand CAPRI changes input data if they are not consistent with each other. Moreover, for some animal activities CAPRI does not use livestock numbers but numbers of the slaughtering statistics. Therefore, some differences exist, especially in case of swine, sheep and goats, where CAPRI generally uses lower numbers than the national inventories. This has to be kept in mind when looking at the results in later sections.

In some cases results differ substantially between CAPRI and the inventory submissions, which can be related to three different reasons:

- First, the approach of CAPRI and the national inventories is not always the same. Especially, the MITERRA approach, which is applied for the calculation of nitrogen emissions in the CAPRI model, differs substantially from the IPCC approach usually applied in the inventories. In CAPRI the excretion is not an exogenous parameter but is calculated as the difference between nitrogen intake and nitrogen retention of animals. For cattle and poultry deviations are generally low, while for swine, sheep and goats the differences are larger (see **Error! Reference source not found.**). In case of swine the usually higher CAPRI values partly compensate the lower livestock numbers.

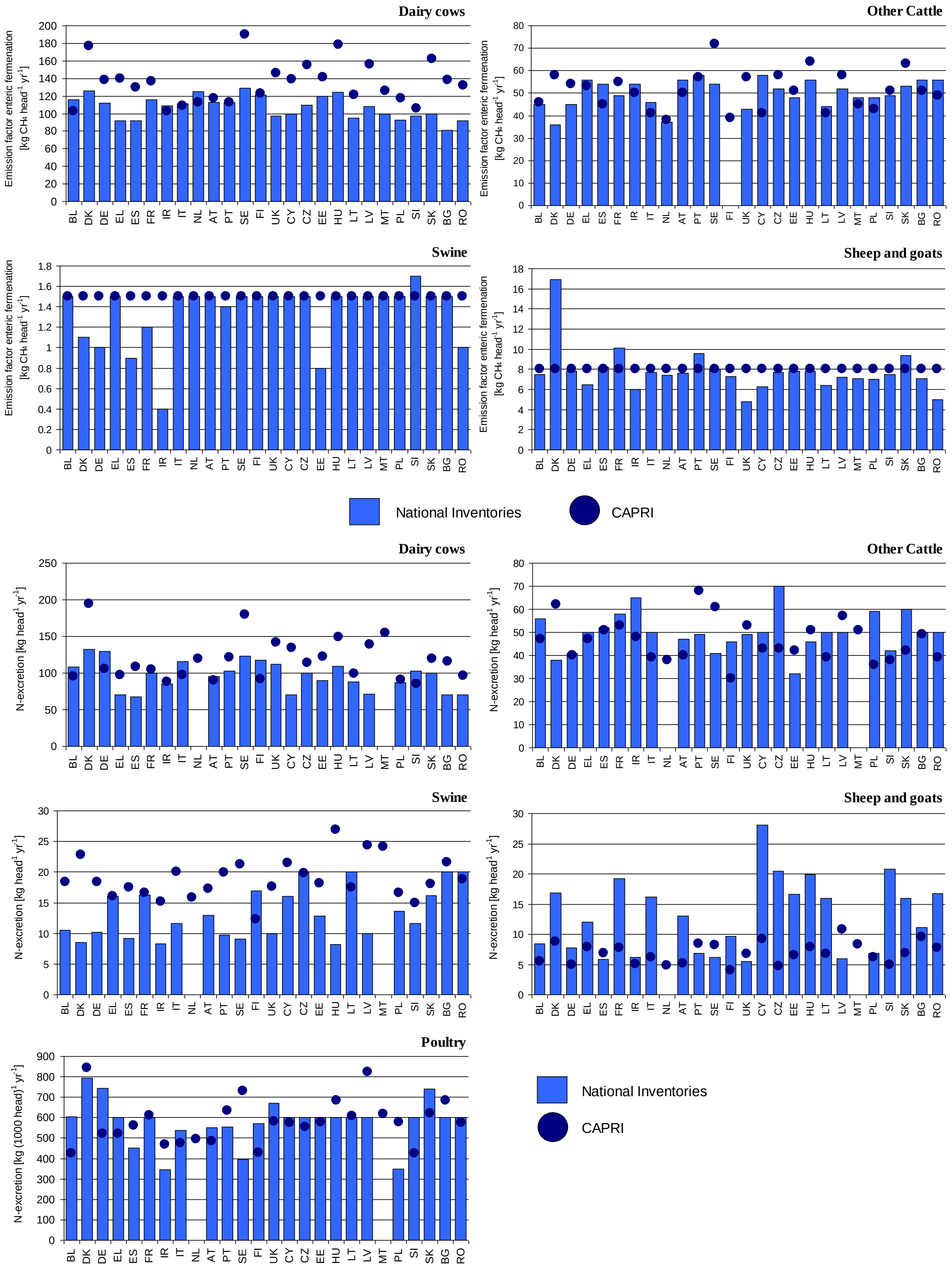
Figure 6.55: **Comparison of livestock numbers used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and livestock numbers used in CAPRI**



- Second, most countries base their inventory calculations on the IPCC guidelines 1996, while CAPRI uses parameters of the most recent guidelines of the year 2006. In some cases emission factors and other parameters suggested by the IPCC changed considerably between 1996 and 2006, leading to corresponding changes in the estimation of emissions.
- Finally, apart from different approaches and different parameters due to changes in the IPCC guidelines, also other input data can impact on the results. This could be i.e. differences in livestock numbers, the distribution of manure management systems or time spent on pastures, average temperatures, or more technical data like fertiliser use, milk yields, live weight, nutrient contents, nitrogen excretion etc., which are partly assumed and partly already an output of calculation procedures in the CAPRI model. Since the national inventories use other input data some differences in the results are not surprising. For example, differences in estimated CH_4 emissions from enteric fermentation are mainly due to different emission factors for dairy and non-dairy cattle, since other animal categories play a less important role with respect to total emissions from enteric fermentation.

The following factors can be identified as potential reasons for the deviations. First, for cattle (Tier 2 approach) CAPRI calculates the digestible energy endogenously, while most inventory reports use default values. Secondly, in the inventories most countries apply a methane conversion factor of 6% (default value according to IPCC 1997, see IPCC 1996), while CAPRI uses 6.5% (default value of IPCC 2006, see IPCC, 2006), leading to higher emission factors in CAPRI of around 8%. Thirdly, animal live weight impacts directly on net energy requirement, but can only be compared for dairy cows. CAPRI generally assumes a live weight of 600 kg, while national inventories use different values ranging from 500 to 700 kg. However, a simple regression suggests that live weight is not a key factor for the generally higher CAPRI values. Finally, there are differences in the weight gain and milk yields. While assumptions on the weight gain are not available in the inventory submissions and, therefore, cannot be compared, milk yields are usually higher in CAPRI than in the national submissions, favouring higher emission factors in case of dairy cows.

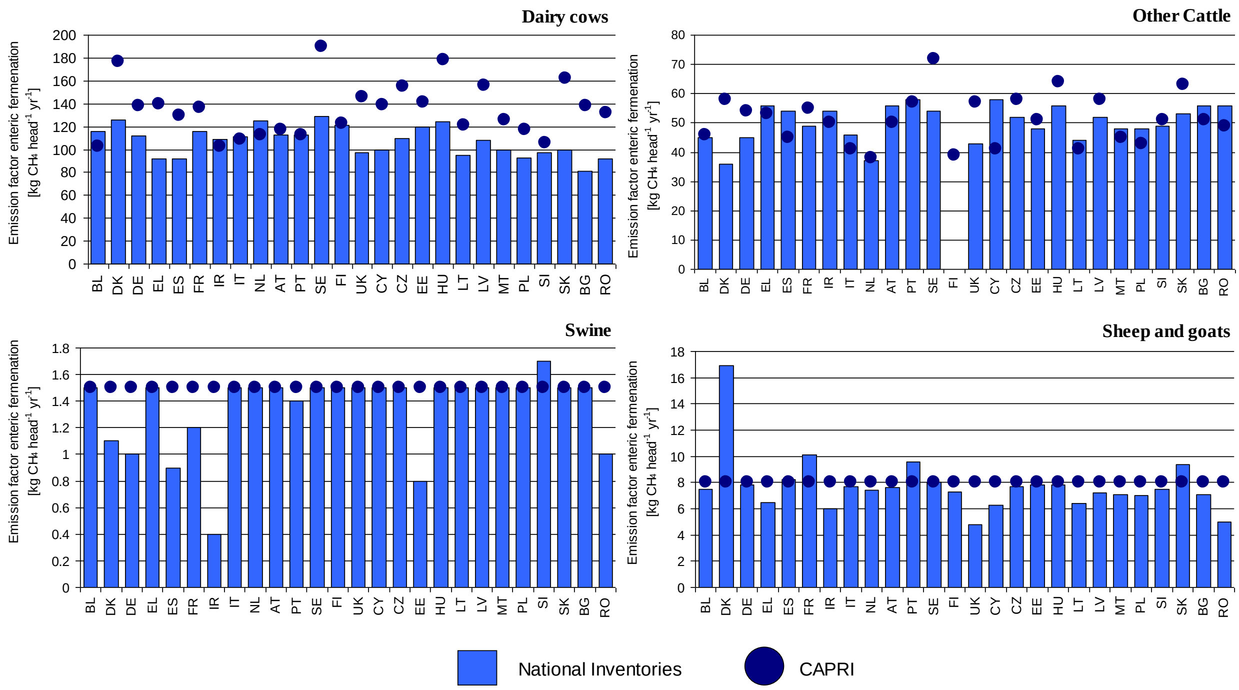
Figure 6.56: **Comparison of N-excretion data used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and N-excretion data calculated with CAPRI**



For EU-27, CAPRI calculates total agricultural sector emissions of 378 Mio tons of CO_{2-eq}, which is 79% of the value reported by the member states (477 Mio tons, biomass burning of crop residues and CH_4 emissions from rice production not included). On member state level this ranges between 54% in

Cyprus and 127% in Denmark. Therefore, Denmark is the only member state for which CAPRI estimates total emissions higher than the NIs. With respect to the different emission sources, the relation of CAPRI emissions to NIs are: 103% for CH_4 emissions from enteric fermentation, 54% for CH_4 and 93% for N_2O emissions from manure management, 92% for N_2O emissions from grazing animals, 81% for N_2O emissions from manure application to managed soils, 89% for N_2O emissions from mineral fertiliser application, 87% for N_2O emissions from crop residues, 89% for indirect N_2O emissions following volatilization of NH_3 and NO_X, 11% of N_2O emissions following Runoff and Leaching of nitrate, and 97% of emissions from the cultivation of organic soils.

Figure 6.57: Comparison of emission factors for enteric fermentation in dairy and non-dairy cattle, swine, and sheep and goats used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and the emission factors calculated (in case of dairy and non-dairy cattle) or used (in case of swine and sheep and goats) in CAPRI



6.5 Sector-specific recalculations

6.5.1 Enteric Fermentation (CRF source category 4.A)

Information on recalculations of emission estimates in category 4A contained in the NIR of some countries are summarized below:

Table 6.105: Available background information for recalculations of emissions in category 4.A

Member State	Recalculations
Austria	Animal numbers of horses, poultry and other animals have been updated with new activity data from

Member State	Recalculations
	the 2010 Agricultural Structure Survey.
Belgium	- In Flanders the methane conversion rate (Ym) of slaughter calves has been changed for the entire time series to be consistent with the IPCC GPG 2000; - the milk production of brood cows is taken into account in calculation of net energy for lactation of brood cows (and not only of dairy cows); - CH_4 emission factors for the "dairy cattle" and "other cattle" categories in the Brussels region were adapted according to the 2000 IPCC GPG or 1996 IPCC GL (tier-1 default values) and applied to the whole time series; - updating milk production in Wallonia.
Denmark	The number of fur animals has been updated due to updated numbers from Dst. The number of weaners, fattening pigs and hens has been updated due to correction of errors in the calculation of the numbers.
Finland	The number of fur animals was updated for 2010. Calf weight was corrected for 2010 because of a transfer error.
France	National method for the quantification of methane emissions from enteric fermentation has been updated in this version of the inventory, based on the preliminary results of MONDFERENT (Eugene et al, 2012) Statistical data for livestock heads 1990-2011 have been modified following the publication of a new census in 2010. These modifications have had an impact on emission data.
Germany	Update of livestock characterization with regard to age of dairy cows and heifer, correction of live weight for dairy cows and heifers in some regions, and of broilers since 2000 and for laying hens in 2010, update of milk yields for 2010, new categorizations for beef cattle; update of the number of piglet per sow. Different livestock performance data leads to different GE; a new calculation method for dairy cows leads to a higher MCF; fattening cows are considered now with dairy cows leading to slightly higher CH_4 emissions.
Greece	
Ireland	Minor revisions to animal populations of poultry and swine between 2007 and 2010. The EPA and the Department of Agriculture, Food and the Marine are actively pursuing the opportunities for both CH_4 and N_2O emissions research in Ireland with a number of projects being currently funded or about to commence. It is also envisaged that as a result of this research, feed intake parameters and assumed nitrogen content of feeds will be reviewed and updated as necessary. In preparation for the next submission Ireland will investigate the applicability of developing Tier 2 estimates of CH_4 from enteric fermentation and manure management from sheep as recommended in the previous annual inventory review report.
Italy	- Recalculations of the net energy growth parameter for dairy cattle and buffalo; - Update of the number of animals for a single category of non-dairy cattle between 1-2 year lead to a change of EF (mean average) and emission for non-dairy cattle in 2009; - update number of rabbits for the year 2009 according to ISTAT data.
Luxembourg	
Portugal	Introduction of RGA 2009 data (from INE), which revised data for all animal types and crops, and also affected dairy cattle milk yield values. Introduction of RGA 2009 data (from INE) which revised the 2000-2009 time series for all animal types. For some animal types (swine, ovine), the AD revision affects all the 1990-2009 time series, because for some animal subcategories livestock values for the first years were corrected with data from later years. Due to in-depth AD revision provided by RGA 2009, efforts were also made to revise the slaughtering values for 1990-1999 time series Following the time series revision provided by RGA 2009, values on crop area and production for the 1990-1999 period were also updated for some crop types (supported by INE values)
Netherlands	
Spain	New tier 2 methodology for the calculation of emissions from dairy and non-dairy cattle (results show lower emissions than with the previous tier 1 approach)
Sweden	Emissions from calves are recalculated, assuming zero emissions from calves feeding only milk.
United Kingdom	- Dairy cow feed digestibility was corrected from 73.588 to 75%, according to information from Bruce Cottrill (ADAS, pers. comm.). This was applied to the entire time series; - dairy cow live weight anomalies (due to the Over Thirty Month Scheme) for the years 1997-2005 have been updated. Live weights for this period were derived by interpolation using the linear regression fitted to the periods before and after these dates; - the enteric emission factor for lambs has been revised. Previously lambs were assumed to have a 6 month lifespan, this has been revised to 8.1 months (ADAS report by Wheeler et al. (2012), "More robust evidence on the average age of UK lambs at slaughter"). The report is based on survey data for data one year only, but the revision has been applied to the whole time series; - recalculations of animal numbers in Cayman Islands.

Member State		Recalculations
Bulgaria	-	**Emissions from young cattle have been recalculated for the entire time series due to animal weight changes;**
	-	**Animal population and animal categories correction of notation key and cross-check with CRF tables**
Czech Republic	-	**new country-specific parameter on digestibility (DE, in %) was determined and implemented in the 2012 submission**
Cyprus	-	**The emissions for 2010 have been re-estimated for Non-Dairy Cattle, Sheep, Goats, Swine and Poultry, due to new data available for animal population.**
Estonia	-	**Population of calves (less than 1 year old) was split into two groups: calves 0–6 months old and calves 6–12 months old;**
	-	**CH_4 emissions from enteric fermentation of bovine animals were excluded from 'Mature cattle' category and included and reported under 'Young cattle' category.**
Hungary	-	**Revision of livestock population for Poultry and Rabbit (1985-1999);**
	-	**revision of Gross Energy Intake for Cattle (1985-2010).**
Latvia		
Lithuania	-	**gross energy (GE) intake for dairy cattle for the period 2008-2011 was recalculated;**
	-	**emissions from non-dairy cattle, sheep and swine for all time series were recalculated due to recalculation of CH_4 emission factors for young animals.**
Malta	-	**animal numbers for horses and rabbits for 2010 have been updated through the publication of the Agricultural Census 2010.**
Poland		
Romania		
Slovakia	-	**Enteric Fermentation/Dairy Cattle/AGEI in MJ/head/day - correction in average gross energy intake based on regional statistics.**
Slovenia	-	**CH_4 emissions from enteric fermentation of swine have been recalculated for the period 1986-2010 using IPCC default EF of 1.5 kg CH_4/head/yr**
	-	**Enteric Fermentation/Goats/emission factor in kg/head/year - correction of methane EF (default 5 kg/head/year) led to the small correction of methane emissions (increase by 0.5%) in year 2009..**

Recommendations of ARR2012

Recommended issues for category 4A) are:

- Luxembourg:
  - The ERT therefore reiterates the recommendation in the previous review report that, in the next annual submission, the Party revise the EFs to take into account weight changes in accordance with the IPCC good practice guidance..
  - The ERT recommends that, in the next annual submission, Luxembourg improve the accuracy of reported cattle live body weight.
  - The ERT recommends that, in the next annual submission, Luxembourg change the label of the category to ensure consistency between the label and animal types included.
- Sweden:
  - The ERT reiterates the recommendation made in the previous review report that Sweden include the values of the average gross energy intake and average CH_4conversion ratein its next annual submission.
  -

6.5.2 Manure Management (CRF source category 4.B(a))

Information on recalculations of emission estimates in category 4B(b) contained in the NIR of some countries are summarized below:

Table 6.106: Available background information for recalculations of emissions in category 4.B

Member State	Recalculations
Austria	In the Austrian QMS regularly extensive QA and verification activities are carried out (Tier 2 QA). In 2012 Agriculture was validated. Some minor inconsistencies within the AWMS data have been found and corrected. The share of anaerobic digestion has been revised on the basis of new input data provided by the Austrian Energy Regulator E-Control.
Belgium	- The implied emission factor for swine in Flanders by using either the VS factor for swine of the Walloon region or a region specific VS factor for swine instead of a default GE factor; - CH_4 emission factors used in the Brussels region were adapted according to the 2000 IPCC GPG or 1996 IPCC GL (tier-1 default values).
Denmark	Planned improvements: the expected reduced emissions of CH_4 and N_2O as a consequence of biogas treated slurry.
Finland	Number of fur animals for 2010 was updated. Calf weight correction (2010)
France	Important changes in the statistical series of number of animals, following the new agricultural census 2010. Calculation of the VS parameter (for cattle): now based on MONDFERENT project results MCF (for all animal categories): now corresponds to a cold climate, instead of temperate climate.
Germany	For the first time biogas installations are considered. Slight recalculations for manure allocation and VS excretion due to updated livestock performance data. Planned improvements are a review of the calculation of manure treated in biogas digesters which will likely lead to slight corrections.
Greece	
Ireland	
Italy	- Update of rabbits and the update of the distribution of biogas recovered between swine and cattle.
Luxembourg	
Netherlands	- Before the constant 0.662 kg/m3 was used as the density of methane within the calculation of EFs for CH_4 emission from manure management. This differs from the value of 0.67 in the IPCC Guidelines, and reason could not be verified in the literature. It was thus deemed an error which has been corrected in the current submission increasing the whole time-series by 1.2%.
Portugal	Introduction of RGA 2009 data (from INE) which revised the 2000-2009 time series for all animal types. For some animal types (swine, ovine), the AD revision affects all the 1990-2009 time series, because for some animal subcategories livestock values for the first years were corrected with data from later years. Due to in-depth AD revision provided by RGA 2009, efforts were also made to revise the slaughtering values for 1990-1999 time series
Spain	New tier 3 methodology for the calculation of emissions from dairy and non-dairy cattle, and inclusion of data from surveys on the manure management systems (results show higher emissions than the previous report, between 20 – 33 %)
Sweden	A small error in the manure production rate for grazing beef cows was corrected
United Kingdom	- Methane emissions from manure management – cattle (see 4A); - methane emissions from manure management – lambs (see 4A); - correction of an error in the beef cattle manure ash value.
Bulgaria	- Change in AWMS distribution and Nex for poultry
Czech Republic	
Cyprus	
Estonia	- Data on weight of dairy cattle were updated (see 4A); - Estonian country-specific module on manure management system was developed for 1990 and 2010; the interpolation between 1990 and 2001, between 2001 and 2010 was applied.
Hungary	- Revision of Manure Management System distribution for Cattle, Sheep, Goat, Swine and Poultry (1985-2010).
Latvia	For 2013 report, recalculations of CH_4 emissions from non-dairy cattle manure management for period 2000-2011 are done based on the use of method Tier 2 instead of Tier 1. Calculations are done based on previously corrected AWMS data.
Lithuania	- emissions from dairy cattle, non-dairy cattle and swine; - since the national data of manure management systems for sheep were used, emissions from animals in these categories were recalculated; - due to updated of gross energy data for dairy cattle for the period 2008-2010 emissions of CH_4 were recalculated; - due to usage of new methodology for calculation of emission factors for sheep emissions of CH_4 were recalculated.
Malta	

Member State	Recalculations
Poland	**Parameters related to Animal Waste Management Systems were updated for 2010 based on information from National Research Institute of Animal Production database. Improvements envisaged: Estimation of GHG emissions related to animal manure for pigs subcategories.**
Romania	**No recalculation since last submission. Improvements are envisaged for the following parameters: ash content, maximum CH_4 producing capacity, and CH_4 conversion factor by manure management systems and climate region.**
Slovakia	
Slovenia	- **CH_4 emissions from manure management of swine have been recalculated for the period 1986-2010 using IPCC default value of VS (0.5 kg VS/head/day.**

Recommendations of ARR2012

Recommended issues for category 4B(a) are

- Austria:
    - a clear presentation of the gross energy intake and volatile solid excretion rates associated with suckling cows and the method used to derive them for the period 1991−2003; information on the derivation of the
    - share of manure digested in biogas plants for the period 1991−2009;
    - and the values of the fraction of livestock manure handled using AWMS for the period 1991−2009 and for all animal subcategories considered in the emission estimates.
- Luxembourg:
    - The ERT commends the Party for this planned improvement and reiterates the recommendation in the previous review report that the Party implement the higher -tier method for the next annual submission.
    - The ERT recommends that, in the next annual submission, Luxembourg improve the transparency of its reporting of the method used to estimate nitrogen excretion from these species by better clarifying the way the IPCC good practice guidance is applied.
- Sweden
    - Further, the ERT recommends that Sweden justify the use of country-specific values (e.g. the MCF for liquid manure), including the provision of additional information in the NIR in order to ensure the transparency of the reporting for the manure management categories, and include an analysis of the CH 4 IEF used for the more significant subcategories in the NIR.
    - The ERT recommends that the Party include information on the definition of animal waste management systems in the relevant chapter of the NIR, in order to ensure the transparency of its reporting.

6.5.3 Manure Management (CRF source category 4.B(b))

Information on recalculations of emission estimates in category 4B(b) contained in the NIR of some countries are summarized below:

Table 6.107: Available background information for recalculations of emissions in category 4.B-N_2O

Member State	Recalculations
Austria	
Belgium	- **The methodology used in the Brussels region for the evaluation of N_2O emissions from manure management was adapted according to the 2000 IPCC GPG.**
Denmark	
Finland	**Number of fur animals for 2010 was updated.**

Member State	Recalculations
	Nitrogen excretion for dairy cows was corrected for year 2010 and for turkeys for year 2009. Error in division of emissions between different manure systems was found and corrected, for years 1990-2004.
France	Important changes in the statistical series of number of animals, following the new agricultural census 2010. Calculation of the VS parameter (for cattle): now based on MONDFERENT project results MCF (for all animal categories): now corresponds to a cold climate, instead of temperate climate.
Germany	N_2O emissions change as a consequence of changes in animal performance and activity data.
Greece	
Ireland	
Italy	- Update of non-dairy female 1-2 years liquid and solid MMS data.
Luxemburg	
Netherlands	
Portugal	Introduction of RGA 2009 data (from INE) which revised the 2000-2009 time series for all animal types. For some animal types (swine, ovine), the AD revision affects all the 1990-2009 time series, because for some animal subcategories livestock values for the first years were corrected with data from later years. RGA AD revision also affected milk yield values (2000-2009) Due to in-depth AD revision provided by RGA 2009, efforts were also made to revise the slaughtering values for 1990-1999 time series
Spain	New tier 3 methodology for the calculation of emissions from dairy and non-dairy cattle, and inclusion of data from surveys on the manure management systems (results show lower emissions than the previous report, between 35 – 41 %)
Sweden	A small error in the manure production rate for grazing beef cows was corrected
United Kingdom	- Nitrous oxide emissions from manure management - AWMS - Removed the upland lowland split for N excretion from ewes and lambs. (In country review recommendation); - updated provisional cow milk yield data for 2010; - corrected error for nitrous oxide emissions from horses (data for 2011 was incorrect).
Bulgaria	
Czech Republic	- Recalculation of N_2O emissions from manure management using revised and complemented country-specific data: Nex values for cattle, manure type distribution (AWMS), protein in milk and protein in feed; - country-specific redistribution of manure management practices across AWMS for cattle and national data on grazing animals.
Cyprus	- The change of annual nitrogen excretion rate per animal: dairy cattle was changed to IPCC “western Europe” factor, to be consistent with sector 4A and goats was changed to the default proposed by EMEP/EEA Emission Inventory GB 2009(Table 3-8); - N_2O-N/kg nitrogen excreted for solid storage and dry lot and other AWMS, to be in line with the GPG.
Latvia	
Lithuania	- N_2O emission was recalculated due to updated of gross energy intake and protein consumption for the period 2008-2010 and N retention for dairy cattle according to IPCC GPG 2000 methodology for entire time series.
Estonia	- Nitrogen excretion rates of all categories of young cattle were calculated based on the updated data.
Hungary	
Malta	
Poland	
Romania	No recalculation since last submission.
Slovakia	
Slovenia	- N_2O emissions from poultry have been recalculated in category 4.B.11 Liquid systems and 4.B.13 Other systems for the entire period 1986-2010; - due to updated data on allocation of swine manure it become evident that the last pig farm which had stored the manure in the anaerobic lagoons was closed in 2009. Therefore swine manure which was allocated to anaerobic lagoon in 2010 was reallocated to liquid.

Recommendations of ARR2012

Recommended issues for category 4B(b) are:

- Sweden:
    - The ERT recommends that Sweden ensure the consistency of the information between CRF tables 4.B(b) and 4.D in the next annual submission.

6.5.4 Agricultural Soils – CH_4 (Source category 4.D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 6.108: Available background information for recalculations of emissions in category 4.D

Member State	Recalculations
Austria	
Belgium	
Denmark	
Finland	
France	Recalculations have been done using 1990-2011 statistical data of crop surfaces and yields of the new agricultural census 2010
Germany	Changes in N input as a consequence of updates in animal performance and activity data and manure management data lead to recalculations of N_2O emissions. N-input by sewage sludge updated. Area of cultivated histosols updated.
Greece	
Ireland	
Italy	
Netherlands	
Portugal	New data from GPP was obtained concerning rice areas in Techniques of Integrated Production and Protection, which revised the 1996-2009 time series
Spain	
Sweden	
United Kingdom	
Bulgaria	
Czech Republic	
Estonia	
Hungary	
Latvia	
Lithuania	
Poland	
Romania	No recalculation since last submission. Improvements are envisaged on data on rice cultivation techniques.

6.5.5 Agricultural Soils - N_2O (Source category 4.D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 6.109: Available background information for recalculations of emissions in category 4.D

Member State	Recalculations
Austria	
Belgium	- In Flanders, the N processed or exported outside Flanders has been updated for the time period 2003-2011. Data from the most recent progress reports from the manure bank have been used; - all three regions use, during the 2013 submission, when available, the values for $Frac_{NCRBF}$ and FracNCR0 from table 4.16 of the IPCC GPG 2000 in combination with the values from the IPCC 1996 GL. Before this submission, all values originated from the IPCC 1996 GL; - the methodology used in the Brussels region for the evaluation of N_2O emissions from agricultural soils was adapted according to the 2000 IPCC GPG.
Denmark	Under review by ESD it has been recommended that the emission of NH_3 from grazing animals is not sub-tracted before calculation of N_2O. This has given rise to a recalculation of N_2O emission from pasture, range and paddock this year. The area of histolsols has been recalculated due to change in the Land Use matrix. The re-calculation increased the area of histolsols. A minor recalculation of 4.D.3.2 Nitrogen Leaching and Run-off have been made due to updated values. The emission of N_2O from sewage sludge and industrial waste has been changed for 2010 due to updated values for N.
Finland	Pasture calculation changed: the amount of volatilised nitrogen is not subtracted from the pasture manure nitrogen when calculating direct emissions (in line with GPG 2000). Emissions from pasture increased less than 5%. Updates: area of cultivated organic soils (for the whole time series), fur animal number (2010) Corrections: Nex of dairy cows (2010) and turkeys (2009), synthetic fertiliser direct emissions (2009, 2010), crop yield of mixed grain (2010) Errors in N mass flow model were corrected, affecting $Frac_{Gasm}$, which changed slightly for 1990-2010, sewage sludge emissions, manure application emissions $Frac_{NCRBF}$ and $Frac_R$ were changed to 'NA' as they are irrelevant in calculation. Cereals harvested green was added as a new group in order to fix time series consistency.
France	Recalculations have been done using 1990-2011 statistical data of crop surfaces and yields of the new agricultural census 2010
Germany	
Greece	
Ireland	Amendments to indirect emissions of N_2O from atmospheric deposition were made due to a change in the NH_3 model inputs. In addition, a reallocation of N_2O emissions was made from Animal Manure Applied to Soils (4.D.1.2) to sub-category sewage sludge (4.D.1.6), following a previous annual inventory review recommendation. Finally, a revision to indirect emissions of N_2O from leaching and run-off (4.D.3.2) was made following a reduction in the amount of nitrogen volatilised as ammonia in the NH_3 model due to a double count of some poultry; broilers and layers in the previous submission. The inventory agency continues to engage with researchers working on N_2O emissions from soils, with a view to adopting a methodology that systematically accounts for the influences of soil type, fertiliser type and application rates, temperature and rainfall, which are not captured by the current IPCC methodology. However, the lack of reliable data in relation to the key soil properties including bulk density and organic carbon content has delayed the application of such a methodology at national level and therefore is unlikely to be implemented during the first commitment period. Ireland will also investigate the possibility of estimating ammonia emissions from the spreading of sewage sludge on agricultural land using an appropriate emission factor if available and adjusting the parameter FS (amount of organic nitrogen in sludge applied to agricultural soils).
Italy	- update of fraction of livestock N excretion that volatilizes and, in 2009, also to the update of fraction of livestock N excreted by female non dairy cattle of 1-2 years;
Luxemburg	
Netherlands	
Portugal	Introduction of RGA 2009 data (from INE) which revised the 2000-2009 time series for all animal types and crops. For some animal types (swine, ovine), the AD revision affects all the 1990-2009 time series, because for some animal subcategories livestock values for the first years were corrected with data from later years. RGA AD revision also affected milk yield values (2000-2009) Due to in-depth AD revision provided by RGA 2009, efforts were also made to revise the slaughtering values for 1990-1999 time series Following the time series revision provided by RGA 2009, values on crop area and production for 1990-1999, for some crop types, were also updated. This revision was also supported by INE values. Revision of the 2009 value for apparent consumption of synthetic fertilisers.
Spain	Emission from compost have been revised with new information available from MAGRAMA ("Medio Ambiente en España"). Emissions from organic fertilisers modified due to the implementation of the new national methodology for cattle. In addition, the methodology to estimate NH_3 in synthetic fertilisers has changed, providing lower N_2O emission values. Finally, new methodologies indicated for direct N input to agriculture have a consequence in atmospheric deposition and leaching and runoff.

Member State	Recalculations
Sweden	Total area of agricultural land has changed for all years, due to the method used by SLU for calculating cropland. Data for sludge use has been updated for 2010. In 2012 report, data for nitrogen lost as ammonia was subtracted before the EF for N_2O emissions was applied. Data were resubmitted without the subtraction of ammonia, and this approach has been maintained in the 2013 report. The total area of agricultural land has changed for all years as a consequence of the method used by SLU for calculating cropland; the largest changes are for latest years.
United Kingdom	- Direct soil emissions - synthetic fertilisers – in 2011 submission fertiliser N rate for rye, triticale and durum wheat and maize for Scotland and NI had been omitted for 2010; - crop area and fertiliser N rate time series' updated; - direct soil emissions - spreading animal manures on land - Removed the upland lowland split for N excretion from ewes and lambs (in country review recommendation); - N fixing crops - crop production time series updated; oats and rye DM corrected for Scotland; - The area of cultivated histosols has been updated to agree with that reported under LULUCF. Area increased from 392 km^2 to 1500 km^2; - reported value of N input from application of synthetic and organic fertiliser and sewage sludge is now corrected for volatilisation (previously reported as the total with no correction); - the fraction of livestock N excretion in excrements burned for fuel is now expressed as a fraction of all livestock groups N (previously expressed as a fraction of poultry N).
Bulgaria	- Animal manure applied to soil - revised according to changes from manure management (4B) The multiplication of FAW by 44/28 was neglected in previous submissions; - N-fixing crop - N-C ratio in biomass residue changed; - Crop residue - Fraction burnt starts from 1 in 1990 and decreases linearly to 0.1 in 2008; - Indirect soil emissions - revised according to changes from manure management (4B)
Czech Republic	- Recalculated value of Nex for cattle led to changes in N_2O emissions from i) animal manure applied to soils (4D1b), ii) PRP (4D2), iii) atmospheric deposition (4D3.1) and iv) N lost through leaching and run-off (4D3.2). These changes apply to the entire reporting period; - N-fixing forage crops such as alfalfa and clover were included in the calculations of N_2O emissions for the entire time series; - potatoes and sugarbeet crops produced in the country were included in the estimations of N_2O emissions from crop residues returned to soils for the entire time series.
Cyprus	
Estonia	- Animal manure applied on agricultural soils (CRF 4.D.1.2) – amounts of manure applied on soils were recalculated due to the changes employed in the estimations of nitrogen excretion rates and because of the development of Estonian module on MMS; - cultivation of organic soils (CRF 4.D.1.5) – data on areas of organic soils; - sewage sludge applied on agricultural lands (CRF 4.D.1.6) – nitrogen content in sewage sludge was updated; country-specific value was used in the estimations.
Hungary	- Introduction of new country-specific dry matter and nitrogen fraction for lucerne hay and red clover hay for the period1985-2010.
Latvia	Areas of cultivated histosols were recalculated for period 2000-2011, according to newest available information provided by Latvian State Forest Research Institute (Silava)
Lithuania	- Activity data on Synthetic N fertilisers (4.D.1.1) were updated, particularly year 2007, 2008 and 2010; - recalculations in subsector animal manure applied to soils; - re-estimation of $Frac_{GRAZ}$ were performed in this submission (4.D.1.2); - recalculations were done in subsectors N-fixing crops (4.D.1.3) and crop residues (4.D.1.4) because a higher Tier method was used (switching from Tier 1a to Tier 1b); - recalculations were performed in histosols (4.D.1.5) by adding additional area of organic drained grasslands as previously this area was not included in to calculations; - N_2O emission calculation from sewage sludge was included in this submission (4.D.16). - N_2O emissions from pasture, range and paddock manure (4.D.2) were recalculated due to recalculations made in subsector manure management – N_2O (4.B.(b)), - recalculations in the subsector "Indirect emissions from agricultural soils" are related to N_2O emission recalculations made in manure management subsector and activity data updates for calculation of emission from Synthetic fertiliser use subcategory. Changes in emissions were also caused by sewage sludge nitrogen (NSEWSLUDGE) that was included in this submissions calculation.
Malta	
Poland	Slight recalculations were made related to correction of parameters like dry matter fraction of N-fixing crops in 4.D.1.3 as well as related to correction and update of AWMS influencing 4.D.2 and 4.D.3 subcategories. No improvements are planned.
Romania	No recalculation since last submission. Improvements envisaged include: $Frac_{GASF}$, $Frac_{GASM}$,

Member State	Recalculations
	FracLEACH, and AD data
Slovakia	- Synthetic Fertilisers/N Applied to Soil in kg N/year – Correction of error in formula calculated the nitrogen fraction applied to soil from synthetic fertilisers. The N_2O emissions for the entire time series 1997-2005 were increased; - Animal Manure Applied to Soil/N Applied to Soil in kg N/year - fraction of nitrogen lost by evaporation was recalculated according to the IPCC default value (20%) instead of previously used 10% of nitrogen. Emissions of N_2O were increased by 10% in the time series.
Slovenia	- The amount of sewage sludge applied to the agricultural soils has been updated for 2003, 2004 and direct and indirect N_2O emissions from the sewage sludge application have been recalculated accordingly; - the amount of sewage sludge applied to the agricultural soils in 2003 and 2004 has been corrected and recalculations have influence on direct and indirect emissions.

Recommendations of ARR2012

Recommended issues for category 4D are:

- Austria.
    - The ERT recommends that Austria include this explanation for the use of the notation key ìNOî to report N_2O emissions from agricultural soils in its next annual submission.
- Luxembourg:
    - ERT recommends that, in the next annual submission, Luxembourg improve the transparency of its reporting in the NIR by providing the background information used to estimate $Frac_{GRAZ}$

6.5.6 Field burning of agricultural residues - N_2O (Source category 4.F)

Information on recalculations of emission estimates in category 4F contained in the NIR of some countries are summarized below:

Table 6.110: Available background information for recalculations of emissions in category 4.F

Member State	Recalculations
Austria	Activity data on viniculture areas have been updated for 2010
Belgium	
Denmark	
Finland	
France	Recalculations have been done using 1990-2011 statistical data of crop surfaces and yields of the new agricultural census 2010
Germany	
Greece	
Ireland	
Italy	
Luxemburg	
Netherlands	
Portugal	Introduction of RGA 2009 data (from INE) which revised the 2000-2009 time series for all crops. New data from GPP was obtained concerning rice areas in Techniques of Integrated Production and Protection, which revised the 1996-2009 time series.
Spain	
Sweden	
United	

Member State	Recalculations
Kingdom	
Bulgaria	
Czech Republic	
Cyprus	The N2O emissions have been recalculated based on the revised N-C ratio (Table 6.16). The emission factors previously used were all based on the defaults suggested by revised IPCC 1996 guidelines (IPCC 1997, Table 4-16). For this submission, N-C ratio is according to the IPCC Good Practice Guidance. The resulting changes in the emissions for 1990-2010 are presented in Table 6.23 compared to the emissions of the previous submission.
Estonia	
Hungary	
Latvia	
Lithuania	
Malta	
Poland	Slight corrections in activities related to crop production were made. No improvements are planned.
Romania	No recalculation since last submission. Improvements envisaged include AD
Slovakia	
Slovenia	

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7 LULUCF (CRF SECTOR 5, EU-15)

Complying with relevant provisions, Sector 5 LULUCF (Land Use, Land Use Change and Forestry) of the European Union (EU) GHG Inventory is a compilation of the reports submitted by the EU's member states (MS). MS' NIRs of 2013 are used as the primary source of data and information, unless otherwise specified and referenced.

This chapter provides the general trends of emissions and removals from LULUCF at the EU-15 level, (information regarding EU-27 is provided in Chapter 22 of the EU NIR) compares the methods used by different countries and describes the efforts carried out to harmonize and improve the complete and consistent reporting of GHG inventory at EU-15 level. More detailed information can be found in the NIRs of individual MS.

In particular, for the EU-15, this chapter includes: an overview on LULUCF sector including overall trends, the contribution of land use changes, the completeness of reporting, the key categories and some general methodological information; the trends of net emissions, activity data and emissions factors for each category; some specific methodological information for the relevant categories; and an overview of cross-cutting issues including uncertainties, QA/QC, time series consistency and recalculations.

Please also note that EU submission contains three sets of the CRF tables:

- "KP" refers to submission done by the group of member states which have commitment under the KP (EU 15). These tables include LULUCF estimates under the Convention, for which information is provided in the rest of this chapter.
- "Convention" refers to EU-27, for which summary information is provided under Chapter 22.
- "KP LULUCF" refers to the LULUCF estimates under the KP, for which information is provided in Chapter 11.

7.1 Overview of the sector (EU-15)

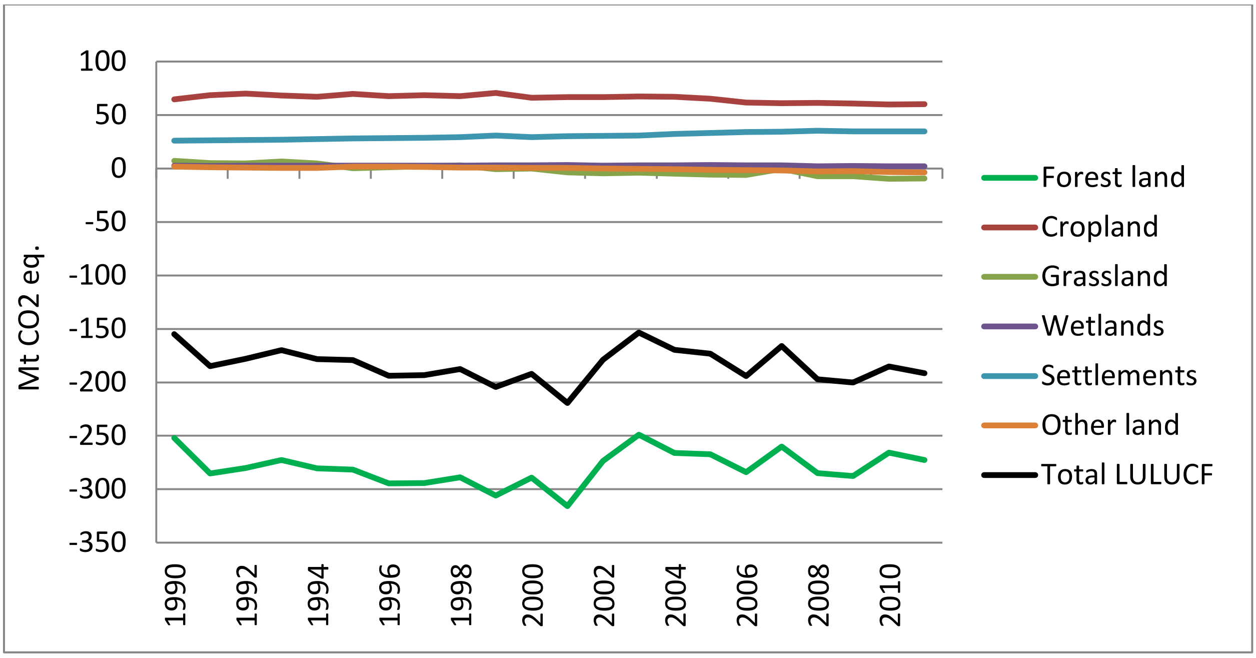
With almost all lands under more or less intensive management, Europe is a fine-grained mosaic of different land uses, resulting in a highly fragmented landscape. The EU agricultural and environmental policies have been the major driver of land use and land use change in Europe especially since 1990. In particular, the Common Agricultural Policy and rural development programs have stimulated less intense agricultural practices and a general decrease of area of the utilized arable land, compensated by the increase in forest and urban areas. Furthermore, the EU environmental policy (e.g. Natura 2000 network) has stimulated a significant increase of forest and woodlands area under conservation regime with the purpose of preserving biodiversity and landscapes. Currently, at EU-27 level, around 25% of total forest and woodland areas are excluded from harvesting, and felling accounts for only 60% of the net annual wood increment, which explains the significant build-up of biomass (i.e. carbon removal) in the forests.

7.1.1 Trends by land use categories

The Sector 5 LULUCF of the EU-15 is a net carbon sink, resulting from higher removals by sinks than emissions from sources. Overall, forests are a significant net carbon sink, croplands are a source and grasslands are a small sink (Figure 7.1). In 2011, the net CO_2 in LULUCF sink in the EU-15 was -

196055 GgCO_2-eq. which represents an increase of about 22% compared to annual sink in 1990 (Figure 7.1). The contribution of CH_4 and N_2O is less than 1% of net annual sink.

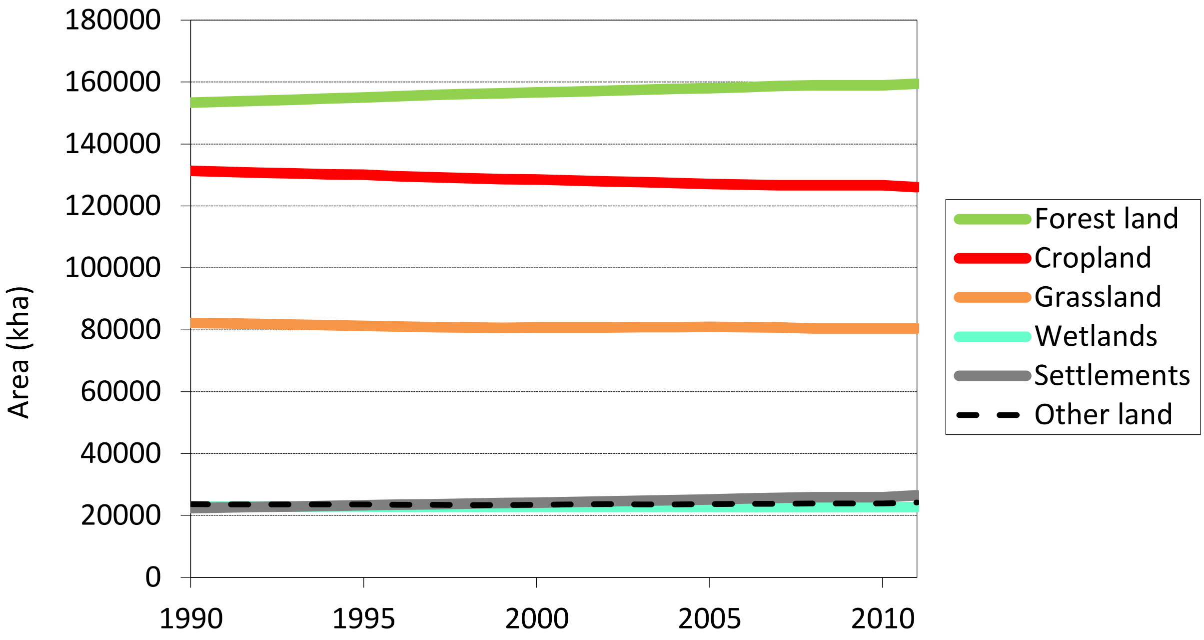
Figure 7.1 **Sector 5 LULUCF: EU-15 GHG emissions (+) and removals (-) for 1990–2011, in CO_2 eq. (Gg), for all land use categories**



The most relevant trend in emissions and removals for the EU-15 is related to forest land. An increase of the forest sink occurred during the '90s, mainly due to forest area expansion. It was followed by a decline largely attributable to a general increase in harvest rate. The significant decrease of the forest sink in 2002 is due to a drop in the 5A1 sink of Germany, evident in a single year due to the stock-change method used. The other year-to-year variations of the forest sink are mainly related to major wind storms (e.g. 1999 and 2007 in central-western Europe) and wild fires (e.g. forest fires in 1990, 2003 and 2007 in Mediterranean countries).

The reported land area of the different categories (Figure 7.2) confirms the trends known from other statistics (e.g. Eurostat), although the absolute numbers may slightly differ due to different definitions linked to different reporting requirements under various processes. For the EU-15, the main changes in area from 1990 to 2011 regarded Forests land (+4%), Cropland (-5%) and Settlements (+18%).

Figure 7.2 EU-15 total land area for each of the LULUCF categories (kha), as reported in the MS' CRFs 2011



Although EU-15 showed a net sink in LULUCF sector in 2011, increasing since 1990 (Table 7.1), it should be noted that the individual countries' estimates show a range from small source (e.g. Germany, The Netherlands) to small sinks (e.g. Belgium and Ireland) or large sinks (e.g. Italy, France, Spain, Finland and Sweden). Few MS estimate LULUCF as a source, at least in some years of 1990-2011: Germany, Denmark, Netherlands or United Kingdom. Compared to 1990, some country report large increase in the sink (e.g. Finland, France, Italy, Spain) while other turned from sink to source (Germany).

Table 7.1 Sector 5 LULUCF: MS' contributions to net CO_2 emissions in 2011

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-9 968	-3 568	-3 542	2.0%	26	-1%	6 426	-64%
Belgium	-927	-1 451	-1 439	0.8%	13	-1%	-511	55%
Denmark	5 456	-487	-2 678	1.5%	-2 191	450%	-8 134	-149%
Finland	-15 309	-24 814	-24 775	13.8%	40	0%	-9 465	62%
France	-25 760	-37 827	-47 710	26.6%	-9 882	26%	-21 950	85%
Germany	-36 024	8 448	9 060	-5.1%	612	7%	45 084	-125%
Greece	-2 527	-2 607	-2 553	1.4%	54	-2%	-27	1%
Ireland	-2 700	-4 204	-3 782	2.1%	422	-10%	-1 082	40%
Italy	-13 035	-43 560	-30 845	17.2%	12 715	-29%	-17 810	137%
Luxembourg	345	-298	-297	0.2%	1	0%	-642	-186%
Netherlands	2 999	2 992	3 265	-1.8%	273	9%	266	9%
Portugal	7 731	-3 999	-5 726	3.2%	-1 726	43%	-13 457	-174%
Spain	-19 296	-28 962	-29 138	16.2%	-176	1%	-9 842	51%
Sweden	-37 266	-30 838	-35 349	19.7%	-4 510	15%	1 917	-5%
United Kingdom	3 169	-4 217	-3 836	2.1%	382	-9%	-7 004	-221%
EU-15	**-143 111**	**-175 394**	**-179 342**	**100.0%**	**-3 948**	**2%**	**-36 231**	**25%**

Overall, for the EU-15, in the year 2011 LULUCF sector offsets about 5 % of the total emissions ("without LULUCF"), with values ranging at member states level from +1.7 % (contributing to national GHG inventory as a source, in Netherlands) to -57.3 % (as sink, in Sweden) (Table 7.2, column a). The most important LULUCF category, Forest Land, in 2011 was a net sink for all MS (Table 7.2 column b), offsetting 1.3 % of total emissions in Netherlands, 63.9% in Sweden, and 7.5% for the whole EU-15. The most significant contributors to EU-15's 5A inventory are France, Sweden and Finland (Table 7.2, column c).

Table 7.2 **Sector 5 LULUCF: Contribution of Sector 5 (column a) and Category 5A (column b) to total emissions (without LULUCF) and MS contribution to EU-15 Category 5A (column c)**

Member State	Sector 5 over total emission excluding LULUCF	Category 5.A over total emissions	Member States contribution to EU-15 total for Category 5A
	(a) (%)	(b) (%)	(c) (%)
Austria	-4.2%	-6.5%	2.0%
Belgium	-1.1%	-3.2%	1.4%
Denmark	-4.7%	-11.4%	2.4%
Finland	-36.7%	-53.7%	13.3%
France	-9.2%	-13.4%	24.1%
Germany	1.0%	-3.6%	12.1%
Greece	-2.2%	-1.8%	0.8%
Ireland	-6.4%	-7.3%	1.6%
Italy	-6.3%	-6.0%	10.9%
Luxembourg	-2.4%	-3.9%	0.2%
Netherlands	1.7%	-1.3%	0.9%
Portugal	-7.6%	-10.9%	2.8%
Spain	-8.3%	-7.2%	9.3%
Sweden	-57.3%	-63.9%	14.5%
United Kingdom	-0.6%	-1.8%	3.7%
EU-15	**-4.8%**	**-7.4%**	**100.0%**

Source: MS' submissions 2013, CRF table 5, 5A and Summary 2.

7.1.2 Contribution of land use changes

Emissions from land conversions reached 32 % in absolute amounts of emission and removals in the EU 15 (Table 7.3, column d). Entire land use change area only represents 8.8 % of the total reported land area in EU-15 (Table 7.3, column a) and b), slightly more than reported for year 2010.

The sink on conversions to forest land and grassland is almost balanced by emissions from conversions to cropland and settlements.

Table 7.3 **Contribution of land use changes in 2011 for EU-15, in terms of area (columns a-b) and GHG emissions (columns c-d).**

Land conversions	a) area of the land category (kha)	b) % of area of the corresponding category[1]	c) emissions (+) and removals (-) (Gg CO_2 equivalents)	d) % of net emissions of the corresponding category[1,2]
5A2. Land converted to Forest Land	6.604	5,3%	-39.327	14%
5B2. Land converted to Cropland	6.804	8,0%	30.143	53%

5C2. Land converted to Grassland	9.504	14,6%	-20.822	65%
5D2. Land converted to Wetlands	765	4,2%	-518	17%
5E2. Land converted to Settlements	4.257	20,3%	30.183	88%
5F2. Land converted to Other Land	2.087	11,3%	-3.460	100%
Total land use changes	29.820	8,8%	-3.801	32%

[1] the corresponding category is 5A (Forest land) for 5A2, 5B (Cropland) for 5B2 and so on.
[2] The contribution of emissions from land use changes to the total of each category was obtained by considering separately the absolute values of each subcategory, i.e. (abs 5A2)/(abs 5A1+ abs 5A2) x 100.

Land use area under conversion is 5 % higher in 2011 than in 1990 (Table 7.4). Overall, land use changes associate with emissions in 1990 and turned into removals in 2011.

Table 7.4 **EU-15 land use change matrix for the years 1990 and 2011, in terms of area (kha) and net emissions ($GgCO_2$). Lands remaining the same are not shown in this table.**

Year 1990		**Land area conversions from… (kHa)**						**Total "to"**
		forest land	cropland	grassland	wetlands	settlements	otherland	
Conversions to	forest land		1.033	2.551	131	238	407	**4.361**
	cropland	458		7.358	25	388	515	**8.743**
	grassland	785	6.929		71	475	320	**8.579**
	wetlands	75	57	99		41	88	**360**
	settlements	501	1423	1.432	40		32	**3.428**
	otherland	118	65	114	28	5		**331**
Total "from"		**1.938**	**9.507**	**11.555**	**295**	**1.147**	**1.361**	**25.803**

Year 1990		**Net emissions in conversion from ...($GgCO_2$)**						**Total "to"**
		forest land	cropland	grassland	wetlands	settlements	otherland	
Net emissions in conversions to …	forest land		-4.805	-13.920	-765	-2.976	69	**-22.396**
	cropland	5.432		30.049	438	11	4.695	**40.625**
	grassland	5.145	-2.0312		922	-2.478	1.775	**-14.947**
	wetlands	911	-579	-1.074		-398	861	**-279**
	settlements	6.733	2.962	11.856	672		188	**22.412**
	otherland	1.964	-302	-7	0	0		**1.657**
Total "from"		**20.186**	**-23.036**	**26.905**	**1.269**	**-5.841**	**7.589**	**27.072**

Year 2011		**Land area conversions from… (kHa)**						**Total "to"**
		forest land	cropland	grassland	wetlands	settlements	otherland	
Conversions to	forest land		1.689	3.447	531	313	624	**6.604**
	cropland	412		5.846	38	338	171	**6.804**
	grassland	687	7.793		100	657	267	**9.504**
	wetlands	229	86	212		72	166	**765**
	settlements	664	1.835	1.640	55		64	**4.257**
	otherland	616	629	688	125	29		**2.087**
Total "from"		**2.608**	**12.032**	**11.833**	**848**	**1.409**	**1.292**	**30.022**

Year 2011		**Net emissions in conversion from ...($GgCO_2$)**						**Total "to"**
		forest land	cropland	grassland	wetlands	settlements	otherland	
emissions in conversions to …	forest land		-14.744	-18.467	-3.806	-3.639	-3.340	**-43.996**
	cropland	6.596		21.321	506	-338	2.057	**30.143**
	grassland	3.910	-23.299		1.011	-3.607	1.169	**-20.816**
	wetlands	1.162	-376	-1.896		-823	1.415	**-518**

	settlements	10.573	3.695	14.441	894		570	**30.173**
	otherland	2.406	-4.462	-1.686	-12	-50		**-3.804**
Total "from"		**24.646**	**-39.185**	**13.714**	**-1.406**	**-8.457**	**1.870**	**-8.818**

In terms of land area involved the conversions from grassland to cropland and vice versa is the most significant, followed by conversion from grassland to forest land. On average, in 2011, from total area “under conversion” 22% is conversion to forest land, 13% is conversions to settlements and 32 % and 23% are conversions to cropland and grasslands, respectively. When interpreting the data of Table 7.4 it is important to note that some differences may occur among MS in terms of both land use definitions and the reported time series (e.g. some countries start only in 1990, not all countries use the 20-yrs default transition period).

7.1.3 Completeness

Table 7.5 illustrates the current coverage of reporting for the various land sub-categories in the year 2011. The three main land uses have practically complete coverage.

Table 7.5 **Sector 5 LULUCF: Coverage of CO_2 emissions and removals for each of the LULUCF land sub-categories for the year 2011, as derived from 2013 CRF submissions**

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5A1 F-F	5A2 L-F	5B1 C-C	5B2 L-C	5C1 G-G	5C2 L-G	5D1 W-W	5D2 L-W	5E1 S-S	5E2 L-S	5F1 O-O	5F2 L-O
Austria	R	R	E	E	E	E		E		E		E
Belgium	R	R	E	E	E	R		R		E		E
Denmark	R	R	E	R	E	E	E	E		E	R	R
Finland	R	E	E	E	E	R		E		E		
France	R	R	E	E	E	R		R		E		E
Germany	R	R	E	E	E	R	E	E	E	E		
Greece	R	R	R	E	E	E		E		E		E
Ireland	R	R	E	E	E	R	E	E		E		R
Italy	R	E	E	E	R	E	E	E	E	R	R	
Luxemb.	R	R	E	E		E		E		E		E
Netherl.	R	R		E	E	E		E		E		E
Portugal	R	R	R	E	R	E		E		E		R
Spain	R	R	R			R				E		
Sweden	R	R	E	E	R	R	E		E	E		
UK	R	R	E	E	R	R	E	E	E	E		

R = the pool change results in net Removals; E = the pool change results in a net Emissions
Empty cells = the pool was not reported, included elsewhere or reported as no changing.

WL, SL and OL sub-categories are poorly reported in comparison to the major land categories. Also, land remaining in the same category is often assumed neutral. On the other side, there is a quite complete reporting of emission and removals conversions.

Table 7.7 shows the completeness of reporting of C stock changes by pools for the three most important land sub-categories in 2011. Compared to the previous submissions, several MS have increased the number of pools estimated and reported. As for Table 7.5, empty cells in Table 7.7 Sector

5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2011 (from Tables 5A, 5B and 5C of MS's CRF 2013 submissions) represent pools which are not reported or demonstrated in the NIR not to be a source; in most cases, efforts are ongoing in these countries to produce estimates for future submissions.

7.1.4 Key categories

The following subcategories of the LULUCF sector of the EU-15 GHG inventory were found to be key categories (Table 7.6) for the trend (T) and the level assessment (L).

Table 7.6 Key category analysis for the EU 15 (LULUCF sector excerpt)

Source category gas	Trend	Level	
		1990	2010
5 A 1 Forest Land remaining Forest Land: (CO_2)	T	L	L
5 A 2 Land converted to Forest Land: (CO_2)	T	L	L
5 B 1 Cropland remaining Cropland: (CO_2)	T	L	L
5 B 2 Land converted to Cropland: (CO_2)	T	L	L
5 C 1 Grassland remaining Grassland: (CO_2)	T	L	L
5 C 2 Land converted to Grassland: (CO_2)		L	L
5 E 2 Land converted to Settlements: (CO_2)	T	T	L

Table 7.7 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2011 (from Tables 5A, 5B and 5C of MS's CRF 2013 submissions)

	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
MS	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org
AT	R	R	E		R	R	R		E		R		E	E	E				E		E	E	R	
BE	R	E	R		R		R				E		E	E	E				E		E	E	R	
DK	R	R		E	R	E	R	E	E		E	E	R		R		E			E	E	E	E	
FI	R		R	E	R		E	E	R		E	E	E	E	E	E			R	E	R		R	E
FR	R	E			R	R	R						E	E	E						E	E	R	
DE	R	R	R	E	R	R	E	E				E	E	E	E	E	R		R	E	R	E	R	E
GR	R				R				R		R	E	E		E		E						E	
IE	R	E		E	R	R		E			R		E		E				R	E			R	E
IT	R	R			R	R	R		E	R		E	R		E		R	R					R	
LU	R				R		R		E				E	E	E						E	E	R	
NL	R	E			R							R	E	E						E	E	E		
PT	R	E	E		R	R	R		R		R		E	E	E				R		E	E	E	
ES	R				R		R		E		R												R	
SE	R	R	R	E	R	R	R	E	R	R	R	E	R	E	E	E	R	R	E	E	R	E	R	E
UK	R	R	R	R					R		E	E	R		E				R					

Pools: DOM – dead organic matter, Biom –living biomas, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other notation keys), assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")

7.1.5 Data and methods

This chapter provides general information on methods, activity data, carbon stock change factors and emissions factors on sink and sources for the three main land sub-categories (5A: Forest Land, 5B: Cropland and 5C: Grassland). Detailed information regarding methodological issues follows in specific chapters.

Given the heterogeneity of the countries in terms of ecological and socio-economic conditions, there are no unique definitions of land use categories across MS. Methods used to estimate emissions and removals from the LULUCF sector also vary among the MS and land use categories, depending on data availability. Table 7.8 is a summary of relevant information on each individual pool in the GHG inventory 2013 for the LULUCF sector.

Because of different underlying methods of each country, when comparing the absolute levels or trends of the implied emission/carbon stock change factors across MS, much caution should be used. Indeed, in some cases, large differences may be attributable to the different estimating methodologies. For example, the gain-loss and stock-difference methods may yield different trends in the short term. Some implied emission factors may be significantly affected by new areas entering in a given category or time series for land conversions started in 1990. Furthermore, the fact that not all countries use the 20-year default transition period for all pools or land conversions suggest that the corresponding emission factors are not fully comparable across MS.

Table 7.8 Summary of methods and C stock change factors used by countries to calculate emission and removals of different pools in the LULUCF sector, as 2013 submissions

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	BM	DOM (1)	SOC Min	SOC Org (2)	BM	DOM	SOC Min	SOC Org (2)	BM (3)	DOM	SOC Min (4)	SOC Org (2)	BM (5)	DOM	SOC Min	SOC Org (2)	BM	DOM	SOC Min (4)	SOC Org (2)	BM	DO M	SOC Min	SOC Org (2)
AT	CS	CS,D	D	NO	CS	CS	CS	NO	D,CS	D	CS,CS	NO	CS,CS	CS	CS	NO	NO	D	CS,CS	CS	CS	CS	CS	NO
BE	CS	CS,D	CS	NO	CS	D	CS	NO	NE	D	CS	NO	CS,NO	D	CS	NO	NO	D	CS	NO	CS, NO	D	CS	NO
DK	CS	CS,D	D	CS	CS	CS	CS	CS	CS	NA	CS	CS	CS,CS	NO	CS	CS	CS	NA	NA	D	D	CS	CS	CS
FI	CS	CS	CS	CS	CS	CS	CS	CS	CS	NE	D	CS	D	CS	CS,D	CS	NE	NA	D	CS	D	NE	CS,D	CS
FR	CS	CS,D	D	NO	CS	CS	CS	NO	D	D	NO	NO	CS,NO	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
DE	CS	CS,D	D	CS	CS	CS	CS	CS	NO	NO	NO	CS	CS,CS	CS	CS	CS	CS	NO	CS	CS	CS	CS	CS	CS
GR	CS	D	D	NO	CS	D	D	NO	CS	D	D,D	D	NO,CS	NO	IE	NO	D	D	NO	NO	NO	NO	IE,N O	NO
IE	CS	CS,D	D	CS	CS	CS	NO	CS	NO	NO	CS,D	NO	CS	NO	CS	NO	NO	NO	CS	CS,D	NO	NO	CS	CS
IT	CS	D,CS	NO	NO	CS	CS	NO	NO	D,CS	CS	NE,NO	D	CS	NO	CS	NO	CS	CS	NE,NO	NO	NO	NO	CS	NO
LU	CS	D	D	NO	CS	D	CS	NO	D	D	NO	NO	CS	D	CS	NO	NO	NO	NO	NO	CS	CS	CS	NO
NL	CS	CS	D	NE	CS	D	NE	NE	NE	NE	NE	IE	CS	CS	NE	NE	NE	NE	NE	CS	CS	CS	NE	NE
PT	CS	CS	CS	NO	CS	CS	CS	NO	CS	NO	CS	NO	CS,CS	CS	CS	NO	NO	NO	CS	NO	CS	CS	CS	NO
ES	CS	D	D	NO	CS	NE	CS	NO	CS	NE	CS	NO	NO,NO	NO	NO	NO	NE	NE	NE	NO	NE	NE	CS	NO
SE	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS,CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
UK	CS	CS	CS	CS	CS	CS	CS	CS	CS	D	CS	CS	CS,CS	CS	CS	IE	NO	NO	CS	NO	CS	CS	CS	CS

(D: default; CS: country specific; NA: not applicable; NE – not estimated; NO- not occurring)
Source: CRFs 2013
"CS" country specific data, associated either with IPCC method (tier 2) or country-specific method (tier 3, if data are highly disaggregated). Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken by IPCC). However it is expected that if "CS" is reported, the most important parameters are truly "CS
"D" means that the default IPCC emission factors are used in the estimation. D is typically associated with IPCC default method (tier 1).
"NE" means either country assumes the emission/removal is negligible or not enough data is available for estimation
"NO" means emissions or removals "not occurring" in a country (it includes also "NA" - not applicable)
(1) for DOM under "FL r FL" the 2 notations separated by a comma mean: first one refers to DW (dead wood), second to LT (litter)
(2) for ORGANIC SOIL any notation key reported for a country showing some activity data of org soil for any land (sub)category is assumed as NE. D refers to the use of IPCC default emissions factors
(3) BIOMASS C stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed zero C stock change by definition.
(4) for SOC MIN on CL and GL the 2 notation keys separated by comma mean that the country uses IPCC default method (which is tier 1 if associated with D data or tier 2 if associated with CS data); in this case, the first notation key refers to "reference C stock", and second to "C stock change factor" (see IPCC-GPG for details). A cell with a single "CS" indicate a country-specific method and data (i.e. tier 3 if data are highly disaggregated)
(5) for BIOMASS under L - CL, "conversion to cropland", the 2 notation keys used mean: first one refers to FL-CL and second to GL-CL
Grey heading means that for these pools IPCC TIER 1 allows to assume no change in C stock (note that if the category is a key category, in theory higher tiers should be used)

7.2 **Forest land (CRF 5A)**

7.2.1 Overview of the Forest land category

Forests land is the dominant category in the LULUCF sector, and represents 37% of EU-15 total land area. According to the data provided by the MS in their 2013 submissions, total forest area in EU-15 increased from 119757 kha in 1990 to 123896 kha in 2011, which is about 4 % more than 1990. About 5% of forest area is represented by land under conversion to forest land. This trend, reflected in official statistics of the MS and EU, is due to the decreasing grazing pressure and decreasing agricultural activities on marginal lands, which promoted natural forest expansion, and also due to the promotion of national afforestation programs (including grant-aid). The largest forest area is in Sweden (65% of total country land area), Finland (65% of total area), while the lowest share is found in Malta (1%), Netherlands (10%) and the United Kingdom (9%).

Deforestation does not appear to be a major issue in Europe; although it may be relevant for specific countries, 8.6% in total area under conversion is represented by conversion from forest land (see NIR's Chapter 11 on KP LULUCF for further information on deforestation). The absolute area under conversion from forest (equal to some 2600 kha cumulated over last 20 years) is more than compensated by that of new planting and forest expansion.

For last decades European forests have shown a considerable sink, documented by both forestry administrative institutions and the scientific community. Also, most national GHG inventories submissions report increasing IEFs (i.e. C stock change factor for biomass) over time series since 1990 for 5A1 forest land remaining forest land, which suggests a sustained sink capacity. Nevertheless, over last decade few MS reported an increased harvest rate (e.g. Austria, Germany) which explains the overall small reduction of EU forest sink.

Forests and forestry are under competence of the MS. At European Union level there is only a general framework mainly aimed at coordinating the national forest policies and supporting the sustainable management of forests (i.e. Forest Strategy, Forest Action Plan).

7.2.2 Forest land remaining forest land (CRF 5A1)

7.2.2.1 *Overview of Forest land remaining forest land*

The area of "forest land remaining forest land" slightly increased by 1.6 % at EU-15 level since 1990 with large differences among MS (e.g., +26% in UK, -10% in Netherlands and Portugal). In absolute terms, most of the land area increase of "forest remaining forest" was reported by Italy (697 kha) and a decreasing of the area by Portugal (of ~ 300kha) (Table 7.9).

Table 7.9 Trend of activity data in the "forest land remaining forest land" subcategory of EU-15's MS (kha, 1990-2011)

Member State	1990	1995	2000	2005	2011	Difference 2011 to 1990
Austria	3.505	3.558	3.684	3.743	3.790	8,1%
Belgium	711	706	701	695	690	-3,0%
Denmark	543	543	543	542	539	-0,8%

Finland	22.027	22.013	21.976	21.911	21.872	-0,7%
France	21.978	22.021	22.099	22.180	22.303	1,5%
Germany	10.205	10.270	10.334	10.457	10.610	4,0%
Greece	3.359	3.358	3.357	3.356	3.355	-0,1%
Ireland	465	465	463	458	458	-1,6%
Italy	6.815	6.968	7.027	7.051	7.512	10,2%
Luxembourg	79	81	82	84	87	9,2%
Netherlands	381	369	358	347	342	-10,2%
Portugal	2.838	2.782	2.625	2.508	2.544	-10,4%
Spain	12.587	12.584	12.582	12.579	12.629	0,3%
Sweden	27.712	27.828	27.854	27.874	27.793	0,3%
United Kingdom	2.192	2.395	2.522	2.628	2.770	26,3%
EU-15	**115.397**	**115.939**	**116.205**	**116.413**	**117.292**	**1,6%**

At EU-15 level, 5A1 is a sink of about 227000 GgCO_2 in 2011, slightly lower than in 1990 and 5% larger than in 2010 (Table 7.10). The strong increase of the sink in 2011 compared to 2010 is largely due to France and Finland (mainly due to variations in harvesting rates).

Table 7.10 5A1 Forest Land remaining Forest Land: MS' contributions to net CO_2 removal/emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-7.617	-2.968	-2.971	1,3%	-3	0%	4.646	-61%	T3	CS
Belgium	-3.118	-3.557	-3.527	1,6%	30	-1%	-409	13%	CS,T2	CS
Denmark	50	-4.041	-6.326	2,8%	-2.285	57%	-6.376	-12714%	CS	CS
Finland	-23.436	-35.941	-36.147	15,9%	-206	1%	-12.711	54%	T2,T3	CS,D
France	-33.633	-48.039	-58.537	25,7%	-10.499	22%	-24.904	74%	T2,T3	CS
Germany	-74.156	-27.894	-27.953	12,3%	-58	0%	46.203	-62%	CS,T1,T2	CS,D
Greece	-1.344	-1.779	-1.779	0,8%	0	0%	-435	32%	T2	CS,D
Ireland	-3.288	-903	-431	0,2%	472	-52%	2.857	-87%	D,T1,T2, T3	CS,D
Italy	-15.574	-30.909	-23.742	10,4%	7.166	-23%	-8.169	52%	T1,T2,T3	CS
Luxembourg	239	-398	-402	0,2%	-4	1%	-641	-268%	T2	CS
Netherlands	-2.407	-2.138	-1.893	0,8%	246	-11%	514	-21%	CS	CS,D
Portugal	-368	303	-1.505	0,7%	-1.808	-596%	-1.137	309%	CS,T2	CS,D
Spain	-18.716	-18.741	-18.792	8,3%	-51	0%	-76	0%	T2	CS,D
Sweden	-41.097	-32.389	-36.256	15,9%	-3.867	12%	4.841	-12%	T2,T3	CS
United Kingdom	-6.128	-7.300	-7.247	3,2%	53	-1%	-1.119	18%	CS,D,T3	CS
EU-15	**-230.592**	**-216.692**	**-227.508**	**100,0%**	**-10.816**	**5%**	**3.084**	**-1%**		

For 2011 all MS report a sink in 5A1. The largest changes of the MS sinks are, when compared to 1990, either sink increase (e.g. Denmark, Finland, France) or decreases (e.g. Germany, Sweden,). France estimated a removal estimates the CH_4 sink represented by undisturbed forest soils (which is reported as CO_2eq and included into 5A1 soil sink estimate), but nonetheless this is not included as accounted amount under Forest management. In most cases, CO_2 emissions from disturbances are implicitly included under CRF table 5A1 as losses in the year of events, while other non-CO_2 emissions are considered under 5(V). The main types of disturbances across EU are forest fires (mainly Southern European countries) and wind storms (mainly in central Europe), while other type of disturbances generally have a localized effect and low magnitude, but also difficult to quantify in terms of biomass loss (e.g. insect outbreaks), thus practically not mentioned in the MS reports. Estimation of emissions from forest fires is made with Tier 1 method in case of small emissions (e.g. Austria) or with higher tiers where such emissions are significant (e.g. Portugal, Spain).

Over the period 1990-2011 it can be recognized a period of increasing sink (in the '90s) mainly due to increasing increments, and a period of decreasing sink (after 2000), mainly due to increasing harvest rates. Furthermore, the inter-annual variability in removals is significantly affected by:

- Forest fires (e.g. Portugal in 1990, 2003 and 2005; Italy in 2007). For instance, Spain reports areas burnt ranging between 20 – 250 kha annually;
- Windstorms (e.g. France in 1999 and 2010, and Denmark in 2000, Sweden in 2005);
- The method used for reporting, e.g. Germany uses the stock-change method between two successive forest inventories: this method is accurate for estimating long-term values but creates a "step" in the reported sink in a single year (2002) (i.e. the significant decrease of the sink which occurred since the previous forest inventory become evident in a single year).

7.2.2.2 *Methodological issues for forest land remaining forest land*

Definitions of forest land are reported by EU-15's MS in their NIR 2013. In this EU-15 report, the consistency of the forest land representation is considered under two aspects: 1) within the country in terms of time and space and 2) across the MS within EU-15. The MS' forest definitions slightly differ in terms of *quantitative* parameters, i.e., crown coverage, tree height and minimum land area (Table 7.11). In general, there is consistency with reporting under other international processes (i.e. Global Forest Resources Assessments 2005, 2001 FRA (FAO)). Land for forestry administration purpose may be included or not in the forest land, thus additional *qualitative* criteria complement the forest definition provided (i.e. treatment of forest roads, nurseries, willow crops, etc. (Table 7.12). Few countries have reported change of forest definition for the period since 1990, but these changes do not affect the time series for activity data consistency. Greece has a new forest definition starting 2003. Denmark changed from questionnaire based forestry information to NFI but implemented methods for GHG inventory estimation ensuring the consistency for the time series (i.e. reassessment of base year data based on earth observation information).

Table 7.11 Information on forest definitions and related parameters in MS's National Inventory Reports under UNFCCC

Member State	NIR 2013			
	Crown cover (%)	Height (m)	Area (ha)	Minimal width (m)
Austria	30	2	0,05	10
Belgium	20	5	0,5	-
Denmark	10	5	0,5	20
Finland	10	5	0.25 for Southern Finland/ 0,5 for Northern Finland	20
France	10	5	0,5	20

Germany	10	5	0.1	-
Greece	25	2	0,3	-
Ireland	20	5	0,1	20
Italy	10	5	0.5	-
Luxembourg	10	5	0.5	-
Netherlands	20	5	0,5	30
Portugal	10	5	0.5	20
Spain	20	3	1.0	25
Sweden	10	5	0,5	10
United Kingdom	20	2	0.1	20

The overall effect of different forest definitions on C stock changes at EU-15 level is difficult to assess, as it depends on numerous factors (i.e. land fragmentation, land use change frequency, transition period, land registry systems, GHG estimation methodology, etc.), but it is likely to be very small.

Table 7.12 Additional qualitative criteria for defining "Forest land"

Member State	Forest land definition, additional information and description (according NIR 2013)
Denmark	Temporarily non wooded areas, fire breaks, and other small open areas inside the Forest land, including Christmas tree crops.
Finland	Productive forest land, part of the poorly productive forest land and forest roads. Parks and yards are excluded regardless of whether they meet the forest definition.
France	Forest roads, forest openings less than 20 m wide (e.g. for fire control), windbreaks and forest belts, as well as the poplar plantations and short rotations woody crops, if the criteria for Forest land are met. 5 % of Frances's European forests are unmanaged on lands such as strong slopes or used for loisir, esthétique, cultural or military. Also, 40 % of France's dependencies Forest land is considered as unmanaged.
Germany	Any area of ground covered by forest vegetation, irrespective of the information in the relevant cadastral survey or similar records. "Forest" also refers to cutover or thinned areas, forest tracks, firebreaks, openings and clearings, forest glades, feeding grounds for game, landings, rides located in the forest, further areas linked to and serving the forest including areas with recreation facilities, overgrown heaths and moorland, overgrown former pastures, alpine pastures and rough pastures, as well as areas of dwarf pines and green alders. Heaths, moorland, pastures, alpine pastures and rough pastures are considered to be overgrown if the natural forest cover has reached an average age of five years and if at least 50% of the area is covered by forest. Forested areas of less than 1,000 m2 located in farmland or in developed regions, narrow thickets less than 10 m wide, watercourses up to 5 m wide do not break the continuity of a forest area.
Ireland	Minimum 50 % of conventional stocking. Includes recently clear felled areas. Tree grown for fruits or flowers, and shrub species (furze, rhododendron) are excluded. Includes open areas within forest boundaries.
Italy	Forest roads, cleared tracts, firebreaks and other open areas within the forest as well as protected forest areas are included in forest. Plantations, mainly poplars, characterized by short rotation coppice system and used for energy crops, are not included as they do not fulfill national forest definition while other plantation typologies, as chestnut and cork oak, have been included in forest and therefore included.
Luxemburg	Permanently unstocked basal areas that are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades, forest roads) also represent forests. Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut do not account as forests but represent cropland. Rows of trees (except shelter belts for wind protection) and areas with woody plants in a park structure are not forest land.
Netherlands	Roads in the forest less than 6 m wide are included under 'Forest According to Definition' (FAD). Additional to FAD, 'Trees outside Forests' (TOF), that is - wooded areas that comply with the previous forest definition except for their surface area (=< 0.5 ha or less than 30 m width). These represent fragmented forest plots as well as groups of trees in parks and nature terrains and most woody vegetation lining roads and fields.
Portugal	Forests (areas occupied by forests and woodlands which can be used for the production of timber or other forest products) and agro-forestry areas (annual crops or grazing land under the wooded cover of forestry species). The forest trees are under normal climatic conditions higher than 5 m with at least 30 % canopy closure.
Spain	Any land having woody vegetation with no agricultural use/activities fulfilling the threshold of forest and any other land which is expected achieve these parameters (including for "dehesa" where tree cover meet the thresholds)

Sweden	Land which hosts a potential yield of stem-wood exceeding one cubic meter per hectare and year. Meanwhile, the Land which hosts a potential yield of stem-wood lower than one cubic metre per hectare and year are classfied as mire (under Wetlands). Permanent forest roads (width>5m) are not considered as forest land. All country forests are considered managed.
UK	Forestry statistics definition used for GHG inventory includes integral open space and felled areas that are awaiting restocking.

NFIs provide basic input both for forest land and conversions to/from forest land areas as well as the necessary data for the estimation of C stock changes in various pools under the implemented method. Methods for the collection of data in NFIs are typically based on repeated measurements in permanent sample plots (Table 7.13), but the design differs among MS in terms of spatial density and frequency of field survey. In recent years, the EU-15 MS have made considerable efforts to adjust their forest inventories to the specific requirements of UNFCCC/KP reporting, together with slight harmonization at European scale. Also, efforts have been made to adjust the inventory cycles to the period included in the first commitment period of the Kyoto Protocol.

Table 7.13 Relevant information on the National Forest Inventories (NFI) of MS

MS	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, plot area	Cycle length (for latest inventory cycle)	Frequency / First NFI in …	Datasource for period 2008-2012
Austria	Sample based inventory with four plots clusters in 4 x 4km grid. A plot is 300 m2 and includes a two concentric plots and an angle count sampling. It follows FL conversions.	3	5-10 years. First inventory 1961-1970.	NFI 2007-2010
Belgium	Regional forest inventories, with same approach for both Walloon and Flemish Regions. Ongoing single-phase, non-stratified inventory in 1.0 x 0.5km grid E-W oriented, with 1000 m2 circular plots area (including 2 other circular plots). 10 years cycle in permanent plots. It follows FL conversions.	10	10 years. First inventory 1984-1988 (Wallonia) and 1997-1999 (Flanders).	NFI 2010-on
Germany	Systematic single-level cluster sample with regionally stratified sampling intensities. Cardinal points orientation of 4x4km grid. Cluster square of side length of 150 with 4 circular plots. It follows FL conversions.	3	10 years. First inventory 1986-1989.	An interim inventory with 8 x 8 km grid in 2008.
Denmark	Continuous sample-based with partial replacement, 2x2 km grid. Four circular plots of radius of 15 m are clustered in a square with side length of 200 m. Plots consist in three concentric sub-plots. 1/3 of plots are permanent and re-measured every 5 years. It follows FL conversions.	5	5 years. First sampling inventory 2002-2006.	NFI 2007-2011
Spain	Systematic sample-based 1x1 km grid with permanent plots. The territorial units are the provinces (50). NIF is done one by one and it lasts 10 years. Sample plots consist in 4 concentric circles. It follows FL conversions.	10	Planned every 10 years	NFI 2008-2017
Finland	Sample-based systematic cluster sampling inventory covering entire country. Entire country measured in a year. Sampling design differ on the 6 regions: plots (of 250-450 m2) are organized in clusters (of 6x6 to 10x10Km).	5	~ 10 years since 1921, with first sampling inventory 1964-1970	NFI 2010-2013
France	Sample based covering entire country with temporary plots. Systematic clusters, 1.41x1.41km. Field measured circular plot is 25 m radius composed from 4 concentric plots.	5	~ 10 years, first inventory 1960-1980	NFI 2004-2010. AD by TERUTI 2005 on
Greece	Forest management planning database for managed forests. Forest districts is revisited every 10 years.	10	First&last NFI 1965-1983	FMP database
Ireland	Forest Inventory and Planning System is a GIS-based system containing stand and site information. It covers all forest in the country.	1	First NFI 2004-2006	Forest Inventory and Planning System (1995) and Forest Service statistics on total area
Italy	Sample-based with regional stratification. 1x1km grid. Plots consist in two circular concentric areas of 530 m2.	4	First in 1983-1986	NFI 2006-2007

Luxemburg	Simple systematic sampling. 0.1x0.05km grid. Plot consist in four concentric circular areas of 1000m2.	3	Every 5-10 years. First NFI 1999–2001	NFI 2008–2010
Netherlands	1x1km grid lay over GIS forest map. Plots are randomly drawn, with half as permanent. Plots are 300 m2. Entire country is surveyed in a year.	5	~ 10 years. First NFI 1988-1999	Digital topographical maps and NFI 2001-2004
Portugal	Qualitative sampling based on interpretation of aerial photograph over a national0.5x0.5km grid, with clusters every 2x2km on forest land and 4x4km on shrub land. NFI clusters are 500/2000 m2 depending on species and consist in 5 plots of 10/40m2.	2	~ 10 years. First NFI 1965-1966	NFI 2003-2012
Sweden	Sample-based covering annually whole country, with North-South decreasing sampling intensity. Plots are distributed in square/rectangular clusters with size decreasing from North to South, both for permanent (2/3) and temporary (1/3) ones. The clusters are square-shaped with 4 or 8 circular plots with (radius 10-20m). It follow FL conversions	10	5-10 years. First NFI 1923-1929	NFI 2003-2012
United Kingdom	Permanent systematic sampling 8x8km grid, combined with a regional simple random sampling. Square sampling plot of 1 ha.	5	Various, NFI since 1924	NFI 2010-2014.

Time series of annual activity data (i.e. forest land area) were obtained by interpolation and extrapolation of available non-annual datasets (Table 7.15). Main provider of 'area' data is the national forest inventories. Methods often national statistics or the re-assessment of remote sensing archives (satellite images, aerial photographs) or their products such as Corine Land Cover maps especially to derive past data or even entire time series. Land use and use change matrix are available for each member state (with a picture of conversions in Table 7.14).

Table 7.15 Land representation and "activity data" sources for subcategory 5A1

Member State	Description
Austria	FL remaining FL area is derived from NFI data, with annual area interpolated between inventory years (1986-1990/1992-1996/2000-2002/2007-2009/2011-2013).
Belgium	A geo-referenced grid covers entire country on which intersection points the diagnosis of land use is carried on vectorial and raster thematic sets and layers images relevant from land us point of view.
Denmark	A land cover map was produced for 1990, 2005 and 2011 based on satellite images, other datasets used to derive 1992-2005 and NFI data from 2005 and 2011.
Finland	Estimation of the area of Forest land is based on successive NFI cycles (NFI 7-11) from different years in Northern and Southern Finland. The forest land category is further sub-divided for organic and mineral soils.
France	Land data system is based on aerial photographs dataset combined with an annual "on-the-ground" survey of lands (defining both the land use and current activity), which allows a land use change matrix both annual (to capture rapid changes) and a 20-year span (to capture slower changes). For French Guyana a photointerpretation system based on satellite images, combined with permanent plots surveying just small share of total area.
Germany	Activity data is derived from a "wall-to-wall" database based on NFIs (for Forest land and conversion from/to), topographical-cartographical information (digital landscape model) and CLC 1990, 2000 and 2006 (for land use) and earth observation (GSE data).
Greece	Several sources and databases: 1st National Forest Inventory (1994), annual Agricultural census, afforestation registry and statistics, general geographical data of National Statistical Service of Greece (i.e. decennial survey).
Ireland	Forest land area is obtained from sectorial Forest Inventory and Planning System data of 1995 and CLC maps (1990/2000/2006).
Italy	Forest area in 1990 -2011 was calculated through a linear interpolation between 1985 and 2002 data (supplied by the 1st and 2nd NFI). Data for 2003-2011 is extrapolated, building on Statistics' annual data on forest area.
Luxemburg	Land use / land cover map for 1989 (data collected in the field), 1999 (on aerial colour infra-red ortho-photos) and 2007 (high resolution satellite images) in digital format covering the entire territory. Annual data is obtained by linear interpolation for 1990-2000 and 2001-2010.

Netherland	Country level wall-to-wall approach based on harmonized and validated digital topographical maps of 1990, 2004 and 2009, linearly extrapolated till 2011.
Portugal	Systematic sampling grid (NFI) for full land-use classification and simultaneous interpretation of high resolution airborne imagery in 1995, 2005 and 2010. Intermediary years are linearly interpolated.
Spain	Forest land area is provided from a combination between CLC 1990 and 2006 with Forest Maps of Spain achieved for period 1998-2007. Further on, annual estimation of area is obtained by linear interpolation between 1990 and 2006, and then extrapolated.
Sweden	Systematic grid of permanent monitoring plots (NFI) provides estimates of the areas of all land-use categories and gross & net land-use transfers across all country.
UK	Areas of forest land come from statistics published by the Forestry Commission.

Furthermore, the MS breakdown own forest land area on various *subdivision* types and levels of detail, according to available datasets. Breakdown criteria differ across EU-15 MS, although they are consistent across time series. It was done by groups of species or forest types (i.e. broadleaves/coniferous; evergreen/deciduous; species based classification – beech, oak, pine, spruce, etc), climate (i.e. temperate, tropical), soil and site type (i.e. lowland, organic or mineral soils), geographic criteria (regions of the country), and management type (clear cut, hedgerows, horticulture area, arable land, fallow land, permanent cultures, peat extraction area, pastures, hayfield, perennial converted to annual crops, annual crops remaining annual/perennial).

For forest land, the *definitions of pools* are reported by most MS. The contributions to the annual sink are 88% by the biomass pool, 8% by SOC and 4% by DOM, while emissions from organic soils are 5% (as absolute amount). There are slight variations regarding the definition of the pools among MS (Table 7.16), whose impact on the estimates may be low, but also difficult to assess in quantitative terms. For instance, forest inventories define the biomass pool according to the threshold of minimal diameter (i.e. DBH–stem diameter at breast height of sampled trees) as ranging from 0 to 7,5 cm. Concerning the belowground biomass, the information on what exactly it includes is rather poor. Dead wood mostly differ in terms of threshold diameter and height/length of pieces included in the pool and decomposition time required considered. Litter is either independently assessed or included with soils (under difficulties to collect it separately). In soils, C stock changes are computed according to various soil depths. Usually, carbon stock in understory's biomass is only accounted for the purpose of forest fires emissions (if not mention then information is not available in MS NIRs) and not as part of the annual sink.

Table 7.16 Forest carbon pools definitions in the GHG inventories of the EU-15's MS

Member State	Description
	Aboveground biomass
Austria	Stem wood over bark with a diameter at breast height over 5 cm.
Belgium	Tree and shrub species with circumference exceeding 20/22 cm at 1.50 m height (i.e. 7 cm in diameter), while in coppices the stems under 7 cm diameter are also included.
Denmark	Living trees with a height over 1.3 m, under different recording schemes (i.e. trees larger than 40 cm are measured only within a 15 m circle). Smaller trees, shrubs and other non woody are not counted. Aboveground biomass is defined as living biomass above stump height (1 % of tree height).
Finland	Biomass of living trees with a height over 1.35 m, i.e. those trees that are measured in NFIs, including the stem wood, stem bark, living and dead branches, cones, needles/foliage. Understory is counted only to estimate the emission from forest fire.
France	Trees with DBH over 7.5 cm.
Germany	Trees with DBH over 7 cm.
Greece	Trees with DBH over 10 cm, but in cases of degraded forests (e.g. oak) and coppices (e.g. castanea) the threshold is 4,6 cm. The trees in the sample area under the minimum diameter are not considered. Understory biomass is considered for GHG emissions from wildfires.

United Kingdom	Modeled living woody biomass (complete individual cycle of trees, it does not include understory and annual/perennial non woody vegetation).
Ireland	Modeled individual cycle of living biomass (but not the understory and annual/perennial non woody vegetation).
Italy	Trees with DBH over 3 cm.
Luxemburg	Diameter of 4 cm at 3,5 m of the total height (average value)
Portugal	Living biomass above the soil, including: stems, stumps, branches, bark and foliage, and forest understory (only for estimation of emissions from forest fires).
Spain	Trees with DBH over 7.5 cm at the ground level are measured, while those under 7.5 cm are only counted.
Sweden	Biomass of living trees with a height over 1.3 m. Small trees, shrubs and other vegetation (i.e. herbs) are not counted. Aboveground biomass is defined as tree part above stump height (1 % of tree height).
Netherlands – na (there is no information available the NIR 2011)	
Belowground biomass	
Austria, Ireland, United Kingdom	Fine roots pool is simulated within integrates models.
Belgium	Diameter of estimated roots > 5 mm.
Denmark	Stumps from harvested trees within a year from the measurement are measured.
France	Fine roots are included with the soil organic matter.
Finland	Stumps and roots down to a minimum diameter of 1cm.
Germany , Greece and Luxemburg,	Applies default “root- to-shoot” factor
Italy and Spain	Applies a country specific “root- to-shoot” factor
Portugal	Living biomass of belowground biomass (the lower limit of root diameter, if any, is not explicitly defined).
Sweden	Biomass of living trees below stump height (1 % of tree height) down to a root diameter of 2 mm.
Netherlands: definition not available in the NIR 2013	
Dead Organic Matter – Litter	
Austria, Ireland, United Kingdom	Litter is simulated by models.
Denmark	Non-living biomass which is not included in other classes, under various status of decomposition on top of mineral or organic soil. It includes the litter, fumic and humic layers.
Finland	Non-living biomass with a diameter less than 10 cm in various status of decomposition (allocated by model in compartments: fine woody litter, coarse woody litter, extractives, celluloses and lignin-like compound). Biomass of ground vegetation (eg moss-, lichen-shrub- and twig vegetation) is not included in the living biomass, but it is included when the litter input to the soil is estimated.
France	Non-living dead wood lying on soil with maximum 7.5 cm diameter, dead leaves, humic and fumic layers, fine roots
Germany	Dead organic cover with a fraction < 20 mm
Italy	The amount of carbon in litter is estimated from the aboveground carbon amount with linear relations.
Portugal	Non-living biomass on top of mineral soil, in various stages of decomposition (include fumic, humic) (considered only in forest fires).
Sweden	Non-living biomass not classified in other classes, under various stages of decomposition, on top of mineral or organic soil: litter, fumic and humic layers. Litter includes, as well: a) live fine roots (<2 mm) from O horizon and b) coarse litter with “wood stem diameter” between 10-100 mm.
Belgium, Greece, Luxemburg, Netherlands, Spain	Assumed in balance (Tier 1). Although sometimes pools is measured, the definitions are not available in the NIR 2013

Dead Organic Matter - Dead wood	
Austria	Only standing dead wood.
Belgium	Dead wood as measured by NFI, namely standing dead trees and fallen logs and branches. A dead tree is considered as fallen when it tilts at a vertical angle equal or superior to 45°. Dead trees above 20 cm of circumference are measured, under 20 cm are estimated visually.
Denmark	Standing deadwood with a DBH larger than 4 cm. Lying dead wood with a diameter of more than 10 cm, whose length is recorded. The degree of decay is recorded on an ordinal scale.
Finland	Non-living biomass which is not contained in litter (described by model as coarse woody litter input, larger than 10 cm in diameter, from natural mortality of trees and harvesting residues)
France	Standing trees, dead for less than 5 years, plus 10 % from the wood which is annually harvested
Germany	Fallen dead wood with a thicker-end diameter of at least 20 cm; standing dead wood with a diameter of at least 20 cm at

	breast height and trunks with either a height of at least 50 cm or a cut surface diameter of at least 60 cm. NFI 2008 collected data on all dead-wood objects with a thicker-end diameter of at least 10 cm. Data collection was for both NFIs on 3 species groups and 4 decomposition class.
Ireland, United Kingdom	Pool is simulated by models.
Italy	The amount of carbon in dead wood is estimated from the aboveground carbon amount with an expansion factor.
Greece	Dead wood that remain on site after fire is assumed to fully decompose in 10 years
Portugal	Non-living woody biomass on top of mineral soil, in various stages of decomposition (considered only in forest fires)
Sweden	Dead wood is defined as fallen dead wood, snags or stumps including coarse and smaller roots down to a minimum "root diameter" of 2 mm. Dead wood of fallen dead wood or snags should have a minimum "stem diameter" of 100 mm and a length of at least 1.3 m.
Luxemburg, Spain	Assumed in balance (Tier 1).
Netherlands: definition not available in the NIR 2013	
Soil Organic Carbon (for organic soils see more in the section 7.6)	
Austria, Finland, United Kingdom, Ireland	Pool is simulated by models (undefined depth or dimensions)
Belgium, France, Germany, Italy, Luxemburg, Portugal,	Organic carbon in 0-30 cm top soil.
Denmark	Organic carbon in the mineral soils below the litter, fumic and humic layers and all organic carbon in soils classified as Histosols. It is for 30 cm depth between top of the mineral soil or, alternatively, from the soil surface (if histosol).
Spain	Organic carbon in the mineral soils down to 100 cm.
Sweden	Organic carbon in the mineral soils below the litter, fumic and humic layers and all organic carbon in soils classified as histosols, down to a depth of 50 cm.
Greece, Netherlands: : definition not available in the NIR 2013	

It should be considered that what is not reported under a pool is often reported under another one (e.g., fine roots are accounted for as either litter or soil organic matter), and as far as C stock change is required, the bias in estimation should be negligible. .

For national GHG inventory purpose, CO_2 removals or emissions are estimated by methods that quantitatively assess the change of the C stocks in forest carbon pools. The method used to determine the C stock change in Living Biomass pool is either the "stock change" or "gain-loss" (IPCC GPG LULUCF 2003) (Table 7.187).

Table 7.17 Estimation method used by MS for the C stock change in Living Biomass pool. Estimation method is either stock change (bold) or gain-loss (thin letters). In *italics* there are GHG methods are based on non-NFI data.

MS	Estimation method
Austria	Gain-loss method based on NFI data
Belgium	**Stock change (Walloon region) and gain-loss method (Flemish region) both based on NFI data**
Germany	**Stock change method based on NFI data**
Denmark	***Stock change based on Forest census (before 2000) and NFI (since 2001)***
Finland	Gain-loss method based on NFI and harvest datasets
France	Gain-loss method based NFI and harvest from non-NFI statistics
Greece	***Stock change method based on FMP database***
Ireland	Gain-loss method from forestry statistics & yield table data based model and harvest statistics & firewood estimates
Italy	Gain-loss method based on NFI and harvest data derived from regional harvest statistics

Luxemburg	*Gain-loss method based on forestry statistics & yield table and harvest statistics*
Netherlands	Gain-loss method based on NFI data and national harvest statistics
Portugal	Gain-loss method based on NFI data and harvest statistics
Spain	**Stock change based on NFI data**
Sweden	**Stock change based on NFI data**
UK	*Gain-loss method modeled from forestry statistics on area & yield table data and harvest statistics*

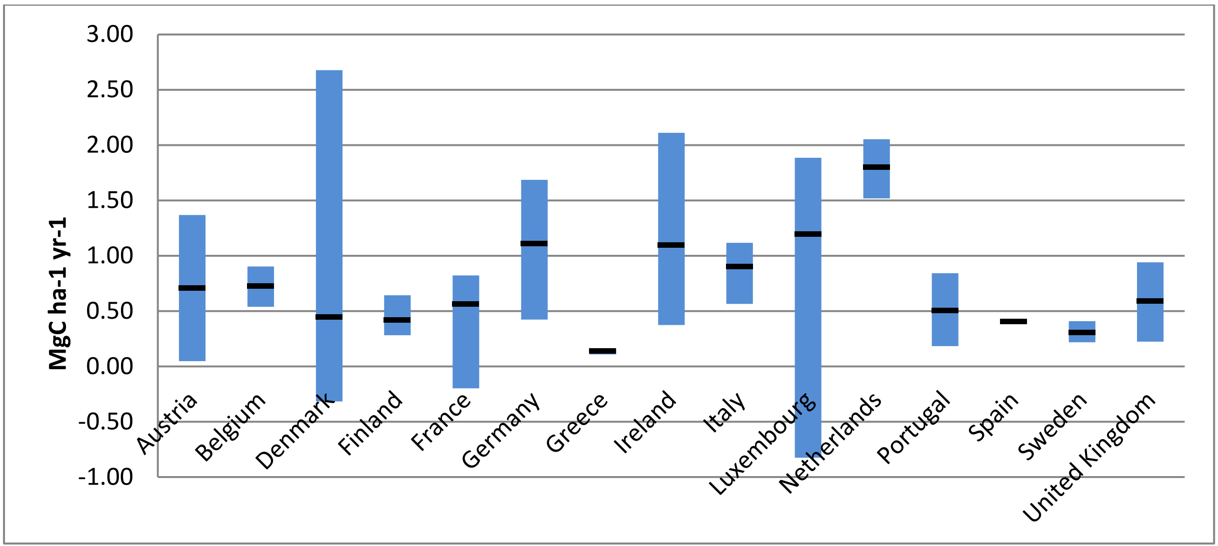
Sources of data for the estimation of *C stocks change in living biomass* also differ across MS, upon data availability. Actually, NFIs represents the primary source of information for 11 MS, while the others use yield tables as well as harvest or forest fire statistics in models (e.g. UK, Ireland). Recent years, considerable effort was allocated to developing country specific biomass equations and parameters.

Table 7.18 Sources of data and basic methodological information for estimating of the C stock changes in Living Biomass pool in the subcategory 5A1

Member State	Description
Austria	Austrian NFI provides data on growing stock volume increment and drain (harvest, other losses). Annual data of increment and harvest result from using relative variation indices. Harvest indices results from ratio of NFI to other non-NFI datasets. Country specific biomass functions are applied to account for branches, evergreen foliage and a general function for below ground biomass.
Belgium	Regional, but National Forest Inventories like, datasets. Solid wood volumes of each species (aboveground woody biomass: stem + branches) is obtained from forest inventories data. BEF2 and R derived by expert judgement from IPCC.
Denmark	Data from and Forest census and NFIs. Tree volume estimates is based on volume functions developed for the most common Danish forest tree species.
Finland	Biomass increment is estimated based on individual tree measurements (DBH, tree height) in successive NFIs and country specific tree biomass models. Loss is calculated from annual statistics, and includes logging, fuel wood and unrecovered natural losses.
France	Gain-loss method is used. National data rely of NFI data on forest growth, while loss by harvest statistics (both commercial and non-commercial). BEFs, allocation in roots, as well as C content in wood are country specific.
Germany	"Stock change method" is used with data from forest inventories. Biomass functions, country specific volume expansion factors and IPCC default root-to-shoot ratio. For former Eastern Germany data from forestry management plans is combined with NFI 2002 and 2008.
Greece	Annual change in carbons stock is calculated as linear interpolation of stocks provided by successive forest inventories (stand wise forest inventories). IPCC default factors are used.
Ireland	Annual increment is estimated using a model which calculates total standing carbon stock of forests year-on-year, based on Irish forest yield tables by species. Wood harvest is from national statistics. Same country specific BEFs and wood density are applied for gain and loss.
Luxemburg	Increment of growing stock biomass in m^3 per ha and year was calculated on forest types using yield-tables and lossess derived from the harvest official statistics.
Italy	Model applied at regional scale under availability of forest-related statistical data. The growing stock volume of the previous year is increased by the annually calculated increment of the current year and reduced by the losses due to harvest, mortality and wildfire in the current year. Aboveground and belowground biomass were obtained by using country specific BEFs. Commercial wood harvest data has been obtained from statistics.
Netherlands	Country specific Tier 2 methodology based on growing stock volume data from NFI plots, using the equations from a European database and national data on harvest statistics.
Portugal	Tier 2 based on NFI data. Annual increment rate constant in time and equal to that from last NFI. Equations used were parameterized for Portuguese conditions and parameters used were country specific (updated in previous NFI).
Spain	Data from successive NFIs.
Sweden	C stock change method that integrates Swedish NFI and Swedish Forest Soil Inventory in the same sample design and plots. Aboveground & belowground biomass per trees in permanent sample plots is obtained by biomass functions on NFI data.
United Kingdom	Carbon accounting model input with pre- and post-1920 plantation statistics and growth modeled according to the Yield tables. Model simulates both gain and losses, with loss based on clear-felled, then replanted, at the time of stand maximum increment.

In 2013 submissions the multiannual simple average of IEF for net C stock change in biomass is 0.73 (in 2012 it was reported 2 % higher) with a range across MS's time series between 0.18 and 1.87 Mg C/ha (see Figure 7.3).

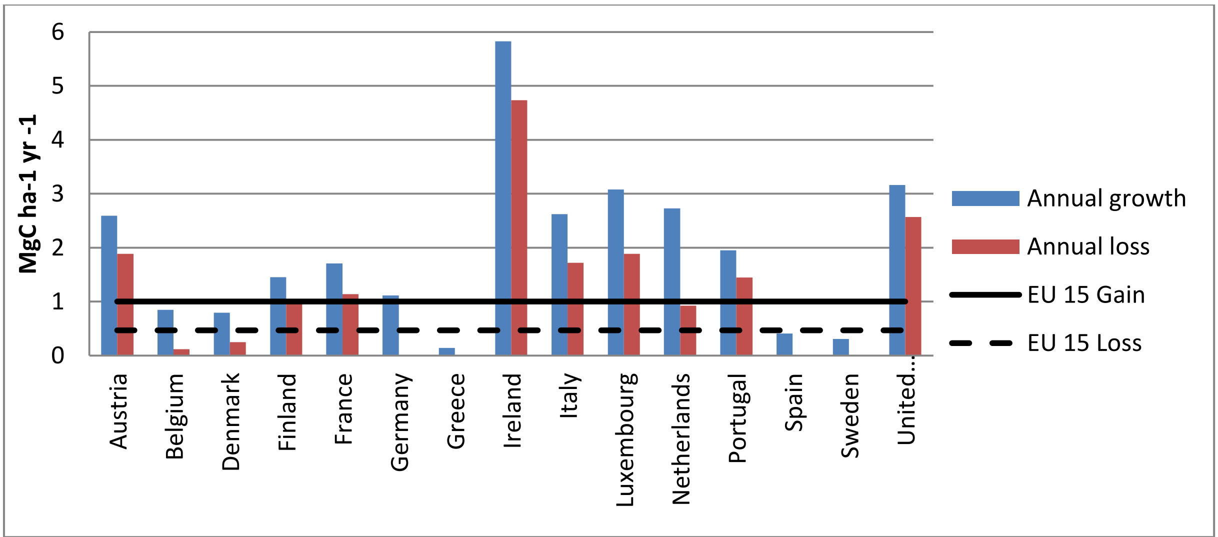
Figure 7.3 **Implied net carbon stock change factor for living biomass pool in 5A1 (Mg C ha-1 year-1). Bars represent average, minimum and maximum values reported by MS over 1990-2011.**



IEF is smallest for the MS with most intensive forestry systems (i.e. Finland, Sweden), while very low or negative values are caused by disturbances (i.e. major windstorm in France in 1999) or occasional annual harvest larger than the growth.

Rates of biomass growth and loss vary across MS according eco-climatic conditions and management approaches (Figure 7.4), with highest values shown when forestry is mainly plantation based.

Figure 7.4 **Multiannual simple average IEF for "growth" and "loss" of living biomass in 5A1 (1990-2011, only net biomass changes displayed for MS reporting stock change methods).**



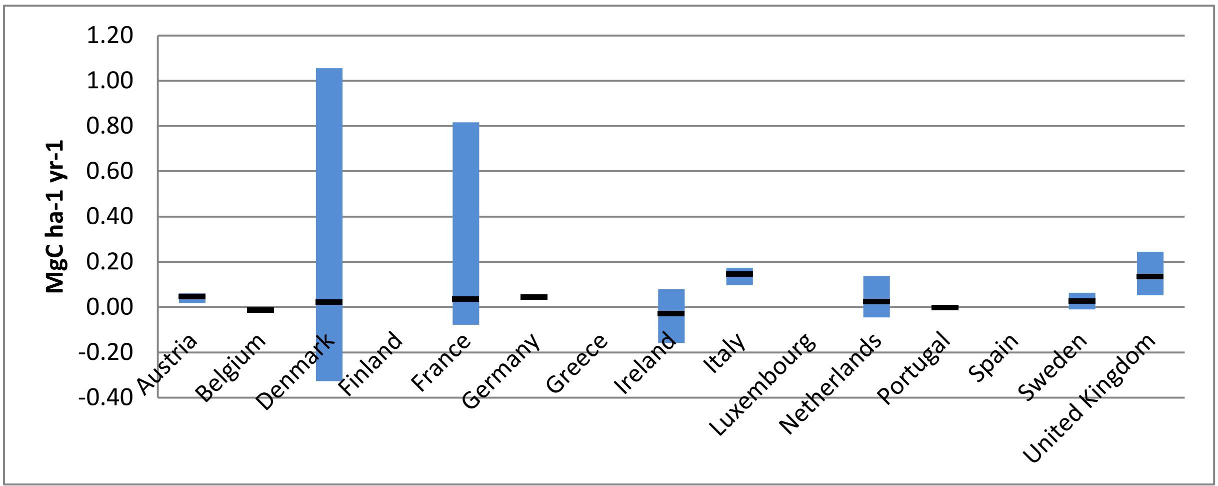
C stock changes in SOCmin and DOM are mostly reported under Tier 1 which assumes that these pools are not a net source of emission (thus NO, NE in the CRF) or when estimated, are mostly connected with NFI (see also Table 7.8 on reporting completness). The large use of the Tier-1 assumption is due to the lack of appropriate data (and the extreme difficulty to get them) or the very high uncertainty of existing data. In most cases, MS provide some evidence that the soil in not a source and document the ongoing efforts to estimate emissions and removals from these pools. Data is either directly used by stock change or gain-loss method, sometimes integrated in models (Table 7.19). DOM is often reported separately on dead wood (DW) and litter (LT) under available dataset by national systems.

Table 7.19 Sources of data and methods for estimating of C stock change in dead organic matter (DOM) and soil organic carbon (SOC) on land subcategory 5A1.

Member State	Methods			Description
	DW	LT	SOCmin	
Austria	Stock-change	Gain-loss	Gain-loss	NFI database, assuming a ratio of DW between deciduous/coniferous as the proportion of the tress in the stand. LT and SOC are modeled by Yasso07 also including management options.
Belgium	Stock-change	Tier1	Stock change	DW is measured in NFI plots. LT pool is considered neutral (based on measurements). SOC is estimated based on various datasets and research projects and activities.
Denmark	Stock-change	Stock-change	Tier1	Database on soil sampling in successive moments in time (first in 1985, roughly every 10 years). NFI soil distribution database is used for scaling the sampled plots to total forest area. C content at 15 cm top soils multiplied by a factor depending on the species and basal area of stand.
Finland	Gain-loss	Gain-loss	Gain-loss	DW, LT and SOC in mineral soils are estimated using a model-based method. In organic soils, country specific measured emission factors were used in estimating decomposition of peat, combined with a model to estimate aboveground C stock changes.
France	Stock-change	Stock-change	Tier1	DW is provided by the NFI and a share of 10 % of the harvest is considered as LT (emitted in the year of the event). An annual removal of 2,4 kg/ha CH_4 is also counted by undisturbed forest soils.
Germany	Stock-change	Stock-change	Stock change	Both LT and DW are computed based on country datasets (NFIs, Biosoil, soil inventory)
Greece	Tier 1	Tier 1	Tier1	Tier 1 for SOC and DOM. For wildfires affected areas there is a Tier 2 approach for DOM with country specific data.
Ireland	Tier 1	Gain-loss	Tier1	SOC and DW are considered neutral. LT C stock change is modeled.
Italy	Stock-change	Stock-change	Tier1	C stock change in DW and LT is linearly regressed with country specific equations from the aboveground carbon stock, on available stratification of forests (on forest type, groups of forests types).
Luxemburg	Tier 1	Tier 1	Tier1	SOM and LT are considered neutral. DW will be derived from NFI.
Netherlands	Gain-loss	Gain-loss	Tier1	DW is computed based on fix rate of tree mortality and dead wood decay. Leaves and roots were not taken into account for the build up of dead wood.
Portugal	Stock-change	Stock-change	Stock change	Country specific data.
Spain	Tier 1	Tier 1	Tier 1	Pools are considered neutral.
Sweden	Gain-loss	Gain-loss	Stock change	DW is modeled by NFI based measured data and harvest dataset. Litter and soils on Forest Soil Inventory database. C stock is estimated by conversion factors from harvest biomass to stump and root biomass. LT is separately estimated for three different compartments: coarse litter, annual litter fall and fine litter, each either associated to soil pool or DOM. Change in mineral soils is estimated based on repeated soil sampling in combination with pedotransfer functions (based on fraction of fine earth and other physical characteristics of soil). Organic soils emissions are estimate with emission factors from annual below ground litter input (from NFI) and the heterotrophic respiration (national and regional research).
United Kingdom	Gain-loss	Gain-loss	Stock change	Pools are simulated in a model with living biomass.

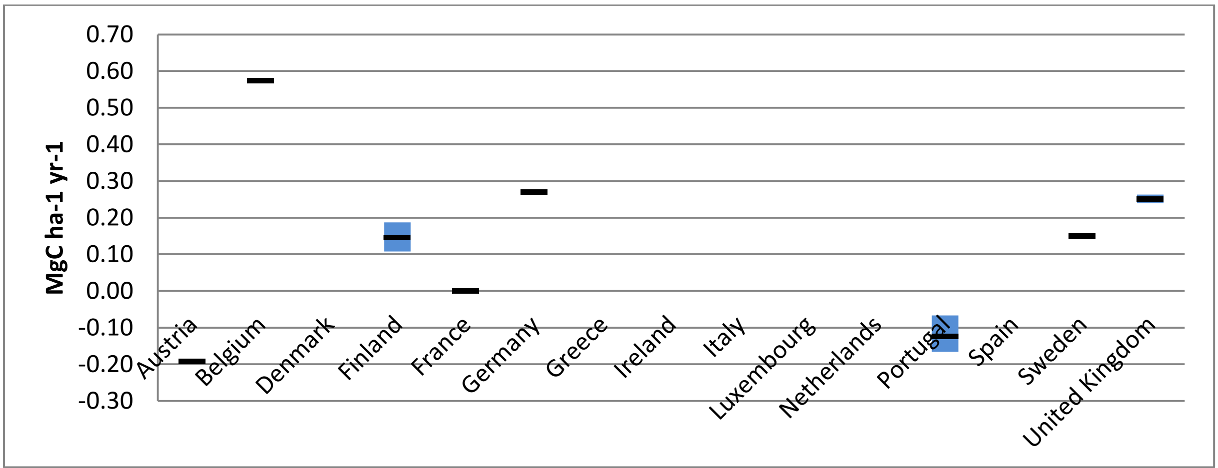
DOM is reported as a sink by most MS reporting this pool, with the highest annual sink reported by the Italy and UK (which rely on country specific data). Belgium, Denmark, Ireland, France and Sweden report it, at least occasionally, as a small source. At the EU-15 level, DOM is a multiannual average sink of 0.04 MgC ha-1 yr-1, with a range from -0.33 to 1.06 MgC ha-1 yr-1 (Figure 7.). Following the windstorm in 1999, France reports DOM as a major sink in 1999 and as source starting 2000, while for pre-storm period DOM was considered neutral (similar approach applies to storm in 2009).

Figure 7.5 **Implied net carbon stock change factors in DOM pool in 5A1 (Mg C ha-1 yr-1). Bars represent average, minimum and maximum values reported by MS over 1990-2011. No mark represents Tier 1.**



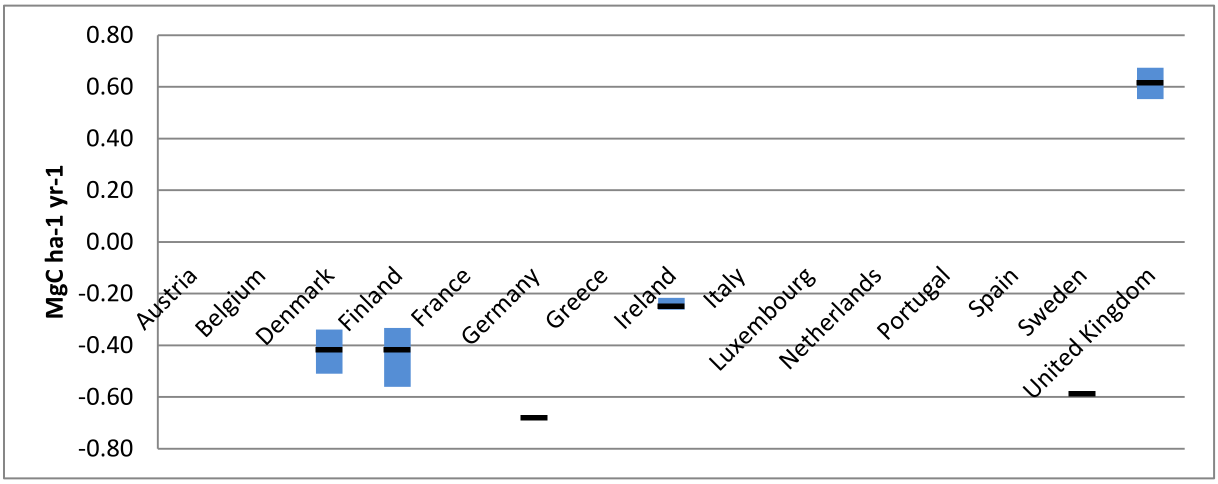
SOC in the forest mineral soils are reported as small annual sinks with exception of Austria (IEF value of -0.2 MgC ha-1yr-1, in average) and Portugal (-0.1 MgC ha-1yr-1, in average), while other member states report it as sinks (Belgium reports it as large sink). At the EU-15 level, the C stock change factor for SOC in mineral soils is 0.13 MgC ha-1 yr-1, with a range from -0.20 to 0.57 MgC ha-1 yr-1 (Figure 7.).

Figure 7.6 **Implied net carbon stock change factor in SOC for mineral soils in 5A1 (Mg C ha-1 yr-1). Bars represent average, minimum and maximum values reported by MS over 1990-2011. No mark represents Tier 1.**



For *organic soils*, multiyear simple average IEF is -0.29 MgC ha-1 yr-1 (i.e. source), with a variation from 0.58 to -0.68 MgC ha-1 yr-1 (just note that UK reports organic soils as a sink for entire time series under the influence of last 100 years of afforestation on land with such soils). Estimates rely on country specific data (more information could be found in sub-chapter 7.6).

Figure 7.7 Implied net carbon stock change factor in SOC for organic soils in 5A1 (MgC ha-1 yr-1). Bars represent average, minimum and maximum values reported by MS over 1990-2011. No mark represents Tier 1.



7.2.3 Land converted to forest land (CRF 5A2)

7.2.3.1 *Overview of Land converted to forest land*

According to data submitted by the MS in 2013 the area of subcategory 5A2 - Land Converted to forest land was around 5.3% of the total forest land area, and increased by about 55 % over previous 20 years (Table 7.20). 5A2 removals represent 15% of total removals of 5A. Largest conversions occur from grasslands (52%), cropland (26%) and other lands (9%) (being also aware on time series starting in 1990 for some MS). For 2011 Italy, France and Spain reports the largest land area under this subcategory.

Table 7.20 Trend of activity data in subcategory 5A2 – land converted to forest land – in the EU-15 MS (kha) (na- if time series reported starts after 1990)

Member State	**1990**	**1995**	**2000**	**2005**	**2011**	Difference 2011 to 1990 (%)
Austria	387	373	271	235	215	-44%
Belgium	0	8	13	19	25	na
Denmark	4	23	43	62	85	2095%
Finland	161	194	210	193	145	-10%
France	995	1.209	1.261	1.287	1.214	22%
Germany	562	562	562	470	323	-43%
Greece	0	6	23	32	33	na
Ireland	16	111	185	244	286	1708%
Italy	635	867	1.193	1.554	1.561	146%
Luxembourg	14	14	13	11	8	-45%
Netherlands	3	18	33	46	56	1787%
Portugal	441	610	724	798	698	58%
Spain	0	287	781	1013	1058	na
Sweden	508	384	354	393	605	19%
United Kingdom	610	498	450	401	293	-52%
EU-15	**4.361**	**5.164**	**6.115**	**6.757**	**6.769**	**55%**

At EU-15 level, in 2011 5A2 is a sink of some 43000 GgCO_2, 98% higher than in 1990 (Table 7.21) and 6% less than 2010. This latter decrease of the sink is mostly explainable by the fact that some land moved to 5A1. In 2011 the largest CO_2 removals were reported by France, Spain and Portugal. Finland report this subcategory as a source mainly due to significant emissions from soils (especially from organic soils) under the early stages of conversion when soils preparation take place.

Table 7.21 5A2 Land converted to Forest Land: MS' contributions to EU15 CO_2 net emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-4 246	-2 443	-2 392	5.5%	51	-2%	1 854	-44%	T2	CS
Belgium	-20	-284	-296	0.7%	-12	4%	-276	-	CS,T1	CS
Denmark	69	-322	-73	0.2%	249	-77%	-142	-207%	CS	CS
Finland	488	187	164	-0.4%	-23	-12%	-324	-66%	T2,T3	CS
France	-4 427	-7 439	-7 099	16.2%	339	-5%	-2 673	60%	T2,T3	CS
Germany	-6 485	-5 232	-4 836	11.1%	395	-8%	1 649	-25%	CS,T1,T2	CS
Greece	NE,NO	-351	-351	0.8%	0	0%	-351	-	T1	D
Ireland	18	-3 576	-3 822	8.7%	-246	7%	-3 840	-21456%	D,T1,T3	CS,D
Italy	-1 708	-7 339	-5 801	13.3%	1 537	-21%	-4 093	240%	T1,T2	CS,D
Luxembourg	-113	-73	-67	0.2%	5	-7%	46	-40%	T1	CS,D
Netherlands	56	-547	-541	1.2%	6	-1%	-598	-1060%	CS,T1	CS,D
Portugal	-252	-6 362	-6 202	14.2%	160	-3%	-5 951	2366%	CS,T2	CS,D
Spain	-94	-6 482	-6 446	14.7%	37	-1%	-6 352	6760%	CS,T1	CS,D
Sweden	504	-3 290	-3 046	7.0%	244	-7%	-3 550	-704%	T1,T2,T3	CS
United Kingdom	-5 837	-3 107	-2 935	6.7%	172	-6%	2 902	-50%	CS,T3	CS
EU-15	**-22 045**	**-46 659**	**-43 744**	**100.0%**	**2 915**	**-6%**	**-21 698**	**98%**		

Overall, Living Biomass is a sink with an average IEF value of 1.60 MgC yr-1 ha-1.

7.2.3.2 *Methodological issues for Land converted to forest land*

Methods used to identify and represent the areas under conversion, as well as to report emissions factors and estimates, are generally linked 5A1's (Table 7.22).

Table 7.22 Background information on sources of data and methodologies in subcategory 5A2.

Member State	Description
Austria	NFI datasets which capture changes to/from Forest land between NFIs cycles. NFI covers entire country and each grid point is terrestrially inspected. The split into subcategories of previous or following land uses is done based on NFI determined ratio. When conversions occur, NFI records data on the type of land in the neighborhood of the plot. C stock change in living biomass is estimated based on national scale value of annual increment (a constant value over the 20 years transition) and loss, with country specific conversions factors, using the default method. SOC in mineral soils and litter pools are estimated as average values for five forest growth Regions from Biosoil project (BFW, 2009) and former forest soil survey (BFW, 1992).
Belgium	Activity data results from the country wide grid of points in the reference years. SOC is estimated based on reference C stocks with each land use, available from various national datasets and research activities. C stock change in DOM (LT, DW) is assumed neutral (Tier 1).
Denmark	Activity data are determined from NFI grid (with 1990 reconstructed on satellite imagery datasets). Living biomass C stock change is estimated using country specific biomass. SOC is estimated based on research projects, old databases and NFI. For DOM change country specific constant values are used for each type of conversion.
Finland	Data on land conversions is derived by successive NFIs. Mean biomass annual increment is estimated as an average of current stock per area unit divided by the number of years since the conversion. SOC, DW and LT are simulated with Yasso07into an integrated estimate.

France	Land conversion area is determined by an approach combining datasets of aerial photographs with an annual on-the-ground survey of lands (assess both land use and occurring activities). NFI provides data to estimate C stock change in biomass and DOM. National reference C stocks in soils is available each land use type. French Guyana is only partially assessed (where relevant for conversions) by a photo interpretation system based on remote sensing combined with permanent plots, while biomass data are delivered by field measurements.
Germany	Based on NFIs in former Western Germany and on management plans & NFI 2002 in former Eastern Germany, the area of conversion is deducted and assumed linearly distributed in time. Previous land use is reported only for the former Western Germany. Data from 2002 is extrapolated till 2007 and starting with 2008 the absolute value of land use changes from and to forest land is provided by federal cadastral system. NFI datasets and single tree biomass functions are used. For SOC there is used a country specific emission factor for each type of conversion. Litter was estimated from national datasets. No dead wood accumulation is determined after field measurements.
Greece	Afforestation area is provided from statistics, disaggregated by forest types. Changes in carbon pools are estimated using a Tier1 methodology and data from the GPG for LULUCF for all type of conversions. SOC and DOM were assumed neutral .
Ireland	Annual area is a spatially explicit GIS database for after 1990, with detailed information given by LPIS (including on the previous land use). Afforested area maps superimposed on Soil map and CORINE 1990 Land Cover Map supported the identification of the soils types. Biomass C stock is modeled. No change is demonstrated for SOC, while DOM (DW and LT) is modeled based on country specific data.
Italy	Land use change matrix starting 1990 has been assembled based on national land use statistics. NFI provides data for biomass increase. Reference soil C stocks on land use are available.
Luxemburg	Annual biomass increment factor is computed based on yield tables for young stands. SOC reference C stocks values are available as country averages on land use.
Netherlands	A land use matrix is available with land-use changes calculated based on land use maps in 1990, 2004 and 2009. Changes in carbon stocks in living biomass are approximated by a linear regression as the mean growth rates per age, derived from the NFI. DW and LT are assumed as sinks of uncertain magnitude and not reported. SOM is reported based on research projects database.
Portugal	Conversion area from systematic sampling grid (NFI). DOM (only litter) stocks are country specific. Reference C stocks in soils are derived based on ICP Forest Level I/ Biosoil data.
Spain	Area data is given by national statistics (related to EU funding schemes and national funding for afforestation). Annual average increment in aboveground biomass is estimated as the value of average C stock from NFI split by 20 years, computed for each of region. SOC is estimated based on reference values on land use on province (several in a region). DOM pools are considered neutral.
Sweden	NFI provides explicit gross & net land-use transfers from the base year onward. Estimation of C stock change in living biomass is based on NFI data and country specific biomass functions. For SOC and DOM a Tier 2 based on country specific method.
United Kingdom	Areas of land use change to Forest are available form planting statistics of the Forestry Commission. C pools changes in post 1990 afforestation are modeled based on country data.

Heterogeneity in the approaches used by MS for subcategory 5A2 suggests caution in interpreting differences in the implied carbon stock change factors. For instance, possible reasons of differences may include time series length and their starting point (on the transition period adopted), use of time averaged or annual biomass growth, emissions from previous land use or the attribution of emissions from previous land use pools in the first year of conversion. In some case, the combined effect of transition period length (and transfer to 5A1) and high annual variation of past/current planted area over time may generate even emissions for some years (e.g. Denmark, Finland, Netherlands).

MS developed land identification systems which are able to track or at least to define the previous land use.

Tier 2 of IPCC is practically used exclusively for reporting emissions/removal from conversions (also for “remaining” cropland or grassland), but not for “forest land remaining forest land”. Part of the EU-15 MS report SOC change in 5A2 based on Tier 3 (e.g. Denmark, UK) or Tier 1 based on IPCC default data (i.e. Greece, Ireland). Spain and Belgium developed reference C stocks in soils on administrative regions bases (e.g. NUTS 3 in Spain) (Table 7.23).

Table 7.23 Values of the reference C stock in mineral soils on forest land/grassland/cropland as reported by the MS

MS	Land use	Value (tC/ha)	**Comments** (i.e. considered depth)

Austria	Forest land	77-117	0-50 cm, includes litter above the mineral soil
	Cropland	56-90	0-50 cm, includes litter above the mineral soil
	Permanent cropland (vineyard)	58-78	0-50 cm, includes litter above the mineral soil
	Grassland (intensive use)	75-100	0-50 cm, includes litter above the mineral soil
	Grassland (extensive use)	120-139	0-50 cm, includes litter above the mineral soil
Belgium	Forest Land	111/94	Wallonia / Flanders
	Cropland	44/52	Wallonia / Flanders
	Grassland	87/86	Wallonia / Flanders
	Peat land	100	Belgium (country level)
Finland	Cropland	59.1/74.6	IPCC based reference for high activity soils/sandy soils
Greece	Cropland	48	National average IPCC derived
Luxemburg	Forest Land	85	Country average
	Cropland	77	Country average
	Grassland	92	Country average
France	Forest land	70	Depth not specified
	Cropland	40	Depth not specified
	Grassland	65	Depth not specified
Italy	Grassland	78.9	For undisturbed soil grasslands
	Cropland	56.7	Depth of 30 cm
Spain	Grassland	94.5	Values are valid at country level for the transition from cropland to grassland. Various depths 30-100 cm as available in the databases
	Cropland	71	Values are valid at country level for the transition from cropland to grassland. Various depths 30-100 cm as available in the databases
United Kingdom	All land use categories		Reference C stock for all regions and all land use, 1 m soil depth

In 5A2 DOM is a small sink with IEF ranging from 0.35 to 0.44, with the average of 0.38 MgC ha-1 yr-1. SOC under 5A2 is reported as sink or as source, depending on the country. Average C stock change in mineral soils is 0.22 MgC ha-1 yr-1 with a range from -0.69 to 1.38. Some countries (Germany, Finland, Portugal, Spain, Sweden, UK) report decrease of the C stocks in soils under conversion to forests.

For C stock change in *SOC of organic soils*, the multiyear average IEF ranges from -2.8 by Finland up to +0.48 MgC ha-1 yr-1 in case of organic soils on grassland and wetlands converted to forest in UK (reported as sink only over recent years, while as sources earlier).

7.3 **Cropland (CRF 5B)**

7.3.1 Overview of the Cropland category

Subject to intensive agriculture, cropland is an important contributor to European Union GHG inventory. This category includes arable lands for annual and permanent crops, set aside lands or covered by grass for no more than a number of years, cultivated areas in ‘dehesa’ and rice-fields. Based on the MS submissions, cropland area in EU-15 covers 84849 kha in 2011 (4% less than in 1990), equal to 25 % of total reported land area.

7.3.2 Cropland remaining cropland (CRF 5B1)

7.3.2.1 *Overview of Cropland remaining cropland*

According to MS' CRFs, the area of "cropland remaining cropland" constantly decreased since 1990 to 78045 kHa or 2.4% less.

MS show decrease of cropland area, with the exception of France, Luxembourg and United Kingdom. The largest percentage decreases are registered by Italy, Ireland and United Kingdom (Table 7.24). Overall, the area of cropland remaining cropland decreased by ~2.4% from 1990 to 2011.

Table 7.24 Trend of activity data in subcategory 5B1 - Cropland remaining Cropland in EU-15's MS (kha)

Member State	1990	1995	2000	2005	2011	Difference 2011 to 1990
Austria	1.425	1.413	1.388	1.383	1.326	-7%
Belgium	966	939	911	883	822	-15%
Denmark	2.711	2.687	2.664	2.632	2.558	-6%
Finland	2.376	2.365	2.338	2.327	2.330	-2%
France	13.587	13.571	13.899	14.341	14.866	9%
Germany	13.630	13.672	13.713	13.585	13.555	-1%
Greece	3.944	3.906	3.848	3.802	3.596	-9%
Ireland	405	392	373	317	235	-42%
Italy	10.963	10.963	10.546	9.939	9.073	-17%
Luxembourg	37	36	37	41	46	23%
Netherlands	999	971	942	911	894	-11%
Portugal	2.983	2.720	2.568	2.346	2.035	-32%
Spain	21.175	20.871	20.317	20.026	19.753	-7%
Sweden	3.075	3.020	2.974	2.909	2.880	-6%
United Kingdom	1.692	2.060	2.507	3.271	4.076	141%
EU-15	**79.969**	**79.587**	**79.026**	**78.714**	**78.045**	**-2,41%**

At EU-15 level, in 2011 subcategory 5B1 was a source, i.e. 11 % higher than in 1990 and 2010 (Table 7.25).

Table 7.25 **5B1 Cropland remaining Cropland: MS' contributions to net CO_2 emissions (CRF table 5)**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-158	56	52	0.1%	-4	-7%	209	-133%	T1,T2	CS,D
Belgium	1 056	915	909	2.2%	-6	-1%	-147	-14%	CS,T2	CS
Denmark	5 052	3 555	3 362	8.0%	-193	-5%	-1 690	-33%	CS,T1,T2	CS,D
Finland	5 022	5 101	5 511	13.1%	410	8%	488	10%	D,T1	D
France	852	774	853	2.0%	79	10%	1	0%	CS,T2	CS
Germany	23 415	25 011	25 209	59.9%	198	1%	1 795	8%	CS,D,T2	CS
Greece	-1 205	-527	-471	-1.1%	56	-11%	734	-61%	T1,T2	CS,D
Ireland	20	8	17	0.0%	9	121%	-3	-15%	T1	D
Italy	-1 858	-1 195	3 339	7.9%	4 534	-379%	5 197	-280%	T1,T2,T3	CS,D
Luxembourg	-6	7	6	0.0%	-1	-18%	12	-192%	T1	CS,D
Netherlands	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	-	NA	NA
Portugal	83	-209	-220	-0.5%	-11	5%	-304	-365%	D	D
Spain	-929	-3 362	-3 527	-8.4%	-165	-	-2 598	-	T2	CS,D
Sweden	2 379	1 998	1 135	2.7%	-863	-43%	-1 244	-52%	T1,T2,T3	CS,D
United Kingdom	4 105	5 815	5 882	14.0%	67	1%	1 776	43%	CS,T3	CS
EU-15	**37 829**	**37 947**	**42 056**	**100.0%**	**4 109**	**11%**	**4 227**	**11%**		

Nevertheless, 5B1 represents an active sink in those MS where there are large areas of permanent croplands under active management. Mediterranean countries report it as a small sink or sources (i.e. France), as owing large areas of permanent croplands (i.e. olive groves, vineyards), although removal is steadily decreasing since 1990. Overall, emissions are dominated by Germany's cropland where this land subcategory is a source for all the pools, with significant emissions associated with organic soils. Other countries report soils as relatively small source (e.g. UK) or sink (e.g. Finland).

7.3.2.2 *Methodological issues for Cropland remaining Cropland*

Land included here by MS generally matches well the IPCC definition (Table 7.26), although there may be small national particularities (e.g. treatment of some woody crops). Quite often, because of the management practices, cropland may not be clearly separated from grassland, and the reporting approach may vary from amongst MS. Fact is that all 15 MS have developed consistent land use change matrices based on well-defined land uses hierarchy.

Table 7.26 **Information on cropland definitions and/or description**

Member State	Description
Austria	Arable land, including annual and perennial crops (rotation period of up to thirty years), as well as forest arboretums, forest seed orchards, Christmas tree plantations and orchards (e.g. walnut or sweet chestnut) and rows of trees and areas with woody plants in parks and green areas, and house garden.
Belgium	Tillage land and agro-forestry systems with vegetation falling below the thresholds for forests.
Denmark	Annual crops, wooden perennial crops, hedgerows and "other agricultural area" (i.e. small undefined areas lying inside the cropland area). It includes farmlands, commercial plantations with perennial crops (fruit trees, orchards and willow), house gardens, hedgerows (perennial trees/bushes not meeting the forest definition) in the agricultural landscape, as well as willow plantations on agricultural land for bioenergy purposes.
Finland	Arable crops, grass covered (for less than 5 years), set-aside, permanent horticultural crops, greenhouses and kitchen gardens.

France	Annual crops, temporary pastures (which last for maximum 6 annual harvests) and permanent crops (orchards, vineyards, olives, etc).
Germany	Annual crops and cropland with perennial crops (long-lived crops: fruit crops, osiers, poplars, Christmas tree farms, nurseries) and lands for cultivation of vegetables, fruit and flowers.
Greece	Annual and perennial crops, temporary fallow land and perennial woody crops, i.e. tree crops and vineyards.
Ireland	Permanent crops and tillage land, including set-aside, as recorded by annual statistics.
Italy	Annual crops and perennial woody crops (e.g. woody plantations, that don't meet national forest definition, olive groves or vineyards). Plantations, mainly poplars, characterized by short rotation coppice system and used for energy crops are included (as they do not fulfill national forest definition).
Luxemburg	Agro-forestry systems where tree cover falls below the forest thresholds, respectively covered by permanent crops, annual crops, artificial meadows (not permanent) and lands temporarily set aside
Netherlands	Arable and tillage land, including rice-fields, and agro-forestry systems where the vegetation structure falls below the thresholds for forest and nurseries (including tree nurseries).
Portugal	Rain-fed annual crops (without irrigation and fallow-land integrated into crop-rotations), irrigated annual crops (under irrigation, greenhouses), rice cultivation lands, wineyards, olives and other species of woody crops
Spain	Annual crops and fallow land, perennial crops (olive groves, wines and other woody crops) and mix of annual and permanent crops (except when they qualify as forest land, i.e. in "dehesa").
Sweden	Regularly tilled agricultural land.
United Kingdom	Arable and horticultureal land.

GHG estimates are reported mainly for soils and living biomass for perennial woody crops (i.e. orchards, vineyards, Christmas trees, fruits, bushes, and plantations). C stock change in living biomass under annual crops is estimated by Germany as neutral sink or slightly increasing by the UK (due to yields improvement). The soil pool definitions vary among MS, in terms of the estimated soil depth (e.g. 30 cm in Finland and 100 cm in Spain); no depth is specified in case of modeled approaches and as well as the threshold content for organic matter in organic soils.

Methods used for GHG estimation depend on data type and their time series availability (Table 7.27).

Table 7.27 Background information on data and methodology for the estimation of activity data and C stocks changes in the subcategory 5B1

Member State	Description
Austria	Activity data is compiled from Statistic Austria (based on IACS*). For crops not covered by the IACS the data are revised and estimated by expert judgment. Annual C stock change in biomass is considered according to the type of permanent woody crops (Tier 1 for orchards, vineyards and house gardens and Tier 1 for energy crops, Christmas tree) and estimated based on country specific total biomass carbon stock at harvest/removal. C stock in mineral soils is computed from national reference C stocks and country specific average C stock change factors adjusted according to the technology and management change.
Belgium	Activity data for SOC is derived based on landscape units distribution generated by the topological intersection of the Corine Land Cover 1990 and the digitized Soil Association map (Tavernier et al., 1972). C stock for each type of unit is estimated for the years 1960, 1990 and 2000, based on several databases and modeling approaches. C stock change in biomass is not estimated.
Denmark	Activity data by Statistics Denmark in a GIS analysis of the country's agricultural area combined with LPIS databases and detailed climate, soil maps, mineral & organic soils and cropland & grasslands, based on aerial photos for 1990 and 2005. Further on stratified on administrative criteria. C stock change in horticultural biomass is estimated based on the country's average stock biomass for each crop type, while for hedgerows is modeled with NFI data. SOC in mineral soils is modeled at county level. For organic soils, emission factors are country specific.
Finland	Cropland area is derived from NFI and Yearbook of Farm Statistics. Based on soil analysis the area is stratified on mineral & organic soils, low/high activity soils and fallow/till/no-till lands. C stock change in woody biomass is determined by country specific data for perennial crops (apple trees and dwarfish). C stock changes in soils are computed from reference soil C stocks and IPCC default factors. CO_2 emissions from cropland on organic soils are computed based on national emission factors on land categories and use.
France	Data derived from a grid based land assessment system for all land categories. C stock changes are considered neutral in all pools.
Germany	"Wall to wall" approach built by the landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informations system), CORINE land cover (CLC – 1990, 2000), digital soil map of Germany (BUEK 1000) and German Official Statistic data (land use surveys in 1991, 1999, 2003), harvests survey in 1989 – 2005, revision of NUTS 3 in 1998 and NFI). The approach allows estimating the area of land uses and the ratio of organic/mineral soils. Emissions from organic

	soils are estimated using a Tier 3 methodology, with country specific emission factors. Mineral soils are considered to be in CO_2-equilibrium.
Greece	Area data form national statistics. The default IPCC method is combined with a Tier 2 methodology to estimate C stock changes in biomass in permanent woody crops. Tier 1 emission factor data is used for the estimation of C stock changes in mineral soils, with IPCC's default C stock change factors and C stock reference in mineral soils. A crop weighted average value for reference soil organic carbon stock is computed at national level, based on default IPCC data.
Ireland	Annual statistics for tillage crops. For C stock change in biomass, Tier 1 is assumed. Tier 1 is applied for C stock change estimation in mineral soils. Soil types on land uses are derived from GIS analysis of CLC 1990 superimposed on the General Soil Association Map of Ireland. Reference C stocks are established in details for each soil type, and then assimilated with IPCC defaults, while adjusted by unique national values of stock change factors.
Italy	National land use statistics is available. Tier 1 based on highly aggregated area estimates for generic perennial woody crops has been used to estimate only aboveground biomass carbon stock change. Biomass plantations C stock change is modeled at regional scale (NUTS2). No change for mineral and organic soils was assumed.
Luxemburg	Living biomass of land converted to cropland follows Tier 1 method. SOC is reasoned as not changing.
Netherlands	Land use maps for 1990, 2004 and 2009 and annual data by linear interpolations or extrapolated to date. Soil carbon is conservatively reported as zero based on country specific data. C stock change is considered as zero in all other pools.
Portugal	Tier 2 based on NFI data. Data for permanent biomass is based on neighbor countries values. Soil C stock change is estimates with country specific data (from national grid).
Spain	Activity data is obtained from CLC 1990 and 2000, Forest Map of Spain (to exclude forest areas), survey of yields and crop areas (1990-2003) and annual statistics of agriculture ministry (2004-2011). C stock change in biomass is estimated only for perennial woody crops based on CS data on each main type of crop: olives, wines and other woody crops. Soil C stock change is weighted from provinces to administrative region under the constraint of management data availability at regional level.
Sweden	Activity data is provided by a national level systematic grid. Change in mineral soils is estimated based on repeated soil sampling in combination with pedotransfer functions. In organic soils the changes are based on country specific emission factors.
United Kingdom	Statistics of CL, GL and SL in 1990, 1998 and 2007 come from the Broad Habitat areas reported for each country (England, Scotland, Wales and Northern Ireland) in the Countryside Surveys. A dynamic model of carbon stock change is used with the land use change matrix to estimate soil C stock changes due to land use change.

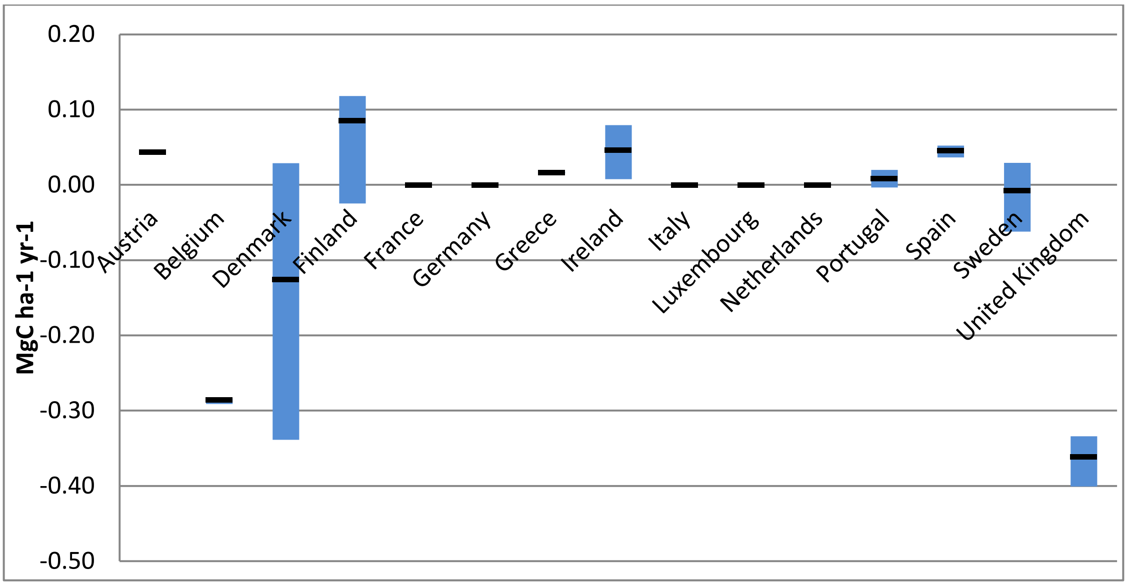
** IACS - Integrated Administrative Control System for EU subsidy payment scheme*

Different C stock change factors for *living biomass* vary by different types of permanent crops and management across Europe, especially from North (i.e. bush-type currant crops) to South (i.e. olives crops and agro-forestry systems). At EU 15 level, there is an average C stock change factor of 0.04 MgC ha-1 yr-1 (range between -0.36 and 0.08). Under dynamics of perennial cropland in some years it may associate with emissions (e.g. since 1992 on in Austria under decreasing of their area) or estimates as sources for some years (e.g. Denmark, Portugal and Spain). In few countries, the biomass C stock change is considered neutral (e.g. Germany, France).

For the estimation of C stock changes in *mineral soils*, most MS apply Tier 1 or 2 for emission factors and methods, while few MS report using Tier 3 methodology based on models (e.g. C-tool by Denmark, C-flow by UK and ICBM by Sweden). Reference C stock (tC/ha) in mineral soils varies between countries (see Table 7.23). Actually, Tier 2 may consist in the use of country specific reference C stocks and IPCC based C stock change factors: tillage/management factor (F_{MG}), land use factor (F_{LU}) and organic material input factor (F_I). Noteworthy, none of EU-15's MS developed its own factors and they all apply default IPCC ones, either directly or slightly modifying or adapting them by expert judgment, but not based on quantitative assessments (e.g. measurements). There is one exception, Austria which derived own factors by close comparison with IPCC similar strata.

Overall, the mineral soils are reported as small sources, with IEF between -0.05 to 0.12 (Figure 7.8).

Figure 7.8 **Implied C stock change factor in SOC mineral soils in 5B1 (Mg C ha-1yr-1).**



Largest IEF values are reported by Belgium, Denmark and UK as based on country specific data.

Organic soils under cropland are mostly reported under Tier 1 (involving IPCC default EF) or Tier 2 involving country-specific emission factors (e.g. Finland, Sweden, UK). Ireland reports there are no annual crops on organic soils (see NIR 2013 for more info). Some countries developed differentiated EF on type of crops or soil status (e.g. DK on soil management type). Emission factors range from -11 by Denmark and Germany to some -4 MgC ha-1y-1 in Sweden and UK. An overview on the organic soils in EU-15 is provided in Ch. 7.6.

7.3.3 Land converted to cropland (CRF 5B2)

7.3.3.1 *Overview of Land converted to cropland*

Area reported under "land converted to cropland" decreased by 22% since 1990 (Table 7.28). Overall, the area under conversions is some 8 % of total cropland area and represents 46% of its annual emissions. Largest conversions occur form grassland (91% of total area under conversion) and 5% from forest land, thus subject to deforestation. UK, but especially France, reports significant share of their cropland area as being under conversions, most of which are reported as occurring from grassland (> 90 % of area) and explained by the practice of swift shift from one use to another under prevalent current farming. Some countries report negligible changes from forestland. Together, the conversion area in these two MS represents around 80% of total EU-15 area reported under grassland converted to cropland.

Table 7.28 **Trend of activity data in subcategory 5B2 - Land converted to cropland – in EU-15 MS (kha)** (na- if time series reported starts after 1990)

Member State	Year					Difference 2011 to 1990
	1990	1995	2000	2005	2011	
Austria	83	79	74	73	104	25%
Belgium	11	39	66	94	142	1192%
Denmark	1	5	10	17	38	4194%
Finland	77	68	74	102	111	45%
France	4.630	4.563	4.284	3.847	3.778	-18%

Germany	767	767	767	733	685	-11%
Greece	0	0	0	0	0	na
Ireland	NO	17	27	67	129	na
Italy	207	209	72	72	18	-91%
Luxembourg	8	8	8	8	7	na
Netherlands	14	14	14	22	22	56%
Portugal	629	423	341	327	381	-39%
Spain	NO	NO	NO	NO	NO	na
Sweden	28	46	58	76	80	182%
United Kingdom	2.287	2.404	2.396	1.894	1.309	-43%
EU-15	**8.743**	**8.642**	**8.192**	**7.332**	**6.804**	**-22%**

Emissions decreased by 26 % since 1990 (Table 7.29). Land converted to cropland is an important source at the EU-15 level: although 5B2 area is about 8% of the total 5B area in 2011, the 5B2 annual emission is only 28% less than 5B1's. Most of the emissions occur in case of conversion from forest land and grassland. In 2011, the largest emissions are reported by France (comparable to 1990). In Spain and Greece such conversion does not occur.

Table 7.29 5B2 Land converted to cropland: MS' contributions to net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	356	454	461	1.5%	7	2%	106	30%	T2	CS
Belgium	113	900	922	3.1%	22	2%	809	718%	CS,T1	CS
Denmark	-6	-25	-25	-	-	-	-	-	CS	CS
Finland	628	1 316	1 324	4.4%	9	1%	696	111%	T1	CS
France	15 985	14 452	14 214	47.2%	-238	-2%	-1 771	-11%	T2,T3	CS
Germany	5 218	3 457	3 423	11.4%	-33	-1%	-1 794	-34%	CS,D,T2	CS
Greece	0	0	0	0.0%	0	-68%	0	88%	T1	CS,D
Ireland	NO	256	329	1.1%	74	29%	329	-	T1	D
Italy	746	9	-6	0.0%	-16	-167%	-752	-101%	T1	D
Luxembourg	40	18	18	0.1%	0	2%	-22	-54%	T1	CS,D
Netherlands	122	164	165	0.5%	1	0%	42	35%	CS,T1	CS,D
Portugal	5 752	3 548	3 664	12.2%	115	3%	-2 088	-36%	T2	CS,D
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	29	149	112	0.4%	-37	-25%	83	288%	T1,T2,T3	CS
United Kingdom	11 643	6 094	5 544	18.4%	-550	-9%	-6 099	-52%	CS,D,T3	CS
EU-15	**40 626**	**30 792**	**30 145**	**100.0%**	**-647**	**-2%**	**-10 481**	**-26%**		

7.3.3.2 *Methodological issues for Land converted to cropland*

Lower tiers are generally used in estimating and reporting C stock changes, especially Tier 2 and enhanced Tier 1 by using country specific data combined with default methods. Data sources used by MS for estimating C stock changes and CO_2 emissions are shown in Table 7.30.

Table 7.30 Background information on C stock change estimation data and methodology for subcategory 5B2

Member State	Description
Austria	FL conversion from/to data from NFI and CL from /to GL from IACS data base. Estimates of living biomass are based on country specific factors. Soils C stock change is estimated by reference C stocks on regions, different land uses and

a default transition period of 20 years.

Belgium	Activity data derived from countrywide NFI grid. Estimates of living biomass only for conversion from forest. SOC is computed based on regional reference C stock values.
Denmark	Data derived from aerial photo in 1990 and 2005, combined with data in LPIS and other statistics. It is further stratified with the soil map in both mineral and organic soils & cropland and grasslands (further broken down for: annual crops, set-a-side, grass in rotation and permanent grassland). No conversion from forest to cropland. SOC is modeled.
Finland	Data from NFI. Woody biomass and DOM data are also from NFI (in conversion from GL). Mineral soils C stock change is estimated by Yasso07 (in conversion from forest) and, for other conversions, computed based on default C stocks, assuming 20 years transition period.
France	Activity data from land systematic use/cover survey. Emissions from conversion from forests are estimated based on biomass, DOM and SOC NFI data. Emission from mineral soils is estimated based on country specific national reference values.
Germany	Activity data derived from "wall-to-wall" methodology. Emissions are estimated based on country specific data (spatially explicit and disaggregated at soil association unit level).
Greece	For conversion from forests, data was provided by local forest service offices and derived from national statistics for other conversions. Tier 1 data for all other conversions.
Ireland	GIS based LPIS* database. SOC emissions are estimated based on a Tier 1 methodology.
Italy	Conversion result from the land use change matrix constructed national land use statistics, annual effective conversions derived under a hierarchy of expert judgment assumptions on well-known patterns of land-use changes in the country. Conversions from forest are from administrative records at regional level collected by National Institute of Statistics. SOC estimated based on country specific papers.
Luxemburg	Calculation of annual change in carbon stocks of living biomass of land converted to cropland follows Tier 1 method with default C stock change factors.
Netherlands	The activity data is derived from "wall to wall database" and soil maps. Digitized soil maps are combined with soil profile details for 1990, 2004 and 2009, then extrapolated. National average data of C stock is from a large database of soil samples from farmers.
Portugal	Area based on NFI data. Data. Soil C stock change is based on country specific data base (from national grid).
Spain	There are no detected conversions to croplands (reported as NO).
Sweden	Activity data is provided by successive NFIs. Biomass data for conversion from forests is given by NFI. For C stock change in soils it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Land use change data is derived from countries statistics from three consecutive Countryside Surveys (1990, 1998 and 2007), extrapolated to 2011 and the areas of land use change from Forest come from Forestry Commission data, the Department for Communities and Local Government and the Countryside Survey dataset. Changes in biomass and SOC due to land use change depends on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density for the UK.

** LPIS – Land Parcel Information System (used by MS to implement the Common Agricultural Policy of the EU).*

Emission from LB, DW and LT are assumed to occur in one year under such conversions, while from SOC over a period of 20 years.

In case of *conversions from grassland to cropland*, mostly soil emissions are reported. When C stock change in living biomass is reported, emissions are mainly estimated using IPCC default values. On mineral soils, the C stock change factors are smaller for grassland than for forest land converted to cropland, with general values under 2 Mg C ha-1 yr-1 (largest IEF by Portugal and Belgium).

7.4 **Grassland (CRF 5C)**

7.4.1 Overview of Grassland (CRF 5C)

According to MS submissions, in 2011 the total grassland area was ~ 62855 kha or 19 % of total reported land area of EU-15. The highest area of grasslands is in France (14200 kha) and United Kingdom (13300 kha).

7.4.2 Grassland remaining grassland (CRF 5C1)

7.4.2.1 *Overview of grassland remaining grassland*

Area reported under this land subcategory is 6% less compared to 1990 (Table 7.31 Trend of activity data in “grassland remaining grassland” subcategory 5C1 in EU-15’s MS (kha, 1990-2011)).

Table 7.31 Trend of activity data in “grassland remaining grassland” subcategory 5C1 in EU-15’s MS (kha, 1990-2011)

Member State	1990	1995	2000	2005	2011	Difference 2011 to 1990
Austria	1.879	1.866	1.871	1.764	1.704	-9%
Belgium	747	704	661	617	552	-26%
Denmark	422	404	386	366	336	-20%
Finland	185	174	175	184	187	1%
France	11.224	10.747	10.685	10.820	10.758	-4%
Germany	6.281	6.150	6.018	5.902	5.771	-8%
Greece	4.796	4.795	4.793	4.790	4.788	0%
Ireland	4.122	4.059	3.977	3.814	3.619	-12%
Italy	8.981	8.552	8.164	8.015	7.515	-16%
Luxembourg	79	79	78	75	71	-10%
Netherlands	1.485	1.449	1.414	1.372	1.352	-9%
Portugal	194	197	203	305	342	76%
Spain	4.720	4.622	4.535	4.470	4.419	-6%
Sweden	480	453	430	397	389	-19%
United Kingdom	11.309	10.887	10.643	11.069	11.548	2%
EU-15	**56.906**	**55.138**	**54.032**	**53.959**	**53.351**	**-6%**

Category 5C1 grassland remaining grassland was a small source of CO_2, with an amount of emissions in 2011 equal to some 30 % of 5B1’s (despite similar areas). Total annual emissions in 2011 were smaller than in 1990 and rather equal to previous year (Table 7.32).

Table 7.32 5C1 Grassland remaining Grassland: MS' contributions to net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	1	2	2	0.0%	0	0%	1	131%	T2	CS
Belgium	671	369	389	3.5%	20	5%	-282	-42%	CS,T2	CS
Denmark	165	142	172	1.6%	30	21%	7	4%	CS,D	CS,D
Finland	877	316	302	2.7%	-14	-4%	-576	-66%	D,T1	D
France	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Germany	11 708	10 359	10 325	93.1%	-34	0%	-1 382	-12%	CS,T1	CS
Greece	0	0	0	0.0%	0	113%	0	-64%	T2	CS
Ireland	602	671	543	4.9%	-128	-19%	-59	-10%	T1	D
Italy	3 784	-1 148	-366	-3.3%	782	-68%	-4 149	-110%	T1,T2,T3	CS
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Netherlands	4 246	4 246	4 246	38.3%	0	0%	0	0%	T2	CS
Portugal	IE,NO	-188	-248	-	-	-	-	-		
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Sweden	-88	167	151	1.4%	-16	-9%	239	-271%	T3	CS
United Kingdom	-1 022	-4 292	-4 427	-39.9%	-135	3%	-3 405	333%	CS,T3	CS
EU-15	**20 945**	**10 643**	**11 090**	**100.0%**	**446**	**4%**	**-9 855**	**-47%**		

The largest contributors are Germany and Netherlands. Several MS report NO (i.e. France reports no change in all pools based on country specific datasets), while several MS report no change under Tier 1 for biomass (see Table 7.7). The C stock change in mineral soils on grassland is reported as not estimated by some half of the MS (e.g. Italy, Spain) or demonstrated as being nil. Few MS report the existence of unmanaged grassland (e.g. Ireland, France).

7.4.2.2 *Methodological issues for Grassland remaining Grassland*

Definitions available in MS' NIRs show good match with the IPCC land use definition, despite different eco-regions and management approaches across the EU (Table 7.33).

Table 7.33 Definition and description of grassland

Member State	Description
Austria	Meadows cut once/twice/several times, cultivated pastures, litter meadows, rough pastures, alpine meadows and pastures and abandoned grassland.
Belgium	Rangelands and pasture land that is not considered under cropland. It also includes systems with vegetation that fall below the threshold of forest land category and are not expected to exceed it, without human intervention.
Denmark	Land defined as grazing land under LPIS, heath land which may or may not be used for sheep grazing, as well as all other areas not meeting the definitions of forest land. The area of grassland is divided in "grazing land" and "other grassland".
Finland	Grassland includes area of grass cover (for more than 5 years), ditches associated with agricultural land and abandoned arable land. Abandoned arable land in this context means fields which are not used any more for agricultural production and where natural reforestation is possible or is already going on.
France	Land covered by natural and seeded herbaceous for more than 5 years. Includes areas covered trees and bushes being under the forest definition or not included under land category.
Germany	Meadow and pasture areas that cannot be considered cropland. Includes land covered with trees and shrubs that does not fall within the definition of "forest", as well as natural grassland and recreational areas.

Greece	Rangeland and pasture with vegetation that falls below the threshold of national forest definition and are not expected to exceed that without human intervention. Pastures that have been fertilized or sown are considered as cropland.
Ireland	Improved grassland (pasture and areas used for the harvesting of hay and silage) and unimproved grassland (rough grazing) in use as recorded by annual statistics.
Italy	Grazing lands, forage crops, permanent pastures, and set-aside lands since 1970, all shrub lands (data derived from NFI) and other woodlands that don't fulfill forest definition.
Luxemburg	All grasslands that are not considered as cropland including systems with vegetation or tree cover below forest threshold, natural grassland, recreational areas as well as agricultural systems. It includes one cut meadows; two and more cut meadows, cultivated pastures, litter meadows, rough pastures and pastures and abandoned grassland.
Netherlands	Any type of terrain which is predominantly covered by grass. Rangeland and pasture land is the land that is not considered croplands. It also includes all orchards (with standard fruit trees, dwarf varieties or shrubs) and the vegetation that falls below the threshold used in the forest land category and are not expected to exceed, without human intervention, the threshold used in the forest land category. The category includes: "Grasslands" - areas predominantly covered by grass vegetation (whether natural, recreational or cultivated) and "Nature" - natural areas (excluding grassland) consisting in heath land, peat moors and other nature areas, with many of them having occasional tree as part of the typical vegetation structure.
Portugal	Lands covered by permanent herbaceous cover.
Spain	Pasture land, including grazing land not included in cropland. It includes also pastures and meadows in the dehesa (forested pasture) that do not comply with the definition of forest.
Sweden	Agricultural land that is not regularly tilled. All grasslands are assumed managed.
United Kingdom	Area classified as following broad habitats: improved grassland, natural grassland, calcareous grassland, acid grassland, bracken, dwarf shrub heath, fen/marsh/swamp, bogs and mountains.

The separation of grassland from cropland, especially on land under conversion, may be difficult (e.g. in Portugal the conversion from and to cropland and grassland is reported up to 70 % of the country's grassland area, while EU15 average of some 15% with largest national shares of max 25%). The methods used by the MS to estimate the emissions related to grassland remaining grassland and conversions to grassland are described under the following subchapter. Lower tiers data are used for reporting emissions and removals for this land use category (Table 7.34).

Table 7.34 Background information on C stock change estimation data and methodology for subcategory 5C1

Member State	Description
Austria	Activity data is compiled from Statistic Austria (based on IACS). Biomass is assumed neutral. SOC is estimated with Tier 2 based on national reference C stock and C stock change factors. Emission from organic soils was estimated based on area from soil inventories and Austrian Soil Information System and the IPCC default emission factors.
Belgium	Activity data is derived based on landscape units distribution generated by the topological intersection of Corine Land Cover (CLC1990) geo-dataset and digitized Soil Association map of Tavernier et al. (1972). Biomass is not estimated. SOC change is estimated based on a number of heterogeneous databases and modeling efforts.
Denmark	Grassland area is obtained by LPIS, with potential area reported under cropland. SOC is modeled based on country specific data. Living biomass is only estimated for conversions from "grazing land" to/from "Other grassland".
Finland	Area estimate of grasslands was derived from national statistics (Farm statistics) and NFI data. C stock change in the biomass is not estimated. IPCC default soil C stocks for high activity and sandy grassland soils for wet temperate climate were used together with the default carbon stock change factors. For organic soils, both activity data and emission factor are country specific.
France	Data derived from a grid based land assessment system for all land categories. Resulting matrix also classifies managed and unmanaged grasslands. For biomass, the C stock change is estimated only for woody biomass, with tree data from NFI. All other pools are considered in equilibrium.
Germany	Integrated "wall to wall" system for land and land conversion classification, mapping and ranking in time. The approach allows for estimating the area of organic soils and their land use. Biomass C stock change is estimated based on country specific datasets for woody and non-woody land uses within the category. SOC stock change is considered based on national datasets and research only for the conversions within the category.
Greece	The area is provided by agricultural statistics. No change in biomass. Aboveground grass and tree biomass are only considered for estimating emissions in case of wildfires. DOM and SOC are assumed to be neutral.

Ireland	Central Statistic Office's statistics on improved grassland (pastures and areas harvested for silage and hay) and unimproved grassland, *in use* for agricultural purposes. The IPCC soil types on land use categories are derived by GIS LPIS analysis of superimposition of CLC 1990 with General Soil Association Map of Ireland (with peat areas entirely classified under wetlands). No biomass C stock change assumed under static management practices. For SOC, the IPCC default values are used to establish the reference C stocks, and they are corrected for by using F_{LU}, F_{MG} and F_I default factors to account for land use and farming practices. On organic soils, emissions are estimated using with the IPCC default factor.
Italy	National land use statistics is available. Grassland includes grazing land and other wooded land. For Grazing land a Tier 1 methodology is used, therefore, no change in carbon stocks in the biomass, SOC and DOM pools is assumed. For "other wooded land (i.e. shrub lands) C stock changes in biomass is modeled and change in DOM is estimated by linear relation against aboveground carbon. SOM is neutral.
Luxemburg	Assumed neutral.
Netherlands	The activity data is derived from "wall to wall" land use database and soil maps. C stock change in Living biomass and SOM is assumed neutral. Country specific method is used to estimate emissions from the drainage of organic soils.
Portugal	Area data Area data is given by Corine Land Cover maps (1990, 2006), nationwide NFI grid data and agricultural statistics. SOC data is country specific.
Spain	The activity data is obtained from CLC 1990 and 2006, and Forest Maps of Spain (to exclude forest areas), survey of yields and crop areas (1990-2003) and annual statistics of agriculture ministry (2004-2011). SOC change is estimated based on country specific data.
Sweden	All data is provided by the nationwide NFI. On organic soils country specific annual heterotrophic respiration is available. For C stock change in soils and DOM, it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Non-spatially-explicit land use land use data is provided from countries statistics, namely areas of CL, GL and SL in 1990, 1998 and 2007 come as Broad Habitat proxy reported for each country (England, Scotland, Wales and Northern Ireland) in the Countryside Surveys. A dynamic model of carbon stock change is used with the land use change matrices to estimate soil C stock changes due to any land use change.

The estimation of emissions covers mainly soils (6 MS report it), from which Ireland, Germany and UK report it as very small sink, while rest of MS report it neutral under Tier 1. Average IEF is 0.01, with the range between -0, 28 and 0, 87 MgC ha-1 yr-1. Largest negative IEFs (as source) is estimated by Sweden and UK, and positive, i.e. sink by Finland.

7.4.3 Land converted to grassland (CRF 5C2)

7.4.3.1 *Overview of Land converted to grassland*

The area of land converted to grassland represents some 15 % in the EU-15 of total grassland area, and it increased 11 % compared to 1990 (Table 7.35). From total area in conversions to grassland, 82 % was from cropland and 7 % from forest land. 5C2 is a sink which in absolute value is double to emissions from 5C1. The highest share of conversion to grassland was reported by UK and France, mainly from cropland.

Table 7.35 Trend of activity data in the "land converted to grassland" subcategory 5C2 in EU-15's MS (kha, 1990-2011) (na- if time series reported starts after 1990)

Member State	Year					Difference 2011 to 1990
	1990	1995	2000	2005	2011	
Austria	114	111	86	79	86	-24%
Belgium	8	28	48	68	115	1347%
Denmark	2	15	27	44	87	3498%
Finland	98	84	85	85	77	-21%
France	5.197	5.187	4.805	4.221	3.359	-35%

Germany	382	382	382	404	399	5%
Greece	0	33	74	112	316	na
Ireland	19	29	65	87	193	939%
Italy	240	240	757	1.071	1.954	715%
Luxembourg	16	16	16	15	14	-17%
Netherlands	16	16	16	30	30	91%
Portugal	429	619	775	836	868	102%
Spain	6	37	67	98	122	1900%
Sweden	26	43	68	83	93	254%
United Kingdom	2.026	2.268	2.412	2.165	1.790	-12%
EU-15	**8.579**	**9.108**	**9.683**	**9.395**	**9.504**	**11%**

In contrast to 5C1, 5C2 is a sink of about 21000 GgCO_2 in 2011. The sink increased by 39 % compared to 1990 and slightly increased compared to 2010. The highest removals are reported by Italy, France and United Kingdom (Table 7.36).

Table 7.36 5C2 Land converted to Grassland: MS' contributions to the net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	353	367	361	-1.7%	-6	-2%	8	2%	T2	CS
Belgium	74	-471	-505	2.4%	-34	7%	-579	-785%	CS,T1	CS
Denmark	18	75	76	-0.4%	1	2%	58	324%	CS,D	CS,D
Finland	-118	-30	-85	0.4%	-54	180%	33	-28%	CS,T1	CS,D
France	-12 362	-8 085	-7 618	36.7%	467	-6%	4 744	-38%	T2,T3	CS
Germany	-380	-1 576	-1 557	7.5%	19	-1%	-1 177	310%	CS	CS
Greece	0	6	6	-	-	-	-	-	T1	CS,D
Ireland	-109	-552	-323	1.6%	229	-42%	-214	197%	T1,T3	CS,D
Italy	-941	-6 401	-7 665	37.0%	-1 264	20%	-6 725	715%	T1	CS,D
Luxembourg	32	29	31	-0.2%	2	7%	0	-1%	T1	CS,D
Netherlands	239	228	236	-1.1%	8	4%	-3	-1%	T1	D
Portugal	3 814	1 349	1 329	-6.4%	-19	-1%	-2 485	-65%	T2	CS,D
Spain	-47	-934	-934	4.5%	0	0%	-888	1898%	T2	CS,D
Sweden	-214	-238	-150	0.7%	88	-37%	64	-30%	T1,T2,T3	CS
United Kingdom	-5 280	-4 183	-3 941	19.0%	242	-6%	1 339	-25%	CS,D,T1,T	CS,D
EU-15	**-14 920**	**-20 418**	**-20 739**	**100.0%**	**-321**	**2%**	**-5 819**	**39%**		

7.4.3.2 *Methodological issues for Land converted to grassland*

The methods and data for estimating the stock changes and emissions of CO_2 from these land categories are already described under 5B2, both for activity data and C stock changes in pools.

For lands converted to grassland, the highest C stock change reported is related to the living biomass in conversions from forest land, although it is also estimated in conversions from Wetlands and Cropland (with the exception of Italy and Spain that report it as neutral). The change in SOC varies between a drop of -1.51 by Portugal (alone reports it as a source) to an increase of 2.09 MgC ha-1 yr-1 by Spain.

7.5 Wetlands, Settlements and Other land

7.5.1 Wetlands (CRF 5D)

In the EU-15, the Wetlands (5D) area is 18175 kha or 5% in 2011. Largest areas were reported in Finland in Sweden. Annual net emissions in 2011 are about 2037 GgCO_2, i.e. 4% more than in 1990 (totally achieved on 5D1 land, with 5D2 as a sink). Out of this, the largest share is represented by soils in conversions to wetlands, with France reporting a large increase of SOC in such conversions (for all land divisions). Emissions/removals are computed only for managed land (usually also considered under “Wetlands remaining wetlands” for which reporting is not mandatory). For lands under conversion to WL, C stock change in soil pool is always computed. C stock change in living biomass is estimated only in conversion from FL. The land included under this category has different definitions among MS (Table 7.37). France also reports CO_2 and CH_4 emissions from flooded area under 5G Other (CRF table 5).

Table 7.37 Definitions of land included by MS under the category 5D Wetlands

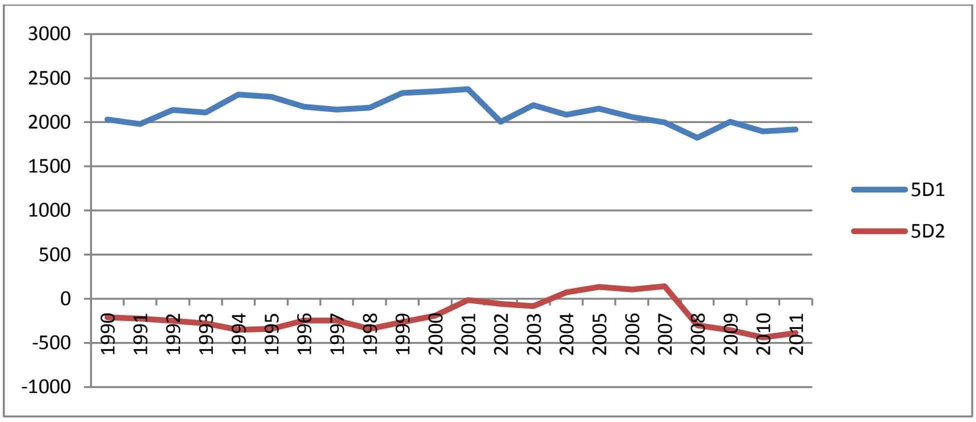
Member State	Description and supplementary elements for land classification
Austria	Rivers, lakes, mires and peat areas (protected areas, in general) as classified by national statistical system.
Belgium	Land covered or saturated by water for all or part of the year (e.g. peatland) and that does not fall into the other land category. It includes reservoirs as a managed subdivision and natural rivers and lakes as unmanaged subdivisions.
Denmark	Permanent wetlands, wetlands for peat extraction and re-established anthropogenic wetlands. Several subdivisions may be distinguished: unmanaged fully water covered wetlands (lakes and rivers); unmanaged partly water covered wetlands (fens and bogs); managed drained land for peat extraction; managed partly water covered wetlands (re-established wetlands on primarily former cropland and grassland).
Finland	Inland waters (reservoirs, natural lakes and rivers), peat extraction areas and peatlands which do not fulfill the definition of other land uses.
Germany	Reporting in the wetlands category primarily covers emissions from organic soils that are released during peat extraction, covering: CO_2 losses from extraction areas, and during extraction and spreading of peat. Also, it includes (but they are not estimated) the few non-drained semi-natural bogs that have been largely free of anthropogenic impacts, flooded lands, water-storage facilities (dams, reservoirs, etc.) and settling basins that are used for energy production, irrigation, shipping and recreation, and that are flooded or drained, or that otherwise have large water-level fluctuations.
Greece	Land that is covered or saturated by water for all or the greatest part of the year (e.g. lakes, reservoirs, marshes), river bed (including torrent beds) and that does not fall into the forest land, cropland, grassland or settlements categories.
France	Lands covered or saturated by water all year long or part of it.
Ireland	Natural unexploited wetlands and areas commercially exploited for public and private extraction of peat and areas used for domestic harvesting of peat.
Italy	Lands covered or saturated by water, for all or part of the year, harmonized with the definitions of the Ramsar Convention on Wetlands.
Luxemburg	Land that is covered or saturated by water for all or part of the year (e.g. peat land, reservoirs) and that does not fall into other categories.
Netherland	Land covered or saturated with water for all or part of the year and does not fall into the other land category. It includes reservoirs as a managed sub-division and natural lakes and rivers as unmanaged, including natural open water in rivers, but also man-made open water in channels, ditches and artificial lakes.
Portugal	Inland wetlands, coastal wetlands, salt marshes, saline and intertidal flats.
Spain	Includes the lands covered or saturated by water all year long or part of it.

Sweden	Wetlands is assumed unmanaged (mires and areas saturated by fresh water) and managed (cca 10 000 ha used for peat extraction).
UK	Includes sites currently registered for commercial extraction where extraction activity is visible on recent aerial/ satellite photographs or by field visits.

From total wetland area in the EU-15, the annual conversion to wetlands (5D2) represented only 4%, with absolute area of wetlands under conversion of roughly 680 kha in 2011. This category is often subject to conversions to natural water regime and wetlands, in general established in areas of organic soils on grasslands. For 2011 the highest share of land under conversion is reported from grassland and forest land (each by 29%). Area of conversion to wetlands doubled since 1990, with the highest contribution of Sweden (area increased by 8 times since 1990).

Permanent wetlands are considered neutral regarding anthropogenic GHG emissions by most member states (e.g. France, Portugal), but other report it as sources because of activities associated to conversion to wetlands (e.g. Finland, Sweden). Overall, the CO_2 emissions from wetlands have decreased by 6% since 1990 (Figure 7). Only few MS report emissions on "remaining" areas (e.g. Germany only from soils and Ireland from biomass and soils).

Figure 7.9 Emissions ($GgCO_2$) from Wetlands remaining wetlands (5D1) and Lands converted to wetlands (5D2)



Emissions of CH_4 and N_2O from peat extraction activities (i.e. Finland, Denmark) are reported under Table 5(II), and these include emissions from active and temporarily set-aside peat extraction fields and abandoned non-vegetated peat extraction areas. IEF N_2O-N per area drained (kg N_2O-N/ha) value vary from 0.17 (by Denmark) to 1.6 (by Finland). To compute emissions from peatland extraction Denmark reports the use of a peat density factor of 200 kg per m3, a dry matter content of 0.5, an ash content of 0.02 and a C-content of 0.58 kgC per kg organic matter. In general, in case of land use change to water bodies, all MS use final reference carbon stock of 0 MgC/ha, so all C from the previous land use is considered emissions, as lost in the year of the conversion. Finland developed regional weather-dependent emission factors following the statistical relationship between CO_2 evolution with soil temperature at a depth of 5 cm and the position of the water table.

7.5.2 Settlements (CRF 5E)

In EU-15, the total reported settlements (5E) area in 2011 is 20259 kha, 20% being conversions. Definitions of lands included under this category vary across EU-15 MS (

Table 7.389). All countries report increasing 5E2 areas compared to 1990. For the lands under conversion, the highest share was reported as conversion form grassland (39%), cropland (43%) and forest land (16%). Recalculations results in 5E2 being key category for some countries (e.g. Netherlands).

Table 7.38 Definitions of land reported by MS under land category 5E Settlements

Member State	Descriptions and supplementary information for land classification
Austria	Includes buildings land: sealed, partly sealed and unsealed areas; parks and gardens; roads and railway tracks; excavation areas, and other not further differentiated settlement area.
Belgium	All developed land, including transportation infrastructure and human settlements of any size (i.e. including road sides) unless they are already included under other categories.
Denmark	Urban cores, industrial areas, roads, high and low buildup areas. Low build-up areas are characterized as single-family houses surrounded by gardens, graveyards, sports facilities, etc (estimates are reported only for low build-up areas).
Finland	Combined area of NFI built-up land, traffic lines and power lines. Includes parks, yards, farm roads and barns.
France	Artificialized land (settlements, parks, roads and infrastructure, etc.).
Germany	Open settlement and transport areas.
Greece	Developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other land-use categories.
Ireland	Urban areas, roads, airports and the footprint of industrial commercial/institutional and residential buildings.
Italy	Artificial surfaces, transportation infrastructures (urban and rural), power lines and human settlements of any size, comprising also parks.
Luxemburg	Developed land, including transportation and any size of human settlement unless already included under other category.
Netherlands	Developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.
Portugal	Artificial areas such as urban, industrial, commerce and transport units, mines, dump and construction sites and artificial non-agricultural vegetated areas.
Spain	All developed land, transport infrastructure and establishments of any size, unless they are included in other categories.
Sweden	Infrastructure such as roads and railways, power lines, municipality areas, gardens and gravel pits.
UK	Covers urban and rural settlements, farm buildings, caravan parks and other man-made built structures such as industrial estates, retail parks, waste and derelict ground, urban parkland and urban transport infrastructure. It also includes domestic gardens and allotments, linearly arranged landscape features such as hedgerows, walls, stone and earth banks, grass strips and dry ditches.

There are no annual emissions reported with “remaining” areas (which are actually reported under others inventory sectors), but under conversions to settlements (5E2) which have increased by 35% since 1990 (Table 7.39).

Table 7.39 5E2 Land converted to Settlements: MS’ contributions to the net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	286	262	258	0,9%	-4	-2%	-29	-10%	T2	CS
Belgium	248	592	585	1,9%	-7	-1%	337	136%	CS,T1	CS
Denmark	16	54	56	0,2%	2	4%	40	247%	CS,T1	CS,D
Finland	929	1.681	1.523	5,0%	-159	-9%	593	64%	T2	CS
France	10.349	14.255	14.229	47,2%	-26	0%	3.880	37%	T2,T3	CS
Germany	707	512	591	2,0%	79	15%	-117	-16%	CS,D,T2	CS
Greece	5	7	6	0,0%	-1	-19%	0	7%	T1,T2	CS,D
Ireland	10	23	10	0,0%	-14	-59%	-1	-7%	T1,T2,T3	CS,D
Italy	2.516	3.422	3.397	11,3%	-25	-1%	881	35%	T1	CS,D
Luxembourg	139	108	107	0,4%	-1	-1%	-32	-23%	T1	CS,D
Netherlands	459	808	817	2,7%	9	1%	358	78%	T1	D
Portugal	31	1.723	1.792	5,9%	69	4%	1.761	5622%	T2	CS,D
Spain	490	557	561	1,9%	3	1%	70	14%	T1,T2	CS,D
Sweden	1.117	2.519	2.507	8,3%	-13	0%	1.390	125%	T1,T2,T3	CS
United Kingdom	5.109	3.650	3.736	12,4%	86	2%	-1.373	-27%	CS,T3	CS
EU-15	**22.412**	**30.175**	**30.173**	**100,0%**	**-1**	**0%**	**7.761**	**35%**		

Emission from conversions to settlements are estimated and reported, unlike 'remaining settlements' under lack of data. Reporting pools is practically complete for conversions from major land categories: forest, cropland and grassland (although IPCC methodology is missing in some cases, e.g DOM under conversion from forest).

Conversion from Forest land to Settlements is an important component of the total deforestation, being some 30 % of total area reported as deforested and some 15 % of total area reported under all conversions. While conversion to WL and OL may be caused by natural effects, direct human induced action is indisputable for conversion to SL, thus all GHG emissions are anthropogenic. Generally, the C pools are not uniformly disturbed over the whole area converted (i.e. usually only part of converted area is sealed, trees or upper soils layer is removed) and carbon transfer to DW, LT and SOM pools diminish significantly. In connection with reporting deforestation, methodologies are country specific.

For reporting DOM (DW, LT) it is generally assumed that entire C stock in DOM pools is instantaneously oxidized in the initial moment of conversion from FL to SL. It is also assumed that there is no dead wood and litter on settlements lands. Emissions are estimated based on per area average C stock of DW and LT determined either at national or regional scale or specific to each deforestation site.

For reporting SOM, several assumptions are involved based on expert judgment or, occasionally, from some scientific studies. For instance, in Sweden C stock in SL is estimated as the weighted average of C stocks under two strata: unsealed and sealed. Unsealed area is considered to cover 40-66% of national SL or conversion to SL area (i.e. AT, LU), going down to 2-3% in cities (i.e. BG). Associated C stock is derived from (depending on MS):

- data from measurements in green area of the city (from scientific studies);
- same C stock as under 'GL remaining GL' (assuming that under national circumstances GL is the source of land for settlement's expansion);
- lowest C stock value among the major land categories FL, CL and GL (assuming limited change of C stock in the soil under construction);
- applying a factor against C stock in previous land use (i.e. constant loss of 50 % by FR).

7.5.3 Other land (CRF 5F)

The area of category Other land (5F) covers at EU-15 level 23760 kha in 2011, 5% in total EU-15 land. Definitions implemented to report such lands are close amongst MS and match IPCC general description (Table 7.40). The largest share of "Other land" is reported by Spain (11300 kha), Sweden (4400 kha), and Portugal (1700 kha).

Table 7.40 Definition for the categorization of lands under 5F - Other land

Member State	Description and supplementary elements for land classification
Austria	Area with i) rocks and screes, ii) glaciers and iii) unmanaged alpine dwarf shrub heaths. It is calculated as the difference of total country area and all other land uses, showing max 2 % difference by relevant cadastral data.
Belgium	Bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories.
Denmark	Unmanaged area like moors, fens, beaches, sand dunes, lakes and other areas without human interference.
Finland	Mineral soils on poorly productive forest land, which do not fulfill the threshold values for forest, unproductive lands on mineral soils on rocky lands and treeless mountain areas.
France	All lands that do not correspond to any other land use categories (e.g.. rock areas).
Germany	Waste and swaths/aisles, glacier areas, scree slopes and sand bars and other land which cannot be allocated under other land categories. "Other land" consists of areas that are neither influenced nor cultivated by people.
Greece	All land areas that do not fall into any of other land-use categories (e.g. rocky areas, bare soil, mine and quarry land).

Luxemburg	This category includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories. It allows the total of identified land areas to match the national area.
Netherlands	Surfaces of bare soil which are not included in any other category like: bare sands and the earliest stages of succession from sand in the coastal areas (beaches, dunes and sandy roads) or uncultivated land alongside rivers. It does not include bare areas that emerge from shrinking and expanding water surfaces (which are included in wetlands).
Ireland	Natural grasslands not in use for agricultural purposes. Water bodies, bare rocks.
Italy	Definition is not available in NIR 2013.
Portugal	Beaches, dunes, sand plains and bare rocks and shrubland.
Spain	Bare soil, rock areas, ice and other areas of land that do not fall into any of the other land category.
Sweden	Waste land and most of the mountain area in northwest Sweden. It is assumed unmanaged.
UK	Inland rock, standing water and canals and rivers and streams.

Other land category is sometimes also used to report unmanaged land areas (e.g. unmanaged grassland in Ireland and Spain). There are no reported emissions on 5F1 land category, but only in case of conversions to "Other land". For conversion from forest land, in many cases, the pools for which reporting is not mandatory were omitted by some MS because methods are not available the IPCC LULUCF GPG (2003). Emissions from 5F2 turned from source to removals since 1990, being in 2011 around 2400 Gg CO_2eq.

7.6 Emissions from organic soils in EU-15

At EU-15 level, organic soils cover some 14000 kha, located especially in Northern MS. Total organic soils area reported in 2011 is slightly higher than in 1990 under likely reclassification or updating (mainly by Germany and Sweden which reported 4 % larger area). A major issue is that organic soils emission cumulated all over major land categories (5A,5B,5C) was in 2011 71000 GgCO_2 which represents 24 % of total EU-15 net LULUCF removals or 18 % from Forest land sink in 2011.

The highest area of organic soils is in Finland (~ 6400 kha), Sweden (~ 4300 kha), Germany (1500 kha) and the UK (250 kha). Only in few cases the definitions of organic soils are reported in the NIRs (Table 7.41), so presumably the other MS follow the IPCC GPG LULUCF 2003's FAO based definition.

Table 7.41 Elements to define C pool in organic soils

MS	Definition
Austria	>17% of organic matter in top 30cm of soil
Denmark and Ireland	>20% of organic matter in top 30cm of soil
Finland	Soil is considered to be organic if the soil type is peat. In forest land a site is classified as peatland if the organic layer is peat or if more than 75% of the ground vegetation consists of peatland vegetation. In cropland and grassland >20% of organic matter in top 20 cm of soil
United kingdom	Modeled based on habitat explicit soil C content database assuming 1 m depth (without implementing any threshold between mineral and organic soils)

In terms of area, forest organic soils is mainly estimated using country specific values, while countries having a small share of organic soils within forest area, report carbons stock changes for this pool by using IPCC default factors. In Finland, as the country with highest organic soils area, mineral and organic soils activity data were derived from NFI database and geo-referenced soil database across all land uses. In Germany areas with organic soils is determined via a geo-referencing procedure with overlaying of General soil map of Germany and cadastral data for each type of land use. In Sweden, data is also provided by NFI combined with Swedish Forest Soil Inventory. Emissions factors are derived based on continuous monitoring or modelling (country specific data reported by MS is provided in EU NIR's sub-chapters).

Overall, in the EU-15, most of organic soils area is under forest land, but most of the emissions come from cropland and grassland (Table 7.42). Biggest drop is shown for 5A1 where Finland estimates slightly lower area but 40% less emissions (under compensating effect of better tree growth giving larger litter input to soil emissions on historically drained areas). Furthermore, most of the organic soils area (94%) is in the category "remaining" in the same category, with small share under various conversions. Area reported under conversion to cropland increased, while all others decreased.

The highest IEFs are associated with stable cropland, conversions to cropland and to grasslands under intensive management interventions, while organic soils in forest lands show the lowest IEF values.

Table 7.42 Total CO_2 emissions and average implied carbon stock change factors in the EU-15 (average over 1990-2011)

Land use subcategory	Area in 2011 (kha)	IEF (MgC ha-1 yr-1)	Net annual CO_2 emissions (Gg CO_2)	Share in annual CO_2 emissions (%)	2011 estimate change compared to 1990 (%)
5A1	10.867	0,42	12.513	23%	78%
5A2	364	0,61	609	1%	87%
5B1	1.256	7,41	25.592	48%	100%
5B2	96	7,71	2.029	4%	106%
5C1	1.195	3,69	12.145	23%	95%
5C2	67	2,38	438	1%	96%
Total	13.845		53.326	100%	

Emissions from organic soils are included under relevant land use categories by the MS, where there is more detailed discussions available on the IEF. Here we only present data for different land use categories averaged over entire time series 1990-2011. Overall, CO_2 emissions at the EU-15 level steady decreased by 7 % compared to 1990 (to 53000 Gg CO_2 in 2011).

In general in the EU-15 MS, there are still small quantitative inconsistency in reporting organic soils under 5B1&5B2 (or/and 5C1&5C2) and Table 4Ds1 regarding organic soils area under cultivation, mainly under the inconsistent definition of cultivation (which in broad sense includes both activities on cropland an grassland, or in a narrow sense on arable land preparation).

7.7 Other emissions from land uses: Tables 5(I)-5(V)

7.7.1 Direct N_2O emissions from N fertilization sources (CRF Table 5(I))

This source category covers direct nitrous oxide emissions from forest land fertilization by synthetic chemicals. For the majority of MS report there is no fertilization of forest land, with few including it in the emissions reported under the agricultural sector, using appropriate notation keys in the CRF tables (Table 7.43). Only Finland, Sweden and the UK report N_2O emissions under this source category, all reporting less emissions than in 1990. Sweden actually reports the highest amount of N_2O emissions from N based fertilization occasionally applied to increase the wood production in some middle aged or older stands on mineral soils.

Table 7.43 Direct N_2O emissions from N-based fertilization of Forest land and Other (Gg N_2O)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Finland	0.09	0.07	0.07	32.1%	0	-7%	0	-22%
France	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Germany	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Portugal	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	0.19	0.21	0.14	66.3%	0	-34%	0	-24%
United Kingdom	0.02	0.00	0.00	1.6%	0	-4%	0	-78%
EU-15	**0.29**	**0.29**	**0.21**	**100.0%**	**0**	**-27%**	**0**	**-26%**

For reporting MS activity data results from national or sectoral statistics, either in terms of total amount and type of synthetic fertilizer annually applied (i.e. Finland, Sweden) or as a fixed application rate and total annually fertilized area (i.e. UK), with IPCC default emission factor. The IEF of the N_2O-N emissions per unit of fertilizer is around 0.01 kg N_2O-N/kg N ha-1 yr-1.

On the whole, N_2O emissions are less in 2011 compared to 1990. Total EU-15 emissions from fertilization of forests soils in 2011 from this category is 0.29 Gg N_2O, knowing that some important share of such emissions is reported under Chapter 4 Agriculture.

7.7.2 N_2O emissions from drainage of soils (CRF Table 5(II))

This source category covers non–CO_2 GHG, respectively direct N_2O and CH_4 emissions from drainage of soils (CO_2 emissions are reported under other land categories, usually under Wetlands, while indirect N_2O emissions are reported under Chapter 4 Agriculture). Nevertheless, according to UNFCCC (decision 13/CP.9) and based on Appendixes 3a.2 and 3a.3 of the GPG LULUCF 2003, it is not mandatory for Parties to estimate emissions from this source. Accordingly, most countries do not report them considering them also negligible (NO or NE in Table 7.44), but few transparently report drained area. EU-15 drainage area reported by MS is 26% larger compared to 1990 in forest land (reaching 878 kha in 2011) and 28% less wetlands. Out of total area under drainage, 96 % occurs on Forest land. Overall annual non-CO_2 emissions practically did not change in time summing up 0.9 Gg N_2O (Table 7.44) and 2.8 Gg CH_4 in 2011 (Table 7.45), with insignificant changes for individual reporting countries.

Table 7.44 **N_2O emissions from drainage of soils (Gg)**

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	0.0515	0.0399	0.0399	4.4%	0.00	0%	-0.0116	-26%
Finland	0.22	0.32	0.34	37.3%	0.02	5%	0.1140	31%
France	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Germany	0.19	0.21	0.21	23.5%	0.00	1%	0	13%
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	0.09	0.13	0.13	14.5%	0.00	-1%	0	48%
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NE	NA,NE	NA,NE	-	-	-	-	-
United Kingdom	0.17	0.18	0.18	20.3%	0.00	0%	0	8%
EU-15	**0.72**	**0.89**	**0.91**	**100.0%**	**0.01**	**2%**	**0.18281**	**25%**

In Denmark and Ireland, N_2O emissions from peatland are estimated based on organic matter's C:N-ratio and default IPCC emission factor of 1.25%, while the activity data is provided by sectoral statistics. In Finland a Tier 2 methodology is used, with directly measured based CS emissions factors for CO_2, N_2O and CH_4, while the activity data (annual area of extraction active peatlands, set aside peat lands, industrial stocks) are compiled from statistics.

Table 7.45 **CH_4 emissions from drainage of soils (Gg)**

Member State	CH_4 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Finland	1.87	2.67	2.79	100.0%	0.1130	4%	1	91%
France	NA	NA	NA	-	-	-	-	-
Germany	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NE	NA,NE	NA,NE	-	-	-	-	-
United Kingdom	NA,NE	NA,NE	NA,NE	-	-	-	-	-
EU-15	**1.87**	**2.67**	**2.79**	**100.0%**	**0**	**4%**	**1**	**49%**

IEF for N_2O emission per area on drained land is in average 0.3 kg N_2O-N/ha/year in case of drainage of organic soils forest lands. IEF for CH_4 emissions per drained area is largest on flooded land some (15 kg CH_4/ha by Finland).

7.7.3 N_2O emissions from disturbances associated with conversion to cropland (CRF Table 5(III))

This source category covers direct N_2O emissions conversions to cropland. Change of soil management associated to such conversions from undisturbed soils lands (forest, grassland, wetlands), creates temporary increase in the mineralization of organic matter followed (emissions of CO_2 and N_2O) by the drop of total C stock and the restructuration of the C content on the soil profile.

At the EU-15 level, land reported under conversions to cropland steadily is 7 % more than in 1990, to 10300 kha nowadays, with 94% represented by conversions from grassland. A very small share occurs on organic soils (<1% of total area). Most of these conversions occur in France, which reports large areas of conversion from grassland to cropland (some 3.5 mil ha in 2011, decreasing with 20 % since 1990) and UK (some 53000 kha, some 40% more than in 1990).

Overall, steady decreasing trend of N_2O emissions from past years continues in 2011, with negligible decrease compared to 2010 but 20% less than in 1990 (Table 7.46), with the highest contribution from France and United Kingdom.

Table 7.46 N_2O emissions from disturbances associated with land-use conversion to cropland (Gg)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	0.13	0.16	0.16	1.9%	0.00	2%	0.03	24%
Belgium	0.03	0.30	0.32	3.8%	0.02	7%	0.30	1105%
Denmark	0.00	0.00	0.00	0.0%	0.00	0%	0.00	121%
Finland	0.02	0.04	0.04	0.4%	0.00	5%	0.02	69%
France	5.32	4.45	4.37	51.1%	-0.08	-2%	-0.95	-18%
Germany	0.63	0.66	0.67	7.8%	0.01	2%	0.03	5%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NA,NO	0.09	0.10	1.2%	0.01	11%	0.10	-
Italy	0.29	0.00	0.03	0.3%	0.02	663%	-0.26	-91%
Luxembourg	0.01	0.01	0.01	0.1%	0.00	-1%	0.00	-11%
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	1.61	0.90	0.95	11.2%	0.05	6%	-0.66	-41%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	0.07	0.23	0.23	2.7%	0.00	0%	0.16	228%
United Kingdom	2.48	1.77	1.67	19.5%	-0.10	-6%	-0.82	-33%
EU-15	**10.60**	**8.61**	**8.54**	**100.0%**	**-0.06**	**-1%**	**-2.05**	**-19%**

Methodology used by MS corresponds to Tier 1, which allows the estimation based on: 1) annual emission of carbon due to soil mineralization (IPCC default), 2) C:N, the average ratio in the soil (CS or IPCC default); 3) the emitted proportion of N_2O from N content (a constant of 1.25 % according the IPCC); 4) the ratio of 44/28 to convert N to N_2O; and 5) soil carbon stock (often IPCC default reference C stock) and 6) CS activity data (e.g. land conversion statistics). IEF N_2O-N emissions per area converted on both mineral and organic soils are around 04-1 kg N_2O-N/ha/year.

7.7.4 CO_2 emissions from agricultural lime application (CRF Table 5(IV))

This source category covers direct N_2O emissions from liming. Liming occurs especially in croplands (84% of applied amount) and on permanent grassland (16%). In the EU-15, annual consumption of lime has decreased by almost 20% since 1990, with a total EU-15 of some 10400 ton applied in 2011. Associated, total EU-15 emissions decreased by 21% since 1990 (Table 7.47). Majority of MS reduced notably the emissions from lime applications (i.e. Denmark, Netherlands).

Table 7.47 CO_2 emissions from agricultural lime application

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	90.30	87.32	87.17	1.9%	0	0%	-3	-3%
Belgium	64.09	52.24	51.40	1.1%	-1	-2%	-13	-20%
Denmark	622.92	156.68	165.48	3.7%	9	6%	-457	-73%
Finland	617.87	245.27	182.89	4.0%	-62	-25%	-435	-70%
France	852.00	774.00	853.00	18.8%	79	10%	1	0%
Germany	1 275.72	1 696.37	1 840.18	40.6%	144	8%	564	44%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	355.04	427.93	360.68	8.0%	-67	-16%	6	2%
Italy	NA,NO	13.49	13.49	0.3%	0	0%	13	-
Luxembourg	0.59	4.18	4.18	0.1%	0	0%	4	609%
Netherlands	183.15	73.32	73.32	1.6%	0	0%	-110	-60%
Portugal	12.60	12.49	12.60	0.3%	0	1%	0	0%
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	169.79	91.03	78.92	1.7%	-12	-13%	-91	-54%
United Kingdom	1 517.13	803.35	806.25	17.8%	3	0%	-711	-47%
EU-15	**5 761.20**	**4 437.69**	**4 529.55**	**100.0%**	**92**	**2%**	**-1 232**	**-21%**

The activity data are available from official national or sectoral statistics (e.g. agriculture sectors) or from field studies, sometimes derived by expert judgment (e.g. Austria). All reporting countries rely on IPCC default factor (*EF limestone* =0.120, and *EF dolomite*=0.122). The majority the MS do not differentiate between dolomite or lime, rather, they use a unique emission factor, as the share of dolomite in total amount applied is small (around 15 %). Commercially available products are discounted in terms of water content to only account for the limestone content in the calculations (i.e. Finland).

7.7.5 CO_2, CH_4 & N_2O emissions from Biomass Burning (CRF Table 5(V))

This source category covers CO_2, CH_4 and direct N_2O emissions from biomass burning, as well as emissions of other GHG (NO_x and CO). It includes emissions both from wildfires and controlled burning, on any type of land use (i.e. Forest land, Cropland, Grassland, Wetland and Settlement). In general, CO_2 emissions from forest fires are reported under 5A Forest land, while CO_2 for the other land categories and non-CO_2 gases emissions are reported under 5(V).

Controlled burning on managed land is not common practice in the EU-15, with few exceptions (i.e. Finland, Sweden, UK) or Grassland (UK, Spain) for confined areas.

Completeness on reporting GHG emission from wildfires improved significantly with current submission as they are reported also on grassland (e.g. Greece, Italy and Portugal, still NE by Spain). For most of the MS such emissions are indeed negligible. Only UK reports fire non-CO_2 emissions from conversion to settlements. The methodology used to report emissions for fires is always Tier 2 for CO_2 with activity data provided by national statistics and country specific emission factors, whereas Tier 1 data is used for estimation of CH_4 and N_2O emissions.

CO_2 emissions from burning biomass are reported as NO or IE, while often CH_4 and N_2O emissions are reported as NE by some MS. Overall, CO_2 emissions have decreased by 67 % since 1990 (Table 7.48). The CH_4 emissions decreased by 43% (Table 7.49) and those of N_2O by 41% (Table 7.50), but their trends are related to wildfire incidence, which is characterized by a large inter-annual variability.

Table 7.48 CO_2 emissions from Biomass Burning (in GgCO_2)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Belgium	5.24	NE,NO	68.35	2.6%	68	-	63	1205%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	3.86	5.05	5.68	0.2%	1	12%	2	47%
France	1 594.00	307.00	310.00	11.6%	3	1%	-1 284	-81%
Germany	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	-
Greece	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Ireland	101.39	223.01	82.76	3.1%	-140	-63%	-19	-18%
Italy	3 625.03	1 040.08	1 088.59	40.7%	49	5%	-2 536	-70%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	5.50	7.97	8.08	0.3%	0	1%	3	47%
Portugal	2 428.22	1 980.37	535.26	20.0%	-1 445	-73%	-1 893	-78%
Spain	3.49	52.33	51.33	1.9%	-1	-2%	48	1372%
Sweden	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
United Kingdom	328.27	411.19	522.81	19.6%	112	27%	195	59%
EU-15	**8 094.99**	**4 027.00**	**2 672.85**	**100.0%**	**-1 354**	**-34%**	**-5 422**	**-67%**

Table 7.49 **CH_4 emissions from Biomass Burning (in Gg CH_4)**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	0.03	0.01	0.01	0.0%	0.00	-10%	-0.02	-78%
Belgium	0.02	NE,NO	0.30	0.5%	0.30	-	0.28	1205%
Denmark	0.03	0.00	0.00	0.0%	0.00	5%	-0.03	-98%
Finland	0.19	0.03	0.05	0.1%	0.02	56%	-0.14	-74%
France	55.47	47.37	41.89	68.7%	-5.48	-12%	-13.58	-24%
Germany	0.43	0.15	0.06	0.1%	-0.09	-59%	-0.37	-86%
Greece	1.29	0.29	0.58	1.0%	0.29	101%	-0.70	-55%
Ireland	0.44	0.97	0.36	0.6%	-0.61	-63%	-0.08	-18%
Italy	28.48	7.74	8.98	14.7%	1.25	16%	-19.50	-68%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0.03	0.03	0.04	0.1%	0.00	1%	0.01	36%
Portugal	10.52	9.26	4.37	7.2%	-4.89	-53%	-6.15	-58%
Spain	8.23	2.90	2.90	4.8%	0.00	0%	-5.33	-65%
Sweden	0.08	0.03	0.10	0.2%	0.07	200%	0.02	24%
United Kingdom	1.15	1.17	1.36	2.2%	0.19	16%	0.21	18%
EU-15	**106.39**	**69.96**	**60.99**	**100.0%**	**-8.96**	**-13%**	**-45.39**	**-43%**

Table 7.50 **N_2O emissions from Biomass Burning (in Gg N_2O)**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg)	(%)	(Gg)	(%)
Austria	0.00044	0.00011	0.00010	0.0%	-0.00001	-10%	-0.0003	-78%
Belgium	0.02	NE,NO	0.21	24.5%	0.20504	-	0.1893	1205%
Denmark	0.00	0.00	0.00	0.0%	0.00000	5%	-0.0014	-96%
Finland	0.001	0.000	0.000	0.0%	0.00012	56%	-0.0010	-74%
France	0.49	0.34	0.30	36.1%	-0.03771	-11%	-0.1849	-38%
Germany	0.01	0.00	0.00	0.1%	-0.00139	-59%	-0.0057	-86%
Greece	0.01	0.00	0.00	0.5%	0.00201	101%	-0.0048	-55%
Ireland	0.00	0.01	0.00	0.3%	-0.00357	-63%	-0.0005	-18%
Italy	0.62	0.18	0.19	22.4%	0.00862	5%	-0.4366	-70%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0.00	0.00	0.00	0.0%	0.00000	1%	0.0001	36%
Portugal	0.14	0.13	0.06	7.2%	-0.06729	-53%	-0.0846	-58%
Spain	0.06	0.02	0.02	2.4%	0.00000	0%	-0.0367	-65%
Sweden	0.00	0.00	0.00	0.1%	0.00047	200%	0.0001	24%
United Kingdom	0.06	0.04	0.05	6.4%	0.01585	42%	-0.0066	-11%
EU-15	**1.41**	**0.71**	**0.84**	**100.0%**	**0.12215**	**17%**	**-0.5736**	**-41%**

On site burning of biomass (controlled burning) is prohibited in most of the EU MS, therefore, emissions are reported as 'not occurring' in the CRF tables. Emissions from biomass burning in power plants are considered as part of the living biomass change estimates (i.e. additional wood removal is included within the wood harvest) or neutral when originate in specialized biomass crops.

7.8 Cross-cutting issues (EU-15)

7.8.1 GHG estimates uncertainty

For the year 2011 the overall LULUCF uncertainty was estimated 34%, with a low uncertainty of 17% determined for 5A1 (Table 7.51).

Table 7.51 Level and trend uncertainty assessment of the annual EU-15 emission/removal on LULUCF land subcategories and GHG sources.

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
5.A Forest Land	CO_2	-193 825	-178 946	-8%	16%	0.1%
5.A Forest Land	CH_4	419	161	-62%	62%	0.2%
5.A Forest Land	N_2O	220	191	-13%	125%	0.1%
5.B Cropland	CO_2	44 223	44 996	2%	55%	0.2%
5.B Cropland	CH_4	17	8	-52%	82%	0.3%
5.B Cropland	N_2O	1 581	1 102	-30%	131%	0.5%
5.C Grasland	CO_2	18 127	-1 600	-109%	789%	0.5%
5.C Grasland	CH_4	438	143	-67%	92%	0.7%
5.C Grasland	N_2O	206	68	-67%	90%	0.7%
5.D Wetlands	CO_2	4 383	5 517	26%	24%	0.1%
5.D Wetlands	CH_4	0	0		0%	0.0%
5.D Wetlands	N_2O	4	1	-87%	20%	0.2%
5.E Settlements	CO_2	14 932	19 672	32%	29%	0.1%
5.E Settlements	CH_4	7	7	8%	20%	0.0%
5.E Settlements	N_2O	1	1	8%	20%	0.0%
5.F Other Land	CO_2	925	470	-49%	643%	5.2%
5.F Other Land	CH_4	0	0		0%	0.0%
5.F Other Land	N_2O	0	0		0%	0.0%
5.G Other	CO_2	-2 356	-2 614	11%	40%	0.2%
5.G Other	CH_4	0	0		0%	0.0%
5.G Other	N_2O	0	0		0%	
5.I	CO_2	0	0		0%	0.0%
5.I	CH_4	0	0		0%	0.0%
5.I	N_2O	27	21	-22%	139%	0.3%
5.II	CO_2	0	0		0%	0.0%

5.II	CH_4	39	59	49%	31%	0.2%
5.II	N_2O	85	117	37%	30%	0.1%
5.III	CO_2	0	0		0%	0.0%
5.III	CH_4	0	0		0%	0.0%
5.III	N_2O	7	12	69%	62%	0.4%
5.IV	CO_2	1 241	348	-72%	35%	0.2%
5.IV	CH_4	0	0		0%	0.0%
5.IV	N_2O	0	0		0%	0.0%
5.V	CO_2	4	6	47%	71%	0.3%
5.V	CH_4	5	1	-77%	71%	0.5%
5.V	N_2O	1	0	-86%	69%	0.4%
5 (where no subsector data were submitted)	*all*	*-19 389*	*-32 224*	66%	*58%*	*39%*
Total	**all**	**-128 679**	**-142 485**	**11%**	**31.7%**	**25.2%**

Overall uncertainty in the trend of LULUCF annual removal was 27%, with highest contribution of 5A1 and 5B2. Removal trend is also uncertain mainly under the influence of CO_2 removal on 5A1 and CO_2 emissions from 5B2.

7.9 Time series consistency

Because EU GHG inventory is compiled by aggregation of national GHG inventories estimates, its consistency strictly depends on MS consistency. Time series consistency is annually checked for all MS submissions as part of the EU GHG Monitoring Mechanism, in terms of land categories definitions and representation in time and space (e.g. the sum of all land uses should be constant over time and match the official country's statistics on area), as well as trends and outliers in datasets. Inconsistencies found in early submissions of 2013 when MS were strongly encouraged to correct them or to provide additional information and document the issues in their respective NIRs.

One of the key features of the methodologies implemented by the national systems is to ensure fully consistent definitions for parameters and datasets used for own estimation and reporting, a challenging issue especially when historically available data is not adequate to the reporting requirements.

Land use category and subcategory definitions are not fully consistent across the EU-15 MS (in the sense of identical quantitative thresholds), but they are consistent with IPCC definitions for each individual member state (IPCC GPG for LULUCF). Differences are given by slightly different treatment of particular lands (e.g. different thresholds for forest definitions; hedges or bush areas categorized either under the cropland, grassland or forest land; woody plantations either under cropland or forest land), which is mainly related to historical definitions and databases.

Following the improvements made within the national systems over recent years, in 2013 submissions there were very small inconsistencies in the time series of activity data and land allocation on land sub-categories (e.g. against country's official geographical area or variation in time). Such small differences are documented and explained due to data updating pace and improvements in the mapping systems and precision across land categories (e.g. measurement errors, feature of assessment system, natural expansion of land or coastal erosion). In general, the land reported under UNFCCC varies by 1-2 % than official geographical area or in time since 1990, so there are negligible risks that some emissions are not accounted.

More often, emission factors are subject to improvements in time (actually recalculations are mainly due to their revision) for entire time series (e.g. by implementing new biomass equations) or most recent period (e.g. subject of new data availability form latest national forest inventories).

7.10 Quality Assurance and Quality control

GHG inventories of the EU's MS are under double QA/QC checks: one at the country level and another one which is performed at EU-15 level under the EU GHG Monitoring Mechanism (covering EU27 MS of the European Union).

National systems implement QAQC procedures as described in their NIRs. The purpose of such systems is to ensure adequate levels of transparency, consistency, comparability, completeness, accuracy and timeliness, as requested both by international agreements and EU-15 GHG monitoring mechanism directive. They were developed under country own initiative on the implementation of the requirements, and often improved at the request of ERTs. Nevertheless, quality of data usually falls with relevant data administrators, while specific GHG related checks are implemented by the national system. The national systems and its QAQC are designed to be continuously improved by taking into account new practices and suggestions coming from the review of national reports or by independent assessments (i.e. scientific papers, institutional evaluation).

In addition to national efforts, several activities were carried out at EU level by the Joint Research Centre of the European Commission, together with the member states.

The main activity is the annual checking of early versions of the MS national GHG inventories. Focus is on errors and inconsistencies, and interaction with national representatives for clarifications and improvements. During the checking of the 2013 submissions, 145 findings (i.e. possible problems and unclear issues) were communicated to the MS, ranging from problems in the use of notations keys, inconsistent land use data, outliers in IEFs value for all the categories, and various requests for clarifications or to document the issues in the NIRs.

Specifically, consistency checks are applied to CRF table (first version available in January) of GHG inventory under the Convention and/between KP's supplementary report, as follows (non-exhaustive list):

1. Checks of *time series of activity data* for both KP and GHG inventory
    a. Total reported land area against official data from national authorities and international databases (i.e. country's official websites, FRA 2010 (FAO));
    b. Time series, and if possible, how land use matrix is implemented: growing or steady for land under conversion over the transition period, the share of land category of "Other land";
    c. Existence of the peaks or jumps in time series for any land subcategory, with checks going down to land divisions.
2. Checks of the *time series of emissions factors* (for each land subcategory and division, and each pool)
    a. Comparison of IEF with IPCC GPG LULUCF default factors;

b. Comparison against own IEF along the time series;
c. Comparison with IEF of other countries, with taking into consideration of eco-regions and method used for estimation, definition of the pool included, and any explanation provided in laest NIR;
d. Comparison with other sources (country's official submission under other international processess, e.g. FAO);
e. Is CO_2 and N_2O emission correctly estimated (related by ratio of C/N and GWP)?

3. Check the *consistency within annual submission*
   a. Between GHG inventory tables (e.g. area of organic soils under 4.Ds1 and sum of areas of organic soils under Cropland (and Grassland); activity data for the estimation of N_2O emissions under conversion from Forest land, Grassland and Wetlands to Cropland)
4. Check the *consistency between KP and GHG inventory tables* (land area between UNFCCC and KP: 5A2 with AR; sum of area of 5B2.1; 5C2.1; 5D2.1; 5E2.1; 5D2.1 with D; 5A1 with FM). It is expected that AR area should equal conversion to forest in 2009 (only if a 20 years tranition is implemented and all conversion to forest are directly human induced) or that FM area is smaller or equal to 5A1 area any time, with explanation to be provided in NIR.
5. Consistency *within KP tables*
   a. Area reported under activity tables matches NIR2;
   b. NIR2 is consistent accross years (i.e. is ARD area increasing or constant over the commitment period? Is CM, GM area change explained by transfers to other elected 3.4 activities?)
   c. For KP CRF 1990 only data which is relevant for net-net activities is provided.
6. Consistency *with the IPCC GPG LULUCF 2003, ERT recommendations and reporting requirements set under D16/CMP1*.
   a. Is a key category ? If so, is a higher tier implemented?
   b. Pools omitted from accounting undeer the KP: is documentation provided showing the "not a source"?
   c. Transparency and documentation: description of data sources, models, assumptions, references used.
   d. Are values reported suported by adequate data and references?
   e. Are reasons, methodological changes and quantitative effects of recalculations explained in the NIR?
7. *Accounting tables*: check of the CRF reporting tool settings (e.g. is 3.3 offset option activated for countries that elected FM ?)

Aditional activities at EU level are meant to improve reporting and the quality of both national GHG inventories of the member states and EU's, as follows:

- Completeness check: the use of the notation key "NE", but also possible inappropriate use of "NA" or "NO", is carefully monitored and followed up where necessary with the relevant MS.
- Starting in 2011, the EU implements an internal review, as annual exercise, which focus on key LULUCF issues identified mainly in conjunction with reporting under Kyoto Protocol. The exercise is led by the JRC and involves LULUCF reviewers also involved in the UNFCCC review process. In 2011 the exercise focused on reporting DW, LT and SOC. In 2013 the following issues were analyzed: "providing transparent demonstration and justification that a pool is not a source" and "methods used by MS to estimate emissions from DOM and SOM in Forest land converted to Settlements".
- Efforts for improving and harmonizing Member State inventories, in close cooperation with the research community. Examples include:
  - Two support projects for improved reporting by some MS are implemented by the European Commission
  - Starting in 2011, the implementation of the "JRC decision trees on notation keys": a) *Use of notations keys for C POOLS - Tables 5(KP-I) of mandatory or elected activities* and b) *Use of notations keys for GHG SOURCES- Tables 5(KP-II) of mandatory or elected activities*. The purpose was to ensure more harmonized use of notation keys as to identify the incompleteness issues in due time and allow further

automatic checks by EU, both for reporting under the Convention and Kyoto Protocol.

- For the purpose of enhancing reporting, sharing experience amongst MS, also for the harmonization of methods for estimation, a series of technical workshops dedicated to UNFCCC reporting (including Kyoto Protocol), under the auspices of European Commission/Joint Research Center (DG ENV, DG JRC) were organized:
- JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 27 February-1 March 2013, Ispra, Italy.
- "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in *Brussels, November 16, 2011.*
- "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in *Brussels, November 9-10, 2010.*
- Technical workshop on projections of GHG emissions and removals in the LULUCF sector, Ispra (Italy), 27-28 January 2010.
- Technical workshop on LULUCF reporting issues under the Kyoto Protocol, Ispra (Italy), November 13-14, 2008.
- "Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol" (Ispra, 27-29 November 2006).
- "Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector", Ispra (Italy), September 22-23, 2005.

For further information on these workshops, see **http://afoludata.jrc.ec.europa.eu/events**.

- The JRC's AFOLU DATA web site (**http://afoludata.jrc.ec.europa.eu/data&tools**) offers interrogative databases (e.g. BEFs, conversion factors, European forest inventories and yield tables, models and other tools) to promote transparent, complete, consistent and comparable estimates of greenhouse gas fluxes in the AFOLU sector in Europe, and for the use of researchers, inventory experts and GHG inventory reviewers.

In the EU, the implementation of the QAQC procedures has a learning and knowledge sharing effect amongst national LULUCF experts, helping improving the reporting capacity.

7.11 Verification

Currently, information on verification of national GHG inventory estimates is rather poor. In the EU there is running a project funded by the European Commission and implemented by its Joint Research Center, "Analysis of proposals for enhancing Monitoring, Reporting and Verification of greenhouse gases from Land Use, Land Use Change and Forestry in the EU (LULUCF MRV)" which has a component aimed at modeling the forest removals for all MS, based on NFI data. The output of this modeling may be used by countries as verification exercise of their own estimates.

Also over the last JRC KP workshop (2013), a straightforward verification exercise was recommended to national LULUCF experts consisting in the estimation of the net annual removal for forest land by comparing (when possible) the "gain-loss" and "stock change" methods, and possibly report the results in their future NIRs.

7.12 Improvement status and plan

Recommendations from draft ARR 2012 for the EU-15 are implemented in the current version of EU-15's national GHG inventory.

Status of implementation of the recommendations (Table 7.52) from the Annual Inventory Review Reports 2012 made to the member states by ERTs was checked in latest submissions to UNFCCC (available as 15.04.2013).

Table 7.52 Recommendations by the expert review team in ARR 2012 and implementation status according NIR 2013

Category	Recommendations	Status
	Austria	
Transparency	Further improve the transparency of the NIR by including, in the next annual submission, information on the calculation method used for soils in cropland and grassland, and the observation periods for the national forest inventories (NFIs) which was provided to the ERT during the review week	Ongoing
Uncertainties	Include the source of information and assumptions used for the uncertainty estimates for non-forest land categories (provided to the ERT during the review week) in the NIR of the next annual submission	Implemented
Forest land remaining forest land. CO_2	Estimate the carbon stock changes in non-productive forests when the new NFI data become available	Ongoing
Grassland remaining grassland. CO_2	Use more recent management factors for grassland management than 2003 to reflect recent management status and report on the updated results in the next submission	Implemented
Grassland remaining grassland . CO_2	Report the area of organic soils under grassland remaining grassland in the CRF table 5.C instead of using the notation key .IE., and examine the assumption that the emissions from organic soils are included in the calculation of the mineral soil stock changes and report the results in the next annual submission	Ongoing/ Implemented
	Italy	
Sector Overview	Use the new land-use matrix and present any related recalculations. Provide a clear description of the area plantations that are not for energy crops and that have been reported under forest land. Include the area of plantations that do not meet the agroforestry system definition in the category forest land.	Implemented/ Ongoing
Forest land remaining forest land CO_2	Assess whether the values taken from Federici et al. (2008) should be updated in the inventory or not and report on that assessment	Ongoing
Cropland remaining cropland – CO_2	Implement the corrected allocation of organic soils from perennial woody crops to annual crops	Implemented
Land converted to forest land – CO_2	Provide transparent documentation on the values used in applying equation 3.2.32.	Implemented
Land converted to cropland – N_2O	Review and, if necessary, correct the 2010 value for N_2O emissions from disturbance associated with cropland conversion, and provide an explanation for the finalization of grassland conversion to cropland in 1996	Implemented/ Ongoing
Land converted to settlements – CO_2	Improve the documentation on why only conversion from grassland to settlements has been reported for the period 1990–1995.	Ongoing
Biomass burning – CH_4 and N_2O	Review the reporting on biomass burning	Ongoing
	Luxemburg	
Cross-cutting	Improve the transparency of the reporting on the method for calculating living biomass carbon stock changes in settlements converted to forest land; the source of the soil carbon stock EFs used for land-use changes; the sector-specific QC checks employed for the LULUCF sector and provide additional information on the data source for the dead organic matter carbon stock changes, on the method and assumptions used to obtain the “20-year areas” and annually converted areas for various land-use categories; on ensuring time series consistency of land area information. Transparently describe the various sector-specific QC procedures for the LULUCF sector	Ongoing
Forest land remaining forest land	Use the results from the NFI as soon as possible to recalculate the emission/removal estimates and AD from forest land remaining forest land. Prioritize reporting on the changes in the dead organic matter and soil carbon pools	Ongoing
Land converted to forest land	Provide the method for calculating living biomass carbon stock changes in settlements converted to forest land and the source of the carbon stock EFs. Justify the assumption that carbon stock changes in dead wood for land converted to forest land is not occurring	Ongoing
	Sweden	
General	Update the uncertainty values when the input parameters used for the estimates are changed	Implemented
Forest land and cropland	Include further information on and an analysis of the drivers behind the emission/removal trends	Implemented
Biomass burning	Ensure the consistent reporting of CO_2 emissions from biomass burning on land converted to forest land between the LULUCF sector and the KP-LULUCF activities	Implemented

Due to continuous improvements in the member states inventories, the status of implementation of recommendations from their ARR 2011 is not captured in detailed manner in this subchapter. Plan of improvement for next year GHG inventory cycle and submission includes:

1) Reporting verification efforts both at national level and EU15
2) For the next JRC’s LULUCF workshop, agenda will include discussion on reporting of emission from organic soils, e.g. data availability and reliability, matching of lands and non-CO_2emissions for 5B1&5B2 (or/and 5C1&5C2) and Table 4Ds1 regarding organic soils area under cultivation, taking into account the different definitions of cultivation amongst MS (which in broad sense includes both activities on cropland an grassland, or in a narrow sense on arable land preparation).

7.13 Recalculations

Due to methodological improvements, including ensuring consistency with KP supplementary reporting and the EU’s QAQC and ERT review reports, recalculations have been done by MS under various reasons (Table 7.53). In some cases, both or either activity data or emissions factors have been improved as a result of new available data or error fixing from previous submissions.

Table 7.53 Reasons for recalculations arising from by EU-15 MS submissions in 2013. X indicated that a recalculation occurred.

Member State	FL	CL	GL	WL	SL	OL	Other sources	Descriptions
Austria		X	X		X			Due to the availability of new CL and GL management data, the C stock changes in mineral soils were revised. Also some mistakes were corrected for GL. LUC from CL and GL areas were updated.
Belgium	X		X	X	X	X	X	The LUC matrix has been refined, to be in line with decision 15/CMP.1 and 16/CMP.1. Emissions from fires were recalculated as some encoding mistake was found. Areas are now included up to 2011 due to data availability. In FL average biomass content was also updated with the results of the 3rd cycle of the Walloon forest inventory. The C-uptake factors were revised during the in the Flemish region.
Denmark	X	X	X	X	X		X	Erroneous reporting of forest carbon pools has been corrected. Updated land use matrix including mapping of three years: 1990, 2005 and 2011 affecting to all LU categories.
Finland	X	X	X	X	X		X	Due to the recalculation of forest land areas (i.e. from updates NFI values), the carbon stock changes in the biomass, DOM and SOM were also recalculated. Losses in the biomass of annual non-woody crops due to the removal of biomass from land-use change from cropland to forest land, was included in the inventory. New Yasso07 model parameters were applied for mineral soils. CL,GL, WL and SL areas were updated and all soil emissions were recalculated
France	X	X					X	Recalculations were based on the availability the new data from NFI.
Germany	X		X	X	X	X	X	New activity data from the current data records of the Basis-DLM (2011). New emissions factor for litter and carbon in mineral soils affecting any conversion from/to forest
Greece	X	X	X	X	X	X	X	Emission from FL estimated with more disaggregated categories. Correction of the small discrepancies in the land use change matrices. Recalculations of carbon stock changes in LB in GL category. Update activity data on areas under different tree crop types for the years 2007, 2008, 2009, 2010. Inclusion of data from the more recent Forest Management Plans. Use of updated data of non-CO_2 emissions from wildfires in FL and GL. Reporting for the first time on emission estimates for and methodologies applied to the dead organic and soil organic pools in FL to other LUs.
Ireland	X	X	X		X	X	X	A change from a stock change model previously used for reporting forest land under convention reporting to the gain loss approach used in the FORCARB and CARBWARE models. Use of new biomass values associated with forest wildfires

Italy	x	x	x	x	x	x	x	New method used to estimate carbon stock changes in perennial crops (living biomass), in rensponse to the EU QAQC. Update in the coefficients used in the estimation DOM under FL, CL and GL. A revision of the land use change matrix (in rensponse to the EU QAQC) also caused some change in the estimates
Luxembourg								Liming: activity data of CaCO3 used for liming for the year 2010 was revised as new statistical data became available.
Netherlands								Inclusion of wildfire emissions in the LULUCF sector. Correction of emission factors for carbon stock change(gain) in living biomass for conversion from Settlements to Grassland (5C.2.4) and from Other land to Grassland.
Portugal	x	x	x	x	x	x	x	Several recalculations have been done as a result of a new activity data acquisition method as well as, several improvements to implement the comments highlighted by the ERT.
Spain								SOC estimations have been updated due to new data on activity data for woody crops.
Sweden	x	x	x		x		x	Living biomass pool, land use areas and areas subject to land use transfers have been recalculated for the years 2007-2011 to improve accuracy. DOM and SOC min on FL and GL have been recalculated. Pet extraction areas are now reported separately from other Wetlands under Wetland remaining wetland
United Kingdom	x		x	x	x		x	Revised activity data on wildfires and inclusion of DOM in biomass burning. New activity data for drainage on forest soils. Adjustment of area split between forest planting on mineral and organic soil due to new data on drainage. Adjustment of grass/cropland split for liming. Adjustment of time series in activity data. New wildfire activity data. WL Extraction sites that are no longer active are assumed to be still producing on-site emissions. 2009-2010: new activity data published. Biomass and DOM losses following deforestation are now estimated using country-specific biomass densities

The EU-15 overall quantitative effect of the recalculations of entire LULUCF sector in 2013 submission compared to previous one is an decrease of net removals, e.g. by a net of 17000 GgCO_2 for the year 2010, however the general trends remain unchanged. Majority of countries estimated downward the LULUCF sink, with largest recalculation by Italy, Portugal and Sweden (all by estimated in 2013 smaller sinks by amounts shown in Table 7.54).

Table 7.54 Quantitative recalculations in LULUCF by EU-15 MS (absolute difference between 2013 and 2012 submissions, for specified years), in Gg CO_2 eq.

MS	1990	1995	2000	2005	2010
Austria	96	98	100	98	93
Belgium	330	279	274	-337	-315
Denmark	1.050	236	-2.676	59	1.696
Finland	556	391	-372	-1.328	-2542
France	-3.406	-3.108	-1.923	-1.841	-2357
Germany	129	817	47	352	178
Greece	45	99	115	119	42
Ireland	-2.863	-2.286	-1646	-2.355	-3.082
Italy	22.330	17.706	17232	15.304	13.190
Luxembourg	0	0	0	0	0
Netherlands	0	0	1	-23	-9
Portugal	15.383	12.827	14.300	7.872	6.395
Spain	0	0	0	0	58
Sweden	4.075	3.893	3.370	3.799	3.355
United Kingdom	129	817	47	352	178

The largest percentage recalculations occurred on forest land category (i.e. 5A, Table 7.) by Denmark, Germany and Portugal, for the entire time series. For 2010 it was calculated an absolute change of about 5600 $GgCO_2$, caused by recalculations of larger sink estimates by Germany, Ireland, France and lower sink by Portugal.

Table 7.55 Quantitative recalculations in 5A by EU-15 MS (absolute difference between 2013 and 2012 submissions, for specified years), in Gg CO_2 eq.

MS	1990	1995	2000	2005	2010
Austria	0	0	0	0	0
Belgium	368	313	303	-313	-326
Denmark	955	-46	-2.685	-402	1.327
Finland	344	153	-574	-1.523	-2.962
France	-3.204	-2.925	-1.760	-1.661	-2.162
Germany	-7.233	-7.409	-7.585	-7.845	-8.066
Greece	35	80	85	77	80
Ireland	-2.865	-2.287	-1.646	-2.355	-3.047
Italy	1.202	3.034	2.474	3.483	1.700
Luxembourg	0	0	0	0	0
Netherlands	6	7	7	8	9
Portugal	6.132	4.301	7.803	4.844	5.111
Spain	0	0	0	0	0
Sweden	3.515	3.308	2.831	3.268	2.473
United Kingdom	242	900	229	506	218

Major recalculations also occurred in 5B, whose previously estimated sink decreased by 15720 $GgCO_2$ in 2010 due to recalculations of much lower removals, i.e. by 11400Gg CO_2 in 2010 by Italy and 3400 $GgCO_2$ in 2010 by Portugal.

Emissions from grassland were also recalculated downward, with Portugal that shifted from a small sink to a relatively large source, e.g. in 2010 an amount of 1700$GgCO_2$ and Sweden that recalculated a small source in 2010.

8 WASTE (CRF SECTOR 6)

This chapter starts with an overview on emission trends in CRF Sector 6 Waste for EU-15 Member states. For each EU-15 key source, overview tables are presented including the Member states contributions to the key source in terms of level and trend, information on methodologies and emission factors. The quantitative uncertainty estimates for this sector and the sector-specific QA/QC activities are summarised in separate sections. This chapter furthermore includes an overview of recalculations. In a separate chapter, an overview of the sector for EU-27 is provided.

8.1 Overview of sector (EU-15)

CRF Sector 6 Waste is the fourth largest sector in the EU-15, contributing 2.81 % to total GHG emissions. Total emissions from Waste have been decreasing by 41 % from 172 Tg in 1990 to 102 Tg in 2011 (Figure 8.1). In 2011, emissions decreased by 2.4 % compared to 2010. The key sources in this sector are:

- 6 A 1 Managed Waste disposal on Land:(CH_4)
- 6 A 2 Unmanaged Waste Disposal Sites:(CH_4)
- 6 B 1 Industrial Wastewater: (CH_4)
- 6 B 2 Domestic and Commercial Wastewater:(CH_4)
- 6 B 2 Domestic and Commercial Wastewater:(N_2O)

Figure 8.1 **Sector 6 Waste: EU-15 GHG emissions, 1990-2011**

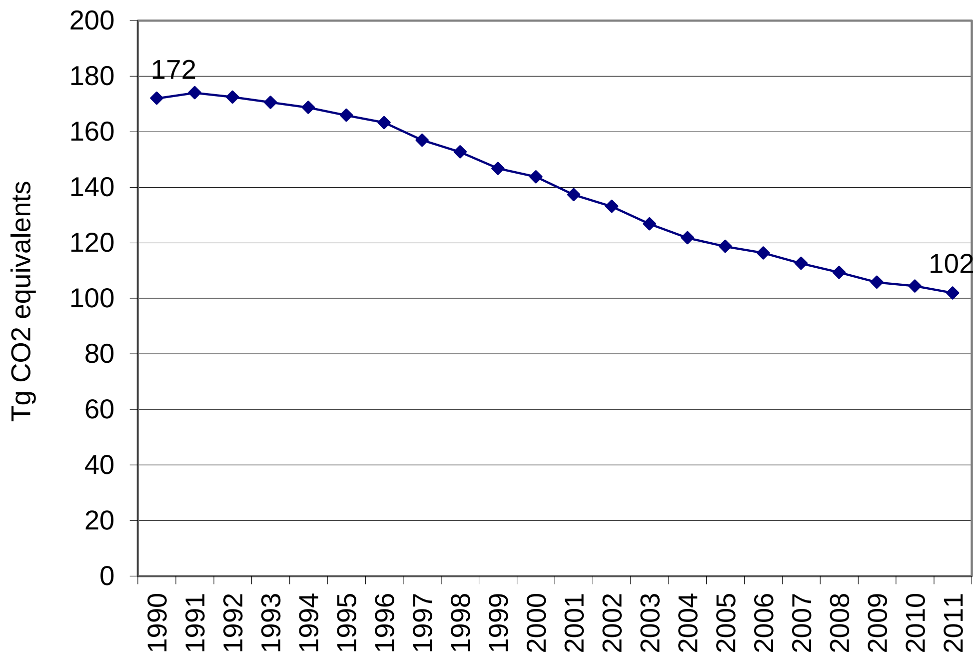
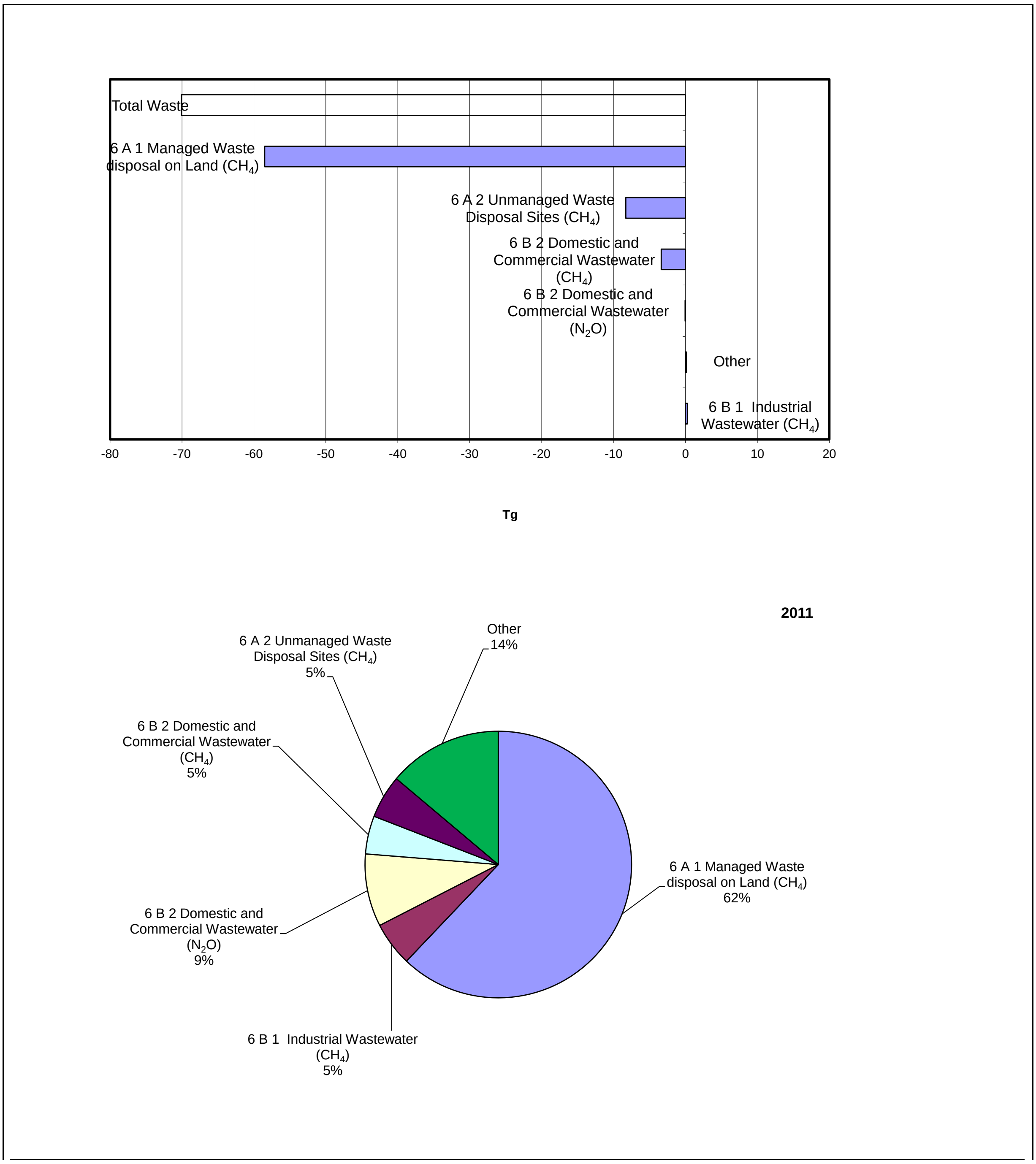


Figure 8.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 66 % of waste-related GHG emissions in the EU-15.

Figure 8.2 **Sector 6 Waste: Absolute change of GHG emissions by large key source categories, 1990–2011, and share of largest key source categories in 2011**



8.2 Source categories (EU-15)

8.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-15)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 6A1 Managed waste disposal on land includes CH_4 emission arising from managed solid waste landfills. Methane recovery can also be reflected in this category. Source category 6A2 comprises corresponding CH_4 emissions from unmanaged landfills (without methane recovery).

Table 8.1 provides total greenhouse gas and CH_4 emissions by Member state from 6A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 47 % between 1990 and 2011 in the EU-15. Eleven EU-15 Member states reduced their emissions from this source, France, Greece, Portugal and Spain did not.

Table 8.1 6A Solid Waste Disposal on Land: Member states' contributions to total GHG emissions and CH_4 emissions, and information on methods applied and emission factors

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]
Austria	3 314	1 253	3 314	1 253		
Belgium	2 614	661	2 614	661	M	CS
Denmark	1 478	699	1 478	699	T2	CS
Finland	3 635	1 769	3 635	1 769	T2	CS,D
France	8 437	8 749	8 437	8 749	CS/T2	CS
Germany	38 598	11 046	38 598	11 046	T2	D,CS
Greece	2 226	3 265	2 226	3 265	NA,T2	CS,D,NA
Ireland	1 173	831	1 173	831	T2	CS
Italy	15 254	12 533	15 254	12 533	T2	D, CS
Luxembourg	67	29	67	29	CR/D	CR/D
Netherlands	12 011	3 166	12 011	3 166	T2	CS
Portugal	3 033	5 122	3 033	5 122	T2	CS,D
Spain	5 330	11 899	5 103	11 897	CS,T2	CS,CR,CS,D
Sweden	2 874	1 193	2 874	1 193	T3	CS,D
United Kingdom	42 927	14 095	42 927	14 095	T2	CS
EU-15	**142 972**	**76 309**	**142 745**	**76 307**	**C, CS, D, M,**	**C,CS,CR,**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.2 provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by Member state. CH_4 emissions from this source account for 1.8 % of total EU-15 GHG emissions. Between 1990 and 2011, CH_4 emissions from managed landfills declined by 47 % in the EU-15. Nine EU-15 Member states reduced their emissions from this source during that period, France, Greece, Italy, Portugal and Spain did not. In 2011, CH_4 emissions from landfills decreased by 3 % compared to 2010. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by 53 % between 1990 and 2011. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilised or flared. The share of CH_4 recovery has increased significantly in EU-15 since 1990.

The Member states with most emissions from this source in 2011 were the United Kingdom, Italy, Germany, Spain and France. These MS account for 82 % of EU-15 emissions in this year. The largest reductions in absolute terms between 1990 and 2011 were reported by the United Kingdom and Germany. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation in the Member states. The landfill waste directive was adopted in 1999 and requires the member states to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

Table 8.2 **6A1 Managed Waste Disposal on Land: Member states' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3 314	1 350	1 253	1.9%	-97	-7%	-2 061	-62%	T2	CS,D
Belgium	2 614	656	661	1.0%	5	1%	-1 953	-75%	CS	CS
Denmark	1 478	720	699	1.0%	-21	-3%	-779	-53%	CS,T2	CS,D
Finland	2 088	1 138	1 090	1.6%	-48	-4%	-998	-48%	T2	CS,D
France	4 658	7 957	7 717	11.5%	-240	-3%	3 059	66%	T2	CS
Germany	38 598	12 012	11 046	16.5%	-966	-8%	-27 552	-71%	T2	D,CS
Greece	63	1 058	944	1.4%	-115	-11%	881	1397%	T2	CS,D
Ireland	NO	602	689	1.0%	86	14%	689	-	T2	CS,D
Italy	10 060	11 209	11 049	16.5%	-160	-1%	989	10%	T2	CS
Luxembourg	67	31	29	0.0%	-2	-6%	-38	-56%	T2	D
Netherlands	12 011	3 384	3 166	4.7%	-218	-6%	-8 845	-74%	T2	CS
Portugal	428	2 260	2 287	3.4%	27	1%	1 859	435%	T2	CS, D
Spain	4 205	10 799	10 970	16.4%	171	2%	6 765	161%	T2	D,CR,CS
Sweden	2 874	1 282	1 193	1.8%	-90	-7%	-1 682	-59%	T2	D, CS
United Kingdom	42 927	14 689	14 095	21.1%	-595	-4%	-28 833	-67%	T2	CS
EU-15	**125 386**	**69 149**	**66 887**	**100.0%**	**-2 261**	**-3%**	**-58 499**	**-47%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

The ERT recommended to provide reasons for the increase of methane emissions from managed waste disposal on land for those Member states showing the largest increase during the time series (France, Spain, Portugal, Italy and Greece) (FCCC/ARR/2009/EC, para 83). Therefore and in response to another recommendation by the ERT (FCCC/ARR/2009/EC, para 81), an analysis of the trends of emissions of these Member states and of those Member States influencing most the European Union's trends is given.

The UK decreased its CH_4 emissions steadily between 1990 and 2004 due to the implementation of methane recovery systems at UK landfill sites which reached a maximum in 2005, thus the British emission change after 2005 is less noticeable.

CH_4 emissions in Spain increased continuously from 1990 and 2002 due to a growth of the annual municipal solid waste going to solid waste disposal sites by 108 %. During 2002 and 2004 no change in emissions could be observed; the reason for the interruption of the trend is the increase in the volume of biogas captured and burned in some of managed waste landfills in that time: a lot of landfills with biogas recovery systems were incorporated in the inventory. While in 2000 there were only 14 managed waste landfills with individual and detailed information, in 2004 the number increased to 25.

Portugal, contributing with 3.4 % to EU-15 emissions in 2011, managed to slow down the increasing trend due to elevated biogas flaring in landfills; four new CH_4 recovery systems were established in 2005 and 2007.

France, contributing with 11.5 % to EU-15 emissions in 2011, increased its emissions steadily until 2003; followed by rather stable emissions until 2008 and a slight decrease thereafter. Emissions followed the increased amount of municipal waste going to landfills until 2000, which decreased afterwards. Following the in-country review in 2010, the capture rate of biogas was revised which resulted in an increase in CH_4 emissions over the entire period. This recalculation is one reason why France, for this year's inventory, has a high share in EU-15 emissions in 2011 (11.5%), whereas for the 2008 inventory (reporting year 2010) the French share in EU-15 methane emissions from managed waste disposal on land was only 7 %.

Greece's share in total EU-15 emissions in 2011 amounts to only 1.4 %, thus its contribution to the EU-15 emissions trend is marginal. The CH_4 generation varies during the time series; for the period 1990 to 2000 it increased steadily, taking into account that the starting year for managed sites is the year 1990 and that quantities of municipal solid waste for the period until 2000 were estimated on the basis of population figures and assumptions regarding generation rates per capita and day. Since 2001, more accurate data was provided by the waste management sector of the Ministry of Environment, Energy and Climate Change (MEECC). CH_4 recovery was considered to have started in 1992, with an increasing trend over the time series, especially after the year 2000.

Germany, contributing with 16.5 % to EU-15 emissions in 2011, managed to reduce CH_4 emissions steadily until now, inter alia due to an increase of methane recovery as facilities for gas collection were installed on almost all landfill sites; the collected part of the landfill gas increased continuously between 1990 and 1999 and declined thereafter due to a decreasing generation of landfill gas.

Italy, contributing with 16.5 % to EU-15 emissions in 2011, featured an increasing trend of CH_4 emissions from landfills until 2001 and a decreasing trend thereafter. This is driven, inter alia, by the increasing amount of waste landfill until 2000 and a decrease thereafter. Also, CH_4 recovery has increased throughout the time series.

In response to the recommendation by the ERT (FCCC/ARR/2009/EC, para 82), EU confirmed with Sweden, that it also applied the tier 2 methodology for estimating CH_4 emissions from managed solid waste disposal on land like all other MS (Table 8.2).

As mentioned above, source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. The twenty largest EU key categories cover close to 80 % of total GHG emissions excluding LULUCF of which CH_4 emissions from managed waste disposal on land are included, whereas CH_4 emissions from 6A2 unmanaged waste disposal on land are not. Thus additional information with respect to a detailed analysis of review findings from UNFCCC inventory reviews is provided for 6A1 in EU-15 only. Table 8.3 summarizes the recommendations from the 2012 (where available, otherwise 2011) UNFCCC inventory reviews in relation to the category 6A1 Managed Waste Disposal on Land.

Table 8.3 **6A1 Managed Waste Disposal on Land: Findings of the 2012 (2011) UNFCCC inventory review in relation to CH_4 emissions and responses in 2013 inventory submissions**

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2012 (2011) submission**	**Status in 2013 submission**
Austria	Austria has used the IPCC first-order decay tier 2 method to estimate CH_4 emissions from landfills, together with the use of country-specific parameters for DOC, the fraction of DOC (DOC_f) and the half-life period. The ERT noted that Austria has divided the total waste into residual waste and non-residual waste, but the description of these splits in the NIR may cause confusion. The NIR indicates that for 2009 only 0.4 per cent of the total waste from households was directly deposited in landfills. However, the AD on residual waste for 2009 and 2010 were reported as 0 (table 251 of the NIR). During the review week, Austria confirmed that the amount of residual waste directly deposited in landfills reported in NIR table 252 has a different meaning to the AD for residual waste presented in NIR table 251. The ERT recommends that Austria improve the transparency of its reporting by clearly describing the different waste types (in NIR tables 251 and 252) in its next annual submission.(FCCC/ARR/2012/AUT, para 79)	In Table 253 ("Recycling and treatment of waste from households and similar establishments"), the confusing notion "residual waste" has been removed, leaving it clear that this part of the waste stream relates to direct depositing on landfills only. The recommendation by the ERT has therefore been addressed [NIR 2013].
	According to NIR figure 32, the DOC value for residual waste changes significantly over time. For example, after 1999, the organic carbon in residual waste increases but is then kept constant after 2004. Therefore, it would be expected that the CH_4 generation potential would change in line with the changes in waste composition, but NIR table 254 shows that the CH_4 generation potential for residual waste is constant for the entire time series (0.016). The ERT recommends that Austria update its waste composition data with a view to improving the calculation of DOC and the CH_4 generation potential for residual waste. (FCCC/ARR/2012/AUT, para 80)	Not yet adressed [NIR 2013].
Belgium	The ERT concluded that the transparency of the reporting for the sector is still insufficient. Given that the different waste treatment methods (landfilled, energy recovery, incineration, composting) are interrelated, the ERT recommends that Belgium show the distribution of these shares of waste in a table in its next NIR, in order to improve the transparency of the inventory. (FCCC/ARR/2011/BEL, para 91)	The section "Description of the sector" now includes information on the share of recycling, incineration (with reference to energy recovery) and composting. The issue raised by the ERT has therefore been addressed (although not in tabular format) [NIR 2013].
	The ERT noted that some of the recommendations of the previous review report have not yet been implemented by the Party (e.g. regarding the transparency of the description of the methodology for solid waste disposal on land in the NIR, and the inconsistency in the reporting of waste incineration activities between the regions), and therefore reiterates those recommendations. (FCCC/ARR/2011/BEL, para 93)	The description of the methodology is includes in section 8.2.2 of the NIR. Since it is not specified in the ARR what aspects are still missing, it is considered that the current description of the methodology is sufficient [NIR 2013].
	Emissions from the category solid waste disposal on land were estimated using two different models: the multiphase model (for landfills with permits) and the first order decay (FOD) model (for old landfills) for the Flemish Region, and the FOD model for the Walloon Region (there are no landfills in the Brussels-Capital Region). The ERT noted a lack of transparency in the description of the models with regard to the management practices on closed landfills in the Flemish Region and inconsistencies in the terminology used for the parameters of the two models across the time series. The ERT reiterates the recommendation of the previous review report that Belgium list, in the next NIR, the parameters used for the two models in a single table, using the same terminology. (FCCC/ARR/2011/BEL, para 94)	Not yet addressed [NIR 2013].

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	The ERT noted some inconsistencies in the formulae used for the estimation of CH_4 emissions from the Flemish Region (see page 138 of the NIR) with regard to the omission of a few parameters, such as the normalization factor (that is currently less than 1, but if changed, this omission may lead to an underestimation of emissions); the oxidation factor; the methane conversion factor; the share of methane in the landfill gas; and the methane recovery, but which are, however, considered in the calculation; and discrepancies between the different assumptions for the two models used in the Flemish Region. The ERT finds that these inconsistencies hinder transparency and may affect the accuracy of the emission estimates. The ERT strongly recommends that the Party enhance the category-specific QC procedures both at the regional and at the national levels, in order to increase the accuracy and consistency of the reporting in the next annual submission. (FCCC/ARR/2011/BEL, para 95)	No explicit description of potential additional QC measures [NIR 2013].
	The ERT notes a lack of justification for the use of the two different models for the estimation of emissions from closed and active landfills with different assumptions and lifetimes, and strongly recommends that Belgium explore the possibility of using a unified/homogeneous approach for the whole country in its next annual submission. Until the Party is able to use a consistent approach, the ERT recommends that Belgium report separately in CRF table 6.A information from the regions, as well as from the closed and active landfills in the Flemish Region with their specific parameters according to the region-specific and model-specific conditions and assumptions used in order to ensure the transparency of its reporting. (FCCC/ARR/2011/BEL, para 96)	Not yet addressed [NIR 2013].
Finland	No recommendations in the ARR 2011. ARR 2012 not yet available.	Not applicable.
Germany	CH_4 emissions from solid waste disposal on land was the key category by level and trend assessment which, in 2009, amounted to 8,463.00 Gg CO_2 eq, a reduction of 78.1 per cent since the base year. Germany used the IPCC first-order decay multiphase method to estimate CH_4 emissions from solid waste disposal on land. Estimation has been improved since the previous submission, and now includes MBT residues sent to landfill and using recovery data collected from landfill, and AD and EFs were transparently presented. However, the ERT noted that reported data on emissions and recovery for 2009 are provisional and will be replaced in the next annual submission. The ERT noted that in some cases, particular for paper and cardboard, Germany still uses IPCC default values and recommends that Germany increase its efforts to develop country-specific values for degradable organic carbon (DOC) for its next annual submission. (FCCC/ARR/2011/DEU, para 95)	Not yet addressed [NIR 2013].
	The ERT found inconsistencies between the NIR and CRF table 6.A as in the multiphase model DOC changes according to the composition of the waste applied to landfill, while a constant value of 0.5 for the whole time series is reported in the additional information in CRF table 6.A. The ERT recommends that Germany strengthen its quality checks before submitting its next annual submission. (FCCC/ARR/2011/DEU, para 96)	Not yet addressed [NIR 2013].
Denmark	No recommendations in the ARR 2011. ARR 2012 not yet available.	Not applicable.
France	In the previous review report it was recommended that France start to gather measured data on landfill gas captured in French landfills, and report those data in the following annual submission. France was not able to implement this recommendation for the 2011 annual submission and the CH_4 recovery is reported as "NO" (i.e. the CH_4 emissions from solid waste disposal on land are overestimated). In the annual submissions in 2012 and 2013, France plans to revise this estimation and collect data on the amount of landfill gas captured and used for energy purposes or flared, using	A survey on CH_4 recovery (for flaring and energy use) was conducted in 2012. CH_4 recovery is now reported in the current CRF tables. It can therefore be concluded that the recommendation by the ERT has been addressed (and is being

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	questionnaires completed by all operating and closed landfills with CH_4 recovery systems. From 2014 onwards, France foresees the inclusion of this information in the regular statistical data collection from landfill operators. The ERT encourages France to continue to implement these plans in its next annual submission in accordance with the recommendations from the 2010 review. (FCCC/ARR/2011/FRA, para 132)	addressed) [NIR 2013, CRF 2013].
Greece	The Party has recalculated CH_4 emissions from solid waste disposal on land by incorporating a revised DOC_f and MCF for unmanaged SWDS and updated data for recycled waste for 2007 and 2008 and by using the IPCC tier 2 method for calculating flared CH_4, which resulted in an increase in emissions of 59.86 Gg CO_2 eq (or 3.5 per cent) in the base year and of 213.40 Gg CO_2 eq (or 9.5 per cent) in 2008. Additionally, Greece has recalculated CH_4 emissions from domestic wastewater handling by incorporating updated data of produced amounts of sewage sludge for the period 1990–2008, which has resulted in a decrease in emissions of 248.42 Gg CO_2 eq (or 8.1 per cent) in the base year and of 381.18 Gg CO_2 eq (or 30.9 per cent) in 2008. Altogether, the recalculations resulted in a decrease in total sectoral emissions of 185.42 Gg CO_2 eq (or 3.6 per cent) in the base year and of 167.78 Gg CO_2 eq (or 4.3 per cent) in 2008. The ERT recommends that the Party include waste flows (including sludge flows) in its next NIR in order to increase transparency. (FCCC/ARR/2011/GRC, para 82)	Quantities of waste generated are included in table 8.8 of the NIR. Estimated quantities of municipal solid waste and sludge disposed are available in table 8.11 [NIR 2013]. It can therefore be considered that the recommendation in the ARR 2011 has been addressed.
	Greece reports only MSW; however, based on information from the Hellenic Statistical Authority, large amounts of industrial and commercial waste are generated but are not included in the inventory. The Party explained that industrial and commercial waste is mainly recycled and the rest is disposed of at the same managed and unmanaged SWDS that are used for MSW. Additionally, it was mentioned by the Party that disposed industrial and commercial waste is included in the amount of MSW disposed. During the review of the annual submission of the EU, that ERT raised the same question and, in response to the list of potential problems and further questions raised by the ERT, Greece submitted revised estimates of the emissions from industrial waste for the entire time series. The revised estimates resulted in an increase in CH_4 emissions from solid waste disposal on land of 39.49 Gg CO_2 eq (or 2.1 per cent) in the base year and of 64.58 Gg CO_2 eq (or 2.6 per cent) in 2009. The AD were obtained from the Hellenic Statistical Authority and, since industrial waste is disposed of at the same landfills as MSW, a similar method was used to estimate CH_4 emissions. Most of the parameters used are IPCC default ones. The ERT considers that these revisions have been done in accordance with the IPCC good practice guidance and recommends that the Party include more information on industrial waste in its next NIR. (FCCC/ARR/2011/GRC, para 84)	Information on industrial solid waste is now included in a dedicated section in the NIR [NIR 2013]. It can therefore be considered that the recommendation in the ARR 2011 has been addressed.
	There are four landfill sites in Greece where CH_4 is recovered. However, according to the Party, for three of the sites it has not been possible to obtain data but it has been assumed that 60 per cent of the CH_4 at those sites is recovered. The Party explained that a recovery rate of 60 per cent is estimated at the SWDS in Athens where the CH_4 is measured because it is used for energy production. Taking into consideration the fact that the other three landfill sites have been constructed with similar characteristics to that of Athens, it is estimated that the same fraction of CH_4 is recovered at those sites. The ERT recommends that the Party further investigate the amount of CH_4 recovered at the sites where it is flared with no energy recovery and provide a justification for the calculation of the amount of CH_4 recovered in its next NIR. (FCCC/ARR/2011/GRC, para 85)	The assumption of 60 per cent CH_4 recovery still holds [NIR 2013]. The recommendation has therefore not yet been implemented.
	Greece does not differentiate between garden and park waste and other non-food putrescibles and food waste as all have been	DOC values are now available for paper and

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	included in the general putrescibles. As the DOC value of these waste types differs, their allocation to the same category is not in line with the Revised 1996 IPCC Guidelines. The ERT reiterates the recommendation made in the previous review report that Greece estimate these waste types separately using appropriate DOC values. (FCCC/ARR/2011/GRC, para 86)	textiles, wood, food waste, non-food waste and sewage [NIR 2013]. It can therefore be considered that the recommendation in the ARR 2011 has been implemented.
Ireland	No recommendations in the ARR 2011. ARR 2012 not yet available.	Not applicable.
Italy	The ERT noted that information regarding the amount of waste disposed to managed and unmanaged landfill sites was included in this annual submission, consistent with recommendations in the previous review report. Italy has explained in the NIR that the amount of solid waste disposed to unmanaged landfills was estimated as a function of the waste disposed to managed landfills on the basis of different studies; however, the ERT noted that the explanation does not include details about how this relationship was determined from these studies. The ERT also noted that the relationship is not constant over time: in 1990 the amount of waste disposed to unmanaged landfills represented 28.0 per cent of all non-hazardous waste disposed to landfills, while in 1995 this percentage was 18.8 per cent. The ERT recommends that Italy provide more information regarding these historical data in its next annual submission. (FCCC/ARR/2012/ITA, para 83)	Not yet implemented [NIR 2013].
	As noted in the previous review report, the methane generation constant (k), which is based on a foreign study and considered by Italian national experts to be representative of Italian conditions, does not result from experimental data in Italy, and the ERT noted that the NIR still does not provide sufficient documentation to support the application of these values to the Italian conditions. The ERT encourages Italy to provide more explanation and documentation to support the use of the chosen values for this parameter in its next annual submission. Further, the ERT noted that, on the basis of the foreign study, Italy used a different (k) value for 1990 (0.46) when compared with that used for the rest of the time series (0.36). In response to questions raised by the ERT during the review, Italy explained that the average (k) value is calculated on the basis of waste composition, so as waste composition changed the average (k) value changed over different time periods (1971–1990, 1991–2005 and 2006–2030). The ERT recommends that Italy include the explanation provided during the review in the NIR of its next annual submission. (FCCC/ARR/2012/ITA, para 84)	An explanation on the derivation of the average k value is included in the current NIR [NIR 2013]. It can therefore be concluded that the recommendation in the ARR 2012 has been addressed.
Luxembourg	The estimates within the sector are generally well documented in the NIR. However, in the NIR (page 399) it is stated that “only uncategorized waste disposal on land is relevant for Luxemburg”. This information conflicts with the information provided in the NIR (page 402) and in the CRF tables where the Party reports CH_4 emissions from managed solid waste disposal sites. The ERT recommends that the Party check the consistency of the reporting in the next annual submission. (FCCC/ARR/2012/LUX, para 98)	The text in the NIR is clear with regard to the fact that only managed landfills are operating in Luxembourg. The term “uncategorised” is still used. It does not, however, refer to unmanaged landfills [NIR 2013]. It can therefore be concluded that the recommendation by the ERT has been addressed.
	The ERT noted that uncertainty estimates have been reported for wastewater handling only. For other categories, uncertainty estimates are referred to in the general uncertainty chapter of the NIR. The ERT reiterates the recommendation of the previous review report that Luxemburg include a discussion on the uncertainty for each category in the waste sector in the next annual submission. (FCCC/ARR/2012/LUX, para 99)	Not yet implemented [NIR 2013].
	Luxemburg has conducted basic tier 1 QA/QC procedures for the waste sector. Category-specific QA/QC procedures have been	Not yet implemented [NIR 2013].

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	implemented for wastewater handling only. Nevertheless, there are some discrepancies between data in the CRF tables and in the NIR. The ERT encourages Luxemburg to more strictly apply verification and QA/QC procedures and conduct category-specific QA/QC procedures for all waste categories in its next annual submission. (FCCC/ARR/2012/LUX, para 100)	
	For uncategorized waste disposal sites the Party used the MCF of 0.1. This low MCF value reflects the situation where all waste is pretreated before it is disposed on the SWDS. The NIR does not include information on how this MCF is calculated. During the review, the Party explained that the 0.1 value is also endorsed in the 2006 IPCC Guidelines, which specified under the mechanical-biological (MB) treatment of waste that "Due to the reduced amount in material, organic content and biological activity, the MB-treated waste will produce up to 95 per cent less CH_4 than untreated waste when disposed in SWDS" (Vol. 5, ch. 4, p. 4.4). The Party explained to the ERT that, the Party estimated that about 90 per cent less CH_4 is emitted, hence the MCF of 0.1 was used. The ERT recommends that the Party include this information provided to the ERT in the NIR of its next annual submission. (FCCC/ARR/2012/LUX, para 104)	A corresponding explanation including a reference to the ARR 2012 is now included in the NIR [NIR 2013]. It can therefore be concluded that the recommendation by the ERT has been implemented.
	The ERT noted that, for CH_4 recovery from solid waste disposal on land, data for the year 2001 was used for the year 2000 due to the unavailability of data for the year 2000. The ERT reiterates the recommendation from the previous review reports that Luxemburg either use monitored data to report CH_4 recovery or apply the default CH_4 recovery ratio from the IPCC good practice guidance for the year 2000. During the review, the Party explained that the recovery value for the year 2000 will be revised in the next annual submission. (FCCC/ARR/2012/LUX, para 105)	Not yet implemented [NIR 2013].
Netherlands	Since the publication of Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC tier 1 approach (Olivier et al., 2009), the Netherlands has started using the uncertainty values contained therein for its uncertainty analysis. The uncertainty data were not updated to reflect the changes in data quality in recent years. During the review, the Netherlands was not able to explain how the uncertainty data based on expert judgement were derived. The ERT recommends that the Netherlands include, in its next annual submission, documentation on the expert judgement used in the uncertainty analysis of the waste sector. Moreover, the ERT identified that the uncertainties associated with the emission estimates are relatively high (for e.g. the uncertainty in annual CH_4 emissions from solid waste disposal on land was 35 per cent) and that the Netherlands has not identified an improvement plan to reduce the uncertainty. The ERT also noted that this high uncertainty is in spite of the Netherlands's increasing use of higher-tier methodologies, which should reduce the uncertainty. This suggests that the Netherlands does not use the uncertainty estimate to identify improvement priorities in the waste sector. The ERT recommends that the Netherlands use the uncertainty data to identify sectoral improvement priorities. (FCCC/ARR/2011/NLD, para 134)	Not yet implemented [NIR 2013].
	The Netherlands also explained how surveys were conducted to collect information on the amount of waste and its composition. (FCCC/ARR/2011/NLD, para 136) Through these surveys, reliable data were collected for the period 1990–2009. However, from 1945 to 1989, the Netherlands has incomplete data. During the review week, the Netherlands provided annual data on the amount of waste sent to landfills. However, the Netherlands was not able to provide information on the methods and assumptions used to fill the data gaps in the historical amount of waste landfilled as requested by the ERT. Inventory experts from	Information on the data used for constructing the time series is now available in the NIR as well as in the accompanying monitoring protocol. The recommendation in the ARR 2011 has therefore been implemented [NIR 2013].

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	the Netherlands indicated that they were not responsible for the generation of these data. During the review week, the inventory experts provided copies of e-mail exchanges, which showed some attempts to understand how the data were derived. The ERT identified that the omission of this information is not in line with the transparency principle of the IPCC good practice guidance and constitutes a failure to provide justifications and explanations for the data used. (FCCC/ARR/2011/NLD, para 137) In response to the list of potential problems and further questions raised by the ERT during the review, the Netherlands provided additional documentation on the data used for the FOD method and described the interpolation/extrapolation approach applied to derive the historical data on the amount of waste sent to landfills. Actual values on degradable organic carbon (DOC) exist in the Netherlands from 1989 onwards and the Netherlands used the 1989 value for the years 1945–1989. The Netherlands also provided information demonstrating that all landfills have been managed and justified the use of the IPCC default value 1 for the methane correction factor and 10 per cent for the oxidation factor. The fraction of DOC dissimilated and the decay rate constant (k) values were based on national studies provided during the review. The ERT agreed that this information explained the data used. The ERT recommends that the Netherlands include this information in its next annual submission. In addition, the ERT encourages the Netherlands to analyse the possibility of applying the interpolation/extrapolation approach based on drivers such as population and gross domestic product as this probably will improve the quality of the historical missing data. (FCCC/ARR/2011/NLD, para 138)	
Portugal	CH_4 emissions from solid waste disposal on land amounted to 5,293.54 Gg CO_2 eq for 2009. The first order decay method (tier 2) was applied to estimate CH_4 emissions from this category. The parameters used for the estimation of emissions are mainly IPCC default values, except degradable organic carbon which is derived from country-specific data on waste composition. The ERT reiterates the recommendations in previous review reports that Portugal explore the possibilities of developing country-specific parameters. (FCCC/ARR/2011/PRT, para 124)	Not yet implemented [NIR 2013].
	Data on the amount and composition of municipal solid waste from 1999 onwards are collected and reported by municipal authorities responsible for waste management. For the period prior to 1999, the amount of municipal waste is based on expert judgement on the per capita waste generation rate. The amount of biodegradable industrial waste deposited on waste disposal sites is based on expert judgement on growth rates and, for recent years (2007–2009), it is based on data from the Waste Registry. The ERT reiterates the recommendations in previous review reports that Portugal provide more information on the changes in emissions trends, particularly those caused by changes in industrial waste disposal, in its next annual submission. The ERT also recommends that Portugal provide more information on how the Party has ensured time-series consistency despite the multiple sources for AD. (FCCC/ARR/2011/PRT, para 125)	The emission trend, including information on changes in behavior, waste management practices, etc. is now explained in the NIR. The NIR also includes a description of how the time series of municipal solid waste and industrial solid has been derived. It can therefore be considered that the recommendations in the ARR 2011 have been (partially) implemented.
Spain	However, the ERT found some inconsistencies in the time series that are mostly the result of the basic AD (e.g. step changes resulting from changes in waste management practices) and also due to the fast evolution in waste management practices, and, therefore, recommends that Spain develop efforts to improve the consistency of its reporting for its next annual submission. (FCCC/ARR/2011/ESP, para 171)	Since no specific inconsistencies are mentioned in the ARR 2011, implementation cannot be confirmed [NIR 2013].
	The ERT also found that the uncertainty of the waste sector is relatively high, which is mainly due to the use of default EFs and/or the use of extrapolations. Further, the inventory of Spain is	In the current inventory, the number of landfills with individual data provision has

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	dependent on a combination of official statistics and data from voluntary surveys. The ERT recommends that Spain enhance the arrangements of the national system to increase the level of responses to surveys, which the ERT believes can be done since the MARM is responsible for this sector. (FCCC/ARR/2011/ESP, para 172)	been increased to 49. The level of response to some parts of the questionnaires is high (amount of waste landfilled, recovery, composition), whereas information provided is scant for some relevant parameters (k, MCF and Ox). It can therefore be concluded that the recommendation by the ERT has been implemented [NIR 2013].
	The ERT reiterates the recommendations in the previous review report, that were not yet resolved by the Party, namely that the Party: update the trend of the time series of composition of wastes and calculated degradable organic carbon (DOC) values in the period 1997–2009, which is kept constant; and update the assumptions related to the depth of solid waste disposal sites (50 per cent deep and 50 per cent shallow) and the amount of waste that is burned. (FCCC/ARR/2011/ESP, para 176)	The DOC content is kept constant from 1997-2011. Assumptions related to the depth of solid waste disposal sites (50 per cent deep and 50 per cent shallow) still hold. The amount of waste burnt per year is available in table 8.2.1 in the NIR. It can therefore be concluded that the recommendations in the ARR 2011 have partially been addressed.
Sweden	Sweden has used the IPCC first order decay method with mostly default parameters and country-specific AD to estimate CH_4 emissions from solid waste disposal sites. The ERT reiterates the recommendation made in the previous review report that Sweden develop country-specific parameters to estimate the emissions for this category in its next annual submission. There have been significant changes in national waste management practices since 1990, which have resulted in the reduction of municipal solid waste disposal on land to only 1.0 per cent of total generated household waste for 2010 compared with 43.8 per cent for 1990. All solid waste disposal sites are categorized as managed in Sweden. The ERT welcomes the transparent reporting of this category. (FCCC/ARR/2012/SWE, para 104)	Not yet implemented [NIR 2013].
United Kingdom	The ERT noted some lack of transparency in the inventory regarding the presentation of OTs and CDs in the CRF tables for waste incineration and the descriptions of categories in the NIR. Thus for OT and CDs emissions are still reported either separately under other (solid waste disposal on land) and other (wastewater handling) or included in the estimates and no AD are provided for them when they are separately reported. The ERT also noted some inaccuracies in the formula for specific CH_4 potential (formula 3 in the NIR), missing values for methane correction factor and F (fraction by volume of CH_4 in landfill gas) in the formula and poor description of the parameters used in the NIR. The NIR is unclear regarding whether there are any unmanaged landfills in the country. The ERT reiterates the recommendation of the previous review report that the United Kingdom improve the transparency of the inventory by providing information on OTs and CDs in all CRF tables and in the NIR, by providing all the necessary data in the NIR with respect of all issues and parameters used in the calculation of emissions from the category and by enhancing QA/QC procedures to ensure accuracy and consistency throughout the CRF tables and NIR in the next submission. (FCCC/ARR/2011/GBR, para 96)	The NIR states that reported emissions refer to "managed landfills that started receiving waste in 1980 and old unmanaged waste disposal sites that closed prior to 1980." (NIR 2013, p. 424). However, in the CRF tables, only emissions from managed landfills are reported. The parameters used in the calculation are described in the NIR. It can therefore be concluded that the recommendations in the ARR 2011 have been partially addressed.
	However, the recalculations made using the new AD and EFs led to a significant decrease of the 2008 emissions from the sector and the	Not yet implemented [NIR

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	ERT noted that the change in values for MSWF and the default values for degradable organic carbon into the country-specific ones is not properly documented in the NIR and its annex 3. The explanations and references provided by the consulting company Eunomia Research & Consulting Ltd on the request of the ERT were analysed and the ERT concluded that they are not sufficiently convincing and require further justification. The reasons for questioning the recalculations are: the poor quality of updated data on waste sent to landfill, as acknowledged by the consulting company itself; lack of justification for 'smoothening' assumption for dissimilable degradable organic carbon for the years since 1997; and the error made in putting new dissimilable degradable organic carbon values into the model. The ERT strongly recommends that the Party double-check the reliability of the data used in the recalculation and the relevance of the methods used and assumptions made, and either: make recalculations with corrected figures supported, in the NIR, by strong justifications for the changes made in methodologies, assumptions, data and parameters; or keep the previous values and approaches (2010 submission) unchanged until the Party is able to show sufficient evidence for justifying the changes. (FCCC/ARR/2011/GBR, para 100)	2013].
	The United Kingdom calculates CH_4 recovery values using the figures of gas utilized for energy and the total available flaring capacity of the landfills. The previous review report noted that the CH_4 recovery rate was increasing, reaching 71 per cent in 2008. For the year 2009 it was raised to 75 per cent. The NIR justifies the value by reference to the permit conditions for landfill operators, who are targeting to collect at least 85 per cent of CH_4 from the sites receiving biodegradable waste. On the request of the ERT the Party provided additional documentation and explanation on the issue, demonstrating that landfill operators are asked to conduct a survey on the flaring process, enabling the Party to calculate the recovered CH_4 values based on the survey data. The ERT reiterates the recommendation of the previous review reports that the United Kingdom collect the survey data and update AD in order to avoid a possible overestimation of recovered CH_4, and provide detailed information on the data in its next annual submission. (FCCC/ARR/2011/GBR, para 100)	Not yet implemented [NIR 2013].

Note: Review reports (ARR 2012, ARR 2011)
Source: NIR 2013, CRF 2013 UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6048.php http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6616.php

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.2 % of total EU-15 GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from this source decreased by 59 % (Table 8.4). All member states with unmanaged waste disposal feature a decreasing emission trend, due to a decreasing amount of municipal waste going to unmanaged waste disposal sites.

In Spain, emissions in 2011 are higher than in 1990, though, due to an increase of emissions until the year 2000 and a decline only thereafter. The trend of the emissions from unmanaged landfills is influenced by two kinds of emissions: instant emissions, due to waste burning, and emissions originated by wasted disposed in a series of years up to the current year. The latter emissions are estimated by Spain with the first order kinetic methodology as the processes for decomposition in landfill of the municipal waste have a maturing period of several years, which may range from one year for the more labile components up to over 35 years for those with the lowest biodegradation rate.

The combination of both processes (burning of wastes disposed in the current year plus emissions from wastes disposed in the past) produces this reversal of CH_4 emissions trend in 2000.

This could similarly be observed for Portugal in 1998, due to a continuous reduction of waste disposal in unmanaged sites. Since 1997 there has been a continuous reduction of this disposal type; the majority of unmanaged dumping sites closed in 2002.

Not all member states reported emissions from this source since all waste disposal sites in the countries are managed (Austria, Belgium, Denmark, Finland, Germany (due to first Waste Act since 1972), Luxembourg, the Netherlands, Sweden) or considered to be not significant sources (the UK). France, Italy, Greece and Spain are responsible for about 88 % of the total EU-15 emissions. France and Italy show large absolute reductions between 1990 and 2011. In these two countries, waste is not disposed on unmanaged landfill sites any more (in Italy since 2000, in France since 2006). However, emissions are still produced from the waste disposed in the past.

The reduction of emissions from unmanaged waste disposal on land in Italy is caused by legal acts. The first legal provision concerning waste management was issued in 1982. In this decree, uncontrolled waste dumping as well as unmanaged landfills are forbidden, but the enforcement of these measures was concluded only in 2000. Thus the share of waste disposed on uncontrolled landfills gradually decreased, and in the year 2000 it is assumed as equal to zero; nevertheless emissions still occur due to the waste disposed in the past years.

Following the Greek National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is in progress, and unmanaged solid waste disposal sites in Greece are expected to decline (from 4690 unmanaged sites in 1987 to 2182 sites still operating in 2000 and further).

Table 8.4 shows that 100 % of the EU-15 emissions are estimated using higher tier methodologies.

Table 8.4 6A2 Unmanaged Waste Disposal on Land: Member states' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	IE,NO	NO	NO	-	-	-	-	-	NA	NA
France	3 779	1 105	1 032	18.3%	-73	-7%	-2 747	-73%	T2	CS
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	1 911	1 609	1 532	27.1%	-76	-5%	-378	-20%	T2	CS,D
Ireland	1 173	152	142	2.5%	-10	-7%	-1 031	-88%	T2	CS,D
Italy	5 194	1 558	1 484	26.3%	-74	-5%	-3 710	-71%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	1 006	579	533	9.4%	-46	-8%	-473	-47%	T2	CS,D
Spain	885	972	927	16.4%	-44	-5%	42	5%	T2	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**13 948**	**5 975**	**5 651**	**100.0%**	**-324**	**-5%**	**-8 297**	**-59%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.5 provides information on the contribution of member states to EU recalculations in CH_4 emissions from 6A Solid Waste Disposal on Land for 1990 and 2010 and main explanations (as available in the national inventory reports) for the largest recalculations in absolute terms.

Table 8.5 6A Solid Waste Disposal on Land: Contribution of member states to EU recalculations in CH_4 emissions for 1990 and 2010 (difference between latest submission and previous submission)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	59	2.3	60	10.1	Flanders: according ICR 2012, the assumption for all waste gas was made with 50%, submission 15/1/2013: for old SWDS waste gas 55%. Walloon region: updated value on biogas recovery
Denmark	1	0.0	27	3.9	The recalculation of emissions from Solid Waste Disposal on Land is caused by adjustments in half-life times, minor changes in the mass balances of waste types versus categories and not least new data from the Energy statistics on the amount of methane collected as well updated information on the density of the methane. A reduction on the density of methane in the recovered biogas combined with the delayed released of methane from historic deposited waste amounts in the main reason for the increase in net emissions from solid waste disposal sites.
Finland	0	0.0	0	0.0	
France	-140	-1.6	-6 587	-42.1	La soumission précédente était basée sur le principe d'une non prise en compte du captage faute de pouvoir l'estimer sur la base des mesures comme demandé par l'équipe de revue CCNUCC de septembre 2010. Suite à l'enquête auprès des ISDND, l'estimation 2013 intègre la prise en compte du captage du biogaz généré et sa combustion en torchères ou installations de valorisation.
Germany	0	0.0	3 045	34.0	New statistical data for CH4-recovery.
Greece	0	0.0	-25	-0.7	Updated AD.
Ireland	0	0.0	27	3.7	Revised data for LFG flared at 1 landfill site.
Italy	0	0.0	-125	-1.0	Update of activity data.
Luxembourg	-7	-10.0	-3	-10.0	1990-2010: revised CH4 emissions due to revised methane oxidation factor (now set to 0.1 - IPCC default for well-managed sites, previously set to 0).
Netherlands	0	0.0	-923	-21.4	Improved method.
Portugal	0	0.0	414	9.0	Urban waste composition: data for 2001-2009, which was previously set equal to 2000 data, has been revised on the basis of interpolation of 2000 and 2010 data. DOC values have been changed and the % of biogenic/ non-biogenic carbon has been revised leading to a decrease of CH4 emissions in CRF 6A and an increase of CRF 6C emissions.
Spain	429	9.2	334	2.9	New information of waste from unmanaged SWDS is provided from 1950 to 1969 and review of the amount from 1990 to 2010. The amount of SWDS wastes from 1950 to 1969 has been included following the recommendations of the ERT and new individualized information is provided .
Sweden	0	0.0	4	0.3	Correction of input data in calculation files. New statistics available. Changes in EWC-stat codes implemented in 2010.
UK	0	0.0	0	0.0	
EU-15	**341**	**0.2**	**-3 751**	**-4.5**	

8.2.2 Wastewater handling (CRF Source Category 6B) (EU-15)

Source category 6B includes two key sources: CH_4 and N_2O from 6B2 Domestic and commercial wastewater. Methane and nitrous oxide are produced from microbial processes (anaerobic decomposition of organic matter, nitrification) in sewage facilities. N_2O is also indirectly released from disposal of wastewater effluents into aquatic environments[37]. Domestic and commercial wastewater includes the handling of liquid wastes and sludge from housing and commercial sources through wastewater collection and treatment, open pits/latrines, ponds, or discharge into surface waters.

Table 8.6 shows total GHG, CH_4 and N_2O emissions by member state from 6B Wastewater Handling. Between 1990 and 2011, CH_4 emissions from wastewater handling decreased by 23 % in EU-15 (a decrease of emissions took place in 8 member states, whereas Denmark, France, Ireland, Italy, Portugal, Spain and Sweden increased their emissions), N_2O emissions from wastewater handling remain at the level of 1990 (with an increase in 10 member states, whereas Denmark, Finland, France, the Netherlands and Sweden reduced their emissions of nitrous oxide).

Table 8.6 6B Wastewater handling: Member states' contributions to total GHG, CH_4 and N_2O emissions from 6B

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2011 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N2O emissions in 2011 (Gg CO2 equivalents)
Austria	211	289	102	23	109	266
Belgium	504	402	210	102	293	300
Denmark	171	156	66	76	105	79
Finland	297	213	154	117	144	97
France	2 248	1 976	847	1 210	1 402	767
Germany	4 568	2 476	2 226	61	2 342	2 415
Greece	3 348	1 430	3 017	1 048	331	383
Ireland	126	158	15	16	112	141
Italy	3 821	4 671	1 990	2 734	1 831	1 937
Luxembourg	15	14	6	3	9	11
Netherlands	771	656	290	199	482	457
Portugal	2 948	3 135	2 486	2 543	462	591
Spain	1 634	1 957	562	707	1 072	1 251
Sweden	502	455	292	299	211	155
United Kingdom	2 835	2 828	1 677	1 630	1 158	1 198
EU-15	**24 003**	**20 815**	**13 939**	**10 767**	**10 064**	**10 048**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 6B1 Industrial Wastewater account for 0.16 % of total EU-15 GHG emissions. Between 1990 and 2011, corresponding CH_4 emissions increased by 5 %. Large decreases in absolute terms are reported by the UK and Italy, whereas Portugal shows significant emission increases (Table 8.7). Portugal is responsible for 31.1 %, the UK for 22.0 % and Italy for 20.9 % of EU-15 emissions from this source in 2011.

[37] In most countries, indirect N_2O emissions from disposal of wastewater effluents are the major source of N_2O emissions from wastewater handling, whereas direct N_2O emissions from wastewater treatment plants are small or not relevant.

Table 8.7 6B1 Industrial Wastewater: Member states' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA
Denmark	IE	IE	IE	-	-	-	-	-	NA	NA
Finland	22	20	16	0.3%	-4	-21%	-6	-28%	D	CS
France	46	53	53	0.9%	0	0%	7	15%	T1	CS
Germany	NA	NA	NA	-	-	-	-	-	NA	NA
Greece	855	852	835	14.5%	-18	-2%	-20	-2%	CS,D	CS,D
Ireland	2	6	6	0.1%	0	2%	4	197%	T1	D
Italy	1 277	1 221	1 206	20.9%	-15	-1%	-71	-6%	D	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	5	7	7	0.1%	0	-1%	2	32%	T2	CS
Portugal	1 430	1 547	1 796	31.1%	249	16%	366	26%	D	CS,D
Spain	482	573	573	11.5%	0	0%	90	19%	D	CS,D
Sweden	7	9	9	0.2%	0	0%	2	22%	CS	CS
United Kingdom	1 376	1 269	1 269	22.0%	0	0%	-108	-8%	CS,T1	D
EU-15	**5 503**	**5 557**	**5 769**	**100.0%**	**212**	**4%**	**266**	**5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'

An important driver for CH_4 emissions from 6B Wastewater Handling are CH_4 emissions from 6B2 Domestic and Commercial Wastewater in France, Germany, Greece, Italy and Portugal[38]. Therefore and in response to the recommendation by the ERT (FCCC/ARR/2009/EC, para 84), more information about the development of CH_4 emissions from wastewater handling in these countries is presented.

CH_4 emissions from 6B2 Domestic and Commercial Wastewater account for 0.14 % of total EU-15 GHG emissions. Between 1990 and 2011, corresponding CH_4 emissions decreased by 40 %. Large decreases in absolute terms are reported by Germany and Greece, contributing together to only 5.5 % of EU-15 emissions in 2011, whereas France and Italy feature show significant emission increases (Table 8.8). Italy is responsible for 30.7 %, France for 23.2 % and Portugal for 15.0 % of EU-15 emissions from this source in 2011. Although two of these member states (Italy and France) increased their emissions between 1990 and 2011, the trend of EU-15 emissions is dominated by the large emission reductions in Germany and Greece.

French CH_4 emissions show an increasing trend from 1990 to 2001 and remain at a rather constant level thereafter (with a slight increase since 2004). One driver influencing the trend is the share of population connected to different wastewater treatment systems. The share of the population connected to septic tanks increased from 1990 to 2000 (from 13 % in 1990 to 18 % in 2000), and remained almost constant thereafter (17 %). In the same period, the share of the population with direct discharge of wastewater decreased from 8 % in 1990 to 2 % in 2011. Wastewater treatment in collective systems increased slightly from 79 % in 1990 to 81 % in 2011.

Germany's reduction in CH_4 emissions occurred mainly between 1995 and 1998. The decrease of 76 % in that period was due to the legal requirement to connect households to decentralised wastewater treatment plants. For this reason many plants were built in the former GDR after the German reunification. Most of them started operation between 1995 and 1998.

[38] Spain also has a significant share in EU-15 CH_4 emissions from wastewater handling. However, these are influenced predominantly by industrial wastewater treatment and are therefore not discussed here.

The Greek CH_4 emissions decreased mainly between 1999 and 2001 (-56 %) due to the increased number of wastewater handling facilities with aerobic conditions. Domestic wastewater handling in aerobic treatment facilities shows a substantial increase since 1999, while in the industrial sector only a few units exist where wastewater is handled under anaerobic conditions. The penetration of facilities with aerobic conditions increased from 32 % (share of population) in 1999 and to 91 % in 2011.

Italian CH_4 emissions from domestic and commercial wastewater handling have increased throughout the time series, with the most prominent increase between 1999 and 2005. This is due to the fact that the organic load in wastewater increased substantially during the same period.

CH_4 emissions from domestic and commercial wastewater handling in Portugal have decreased continuously during the time series, with emissions remaining at a stable level since 2007. Whereas the organic load remained rather constant, the share of different wastewater treatment types has changed significantly. In 1990, 37 % of the population did not have access to a sewage system. This share decreased significantly until 1999. By 2005, the whole population was connected to a kind of wastewater treatment system. Especially, the share of the population connected to secondary and tertiary treatment has increased significantly from about 10 % in 1990 to almost 60 % in 2011. Similarly, the share of population with private septic tanks has increased from 1.5 % to 21.0 % in the same period.

Table 8.8 6B2 Domestic and commercial wastewater: Member states' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	102	23	23	0.5%	0	0%	-79	-77%	D	CS,D
Belgium	210	100	102	2.0%	2	2%	-109	-52%	CR,T1	CR,D
Denmark	66	75	76	1.5%	1	1%	10	15%	CS	CS
Finland	131	99	101	2.0%	1	1%	-30	-23%	D	CS,D
France	800	1 150	1 156	23.2%	6	1%	356	44%	T1	CS
Germany	2 226	71	61	1.2%	-10	-14%	-2 165	-97%	D	CS,D
Greece	2 163	216	213	4.3%	-3	-1%	-1 950	-90%	D	D
Ireland	13	10	10	0.2%	0	2%	-2	-18%	T1	D
Italy	713	1 519	1 528	30.7%	9	1%	815	114%	D	D
Luxembourg	6	3	3	0.1%	0	-2%	-3	-51%	T1	CS
Netherlands	190	181	176	3.5%	-5	-3%	-15	-8%	T2	CS
Portugal	1 056	756	748	15.0%	-9	-1%	-309	-29%	D	CS,D
Spain	75	125	126	2.5%	1	0%	50	67%	D	CS,D
Sweden	284	290	290	5.8%	0	0%	6	2%	CS,T1	CS,D
United Kingdom	300	346	361	7.3%	15	4%	61	20%	CS	CS
EU-15	**8 337**	**4 965**	**4 974**	**100.0%**	**9**	**0%**	**-3 363**	**-40%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.9 provides information on the contribution of Member states to EU recalculations in CH_4 from 6B Wastewater handling for 1990 and 2010 and main explanations (if available in member states' inventories) for the largest recalculations in absolute terms.

Table 8.9 **6B Wastewater Handling: Contribution of member states to EU recalculations in CH_4 for 1990 and 2010 (difference between latest submission and previous submission)**

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-4	-15.3	Update of the connection rate.
Belgium	-8	-3.6	-27	-21.2	Flanders: harmonisation with other regions (estimates for industrial wastewater is removed).
Denmark	-0.1	-0.1	-0.1	-0.1	
Finland	0.0	0.0	0.0	0.0	
France	3	0.4	-6	-0.5	La quantité de boues générées par les STEP domestiques et industrielles a été mise à jour sur la série temporelle, ainsi que la quantité d'azote issue des eaux industrielles traitées en station d'épuration collective.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-11	-0.4	Update of industrial wastewater activity data.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	6	3.0	Improved method.
Portugal	5	0.2	34	1.5	Industrial Wastewater Treatment types: updates based on the Environmental Licenses for several sectors and units, in particular for those sectors were the situation were classified as Unknown. Industrial Wastewater: revision of some industrial categories/codes considered in the estimates of organic wastewater production Methane recovery in pig farms was previously wrongly accounted in 6.B.2. To correct this, the methane recovered in pig-farms is now considered in 4.B (agriculture).
Spain	-681	-54.8	-1 651	-70.1	New information available about domestic and commercial wastewater
Sweden	0	0.0	0	0.0	
UK	1 398	502.4	1 276	377.9	Consultation with water companies has lead to updated data.
EU-15	**718**	**5.4**	**-383**	**-3.5**	

N_2O emissions from 6B2 Domestic and Commercial wastewater account for 0.26 % of total EU-15 GHG emissions. Between 1990 and 2011, emissions remained at the same level (Table 8.10). Comparably large decreases in absolute terms are only reported for France, whereas Austria, Italy and Spain feature emission increases (Table 8.10). France increased the N efficiency of wastewater plants significantly since 1990, leading to decreasing N_2O emissions. Therefore, France contributes with a share of 7.4 % to EU-15 emissions in 2011, whereas this share amounted to 13.9% in 1990.

Table 8.10 **6B2 Domestic and Commercial Wastewater: Member states' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	106	207	208	2.2%	1	0%	103	97%	D	CS,D
Belgium	293	298	300	3.2%	2	1%	7	2%	D	D
Denmark	105	76	79	0.8%	3	4%	-25	-24%	CS	CS
Finland	105	75	76	0.8%	1	1%	-29	-28%	CS,D	D
France	1 326	702	706	7.4%	4	1%	-620	-47%	T1	CS
Germany	2 224	2 303	2 305	24.3%	3	0%	82	4%	D	CS,D
Greece	326	377	377	4.0%	0	0%	51	16%	D	D
Ireland	112	141	141	1.5%	0	0%	30	27%	T1	D
Italy	1 761	1 918	1 881	19.8%	-37	-2%	120	7%	D	D
Luxembourg	9	11	11	0.1%	0	-2%	1	15%	T1	D
Netherlands	466	447	454	4.8%	7	2%	-12	-2%	T2	D
Portugal	302	381	378	4.0%	-3	-1%	77	25%	D	D
Spain	1 072	1 248	1 251	13.2%	3	0%	179	17%	D	D
Sweden	173	135	135	1.4%	0	0%	-39	-22%	CS	D
United Kingdom	1 158	1 202	1 198	12.6%	-4	0%	40	3%	T1	D
EU-15	**9 537**	**9 520**	**9 500**	**100.0%**	**-20**	**0%**	**-37**	**0%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from household wastewater are mainly driven by the daily per capita protein consumption. Germany was responsible for 24 %, Italy for 20 %, Spain and the United Kingdom for 13 % each of the emissions from this source in 2011. Table 8.9 also suggests that 8 % of the EU-15 emissions are estimated using higher tier methodologies.

Table 8.11 provides information on the contribution of member states to EU recalculations in N_2O emissions from 6B Wastewater Handling for 1990 and 2010 as well as the main explanations.

Table 8.11 6B Wastewater Handling: Contribution of member states to EU recalculations in N_2O for 1990 and 2010 (difference between latest submission and previous submission)

	1990		2010		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	-5	-4.1	-8	-9.1	Smaller changes in the effluent tons N for the years 2007-2010 have been made due to updated information from the Danish EPA. The major reason for the observed reduction of the total emission from sector 6.B is due to the elimination of a correction factor that was not justified after verification of nitrogen effluent data with the newest reporting of effluent data in the report series "point sources" published by the Danish EPA.
Finland	0	0.0	-0.1	-0.1	Preliminary protein consumption data corrected.
France	-2	-0.1	-17	-2.2	La quantité de boues générées par les STEP domestiques et industrielles a été mise à jour sur la série temporelle, ainsi que la quantité d'azote issue des eaux industrielles traitées en station d'épuration collective.
Germany	119	5.3	109	4.7	No explanation available
Greece	0	0.0	-11	-2.8	Updated AD.
Ireland	-2	-2.0	-4	-3.0	Revised protein consumption (kg/capita/yr) from FAOSTAT.
Italy	-1	-0.1	0	0.0	Update of industrial wastewater activity data.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	1	0.2	New statistics.
Portugal	-1	-0.2	-3	-0.6	Industrial Wastewater: revision of some industrial categories/codes considered in the estimates of organic wastewater production
Spain	0	0.0	0	0.0	
Sweden	0	0.0	-6	-3.5	New data has been available on discharges from wastewater treatment. New data on protein consumption.
UK	0	0.0	58	5.1	Revised data for 2010 protein consumption in the UK.
EU-15	**108**	**1.1**	**119**	**1.2**	

8.2.3 Waste incineration (CRF Source Category 6C) (EU-15)

This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy use are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture.

Table 8.12 and Table 8.13 give an overview of greenhouse gas emissions from waste incineration by member state. CO_2 emissions from waste incineration account for 0.07 % of total EU-15 GHG emissions. CO_2 emissions decreased by 38 % between 1990 and 2011. All member states decreased their CO_2 emissions from waste incineration between 1990 and 2011, except for Belgium, Greece, Portugal and Sweden. The United Kingdom, France and Italy feature the largest decreases in absolute terms; these member states account for 74 % of CO_2 emissions from this source in 2011.

Table 8.12 **6C Waste Incineration: Member states' contributions to total GHG and CO_2 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2011 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2011 (Gg)
Austria	27	2	27	2
Belgium	293	525	290	525
Denmark	0.21	0.29	NO	NO
Finland	0.00	0.00	IE	IE
France	1 861	1 459	1 737	1 369
Germany	0.00	0.00	NO	NO
Greece	0.35	4	0.22	3
Ireland	83.84	54.06	83	53
Italy	590	312	507	235
Luxembourg	0.00	0.00	IE	IE
Netherlands	0.00	0.00	IE	IE
Portugal	14	24	13	14
Spain	88	12	78	3
Sweden	45	65	44	60
United Kingdom	1 484	320	1 292	268
EU-15	**4 486**	**2 776**	**4 071**	**2 532**

CO_2 emissions of Denmark, Finland, Germany, Luxembourg and the Netherlands are included in the energy sector. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.13 **6C Waste incineration: Member states' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	27	2	2	0.1%	0	0%	-25	-92%
Belgium	290	691	525	20.7%	-166	-24%	235	81%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	IE	IE	IE	-	-	-	-	-
France	1 737	1 455	1 369	54.1%	-86	-6%	-368	-21%
Germany	NO	NO	NO	-	-	-	-	-
Greece	0.22	3	3	0.1%	0	-5%	3	-
Ireland	83	53	53	2.1%	0	0%	-29	-36%
Italy	507	222	235	9.3%	13	6%	-273	-54%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Portugal	13	18	14	0.5%	-4	-24%	1	10%
Spain	78	3	3	0.1%	0	0%	-75	-96%
Sweden	44	56	60	2.4%	3	6%	16	36%
United Kingdom	1 292	276	268	10.6%	-8	-3%	-1 024	-79%
EU-15	**4 071**	**2 779**	**2 532**	**100.0%**	**-247**	**-9%**	**-1 539**	**-38%**

CO_2 emissions of Denmark, Finland, Germany, Luxembourg and the Netherlands are included in the energy sector. Abbreviations explained in the Chapter 'Units and abbreviations'.

8.3 Methodological issues and uncertainties (EU-15)

The following considerations address national methods and circumstances which are available in the member states' national inventory reports. The focus is laid on the reporting categories 6A1 CH_4

emissions from managed solid waste disposal sites and 6A2 CH_4 emissions from unmanaged solid waste disposal sites since they are EU-15 key categories and contribute 1.8 % and 0.16 % of total GHG emissions, respectively. CH_4 emissions from the reporting category 6B2 from domestic and commercial wastewater are a key source in the EU-15 as well and is also comprehensively analysed. Source categories 6B1, 6C and 6D are only briefly discussed.

8.3.1 Managed Solid Waste Disposal (CRF Source Category 6A1) (EU-15)

For key sources in the source category 6A it is good practice to use the First Order Decay (FOD) method (Tier 2) to calculate the emissions and to display emissions trends over time. Almost all EU-15 member states (with the exception of Luxembourg) applied – in line with the IPCC Good Practice Guidance – Tier 2 methodologies in order to estimate CH_4 emissions from managed solid waste disposal sites, which means that nearly 100 % of all EU-15 emissions are calculated using higher tier methods, see Table 8.2. Two member states used a country-specific emission model in accordance with the Tier 2 methodology (Denmark and Belgium). Most remaining member states applied the Tier 2 methodology proposed by the IPCC Good Practice Guidance and the IPCC Guidelines. Luxembourg applied the Tier 1 methodology. Table 8.14 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites (SWDS).

Table 8.14 6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions

Member State	Description of methods
Austria	For the calculation of emissions of solid waste disposal on land, IPCC Tier 2 method is applied. Where available and within the range of the IPCC guidelines, country-specific factors are used. If these are not available, IPCC default values are taken.
Belgium	The methodology used to calculate the emissions from solid waste disposal on land differs between the two regions in Belgium where these sites are located (Flanders and Wallonia). In the Flemish region, a combination of two models is used: a multiphase model for the estimation of emissions of the sites which are permitted and a first order decay model for all other, old waste disposal sites which are no longer permitted to dispose, but where still emissions occur after the ban of disposal on these sites (these are the solid waste disposal sites in after-care). In the Walloon region, CH_4 emissions from solid waste disposal on land are calculated with a first order decay model that considers separately emissions from industrial and municipal waste until 2007. Since 2010, Walloon waste statistics are given in another format which does not consider separately the amounts of industrial and municipal waste anymore. The overall methodology follows the Tier 2 IPCC methodology. No waste disposal site is located in the Brussels region.
Denmark	The calculation of CH_4 emissions at the Danish SWDSs is based on a First Order Decay (FOD) model according to an IPCC tier 2 approach. The model calculations are performed using national statistics on landfill site characteristics and amounts of waste fractions deposited each year. This year's submission is based on nine verified nine waste types allocated across eight waste categories and of individual content of degradable organic matter and half-lives.
Finland	Finland uses a IPCC Tier 2 method (with a slight modification) as a basis for the estimation of CH_4 emissions. Calculations are not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous years (and degraded later in year t) as well.
France	Country-specific first order decay method consistent with IPCC Tier 2 Method by integrating data on the effectiveness of capture from biogas flared or recovered. Country-specific parameters are based on measurements. Quantities of waste landfilled are known from 1960 onwards and based on the surveys ITOMA of ADEME.
Germany	IPCC Tier 2 Method used partly with IPCC default parameters, partly with country-specific parameters where available.
Greece	IPCC Tier 2 Method used. The estimation of methane emissions from solid waste disposal on land is based on the application of the FOD method. The method was applied separately for the managed and unmanaged waste disposal, taking account of the different conditions in those sites and the detailed information available regarding the opening and closure years of the operation of the managed sites.
Ireland	The methodology for estimating CH_4 production given in the 2006 IPCC Guidelines has been applied for use in the 2010 and subsequent submissions. In the present model analyses undertaken for both individual sites and groups of landfills, annual MCF values show an increase over time to reflect the change from generally shallow, poorly-managed landfills before 1998 (and therefore pre landfill licensing) to well controlled and engineered landfills in subsequent years. The model was applied for the six largest landfills individually and to all other landfills by assigning them to seven separate groups according to annual waste amount and life cycle. Two additional runs were used to account for sewage sludge and street cleanings.
Italy	Emission estimates from solid waste disposal on land have been carried out using the IPCC Tier 2 methodology, through the application of the First Order Decay Model (FOD). It is assumed that all the landfills, both managed and unmanaged, started operation in the same year, and have the same parameters, although characteristics of individual sites can vary substantially.

Luxembourg	The spreadsheet implementing the Tier 1 methodology from the 2006 IPCC Guidelines for national greenhouse gas inventories has been used. Following the recommendations of the in-country review of 2008 and the centralized review of 2009, the calculation was made since 1950 and also taking into account the pre-treatment of waste before being landfilled. In 2009, the Environment Agency conducted two studies: 1) Composition of the high caloric fraction from SIDEC and 2) Emissions of the waste deposited at the MSW landfills. In 2011 the study "Emissions of the waste deposited at the MSW landfills" was refined for the period 2004-2007, calculated for the years 2008 and 2009 and extrapolated for the years 2010 to 2030.
Netherlands	In order to calculate the CH_4 emissions from all the landfill sites in the Netherlands, the simplifying assumption was made that all the wastes are assumed to be landfilled on one landfill site, an action that started in 1945. However, characteristics of individual sites vary substantially. CH_4 emissions from this 'national landfill' are then calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited and the characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since the CH_4 emissions from landfills are a key source, the present methodology is in line with the IPCC Good Practice Guidance.
Portugal	To better take into account to the fact that CH_4 emissions from SWDS occur over a long period of time and not immediately after disposal of waste on land, the methodological approach considered was the First Order Decay Method (Tier 2).
Spain	IPCC Tier 2 Method is used. Estimation parameters are partly taken from country-specific data as provided by landfill operators as well as from IPCC default parameters.
Sweden	Methane emissions have been calculated by using the IPCC default model and the IPCC First Order Decay (FOD) model respectively. The two methods are not really comparable. The FOD model, on the other hand, uses a time factor representing the delay in methane production, which results in a slower decrease of emitted methane. The estimates of the FOD model are used in the Swedish National GHG Inventory.
United Kingdom	The UK approach to calculating emissions of methane from landfills uses a "Tier 2" methodology based national data on waste quantities, composition, properties and disposal practices over several decades. The equations for calculating methane generation use a first-order decay (FOD) methodology.

Source: NIR 2013

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following, a detailed overview of the most important parameters and methodological aspects of the FOD method applied by the member states is presented. The main factors influencing the quantity of CH_4 produced are the amount of waste disposed of on land and the concentration of biodegradable carbon in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the member states are summarised in Table 8.15.

Table 8.15 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data

Member State	**Data sources used for generating time series (6A1)**
Austria	Data for 2008-2011 is taken from the EDM (Electronic Data Management), administered by the Federal Ministry of Agriculture, Forestry, Environment and Water Management. These data are available due to the fact that since 2009 landfill operators are obliged to register their data at the portal of http://edm.gv.at. From 1998 to 2007, data are taken from a database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"), a database administered and maintained by the Umweltbundesamt until 2008. From 1950 to 1997, the amounts of deposited residual waste are taken from national studies and the Federal Waste Management Plans. However, the amount of waste from administrative facilities of businesses and industries is not considered in the data from

Member State	Data sources used for generating time series (6A1)
	1950 to 1999, whereas it is included in the Deponiedatenbank, which is used for the activity data from 1998 onwards. To achieve a consistent time series, data of the two overlapping years (1998 and 1999) were examined and the difference, which represents the residual waste from administrative facilities of industries and businesses, was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly. The quantities of non-residual waste from 1998 to 2007 are taken from the Deponiedatenbank. For the years 2008-2011, the quantities are taken from the EDM. Only the amounts of waste with biodegradable lots are considered. There are no data available for the years before 1998. Thus extrapolation was done using the Austrian GDP (gross domestic product) per inhabitant as indicator.
Belgium	In the Walloon region, the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). Until 2008, the industrial and municipal waste disposed was published based on taxes declaration forms covering solid waste disposal sites of various sizes. For 2008, data on industrial and municipal waste were gathered including classification to main categories and subcategories. Those statistics are available on a yearly basis since 1994. For the years before, the amounts are estimated using available data and OWD expert judgement assumptions. In the Flemish region, input data of waste disposal sites are available since 1990. The main data source is the Flemish Institute for Waste Management (OVAM).
Denmark	The data used for the amounts of municipal solid waste deposited at managed solid waste disposal sites are worked out by the Danish Environmental Protection Agency (DEPA) in the ISAG database which provides landfill data for the years 1994-2009. A new data system that is to replace the ISAG database was expected in 2011 (starting with 2010 data). The new system is however not yet functional and the 2010 and 2011 data in this inventory has therefore been taken from the projection.
Finland	Activity data for the time series is taken from different sources: The VAHTI database contains data on the total amounts of waste taken to landfills from 1997 onwards. Corresponding data for the years 1992-1996 were collected to the Landfill Registry of the Finish Environment Institute. The activity data for municipal waste for the year 1990 is based on the estimates of the Advisory Board for Waste Management (1992) for municipal solid waste generation and treatment in Finland in 1989. The disposal data (amount and composition) at the beginning of 1990s for industrial, construction and demolition waste are based on surveys and research by Statistics Finland, VTT Technical Research Centre of Finland and National Board of Waters and the Environment. Estimated data on waste amounts before the year 1990 is based on a report by VTT.
France	Quantities of waste landfilled are known from 1960 onwards and based on the surveys ITOMA of ADEME.
Germany	The amount of landfilled municipal waste is taken from the Federal Statistics Office (1975 – 2004). The surveys of waste quantities commenced in 1975 on the basis of the Environmental Statistics Act in 1974. Waste quantities for the period from 1950 to 1975 were extrapolated on the basis of population data. Landfilled wastes after 1 June 2005 must not, according to the legislation, contain biodegradable components and do not, therefore, contribute to the generation of landfill gas. Data for landfilled waste in the former GDR in the 1980s were provided by a national study. According to that study the amount of landfilled waste per capita was significantly lower than in the old German Länder (190 kg/capita versus 330 kg/capita). For the years 1990 and 1993 for the new German Länder detailed data about landfilled municipal solid waste is available. Since 1996, differentiated data is available on landfilled quantities of individual fractions of industrial waste. The amount of landfilled industrial waste between 1975 and 1996 was derived on the basis of the overall amount of landfilled waste. The amount of landfilled industrial waste is kept constant between 1950 and 1975. Data on landfilled sludges from municipal and industrial wastewater treatment is available since 1975 for the Old German Länder and was extrapolated for the time period before 1975 based on population data as well as on the assumption that the amount of sludges from industrial wastewater remained constant.
Greece	Estimates on solid waste quantities generated are included in various reports from research programmes and studies, but refer to specific points in time rather than to a whole period, while different assumptions have been applied in each case for the estimation of quantities generated. Therefore, data for some years are either missing or are unreliable. The quantities of municipal solid wastes for the period 1960-2000 was estimated on the basis of population figures and coherent assumptions regarding generation rates per capita and day, in order to derive complete time series for waste quantities generated. For the rest of the period 2001-2011 more accurate data for the quantities of municipal solid wastes was used as they were provided by the waste management sector of the Ministry of Environment, Energy and Climate Change (MEECC). For the estimation of the quantities of municipal solid wastes the method was used in previous submission were based on the assumption that MSW generation rates was in the order of 0.8 – 1.1 kg/ capita and day, depending on the type of region (rural, semi-urban, urban, large urban regions) in 1997. According to the Ministry of Environment, Energy and Climate Change (MEECC) the MSW generation rate was assumed to change annually by 0.028 kg/ capita and day, while a higher figure (annual increase by 0.035 kg/capita and day) was assumed for the regions of Athens, Central Macedonia, Crete and the islands of South Aegean. A higher figure for MSW generation rate (2.1 kg/ capita and day) was considered for foreign visitors. For the period 1960 – 1990 the rates of annual per capita waste increase are lower (0.8% - 1.5% depending on the region).
Ireland	The EPA commenced the development of the National Waste Database (NWD) in the early 1990s to address a severe lack of information on waste production and waste management practices in Ireland. The database was needed to support radical reform of national policy and legislation on waste pursuant to the Waste Management Act of 1996 and subsequent Government

Member State	Data sources used for generating time series (6A1)
	strategies on sustainable development and waste management. National statistics generated from this database published on a three-year cycle, and interim reports published on a yearly basis since 2001 by the EPA are the primary basis for establishing the historical time-series of municipal solid waste (MSW) placed in landfills from 1995 onwards. Identification and risk assessment of historical landfills serves as the main source of information on landfilling of waste prior to 1995. The results of other surveys undertaken in previous years have also been used to some extent in compiling the MSW time series.
Italy	Basic data on waste production and landfills system used for the emission inventory are those provided by the Waste Cadastre. The Waste Cadastre is formed by a national branch, hosted by ISPRA, and by regional and provincial branches. The basic information for the Cadastre is mainly represented by the data reported through the Uniform Statement Format (MUD), complemented by those provided by regional permits, provincial communications and by registrations in the national register of companies involved in waste management activities. Since 1999, ISPRA yearly publishes a report, in which waste production data, as well as data concerning landfilling, incineration, composting and generally waste life-cycle data, are reported. It has been assumed that waste landfilling started in 1950. The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in landfills is reconstructed on the basis of different sources, national legislation and regression models based on population. Since waste production data are not available before 1975, they have been reconstructed on the basis of proxy variables. Gross Domestic Product data have been collected from 1950 and a correlation function between GDP and waste production has been derived from 1975; thus, the exponential equation has been applied from 1975 back to 1950. Consequently the amount of waste disposed into landfills has been estimated, assuming that from 1975 backwards the percentage of waste landfilled is constant and equal to 80%. The amount of waste disposed in managed landfills is yearly provided by the national Waste Cadastre since 1995. The time series has been reconstructed backwards on the basis of several studies reporting data available for 1973, 1988, 1991, 1994. In non-hazardous landfills industrial wastes assimilated to municipal solid waste (AMSW) could be disposed. Their composition must be comparable to municipal solid waste composition. From 2001, data on industrial waste disposed in municipal landfills are available from Waste Cadastre. For previous years, assimilated municipal solid waste production has been reconstructed, and the same percentage of MSW disposed in landfill has been applied also to AMSW. Apart from municipal solid waste, sludge from urban wastewater handling plants has also been considered. Sludge disposed in landfill sites has been estimated from the equivalent inhabitants treated in wastewater treatment plants, distinguished in primary and secondary plants, applying the specific per capita sludge production. The total amount of sludge per year can be treated by incineration or composting, or once digested disposed to soil for agricultural purpose or to landfills. As for the waste production, also sludge landfilled has been reconstructed from 1950. Starting from the number of wastewater treatment plants in Italy in 1950, 1960, 1970 and 1980, the equivalent inhabitants have been derived and consequently the amount of sludge disposed in landfill sites, assuming 80 kg $inhab.^{-1}$ yr^{-1} sludge production.
Luxembourg	Activity data were calculated in accordance to the MSW produced per capita/year. Data on the population are from STATEC. No national data on municipal waste production from 1950 to 1989 were available. Data from Germany for the years 1950 and 1975 were used. Data in-between were interpolated. Data for Luxembourg for the year 1990 were available (581 kg) which were nearly identical to the IPPC default values (560 kg). Data up to the year 2011 were from the Environment Agency taking into account the effect of aerobic decomposition at SIGRE since 1993 and at SIDEC since 2007.
Netherlands	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
Portugal	Since 1999, data on MSW is available, including production amounts, final disposal and, to a less extent, waste composition. For previous years information was available from the Strategic Plan on Municipal Solid Waste which was approved by the Government in 1997. This plan includes data from annual municipal registries. Another source of information is a research study performed by Quercus. The data was based on a survey performed in 1994, which enabled the calculation of per capita generation rates for 1994, based on the amounts of waste collected and the population served by waste collection. Before 1994, data on landfill wastes had to be estimated based on expert judgment for waste generation growth rates. For the period 1960-1980 it was considered a per capita waste generation growth rate of 2.5% per year; for the following years (1980-1994) 3% per year. To take into account the fact that part of the population (rural areas) was not served by an organised waste collection and waste disposal system, values of annual production were multiplied by the percentage of population served by waste collection in each municipality. After 2000, it was assumed that all the population of the country is served by waste collecting systems. The total amount of waste disposed to SWDS was then calculated based on this estimated value minus the amounts of waste incinerated and composted. The share of final disposal destiny for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems.
Spain	From 1990 onwards, the information is provided directly by the Ministry of the Environment (MMA) in the publication, “The Environment in Spain”. For large SWDS and those with biogas recovery, the activity data is derived from questionnaires provided by each landfill. For the calculation of emissions, the MSW quantities to consider are those deposited since 1970. In the period from 1970 to 1990, the calculation of the waste deposited at managed SWDS without biogas capture and

Member State	Data sources used for generating time series (6A1)
	unmanaged SWDS has been estimated by multiplying the coefficient of MSW generation per inhabitant and day, by the population, the number of days in the year and the fraction of MSW generated that is deposited in each type of landfill. In 2011, 37 landfills operated with landfill gas capture.
Sweden	Household waste: A first national survey was elaborated by EPA in 1980, similar data in 1985 and 1990 and 1994 were provided by Statistics Sweden, since 1994 an annual survey on landfilled waste is carried out by Avfall Sverige – Swedish Waste Management. Figures on sludge from wastewater treatment and garden waste are available since 1990. Industrial waste: There is information on industrial waste from the 1980s but organic fractions were not specified. Studies on quantities and treatment of organic waste from industry in 1993 and 1996 were carried out by the Swedish EPA. Landfilled wastewater sludge from the pulp industry (important waste fraction) was yearly documented until 2000 by the Swedish EPA. Today the sludge from the pulp industry is incinerated and composted. Since 2006 waste statistics are reported to the EU. The treatment of waste is to be reported by treatment method for the different types of waste according to EWC-Stat. The method of treatment relates to various recovery and disposal operations (“R and D codes”) are compiled into 5 different groups. Group 4, ”Disposal operations: Land filling, deep injection, surface impoundment, permanent storage and others”, is relevant for “Solid waste disposal on land, CRF 6A”. So far, waste data has been reported for the reference years 2004, 2006 and 2008. No waste statistics on landfilling are compiled for the intermediate years by SEPA. In 2010, a study was carried out in order to analyse possibilities to use the reported waste data to WStatR for the calculations of CH_4 from solid waste land-fills. The study recommended implementation of WStatR-data from reference year 2006 and onwards.
United Kingdom	Estimates of waste composition and quantities have been taken from different sources – prior to 1995 they are from Brown *et al.* (1999), prior to 2000 they are based on the LQM (2003) study and from 1995 they are based on new information compiled by Eunomia (Eunomia, 2011). The new waste to landfill data indicates a significant decrease in the amount of LA-controlled and C&I waste sent to landfill since about 2002 and 2003.

Source: NIR 2013

Some member states explicitly describe the consistency of their time series (compare Table 8.16).

Table 8.16 6A1 Managed Solid Waste Disposal: Consistency of time series of activity data

Member State	Consistency of time series
Austria	The amount of waste from administrative facilities of businesses and industries is not considered in the data from 1950 to 1999, whereas it is included in the Deponiedatenbank, which is used for the activity data from 1998 onwards. To achieve a consistent time series, data of the two overlapping years (1998 and 1999) were examined and the difference, which represents the residual waste from administrative facilities of industries and businesses, was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly. There is no explicit description of time series consistency for non-residual waste.
Belgium	In the Flemish region, input data of waste disposal sites are available since 1990. In Wallonia, complete statistics on the amount of waste input in solid waste disposal sites are delivered on a yearly basis since 1994. For the previous years, the amounts are estimated using available data and expert judgment from the waste offices.
Denmark	Registration of the amount of waste has been carried out since the beginning of the 1990s in order to measure the effects of action plans. The activity data are, therefore, considered to be consistent through the time series to make the activity data input to the FOD model reliable. The consistency of the emissions and the emission factor is a result of the same methodology and the same model used for the whole time series. The parameters in the FOD model are the same for the whole time series.
Finland	In Finland, the historical waste amount is assessed starting from the year 1900. The uncertainties in historical activity data (estimated on the basis of different weighting of the population and GDP that are assumed to be good indicators of the amount of waste) are large but the amount of waste produced at the beginning of the 1900’s was fairly small, thus reducing the significance of large uncertainties. The uncertainty estimates of the current amounts of waste are based on differences between different statistics and complemented with expert judgment. In the case of municipal sludge, the uncertainties in both historical and current activity data are quite large. On the other hand, the amount of industrial waste can be fairly accurately estimated based on industrial production, and therefore these uncertainties are the smallest in historical years. In Finland, the amount of landfill gas recovered is obtained from the Finnish Biogas Plant Register, and this figure is considered accurate. The time series’ consistency of rejects from wood waste is imperfect considering the classification of these wastes. These rejects have been classified according to the origin (e.g. construction and demolition waste) of the

Member State	Consistency of time series
	wood waste since 2010 inventory. These EWC codes (191212 and 191211) were classified only as solid industrial waste in earlier inventories. If necessary this classification change could be done for earlier years in the next submission, also.
France	The statistical data sources are the same throughout the time series.
Germany	Over the long activity-data period involved, thirty years, time series inconsistencies are inevitable. In Germany, such inconsistencies are primarily a result of German reunification and the fusion of two different economic and statistical systems. Further aspects are changes of legislation and statistics in the waste sector.
Greece	The time-series consistency of emissions is controlled by applying consistent methodologies and verified activity data in line with IPCC guidelines. In case of changes or refinements in methodologies and EFs based on plant-specific data time-series consistency is ensured by performing recalculations according to the IPCC good practice guidance.
Ireland	The methodologies used in the derivation of emissions estimates from the waste sector are consistent over the time series. In the case of category 6.A, this consistency applies to all three components that determine the ultimate emissions, i.e. CH_4 generation, CH_4 flared and CH_4 utilised. Adoption of the model in the 2006 IPCC Guidelines is justified by the information available for its detailed application and brings Ireland into line with other Parties using this methodology well in advance of the expected mandatory use of these guidelines for inventory reporting post-2012.
Italy	No detailed description of time series consistency.
Luxembourg	No information available.
Netherlands	The estimates for all years are calculated from the same model, which means that the methodology is consistent throughout the time-series. The time-series consistency of the activity data is very good due to the continuity in the data provided.
Portugal	No detailed description of time series consistency.
Spain	Approaches in line with IPCC Good Practice Guidance are used for the activity data. Detailed descriptions are provided how some of the estimation parameters such as DOC have been interpolated.
Sweden	The times series in the waste sector are calculated consistently, and when statistics are not produced annually, interpolation and extrapolation have been necessary tools for imputation.
United Kingdom	The estimates for all years have been calculated from the MELmod model and thus the methodology is consistent throughout the time series.

Source: NIR 2013

The amount of waste disposed on SWDS depends on the total amount of waste generated and on the per capita waste generation rate, respectively. However, solid waste disposal in EU member states is not estimated based on the per capita waste generation rate; the waste generation rate is not a parameter used in the higher tier emission estimation. All member states use higher tier methods for the estimation of emissions from solid waste disposal, based on national statistics of solid waste disposal on waste disposal sites (see Table 8.2).

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability; neither the UNFCCC reporting guidelines, nor the CRF, nor the IPCC Guidelines provide an exact definition which waste types and waste streams should be included in the estimation of the waste generation rate.

For instance, in Austria considerable amounts of composting are reported under 6D (other), which means that the composted waste is excluded from 6A. Between 2000 and 2011, the waste generation rate in Austria as reported in CRF table 6A,C decreased from 0.64 kg/capita/day to 0.09 kg/capita/day. This decline is due to a drop in the amount of annual municipal waste disposed on landfills (which is the basis for the calculation of the waste generation rate in Austria) by 85 % in the same period while the population only increased by 5 %. Since 2009, no further deposition of residual waste takes place on Austrian landfills, while there is still some non-residual waste landfilled (with a decreasing trend).

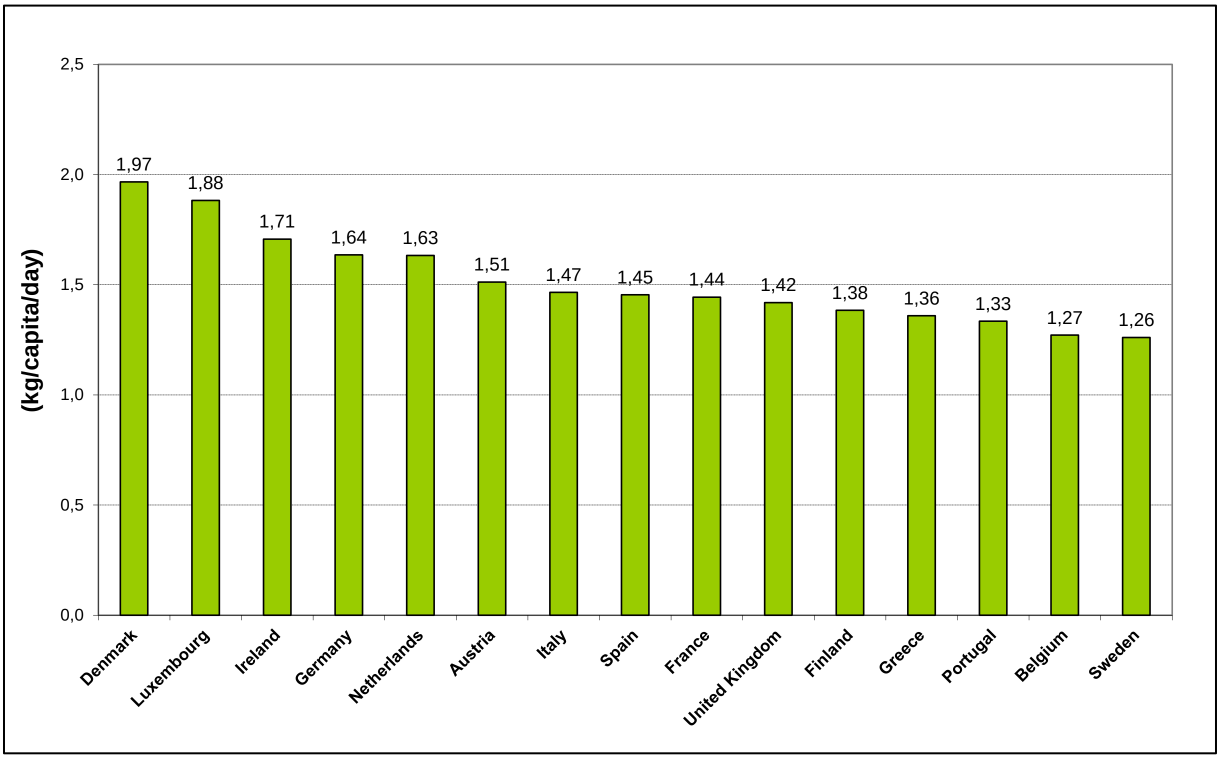
In Spain, tourists increase the amount of waste, but are not reflected in the population numbers.

It is difficult to explain the differences for all member states from the information available in the NIR. Because of the different coverage of wastes included, the waste generation rate reported does not reflect policies and measures to reduce waste generation.

To understand the background of the differences in the MS a decomposition analysis of this parameter would be necessary, but drivers are poorly monitored, such as the links between waste generation and public awareness on waste or the amount of waste generated by tourists.

Therefore, Figure 8.3 shows the waste generation rate for EU-15 member states for 2011 based on EUROSTAT data. On the basis of the Regulation on waste statistics (EC) No. 2150/2002, amended by Commission Regulation (EU) No. 849/2010, data on the generation and treatment of waste is collected from the member states. The information on waste generation has a breakdown in sources (several business activities according to the NACE classification and household activities) and in waste categories (according to the European Waste Classification for statistical purposes). The information on waste treatment is broken down to five treatment types (recovery, incineration with energy recovery, other incineration, disposal on land and land treatment) and in waste categories. The waste generation rate per capita ranges from 1.26 kg/capita/day for Sweden to 1.97 kg/capita/day for Denmark.

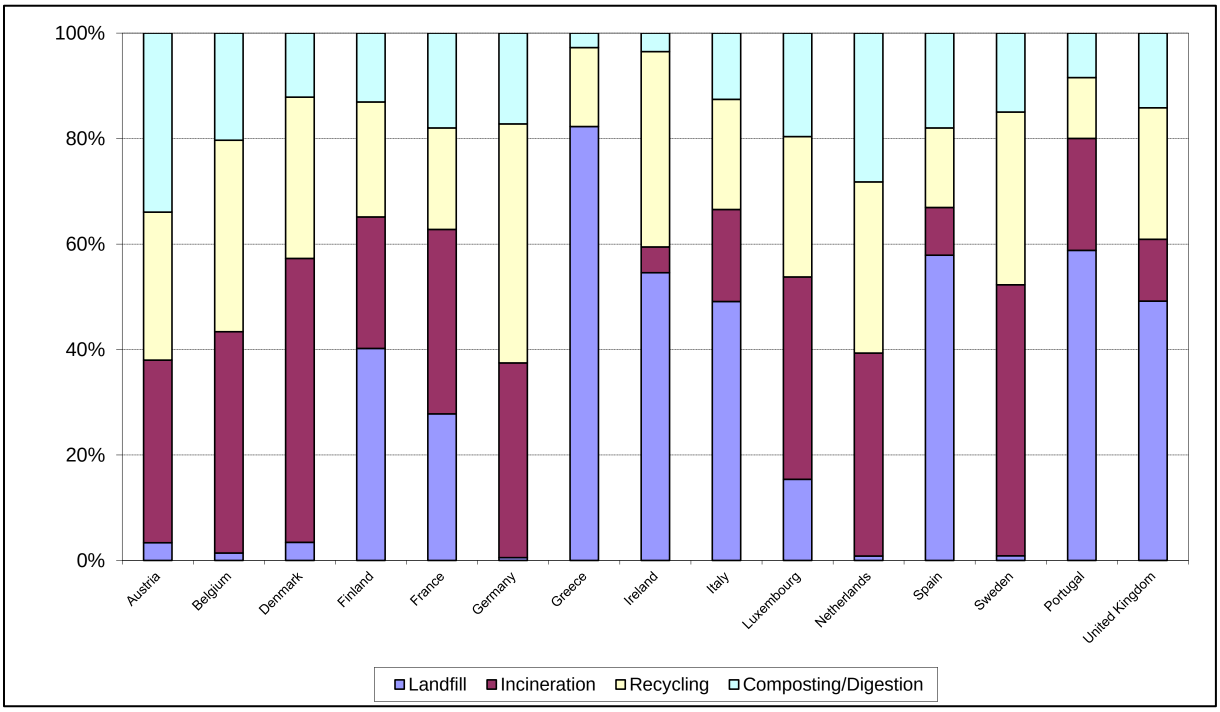
Figure 8.3 6A1 Managed Waste Disposal: Waste Generation Rate, 2011



Source: EUROSTAT 2013, own calculations

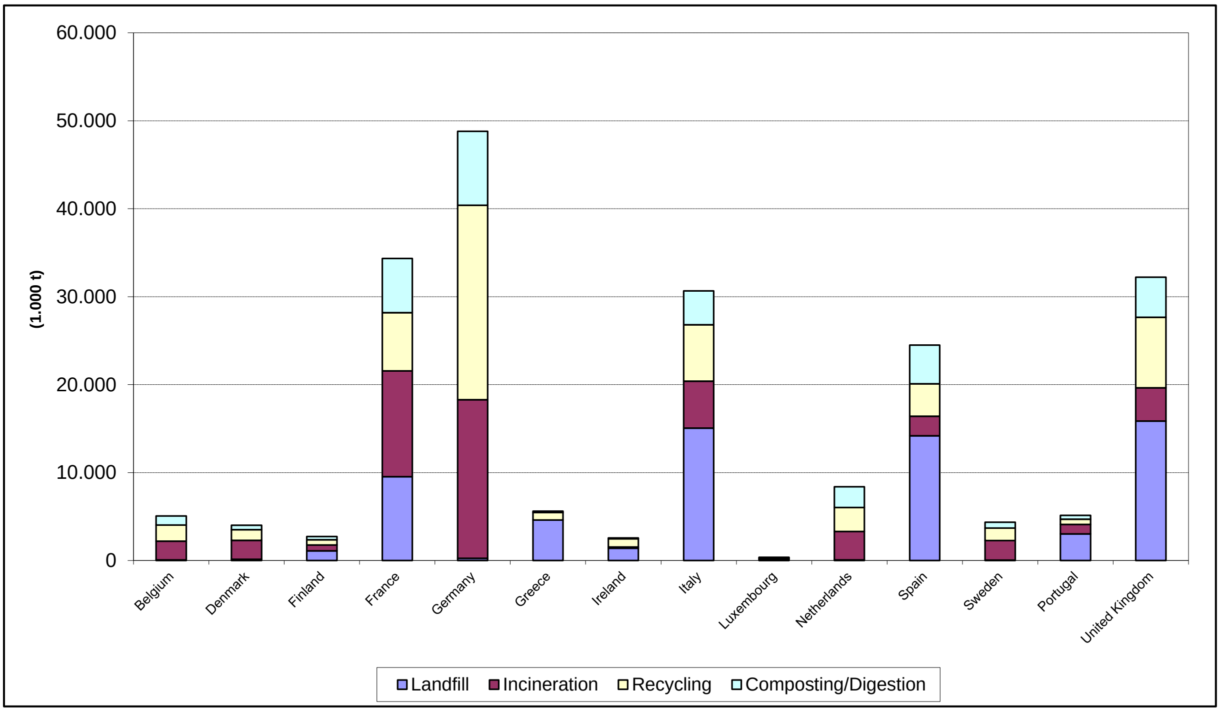
The amount of waste disposed on SWDS is also strongly influenced by the waste management practices in the member states: by the share of waste landfilled, incinerated, recycled and treated in other ways (including composting and digestion), compare Figure 8.4 and Figure 8.5.

Figure 8.4 **6A1 Managed Waste Disposal: Waste management practices in the EU-15 (shares) in 2011**



Source: EUROSTAT 2013, own calculations

Figure 8.5 **6A1 Managed Waste Disposal: Waste management practices in the EU-15 (absolute values) in 2011**



Source: EUROSTAT 2013, own calculations

Many member states experienced a reduction of waste landfilled and an increase of recycling, composting and landfill gas recovery. These trends have already taken place before the Landfill Directive and the Directive on packaging waste, but are further supported by these directives.

The waste management practices and policies which determine the fraction of municipal solid waste (MSW) disposed to SWDS, the fraction of waste incinerated and the fraction of waste recycled or composted differ significantly between the member states. For example, disposing waste on SWDS is the predominant waste disposal route in Greece and Ireland with correspondingly fewer quantities of waste incinerated, recycled and composted. The low share of incineration is also due to public concern about the use of large-scale waste incineration. In Germany, Denmark and the Netherlands it is vice versa. Since 2005, landfills in Germany remaining in operation may only store waste that conforms to strict categorisation criteria. Landfills also must reduce landfill gas formation from such waste by more than 90 % compared to gas production from untreated waste. In the Netherlands, waste policy also has the aim of reducing landfilling by introducing bans for the landfilling of certain categories of waste, e.g. the organic fraction of household waste (in the early 1990s) and by raising the landfill tariff to comply with the incineration of waste.

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. While the first three parameters do not vary strongly among the member states, more information is provided on the DOC (Figure 8.6 and Table 8.18) as well on waste composition of land filled waste (Table 8.17). The latter parameters are again strongly influenced by waste management practices and policies.

Table 8.17 6A1 Managed Solid Waste Disposal: Waste composition of landfilled waste

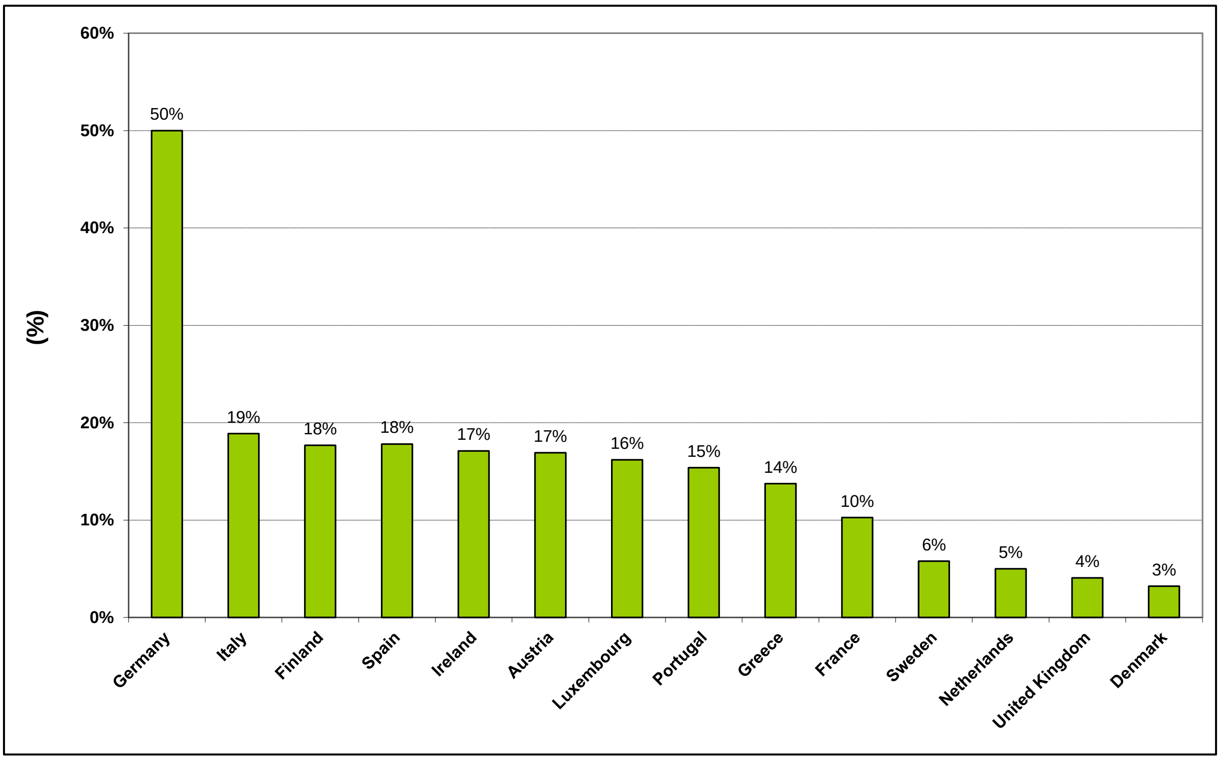
Member State	Composition of landfilled waste
Austria	Two main categories of waste are distinguished: residual waste and non-residual waste. Residual waste refers only to the part of municipal solid waste collected by the municipal system (mixed composition) that is directly deposited without any pretreatment. Non-residual waste comprises among others municipal solid waste having been pretreated, sludge from wastewater treatment and waste from industrial sources. Detailed values such as for the half-life period, DOC, and DOCF are available for these waste types. The composition of residual waste is specified according to different waste fractions.
Belgium	Waste types are differentiated into municipal and industrial waste and subcategories. Several values for DOC, DOC_F and k are given.
Denmark	Eight waste categories are considered: domestic waste, bulky waste, garden waste, commercial & office waste, industrial waste, building & construction waste, sludge, ash & slag. As material fractions, nine types are differentiated: food waste, cardboard, paper, wet cardboard and paper, plastics, other combustibles, glass, metal and other non-combustibles.
Finland	Solid municipal waste, municipal sludge, industrial sludge, solid industrial waste, construction and demolition waste, industrial and municipal inert waste, and other inert waste are considered as waste groups. These groups are further split into several subgroups. The composition of solid municipal waste is paper and paperboard, food, garden, plastics, glass, textiles, napkins, wood, other (inter) and other (organic). Detailed DOC values are provided in the NIR.
France	The method used differentiates between easily biodegradable, average degradable and weakly biodegradable waste.
Germany	Several studies on the waste composition were evaluated. The analysis for the Old German Länder was performed for different waste types: household waste (organic material, paper/cardboard, composites, textiles, diapers, and wood), commercial waste, and bulky waste (organic material, paper/cardboard, textiles, and wood). For the former GDR waste fractions were taken from a study. According to that study, household waste in the GDR was composed of vegetable waste, paper/cardboard, wood, rubber, composites as well as textiles.
Greece	Accurate data on the composition of municipal solid waste generated at national level are not available, as a comprehensive analysis at national scale covering a complete time period (so as to take into account seasonal variations because of tourist activity) has not been accomplished yet. However, measurements in some regions have been carried out, although they refer to different time periods. The composition of generated MSW comprises the

Member State	Composition of landfilled waste
	following fractions: Food and non-food, textiles, wood, paper, plastics, metals, glass, and rest.
Ireland	Waste constituents of MSW that contribute to DOC are food waste, paper, wood, textiles and disposable nappies. Furthermore, street cleanings and sludge from municipal wastewater treatment are considered.
Italy	An in-depth survey has been carried out, in order to diversify waste composition over the years. A fourth slot (2006-2009) has been individuated on the basis of the analysis of several regional waste composition and the analysis of waste disposed into non-hazardous landfills specified by CER code for the year 2007, available from Waste Cadastre database. The following waste fractions are considered: organic, garden and park waste, paper and paperboard, nappies, textiles and leather, sludge and wood.
Luxembourg	Waste composition is exactly known since 1992. The data from the national waste composition analysis 1992/94 were used until 2003. For the years 2004 to 2009 the data from the 2011 study were used taking into account the aerobic pre-treatment before landfilling. For 2010-2011 values of the composition of the waste are as of 2009. For the years before 1992 no data are available. Luxembourg oriented its values near the IPPC default values but some changes were made: 1950-1974 it is assumed that the fractions “food”, “paper” and “wood” landfilled were lower. The difference was allocated to the fraction “plastics, other inert” waste. For the years before 1992 no data are available. Waste composition comprises the following fractions: food, garden, paper, wood, textile, nappies and plastics, other inert.
Netherlands	An average DOC value for waste as a whole is provided changing over time due to such factors as the prohibition of landfilling of combustible wastes.
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes. For the fermentable fractions of urban waste the following categories apply: paper and textiles, non-food fermentable materials, food waste, and wood or straw. For industrial waste several groups exist: paper and textiles, garden waste, park waste or other non-food organic putrescibles, food waste, wood or straw, fuels, plastics, sludge from natural origin, sludge from non-natural origin or hydrocarbons, synthetic fibres, and non-natural organic substances.
Spain	The composition of municipal solid waste comprises the following categories: organic matter, paper and cardboard, plastics, glass, ferrous metals, non-ferrous metals, wood, textiles, rubber and latex, disposable and rechargeable batteries, other. For waste from origins other than direct household collection, other categories apply: compost, waste water sludge and others. Specific information on the waste composition is provided based on questionnaires by plant operators.
Sweden	Landfilled waste includes includes household and similar waste, park and garden waste, industry- and non-industry specific waste (organic fractions), industry- and non-industry specific waste (organic and inorganic fractions), construction and demolition waste (organic and inorganic fractions) and sludge from wastewater handling and pulp industry.Deposited waste is further broken down into different waste fractions for household and industrial wastes.
United Kingdom	The UK method divides the waste stream into three categories of waste: rapidly degrading, moderately degrading, slowly degrading, and inert. A further detailed breakdown of the waste composition is available in the NIR.

Source: NIR 2013

Fraction of Dissolved Organic Carbon (DOC) in MSW: The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste. Member states have MSW with widely differing waste compositions. While the average DOC value in MSW is illustrated in Figure 8.6, Table 8.18 provides corresponding detailed information on the DOC values extracted from the NIR.

Figure 8.6 **6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW**



Source: CRF 2013 Table 6A,C Additional information.

Table 8.18 **6A1 Managed Solid Waste Disposal: Further information on DOC values**

Member State	Further information on DOC values
Austria	Detailed values for DOC_F and DOC differentiated with respect to the waste type are available in the NIR. A time series of bio-degradable organic carbon content of directly deposited residual waste is available for the years 1950 to 2008.
Belgium	Municipal waste is divided into 10 main fractions during sorting analysis in the Flemish region. These analyses were carried out in 1985, 1993-1994, 1994-1995 and 1995-1996 by the Flemish institute OVAM. These fractions are connected to biodegradation rates (quick, average and slow). These data are the basis for the amount of organic carbon which is actually degraded. The DOC values in the Walloon region for municipal and industrial waste were calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology.
Denmark	The DOC content is available for the waste categories food waste, cardboard, paper, wet cardboard and paper and other combustibles. DOC values for other combustibles are further differentiated in the waste types domestic waste, bulky waste, garden waste, commercial and office waste, industrial waste, building and construction waste, sludge as well as ash and slag.
Finland	DOC fractions of different types of waste are based on the IPCC 2006 default values and national research and measurements made in industry (revised DOC value for de-inking sludges). DOC values of groups (solid municipal waste, municipal and industrial sludge (from dry matter), solid industrial waste, construction and demolition waste, industrial inert waste, and other inert waste) and of subgroups are provided in the NIR.
France	An average DOC of 150 kg/t for the easily degradable waste, 75 kg/ton is used for the average degradable waste and 0 for the weakly degradable wastes. The annual average DOC varies between 102 and 110 kg/ton.
Germany	For the DOC, national and IPCC default factors were used. The following values were chosen: Organic material: 18%, garden and park waste: 20%, paper and cardboard: 40%, wood and straw: 43%, textiles: 24%, diapers: 24%, composites: 10%, sludges from wastewater treatment: 50%, waste from MBT facilities 2.3%.
Greece	Time series of total amounts of DOC for waste on managed and unmanaged waste disposal sites as well as of sludge are provided. Degradable organic carbon (DOC): 0.4 for paper and textiles (default value), 0.3 for wood (default

Member State	Further information on DOC values
	value), 0.15 for food waste (default value), 0.17 for non-food waste and 0.4 for sewage sludge.
Ireland	The waste constituents of MSW that contribute to DOC are food waste, paper, wood, textiles and disposable nappies are identified in the available NWD breakdown for 1995, 1998, and 2001 through 2011. The IPCC default proportions of DOC content are used for all these constituents. Street cleansing composition data is available, and the DOC content is therefore calculated from its constituent components. In addition, a DOC content of 5 percent has been assumed for sewage sludge.
Italy	On the basis of data available on waste composition, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated.
Luxembourg	Waste analysis is being used to determine IPCC waste fractions to which default DOC contents are applied. The composition of the combustible fraction taken off the SIDEC waste and delivered to the MWI was analysed in 2009. This fraction having a higher C content than the average waste was taken into account for the calculation at the MWI.
Netherlands	The DOC changes over the time series. This change in DOC values over time is due to such factors as the prohibition of landfilling of combustible wastes.
Portugal	The estimation of DOC for urban waste is based on information on the waste composition from several sources. Furthermore, DOC values are available for the different groups of industrial waste. These DOC values resulted from weighted averages based on the quantities reported for each EWC category considered and the respective assigned DOC, and refer to disposal on land.
Spain	The degradable organic carbon content in MSW is obtained by applying equation 5.4 of the IPCC Good Practice Guidance to the data on the standard composition information derived from the data evaluated in the corresponding questionnaires provided by landfills that perform biogas capture as well as the information on the national mean standard composition from the remaining landfills that is provided by the publication “The Environment in Spain”. For waste from origins other than direct household collection, specific values based on the IPCC 2006 Guidelines have been used for compost plants (0.2), waste water sludge (0.175) and others (0.04).
Sweden	IPCC values for gas potentials are used for the different fractions of household waste, as well as garden waste. Estimated DOC contents for each waste category are provided.
United Kingdom	A detailed review of waste composition, in terms of materials, moisture content and dissimilable degradable organic carbon (DDOC) content has been undertaken and the results are described in Eunomia’s report (Eunomia, 2011). The new methodology calculates the DDOC content of various waste materials through reference to the lignin and non-lignin content.

Source: NIR 2013, CRF 2013, Table 6A,C Additional information

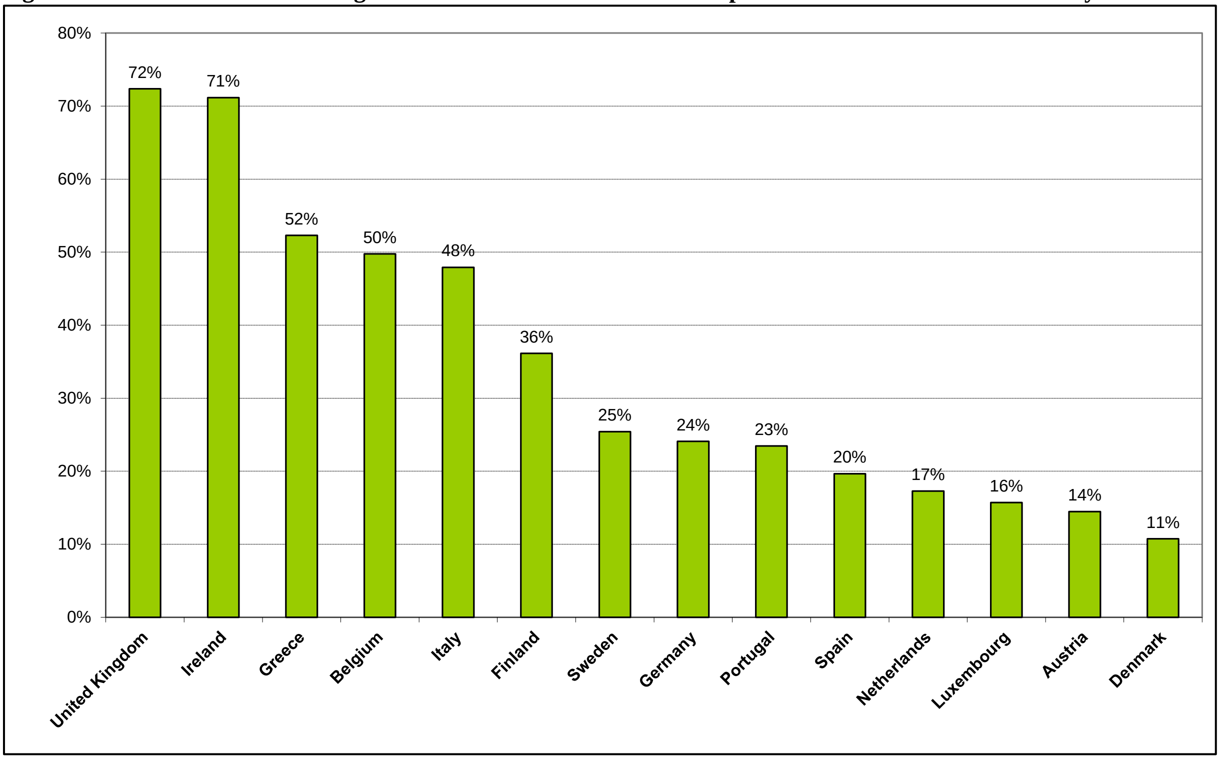
Figure 8.6 presents an average DOC, however usually different DOC values for individual waste fractions are used. In the case of the United Kingdom, a detailed review of waste composition with regard to materials, moisture content and dissimilable degradable organic carbon was carried out. For Austria composting of biodegradable waste is reported separately. Consequently, considerable amounts of waste with high DOC are excluded from category 6A which results in a lower DOC for the remaining MSW. In Italy, DOC values are based on different national studies. In addition the DOC reflects the considerable reductions achieved in diverting biodegradable waste to other waste management methods such as composting or mechanical-biological treatment.

Besides lower quantities of organic carbon deposited on landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills.

Methane recovery: The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered, compare Figure 8.7, varies among the member states between 11 % in Denmark and

72 % in the United Kingdom and depends on the share of solid waste disposal sites that are able to recover CH_4 (see Table 8.19).

Figure 8.7 6A1 Managed Solid Waste Disposal: Methane recovery rates



*CH_4 recovery in % = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100*
Source: CRF 2013 Table 6A,C

Compared to last year's information the methane recovery increased for seven member states, out of which for one with a significant increase[39] (Greece: +10.2 %). For seven MS, the share remained constant or decreased, out of which for three with a significant decrease: Germany: -20.7 %, Denmark: -5.8 % and Ireland: -5.2 %. In the case of Germany, methane recovery also decreased in the previous year which may be an indicator that landfill gas production is decreasing and that landfilling policies implemented in the past are showing effects.

Recovery from UK landfills is financially driven, as the set minimum price given for the electricity generated in UK landfills results in a large financial incentive for recovery operators to collect all the gas produced. Furthermore, regulatory pressure exists to require a high level of gas collection in order to conform to the requirements of the 1993 Landfill Directive.

CH_4 recovery in EU-15 amounts to 50 % of generated CH_4. Methane recovery is further promoted by the Landfill Directive, and monitoring programs will need to be established. The recovery potential depends on the waste management strategies, e.g. diverting organic fractions to composting leaves more inert materials on landfills and reduces the potentials to recover and use CH_4 (as in the case of the Netherlands, Austria or Denmark). Compared to last year's inventory report, CH_4 recovery for the EU-15 increased by 3 %.

Moreover, member states use different methods to determine CH_4 recovery. Belgium, Finland, Luxembourg, the Netherlands and Spain use measured plant-specific data. In Austria, France, Ireland,

[39] Changes in comparison to last year's submission refer to percentage points.

Italy and Portugal surveys are carried out. Denmark and Sweden take the data from their energy statistics. Germany uses statistical data as well as expert judgment.

Table 8.19 6A1 Managed Solid Waste Disposal: Further information on methane recovery

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
Austria		Excavated soil material landfills: 475 (2008) Construction and demolition waste landfills: 82 Residual waste landfills: 42 (2010) Mass waste landfills: 34 (2010)	In 2004, the amount of annual collected landfill gas was investigated by questionnaires to landfill operators showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990, only 9 landfills were equipped with landfill gas wells. In 2001, at all operating mass landfills landfill gas was collected. In 2008, a further study was conducted sending questionnaires to landfill operators to get data on collected landfill gas and information on its use. Results show that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice). As no new information on the amount of landfill gas recovered is available for the years 2008 to 2011, the mean value of the recovery rate of the years 2002 to 2007 was taken as a proxy (13.2 %) to calculate the actual amount of landfill gas recovered. Moreover, the changing methane concentration in recovered landfill gas – decreasing from 48% (2002) to 45% (2007) – has been considered in the calculation, resulting in less methane recovered and higher methane emitted accordingly. This is mainly due to the extensive capturing of landfill gas and the dilution of the landfill gas captured. For the years 2008-2011 the same methane concentration as 2007 is assumed.
Belgium			In Flanders, recovery is considered separately for flaring and valorisation, in accordance with the IPCC guidelines. For energetic valorisation, recovery of landfill gas (volume of CH_4) has been calculated based on measurements at the individual SWDS. These data are available from the Flemish Energy Balance from 2001 onwards. For flaring, recovery is assumed to be zero (IPCC default value), due to the absence of data based on measurements. In Wallonia, methane is recovered since 1993. The amount of CH_4 recovery is measured in all the SWDS which are equipped with recovery system. For Wallonia, the information is provided by the landfills owners under their environmental reporting: they declare each year the volume of biogas for motors or flaring and the fraction of CH_4 and CO_2. The CH_4 content is measured by landfill owners as it determines the possible use of the biogas (only "rich" biogas" is used in engines, the rest is flared).
Denmark	16 (2007)	53 (still active; 2007)	Energy producing installations at 16 sites are registered. The Danish Energy Agency registers the biogas amounts recovered at disposal sites in energy units which are then converted to volume of gas.
Finland	39		Data on landfill gas recovery are obtained from Finnish Biogas Plant Register.
France		310 (244 active)	Questionnaires were sent to all landfills in order to find out about the quantity of landfill gas capture in private landfills (differentiated to flaring and energy use). Values for 2008 to 2011 are available. The values for the years 1990-2008 were extrapolated.
Germany		150	Until 1998, landfill gas capture is taken from expert judgments based on different data sources. From 1999 to 2005 a share of landfill gas capture of 19.3 % is assumed (based on landfill gas capture data in 2004). Similarly, landfill gas capture rates in 2006/2007, 2008/2009 and 2010/2010 are based on capture data in 2006, 2008 and 2010, respectively. For the years 2004, 2006, 2008 and 2010 statistical data on landfill gas capture is available.
Greece	4		According to data from the Ministry for Environment, recovery and flaring of biogas constitute management practices in the 4 major managed SWDS of Greece (in the cities of Athens, Patra, Thessalonica and Larissa). For two of these sites, Athens and Thessalonika, biogas is used for energy generation. For the other two sites, Patra and Larissa, flaring of biogas constitutes management practice for environmental

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			protection and not for energy recovery. Thus, the collection of data on the amount of biogas flared has not been yet possible for these sites and the estimation of biogas recovered was based on the assumption that for technical reasons, 60% of biogas released is finally recovered and flared. For the SWDS of Athens and Thessalonica, data were collected by the National Energy Balance.
Ireland	10		A survey of landfill sites in 2010 to collect data for the years 2008 and 2009 was undertaken. The study was aimed at validating the values for 2008 as there were known issues with the information presented in the previous study and collecting information on flaring and utilisation for 2009. The survey was sent to 49 sites (both open and closed sites) on which flaring and or utilisation of landfill gas is known to occur. The same survey was conducted in subsequent years to obtain data for 2010 and 2011 from all 49 sites. Information on the number of flares in use, together with data relating to flare capacity, run time and performance was used to estimate the volume of landfill gas flared at each site. The tonnage of CH_4 flared was calculated from landfill gas volume by accounting for gas temperature (assumed to be ambient air temperature) and pressure (provided in survey returns) and by using methane destruction efficiencies of 50 percent for open flares and 98 percent for closed flares. The study found that there were ten methane utilisation plants at landfills in Ireland in 2011 with a total of 27 engines. The amount of methane input to landfill gas utilisation plants is calculated from their known electricity outputs as obtained by SEAI from EIRGRID (Electricity Transmission System Operator) using an overall efficiency of 34.6 percent for the engines, which is considered typical of the engine types in general use.
Italy			The amounts of methane recovered and flared have been estimated taking into account the amount of energy produced, the energy efficiency of the methane recovered, the caption efficiency and the efficiency in recovering methane for energy purposes assuming that the rest of methane captured is flared. The total CH_4 recovered is the sum of methane flared and methane used for energy purposes. The methane used for energy production is estimated starting from the electricity produced annually by landfills assuming an energy conversion efficiency equal to 0.3, typical efficiency value for engines that produce electricity from biogas. The methane flared has been estimated for the years 1990-1997 on the basis of information supplied by the plants; for the following years the methane flared has been estimated on the basis of information supplied by the main operators regarding the efficiency in recovering methane for energy purposes with respect to the total methane collected. This value increased from 60% of the total, in 1998, to 70% since 2002.
Luxembourg	1	2	At the SIGRE site, a methane recovery system is operated since 2000, and, since 2002, at the SIDEC site. Recovery of landfill gas started in 2002 (flaring) and 2000 (electricity and heat plant), respectively. Recovered CH_4, as determined from monthly reports of the landfill operators (measured quantities) is subtracted from the estimated emissions. Data on CH_4 recovery is also available (from 2001 onwards) from the annual reports from SIGRE and SIDEC being sent to the Environment Agency in accordance to their permits.
Netherlands	53 (2011)	22 operating landfills (2011) and a few thousand older sites that are still reactive	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
Portugal	26	34 (in exploration, 2011)	Data on landfill gas recovered and combusted is flared or used for energy purposes. The first quantities of biogas consumed for energy purposes reported by DGEG (the national energy authority) refer to 2004. This situation is related to the fact that the great majority of landfills have been implemented in the late 90s or the early 2000s. However, flaring (without energy recovery) started before. In order to account with this practice, the APA launched a questionnaire in 2012 with the aim of collecting the total amount of landfill gas combusted either in flaring (without energy recovery) or used for energy purposes. This inquiry is focused on the more recent years (since 2005) in order not to overload the waste systems managers. As regards the coverage of

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			the APA´s questionnaire, it considered all managed SWDS, which totals, in 2011, 34 landfill sites in exploration (receiving waste) in Mainland, plus 3 closed landfill sites which do not receive waste anymore (but burn biogas). Landfill sites in the 2 Autonomous Regions do not burn biogas. Out of the 37 landfill sites (corresponding to 23 different management entities) considered, 11 landfills reported not to burn biogas. From the 26 sites burning biogas, only data referring to measured data and no extrapolation was done to consider estimates from models. CH_4 recovered in flares and valorised for energy purposes is estimated on the basis of average biogas flows (continuous measurement) and the number of hours of burning. The concentration of CH_4 in biogas used in the estimates of the CH_4 quantities refer to monitoring plans (quarterly measurements) measuring the biogas quality at the entrance of the flares or the biogas energy recovery system. The annual quantities of biogas burnt (in flares and energy recovering units) reported by each landfill (in cubic meters) were converted into CH_4 amounts considering the CH_4 percentages in biogas (based on measurements) reported by management systems.
Spain	37		37 landfills in Spain have landfill gas recovery systems. Landfill gas is partly flared, partly utilized for energy purposes.
Sweden	57 (2011)	79 (2011)	In Sweden the first plant for biogas extraction from landfills was started in 1983. The business has increased until 2003 when gas was recovered in 72 plants. Since 2009, about 57 gas plants are in operation, and the amount of recovered gas is now decreasing because of the dramatic reduction of deposition of organic waste. Information on recovered gas (in energy units) is provided by Avfall Sverige and converted to use quantities by Statistics Sweden.
United Kingdom			A key factor in determining methane emissions is information on the amount of methane collected, either for utilisation or flaring. Data on utilisation is available and of good quality, but data on flaring is generally scarce and of poor quality. The current inventory is based on the estimates of gas collection efficiency developed by Golders (2005) and described in further detail in their report and in subsequent inventory reports. The adopted recovery rates for modern landfills are estimated to have increased from 15% of the methane generated in 1990 to about 75% by 2005 and are assumed to have remained constant thereafter, with no gas collection for old pre-1980 closed sites. The continued use of the 75% time integrated collection efficiency for modern landfills was agreed with peer reviewers of the latest review of the assessment model input data undertaken by Eunomia.

Source: NIR 2013

Industrial waste: Data on industrial waste may be difficult to obtain in many countries. DOC default values for industrial waste are not provided by the IPCC. Table 8.20 illustrates how industrial waste is considered in the individual member states. Three member states (France, Ireland, the Netherlands) do not consider or provide very little information on industrial waste in the NIR.

Table 8.20 6A1 Managed Solid Waste Disposal: Methodological issues regarding industrial waste

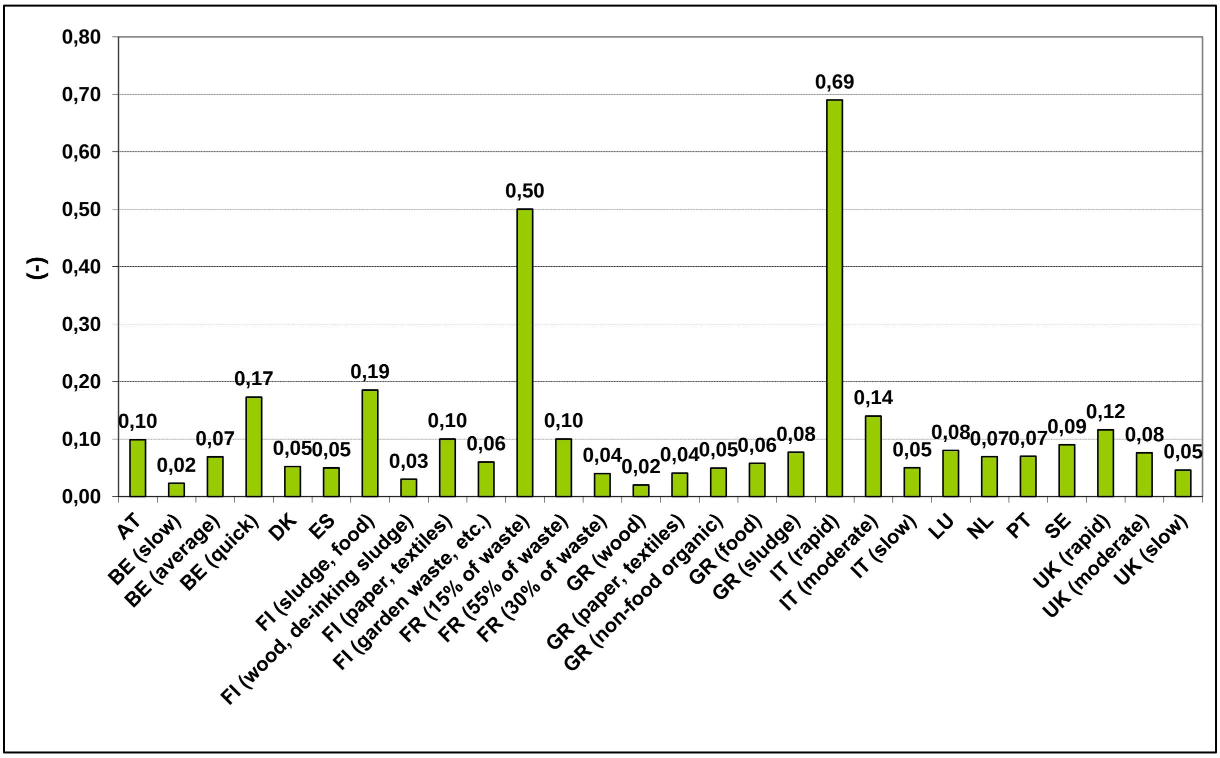
Member State	Industrial waste
Austria	Industry is referred to as one source both for residual and non-residual waste. Several waste types with their respective waste identification numbers are described. These are not clearly referenced as industrial wastes, though.
Belgium	In the Flemish region, industrial waste is taken into account in the modelling. Values for the combination of organic carbon content and decay rate are available. In Wallonia, CO_2 and CH_4 emissions from solid waste disposal on land are calculated with a first order decay model that considers separately the emissions of industrial and municipal waste until 2008. After 2008, industrial and municipal wastes

Member State	Industrial waste
	are reported together. Emissions from industrial waste are calculated with the same model as municipal waste. The DOC value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology.
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in the emission model.
Finland	Industrial solid waste and industrial sludge as well as industrial inert waste are considered as waste groups which are further broken down to waste types. Activity data and DOC values are provided in the NIR.
France	Industrial waste is included in the estimation.
Germany	The Federal Statistical Office provides detailed data about landfilling of industrial waste since 1996. In the inventory, waste quantities from the following industry branches are considered: wastes from agriculture, horticulture, forestry, fishery and food processing, wastes from wood processing, wastes from the production of cellulose, paper and cardboard, wastes from the textiles industry, packaging wastes as well as the wood fraction from construction and demolition wastes.
Greece	Industrial waste amounts disposed in land provided by ELSTAT are used. These amounts are collected by the experts of ELSTAT based on individual researches (e.g. questionnaires sent to industries, etc.). It must be noticed that these data are provided by ELSTAT only for the years 2004, 2006 and 2008. Thus, the historical data necessary for the rest of the years were estimated by using relative drivers i.e. the Greek GDP for the case of paper, wood and textiles and the Gross Production Value of livestock for the case of animal waste from food preparation and products, for the period 1960 to 2009. According to the data provided by the ELSTAT, industrial waste refers to animal waste from food preparation and products, paper, wood, textiles, mixed waste residues and sorting waste residues.
Ireland	Industrial waste neither mentioned nor considered explicitly.
Italy	In non-hazardous landfills industrial wastes assimilated to municipal solid waste (AMSW) could be disposed. Their composition must be comparable to municipal solid waste composition. From 2001, data on industrial waste disposed in municipal landfills are available from Waste Cadastre. For previous years, assimilated municipal solid waste production has been reconstructed, and the same percentage of MSW disposed in landfill has been applied also to AMSW. The complete database of AMSW production from 1975 to 2000 is reconstructed starting from data available for the years 1988 and 1991 with a linear interpolation, and with a regression model based on Gross Domestic Product. From 1975 back to 1950 AMSW production has been derived as a percentage of MSW production; this percentage has set equal to 15%, which is approximately the value obtained from the only data available (MSW and AMSW production for the years 1988 and 1991).
Luxembourg	Today, there are no landfill sites for purely industrial waste in Luxembourg. However, one site existed in the past and it has been closed down in the early 1990s (Ronnebierg site). The emissions of the closed industrial waste disposal on land site (Ronnebierg) are estimated for the period 2000 to 2011.
Netherlands	Industrial waste is neither mentioned nor considered explicitly.
Portugal	The fermentable part of industrial waste is considered. Historical time series are based on 1999 data which refer to annual registries relating to industrial unit declarations sent to the regional environment directorates which have been estimated on expert judgment. For the period 1960-1990 it was considered a growth rate of 1.5% per year; for the following years (1990-1998) 2% per year. Data for the years 2000, 2002 and 2003 refer to annual registries. The year 2001 refer to estimates based on the average of 1999 and 2000 data. Data for period 2004 to 2006 are interpolated values based on the 2003 and 2007 figures. Data from 2007 onwards refer to data collected under the Waste Registry. All industrial waste generated was considered to be disposed in SWDS together with urban waste. However, as there is no available information concerning final industrial waste disposal, it was assumed that all estimated waste produced has followed the urban disposal pattern between uncontrolled and controlled SWDS. Except for DOC, the same parameters are used for industrial waste as for municipal waste.
Spain	In questionnaires to landfill operators, information is collected also on “other non-classified waste”, such as construction waste, ash from combustion processes and industrial wastes.
Sweden	Detailed description available in the NIR of how activity data and emissions of relevant industrial wastes and sludges are generated.
United Kingdom	Industrial waste is not mentioned explicitly in the NIR.

Source: NIR 2013

Methane generation rate constant: CH_4 is emitted on SWDS over a long period of time rather than instantaneously. The tier 2 FOD model can be used to model landfill gas generation rate curves for individual landfill over time. One important parameter is the methane generation rate constant. It is determined by a large number of factors associated with the composition of waste and the conditions at the site. Rapid rates which are associated with a high moisture content and rapidly degradable material can be found for example in part of the waste in Finland, France, Italy and the United Kingdom. Figure 8.8 provides some CH_4 generation rate constants as reported by the member states in CRF table 6 A,C, while Table 8.21 summarizes information on the applied country-specific approach.

Figure 8.8 6A1 Managed Solid Waste Disposal: Methane generation rate constant



Source: CRF 2013 Table 6 A,C Additional information, NIR 2013

Table 8.21 6A1 Managed Solid Waste Disposal: Further information on the methane generation rate constant

Member State	Information on the half-time respectively the methane generation rate constant
Austria	Several values for the half-life period of different waste types (residual waste, wood, paper, sludges, sorting residues, output MBT, bulky waste, bio waste, textiles, construction waste and fats) are presented.
Belgium	Several values for the biodegradation rate are given. The multiphase model in the Flemish region uses three categories: quick degradation: k1=0.173 (t1/2=4), average degradation: k2=0.069 (t1/2=10), slow degradation: k3 = 0.023 (t1/2 = 30). In Wallonia, the IPCC default value is chosen (k=0.05 which corresponds to t1/2=14 years).
Denmark	Decay rates (and half-life times) for individual waste types are available for food waste (k=0.17), cardboard (k=0.06), paper (k=0.06), wet cardboard and paper (k=0.06), other combustibles (k=0.05).
Finland	Methane generation rate constants are divided into four categories: k1= 0.185 for wastewater sludges and food waste, k2=0.03 for wood waste and de-inking sludge, k3=0.1 paper waste and textile waste, and k4=0.06 for garden waste, napkins, fibre and coating sludges.
France	NIR provides three values: k1=0.5 for 15 % of the waste (easily biodegradable), k2=0.1 (average biodegradability) for 55 % of the waste and k3=0.04 for 30 % of the waste (weakly biodegradable).

Member State	Information on the half-time respectively the methane generation rate constant
Germany	Several values for the half-life are provided (years): food waste: 4, garden and park waste: 7, paper and cardboard: 12, wood: 23, textiles/diapers: 12, composites: 12, sludges from wastewater treatment: 4, waste from MBT facilities 12.
Greece	The estimation of k is determined by the conditions in the disposal sites (e.g. moisture content, temperature, soil type) and by the composition of waste landfilled. Considering the fact that climate in Greece is dry temperate (the ratio of mean annual precipitation to potential evapotranspiration is around 0.5), half-life was estimated at 17 years for paper and textiles, 35 for wood, 12 years for food waste, 14 years for non-food-waste and 9 years for sewage sludge disposed on land.
Ireland	The 2006 IPCC Guidelines provide narrow ranges for the value of decay rate constant appropriate to the individual waste components under different climatic zones. Ireland has chosen the highest values given for the Western Europe wet temperate conditions for all waste constituents, as the value of the ratio MAP:PET (Mean Annual Precipitation: Potential Evapotranspiration) is greater than 2 in Ireland.
Italy	The methane generation rate constant k in the FOD method is related to the time taken for DOC in waste to decay to half its initial mass The maximum value of k applicable to any single SWDS is determined by a large number of factors associated with the composition of the waste and the conditions at the site. The most rapid rates are associated with high moisture conditions and rapidly degradable material such as food waste. The slowest decay rates are associated with dry site conditions and slowly degradable waste such as wood or paper. Thus, for each rapidly, moderately and slowly biodegradable fraction, a different maximum methane generation rate constant has been assigned. National half-life values are suggested in a study. Accordingly, waste streams have been categorized in three main types: rapidly biodegradable waste (food waste, sewage sludge, k1=0.69), moderately biodegradable waste (garden and park waste, k5=0.14) and slowly biodegradable waste (paper and paperboard, textile and leather, wood and straw, k15=0.05).
Luxembourg	IPCC default values are used for the different waste fractions.
Netherlands	Methane generation rate constant: 0.094 up to and including 1989, decreasing to 0.0693 in 1995. From 2000 to 2004, the value is decreasing to 0.05 (IPCC value) and constant thereafter. This corresponds to a half-life time of 14 years. The change in k-values is caused by a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990s.
Portugal	The value of CH_4 generation rate constant (k) depends on several factors as the composition of the waste and the conditions of the SWDS. In the absence of national studies to determine this parameter, and following the recommendations of the in-depth review, the values used in the previous submissions were revised in order to apply the guidance from IPCC 2000. The k value considered was 0.07 (half-life of about 10 years), which represents a higher decay rate compared to the k default value proposed by the IPCC 2000 (0.05 - half-life of about 14 years).
Spain	The constant rate of methane generation takes the value recommended by the IPCC Good Practice Guidance (0.05) with the exception of four managed landfills for which k values of 0.035, 0.08, 0.043 and 0.049 have been chosen.
Sweden	National value for half-life time of 7.5 years. The choice of the half-life factor has also been motivated by the rather wet climate conditions in Sweden (MAP/PET>1), and that the 2006 IPCC Guidelines recommends the default value of 7 for such climate conditions.
United Kingdom	The characteristic decay rates for these three pools are: 0.046 $year^{-1}$ (slowly degrading), 0.076 year-1 (moderately degrading) and 0.116 year-1 (rapidly degrading). These are within the range of 0.030 to 0.200 $year^{-1}$ quoted in IPCC, 2006. Fats, sugars and proteins are assigned to the rapidly degrading pool (RDO), lignin to the slowly degrading pool (SDO) and cellulose, hemicelluloses and remaining compounds are allocated to the moderately degrading pool (MDO).

Source: NIR 2013, CRF 2013 Table 6 A,C Additional information

Concerning the magnitude of the methane generation factor, Italy explains its high weighted average degradation rate with high moisture contents. The weighted averages of k should reflect the waste composition as well as the moisture content or average temperatures. In general, a comparison is difficult since many parameters have influence on the average value.

8.3.2 Unmanaged Solid Waste Disposal (CRF Source Category 6A2) (EU-15)

CH_4 emissions from unmanaged solid waste disposal were reported in only six member states in 2011 (France, Greece, Ireland, Italy, Portugal and Spain). Two of these six member states (Spain, Greece) still dispose MSW to unmanaged SWDS, although in small quantities, compare column 'Annual MSW to unmanaged SWDS' in Table 8.22, while in France, Ireland, Italy and Portugal waste disposals from the past still emits (see Table 8.4). 100% of all EU-15 emissions from this category are calculated using higher tier methods. The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. According to the Revised 1996 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow, deep or uncategorised. Table 8.23 gives an overview of the MCF applied by the relevant member states.

Table 8.22 6A2 Unmanaged Solid Waste Disposal: Selected parameters for calculating emissions from source category 6A2

Member State	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS (Gg)	MCF CH_4		
			Unmanaged SWDS	Deep	Shallow
France	X	NO	0.50	NO	0.50
Greece	X	27.61	0.80	0.80	IE
Ireland	X	NO	NA	NA	NA
Italy	X	NO	0.60	NO	0.60
Portugal	X	NO	0.60	IE	0.60
Spain	X	77.67	0.60	0.80	0.40

Source: CRF 2013 table 6 and 6A,C

Table 8.23 6A2 Unmanaged Solid Waste Disposal: Further information

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is based on the degree of compaction of waste in MSWD. In French oversee territories, uncontrolled landfills are also considered. Uncompacted landfills were gradually closed in favor of compacted landfills. However, closed MSWD continue to emit methane because of the kinetics of the reaction.
Greece	Unmanaged wastes are considered to be landfilled in sites of similar characteristics concerning their composition and management (depth of sites), while the starting year of disposal and degradation of total unmanaged waste is assumed to be 1960. According to the Ministry of Environment, Energy and Climate Change (MEECC), 2182 unmanaged SWDS were still operating in 2000. Following the National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is already in progress and is expected to be completed in the following years, along with the construction of managed SWDS, following to the standards set by the EU directives, in order to cover the needs of the country. Nowadays, there is a small number of unmanaged waste disposal sites which is planned to be eliminated until the end of 2013.
Ireland	In the 2006 IPCC guidelines the MCF varies from 0.4 for shallow unmanaged landfills to 1.0 for fully anaerobic deep and managed landfills. In the present model analyses undertaken for both individual sites and groups of landfills, annual MCF values show an increase over time to reflect the change from generally shallow, poorly-managed landfills before 1998 to well controlled and engineered landfills in subsequent years. The larger landfills that were in existence prior to the introduction of waste licensing were subject to some level of management but not to the extent of fully managed licensed sites after 1998. These large sites are assigned to the IPCC category of unmanaged deep sites for the years up to 1998 with MCF of 0.8 and to the managed category with MCF of 1.0 for the remainder of their lifetime. The 250 sites that operated primarily as small open town dumps and shallow uncontrolled disposal sites with significant aerobic conditions up to the introduction of waste licensing are assigned to the IPCC category of unmanaged shallow sites up to 1998, for which the appropriate MCF is 0.4. A transition from unmanaged shallow classification in 1960 to one-third unmanaged shallow and two-thirds unmanaged deep sites in 1998 is applied to the remainder of sites, giving an increasing MCF from 0.4 to 0.67 over this period.

Member States	Unmanaged waste disposal on SWDS
Italy	The share of waste disposed of into uncontrolled landfills has gradually decreased due to the enforcement of new regulations, and in the year 2000 it has been assumed equal to 0; emissions still occur due to the waste disposed in the past years. The unmanaged sites have been considered shallow. The MCF value used for unmanaged landfill is the default IPCC value reported for uncategorised landfills: in fact, in Italy, before 2000 existing unmanaged landfills were mostly shallow, because they resulted in uncontrolled waste dumping instead of real deep unmanaged landfills. To be conservative, the default IPCC value reported for uncategorised landfills has been used. It is assumed that landfill gas composition is 50% carbon dioxide and 50% methane.
Portugal	The share of final disposal destiny (inter alia uncontrolled dumping sites) for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems. There have been significant efforts at national level to deactivate and close all uncontrolled dumping sites. This effort was concluded in 2002 when all uncontrolled dumping sites had been closed. Concerning uncontrolled dumping sites, it was considered that there is gas burning when a dumping site has been closed and is associated with a managed landfill having recovery of CH_4. It was assumed that all estimated industrial waste produced have followed the urban disposal pattern between uncontrolled and controlled SWDS.
Spain	No statistical information is available for unmanaged SWDS. It is assumed that 50% of unmanaged landfills are deep (depth > 5 m) and the remaining 50% are shallow (depth < 5 m). For unmanaged SWDS it is also assumed that the waste is partly burned to reduce the volume. The burning fractions have been decreased during the inventory period.

Source: NIR 2013.

8.3.3 Waste water handling (CRF Source Category 6B) (EU-15)

CH_4 emissions from domestic and commercial waste water handling (6B2) are a significant emission source in category 6B and key source in the EU. CH_4 emissions from waste water handling are calculated with the help of diverse methods (CR, CS, D, T1 and T2). 9 % of all EU-15 CH_4 emissions from wastewater handling (6B) are calculated using higher tiers. Table 8.24 provides an overview of the CH_4 emission sources in domestic and commercial wastewater handling identified by the member states. Furthermore, methods applied to determine CH_4 emissions from municipal wastewater and sludge handling are described in detail.

Table 8.24 6B2 Domestic and Commercial Waste Water Handling: CH_4 emission sources and methods for determining CH_4 emissions

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Austria	In 2010, 93.9% of the population was connected to municipal wastewater treatment plants. The remaining wastewater is treated either in septic tanks (3.8%), domestic wastewater treatment plants (2.1%), or other disposal facilities (0.3%). Wastewater treatment plants use aerobic procedures (resulting in N_2O emissions), whereas septic tanks are characterised by anaerobic conditions (resulting in CH_4 emissions). CH_4 emissions from cesspools and septic tanks are calculated according to the IPCC method. The following parameters were used: Average organic load: 60 g BOD_5/inhabitant/day, methane producing capacity B_o: 0.6 kg CH_4/kg BOD, methane conversion factor MCF: 0.27 (country-specific). Data on wastewater disposal routes and connection rates to the sewage system are taken from the Austrian reports on water pollution control. Data for the years 1971, 1981, 1991, 1995 and 1998, 2001, 2003, 2006, 2008 and 2010 are available. The missing data are interpolated. The share of inhabitants connected to septic tanks has to be extrapolated from the year 2000 onwards.
Belgium	For septic tanks, the methodology is based on an article which describes the characteristics and parameters of individual septic tanks. The IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 0.060kg BOD/day, whose 60 % eventually settles (IPCC fraction that readily settle). It is considered that only 25 % of the BOD loading is anaerobically degraded (0,060*0,6*0,25), because the septic tanks are regularly emptied and consequently the sludge is then treated aerobically. The annual emission factor becomes 1.971 kg CH_4/inhab*year (0.6*0.060*60%*25%*365 kgCH_4/kg BOD). The CH_4 emissions are estimated by multiplying these emission factors

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	by the number of inhabitants not connected with a municipal wastewater treatment plant. No CH_4 emissions are accounted for municipal wastewater treatment plants in Wallonia and in Brussels. Most of the plants are conducted aerobically, and those who use anaerobical digestion of the sludge recover the CH_4 for energy purposes. The emissions linked to the energy recovered by these anaerobical treatment plants are included in the energy sector, as biomass fuels. The energy balance in the Flemish region reports 29 installations of waste water treatment that use the biogas to produce electricity (15 installations with biogas of sewage sludge of municipal waste water treatment installations and 14 installations with anaerobical water treatment). The emissions linked to the energy recovered by these treatment plants are also included in the energy sector (category 1A1a, biomass fuels).
Denmark	Fugitive methane releases from the municipal and private WWTPs have been divided into contributions from 1) the sewer system, primary settling tank and biological N and P removal processes, 2) from anaerobic treatment processes in closed systems with biogas generation and combustion for energy production and 3) septic tanks. The methodology developed for this submission for estimating emission of methane from wastewater handling follows the IPCC Guidelines and the IPCC Good Practice Guidance.
Finland	A national methodology that corresponds to the methodology given in the Revised 1996 Guidelines is used in the estimation of the CH_4 emissions. Emission sources cover municipal (domestic) and industrial wastewater handling plants and uncollected domestic waste water for CH_4 emissions. For uncollected domestic wastewaters, the check method with default parameters (IPCC Good Practice Guidance) has been used.
France	Emissions from wastewater treatment are calculated according to the IPCC tier 1 method, distinguishing between collective wastewater treatment plants and cesspools. It is assumed that 2.4% of the water of the residential/commercial sector collected in waste water treatment plants is treated in natural lagoons and that this treatment corresponds to a conversion rate of 0.23.
Germany	Municipal wastewater treatment in Germany uses aerobic procedures (municipal wastewater-treatment facilities, small wastewater-treatment facilities), i.e. it produces no methane emissions, since such emissions occur only under anaerobic conditions. Treatment of human sewage from persons not connected to sewage networks or small wastewater treatment facilities represents an exception: in cesspools, uncontrolled processes (partly aerobic, partly anaerobic) may occur that lead to methane formation. Organic loads from cesspools are calculated pursuant to the IPCC method, in which the relevant population is multiplied by the average organic load per person.
Greece	CH_4 from waste water handling was estimated according to the default methodologies suggested by IPCC. Considering the fact that there are not sufficient data regarding all the wastewater handling facilities of the country and as a result methane emissions are calculated based on the total population served, emissions from wastewater treatment and the sewage sludge removed from wastewater are not considered separately. However, methane emissions from sewage sludge disposed in managed sites have been estimated. Therefore, in order to avoid double counting of emissions from sludge treatment, the organic load (in biochemical oxygen demand) of sludge that is actually disposed on land was subtracted by the organic load of wastewater treated.
Ireland	The only source of emissions from wastewater handling in Ireland is the anaerobic treatment of sludge. Approximately one-third of the population in Ireland is served by urban wastewater treatment plants, which are based on aerobic systems with no emissions of CH_4. The other one-third of the population uses septic tanks to treat wastewater mainly for individual houses in non-urban areas. CH_4 emissions from septic tanks are deemed not to occur in Ireland.
Italy	In Italy wastewater handling is managed mainly using a secondary treatment, with aerobic biological units. The stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. It is assumed that domestic and commercial wastewaters are treated 95% aerobically and 5% anaerobically, whereas industrial wastewaters are treated 85% aerobically and 15% anaerobically. CH_4 emissions from sludge generated by domestic and commercial wastewater treatment have been calculated using the IPCC default method on the basis of national information on anaerobic sludge treatment system. Emissions from methane recovered, used for energy purposes, in wastewater treatment plants are estimated and reported under category 1A4a. CH_4 emissions from wastewater have been estimated assuming that 5% of domestic and commercial wastewater is treated anaerobically. This assumption may correspond to the Italian situation where wastewater is treated in aerobic biological units with the possibility of bad management cases. In the case of sludge, most of the CH_4 produced is recovered and not emitted because of the anaerobic digestion of sludge where the reactors are

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	covered and provided of gas recovery and the efficiency of capture is equal to 100%. Only CH_4 produced in Imhoff tanks is emitted.
Luxembourg	Municipal wastewater treatment in Luxembourg uses mainly aerobic processes such as activated sludge or biofiltration. As a result, no or negligible methane emissions are produced, since such emissions only occur under anaerobic conditions. In these plants, sludge stabilisation is carried out in order to prevent uncontrolled putrefaction. In facilities with a treatment capacity smaller than 30.000 population-equivalents (p.e.) the stabilisation is usually carried out aerobically, with oxygen and energy consumption, while for facilities with a treatment capacity larger than 30.000 p.e., the stabilisation is normally carried out anaerobically with production of methane gas. The gas produced is usually used for energy recovery in combined heat/power generating systems or may be flared. In this emission inventory, methane emissions from these small anaerobic sludge treatments have been taken into account as there is no gas reuse and therefore methane emissions have been assumed. The methodology for these septic tanks is based on the IPCC method in which the relevant population (individual septic tanks) or population equivalents (for the small mechanical treatment plants) is multiplied by the average organic load per person. The 2006 IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 60 g BOD/day, and a MCF of 0.27 is assumed. According to the national expert judgment and based on a study, the MCF has been adapted to the national situation in Austria which is also applicable for Luxembourg.
Netherlands	In general, the emissions are calculated according to the IPCC guidelines, with country-specific parameters and emission factors being used for CH_4 emissions from wastewater handling (including sludge). The calculation methods are equivalent to the IPCC Tier 2 methods. The treatment of domestic and commercial wastewaters and the resulting wastewater sludge is accomplished using aerobic and/or anaerobic processes in public wastewater treatment plants.
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines and Good Practice Guidance, which follows three basic steps: determination of the total amount of organic material originated in each wastewater handling system, estimation of emission factors and calculation of emissions.
Spain	The methodology in Section 6.2 of the IPCC Good Practice Guidance has been applied. Computing the contributions of the water and sludge lines, the emissions are obtained as a product of the degradable organic load (water and sludge) and the methane emission factors, discounting from this product the amount of methane recovered. The methane emission factors are expressed as the product of the respective parameter B_0 of maximum capacity for methane production times the weighted methane conversion factor, WMCF. For domestic/commercial waste water, the organic load is the activity variable selected, expressed in mass of Biochemical Oxygen Demand (BOD_5). For the calculation of this variable, the population data currently served by waste-water treatment stations has been used, as detailed in the publication “The Environment in Spain” from the Ministry of the Environment. For the degradable organic load, a value of 300 mg BOD_5/litre of waste water and a flow of 200 litres/inhabitant equivalent per day, and 365 operating days per year, have been assumed.
Sweden	6B2a has been divided into three sections: a) Large wastewater treatment plant (treatment capacity: more than 2 000 pe); b) Small wastewater treatment plants (treatment capacity: 25 -2000 pe); c) Population not connected to wastewater discharge system. a) In Sweden, all large wastewater treatment plants are using aerobic wastewater treatment processes. No CH_4 is supposed to be generated because of the use of aeration in the wastewater treatment process. b) For small wastewater treatment plants, the situation is at the moment not well enough investigated and therefore Sweden is using the IPCC Good Practice Guidance method (Check method). Activity data on population connected to small wastewater treatment plants (700 000 people) is derived from background data from a survey in 2010. c) For population not connected to wastewater discharge system, the following applies: 1.) The sludge in the wastewater is collected in sand filters or infiltration beds, collected and transported to anaerobic digestion plants located at larger wastewater treatment plants. It is covered and reported in section CRF6B2b (sludge treatment). 2.) CH_4 emissions from the remaining waste water are likely to be NO (not occurring) or negligible. The waste water is rich in oxygen, and for biological processes to occur the water must not be too cold. Sweden has a rather cold climate with an average annual temperature of 4.8 (°C) 1991-2005.
United Kingdom	A UK-specific method is used, using activity data for the municipal waste water treatment volumes, organic content and sludge treatment and disposal routes. Emission factors are derived from water company reported data for recent years, extrapolated back to 1990.

Source: NIR 2013, CRF 2013 Tables 6, 6Bs1 and 6Bs2

CH_4 emissions from industrial wastewater and sludge handling are not key sources. Nevertheless, information about the methods applied for the estimation of CH_4 emissions from this source category is provided in Table 8.24.

CH_4 missions from industrial wastewater handling are reported by ten member states (Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom); five member states indicate that emissions are not estimated (Belgium), not applicable (Austria, Germany), not occurring (Luxembourg) or are reported elsewhere (Denmark).

The only member state that indicates CH_4 emissions from industrial wastewater as not estimated is Belgium. Emissions from industrial waste water treatment are not included since most of the industrial waste water is treated aerobically or recovery of CH_4 occurs (flaring or for energy production) for those installations that treat wastewater anaerobically.

Emissions from sludge handling of industrial wastewater are reported by four member states (France, Greece, Ireland and Spain), other member states either reported emissions as not estimated (Belgium and the Netherlands), not occurring (Luxembourg and Sweden) or not applicable (Austria and Germany) or reported the emissions elsewhere (Denmark, Finland, Italy, the Netherlands, Portugal and the United Kingdom).

An overview of methodological issues regarding CH_4 emissions from industrial wastewater and sludge handling and methods applied is provided in Table 8.25.

Table 8.25 6B1 Industrial Waste Water Handling: CH_4 emissions and methods applied

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	NA	NA	Industrial wastewater and sewage sludge treatment is carried out under aerobic and anaerobic conditions. As CH_4 gas is usually used for energy recovery or is flared, the amount of CH_4 emissions from industrial wastewater and sewage sludge treatment is negligible and therefore reported as "not applicable". In the energy sector sewage gas is considered as an energy source.
Belgium	NE	NE	CH_4 emissions from industrial wastewater handling and treatment are not included in the Belgian greenhouse gas inventory because most of the industrial waste water is treated in an aerobic way. Recovery of CH_4 occurs (flaring or energy production) for these installations that treat the waste water anaerobically.
Denmark	IE	IE	No distinction between emissions from industrial and municipal WWTPs is made, as Danish industries to a great extent are coupled to the municipal sewer system. Wastewater streams from households and industries are therefore mixed in the sewer system prior to further treatment at centralised WWTPs. The contribution from the industry to the influent wastewater at the centralised WWTPs has increased from zero to around 40% from 1987 to 2010 with the highest influent contribution occurring at the biggest and most advanced technological WWTPs in Denmark. Monitoring data on the biological oxygen demand (BOD) for the mixed household and industrial influent are available for all WWTPs with a capacity above 30 PE treating more than 90 % of the Danish wastewater.
Finland	X	IE	A national methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used in estimation of the CH_4 emissions. The emissions from industrial wastewater treatment are based on the COD load. The DC (Degradable Organic Component) values of wastewaters with shared methane conversion factors have been used for both wastewater and sludge handling. The emissions from sludge disposal on land are, however, estimated and reported in the Solid waste disposal on land

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			(landfills) subsector. For the industrial wastewaters, the emission factor is the IPCC default for the maximum methane producing capacity Bo = 0.25 kg CH_4/kg COD and a country-specific emission factor based on expert knowledge for the methane conversion factor MCF = 0.005.
France	**X**	**X**	For the estimation of CH_4, it is considered that the industrial effluent received at the wastewater treatment plants are treated completely under aerobic conditions, unlike the effluent from the residential and commercial sector. However, some agro-food processing industries treating their waste water in situ are likely to use the natural lagoon. The IPCC equation for industrial water is then applied with Bo = 0.25 kg / kg COD.
Germany	**NA**	**NA**	The composition of industrial wastewater, in contrast to that of household wastewater, varies greatly by industrial sector. In Germany, the biological stage of industrial wastewater treatment is partly aerobic and partly anaerobic. Anaerobic wastewater treatment is especially useful for industries whose wastewater has high levels of organic loads. This treatment method has the advantages that it does not require large amounts of oxygen, produces considerably smaller amounts of sludge requiring disposal and generates methane that can be used for energy recovery. As in treatment of municipal wastewater, treatment of industrial wastewater releases no methane emissions into the environment. The processes include aerobic treatment and anaerobic digestion; gas formed in the latter is either used for energy recovery or is flared. No calculations for this source category are carried out at present.
Greece	**X**	**X**	The methodology for calculating methane emissions from industrial wastewater is similar to the one used for domestic wastewater. In order to estimate the total organic waste produced through anaerobic treatment, the following basic steps were followed: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2011. Calculation of wastewater generated, by using the default factors per industrial sector (m^3 of wastewater/t product) as suggested by the IPCC Good Practice Guidance. Calculation of degradable organic fraction of waste, by using the default factors (kg COD/m^3 wastewater) suggested by the IPCC Good Practice Guidance for each sector / sub-sector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling. For the first time in the current submission, country specific data were collected, thus additional industrial sectors with 100 % aerobic treatment of their wastewater were included in the estimation. In the previous submission, in case where 100% of sector was served by aerobic treatment, it was not taken into account, considering zero emissions. The additional sectors included in the wastewater were additional subsectors of food and beverage, and the sectors of paper and pulp, organic chemicals, soap and detergents, plastic and resins, paints and petroleum refinery in the already existing sectors of food and beverage, and in the sugar and textiles sectors. For the estimation of CH_4 emissions from sludge generated industrial wastewater handling is being used a methodology similar to the one used for the estimation of CH_4 emissions from industrial wastewater handling using the same country specific and default factors.
Ireland	**NO**	**X**	The anaerobic stabilisation of sludge is a source of CH_4 emissions in Ireland. The amounts of industrial wastewater sludge produced are available from biennial reports on urban wastewater treatment and approximately three percent of this sludge is treated anaerobically. The average BOD of industrial wastewater sludge is 60 kg/t (40 percent of the typical BOD content of treated industrial wastewater) and DOC is estimated as the product of average BOD content and tonnes of dry solids of sludge. The emission factor for CH_4 is derived from the 1996 IPCC Guidelines using the IPCC default value of 0.6 for B_O, 0.3 for the fraction of sludge treated and 1.0 for MCF.
Italy	**X**	**IE**	In Italy industrial wastewaters are treated 85% aerobically and 15% anaerobically. The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective degradable organic carbon for each major industrial wastewater source. No country-specific emission factors of methane per Chemical Oxygen Demand are available so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series. As recommended by the Good Practice Guidance for key source categories, data have been collected for several industrial sectors (iron and steel, refineries, organic chemicals,

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			food and beverage, paper and pulp, textiles and leather industry). The total amount of organic material for each industry selected has been calculated multiplying the annual production by the amount of wastewater consumption per unit of product and by the degradable organic component. Moreover, the fraction of industrial degradable organic component removed as sludge has been assumed equal to zero. The yearly industrial productions are reported in the national statistics, whereas the wastewater consumption factors and the degradable organic component are either from Good Practice Guidance or from national references. National data have been used in the calculation of the total amount of both COD produced and wastewater output for refineries, organic chemicals, beer production, wine, milk and sugar sectors, the pulp and paper sector, and the leather sector.
Luxembourg	**NO**	**NO**	Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic conditions (activated sludge process). As for the municipal facilities there are no methane emissions.
Netherlands	**X**	**NE, IE**	The source category „wastewater handling" also includes the CH_4 emissions from anaerobic industrial wastewater treatment plants, but these are small compared to urban wastewater treatment plants (WWTP). For anaerobic industrial WWTPs, the CH_4 emission factor is expressed as 0.176 t/t DOC design capacity, assuming a utilization rate of 80%, a CH_4-producing potential (B_o) of 0.22 t/t DOC and a methane recovery (MR) of 99%.
Portugal	**X**	**IE**	Methane emissions from industrial wastewater handling also follow the default methodology proposed in the 1996 IPCC Guidelines and the Good Practice Guidance. The organic wastewater load (TOW) is estimated using statistical production data on industries (ton product/yr) multiplied by pollution coefficients (kg O_2/ton product). These coefficients result from a study specifically done for the estimate of the loads from the Portuguese Industry and had been developed from field monitoring data at installations in Portugal.
Spain	**X**	**X**	For industrial point sources, the emissions are based on data obtained from individualized questionnaires sent to each plant. The point source activity data comprise oil refineries and paper pulp manufacturing plants. Wastewater from food industry and chemical industry was estimates as area source based on the organic load. The methane emission factor selected, with regard to the volume of waste water treated, is derived from the EMEP/CORINAIR Guidebook. For the period 1990-2000 no data is available for the wastewater volume treated and the amount is derived by an extrapolation based on the driver production data.
Sweden	**X**	**NO**	The majority of the facilities in Sweden are using aerobic processes, where no CH_4 is supposed to be generated because of the use of aeration in the wastewater treatment process. In 2010, there were only five (5) facilities using anaerobic waste-water treatment processes in Sweden. These facilities were in the pulp industry and food industry. For methane emissions from industries with internal wastewater treatment, Sweden has chosen a national method to estimate the emissions based on data availability. According to wastewater treatment expertise, the loss of CH_4 in the energy recovery process should be within the range of 2 - 5 %. This factor can be combined with data on energy recovery from the anaerobic processes.
United Kingdom	**X**	**IE**	The default IPCC methodology is applied to UK waste water estimates of organic load from the food and drink and chemical industries.

Source: NIR 2013, CRF 2013 Tables 6, 6.Bs1 and 6.Bs2
According to table 6.Bs1in CRF 2013; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occurring

According to the IPCC Good Practice Guidance, the emission factor for determining CH_4 emissions from wastewater and sludge handling is composed of the maximum methane producing potential (B_0) and the methane conversion factor (MCF). There is an IPCC default value available for the maximum methane producing potential which is applied in most of the member states. In contrast, the MCF has to be determined country specifically and varies strongly among the member states depending on wastewater and sludge treatment systems used; Table 8.26 provides an overview of the MCF applied by the member states.

Table 8.26 6B Waste Water Handling: Methane Conversion Factors

Member State	MCF	Specification of MCF	Further information on MCF
Austria	**0.27**	Cesspools and septic tanks	Value is taken from a national study.
Belgium	-	-	No information provided.
Denmark	**0.003** **1** **0.5**	Wastewater treatment plants Anaerobic digestion. Septic tanks	The MCF for wastewater treatment plants equals 0.003 based on an expert judgement of a conservative estimate of the fugitive methane emission from the primary settling tanks and biological treatment processes is well below 0.1% of influent BOD, while the fugitive emission from the sewer system is unknown. For anaerobic digestion, the MCF equals 1. For septic tanks, the MCF has been set equal to 0.5 assuming that degradation for the settled DOC occurs under 100% anaerobic conditions.
Finland	**0.01** **0.005**	Municipal (domestic) wastewaters Industrial wastewaters	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on expert knowledge.
France	**0.23**	For natural lagoons	Only for natural lagoons CH_4 emissions occur.
Germany	**0** **0.5**	Municipal wastewater treatment Cesspools	Aerobic conditions Based on IPCC 2006 Guidelines
Greece	**-**	-	The default values for these factors are 0 for aerobic conditions and 1 for anaerobic conditions (and these values were applied in the calculations).
Ireland	**1**	Industrial wastewater sludge	The emission factor for CH_4 is derived from the 1996 IPCC Guidelines using the IPCC default value of 1.0 for MCF.
Italy	**1**	Industrial wastewater	In the case of wastewater, the lack of information has led to use the most conservative estimate considering MCF=1 again. Further investigations are planned.
Luxembourg	**0.27**	Septic tank	The 2006 IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 60 g BOD/day, and a MCF of 0.27 is assumed. According to the national expert judgment and based on a study, the MCF has been adapted to the national situation in Austria which is also applicable for Luxembourg. The MCF defines the portion of methane producing capacity (B0) that degrades anaerobically and may vary between 0.0 (completely aerobic) to 1.0 (completely anaerobic) according to the IPCC 2006 Guidelines.
Netherlands	**0.5**	Septic tank	For septic tanks, a methane correction factor (MCF) of 0.5 is assumed. In 2011, only 0.62% of the population was connected to a septic tank.
Portugal	**0.1** **0** **0**	No treatment Primary Secondary (well managed)	The new guidelines from IPCC that were recently published (IPCC,2006) present more detailed values, now specific of treatment systems and management conditions, and they were used to establish the new MCF values. In the case where the industrial effluent was discharged into the unitary municipal treatment system, the MCF was determined from the average situation in Portugal for the domestic wastewater system when

	0.3 **0.8** **0.5**	Secondary (not well managed) Secondary (anaerobic, no CH_4 recovery) Septic tanks	there is any form of treatment, either primary, secondary or tertiary.
Spain	**0.15** **0.3**	industrial wastewater industrial sludge	The Weighted Methane Conversion Factor, WMCF, is calculated in accordance with Equation 5.8 in the IPCC Good Practice Guidance. Further MCF values are taken from the IPCC 2006 Guidelines.
Sweden	**-**	-	No information available.
United Kingdom	**-**	-	No information available.

Source: NIR 2013

Most member states report N_2O emissions from waste water handling. Different methods are applied (CS, D, T1 and T2). 5% of N_2O emissions from domestic wastewater handling are estimated by higher tier methods (T2, CS). In Table 8.27 the methods for determining N_2O emissions from wastewater handling applied by the member states are described in detail.

Table 8.27 6B Waste Water Handling: Methods for determining N_2O emissions

Member State	**N_2O emissions from wastewater**		**Description of methods used (N_2O)**
	Industrial	**Domestic**	
Austria	**X**	**X**	N_2O emissions from domestic and commercial wastewater handling are calculated separately for households connected and for households not connected to the municipal sewage system. N_2O emissions resulting from households not connected to the public sewage system are calculated according to the IPCC default method, as described in revised 1996 IPCC Guidelines. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by *Austria Statistics*. The emission factor (0.01) and fraction of nitrogen in protein (0.16) are IPCC default values. N_2O emissions arising from waste water treatment plants are calculated by using a country-specific method based on IPCC. According to a national study, the amount of wastewater that is treated in sewage plants and the amount of nitrogen that is denitrified should be considered. Finally the N_2O emissions arising from waste water treatment plants and other treatment are summed up. It is assumed that industrial wastewater handling additionally contributes 30% of N_2O emissions from municipal wastewater treatment plants. Data for the amount of wastewater that is treated in sewage plants as well as on the denitrification rate are taken from the Austrian reports on water pollution control and situation reports on the disposal of urban wastewater and sludge; missing data in between is interpolated.
Belgium	**NE**	**X**	N_2O emissions from human sewage are estimated by using the methodology described in the IPCC 1996 Guidelines by multiplying the protein consumption per capita with the population, the N fraction in the protein and the default emission factor. The default values for N fraction in protein (kg N / kg protein) and N_2O emission factor are 16 % and 0.01 kg N_2O-N / kg sewage-N produced. The figure of protein consumption originates from the FAO statistics. The population figures come from the National Institute of Statistics.
Denmark	**IE**	**X**	The emission of N_2O from wastewater handling is calculated as the sum of contributions from wastewater treatment processes at the WWTPs and from sewage effluents. The emission from effluent wastewater, i.e. indirect emissions, includes separate industrial discharges, rainwater conditioned effluents, effluents from scattered houses, from mariculture and fish farming. The methodology for estimating emission of

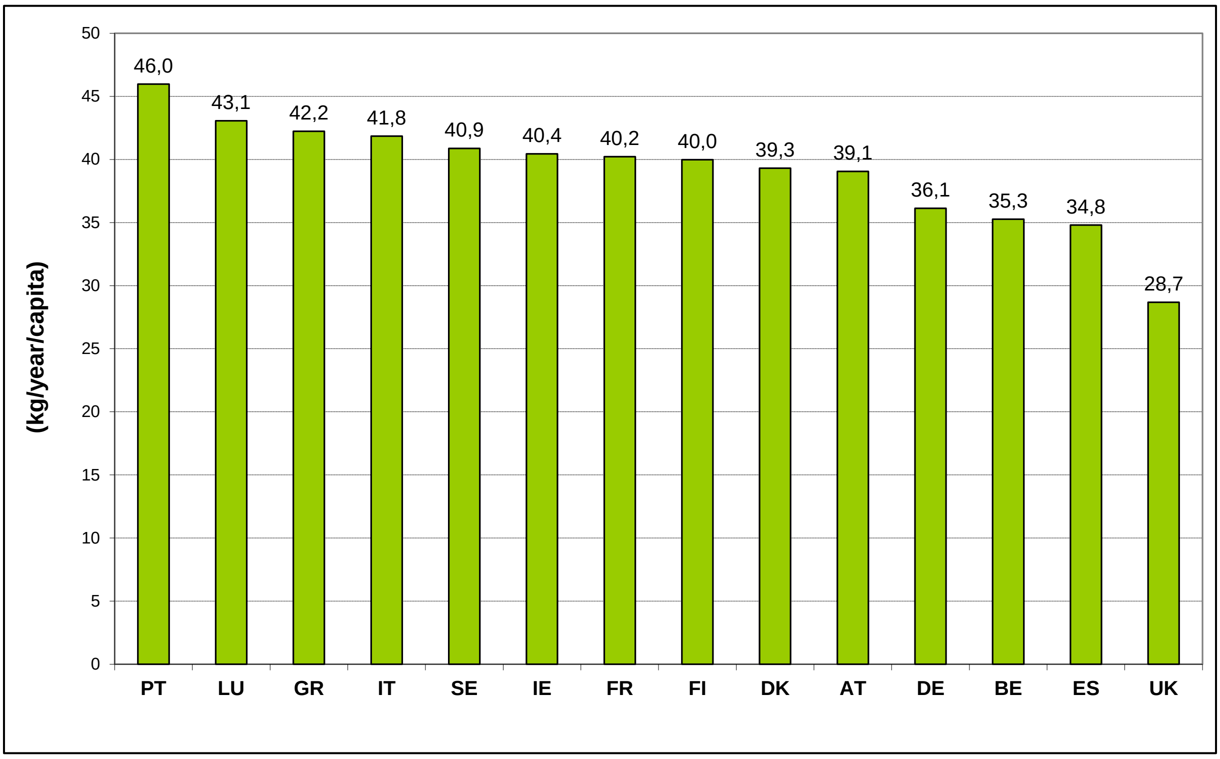
Member State	N_2O emissions from wastewater: Industrial	N_2O emissions from wastewater: Domestic	Description of methods used (N_2O)
			methane and nitrous oxide from wastewater handling follows the IPCC 1996 Guidelines and the IPCC 2000 Good Practice Guidance.
Finland	**NE**	**X**	In Finland, the N input from fish farming and from municipal and industrial wastewaters into the waterways is collected into the VAHTI database. For municipal wastewaters the measured values have been considered more reliable than the N input according to population data. In addition to the IPCC approach, also nitrogen load from industry and fish farming were taken into account. For uncollected wastewaters the nitrogen load is based on population data and protein consumption. The assessed N_2O emissions cover only the emissions caused by the nitrogen load to waterways. In addition to the emissions caused by nitrogen load of domestic and industrial wastewaters also the emissions caused by the nitrogen load of fish farming have been estimated. N_2O emission calculations are consistent with the IPCC method for discharge of sewage nitrogen to waterways.
France	**X**	**X**	IPCC method is used for domestic wastewater. The final emission factor is 20.7 g N_2O/inhabitant/year. The wastewater treatment plants have been eliminating N and therefore the emission factor decreased between 1990 and 2011. For industrial waste the N_2O emission factor is 14 g N_2O/inhabitant/year.
Germany	**X**	**X**	IPCC default method applied. For the amount of protein per person and day, FAO data is used.
Greece	**X**	**X**	N_2O from waste water handling were estimated according to the default methodology suggested by IPCC. N_2O emissions from domestic wastewater handling are estimated as the indirect nitrous oxide emissions from human consumption of food and their subsequent treatment through wastewater handling systems. Data on protein consumption are provided by FAO. N_2O emissions from industrial wastewater have been estimated on the basis of the emission factors equal to 0.25 g N_2O/m^3 of wastewater production. The waste water production is resulting from the model for the estimation of methane emissions from industrial waste water.
Ireland	**NA, NE**	**X**	Human consumption of food results in the production of sewage, which is processed in septic tanks or in wastewater treatment facilities and is then disposed of directly onto land, into the soil through percolation areas or discharged to a water body. N_2O emissions are estimated by taking the IPCC default value of 0.16 for the nitrogen content in protein and applying the default emission factor of 0.01 (kg N_2O-N/ kg sewage produced) to obtain the quantity of nitrogen in sewage ultimately entering the atmosphere as N_2O.
Italy	**X**	**X**	N_2O emissions from domestic and commercial wastewater treatment are reported in human sewage. The default approach suggested by the IPCC Guidelines and updated in the Good Practice Guidance, based on population and per capita intake protein has been followed. Fraction of nitrogen protein of 0.16 kg N kg^{-1} protein and an emission factor of 0.01 kg N-N_2O kg^{-1} N produced have been used, whereas the time series of the protein intake is from the yearly FAO Food Balance. N_2O emissions from industrial wastewater have been estimated on the basis of the emission factors equal to 0.25 g N_2O/m^3 of wastewater production. The waste water production is resulting from the model for the estimation of methane emissions from industrial waste water.
Luxembourg	**X**	**X**	Pursuant to the 2006 IPCC Guidelines, nitrous oxide emissions from household wastewater can be evaluated by taking into account the average per-capita protein intake. The IPCC default values are used in each case for the nitrous oxide emission factor per kg of nitrogen in wastewater and for the nitrogen fraction in protein. The number of inhabitants and the commuters are provided by the STATEC. N_2O emissions from industrial wastewater handling are issued from only one chemical plant that produces plastics and which releases N to aquatic environments. This industrial wastewater treatment plant (WWTP) is equipped with a biological treatment with denitrification. N_2O emissions are based on the measured inflow data in the

Member State	N_2O emissions from wastewater Industrial	Domestic	Description of methods used (N_2O)
			WWTP. The data available since the year 2002 are the flow as well as the mean annual nitrogen concentration in the WWTP.
Netherlands	**NE**	**X**	N_2O emissions from the biological N-removal processes in urban WWTP as well as indirect N_2O emission from effluents are calculated using the IPCC default emission factor of 0.01 tons N_2O-N per ton N removed or discharged. Since N_2O emissions from wastewater handling was identified in previous NIRs as a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance. Because of their insignificance compared to N_2O from domestic wastewater treatment, no N_2O emissions were estimated for industrial wastewater treatment. The N_2O emissions from septic tanks are calculated according to the default method provided in the IPCC 1996 revised Guidelines. For the calculation of the annual per capita protein uptake, data from FAO Statistics were used. For data on the % of people connected to septic tanks, the same time series is used as in the calculation of CH_4 emissions from septic tanks.
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines. Activity data results of protein intake, according to FAO database, multiplied by total population. For industrial wastewater, the methodology proposed in the CORINAIR/EMEP Handbook, based on the knowledge of total production of wastewater, expressed in equivalent inhabitants, and the use of a simple and unspecific emission factor, was chosen.
Spain	**NE**	**X**	N_2O emissions from waste water are calculated based on protein intake in accordance with the IPCC 1996 Guidelines. Values for the daily protein intake stem from the Ministry of the Environment.
Sweden	**X**	**X**	National activity data on nitrogen in discharged wastewater from municipal wastewater treatment plants and industries are used, in combination with a model estimating nitrogen in human sewage from people not connected to municipal wastewater treatment plants.
United Kingdom	**IE, NE**	**X**	The default IPCC methodology is applied to the UK time series of population and protein intake estimates from food surveys. The UK GHGI estimate of protein consumption is derived from the Expenditure and Food Survey (Defra, 2011). This is a sample household survey in which households record the actual purchases of food they make. UK-specific conversion factors are then applied to these individual food items to estimate consumption of protein and other nutrients. The UK-specific conversion factors are based on a detailed analysis of the individual types of food purchased and contrasts to the more broad-brush factors used by the FAO. The Expenditure and Food Survey estimate is also net of any losses through the food chain through to retail as it is based on actual purchases. The only limitation to the Expenditure and Food Survey is that it may have an element of under-recording due to purchases of some food items not being included in the diary of survey participants, but the inventory agency considers that it is more representative of UK protein consumption per capita than the FAO estimate.

Source: NIR 2013, CRF 2013 Tables 6, 6.Bs1 and 6.Bs2
According to table 6.Bs1in CRF 2012; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occuring

One important parameter for the determination of N_2O emissions from wastewater handling, the annual per capita protein consumption is country-specific and applied by almost all member states; an overview of the values is given in Figure 8.9. The Netherlands, however, does not determine N_2O emissions from wastewater handling via the average per-capita protein intake – as many countries do – but on basis of data on the total nitrogen loads removed in urban waste water treatment plants. Similarly, Denmark reports the indirect emissions from wastewater effluents under human sewage. The effluent considers discharged sewage nitrogen load consisting of contributions from municipal wastewater treatment plants, the separate industry, effluent from mariculture and fish farming, rainwater conditioned effluents and scattered houses not connected to the sewerage system.

Figure 8.9 6B Waste Water Handling: Protein consumption



Source: CRF 2013, Table6.Bs1

8.3.4 Waste Incineration (CRF Source Category 6C) (EU-15)

Emissions from waste incineration are reported by eleven member states in 2011 (Austria, Belgium, Denmark, France, Greece, Ireland, Italy, Portugal, Spain, Sweden and the United Kingdom). In Table 8.28 an overview of category descriptions and methodological issues is provided.

Table 8.28 6C Waste Incineration: Emissions reported and methodological issues

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category, emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery. In Austria waste oil is incinerated in especially designed so called “USK-facilities”. The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combustion. In 2002, the Austrian waste incineration regulation came into force, introducing strong limits (from 2005 on) for air pollution for all kind of waste incineration plants without any limit of size. The facilities which do have the allowance for incineration of waste oil other than cement plants and large waste incineration plants were only 5 in the year 2010. In general, municipal, industrial and hazardous waste are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported under fuel combustion. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant are reported under fuel combustion from 1996 onwards. CORINAIR methodology is applied: the quantity of waste is multiplied by an emission factor for CO_2, CH_4 and N_2O. National emission factors for CH_4 are derived from residual fuel oil VOC emission factors. N_2O emission factors are taken from a national study. For waste oil, the same CO_2 emission factor as for *1 A 1 a* heavy oil is used. For municipal solid waste and clinical waste the CO_2 emission factor is calculated by means of default assumptions from IPCC.
Belgium	X	Waste incineration includes incineration of municipal and industrial waste, incineration of hospital waste and incineration of corpses (crematoriums). Emissions originating from flaring activities are allocated partly to the sectors 1B2 (Flemish region, refineries), and partly to the sector 6C (Flemish and Walloon regions). The emissions of the waste incineration plants with energy recovery are allocated to the category 1A1a. The N_2O emission factor for municipal waste incineration has been recalculated using is situ measurements (stack emissions) combined with activity data, for some representative individual companies. This value was accordingly used for the complete time series in the 3 regions. Emissions of CH_4 are not relevant here. To estimate CO_2 emissions, each region applies its own methodology according to the available activity data: In Flanders, only the fraction of organic-synthetic waste is taken into consideration (assuming that organic waste does not give any net CO_2 emissions). For the municipal waste, the institute responsible for waste management in Flanders (OVAM) is given the analysis of the different fractions in the waste. Based on this information, the amount of non-biogenic waste (excluding the inert fraction) is determined. The carbon emission factor is based on data from literature for the different fractions involved. For industrial waste, the amount of biogenic waste is considered to be the same as in municipal waste. The remaining amount is considered to be the non-biogenic part in which no inert fraction is present. For industrial waste, the content of C and is taken from a study which gives a content of C of the industrial waste of 65.5 %. In Wallonia, since 2004, the amount of incinerated waste (in ton) and the annual emissions (calculated on the basis of stack measurement) are reported annually by the operators in a software dedicated to environmental reporting. From 1990 to 2000, CO_2 emissions of municipal waste incineration are reported assuming that 68 % of the waste is composed of organic material. This is based on the average garbage composition in Wallonia and the use of IPCC equation on organic content of the various materials. Since 2001, the waste incineration plants provide each year the organic content of the incinerated waste in the context of their environmental reporting. The time-series was not recalculated from 1990 to 2000 because of the lack of data on the composition of the incinerated waste for these years. Due to a quick evolution of the policies regarding waste sorting, collection and composting, the composition of the incinerated waste has been modified. So, the organic content of the years 2001 to 2009 cannot be used to recalculate the time-series before 2001. In 2005 and 2010, the average organic content is respectively 31 % and 50%. The increase of the organic content between 2005 and 2010 is mainly explained by the stop of old plants where part of the waste was composted instead of being incinerated. In the early 1990s, about 45% of the waste was still incinerated without energy recovery. Since 2006, the 4 municipal waste incineration plants are fully equipped to produce electricity. The emissions with energy recovery are allocated in the energy sector. A small part of the emissions from municipal waste incineration is still allocated in the waste sector, category 6C, when waste is incinerated without energy recovery because of occasional problems in the energy recovery systems. In 2010, this represents 2% of the incinerated waste. The composition of the incinerated waste is: municipal solid waste, standard industrial waste, sewage sludge and some hospital waste. In the Brussels region, emissions from the waste incineration plant with energy recovery are allocated to the

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		sector 1A1a. Another municipal waste incineration plant was also in activity until 1998, as well as two hospital waste incineration plants until 1997. No energy recovery occurs in these 3 plants. No flaring activities in the chemical industry take place in the Brussels region. The emissions of CO_2 from the flaring in the chemical industry are reported in category 6C according to the IPCC Guidelines. In absence of emission factors to estimate CH_4 and N_2O emissions from flaring activities, these emissions are not estimated in Belgium.
Denmark	X	The CRF source category 6.C. Waste Incineration, includes cremation of human bodies and cremation of animal carcasses. Incineration of municipal, industrial, clinical and hazardous waste takes place with energy recovery, therefore the emissions are included in the relevant subsectors under CRF sector 1A. Emission factors for human cremation are based on literature. For animal cremation, it is assumed that humans and animals are similar in composition. Emission factors from human cremation are recalculated to match the activity data for animal cremation.
Finland	IE	Emissions of greenhouse gases CO_2, N_2O and CH_4 from Waste Incineration (CRF 6C) are reported in the energy sector (CRF 1A) in the Finnish inventory. There is no waste incineration on landfills in Finland and waste incineration for energy production is included in the energy sector. Waste incineration without energy recovery is nearly zero in combustion plants and it is also included in the energy sector. Waste incineration in households is quite small. In annual reporting of the recycling of wastepaper, the incineration of wastepaper is estimated to be only 23,000 tons. The incineration of paper and paperboard in households is estimated to be 31,000 tons together [NIR 2011]
France	X	Emissions from waste incineration are reported for the following categories: dangerous industrial waste incineration, municipal waste incineration without energy recovery, wastewater sludge incineration, (domestic) green waste burning, non-hazardous waste incineration, agricultural plastic film burning and hospital waste incineration. Emissions are estimated based on tier 1 and 2 methodologies using emission factors from different sources or emissions declaration by the facilities.
Germany	NO	Waste incineration is coupled with energy recovery. Therefore, corresponding emissions are reported in the energy sector (CRF 1).
Greece	X	CO_2, CH_4 and N_2O emissions from the incineration of clinical waste produced have been estimated. Incineration of clinical waste in a central plant is still limited, despite the fact that the facilities existed cover the total daily needs of hospitals in Athens. Moreover, emissions from the incineration of biogenic agricultural residues produced in slaughterhouses and from the incineration of small amounts of industrial chemical waste are estimated. For these estimations, data provided by the Hellenic Statistical Authority as waste incinerated without energy recovery in Greece. These data were obtained by individual researches of ELSTAT. For the estimation of CO_2 emissions from clinical and industrial waste, the default method suggested by the IPCC Good Practice Guidance was used. CO_2 emissions were not estimated for the agricultural residues taking into account that these were of biogenic nature. CH_4 and N_2O emissions were estimated using default methodology and country specific emission factors. Data related to the amount of clinical waste incinerated derive from the ACMAR, which is operating the incinerator. For the other categories, data were collected by the ELSTAT for the 2004, 2006, 2008 and 2010, while for the rest of the years similar figures were assumed. The relevant parameters and emission factor used are the ones suggested in the IPCC Good Practice Guidance.
Ireland	X	Emissions of CO_2, CH_4 and N_2O from waste incineration for all years from 1990-2011 have been estimated for the first time in this submission. The category includes incineration of clinical waste (which ceased in the year 2000) and solvent waste incineration. The methodology (including emission factors) corresponds to tier 1 in the IPCC 2006 Guidelines.
Italy	X	Existing incinerators in Italy are used for the disposal of municipal waste, together with some industrial waste, sanitary waste and sewage sludge for which the incineration plant has been authorized from the competent authority. Other incineration plants are used exclusively for industrial and sanitary waste, both hazardous and not, and for the combustion waste oils, whereas there are few plants that treat residual waste from waste treatments, as well as sewage sludge. Emissions from waste incineration facilities with energy recovery are reported under category 1A4a, whereas emissions from other types of waste incineration facilities are reported under category 6C. For 2011, nearly

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		95% of the total amount of waste incinerated is treated in plants with energy recovery system.CH_4 emissions from biogenic, plastic and other non-biogenic wastes have been calculated. Regarding GHG emissions from incinerators, the methodology reported in the IPCC Good Practice Guidance has been applied, combined with that reported in the CORINAIR Guidebook. A single emission factor for each pollutant has been used combined with plant-specific waste activity data. Emissions have been calculated for each type of waste: municipal, industrial, hospital, sewage sludge and waste oils. A complete data base of these plants has been built, on the basis of various sources available for the period of the entire time series, extrapolating data for the years for which there was no information. For each plant a lot of information is reported, among which the year of the construction and possible upgrade, the typology of combustion chamber and gas treatment section, if it is provided of energy recovery (thermal or electric), and the type and amount of waste incinerated (municipal, industrial, etc.). Different procedures were used to estimate emission factors, according to the data available for each type of waste. As regards municipal waste, a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. On the other hand, CO_2 emissions from the incineration of sewage sludge were not included at all, while all emissions relating to the incineration of hospital and industrial waste were considered. CH_4 and N_2O emissions from agriculture residues removed, collected and burnt 'off-site', are reported in the waste incineration sub-sector. Removable residues from agriculture production are estimated for each crop type taking into account the amount of crop produced, the ratio of removable residue in the crop, the dry matter content of removable residue, the ratio of removable residue burned, the fraction of residues oxidised in burning, the carbon and nitrogen content of the residues. CO_2 emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC Guidelines and country-specific values.
Luxembourg	IE	This category is report under energy because in the only incinerator of the country (SIDOR site), energy from waste burning is recovered and injected in the electric public network.
Netherlands	IE	The source category Waste incineration is included in source category 1A1 Energy industries since all waste incineration facilities also produce electricity or heat used for energetic purposes. Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports. The fossil-based and organic CO_2 emissions from waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fossil carbon fractions are assumed, which will yield the CO_2 emissions. The method is described in detail in a national study and in a monitoring protocol.
Portugal	X	Waste incineration in Portugal includes combustion of municipal, clinical and industrial wastes. CO_2 emissions from incineration are calculated according to IPCC Guidelines, for each waste type (e.g. municipal solid waste (MSW), hazardous waste, clinical waste, and sewage sludge). Until 1999, incineration of solid wastes refers exclusively to incineration of hospital hazardous wastes. The figure for 1995 was used as an estimated for the former years. In 1999, two new incineration units started to operate in an experimental regime. Their industrial exploration started at the end of the same year or early January 2000. More recently another unit started operating. These units are dedicated to the combustion of MSW which is composed of domestic/commercial waste. Emissions associated with the components of fossil origin – plastics, synthetic fibres, and synthetic rubber – are accounted for in the net emissions, which include also the non-CO_2 emissions from the combustion of organic materials (e.g. food waste, paper). CO_2 emissions from the biogenic component are only reported as a memo item. Data on clinical waste incinerated refers only to Mainland Portugal and corresponds to data declared in registry maps of public hospital units (there is no incineration in private units). The quantities of clinical waste incinerated decreased strongly in recent years. 25 incinerators were closed in recent years in Mainland Portugal, only remaining at present one hospital incinerator. Other clinical wastes receive alternative treatment or are treated abroad. The non-biogenic components fractions are considered to be different for MSW, and clinical waste.

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		Data refer to combustion of industrial solid waste in industrial units which were collected from INR. Data for the years 2000, 2002 and 2003 refer to industrial units declarations. Data for the period 1990-98 are based on the same assumptions used for Industrial Solid Waste Disposed on Land: a per year growth rate of 2%. Data from 2004 onwards refer to data collected under the Waste Registry (Mapa Integrado de Registo de Resíduos (MIRR)) on the framework of SIRAPA (APA website for the communication between APA and environmental stakeholders). Data provided by the different waste operators and industrials on the amounts of non-urban waste generated are statistical treated by the INE (Statistical Institute) in order to extrapolate the information for the universe of each economic branch. Therefore, data from 2004 onwards represent a break from previous years, as data in earlier years were not extrapolated to consider the non-responses. CH_4, N_2O and other emissions were estimated as the product of the mass of total waste combusted, and an emission factor for the pollutant emitted per unit mass of waste incinerated. Emission factors applied are either country-specific, being obtained from monitoring data in incineration units, or obtained from other references (US data, EMEP/CORINAIR).
Spain	X	Within this category, the emissions produced by the following activities have been estimated: incineration of corpses and clinical waste, municipal solid waste incineration without energy recovery and wastewater sludge incineration. For the incineration of human corpses in crematories, the combustion of a supporting fuel and some other material elements incinerated during the process also account for emissions. Emission factors are derived from data of the crematories of the Municipality of Madrid. The clinical waste streams suitable for treatment by incineration are those with a low infection potential and those named "cytotoxic waste" which present a high infection potential. The estimation of the amount of this type of waste produced is calculated by considering the number of hospital beds and a waste production factor per bed and day. Activity data are derived from the Statistical Yearbook of Spain published by INE and from the Statistics on Health Establishments from Ministry of Health and Consumption. Since 2004, all municipal waste incinerators are equipped with energy recovery. Sludge incineration includes sludges from urban and industrial wastewater treatment. The main source of emission factors is the EMEP/CORINAIR Guidebook.
Sweden	X	Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6C. Reported emissions are for the whole time series obtained from the facility's Environmental report or directly from the facility on request. CO_2, SO_2 and NO_x are measured continuously in the fumes at the plant. In 2003 capacity was increased substantially at the plant by taking one new incinerator into operation. The new incinerator incinerates a mixture of MSW, industrial waste and hazardous waste. Only a minor part (less than 0.5%) of the total amount of MSW incinerated for energy purposes in Sweden are incinerated in the facility included in 6C. All other emissions from incineration of MSW are reported in CRF 1.Emissions reported are CO_2, NO_x, SO_2 and NMVOC.
United Kingdom	X	Incineration of chemical wastes, clinical wastes, sewage sludge and animal carcasses is included here. There are approximately 70 plants incinerating chemical or clinical waste or sewage sludge and approximately 2600 animal carcass incinerators. Animal carcass incinerators are, typically, much smaller than the incinerators used to burn other forms of waste. This source category also includes emissions from crematoria. Emissions are taken from research studies or are estimated on literature-based emission factors, IPCC default values, or data reported by the Environment Agency's Pollution Inventory.

X = Emissions are reported in source category 6C, IE = included elsewhere, NO=not occurring
Source: NIR 2013, CRF 2013.

8.3.5 Waste – Other (CRF Source Category 6D) (EU-15)

Under CRF source category 6D, twelve member states report emissions for 2011. Emissions from composting have been reported by ten member states (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg and the Netherlands). Denmark, France and Spain determine emissions from biogas production, Spain and Italy report emissions from sludge spreading, Germany from mechanical-biological waste treatment plants. In addition Denmark reports emissions of CO_2, CH_4 and NO_x from accidental fires; compare Table 8.29.

Table 8.29 6D Other: Reported emissions, 2011

Member State	Specification of "other waste"	6 D CO_2	6 D CH_4	6 D N_2O	6 D NO_x
Austria	Compost production	NA	2.57	0.36	NA
Belgium	Compost production	NA	1.22	NA	0.05
Denmark	Gasification of biogas	NO	NO	NO	NO
Denmark	Accidental fires	18.21	0.08	NE	0.04
Denmark	Compost production	o NA	3.93	0.14	NA
Finland	Compost production	NO	3.07	0.21	NO
France	Compost production	NA	6.82	1.38	NA
France	Biogas production	NA	1.45	NA	NA
Germany	Composting	NO	25.31	0.63	NO
Germany	Mechanical-biological waste treatment	NO	0.23	0.42	NO
Greece	Composting	NA	0.11	0.01	NA
Italy	Compost production	NA	0.26	NA	NA
Italy	Sludge spreading	NA	NA	NA	1.56
Luxembourg	Compost production	NO	0.35	0.03	NE
Netherlands	Compost production	NA	1.02	0.11	0.03
Netherlands	Recycling activities	NA	NO	NO	NO
Portugal	Non-specified	NO	0.00	0.00	0.01
Spain	Anaerobic digestion at biogas facilities	NA	0.01	0.00	0.00
Spain	Sludge spreading	NE	1.50	NE	NE

Source: CRF 2013 Table 6

In Table 8.30 the source category is described further in detail.

Table 8.30 6D Other: Description and methodological issues

Member State	**Waste – Other**
Austria	This category includes CH_4 and N_2O emissions from mechanical-biological treatment of residual waste and composted waste. Two waste fractions are considered: waste from households and similar establishments covered by the municipal waste collection system, undergoing bio-technical treatment. To a smaller extent also waste from industrial sources is included; biogenic waste composted (both in centralised composting and home composting). Emissions are estimated by multiplying the quantity of waste by the corresponding emission factor based on national references, using a simple country-specific methodology according to the 2006 IPCC Guidelines.
Belgium	CH_4 emissions from composting of organic waste are estimated using regional activity data combined with a default emission factor of 0.75 kg CH_4/ton waste entering in the compost centres. The emission factor of 0.75 kg CH_4/ton waste composted is used after consultation with colleagues in the Netherlands who use this factor as a result of measurements carried out since 2009. In Wallonia, new figures are available for the activity data of 2010. The activity data figures are based on the quantities of waste coming out of the compost centres. According to experts' judgement, the rate between the output of the compost centres (i.e. the amount of compost production) and the input (i.e. the amount of fresh organic waste that is composted) is around 35 %. The amount of waste composted can be calculated accordingly.
Denmark	In the Danish inventory emissions from compost production and accidental fires are included in this category. Emissions from composting have been calculated according to a country-specific method. Activity data for the years 1995-2009 are collected from ISAG data for the categories: "sludge", "organic waste from households and other sources" and "garden and park waste". Activities for 2010-2011 are calculated by using the trend from previous years. Emission factors for composting are based on literature. Emissions from building fires are calculated by multiplying the number of building fires with selected emission factors. Six types of buildings are separated with different emission factors: detached houses, un-detached houses, apartment buildings, industrial buildings, additional buildings and containers. Emissions from vehicle fires are calculated by multiplying the number of vehicle fires with selected emission factors.
Finland	Emissions from composting have been calculated using the methods given in the 2006 IPPC Guidelines for Greenhouse Gas Inventories. Activity data are based on VAHTI database and the Water and Sewage Works Register. The activity data for composted municipal biowaste for the year 1990 are based on the estimates of the Advisory Board for Waste Management for municipal solid waste generation and treatment in Finland in 1989. Data on 1997, 2004 and 2005 are from the VAHTI

Member State	Waste – Other
	database and the intermediate years have been interpolated. In addition, composted solid biowaste in the years 1991-1996 has been interpolated using auxiliary information from the National Waste Plan until 2005. The new composting treatment code and composting plant code in Vahti registry have been used in the calculation of the years 2006-2011.
France	CH_4 and N_2O emissions from composting as well as CH_4 emissions from biogas production are considered. Emissions are estimated by multiplying emission factors with the amount of waste composted and the amount of waste used for the production of biogas, respectively (tier 1). Activity data for composting is derived from periodic surveys ITOM performed by ADEME. For CH_4 emissions, a single emission factor of 952 g/t compost is used for all categories of waste. For N_2O emissions, the emission factor applied depends on the waste type. Activity data for the estimation of CH_4 emissions from biogas production is also derived from periodic surveys ITOM from ADEME; an emission factor of 2,678 g/t waste is used.
Germany	In Germany, yearly increasing amounts of organic waste are composted. For this purpose, CH_4 and N_2O emissions from composting of municipal solid waste are estimated using a national method. Activity data is provided by the National Statistical Agency. Emission factors stem from a national study. Composting of garden and organic waste in individual households is not considered in this category. Since 1 June 2005, landfilling of biologically degradable waste is not permitted in Germany anymore. MSW has to be treated, therefore, prior to landfilling. Mechanical-biological treatment of waste is one of the options. A national method has been developed for the calculation of CH_4 and N_2O emissions in which the amount of waste treated in mechanical-biological treatment plants is multiplied with emission factors from a national study. Activity data is provided by the National Statistical Agency.
Greece	For the estimation of CH_4 and N_2O emissions from biological treatment composting) of solid waste, a Tier 1 approach was used (according to the IPCC 2006 Guidelines), emission factors are IPCC default values.
	Under this source category CH_4 emissions from compost production have been reported. The composting plants are classified in plants that treat selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and the mechanical-biological treatment plants, that treat the unselected waste to produce compost, refuse derived fuel (RDF), and a waste with selected characteristics for landfilling or incinerating system. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references. Information on input waste to composting plants are published yearly by ISPRA since 1996, including data for 1993 and 1994, while for 1987 and 1995 only data on compost production are available; on the basis of this information the whole time series has been reconstructed. Since no methodology is provided by the IPCC for these emissions, literature data have been used for the emission factor, 0.029 g CH_4 kg^{-1} treated waste, equivalent to compost production.
Luxembourg	Compost production sites generate N_2O and CH_4 emissions. The IPCC Tier 1 method has been applied to estimate both methane and nitrous oxide emissions from compost production. Default EFs have been used. Activity data is taken from STATEC Statistical Yearbook and from Soil-Concept annual reports transmitted to the Waste Division of the Environment Agency.
Netherlands	This source category consists of the CH_4 and N_2O emissions from composting separately collected organic waste from households. A country-specific methodology for this source category is used with activity data based on the annual survey performed by the Working Group on Waste Registration at all the industrial composting sites in the Netherlands and emission factors based on the average emissions (per ton of composted organic waste) of some facilities in the late 1990s (measured during a large-scale monitoring programme in the Netherlands). Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the IPCC Good Practice Guidance.
Portugal	CH_4 and N_2O emissions from landfill gas and other biogas burning: The capture and burning of landfill gas and biogas (e.g. from sewage sludge) is used for energy purposes or flaring (without energy recovery). For practical reasons all information related to the estimates of emissions from biogas combustion (with and without energy recovery) is presented here. However, the emissions related to energy recovery situations are accounted in sector 1A1a, and the emissions resulting from flaring are considered in category 6D. Emissions from the combustion of landfill gas and biogas with and without energy recovery have been estimated using emission factors based on the energy of the biogas consumed (combusted).
Spain	This category includes emissions from the spreading of sludge from waste water treatment plants. CH_4 emissions are estimated by applying an emission factor of 29 kg per tonne of dried sludge as derived from the "Report on Complementary Information in the Frame of the Assistance provided for CORINAIR 90 Inventory, CITEPA".

Source: NIR 2013

8.4 EU-15 uncertainty estimates (EU-15)

Table 8.31 shows the total EU-15 uncertainty estimates for the sector Waste and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for CO_2 from 6D Other and the lowest for CO_2 from 6A and 6B and for N_2O for 6A. With regard to trend N_2O from 6D shows the highest uncertainty estimates, CO_2 from 6A and 6B and for N_2O for 6A, the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 8.31 Sector 6 -Waste: EU-15 uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
6.A Solid Waste Disposal	CO_2	0	0		0%	0,0%
6.A Solid Waste Disposal	CH_4	142.952	76.477	-47%	27%	0,2%
6.A Solid Waste Disposal	N_2O	0	0		0%	0,0%
6.B Waste Water Handling	CO_2	0	0		0%	0,0%
6.B Waste Water Handling	CH_4	13.840	10.751	-22%	52%	0,2%
6.B Waste Water Handling	N_2O	10.064	10.049	0%	158%	0,1%
6.C Waste Incineration	CO_2	3.966	2.548	-36%	23%	0,2%
6.C Waste Incineration	CH_4	178	57	-68%	19%	0,4%
6.C Waste Incineration	N_2O	102	93	-8%	134%	0,2%
6.D Other	CO_2	18	18	0%	260%	0,3%
6.D Other	CH_4	105	738	603%	39%	2,1%
6.D Other	N_2O	106	860	713%	54%	3,8%
Total - 6	all	171.330	101.593	-41%	26,3%	12,7%

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories;*

8.5 Sector-specific quality assurance and quality control (EU-15)

Under the Climate Change Committee a workshop was conducted in Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop were: (1) to provide an opportunity to learn about the methods used for inventories and projections in the different member states, to share information, experience and best practice; (2) to compare the parameters chosen in the estimation methodologies across EU-15 member states; (3) to compare emissions and methods used for GHG inventories with data and methods for EPER; and (4) to strengthen links between assessment of air pollution under the IPPC and emissions under the UNFCCC. In addition, the workshop provided an opportunity to discuss potential methodological changes or improvements of the draft 2006 IPCC inventory guidelines. The recommendations and presentations of this workshop can be downloaded from the Internet under the following link: **http://air-climate.eionet.eu.int/docs/meetings/050502_GHGEm_Waste_WS/meeting050502.html**. Clarifications from discussions of individual parameters used in the estimation of emissions from waste were incorporated in this report.

A second expert meeting under the Climate Change Committee on the estimation of CH_4 emissions from solid waste disposed to landfills was conducted in March 2006. This meeting was targeting in particular those EU member states that do not yet use the IPCC FOD methods for their inventories (mostly new EU member states). The objective of the expert meeting was to use the new default model provided by draft 2006 IPCC Guidelines for national GHG inventories in order to calculate CH_4 emissions for the participants' countries. 11 member states, 2 EEA Member countries, and one accession country participated. 9 of the 14 countries had previously not estimated CH_4 emissions with a FOD method. The meeting enabled those member states that still used Tier 1 method to use the FOD model with national/default data as available. Other member states used the IPCC FOD model as quality check and for comparison with the results of the country-specific model with usually minor differences compared to the national model. The meeting also contributed to the exchange of experiences of specific circumstances regarding waste generation, composition and solid waste disposal in new member states and on the estimation of CH_4 recovery in the absence of monitored data. In addition, the meeting provided recommendations to IPCC for further improvement and corrections of the draft default model.

In 2012 a comprehensive review was carried out for all sectors and all EU Member States in order to fix the base year 2020 under the EU Effort Sharing Decision. (ESD review 2012). This review also covered the waste sector of the MS GHG inventories (peer review).

8.6 Sector-specific recalculations (EU-15)

Table 8.32 shows that in the waste sector the largest recalculations in 1990 and 2010 were made for HFC.

Table 8.32 Sector 6 Waste: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2010 by gas (Gg CO_2 equivalents and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	33 412	1.0%	1 062	0.2%	329	0.1%	3	0.0%	0	0.0%	20	0.2%
Waste	196	4.7%	936	0.6%	74	0.7%	NO	NO	NO	NO	NO	NO
2010												
Total emissions and removals	15 626	0.5%	-8 309	-2.7%	-2 845	-1.1%	67 953	-5.2%	-28	-0.9%	114	1.9%
Waste	633	29.2%	-4 338	-4.6%	18	0.2%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.33 provides an overview of member states' contributions to EU-15 recalculations. The large recalculations reported for France are due to the inclusion of estimates for CH_4 recovery in emissions from landfills in accordance with the results of a new study following a recommendation from the UNFCCC review team.

Table 8.33 **Sector 6 Waste: Contribution of member states to EU-15 recalculations for 1990 and 2010 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)**

	1990						2010					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	-4	2	NO	NO	NO
Belgium	37	46	3	NO	NO	NO	600	33	0	NO	NO	NO
Denmark	0	2	-4	NO	NO	NO	0	27	-8	NO	NO	NO
Finland	IE,NO	0	0	NO	NO	NO	IE,NO	0	0	NO	NO	NO
France	0	-139	-2	NO	NO	NO	19	-6 580	-8	NO	NO	NO
Germany	NO	0	119	NO	NO	NO	NO	3 037	79	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	-23	-9	NO	NO	NO
Ireland	83	0	-1	NO	NO	NO	53	27	-4	NO	NO	NO
Italy	0	-117	-49	NO	NO	NO	-9	-346	-88	NO	NO	NO
Luxembourg	IE,NA,NO	-7	0	NO	NO	NO	IE,NA,NO	-4	0	NO	NO	NO
Netherlands	IE,NA,NO	0	0	NO	NO	NO	IE,NA,NO	-917	1	NO	NO	NO
Portugal	2	5	-1	NO	NO	NO	16	448	-3	NO	NO	NO
Spain	8	-252	1	NO	NO	NO	-1	-1 317	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	-48	4	-6	NO	NO	NO
UK	65	1 398	9	NO	NO	NO	2	1 276	62	NO	NO	NO
EU-15	**196**	**936**	**74**	**NO**	**NO**	**NO**	**633**	**-4 338**	**18**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated; NA: not applicable; IE: included elsewhere

9 OTHER (CRF SECTOR 7)

This sector does not include any emissions in 2011.

10 RECALCULATIONS AND IMPROVEMENTS

10.1 Explanations and justifications for recalculations

Table 10.1 to Table 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2010 for each EU-15 Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 Gg CO_2 equiv.). For more details see the information provided by the Member States' submissions in Annex 1.12.

Table 10.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	France	-506	-0.8	Les émissions de CO_2, sur 1990-2004, ont été recalculées à partir des FE moyens, par combustible, déterminés sur la période 2005-2011.
1A1_Energy Industries CO_2	UK	-1 030	-0.4	Updated emission factor for combustion at gas separation plant under 1A1c.
1A2_Manufacturing Industries and Construction CO_2	France	2 489	3.0	La prise en compte des données individuelles pour le calcul des émissions de CO_2, CH_4 et N_2O dans différents secteurs de la combustion pour les procédés énergétiques avec contact, afin d'obtenir des facteurs d'émission rapportés à la consommation de combustibles et non plus à la production. Ce travail nécessite d'être affiné l'année prochaine.
1A2_Manufacturing Industries and Construction CO_2	UK	2 212	2.2	Liquid fuels: Addition of estimates of emissions from combustion of byproducts at ethylene crackers following UNFCCC review.
1A2_Manufacturing Industries and Construction CO_2	Portugal	588	6.4	Emission factor update for glass production, due to an in-depth revision of estimation procedures for this sector. Fuel consumption update for glass production, due to an in-depth revision of estimation procedures for this sector. Update for the Natural Gas consumption in a Pulp/Paper installation. Revision of fuel consumption in iron and steel production.
1A3_Transport CO_2	Spain	759	1.4	A transcription error in the applied figure on total aviation fuel sales has been corrected for 2010, affecting consumption estimates of all fuel types (aviation gasoline and jet kerosene) and all traffic segments (domestic and international aviation). The recalculations for road transportation/gasoline, LPG, natural gas is due to the introduction of the CO_2 emissions from lubricant oil consumption. The recalculation for road transportation/diesel oil is due to the introduction of the CO_2 emissions from lubricant oil consumption and the change of the activity data. The information reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. The information for navigation/residual oil reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. Revision of fuel consumption with the updated information provided by compressor stations of natural gas
4A_Enteric fermentation CH_4	Germany	2 890	10.8	New national method in 4.A Enteric Fermentation \ Cattle \ Option A \ Dairy Cattle Re-allocation within the cattle category in 4.A Enteric Fermentation \ Cattle \ Option A \ Non-Dairy Cattle Updated "piglets per sow" ratio in 4.A Enteric Fermentation \ Swine.
4B_Manure management CH_4	Spain	1 242	31.6	New national methodology for Cattle introduced that also includes new information regarding manure management systems.

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
4B_Manure management CH_4	France	-3 979	-32.4	Les séries statistiques de 1990 à 2011 portant sur les effectifs animaux ont été modifiées suite au Recensement Agricole de 2010. Ces modifications ont eu un impact sur les données d'activités et sur les facteurs d'émissions pour les catégories animales agrégées. Les VS des bovins ont été mis à jour suite à la livraison des premiers résultats de l'étude MONDFERENT. Cette mise à jour méthodologique permet d'améliorer la transparence de la méthode et s'accompagne d'une mise en cohérence des calculs d'émissions de méthane entérique et de méthane liées à la gestion des déjections. Les valeurs utilisées pour le paramètre FCM ont été modifiées, passant d'un climat « tempéré » à un climat « froid » pour la métropole, suite à la revue ESD de l'année 2012.
4B_Manure management N_2O	Germany	1 348	52.5	New emission factor in 4.B Manure Management \ Solid storage and dry lot. Digesters are now part of liquid systems in 4.B Manure Management \ Liquid system
4B_Manure management N_2O	Spain	-916	-40.5	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4D_Agricultural soils N_2O	UK	606	1.8	Activity Data: Fraction of livestock N excretion in excrements burned for fuel was expressed as a fraction of poultry N as opposed to all livestock groups, now corrected
6B_Waste water handling CH_4	UK	1 398	502.4	Consultation with water companies has lead to updated data.
6B_Waste water handling CH_4	Spain	-681	-54.8	New information available about domestic and commercial wastewater

Table 10.2 Main recalculations by source category for 2010 and Member States' explanations for recalculations given in the CRF or in the NIR

		2010		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	Germany	2 677	0.8	Final data available from the national energy balance.
1A1_Energy Industries N_2O	Germany	-884	-23.7	Revision of N_2O emission factors as a result of a research project. Final data available from the national energy balance.
1A2_Manufacturing Industries and Construction CO_2	France	912	1.4	La prise en compte des données individuelles pour le calcul des émissions de CO_2, CH_4 et N_2O dans différents secteurs de la combustion pour les procédés énergétiques avec contact, afin d'obtenir des facteurs d'émission rapportés à la consommation de combustibles et non plus à la production. Ce travail nécessite d'être affiné l'année prochaine.
1A2_Manufacturing Industries and Construction CO_2	Germany	750	0.7	Final data of activity data available from the national energy balance.
1A2_Manufacturing Industries and Construction CO_2	Spain	-3 780	-6.1	El cambio de alcance más relevante es la revisión sistemática que se hace del balance de combustibles que se utiliza específicamente para el inventario de emisiones. Debe reseñarse aquí que para el último año de cada edición del inventario sólo se dispone de los cuestionarios energéticos internacionales, y de éstos a veces sólo un avance, lo que implica en general que en la edición del año siguiente deban ser revisadas las cifras que en el año anterior se habían tomado de dichos cuestionarios al disponerse en este momento posterior de la información de los propios balances energéticos de AIE y EUROSTAT.
1A2_Manufacturing Industries and Construction CO_2	UK	3 047	4.6	Liquid fuels: Addition of estimates of emissions from combustion of byproducts at ethylene crackers following UNFCCC review.
1A3_Transport CO_2	Belgium	2 858	11.9	Final energy balance available; Liquid Fuels: Copert EFs according ICR.
1A3_Transport CO_2	Greece	-910	-4.03	Update of LTO number and average consumption per flight
1A3_Transport CO_2	Spain	529	0.6	A transcription error in the applied figure on total aviation fuel sales has been corrected for 2010, affecting consumption estimates of all fuel types (aviation gasoline and jet kerosene) and all traffic segments (domestic and international aviation). The recalculations for road transportation/gasoline, LPG, natural gas is due to the introduction of the CO_2 emissions from lubricant oil consumption. The recalculation for road transportation/diesel oil is due to the introduction of the CO_2 emissions from lubricant oil consumption and the change of the activity data. The information reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. The information for navigation/residual oil reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. Revision of fuel consumption with the updated information provided by compressor stations of natural gas
1A3_Transport CO_2	UK	-1 578	-1.3	Liquid fuels: Updated fleet composition and vkm data.

		2010		Main explanations
		Gg CO_2 equiv.	Percent	
1A4_Other sectors CO_2	Austria	533	4.9	Gaseous fuels: Energy balance: changes in other sectors increase this 'residual amount'
1A4_Other sectors CO_2	Belgium	-2 208	-6.8	Brussels: new OFFREM run. Flanders: integration of results from a new survey (automn 2012) RBC: update (validation) of the 2010 regional energy balance. Final EB for Wallonia and Flanders (-19,5 PJ for Flanders)
1A4_Other sectors CO_2	France	1 844	1.8	Pour tout le secteur, les consommations de combustibles ont été mises à jour. De plus, la répartition des consommations entre les secteurs résidentiel et tertiaire a été modifiée, entrainant un ajustement des émissions de l'année 2010 touchant principalement le CO_2 (-1,38 Tg pour le tertiaire, +2,84 Tg pour le résidentiel, +0,39 Tg pour l'agriculture et la pêche).
1A4_Other sectors CO_2	Germany	4 617	3.2	Gaseous fuels: final data available from the national energy balance.
1B2_Oil and natural gas CH_4	Germany	-853	-12.9	Improved emission factor for storage of gas.
2A_Mineral products CO_2	UK	843	15.4	Activity data revised for lime production . Now consistent with ETS data. Revision to AD for limestone and dolomite use for 2005 onwards to use EU ETS data since BGS data is incomplete. Review of notation keys for soda ash production, asphalt roofing and road paving with asphalt. Updated activity data time series from British Glass for glass production.
2B_Chemical industries CO_2	Belgium	-1 387	-44.0	Flanders: optimization emissions 2010 for cat. 2B5/other (completed survey by the industry). Flanders: re-allocation of some emission to flaring from 2B5 to 6C2 flaring (complete timeseries, 592 kton CO_2 in 2010).
2C_Metal production CO_2	France	1 170	34.0	Les consommations d'énergie et matière fournies par la FFA ont été mises à jour pour 2010. De plus, une modification des teneurs en carbone des combustibles et matières premières, à partir de la moyenne 2001-2008 calculée grâce aux bilans de la Fédération Française de l'Acier, entrainent des modifications des émissions de CO_2 sur toute la période (+0,15 Tg CO_2 en 1990, +1,25 Tg CO_2 en 2010).
2C_Metal production CO_2	Germany	-903	-4.8	Final activity data available from national energy balance in 2.C.1.1 steel. Updated statistical data in 2.C.2 Ferroalloys Production.
2F_Consumption of halocarbons HFC	France	-1 784	-10.7	Toute la période d'inventaire a été revue suite à l'étude de EReIE réalisée en 2012. Un nouveau type de HFC, le HFC-245fa, est rapporté. Celui-ci apparait sous l'appellation « Unspecified mix of HFCs » dans la Table2(II).Fs1. D'importantes modifications ont eu lieu suite à la mise en place d'une nouvelle méthodologie de calcul des émissions d'aérosols techniques et à de nouvelles données de ventes pour les aérosols pharmaceutiques.
2F_Consumption of halocarbons HFC	Germany	-2 634	-23.4	Implementation of an improved calculation method with new data sources and changed EFs.
4A_Enteric fermentation CH_4	Germany	726	3.6	New national method in 4.A Enteric Fermentation \ Cattle \ Option A \ Dairy Cattle Re-allocation within the cattle category in 4.A Enteric Fermentation \ Cattle \ Option A \ Non-Dairy Cattle Updated "piglets per sow" ratio in 4.A Enteric Fermentation \ Swine.
4A_Enteric fermentation CH_4	Spain	-1 433	-11.6	New national methodology introduced.

		2010		Main explanations
		Gg CO_2 equiv.	Percent	
4B_Manure management CH_4	France	-3 596	-26.5	Les séries statistiques de 1990 à 2011 portant sur les effectifs animaux ont été modifiées suite au Recensement Agricole de 2010. Ces modifications ont eu un impact sur les données d'activités et sur les facteurs d'émissions pour les catégories animales agrégées. Les VS des bovins ont été mis à jour suite à la livraison des premiers résultats de l'étude MONDFERENT. Cette mise à jour méthodologique permet d'améliorer la transparence de la méthode et s'accompagne d'une mise en cohérence des calculs d'émissions de méthane entérique et de méthane liées à la gestion des déjections. Les valeurs utilisées pour le paramètre FCM ont été modifiées, passant d'un climat « tempéré » à un climat « froid » pour la métropole, suite à la revue ESD de l'année 2012.
4B_Manure management CH_4	Spain	1 158	21.4	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4B_Manure management N_2O	Germany	612	27.0	New emission factor in 4.B Manure Management \ Solid storage and dry lot. Digesters are now part of liquid systems in 4.B Manure Management \ Liquid system
4B_Manure management N_2O	Spain	-963	-36.8	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4D_Agricultural soils N_2O	UK	554	2.1	Activity Data: Fraction of livestock N excretion in excrements burned for fuel was expressed as a fraction of poultry N as opposed to all livestock groups, now corrected
6A_Solid waste disposal on land CH_4	France	-6 587	-42.1	La soumission précédente était basée sur le principe d'une non prise en compte du captage faute de pouvoir l'estimer sur la base des mesures comme demandé par l'équipe de revue CCNUCC de septembre 2010. Suite à l'enquête auprès des ISDND, l'estimation 2013 intègre la prise en compte du captage du biogaz généré et sa combustion en torchères ou installations de valorisation.
6A_Solid waste disposal on land CH_4	Germany	3 045	34.0	New statistical data for CH_4-recovery.
6A_Solid waste disposal on land CH_4	Netherlands	-923	-21.4	Improved method.
6B_Waste water handling CH_4	Spain	-1 651	-70.1	New information available about domestic and commercial wastewater
6B_Waste water handling CH_4	UK	1 276	377.9	Consultation with water companies has lead to updated data.

10.2 Implications for emission levels

Table 10.3 provides the differences in total EU-15 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-15 1990 GHG emissions excluding LULUCF have increased in the latest submission compared to the previous submission by 5.159 Gg (0.1 %). EU-15 GHG emissions for 2010 decreased by -7.388 Gg (-0.2 %) due to recalculations.

Table 10.3 Overview of recalculations of EU-15 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total CO_2 equivalent emissions including LULUCF (absolute)	34 825	19 799	18 851	11 618	13 070	14 000	7 894	5 731	9 974	10 006	-6 793	3 333	751
Total CO_2 equivalent emissions including LULUCF (percent)	0.9%	0.5%	0.5%	0.3%	0.3%	0.3%	0.2%	0.1%	0.3%	0.3%	-0.2%	0.1%	0.0%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	5 159	-2 986	-1 695	-6 293	-4 181	-3 275	-5 226	-7 561	-3 600	-8 416	-9 743	-8 997	-7 388
Total CO_2 equivalent emissions excluding LULUCF (percent)	0.1%	-0.1%	0.0%	-0.2%	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	-0.2%	-0.2%	-0.2%	-0.2%

Table 10.4 provides an overview of recalculations for the EU-15 key categories for 1990 and 2010 (see Section 1.5 for information on identification of EU-15 key categories). The table shows that the largest recalculations in absolute terms were made in the key category CO_2 from 1A2 ‘Manifacturing Industries’ for 1990 and in the key category HFC from 2F ‘Consumption of Halocarbons and SF_6’ for 2010.

Table 10.5 and Table 10.6 give an overview of absolute and percentage changes of Member States’ emissions due to recalculations for 1990 and 2010. Large recalculations in absolute terms were made in Germany, France, the UK, Greece, Portugal and Spain. Recalculations in relative terms of more than 1,5 % were made in the France, Spain, Portugal and Luxembourg.

Table 10.4 Recalculations for the EU-15 key source categories 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2010	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1A1 Energy Industries	CO_2	-1616	-0,1%	2039	0,2%
1A1 Energy Industries	N_2O	-73	-0,8%	-886	-10,0%
1A2 Manufacturing Industries	CO_2	5063	0,8%	485	0,1%
1A3 Transport	CO_2	885	0,1%	1095	0,1%
1A3 Transport	CH_4	67	1,5%	-5	-0,4%
1A3 Transport	N_2O	-353	-5,1%	-477	-6,0%
1A4 Other Sectors	CO_2	-248	0,0%	3634	0,6%
1A4 Other Sectors	CH_4	144	1,3%	124	1,6%
1A5 Other	CO_2	299	1,4%	252	3,5%
1B1 Solid Fuels	CH_4	29	0,1%	293	4,5%
1B2 Oil and Natural Gas	CH_4	-394	-1,3%	-778	-3,7%
2A Mineral Products	CO_2	484	0,4%	592	0,6%
2B Chemical Industry	CO_2	-391	-1,3%	-1029	-3,2%
2B Chemical Industry	N_2O	-1	0,0%	1	0,0%
2C Metal Production	CO_2	-129	-0,2%	159	0,4%
2C Metal Production	PFC	0	0,0%	0	0,0%
2C Metal Production	SF_6	0	0,0%	0	0,0%
2E Production of Halocarbons and SF6	HFC	0	0,0%	43	2,4%
2F Consumption of Halocarbons and SF6	HFC	3	1,3%	-3851	-5,4%
2E Production of Halocarbons and SF6	PFC	20	0,3%	170	3,1%
2F Consumption of Halocarbons and SF6	SF_6	20	0,3%	170	3,1%
4A Enteric Fermentation	CH_4	2621	1,9%	-554	-0,5%
4B Manure Management	CH_4	-2755	-6,9%	-3215	-8,0%
4B Manure Management	N_2O	12	0,1%	-691	-3,4%
4D Agricultural Soils	N_2O	292	0,1%	149	0,1%
6A Solid Waste Disposal on Land	CH_4	341	0,2%	-3751	-4,5%
6B Waste-water Handling	CH_4	718	5,4%	-383	-3,5%
6B Waste incineration	CO_2	187	4,8%	633	29,5%

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5.

Table 10.5 Contribution of Member States to EU-15 recalculations of total GHG emissions without LULUCF for 1990–2010 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	-6	-77	-271	15	33	-119	7	217	418
Belgium	-186	-121	-163	-354	-334	-257	-41	-719	-677
Denmark	116	91	145	194	167	167	212	157	152
Finland	72	69	91	126	244	221	-33	-69	-19
France	-2.548	-3.860	-5.855	-8.792	-6.183	-5.999	-6.078	-6.691	-8.173
Germany	4.126	893	1597	652	1492	-1046	-974	-494	6.975
Greece	-419	-488	-830	-741	-808	-860	-930	-1059	-1009
Ireland	85	215	100	135	129	103	41	83	179
Italy	-261	-1673	-269	-316	-321	-394	-412	-749	-1004
Luxembourg	67	74	164	146	150	148	140	175	177
Netherlands	-170	-191	-195	-1489	-1418	-1320	-1256	-1066	-876
Portugal	876	1108	2.010	1497	1499	1490	657	844	783
Spain	-32	-1569	-2.055	-2.594	-2.980	-4.317	-4.942	-3.553	-7.256
Sweden	-4	-57	-57	-116	-109	-93	-192	-333	-745
UK	3.445	2.600	3.894	4.075	4.837	3.860	4.057	4.259	3.687
EU-15	**5.159**	**-2.986**	**-1.695**	**-7.561**	**-3.600**	**-8.416**	**-9.743**	**-8.997**	**-7.388**

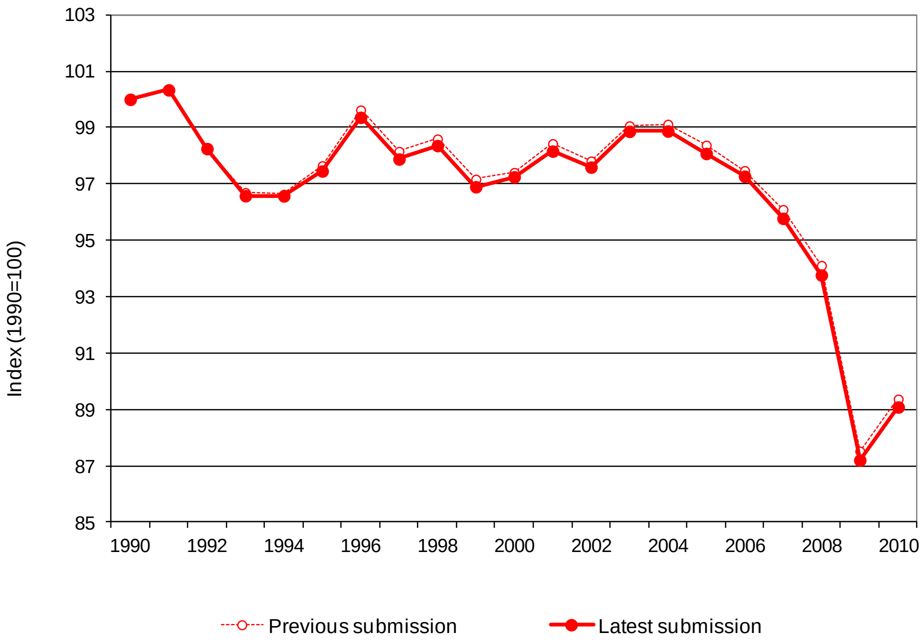
Table 10.6 **Contribution of Member States to EU-15 recalculations of total GHG emissions without LULUCF for 1990–2010 (difference between latest submission and previous submission in percentage)**

	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	0,0	-0,1	-0,3	0,0	0,0	-0,1	0,0	0,3	0,5
Belgium	-0,1	-0,1	-0,1	-0,2	-0,2	-0,2	0,0	-0,6	-0,5
Denmark	0,2	0,1	0,2	0,3	0,2	0,2	0,3	0,3	0,2
Finland	0,1	0,1	0,1	0,2	0,3	0,3	0,0	-0,1	0,0
France	-0,5	-0,7	-1,0	-1,6	-1,1	-1,1	-1,1	-1,3	-1,6
Germany	0,3	0,1	0,2	0,1	0,1	-0,1	-0,1	-0,1	0,7
Greece	-0,4	-0,4	-0,7	-0,5	-0,6	-0,6	-0,7	-0,8	-0,9
Ireland	0,2	0,4	0,1	0,2	0,2	0,2	0,1	0,1	0,3
Italy	-0,1	-0,3	0,0	-0,1	-0,1	-0,1	-0,1	-0,2	-0,2
Luxembourg	0,5	0,7	1,7	1,1	1,2	1,2	1,2	1,5	1,5
Netherlands	-0,1	-0,1	-0,1	-0,7	-0,7	-0,6	-0,6	-0,5	-0,4
Portugal	1,5	1,6	2,4	1,7	1,8	1,9	0,8	1,1	1,1
Spain	0,0	-0,5	-0,5	-0,6	-0,7	-1,0	-1,2	-1,0	-2,0
Sweden	0,0	-0,1	-0,1	-0,2	-0,2	-0,1	-0,3	-0,6	-1,1
UK	0,5	0,4	0,6	0,6	0,7	0,6	0,6	0,7	0,6
EU-15	**0,1**	**-0,1**	**0,0**	**-0,2**	**-0,1**	**-0,2**	**-0,2**	**-0,2**	**-0,2**

10.3 Implications for emission trends, including time series consistency

Table 10.7 shows that due to the fact that neither the 1990 nor 2011 emissions have been recalculated significantly the emission trend in the EU-15 did hardly change. In the previous submission the trend of GHG excluding LULUCF between 1990 and 2010 was – 10,6 %. In the latest submission the trend is -10,9 %.

Table 10.7 **Comparison of EU-15 GHG emission trends 1990–2010 (excl. LULUCF) of the latest and the previous submission**



10.4 Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1 EU response to UNFCCC review

A list of recommendations and improvements is presented in (Table 10.10.8). The table focuses on UNFCCC recommendations from the review reports 2010 and 2011 due to late receipt of the draft review report 2012.

Table 10.10.8 Improvements in 2013 including in response to UNFCCC review findings

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
General	Key category analysis	The documentation relating to the key category analysis is not fully transparent (e.g. the tier 2 analysis is only documented in one table in annex 1 to the NIR). The tier 2 analysis does not contain the LULUCF sector. The ERT recommends that the European Union give priority to the tier 2 key category analysis, that it include the LULUCF sector and that it document the tier 2 analysis in the NIR. (para 20)	ARR 2010	implemented, see chapter 1
General	QA/QC, completeness	The ERT recommends that the Party continue its efforts to enhance the usage of notation keys, to guarantee that it is transparent to the ERT that reported emissions are not underestimated. The ERT also recommends that the Party report on the results of actions undertaken for every submission and progress achieved in relation to these issues in future annual submissions. (para 16)	ARR 2011	Since 2012 the completeness checks also cover the notation keys NO and NA, aditional to NE.
General	geographical coverage	The GHG inventory of the European Union submitted under the Kyoto Protocol comprises the sum of the national inventories compiled by the 15 member States making up EU-15. The ERT noted a systematically difference in the time-series between the total GHG emissions reported by the European Union's inventory and the sum of emissions for the 15 member States. Responding to the ERT during the review week, the EU clarified that this is due to the difference in the geographical coverage of some member States between their national submission and their submissions to the European Union. Indeed, the inventory of the European Union covers the total area of most member States, with exceptions for Denmark (excluding Greenland and Faroe Islands), France (excluding New Caledonia, Wallis and Futuna, Austral and Antarctic territories), the Netherlands (excluding Aruba and the Netherlands Antilles and including a 12-mile zone from the coastline) and for United Kingdom of Great Britain and Northern Ireland (excluding Gibraltar). The ERT recommends that the European Union clarify this issue in the NIR of its next annual submission. (para 11)	ARR 2011	implemented, see chapter 1.7.3
General	Key category analysis	The ERT noted that the tier 2 key category analysis does not include the LULUCF sector, while large uncertainties associated with the categories of this sector usually have significant influence in the final results of the analysis. The Party indicated its intention to include the LULUCF sector in the tier 2 analysis to be prepared for the next annual submission and to	ARR 2011	implemented, see chapter 1.4

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
		determine the key categories for KP-LULUCF activities. The ERT commends the intention by the EU and recommends that it report on improvements made in the next annual submission. (para 21)		
General	QA/QC procedures	....The ERT concluded that these actions represent QA procedures and recommends that the Party describe in the NIR of its next annual submission the results of the implementation of these actions. The ERT commends the efforts of the European Union in the continuous improvement of its QA/QC procedures and recommends that it update related information in the NIR on a regular basis. (para 30)	ARR 2011	implemented, see chapter 1.5.3
General	EU ETS	The ERT recommends that the Party continue to describe the annual changes and improvements in the usage and verification of EU ETS data in the NIR of future annual submissions. (para 31)	ARR 2011	implemented, see chapter 1.3.2
Chapter 3 / Sector Energy	QA/QC	The European Union has a well-developed QA/QC system for the energy sector. However, the ERT noted several instances of errors in tables in the NIR (e.g. tables referring to fugitive CO_2 and CH_4 emission data associated with venting/flaring and natural gas). The Party confirmed to the ERT that these were errors in the NIR tables and the emission data reported in the CRF tables were correct. In addition, the ERT identified that the table reporting on methodologies used by the EU-15 member States was incorrect. The EU informed the ERT that the table had not been updated from the previous year, but confirmed that data reported in the CRF tables were correct. Although the ERT recognizes the significant task in compiling the NIR of the European Union, it recommends that the EU enhance its QA/QC procedures, particularly regarding fugitive emissions, in order to prevent these errors from occurring in future annual submissions. (para 42)	ARR 2011	The QA/QC programme has been updated and improved in 2013
Chapter 3 / Sector Energy	Aviation	The ERT notes the continuing progress of the EU in comparing the aviation emissions reported by member States with modelling results provided by EUROCONTROL, as a QA/QC procedure. The ERT recommends that the European Union continue such QA exercises and that it work towards making data from EUROCONTROL available to member States on a regular basis for quality checking of the inventories of member States. (para 46)	ARR 2011	implemented, see chapter 3.8.4
Chapter 3 / Sector Energy		The EU provided revised its CH_4 emission estimates for both distribution and transmission based on Sweden's pipeline length and the use of IPCC good practice guidance default EFs (6.15*10–4 Gg/year/kilometre of transmission pipeline for distribution 2.90*10–3 Gg/year/ kilometre of pipeline for transmission). The ERT considers that the potential problem of under-estimation was solved, and recommends that the EU make efforts so that Sweden provides revised estimates for this category in its next annual submission.	ARR 2011	implemented

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
Chapter 3 / Sector Energy	International bunker fuels	The NIR includes a brief summary of a study on bunker fuel emissions conducted in 2007 by the ETC/ACC comparing the aviation emissions reported by member States with modelling results provided by Eurocontrol and discussed in the previous review report. The ERT again recommends that the European Union continue such QA exercises, that it try to address the issues identified, and that it continue to work on making data from Eurocontrol available to member States on a regular basis. (para 37)	ARR 2010	implemented, see NIR chapter 3.8
Chapter 4 / Industrial processes	notation keys	Although there is a three-step process for addressing "NEs" in the inventory, the ERT identified several 'NEs' remaining in emission estimates for consumption of halocarbons and SF_6 in individual member States. During the review, further communication with the Party revealed that many of these "NEs" should have been reported as "NO", not applicable ("NA") or included elsewhere ("IE"). Therefore, the ERT recommends that the EU enhances its QA/QC procedures on notation keys in the next annual submission (para 57; see para. 66 below, for further details).	ARR 2011	Since 2012 the completeness checks have been extended to the use of the notation key NO and NA. All cases where less than seven Member States reported NO or NA and all other MS reported emission estimates were checked by the sector experts and clarified with Member States, if needed.
Chapter 4 / Industrial processes	2A2 / accuracy	Responding to the list of potential problems and further questions, the EU indicated that the United Kingdom will explore further whether they can identify separate data on limestone and dolomite consumption for use in their next inventory submission. In the absence of the relevant data, the EU prepared revised estimates in accordance with the recommendation of the ERT that the IPCC default assumption should be applied: assumption of 15 per cent dolomite and 85 per cent limestone. The revised estimates resulted in additional emissions of 14.90 kt CO_2 in 1990 and 7.80 kt CO_2 in 2009. The ERT recommends that the European Union continue its efforts together with the United Kingdom in order to prepare estimates using the country-specific information that the Party is preparing. (para 60)	ARR 2011	implemented The UK recalculated the emissions using EU ETS data, see chapter 4.2.1.
Chapter 6 / Agriculture	Transparency of reporting	Most of the recommendations made in previous review reports have been addressed in the 2011 annual submission. The NIR contains several background tables that contain data for each member State but the ERT noted that not all tables compile information for all member States. The ERT commends this effort to improve transparency of reporting, but recommends that the Party provide complete background tables with information from all member States in the next annual submission. (para 72)	ARR 2011	We modified the relevant table caption that available background information is compiled to improve transparency.

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
Chapter 6 / Agriculture		In the previous review report,10 the European Union informed the ERT that a project has been carried out at the European Commission JRC, which was commissioned to evaluate the contribution of livestock production in Europe to overall European Union GHG emissions, the results of which will be included in the 2011 annual submission. The ERT commends the Party's efforts and notes that a new section was added to its NIR summarizing the project CGELS (evaluation of the livestock sector's contribution to the EU greenhouse gases) and a comparison with European CAPRI model. The ERT recommends that the Party continue to improve this research and specially develop the objective to compare members States' methodologies, to identify and explain the main differences between member states, and improve the methods utilized. The ERT recommends that the Party continue reporting on this issue in the next annual submission. (para 73)	ARR 2011	The following text has been added: "Additional work on the comparison of GHG emission estimates from agriculture with the CAPRI model using different methodologies (IPCC 1997, IPCC 2006, IPCC 1997 with country-specific information as provided by MS IRs) is ongoing but not yet finalised. The JRC is cooperating with EUROSTAT on a methodology to use the CAPRI model for the regionalisation of the Gross Nutrient Budget (GNB) indicators (nitrogen and phosphorus) that needs to be reported regularly by countries to EUROSTAT and OECD. The GNBs are identified as one of the key agro-environmental indicators. Current reporting occurs at the national level. For policy making, a higher resolution, matching with legislative and environmental boundaries (NVZ, watershed) rather than administrative boundaries (country) is required. The CAPRI model is an economic model for agriculture, which has an environmental accounting model integrated. It has a spatial resolution of NUTS2 and reports, a.o. Nitrogen Balances at this level. The CAPRI model has a down-scaling module integrated which estimates land use shares and environmental indicators at the pixel level (1 km by 1 km). The use of the CAPRI model is motivated in view of the lack of methodology for regionalisation of the GNB and the high costs associated with building up such systems in the countries at one hand, and the thrive to harmonise the conceptual approaches. For the submission 2013, the discussion of the share of manure excretion by IPCC climate zones was extended and amended with an independent Europe-wide estimation of shares, together with additional background-information on the methodologies used by the MS. This project is of high relevance also for the submission of the EC GHG inventories, because • The project might help identifying data gaps which will be discussed in the Working Group on Agri-environemental indicators at EUROSTAT and could lead to

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
				improvements of data collection, such as the Survey on Agricultural Production Methods (SAPM) which was carried out in 2010 • The project aims at enhancing cooperation between countries and for various reporting obligations. The EUROSTAT/OECD methodology and handbook on Nutrient Budgets explicitly mentions the link to GHG inventory systems."
Chapter 6 / Agriculture	4B –CH_4, Key categories - manure management	75. The ERT also found inconsistent data in the table showing the allocation of the Animal Waste Management System (AWMS) in the NIR: swine for the Netherlands and Spain are reported as "NO" for all AWMS. During the review week, the European Union informed the ERT that the data for the Netherlands was not provided and Spain is allocated to other systems, which is not included in the NIR. The ERT recommends that the Party add a column with other in this table and to complete the Netherlands' data in the next annual submission.	ARR 2011	This has been corrected in the current submission, by adding an additional column indicating the quantity of manure managed under 'other' systems. Information from NL is included as well.
Chapter 6 / Agriculture	4B –CH_4, Consistency	76. CH_4 emissions from manure management vary substantially from Party to Party due the use of different classification by climate regions. Most of the member States fall into the cool climate region, but some member States allocate a part of the population livestock into the temperate climate region, which sometimes appears inconsistent considering the reports of neighbour member States. For example, France allocates all its population livestock to the temperate climate region, while Spain and Portugal also consider part of these emissions under the cool climate region (the allocation for the swine population in the temperate climate region, in 2009, is 80 per cent for Portugal, 37 per cent for Spain, and 3 per cent for Italy). During the review, the European Union informed the ERT that the allocation of animals to climate regions is done by member States in accordance with the best national data available. However, in order to improve the consistency and accuracy of the inventory, the ERT recommends that the EU make efforts to achieve consistent reporting. Meanwhile, and for the sake of transparency, the ERT recommends that the Party includes member States' climate data for each country in the next annual submission.	ARR 2011	An additional section has been included in the chapter 6.2.2.2 - Methodological issues for cat 4B(a) - on the allocation to climate regions. This section assesses in depth the distribution of climate regions in Europe and the distribution of livestock across these regions in European countries, based on an independent assessment and in comparison with MS submissions. The section discusses also sources of uncertainty and provides additional background information obtained from MS enhancing thus transparency.

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
Chapter 7 / LULUCF	Completeness	In response to recommendations made in previous review reports, the 2010 NIR of the European Union shows continued improvements in the completeness of reporting of emissions and removals of all categories/subcategories, and in the reporting of carbon pools. However, some categories/subcategories are still reported as "NE" by several member States, such as the carbon stock changes in dead organic matter (DOM), as well as the emissions due to biomass burning in several land-use categories, and significant gaps exist in the reporting of all carbon pools. The European Union has provided information on its continuous efforts to encourage all member States to improve their LULUCF inventories, including for the reporting of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol for future submissions. The ERT welcomes the improvements in the reporting of the LULUCF sector and recommends that the European Union continue to encourage its member States to develop the ability of the various national systems to report complete emissions and removals from the LULUCF sector and identify activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. It further encourages the Party to provide further support to those member States that are still unable to fulfil the requirements of reporting a complete LULUCF inventory under the Convention. (para 69)	ARR 2010	Ongoing. There is a significant improvement for all land categories and sources/sinks, over last couple of years. Although, CL and GL are still under improvement (major issues to be reviewed with MS for the KP LULUCF workshop 2013), which mostly report under Tier 1 for relevant pools.
Chapter 7 / LULUCF	time series consistency	86. At the EU-15 level, this category is a sink of about 310,549.56 Gg CO_2 eq. in 2009, which represents an increase by 15.7 per cent in comparison with 1990 and 6.0 per cent more than in 2008. The strong increase in the sink in 2009 compared with 2008 is largely due to Finland and Sweden. Some member States (i.e. Denmark, Ireland) show fluctuating time trends of 'net CO_2 emissions/removals' and IEF. The ERT recommends that the European Union continue to work with these countries to ensure time-series consistency, and report on the results obtained in the next annual submission.	ARR 2011	We will work on improving the transparency of reporting of climate regions and will improve the respective sections in the EC-IR.
Chapter 7 / LULUCF	5A1 /accuracy	87. An issue identified in previous review reports continues to be observed in the current inventory. As noted in the previous review report, Italy's approach assumes that soils build up their carbon stock in a year time frame, which is as fast as vegetation. This assumption is not supported by adequate evidence and thus may lead to an overestimation of the increase in soil carbon stocks under growing forest vegetation. Hence, the approach applied by Italy may not be fully consistent with the IPCC good practice guidance for LULUCF. The ERT recommends that the European Union continue to work with member States to improve the reporting of forest land remaining forest land and to ensure that the reported values are as accurate as possible.	ARR 2011	Implemented IT reports Tier 1 under the convention (notation keys) and provides demonstration that soil pool is not a source under KP chapter.
Chapter 7 / LULUCF	5B2 / tier methods	Some member States still use the lower-tier method to estimate emissions/removals. Given the importance of this category for the European Union, the ERT reiterates its recommendation in the previous review report[1] that the Party should continue to support member States in improving the reporting in this area to use a higher-tier method where possible, as well as	ARR 2011	Effort is made to improve reporting of this category, but national data is usually missing. The KP LULUCF workshop in February 2013 dedicated one day for improved reporting of CM, GM and other activities relevant for the

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
		by improving the completeness of reporting. (para92)		2nd commitment period.
Chapter 7 / LULUCF	5C1 / consistency of assumptions	Few member States report the existence of unmanaged grassland (e.g. Ireland, France). The ERT recommends that the European Union support member States in improving the consistency of their assumptions and methods and in the completeness of the reporting of this category whenever appropriate. (para 94)	ARR 2011	The KP LULUCF workshop in February 2013 dedicated one day for improved reporting of CM, GM and other activities relevant for the 2nd commitment period.
Chapter 8 / Waste	6B	Six member States (Finland, Greece, Italy, Netherlands, Portugal and Spain) reported CH_4 emissions from industrial wastewater in 2008 while Denmark reported these emissions as “IE”, Austria as ‘NA’, France, Germany, Ireland and Luxembourg as ‘NO’ and three member States reported these emissions as ‘NE’ (Belgium, Sweden and the United Kingdom). Six member States (Austria, France, Italy, Luxembourg, Portugal and Sweden) reported N_2O emissions from industrial wastewater, while the remaining member States reported these emissions as “NA”, “NE” and “IE”. The ERT recommends that the European Union encourage those member States reporting these emissions as “NE” to provide emission estimates. (para 91)	ARR 2010	Sweden and the UK report CH_4 emissions from 6B1 in the latest inventory. Belgium reports "NA" and clarifies in the NIR: "Regarding the emissions from industrial wastewater handling and treatment : emissions from industrial waste water treatment are not included in the Belgian greenhouse gas inventory because most of the industrial waste water is treated in an aerobic way. Recovery of CH_4 occurs (flaring or energy production) for these installations that treat the waste water anaerobically."
Chapter 8 / Waste	6A – CH_4, consistency	During the review, the ERT noted that industrial waste is not mentioned nor considered in the NIR for two member States (Greece and Netherlands), and that the inventory of the European Union could be underestimated for this category. In response to questions raised by the ERT, the European Union explained that for the Netherlands, and in accordance with member State’s NIR, AD for landfilling includes industrial waste. Since the Party could not provide a clarification for Greece, this issue was included in the list of potential problems and further questions. In the follow-up, the EU confirmed that emissions from industrial waste were not included in the inventory of Greece and provided revised estimates of CH_4 emissions from industrial waste in Greece and the European Union. The estimates were prepared by Greece using data from inquires to industries made by Hellenic Statistical Authority (EL.STAT) for some years (2004, 2006 and 2008) and extrapolated/interpolated for the remaining time series (1960–2009). The methodology to estimate emissions follow the same used for municipal wastes, considering that the wastes are landfilled in common places. The revised estimates added 64.58 Gg CO_2 eq in 2009. The ERT concluded that the issue was solved and recommends that the EU make efforts so that the submission of Greece is recalculated in a consistent manner in the next annual submission. (para 97)	ARR 2011	Greece has implemented this recommendation in its 2013 submission.

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
Chapter 8 / Waste	6C - CO_2, notation keys	Nine member States reported emissions from this category, while four member States (DK, FI, LU and NL) reported these emissions as “IE” and two member States (DE and IE) reported them as “NO” in CRF tables. The ERT recommends that the European Union encourages member States to be consistent in using the notation key as “IE” and “NO” for this category and to make the appropriate correction in its next annual submissions. (para 99)	ARR 2011	This issue was discussed in WG1 and as response DK changed their reporting to ‘NO’, while FI, LU and NL are still using the notaion key ‘IE’. We wil follow up this issues in 2014 to improve consistency in reporting.
Chapter 8 / Waste	6B – CH_4, N_2O, tier methods	CH_4 emissions from domestic and commercial wastewater handling are a significant emission source for the waste sector and have been identified as a key category for the European Union. Nevertheless, the ERT noted that only 25% of all EU-15 CH_4 emissions from domestic and commercial wastewater handling are calculated using higher tiers, and the rest of the member States only use the check and tier 1 methods. Therefore, the ERT recommends that the European Union continue to encourage member States to move to a higher-tier method to estimate emissions in the next annual submissions in order to improve the accuracy of emissions for this key category. (para 98)	ARR 2011	This issue has been discussed in WG1. MS will check possiblities to change to higher tier methods. However if this category is not a key category in the relevant MS the implmentation of higher tier methods is of low priority.
Chapter 11 / KP-LULUCF	Completeness	Not all member States have reported the carbon stock changes for each of the five carbon pools as required for all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. This issue is further addressed in the individual review report of the member States. The ERT recommends that the European Union work with member States to report on all pools for activities under Article 3, paragraphs 3 and 4, or to demonstrate that a particular pool is not a net source. (para 96)	ARR 2010	Ongoing. Several support activities are implemented (i.e. workshops, internal reviews, focused support) . There is a significant improvement in reporting, with MS providing either individual estimate for each pool, demonstration of "not a source" or better justification for the inclusion of some pool under other pools.
Chapter 11 / KP-LULUCF	Afforestation / Reforestation	The European Union has included in its NIR a table (11.16) listing the justifications provided by member States as to why afforestation and reforestation activities are directly human-induced. Several member States have not provided adequate information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested. As the European Union has noted in the NIR, further improvement is needed in this area and the ERT recommends that the European Union work with member States to provide more complete information on this category. (para 97)	ARR 2010	Ongoing. Need for increased transparency is always highlighted to the MS and support activities are implemented to this end (i.e. workshops, internal reviews, focused support) EU makes an effort to ensure that all MS report all items required under Decission 15/CMP1 by sharing experinece and organizing meetings, bilateral/multilateral activities.
Chapter 11 / KP-LULUCF	Transparency	Tables 11.9 and 11.10 of the NIR list the different approaches used by member States to identify land and units of land. Most member States use a national forestry inventory (NFI) to identify land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol (afforestation and reforestation, and deforestation). While land areas are provided, limited information on whether the countries have provided georeferencing or geographical boundaries for multiple or single activities is provided. The ERT recommends that the European Union work with member States to provide more detailed information on geographical boundaries for land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol, including maps and/or databases to identify the geographical locations and the system of identification codes for the	ARR 2010	Ongoing. Several support activities are implemented (i.e. workshops, internal reviews, focused support to MS). Land identification methods are better reported by the MS, following the UNFCCC review over last two years and the EU QAQC checks.

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
		geographical locations. (para 95)		
General	Key category analysis	The documentation relating to the key category analysis is not fully transparent (e.g. the tier 2 analysis is only documented in one table in annex 1 to the NIR). The tier 2 analysis does not contain the LULUCF sector. The ERT recommends that the European Union give priority to the tier 2 key category analysis, that it include the LULUCF sector and that it document the tier 2 analysis in the NIR. (para 20)	ARR 2010	implemented, see chapter 1

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EU inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, **Error! Reference source not found.** provides an overview of Member States' responses to the UNFCCC review ([40]). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 10.9 General improvements related to national inventory system made by EU-15 Member States in response to the UNFCCC review

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
Austria	<u>Key category analysis:</u> The expert review team (ERT) recommends that Austria investigate the differences between the key category analysis performed by the Party and that performed by the secretariat, including the possible missing categories, in order to ensure that it is applying the appropriate methodologies and to report thereon in the next annual submission. **(para18)**	"The differences have been analysed and the level of disaggregation has been changed for NIR 2013." [NIR, April 2013, Chapter 9.4.1., Table 275, p.446]
	<u>Transparency:</u> Improve the transparency of the reporting with regard to the energy, industrial processes, agriculture, land use, land-use change and forestry (LULUCF) and waste sectors. **(para 30)**	"A summary on the process of eliciting and documentation of expert judgements is included in NIR 2013 (see Chapter 1.6.1.4)." [NIR, April 2013, Chapter 9.4.1., Table 275, p.446]

([40]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	<u>Uncertainties:</u> Include uncertainty estimates for entire LULUCF sector in its next annual submission**.(para 21)**	"Uncertainties for the whole LULUCF have been assessed and reported in NIR 2012." [NIR, April 2013, Chapter 9.4.1., Table 275, p.445]
	<u>Recalculations:</u> Complete common reporting format (CRF) table 8(b) for all the years for which recalculations have been undertaken. **(para 25)**	Considered in Table AUT-2013-2010 –v1.2.xl with reference to the respective chapters in the NIR.
	<u>Quality assurance/quality control (QA/QC):</u> Implement additional QA/QC procedures in order to ensure that the presented data in the NIR correspond to the actual data used for the emission estimates, as presented in the official national energy balance, and check them against other data sources. **(para 29)** Include a corrected national energy balance table in annex 4 to the national inventory report (NIR) in the next annual submission and implement adequate QA/QC procedures prior to the submission of the NIR. **(para 29)**	Not yet addressed. "Recalculations - Activity data Imports, Exports and Production are updated according to the new version of the energy balance (IEA JQ 2012). Changes of activity data are based on energy balance recalculations as described in Annex 2. Net calorific values and carbon contents In response to the UNFCCC review more country specific values are now used. The selected values and IPCC default values are shown in Table A 67. [NIR, April 2013, Annex 3, p A-74]
	<u>Previous annual review reports:</u> The ERT reiterates the recommendations from the previous ARR. (a) Reporting of information in CRF table 8 (b); (b) Providing a brief summary of the procedures used for eliciting and archiving the expert judgement; (c) Improving the transparency and time-series consistency of: the allocation of fuel consumption between navigation and international marine bunkers; the use of EU ETS data to estimate CO_2 emissions from cement and from iron and steel production; and the use of country-specific parameters in the LULUCF sector; (d) Improving the transparency of its reporting with regard to the impact of fuel exports on implied EFs (IEFs) and CO_2 emissions from road transportation; (e) Implementing editorial changes in the NIR to clarify and improve the ERT's understanding of issues concerning the difference between the reference approach and the sectoral approach, with a particular reference to the disaggregation of the biogenic and fossil fuel fractions; (f) Improving the transparency of its reporting with regard to the use of the methane conversion factor (MCF) for emissions from deep litter systems, including information on storage duration and mixing practices; (g) Undertaking further methodological work with regard to the reporting requirement under paragraph 8(a) of the annex to decision 15/CMP.1 (information that demonstrates that activities under Article 3, paragraph 3, of the Kyoto Protocol began on or after 1 January 1990 and before 31 December of the last year of the commitment period, and are directly human-	(a) See comment regarding CRF table 8 (b);; (b) See comment under Transparency; (c) Description provided in NIR for: navigation, bunkers, estimate CO_2 emissions from cement and from iron and steel and LULUCF [NIR, April 2013, Chapter 9.4.1., Table 275, p.446 - 448]; (d) "NIR 2013 now includes an explanation on GHG emissions from and development of fuel exports." [NIR, April 2013, Chapter 9.4.1., Table 272, p.446]; (e) Not yet addressed; (f) "NIR 2013 includes information on this issue." [NIR, April 2013, Chapter 9.4.1., Table 275, p.447]; (g) Not yet addressed.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	induced) **(para33)**	
	Article 3, paragraph 14, of the Kyoto Protocol: Report any changes in the information provided under Article 3, paragraph 14, in accordance with chapter I.H of the annex to decision 15/CMP.1 **(para 95), (FCCC/ARR/2013/AUT, Table 6)**	Not yet addressed. "The information has been updated according to recent developments." [NIR, April 2013, Chapter 14, p.483]
Belgium **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The improvement of the transparency of the reporting across all sectors regarding the assumptions used for the recalculations, the inclusion of a discussion on the selection of the methodologies and EFs, the enhancement of the description of the sector specific QA/QC checks performed, and the provision of a clear explanation for the differences between the data sets used;	Not for all sectors addressed. For example: "Tier 1 quality control checks are performed in the 3 regions for the Belgian key source categories and can be provided by the Belgian experts on request." [NIR 2012, p. 163], *not addressed in NIR 2013*
	(b) The intensification of the harmonization process for the methodologies, EFs and data sets used, as well as the improvement of overall cooperation and internal QA procedures between the three regions, in order to avoid inconsistencies in the emission estimates and to increase the transparency of the reporting;	*not further addressed in NIR 2013*
	(c) The inclusion of a discussion of time-series consistency in the appropriate sections of the NIR;	"The LULUCF issue on the past 20 years is planned to be investigated in the next submission." [NIR 2012, Chapter 9.1.2, p. 179] "Emissions of CO_2 from petroleum refining are the verified emissions from the ETS-Directive and are consistent for the complete time series. Monitoring protocol and monitoring plans are obliged performed by these companies. (see 3.2.6.2. petroleum refining (1A1b) in NIR)." [NIR 2012, Chapter 9.1.2, p. 179] "Belgium did enhance the reporting of the emissions in the iron & steel sector. A recalculation for the complete time series was performed during the 2011 submission in the Flemish region. (see 3.2.7.2. and 4.4.2. in NIR)." [NIR 2012, Chapter 9.1.2, 179]
	(d) The implementation of category-specific QC procedures at the national level, particularly where different methodologies are used for the same categories across the regions and ensuring that the QC procedures are consistently applied across all sectors during the preparation of the NIR, in order to avoid errors, and providing updated information;	"Tier 1 QC checks are applied in the 3 regions in Belgium and can be provided on request. QC activities: Tier 1 QC checks (see 1.6.1.5 in NIR)." [NIR 2012, Chapter 9.1.2, p. 179] *"The quality management system used in the Flemish region with the more technical procedures and an example of the forms used to control the data and the calculation of the emissions ("QMS Flanders")."* *"Belgian QA/QC-plan of April 2010" [NIR 2013, Annex 3, p. 291]*
	(e) The strengthening of efforts in the implementation of sector-specific recommendations in the previous review report that have not yet been addressed. **(FCCC/ARR/2011/BEL, para. 132)**	*"A copy of the model used to calculate the CH_4 emissions from enteric fermentation en manure management (category 4A en 4B(a)) in Flanders (CH_4model_2010_Flanders.xls), Wallonia (15th April submission) and Brussels (agri_RBC_database_130115.xls)"*

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		"A copy of the model used to calculate the direct and indirect N_2O emissions (category 4D) and the N_2O emissions from manure management (category 4B(b)) in Flanders (N_2Omodel_2010_Flanders.xls), Wallonia (15th April submission) and Brussels (agri_RBC_database_130115.xls)" *"Information related to the calculation of the Manure Balance in Flanders (2010)" [NIR 2013, Annex 3, p. 291]*
Denmark (late availability of 2012 ARR)	The ERT identifies the following cross-cutting issues for improvement: (a) The provision of a complete set of CRF tables in the next annual submission, including CRF tables 7 and 8(b), in accordance with the UNFCCC reporting guidelines;	"By mistake the recalculation explanations in CRF Table 8(b) had not been included in the aggregated submission of Denmark and Greenland for 2011. This will be corrected in the 2012 submission." [NIR, May 2012, Table 10.6, p. 562] *Table 8(b) in DNM – 2013 – 2010-v1.3.xls includes recalculation explanations with references to the NIR 2013*
	(b) The improvement of the transparency of documentation for several categories (see para. 42 above) and the improvement of the transparency of the reporting on the industrial processes sector, in particular for cement industry (see para. 72 above) and consumption of halocarbons and SF_6 (see paras. 74 and 77 above), on the agriculture sector (see paras. 81, 83, 89, 91 and 93 above), on the LULUCF sector (see paras. 102 and 106 above) and on the waste sector (see para. 112 above);	For cement industry: "The ERT has been informed that no further information is available for the years1990-1997. The work with including CKD in the emission estimates is on-going." [NIR May 2012, Table 10.6, p. 565] *"The work is ongoing." [NIR 2013, Table 10.6, p. 568]* For consumption of halocarbons and SF_6: "Corrections have been made for activity data for consumption of HFCs for hard foam.. (Chapter 4.7.3)… The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going… (Chapters 4.7.2. – 4.7.5.) ….. This improvement was carried out in the 2012 submission…(Chapter 5)". [NIR, May 2012, Table 10.6, p. 566] *"The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going." [NIR 2013, Table 10.6, p. 570]* For agriculture: for para 81:"Chapter 6.4 of the NIR describing the estimation of lower emission of CH_4 and N_2O includes more information and furthermore another table in Annex 3E showing the basic data from Sommer et al. (2001) is provided." [NIR, May 2012, Table 10.6, p. 567] For para 83: "During the in country review in September 2010 an extra quality control process was provided for some emission sources, among these the calculation of lower emission as a consequence of biogas treated slurry. Unfortunately, an error concerning the basic data for CH_4 reduction potential was found and corrected in submission 2011. Thus, the methodology is unchanged and the calculation is still based on the same reference (Sommer et al., 2001). Unfortunately this recalculation was not mentioned in the 2011 NIR submission." [NIR, May 2012,

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		Table 10.6, p. 568] *Chapter 6.4 of the NIR describing the estimation of lower emission of CH_4 and N_2O includes more information and furthermore another table in Annex 3E showing the basic data from Sommer et al. (2001) is provided. [NIR 2013, Table 10.6, p. 572]* For para 89: CRF table 4.B(a), concerning the allocation and MCF values for animal waste management systems (AWMS) per animal type provides information. For para 91: "Denmark has included this table in the NIR for the 2012 submission. …(Annex 3E)" [NIR, May 2012, Table 10.6, p. 569] For para 93: "The table has been modified specifying the N excretion by grazing animals. (chapter 6.5.2.)" [NIR, May 2012, Table 10.6, p. 569] For LULUCF: For para 102: "Information on tree species composition and age structure has been included in the NIR reporting. Due to the late reception of the draft review report, it was not possible to implement information on area and volume of clear cuttings or disturbance in the 2012 submission. The recommendation has been noted as a planned improvement and will be implemented in the 2013 submission based on the available data. (Chapter 7.2)" [NIR, May 2012, Table 10.6, p. 569] For para 106: "A figure with total input data has been included in the NIR as well as description. (see chapter 7.4)" [NIR, May 2012, Table 10.6, p. 570] *"The QA/QC procedure has been increased with by using independent people in the inventory process as quality controllers." [NIR 2013, Table 10.6, p. 573]* For waste: For para 112: "A Tier 2 approach with a first order decay model is introduced for estimation of emissions of CH_4 from the solid waste disposals. For this purpose the activity data in Table 16.8.2 are estimated back to 1960 (not shown) based on the methodology described in connection to Table 16.8.2. Combining these activity data and the composition data in Table 16.8.3 time series for 1960-2010 with amounts of waste in waste fractions are calculated." [NIR, May 2012, p. 693]
	(c) The further development of the QA/QC procedures, in particular for fluorinated gases (see paras. 77 and 78 above), the agriculture sector (see paras. 84, 87 and 89 above) and KP-LULUCF activities (see para. 115 above). **(FCCC/ARR/2011/DNK, para. 158)**	For F-gases: "The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going…" (Chapters 4.7.2. – 4.7.5.) [NIR, May 2012, Table 10.6, p. 566]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		For agriculture: see above For KP-LULUCF: "A recalculation for KP-LULUCF has been performed for all areas as a consequence of the new data and the review process." [NIR, May 2012, p. 543]
Finland **(late availability of 2012 ARR)**	The ERT identified the following cross-cutting issues for improvement: (a) The further improvement of transparency in the energy sector and the industrial processes sector, by including in the NIR the information provided to the ERT during the review;	"For industrial processes information provided during the review has been included in the NIR 2012." [NIR 2012, p.398] *2013_FIN_NIR_changes_table.xls includes all methodological descriptions compared to the 2012 NIR.* *For 1A4: "The estimation system for fuel consumption in stationary sources in agriculture was revised to include new data sources (Section 3.4.5)"* *For 1B2: "The share of biogenic components in fuels were included in calculation of indirect CO_2 emissions (Section 3.6.2.1)"* *For 2B: "Method for calculating emissions from hydrogen production was slightly updated as a result of in-country review feedback. (Section 4.3.3.1 and 4.3.3.6)"* *For 2F: "Timeseries of 2F8 was recalculated to improve the time series consistency (Section 4.6.5 and 4.6.3) "* *[NIR 2013]*
	(b) The further improvement of transparency in the LULUCF sector and on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;	"The LULUCF section has been re-written to be more transparent. Under KP the identification of ARD has been described in higher detail. "[NIR 2012, p.398]
	(c) The development of uncertainty estimates for activities under Article 3, paragraphs 3 and 4; **(FCCC/ARR/2011/FIN, para 114)**	"The development of the uncertainty estimation method and procedure is ongoing." [NIR 2012, p.398]
France **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The enhancement of general transparency for all sectors, in particular where country-specific methods, EFs and parameters are used, by providing more detailed explanations of the trends, and by continuing the efforts to better balance the share of information between the main part of the NIR and the OMINEA report (see para. 42 above);	Not yet addressed.
	(b) The application of a tier 2 key category analysis, and the inclusion of the KPLULUCF activities under the key category analysis (see paras. 32-33 above);	Realized. [NIR, April 2012, part 2, p. 1360] *"Réalisé pour le secteur 4D. Réflexions à mener pour d'autres secteurs selon les possibilités." [NIR 2013, Table 81, p. 1547]*
	(c) The restructuring of the plan for the uncertainty analysis, by adjusting the level of aggregation of categories and subcategories, so that uncertainty values represent the real accuracy of the methodologies and data (see para. 35 above);	Partly realized for 4D. Chapter NIR 1.7 and 6.5.3. [NIR, April 2012, part 2, p. 1360]
	(d) The improvement of the reporting of recalculations, with clearer explanations of the reasons for the recalculations for individual	Realized. [NIR, April 2012, part 2, p. 1360]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	categories (see para. 38 above);	
	(e) The enhancement of the QA/QC plan, by integrating more automatic checks and tier 2 QC checks;	*Ongoing process. [NIR 2013]*
	(f) Increasing the timeliness of the availability and approval of the detailed energy balance (see para. 57 below);	Not yet addressed.
	(g) Increasing the consistency of estimates for related categories in the agriculture sector (see para. 97 below);	Realized. [NIR, April 2012, part 2, p. 1360]
	(h) The collection of monitored data for CH_4 recovery from all landfills (see para. 133 below);	Contacts have been made. On the other hand, actions will be initiated. [NIR, April 2012, part 2, p. 1360]
	(i) The improvement of the cooperation with data providers for the LULUCF sector, and ensuring a consistent representation of land use over the whole time series (see para. 30 above). **(FCCC/ARR/2010/FRA, para 50)**	This recommendation was followed this years in particular by strengthening our collaboration with IFN (the statistical office French forestry) to take account their latest important statistical revisions. NIR chapter 7.5 [NIR, April 2012, part 2, p. 1360]
Germany **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Providing a clarification to explain the responsibilities of the single national entity UBA and the Federal Ministry of Agriculture and Consumer Production with respect to the reporting on agriculture, LULUCF and KP-LULUCF;	"The German Federal Ministry of Food, Agriculture and Consumer Protection has established a concepts for the preparation of GHG emissions- and carbon inventory of the source and sink groups 4 and 5 by the Johann Heinrich von Thünen Institute (vTI). The National Coordination Agency and the vTI have established regular coordiniation meetings to enhance the incooporation of the Agricultural- and LULUCF experts into the National System." [NIR, April 2012, Table 281, p. 602]
	(b) Improving the timeliness and accuracy of the NEB;	See above.
	(c) Providing justification on the consistency of the time series in the energy sector where revisions do not cover the whole time series, and in the LULUCF sector where different methods are used over time;	"Germany provided detailed descriptions of emssions trends at the category level for the most categories." [NIR, April 2012, Table 281, p. 598]
	(d) Including information on the results of the QA/QC procedures;	"Germany has improved the QA / QC procedures." [NIR, April 2012, Table 281, p. 604]
	(e) Improving the reporting of land area to ensure a consistent land-use matrix in the LULUCF sector and under KP-LULUCF;	"The 2010 In-Country Review (UNFCCC, 2011) provided recommendations for changing the then-used method for identifying land uses and land-use changes. In the Submission 2011, Germany addressed some of those recommendations. The present submission now addresses the reviewers' key recommendation by introducing a consistent, unified methodology for identifying land-use changes in the LULUC and forestry sector. This expands the previously used sample-based system for determining forest land and land-use changes from and to forest land, for all land-use categories and changes. The new system is based on the grid of the BWI (National Forest Inventory) 2012." [NIR, April 2012, Chapter 7.1.3.1, p. 451]
	(f) Improving the implementation of the QC checks, especially in the LULUCF sector and under KP-LULUCF. **(FCCC/ARR/2010/DEU, para 46)**	"The Heinrich von Thünen Institute has established an internal quality management, applying the quality management system of the UBA. Hence Germany has improved the QA/QC procedures." [NIR, April 2012, Table 281, p. 602]
Greece	The ERT identified the following cross-cutting issues for improvement:	After 11th April NIR, CRF, SEF tables and KP LULUCF were submitted.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
(late availability of 2012 ARR)	(a) The action needed to ensure that, in the future, all parts of the Party's inventory submission will be submitted by 15 April;	
	(b) The continuation of efforts to strengthen the national system so that it can perform fully all its required functions, particularly those related to reporting on the LULUCF sector and activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, and those with regard to the timeliness of the annual submission;	Not yet addressed.
	(c) The implementation of sector-specific QA/QC procedures for all key categories and for the LULUCF sector and the provision of additional information on the QA/QC procedures for the data supplied by external sources (in particular the EU ETS);	Not yet addressed.
	(d) The improvement of transparency in the energy (see paras. 31 and 36–42 above), agriculture (see paras. 55 and 57 above), LULUCF (see paras. 66–67, 72–74 and 79–80 above) and waste (see paras. 82 and 88 above) sectors and KP-LULUCF activities (see paras. 90 and 92–95 above);	See Energy: "Details of the use of ETS reporting in energy sector's inventory calculations are provided in Annex II. …Inconsistencies in tables 1Ab, 1Ac and 1Ad have been corrected. A description of how "Apparent energy consumption" is calculated has been added in section 3.2.1. Table 3.9 was updated, accordingly. Natural gas used as feedstock for hydrogen production was reallocated to the IP sector. ….. Agriculture: Further improvements (corrections of values, QA/QC checks, further descriptions of swine and cattle) are done. Waste: Recalculations of CH_4 and N_2O emissions are done." [NIR 2012, p.324, Tab. 9.8] LULUCF and KP-LULUCF: The QA/QC procedures implemented in the LULUCF sector and their corresponding findings are not documented in the NIR.
	(e) The provision of the planned inventory improvements, together with a prioritization and a time frame for implementing the improvements in the next annual submission. **(FCCC/ARR/2011/GRC, para 120)**	Not mentioned in the NIR.
Ireland **(late availability of 2012 ARR)**	The ERT identified a number of cross-cutting issues for improvement, and recommends that Ireland: (a) Provide more precise and transparent descriptions of methodologies for some categories in the energy, industrial processes and waste sectors (see paras. 51, 56, 64, 68, 69 and 103 below);	"Sector specific QA\QC for the Industrial Processes sector is now documented in NIR 2011. Additional information on the use of EU ETS data is provided for the Power Generation sector of Energy Industries. Chapter 4, section 4.6. Chapter 3, section 3.2.1.1." [NIR. April 2012, Annex I, p. 299]
	(b) Improve the transparency of the reporting on the national system by including more detailed information on its archiving system;	"Additional information is provided in NIR 2011. Chapter 1 section 1.3.2" [NIR. April 2012, Annex I, p. 299]
	(c) Improve the transparency of the reporting by including more information on implemented QA/QC activities for all sectors, particularly for the industrial processes and LULUCF sectors;	"Sector specific QA\QC for the Industrial Processes sector is now documented in NIR 2011. Additional information on the use of EU ETS data is provided for the Power Generation sector of Energy Industries. Chapter 4, section 4.6. Chapter 3, section 3.2.1.1." [NIR. April 2012, Annex I, p. 299]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	(d) Improve the uncertainty analysis by the use of a higher level of category disaggregation for the LULUCF sector, in accordance with the IPCC good practice guidance for LULUCF;	"This will be considered for the 2012 submission. The timing of Ireland's draft ARR 2010 did not allow sufficient time for this recommendation to be implemented in submission 2011." [NIR. April 2012, Annex I, p. 298]
	(e) Improve the completeness of the inventory, in particular by reporting estimates for the remaining emissions reported as "NE" in the LULUCF sector (see para. 89 below);	"Notation Keys have been revised in CRF Submission 2011. Chapters 7 and 11" [NIR. April 2012, Annex I, p. 307]
	(f) Reconcile the AD from the energy balance used to estimate emissions from the energy sector with the EU ETS data; (f) Reconcile the AD from the national energy balance used to estimate emissions from the energy sector with the EU ETS data (see para. 53 below);	"The inventory agency will work with the energy Balance provider to improve the allocation of fuels in the EB for peat briquette production for the fuel: Gasoil. The timing of Ireland's draft ARR 2010 did not allow sufficient time for this recommendation to be implemented in submission 2011. " [NIR. April 2012, Annex I, p. 300]
	(g) Improve the methodological tier level used to estimate emissions for categories in the LULUCF sector other than forest land, in particular for grassland, in accordance with the recommendations in the IPCC good practice guidance for LULUCF;	"Additional information on Grassland is provided in NIR 2011. Chapter 7 section 7.5.1" [NIR. April 2012, Annex I, p. 308]
	(h) Improve the consistency of the information reported for the LULUCF sector under the Convention and on KP-LULUCF activities, and provide more detailed information on forest-related land-use changes that occurred prior to 2006 (see paras. 92 and 115 below). **(FCCC/ARR/2010/IRL, para 39)**	"Significant improvements have been made in submission 2011 for Convention and KP LULUCF reporting. Chapter 7, section 7.11 and Chapter 11, section 11.1.5. " [NIR. April 2012, Annex I, p. 308]
Italy	Inventory preparation: Improve the transparency in the energy sector regarding the reporting of fugitive emissions and in the industrial processes sector regarding the trends impacting emissions. **(para 26)** Improve the transparency of the reporting on the LULUCF sector, especially the reporting under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. **(para 26)**	"See response to review report paragraphs 33, 45, 52, 55, 87 and 70 " [NIR, April 2013, Annex 12, p.509]
Luxembourg	National system: Provide the national inventory report (NIR) of its next annual submission on time **(para 7)**	Not yet addressed.
	Completeness: Includes estimates of fugitive emissions from oil **(para 11)**	Not yet addressed. "Fugitive emissions from the distribution of oil products from oil distribution (IPCC sub-category 1B2a5) are reported with notation key NA in the CRF tables, as only NMVOC emissions occur." [NIR 2013, chapter 3.3.2.1, p. 174]
	National system: Report on the progress in ensuring additional staff; designate responsible person for the LULUCF sector **(para 14 and 123)**	Not yet addressed.
	Key category analysis: Enhance QC procedures and accurate reporting of the key category analysis **(para 17)**	Not yet addressed.
	Uncertainties: Improve the uncertainty analysis	Not yet addressed.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	by covering all inventory categories and report on all performed analyses (including for LULUCF and KP-LULUCF) in the next NIR **(para 19, 20 and 84)**	
	Recalculations: Expand the recalculation section to include values recalculated and the impact of the change on the sector **(para 22, 33 and 64)**	Not yet addressed.
	QA/QC: Include priorities, level of difficulty and timeline for implementation in the improvement plan list **(para 24)** Carry out the necessary QA/QC procedures prior to inventory submission and ensure updated and consistent data are reported in the NIR **(para 25, 35, 39, 43, 58, 68 and 85)**	Not yet addressed.
	Transparency: Continue to improve the transparency of the inventory (see below) **(para 26)**	Not yet addressed.
	Follow-up of previous reviews: Address pending recommendations from previous review reports **(para 28, 36, 57, 69 and 87)**	Not yet addressed.
	Article 3, paragraph 14: Provide information on any changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14 **(para 132)**	Not yet addressed.
Netherlands **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The enhanced implementation of the QA/QC management system, especially with regard to ensuring consistency between the CRF tables and the NIR (see para. 24 above);	"However, the draft report by the ERT was not received until 28 February 2012. Therefore, the Netherlands could not use the recommendations in the ERT report for further improvements in this NIR. Table 10.4 contains the improvements made in response to the UNFCCC Saturday paper of the 2011 review and the remaining issues from the 2010 review report." [NIR 2012, p. 143] "Improved" [NIR 2012, Table 10.4]
	(b) Ensuring the correct operation of the archiving system (see paras. 24, 39 and 79 above);	"Implemented" [NIR 2012, Table 10.4, p. 145]
	(c) The provision of more precise and up-to-date descriptions of the methodologies used by the Netherlands that differ from those of the IPCC, in both the NIR and/or the associated protocols (see paras. 32 and 36 above);	"Based on changes in methodologies protocols are improved (i.e. waste water, F-gases)" [NIR 2012, Table 10.4, p. 144]
	(d) The improvement of transparency by including in the NIR a land-use change matrix; a complete the description of the QA/QC measures and data flows in the LULUCF sector; brief explanations of anomalous data and information; complete explanations of data sources; sufficient detailed information to allow for a full understanding of the recalculations performed;	"Implemented: inclusion of land use change matrices in NIR, additional information for category 5A" [NIR 2012, Table 10.4, p. 146]
	(e) The provision of quantified uncertainty estimates that relate to the methodologies used in the inventory (see para. 29 above);	"Current uncertainty estimates are included in the inventory database. Sectoral specialist can now update estimates which will (can) be incorporated in next submissions" [NIR 2012, Table 10.4, p. 144]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	(f) Explore ways to allow the reporting of sufficient data to the inventory experts in order to ensure adequate QC, while maintaining the confidentiality of confidential plant data in the PRTR. (**FCCC/ARR/2011/NLD, para 176)**	Not yet addressed. *"Although this does impair the transparency of the inventory, all confidential data can be made available to the official review process of the UNFCCC." [NIR 2013, Chapter 1.7, p. 38]*
Portugal **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Increase the completeness of reporting by including estimates for categories reported as "NE", giving priority to missing categories for which the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF provide estimation methodologies;	"Biogas flaring is no longer reported as NE in this submission"
	(b) Increase the accuracy of estimates by using higher-tier methods with country specific EFs and parameters for key categories and increase the consistency by replacing the use of surrogate or forecast data with national statistics in the industrial processes sector;	"Under Development" [NIR, April 2012, p. 9-3, 9-4]
	(c) Enhance the transparency of reporting by improving the description of international bunkers estimates, reporting in the NIR category-specific QC and verification activities for all categories, including the rationale for the choice of AD, parameters and EFs in the agriculture sector, and including the description of methods and assumptions made for estimates in the LULUCF sector;	"Implemented/Under Development" [NIR, May 2012, p. 9-5]
	(d) Enhance the completeness and transparency of the reporting of KP-LULUCF by completing the calculations for 1990, reporting consistent land area representation figures and calculating carbon stock changes for the unaccounted pools or providing a clear description that these pools are not net sources of GHG emissions. **(FCCC/ARR/2010/PRT, para 32)**	"Implemented" [NIR, May 2012, p. 9-6]
Spain **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement, namely that the Party: (a) Prepare emission estimates for the remaining categories reported as "NE" for which there are estimation methodologies available in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance, namely N_2O emissions from use of gaseous fuels in road transportation and N_2O emissions from flaring of oil;	Implemented. [NIR, April 2012, Table 3.2.1, p. 3.13]
	(b) Continue with its efforts to increase the transparency of its reporting, including in relation to the use of the notation keys and explanations of the underlying reasons for trends and inter-annual variations;	In General: Under the respective sub chapters "Realización de nuevos calculus" written.
	(c) Continue with its efforts to implement a tier 2 uncertainty analysis and to broaden the coverage of sectors in that analysis;	Not yet addressed.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	(d) Improve its reporting of the results of QA/QC activities during the preparation of the annual inventory submission in the NIR, in order to facilitate the assessment of the inventory and its accuracy by review teams;	Not yet addressed.
	(e) Implement QA activities on a regular basis;	Not yet addressed.
	(f) Undertake, as a matter of urgency, a review of the energy balance (see paragraph 52 below), including to ensure consistency between the energy balance used to prepare the inventory and those submitted to the International Energy Agency (IEA) and Eurostat, and include the energy balance in the NIR;	Not yet addressed.
	(g) Use EU ETS data to improve the accuracy of the inventory with country specific data and to enhance the QA/QC procedures;	Not yet addressed.
	(h) Improve the reporting on feedstocks and non-energy use of fuels, by providing clarity on where these fuels are used;	Not yet addressed.
	(i) Find alternative ways to report confidential AD and emission estimates without violating the existing rules on confidentiality. **(FCCC/ARR/2010/ESP, para 42)**	Regarding the question about alternatives to disaggregate on steel production without violating the confidentiality restriction raised by the review team that conducted the review SCMNUCC in the country (in-country review) on (17-22 October 2011) for the 2011 inventory, it is worth noting here that, although indeed in the case of electric steel plant the number is high (over 20 in 2010). To report information for this block would mean to quantify the corresponding oxygen steel production information. But in this case it occurs only in one company. [NIR, April 2012, p. 4.22]
Sweden	Key category analysis: Improve the reporting of the key category analyses for the energy and land use, land-use change and forestry (LULUCF) sectors, and for LULUCF activities under the Kyoto Protocol (KP-LULUCF) **(para 18 and 20)**	Not yet addressed.
	Uncertainties: Explain which inventory improvements lead to improved uncertainty estimates in the national inventory report (NIR) **(para 23 and 32)**	Not yet addressed.
	Transparency: Improve the transparency of the reported information on the uncertainty analysis by explaining any remaining “0” values, any changes in the uncertainty values across annual submissions and any plans to reduce the uncertainty of the estimates **(para 24, 57, 101 and 116)** Improve the transparency of the reporting across all sectors (see below) **(para 29)**	Not yet addressed.
	Quality assurance/ quality control: Make efforts to expand the tier 2 quality assurance/quality control (QA/QC) checks to cover the agriculture, LULUCF and waste sectors **(para 32)**	Not yet addressed.
	Article 3, paragraph 14, of the Kyoto Protocol: General: Report any changes in the information provided under Article 3, paragraph 14, of the	Not yet addressed.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	Kyoto Protocol in accordance with decision 15/CMP.1, annex, chapter I.H **(para 129)**	
United Kingdom **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Strengthen the efforts to implement the recommendations of previous review reports, especially those that had already been reiterated from the review before (see para. 30); (see para 30: complete discussion of completeness, allocating emissions from fuels used in the manufacturing industries, reporting emissions of F-gases by species, improving the reporting of OTs and CDs, undertaking a qualitative analysis of categories identified as key categories, information on the time frame for addressing the recommendations of the review team, estimating emissions from the wildfires on deforestation land).	"As well as the completeness table in Annex 5, a short discussion on completeness is now included in each methodological chapter." "Emissions from fuels used in manufacturing industries are now reported in the appropriate categories where possible. See Section 3.2.7 for more details." "Included in 2012 submission." "Where available, speciated emissions of f-gases are reported. Unspeciated emissions are reported for some of the emissions of fugitive PFCs from manufacture, where speciated data are not available, and for the Overseas Territories and Crown Dependencies. Estimates for these locations are made at an aggregated level. The investigation of reporting further speciated emissions will be added to the improvement programme although this is a low priority." "More description has been included in the NIR on the methods and data used for estimating these emissions. Where it is possible to include OT and CD emissions within main sectors (not reporting as 'other') this has been done and stated as such in the main chapters. Further information has been included in the 2012 submission. Reporting will be reviewed and improved for the 2013 submission." "A qualitative analysis is now done to ensure significant categories are identified. No additional key categories were identified. Description of qualitative analysis included in Section 1.2.2.4." "Where possible, the time frame for addressing recommendations is included in the NIR. The assessment of a fire incidence dataset and the potential of remote sensing for reporting wildfires is now underway. New data for UK wildfires is being examined and we will report emissions for this category in the 1990-2011 inventory. To be reported in 2013 submission." [NIR 2012, Table 10-4, p. 274]
	(b) Improve reporting of KP-LULUCF to ensure complete, accurate and unbiased reporting of KP-LULUCF activities on all lands in the United Kingdom (see para. 140);	"We have used new activity data to update the deforestation estimates for all countries in the UK. Methods are fully explained in Annex 3.7. We have used NFI data in the latest submission where available, but estimates of woodland loss from the NFI are still being assessed by the Forestry Commission. There is very limited forest area information for the OTs and CDs and the FAO Forest Resource Assessment 2010 reports that there has been no change in the forest area of these territories since 1990 (section 11.2.1). If/when new data becomes available we will include it in the next submission. Part complete - more information to be included in 2013 submission." [NIR 2012, Table 10-4, p. 275]
	(c) Improve the description of recalculations by providing clear documentation and explanations	"All method changes feed into the inventory through the improvement programme and are approved by the NISC at

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	on the justifications used for the changes made in methodologies, assumptions, data and parameters, and also ensure that any recalculation performed leads to a real improvement of the inventory (see para. 22);	the pre-submission review. Additional descriptions have been included within the main chapter of the NIR on the reasons for recalculations and additional checks have been performed to ensure these descriptions are consistent in chapter 10 as in the methodology chapters. Improvements have been made to the text in the 2012 submission." [NIR 2012, Table 10-4, p. 275]
	(d) Continue to strengthen QC procedures at the stage of inventory compilation to avoid erroneous entries in CRF tables and mistakes in the text of the NIR (see para. 24);	"All submissions now undergo a 'knowledge leader check' where a senior member of the team who has not had the responsibility of compiling the CRF, or performing any of the initial cross checks, checks the outputs to ensure consistency with the NIR and our internal database. Additional checks have been implemented for the 2012 submission." [NIR 2012, Table 10-4, p. 275]
	(e) Improve the transparency of the inventory regarding the presentation of information on OTs and CDs in the CRF (e.g. include distinct AD and emissions from OTs and CDs under waste incineration) and the description of the geographical coverage for each reported category in the NIR (see para. 26);	"More description has been included in the NIR on the methods and data used for estimating these emissions. Where it is possible to include OT and CD emissions within main sectors (not reporting as 'other') this has been done and stated as such in the main chapters. The improvement programme includes trying to obtain more detailed information, particularly for the waste sector for the 2013 submission." [NIR 2012, Table 10-4, p. 275]
	(f) Continue to improve the consistency and appropriateness of notation keys usage (see para. 10). (**FCCC/ARR/2011/GBR, para 171)**	"All submissions now undergo a 'knowledge leader check' where a senior member of the team who has not had the responsibility of compiling the CRF or carrying out initial cross checks, checks the outputs to ensure consistency with the NIR and our internal database. Additional checks have been carried out for the 2012 submission." [NIR 2012, Table 10-4, p. 276]

Note: Review findings of submission 2011, which were also commented in the NIR 2013 were added in italics.

10.4.3 Improvements planned at EU level

The following activities are planned at EU level with a view to improving the EU GHG inventory:

- Further implement the recommendations from the past reviews;
- Continue sector-specific QA/QC activities within the EU internal review;
- Further develop the EU QA/QC activities on the basis of the experience in 2012/2013

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

The EU submission under the KP-LULUCF results by summing up the removals and emissions for elected activities from the supplementary KP-LULUCF reporting of each individual MS. It is important to note that the EU will neither issue nor cancel units based on the emissions and removals reported by EU-15 or EU-27 for KP-LULUCF activities. Therefore, all the emissions/removals and any information on KP-LULUCF activities presented here are shown for information purpose only. Major part of the chapter is dedicated to EU-15.

This chapter presents:

- The activities elected by EU-15 member states under Art. 3.4 and the accounting frequency.
- An overview of emissions/removals and information reported in the KP-LULUCF tables submitted by EU-15 member states for 2008 -2013.
- A synthesis of the supplementary information required for 3.3 activities and any elected 3.4 activities, as reported by EU-15 member states in their NIRs.
- Short information on KP-LULUCF activities by the new EU MS (this subchapter only refers to 10 new MS out of 12, because Malta and Cyprus do not have commitments under Kyoto Protocol).

A main assumption when reporting under the KP is that the EU consistency with IPCC guidance is ensured when all MS reports consistently with IPCC guidance; to the extent possible, this is checked by both each MS' own QA/QC and by EU's QA/QC procedure. Also,

As shown by Table 11.1, 17 member states out of EU-27 have elected Forest Management (FM), while only 3 have elected Cropland Management (CM), 2 have elected Grazing land Management (GM) and only 1 has elected Revegetation (RV). Only 3 MS have chosen annual accounting frequency.

Table 11.1 **Activities elected under Art. 3.4 and accounting frequency. FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation, CP: commitment period.**

EU and member states			Art 3.4 elected activities	Accounting frequency
EU 27	EU-15	Austria	-	end of CP
		Belgium	-	end of CP
		Denmark	FM, CM, GM	annual
		Finland	FM	end of CP
		France	FM	annual
		Germany	FM	end of CP
		Greece	FM	end of CP
		Ireland	-	end of CP
		Italy	FM	end of CP
		Luxemburg	-	end of CP
		Netherlands	-	end of CP
		Portugal	FM, CM, GM	end of CP
		Spain	FM, CM	end of CP
		Sweden	FM	end of CP
		UK	FM	end of CP
	New member states	Bulgaria	-	end of CP
		Czech Republic	FM	end of CP
		Cyprus	na	na
		Estonia	-	end of CP
		Hungary	FM	annual

		Latvia	FM	end of CP
		Lithuania	FM	end of CP
		Malta	na	na
		Poland	FM	end of CP
		Romania	FM, RV	end of CP
		Slovakia	-	end of CP
		Slovenia	FM	end of CP

11.1 Overview of emissions /removals and information reported by EU-15 MS in the KP-LULUCF tables

11.1.1 Coverage of carbon pools and GHG reported (KP CRF NIR-1)

EU-15 reports all mandatory and elected activities (Table 11.2). Carbon stock changes are always estimated and reported for living biomass pools, whereas for other pools notation keys are sometimes used. Concerning the GHG emissions from sources, the situation is rather country-specific.

Despite of the continuous improvements performed by MS on the completeness of reporting, both the EU QA/QC procedure and the latest Annual Review Report highlighted the need for providing more transparent information, particularly when the “not a source” provision is applied and when individual pool are merged.

“NE” is exceptionally used in table NIR 1, for GHG sources when emissions are considered to be “negligible” or no data exist. For instance, The Netherlands reports emissions from biomass burning in wildfires as NE since no data was available but argued as negligible. Spain states that emissions of controlled burning under FM were not yet reported in 2013 due to a lack of reliable statistics on activity data. Under CM, dead organic matter is also reported as NE by Spain.

Under the ARD and FM activities, the notation key “IE” is used by several MS. For instance, below ground biomass is reported along with above ground biomass by Luxemburg and Spain and merged in soil organic matter pool by UK. Also, Portugal and UK report litter and dead wood as a unique pool. Because of model and data sources, Finland and Luxemburg report SOM and DOM merged under SOC pool. Denmark, Ireland and Portugal reported N_2O Emissions from N fertilization as IE under Agricultural chapter. Several MS report CO_2 emissions from biomass burning under 5(KP-I) A.1.1 or B.1 (i.e. including these emissions as loss of carbon).

When NR (not reported) is used for a C pool in table NIR 1 (e.g. in few cases litter and dead wood or mineral soil), documentation is provided in each MS’ NIR (and synthesized in Table 11.2 Synthesis of pools and GHG coverage for KP LULUCF activities for 2013 in EU-15 MS, based on table NIR 1 (for the year 2011)) showing that this pool is not a source.

Table 11.2 **Synthesis of pools and GHG coverage for KP LULUCF activities for 2013 in EU-15 MS, based on table NIR 1 (for the year 2011)**

MS	Change in carbon pool reported					Greenhouse gas sources reported						
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil	Fertilization	Drainage of soils under forest management	Disturbance associated with land-use conversion to Croplands	Liming	Biomass burning		
						N_2O	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
Afforestation/Reforestation												
Austria	R	R	R	NO	R	NO	0	0	NO	NO	NO	NO
Belgium	R	R	NR	NR	R	NO	0	0	NO	NO	NO	NO
Denmark	R	R	R	R	R	IE	0	0	IE	NO	NO	NO
Finland	R	R	IE	IE	R	NO	0	0	NO	R,NO	R,NO	R,NO
France	R	R	R	R	R	NO	0	0	NO	R	R	R
Germany	R	R	R	NO	R	NO	0	0	R	R	R	R
Greece	R	R	NR	NR	NR	NO	0	0	NO	NO	NO	NO
Ireland	R	R	R	R	R	IE	0	0	NO	R	R	R
Italy	R	R	R	R	R	NO	0	0	NO	IE	R	R
Luxembourg	R	IE	IE	NO	R	NO	0	0	NO	NO	NO	NO
Netherlands	R	R	NR	NR	R	NO	0	0	NO	NE	NE	NE
Portugal	R	R	R	IE	R	IE	0	0	NO	R	R	R
Spain	R	IE	NR	NR	R	NO	0	0	NO	NO,R	NO,R	NO,R
Sweden	R	R	R	R	R	NO	0	0	NO	NO	NO	NO
UK	R	IE	R	IE	R	R	0	0	NO	R	R	R
Deforestation												
Austria	R	R	R	IE	R	0	0	R	NO	NO	NO	NO
Belgium	R	R	R	R	R	0	0	NE	NO	NO	NO	NO
Denmark	R	R	R	R	R	0	0	NO	IE	NO	NO	NO
Finland	R	R	IE	R,IE	R	0	0	R	R	NO,IE	NO,IE	NO,IE
France	R	R	R	R	R	0	0	R	R	R	R	R
Germany	R	R	R	R	R	0	0	R	NO	NO	NO	NO
Greece	R	R	R	R	R	0	0	NO	NO	NO	NO	NO
Ireland	R	R	R	R	R	0	0	NO	R	NO	NO	NO
Italy	R	R	R	R	R	0	0	NO	NO	NO	NO	NO
Luxembourg	R	IE	IE	R	R	0	0	NO	NO	NO	NO	NO
Netherlands	R	R	R	R	R	0	0	R	R	NE	NE	NE
Portugal	R	R	R	IE	R	0	0	R	NO	R	R	R
Spain	R	IE	R	R	R	0	0	NO	NO	NO	NO	NO
Sweden	R	R	R	R	R	0	0	R	NO	NO	NO	NO
UK	R	IE	R	IE	R	0	0	R	R	R	R	R
Forest management												
Austria	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Denmark	R	R	R	R	R	IE	R	0	IE	NO	R	R
Finland	R	R	IE	IE	R	R	NE	0	NO	R	R	R
France	R	R	R	R	R	NO	NO	0	NO	R	R	R
Germany	R	R	R	R	R	NO	R	0	R	R	R	R
Greece	R	R	NR	NR	NR	NO	NO	0	NO	IE	R	R
Ireland	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Italy	R	R	R	R	NR	NO	NO	0	NO	IE	R	R
Luxembourg	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Portugal	R	R	R	IE	R	IE	NO	0	NO	R	R	R
Spain	R	IE	NR	NR	NR	NO	NO	0	NO	IE,NE	R,NE	R,NE
Sweden	R	R	R	R	R	R	NE	0	NO	R	R	R
UK	R	IE	R	IE	R	NO	R	0	NO	R	R	R

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported (under assumption of not a source); NE – removal/emission is not estimated; IE – included elsewhere; NO –not occurring; NA – MS does not account the activity.

11.1.2 Areas and changes in areas under KP-LULUCF activities

Based on the information included in MS' CRF sectorial tables, the total land area reported under KP activities is 144071 kha, with the largest area under Forest Management (75%), followed by Cropland Management (18%), Afforestation/reforestation (5%), Deforestation (2%) and Grazing land Management (1%).

Significant recalculations in area occurred in Portugal (which more than doubled the area of AR, tripled the area of D and reduced the area of FM by one third), due to a new land matrix system. During the EU QAQC it was noted that this new system may require further checks (e.g. it is possible that some of the area under D is temporarily un-stocked rather than truly deforested). For other MS there no or very minor recalculations compared to last year.

Most of AR area is reported in Italy, France and Spain (together they account for some 61% of total area reported in EU-15), while most of D area is reported by France and Portugal (that represent together 62% of EU-15 deforested area since 1990). In Finland, The Netherland, Portugal and Luxemburg the deforested area is larger or almost equal to afforested area.

The areas of AR and D vary considerably also among countries with apparently rather similar conditions. Although to some extent this is explainable by different definitions used by countries for forest land and lands in conversions, this issue will be further investigated with specific MS, as part of the efforts done by the JRC to help MS in improving their LULUCF reporting.

Table 11.3 Synthesis of total area (kha) of KP-LULUCF activities as reported by EU-15 MS at the end of the 2011, based on the CFR sectorial tables. Grey cells indicate that the activity has not been elected.

Member State	Art. 3.3 activities		Article 3.4 activities			
	AR	D	FM	CM	GM	RV
Austria	244	126				
Belgium	25	24				
Denmark	85	4	539	2.621	436	
Finland	168	334	21.818			
France	1.241	821	21.538			
Germany	379	200	10.554			
Greece	33	5	1.219			
Ireland	270	8				
Italy	1.716	16	7.357			
Luxembourg	9	8				
Netherlands	49	48				
Portugal	756	832	2.455	2.394	1.149	
Spain	1.111	12	12.629	20.476		
Sweden	264	223	28.166			
United Kingdom	309	29	1.371			
EU-15	**6.705**	**2689**	**107.641**	**25.491**	**1.585**	**0**
EU-12 (see Table 11.19)	1.414	170	25.611			11
EU-27	8.119	2.859	133.256	25.491	1.585	11

Notation: AR: forestation/Reforestation, D: deforestation, FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation.

Note that this table uses numbers from sectorial tables and not from table NIR 2, because in few cases it was noted minor inconsistencies between sectorial tables and NIR 2. This problem was notified to the relevant MS during the EU QAQC process but not entirely addressed in the May resubmission.

11.1.3 Key categories for KP-LULUCF activities (KP CRF NIR-3)

EU-15 key category analysis relies on MS's NIR-3 tables (

Table 11.4). Some MS did not perform key category analysis for 2008 – 2013 (i.e. Luxemburg and Finland) which make it difficult to assess if they are using the correct tier methods to estimate the GHG associated with KP activities. All key categories relate only to CO_2 emissions or removals. In most cases, AR and FM are key categories, whereas D is key category in six MS. CM and GM, when elected, appeared always as a key category.

Table 11.4 **Synthesis of KP-LULUCF activities being key category as reported by EU-15 member states in NIR-3 of 2013 submission.** "KC" indicates a key category. Grey cells indicate that the activity has not been elected.

MS	AR	D	FM	CM	GM	RV	Comments
Austria	KC	KC					Key category analysis is not only based on emissions/removals from deforestation areas but also from LUC between other categories
Belgium		KC					Corresponding land category is key under GHG inventory
Denmark	KC		KC	KC	KC		Corresponding land category is key under GHG inventory
Finland							KC analysis is not available in the NIR-3
France	KC	KC	KC				Corresponding land categories are key under GHG inventory, with mention that D is key category for both CO_2 and N_2O
Germany	KC		KC				Corresponding land categories are key under GHG inventory
Greece	KC		KC				Corresponding land categories are key under GHG inventory
Ireland	KC						Level assessment
Italy	KC		KC				AR category identified only for trend assessment with Tier2
Luxembourg							KC analysis is not available in the NIR 3
Netherlands		KC					Corresponding land category is key under GHG inventory
Portugal	KC	KC	KC	KC	KC		Corresponding land categories are key under GHG inventory
Spain	KC		KC	KC			Corresponding land categories are key under GHG inventory
Sweden	KC	KC	KC				Corresponding land categories are key under GHG inventory, a qualitative approach is used
UK			KC				The associated GHG inventory category is a key category and the Forest Management category contribution is greater than the smallest UNFCCC key category

11.1.4 Summary of emissions/removals and accounting quantities for KP-LULUCF activities by EU-15 MS (KP CRF "Accounting" table)

Table 11.5 shows detailed amount on each KP activity on member states. In 2011 net annual amount for accounting is 281279 Gg CO_2 (Table 11.6).

Emissions from D represent in absolute amount 63 % of removals in AR. By far, the largest contributors to D emissions are France and Portugal, responsible of 65 % of total emissions from deforestation in EU-15. The FM largest sinks are reported by Italy and France.

Countries offsetting debits under Art 3.3 with removals from forest management are Belgium, Denmark, Finland, France, Netherlands and Sweden.

The largest amounts of credits to be accounted from LULUCF activities are reported by Italy, followed by Spain, Germany and Portugal (each accounts some half of Italy's amount). Luxembourg, Belgium and Netherlands report small amount of emissions from LULUCF activities.

Compared to 2010, the amount estimated for 2011 is 25 % larger, due to AR as 53% larger removals, D estimated as 52% larger source, while CM and GM amounts also doubled (caused by both recalculations and accumulation over the commitment period).

Table 11.5 **Emissions/removals in submission 2013 for KP-LULUCF activities, as reported by EU-15 member states** (notation keys reported in this table are: NE – removal/emission is not estimated; IE – included elsewhere; NO –not occurring; NA – MS does not account the activity)

Member states	Net emissions (+) and removals (-), Gg CO2eq																														
	A. Art 3.3 activities												B. Art. 3.4 activities																		
	A.1 AR								A.2. D				B.1 FM				B.2 CM					B.3 GM					B.4 RV				
	A.1.1 Lands not harvested				A.1.2 Lands harvested																										
	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	1990	2008	2009	2010	2011	1990	2008	2009	2010	2011	1990	2008	2009	2010	2011
Austria	-2488	-2608	-2621	-2633	NO	NO	NO	NO	1364	1381	1365	1350	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Belgium	-261	-273	-284	-296	NO	NO	NO	NO	505	499	499	499	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Denmark	352	-212	-322	-73	IE,NO	IE,NO	IE,NO	IE,NO	79	79	80	83	-5924	-24	-4028	-6314	5054	3940	2835	3560	3368	184	225	213	204	235	NA	NA	NA	NA	NA
Finland	217	206	184	158	NA	NA	NA	NA	3607	3295	3490	3301	-39040	-49749	-34623	-34793	0	0	0	0	0	0	NA	NA	NA	NA	0	NA	NA	NA	NA
France	-7252	-7699	-8039	-8414	NA,NO	NA,NO	NA,NO	NA,NO	14795	13898	11178	11241	-63631	-53711	-46685	-56546	0	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO
Germany	-5313	-5625	-5700	-5772	NA,NO	NA,NO	NA,NO	NA,NO	333	83	112	139	-27726	-27700	-27705	-27682	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greece	-351	-351	-351	-351	NA	NA	NA	NA	53	48	44	46	-1770	-1769	-1774	-1777	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Ireland	-3231	-3430	-3435	-3596	171	90	-90	-155	26	35	20	30	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Italy	-6390	-7218	-7817	-6463	0	0	0	0	375	377	379	380	-27944	-30245	-31304	-23977	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	0	0	0	0
Luxembourg	-77	-78	-94	-110	NO	NO	NO	NO	141	141	141	140	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Netherlands	-404	-441	-450	-459	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	763	788	813	839	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Portugal	-8787	-8871	-8566	-8806	2022	1916	1810	1704	5724	6291	6517	6194	-1937	-1893	780	-648	5258	1510	1341	1158	909	2035	-226	-344	-471	-665	NA	NA	NA	NA	NA
Spain	-6386	-6475	-6477	-6440	NA,NO	NA,NO	NA,NO	NA,NO	106	107	108	109	-18677	-18636	-18680	-18730	-712	-3469	-2845	-3238	-3449	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden	-885	-915	-899	-898	NO	NO	NO	NO	2996	2772	2536	2555	-35688	-35455	-33614	-37586	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
United Kingdom	-2669	-2798	-2972	-3059	NO	NO	NO	NO	589	654	553	552	-10733	-9761	-7492	-7222	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EU-15	-43925	-46787	-47841	-47215	2193	2006	1720	1548	31458	30447	27835	27457	-233029	-228902	-205082	-215247	9600	1981	1330	1480	827	2219	-1	-131	-267	-430	0	0	0	0	0
total EU	-52955	-56410	-58124	-58036	2168	1959	1635	1415	36394	33819	31005	30306	-329606	-329164	-299013	-307441	9600	1981	1330	1480	827	2219	-1	-131	-267	-430	-1275	-239	-254	-268	-287

Table 11.6 **Accounting quantities for the year 2011 for KP-LULUCF activities as reported by EU-15* (Gg CO_2eq), based on MS' CRF accounting tables**

MS	Accounting quantity on activities						MS accounting amount on LULUCF activities
	AR	D	FM	CM	GM	RV	
Austria	-10.351	5.460					-4.891
Belgium	-1.114	2.002					888
Denmark	-255	320	-982	-6.513	141		-7.289
Finland	765	13.693	-17.391				-2.933
France	-31.403	51.112	-35.842				-16.133
Germany	-22.410	667	-22.733				-44.476
Greece	-1.403	190	-1.650				-2.863
Ireland	-13.691	110					-13.581
Italy	-27.888	1.511	-50.967				-77.344
Luxembourg	-358	564					206
Netherlands	-1.753	3.203					1.450
Portugal	-35.030	24.726	-3.697	-16.114	-9.846		-39.961
Spain	-25.779	430	-12.283	-10.155			-47.787
Sweden	-3.597	10.859	-17.896				-10.634
United Kingdom	-11.497	2.349	-6.783				-15.931
EU 15	-185.764	117.196	-170.225	-32.782	-9.704	0	-281.279

*****any information on EU KP-LULUCF activities presented here is shown for information purpose *only*

11.2 Synthesis of supplementary information on KP-LULUCF activities reported by EU-15 MS in their NIRs

This chapter provides EU-15 relevant supplementary mandatory information requested for KP-LULUCF activities, based on the information in MS' NIRs. Although most MS followed the structure suggested by the annotated NIR, the approach used to include the supplementary information sometimes differed among countries, as well as the amount of information provided; this made it difficult to include everything in an exhaustive and synthetic way. For more detailed information, it is suggested to refer to the individual MS' NIRs.

11.2.1 General information

11.2.1.1 *Definition of forest land and any other criteria*

The parameters used to define "forest" under the Kyoto Protocol by EU-15 MS are summarized in Table 11.7.

Table 11.7 **Parameters used to define "forest" under the Kyoto Protocol**

Member State	Minimum crown cover (%)	Minimum height (m)	Minimum area (ha)	Minimum width (m)

Member State	Minimum crown cover (%)	Minimum height (m)	Minimum area (ha)	Minimum width (m)
Austria	30	2	0.05	10
Belgium	20	5	0.5	-
Denmark	10	5	0.5	20
Finland	10	5	0.5	20
France	10	5	0.5	20
Germany	10	5	0.1	-
Greece	25	2	0.3	-
Ireland	20	5	0.1	20
Italy	10	5	0.5	-
Luxemburg	10	5	0.5	-
Netherlands	20	5	0.5	30
Portugal	10	5	1	20
Spain	20	3	0.1	25
Sweden	10	5	0.5	10
United Kingdom	20	2	0.1	20

With two exceptions, parameters and definitions used for reporting forest areas under the Kyoto Protocol are identical to those used under the Convention. Finland reports minimal area of 0.5 ha under KP, whereas different minimal areas are used under the Convention (i.e. minimal forest area in Southern is 0.25 and 0.5 ha in Northern Finland). Furthermore, the Netherlands reports under Kyoto only the lands classified as FAD ("Forests according to the Kyoto definition"), but not TOF ("Trees outside Forest" which is only included under Convention reporting).

11.2.1.2 *Elected activities under Article 3, paragraph 4, of the Kyoto Protocol*

The 3.4 activities elected by EU-15 member states were already included in the initial reports (IRR) (listed above in Table 11.1).

11.2.1.3 *Description of how definitions of each activity under Art. 3.3 and each elected activity under Art. 3.4 have been implemented and applied consistently over time*

In most cases, definitions of KP activities have been applied with a broad interpretation of human induced action, assuming generally that the entire national territory is subject to anthropogenic influence. For instance, some countries considered as “directly human induced AR” any expansion in forest area since 1990 (see following chapters for more details). For FM, most countries considered all national forest area as subject to “forest management” activity, a few considered it only partially subject to FM (e.g. France reports 3% of forests are unmanaged and Greece reports under FM only one third of its forest land areas).

Consistency in land representation, identification and tracking are ensured by implementation of adequate methods by each MS, generally the same as the system used for reporting under the Convention. Usually in the EU-15 the data necessary for the KP activities estimations is provided by repeated cycles of the National Forest Inventories (NFIs), with additional involvement of spatially geo-referenced datasets (digital maps, remote sensing). More and more, the NFI grids are expanded to cover the entire country territory, and in combination with remote sensing datasets, the consistency is adequately achieved all along time series for all land use categories and activities since 1990 (e.g. Austria, Belgium, Germany, Portugal and Sweden).

Some MS have also performed comparison and internal verification of the activity data area among various national datasets, if such datasets are available (i.e. Finland compared AR and D data generated from NFI with forest authority statistics).

11.2.1.4 *Description of precedence conditions and/or hierarchy among Art. 3.4 activities, and how they have been consistently applied in determining how land was classified*

Member states having elected activities under Art.3.4 (Denmark, Portugal and Spain) are giving higher priority to CM, in the sequence CM-FM-GM (driven by the intensity of human intervention on land and other environmental considerations).

National systems ensure that once the land started to be accounted, it cannot leave the accounting in subsequent reporting years (i.e. it has to be continuously estimated, reported and accounted for over the commitment periods), so KP lands have precedence over non-KP lands.

For forest related activities, MS implement methods which should avoid double counting of lands (ranging from field repeated assessments to field verification of the automatic procedures like remote sensing based mapping).

The KP-NIR 2 table implicitly fulfills the obligation to demonstrate that emissions by sources and removals by sinks resulting from activities elected under Article 3, paragraph 4 are not accounted for under activities under Article 3, paragraph 3: as long as the total area of NIR 2 is correct and constant over time, no double counting of lands (and thus no double counting of emissions) may occur.

11.2.2 Land-related information (EU-15)

11.2.2.1 *Spatial assessment unit used for the area of the units of land under Art. 3.3*

Units of land area used for the assessment of the Art 3.3 activities are the same as minimal area or width defining forest. Methodologies developed to estimate land use conversions under GHG inventory are in line with the technological needs for the minimum defined area (monitoring systems that can offer better resolution than for minimal area committed in the initial report, e.g. Germany, Netherland, Sweden).

11.2.2.2 *Methodology used to develop the land transition matrix*

The land transition matrix provides activity data for GHG estimation, while allows to check the consistency of land area reporting over time (i.e. and the consistency with land categories reported under the Convention inventory). In order to ensure consistency along the entire time series, additional procedures were implemented for previous NFIs datasets to become compatible with latest NFI (i.e. field assessments to fully identify ARD areas in Austria or studying the effect of various averaging of most updated NFI data to obtain accurate D area estimates in Sweden).

Under cyclic sampling, the annual areas for activities related to land conversions are based either on the extrapolation/interpolation of two/several assessments points in time with constant yearly distribution (grid based systems like NFIs and remote sensing based mapping) or based on precise annual data provided by specific land surveys (i.e. subsidies schemes, land registries). Sometimes, MS combine several sources of data, involving expert judgment (i.e. Italy's assumption that the conversions to forest can only occur form grassland).

Methodologies for land identification and tracking are shortly described in Table 11.8. For more detailed information on data sources and methods see Ch.7.

11.2.2.3 *Maps and/or databases to identify the geographical locations, and the system of identification codes for the geographical locations*

The majority of the EU-15 member states reported a single geographical boundary at country level due to the fact that the systems underpinning estimations of national GHG inventory (i.e. data collecting systems, databases, QA/QC and verification procedures) have been designed at the entire country scale. Consequently, any further breakdown of the country area into several reporting regions, followed by aggregation at national scale, risks generating larger uncertainty for the estimates. Nevertheless, several large countries report two (e.g. Finland) or more geographical boundaries (e.g. France, Greece, Italy, Spain and UK, all of them on administrative regions).

Member states developed various methods and approaches to identify and track "units of land" under art 3.3 and "lands" under Art 3.4 of the Kyoto Protocol, according to availability of data and resources (Table 11.8). In many cases the existing data characteristics were considered sufficient as to meet the land identification and tracking requirements of land activities under KP.

Table 11.8 Methodologies for land identification and tracking by the EU-15 MS of the land or units of land (for more detailed information on data sources and methods see Ch.7)

MS	Methods			Land identification and tracking features for the "lands" or "units of lands"
	NFI	Mapping by Earth Observations methods	Land registry systems, including surveys	
Austria	X			Statistical methods
Belgium	X	X		Statistical methods
Denmark	X	X		Statistical methods
Finland	X			Statistical methods
France			X	Statistical methods
Germany	X	X		Wall-to-wall mapping approach
Greece			X	National land registry and forest mapping database
Ireland		X		Sectorial ARD land registry, GIS database
Italy	X		X	NFI plots coordinates (AR), thus random distribution of units of land and land statistics for D for each region
Luxembourg		X		Geo-processing based on successive land use maps
Netherlands	X	X		Wall-to-wall mapping approach
Portugal	X	X		Statistical methods
Spain	X	X	X	AR data is based on land registry system. FM, D is based on CLC maps and forest map (in parallel with NFI)
Sweden	X			Statistical methods

UK			X	Statistics by forest authorities

Reporting methods achieved by member states are complying with requirements (Table 11.9). Reporting method 1 is ensured by the use of grid based assessments, under Approach 3 or approach 2 with supplementary information. Most of the national systems rely on NFI grids to identify and track units of lands under AR and D and lands under FM, very often strengthen with remote sensing datasets (especially to derive 1990). Mapping based on Earth Observation (e.g. processing of raw satellite images or aerial photography) and derived products (e.g. Corine Land Cover) are used as such or in combination with NFI. MS report in their NIR that developments thorough checks (e.g. with aerial photos) and harmonization of various databases and sources were performed. National systems sometimes rely on land parcel identification systems (e.g. as used for subsidy payments or licensing) which allow recording and tracking individual parcels in time and space since the onset of the subsidized activity (often digitized and available in GIS, like in Ireland). Such systems are supported by adequate verification and validation/audit procedure at the country level as they are under public funding (e.g. Ireland, Greece, Spain). For the end of commitment period estimates (i.e. 2012) the assessments were set as to match it. When Approach 2 is use, additional information is provided (i.e. license database, payment scheme database, forest management planning related planning database, expert judgment), to allow land identification at least on a statistical basis.

Table 11.9 Information on reporting methods and approaches used (elaboration based on the information available from MS' NIRs)

MS	Reporting Method used for identifying the geographical locations	Approach used for land representation
Austria	1	2/3
Belgium	1	3
Denmark	1	3
Finland	1	3
France	1	3
Germany	2	3
Greece	1	2
Ireland	2	3
Italy	1	2
Luxembourg	1	3
Netherlands	2	3
Portugal	1	3
Spain	1	2
Sweden	1	3
UK	1	2

11.2.3 Activity-specific information

11.2.3.1 *Methods for carbon stock changes and GHG emission and removal estimates*

Methods used for the estimation of emissions/removals related to the Art 3.3 and 3.4 activities are consistent with those used for reporting the corresponding land use subcategories under the GHG inventory, as described under Chapter 7 of this NIR. In same chapter, methods and datasets are described in detail for each of the relevant land use subcategory (5A2, 5B2.1, 5C2.1, etc). The appropriateness of the Tier used (e.g. higher tier for key categories) is checked by the QAQC done at country and EU levels.

11.2.3.2 *Description of the methodologies and the underlying assumptions used*

The main source of data for estimates in ARD and FM is the national forest inventory. In few cases annual removals are modeled based on non-NFI data (modeling based on yield table and age-distribution of plantations from national statistics). SOC emissions associated with any conversion to/from forest land are estimated by modeling or by country specific reference C stock in soils on different land uses. The most problematic pools are Litter, Dead Wood and Soils, for which efforts are still ongoing either to estimate source/sink or to demonstrate that a pool is not a source. Data sources and methods are consistent with those described under relevant chapters of the NIR of member states and synthetically compiled in the Ch. 7 of the EU's NIR.

The values range of the Implied Emission Factors (IEF of C stock changes) reported for Afforestation/Reforestation (

Table 11.10) is similar as those reported for estimation of GHG inventory estimates. Among MS, there are notable differences between IEF on net biomass increment reported, caused by the type of species and climatic conditions and other characteristics (i.e. non-uniform rate of harvesting, different species including fast growing). One additional reason for large differences is the use of either time averaged or actual annual growth data, depending on the methodological approach of the MS. DW and LT are mainly reported as “no source” with justification provided in the MS’s NIR. Mineral soils are either reported as source or sinks.

Table 11.10 **IEF for net C stock changes (MgC ha-1yr-1) by pool on lands under AR activity in EU-15 (year 2011), based on MS' NIRs.**

Member State	Above ground Biomass (net change)	Below ground Biomass (net change)	Litter	Dead wood	Min Soils	Org Soils
Austria	1.0	0,18	1,12	NO	0,64	NO
Belgium	0,62	0,32	NO	NO	1,23	NO
Denmark	0,25	0,06	-0,06	-0,11	0,15	-0,34
Finland	0,32	0,11	IE	IE	-0,11	-1,62
France	0,93	0,43	0,25	0,04	0,20	NO
Germany	3,07	1,03	-0,44	NO	-0,37	-0,68
Greece	2,01	0,87	NO	NO	IE,NA	NA,NO
Ireland	2,68	0,74	0,45	0,10	NA,NO	-0,44
Italy	0,70	0,14	0,03	0,02	0,14	NO
Luxembourg	2,51	IE	IE	NO	0,77	NO
Netherlands	2,12	0,75	NE	NE	0,17	-6,46
Portugal	2,03	0,35	0,02	IE	0,86	NO
Spain	1,45	IE	NE	NE	0,15	NO
Sweden	0,62	0,21	0,27	0,01	-0,11	-0,57
UK	2,40	IE	0,09	IE	0,22	0,50

Notation keys: IE – data is reported elsewhere i.e. included in other pools. NO – not occurring. NA- not applicable, NE-not estimated (the countries using NE still justify these pools as "no source" or negligible).

IEF values reported for Deforestation (Table 11.11) are consistent with those reported under relevant CRF tables in the GHG inventory. Both Germany and Denmark reported a sink in mineral soil, as estimated based on country specific data.

Table 11.11 **IEF for net C stock changes (MgC ha-1yr-1) in the pools under Deforestation activity in EU-15 (year 2011), based on MS' NIRs.**

Member State	Above ground Biomass (net change)	Below ground Biomass (net change)	Litter	Dead wood	Min Soils	Org Soils
Austria	-0,69	-0,18	-1,18	IE	-0,86	NO
Belgium	-3,29	-0,66	-0,29	-0,07	-1,41	NO
Denmark	-3,76	-0,90	-0,77	-0,07	0,16	NA
Finland	-1,27	-0,38	IE,NE,NO	-0,02	-0,25	-4,04

Member State	Above ground Biomass (net change)	Below ground Biomass (net change)	Litter	Dead wood	Min Soils	Org Soils
France	-1,99	-0,44	-0,19	-0,08	-0,96	NO
Germany	-0,07	-0,03	-0,16	-0,03	0,38	-4,62
Greece	-0,15	-0,06	-0,06	-0,01	-2,46	NO
Ireland	-0,41	-0,37	-0,11	-0,01	NA,NO (1)	-0,18
Italy	-2,10	-0,45	-0,15	-0,09	-3,73	NO
Luxembourg	-4,36	IE	IE	-0,06	-0,38	NO
Netherlands	-2,51	-0,47	-1,23	-0,06	-0,21	-5,74
Portugal	-0,77	-0,03	0,03	IE	-1,05	NO
Spain	-1,38	IE	-0,19	-0,23	-0,70	NO
Sweden	-0,59	-0,20	-1,16	0,00	-1,12	-1,49
UK	-2,22	IE	-0,28	IE	-1,09	IE

(1) Following a request of clarification during the EU QAQC, Ireland replied that its NIR includes documentation showing that mineral soil under deforestation is not a source. This issue will be closely followed.

Notation keys: IE – values are reported together with other pools (their separation is not possible under the availability of data without increasing uncertainty of estimates). NA- not applicable, NO-not occurring.

For Forest Management (Table 11.12), the difference in IEF among MS is mainly caused by the different increment rates (determined by species, ecological conditions, management, etc), the proportion of annual increment which is harvested, and for some country by the occurrence of natural disturbance events. DW, LT and SOC are mainly reported as "no source" with justification provided in the MS's NIR.

Table 11.12. IEF for net C stock changes (MgC ha-1yr-1) in the pools under Forest management activity in EU-15 (year 2011), based on MS' NIRs

MS	Above ground Biomass (net change)	Below ground Biomass (net change)	Litter	Dead wood	Min Soils	Org Soils
Austria	NA	NA	NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	NA
Denmark	2,22	0,46	0,49	0,05	NA	-0,34
Finland	0,36	0,08	IE	IE	0,11	-0,33
France	0,57	0,21	0,00	-0,05	0,00	NO
Germany	0,33	0,10	-0,05	0,09	0,27	-0,68
Greece	0,29	0,10	NA,NE	NA,NE	NA,NE	NA,NO

Ireland	NA	NA	NA	NA	NA	NA
Italy	0,70	0,14	0,03	0,02	NE	NO
Luxembourg	NA	NA	NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	NA
Portugal	0,18	0,05	0,00	IE	-0,11	NO
Spain	0,41	IE	NE	NE	NE	NO
Sweden	0,23	0,08	-0,05	0,07	0,16	-0,59
UK	0,48	IE	0,44	IE	0,54	0,55

Notation keys: IE – data is reported elsewhere i.e. included in other pools. NO – not occurring. NA- not applicable, NE-not estimated (the countries using NE still justify these pools as "no source" or negligible).

11.2.3.3 *Direct N_2O emissions from N fertilization (Table 5(KP-II) 1)*

Some countries report fertilization in old forests (e.g. Sweden) or young plantations (e.g. UK) however, for the majority of MS, N fertilization of forests do not occur or, if any, emissions are expected to be extremely low and are in any case reported under agriculture. Only Finland and Sweden provides estimates for this source category.

11.2.3.4 *N_2O emissions from drainage of soils (Table 5(KP-II) 2)*

Several MS did not report N_2O emissions from drainage of soils under FM, as the method of estimation is included only in the Appendix 3a.2 of the IPCC GPG for LULUCF (i.e. the reporting is not mandatory). Nevertheless, Denmark and Germany report emissions from this source category based on IPCC default factors and UK based on country specific factor. Other countries report NE because of no IPCC method or mention that a country specific method and emission factors for this source are under development (e.g. Finland). Estimation methods are consistent with those described under Chapter 7 of this report.

11.2.3.5 *N_2O emissions from disturbance associated with land use conversion to Cropland (Table 5(KP-II) 3)*

Forested areas converted to Cropland are rather small in EU-15 (some 170 kha in EU-15), nonetheless MS reported emissions with the exception of Spain, Greece, Ireland and Italy where this conversions do not occur. Currently, the consistency among KP and Convention tables was specifically checked by the EU QA/QC procedure, so there is more harmonized approach in current submissions. Estimation method is consistent with that described under Chapter 7 of this report.

11.2.3.6 *Carbon emissions from lime application (Table 5(KP-II) 4)*

Liming is not much applied as it is not economically reasonable at the heavy rates required (e.g. united kingdom's NIR 2012). Sometimes liming is separately reported for deforestation areas (e.g. Finland, Netherland). In general, even if liming may occur occasionally, there are no separate reliable statistics, thus it is often reported under Chapter 4 Agriculture. Estimation method is consistent with that described under Chapter 7 and mainly based in default factors.

11.2.3.7 *GHG emissions from biomass burning (Table 5(KP-II) 5)*

Forest fires on ARD units of lands are generally reported as not occurring, although sometimes such emissions are demonstrated to be negligible, but still reported as NE in CRF tables. Because of usually aggregated statistics on fires on entire forest area, the EU QA/QC identified a number of misallocation with potential accounting effects (e.g. emissions from burning occurring on AR were included under FM). Consequently, the EU member states have made efforts to estimate separately emission from biomass burning, including forest fires. In the case of missing data on burnt AR areas, it was assumed that the percentage of burnt AR areas compared to total forest burnt equal AR area share of total Forest land (e.g. Finland). Estimation methods are consistent with what described under Chapter 7.

Emissions from controlled burning of CM is reported by Spain under Agriculture sector, Table 4S2 "Field burning of agricultural residues". Portugal reported fire related emissions for each both CM and GM.

11.2.3.8 *Justification when omitting any carbon pool or any GHG emissions/removals for reporting*

During the EU QA/QC process, MS were recommended to use the notation key "NR" in NIR-1 CRF tables to indicate pools which were not reported under "not a source" provision, provide reference to the relevant NIR chapter in the documentation box (where it was demonstrated that the respective pool was not a source), and to add a comment to the reporting cell.

Furthermore, a decision tree guiding on the use of "not a source" provision was elaborated by the JRC and MS were encouraged to follow it (http://afoludata.jrc.ec.europa.eu/index.php/public_area/LULUCF_workshop), as explained in Chapter 7, section on QAQC.

In

Table 11.13 are summarized the type of documentation provided by the countries when pools where omitted. In the following text, more information is provided by activity.

Table 11.13 Overview of reasons for omissions of carbon pools.

Member State	Pools	Activity	Demonstration/Reasoning
Austria	DW	AR	Due to the young age of the forests at AR areas and assuming lack of dead wood at areas of all other land uses a stock change of dead wood does not occur on AR areas
Belgium	LT, DW	AR	As carbon stock of dead wood and litter in forest land is higher than those in other land uses in Belgium, Belgium applies conservative Tier.1 method for this carbon pool in AR activity
Denmark	SOC	FM	NFI monitoring was supplemented by an additional forest soil inventory in order to document that forest soils is not an overlooked source for CO_2 emissions
	LT, DW	CM, GM	Assumed not occurring
France	LT, SOC	FM	Small sinks are confirmed by national research project
Germany	DW	AR	Estimated (based on repeated field measurements) as not occurring
Greece	LT,DW,SOC	ARD,FM	Areas under AR include conversions from croplands by plantation. Croplands are assumed to not contain dead organic matter and therefore the litter and the dead wood pools cannot be a source for AR land, strongly supported by international literature. Carbon stock increment in soil in areas afforested has been estimated according to the Tier 1 methodology. Regarding the dead organic matter and soil under Forest Management, the Tier1 approach that there is no change in carbon stocks was followed based on international literature
Ireland	SOC	AR	Statistical supported data that this pool is not a source
Italy	SOC	FM	Demonstration based on country specific datasets and estimates
Luxembourg	DW	AR	Dead wood is assumed not to occur on AR areas, assumption verified in different sample plots of the second forest inventory (IFL2). Due to the young age of the forests at AR areas (since 1990) and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur. If there was any in the young forests of AR areas it would represent a C stock increase due to the lack of dead wood in the previous land uses
Netherlands	LT, DW	AR	It is assumed that no other land use has carbon in litter and dead wood. Adequate data are lacking to quantify litter, accumulation of carbon in re/afforestation is conservatively set to zero, although expert judgment on forest age and ecosystem processes suggests a small sink. Also, the conversion of non-forest to forest involves a build-up of carbon in dead wood. However, as it is unlikely that much dead wood will accumulate in very young forests (having regeneration years in 1990 or later), accumulation of carbon in dead wood in re/afforested plots is most likely a very tiny sink that is too uncertain to quantify reliably, also reported as not a source
Spain	LT,DW	AR	Reasoning based on system functioning (following Tier 1), supported by national literature
	LT,DW, SOC	FM	Reasoning based on system functioning (following Tier 1), supported by national literature
	DW,LT	CM	Reasoning based on system functioning (following Tier 1)
Finland, Portugal, Sweden, United Kingdom			All pools are estimated and accounted (although individual change pools are often reported as included IE)

11.2.3.9 Forest management

Most member states provided estimates for all the pools. For the member states that apply “not a source” in the 2013 submissions (Greece and Spain for LT, DW and SOC, Italy for SOC), the demonstration relies on c*ombination of qualitative and quantitative information* (including some data on C stock changes, although non-representative for the entire country). Three member states provide cumulated estimates for merged pools.

11.2.3.10 **Afforestation/Reforestation**

Some member state used the ‘not a source’ provision for litter or deadwood, using reasoning that no significant litter or deadwood pool exists or that the assumption of not a source was conservative. In several cases, specific studies and international references were used.

With regard to soil organic matter pool, only three MS estimated and reported it as a source at national level (Finland, Germany, and Sweden). Reporting of aggregated estimates at country level makes difficult to understand whether all or partly of relevant land conversions are actual sources. Specifically, conversions from annual/perennial cropland to forest land are reported as sources by Finland; conversions from grassland to forest land are reported as sources by Finland, Luxemburg, Netherlands. Demonstration of “not a source” relied on a combination of arguments, including assumption that soil organic matter increase following afforestation on agricultural areas as demonstrated by national research, national and international literature and quantitative information from repeated sampling from a reduced number of plots (which is considered insufficient to provide quantitative estimates at country level).

11.2.3.11 **Deforestation**

Member states report C stock change in all pools as emissions, with the exception of Ireland that justifies by expert judgment a “not a source” for mineral soil change and arguing the missing methodology in the GPG for LULUCF 2003. This issue will be re-checked and closely followed in future submission.

Cropland and Grazingland management

Denmark reports NA for both litter and dead wood under CM and GM, Spain report NE for both litter and dead wood under CM, and Portugal reports NO for deadwood under GM and IE (included under FM) deadwood under CM. In both cases, the respective NIRs explain that carbon stock changes in these pools are considered negligible. Given the definitions of CM and GM areas provided, notation key used by these countries look appropriate (further information is included in the respective NIRs), because the presence of trees under CM or GM is really negligible. For CM, DMK states that “no litter and dead organic matter are reported as this is seen as not occurring or as very insignificant as it is only related to the small area with fruit plantations and hedges”.

11.2.3.12 ***Information on whether or not indirect and natural GHG emissions and removals have been factored out***

In general, it is recognized that: (i) for Article 3, paragraph 4 activities, the issue of “factoring out” was solved during negotiations with the *cap* for Forest Management and with the net-net accounting for the other Article 3, paragraph 4 activities; (ii) for Article 3, paragraph 3 activities, the dynamic effect of age is not relevant since all these activities have occurred after 1990; (iii) for the elevated CO_2 concentration and the indirect nitrogen deposition, there are no methodologies adopted by the UNFCCC.

11.2.3.13 *Changes in data and methods since the previous submission (recalculations)*

Following improvements started in previous years there were recalculation in 2013 submissions compared to previous submission (Table 1.11.14). They were caused by availability of new data and parameters. s a result, the accuracy and completeness of the reporting have increased.

Table 1.11.14. Synthesis of reasons for recalculations as reported by new EU MS

MS	AR	D	FM	CM	GM	RV	Comments
Austria		X					A unit calculation error was corrected, leading to minor recalculations in the N_2O emissions from Deforestation
Belgium	X	X					For Deforestation values for BGB were corrected and annual value of living biomass C stock is used. For ARD, reporting cumulated 20 years transition period
Denmark	X	X	X	X	X		Minor recalculations have been made as updated values from the NFI have become available, with minor changes in the Land Use Matrix have occurred
Finland	X	X	X				Recalculations due to available new data, additional information of land-use changes and change in the method (as to include transitions to and from inland waters)
France							Recalculations due to available new data from NFI
Germany							Recalculations were done due to availability of more updated activity data and improvements on methods applied
Greece							No recalculations
Ireland	X	X					Deforested areas now include organic soils emissions for conversions to Other lands and Settlements. Burned areas under AR are now based on revised biomass, litter and deadwood inputs. The litter C flow model and leaf biomass equations for conifers were modified. There are new data from some repeated NFI plots
Italy	X	X					Update of the coefficients used to estimate the carbon stock changes in the deadwood pool for ARD lands, correction of computation errors and updating of activity data, revision of the land use matrix
Luxembourg							No recalculations
Netherlands							No recalculations
Portugal	X	X	X	X	X		New activity data from NFI and new parameters available, deforestation estimates still to be checked
Spain	X	X	X	X			As requested on the EU-QA/QC procedure some notations keys have been change on the KP- NIR tables.
Sweden	X	X	X				Recalculation of living biomass; update the area by extrapolation for inventory cycles without a full record of sample plots until 2013; fixing consistency of estimation of direct N_2O emissions for N fertilization and N_2O emissions from disturbance associated with conversion to cropland between the UNFCCC-reporting and the KP-LULUCF
UK	X	X					Increase of the completeness on pools and improvement of the parameters

11.2.3.14 *Uncertainty estimates*

Preliminary estimates (aggregating countries' available estimates at the EU-15 level) show an uncertainty around 24% for EU-15 total accounting amount (including all the mandatory and elected activities). More detailed information and discussion on uncertainty analysis of emissions/removals is provided in Chapter 7 of this report.

11.2.3.15 *Information on other methodological issues*

The methods used to estimate and reports under C stock changes and GHG emissions KP are the same as those used for the UNFCCC reporting, estimates and IEFs values are consistent (and equal whenever is the case). Estimation methods also fulfill the requirement on minimum tier allowed according to if the subcategory is or not key category.

11.2.3.16 *The year of the onset of an activity, if after 2008*

This information is implicitly achieved as the estimates are provided in the NIR-2 CRF table of KP and discussed in the Ch. 11 text (Ch. 11.1.2 Areas and changes in areas between KP-LULUCF activities KP CRF NIR-2). It is provided according land identification methodology and land use change matrix and activity.

11.2.4 Article 3.3

11.2.4.1 *Information that demonstrates that activities under Art. 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced*

For AR it is mentioned the year of planting (e.g. DK, UK, GR, IE) or in case of assisted afforestation the moment when the encroaching woody vegetation meet the definition of forest or for D direct field assessment checks. Year 2012 received particular attention for the countries that rely on statistical sampling data (e.g. NFI) where cyclic measurements are implemented and accuracy of the annul estimates is smaller for last measured year (i.e. 2012 when information from only 1/5 is updated).

NFI based methodologies (alone or combined with aerial photographs) allow for the assessment of the base year and thus any later change compared to that as “since 1990”. Early afforested area (i.e. immediately after 1990) is likely more uncertain if NFI was not performed in exactly the same year, which does not occur for the commencement and end of the commitment period (assuming better planning of assessments and availability of better methods and data nowadays). The annual area change rates are often assumed constant or randomly distributed over the assessed period (e.g., Sweden before 2006).

According to the IPCC GPG LULUCF (Chapter 4.2.5.2) “*It is good practice to provide documentation that all afforestation and reforestation activities included in the identified units of land are direct human-induced. Relevant documentation includes forest management records or other documentation that demonstrates that a decision had been taken to replant or to allow forest regeneration by other means*”.

Table 11.15 shows a synthesis of current information reported by EU-15 member states on the direct-human induced origin of AR lands.

Table 11.15 **Summary of current information reported by EU-15 MS aimed at demonstrating that Afforestation/Reforestation activities are direct human-induced**

MS	Type of information / justification provided					
	Areas converted have been verified and reported in registries for authorization	Areas converted, either subject to subsidies or not, have been reported in registries either for authorization or compilation of land use changes	Whole national territory covered by legal instruments for Land planning and/or management, therefore any change in land use is directly human-induced	Where a conversion results in a land use subject to management practice, the conversion is considered directly human-induced	As all land area is under management (i.e. subject to some kind of human interactions), all changes are considered as directly human-induced	A decision to change the use of a land or a decision not to continue the previous management practices has been made, which allow for conversion
Austria			**X**			
Belgium					X	
Denmark					X	
Finland						X
France				X		
Germany			X			
Greece	X					
Ireland	X					
Italy			X			
Luxembourg			X			
Netherland					X	
Portugal					X	
Spain		X				
Sweden				X		
UK		X				

In general a rather “broad” interpretation of “direct human induced AR” is applied. From total EU-15 area reported under conversion to forest land (5A2), only 92 % is assumed as directly human induced AR because France reports 90 %, Sweden 39% and UK 88% of 5A2 as directly human induced. For instance, UK does not report under AR the areas of planting that are not state-owned or grant-aided (i.e. whether these woodlands are explicitly managed is unknown). MS considered natural forest expansion included under forest management if elected.

In Sweden, differences in deforestation between the Convention and the KP reporting are justified by the fact that some of these conversions are considered as non-human induced, i.e. in the forest conversions to Other Land and Wetlands (see NIR of Sweden for more details).

11.2.4.2 *Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation*

Although the loss of forest cover is often readily identified, the classification of an area as deforested is more challenging. Most MS provided information on the criteria by which temporary removal or loss of tree cover can be distinguished from deforestation and how these criteria are consistently applied (Table 11.16). The simple combination of NFI data with remote sensing data may not be fully adequate to assess the areas which can be classified as deforested, and thus these data are often complemented by other type of information (i.e. a deforestation typically requires a specific permit or specific visible changes of the soils). For instance, in the absence of detailed information of the future use of land, some MS defined the expected time periods (in years) between removal of tree cover and successful natural regeneration or planting. Most member states reported that there are legal obligations to restore the forest on harvested areas, with these legal provisions enforced under national circumstances. Furthermore, legislation usually does not allow for a land use change following a natural disturbance. Given the high values of deforestation reported by Portugal, during the EU QAQC it was agreed to re-check the methodology next year.

Table 11.16 Information on differentiation between temporary forest cover loss and deforestation (from MS' NIRs)

MS	Short description
Austria	Differentiation of temporarily un-stocked areas (e.g. harvested area, disturbances) and deforestation is made by actual procedures implemented by NFIs (e.g. handbooks and guides for field assessment, training of field staff to rightly distinguish between them). For deforestation field assessment procedure involve identification of the significant visible changes in soil structure or ground vegetation which may not represent the natural succession of a forest (e.g. consequences of anthropogenic activities like plowing, crop production, mowing or construction activities or natural abortion of the forest and its stand by e.g. landslides). *Temporarily unstocked areas* by forest management or forests with biotic and abiotic reduction of their crown coverage (windfall, fire, beetles) maintain the natural succession of ground vegetation and soil and therefore remain part of the forest
Belgium	Deforestation permits released by the regional forestry authorities (usually only for settlements purpose)
Denmark	Deforested land is detected by analysis of satellite images, further on confirmed by additional sources (i.e. documentations). Mandatory period for reforestation of cut areas is 10 years
Finland	If a NFI sample plot is on a clear-cut area, the field assessor assesses if there are signs for permanent conversion or only cut. Maximum period allowed for regeneration is 3 years, with a usual delay in reforestation of 2 years
France	Land use/cover and ground assessment are able to identify the land use and activity change on annual basis
Germany	Law and observance of its implementation ensure that cut or natural disturbance area is reestablished as forest
Greece	Only legally executed deforestations are considered under deforestation while the land that has lost illegally the forest cover is not classified as deforested, but as areas that temporary loss of woody vegetation
Ireland	NFI identifies if the lands are un-stocked or deforested (5 years periodicity)
Italy	Implementation of different legal procedure for harvesting and deforestation
Luxembourg	Legal obligation that the owner has to ensure the regeneration of forest in 3 years after a clear cut
Netherland	Mapping method used to ensure differentiation between deforestation and non-deforested tree cover loss
Portugal	With current methodology if in 5 years the forest is not restored then the land is considered as deforested
Spain	NFI captures any areas which did not regenerated and the reasons for it (e.g. after forest fires). NFI is performed every 10 years
Sweden	Missing forest cover identified for two consecutive inventories is not enough to classify the plot as deforested, but additional observable changes (as presence of infrastructure)
UK	Felling licenses system, in the near future doubled by new NFI, ensures the relevant activity areas are fully captured

11.2.4.3 *Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested*

Methodologies adopted by each MS ensure consistent reporting in time and space of these areas (usually declared as temporary un-stocked areas). Such areas may be found after either natural or man-made disturbances, and may result in misallocation of lands (i.e. a harvested land should remain under FM while a deforested land should be reported under D). In general, the distinction between deforested areas and temporarily un-stocked areas is allowed by the national methodologies, which implement multiple assessment criteria and hierarchical phases (including precise guidelines for field checks). Supplementary arguments for correct classification of the land status are given by the law requirements and enforcement according national circumstances, referring to the years allowed for a land to be without woody vegetation.

11.2.4.4 *Information on emissions and removals of GHG from lands harvested during the first commitment period following AR on these units of land since 1990*

Most member states report that for AR, due to normative technical rules or economic constraints, harvest do not usually occur before plantations are 20 years old, with the exceptions of some fast growing species. The majority of the MS interpret "harvesting" as clear cut done on short rotation forests or woody biomass crops (e.g. Ireland and Portugal report together some emission of 7,500 GgCO_2 benefitting provision from para 4 section B of Annex to D16/CMP1).

11.2.5 Article 3.4

11.2.5.1 *Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced*

General consideration applies that all land that meet forest definition are forest land. Within that the land which are subject for forest management are defined at national level based on applicable definition and practices.

11.2.5.2 *Information relating to Forest Management*

Forest management is understood as the set of forest practices and operations, which occur at the stand-level: felling for natural and artificial/planting regeneration, site and soil preparation (including drainage, burning of slash), planting of seedlings, seeding, thinning, pruning, fertilization and liming, harvesting of cutting residues and conservation of important habitats, and fire prevention. Instruments for sustainable forest management are obligations under national legislation of all MS with adequate institutional framework, further enhanced by strategies/programs and management plans. Sustainable forestry has a long tradition in Europe, with earliest management planning dating hundreds years back. Currently, each MS has in force their own legislation on forest lands, as well as other laws supporting in general the improvement and protection of forests. At the EU level, forestry is not regulated directly by specific rules, but there are strong requirements for the protection of forests via common environmental obligations (on nature protection, biodiversity protection etc.), sustainable rural development and renewable energy policies. Some countries report certification of the forests as an additional tool to highlight the sustainability of the whole chain of forestry and wood products (i.e. many MS certified forest management under various schemes).

EU-15 MS apply rather broad definition of "Forest management", with only few MS reporting some areas of forest not falling also under the FM definition. In few cases there are strict assumptions, i.e. that only the forests with a landscape or/and forest management plan in 1990 and 2012 are under FM (e.g. Greece considers under FM only 35% of forest land area reported under the 5A1). France also does not report large areas of forest from overseas territories, because that is regarded as being unmanaged.

Data reported under different international processes (e.g. FAO, MCFPE, CBD) may be different due to the different reference time and definitions applied underlying different reporting obligations. Thus, any comparisons have to be done cautiously.

11.2.5.3 *Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year*

Three MS elected 3.4 activities. Cropland and Grazing land management activities consist in the implementation of specific practices and operations, which differ substantially from country to country. Cropland management is dedicated to agricultural cultures and crops, perennial and annual, woody and non woody, including lands temporary under reserve or out of the productive activity.

In Denmark and Portugal CM was a source for entire time series, while in Spain a sink. GM was a sink in Denmark and it has turned from source to sink in Portugal.

Data for the reference year 1990 and the first year of the commitment period are constructed based on remote sensing, sometimes enhanced by statistics (i.e. activity data) or surveys (i.e. crop species share). Data on improved technologies for cultivation are likely missing for the base year and generally it is realistically assumed that they did not occur (i.e. Portugal).

MS includes also some types of wooded vegetation areas (reported under cropland in the convention) as subject to management, implementing adequate stratification for estimation of C stock changes also for the base year. Denmark includes under grazing land management “grassland having some wooden vegetation that does not meet the forest definition” and “wooded perennial fruit plantations and hedgerows” in the cropland management area.

11.2.6 Other information (EU-15)

11.2.6.1 *Key category analysis for Art. 3.3 activities and any elected Art. 3.4 activity*

Member states apply mainly quantitative criteria for the assessment of the key categories (see

Table 11.4), based on the correspondence between KP activities and land categories under the GHG inventory. Further information regarding KC analysis can be found in section 11.1.3.

15.2.1.1. *Information relating to Article 6*

There is no JI project developed by EU-15 member states.

11.3 Overview of emissions/removals and information reported by new EU MS in the KP-LULUCF tables

Forest land definition adopted by the new EU-12 MS is in line with national legislation and within the range defined by FAO and UNFCCC. Cyprus and Malta are not included as they do not have commitments under Kyoto Protocol. Criteria applied by new MS for forest land classification are shown in Table 11.17.

Table 11.17 Parameters used by the new EU MS to define "forest" under the Kyoto Protocol

Member State	NIR 2013			
	Crown cover (%)	Height (m)	Minimum area (ha)	Minimal Width (m)
Bulgaria	10	5	0.1	-
Czech Republic	30	2	0.05	20
Estonia	30	2	0.5	-
Hungary	30	5	0.5	10
Latvia	20	5	0.1	20
Lithuania	30	5	0.1	10
Poland	10	2	0.1	10
Romania	10	5	0.25	20
Slovakia	20	5	0.3	-
Slovenia	30	2	0.25	-

11.3.1 Coverage of carbon pools and GHG reported (KP CRF NIR-1)

Seven new EU MS have elected Forest Management and only one has elected Revegetation (Romania). Among the new EU MS, only Hungary has chosen annual accounting.

All new MS report carbon stock changes under living biomass pool while they provide estimates or justification for "not a source" is reported for other pools (

Table 11.18). Litter pool is sometimes reported as included with soils organic carbon because of data availability (e.g. Czech Republic) or assumed not to be a net source of emissions (e.g. Hungary for AR). Soil Organic Carbon under FM is mainly assumed in balance therefore considered as “not a net source”.

Table 11.18 Synthesis of pools coverage for KP LULUCF activities for 2013 in new EU MS (from tables NIR 1)

MS	Change in carbon pool reported					Greenhouse gas sources reported						
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil M	Fertilization	Drainage of soils under forest management	Disturbance associated with land-use conversion to Croplands	Liming	Biomass burning		
						N_2O	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
Afforestation/Reforestation												
Bulgaria	R	IE	R	NR	R	NO	0	0	NO	NO	NO	NO
Czech Republic	R	R	IE	R	R	NO	0	0	NO	NO	NO	NO
Estonia	R	R	R	NO	R	NO	0	0	NO	R	R	R
Hungary	R	R	NR	NR	NR	IE	0	0	NO	IE	R	R
Latvia	R	R	R	R	R	NO	0	0	NO	NO	NO	NO
Lithuania	R	R	R	R	R	NO	0	0	NO	R	R	R
Poland	R	R	IE	R	R	NO	0	0	NO	R	R	R
Romania	R	R	R	NR	R	NO	0	0	NO	NO	NO	NO
Slovakia	R	R	R	NO	R	NO	0	0	NO	NO	NO	NO
Slovenia	NO	NO	NO	NO	NO	NO	0	0	NO	NO	NO	NO
Deforestation												
Bulgaria	R	IE	R	R	R	0	0	NO	NO	NO	NO	NO
Czech Republic	R	R	IE	R	R	0	0	R	NO	NO	NO	NO
Estonia	R	R	R	R	R	0	0	NO	NO	NO	NO	NO
Hungary	R	R	R	R	R	0	0	R	NO	IE	R	R
Latvia	R	R	R	R	R	0	0	NO	NO	NO	NO	NO
Lithuania	R	R	R	R	R	0	0	NO	NO	NA	NA	NA
Poland	R	R	IE	R	R	0	0	NA	NO	NO	NO	NO
Romania	R	R	R	R	R	0	0	NO	NO	NO	NO	NO
Slovakia	R	R	R	R	R	0	0	NO	NO	NO	NO	NO
Slovenia	R	R	R	R	R	0	0	R	NO	NO	NO	NO
Forest management												
Bulgaria	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Czech Republic	R	R	IE	R	NR	NO	NO	0	R	R	R	R
Estonia	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Hungary	R	R	NR	NR	NR	IE	NO	0	NO	IE	R	R
Latvia	R	R	R	R	R	NO	R	0	NO	R	R	R
Lithuania	R	R	R	R	R	NO	R	0	NO	R	R	R
Poland	R	R	IE	R	R	NO	R	0	NO	R	R	R
Romania	R	R	NR	NR	NR	NO	NO	0	NO	R	R	R
Slovakia	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Slovenia	R	R	R	R	R	NO	NO	0	NO	R	R	R

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported, NE – removal/emission is not estimated (could be either negligible or truly not estimated); IE – included elsewhere; NO –not occurring; NA – MS does not account the activity.

Land area reported under KP activities is 27206 Kha. Areas on which different KP activities occur represents some 5% by AR, 1% by D, 94% by FM and <1% by Rv in total new EU-12 MS KP reported land (

Table 11.19). Recalculations from previous submission are negligible, mainly affecting FM area (by Slovenia). The largest area of AR is reported by Bulgaria and Poland, together 62% of EU-15 AR area. Deforestation areas are small in all countries, with few countries showing practically very general small land conversions.

Table 11.19 **Synthesis of total area (kha) of KP-LULUCF activities as reported by new EU MS at the end of the 2010 (from Tab. NIR-2). Grey cells indicate that the activity has not been elected.**

Member State	Art. 3.3 activities		Article 3.4 activities			
	AR	D	FM	CM	GM	RV
Bulgaria	224	7				
Czech Republic	46	14	2.561			
Estonia	27	19				
Hungary	170	9	1.656			
Latvia	219	37	3.128			
Lithuania	28	1	2.146			
Poland	662	12	8.668			
Romania	27	55	6.335			11
Slovakia	34	8				
Slovenia	NO	7	1.117			
EU 12	**1.414**	**170**	**25.611**			**11**
EU-15 (see Table 11.3)	6.660	2.689	107.641	25.491	1.585	0
Total EU 27	8.073	2.859	133.256	25.491	1.585	11

Notation: AR: forestation/Reforestation, D: deforestation, FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation

Note that this table uses numbers from sectorial tables and not from table NIR 2, because in few cases it was noted minor inconsistencies between sectorial tables and NIR 2. This problem was notified to the relevant MS during the EU QAQC process but not entirely addressed in the May resubmission

FM is a key category for all member states that elected it (Table 11.20). Deforestation does not bring important share of emissions in the national estimates. There is general full agreement between importance of the category and methodological tiers involved in the estimation.

Table 11.20 **Synthesis of KP-LULUCF activities being key category as reported by new EU MS (from tables NIR-3) "KC" indicates a key category. Grey cells indicate that the activity has not been elected.**

MS	AR	D	FM	CM	GM	RV	Comments
Bulgaria	KC						Corresponding land category is Key under GHG inventory
Czech Rep.			KC				Level assessment incl. LULUCF
Estonia	KC	KC					Quantitative Tier 2 method was used
Hungary	KC		KC				Corresponding land category is Key under GHG inventory
Latvia	KC	KC	KC				Corresponding land category is Key under GHG inventory
Lithuania			KC				Corresponding land category is Key under GHG inventory
Poland	KC		KC				Corresponding land category is Key under GHG inventory
Romania	KC		KC				Key category level assessment including LULUCF
Slovakia	KC	KC					Level assessment
Slovenia		KC	KC				Key category level assessment including LULUCF

11.3.2 Summary of emissions/removals and accounting quantities for KP LULUCF activities by EU-15 MS (KP CRF “Accounting” table)

Total amount to be accounted by new EU-12 MS is equivalent to a net of 89047 $GgCO_2$ (Table 11.21, Table 11.22). Out of this, 76% is due to removals in FM and 45 % to AR. In absolute amounts, emissions from D represent 16 % and emissions from Rv is 5%.

Three countries offset their emissions from 3.3 with removals from 3.4. (i.e. Latvia, Romania and Slovenia). Slovenia reports no afforestation/reforestation activity.

Poland and Romania account the largest amount from LULUCF activities (with largest sink in AR or FM), while Estonia records emissions (because of Deforestation).

Table 11.21 Synthesis Emissions/removals and accounting quantities for KP-LULUCF activities as reported by new EU MS as 2013 submission (Note: sum of MS' emissions/removals is shown for information purpose only. (The EU will neither issue nor cancel accounting units)

Member States	Net emissions (+) and removals (-), Gg CO2eq																																		
	A. Art 3.3 activities												B. Art. 3.4 activities																						
	A.1 AR								A.2. D				B.1 FM				B.2 CM					B.3 GM					B.4 RV				
	A.1.1 Lands not harvested				A.1.2 Lands harvested																										
	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	1990	2008	2009	2010	2011	1990	2008	2009	2010	2011	1990	2008	2009	2010	2011
Bulgaria	-587	-650	-801	-962	NO	NO	NO	NO	310	165	215	180	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO
Czech Republic	-272	-295	-322	-357	NO	NO	NO	NO	160	170	207	164	-4404	-6441	-5096	-7569	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Estonia	-98	-121	-131	-145	0	0	0	0	722	638	476	377	0	0	0	0	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Hungary	-1130	-1103	-1206	-1120	-25	-47	-84	-133	47	90	49	70	-2784	-1892	-1680	-1523	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA
Latvia	-908	-1007	-1007	-1007	NA,NO	NA,NO	NA,NO	NA,NO	1080	1068	1045	1043	-19093	-17774	-14603	-14851	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Lithuania	-89	-108	-109	-120	0	0	0	0	9	9	26	10	-9024	-11642	-10592	-10850	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Poland	-5159	-5516	-5820	-6192	IE,NO	IE,NO	IE,NO	IE,NO	258	268	229	236	-27409	-28169	-28043	-25233	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
Romania	-334	-354	-374	-392	IE,NO	IE,NO	IE,NO	IE,NO	2090	480	476	498	-22263	-22740	-22300	-20564	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-1275	-239	-254	-268	-287
Slovakia	-454	-470	-512	-528	0	0	0	0	135	212	141	39	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	0	0	0	0
Slovenia	NA,NO	NA,NO	NA,NO	NA,NO	0	0	0	0	127	272	306	233	-11559	-11563	-11576	-11576	0	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA	NA	NA	NA
EU-12	-9030	-9624	-10283	-10824	-25	-47	-84	-133	4936	3372	3170	2849	-96536	-100221	-93890	-92166	0	0	0	0	0	0	0	0	0	0	-1275	-239	-254	-268	-287
EU-25	-52955	-56410	-58124	-58036	2168	1959	1635	1415	36394	33819	31005	30306	-329606	-329164	-299013	-307441	9600	1981	1330	1480	827	2219	-1	-131	-267	-430	-1275	-239	-254	-268	-287

Table 11.22 Synthesis Accounting quantities ($GgCO_2$ eq.) in 2013 for KP-LULUCF activities as reported by new EU-12 member states.

MS	Accounting quantity on activities						MS accounting amount on LULUCF activities
	AR	D	FM	CM	GM	RV	
Bulgaria	-3.000	870	NA,NO				-2.130
Czech Rep	-1.246	701	-5.867				-6.412
Estonia	-495	2.213	0				1.718
Hungary	-4.849	255	-5.317				-9.911
Latvia	-3.930	4.235	-6.233				-5.928
Lithuania	-426	54	-5.133				-5.505
Poland	-22.686	991	-15.033				-36.728
Romania	-1.454	3.544	-22.256			4.052	-16.114
Slovakia	-1.964	527	NA				-1.437
Slovenia	NA,NO	938	-7538				-6.600
EU 12	**-40.050**	**14.328**	**-67.377**			**4.052**	-89.047

11.4 Synthesis of supplementary information on KP-LULUCF activities reported by EU-12 MS in their NIRs

Estimation methodologies adopted by the EU-12 MS are consistent with those used for reporting GHG inventory under the Convention. Implied Emissions Factors for C stock change are within the ranges reported by EU-15 MS for Afforestation/Reforestation (Table 11.23), Deforestation (Table 11.24) and Forest Management (Table 11.25).

Table 11.23 IEF for net C stock changes (MgC ha-1yr-1) by pools on lands under AR activity in EU-15 (submission 2013)

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	2,13	IE,NO	0,25	NO	-1,20	NO
Czech Republic	1,65	0,33	NO	0,33	IE	NO
Estonia	1,07	0,42	0,30	NO	-0,27	-0,57
Hungary	1,67	0,42	NE	NE	NE	NO
Latvia	0,49	0,16	0,47	0,15	NO	-0,68
Lithuania	1,19	IE	1,10	NO	-1,21	-2,24
Poland	1,96	0,55	IE	0,00	0,06	-0,68
Romania	1,63	0,41	0,26	NO	1,61	NO
Slovakia	1,24	0,29	0,41	NO	2,27	NO
Slovenia	NA	NA	NA	NA	NA	NA

NE, NO are used for reporting, when the pool either as “not a source” (with not all the cases enough supported by information provided in the NIR), or for pools which are not represented on their territories (i.e. organic soils) or when data is not yet reported and planed for improvements. NA is mainly reported when activity does not take place in the country (i.e. Slovenia for AR).

Values of biomass IEF for Deforestation range widely under biomass stocks considered (i.e. average by majority of countries or specific data determined by NFI by Slovenia).

Table 11.24 IEF for net C stock changes (MgC ha-1yr-1) in the pools under Deforestation activity in EU-15 (submission 2013)

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	-3,73	IE	-0,41	-0,19	-2,55	NO
Czech Republic	-2,46	-0,49	IE,NA	-0,06	-0,06	NO
Estonia	-2,66	-0,63	-1,11	-0,01	-0,87	-1,44
Hungary	-1,07	-0,27	-0,26	-0,07	-0,38	NO
Latvia	-0,81	-0,26	-0,61	-0,17	-5,76	-0,97
Lithuania	IE	IE	-0,62	-0,08	-1,86	-1,86
Poland	-2,48	-0,50	IE	-0,03	-2,30	NO
Romania	-0,18	-0,04	-0,02	0,00	-2,22	NO
Slovakia	-1,02	-0,23	0,00	-0,05	-0,03	NO
Slovenia	-8,32	IE	IE	-1,18	-0,17	NO

In the Forest Management areas, DW, LT and SOC are mainly reported as “not a source” (thus NE, NO or NA is used). For organic soils, NO is used when they activities do not occur on such lands.

Table 11.25 IEF for net C stock changes (MgC ha-1yr-1) in the pools under Forest management activity in EU-15 (submission 2013)

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	NA	NA	NA	NA	NA	NA
Czech Republic	0,73	0,15	NE,NO	NO	NE,NO	0,00
Estonia	NA	NA	NA	NA	NA	NA
Hungary	0,19	0,06	NE	NE	NE	NO
Latvia	1,04	0,36	NO	0,01	NO	-0,68
Lithuania	1,05	0,24	0,04	0,10	NO	-0,34
Poland	0,48	0,55	-0,32	0,22	IE	0,00
Romania	0,65	0,23	NO	NO	NO	NO
Slovakia	NA	NA	NA	NA	NA	NA
Slovenia	2,29	0,44	IE	0,11	NO	NO

GHG emissions from sources associated with KP activities are generally reported by the MS as not occurring.

In the new EU-12 MS there is an ongoing effort for improvement of reporting, especially for the problematic pools (soil and litter) for which historical data is practically not available.

11.4.1.1 ***Justification when omitting any carbon pool or any GHG emissions/removals for reporting*** **Afforestation/Reforestation and Forest management**

For the countries "that apply not a source" on SOC, DW and LT pools in the 2013 submissions, the demonstration is based on: q*ualitative" information from scientific literature or other sources, including various statistics*; c*ombination of qualitative and quantitative information* (including some data on C stock changes, although non-representative for the entire country) and d*emonstration of 'not a source' by a simulation exercise* with a model (peer reviewed in scientific papers), assuming country specific data and circumstances.

12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 Background information

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2011 for the Community registry is submitted together with this report (Annex 1.13). The data in the Community registry reflect only the transactions to and from the Community registry, but not the sum of all Member States' transactions. Member States' separately submit information on Kyoto units in SEF tables to the UNFCCC.

12.2 Summary of information reported in the SEF tables for the Community registry

The standard electronic format tables for the Community are included in the submission. The SEF reporting software has been used for this purpose. The tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Community registry at 31.12.2012 as well as information on transfers of the units in 2012 to and from other Parties of the Kyoto Protocol.

The assigned amount for the EU, calculated pursuant to Article 3 paragraphs 7 and 8 as described in the EU's initial report, exceeds the sum of Member States' assigned amounts by 19,357,531 tonnes CO_2-equivalent. This arithmetical difference is due to the fact that the joint agreement under Article 4 of the Kyoto Protocol was formulated in percentage contributions based on base-year data available in 1998. As the Member States have revised their base-year emissions, the adopted percentage contributions under the burden sharing agreement no longer exactly match EU's 92 % commitment. As each assigned amount unit (AAU) can only be issued into a national registry once, the assigned amount of each Member State should be issued into its respective national registry after being recorded in the compilation and accounting database. The remaining assigned amount for the EU, amounting to 19,357,531 tonnes CO_2-equivalent (which is the arithmetical difference between the Community's assigned amount and the sum of the Member States' assigned amounts), was issued in the registry of the EU in 2011.

The total quantities of AAUs acquired and transferred during the reporting period are provided in SEF table 2b and 2c.

12.3 Summary of information reported in the SEF tables of Member States

SEF tables for the Community registry, EU-15 are provided in Annex 1.13. The SEF tables for EU-15 include aggregated information for EU-15 Member States. Note that the EU-15 SEF tables also include transactions between the Community registry and the new EU Member States and non-EU Member States. Table 11.1 provides an overview of transactions included in Table 2(b) in the Community registry and EU-15 SEF tables.

Table 12.1 **Transactions included in Table 2(b) in the Community registry and EU-15 SEF tables**

Table 2(b)		Community registry SEF tables	EU-15 SEF tables	EU-25 SEF tables
From	**To**			
Community registry	EU-15 MS	Yes		
Community registry	new MS	Yes	Yes	
Community registry	Non-EU MS	Yes	Yes	Yes
EU-15 MS	Community registry	Yes		
EU-15 MS	new MS		Yes	
EU-15 MS	Non-EU MS		Yes	Yes
new MS	Community registry	Yes	Yes	
new MS	EU-15 MS			Yes
new MS	Non-EU MS			Yes

12.4 Discrepancies and notifications

With respect to the respective paragraphs of decision 15/CMP.1 the following information is provided for the Community registry:

- **Paragraph 12:** No discrepancies identified by the transaction log.
- **Paragraph 13**: No notifications directed to the Party to replace ICERs in accordance with Paragraph 49 of the annex to decision 5/CMP.1.
- **Paragraph 14:** No notifications directed to the Party to replace ICERs in accordance with para 50 of the annex to decision 5/CMP.1.
- **Paragraph 15:** No issue of non-replacement.
- **Paragraph 16**: No KP Units that are not valid.
- **Paragraph 17:** No actions were necessary to correct any problem causing a discrepancy.

12.5 Publicly accessible information

The information based on the requirements in the annex to decision 13/CMP is publicly available on the European Commission website: http://ec.europa.eu/environment/climat/gge_registry.htm

In accordance with Decision 13 of the first Meeting of the Parties to the Kyoto Protocol (COP/MOP 1), the following information is made publicly available from the Community Registry[41].

[41] The list of information that is made publicly available has not changed compared to previous submissions

List of accounts

TYPE	COMM PRD	ACCOUNT HOLDER	REPRESENTATIVE ID	REPRESENTATIVE	TEL	FAX	EMAIL
Holding account	0	European Commission	EU100000000002312	Ronald Velghe	+32-229-84052	-	ronald.velghe@ec.europa.eu

Article 6 project information

No ERUs have been issued in the Community Registry in 2008

No ERUs have been issued in the Community Registry in 2009

No ERUs have been issued in the Community Registry in 2010

No ERUs have been issued in the Community Registry in 2011

The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year

This information is confidential.

The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8

No AAUs have been issued in the Community Registry in 2008

No AAUs have been issued in the Community Registry in 2009

No AAUs have been issued in the Community Registry in 2010

19,357,532 AAUs have been issued in the Community Registry in 2011

No AAUs have been issued in the Community Registry in 2012

The total quantity of ERUs issued on the basis of Article 6 projects

No ERUs have been issued in the Community Registry in 2008

No ERUs have been issued in the Community Registry in 2009

No ERUs have been issued in the Community Registry in 2010

No ERUs have been issued in the Community Registry in 2011

No ERUs have been issued in the Community Registry in 2012

The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries

YEAR	Registry	AAU	ERU	RMU	CER
2008	AT	159,153	0	0	0
2008	CZ	1,884,071	0	0	0
2008	ES	10,229,902	0	0	0
2008	FI	792,678	0	0	0
2008	LU	72,000	0	0	0
2008	PT	2,235,418	0	0	0
2008	SK	2,684,303	0	0	0
2010	GB	633,525	0	0	303,069
2011	GB	377,706			653,402
2012	AT	0	19177	0	923258
2012	BE	0	205373	0	962439
2012	BG	0	827103	0	175000
2012	CDM	0	0	0	704658
2012	CH	651085	230236015	0	80719055
2012	CZ	0	809880	0	104266
2012	DE	0	21137172	0	45288186
2012	DK	0	998198	0	741811
2012	ES	0	2856255	0	10025533
2012	FI	0	0	0	478440
2012	FR	220	19057046		24521632
2012	GB	84925	71693964	0	97314896
2012	GR	0	0	0	47229
2012	HU	0	411316	0	395001
2012	IE	0	0	0	1343136
2012	IT	0	426396	0	18216467
2012	JP	35803	0	0	3742415
2012	LT	0	71065	0	0
2012	NL	0	4932818	0	23695975
2012	NO	38896	49999	0	939356
2012	PL	0	518379	0	24107
2012	PT	0	1400727	0	772000
2012	RO	0	0	0	788650
2012	RU	993770	1215412	0	0
2012	SE	0	232084	0	607249
2012	SI	0	449545	0	076531
2012	SK	0	12871	0	0

No unit has been acquired from another registry in 2009.

The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4

No RMUs have been issued in the Community Registry in 2008
No RMUs have been issued in the Community Registry in 2009
No RMUs have been issued in the Community Registry in 2010
No RMUs have been issued in the Community Registry in 2011
No RMUs have been issued in the Community Registry in 2012

The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries

YEAR	Registry	AAU	ERU	RMU	CER
2008	BE	162,019	0	0	0
2008	DK	2,593,754	0	0	0
2008	FR	5,664,238	0	0	0
2008	HU	131,000	0	0	0
2008	IT	579,204	0	0	0
2008	NL	3,062,720	0	0	0
2008	PL	90,000	0	0	0
2008	SE	18,429	0	0	0
2008	GB	5,627,661	0	0	0
2008	IE	128,500	0	0	0
2010	GB	508,009	0	0	0
2011	GB	65,000	0	0	0
2011	DK	5,000,000	0	0	0
2012	AT	0	0	0	148768
2012	BE	0	34257	0	293710
2012	BG	0	8427	0	0
2012	CH	615093	54194442	0	47274080
2012	CZ	0	52585	0	91335
2012	DE	0	25461755	0	6198252
2012	DK	0	287511	0	741811
2012	EE	0	24837	0	0
2012	ES	0	1457136	0	3669141
2012	FI	0		0	
2012	FR	0	11948162		8289170
2012	GB	412722	33504305	0	42047871
2012	GR	0	0	0	50000
2012	HU	0	6496	0	0
2012	IT	0	970262	0	3134513
2012	JP	0	56619	0	1952486
2012	LV	0	42900	0	0
2012	NL	59881	2018355	0	6164713
2012	NO	568536	190010	0	652559
2012	NZ	0	2989000	0	882000
2012	PL	0	518379	0	24107
2012	PT	0	1400727	0	772000
2012	RO	0	0	0	788650
2012	SE	0	232084	0	607249
2012	SI	0	119731	0	0
2012	SK	0	5400	0	0

No unit has been transferred to another registry in 2009.

The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4

YEAR	AAU	ERU	RMU	CER
2008	0	0		
2009	0	0		
2010	0	0		
2011	0	0	0	0
2012	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0

The total quantity of other ERUs, CERs, AAUs and RMUs cancelled

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs retired

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0

12.6 Calculation of commitment period reserve (CPR)

The EU commitment period reserve is 17,659,243,358 tonnes CO_2eq. as indicated as revised estimate in the report of the review of the initial report of the European Union (FCCC/IRR/2007/EC). The commitment period reserve for the EU is calculated as 90 per cent of its assigned amount pursuant to article 3, paragraphs 7 and 8 of the Kyoto Protocol and therefore remains unchanged during the first commitment period.

12.7 KP-LULUCF accounting

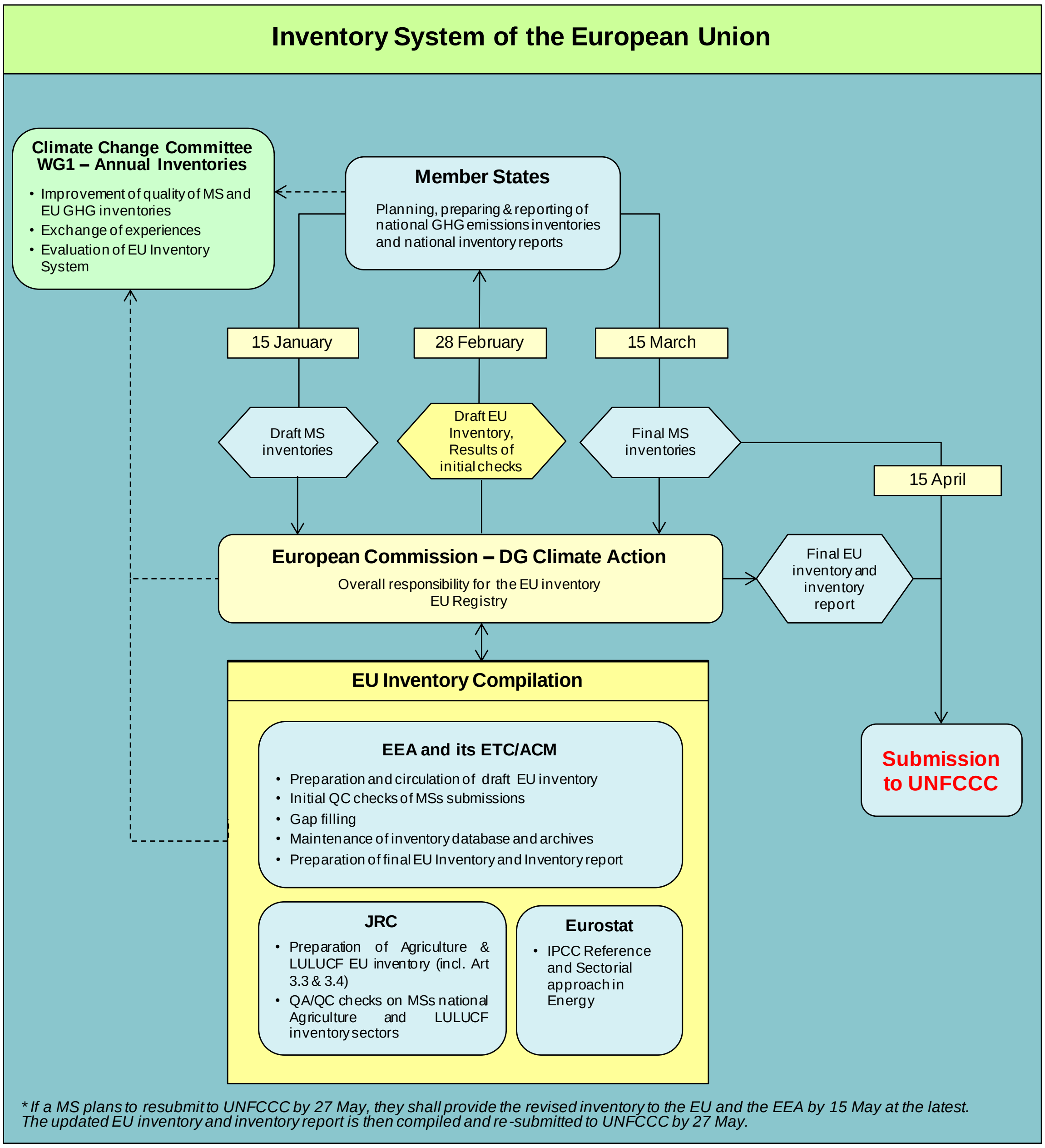
Each EU Member State will account for net emissions and removals for each activity under Article 3, paragraphs 3 and 4, if elected, by issuing RMUs or cancelling Kyoto Protocol units based on the corresponding reported emissions and removals from these activities and the specific accounting rules. The EU will neither issue nor cancel units based on the reported emissions and removals from activities under Article 3, paragraph 3 and paragraph 4. The EU will report the sum of Member States' cumulative accounting quantities for these activities at the end of the commitment period, representing the Member States' cumulative additions to or subtractions from their assigned amount at the end of the commitment period.

13 INFORMATION ON CHANGES IN NATIONAL SYSTEM

No changes were made to the EU national system.

Figure 13.1 provides information about the National Inventory System of the European Union.

Figure 13.1 National Inventory System of the European Union.



14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and decision 24/CP.8.

With a view to complying with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011, in addition to implementing the platform shared by the consolidating Parties, the registry of EU has undergone a major re-development. The consolidated platform which implements the national registries in a consolidated manner (including the registry of EU) is called Consolidated System of EU registries (CSEUR) and was developed together with the new EU registry on the basis the following modalities:

(1) Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;

(2) Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;

(3) Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry keeps a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;

(4) Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;

(5) The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;

(6) The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 concerning making non-confidential information accessible to the public would be fulfilled by each Party individually;

(7) All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:

    (a) With regards to the data exchange, each national registry connects to the ITL directly and establishes a distinct and secure communication link through a consolidated communication channel (VPN tunnel);

    (b) The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes such that those actions cannot be disputed or repudiated;

(c) With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;

(d) The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;

(e) In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

Following the successful implementation of the CSEUR platform, the 28 national registries concerned were re-certified in June 2012 and switched over to their new national registry on 20 June 2012. During the go-live process, all relevant transaction and holdings data were migrated to the CSEUR platform and the individual connections to and from the ITL were re-established for each Party.

The following changes to the national registry of the European community have therefore occurred in 2012, as a consequence of the transition to the CSEUR platform:

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	N/A
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	The EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway have decided to operate their registries in a consolidated manner. The Consolidated System of EU registries was certified on 1 June 2012 and went to production on 20 June 2012. A complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. This description includes: • **Readiness questionnaire** • **Application logging** **Change management procedure** **Disaster recovery** • **Manual Intervention** • **Operational Plan** • **Roles and responsibilities** • **Security Plan** • **Time Validation Plan** • **Version change Management** The documents above are provided as an appendix to this document. A new central service desk was also set up to support the registry administrators of the consolidated system. The new service desk acts as 2nd level of support to the local support provided by the Parties. It also plays a key communication role with the ITL Service Desk with regards notably to connectivity or reconciliation issues.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	In 2012, the EU registry has undergone a major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR). The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission. During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to **successful certification on 1 June2012.**
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	The overall change to a Consolidated System of EU Registries triggered changes the registry software and required new conformance testing. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission. During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES. All tests were executed successfully and lead to successful certification on 1 June 2012,
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated **manual intervention** document and **the operational plan**. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission..
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated **security plan**. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	N/A
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	The new internet address of the European Community registry is: https://ets-registry.webgate.ec.europa.eu/euregistry/EU/index.xhtml
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated **disaster recovery plan.** The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	On 2 October 2012 a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production. The trusted account list adds to the set of security measures available in the CSEUR. This measure prevents any transfer from a holding account to an account that is not trusted.
The previous Annual Review recommendations	N/A

15 INFORMATION ON MINIMIZING ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

15.1 Information on how the EU is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement the commitments mentioned in Article 3, paragraph 1, of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention

Editorial comment: The EU is only required to report changes related to the information on minimizing adverse impacts in accordance with Article 3, paragraph 14. However for an improved understanding, the text from the last year's inventory report was included and updated parts are marked in bold.

In this section the EU provides information on how it is implementing its commitment under Article 3, paragraph 14 of the Kyoto Protocol, i.e. how it is striving to implement its commitment under Article 3, paragraph 1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries. In order to strive for such a minimization, an assessment of potential positive and negative impacts – both of direct and indirect nature - is necessary with a double objective to maximize positive impacts and to minimize adverse impacts. The EU is well aware of the need to assess impacts, and has built up thorough procedures in line with our obligations. This includes bilateral dialogues and different platforms in which we interact with third countries, explain new policy initiatives and receive comments from third countries.

Impacts on third countries are mostly indirect and can frequently neither be directly attributed to a specific EU policy, nor directly measured by the EU in developing countries. Therefore, the reported information covers potential adverse social, environmental and economic impacts that result from complex assessments of indirect influences and that are based on accessible data sources in developing countries.

Impact assessment of EU policies

In the EU a wide-ranging impact assessment system accompanying all new policy initiatives has been established. This regulatory impact assessment is a key element in the development of the Commission's legislative proposals. The Commission is required to take the impact assessment reports into account when taking its decisions, while the impact assessments are also presented and discussed during the scrutiny of legislative proposals from the Council and the Parliament. This approach ensures that potential adverse social, environmental and economic impacts on various stakeholders (in the case on developing country Parties) are identified and minimized within the legislative process. In general, impact assessments are required for all legislative proposals, but also other important Commission initiatives which are likely to have far-reaching impacts. Below the impact assessment process implemented in the EU policy making is explained in more detail in order to better demonstrate how the EU is striving for all strategies and policies to minimize their adverse impacts. Specific guidelines for the impact assessment have been adopted (European Commission 2009).

The Impact Assessment Guidelines specifically address impacts on third countries and also issues related to international relations. In this area the following questions have to be assessed:

- Trade relations with third countries: some policies may affect trade or investment flows between the EU and third countries; the impact assessment should analyse how different groups (foreign and domestic businesses and consumers) are affected, and help to identify options which do not create unnecessary trade barriers.
- Impact on WTO obligations: it should be analysed which impact each proposed policy option has on the international obligations of the EU under the WTO Agreement; the impact assessment should examine whether the policy options concern an area in which international standards exist.
- Impacts on developing countries: initiatives that may affect developing countries should be analysed for their coherence with the objectives of the EU development policy. This includes an analysis of consequences (or spill-overs) in the longer run in areas such as economic, environmental, social or security policies.

Key economic questions to be assessed in relation to third countries are:

- How does the policy initiative affect trade or investment flows between the EU and third countries? How does it affect EU trade policy and its international obligations, including in the WTO?
- Does the option affect specific groups (foreign and domestic businesses and consumers) and if so in what way?
- Does the policy initiative concern an area in which international standards, common regulatory approaches or international regulatory dialogues exist?
- Does it affect EU foreign policy and EU development policy?
- What are the impacts on third countries with which the EU has preferential trade arrangements?
- Does it affect developing countries at different stages of development (least developed and other low-income and middle income countries) in a different manner?
- Does the option impose adjustment costs on developing countries?
- Does the option affect goods or services that are produced or consumed by developing countries?

Key questions on social impacts in third countries are:

- Does the option have a social impact on third countries that would be relevant for overarching EU policies, such as development policy?
- Does it affect international obligations and commitments of the EU arising from e.g. the ACP-EU Partnership Agreement or the Millennium Development Goals?
- Does it increase poverty in developing countries or have an impact on income of the poorest populations?

Key questions on environmental impacts in relation to third countries are:

- Does the option affect the emission of greenhouse gases (e.g. carbon dioxide, methane etc) into the atmosphere?
- Does the option affect the emission of ozone-depleting substances (CFCs, HCFCs etc)?
- Does the option affect our ability to adapt to climate change?
- Does the option have an impact on the environment in third countries that would be relevant for overarching EU policies, such as development policy?

If third countries are likely to be affected, the impact assessment should analyse in greater detail what the specific impacts may be, how undesired effects can be avoided or minimised, or mitigated, how the policy options compare in this respect and what trade-offs have to be addressed in the final policy choice.

Consulting interested parties is an obligation for every impact assessment and all affected stakeholders should be engaged, using the most appropriate timing, format and tools to reach them. Appropriate consultation tools can be consultative committees, expert groups, open hearings, ad hoc meetings, consultation via Internet, questionnaires, focus groups or seminars/workshops. Existing international policy dialogues are also be used to keep third countries fully informed of forthcoming initiatives, and as a means of exchanging information, data and results of preparatory studies with partner countries and other external stakeholders.

The EU's 5th national communication provides a detailed overview of the European policies and measures to mitigate GHG emissions in all sectors; **the 6th national communication, currently under preparation, will update this overview**. All key strategies and climate policies have been subject to impact assessments as described above. All impact assessments and all opinions of the Impact Assessment Board are published online (see **http://ec.europa.eu/governance/impact/ia_carried_out/cia_2012_en.htm**). In addition to the general approach described above to address adverse social, environmental and economic impacts, more specific ways to minimize impacts depend on the respective policies and measures implemented. As the reporting obligation related to Article 3, paragraph 14 does not include an obligation to report on each specific mitigation policy, the EU chooses the approach to provide some specific examples for a more complete overview on the ways how the EU is striving to minimize adverse impacts.

Major EU policies such as the Directive on the promotion of the use of renewable energy (Directive 2009/28/EC and the extension of the EU emission trading scheme (ETS) to the aviation sector (Directive 2008/101/EC) are presented in more detail as examples in this chapter, because the related impact assessments identified potential impacts on third countries. Furthermore, updates of EU policies which should lead to a low carbon and energy efficient economy are also addressed in more detail in the following subchapters

Directive on the promotion of the use of renewable energy - Promotion of biomass and biofuels

The Directive on renewable energy (Directive 2009/28/EC), a part of the EU's climate and energy package, sets ambitious targets for all Member States, such that the EU will reach a 20% share of energy from renewable sources in the overall energy consumption by 2020 (with individual targets for each Member State) and a 10% share of renewable energy specifically in the transport sector, which includes biofuels, biogas, hydrogen and electricity from renewables.

The impact assessments related to enhanced biofuel and biomass use in the EU showed that the cultivation of energy crops have both potential positive and negative impacts. Positively, as the growing of EU demand for bioenergy generates new export revenues and employment opportunities for developing countries and boosts rural economies. Thus there could be clear economic and social benefits. At the same time, the new EU energy crop demand could increase the impact on biodiversity, soil and water resources and can have positive as well as negative effects on air pollutants. The extent of carbon reduction and other environmental effects from the promotion of biofuels can vary according to the feedstock employed, the way the feedstock and the biofuels are produced, how they are transported and how far. Growing future demand for biomass feedstock combined with growing global food consumption could add to the agricultural sector's pressure on land use and result in adverse land use change.

To address the risk of adverse impacts, Article 17 of the EU's Directive on renewable energy sources creates pioneering "sustainability criteria", applicable to all biofuels (biomass used in the transport sector) and bioliquids. The sustainability criteria adopted include:

- establish a threshold for GHG emission reductions that have to be achieved from the use of biofuels;
- exclude the use of biofuels from land with high biodiversity value (primary forest and wooded land, protected areas or highly biodiverse grasslands),
- exclude the use of biofuels from land with high C stocks, such as wetlands, peatlands or continuously forested areas.

Developing country representatives as well as other stakeholder were extensively consulted during the development of the sustainability criteria and preparation of the directive and the extensive consultation process has been documented.

In October 2012 a new Commission proposal was published to limit global land conversion for biofuel production, and raise the climate benefits of biofuels used in the EU (European Comission 2012b). The Commission is therefore proposing to amend the current legislation on biofuels through the Renewable Energy and the Fuel Quality Directives and in particular:

- **To increase the minimum greenhouse gas saving threshold for new installations to 60% in order to improve the efficiency of biofuel production processes as well as discouraging further investments in installations with low greenhouse gas performance.**
- **To include indirect land use change (ILUC) factors in the reporting by fuel suppliers and Member States of greenhouse gas savings of biofuels and bioliquids;**
- **To limit the amount of food crop-based biofuels and bioliquids that can be counted towards the EU's 10% target for renewable energy in the transport sector by 2020, to the current consumption level, 5% up to 2020, while keeping the overall renewable energy and carbon intensity reduction targets;**
- **To provide market incentives for biofuels with no or low indirect land use change emissions, and in particular the 2nd and 3rd generation biofuels produced from feedstock that do not create an additional demand for land, including algae, straw, and various types of waste, as they will contribute more towards the 10% renewable energy in transport target of the Renewable Energy Directive.**

With these new measures, the Commission wants to promote biofuels that help achieving substantial emission cuts, do not directly compete with food and are more sustainable at the same time. While the current proposal does not affect the possibility for Member States to provide financial incentives for biofuels, the Commission considers that in the period after 2020 biofuels should only receive financial support if they lead to substantial greenhouse gas savings and are not produced from crops used for food and feed. The Impact Assessment of the proposal for for a Directive is analysing social, economic and environmental impacts on third countries in detail.

Any negative economic aspects will also be monitored by the Commission. In addition, Article 18(4) of the Directive provides that the EU shall endeavour to conclude bilateral or multilateral agreements with third countries containing provisions on sustainability criteria that correspond to those of this Directive. Where the EU has concluded agreements containing provisions relating to matters covered by the sustainability criteria set out in Article 17(2) to (5), the Commission may decide that those agreements demonstrate that biofuels and bioliquids produced from raw materials cultivated in those countries comply with the sustainability criteria in question.

The Directive also ensures that the Commission will report every two years, in respect to both third countries and Member States which constitute a significant source of biofuels or of raw material for biofuels consumed within the Union, on national measures taken to respect the sustainability criteria for soil, water and air protection. On 27 March 2013, the European Commission published its first Renewable Energy Progress Report (European Commission 2013a) under the framework of the 2009 Renewable Energy Directive, which also includes information on biofuels and bioliquids sustainability criteria. The report and its accompanying staff working document discuss inter alia the origin of biofuel foodstock consumed in the EU, whereby 83% of EU consumed biodiesel in 2010 was produced within the EU and 80% of the EU consumed bioethanol was produced in the EU. In 2010, imports of biodiesel came primarily from Argentina (10%), Indonesia (3%), Malaysia (1%) and China (1%), while Brazil (8%), USA (4%), Peru (1%), Kazakhstan (1%) and Bolivia (1%) were the top five importers of bioethanol. The report states that key export countries (Argentina, Brazil, Indonesia, and Malaysia) have adopted new regulatory measures to improve their environmental practices in biofuels related areas.

Whilst imported mineral oil still constitutes the vast bulk of fuel used in the transport sector, the 4.7% share of biofuels is estimated to have generated 25.5 Mt CO_2eq savings, based on national reporting (22.6 Mt CO_2eq based on the application of global default values), not taking into account indirect land use change effects.

The same report finds that the transposition and implementation of the biofuel sustainability criteria in many Member States is still not complete or correct. The Commission continues to assess Member State progress in implementation of the renewable energy Directive and legal measures are being taken in those cases where the transposition is incomplete.

In addition, the Commission reported on the effects on food prices, on land use rights and on the need for specific measures for air, soil and water protection, all of which concluded that notwithstanding current lack of major issues, future monitoring on these parameters should continue.

The criteria pursuant to Article 17 apply to biofuels and bioliquids, not to solid biomass which is also promoted by the Directive. With regard to the energy use of all biomass forms, Article 17, paragraph 9 of the Directive requires the Commission to report on "*requirements for a sustainability scheme for energy uses of biomass, other than biofuels and bioliquids, by 31 December 2009.*" In 2010, the Commission adopted a report on sustainability requirements for the use of solid biomass and biogas in electricity, heating and cooling together with an impact assessment. The report makes recommendations on sustainability criteria to be used by those Member States that wish to introduce a scheme at national level, in order to avoid obstacles for the functioning of the internal market for biomass.

In addition to the official progress report, the Commission contracted a consortium led by Ecofys to perform support activities concerning the assessment of progress in renewable energy and sustainability of biofuels (Ecofys and consortium 2012). The Ecofys study revealed *inter alia* that:

- In 2010, the use of renewable energy in transport was 4.70%, consisting of:
  - 13.0 Mtoe of sustainable biofuels or 4.27%;
  - 1.3 Mtoe of renewable electricity, or 0.43%;
- Between 2008 and 2010, the volume of biofuels consumed in the EU increased by 39%, whereas the volume of petroleum fuels consumed in road transport decreased with 3.5%;
- The role of the EU in the global biofuel market has remained constant in the last years. The EU remained in 2010 by far the largest producer of biodiesel in the world with 8.5 Mtoe (55% of global market share) compared to global production of 15.5 Mtoe. Brazil and Argentina have significantly increased the production of biodiesel in recent years, whereas the production of biodiesel in the USA decreased by almost more than half compared to 2008. In the rest of the world, bioethanol plays a much larger role. World bioethanol production reached 43.8 Mtoe in 2010, of which only 2.0 Mtoe or 5% were produced in the EU. The USA is the world's largest ethanol producer since 2006 (24,929 Mtoe produced in 2010), followed by Brazil. Net EU trade in the global biofuels market is therefore fairly insignificant;
- The most important feedstock for biodiesel is rapeseed originating from the EU, followed by Argentinean soy, Indonesian and Malaysian palm oil, and rapeseed from Canada and Ukraine. EU-produced biodiesel is partially produced from imported feedstock (palm oil, soy and part of the rapeseed);
- EU-produced bioethanol is mainly produced from EU feedstock, with only small shares of wheat and maize originating from Switzerland, Ukraine and a few other countries. Sugar cane and maize play a role via the bioethanol supplying countries – Brazil and the USA mainly;
- Statistical analysis reveals that the total land use worldwide, to produce the feedstock for EU-consumed biofuels in 2010, is about 5.7 Mha. Of this, 3.2 Mha (57%) is within the EU and 2.4 Mha (43%) resides outside the EU. True valuation of co-products would yield a lower figure;
- In most of the non-EU countries, the land dedicated to the production of feedstock for EU biofuels is less than 1% of the cropland. Notable exceptions are Argentina and Paraguay, where 3% and 4% of the total cropland produces soybean for EU biodiesel in 2010;
- Back-casting scenario analysis of the global agricultural market development clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases from 2007 to 2010, resulting in a wheat and coarse grain price increase of about 1-2%. The impact was more substantial for price increases of non-cereal food commodities by about 4%, notably through its demand for vegetable oil in the production of biodiesel;
- Estimates of the effects of EU biofuels consumption on global employment vary widely and are not often easy to determine. Still, based on on estimates and projections of the Global Renewable Fuels Association global ethanol and biodiesel production supports nearly 1.4 million jobs in all sectors of the global economy in 2010.

The EU's biofuel sustainability criteria form the first global initiative to address the climate change and sustainability issues surrounding crop production.

The biofuels scheme, by imposing environmental standards and requiring high greenhouse gas savings (35% rising to 60%), put also pressure on the production of the raw materials used for other purposes. Some examples of voluntary sustainability scheme out of the biofuels field are in the pipeline.

The recent Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01)[42] sets up a system for certifying sustainable biofuels, including those imported into the EU. It lays down rules that such schemes must

[42] OJ C160, 19.6.2010, p.1

adhere to if they are to be recognized by the Commission. This will ensure that the EU's requirements that biofuels deliver substantial reductions in greenhouse gas emissions and that biofuels do not result from forests, wetlands and nature protection areas.

The European Commission has so far (April 2013) recognised 13 voluntary schemes: International Sustainability and Carbon Certification (ISCC), Bonsucro EU, Round Table on Responsible Soy (RTRS EU RED), Roundtable of Sustainable Biofuels (RSB EU RED), Biomass Biofuels voluntary scheme (2BSvs), Abengoa RED Bioenergy Sustainability Assurance (RSBA), Greenergy Brazilian Bioethanol verification programme, Ensus voluntary scheme under RED for Ensus bioethanol production, Red Tractor Farm Assurance Combinable Crops & Sugar Beet Scheme, SQC (Scottish Quality Farm Assured Combinable Crops (SQC) scheme), Red Cert, NTA 8080 and RSPO RED (Roundtable on Sustainable Palm Oil RED)[43].

In line with Article 19(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources[44] the Commission published in 2010 a report on the feasibility of drawing up lists of areas in third countries with low greenhouse gas emissions from cultivation (COM(2010) 427 final) concluding that, “while desirable, it is not yet feasible to set up legally binding lists of areas for third countries where a major component of the underlying calculation is uncertain and can easily be questioned, and where third countries have had no possibility to contribute on the methodology and data used. It is therefore not appropriate, at least at this stage, to produce legislative lists for third countries based on the current modelling of N_2O emissions from agriculture. However, it is important to enhance the understanding of the topic and survey the data used in view of a new assessment in 2012. The Commission has thus published the preliminary results of the JRC work together with all necessary data and description of methodology to support such a process on the webpage of the JRC. It will use this as the basis for a discussion with third countries in the framework of its dialogue and exchange with them under Article 23(2) of the Renewable Energy Directive.”

Another way the EU will strive to minimize potential adverse impacts of biomass use is to promote second generation biomass technologies. Within the renewable energy Directive, second generation biofuels are promoted through Article 21, paragraph 2 which establishes that the contribution made by biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels for the purposes of demonstrating compliance with national renewable energy targets; and EU research also has a major focus on bioenergy technologies. The goal of second generation biofuel processes is to extend the amount of biofuel that can be produced sustainably by using biomass consisting of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as other crops that are not used for food purposes (non food crops) and also industry waste such as woodchips, skins and pulp from fruit pressing. Second generation biofuels are expected to expand the biomass feedstock available for biofuel production. Further research and impact assessments in this area are necessary to assess e.g. the long-term effects of the energy use of non-food parts of crops compared to their existing use. **The Commission continues the efforts to promote second and third generation biofuels, shifting away from food-crop based fuels. In this light, it recently put forth a proposal to limit to 5% the use of food-based fuels in meeting the EU renewable energy target in transport (see discussion above on Proposal from October 2012).**

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43 http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm

44 OJ L 140, 5.6.2009, p. 16

Inclusion of aviation in the EU emission trading scheme

In 2005 the Commission adopted a Communication entitled "Reducing the Climate Change Impact of Aviation", which evaluated the policy options available to this end and was accompanied by an impact assessment. The impact assessment concluded that, in view of the likely strong future growth in air traffic emissions, further measures are urgently needed. Therefore, the Commission decided to pursue a new market-based approach at EU level and included aviation activities in the EU's scheme for greenhouse gas emission allowance trading. The finally adopted legislation was the result of an extensive stakeholder consultation including an internet consultation and an Aviation Working Group of experts set up as part of the European Climate Change Programme that identified the integration of aviation in the EU ETS as the lowest cost option to address the challenge of reducing emissions from this sector. The impact assessment also specifically addressed the effects on developing countries (European Commission 2006).

Aircraft operators from developing countries will be affected to the extent they operate on routes covered by the scheme. Data from Eurocontrol on the nationality of operators has been used to make an estimate of the aggregated costs for third country airlines from regions that include developing countries. As operators from third countries generally represent a limited share of emissions covered, the impact is also modest. For example, the total additional operating costs according to the impact assessment for all operators based in Africa would, at current activity levels, vary from €2 to €35 million per year depending on allowance prices and the share of allowances auctioned. In terms of the economic impacts, a larger proportion of the compliance costs would naturally be borne by carriers from Annex I countries as they generally have a higher market share on the routes covered. However, carriers from developing countries that are able to operate in competition with Annex I carriers on such routes would need to be covered in order to avoid a) distortions of competition and b) discrimination as to nationality in line with the Chicago Convention.

For carriers with relatively old and inefficient fleets the impact may be higher as the effective proportion of allowances acquired for free through benchmarking is lower. However, as third country airlines would generally only have a fraction of their fleet operating in Europe, they may in some cases be able to reduce any negative effects by shifting their most efficient aircraft to operate on routes covered by the scheme.

To the extent that aviation's inclusion in the EU ETS creates additional demand for credits from JI and CDM projects, there will also be indirect positive effects as such projects imply additional investments in clean technologies in developing countries.

Similarly, additional finance for climate change mitigation and adaptation in developing countries should be raised through the auction of emissions allowances by EU Member States. The legislation provides a list of such areas by which the Member State should use the monies raised, and specifically mentions use for adaptation in developing countries.

The aviation sector joined the EU emissions trading system in January 2012, requiring airlines to hand over emission allowances to cover CO_2 emissions from all domestic and international flights to and from airports in the EU and the EFTA countries, Iceland, Liechtenstein and Norway. In November the Commission proposed deferring the application of the scheme to 2013 for flights to and from countries outside this group (the so-called 'stop-the clock' proposal as a goodwill gesture to allow more time for a global market-based agreement addressing aviation emissions to be reached within the International Civil Aviation Organisation (ICAO) in 2013. The Commission's proposal demonstrates the EU's strong political commitment to facilitate and bring forward the successful conclusion of these ICAO processes. The legislation continues to apply to all flights within and between the 30 European countries.]

A roadmap for moving to a competitive low carbon economy in 2050

In 2011 the Commission released the Communication "A Roadmap for moving to a competitive low carbon economy in 2050" (COM(2011) 112 final) outlining a strategy to meet the long-term target of reducing domestic emissions by 80 to 95% by 2050 as agreed by European Heads of State and governments. The Roadmap shows how the sectors responsible for Europe's emissions - power generation, industry, transport, buildings and construction, as well as agriculture - can make the transition to a low-carbon economy over the coming decades. The transition towards a competitive low-carbon economy means that the EU should prepare for reductions in its domestic emissions by 80% by 2050 compared to 1990. Such a pathway would result in annual reductions compared to 1990 of roughly 1% in the first decade until 2020, 1.5% in the second decade from 2020 until 2030, and 2 % in the last two decades until 2050.

The shift to a resource-efficient and low-carbon economy should be supported by using all resources, decoupling economic growth from resource and energy use, reducing CO_2 emissions, enhancing competitiveness and promoting greater energy security. A low-carbon economy will mean a much greater use of renewable sources of energy, energy-efficient building materials, hybrid and electric cars, 'smart grid' equipment, low-carbon power generation and carbon capture and storage technologies.

Because more locally produced energy would be used in a low-carbon economy, mostly from renewable sources, the EU would be less dependent on imports of oil and gas from outside the EU. On average, the EU could save € 175 - 320 billion annually on fuel costs over the next forty years.

With the shift from fuel expenses (operating costs) to investment expenditure (capital expenditure) in clean technology and clean energy, investments costs will occur in the domestic economy, requiring increased added value and output from a wide range of manufacturing industries (automotive, power generation, industrial and grid equipment, energy–efficient building materials, construction sector etc.), while fuel expenses for fossil fuel imports which are to a large extent flowing to third countries would be reduced.

Green Paper on a 2030 framework for climate and energy policies

In March 2013 the European Commission published a Green Paper with the title "A 2030 framework for climate and energy policies" (COM(2013)169 final) (European Commission 2013b) to reflect on a new 2030 framework for climate and energy policies. The EU has a clear framework to steer its energy and climate policies up to 2020, but providing clarity on a policy framework for 2030 is also needed, giving more certainty to investors, stimulating innovation

and demand for low-carbon technologies and allowing the EU to engage actively in the international negotiations for a new climate agreement.

The 2030 framework should build on the experience and lessons from the current framework. It should also take into account the longer term perspective set out by the Commission in the Roadmap for moving to a competitive low carbon economy in 2050, the Energy Roadmap 2050 and the Transport White Paper.

The Green Paper raises a set of questions: on the main lessons from the 2020 framework; on the type, nature and level of climate and energy targets for 2030; on the coherence between different policy instruments; on competitiveness and security of energy supply; and on distribution of efforts between Member States.

The aim of this Green Paper is to consult stakeholders to obtain evidence and views to support the development of the 2030 framework. The 2030 policy framework should strike a balance between concrete implementing measures at EU level and Member States' flexibility to meet targets in ways which are most appropriate to national circumstances, while being consistent with the internal market.

The consultation on the Green Paper will be open for until 2 July 2013.

Resource Efficient Europe flagship initiative

In 2011 a new initiative “Resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy” was launched (European Commission 2011b). as part of the overall Europe 2020 Strategy for smart, sustainable and inclusive growth. The flagship initiative for a resource-efficient Europe supports the shift towards a resource-efficient, low-carbon economy to achieve sustainable growth. It provides a long-term framework for actions in many policy areas, supporting policy agendas for climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. This is to increase certainty for investment and innovation and to ensure that all relevant policies factor in resource efficiency in a balanced manner. The Communication on the strategy outlines that the EU has a strong interest in deepening cooperation on resource efficiency with international partners and emphasizes its willingness to continue efforts to provide a level playing field for industry, to improve the conditions for sustainable supply of raw materials, and better deployment of green technologies to support the most efficient use of scarce resources globally.

15.2 Information on how the EU gives priority, in implementing the commitments under Article 3, paragraph 14, to specific actions

The EU reports activities that are related to the actions specified in the subparagraphs (a) to (f) of paragraph 24 of the reporting requirements in the Annex to decision 15/CMP.1. However, no decision was agreed yet that these actions form part of the commitment under Article 3, paragraph 14. For some of the actions specified in the reporting requirements, it seems rather unclear how they relate to the minimization of adverse social, environmental and economic impacts resulting from policies and measures to mitigate GHG emissions, e.g. information related to the cooperation activities requested are activities that help both Annex I and Non-Annex I Parties in reducing emissions from fossil fuel technologies, but they do not directly address the minimization of potential adverse impacts in Annex I Parties.

For the purposes of completeness in reporting, the EU addresses all subparagraphs specified in the reporting requirements, however the main ways how the EU is striving to minimize adverse impacts are described in the previous section.

a) The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities

The actions addressed in subparagraph a) also form part of the commitment to implement policies and measures requested under Article 2, paragraph 1(a) (v), however Article 2 specifies that Annex I Parties shall "implement and/or further elaborate policies and measures in accordance with national circumstances, such as progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors that run counter to the objective of the Convention and application of market instruments." Subparagraph a) in the reporting requirements lacks such objective and therefore seems somewhat inconsistent with the commitment under Article 2. The promotion of research, demonstration projects, fiscal incentives or carbon taxes is important instrument to advance the objectives of the Convention, e.g. the use of renewable energies. A progressive reduction of all fiscal incentives or subsidies in all GHG emitting sectors would run counter the objective of the Convention and counter the ability of the EU to meet its commitment under Article 3, paragraph 1 of the Kyoto Protocol. Therefore the EU interprets this reporting requirement in a way consistent with Article 2 paragraph 1(a)(v) that the EU should focus on the progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies that run counter the objectives of the Convention and application of market instruments.

The 2009 Review of the EU Sustainable Development Strategy assesses that *"the Commission has been mainstreaming the progressive reform of environmentally harmful subsidies into its sectoral policies"*. For instance, environmental concerns have been gradually incorporated into the EU Common Agricultural Policy, including "decoupled" direct payments which have replaced price support; environmental cross compliance; a substantial increase in budget for rural development. As part of 2008 Common Agriculture Policy Health Check, additional part of direct aid has been shifted to climate change, renewable energy, water management, biodiversity, innovation; - transparency of agricultural subsidies has improved. It is important to note that in the other areas most subsidies are within the competence of the Member States and not of the EU, within the limits established by EU state aid rules.

EU policies aim to address market imperfections and to reflect externalities. For example the EU has made significant efforts to liberalise the internal energy market and to create a genuine internal market for energy as one of its priority objectives. The existence of a competitive internal energy market is a strategic instrument both in terms of giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, but also in terms of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.

With the implementation of the EU Emissions Trading Scheme, the EU uses a market instrument to implement the objective of the Convention and its commitment under Article 3, paragraph 1 of the Kyoto Protocol which aims at creating the right incentives for forward looking low carbon investment decisions by reinforcing a clear, undistorted and long-term carbon price signal.

With respect to financial support provided by the Member States to undertakings, the EU Treaty pronounces a general prohibition of "State aid". This concept encompasses a broad range of financial support measures adopted at national or sub-national level (i.e. not at EU level), and which can take various forms (subsidies, tax relieves, soft loans…). The Treaty provides for exceptions to this general prohibition. When State aid measures can contribute in an appropriate manner to the furtherance of objectives of common interest for the EU, and provided that they comply with certain strict conditions, they may be authorised by the Commission. By complementing the fundamental rules through a series of legislative acts and guidelines, the EU has established a worldwide unique system of rules under which State aid is monitored and assessed in the European Union. This legal framework is regularly reviewed to improve its efficiency. EU State aid control is an essential component of competition policy and a necessary safeguard for effective competition and free trade.

State aid reform in the EU aims to redirect aid to objectives of common interest which are related to the EU Lisbon Treaty, such as R&D&I, risk capital measures, training, and environmental protection. Environmental protection, and in particular, the promotion of renewable energy and the fight against climate change, is considered one of the objectives of common interest for the EU which may, under certain circumstances, justify the granting of State aid.

Specific “Community Guidelines on State aid for Environmental Protection”[45] have been established. The Guidelines foresee in particular the possibility to authorise the following types of State aid under certain conditions:

- Aid for undertakings which go beyond EU environmental standards or which increase the level of environmental protection in the absence of EU standards
- Aid for early adaptation to future EU standards
- Aid for energy saving
- Aid for renewable energy sources
- Aid for high-efficient cogeneration
- Aid for energy-efficient district heating (DH).

Directive 2003/96/EC on the taxation of energy products and electricity establishes EU-wide rules for the taxation of energy products used as motor or heating fuel, taxes on energy consumption, and common minimum levels of taxation. Under certain conditions the Directive allows for exemptions or reductions to promote renewable sources of energy. Thus, the tax exemptions allowed under this directive further promote the objectives of the Kyoto Protocol.

In June 2012, the Commission adopted Guidelines on certain State aid measures in the context of the EU Emissions Trading System (EU ETS). The Guidelines provide a framework under which Member states may compensate some electro-intensive industries, such as steel and aluminium producers, for part of the higher electricity costs expected to result from the application of the harmonised allocation rules to be applied in the EU ETS as from 2013. The rules, subject to state aid scrutiny, ensure that national support measures are designed in a way that preserves the EU objective of decarbonising the European economy and maintains a level playing field among competitors in the internal market. The sectors deemed eligible for compensation include producers of aluminium, copper, fertilisers, steel,

[45] Official Journal No C 82, 1.4.2008, p.1

paper, cotton, chemicals and some plastics. The Guidelines give a right, not an obligation to provide subsidies to energy intensive industries.

Carbon leakage means that global greenhouse gas emissions increase when companies in the EU shift production outside the EU because they cannot pass on the cost increases induced by the ETS to their customers without a significant loss of market share to third country competitors. Based on the ETS Directive (2003/87/EC as amended by 2009/29/EC), the Commission shall compile a list of sectors and sub-sectors deemed exposed to significant risk of carbon leakage. Sectors on the list will receive a higher share of free allowances. The criteria and thresholds to determine whether a sector is deemed exposed to carbon leakage or not are defined in Article 10a(13-18) of the ETS Directive and focus on additional costs incurred by the ETS Directive and trade intensity. The calculations are based on official Eurostat data and data collected from Member States.

b) Removing subsidies associated with the use of environmentally unsound and unsafe technologies

There is no clear definition of environmentally unsound and unsafe technologies; therefore the EU interprets this provision in the context of the Kyoto Protocol that unsound and unsafe technologies would be those increasing GHG emissions.

The phase-out of subsidies to fossil fuel production and consumption by 2010 was one of the objectives in the Communication from the Commission “A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development (Commission's proposal to the Gothenburg European Council, 2001)”.[46]

Council Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of uncompetitive coal mines adopted a new coal regulation enabling Member States to grant State aid to facilitate the closure of uncompetitive mines until 2018, following the expiry of the current Coal Regulation (Council Regulation (EC) N° 1407/2002 of 23 July 2002) on 31 December 2010. The decision includes the following main elements:

- the possibility of continuing to grant, under certain conditions, public aid to the coal industry with a view to facilitating the closure of uncompetitive hard coal mines until December 2018;
- the modalities for the phasing-out of the aid, under which the overall amount of aid granted by a member state must follow a downward trend, in order to prevent undesirable effects of distortion of competition in the internal market. Subsidies will have to be lowered by at least 25% until 2013, by 40% until 2015, by 60% by 2016 and by 75% by 2017;
- the obligation for member states granting aid to provide a plan on intended measures to mitigate the environmental impact of the production of coal; and
- the possibility of allowing subsidies, until December 2027, in order to cover exceptional expenditure in connection with the closure of mines that are not related to production, such as social welfare benefits and rehabilitation of sites.

[46] See http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0264en01.pdf

c) Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end;

The technological development of non-energy uses of fossil fuels is not a current research priority in the EU, nor a priority of cooperation with developing countries because the EU is not a major producer of oil and gas. Given the long-term depletion of fossil fuel resources and the decline in coal production, the EU's priority in general is the replacement of the use of fossil fuels by renewable resources and the more efficient use of resources.

d) Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort;

In March 2005, the EU and China signed an Action Plan on Clean Coal, which included cooperation on carbon capture and storage. The subsequent 2005 EU-China Summit established the EU-China Climate Change Partnership, which includes a political commitment to develop and demonstrate in China and the EU advanced, near-zero emissions coal (NZEC) technology through carbon capture and storage (CCS) by 2020. Phase I of this cooperation will be completed in 2009. Phase II of NZEC will run from 2010-2012. It will examine the site-specific requirements for and define in detail a demonstration plant and accompanying measures. It will include the technical and cost analysis of different options. Based on this analysis, the site of the power plant as well as the combustion technology (pulverised coal or IGCC), the capture technology and the transport and storage concepts will be determined. Phase II shall also include a detailed roadmap for the construction and operation of the demonstration plant as well as an Environmental Impact Assessment of the demonstration power plant and the carbon storage site. Phase III should commence thereafter and will see the construction and operation of a commercial-scale demonstration plant in China.

The EU is cooperating with other Annex I and Non-Annex I Parties (Australia, Brazil, Canada, China, Colombia, Denmark, France, Germany, Greece, India, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Russian Federation, Saudi Arabia, South Africa, United Arab Emirates, United Kingdom and USA) in the "Carbon Sequestration Leadership Forum (CSLF)". The CSLF is a Ministerial-level international climate change initiative that is focused on the development of improved cost-effective technologies for the separation and capture of carbon dioxide (CO_2) for its transport and long-term safe storage. The mission of the CSLF is to facilitate the development and deployment of such technologies via collaborative efforts that address key technical, economic, and environmental obstacles. The CSLF will also promote awareness and champion legal, regulatory, financial, and institutional environments conducive to such technologies. In 2010 a Technology Roadmap was released by the Carbon Sequestration Leadership Forum. This road map indicates that significant international progress has been made in the past year on advancing carbon capture and storage, but that a number of important challenges remain that must be addressed to achieve widespread commercial deployment of CCS. The 2012 Strategic Plan Implementation Report recognized five new CCS projects bringing the total number of CSLF recognized technology demonstrations to 34, including 24 active projects. A number of meetings and workshops were held in 2012, such as the 2012 CSLF Technical Group Meeting and CO_2 Capture Workshop, CSLF Risk and Liability Workshop, Financing CCS Roundtable held in Paris, Capacity Building Workshops in Mexico City and Capacity Building Courses in Brazil. In 2012 also the final report from CSLF Risk Assessment Task Force was published. 47

e) Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities

In the oil and gas industry the upstream sector is a term commonly used to refer to the exploration, drilling, recovery and production of crude oil and natural gas. The downstream sector includes the activities of refining, distillation, cracking, reforming, blending storage, mixing and shipping and distribution.

The EU contributes to strengthening of the capacities of fossil fuel exporting countries in the areas of energy efficiency via the work of the Energy Expert Group of the Gulf Cooperation Council (GCC)[48], in particular in the working sub-group on energy efficiency. As part of the EU's research programme, a project called "EUROGULF" was launched with the objective of analysing EU-GCC relations with respect to oil and gas issues and proposing new policy initiatives and approaches to enhance cooperation between the two regional groupings.

The European e-network on clean energy technologies, currently under development as part of the EU's research and development, is also aiming at the objective: promote research and technical development of clean energy technologies in the GCC countries. The Commission has recently started a project with the specific objective to create and facilitate the operation of an EU-GCC Clean Energy Network during the next three years. The network is to be set up to act as a catalyst and element of coordination for development of cooperation on clean energy. A website was created at http://www.eugcc-cleanergy.net where further information on the EU-GCC Clean Energy Network and its recent activities can be found. The Masdar Institute of Science and Technology in Abu Dhabi has been selected as the lead research institution to represent the Gulf Cooperation Council (GCC) in the European Union-GCC Clean Energy Network. A number of discussion groups and training seminars took place, e.g. on solar resource assessment. In January 2013, the EU-GCC Energy Cooperation Conference was held in Abu Dhabi, UAE, as a side event of the "World Future Energy Summit- WFES 2013. The presentation by the high-level team of attendees from the GCC and Europe highlighted the achievements in areas of mutual interest for the two regions including renewables, energy efficiency and demand-side management, electricity interconnections, carbon capture and storage, as well as natural gas. Some of the concrete outcomes that were summarized during the sessions include publications, research work/papers, established partnerships between the GCC and EU, co-operation project ideas, targeted working meetings and training workshops.

[47] See http://www.cslforum.org/ for more specific information

[48] The Gulf Cooperation Council covers Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

Energy efficiency activities in the upstream or downstream sector are also candidates for CDM projects. Thus, the development of the CDM under the Kyoto Protocol and the demand of CERs by Annex I Parties under the Kyoto Protocol as well as by operators under the EU ETS have fostered such activities performed by the private sector. Related CDM projects are for example:

- Rang Dong Oil Field Associated Gas Recovery and Utilization Project in Vietnam: The purpose of this project activity is the recovery and utilization of gases produced as a by-product of oil production activities at the Rang Dong oil field in Vietnam with the involvement of ConocoPhillips (UK).
- Recovery of associated gas that would otherwise be flared at Kwale oil-gas processing plant in Nigeria involves the capture and utilisation of the majority of associated gas previously sent to flaring at Kwale OGPP plant. The Kwale OGPP plant receives oil with associated gas from oil fields operated by Eni Nigeria Agip Oil Company.
- Recovery and utilization of associated gas produced as by-product of oil recovery activities at the Al-Shaheen oil field in Qatar
- Flare gas recovery and utilisation project at Uran oil and gas processing plant in India which is handling the oil and gas produced in the Mumbai High offshore oil field.
- Flare gas recovery and utilisation project at Hazira gas and condensate processing plant in India.
- Flare gas recovery and utilisation project from Kumchai oil field in India
- Flare gas recovery and utilisation project at the Ovade-Ogharefe oil field operated by Pan Ocean Oil Corporation in Nigeria
- Flare gas recovery and utilisation project at Soroosh and Nowrooz offshore oil fields in Iran.
- Leak reduction in aboveground gas distribution equipment in the KazTransgaz-Tbilisi gas distribution system in Georgia where leakages at gate stations, pressure regulator stations, valves, fittings as well at connection points with consumers are reduced.
- There are currently 21 Coal Mine Methane Utilization Project in China which use coalmine methane previously released to the atmosphere.

Improved energy efficiency in the energy and the transport sector in a more general way is one of the priorities in the EU's development assistance as well as for the EIB (European Investment Bank) and the EBRD (European Bank for Reconstruction and Development). The EIB has also developed other means of financing, such as equity and carbon funds, to further support renewable energy and energy-efficiency projects (see here GEEREF and the Mediterranean Solar Plan, MSP). Related projects and specific activities can be found for example at http://www.eib.org/projects/topics/environment/renewable-energy/index.htm or http://www.ebrd.com/saf/search.html?type=eia

f) Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.

The EU actively undertakes a large number of activities aiming at reducing dependence on the consumption of fossil fuels, in particular the EU support activities for the promotion of renewable energies and energy efficiency in developing countries contribute to reduction of dependence on fossil fuels, meeting rural electricity needs, and the improvement of air quality. As explained in more detail in chapter 8 of the EU's 5th national communication several support programmes exist in this respect. These include:

- *Renewable energy cooperation with the Mediterranean and Gulf countries*

The major objective of the cooperation between the EU and the Mediterranean and Gulf countries in the field of renewable energy is to contribute to sustainable energy and climate mitigation and to develop an integrated and interconnected 'Green Energy Market'.

Several initiatives are already being developed by the European Union in cooperation with the partners in the Gulf region to boost energy as well as renewable energy development. This includes the EU-GCC (Gulf Cooperation Council) Energy Expert Group, which started working at the beginning of 1990s' and the EU-GCC Climate Change Expert Group that has met on a regular basis since 2007. In 2009 EU and GCC partners agreed on extending energy cooperation and more specifically on establishing an EU-GCC clean energy network thus bringing together the relevant EU and GCC stakeholders. The European Commission supports the establishment of a network of key actors from public and private sectors in the EU and the GCC with a view to deepening cooperate on clean energy. This network will act as a facilitator and identify projects in fields of common interest, such as solar and other renewable energies.

Given the importance of research to further development of renewable energy in the GCC region, the Commission is also contributing to the establishment of a specific large-scale platform to foster international R&D cooperation with partners of the Gulf region.

The expansion and deployment of renewable energy is currently a key element in cooperation between the EU and the Mediterranean countries. The most important initiative is the Mediterranean Solar Plan, endorsed in 2008. The objective is the creation of 20 GW of new generation capacity in solar and other renewable energy sources around the Mediterranean Sea by 2020. The Regional Centre of Excellence for Renewable Energy and Energy Efficiency (RCREEE) facilitates development of renewable energy sources and promotion of energy efficiency measures in the Southern Mediterranean partner countries. Since 2008, when the centre was established in Cairo, the European Union has provided a financial contribution to enable the launch and initial operation of the Centre. Bearing in mind the importance of the infrastructures necessary for deployment and exports of green energy, the EU is contributing to the Maghreb Electricity Market Integration Project (IMME). The objective is to create a sub-regional electricity market between Morocco, Tunisia and Algeria and its progressive integration with the EU's electricity market. The Commission has so far provided a support of €5.6 million. These are only some examples from the cooperation with the Mediterranean countries.

- *Africa, Caribbean and the Pacific (ACP-E) Energy Facility*

The ACP-EU Energy Facility is a contribution under the EU Energy Initiative to increase access to energy services for the poor. The Facility was approved by the joint ACPEU Council of Ministers in June 2005, with an amount of € 220million. The main activity of the Facility is to co-finance projects that deliver energy services to poor rural areas.

The Energy Facility was mainly implemented through a €198 million Call for Proposals which was launched in June 2006. Out of 307 proposals received, 74 projects have been contracted by the end of 2008 for a total amount of €196 million from the Energy Facility, with a total project cost of €430 million. Since 2008, the Facility has financed around 140 national and cross-border projects in ACP countries for about EUR 300 Million. Almost 13 Million people should benefit of an improved access to energy mostly utilising Renewable Energy technologies.

The main activities performed through Energy Facility projects can be classified into three different groups: (1) energy production, transformation and distribution, (2) extension of existing electricity grids and (3) "soft" activities such as governance, capacity building or feasibility studies. The sources of energy used for electricity generation were mainly renewable energies (77 % of the projects). Only one project using exclusively fossil fuels was funded. In total, € 81 million of commitments have been marked as climate change related under the Energy Facility, covering support to enhance use of renewable energies or increase energy efficiency. A replenishment of the ACP-EU Energy Facility has been decided under the 10th European Development Fund for the period of 2009-2013. Endowed with € 200 Million, it will focus on improving access to safe and sustainable energy services in rural and peri-urban areas. The new Energy Facility will also contribute to the fight against climate change by emphasizing the use of renewable energy sources and energy efficiency measures and by taking into account impacts of climate change on energy systems. The new Facility started being implemented by the end of 2009 and funding guidelines were approved in October 2010. **The Second Call for Proposals of the Energy Facility with a budget of EUR 55 million has been launched. The deadline for submission of Concept Notes and Full Applications is 03/06/2013. The second ACP-EU Energy Facility is one of the instruments implementing the Africa-EU Energy Partnership, which is part of the 2011-2013 Joint Africa-EU Strategy. A specific website for the monitoring of the ACP-EU Energy Facility was created under http://www.energyfacilitymonitoring.eu/.**

- *Latin America Investment Facility (LAIF)*
  The European Commission **also** establish**ed** the Latin America Investment Facility (LAIF). The European Commission has foreseen an amount of € 125 million for the period 2009-2013. The LAIF focuses on energy, environment and transport investment, contributing to cleaner transport infrastructure, improved energy efficiency and energy savings, the use of renewable energy, low-carbon production and of climate change adaptation technologies. The LAIF will operate by providing financial non-refundable contributions to support loans to partner countries from the European Investment Bank (EIB) and other European, multilateral and national, development finance institutions and will encourage the beneficiary governments and public institutions to carry out essential investments in the relevant sectors. The contribution of the Commission to the LAIF will be decided annually. In 2010 a commitment of € 34.85 million was available for grants. In 2011, additional € 40 million were approved.

- *Global Energy Efficiency and Renewable Energy Fund (GEEREF)*
  The European Commission has launched an innovative pilot instrument to involve the private sector. The Global Energy Efficiency and Renewable Energy Fund (GEEREF), launched in 2007, is focused on energy efficiency and renewable energy projects in developing countries and economies in transition. GEEREF invests in regionally-oriented investment schemes and prioritises small investments below €10 million. It particularly focuses on serving the needs of the ACP, which is a group of 79 African, Caribbean and Pacific developing countries. It also invests in Latin America, Asia and neighbouring states of the EU (except for Candidate Countries). Priority is given to investment in countries with policies and regulatory frameworks on energy efficiency and renewable energy.:

• €12.5 million investment in Berkeley Energy's Renewable Energy Asia Fund (REAF) for operationally and economically mature wind, hydro, solar, biomass, geothermal and methane recovery projects in India, Philippines, Bangladesh and Nepal.

- €10 million investment in the Evolution One Fund, dedicated to clean energy investment in Southern Africa (SADC countries).

- Furthermore, GEEREF invested €12.5 million in the Clean Tech Latin American Fund (CTLAF II), where the main objective is focused on the areas of renewable energy and clean technologies The CTLAF II is a capital fund investing in private companies and was established as the continued success of Cleantech Fund (I) which is now fully made available. The main geographic focus is Mexico, Brazil, Chile, Peru and Colombia and more information is available http://www.emergingenergy.com/).

- A new Fund called DI Frontier Market Energy and Carbon Fund ("DI") under the GEEREF package committed € 10 million. The main distinguishing feature is an integrated approach to project development, investment, and carbon trade. The Fund has a focus on Eastern and Southern Africa. Core focus countries include: Kenya, Mozambique, Tanzania, Uganda and Zambia. (more information is available under http://www.frontier.dk/).

- Armstrong Asset Management receives commitment of Euro 10 million from GEEREF for their South East Asia Clean Energy Fund.

In the regions where the two funds operate, there is a lack of equity investment available through the market for these types of projects. It is envisaged that GEEREF will invest in regional sub-funds for the African, Caribbean and Pacific (ACP) region, Neighbourhood, Latin America and Asia. Together the European Commission, Germany and Norway have committed about €**112** million to the GEEREF over the period 2009-2013, the majority of which is provided by from the EU budget. It is envisaged that further financing from other public and private sources will be forthcoming. GEEREF will fundraise in 2013 to bring the total funds under management above €200 million. The target funding size for GEEREF is €200-250 million and as of March 2013, GEEREF has secured a total of €112 million.

The EU through Directorate General Development and Cooperation - EuropeAid also supports African, Carribean and Pacific countries in diversifying their economies; however, these activities are not limited to fossil fuel exporting countries, but are open to ACP countries based on Economic partnership agreements (EPAs). EPAs help ACP countries integrate into the global economy and improve the business environment, build up regional markets and promote good economic governance through reinforced regional cooperation in trade related issues. In 2008 the EU signed a comprehensive EPA with 13 CARIFORUM countries. **In January 2009, Côte d'Ivoire and Cameroon have signed interim EPAs.** Some ACP partners have signed interim economic partnership agreements with the EU as a first step towards comprehensive regional EPAs. The interim agreements secure and improve ACP access to the EU market and provide for more favourable rules of origin. Negotiations are ongoing with the African and Pacific regions to move from interim agreements to comprehensive regional agreements. The negotiations cover regional trade integration, trade in services, investment and trade-related rules. The strategy for private sector development in the ACP recommends the use of horizontal instruments (applicable to all ACP countries) in five priority areas where the Commission has a good experience and comparative advantages:

(1) Improvement of the macroeconomic framework and regulatory environment for enterprise development (Private Sector Enabling Environment Facility of the Business Environment (PSEEF) or BizClim with €20 million for 5 years);

(2) Investment and inter-enterprise co-operation promotion activities (PROINVEST - €110 million for 7 years);

(3) Facilitation of investment financing and development of financial markets (Investment Facility managed by the European Investment Bank (EIB) as revolving fund with €3,137 billion, completed by the EIB own resources with €2 billion for 2008-2013 and financial envelope of €400 million for the interest subsidies and technical assistance);

(4) Support for Small and Medium- sized Enterprises in the form of non-financial services (Centre for the Development of Enterprise (CDE) with €18 million per year, PROINVEST);

(5) Support for micro-enterprises and micro-finance (ACP-EU Microfinance Framework Programme with €15 million for 6 years, in collaboration with Consultative Group to Assist the Poor program (CGAP) and investment in debt and equity for banks and microfinance institutions provided by the EIB Investment Facility).

More specific information related to these activities can be obtained at: http://ec.europa.eu/europeaid/what/development-policies/intervention-areas/epas/epas_en.htm

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http://ec.europa.eu/energy/renewables/reports/doc/swd_2013_0102_res_en.pdf

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http://ec.europa.eu/energy/consultations/20130702_green_paper_2030_en.htm**.**

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PART 3: ANNUAL INVENTORY SUBMISSION (EU-27)

16 INTRODUCTION

This part of the EU GHG inventory report includes data for the EU-27 Member States. The EU-27 Member States are (new MS are marked with n): Austria, Belgium, Bulgaria (n), Cyprus (n), the Czech Republic (n), Denmark, Estonia (n), Finland, France, Germany, Greece, Hungary (n), Ireland, Italy, Latvia (n), Lithuania (n), Luxembourg, Malta (n), the Netherlands, Poland (n), Portugal, Romania (n), Slovakia (n), Slovenia (n), Spain, Sweden and the United Kingdom. As the relevant information for the EU-15 Member States was given in part 1 of this report, this part provides information for the 12 new Member States. The relevant tables for the new Member States are included in this part as well as more detailed information on the 20 largest key categories. The general description of institutional arrangements at EU level are also included in part 1.

16.1 Institutional arrangements and inventory preparation

Table 16.1 shows the main institutions and persons involved in the compilation and submission of the new Member States' inventories.

Table 16.1 **List of institutions and experts responsible for the compilation of new Member States' inventories and for the preparation of the EU inventory**

Member State/EU institution	Contact address
Bulgaria	Detelina Petrova Executive Environment Agency 136, Tzar Boris III Blvd. 1618 Sofia
Cyprus	Theodoulos Mesimeris Head of Climate Action Unit Department of Environment Ministry of Agriculture, Natural Resources and Environment 1498, Nicosia, Cyprus
Czech Republic	Ondrej Minovsky Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Estonia	Karin Radiko Ministry of the Environment Narva mnt 7a, 15172 Tallinn, Estonia Anne Mändmets Ministry of the Environment Narva mnt 7a 15172 Tallinn, Estonia
Hungary	László Gáspár Ministry of Environment and Water, department of Climate Policy Fõ u. 44-50, Budapest, 1011 Hungary
Latvia	Agita Gancone Ministry of Environmental Protection and Regional Development Peldu street 25, LV-149
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
Malta	Krista Rizzo Malta Resources Authority – Climate Change Unit Millennia, 2nd Floor, Aldo Moro Road, Marsa MRS 9065, Malta.
Poland	Anna Olecka National Centre for Emissions Management Institute of Environmental Protection - National Research Institute

Member State/EU institution	Contact address
	Chmielna 132/134, 00-805 Warszawa, PL
Romania	Sorin Deaconu National Environmental Protection Agency Splaiul Independentei 294, Sector 6, Cod Postal 060841, Bucharest, Romania
Slovakia	Janka Szemesova Department of Emissions, Slovak Hydrometeorological Institute Jeseniova 17, 833 15 Bratislava, Slovak Republic
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SI-1000 Ljubljana

Table 16.2 summarises the information on national systems/institutional arrangements in the new EU Member States.

Table 16.2 Summaries of institutional arrangements/national systems of new Member States

MS	Institutional arrangements/national systems	Source
Bulgaria	The Bulgarian National Inventory System (BGNIS) is developed following the requirements of the provisions of Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol. The BGNIS has been enshrined in law through a special Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010. The new regulation establishes and maintain the institutional, legal and procedural arrangements necessary to perform the general and specific functions of BGNIS, defined in Decision 19/CMP.1. The new regulation reinforces the existing institutional agreements by specifying the roles of all data providers. Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The Bulgarian Government by MoEW has the political responsibility for compliance with commitments under the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol: • National Focal Point; • QA exeperts from Climate Change Policy Directorate and Air Protection Directorate; • Approval of inventory; • Submission of CRF / NIR / Kyoto Tables / SEF. The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory: • acts as National Inventory Compiler (supervises inventory preparation process); • manages BGNIS; • compiles CRF tables and NIR; • coordinates the work of engaged consultants for supporting inventory; • coordinates and implements the activity of National QA/QC Plan; • National Inventory Focal Point. The ExEA coordinates all activities, related to collecting inventory data of GHG emissions by the following authorities: 1. National Statistics Institute (NSI); 2. Ministry of Agriculture and Food (MAF) and their relevant services (Agrostatistic Directorate and Executive Forestry Agency); 3. Ministry of Economy, Energy and Tourism (MEET); 4. Ministry of Interior (MI); 5. Ministry of Environment and Water (MoEW); 6. Ministry of Transport, Information Technologies and Communications (MTITC). Other arrangement of the Bulgarian National Inventory System 7. Large industrial plants; 8. Branch Business Associations	Short NIR of GHG emissions in Republic Bulgaria 1988-2011 Jan 2013 pp 2 ff.

MS	Institutional arrangements/national systems	Source
Cyprus	The Ministry of Agriculture, Natural Resources and Environment (MANRE) is the governmental body responsible for the development and implementation of the majority of the environmental policy in Cyprus. Moreover, the MANRE is responsible for the co-ordination of all involved ministries, as well as any relevant public or private organisation, in relation to the implementation of the provisions of the European legislation associated with climate change. In this context, the MANRE has the overall responsibility for the national GHG inventory, and the official preparation and approval of the inventory prior to its submission.. Figure 1.1 provides an overview of the organisational structure of the National Inventory System. The entities participating in it are: • The MANRE designated as the national entity responsible for the national inventory, which keeps the overall responsibility, plays an active role in the inventory planning, preparation and management, and also compiles the annual inventory. • Governmental ministries and agencies through their appointed focal persons, ensure the data provision. No legal framework is available defining the roles-responsibilities and the co-operation between the MANRE and contact points of the involved ministries and agencies.	National GHG Inventory Report 1990-2011 2013 Submission Jan 2013, p 5
Czech Republic	The arrangement of institutions co-operating in the national GHG inventory is given by National Inventory System - NIS, which was established in accord with Decision 280/2004/EC, Article 4.4. This system accepted the rules from Resolution 20/CP.7 (FCCC/CP/13/Add.3) that was approved by COP/MOP-1 in Montreal, December 2005. The relevant information is given in the Czech Republic's Initial Report under the Kyoto Protocol, which was sent to European Commission (June 2006) and to UNFCCC (October 2006) In the Czech Republic, the Ministry of the Environment (MoE) is the national entity with overall responsibility for the NIS. The Czech Hydrometeorological Institute (CHMI), founded by the MoE, is designated as the coordinating and managing organisation responsible for the compilation of the national greenhouse gas inventory and reporting its results. In addition, the MoE provides additional specific financial resources for the NIS performance to the CHMI. The representative of CHMI for the NIS is Mr. Pavel Fott (fott@chmi.cz). The main roles and responsibilities of the CHMI are: inventory management, general and cross-cutting issues, QA/QC, reporting data (CRF), preparation of NIR, communication with the relevant UN FCCC and EU bodies, etc. Sectoral inventories are prepared by specialized institutions (sectoral compilers), which are coordinated and controlled by the CHMI. The responsibilities for the GHG inventory compilation from individual sectors are allocated as follows: • KONEKO marketing, Ltd. (KONEKO), with responsibility for the inventory compilation in the Energy sector, in particular for stationary sources and fugitive emissions; • The Transport Research Centre (CDV), with responsibility for the inventory compilation in the Energy sector, in particular for mobile sources; • The Czech Hydrometeorological Institute (CHMI), with responsibility for the inventory compilation in the Industrial Processes and Product Use sectors; • The Institute of Forest Ecosystem Research (IFER), with responsibility for the inventory compilation in the Agriculture and Land Use, Land Use Change and Forestry sectors; • Charles University Environment Centre (CUEC), with responsibility for the inventory compilation in the Waste sector. The official submission of the National GHG Inventory is prepared by the CHMI and approved by the MoE. Moreover, the MoE secures contacts with other relevant governmental bodies, such as the Czech Statistical Office (CSO), the Ministry of Industry and Trade (MoIT) and the Ministry of Agriculture (MoA).	National GHG Inventory Report 2011 of the Czech Republik Jan 2011 pp 5-6 No change with regard to previous submission

MS	Institutional arrangements/national systems	Source
Estonia	Single national entity with overall responsibility for the Estonian greenhouse gas inventory is MoE. The inventory is produced in collaboration between the MoE, EERC, EEIC and TUT. The MoE is responsible for: ☐Coordinating the overall inventory preparation process; ☐Approving the inventory before official submission to the UNFCCC; ☐Reporting the greenhouse gas inventory to the UNFCCC, including the National Inventory Report and CRF tables; ☐Concluding the formal agreements with inventory compiler (EERC); ☐Coordinating the cooperative work between the inventory compilers and UNFCCC Secretariat; ☐Informing the inventory compilers about the requirements of the national system and ensuring that existing information in national institutions is considered and used in the inventory where appropriate; ☐Informing the inventory compilers about new or revised guidelines; ☐Coordinating the UNFCCC inventory reviews. Climate Department in EERC is responsible for: ☐Compiling the National Inventory Report according to the parts submitted by the inventory compilers; ☐Coordinating of the implementation of the QA/QC plan; ☐Coordinating the inventory process; ☐Preparation of the UNFCCC inventory reviews and coordinating the communication with the expert review team, including responses to the review findings; ☐Overall archiving system. The EERC is responsible for preparing the estimates of Energy, Industrial Processes, Solvents and Other Product Use, Agriculture and Waste sectors. EERC has signed a contract agreement with the Department of Chemistry at TUT for preparing the estimates of Agriculture sector. Department of the National Forest Inventory at EEIC is responsible for the LULUCF and KP LULUCF sectors. All experts collect activity data, calculate emissions, prepare relevant QC, fill in the sectoral data to the CRF Reporter and prepare sectoral parts of the NIR. They also have archiving system for the sectors that they are working with.	Greenhouse Gas Emissions in Estonia 1990-2011 Jan 2013 p 20ff

MS	Institutional arrangements/national systems	Source
Hungary	The minister responsible for the environment has overall responsibility for the Hungarian Greenhouse Gas Inventory and the Hungarian National System for Climate Reporting. He is responsible for the institutional, legal and procedural arrangements for the national system and the strategic development of the national inventory. Since the Ministry of Environment and Water had been abolished after the elections in spring 2010, and its tasks have been taken over by the Ministry of Rural Development, the designated single national entity is now the Ministry of Rural Development. As a new feature, the national system has to be operated by the minister responsible for the environment like earlier but, as prescribed by legislation, in consent and cooperation with the ministers responsible for energy policy and forest management. Within the Ministry of National Development, i.e. the ministry responsible for energy policy, a Climate Policy Department has been established that plays some coordinating and supervisory role in the national system. The head of this department is Hungary's current UNFCCC Focal Point. At the end of 2006, a Greenhouse Gas Inventory Division (GHG division) was established in the Hungarian Meteorological Service (OMSZ) for the preparation and development of the inventory. This division is responsible for all inventory related tasks, compiles the greenhouse gas inventories and other reports with the involvement of external institutions and experts on a contractual basis and supervises the maintenance of the system. At the very end of 2009, a new government decree on data provision relating to GHG emissions was put into force. This decree confirmed the designation of the Hungarian Meteorological Service as the compiler institute. As a new element, the participation of the Forestry Directorate of the National Food Chain Safety Office (NFCS, Forestry Directorate, formerly known as Central Agricultural Office) together with the Forest Research Institute is formalized by this decree. These two institutes are responsible for the forestry part of the LULUCF sector and for the supplementary reporting on LULUCF activities under Articles 3.3 and 3.4 of the Kyoto Protocol by making recommendations to HMS of the content of the inventory. The Hungarian Meteorological Service is a central office under the control of the Ministry of Rural Development. The duties of the Service are specified in a Government Decree from 2005. The financial background of operation is determined in the Finances Act. OMSZ has introduced the quality management system ISO 9001:2000 for the whole range of its activities in 2002 to fulfill its tasks more reliably and for the better satisfaction of its partners. The GHG Inventory Division functions as part of the Climate and Atmospheric Environment Department. The GHG division of the Hungarian Meteorological Service coordinates the work with other involved ministries, government agencies, consultants, universities and companies in order to be able to draw up the yearly inventory report and other reports to the UNFCCC and the European Commission. The GHG division can be regarded as a core expert team of four people. The division of labor and the sectoral responsibilities within the team are laid down in the QA/QC plan and other official documents of OMSZ. The Head of Division coordinates the teamwork and organizes the cooperation with other institutions involved in inventory preparations. He is responsible for the compilation of CRF tables and NIR. Within the team the experts are responsible for different sectors. Besides, a QA/QC coordinator and an archive manager have been nominated. Some parts of the inventory (mainly energy, industrial processes and waste) are prepared by the experts of the GHG division themselves. The calculations of agriculture and LULUCF (except forestry) sector are compiled by the HMS with contribution of external experts / institutions on contractual basis as follows. The forestry related parts are compiled by the Forestry Directorate of the National Food Chain Safety Office and the Forest Research Institute as laid down by the above mentioned government decree. For the calculation of emissions from agricultural soils the Karcag Research Institute of University of Debrecen (Department of Soil Utilization and Rural Development) was contracted like in the last three years. The Research Institute for Animal Breeding and Nutrition had been heavily involved in the calculations for the agriculture sector of the inventory for several years.	National Inventory Report for 1985-2011, Hungary (Draft Excerpts) Jan 2013 pp 11-12

MS	Institutional arrangements/national systems	Source
Latvia	Ministry of the Environmental Protection and Regional Development of the Republic of Latvia (MEPRD) Climate Policy and Technology Department coordinate policy related to climate change and renewable energy in Latvia as well as are designated single national entity with overall responsibility for the Latvian GHG inventory. The MEPRD is responsible for: •Preparation of legal basis for maintaining the National System; •Informing the inventory compilers about requirements of the national system; • Overall coordination of GHG inventory process (including compilation of the final NIR and CRF, approval of QA/QC plan and procedures); •Final checking and approving of the GHG inventory before official submission to the EC and UNFCCC; •Timely submission of GHG inventory to the UNFCCC and Europen Commission; •Formal agreements with inventory experts and for experts that evaluate quality assurance process; • Coordinating the work between the involved institutions, experts, Europen Commission and UNFCCC (including coordination of the UNFCCC inventory reviews); •Keeping of archive of official submissions to UNFCCC and Europen Commission (starting from 2012 submission). Since 1st of August 2009 Latvian Environment, Geology and Meteorology Centre (LEGMC) is a governmental limited liability company and is responsible for collecting of activity data (activity data are mainly collected from other institutions and LEGMC uses them to calculate emissions), preparation of the emission estimates for the Energy, Industrial Processes, Solvent and Other Product use and Waste sectors, preparation of QC procedures for relevant categories and documentation and archiving of used materials for emission calculation. Since submission 2009, removals and emission calculations for the LULUCF sector were done by Latvian State Forest Research Institute "Silava" in collaboration with MoA. "Silava" is responsible for collecting of activity data, preparation of the removals/emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. Since submission 2009, Institute of Physical Energetic (IPE) calculates emissions for Transport sector according to agreement with MEPRD. IPE is responsible for collecting of activity data, preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. For submission 2012, emissions from Agriculture sector were done by Latvia's University of Agriculture in collaboration with MoA. Latvia's Agriculture University is responsible for collecting of necessary activity data (cooperating with CSB), preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. The main data supplier for the Latvian GHG inventory is the Central Statistical Bureau of Latvia (CSB). Mainly MEPRD, LEGMC, IPE, Latvia's University of Agriculture contacted with five CSB experts.	Latvia's National Inventory Report 1990-2010 Mar 2012 p 25ff.
Lithuania	The main entities participating in GHG inventory process are: - Ministry of Environment - Environmental Protection Agency - State Forestry Service - National Climate Change Committee - Permanent GHG inventory working group - Data providers - External consultants The Ministry of Environment is responsible for: • Overall coordination of GHG inventory process; • Preparation of legal basis necessary for National System functioning; • An official consideration and approval of GHG inventory; • Approval of QA/QC plan and procedures; • Timely submission of GHG inventory to UNFCCC Secretariat and European Commission; • Coordination of the UNFCCC inventory reviews in Lithuania; • Keeping of archive of official submissions to UNFCCC and European Commission; • Informing the inventory compilers about relevant requirements for the national system. Before final submission to the UNFCCC Secretariat and the European Commission, National Inventory Report is forwarded to the National Climate Change Committee for the comments and final approval. The National Committee on Climate Change was set up in 2001 in the first instance and renewed in April 2010. It consists of experts from government, academia and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to ensure attainment of the goals related to the restriction of GHG emissions as set in the National Sustainable Development Strategy and implementation of the measures for attaining such goals.	Draft National GHG Emission Inventory Report 2012 of the Republic of Lithuania (Reported Inventory 1990 – 2010) Jan 2012 p10 ff.

MS	Institutional arrangements/national systems	Source
Malta	From 2010 (monitoring year 2009) the Malta Resources Authority (MRA) is the authority entrusted with the role of compiling national greenhouse gas emission inventories, with the National Emissions Inventory Team within the Climate Change Unit at MRA being delegated the main responsibility for managing the inventory compilation system and for preparing the relevant submissions. The National Emissions Inventory System Team is responsible for all functions of the inventory system, from data collection, through data management, to the preparation and submission of reports. Activity data used for the preparation of this inventory was obtained from Malta's past GHG inventory compilation, the National Statistics Office, government entities (ministries, departments), other public bodies such as regulatory authorities, private establishments and published reports.	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2009 Jan 2011 pp 5-7
Poland	The legal base for aligning the institutional base for preparation of the Polish GHG inventories constitutes the Act of 17 July 2009 on the System to Manage the Emissions of Greenhouse gases and Other Substances. The same Act created the National Centre for Emissions Management (KOBIZE) in the Institute of Environmental Protection – National Research Institute in Warsaw and described the tasks related to GHG inventories for national and international purposes. The Minister of Environment supervises the tasks carried out by KOBiZE. The emission calculation, choices of activity data, emission factors and methodology are performed by KOBiZE. KOBiZE is collaborating with a number of individual experts as well as institutions when compiling inventories. Among the latter are: Central Statistical Office (GUS), Agency of Energy Market (ARE), Institute of Ecology of Industrial Areas in Katowice (IETU), Motor Transport Institute (ITS) as well as Office for Forest Planning and Management (BULGiL). These institutions are mainly involved in providing activity data for inventory estimates. The KOBIZE experts have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This ensures availability of data for major sources in emissions from stationary combustion sectors (1.A.1, 1.A.2) as well as from specific industrial processes. Such data are successively included into GHG inventory where possible after verification. Prior to submission the elaborated inventories undergo internal process for the official consideration and approval. .	Information based on Poland,s National Inventory Report 2011 March 2011

MS	Institutional arrangements/national systems	Source
Romania	The Governmental Decision (GD) no. 668/2012 for modifying and completing the GD no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks (NS), adopted in 2007, and the subsequent relevant procedures (procedure on processing, archiving and storage of the Greenhouse Gas Inventory (GHGI) data, procedure on reporting the GHGI and the responses to the observations/questions following the GHGI review, GHGI quality assurance and quality control plan and the procedure on the selection of the methods and emission factors needed for the estimation of the GHG emissions level) are regulating all the institutional, legal and procedural aspects for supporting the Romanian authorities to estimate the greenhouse gas emissions/removals levels, to report and to archive the National GHGI (NGHGI) information, including supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol (KP). The main objective of the Governmental Decision is to ensure the fulfillment of the relevant provisions and the obligations of Romania under the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the European Community legislation. The elements characterizing the institutional arrangements comprise: • according to the Governmental Decision no. 1570/2007 as ulteriorly modified and completed, the single national entity with overall responsibility for the national inventory, including with the responsibilities of administrating the NS and of preparation and management of the NGHGI, is the National Environmental Protection Agency (NEPA), organization under the subordination of the Ministry of Environment and Forests (MEF); • central and territorial public authorities, research and development institutes and other public organizations under the authority, in the subordination or in the coordination of central public authorities, owners and professional associations, economic operators and other relevant organizations have the obligation of providing to NEPA the necessary activity data, emission factors and associated uncertainty data; • the main activity data supplier is the National Institute for Statistics through the yearly-published documents as the National Statistical Yearbook and the Energy Balance and other documents • the characteristics of the institutional arrangements include: - centralized approach – NEPA maintain a large degree of control and decision making authority over the inventory preparation process; - in-sourced approach, in majority – the major part of the inventory is prepared by NEPA (governmental agency); - single agency – the single national entity is housed within a single governmental agency; - separate approach – the NGHGI related work is not integrated with other air pollutant inventories work; however, cross checking activities are periodically implemented. • the Ministry of Environment and Forests officially considers, approves and submits the National GHGI to the UNFCCC Secretariat, the European Commission and the European Environment Agency taking into account the specific deadlines.	Information pursuant Article 4.1 (a) of Decision 166/2005/EC Institutional arrangements Jan 2013 p 1ff

MS	Institutional arrangements/national systems	Source
Slovakia	The revised National Inventory Report 2011 dated on August 2011 reports the changes in the institutional arrangement, quality assurance/quality control plan and planned improvements in the NIS. Organisational changes in relation to the National Inventory System of Slovakia: • Rearrangement of the National Focal Point to the UNFCCC at the Ministry of Environment: In June 2011 a brand new division focused on climate change tasks was established within the organizational structure of the Ministry of the Environment. Specific Climate Change Policy Department serving also as the national Focal Point to the UNFCCC (Director Helena Princova) is now part of the Division of Climate Change and Economic Instruments, which also comprises Emission Trading Department and Department of Economic Instruments and Analyses. These changes increased importance of climate change policy as a whole in the context of environmental policy in the Slovak Republic. • Establishment of the High Level Committee on Coordination of Climate Change Policy: According to the Governmental Resolution No. 821/2011 from 19 December 2011, the High-level Committee on Coordination of Climate Change Policy (CCCP) was established. This Committee is created at the state secretary level and will replace previous co-ordinating body, i.e the High Level Committee on Climate-Energy Package established in August 2008. Main objectives of proposed close co-operation is to achieve all national and international goals in tackling climate change and adaptation in more efficient way and to increase all potential benefits from this effort. According to the Governmental decision No. 821/2011 the Committee will play an important role also in process of adopting new policies and measures (if necessary) based on information from the latest GHG emission inventory. • Rearrangement of the Single National Entity for the NIS SR During the process of changes in the organizational structure of SHMU (to increase efficiency and to save financial resources) the Department of Emissions was merged with the Department of Air Quality on 1 December 2010. The new unit is named the Department of Emissions and Air Quality Monitoring and serves also as the Single National Entity while providing all activities connected with coordination of the National Inventory System for the KP under the Article 5.1. This change has had no practical impact on the function of the SNE. SNE was officially appointed by the decision of the Director General of the SHMU in August 2011. It currently comprises 2.5 experts working on inventory tasks as a full time job. Composition of SNE is: NIS Coordinator, Deputy NIS Coordinator and Quality Manager. • Continuing the cooperation with the Ministry of Agriculture and Rural Development and National Forest Centre in Zvolen for KP requirements: A sectoral expert for LULUCF cooperates with National Forest Centre in Zvolen especially for Kyoto Protocol reporting requirements under Article 3.3. The cooperation will also continue in 2012. Unlike the previous period, Ministry of Agriculture and Rural Development will directly guarantee for some of activities under the reporting obligation for the LULUCF sector in the year 2012 on the basis of contract with the National Forest Centre and approved budget.	Slovak Republic Annual Report 2012 Jan 2012 p 15 f

MS	Institutional arrangements/national systems	Source
Slovenia	In Slovenia, the institution responsible for GHG inventories is the Environmental Agency of the Republic of Slovenia. In accordance with its tasks and obligations to international institutions, the Environmental Agency is charged with making inventories of GHG emissions, as well as emissions that are defined in the Convention on Long Range Transboundary Air Pollution within the specified time limit. In making the inventories, the Environmental Agency cooperates with numerous other institutions and administrative bodies which relay the necessary activity data and other necessary data for the inventories. The chief sources of data are the Statistical Office of the Republic of Slovenia (SORS) and the Ministry of Environment and Spatial Planning; however, the Environmental Agency obtains much of its data through other activities which it performs under the Environmental Protection Act. Emissions from Agriculture are calculated in cooperation with the Slovenian Agriculture Institute (KIS), and sinks in the LULUCF sector are calculated by the Slovenian Forestry Institute (GIS). A Memorandum of Understanding has been concluded with institutions that participate in inventory preparation, binding these institutions to submit quality and verified data to the Environmental Agency in due time, because the time limits for inventories and the NIR have shortened with the entry of Slovenia into the EU, since inventories and part of the NIR for the year before last must be made by 15 January, and with corrections and final submission of the NIR by 15 March. In view of this, an agreement has been reached with the participating institutions to shorten the time limits for submitting data. For reasons of complexity, attention was mostly focused on the Joint Questionnaires of the Statistical Office of the Republic of Slovenia, on the basis of which the Statistical Office produces the Energy Balance of the Republic of Slovenia, wherein the most important data on the energy sector are to be found. Experts from the Slovenian Forestry Institute and the Agricultural Institute of Slovenia work on GHG inventories according to the standing rules of institutes (ordinance). Financing is assured by governmental institutions according to the yearly work plan. All data from external institutions are submitted to the Environmental Agency, where they are archived. The detailed process from gathering data to emissions calculation and reporting is described in our Manual of Procedures, which was prepared in 2005 and updated in 2008. In 2009, the QA/QC plan as part of the Manual was developed and mostly implemented.	Slovenia's National Inventory Report 2013 (selected chapters) Jan 2013 p 7-9

16.2 General description of methodologies and data sources used

16.2.1 The compilation of the EU GHG inventory

The EU inventory is compiled in accordance with the recommendations for inventories set out in the *'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories'* (FCCC/SBSTA/2004/8), to the extent possible. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. In addition, for the compilation of the EU GHG inventory, Council Decision No 280/2004/EC and the Commission Decision 2005/166/EC.

The EU-27 GHG gas inventory is compiled on the basis of the inventories of the 27 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 27 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report (which is included in part 1). Table 16.3 shows the base year emissions for the new EU Member States.

All EU Member States are Annex I parties to the UNFCCC. Malta acceded to Annex I status under the UNFCCC in October 2010 and Cyprus in January 2013; however, no quantified emissions limitation or reduction target is inscribed for Malta and Cyprus in Annex B to the Kyoto Protocol. Therefore, all Member States have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all Member States are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the Commission by 15 January every year under Council Decision 280/2004/EC.

Table 16.3 Base year emissions for the new Member States

New MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Bulgaria	1988	1995	132,618,658
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	194,248,218
Estonia	1990	1995	42,622,310
Hungary	1985-87	1995	115,397,149
Latvia	1990	1995	25,909,160
Lithuania	1990	1995	49,414,386
Malta	Not relevant	Not relevant	
Poland	1988	1995	563,442,774
Romania	1989	1989	278,225,022
Slovakia	1990	1990	72,050,764
Slovenia	1986	1995	20,354,042

1) Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990. Source: Initial review reports of the new Member States (www.unfccc.int)

16.2.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

For a general overview see section 1.3.2.1.

16.1.1.1 Bulgaria

General

A total of 158 operators have provided their verified CO_2 emissions required under the EU ETS for the years 2007-2011. These emissions have been incorporated in the inventory as far as posssible. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Energy

Data from the verified ETS reports was analysed in order to use a Tier 2 methodology for emission calculations. From all the operators, in 2011 only the largest 30 plants use plant specific methodologies, so it was possible to derive country specific EFs for the major solid fuels only. These country-specific emission factors are derived from the verified ETS reports as a weighted average from all operators, which have declared that they have used plant-specific emission factors (Tiers 2b or 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS). The EFs are calculated as the total sum of the verified CO_2 emissions divided by the total amount of the respective fuel as reported by the operators. For the years 2007 to 2011 are applied the respective annual emission factors and for the years 1988 to 2006 is applied an average EF, calculated as a weighted average.

For the 2010 submission, the country specific emission factors were calculated as a weighted average from the ETS reports for 2008 and applied to all the years. For the 2011 submission, the country specific factors were recalculated as a weighted average from all reports for 2007, 2008 and 2009. For the 2012 submission were applied the annual emission factors for the years 2007-2010, and an average emission factor for the years 1988-2006.

Since it was found that the use of alternative fuels (industrial waste) is not reported in the energy balances for the full time series, the reports provided by the plant operators according to the Bulgarian waste legislation and the ETS reports were used, in order to calculate the GHG from waste incineration in the cement plants.

For the country-specific EFs for solid fuels were used the ETS verified reports, which have much lower uncertainty. Nevertheless, the conditions in which solid fuels are burnt are very different, especially considering the oxidation factors for solid fuels in households could cause higher uncertainty.

1A2 Manufacturing industries and production: There is a specific case for other fuels used in the cement industry, for which a separate calculation model was developed. Due to the fact that all cement plant participate in the ETS, their verified reports were used in order to calculate the country-specific EFs for the following fuels: SRF/RDF, Waste oils, Tyres, Filters, Biomass.

Industrial Processes

In some categories emission and production data were reported directly by industry or ETS, IPPC and/or E-PRTR reports thus represent plant and country specific data. Verified CO_2 emissions reported under the EU ETS were available for the years 2007-2011. These emissions have been incorporated in the inventory as far as possible. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Emission estimations as well as activity data and emission factors are compared with EU ETS verified emission reports, IPPC reports as well as E-PRTR reports where available.

- 2A1 Cement Production: All 5 plants are covered by the EU ETS and the IPPC Directive and have been modernized accordingly during the last 10 years. One from the 5th existing/operational installation was the decrease substantially its production during 2010. In 2011 this factory completely ceases operation and all equipment is decommissioned. At present there are only 4 operating plants. The 2011 CO_2 emissions are taken from the operators EU ETS reports. In their reports CaCO3, MgCO3 and other carbonates content in the raw materials used is taken into account. As a part from the QA activities the aggregated national clinker production data provided by the NSI were compared with the production data reported by the cement plants in the annual reports for compliance with their IPPC permits (EPRTR data), as well as in their verified emission reports within the EU ETS.
- 2A2 Lime Production: Currently there are 4 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce quicklime.
- 2A4 Soda Ash Production and Use: Source specific QA/QC and verification: Emissions from soda ash used in glass production (calculated by plants in the EU ETS reports) and using the mass balance approach are compared.
- 2A7 Glass Production: Currently there are six glass plants in Bulgaria mainly producing flat, container and domestic glass. All of them fall under IPPC and EU ETS. For the period 2007 - 2011 plant specific emissions, activity data and emission factors were used based on the data reported by operators under EU ETS (except one plant) and IPPC. For the period 2007 - 2010 plant specific (for five plants) emission factors were calculated on the basis of data from IPPC and ETS reports. These emission factors were used to calculate an implied emission factor which was further used to recalculate the emissions for the rest of the time series. Plant specific activity data from IPPC and ETS reports are available for the years 2007 - 2011. Source specific QA/QC and verification:

Revision of the activity data by using IPPC and EU ETS reports as well as statistical data. Development of country specific emission factor for glass production based on IPPC and ETS data.

- 2A7 Others (Ceramics Production): The CO_2 emissions from the verified ETS reports are used. These emissions are estimated taking into account the CaO and MgO content in the products. Country specific emission factor was calculated on the basis of data from ETS and IPPC reports of the operators. The ETS data used to estimate the EF take into account the CaCO3, MgCO3 in the used in the raw materials (clay). Source specific QA/QC and verification: ETS CO_2 emissions used for the emission factor estimation and recalculations.
- 2A7 Others Non-Specified (Desulphurisation): Currently there are three large combustion plants (LCP) in Bulgaria applying desulphurization for the flue gas cleaning. Tier 2 method for the CO_2 emissions estimation is used. The CO_2 emissions estimated are taken from the LCP operators EU ETS reports. The quantities of calcium carbonate (CaCO3) and magnesium carbonate (MgCO3) used for the estimations are also taken form the EU ETS reports thus allowing to take into account the pure carbonates used in the process. Plant specific activity data on the amount of carbonates use are obtained from EU ETS reports. EU ETS reports are used for source specific QA/QC and verification.
- 2B1 Ammonia Production: Currently ammonia is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and EU ETS.
- 2B2 Nitric acid Production: Currently nitric acid is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and ETS.
- 2B42 Carbide Production and Use: There is one carbide producing plant in Bulgaria. It reports under EU ETS and has an IPPC permit. EU ETS reports are used for source specific QA/QC and verification.
- 2C1 Iron and Steel Production: The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2009. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Country specific activity data from EU ETS reports as well as from BAMI and WSA on total crude steel production were received. Taking into account that plant specific activity data from EU ETS reports were used to estimate emissions an uncertainty of 5% is considered. Applying Tier 2 material-specific carbon contents would be expected to have an uncertainty of 10 percent for EF. This uncertainty is considered due to using EU ETS data. CO_2 emissions were taken from ETS reports for source specific QA/QC and verification.

16.1.1.2 Cyprus

The main data sources used are the National Statistical Service, the national energy balance, the government ministries / agencies involved, along with the verified reports from installations under the EU ETS. Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. National Statistical Service, ETS reports and energy balance) as well as time-series assessment in order to identify changes that cannot be explained.

Energy

- 1A1 Energy Industries: For all gases and all sources, the revised IPCC1996 guidelines were applied with the exception of CO_2 from public electricity for the years 2005-2011. CO_2 from public electricity for the years 2005-2011 is according to the information submitted by the one electricity provider in its annual verified report for the EU ETS. Data for fuel consumption for electricity production for 1990-2004 was obtained from the Department of Labour Inspection, which has been maintaining consumption data for each installation. Activity data for the period

2005-2011 is from the ETS annual reports. Carbon content and oxidation factor of the fuels are according to the revised IPCC 1996 guidelines, with the exception of HFO and diesel for electricity production for 2005-2011 which is according to the ETS annual reports. The net calorific value of the HFO and diesel for electricity production for 1990-2004 is the weighted average of the values reported in the ETS reports of 2005. The weighted average implied CO_2 emission factor and net calorific values according to the ETS reports have been reported as country specific data. All activity data other than the data available from the ETS reports was obtained from one source, the statistical service, to maximise the time-series consistency. The assumption that the net calorific value is the same as the first of ETS was made due to the difference that exists between the values obtained from the ETS and the default in the revised IPCC 1996 guidelines. Activity data for fuel consumption was compared between four source including annual ETS reports (2005-2011) and the data submitted during the preparation of the national allocation plan for the period 2005-2007 by the EAC (1990-2004). Activity data, methodology and any information used for electricity production after 2005 have been obtained from the reported submitted for the ETS directive and are therefore verified according to the ETS monitoring regulations.

- 1A2 Manufacturing Industries and Construction: The main industrial activities that take place in Cyprus are food and beverage processing, cement and gypsum production, light chemicals (predominately pharmaceuticals), metal and wood products. However, only the total fuel consumption is available for industrial activity from the energy balance of the country. No data is available on the consumption of fuels by specific industrial activities other than the activities included in the EU ETS (cement and ceramics production). Therefore, all emissions are reported under other (1A2F). For all gases and all sources, the revised IPCC1996 guidelines were applied with the exception of CO_2 from cement and ceramics production (in non-metallic minerals and other respectively) for the years 2005-2010. CO_2 from the two sources for the years 2005-2010 is according to the information submitted by the installations in their annual verified report for the EU ETS. The fuel consumption data for the years 1990-2004 was obtained from the Statistical Service and for 2005-2011 from the ETS annual reports. The carbon content and oxidation factor of the fuels is according to the revised IPCC 1996 guidelines, with the exception of Pet-coke, HFO, Diesel, LFO and LPG consumed for cement production during 2005-2011 which is according to the ETS annual report of the cement installations. The net calorific value for the other bituminous coal consumed is according to the ETS report of 2005 of the installation that consumes the fuel. The weighted average implied CO_2 emission factor and net calorific values according to the ETS reports have been reported as plant specific data. Oxidation factor is assumed 1 for the ETS period (2005-2011) and 0.99 for 1990-2004. Source-specific QA / QC and verification: Activity data for fuel consumption was compared between four sources including the annual ETS reports (2005-2011). Activity data, methodology and any information used for electricity production after 2005 have been obtained from the reported submitted for the ETS directive and are therefore verified according to the ETS monitoring regulations. A mistake was identified for the CO_2 emissions from RFO consumption for cement production to the data transferred from the ETS database for 2010 resulting to a very high implied emission factor. This was corrected and the implied emission factor is comparable to the rest of the time series.

Industrial Processes

- 2A1 Cement Production: For the years 2005-2011 detailed data is available via the verified EU ETS reports of the plants. The reports were prepared according to Annexes I & II of monitoring and reporting regulation (2007/589/EC). Cement producing plants also report on emissions from non-carbonate carbon (organic carbon). For years after 2005, data submitted in the annual reports of the installations for the ETS are used. Both cement plants in Cyprus are above the EU ETS benchmarks for inclusion.

- 2A7.1 Ceramics Production: In Cyprus, there are 8 ETS and 1 non-ETS ceramics installations in operation. The CO_2 process emissions from ceramics production were estimated following the methodology below:

  (a) The activity data and CO_2 process emissions from the 8 ETS installations were tabulated. The years for which activity data and CO_2 emissions are available are 2001-2011. For 2001-2004 was data obtained during the preparation of the first national allocation plan of Cyprus and for 2005-2011 the data was obtained from the verified emissions reports submitted annually according to the ETS legislation.

(b) Dividing the total CO_2 process emissions of the ETS installations by the total production, the annual implied emission factor was estimated for the years 2005-2011.

(c) The activity data for the non-ETS installation for the years 2001-2011 was estimated by subtracting from the total annual production of ceramics obtained from the Department of Labour Inspection, the total annual production of the ETS installations collected from (a).

(d) The CO_2 process emissions of the non-ETS installation for 2001-2011 were estimated by multiplying the implied emission factor estimated in (b) by the annual production.

(e) For the years 1990-2000 the total annual ceramics production data was obtained from the Department of Labour Inspection. For the estimation of total CO_2 process emissions, the highest emissions factor of the estimated ETS annual implied emission factor was used (0.15988 tCO_2/t product in 2003).

Verified emissions are available for the majority of the emissions of the source, since 8 of the 9 installations operating are participating in the EU-ETS.

16.1.1.3 Czech Republic

General

So far, data from the emission trading system has been used to only a limited degree in the Czech national greenhouse gas inventory (e.g. in the sector of Industrial processes - mineral products). It was recommended to the Czech inventory team during the recent “in-country review” that the data from EU ETS be used to a greater degree. For this purpose, the team began to prepare an “improvement plan” to provide for gradual inclusion of the relevant EU ETS data in the national inventory. At the present time, CHMI, in cooperation with MoE, is preparing a database of activities and emission data from the EU ETS system, which could be used in preparation of the national inventory. Consequently, it can be expected that these data will be employed more extensively only in future inventories. The main part of this “improvement plan” consists in gradual introduction of higher tiers into the national inventory.

Energy

- 1A Fuel combustion: The fuel consumption is taken from the energy balance of the Czech Republic and is transformed to the IPCC structure. Information on the consumption of Other Fuels was taken from the national ETS database and is related only to the use of these fuels in cement production.
- 1A2f Other: In this year’s submission, this subcategory also includes the combustion of other kinds of fuel (Other Fuels). Activity data and data on CO_2 production were taken from the national ETS system, while CH_4 and N_2O emissions were calculated using the default emission factors for solid and liquid fuels.
- QA/QC: QC procedures at the Tier 2 are included upon the suggestion of the QA/QC sectoral guarantor after the consultation with the NIS coordinator. They are aimed mainly at the comparison with independent data sources that are not based on data processing from the CzSO energy balance. The relevant independent sources in the Czech Republic are represented by data

published and verified within the EU Emission Trading Scheme (ETS), from the national system REZZO, used for the registration of ambient air pollutants, and based mainly on data collection from individual plants.

- Source-specific planned improvements: Attention is constantly devoted to obtaining data from the ETS national database for use in performing QA/QC procedures. At the present time, the creation of this database is included in the plan of the Ministry of the Environment.

Industrial Processes

- 2A1 Cement Production: Since 2006 submission methodology equal to the Tier 3 has been employed. CO_2 emissions are based on data submitted by the cement kiln operators to the EU ETS system. EU ETS system covers all cement kiln operators in the Czech Republic. Information submitted directly by cement kiln operators is available for years 1990, 1996, 1998 - 2002 and 2005 - 2011. For these years, the emission factor value was derived from individual installation data collected for EU ETS (emissions) and from CCA data (activity data about production of clinker). For other years the EFs were interpolated. All operating cement plants in the Czech Republic are equipped with dust control technology and the dust is then recycled to the kiln. Only in one cement plant is a small part of the CKD discarded, for technical reasons. Use of dolomite or amount of magnesium carbonate in the raw material, as well as fissile carbon (C) content is known, all above mentioned variables are used for emissions estimates in the EU ETS system.

- 2A2 Lime Production: ETS data closely corresponds to the IPCC methodology and national circumstances. Two lime producers are not included in the EU ETS data. The calculations in the lime production category are based on data taken from the Czech Lime Association and EU ETS data are used for verification of the CO_2 emissions. The EU ETS reports are proved by independent verifiers. The country-specific emission factor was compared with the emission factors used by individual operators for the calculation.

- 2A3 Limestone and Dolomite Use: In 2005 data was verified by comparison with data from the individual power plants, which were collected for EU ETS preparation and which cover the years 1999 – 2005. The EU ETS data form has been used since 2006. Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO_2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc - production of agglomerate / sinter) and the EF value, which was derived from EU ETS CO_2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO_2 / t sinter). The calculations in the limestone and dolomite use category are based on data taken from CzSO and EU ETS. The EU ETS data are verified by independent verifiers. CzSO has its own verification procedures employed before data is published.

- 2A7 Other: Emissions from 2A7.2 Brick and Ceramics Production are derived particularly from the decomposition of alkaline carbonates fossil and biogenic carbon based substances included in the raw materials. The EF value was derived from individual installation data collected for EU ETS (emissions) and from CzSO (production). The calculation is based on the total production of ceramic products (fine ceramics, tiles, roofing tiles, and bricks) and the EF value. It is planed to process all available information about uncertainty form the EU ETS and provide category and national specific uncertainty assessment.

- 2B5 Other: Production of Caprolactam: More exact data should be available in the coming years, when the N_2O emissions from the production of caprolactam will be continuously measured from 2012 as a consequence of inclusion of the production in the emission trading scheme (EU ETS) and thus recording in the relevant register.

Improvement plan

Improvement Plan also includes using of EU ETS data for the purposes of national inventory. Substantial effort is put into implementation of this issue. In this submission EU ETS data were used for emission estimates in some subcategories in 2A Mineral Product (e.g. 2A1 Cement Production). EU ETS data would be useful tool for QA/QC procedures also in Energy sector.

16.1.1.4 Estonia

Energy

In 2012 inventory submission Energy Sector CO_2 emission factors were compared also with EFs used by Emission Trading System (ETS) enterprises.

Industrial Processes

- 2A1 Cement Production: The emissions of last seven years (including 2011 emissions) have been compared with EU ETS data (as recommended by the UNFCCC review team). The emissions from bigger plant (responsible more than 99% of the lime production emissions in Estonia) have been compared with EU ETS data. Differences have been less than 0.1% (2005–2011).

16.1.1.5 Hungary

Since the use of ETS data has several advantages, the inventory team was granted access to the verified emissions database held by the National Inspectorate for Environment, Nature and Water. Further QA and verification activities to be continuously performed and/or planned:

- Checking the differences in activity data to increase the consistency between different emission databases, especially the GHG inventory, LRTAP inventory, ETS data, NAMEA data, and the E-PRTR data.
- Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions.

Energy

It is important to note first that no emission data are taken directly from the ETS database and put into the CRF as they are without analysis. Instead, facility level activity data (fuel use) and carbon emission factors are used from the ETS database to calculate weighted averages of the emission factors for different fuel types. These derived country specific EFs are then applied with the fuel use from the national energy statistics. The time series of these country specific emission factors and their comparison with the default values are summarized in Table 3.4. Fuel uses in energy statistics and ETS are compared also to see whether the fuel use in a given category is fully covered by ETS plants or not.

- 1A1 Energy Industries: Energy consumption data were taken from the energy balance (1985-2011) of the Energy Statistics Yearbooks prepared by the Energy Office or from the IEA annual questionnaires compiled by the same national institute. Besides, waste statistics and ETS data were taken into account. Most liquid fuels in energy industries are used in the oil refinery. Taking a closer look into the ETS data of the refinery, it turned out that most part of the "heavy fuel oil" use allocated to 1.A.1.b was basically refinery gas. However, as the ETS data show, refinery gases have significantly different characteristics. Country specific OF and EF values – taken mostly from the ETS database – were used for most solid fuels and some liquids. It should be noted that only those measured factors were applied where the EU ETS covers all or most of the installation of the sector. Default emission factors for methane and nitrous oxide have been used in the case of liquid fuels since last year. However, emissions estimation in the energy sector is somewhat different from the methodology used in the waste incineration category. Activity data in this source category are expressed in energy consumption units (TJ) whereas in the waste sector mass of waste serves as basis of calculations. For Hungary's calculations three main activity data sources were used: data from the Waste Incineration Works (FKF) of Budapest (1985-2011), the

Hungarian Waste Management Information System (2004-2011) and the ETS data (2006-2011). The biggest co-incinerator plant is Mátra Power Plant. Since this plant reports its verified emissions in the framework of the European emission trading, direct ETS data relating its fuel use and CO_2 emissions were taken over. Verified energy use from EU ETS was compared to statistical data. It was noticed that data in metric tonnes are similar in the ETS to those in the statistics, but there are some differences in energy values due to different NCVs. Since the energy consumption in sectoral approach should be compared with those of reference approach, we kept the NCVs of energy statistics, however emission factors of coals were corrected for some years to achieve consistency in energy balance and verified emissions. As the main fuel consumption is related to public electricity and heat production, a comparison was also performed with independent dataset collected by the Hungarian Energy Office. For the main power plants the total fuel consumption's difference between the ETS and this dataset was around 1% in 2009. Determination of country specific parameters of the different fuels based on ETS data is one of the most important elements of the recalculations.

- 1A2 Manufacturing Industries and Construction: Part of the emissions from waste incineration for energy purposes was allocated to this source category. Special attention was given to the four big cement factories, as they incinerate large amount of waste of fossil origin (plastics, rubber etc.). Their verified ETS data (emissions and fuel use) were analyzed, from which a specific emission factor was derived: 2.2 tonne CO_2/tonne fossil waste. This EF was used for the years 2004 and 2005 in case of fossil wastes. From 2006 on, ETS data (fuel consumption and emission) of the cement factories were used directly. CO_2 emission in the process of manufacturing bricks and ceramics is calculated using the verified emission reports (EU ETS) in the *Industrial Processes Sector.* Carbon emission factors for coke oven coke and coke oven gas combusted by the iron and steel industry, where measured (by accredited laboratory) carbon content of fuels were available from the EU ETS ETS, the resulting carbon dioxide emission factor was 110.3 t CO_2/TJ in 2011 and the factory used an oxidation factor of 0.99. In the non-metallic minerals category country specific emission factors were used (based on ETS information) for bituminous coal (93.9 t CO_2/TJ) and sub-bituminous coal (95.1 t CO_2/TJ) for 2011. Energy consumption data were subject of several rounds of verification before use. Verified energy use from EU ETS was compared to the statistical data. It was noticed that data in metric tonnes are similar in the ETS to those in the statistics, but there are some differences in energy values due to different NCVs.
- 1A3 Transport: Emissions from combustion related to natural gas transport are included under sector 1.A.2 (Manufacturing Industries and Construction) instead of Other Transport. Nevertheless, Hungary have checked that five compressor stations reported under the EU-ETS in 2010.
- 1B2 Fugitive Emissions from Oil and Natural Gas: In the recent 2013 submission, completeness was further improved by including estimation of emissions from oil refinery flaring for the years before 2005 as well. In category 1B2c-Venting and flaring of oil and natural gas, Hungary has reported CO_2 emissions from oil refinery flaring since the 2009 submission in addition to gas and oil production/processing venting and flaring emissions. The latter emissions are reported using default emission factors from GPG2000 and oil refinery flaring CO_2 emissions were taken from EU ETS annual emission reports since 2005 due to lack of emission factors in the Guidebooks. In this year oil refinery flaring EU ETS data of an additional oil refinery in Hungary was included and oil refinery flaring data was extrapolated for the years before 2005 using the amount of "Refinery intake" as surrogate data. In this way full coverage and consistency within the time-series has been reached.

Industrial Processes

Several sub-sectors within Industrial Processes sector consistent of emission originating from industrial facilities that are also falling under the scope of EU Emission Trading System (Directive 2003/87/EC). Although EU ETS data reported by the individual operators (summed together by industrial sector) would be probably more accurate than the use of default factors, its use in inventory preparation is very limited due to time series consistency problems. In Processes sector EU ETS data is directly used solely in sector 2.A.1 Cement production, 2.A.7 Other mineral (Glass and Bricks and ceramics) and partly in 2.A.3 Limestone and dolomite use.

- 2A1 Cement Production: In 2011 five factories were operating in Hungary. Production data for the whole time series were obtained directly from the factories and from the EU Emission Trading System (ETS) According to the ETS introduced by the European Union from 2005 on, the factories report their CO_2 emission. It is assumed that the data after 2005 is more accurate since in EU ETS accredited laboratories are to be used. As the country specific method is mainly the same as the emission reporting methodology of the EU ETS, the time series is more consistent this way, than it would be in the case of the use of Tier1 or Tier2 method of the IPCC Guidelines. As the use of ETS data means the use of verified data, where the carbon contents should be measured in accredited laboratory (or at least a laboratory yearly validated and inter-compared with accredited laboratory as it is prescribed in section 13.5 of Annex I of 589/2007/EC), Hungary believe that the use of ETS data improves the accuracy of the data reported in the inventory.
- 2A2 Lime Production: During the 2012 EU Technical review a question was raised, whether the autoproduction of lime of sugar producers is included. The investigation resulted that sugar producing companies have never reported technological (originating from dissociation of limestone) emissions in EU ETS annual emission report (as they do not have this emission source in their GHG emission permit). The activity data were received directly from the operators which increased the reliability of the information. Since 2005 also EU ETS data have been available. At the moment EU ETS data is used only for verification purpose in order to avoid time series consistency problem caused by the 4-8% difference
- 2A3 Limestone and Dolomite Use: Activity data on the use of carbonates for SO_2 scrubbing is either reported by the operators directly to the HMS or to EU ETS competent authority (In EU ETS the operators are required to report CO_2 emission from the use of carbonate for scrubbing separately in their annual emission report).
- 2A7 Glass Production: Hungary has compared the CO_2 emission from ETS data with the emissions calculated with its country-specific factor. CO_2 emission from ETS was higher in 2006 and 2007 by 10.62% and 6.08%, respectively but lower in 2008, 2009, 2010 and 1011. The lower value was due to the new data logging methodology of the HCSO, i.e. estimations were made from salesmanship. The development of a new country-specific IEF based on 2005-2011 EU ETS data is planned.
- 2A7 Other: Bricks and Ceramics: The estimation of uncertainties is based on the uncertainty of EU ETS data. The years before 2005 in the time series are calculated by the application of an emission factor calculated based on the 2005 EU ETS data.

QA/QC

There are several actions with regard to QA/QC which include the use of ETS data:

- Checking the differences in activity data to increase the consistency between different emission databases, especially the GHG inventory, LRTAP inventory, ETS data, NAMEA data, and the E-PRTR data.
- Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions

16.1.1.6 Latvia

General

As all Latvia's industrial processes sector's companies are participating in ETS then data from these companies can be obtained from their annual GHG report within compliance obligations within ETS. These activity data used emission factors and used emission estimation methodologies can be reported in NIR and in CRF Tables as the data of ETS can't be confidential and all companies' annual GHG reports are published in LEGMC webpage.

Energy

- 1A: Carbon emission factor for industrial wastes (used tires) was estimated based on CO_2 emission factor reported by cement production plant within ETS.
- 1A2f Others: EF for CO_2 emission estimation for other fuels – used tires, combusted in CRF 1.A.2.f Other Manufacturing Industries – cement production, category for years 1999–2010 is taken from GHG emission reports that plant submitted under ETS. This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory.
- 1A2: CO_2 emission factor of municipal wastes combusted in cement production plants is taken from plant's annual GHG report within EU ETS for 2008-2011 IPCC 2006 as there is no information available of such fuel type. This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory. Uncertainty of other fuels consumption – municipal and industrial wastes, used in mineral production is assumed also low – 2%, as the activity data is obtained from only one producer within EU ETS therefore the data is verified by accredited verifier and Regional Environmental Board. Activity data, CO_2 EF and estimated emissions of used tires and municipal wastes are taken from cement production plant's annual GHG reports within EU ETS. The data is verified by accredited verifier and then checked and approved by Regional Environmental Boards.

Industrial Processes

All industrial production data used in emission estimation from 2.A Mineral Products sector is taken from the annual GHG reports that industrial producers submit within EU ETS. According to EU ETS legislation all GHG reports have to be verified by the ISO accredited verifiers that checks that all reported information – activity data, CO_2 emission factors, estimated emissions as well as estimation methodology, is correct and corresponds to certain requirements from the legislation. Activity data, CO_2 emission factors and estimated emissions from glass production plants are taken from the annual GHG reports that plants submit within EU ETS. All GHG reports are verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation.

- 2A1 Cement Production: According to IPCC GPG alternative of activity data if clinker production data is not available is to use cement clinker data and the estimate this amount back to clinker production data. In the cement production plant it is done for the EU ETS annual reporting by taking into account clinker and cement ratio for the particular types of cement produced. According to cement production plant the CKD amount is weighted before it is sent to disposal site. The amount of weighted CKD as well as procedures of all data obtaining is verified by the accredited verifier within EU ETS. Cement, cement kiln dust production data and estimated clinker production data is taken from plant's annual GHG reports within EU ETS.
- 2A2 Lime Production: In iron & steel production facility lime necessary for steel smelting in open heart furnaces is produced only from limestone in vertical shaft kiln. The plant is reporting their non-marketed quicklime production data for 2005-2010 within ETS so the estimated emissions as well as used activity data and emission factor are taken from plant's annual GHG report within GHG. Activity data of produced lime in steel production company is taken from plant's GHG reports within ETS. Source-specific QA/QC and verification: Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS. According to EU ETS legislation all GHG reports have to be verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation.
- 2A3, 2A4 Limestone, Dolomite and Soda Ash Use: Limestone, dolomite and soda ash are used in glass production plants, steel production plant and lime production plants. All these plants are participants of EU ETS so the detailed information of used technologies, raw materials as well as emission factors are available as plants report their annual GHG reports to LEGMC. Activity data

were taken from industrial production plants. Industrial producers are participants of the ETS the GHG reports of these enterprises have to be freely available according to EU ETS regulations. The GHG reports of ETS operators are published on LEGMC home page. The activity data reported in production plants' annual GHG reports within ETS is verified by accredited verifiers and Latvia's Regional Environment Boards so the activity data is adequately verified.

- 2A7 Glass Production: For time period 1990-1996 only butylacetate data is available from glass fibre production company's application for GHG permit within EU ETS. For year 2005 also glass production company had reported its NMVOC emissions (these emissions are reported together under Glass fibre production sector in CRF Reporter) but since then glass production is not operating therefore NMVOC emissions from glass production are reported only for 2005. CO_2 emission factors used to estimate emissions from raw materials use in glass production are plant specific and taken from plants' annual GHG reports within ETS. CO_2 emission factors for emission from additional raw materials use in glass production processes were taken from reports of glass production plants submitted within EU ETS implementation and from applications to GHG permits. Accredited verifiers and Latvia's Regional Environmental Boards verify the activity data reported in production plant's annual GHG reports within ETS so the activity data is adequately verified.
- 2A7 Bricks Production: There are five bricks production plants in Latvia. Some plants used 2004 in its application for GHG permit during the implementation of ETS in Latvia a methodology that is not in line with IPCC Guidelines. CO_2 emission factors used in emission calculation from bricks and tile production are the default from Monitoring and Reporting Guidelines within ETS so the uncertainty of emission factors is assumed as 50%. Activity data is taken from plants reported annual GHG reports within EU ETS.
- 2A7 Tiles Production: There is only one tiles production plant in Latvia and CO_2 emissions from use of clay in tile production process in 1995-2010 are reported in this sector. The tiles production plant is participant of ETS so the data from plant's annual GHG reports is available for inventory. Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS. The activity data reported in production plant's annual GHG reports within ETS is verified by accredited verifiers and Latvia's Regional Environmental Boards so the activity data is adequately verified. CO_2 emission factors used in emission calculation from tiles production are the default from MRG ETS so the uncertainty of emission factors is assumed as 50%.
- 2C Metal Production: There is only one Iron & Steel production plant in Latvia that produces crude steel by melting crude iron not only by melting scrap metals. The plant is participant of ETS and submits their annual GHG reports to LEGMC. It is possible to obtain more accurate and complete activity data and emission factors from enterprise that is involved in the emission trading system. CO_2 emissions from plant's GHG reports were taken to report emissions from crude steel production.

16.1.1.7 Lithuania

General

Annual ETS data reports by operators are indicated as one of the most important data sources for the Lithuanian GHG inventory preparation. For 1A Fuel combustion and Industrial processes EU ETS emissions data is used as a data source.

Energy

- For 1A1a Public Electricity and Heat Production: Plant specific CO_2 emission factor based on EU ETS data is used for orimulsion. Plant specific CO_2 emission factor based on EU ETS data used for emulsified vacuum residue which is combusted at the ORLEN Lietuva CHP. The following improvement is foreseen: Further investigate the possibility of using data provided in the EU ETS, reported by the operators for the energy sector emission estimates.
- 1A1b Petroleum Refinery: Plant specific CO_2 emission factor based on EU ETS data is used for residual fuel oil.

- 1A1f Other Industries: Recalculations in this category has been done taking into account ERT recommendations: addition of used tires consumption based on EU ETS data. Plant specific CO_2 emission factor based on EU ETS data is used for used tires (industrial waste).

Industrial Processes:

- 2A1 Cement production: For the period 2005-2011 CO_2 emission data have been accessed via the verified EU ETS reports of the production plant. CO_2 emissions were caclulated using plant specific data on production of clinker and CKD, and plant specific emission factors (t CO_2/ t clinker, t CO_2/ t CKD). For the period 1990-2004 CO_2 emission was calculated using Tier 2 method using specific production data provided by the production company. As the producer reports CO_2 emissions for EU ETS, it was decided to perform a quality control quality by comparing the two estimates (IPCC Tier 2 versus EU ETS). The difference between the Tier 2 estimations based on plant-specific data (annual clinker and CKD data, CaO and MgO content in clinker) and EU ETS data was less than 1%. Therefore it is concluded that the estimates for the period 1990-2004 and 2005-2011 are comparable.

- 2A2 Lime Production: Source category-specific quality control procedures have been carried out in this submission. Emission data for years 2008-2010 have been verified with EU ETS data. For all three years calculated emissions are significantly higher than reported in EU ETS (23% in 2008 and 25% in 2010). This difference in estimated CO_2 emission is due to difference in methodology. In GHG inventory CO_2 emissions from lime production were calculated by Tier 2 method using plant specific limestone composition data. In EU ETS emissions were estimated using Tier 1 method. The default EFs used in the EU ETS are lower than EFs used in GHG inventory.

- 2A7.1 Glass Production: According to EU ETS report of Kauno stiklas, small quantity of carbon is oxidised directly in glass furnace. CO_2 emissions were calculated for each production plant based on plant specific data on use of particular carbonates. Summary for each production plant is provided below: AB Ekranas: EU ETS reports provide data on consumption of particular carbonates: Na2CO3, K2 CO3, Ba CO3, Ca CO3, Sr CO3 and dolomite in 2005 and 2006. Average plant specific emission factor (t CO_2 / t glass produced, excluding cullet) was calculated based on available 2005-2006 data. The emission factor was used for extrapolation of emissions in 1990-2004. UAB Warta Glass Panevėžys: Since 2005 the company is reporting under EU ETS, thus data on consumption of MgCO3, CaCO3 and Na2CO3 is available for the period 2005-2011. Plant specific emission factor (t CO_2 / t glass produced, excluding cullet) was calculated based on available data including EU ETS data. The emission factor was used for extrapolation of emissions in 1990-1998. UAB Kauno stiklas: Since 2007 the company is reporting under EU ETS, thus data on consumption of MgCO3, CaCO3, Na2CO3 and Carbon oxidised directly in glass furnace is available for the period 2007-2011. Plant specific emission factor (t CO_2 / t glass produced, excluding cullet) was calculated based on available data including EU ETS data. The emission factor was used for extrapolation of emissions in 1990-2003. Source category-specific quality control procedures have been carried out in this submission. Emission data for years 2007-2011 have been verified with EU ETS data. The difference between the GHG inventory and the EU ETS data is less than 0.4%

- 2A7.Other: Mineral Wool Production: Source category-specific quality control procedures have been carried out in this submission. The recalculated emission data based on updated activity data and plant-specific emission factors provided by the producer for years 2008-2011 have been verified with ETS data and the correspondence between these data is 100%.

- 2B2 Nictric Acid Production: Report of the AB Achema for the calculation of EU allowances for the third EU ETS period 2013-2020 is used for calculaton of production unit specific N_2O emission factors for 2007-2008 using measured and registered data in automated monitoring system.

16.1.1.8 Malta

The total allocation for Phase II amounts to 10.715 million allowances allowances, completely allocated to the two installations. It is pertinent to note that in 2010, emissions covered by the EU ETS amounted to approximately 66% of total net national greenhouse gas emissions.

Energy

- 1A1a: Only emissions of CO_2 from the two power plants fall within the scope of the Directive 87/2003/EC up to the year of this report. The only two installations situated in the territory of Malta falling within the scope of the EU ETS Directive remain the two power electricity generation plants which also account for all emissions under CRF sub-category 1A1a. These are two power plants that are currently run on liquid fossil fuels, namely residual fuel oil (RFO) and gas oil (GO). It is important to note that for the years 2005 to 2011, fuel consumption data reported in verified emission reports as submitted by the operator under Directive 2003/87/EC have been used. For the years 2009, 2010, 2011 the calorific values and oxidation factor used in the verified emission reports have been used for the Residual fuel Oil and the Diesel gas Oil.

16.1.1.9 Poland

General

The experts of the National Centre have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This verified data is included in GHG inventory for some IPCC subcategories (e.g. in some subsectors in industrial processes).

Energy

Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE).

- 1A3e Pipelines transport: Since 2008, data from the transport via pipelines covered by the Community Emission Trading Scheme (EU ETS) were taken directly into GHG inventory.
- 1B2c Fugitive Emissions from Fuels – Venting and Flaring: CO_2 process emission from refineries and flaring was included into sub-category 1.B.2.C.2. These emissions were estimated based on the verified reports for refineries, which participate in EU ETS.

Industrial Processes

For estimation of the 2011 emission, in sector 2. *Industrial Processes*, CO_2 process emission data were used from installations which take part in the EU ETS. Emissions based on such data were estimated in the following subcategories:

- subcategory 2.A. *Mineral Products*: 2.A.1. *Clinker Production*, 2.A.3. *Limestone and Dolomite Use* and from subcategory 2.A.7. *Other*: *Glass Production*, *Ceramics materials production*
- subcategory 2.C. *Metal Production*: processes included into *Iron and Steel Production* (2.C.1) such as: sinter production, pig iron production, steel production in basic oxygen process, steel production in electric arc furnace process
- subcategory 2.D. *Other Production*: 2.D.1. *Pulp and Paper*
- subcategory 2.G. *Other* – this subcategory includes data containing CO_2 process emissions from installations which take part in emission trading scheme that cannot be included in subcategory 2.A-2.F; for example emissions from refineries (process emissions, discharges and flaring)
- 2A1 Cement Production: CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2011 for installation of clinker production, which

participate in the EU ETS. CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2011 for installations which participate in EU ETS.

- 2A3 Limestone and Dolomite Use: In this subcategory there were used only emissions from limestone and dolomite use in sulphur removal installations in power industry installation that participate in EU ETS. Emissions for this subcategory in GHG inventory correspond to emissions from the EU ETS verified reports. CO_2 emissions concerning limestone and dolomite use in production of glass, ceramics and paper includes only the emission from installations covered by EU ETS.
- 2A7 Other (Glass production): CO_2 emission from glass production was taken from the verified reports for 2011 for installation of glass and glass wool production, which participate in the emission trading scheme.
- 2A7 Other (Ceramics material production): CO_2 emission from production of ceramics materials was calculated based on the verified reports for 2010 for installation of ceramics production, which participate in EU ETS.
- 2C1 Iron and Steel Production: Carbon dioxide process emissions from iron and steel production for 2011 come from the verified reports on annual emissions of CO_2 from iron and steel installations in EU ETS. The values of annual iron ore sinter productions were also taken from production amounts indicated in the verified reports. Based on verified reports of CO_2 emissions elaborated for the purpose of emission trading scheme, also emissions and production within this subcategory for years 2005-2010 were estimated. Emissions of CO_2 for the years 1988-2004 were calculated (using carbon balance method) based on data (amount of feedstock material and output from production process) from questionnaires regarding to installations included into the EU ETS collected by the National Administration of Emission Trading Scheme. CO_2 emission for 2011 from pig iron production, basic oxygen furnace steel production, and steel production in electric furnaces was taken from the verified reports prepared by installations included in EU ETS. Because of the lack of data in national statistics, the output of oxygen furnace gas was assumed on the basis of the rate: amount of produced oxygen furnace gas to amount of produced steel. It was based on steel plants reports included in EU ETS.
- 2D Other Production: CO_2 process emissions from pulp and paper production for 2011 and for 2005-2010 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS.
- QA/QC: Activity data used in the GHG inventory concerning industry sector come from yearbooks published by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. Data on selected production is compared to data collected from installations/entities covered by the EU ETS. Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE). Additionally data on industrial production is compared with public statistics in case where entire sector is covered by EU ETS.
- Source-specific planned improvements: Further development of methodology of EU ETS data implication in GHG inventory. Further attempt to improve the comparability of data in particular subsectors of 2.C.1 (sinter, steel and pig iron productions) between periods 1988-2004 and 2005-2011 (for which ETS data was applied) to get the data comparability for the entire time period in both 2.C.1 and 1.A.2.a categories.

16.1.1.10 Romania

General

A sum of operators has provided their verified CO_2 emission reports required under the EU ETS for the years 2007-2011. Data from the verified ETS reports were analysed in order to use a Tier 2 methodology for emission calculations. The number of plants, using a plant specific methodologies, made possible to achieve country specific EFs for a sum of solid and liquid fuels and natural gas. Also, the contry specific emission factor for the industrial wastes ETS reporting, was derived. These emission factors (without oxidation fraction included) are derived from the verified ETS reports as a weighted average from all operators which have declared that they have used plant-specific emission factors (Tiers 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS).

Energy

- 1A Stationary combustion: To achieve the estimations of the CO_2 emissions on the national circumstances, a study, has determined the national emission factors based on EU-ETS operators reporting on the period of 1989–2010; for 2011 the estimations for the CO_2 emissions were determined using the national emission factors, based on the methodology of the same study. It was accomplished a study by the Romanian Institute for Studies and Power Engineering (ISPE), analysing the data from the operators reporting on EU ETS, conducting to the development of the Country Specific Emission Factors.
- A further analysis on the EU-ETS 2012 reporting (object of a further Study) will be conducted in order to take into consideration these emissions, as Tier 3 approach, on the activity category where these operators have to report. Furthermore the background data for the emission factors calculations under the ETS, were used for further QA/QC checks. Further investigations and co-operation with Romanian authorities administrating the EU-ETS and National Institute for Statistics will be conducted in order to have a fully correspondence concerning the definitions (fuel‘s calorific power) and quantities of the fuels, between the declarations of the operators under EU-ETS and, respectively, to NIS. A further analysis on the EU-ETS reporting will be conducted in order to take into consideration these emissions data, in the context of Tier 3 approach, on the activity category where these operators have to report. A further analysis on the EU-ETS reporting in comparison with Large Combustion Plants reporting, in order to check the concistency of the reported data, will be performed. Following the same procedure used until now, based on EU-ETS operators reporting, the country-specific CO_2 emission factors will be calculated and included in the next inventory submission.
- 1A1 Energy Industries: Country Specific CO_2 Emission Factors for the analysed fuels (solid, liquid, gaseous and other) on EU-ETS reporting are used It is planned to take into consideration the emissions from the operators reporting on EU-ETS (having their reports verified by accredited verifiers) in order to achieve a higher tier approach in the estimation of the CO_2 emissions.
- 1A2 Manufacturing Industries and Construction: Country Specific CO_2 Emission Factors for the analysed fuels (solid, liquid, gaseous and other fuels) on EU-ETS reporting are used. It is planned to take into consideration the emissions from the operators reporting on EU-ETS (having their reports verified by accredited verifiers) in order to achieve a hire tier approach in the estimation of the CO_2 emissions.
- 1A3b Road Transport: To achieve the estimations of the CO_2 emissions on the national circumstances, a study, has determined the national emission factors based on EU-ETS operators reporting on the period of 1989 – 2010; for 2011 the estimations for the CO_2 emissions were determined using the national emission factors, based on the methodology of the same study. Furthermore the background data for the emission factors calculations under the ETS, were used for further QA/QC checks.
- 1A4 Other Sectors: Since the resources for solid fuels in the Romanian economy are mainly from the internal exploitations, the weighted arithmetic averages for the emission factors calculated based on all the EU-ETS activities reporting, are used in the 1.A.4 – Other Sectors. For the fuels reported in this activity category having determined Country Specific Emission Factors on EU-ETS reporting, Tier 2 methodology is used. Country Specific CO_2 Emission Factors for the analysed fuels (solid, liquid, gaseous and other fuels) on EU-ETS reporting are used. Based on the recommendation of the ISPE Study, have been used the weighted arithmetic averages for the Emission Factors calculated based on the all the EU-ETS activities reporting.

- 1A5 Other: For the fuels reported in this activity category having determined Country Specific Emission Factors on EU-ETS reporting, Tier 2 methodology is used. Country Specific CO_2 Emission Factors for the analysed fuels (solid, liquid, gaseous and other fuels) on EU-ETS reporting are used. Based on the recommendation of the ISPE Study, have been used the weighted arithmetic averages for the Emission Factors calculated based on the all the EU-ETS activities reporting.

Industrial Processes

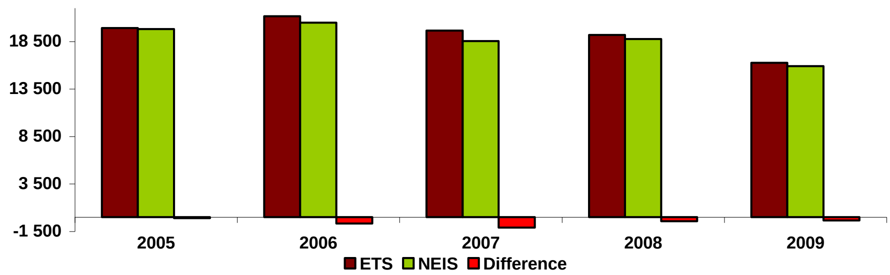
The CO_2 emissions from Lime Production, Limestone and Dolomite Use, Soda Ash Use and Glass Production, were compared with the emissions reported in monitoring plans of GHG emissions for the EU-ETS installations.

- 2A1 Cement Production: Starting with 2008 the figures related with clinker production, plant specific CO_2 EF for clinker production and CO_2 emissions from clinker production were compared with the data reported in monitoring plan of GHG emissions for the EU-ETS cement production installations. The data are similar.
- 2C1 Iron and Steel Production: The CO_2 emissions from Iron and Steel Production were compared with the emissions reported in monitoring plans of GHG emissions for the EU-ETS installations.

16.1.1.11 Slovakia (NIR 2011, NIR 2013 not yet available)

QA/QC: In order to comply with the quality management criteria and data harmonization between ETS and the national emission balance at sectoral level, emission factors of the most important fuels have been re-evaluated and new methods have been implemented at the level of source operators. By comparison and correct allocation of CO_2 emissions in sector energy, it can be concluded that the balance is in a good compliance with the emissions verified within ETS. The comparison was provided for most important sources (energy and technology) (Table 3.27), but also only for energy sources (Figure 3.21). For the comparison study, 26 biggest emitters were taken, which represent more than 90% of all allocated emissions in the Slovak Republic.

Figure 3.21: Comparison of CO_2 emissions from energy sources (in Gg) allocated in ETS and estimated by sectoral approach from the dbase NEIS for 2005 – 2009



Source: NIR of Slovakia, submission 2011, p. 54, Figure 3.21

Industrial Processes

- 2A1 Cement Production: The cement plants in the Slovak Republic (4 plants), where cement clink is produced, are included into the ETS and the verification reports from the ETS were used for CO_2 emission inventory. On the basis of the information provided into the verified ETS reports, Tier 3 methodology according to the IPCC 2006 Guidelines has been applied since 2002 based on plant specific information. The calculations provided by the cement clinker producers in the ETS reports balanced CO_2 emissions on the basis of cement clink production and CaO and MgO contents.

- 2A2 Lime Production: Tier 3 according to the IPCC 2006 GL has been applied since 2003 with the combination of plant specific activity data and emission factors estimated for each plant. The calculations provided by the lime producers in the ETS reports balanced CO_2 emissions on the basis of raw material used for production (Calmit lime plant) or produced lime (other lime plants) and $CaCO_3$ and $MgCO_3$ contents (Calmit lime plant) and CaO and MgO contents (other lime plants).

- 2B1 Ammonia Production: The Tier 2 methodology according to the IPCC 2000 GPG was applied to category 2B1 ammonia production and the plant specific emission factors were used. The information on ammonia production, provided directly by the company, was used based on ETS information in 2009. The data on the consumption of natural gas are available from ETS reports.
- 2C1 Iron and Steel Production: According to the information provided in the ETS reports, several plants produced steel in electric arc furnaces. The emissions from these plants were not reported in previous submission (2010). According to the ERT recommendation during centralized review 2010, the thorough survey of the CO_2 emissions from these plants was done. The information are summarized in Table 4.26. The emission calculation was based on the available data and assumptions:
    - Železiarne Podbrezová: EU ETS reports are available for the period 2005 – 2009. According to the questionnaires concerning the period 2000 – 2004; it was used approximately 13.4 kg of carbon (in all material inputs) for production of 1 tone of steel.
    - Metalurg Steel: EU ETS reports are available for the period 2007 – 2009. According to the questionnaires concerning the period 2000 – 2006; the emission factor of CO_2 was 0.165 t per 1 tone of steel.
    - UNEX Prakovce: The plant is not included in the EU ETS. The default emission factor of CO_2 was used (0.08 t CO_2 / 1 t of steel).
- 2C2 Ferroalloys Production: Information about activity data were taken from the ETS reports and directly from the producers of ferroalloys in the Slovak Republic based on questionnaires.

QA/QC: For 2A1, 2A2 and 2B1, 2B4 (Carbide Production) and 2C1: Information used for GHG emission inventories of IP sector are directly from the questionnaires sent to operators and producers in the Slovak Republic. First preliminary data related to the production and the quality of products in the Slovak Republic from the previous year is available at the beginning of October. This data are used for the estimation and verified by Mr. Vladimir Danielik – the sectoral expert for IP sector in the cooperation of the Slovak Technical University in Bratislava, the Faculty of Chemical and Food Technology. The data are compared with the information from the Statistical Office of the Slovak Republic and available ETS reports.

16.1.1.12 Slovenia

General

In 2006, an additional quality control check point was introduced by forwarding the assessment of verified emission reports from installations included in the National Allocation Plan to the Statistical Office of the Republic of Slovenia (SORS). The role of SORS is to compare data from installations included in the EU-ETS with data from their reporting system and to propose corrective measures, if necessary. The outcome of data consistency checks is used as preliminary information for the Ministry of the Environment and Spatial Planning to perform on-site inspections.

Energy

- 1A1a Public Electricity and Heat Production: From 2005 the activity data from the verified reports from ETS have been used for four power plants. For four thermal power plants the aggregated fuel from SORS data are compared with the sum of fuel used from verified ETS reports. The NCV values are also checked. If case these numbers are not the same the ETS data are taken in account for GHG inventory and notification to SORS is made to correct their data. In other cases where connection between both set of data is uniform, the data from Statistical office are substitute with data from verified reports from installations included in ETS, if necessary. ETS data are also used for different types of waste used as a fuel. The list of waste types is not always complete in the SORS data. The uncertainty was lowered because of use of EU-ETS data.
- QA/QC: The main source specific QA/QC activity is comparison of the ETS data with statistical data.

Industrial Processes

- 2A1 Cement Production: For the period 2005 - 2010, the EFs reported by the cement plants to the Ministry of Environment and Spatial Planning, as a competent authority in the European Union Greenhouse Gas Emission Trading System (EU ETS), are used to calculate emissions. To calculate emissions from cement production after 2005 Slovenia has been using data obtained by EU ETS. Data on clinker production and plant specific emission factors for both cement factories have been annually verified by independent verifiers. ETR recommended showing that the estimated CO_2 process emissions from cement production are comparable and consistent with the emissions reported under the EU ETS. EU ETS reports can not be publicly revealed due to sensitivity of information.
- 2A2 Lime Production: The EFs for the period 2005-2010 are based on EU ETS data. They were derived from emissions and activity data on annual production of quicklime reported under EU ETS scheme. Detailed information on how the plant-specific data was determined and how time series consistency between the EU ETS data (after 2005) and earlier plant specific data was ensured is presented in the following paragraph. EFs from both before 2005 and for EU ETS data based on plant specific production conditions. There are three producers of lime in Slovenia and the data for both periods were obtained from these three lime works. The same sources of raw material and methodology were used for calculation both, before and after 2005 EFs. Before the year 2005 the producers have reported data directly to Agency of the Republic of Slovenia, after 2005, when Slovenia entered into EU ETS scheme, they have reported data via EU ETS. To calculate emissions from lime production after 2005 we have been using data obtained by ETS. These data have been annually verified by independent verifiers. The EFs for lime production is calculated annually on data (amount of CaO and MgO or amount of CaCO3 and amount of lime produced) obtained from these three producers.
- 2A3 Limestone and dolomite use: SO_2 scrubbing & Ceramics production: Data on CaCO3 and MgCO3 for the period 2005–2010 have been obtained from verified ETS reports.
- 2A3 Limestone and dolomite use: Ceramics production: Activity data on CaCO3 and MgCO3 due to limestone and dolomite use in ceramics production for the period 2005–2010 have been obtained from verified ETS reports.
- 2C1 Iron and Steel production: For the period 2005-2010 Slovenia has used precise and verified data obtained from EU ETS.
- 2C5 Aluminium – Anode burn-off: From the same source (EU-ETS) more precise data have been obtained on anode burned-off from Slovenian only aluminium producer and associated CO_2 emissions have been recalculated for the period 2005 to 2009.
- QA/QC: QC procedures for the plant data included in the inventory that are collected under the European Union Emissions Trading Scheme (EU ETS) have been performed. ETS emissions data from verified printed reports have been compared with data obtained in electronic form. ETS emissions data are collected by EU ETS experts from Environmental Agency of Republic of

Slovenia. As national inventory team and EU ETS experts work together in the same institution, even in the same unit, it is very easy to access these hard copy reports for each company. Besides the data, reports include also the description of monitoring of this data, eventual stops and changes of production. As Slovenia is small country only 12 installations from EU ETS report process emissions (2 cement, 3 lime, 3 steel and 4 glass producers), this QC can be performed manually. After entering this data to the calculation spreadsheet the QC is performed.

16.3 Key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000) for the EU-27. The tables are included in Annex 2.1.

16.4 Information on the quality assurance and quality control plan

Table 16.4 gives an overview of QA/QC procedures in place for the new EU Member States.

Table 16.4 Overview of quality assurance and quality control procedures for the new MS (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Bulgaria	The ExEA is also responsible for coordination and implementation of QA/QC activities for the national inventory. A quality manger is in place. The Bulgarian Quality Management System was established in the frame of project with Bulgarian Academy of Science, Geophysical Institute. The project was carried out and finished in 2008. The QA/QC plan is an internal document to organize, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate. The QA/QC plan has been updated in August 2010 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in September 2010. National QA/QC Plan includes following elements: Responsible institutions; Data collection; Preparation of inventory; QC Procedures; QA Procedures; Uncertainty evaluation; Organisation of the activities in quality management system; Documentation and archiving. The legal and institutional arrangements within the BGNIS regulate the responsibilities of all engaged institutions for implementation of the requirements of the National QA/QC Plan. The QC procedures are performed by the sectors, who are directly involved in the process of preparation of inventory with their specific responsibilities. The QC procedures are implemented by all activity data provider and ExEA's sector experts (Order N 202/29.09.2010 by the Executive Director of ExEA) and/or external consultants. For 2013 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.	Short NIR of GHG emissions in Republic Bulgaria 1988-2011 Jan 2013 p 19 ff

MS	Description of the national QA/QC activities	Source
Cyprus	In this framework, a QA/QC system is being implemented since the May 2007. The Ministry of Agriculture, Natural Resources and Environment is responsible for the implementation of the QA/QC system. The system has the following objectives: 1. Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. 2. Continuous improvement of GHG emissions/removals estimates. 3. Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements The accomplishment of the above-mentioned objectives can only be ensured by the implementation, from all the members of the Inventory Team (see Figure 1.4 for the flow chart of activities concerning emissions inventory), of the QA/QC procedures included in the plan for the following: • Data collection and processing. • Applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals. • Making quantitative estimates of inventory uncertainty. • Archiving information and record keeping. • Compiling national inventory reports. The QA/QC system developed covers the following processes (see Table 1.6 for the list of procedures within each process and Figure 1.5 for the relationship between the processes and the activities of the inventory team): QA/QC system management: comprises of all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the abovementioned quality objectives. Quality control: directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. Archiving inventory information: comprises of activities related to central archiving of inventory information and the compilation of the national inventory report. Quality assurance: comprises of activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public Estimation of uncertainties: defines procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory. Inventory improvement: related to the preparation and the justification of any recalculations made. The implementation of the plan started in May 2007 and the first internal review was carried out in October 2011.The outcome of the review is the current version of the QA/QC. No activities have yet taken place for the procedure no. QM 03 concerning training.	National GHG Inventory Report 1990-2011 2013 Submission Jan 2013 pp 16-19
Czech Republic	In the "in-country review" in October of 2009, the original QA/QC plan was considered inadequate and thus it was necessary to immediately establish a new conception of the QA/QC plan, an outline of which is presented in this chapter. The QA/QC system is an integral part of the national system. It ensures that the greenhouse gas inventories and reporting are of high quality and meet the criteria of transparency, consistency, comparability, completeness, accuracy and timeliness set for the annual inventories of greenhouse gases. The objective of the National Inventory System (NIS) is to produce high-quality GHG inventories. In the context of GHG inventories, high quality provides that both the structures of the national system (i.e. all institutional, legal and procedural arrangements) for estimating GHG emissions and removals and the inventory submissions (i.e. outputs, products) comply with the requirements, principles and elements arising from UNFCCC, the Kyoto Protocol, the IPCC guidelines and the EU GHG monitoring mechanism (Decision of the European Parliament and of the Council No 280/2004/EC). Annex 8 provides general form for QC procedures which is used in CR by each sectoral expert. Possible findings are examined and if possible corrected or included in Improvement plan for future submissions. Quality assurance comprises a planned system of review procedures. The QA reviews are performed after application of the QC procedures to the finalised inventory. The inventory QA system comprises reviews and audits to assess the quality of the inventory and the inventory preparation and reporting process, to determine the conformity of the procedures employed and to identify areas where improvements could be made. While QC procedures are carried out annually and for all the sectors, it is anticipated that QA activities will be performed by the individual sectors at longer intervals. Each sector should be reviewed by a QA audit approx. once in three years, as far as possible. In addition, QA activities should be focused mainly on key categories. Peer reviews (QA procedures) are sector- or category-specific projects that are performed by external experts or groups of experts. The reviewers should preferably be external experts who are independent of the inventory preparation. The objective of the peer review is to ensure that the inventory results, assumptions and methods are reasonable, as judged by those knowledgeable in the specific field.	National GHG Inventory Report 2013 of the Czech Republic, Apr 2013 Pp 28-31-11

MS	Description of the national QA/QC activities	Source
Estonia	This section presents the general QA/QC program including the quality objectives and the QA/QC plan for the Estonian greenhouse gas inventory at the national inventory level. Source specific QA/QC details are discussed in the relevant sections of this NIR. All institutions involved in the inventory process (MoE, EERC, EEIC and TUT) are responsible for implementing the QC procedures to meet the data quality objectives. MoE as a national entity is responsible for overall QC and is in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in EERC, EEIC and TUT. EERC as the quality coordinator has an overall responsibility for coordinating and implementing the QA/QC plan. EERC checks the QC reports of EERC, EEIC and TUT performed by sectoral experts, and the QA report performed by independent experts. Also a public review is carried out annually. The draft NIR is uploaded to the MoE website www.envir.ee where all interested parties have an opportunity to comment on it. During the Twinning Light project "Improving the quality of Estonia's National Greenhouse Gas Inventory" with Finland in 2009 Estonia updated its QA/QC plan. The Estonia's QA/QC plan consist of seven parts: (1) production plan (see Table 1.1); (2) annual meetings; (3) QA/QC checks; (4) QA results documentation form; (5) archiving structure; (6) response tables to the review process and (7) a list of planned activities and improvements.	Greenhouse Gas Emissions in Estonia 1990-2011 Jan 2013 p 35-37
Hungary	QA/QC activities are performed in two levels: based on the ISO 9001 standards and following the IPCC recommendations. The Hungarian Meteorological Service introduced the quality management system ISO 9001:2000 in 2002 for the whole range of its activities which was quite unique among meteorological services. However, GHG inventory preparation was not among its activities in that time. Therefore, the scope of our ISO accreditation had to be modified and lots of efforts have been made to bring also the national system under the umbrella of the ISO QM system. Several regulatory ISO documents were created, among others: ISO procedure on the activities of the GHG Division; QA/QC plan; registers and records for quality checks and documentation. As part of the QA and verification activities there is an ongoing QA procedure between the two institutes involved in the forestry part of the inventory. Peer-reviews will be conducted depending on available resources. In 2012 the EU carried out a comprehensive individual technical review concentrating on the years 2005, 2008, 2009 and 2010, which can be regarded as an additional QA activity. Further QA and verification activities to be continuously performed and/or planned: · Checking the results of the EU's internal review for the EU15, and analyze its relevance for Hungary. · Checking the differences in activity data to increase the consistency between different emission databases, especially the GHG inventory, LRTAP inventory, ETS data, NAMEA data, and the E-PRTR data. · Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions. · Comprehensive consistency check between national energy statistics and IEA time series. · R+D projects. The Hungarian Meteorological Service funds research and development projects for the improvement of the inventory whenever possible. · Training plan.	NIR for 1985-2011, Hungary (Draft Excerpts) Jan 2013, pp 19-21

MS	Description of the national QA/QC activities	Source
Latvia	According to CoM Regulation No. 217 (17.02.2009) all institutions involved in inventory process are responsible for implementing QC procedures. Mainly Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000 are used. The legislation act determines: -) the quality objectives for GHG inventory; -) QA/QC plan that has been prepared to improve transparency, comparability, and completeness of GHG inventory. In the QA/QC plan quality control procedures to be used before and during the compilation of GHG inventory are described. -) tasks and responsibilities of involved institutions; -) check-list and procedure description for independent experts for quality assurance of GHG inventory. The result of quality depends on four main stages – planning, preparation, evaluation and improvements and is ensured by inventory experts during compilation and reporting of inventory. The quality objectives for the 2013 inventory were the following: In order to ensure improvements: • All improvements promised in the NIR are carried out; • Feedback on reviews is systematic; • Inventory QC procedures meet requirements. In order to ensure transparency: • transparent information is included in the National Inventory Report and CRF (including information regarding the used methodology, activity data and emissions in tables); • key words and indicators is used according to the IPCC guidelines; • recommendations of inventory reviews regarding transparency is taken into account as far as possible; • documentation regarding quality control check is indicated; • a summary regarding the changes since the last inventory in relation to transparency is provided in the National Inventory Report. In order to ensure consistency: • time series are consistent; • recommendations received during inventory review regarding consistency is taken into account after evaluation as far as possible; • information regarding consistency and recalculations is provided in the National Inventory Report; • an explanation for a decline or increase in emissions of time series is provided. In order to ensure comparability: • methodologies and formats used in the inventory meet comparability requirements; • emissions and CO_2 removal is localized and distributed according to the IPCC. In order to ensure completeness: • emissions from all potential sources and gases is calculated; • recommendations of review – international experts – regarding improvements is taken into account as far as possible; • information regarding completeness is provided in the National Inventory Report; • all reasons for recalculations and reasons why a designation NE (not evaluated) and IE (included elsewhere) is used instead of data is indicated; In order to ensure accuracy: • Tier 2 or a higher method is used for the main sources as far as possible; • uncertainties is calculated and information is provided in the National Inventory Report; • a summary regarding changes in uncertainties and regarding improvements in comparison with the previous inventory is provided in the National Inventory Report. In order to ensure timeliness: • inventory reports reach their recipient (EU / UNFCCC) within the set time.	Latvia's National Inventory Report 1990-2011 March 2013 p 39 ff

MS	Description of the national QA/QC activities	Source
Lithuania	The overall aim of the quality system is to maintain and improve the quality in all stages of the inventory work, in accordance with decision 19/CMP.1. The quality objectives of the QA/QC plan and its application are an essential requirement in the GHG inventory and submission processes in order to ensure and improve the inventory principles: transparency, consistency, comparability, completeness, accuracy, timeliness and confidence in the national emissions and removals estimates for the purposes of meeting Lithuania's reporting commitments under the UNFCCC and the Kyoto protocol. In addition, one of the objectives of the quality system is to determine short-term and long-term activities for the GHG inventory improvement plan. QA/QC plan was updated in 2012. The Ministry of Environment and the Environment Protection Agency was responsible for the development of the updated QA/QC Plan. The EPA will be responsible for the coordination and implementation of the Plan with a supervision performed by the MoE. The QA/QC Plan describes the quality objectives of the GHG inventory, the national system for inventory preparation, tasks and responsibilities. A description is provided of various formal procedures already implemented in the development of the GHG inventory and of planned improvements. As defined in GPG 2000, quality control is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. A basic quality control system should provide routine checks to ensure data integrity, correctness, and completeness and identify errors or omissions. In addition, procedures for documentation and archiving of inventory material and recording of all quality control activity data should be developed. Quality Assurance (QA) activities include planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) program.	Draft National GHG Emission Inventory Report 2013 of the Republic of Lithuania, Reported inventory 1990-2011 Jan 2013 pp 50-51
Malta	The need for a standardized Quality Assurance/Quality Control (QA/QC) system within the national inventory system is recognized and is acknowledged as being an important aspect to be addressed in the ongoing development of the system in general. Work specifically aimed at developing a QA/QC system is expected to form part of the national inventory system team's work plan for 2011, to ensure the quality and reliability of the activity data, emission factors and emission estimates, in line with the principles of transparency, accuracy, consistency, comparability and completeness. Efforts were made to ensure as high a level of quality and reliability as possible. A priority task has been to ensure that the best available sources of data are used, especially where these have been verified (for example data on fuel consumption in power generation plants for the most recent years has been derived from verified emission reports that local installations are obliged to submit pursuant to Directive 2003/87/EC).	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2009 Jan 2011 pp 5-7
Poland	The national entity – National Centre for Emission Management – which is responsible for preparation of GHG inventories, is also responsible for coordination and implementing the QA/QC activities. The program for Quality Assurance and Quality Control has been elaborated to improve and assure high quality of the Polish annual greenhouse gas inventory. It has been elaborated in line with the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (2000). The QA/QC program contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures. The following elements of the Quality Assurance and Quality Control system has been addressed: Inventory agency responsible for coordinating QA/QC activities, QA/QC plan, General QC procedures (Tier 1 method), Source category-specific QC procedures (Tier 2), QA review procedures, Reporting, documentation and archiving procedures.	direct communication based on NIR 2010

MS	Description of the national QA/QC activities	Source
Romania	This QA/QC Programme was established according to the UNFCCC and Kyoto Protocol's provisions related to GHG inventory preparation and national system establishment and also to 1996 Revised IPCC Methodology and Good Practice Guidance. Therefore, the document comprises information on: • The national authority responsible for the coordination of QA/QC activities; • The objectives of the QA/QC framework; • The QA/QC Plan; • The QC procedures; • The QA procedures; • The reporting, documenting and archiving procedures. According to the provisions of the Governmental Decision no.1570/2007 establishing the national system and to those in the NEPA's President Decision no. 119/2012, NEPA represents the competent authority responsible with the implementation of the QA/QC activities under the NGHGI. For this purpose, NEPA is performing the following activities: • Ensures that specific QA/QC objectives are established; • Develops and regularly updates a QA/QC plan; • Implements the QA/QC procedures Considering the provisions of relevant regulations, NEPA designated a QA/QC coordinator. The overall objective of the QA/QC programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission. Romania's QA/QC plan closely follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan constitutes the heart of the QA/QC procedures. It outlines the current and planned QA/QC activities. The specific QA/QC activities are performed during all stages of the inventory preparation. The QA/QC plan will be reviewed periodically if needed and can be modified as appropriate when changes in processes occur or based on the advice from independent reviewers. The QA/QC plan is intended to ensure the fulfillment of the NGHGI principles in Romania. The objectives of the plan include: • Applying greater QC effort for key source categories and for those source categories where data and methodological changes have occurred recently; • Periodically checking the validity of all information as changes in reporting, methods of collection or frequency of data collection occur; • Conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise; • Balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates; • Customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory; • Confirming the national statistical institute and other agencies supplying activity data to NEPA have implemented QC procedures	Romania's Greenhouse Gas Inventory 1989 – 2012 Mar 2012 p71

MS	Description of the national QA/QC activities	Source
Slovakia	The Slovak Hydrometeorological Institute has built and introduced the quality management system (QMS) according to the requirements of EN ISO 9001:2008 standard of conformity for the following activities (http://www.shmu.sk/File/cert_slovak.gif): • Monitoring of the determinants characterising the state of air and waters in the Slovak Republic. • Assessment, archiving and interpretation of data and information on the state and regime of air and waters. • Providing data and information on the state and regime of air and waters. • Study and description of the atmosphere and hydrosphere phenomena. • Education and training within the activity of the Institute. The steps in QA/QC activities are managed and documented in several protocols (verification protocol, recalculation protocol, contracts or sectoral reports) which are in full compliance with internal documentation. All documents are approved and archived. Verification procedures are provided by competent authorities in several steps. The quality manager has the overall responsibility for documentation, formal contact with sectoral experts and approval activities, taking over the sectoral reports and archiving them. The results of the check are recorded in a verification protocol, the form of which is given in the quality management system of the SHMU. The sectoral experts shall fill out the first article, sign and shall respond to the comments, specify the actions taken in response to the comments (if necessary, correct the data, calculation methodology or the report accordingly). Quality manager shall fill out the second article, check and sign. NIS coordinator shall fill out the third article, check, sign and return the verification protocol for archiving. Sectoral experts apply the QA/QC methodology according to the Quality Manual, collect data from providers and process emission inventory for a given sector – they provide partial reports with information on quality and reliability of data on activities and emissions. These partial conclusions serve as a basis to estimate total uncertainties in emission inventories by a coordinator for uncertainties for all sectors. In some cases Tier 2 – Monte Carlo methodology (wastes, energy and industry) which requires detailed review of quality of each input parameter, works out uncertainty analysis	Annual report 2013 Submission under the EC GHG Monitoring Mechanism Jan 2013, p 9-10
Slovenia	In 2009 the Republic of Slovenia has developed and mostly implemented a Quality Assurance and Quality Control plan as recommended by IPCC Good Practice Guidelines (IPCC 2000). QA/QC plan is a part of the Manual of Procedures, which has already been elaborated in 2005 and was updated in 2009. In beginning of 2009 a QA/QC manager within the inventory agency has been designated. The general part of this system is incorporated into Oracle database (ISEE – "Emission inventory" information system) which has been established in the end of 2008. The main purpose of ISEE is: • to enable collection and archiving of activity data, emission factors and other parameters including description of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions. • to enable collection and archiving of activity data, emission factors and other parameters including descriptions of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions; • to calculate GHG and other pollutant emissions; • to automatically fill in reporting tables (CRF Reporter). As all calculations are performed in the database with software generated for this purpose, no human errors, common in calculations made in Excel spreadsheets, are expected. After these procedures, the activity data (fuel consumption and NCV) are transferred into the database, while EFs are imported manually. Then emissions are calculated automatically according to the built-in formulas. For 2008 and 2009, GHG emissions were also calculated in Excel spreadsheets. Both estimates were compared and all differences were carefully investigated and corrected.	Slovenia's National Inventory Report 2012 (selected chapters) Jan 2012 pp.15-16

16.5 **Uncertainty estimates**

Table 16.5 gives an overview of information provided by the new Member States on uncertainty estimates in their national inventory reports 2011 and presents summarised results of these estimates.

Table 16.5 Overview of uncertainty estimates available from new Member States

Member State	Bulgaria	Cyprus	Czech Republic	Estonia	Hungary	Latvia	Lithuania		Malta	Poland	Romania	Slovakia	Slovenia
Citation	NIR, Apr 2013, p. 67	NIR, Mar 2013, pp. 21-22	NIR, Apr 2013, pp. 35-36	Uncertainty Table 2013	NIR, May 2013, p. 23	Uncertainty Table 2013	Uncertainty Table 2013		Uncertainty Table 2013	NIR, March 2013, p. 293	Uncertainty Table 2013	Uncertainty Table 2013	NIR Mar 2013, p. 25
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes	Yes	Yes	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 2)		Yes (Annex 7)	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex III)	Yes (Annex 7)
Years and sectors included	emissions: 2011; BY-2011; excluding LULUCF	emissions: 2011; trend: 1990-2011; including LULUCF	emissions: 2011; trend: 1990- 2011; including LULUCF	emissions: 2011; trend: 1990-2011; including LULUCF	emissions: 2011; trend: BY-2011; excluding LULUCF	emissions: 2011; trend: 1990-2011; including LULUCF	emissions: 2011; trend: 1990-2011; including LULUCF		emissions: 2011; trend: 1990-2011; including LULUCF	emissions: 2011; including LULUCF	emissions: 2011; trend: BY - 2011; including LULUCF	emissions 2011; trend: 1990-2011; including LULUCF	emissions: 2011; trend: 1986-2011; including LULUCF
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2		3.39%			5.5%					4.1%			
CH_4		2.82%			16.8%					22.3%			
N_2O		6.43%			189.8%					48.8%			
F-gases		2.85%								HFC 43.6% PFC 83.6% SF6 89.1%			
Total	13.35%	15.49%	i. L.: 3.62% e. L.: 3.24%	i. L.: 31.72% e. L.: 24.93%	20.2%	i. L.: 92.6%; e. L.: 83.61%	42.23%	11.74%	4.84%		e. L.: 19.3% i. L.: 30.2%	12.92%	e. L.: 33.48% i. L.: 6.75%
Uncertainty in trend (%)	Tier 1		Tier 1		Tier 1						Tier 1	Tier 1	Tier 1
CO_2		9.36%											
CH_4		3.52%											
N_2O		0.38%											
F-gases		3.28%											
Total	±4.23% points	±16.53% points	i. L.: ±2.3% points e. L.: ±2.23% points	i. L.: ±3.64% points e. L.: ±2.78% points	±2.7% points	i. L.: ±5.99% points e. L.: ±10.13% points	±8.22% points	±2.46% points	±6.57% points		e. L.: ±2.4% points i. L.: ±13% points	±4.35% points	e.L.:±2.74% points i.L.:±4.83% points

16.6 Completeness and data basis

Table 16.6 summarises timeliness and completeness of the new Member States' submissions in 2013. It shows that GHG inventories for 2011 were submitted by all new Member States by 20 March 2013 (cut off date). The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 2.3.

Table 16.6 Date, mode and content of submissions of new Member States in 2011 (status 29 March 2013)

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
BG	15.01.2013	CDR	BGR-2013-v1.1		1988-2011	2008-2011	short NIR
BG	05.02.2013	CDR	-	x	-	-	-
BG	15.03.2013	CDR	BGR-2013-v1.2		1988-2011	2008-2011	x
BG	12.04.2013	CDR	-	x	-	-	-
BG	15.04.2013	CDR	BGR-2013-v1.3	-	1988-2011	2008-2011	x
BG	16.05.2013	CDR	BGR-2013-v2.1	-	1988-2011	2008-2011	-
CY	24.01.2013	CDR	CYP-2013-v1.1		1990-2011	-	-
CY	01.02.2013	CDR			-	-	x
CY	14.03.2013	CDR	CYP-2013-v1.2		1990-2011	-	x
CZ	15.01.2013	CDR	CZE-2013-v1.1		1990-2011	2008-2011	short NIR

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
CZ	15.03.2013	CDR	CZE-2013-v1.2	x	1990-2011	2008-2001	x
CZ	16.04.2013	CDR	CZE-2013-v1.3	x	1990-2011	2008-2001	x
EE	15.01.2013	CDR	EST-2013-v1.2		1990-2011	2008-2011	x
EE	12.03.2013	CDR	EST-2013-v1.4		1990-2011	2008-2011	x
EE	10.04.2013	CDR	-	x	-	-	-
EE	30.04.2013	CDR	-	-	-	-	-
EE	15.04.2013	CDR	EST-2013-v1.5	-	1990-2011	2008-2011	x
HU	15.01.2013	CDR	HUN-2013-v1.1		1985-2011	2008-2011	short NIR
HU	15.03.2013	CDR	HUN-2013-v1.2	x	1985-2011	2008-2011	x
HU	15.05.2013	CDR	HUN-2013-v1.3	-	-	-	x
LT	15.01.2013	CDR	LTU-2013-v1.1		1990-2011	2008-2011	x
LT	15.03.2013	CDR	LTU-2013-v1.2	x	1990-2011	2008-2011	x
LT	09.04.2013	CDR	-	x	-	-	-
LT	15.04.2013	CDR	LTU-2013-v1.3	-	1990-2011	2008-2011	x
LV	15.01.2013	CDR	LVA-2013-v1.2		1990-2011	2008-2011	x
LV	15.03.2013	CDR	LVA-2013-v1.3		1990-2011	2008-2011	x
LV	18.03.2013	CDR	-	x	-	-	-
LV	11.04.2013	CDR	-	x	-	-	-
LV	15.04.2013	CDR	LVA-2013-v1.4	-	1990-2011	2008-2011	x
MT	15.01.2013	CDR	MLT-2013-v1.1		1990-2011	-	x
MT	12.03.2013	e-mail	-		-	-	-
MT	13.03.2013	CDR	MLT-2013-v1.2		1990-2011	-	x
MT	15.03.2013	CDR	-		-	-	x
MT	16.04.2013	CDR	MLT-2013-v1.3	-	1990-2011	-	x
PL	11.01.2013	CDR	POL-2013-v1.1		1988-2011	2008-2011	short NIR
PL	14.03.2013	CDR	POL-2013-v1.2	x	1988-2011	2008-2011	x
PL	15.05.2013	CDR	POL-2013-v2.1	-	1988-2011	2008-2011	-
RO	15.01.2013	CDR	ROU-2013-v1.1		1989-2011	1989, 2008-2011	-
RO	15.01.2013	CDR	-		-	-	short NIR
RO	15.03.2013	CDR	ROU-2013-v1.2	x	1989-2011	1989, 2008-2011	x
RO	14.05.2013	CDR	ROU-2013-v1.4	x	1989-2011	1989, 2008-2011	x
SI	15.01.2013	CDR	SVN-2013-v1.3		1986-2011	2008-2011	short NIR
SI	15.03.2013	CDR	SVN-2013-v1.4	x	1986-2011	2008-2011	x
SI	10.04.2013	CDR	-	x	-	-	-
SI	15.05.2013	CDR	SVN-2013-v1.6	-	1986-2011	2008-2011	-
SK	15.01.2013	CDR	SVK-2013-v1.1		1990-2011	2008-2011	short NIR

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
SK	25.02.2013	CDR	-		-	-	-
SK	15.03.2013	CDR	SVK-2013-v1.2		1990-2011	2008-2011	-
SK	18.03.2013	CDR	-	x	-	-	-

The grey xml files have been used for the EU-27 inventory

In response to the Saturday paper 2010 the EU mobilized the mechanisms of its national system to further enhance its QA/QC programme and develop an appropriate action plan, in consultation with the MS, geared in particular towards complementing the existing procedures and improving the completeness regarding NEs of the EU greenhouse gas inventory in 2011 and beyond (see description in Chapter 1).

GHG inventory estimates for 2011 are available for all new Member States. The EU inventory team has provided gap filled estimates for KP LULUCF for Estonia. This does not affect the EU inventory submission as KP LULUCF tables are not compiled for the EU-27.

Table 16.7 to Table 16.10 show the data basis of the 2011 EU GHG inventory.

Table 16.7 Data basis of CO_2 emissions excluding LULUCF (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	3 367	3 298	3 373	3 484	3 467	3 408	3 332	3 067	3 155	3 003
Bulgaria	80	58	46	50	52	55	54	45	48	53
Cyprus	5	6	7	8	8	8	9	8	8	8
Czech Republic	165	128	126	126	127	127	122	114	118	114
Estonia	37	18	15	16	16	19	17	14	18	19
Hungary	73	62	59	60	60	58	57	51	52	50
Latvia	19	9	7	8	8	9	8	7	9	8
Lithuania	36	15	12	14	14	16	15	13	14	14
Malta	2	2	2	3	3	3	3	3	3	3
Poland	372	358	316	318	332	333	327	312	333	330
Romania	176	124	92	99	105	103	100	83	81	88
Slovakia	61	45	41	42	42	40	40	36	38	38
Slovenia	15	15	15	17	17	17	18	16	16	16
EU-27	**4 407**	**4 139**	**4 112**	**4 246**	**4 250**	**4 196**	**4 101**	**3 770**	**3 891**	**3 743**

Table 16.8 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	438	410	369	320	313	308	304	298	296	289
Bulgaria	17	11	9	8	8	8	8	7	7	8
Cyprus	1	1	1	1	1	1	1	1	1	1
Czech Republic	18	13	11	11	11	10	11	10	10	10
Estonia	2	1	1	1	1	1	1	1	1	1
Hungary	13	10	10	9	9	9	9	9	9	8
Latvia	3	2	2	2	2	2	2	2	2	2
Lithuania	6	4	3	3	3	3	3	3	3	3
Malta	0	0	0	0	0	0	0	0	0	0
Poland	49	46	42	41	41	40	39	38	39	38
Romania	43	31	26	26	26	25	25	24	23	22
Slovakia	4	4	4	4	4	4	4	4	4	4
Slovenia	2	2	2	2	2	2	2	2	2	2
EU-27	**596**	**535**	**480**	**428**	**422**	**415**	**409**	**400**	**397**	**389**

Table 16.9 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	400	379	339	308	295	294	286	275	266	264
Bulgaria	12	7	6	6	5	5	5	5	5	5
Cyprus	0	1	0	0	0	0	0	0	0	0
Czech Republic	13	9	9	8	8	8	8	8	8	8
Estonia	2	1	1	1	1	1	1	1	1	1
Hungary	13	7	8	9	8	8	7	7	7	7
Latvia	4	2	2	2	2	2	2	2	2	2
Lithuania	7	3	5	6	6	7	6	4	4	4
Malta	0	0	0	0	0	0	0	0	0	0
Poland	37	30	29	29	30	31	31	27	27	27
Romania	24	16	13	15	14	14	14	12	12	13
Slovakia	6	4	4	4	4	4	4	4	3	3
Slovenia	1	1	1	1	1	1	1	1	1	1

EU-27	**522**	**462**	**417**	**389**	**376**	**376**	**367**	**346**	**336**	**335**

Table 16.10 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	HFC	27 882	39 992	44 952	54 418	55 866	58 818	62 768	66 040	69 311	70 745
	PFC	17 329	11 718	8 093	5 490	5 067	4 738	4 120	2 715	3 193	3 461
	SF_6	10 768	15 012	9 867	7 721	7 135	6 828	6 421	6 081	6 184	6 073
Bulgaria	HFC	NA,NO	2	18	112	164	204	315	340	361	396
	PFC	NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0	0	0	0
	SF_6	4	5	7	9	9	9	10	10	13	15
Cyprus	HFC	NA,NO	NA,NO	19	22	24	26	26	40	56	127
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NO	NA,NO	0	0	0	0	0	0	0	0
Czech Republic	HFC	NA,NE,NO	1	263	594	872	1 606	1 262	1 020	1 468	1 130
	PFC	NA,NE,NO	0	9	10	23	20	27	27	29	29
	SF_6	78	75	142	86	83	76	47	50	16	35
Estonia	HFC	NA,NE,NO	25	70	118	135	149	131	138	153	159
	PFC	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0	0	0	NA,NE,NO	NA,NE,NO	NA,NE,NO
	SF_6	NA,NE,NO	3	3	1	1	1	1	1	2	2
Hungary	HFC	NA,NO	24	214	675	769	840	949	880	959	988
	PFC	271	167	212	210	3	4	4	3	1	2
	SF_6	88	170	195	238	186	253	276	221	235	184
Latvia	HFC	IE,NA,NE,NO	1	5	28	63	99	73	74	72	83
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NE,NO	0	1	8	7	9	10	14	13	12
Lithuania	HFC	NA,NO	3	14	68	93	123	153	167	190	217
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NO	0	0	1	1	1	3	3	6	8
Malta	HFC	NA,NE,NO	NA,NE,NO	8	65	88	106	117	120	122	132
	PFC	NA,NE,NO	NA,NE,NO	0	23	23	23	13	7	7	3
	SF_6	0	2	2	2	2	2	2	2	2	5
Poland	HFC	NA,NO	190	1 128	4 425	5 054	5 642	5 114	5 453	5 694	6 211
	PFC	123	149	152	161	166	158	140	59	56	50
	SF_6	NA,NO	31	24	28	35	33	34	39	37	41
Romania	HFC	NA,NE,NO	95	163	487	641	840	890	703	695	441
	PFC	2 116	1 774	1 292	82	55	24	15	7	8	11
	SF_6	NA,NE,NO	0	0	50	68	58	16	7	5	7
Slovakia	HFC	NA,NO	12	77	206	248	284	335	380	420	439
	PFC	271	114	12	20	36	25	36	18	21	17
	SF_6	0	10	13	16	17	17	19	19	20	21
Slovenia	HFC	NA,NO	32	41	133	154	177	188	196	207	217
	PFC	257	106	106	133	125	91	21	7	14	29
	SF_6	10	13	16	19	18	18	17	16	17	17
EU-27	HFC	27 882	40 376	46 971	61 352	64 172	68 913	72 321	75 554	79 709	81 285
	PFC	20 368	14 028	9 876	6 129	5 497	5 083	4 376	2 844	3 329	3 602
	SF_6	10 947	15 320	10 270	8 178	7 561	7 304	6 855	6 463	6 549	6 419

Table 16.11 shows the geographical coverage of the new Member States' national inventories. As the EU inventory is the sum of the Member States' inventories, the EU inventory covers the same geographical area as the inventories of the Member States.

Table 16.11 Geographical coverage of the new Member States

Member State	**Geographical coverage**
Bulgaria	Bulgaria
Cyprus	Area under the effective control of the Republic of Cyprus
Czech Republic	Czech Republic
Estonia	Estonia
Hungary	Hungary
Latvia	Latvia
Lithuania	Lithuania
Malta	Malta
Poland	Poland
Romania	Romania
Slovakia	Slovakia
Slovenia	Slovenia

17 EU-27 GREENHOUSE GAS EMISSION TRENDS

This chapter presents the main GHG emission trends in the EU-27. Firstly, aggregated results are described for EU-27. Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EU GHG trends is given. Finally, also the trends of indirect GHGs and SO_2 emissions are also presented.

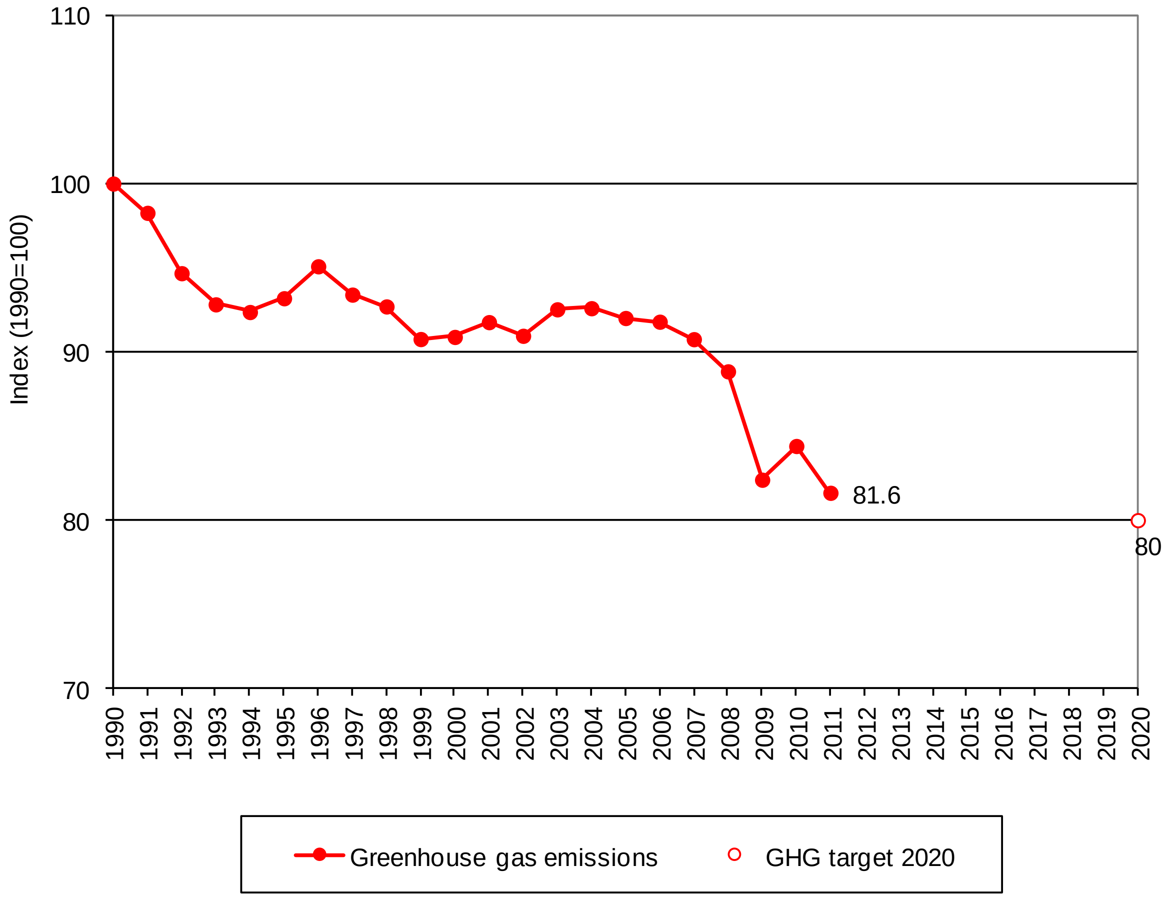
17.1 Aggregated greenhouse gas emissions

On 23 January 2008 the European Commission adopted the 'Climate Action and Renewable Energy' package. The proposal was part of draft legislation implementing the 'Integrated Energy and Climate Change' package of 10 January 2007, which was endorsed by the European Council in March 2007. In December 2008 the European Parliament and the Council reached agreement on the package. It was adopted by the Council on 6 April 2009. The package underlines the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal the EU committed to a unilateral emission reduction target of 20%[49] by 2020, compared with 1990 levels, and agreed to a reduction by 30% provided that other major emitters agree to take on their fair share of a global reduction effort.

Total GHG emissions, without LULUCF, in the EU-27 decreased by 18.4 % between 1990 and 2011 (-1024 million tonnes CO_2 equivalents). Emissions decreased by 3.3 % (155,0 million tonnes CO_2 equivalents) between 2010 and 2011 (Figure 17.1).

[49] All emission information for EU-27 in this report uses 1990 as the starting point when addressing emission reductions. EU-27 does not have a common target under the Kyoto Protocol in the same way as EU-15.

Figure 17.1 EU-27 GHG emissions 1990–2011 (excl. LULUCF)



Notes: GHG emission data for the EU-27 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

17.1.1 Main trends by source category, 1990-2011

Table 17.1 shows the source categories contributing the most to changes in greenhouse gas emissions between 1990 and 2011.

Table 17.1 EU-27: Overview of Top decreasing/increasing source categories 1990-2011 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-27
	Million tonnes (CO_2
Road Transportation (CO_2 from 1A3b)	152.1
Consumptions of halocarbons (HFC from 2F)	80.1
Cement Production (CO_2 from 2A1)	-23.1
Production of halocarbons (HFC from 2E)	-26.7
Nitric Acid Production (N_2O from 2B2)	-40.6
Enteric fermentation (CH_4 from 4A)	-47.4
Manufacture of Solid fuels (CO_2 from 1A1c)	-49.5
Adipic Acid Production (N_2O from 2B3)	-59.1
Solid waste disposal on land (CH_4 from 6A)	-62.7
Agricultural soils (N_2O from 4D)	-68.0
1B Fugitive emissions from fuels (CH_4)	-73.4
Households and servicies (CO_2 from 1A4)	-177.8
Iron and Steel Production (CO_2 from 1A2a +2C1)	-85.4
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-226.6
Public Electricity and Heat Production (CO_2 from 1A1a)	-226.5
Total	**-1,024.2**

Notes: *As the table only presents sectors whose emissions increased or decreased by 20 million tonnes CO_2-equivalents, the sum of the source categories presented does not match the total change listed at the bottom of the table.*

17.1.2 Main trends by source category, 2010-2011

Between 2010 and 2011 emissions decreased by 3.3 % in the EU-27. This was mainly due to emission decreases in the sectors households and services and public electricity and heat production. Manufacturing industries (excl. iron and steel) and road transportation also contributed significantly to the emissions reductions in 2011 (Table 17.2).

Table 17.2 EU-27: Overview of Top decreasing/increasing source categories 2010-2011 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-27
	Million tonnes (CO_2
Agricultural Soils (N_2O from 4D)	4.2
Solid Waste Disposal (CH_4 from 6A)	-3.6
Iron and Steel Production (CO_2 from 1A2a +2C1)	-3.6
Nitric acid production (N_2O from 2B2)	-4.0
Road Transportation (CO_2 from 1A3b)	-8.4
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	-10.7
Public Electricity and Heat Production (CO_2 from 1A1a)	-19.7
Households and servicies (CO_2 from 1A4)	-104.3
Total	**-155.0**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2- equivalents, the sum of the source categories presented does not match the total change listed at the bottom of the table*

17.1.3 Main reasons for emission changes 2010-2011

Between 2010 and 2011, emission decreases in the EU-27 were mainly due to:

- CO_2 from households and services (-104.3 million tonnes or -14.5 %)

  This decrease was mainly caused by emission reductions in the EU-15. Within the new Member States Poland and the Czech Republic reported the highest decreases.

- CO_2 from public electricity and heat production (-19.7 million tonnes or -1.6 %)

  This decrease was mainly caused by the EU-15, while Bulgaria, Romania and Poland had an opposing trend.

- CO_2 from manufacturing industries excl. iron and steel (-10.7 million tonnes or -2.0 %).

  This decrease was mainly due to EU-15 Member States. Half of the new Member States also reported slightly decreasing emissions, while especially Romania's emission increased by 12 %

- CO_2 emissions from road transport (-8.4 million tonnes or -1 %)

  This decrease was mainly due to emission reductions in the EU-15. Most of the new Member States also contributed to this decreasing trend, while Estonia, Poland, Romania and Slovenia reported emission increases.

- Other major emission decreases occurred in nitric acid production, iron and steel production and solid waste disposal.

Substantial emission increases between 2010 and 2011 in the EU-27 were only reported for:

- N_2O from agricultural soils (+4.2 million tonnes or +1.8 %)

17.1.4 Overview of GHG emissions in new Member States

Table 17.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2011 (million tonnes)	2010-2011 (million tonnes)	Change 2010-2011 (%)	Change 1990-2011 (%)	Change base year–2011 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
EU-15	**4254.5**	**4265.5**	**3630.7**	**-159.6**	**-4.2%**	**-14.7%**	**-14.9%**	**-8.0%**
Bulgaria	109.5	132.6	66.1	5.8	9.6%	-39.6%	-50.1%	-8.0%
Cyprus	6.1	Not applicable	9.2	-0.3	-3.1%	50.3%	Not applicable	Not applicable
Czech Republic	196.0	194.2	133.5	-3.9	-2.9%	-31.9%	-31.3%	-8.0%
Estonia	40.5	42.6	21.0	1.0	4.8%	-48.3%	-50.8%	-8.0%
Hungary	99.0	115.4	66.1	-1.8	-2.6%	-33.2%	-42.7%	-6.0%
Latvia	26.3	25.9	11.5	-0.5	-4.5%	-56.3%	-55.6%	-8.0%
Lithuania	48.8	49.4	21.6	0.5	2.3%	-55.7%	-56.3%	-8.0%
Malta	2.0	Not applicable	3.0	0.02	0.8%	50.6%	Not applicable	Not applicable
Poland	457.0	563.4	399.4	-2.3	-0.6%	-12.6%	-29.1%	-6.0%
Romania	244.4	278.2	123.3	6.7	5.8%	-49.5%	-55.7%	-8.0%
Slovakia	71.8	72.1	45.3	-0.6	-1.3%	-36.9%	-37.1%	-8.0%
Slovenia	18.4	20.4	19.5	0.0	0.1%	5.8%	-4.1%	-8.0%
EU-27	**5574.4**	**Not applicable**	**4550.2**	**-155.0**	**-3.3%**	**-18.4%**	**Not applicable**	**Not applicable**

([a]) *The base year under the Kyoto Protocol for each new Member State is further outlined in Table 16.3. As Cyprus, Malta and EU-27 do not have targets under the Kyoto Protocol, they do not have applicable Kyoto Protocol base years.*

17.2 **Emission trends by gas**

Table 17.4 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2011. The most important GHG by far is CO_2, accounting for 82.3 % of total EU-27 emissions in 2011 excluding LULUCF. In 2011, EU-27 CO_2 emissions without LULUCF were 3743 Tg, which was 15.1 % below 1990 levels. Compared to 2010, CO_2 emissions decreased by 3.8%. Emissions of CH_4 and N_2O decreased in 2010, while HFCs and PFCs increased again in 2011.

Table 17.4 Overview of EU-27 GHG emissions and removals from 1990 to 2011 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Net CO_2 emissions/removals	4 143	3 851	3 822	3 963	3 944	3 927	3 790	3 449	3 595	3 445
CO_2 emissions (without LULUCF)	4 407	4 139	4 112	4 246	4 250	4 196	4 101	3 770	3 891	3 743
CH_4	596	535	480	428	422	415	409	400	397	389
N_2O	522	462	417	389	376	376	367	346	336	335
HFCs	28	40	47	61	64	69	72	76	80	81
PFCs	20	14	10	6	5	5	4	3	3	4
SF_6	11	15	10	8	8	7	7	6	7	6
Total (with net CO_2 emissions/removals)	**5 320**	**4 918**	**4 786**	**4 856**	**4 819**	**4 799**	**4 650**	**4 280**	**4 417**	**4 260**
Total (without CO_2 from LULUCF)	**5 584**	**5 205**	**5 076**	**5 138**	**5 126**	**5 068**	**4 961**	**4 602**	**4 714**	**4 558**
Total (without LULUCF)	**5 574**	**5 195**	**5 066**	**5 129**	**5 117**	**5 059**	**4 952**	**4 593**	**4 705**	**4 550**

17.3 **Emission trends by source**

Table 17.5 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2011. The most important sector by far is Energy (i.e. combustion and fugitive emissions) accounting for 79.4 % of total EU-27 emissions in 2011. The second largest sector is Agriculture (10.1%), followed by Industrial Processes (7.3 %).

Table 17.5 Overview of EU-27 GHG emissions in the main source and sink categories 1990 to 2011 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
1. Energy	4 297	4 029	3 981	4 084	4 080	4 015	3 936	3 659	3 763	3 614
2. Industrial Processes	458	437	390	403	400	412	388	323	335	332
3. Solvent and Other Product Use	17	14	13	11.993	12	12	11	10	10	10
4. Agriculture	600	517	505	478	474	475	474	463	460	461
5. Land-Use, Land-Use Change and Forestry	-255	-277	-280	-273	-298	-260	-303	-313	-288	-290
6. Waste	204	198	177	152	150	146	142	139	137	133
7. Other	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5 320**	**4 918**	**4 786**	**4 856**	**4 819**	**4 799**	**4 650**	**4 280**	**4 417**	**4 260**
Total (without LULUCF)	**5 574**	**5 195**	**5 066**	**5 129**	**5 117**	**5 059**	**4 952**	**4 593**	**4 705**	**4 550**

17.4 **Emission trends by Member State**

Table 17.6 gives an overview of new Member States' contributions to the EU GHG emissions for 1990–2011. Member States show large variations in GHG emission trends.

Table 17.6 Overview of new Member States' contributions to EU GHG emissions excluding LULUCF from 1990 to 2011 in CO_2 equivalents (Tg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	**4 255**	**4 146**	**4 138**	**4 173**	**4 138**	**4 075**	**3 989**	**3 710**	**3 790**	**3 631**
Bulgaria	110	76	60	64	65	68	67	58	60	66
Cyprus	6	7	9	9	10	10	10	10	9	9
Czech Republic	196	151	146	145	147	148	142	133	137	133
Estonia	41	20	17	18	18	21	20	16	20	21
Hungary	99	80	78	79	78	76	74	67	68	66
Latvia	26	13	10	11	12	12	12	11	12	11
Lithuania	49	22	20	23	24	26	25	20	21	22
Malta	2	2	3	3	3	3	3	3	3	3
Poland	457	432	385	390	406	408	400	381	402	399
Romania	244	173	134	142	146	143	140	120	117	123
Slovakia	72	53	49	51	51	49	49	44	46	45
Slovenia	18	19	19	20	21	21	21	19	19	20
EU-27	**5 574**	**5 195**	**5 066**	**5 129**	**5 117**	**5 059**	**4 952**	**4 593**	**4 705**	**4 550**

The overall EU GHG emission trend is dominated by the EU-15 (mainly by Germany, the United Kingdom, Italy, France and Spain) accounting for 79.8 % of total EU-27 GHG emissions. Of the new Member States Poland contributes most to the total EU-27 GHG emissions, namely 8.8 %, followed by the Czech Republic and Romania (share of 2.9 % and 2.7 %, respectively). Poland decreased GHG emissions by 12.6 % between 1990 and 2011 (-29.1 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

17.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. In the EU-27, SO_2 emissions decreased by 78 %, followed by CO (-64 %), NMVOC (-55 %) and NO_x (-48 %) (Table 17.7).

Table 17.7 Overview of EU-27 indirect GHG and SO_2 emissions for 1990–2011 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	(Gg)									
NOx	16996	14676	12674	11573	11292	10938	10125	9283.7	9144.9	8820.6
CO	66440	51296	38708	30561	29226	28526	27121	24839	25882	24103
NMVOC	17845	14411	11873	9974.9	9847.4	9182.4	8749.4	8266.7	8224.7	7993.1
SO2	25204	16733	10401	8243.3	8073.9	7743.1	6374.7	5615.8	5433.6	5615.9

Table 17.8 shows the NO_x emissions of the new Member States between 1990 and 2011. The EU-15 makes up for 79 % of total NO_x emissions, followed by Poland with a share of 9.6 % in 2011. Most new Member States reduced their emissions, only Hungary, Cyprus and Malta had emission increases between 1990 and 2011.

Table 17.8 **Overview of the EU-15 and the new Member States' contributions EU-27 NO_x emissions for 1990–2011 (Gg)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	**13 673**	**12 023**	**10 490**	**9 482**	**9 175**	**8 866**	**8 140**	**7 453**	**7 246**	**6 966**
Bulgaria	263	177	145	158	158	165	162	140	146	163
Cyprus	16	18	20	20	19	20	19	18	16	20
Czech Republic	742	430	397	279	284	286	263	253	240	226
Estonia	77	41	38	34	33	36	33	28	34	34
Hungary	9	185	185	203	202	185	169	154	152	120
Latvia	65	39	36	37	37	38	34	32	34	32
Lithuania	137	61	55	58	60	57	57	53	56	52
Malta	8	9	8	10	9	10	10	9	9	9
Poland	1 280	1 120	862	860	891	868	830	791	863	851
Romania	440	331	278	277	273	257	262	223	214	218
Slovakia	227	179	108	102	97	96	94	83	89	86
Slovenia	59	63	52	53	53	54	53	46	45	44
EU-27	**16 996**	**14 676**	**12 674**	**11 573**	**11 292**	**10 938**	**10 125**	**9 284**	**9 145**	**8 821**

Table 17.9 shows the CO emissions of the new Member States between 1990 and 2011. The EU-15 has a share of 74 %, followed by Poland and Romania. These two account for 17.4 % of EU-27 emissions in 2011. All new Member States, except for Hungary and Malta reduced emissions between 1990 and 2011.

Table 17.9 **Overview of the EU-15 and the new Member States' contributions EU-27 CO emissions for 1990–2011 (Gg)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	**53 825**	**42 345**	**31 937**	**23 992**	**22 568**	**22 087**	**20 478**	**18 419**	**19 239**	**17 844**
Bulgaria	665	367	272	265	273	246	256	243	266	277
Cyprus	60	52	35	27	26	24	21	20	18	1
Czech Republic	1 072	934	682	558	542	584	498	454	456	405
Estonia	190	165	166	139	134	149	145	146	152	137
Hungary	32	553	511	504	511	491	488	482	487	421
Latvia	455	347	289	282	282	266	249	269	259	225
Lithuania	454	239	224	203	202	189	182	171	212	194
Malta	24	30	30	29	29	30	30	31	32	31
Poland	7 406	4 547	2 633	2 649	2 857	2 739	2 769	2 715	3 052	2 916
Romania	1 415	999	1 427	1 488	1 383	1 340	1 613	1 519	1 320	1 268
Slovakia	521	427	306	281	280	252	254	218	230	237
Slovenia	321	290	195	143	140	129	136	152	158	148
EU-27	**66 440**	**51 296**	**38 708**	**30 561**	**29 226**	**28 526**	**27 121**	**24 839**	**25 882**	**24 103**

Table 17.10 shows the NMVOC emissions of the EU-27 Member States between 1990 and 2011. The EU-15 makes up 81.9 % of total NMVOC emissions in 2011. Of the new Member States Poland and Romania have the highest shares. All new Member States except for Hungary reduced emissions between 1990 and 2011.

Table 17.10 **Overview of the EU-15 and the new Member States' contributions EU-27 NMVOC emissions for 1990–2011 (Gg)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	**15 270**	**12 596**	**10 237**	**8 385**	**8 239**	**7 621**	**7 178**	**6 824**	**6 751**	**6 549**
Bulgaria	519	112	68	60	62	59	59	53	54	55
Cyprus	16	16	14	13	13	13	12	11	11	9
Czech Republic	311	215	244	182	179	174	166	151	151	140
Estonia	54	43	38	34	34	37	34	30	31	31
Hungary	54	153	149	157	163	145	148	116	98	91
Latvia	101	67	65	73	74	83	73	61	66	70
Lithuania	81	65	65	81	76	76	68	64	68	66
Malta	6	8	3	4	4	4	3	3	3	3
Poland	831	769	574	572	630	611	634	615	654	652
Romania	420	229	297	293	264	254	276	241	240	230
Slovakia	134	91	67	71	69	67	66	64	62	68
Slovenia	48	47	53	50	42	40	34	34	34	30
EU-27	**17 845**	**14 411**	**11 873**	**9 975**	**9 847**	**9 182**	**8 749**	**8 267**	**8 225**	**7 993**

Table 17.11 shows the SO_2 emissions of the new Member States between 1990 and 2011. The largest emitters beside the EU-15, which makes up 42.6 %, are Bulgaria, Poland and Romania. These three States account for 50 % of total EU-27 emissions in 2011. All new Member States except for Hungary reduced emissions between 1990 and 2011.

Table 17.11 **Overview of Member States' contributions to EU-15 and EU-27 SO_2 emissions for 1990–2011 (Gg)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	**16 459**	**9 986**	**6 144**	**4 572**	**4 353**	**4 142**	**3 090**	**2 668**	**2 451**	**2 390**
Bulgaria	1 582	1 228	1 106	1 162	1 157	1 288	1 244	1 166	1 241	1 526
Cyprus	29	37	45	35	29	27	22	17	21	21
Czech Republic	1 876	1 095	264	219	211	217	174	173	170	169
Estonia	184	77	85	83	80	86	78	64	75	73
Hungary	7	701	487	140	115	91	98	82	30	35
Latvia	105	49	16	7	6	6	5	4	3	3
Lithuania	179	74	44	39	38	29	24	27	30	32
Malta	16	27	24	12	12	13	12	8	8	8
Poland	3 210	2 376	1 445	1 233	1 311	1 223	1 001	867	950	910
Romania	836	709	515	611	655	537	544	464	373	370
Slovakia	524	245	127	89	88	71	69	64	69	68
Slovenia	197	129	98	41	18	15	13	11	10	11
EU-27	**25 204**	**16 733**	**10 401**	**8 243**	**8 074**	**7 743**	**6 375**	**5 616**	**5 434**	**5 616**

18 ENERGY (CRF SECTOR 1)

18.1 Overview of sector (EU-27)

Figure 18.1 CRF Sector 1 Energy: EU-27 GHG emissions in CO_2 equivalents (Tg) for 1990–2011

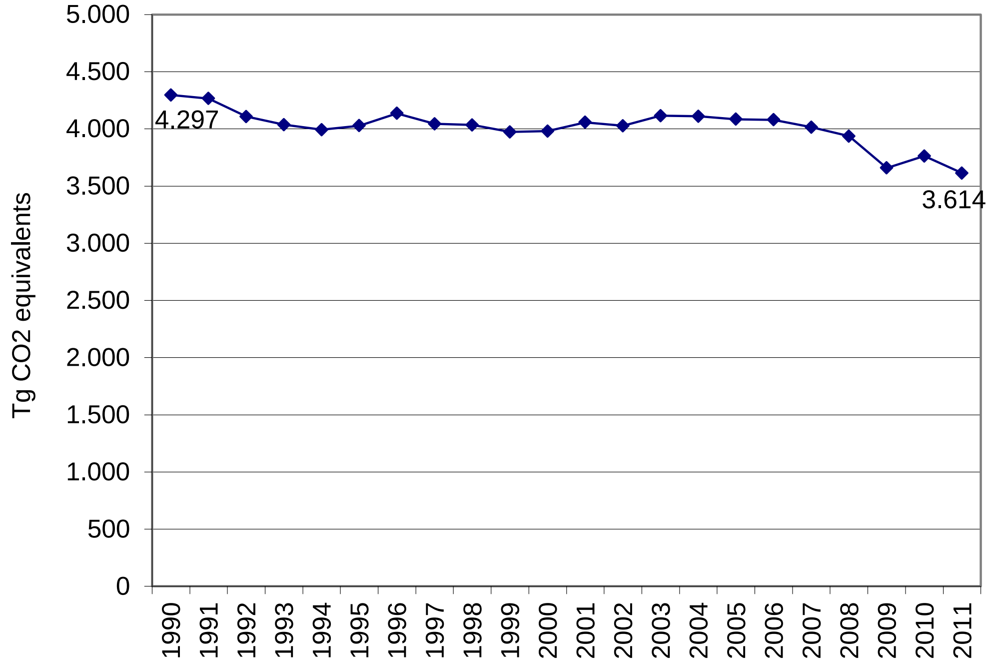
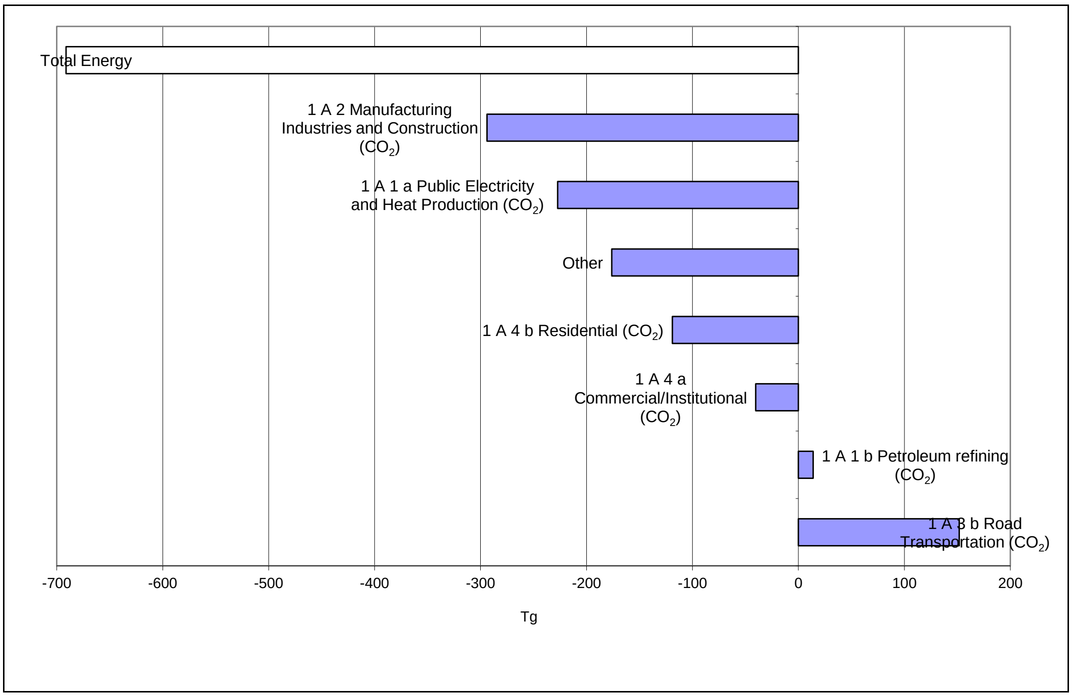
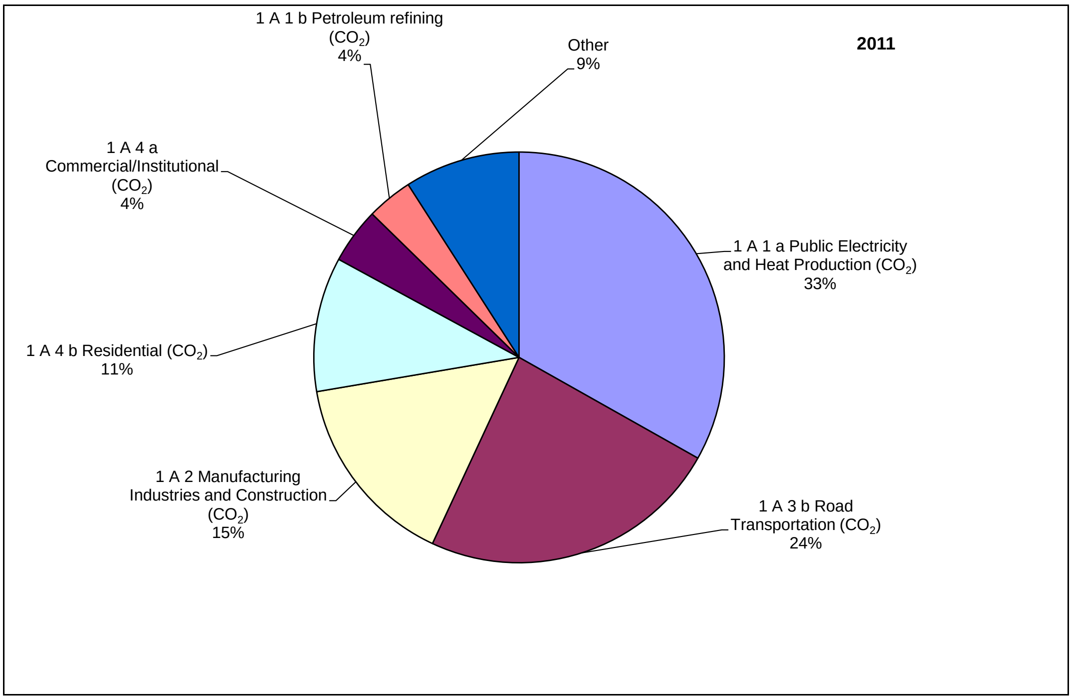


Figure 18.2 CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2011 and share of largest key source categories in 2011





18.2 **Source categories (EU-27)**

18.2.1 Energy industries (CRF Source Category 1A1)(EU 27)

18.2.1.1 ***Public Electricity and Heat Production (1A1a) (EU-27)***

Figure 18.3 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

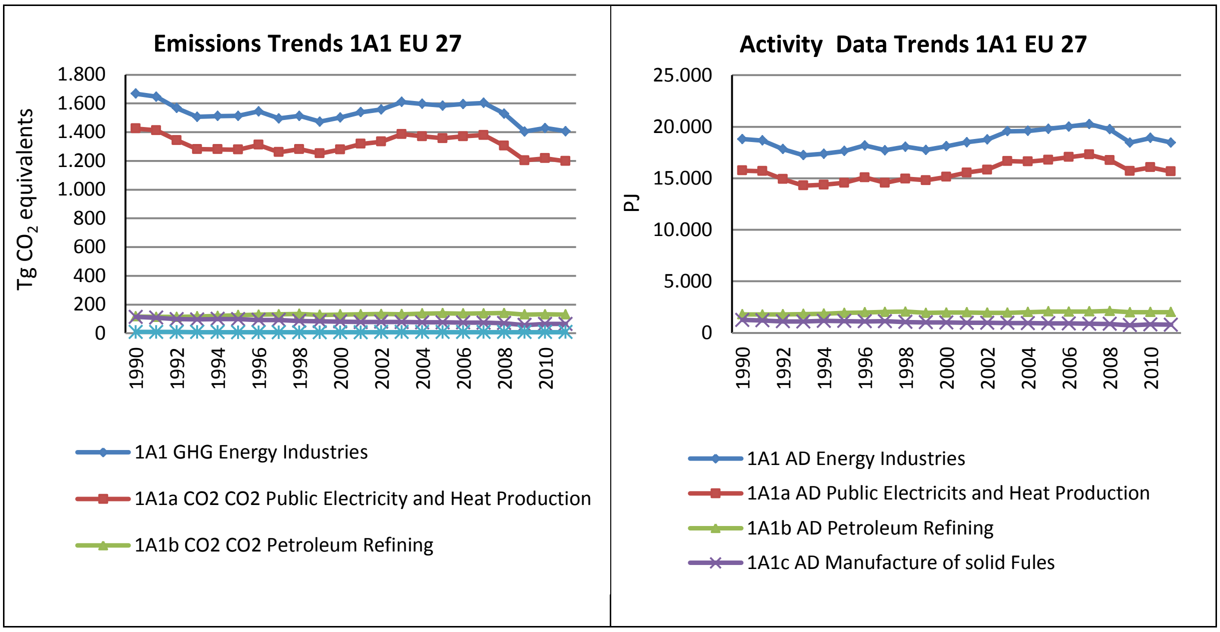


Table 18.1 **1A1a Public Electricity and Heat Production, liquid fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	123 584	35 981	25 984	74.8%	-9 997	-28%	-97 600	-79%		
Bulgaria	3 211	843	425	1.2%	-418	-50%	-2 787	-87%	T1	D
Cyprus	1 674	3 868	3 710	10.7%	-158	-4%	2 036	122%	D	CS
Czech Republic	819	188	136	0.4%	-52	-28%	-683	-83%	T1	D
Estonia	4 825	377	339	1.0%	-38	-10%	-4 486	-93%	T1,T2	CS,D
Hungary	1 830	372	177	0.5%	-194	-52%	-1 653	-90%	T2	CS,PS
Latvia	3 050	55	47	0.1%	-9	-15%	-3 004	-98%	T1	CS
Lithuania	6 021	473	199	0.6%	-274	-58%	-5 823	-97%	T1,T2	CS,D
Malta	749	1 887	1 931	5.6%	44	2%	1 182	158%	D,T1	D
Poland	5 115	635	608	1.8%	-27	-4%	-4 507	-88%	T1	D
Romania	19 932	1 005	1 114	3.2%	109	11%	-18 818	-94%	T2	CS
Slovakia	1 033	32	24	0.1%	-7	-23%	-1 009	-98%	T2	CS
Slovenia	277	23	23	0.1%	1	3%	-253	-92%	T1	D
EU-27	**172 121**	**45 738**	**34 718**	**100.0%**	**-11 020**	**-24%**	**-137 404**	**-80%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.4 **1A1a- Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2**

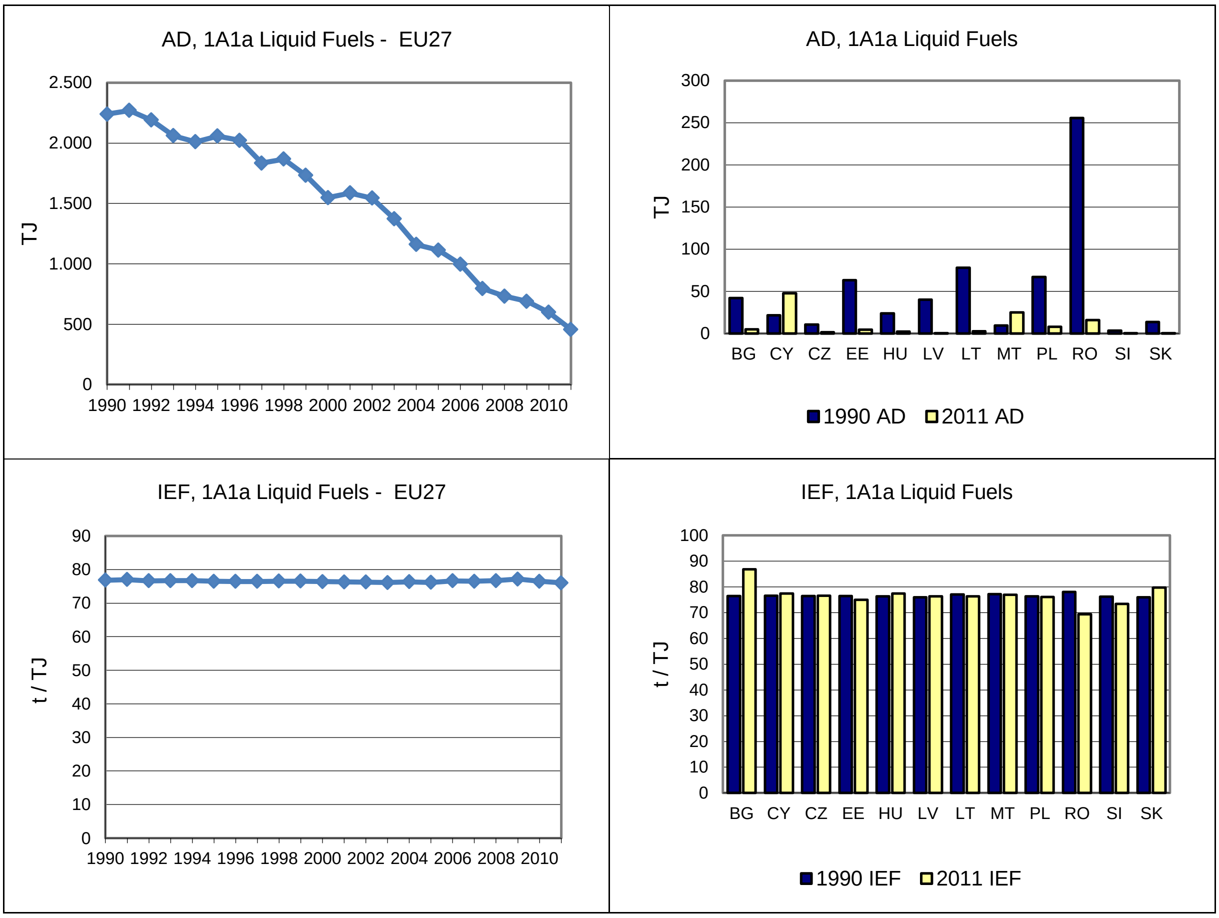


Table 18.2 **1A1a Public Electriciy and Heat Production, solid fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	752 470	554 898	566 986	65.5%	12 088	2%	-185 484	-25%		
Bulgaria	27 884	27 404	32 516	3.8%	5 112	19%	4 632	17%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	51 658	51 168	50 905	5.9%	-263	-1%	-754	-1%	T1	CS,D
Estonia	21 889	12 395	13 162	1.5%	767	6%	-8 727	-40%	T1,T2,T3	CS,D
Hungary	12 725	7 526	7 651	0.9%	125	2%	-5 074	-40%	T3	PS
Latvia	339	40	40	0.0%	0	0%	-299	-88%	T1	CS
Lithuania	185	27	28	0.0%	1	4%	-157	-85%	T2	CS
Malta	618	NO	NO	-	-	-	-618	-100%	NA	NA
Poland	220 494	159 107	160 307	148.2%	1 200	1%	-60 187	-27%	T1,T2	CS,D
Romania	25 086	20 561	24 378	22.5%	3 817	19%	-708	-3%	T1, T2	D, CS
Slovakia	11 542	4 083	4 085	0.5%	3	0%	-7 457	-65%	T2	CS
Slovenia	5 600	5 808	5 862	0.7%	54	1%	262	5%	T2	CS
EU-27	**1 130 491**	**843 017**	**865 921**	**100.0%**	**22 904**	**3%**	**-264 570**	**-23%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.5 **1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2**

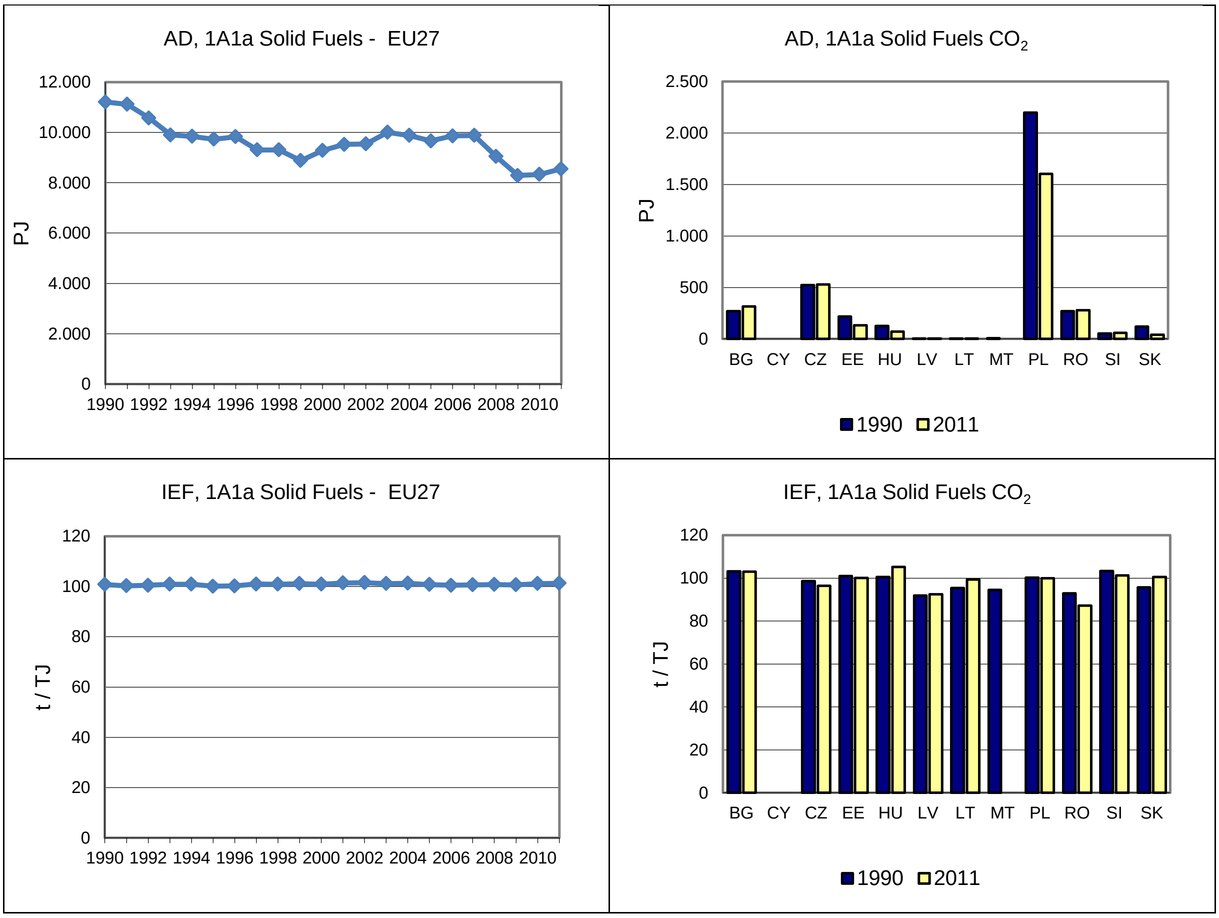


Table 18.3 1A1a Electricity and heat production, solid fuels: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6 378	3 927	3 910	75.0%	-18	0%	-2 468	-39%
Bulgaria	117	116	137	2.6%	21	18%	20	17%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	229	230	229	4.4%	-1	0%	0	0%
Estonia	4	9	9	0.2%	0	-4%	5	127%
Hungary	59	33	33	0.6%	0	1%	-25	-43%
Latvia	3	0.19	0.19	0.0%	0.00	0%	-3	-93%
Lithuania	1	0.12	0.13	0.0%	0.00	4%	-1	-85%
Malta	3	NA	NA	-	-	-	-3	-100%
Poland	1 009	731	731	14.0%	0	0%	-278.0	-28%
Romania	117	100	121	2.3%	21	21%	4	4%
Slovakia	56	19	19	0.4%	0	0%	-37	-66%
Slovenia	24	25	25	0.5%	0	1%	2	7%
EU-27	**8 000**	**5 191**	**5 215**	**100.0%**	**24**	**0%**	**-2 785**	**-35%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.4 1A1a Electricity and heat production, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	60 401	261 378	230 731	89.2%	-30 647	-12%	170 330	282%		
Bulgaria	6 264	2 147	2 273	0.9%	127	6%	-3 991	-64%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 507	1 959	1 897	0.7%	-62	-3%	389	26%	T1	CS
Estonia	1 969	1 005	914	0.4%	-91	-9%	-1 055	-54%	T2	CS
Hungary	5 825	6 722	6 068	2.3%	-654	-10%	244	4%	T2	D
Latvia	2 644	2 089	1 914	0.7%	-174	-8%	-730	-	T2	CS
Lithuania	5 806	3 214	2 651	1.0%	-562	-17%	-3 155	-54%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1 208	2 915	3 186	1.2%	270	9%	1 978	164%	T1	D
Romania	20 789	6 162	6 443	2.5%	281	5%	-14 346	-69%	T2	CS
Slovakia	2 089	2 043	2 199	0.9%	156	8%	110	5%	T2	CS
Slovenia	112	328	328	0.1%	0	0%	216	193%	T1	CS
EU-27	**108 613**	**289 961**	**258 604**	**100.0%**	**-31 357**	**-11%**	**149 991**	**138%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.6 **1A1a- Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**

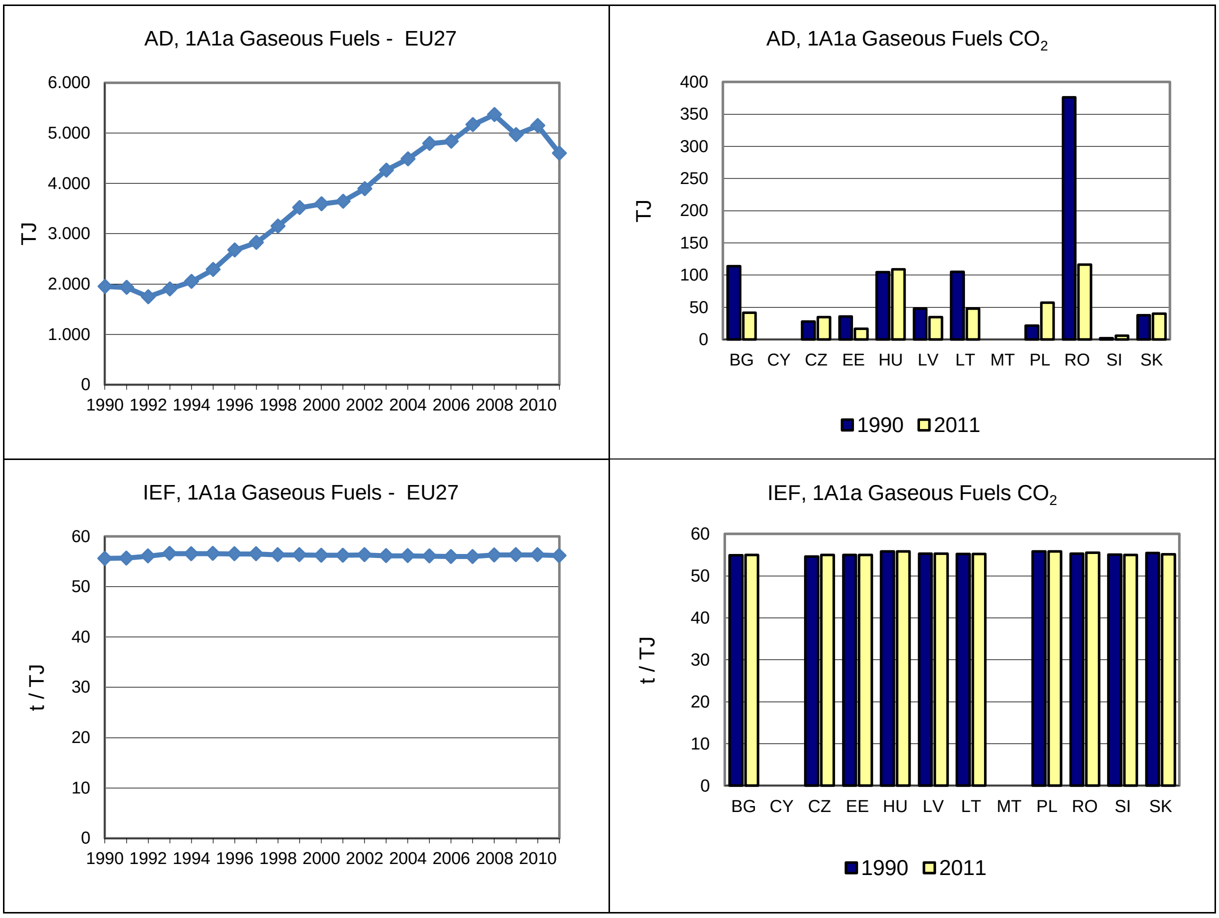


Table 18.5 **1A1a Public Electriciy and Heat Production, other fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	12 897	38 172	37 820	96.1%	-351	-1%	24 924	193%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	37	260	326	0.8%	66	25%	290	794%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	63	279	279	0.7%	-1	0%	216	343%	T2	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	738	803	846	2.2%	43	5%	108	15%	T1	D
Romania	NO	NO	4	0.0%	4	-	4	-	T2	CS
Slovakia	170	59	63	0.2%	5	8%	-107	-63%	T1a,T2	CS,D
Slovenia	NO	10	10	0.0%	0	-	10	-	T1	D
EU-27	**13 904**	**39 583**	**39 349**	**185.8%**	**-234**	**-1%**	**25 445**	**183%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.1.2 ***Petroleum Refining (1A1b) (EU-27)***

Figure 18.7 1A1b Petroleum Refining: Total, CO_2 and N_2O emission and activity trends

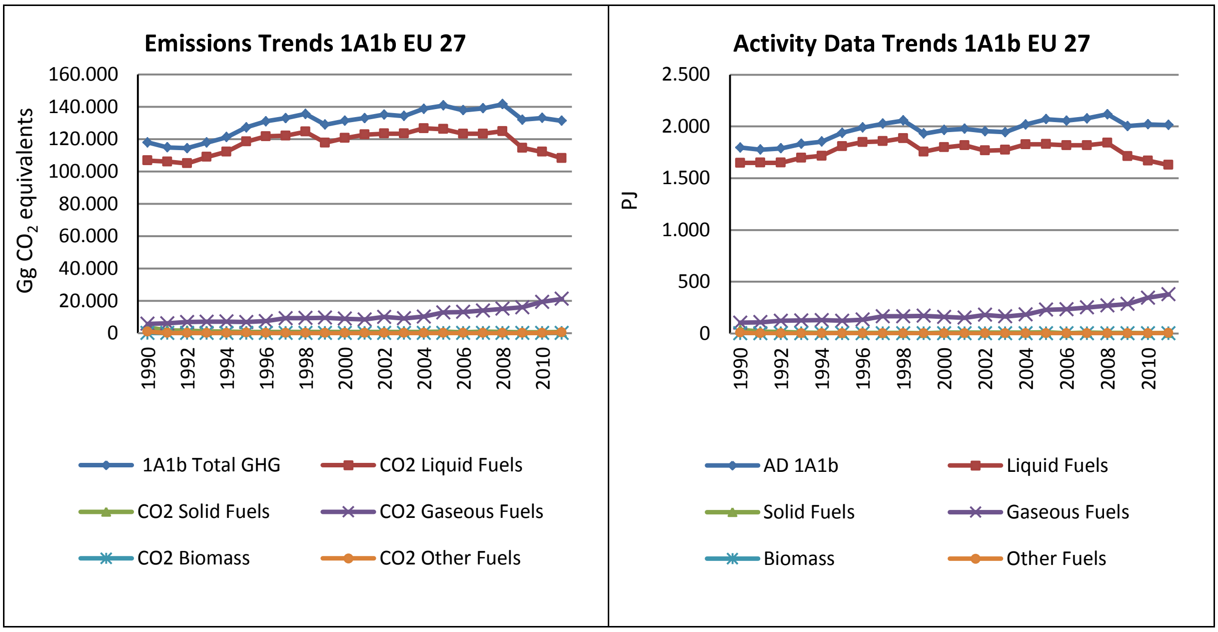


Table 18.6 1A1b Petroleum Refining, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	96 150	99 563	96 843	89.6%	-2 720	-3%	693	1%		
Bulgaria	856	960	908	0.8%	-52	-5%	53	6%	T1	D
Cyprus	91	NO	NO	-	-	-	-91	-100%	NA	NA
Czech Republic	923	910	819	0.8%	-91	-10%	-104	-11%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1 384	935	991	0.9%	56	6%	-393	-28%	T2	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 496	1 560	1 518	1.4%	-43	-3%	22	1%	T2,T3	CS,PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1 373	5 130	4 536	4.2%	-594	-12%	3 163	230%	T1	D
Romania	4 473	2 720	2 210	2.0%	-509	-19%	-2 262	-51%	T2	CS
Slovakia	IE	353	310	0.3%	-43	-	310	-	T2	CS
Slovenia	43	0	0	0.0%	0	-15%	-42	-99%	T1	D
EU-27	**106 788**	**112 131**	**108 136**	**100.0%**	**-3 995**	**-4%**	**1 347**	**1%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.8 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2

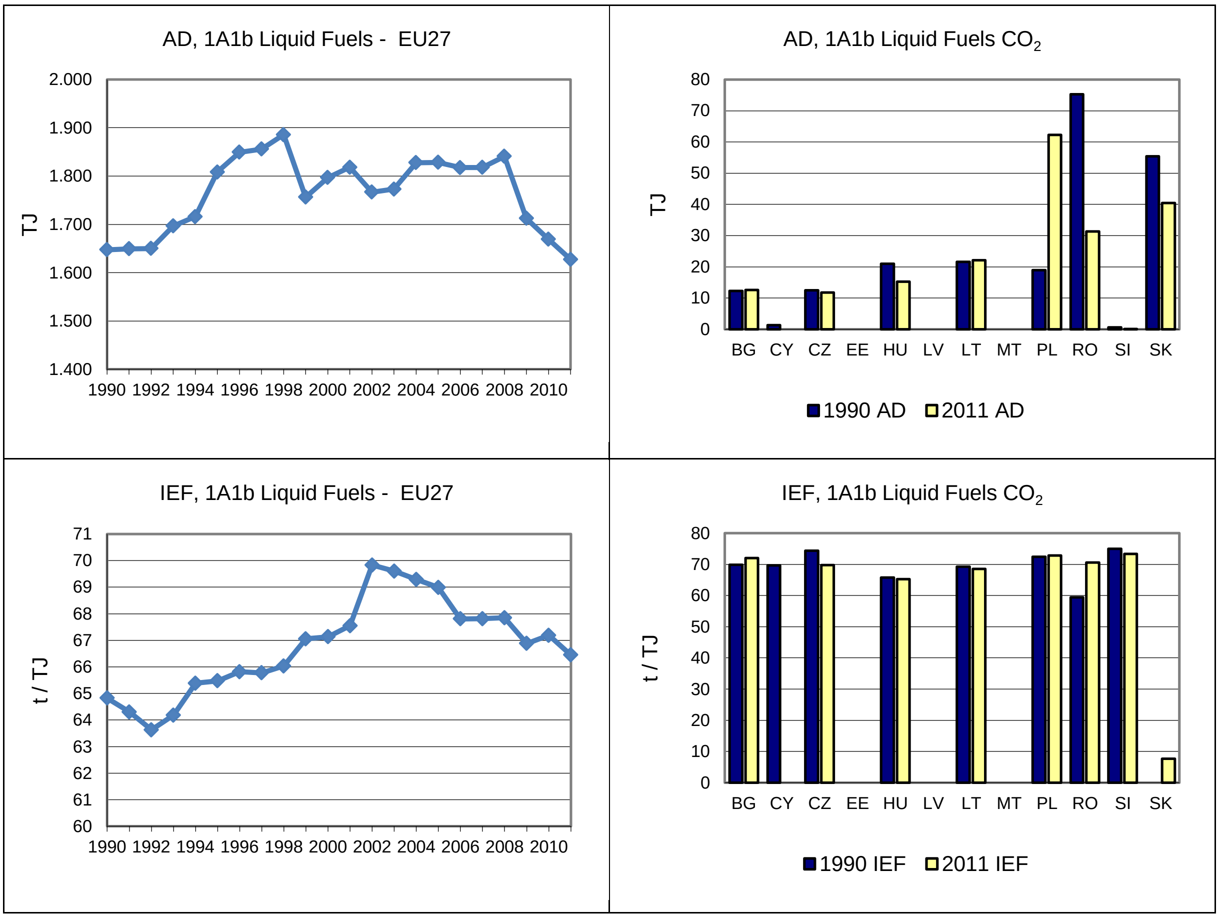


Table 18.7 1A1b Petroleum Refining, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3 575	426	575	2.9%	149	35%	-3 000	-84%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4	2	8	0.0%	5	-	3	76%	T1,T2	CS,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	18	135	171	0.9%	36	27%	153	-	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**3 597**	**564**	**754**	**100.0%**	**190**	**34%**	**-2 843**	**-79%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.8 1A1b Petroleum Refining, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3 869	15 210	16 631	82.5%	1 421	9%	12 762	330%		
Bulgaria	68	60	85	0.4%	26	43%	17	25%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	218	221	1.1%	3	1%	-96	-30%	T1	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	689	531	551	2.7%	20	4%	-138	-20%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	0	0	0.0%	0	-50%	-	-	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	93	1 074	1 562	7.7%	488	45%	1 468	1574%	T1	D
Romania	NO	911	861	4.3%	-49	-5%	861	-	T2	CS
Slovakia	647	1 343	1 264	6.3%	-80	-6%	616	95%	T2	CS
Slovenia	126	14	4	0.0%	-10	-	-122	-97%	T1	CS
EU-27	**5 811**	**19 361**	**21 179**	**100.0%**	1 818	9%	15 368	-		

Abbreviations explained in the Chapter 'Units and abbreviations'

18.2.1.3 *Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-27)*

Figure 18.9 1A1c- Manufacture of Solid Fuels and Other Energy Industries: Total, CO_2 and N_2O emission and activity trends

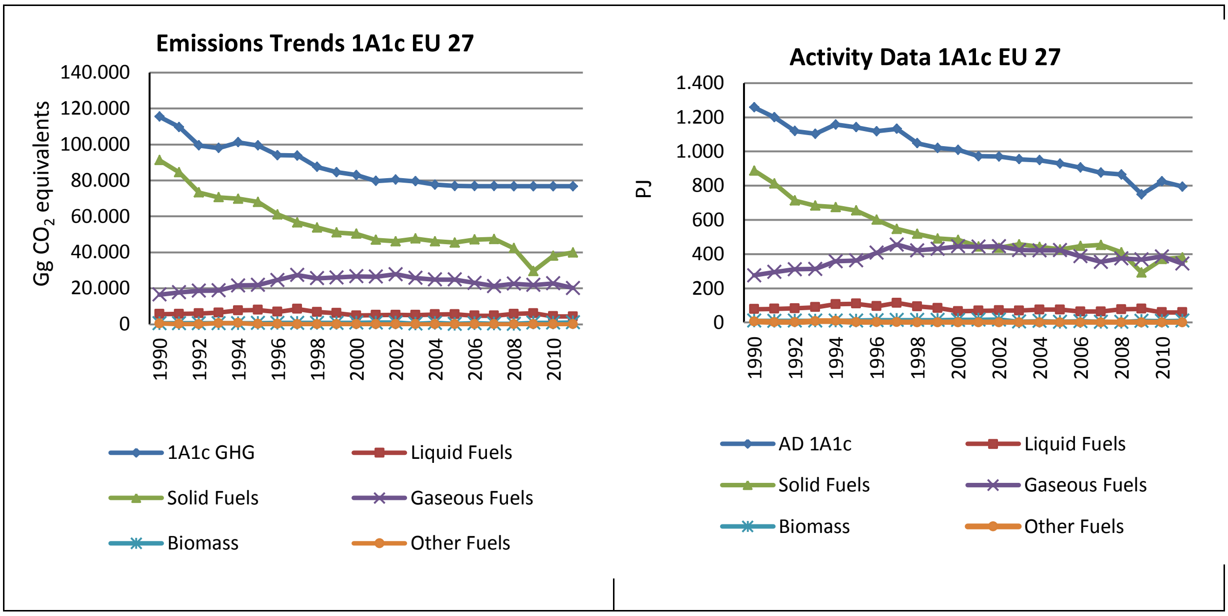


Table 18.9 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	15 768	21 258	18 786	93.2%	-2 472	-12%	3 018	19%		
Bulgaria	NO	2	1	0.0%	-1	-37%	1	-	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	8	8	0.0%	0	-1%	8	-	T1	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	IE	3	3	0.0%	0	14%	3	-	T1	D
Latvia	45	48	52	0.3%	4	8%	7	17%	T2	CS
Lithuania	NO	3	11	0.1%	7.5	223%	11	-	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	691	576	555	2.8%	-21	-4%	-135	-20%	T1	D
Romania	NO	849	696	3.5%	-153	-18%	696	-	T2	CS
Slovakia	NO	49	44	0.2%	-5	-10%	44	-	T2	CS
Slovenia	42	NO	NO	-	0	-	-42	-100%	NA	NA
EU-27	**16 545**	**22 796**	**20 156**	**100.0%**	**-2 640**	**-12%**	**3 611**	**22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.10 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	82 793	30 166	32 268	80.8%	2 102	7%	-50 525	-61%		
Bulgaria	291	4	2	0.0%	-2	-49%	-289	-99%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 393	3 838	3 752	9.4%	-86	-2%	1 359	57%	T1	CS,D
Estonia	65	418	414	1.0%	-5	-1%	349	535%	T3	PS
Hungary	118	190	196	0.5%	6	3%	78	-	T2	D,PS
Latvia	164	NO	NO	-	0	-	-164	-	NA	NA
Lithuania	NO	NO	1	0.0%	1	-	1	-	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4 085	2 178	2 053	5.1%	-125	-6%	-2 032	-50%	T1,T2	CS,D
Romania	NO	6	5	0.0%	0	-4%	5	-	T2	CS
Slovakia	1 319	1 259	1 233	3.1%	-26	-2%	-86	-7%	T2	CS
Slovenia	36	NO	NO	-	-	-	-36	-100%	NA	NA
EU-27	**91 265**	**38 058**	**39 924**	**100.0%**	**1 866**	**5%**	**-51 341**	**-56%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2 Manufacturing industries and construction (CRF Source Category 1A2)(EU 27)

18.2.2.1 *Iron and Steel (1A2a) (EU-27)*

Figure 18.10 1A2a- Iron and Steel: Total, CO_2 and N_2O emission and activity trends

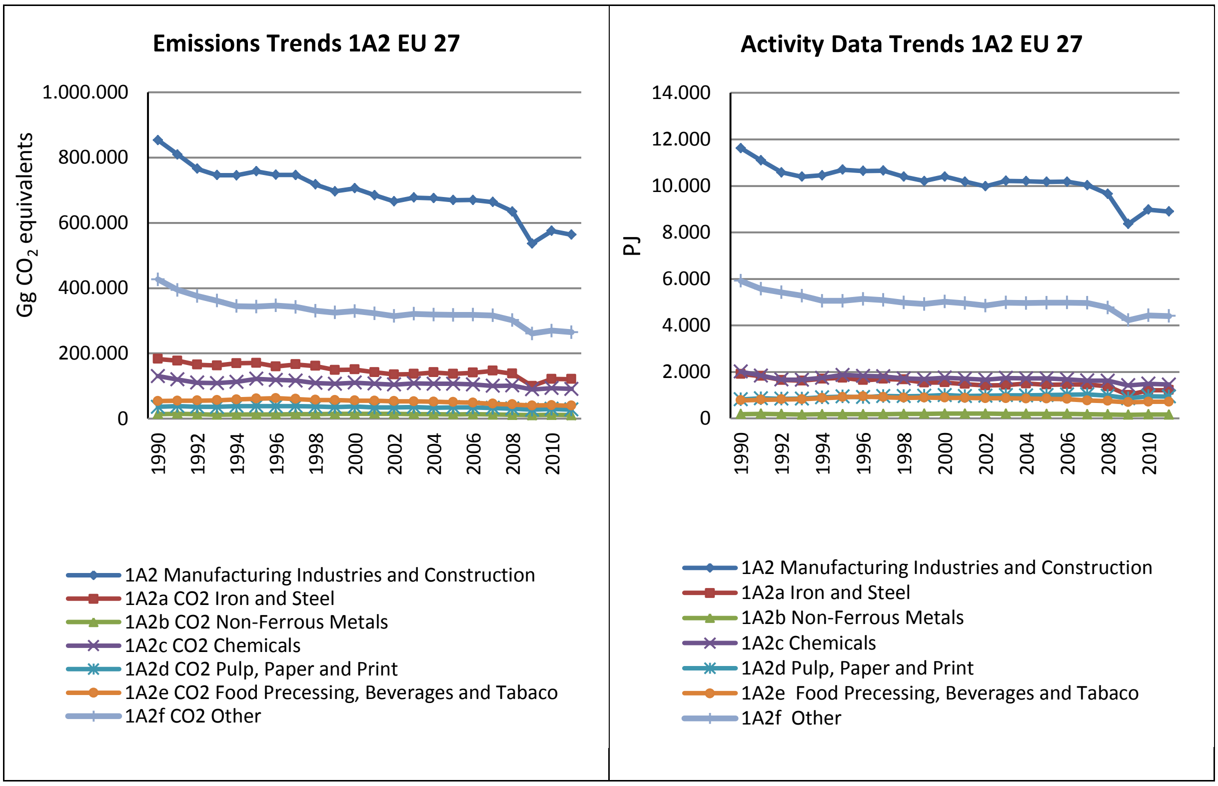


Table 18.11 1A2a Iron and Steel, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7 307	4 555	3 459	97.4%	-1 097	-24%	-3 848	-53%		
Bulgaria	37	NO	2.9	0.1%	3	-	-34	-92%	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	455	113	62	1.8%	-50	-45%	-393	-86%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	661	3	NO	-	-3	-100%	-661	-100%	NA	NA
Latvia	136	82	NO	-	-82	-100%	-136	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	855	9	9	0.3%	0	0%	-846	-99%	T1	D
Romania	NO	6	10	0.3%	3	-	10	-	T2	CS
Slovakia	164	0.3	1	0.0%	0.8	221%	-163	-99%	T2	CS
Slovenia	54	8	9	0.2%	1	14%	-45	-84%	T1	D
EU-27	**9 669**	**4 777**	**3 553**	**100.0%**	**-1 224**	**-26%**	**-6 116**	**-63%**		

Table 18.12 1A2a Iron and Steel, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	116 157	84 163	83 712	85.9%	-451	-1%	-32 445	-28%		
Bulgaria	1 622	33	41	0.0%	8	26%	-1 581	-97%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7 680	2 605	2 676	2.7%	71	3%	-5 004	-	T1	CS,D
Estonia	3	1	NO	-	-1	-100%	-3	-100%	NA	NA
Hungary	457	306	322	0.3%	16	5%	-135	-30%	T2	D,PS
Latvia	5	9	9	0.01%	0	0%	5	103%	T1	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	11 332	3 880	3 484	3.6%	-396	-10%	-7 848	-69%	T1,T2	CS,D
Romania	2 113	1 320	2 483	2.5%	1 164	88%	371	18%	T1, T2	D, CS
Slovakia	2 296	3 661	4 668	4.8%	1 007	28%	2 372	103%	T3	PS
Slovenia	56	25	29	0.0%	4	16%	-27	-47%	T1	D
EU-27	**141 721**	**96 003**	**97 425**	**100.0%**	**1 423**	**1%**	**-44 296**	**-31%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.11 1A2a Iron and Steel, solid fuels: Activity Data and Implied Emission Factors for CO_2

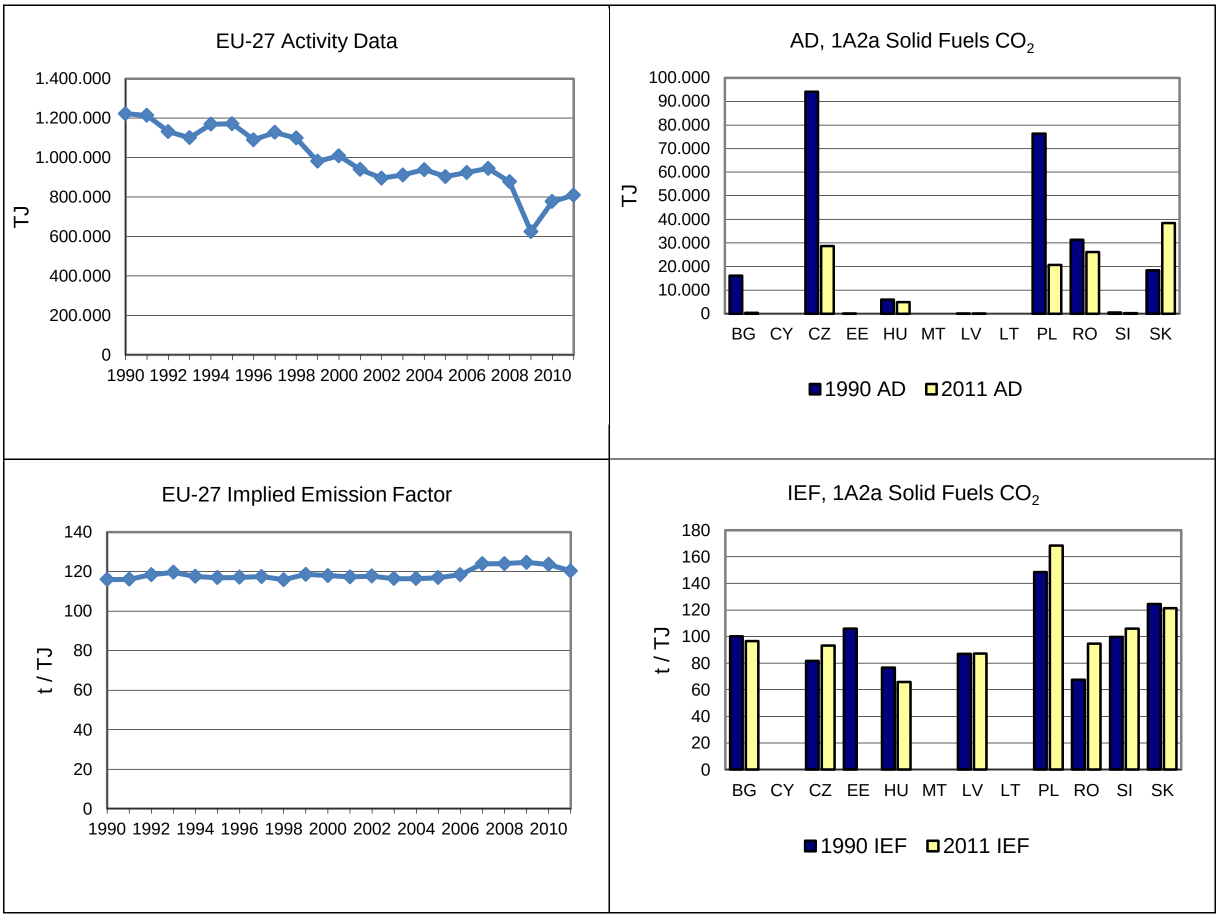


Table 18.13 **1A2a Iron and Steel, gaseous fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	17 543	17 538	16 705	83.4%	-834	-5%	-839	-5%		
Bulgaria	1 032	130	145	0.7%	15	12%	-886	-86%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	725	705	660	3.3%	-46	-6%	-66	-	T1	CS
Estonia	NO	0	0	0.0%	0	-50%	0	-	T2	CS
Hungary	1 361	84	84	0.4%	1	1%	-1 276	-94%	T2	D
Latvia	234	212	65	0.3%	-147	-69%	-169	-72%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2 950	916	923	4.6%	8	1%	-2 027	-69%	T1	D
Romania	6 661	1 100	1 191	5.9%	91	8%	-5 470	-82%	T2	CS
Slovakia	221	81	104	0.5%	23	28%	-117	-53%	T2	CS
Slovenia	308	165	156	0.8%	-8	-5%	-152	-49%	T1	CS
EU-27	**31 036**	**20 931**	**20 034**	**100.0%**	**-897**	**-4%**	**-11 002**	**-35%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.2 *Non Ferrous Metals (1A2b) (EU-27)*

Figure 18.12 **1A2b- Non ferrous Metals: Total, CO_2 emission and activity trends**

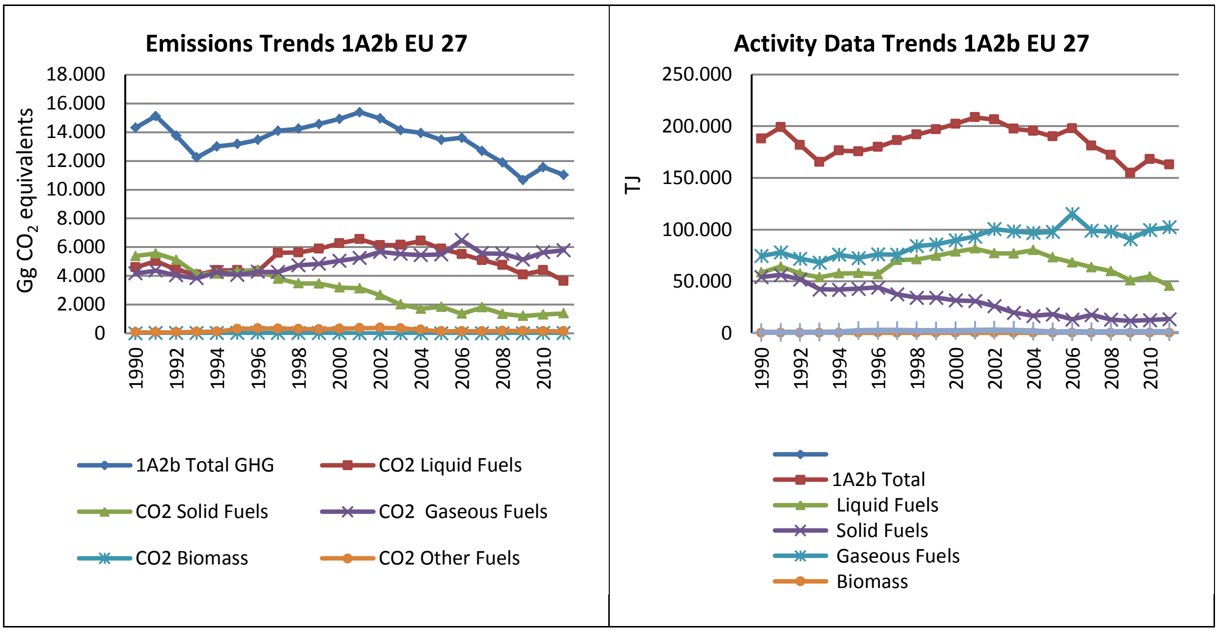


Table 18.14 1A2b Non ferrous Metals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3 295	543	539	38.7%	-4	-1%	-2 756	-84%		
Bulgaria	213	NO	NO	-	-	-	-213	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	141	18	18	1.3%	0	0%	-123	-	T1	CS,D
Estonia	NO	3	NO	-	-3	-100%	0	-	NA	NA
Hungary	IE	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	3	0	0.0%	-3	-90%	0	-	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	701	640	684	49.2%	44	7%	-17	-2%	T1,T2	CS,D
Romania	75	IE	IE	-	-	-	-75	-100%	NA	NA
Slovakia	798	91	145	10.4%	54	59%	-653	-82%	T2	CS
Slovenia	152	5	5	0.3%	0	-	-147	-97%	T1	D
EU-27	**5 374**	**1 303**	**1 391**	**100.0%**	**88**	**7%**	**-3 983**	**-74%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.15 1A2b Non ferrous Metals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	3 153	4 810	4 920	85.1%	109	2%	1 767	56%
Bulgaria	23	44	53	0.9%	9	20%	29	126%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	53	100	92	1.6%	-8	-8%	39	-
Estonia	NO	3	NO	-	-3	-100%	0	-
Hungary	87	188	190	3.3%	1	-	103	-
Latvia	NO	7	9	0.2%	2	25%	9	-
Lithuania	NO	NO	3	0.0%	3	-	3	-
Malta	IE	IE	IE	-	-	-	-	-
Poland	257	338	373	6.4%	35	10%	116	45%
Romania	IE	IE	IE	-	-	-	-	-
Slovakia	435	93	86	1.5%	-7	-7%	-349	-80%
Slovenia	163	56	55	0.9%	-2	-3%	-108	-66%
EU-27	**4 170**	**5 640**	**5 779**	**100.0%**	**139**	**2%**	**1 609**	**39%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.3 *Chemicals (1A2c) (EU-27)*

Figure 18.13 1A2c- Chemicals: Total, CO_2 and N_2O emission and activity trends

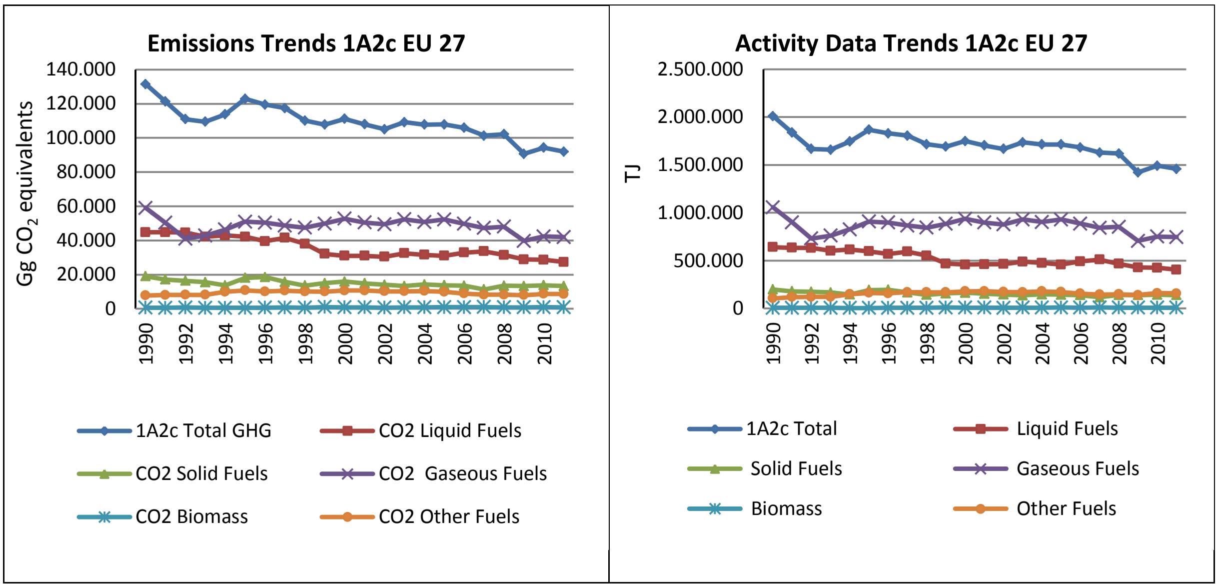


Table 18.16 1A2c Chemicals, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	38 776	22 889	22 093	80.6%	-797	-3%	-16 683	-43%		
Bulgaria	930	25	19	0.1%	-6	-24%	-911	-98%	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	2 678	2 578	2 250	8.2%	-328	-13%	-428	-	T1	D
Estonia	13	6	7	0.0%	1	17%	-6	-44%	T1,T2	CS,D
Hungary	387	69	3	0.0%	-66	-96%	-384	-99%	T2	D
Latvia	277	7	9	0.0%	2	-	-268	-97%	T1	CS
Lithuania	69	5	0	0.0%	-4	-95%	-68	-100%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	306	1 495	1 379	5.0%	-117	-8%	1 073	350%	T1	D
Romania	NO	667	734	2.7%	67	10%	734	-	T1, T2	D, CS
Slovakia	1 363	961	881	3.2%	-80	-8%	-482	-35%	T2	CS
Slovenia	31	24	20	0.1%	-4	-17%	-11	-35%	T1	D
EU-27	**44 829**	**28 727**	**27 395**	**100.0%**	**-1 332**	**-5%**	**-17 434**	**-39%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.17 1A2c Chemicals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	8 412	3 352	3 548	26.7%	196	6%	-4 864	-58%		
Bulgaria	416	314	371	2.8%	57	18%	-45	-11%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	6 313	4 761	3 987	30.0%	-774	-16%	-2 326	-	T1	CS,D
Estonia	621	NO	NO	-	0	-	-621	-100%	NA	NA
Hungary	61	3	3	0.0%	0	-	-58	-95%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	1 025	4 824	4 838	36.3%	14	0%	3 812	372%	T1,T2	CS,D
Romania	594	485	477	3.6%	-8	-2%	-117	-20%	T1, T2	D, CS
Slovakia	1 584	96	85	0.6%	-11	-12%	-1 499	-95%	T2	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NA	NA
EU-27	**19 027**	**13 835**	**13 308**	**100.0%**	**-526**	**-4%**	**-5 718**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.18 1A2c Chemicals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	35 016	35 370	34 909	83.1%	-461	-1%	-107	0%		
Bulgaria	1 437	535	712	1.7%	177	33%	-726	-50%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	334	616	615	1.5%	0	0%	281	-	T1	CS
Estonia	166	7	5	0.0%	-1	-17%	-160	-97%	T2	CS
Hungary	821	662	695	1.7%	33	5%	-125	-15%	T2	D
Latvia	23	33	22	0.1%	-11	-33%	-1	-5%	T2	CS
Lithuania	331	181	152	0.4%	-29	-16%	-179	-54%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	295	672	794	1.9%	122	18%	499	169%	T1	D
Romania	18 499	2 658	2 964	7.1%	306	12%	-15 535	-84%	T2	CS
Slovakia	1 961	1 540	1 080	2.6%	-460	-30%	-882	-45%	T2	CS
Slovenia	175	91	64	0.2%	-27	-29%	-111	-63%	T1	CS
EU-27	**59 060**	**42 364**	**42 013**	**100.0%**	**-351**	**-1%**	**-17 047**	**-29%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.19 1A2c Chemicals, other fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	5 427	7 510	7 514	87.3%	4	0%	2 087	38%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2 342	1 140	1 033	12.0%	-107	-9%	-1 309	-56%	T1	D
Romania	NO	64	62	0.7%	-2	-3%	62	-	T2	CS
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	0.5	NA	NA	-	0	-	-0.5	-100%	NA	NA
EU-27	**7 770**	**8 715**	**8 609**	**100.0%**	**-106**	**-1%**	**840**	**11%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.4 *Pulp, Paper and Print (1A2d) (EU-27)*

Figure 18.14 1A2d- Pulp, Paper and Print: Total, CO_2 and N_2O emission and activity trends

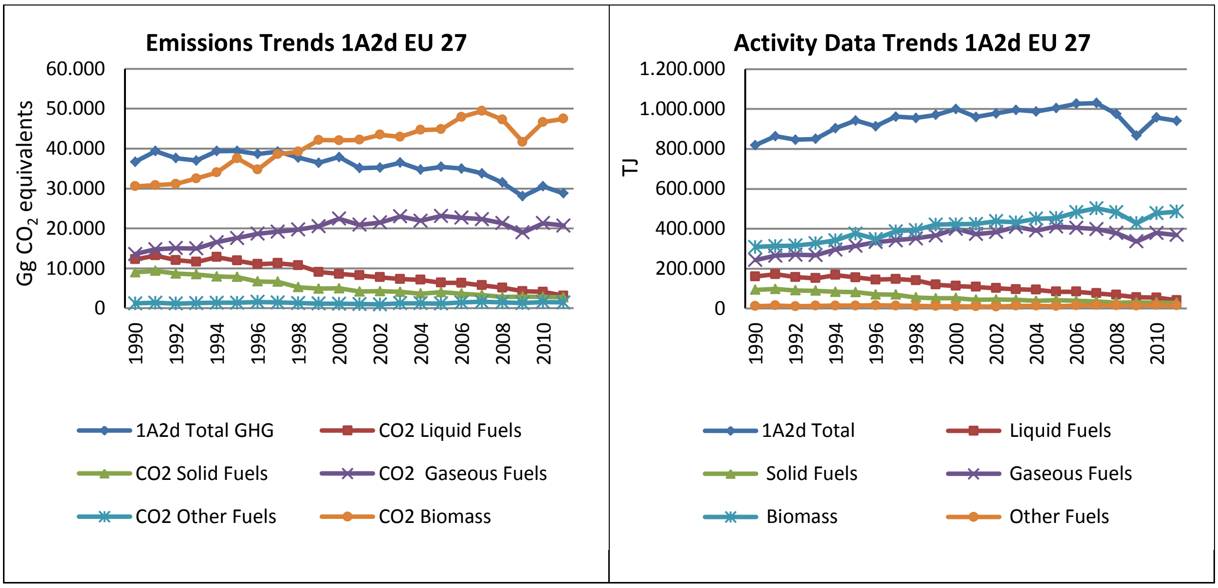


Table 18.20 1A2d Pulp, Paper and Print, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	10 317	3 795	2 890	92.0%	-905	-24%	-7 427	-72%		
Bulgaria	15	28	31	1.0%	3	-	15	99%	T1	D
Cyprus	IE	IE	IE		-	-	-	-	NA	NA
Czech Republic	473	58	33	1.0%	-25	-43%	-441	-93%	T1	D
Estonia	NO	1	0	0.00%	-0.51	-89%	0	-	T1,T2	CS,D
Hungary	86	10	6	0.20%	-3.58	-37%	-80	-93%	T2	D
Latvia	16	NO	NO	-	-	-	-16	-100%	NA	NA
Lithuania	162	3.84	2.11	0.07%	-1.73	-45%	-160	-99%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	104	150	150	4.8%	0	0%	46	44%	T1	D
Romania	NO	15	NO	-	-15	-	0	-	NA	NA
Slovakia	985	25	24	0.8%	-1	-3%	-961	-98%	T2	CS
Slovenia	97	6	5	0.2%	-1	-12%	-92	-95%	T1	D
EU-27	**12 255**	**4 090**	**3 142**	**100.0%**	**-949**	**-23%**	**-9 114**	**-74%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.21 1A2d Pulp, Paper and Print, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	5 119	1 008	931	34.0%	-76	-8%	-4 187	-82%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 376	480	390	14.2%	-91	-19%	-1 986	-84%	T1	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	24	NO	NO	-	-	-	-24	-100%	NA	NA
Latvia	2	NO	NO	-	-	-	-2	-100%	NA	NA
Lithuania	NO	0	NO	-	0	-100%	0	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	174	945	1 051	38.4%	106	11%	877	504%	T1,T2	CS,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	1 142	243	227	8.3%	-15	-6%	-915	-80%	T2	CS
Slovenia	169	137	140	5.1%	3	2%	-28	-17%	T1	D,PS
EU-27	**9 006**	**2 813**	**2 739**	**100.0%**	**-74**	**-3%**	**-6 267**	**-70%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.22 1A2d Pulp, Paper and Print, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	12 646	19 851	19 489	94.1%	-362	-2%	6 842	54%		
Bulgaria	NO	74	81	0.4%	7	9%	81	-	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	179	242	264	1.3%	22	9%	85	47%	T1	CS
Estonia	NO	4	2	0.0%	-2	-48%	2	-	T2	CS
Hungary	51	152	153	0.7%	1	1%	102	199%	T2	D
Latvia	149	6	6	0.0%	0	0%	-144	-96%	T2	CS
Lithuania	252	117	87	0.4%	-30	-26%	-165	-66%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	6	281	256	1.2%	-25	-9%	250	4440%	T1	D
Romania	NO	247	62	0.3%	-185	-75%	62	-	T2	CS
Slovakia	203	128	117	0.6%	-11	-9%	-86	-42%	T2	CS
Slovenia	109	237	203	1.0%	-34	-14%	94	86%	T1	CS
EU-27	**13 595**	**21 339**	**20 719**	**100.0%**	**-620**	**-3%**	**7 124**	**52%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.5 ***Food Processing, Beverages and Tobacco (1A2e) (EU-27)***

Figure 18.15 1A2e- Food Processing, Beverages and Tobacco: Total, CO_2 and N_2O emission and activity trends

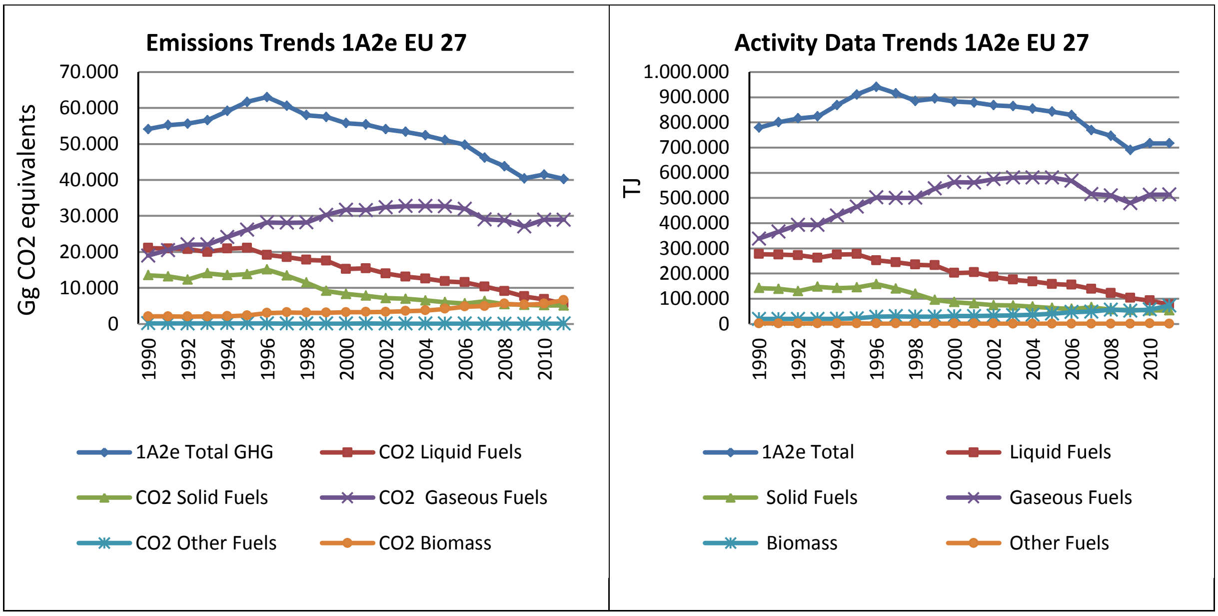


Table 18.23 1A2e Food Processing, Beverages and Tobacco, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	17 155	6 063	4 991	87.7%	-1 072	-18%	-12 163	-71%		
Bulgaria	405	70	51	0.9%	-19	-27%	-354	-87%	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	566	70	70	1.2%	-1	-1%	-496	-88%	T1	D
Estonia	439	4	2	0.0%	-3	-59%	-437	-100%	T1,T2	CS,D
Hungary	817	20	12	0.2%	-7	-38%	-805	-99%	T2	D
Latvia	798	45	33	0.6%	-12	-27%	-765	-96%	T1	CS
Lithuania	174	36	40	0.7%	4	10%	-135	-77%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	228	359	325	5.7%	-34	-10%	97	42%	T1	D
Romania	NO	141	126	2.2%	-15	-11%	126	-	T1, T2	D, CS
Slovakia	359	0	0	0.0%	0	39%	-359	-100%	T2	CS
Slovenia	144	42	38	0.7%	-3	-8%	-106	-73%	T1	D
EU-27	**21 085**	**6 850**	**5 688**	**100.0%**	**-1 162**	**-17%**	**-15 396**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.24 1A2e Food Processing, Beverages and Tobacco, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	6 461	2 348	2 340	46.0%	-9	0%	-4 122	-64%		
Bulgaria	33	40	9	0.2%	-31	-78%	-24	-73%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 863	189	192	3.8%	3	2%	-2 671	-93%	T1	CS,D
Estonia	5	NO	NO	-	0.0	-	-5	-100%	NA	NA
Hungary	194	13	13	0.2%	-1	-6%	-181	-93%	T2	D
Latvia	91	5	2	0.0%	-3	-53%	-89	-97%	T1	CS
Lithuania	33	12	12	0.2%	0	-2%	-22	-66%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	3 389	2 519	2 483	48.8%	-36	-1%	-906	-27%	T2	CS,D
Romania	118	5	3	0.0%	-2	-49%	-116	-98%	T1	D
Slovakia	312	35	38	0.7%	3	9%	-274	-88%	T2	CS
Slovenia	9	NO	NO	-	-	-	-9	-100%	NA	NA
EU-27	**13 508**	**5 166**	**5 090**	**100.0%**	**-76**	**-1%**	**-8 418**	**-62%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.25 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16 156	24 781	24 721	85.4%	-60	0%	8 565	53%		
Bulgaria	11	243	256	0.9%	14	6%	245	2155%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	728	743	749	2.6%	5	1%	20	3%	T1	CS
Estonia	15	3	1	0.0%	-1	-46%	-13	-91%	T2	CS
Hungary	804	602	556	1.9%	-46	-8%	-248	-31%	T2	D
Latvia	174	105	103	0.4%	-2	-2%	-71	-41%	T2	CS
Lithuania	469	221	237	0.8%	16	7%	-232	-49%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	110	1 206	1 235	4.3%	29	2%	1 125	1023%	T1	D
Romania	NO	724	761	2.6%	37	5%	761	-	T2	CS
Slovakia	470	271	274	0.9%	3	1%	-195	-42%	T2	CS
Slovenia	65	70	61	0.2%	-9	-13%	-4	-7%	T1	CS
EU-27	**19 002**	**28 969**	**28 955**	**100.0%**	**-14**	**0%**	**9 953**	**52%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

16.1.1.1 Other (1A2f) (EU-27)

Figure 18.16 1A2f- Other, liquid fuels: Total, CO_2 and N_2O emission and activity trends

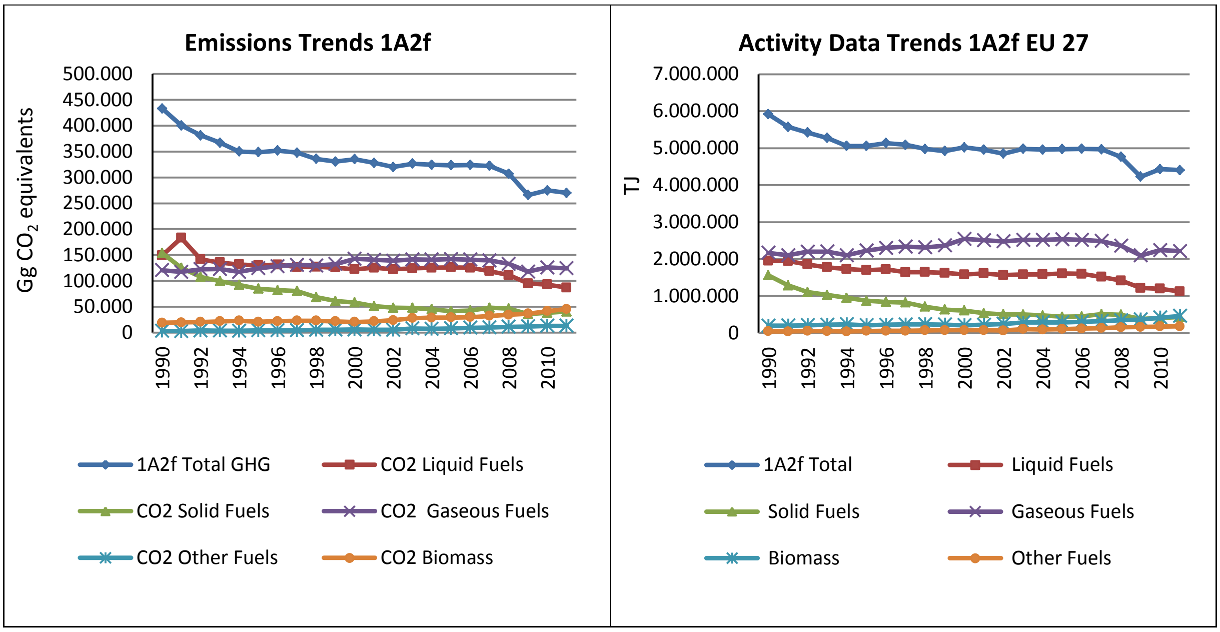


Table 18.26 1A2f Other, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	118 310	86 110	80 472	92.4%	-5 638	-7%	-37 838	-32%		
Bulgaria	9 224	943	568	0.7%	-375	-40%	-8 656	-94%	T1	D
Cyprus	806	570	480	0.6%	-90	-16%	-326	-40%	D,T1	CS,D,PS
Czech Republic	4 935	1 420	1 422	1.6%	2	0%	-3 513	-71%	T1	D
Estonia	325	114	146	0.2%	32	28%	-179	-55%	T1,T2	CS,D
Hungary	1 149	424	292	0.3%	-132	-31%	-856	-75%	T1,T2	D
Latvia	945	141	138	0.2%	-3	-2%	-807	-85%	T1	CS
Lithuania	3 096	40	25	0.0%	-15	-37%	-3 071	-99%	T2	CS
Malta	59	46	73	0.1%	27	58%	13	23%	D,T1	D
Poland	1 396	1 329	1 189	1.4%	-141	-11%	-207	-15%	T1	D
Romania	6 861	1 347	1 963	2.3%	616	46%	-4 898	-71%	T1,T2	CS,D
Slovakia	1 286	56	81	0.1%	26	46%	-1 204	-94%	T2	CS
Slovenia	696	298	257	0.3%	-41	-14%	-439	-63%	T1	D
EU-27	**149 088**	**92 838**	**87 106**	**100.0%**	**-5 732**	**-6%**	**-61 982**	**-42%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.17 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2

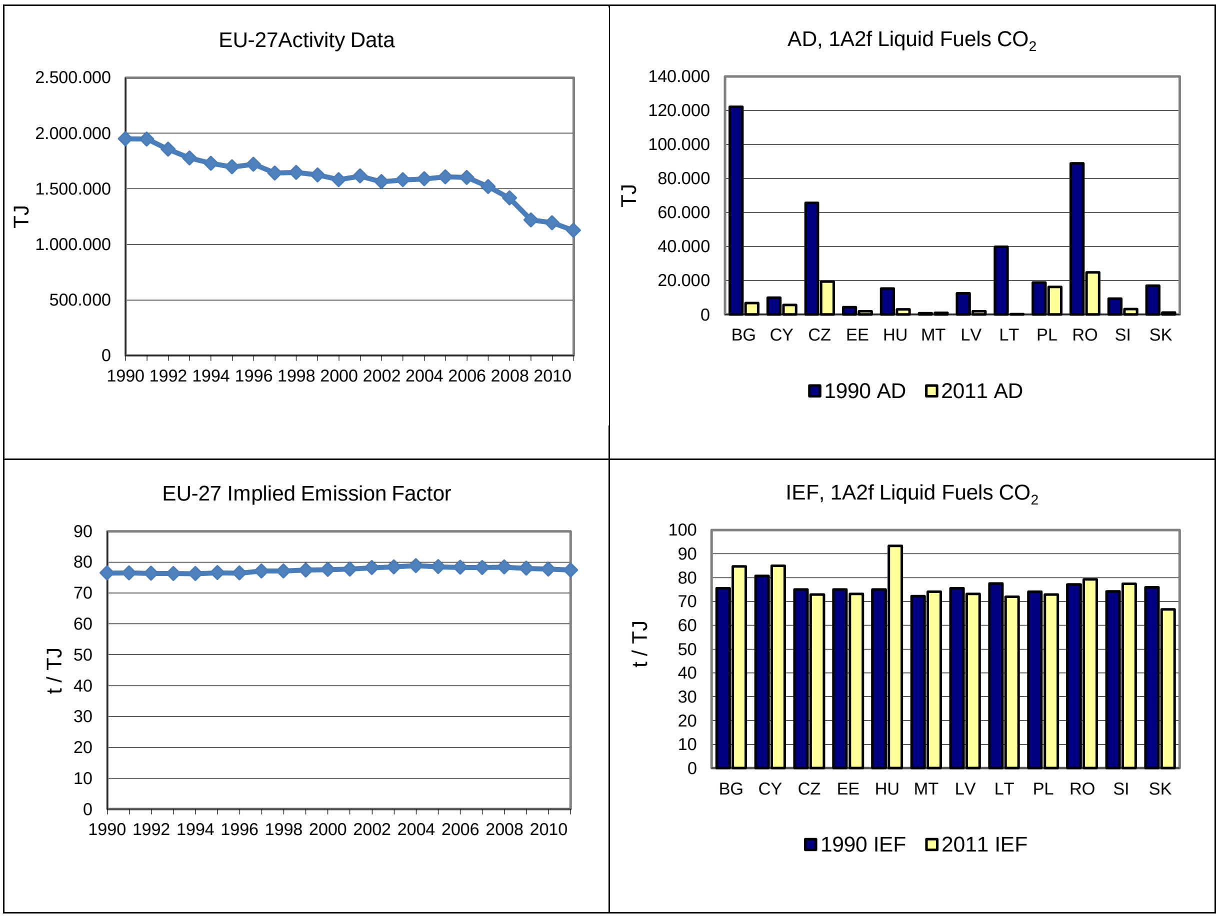


Table 18.27 1A2f Other, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	113 432	28 467	29 832	73.6%	1 365	5%	-83 601	-74%		
Bulgaria	2 178	495	414	1.0%	-81	-16%	-1 765	-81%	T2	CS,D
Cyprus	271	70	29	0.1%	-40	-58%	-242	-89%	D	PS
Czech Republic	12 150	1 031	1 090	2.7%	59	6%	-11 060	-91%	T1	CS,D
Estonia	793	247	449	1.1%	202	82%	-344	-43%	T1,T2	CS,D
Hungary	948	180	179	0.4%	-1	0%	-769	-81%	T1,T2	CS,D
Latvia	38	166	201	0.5%	35	21%	162	425%	T1	CS
Lithuania	156	335	419	1.0%	84	25%	263	169%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	13 788	4 160	4 709	11.6%	549	13%	-9 079	-66%	T1,T2	CS,D
Romania	6 985	1 818	2 121	5.2%	303	17%	-4 864	-70%	T1,T2	CS,D
Slovakia	2 897	1 043	1 018	2.5%	-26	-2%	-1 879	-65%	T2	CS
Slovenia	199	87	92	0.2%	4	5%	-107	-54%	T1	CS,D
EU-27	**153 835**	**38 099**	**40 552**	**100.0%**	**2 454**	**6%**	**-113 282**	**-74%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.18 1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2

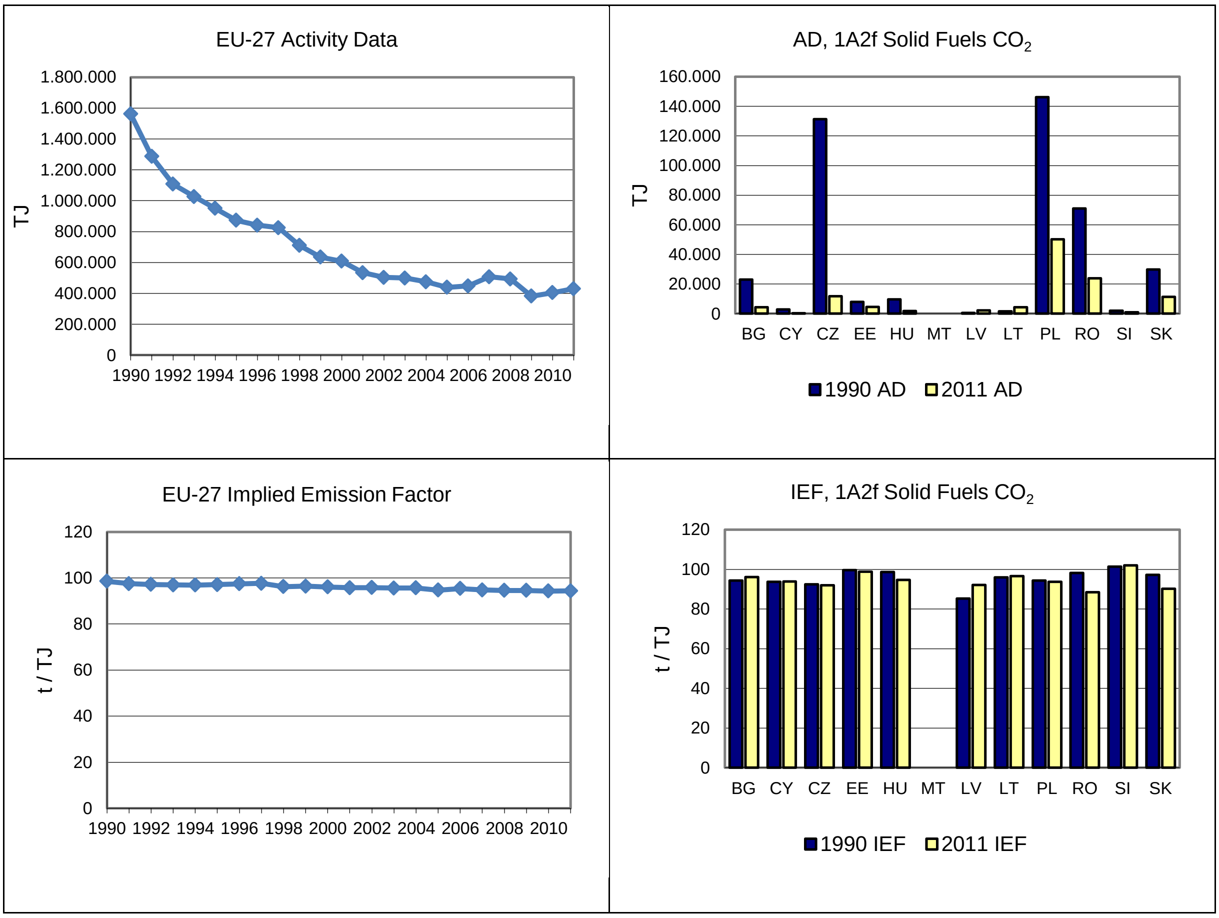
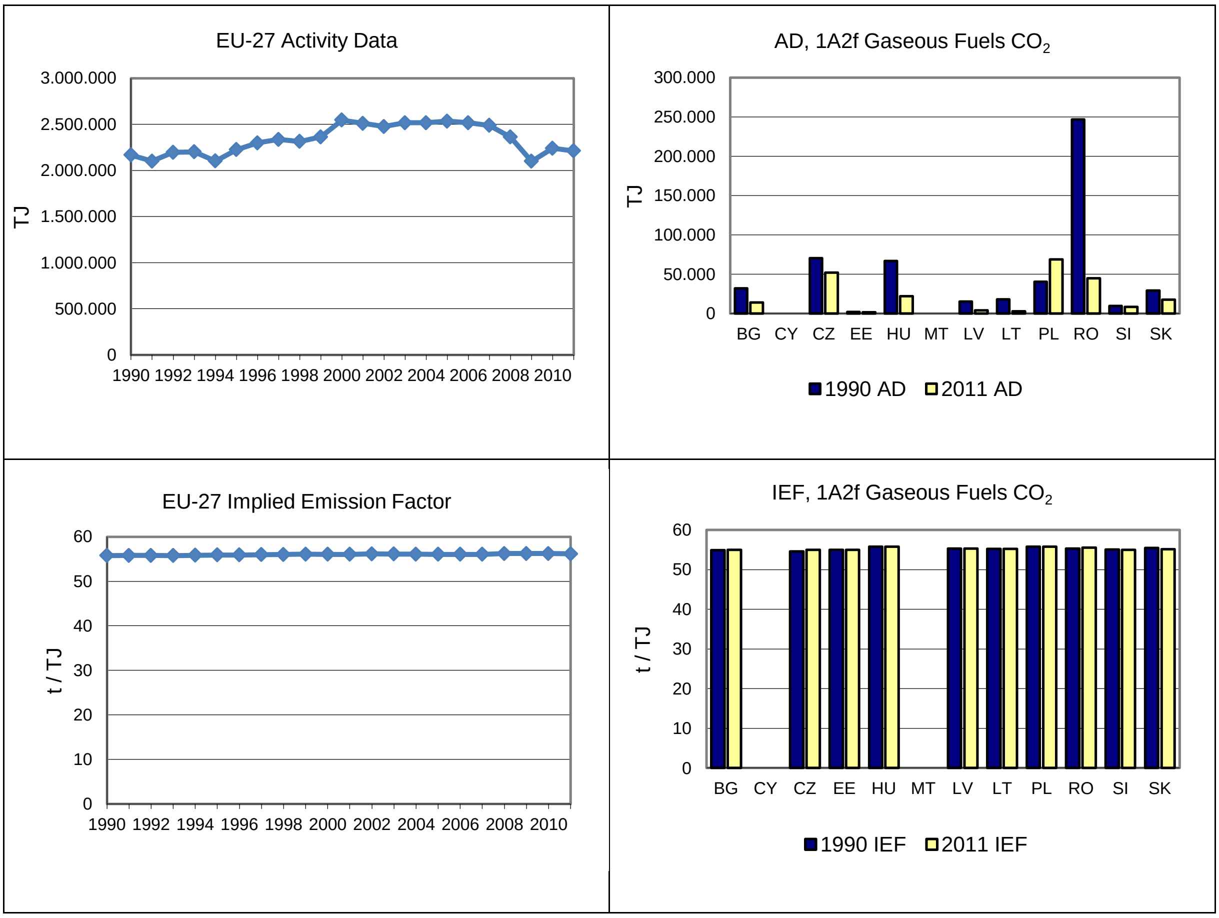


Table 18.28 1A2f Other, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	91 532	112 919	111 192	89.5%	-1 727	-2%	19 660	21%		
Bulgaria	1 764	701	774	0.6%	73	10%	-990	-56%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	3 832	3 244	2 859	2.3%	-384	-12%	-973	-25%	T1	CS
Estonia	100	69	82	0.1%	14	20%	-17	-18%	T2	CS
Hungary	3 717	1 039	1 223	1.0%	184	18%	-2 494	-67%	T1,T2	D
Latvia	835	217	211	0.2%	-5	-2%	-624	-75%	T2	CS
Lithuania	996	143	157	0.1%	14	10%	-839	-84%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	2 245	3 803	3 830	3.1%	27	1%	1 585	71%	T1	D
Romania	13 635	2 343	2 485	2.0%	142	6%	-11 150	-82%	T2	CS
Slovakia	1 613	967	976	0.8%	9	1%	-637	-40%	T2	CS
Slovenia	530	529	466	0.4%	-62	-12%	-63	-12%	T1	CS
EU-27	**120 800**	**125 972**	**124 256**	**100.0%**	**-1 716**	**-1%**	**3 456**	**3%**		

Figure 18.19 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



18.2.3 Transport (CRF Source Category 1A3) (EU-27)

18.2.3.1 *Civil Aviation (1A3a) (EU-27)*

Figure 18.20 1A3a- Civil Aviation: Total, CO_2 and N_2O emission and activity trends

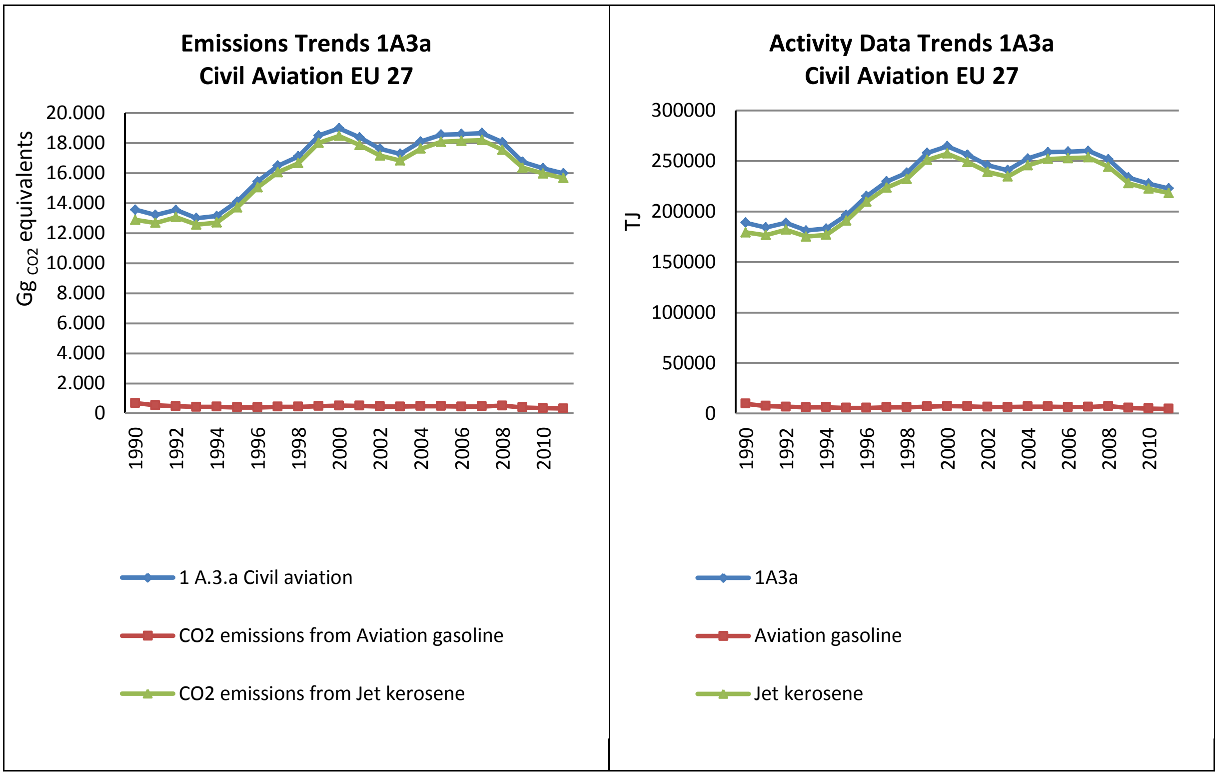


Table 18.29 1A3a Civil Aviation, jet kerosine: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	12 697	15 537	15 244	97.3%	-293	-2%	2 547	20%		
Bulgaria	114	43	62	0.4%	18	43%	-52	-46%	T2	D
Cyprus	NA	NA	NA	-	-	-	-	-	NA	NA
Czech Republic	1	3	2	0.01%	-1.1	-40%	0	14%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	0.05	0	0.15	0.00%	0.0	-5%	0.10	173%	T2	D
Lithuania	8	0	1	0.004%	0.2	60%	-8	-93%	T1	CS
Malta	0	1	1	0.004%	0.0	-6%	0	57%	T1	D
Poland	34	78	71	0.5%	-7	-9%	37	109%	T1	D
Romania	25	314	282	1.80%	-31	-10%	258	1045%	T2	D
Slovakia	7	5	6	0.04%	0	1%	-1	-21%	T2	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
EU-27	**12 886**	**15 981**	**15 667**	**100.0%**	**-314**	**-2%**	**2 781**	**22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.2 *Road Transportation (1A3b) (EU-27)*

Figure 18.21 1A3b- Road Transport, CO_2 and N_2O emission and activity trends

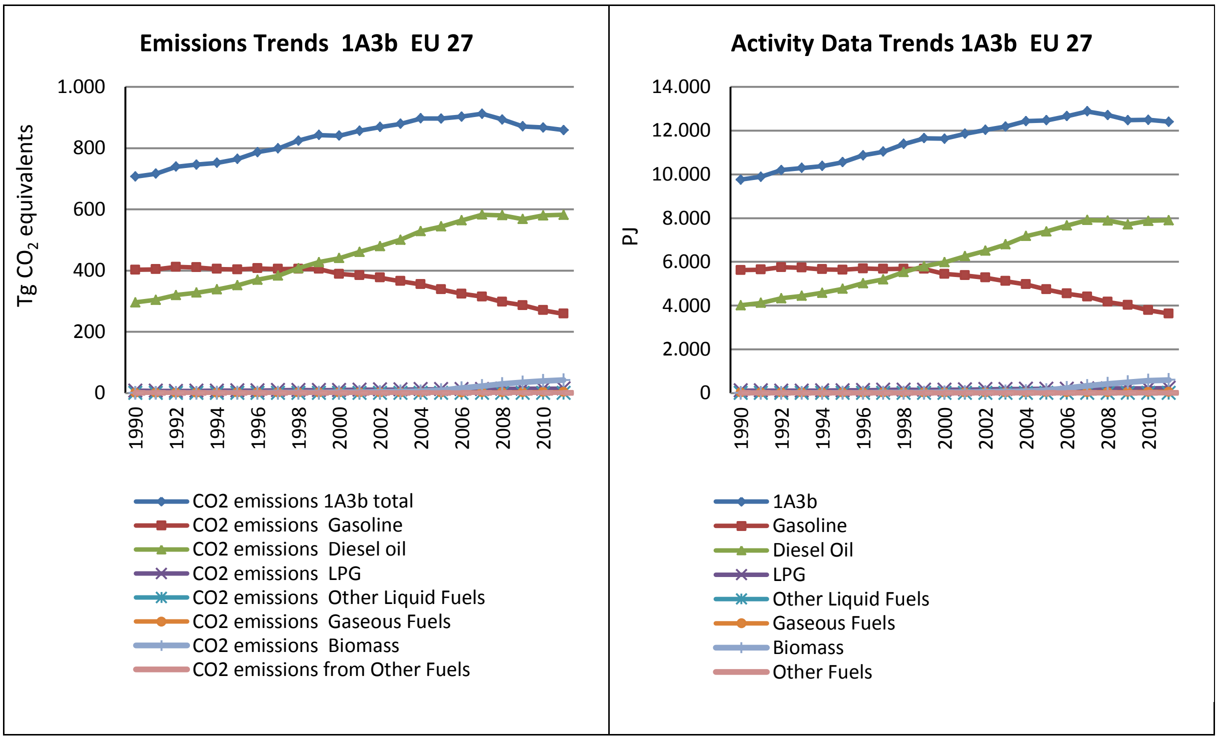


Table 18.30 1A3b Road Transport, diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	268 931	504 559	504 285	86.6%	-274	0%	235 354	88%		
Bulgaria	1 547	4 430	4 664	0.8%	234	5%	3 117	201%	CR	CR
Cyprus	667	1 099	1 052	0.2%	-48	-4%	384	58%	T1	D
Czech Republic	2 836	10 433	10 517	1.8%	85	1%	7 681	271%	T1	D
Estonia	697	1 189	1 305	0.2%	116	10%	608	87%	T1	CS
Hungary	2 364	7 409	7 429	1.3%	20	0%	5 064	214%	T1	CS
Latvia	616	2 031	1 993	0.3%	-38	-2%	1 377	224%	M	CS
Lithuania	2 134	2 689	2 742	0.5%	53	2%	608	28%	T2	CS
Malta	150	290	273	0.0%	-17	-6%	123	82%	D,T1	D
Poland	8 641	29 157	30 519	5.2%	1 363	5%	21 879	253%	T2	CS
Romania	3 573	8 886	9 093	1.6%	207	2%	5 520	154%	T3	OTH
Slovakia	3 123	4 483	4 417	0.8%	-65	-1%	1 295	41%	M	D
Slovenia	904	3 401	3 819	0.7%	419	12%	2 915	322%	M	M
EU-27	**296 184**	**580 055**	**582 110**	**100.0%**	**2 055**	**0.4%**	**285 925**	**97%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.22 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factors for CO_2

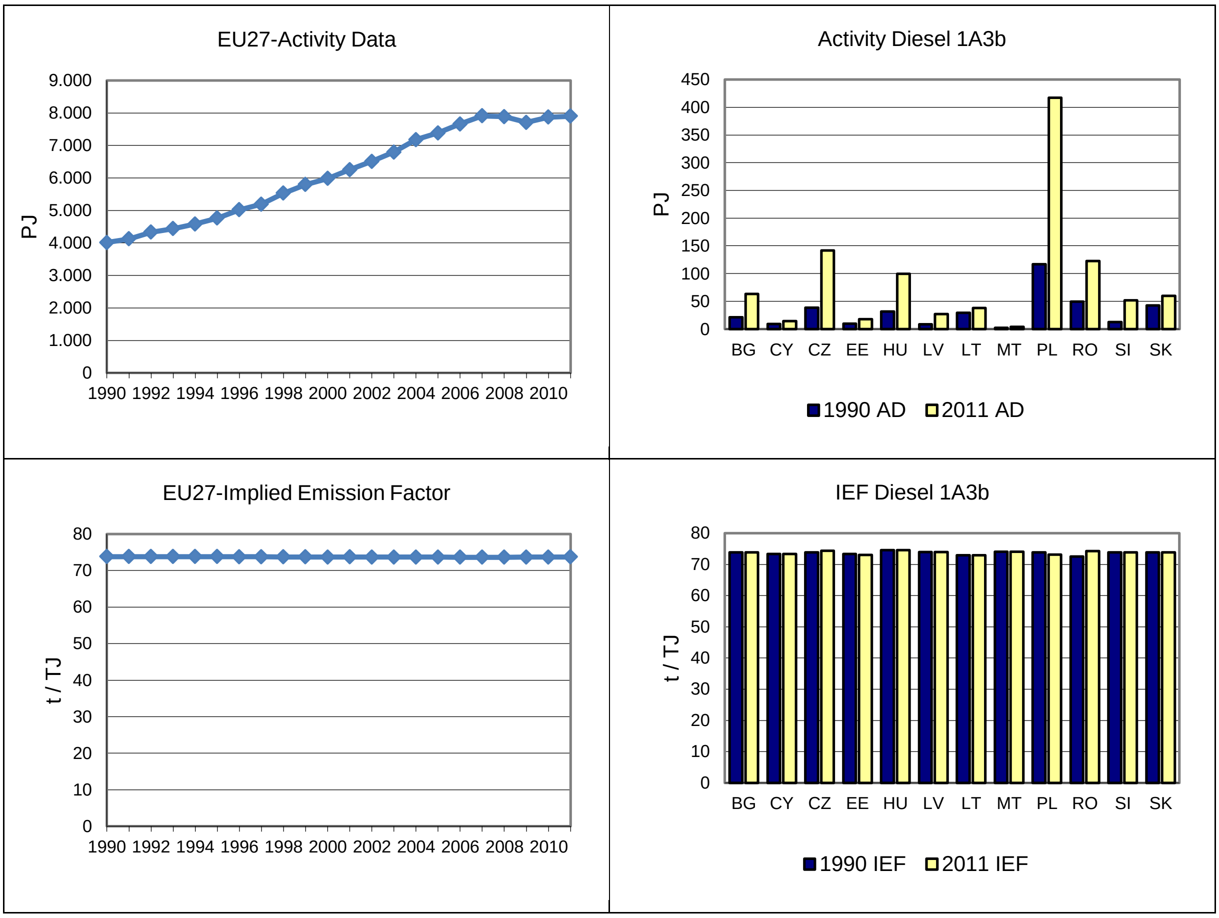


Table 18.31 1A3b Road Transport, gasoline: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	363 056	234 599	225 369	87.0%	-9 230	-4%	-137 687	-38%		
Bulgaria	4 390	1 805	1 669	0.6%	-137	-8%	-2 721	-62%	CR	CR
Cyprus	501	1 199	1 183	0.5%	-15	-1%	682	136%	T1	D
Czech Republic	3 403	5 586	5 360	2.1%	-226	-4%	1 958	58%	T1	D
Estonia	1 530	852	808	0.3%	-43	-5%	-722	-47%	T1	CS
Hungary	5 276	3 929	3 598	1.4%	-331	-8%	-1 678	-32%	T2	CS
Latvia	1 689	876	764	0.3%	-113	-13%	-926	-55%	M	CS
Lithuania	3 053	905	788	0.3%	-117	-13%	-2 265	-74%	T2	CS
Malta	183	228	226	0.1%	-2	-1%	43	23%	D,T1	D
Poland	9 714	12 490	11 814	4.6%	-677	-5%	2 099	22%	T2	CS
Romania	6 414	4 198	4 002	1.5%	-197	-5%	-2 412	-38%	T3	OTH
Slovakia	1 380	1 878	1 709	0.7%	-169	-9%	329	24%	M	D
Slovenia	1 695	1 744	1 755	0.7%	11	1%	60	4%	M	M
EU-27	**402 284**	**270 291**	**259 046**	**100.0%**	**-11 245**	**-4.2%**	**-143 239**	**-36%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.23 1A3b Road Transport, gasoline: Activity Data and Implied Emission Factors for CO_2

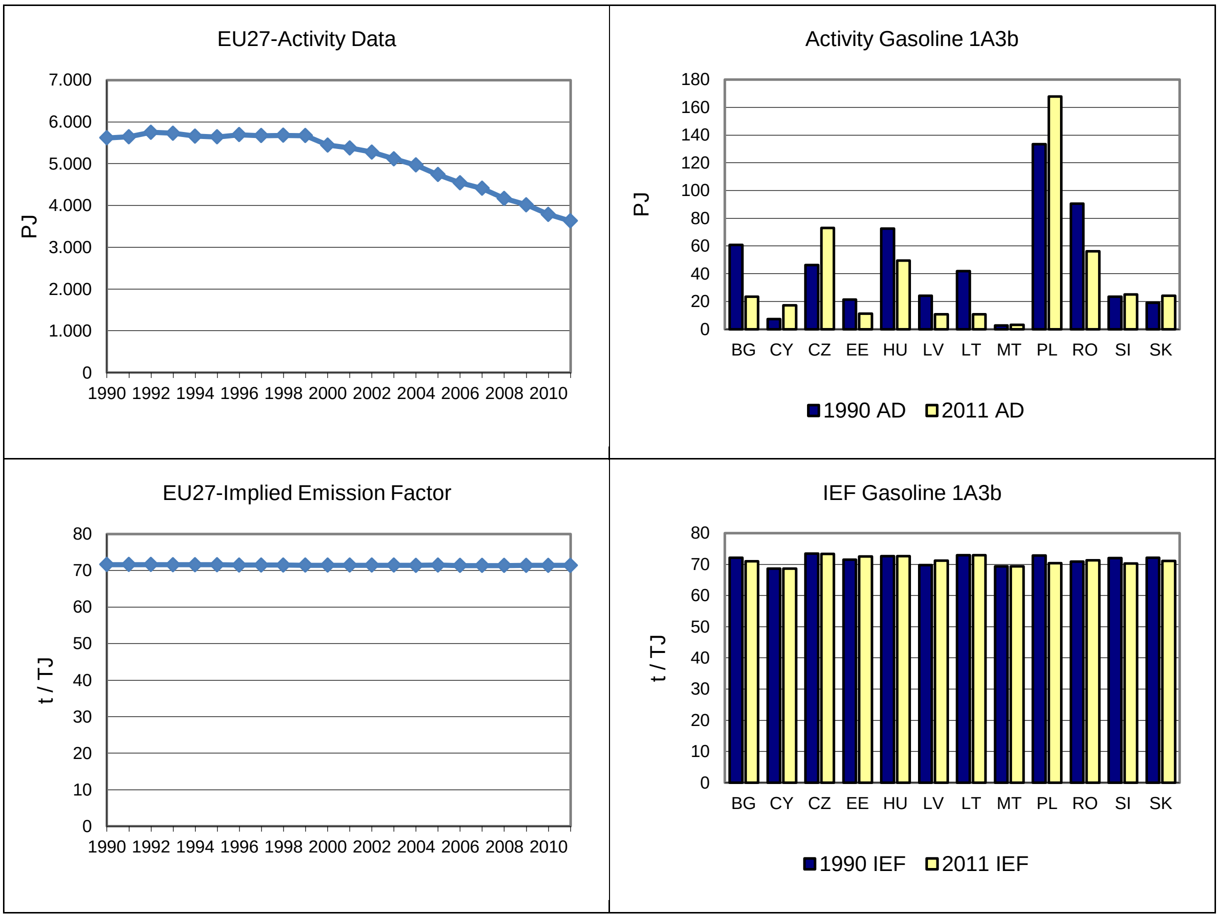


Table 18.32 1A3b Road Transport, LPG: Member CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7 323	7 144	7 869	53.7%	726	10%	547	7%		
Bulgaria	NO	1 028	961	6.6%	-67	-6%	961	-	CR	CR
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	230	224	1.5%	-6	-3%	224	-	T1	D
Estonia	9	0.3	0.4	0.003%	0.1	19%	-9	-96%	T1	CS
Hungary	NA	76	82	0.6%	5.7	7%	82	-	T1	D
Latvia	37	63	74	0.5%	11	18%	37	100%	M	CS
Lithuania	60	494	475	3.2%	-19	-4%	415	690%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	NO	4 819	4 668	31.9%	-151	-3%	4 668	-	T2	CS
Romania	NO	53	222	1.5%	169	322%	222	-	T3	OTH
Slovakia	NO	83	54	0.4%	-28	-34%	54	-	M	D
Slovenia	NO	15	18	0.1%	3	-	18	-	M	M
EU-27	**7 429**	**14 005**	**14 649**	**100.0%**	**644**	**5%**	**7 220**	**97%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.33 1A3b Road Transport, diesel oil: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	1 647	4 942	5 269	84.4%	327	7%	3 623	220%		
Bulgaria	20	37	42	0.7%	4	12%	22	108%	CR	CR
Cyprus	2	3	3	0.0%	0	-4%	1	58%	T1	D
Czech Republic	29	200	201	3.2%	0	0%	172	589%	T2	CS
Estonia	7	7	11	0.2%	4	48%	3	45%	T3	CS
Hungary	41	72	78	1.2%	6	8%	37	89%	T2	D
Latvia	6	13	14	0.2%	1	8%	9	147%	M	M
Lithuania	20	23	25	0.4%	1	6%	4	21%	T3	CR
Malta	2.45	5	4	0.1%	-0.28	-6%	2.01	82%	D,T1	D
Poland	116	420	439	7.0%	20	5%	323	278%	T2	D
Romania	9	83	87	1.4%	4	4%	78	848%	T3	OTH
Slovakia	43	35	36	0.6%	1	3%	-7	-17%	M	D
Slovenia	11	30	35	0.6%	6	20%	24	222%	M	M
EU-27	**1 954**	**5 870**	**6 244**	**100.0%**	**374**	**6%**	**4 290**	**219%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.34 1A3b Road Transport, gasoline: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4 182	1 548	1 329	64.8%	-220	-14%	-2 853	-68%
Bulgaria	56	17	14	0.7%	-2.65	-16%	-41	-74%
Cyprus	1	3	3	0.2%	0	-1%	2	136%
Czech Republic	103	441	429	20.9%	-12	-3%	327	318%
Estonia	15	11	7	0.4%	-4	-33%	-8	-51%
Hungary	58	37	34	1.6%	-3	-9%	-25	-42%
Latvia	14	6	5	0.3%	-1	-11%	-8	-61%
Lithuania	19	9	7	0.4%	-2.05	-22%	-12	-62%
Malta	2.62	3	3	0.2%	-0.03	-1%	1	23%
Poland	68	147	139	6.8%	-8	-5%	71	104%
Romania	17	41	38	1.8%	-2.92	-7%	21	123%
Slovakia	16	30	28	1.4%	-2	-5%	13	80%
Slovenia	21	16	15	0.7%	-1	-7%	-6	-30%
EU-27	**4 573**	**2 310**	**2 052**	**100.0%**	**-258**	**-11%**	**-2 521**	**-55%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.3 ***Railways (1A3c) (EU-27)***

Figure 18.24 1A3c- Railways, CO_2 and N_2O emission and activity trends

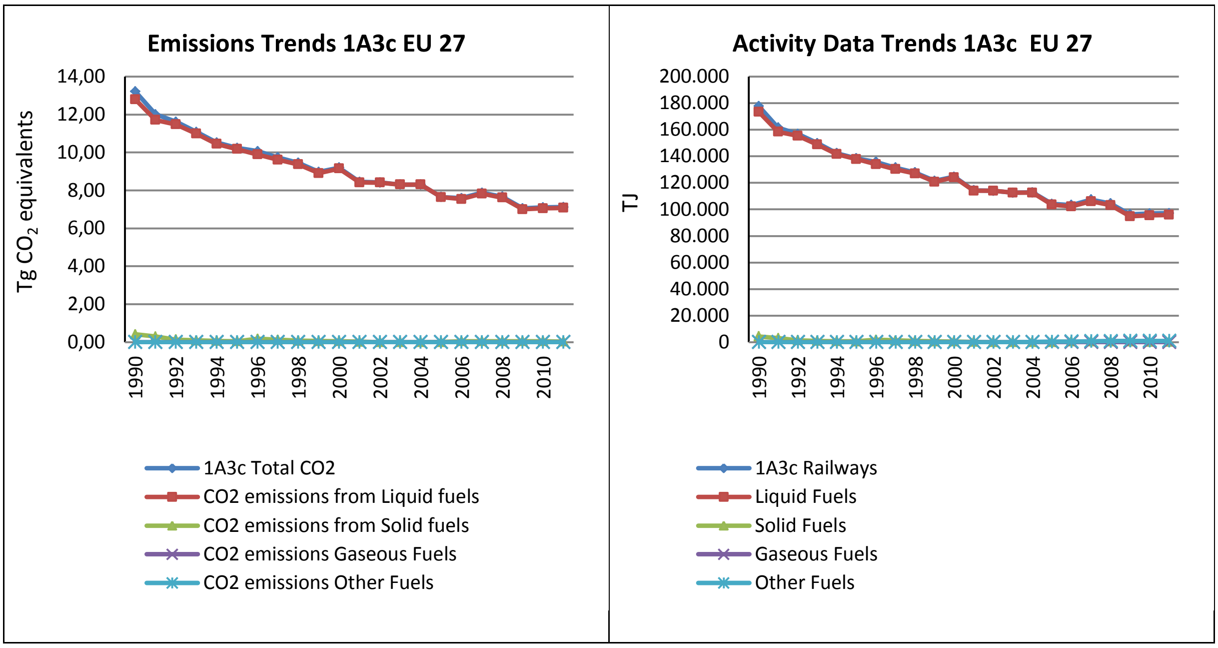


Table 18.35 1A3c Railways, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7 817	4 964	4 984	70.4%	19	0%	-2 833	-36%		
Bulgaria	318	62	56	0.8%	-6	-10%	-262	-83%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	651	289	282	4.0%	-6	-2%	-369	-57%	T1	D
Estonia	143	156	106	1.5%	-50	-32%	-37	-26%	T2	CS
Hungary	513	268	142	2.0%	-126	-47%	-371	-72%	T1	D
Latvia	531	207	233	3.3%	25	12%	-299	-56%	T1	CS
Lithuania	350	185	193	2.7%	8	4%	-157	-45%	T2	CS
Malta	NO	NA	NA	-	-	-	-	-	NA	NA
Poland	1 323	355	367	5.2%	13	4%	-955	-72%	T2	CS
Romania	710	440	593	8.4%	153	35%	-117	-16%	T2	CS
Slovakia	377	88	85	1.2%	-3	-3%	-292	-78%	T1	D
Slovenia	64	37	37	0.5%	0	0%	-27	-42%	T1	D
EU-27	**12 798**	**7 051**	**7 077**	**100.0%**	**26**	**0%**	**-5 720**	**-45%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.4 *Navigation (1A3d) (EU-27)*

Figure 18.25 1A3d- Navigation, CO_2 and N_2O emission and activity trends

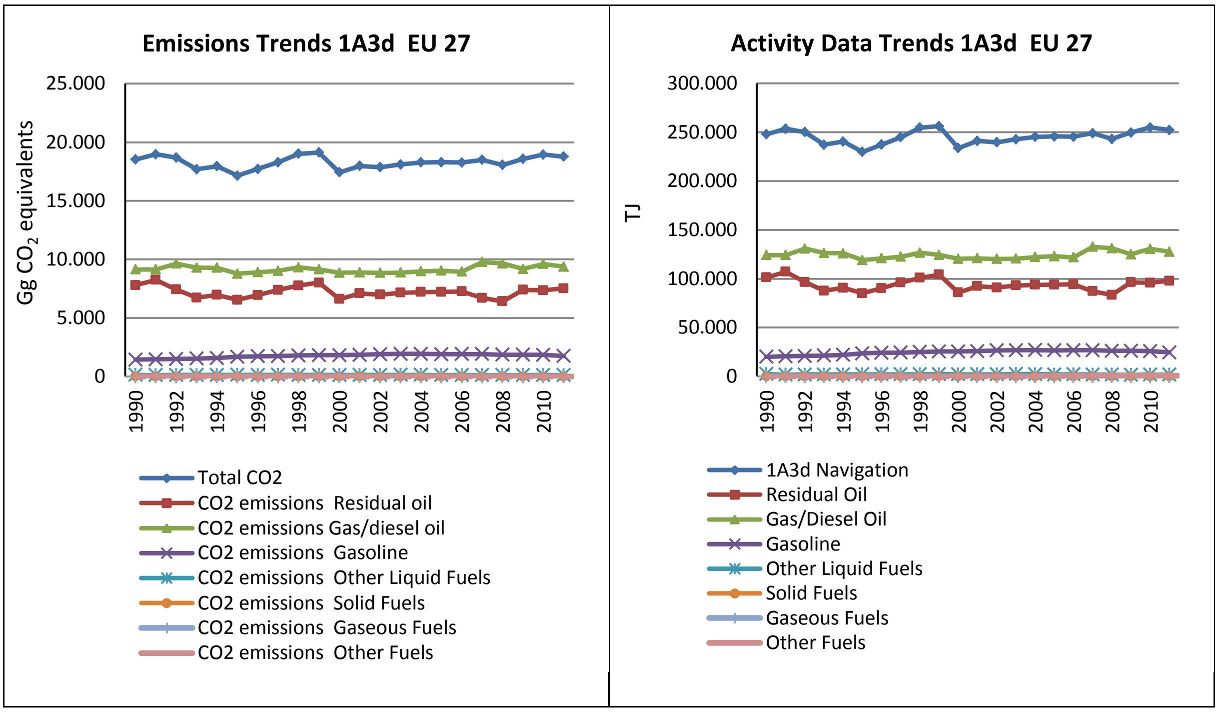


Table 18.36 1A3d Navigation, residual oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	6 738	7 364	7 521	100.0%	157	2%	783	12%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	2	NO	NO	-	-	-	-2	-100%	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	0	-	0	-	NA	NA
Malta	NO	NO	0	-	-	-	-	-		
Poland	58	1	1	0.01%	0	-11%	-57	-99%	T1	D
Romania	996	NO	NO	-	-	-	-996	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**7 793**	**7 365**	**7 522**	**100.0%**	**157**	**2%**	**-271**	**-3%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.37 1A3d Navigation, gas/diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	8 762	9 291	9 112	97.1%	-178	-2%	350	4%		
Bulgaria	56	9	9	0.1%	1	9%	-47	-83%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	56	13	9	0.1%	-3	-25%	-47	-83%	T1	D
Estonia	22	23	15	0.2%	-9	-37%	-7	-33%	T1	CS
Hungary	28	3	3	0.0%	0	0%	-25	-89%	T1	D
Latvia	1	22	16	0.2%	-6	-29%	15	1774%	T1	CS
Lithuania	15	20	16	0.2%	-3	-17%	1	5%	T1	CS
Malta	8	47	36	0.4%	-11	-23%	28	328%	D,T1	D
Poland	76	0	10	0.1%	9	2040%	-67	-87%	T1	D
Romania	123	178	156	1.7%	-22	-12%	33	27%	T2	CS
Slovakia	0.02	0.04	0.03	0.0%	0	-25%	0	34%	CS	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
EU-27	**9 149**	**9 606**	**9 383**	**100.0%**	**-223**	**-2%**	**234**	**3%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.5 *Other (1A3e) (EU-27)*

Table 18.38 1A3e Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	7 031	8 045	7 550	84.3%	-495	-6%	518	7%
Bulgaria	132	324	469	5.2%	145	45%	337	256%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	484	150	144	1.6%	-6	-4%	-339	-70%
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Lithuania	1 853	215	214	2.4%	-1	-1%	-1 640	-88%
Malta	IE,NO	17	17	0.2%	0	1%	17	-
Poland	IE,NA,NO	513	522	5.8%	9	2%	522	-
Romania	11	41	37	0.4%	-4	-10%	26	240%
Slovakia	NA	NA	NA	-	-	-	-	-
Slovenia	NO	4	1	0.0%	-4	-81%	1	-
EU-27	**9 511**	**9 310**	**8 954**	**100.0%**	**-356**	**-4%**	**-557**	**-6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.4 Other Sectors (CRF Source Category 1A4) (EU-27)

18.2.4.1 *Commercial/Institutional (1A4a) (EU-27)*

Figure 18.26 1A4a Commercial/Institutional, CO_2 and N_2O emission and activity trends

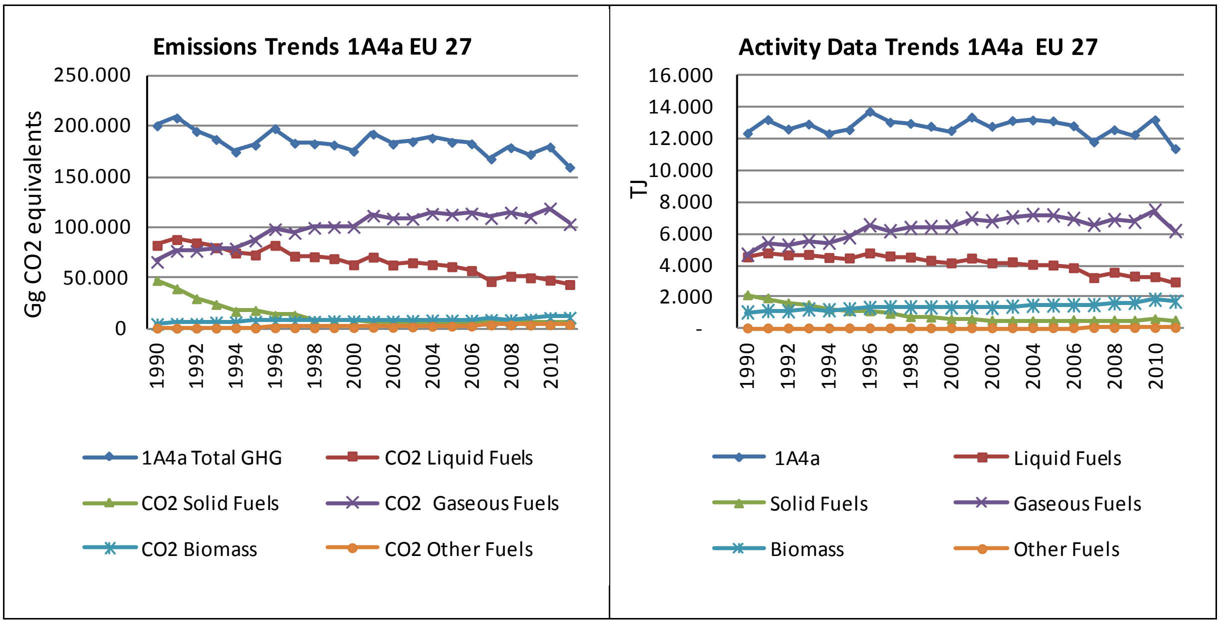


Table 18.39 1A4a Commercial/Institutional, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	74 044	44 823	40 836	92.5%	-3 986	-9%	-33 208	-45%		
Bulgaria	2 954	138	107	0.2%	-31	-23%	-2 848	-96%	T1	D
Cyprus	NA	79	70	0.2%	-10	-12%	70	-	T1	D
Czech Republic	1 786	55	55	0.1%	0	0%	-1 731	-97%	T1	D
Estonia	19	10	1	0.0%	-8	-87%	-18	-93%	T1,T2	CS,D
Hungary	1 296	61	59	0.1%	-3	-4%	-1 237	-95%	T1	D
Latvia	1 131	111	99	0.2%	-13	-12%	-1 033	-91%	T1	CS
Lithuania	933	10	11	0.0%	1	11%	-923	-99%	T2	CS
Malta	62	71	50	0.1%	-21	-29%	-11	-18%	D,T1	D
Poland	NO	2 219	2 059	4.7%	-160	-7%	2 059	-	T1	D
Romania	NO	211	319	0.7%	108	51%	319	-	T1, T2	D, CS
Slovakia	384	8	6	0.0%	-3	-31%	-378	-99%	T2	CS
Slovenia	267	593	481	1.1%	-112	-19%	213	80%	T1	D
EU-27	**82 877**	**48 389**	**44 152**	**100.0%**	**-4 237**	**-9%**	**-38 725**	**-47%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.40 1A4a Commercial/Institutional, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	27 789	2 027	2 283	37.9%	257	13%	-25 506	-92%		
Bulgaria	60	17	19	0.3%	2	12%	-40	-68%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	6 274	123	122	2.0%	-2	-1%	-6 153	-98%	T1	CS,D
Estonia	8	1	1	0.0%	0	26%	-7	-82%	T1,T2	CS,D
Hungary	650	12	12	0.2%	0	1%	-638	-98%	T1	D
Latvia	1 332	94	106	1.8%	12	13%	-1 226	-92%	T1	CS,OTH
Lithuania	1 185	215	240	4.0%	25	12%	-945	-80%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	8 960	3 804	3 196	53.0%	-609	-16%	-5 764	-64%	T1,T2	CS,D
Romania	NO	2	3	0.0%	1	43%	3	-	T2	CS
Slovakia	1 729	44	45	0.7%	1	1%	-1 684	-97%	T2	CS
Slovenia	200	NO	NO	-	-	-	-200	-100%	NA	NA
EU-27	**48 186**	**6 340**	**6 027**	**100.0%**	**-313**	**-5%**	**-42 159**	**-87%**		

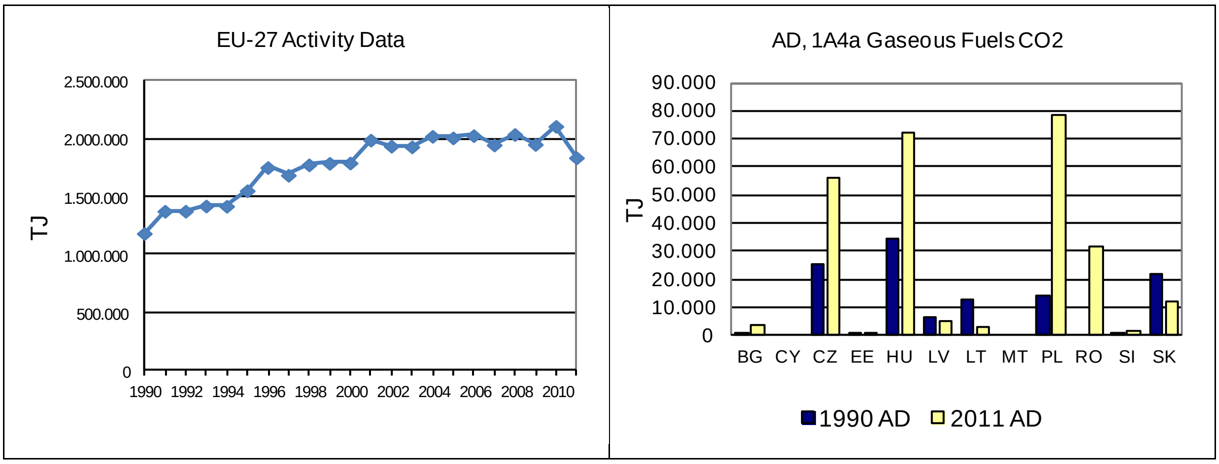
Abbreviations explained in the Chapter 'Units and abbreviations'.

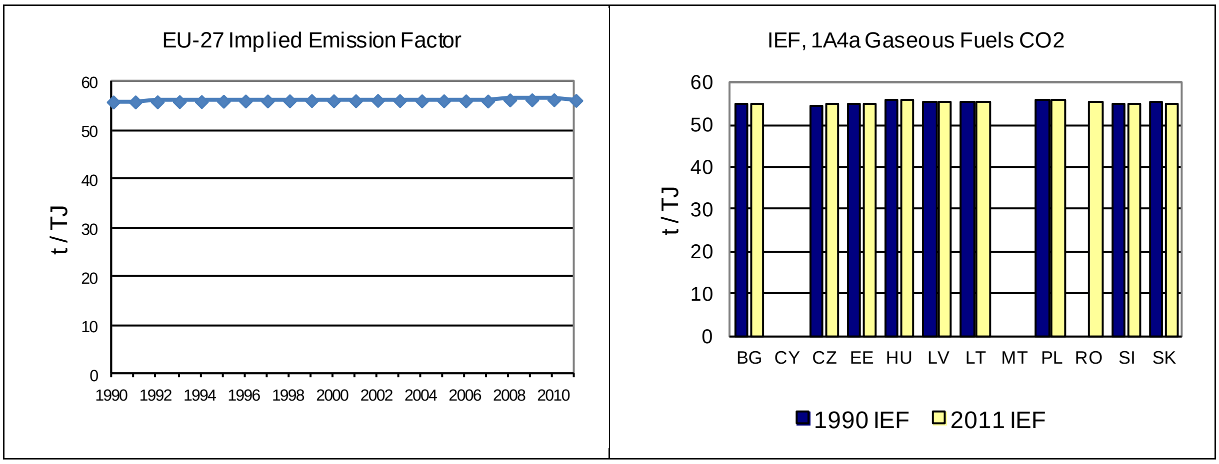
Table 18.41 1A4a Commercial/Institutional, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	60 058	103 603	89 126	85.9%	-14 478	-14%	29 068	48%		
Bulgaria	39	184	189	0.2%	5	3%	151	389%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 396	3 370	3 086	3.0%	-284	-8%	1 690	121%	T1	CS
Estonia	20	76	41	0.0%	-35	-45%	21	104%	T2	CS
Hungary	1 928	4 009	4 033	3.9%	25	1%	2 106	109%	T1	D
Latvia	337	306	275	0.3%	-31	-10%	-62	-18%	T2	CS
Lithuania	709	154	139	0.1%	-15	-10%	-569	-80%	T2	CS
Malta	NO	NO	NO	-	-	-	0	-	NA	NA
Poland	770	4 657	4 362	4.2%	-296	-6%	3 592	467%	T1	D
Romania	NO	2 171	1 757	1.7%	-414	-19%	1 757	-	T2	CS
Slovakia	1 215	718	672	0.6%	-46	-6%	-544	-45%	T2	CS
Slovenia	29	50	89	0.1%	39	78%	60	208%	T1	CS
EU-27	**66 501**	**119 299**	**103 770**	**100.0%**	**-15 529**	**-13%**	**37 269**	**56%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.27 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2





18.2.4.2 *Residential (1A4b) (EU-27)*

Figure 18.28 1A4b Residential, CO_2 and N_2O emission and activity trends

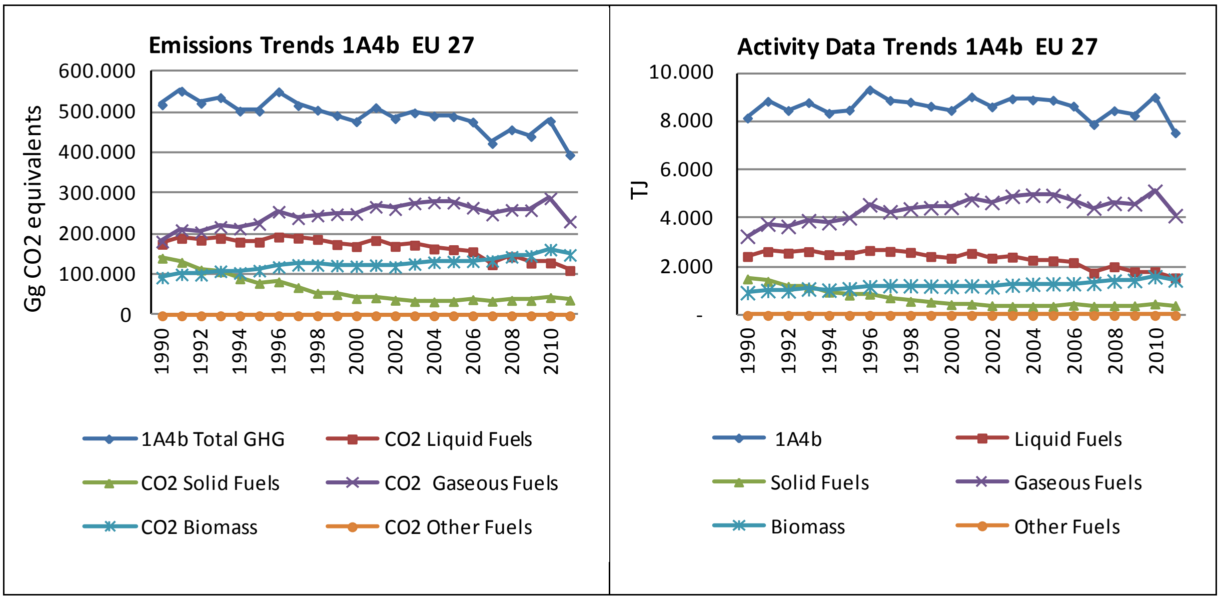


Table 18.42 1A4b Residential, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	169 602	126 184	107 261	96.0%	-18 923	-15%	-62 341	-37%		
Bulgaria	156	61	72	0.1%	11	19%	-84	-54%	T1	D
Cyprus	183	424	479	0.4%	56	13%	296	162%	T1	D
Czech Republic	490	11	29	0.0%	18	162%	-461	-94%	T1	D
Estonia	550	38	41	0.0%	3	9%	-509	-93%	T1,T2	CS,D
Hungary	3 423	276	396	0.4%	121	44%	-3 027	-88%	T1	D
Latvia	330	154	154	0.1%	0	0%	-176	-53%	T1	CS
Lithuania	310	113	118	0.1%	5	4%	-192	-62%	T2	CS
Malta	35	41	49	0.0%	8	21%	14	41%	D,T1	
Poland	106	1 879	1 780	1.6%	-99	-5%	1 673	1575%	T1	D
Romania	912	620	614	0.5%	-6	-1%	-298	-33%	T1, T2	D, CS
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	434	930	757	0.7%	-172	-19%	323	74%	T1	D
EU-27	**176 531**	**130 729**	**111 750**	**100.0%**	**-18 979**	**-15%**	**-64 781**	**-37%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.29 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2

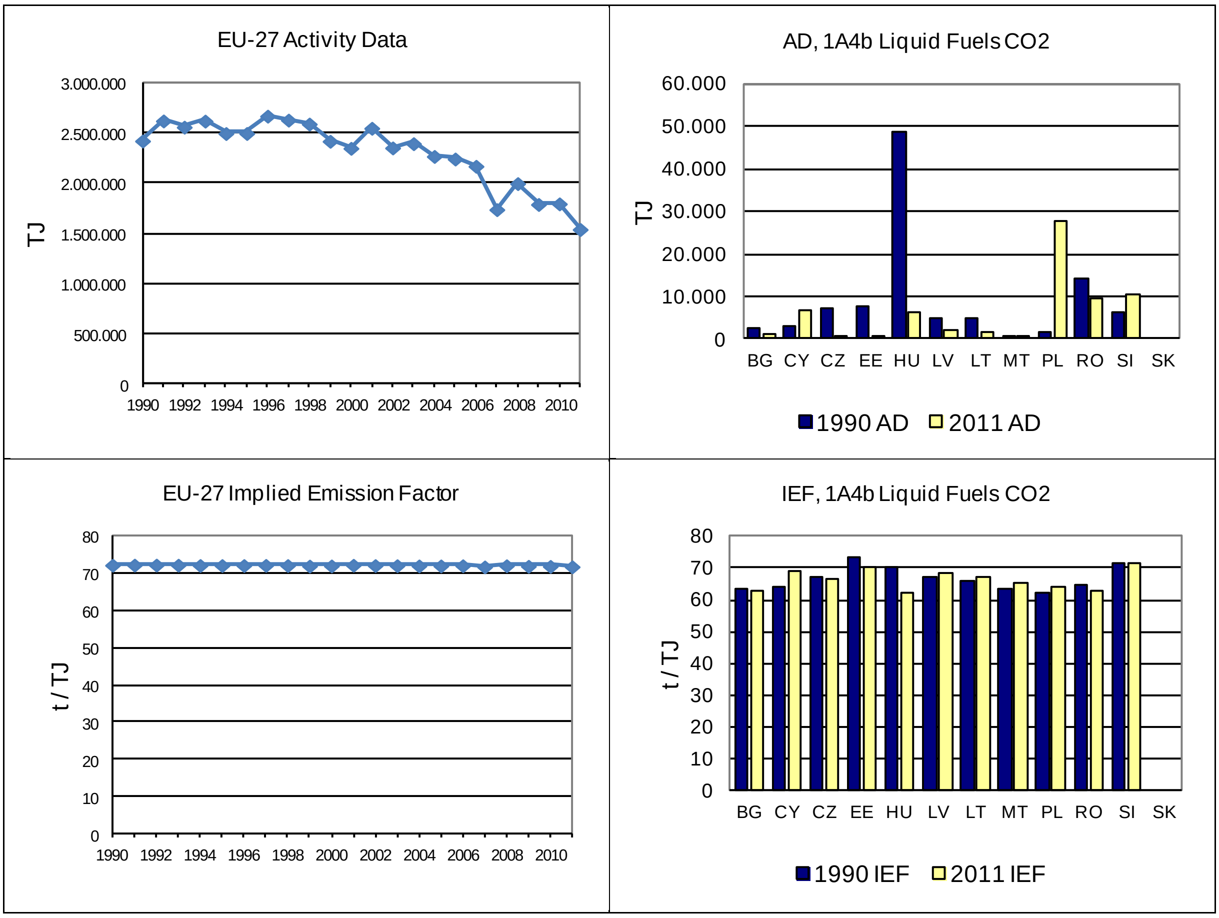


Table 18.43 1A4b Residential, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	74 513	12 532	11 717	30.3%	-815	-7%	-62 796	-84%		
Bulgaria	2 635	758	954	2.5%	196	26%	-1 681	-64%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	17 373	2 346	1 928	5.0%	-418	-18%	-15 446	-89%	T1	CS,D
Estonia	669	34	44	0.1%	10	28%	-625	-93%	T1,T2	CS,D
Hungary	7 981	610	711	1.8%	101	17%	-7 270	-91%	T1	CS,D
Latvia	585	99	102	0.3%	3	4%	-483	-83%	T1	CS
Lithuania	1 457	285	281	0.7%	-4	-1%	-1 176	-81%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	28 445	27 783	22 707	58.7%	-5 076	-18%	-5 738	-20%	T1,T2	
Romania	2 706	37	71	0.2%	33	89%	-2 635	-97%	T1,T2	D,CS
Slovakia	5 441	452	176	0.5%	-276	-61%	-5 265	-97%	T2	CS
Slovenia	338	3	2	0.0%	0	-7%	-336	-99%	T1	D
EU-27	**142 143**	**44 940**	**38 693**	**100.0%**	**-6 247**	**-14%**	**-103 450**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.44 1A4b Residential, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	161 967	258 696	203 894	87.7%	-54 802	-21%	41 927	26%		
Bulgaria	NO	114	129	0.1%	15	13%	129	-	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 686	5 481	4 607	2.0%	-874	-16%	1 922	72%	T1	CS
Estonia	116	126	117	0.1%	-9	-7%	1	1%	T2	CS
Hungary	3 937	7 905	7 142	3.1%	-763	-10%	3 206	81%	T1	D
Latvia	220	288	247	0.1%	-41	-14%	28	13%	T2	CS
Lithuania	510	366	335	0.1%	-31	-8%	-175	-34%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	6 821	8 285	7 562	3.3%	-723	-9%	741	11%	T1	D
Romania	5 225	5 119	5 421	2.3%	302	6%	196	4%	T2	CS
Slovakia	1 628	3 066	2 708	1.2%	-358	-12%	1 080	66%	T2	CS
Slovenia	25	262	261	0.1%	-1	0%	236	944%	T1	CS
EU-27	**183 135**	**289 708**	**232 424**	**100.0%**	**-57 284**	**-20%**	**49 289**	**27%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.30 1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

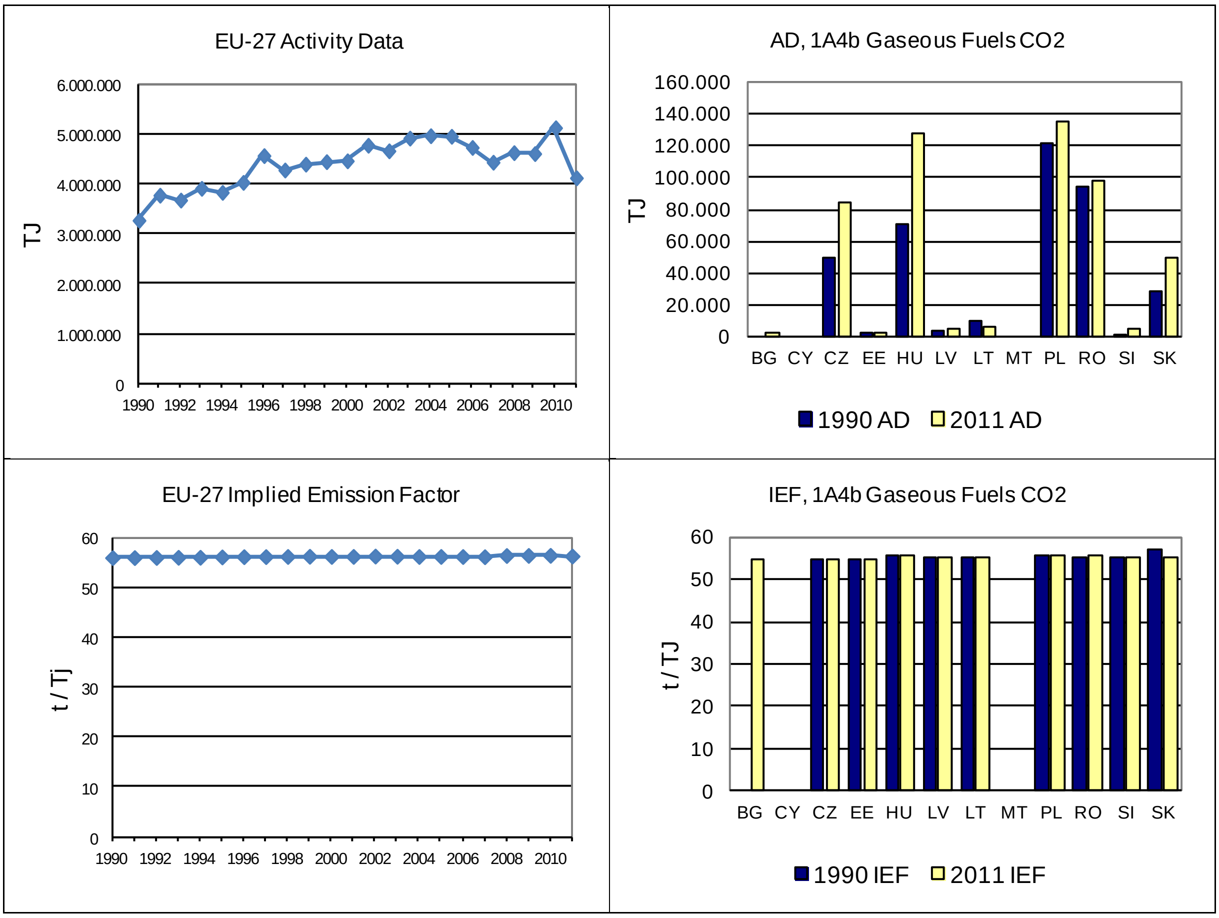


Table 18.45 1A4b Residential, biomass: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6 059	4 618	4 168	60.1%	-450	-10%	-1 892	-31%
Bulgaria	45	188	NA	-	-188	-100%	-45	-100%
Cyprus	NA	1	1	0.0%	0.92	174%	1	-
Czech Republic	37	307	294	4.2%	-14	-4%	256	686%
Estonia	34	112	96	1.4%	-15.36	-14%	62	186%
Hungary	46	174	191	2.8%	17	10%	145	311%
Latvia	126	194	165	2.4%	-29	-15%	39	31%
Lithuania	57	151	147	2.1%	-4.13	-3%	91	160%
Malta	NA	NA	NA	-	-	-	-	-
Poland	216	710	725	10.4%	14	2%	508	235%
Romania	152	930	830	12.0%	-100	-11%	678	447%
Slovakia	3	11	13	0.2%	2	19%	10	326%
Slovenia	86	122	109	1.6%	-12.27	-10%	23.95	28%
EU-27	**6 862**	**7 516**	**6 936**	**100.0%**	**-581**	**-8%**	**74**	**1%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.4.3 *Agriculture/Forestry/Fisheries (1A4c) (EU-27)*

Figure 18.31 1A4c Agriculture/Forestry/Fisheries, CO_2 and N_2O emission and activity trends

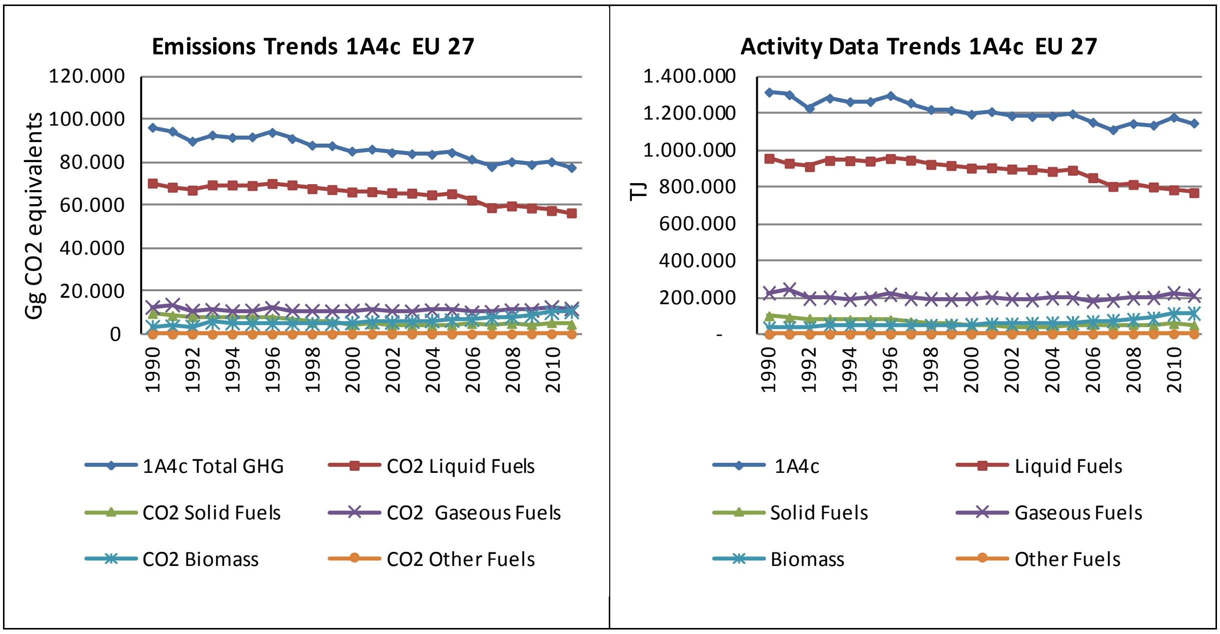


Table 18.46 1A4c Agriculture/Forestry/Fisheries, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	56 750	49 185	48 499	84.7%	-686	-1%	-8 252	-15%		
Bulgaria	1 482	381	412	0.7%	31	8%	-1 071	-72%	T1	D
Cyprus	NA	73	79	0.1%	6	9%	79	-	T1	D
Czech Republic	342	30	33	0.1%	3	9%	-309	-90%	T1	D
Estonia	476	199	246	0.4%	47	24%	-230	-48%	T1,T2	CS,D
Hungary	2 134	780	820	1.4%	40	5%	-1 314	-62%	T1	D
Latvia	694	330	349	0.6%	19	6%	-345	-50%	T1	CS
Lithuania	99	29	31	0.1%	2	8%	-68	-69%	T2	CS
Malta	NE	12	5	0.0%	-6	-55%	5	-	D,T1	D
Poland	4 629	5 698	5 781	10.1%	83	1%	1 152	25%	T1	D
Romania	3 483	682	826	1.4%	143	21%	-2 658	-76%	T1, T2	D, CS
Slovakia	3	6	3	0.0%	-4	-60%	-1	-17%	T2	CS
Slovenia	332	209	201	0.4%	-8	-4%	-131	-39%	T1	D
EU-27	**70 426**	**57 613**	**57 285**	**100.0%**	**-329**	**-1%**	**-13 141**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.47 1A4c Agriculture/Forestry/Fisheries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3 712	309	379	8.2%	69	22%	-3 334	-90%		
Bulgaria	147	16	19	0.4%	3	22%	-128	-87%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 493	53	40	0.9%	-13	-24%	-1 452	-97%	T1	CS,D
Estonia	16	NO	0	-	0	-	-16	-	T1,T2	CS,D
Hungary	212	2	2	0.0%	1	38%	-210	-99%	T1	D
Latvia	95	2	2	0.1%	0	0%	-92	-97%	T1	CS
Lithuania	148	3	4	0.1%	1	35%	-143	-97%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3 768	5 022	4 160	89.6%	-862	-17%	392	10%	T1,T2	CS,D
Romania	67	35	35	0.75%	0	0%	-32	-48%	T1	D
Slovakia	1	1	1	0.0%	0	-15%	0	-10%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**9 660**	**5 444**	**4 644**	**100.0%**	**-800**	**-15%**	**-5 016**	**-52%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.48 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	8 716	11 706	11 082	92.5%	-624	-5%	2 366	27%		
Bulgaria	3	56	70	0.6%	13	24%	66	2036%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	406	147	123	1.0%	-24	-16%	-282	-70%	T1	CS
Estonia	4	2	4	0.0%	1	65%	0	-1%	T2	CS
Hungary	627	288	290	2.4%	2	1%	-337	-54%	T1	D
Latvia	779	52	43	0.4%	-9	-18%	-736	-94%	T2	CS
Lithuania	163	72	70	0.6%	-2	-3%	-92	-57%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	25	83	85	0.7%	3	3%	60	242%	T1	D
Romania	1 919	171	131	1.1%	-40	-23%	-1 788	-93%	T2	CS
Slovakia	41	101	88	0.7%	-12	-12%	47	116%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**12 682**	**12 679**	**11 987**	**100.0%**	**-692**	**-5%**	**-695**	**-5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.5 Other (CRF Source Category 1A5) (EU-27)

18.2.5.1 *Stationary (1A5a) (EU-27)*

Table 18.49 1A5a Stationary, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	4 667	10	8	71.2%	-2	-20%	-4 659	-100%		
Bulgaria	29	NO	NO	-	-	-	-29	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	1 191	NO	NO	-	-	-	-1 191	-100%	NA	NA
Slovakia	216	4	3	28.8%	-1	-23%	-213	-99%	T2	CS
Slovenia	NA	NA	NA	-	-	-	-	-	NA	NA
EU-27	6 103	14	11	**100.0%**	**-3**	**-21%**	**-6 092**	**-100%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.5.2 *Mobile (1A5b) (EU-27)*

Table 18.50 1A5b Mobile, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13 717	5 200	5 033	81.6%	-166	-3%	-8 683	-63%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NA	NA	NA	-	0	-	-	-	NA	NA
Czech Republic	1 601	1 083	1 091	17.7%	8	1%	-509	-32%	T1	D
Estonia	44	41	20	0.3%	-21	-51%	-24	-54%	T1,T2	CS,D
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	8	7	0.1%	-1	-8%	7	-	T2	CS
Lithuania	NE,NO	16	13	0.2%	-3	-20%	13	-	T1	CS
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NA	NA	NA	-	-	-	-	-	NA	NA
Slovakia	7	2	2	0.0%	0	3%	-5	-77%	T2	D
Slovenia	32	3	3	0.1%	0.48	17%	-28	-89%	T1	D
EU-27	**15 400**	**6 352**	**6 170**	**100.0%**	**-182**	**-3%**	**-9 230**	**-60%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-27)

18.2.6.1 *Fugitive emissions from Solid Fuels (1B1) (EU-27)*

Table 18.51 1B1a Coal Mining: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	42 968	6 218	6 081	32.2%	-138	-2%	-36 887	-86%		
Bulgaria	1 736	863	1 069	5.7%	206	24%	-667	-38%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7 600	3 265	3 279	17.3%	13	0%	-4 321	-57%	T1,T2	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	659	12	10	0.1%	-2	-18%	-650	-99%	D,T2	CS,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	13 092	7 148	6 991	37.0%	-157	-2%	-6 100	-47%	CS	CS
Romania	3 240	761	879	4.7%	118	15%	-2 361	-73%	T1	D
Slovakia	571	320	340	1.8%	20	6%	-231	-41%	T2	CS
Slovenia	303	249	253	1.3%	4.00	2%	-49	-16%	T3	CS
EU-27	**70 169**	**18 837**	**18 902**	**100.0%**	**65**	**0%**	**-51 268**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.6.2 *Fugitive emissions from oil and natural gas (1B2) (EU-27)*

Table 18.52 1B2a Fugitive CO_2 emissions from oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7 994	8 796	8 948	93.9%	152	2%	954	12%		
Bulgaria	1	0.25	0.24	0.0%	-0.01	-4%	-0.42	-63%	T1	D
Cyprus	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-	NA	NA
Czech Republic	0.02	0.06	0.06	0.0%	0.00	-7%	0.04	183%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1	0	0	0.0%	-0.02	-10%	-0.41	-66%	D	D
Latvia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Lithuania	0.051	0.062	0.062	0.001%	0.000	0%	0.011	22%	T1	D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Poland	43	185	166	1.7%	-19	-10%	123	289%	CS,T1	CS,D
Romania	769	416	412	4.3%	-4	-1%	-358	-46%	T1	D
Slovakia	0.0012	0.0006	0.0007	0.0%	0.000167	30%	-0.000424	-37%	T1	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**8 807**	**9 397**	**9 526**	**100.0%**	**129**	**1%**	**719**	**8%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.53 1B2b Fugitive CH_4 emissions from natural gas: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	25 537	17 776	17 048	59.1%	-728	-4%	-8 488	-33%		
Bulgaria	787	521	662	2.3%	140	27%	-125	-16%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	878	701	655	2.3%	-45	-6%	-222	-25%	T1,T2	CS
Estonia	178	82	74	0.3%	-8	-10%	-104	-59%	T1	D
Hungary	908	1 533	1 526	5.3%	-7	0%	618	68%	D	OTH
Latvia	285	132	90	0.3%	-43	-32%	-196	-69%	CS,T1	D,PS
Lithuania	139	244	244	-	-	-	-	-	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3 076	4 405	4 444	15.4%	39	1%	1 368	44%	T1	CS
Romania	7 088	3 350	3 427	11.9%	77	2%	-3 661	-52%	T1	D
Slovakia	448	657	660	2.3%	3	0%	212	47%	T1	CS
Slovenia	58	29	29	0.1%	-0.21	-1%	-29	-50%	T1,T3	CS,D
EU-27	**39 381**	**29 430**	**28 859**	**100.0%**	**-572**	**-2%**	**-10 523**	**-27%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.54 1B2c Fugitive CO_2 emissions from venting and flaring: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	6 733	5 952	5 541	93.9%	-411	-7%	-1 192	-18%		
Bulgaria	3	4	20	0.3%	16	381%	17	539%	T1	D
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Czech Republic	4	14	13	0.2%	-0.89	-7%	9	230%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	197	91	89	1.5%	-2	-2%	-108	-55%	D	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1	9	9	0.2%	0	0%	8	853%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	0	0	0	0.0%	-0.001	-10%	0.005	286%	T1	D
Romania	438	234	232	3.9%	-1.761	-1%	-205.691	-47%	T1	D
Slovakia	0.02	0.02	0.02	0.0%	0.004	23%	0.003	21%	T1	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**7 375**	**6 303**	**5 903**	**100.0%**	**-400**	**-6%**	**-1 472**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.3 Reference approach (new Member States)

Table 18.55 Comparison between Eurostat and national reference approach for fuel combustion for the new MS (CRF 1.A) (50);

MS	Gaseous fuels			Liquid fuels			Solid fuels		
	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %
BG	110.124	110.172	0,04%	154.337	151.941	-1,6%	339.575	339.369	-0,1%
CY	- -	- -	0,0%	93.839	95.263	1,5%	312	358	14,6%
CZ	283.607	283.607	0,0%	367.971	357.636	-2,8%	788.444	777.702	-1,4%
EE	21.072	21.235	0,8%	43.647	21.462	-50,8%	169.837	170.335	0,3%
HU	391.631	391.506	-0,03%	262.585	272.291	3,7%	115.503	115.189	-0,3%
LT	113.799	113.817	0,02%	100.892	99.196	-1,7%	10.367	10.459	0,9%
LV	53.943	53.998	0,1%	47.352	47.252	-0,2%	5.029	4.560	-9,3%
MT	- -	- -	0,0%	43.176	33.929	-21,4%	- -	- -	0,0%
PL	537.434	537.435	0,0%	1.088.976	1.071.895	-1,6%	2.286.058	2.299.840	0,6%
RO	464.946	464.946	0,0%	377.896	432.559	-12,9%	341.718	339.835	-0,6%
SI	30.883	30.895	0,04%	107.491	106.424	-1,0%	61.392	61.244	-0,2%
SK	194.144	194.292	0,1%	148.511	140.509	-5,4%	154.877	155.179	0,2%

([50]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

19 INDUSTRIAL PROCESSES (CRF SECTOR 2)

19.1 Overview of sector (EU-27)

CRF Sector 2 Industrial Processes is the third largest sector contributing 7 % to total EU-27 GHG emissions in 2011. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (2 %) and N_2O (0.4 %). The emissions from this sector decreased by 27.5 % from 458 Tg in 1990 to 332 Tg in 2011 (Figure 19.1). In 2011, the emissions decreased by 0.9 % compared to 2010. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in HCFC production. The large decrease in 2009 mainly occurred in cement production and iron and steel production.

Figure 19.1 CRF Sector 2 Industrial Processes: EU-27 GHG emissions for 1990–2011 in CO_2 equivalents (Tg)

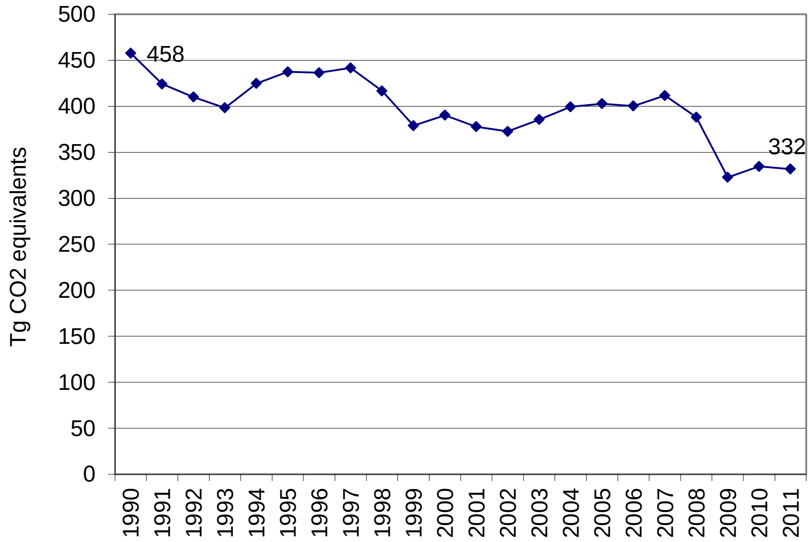
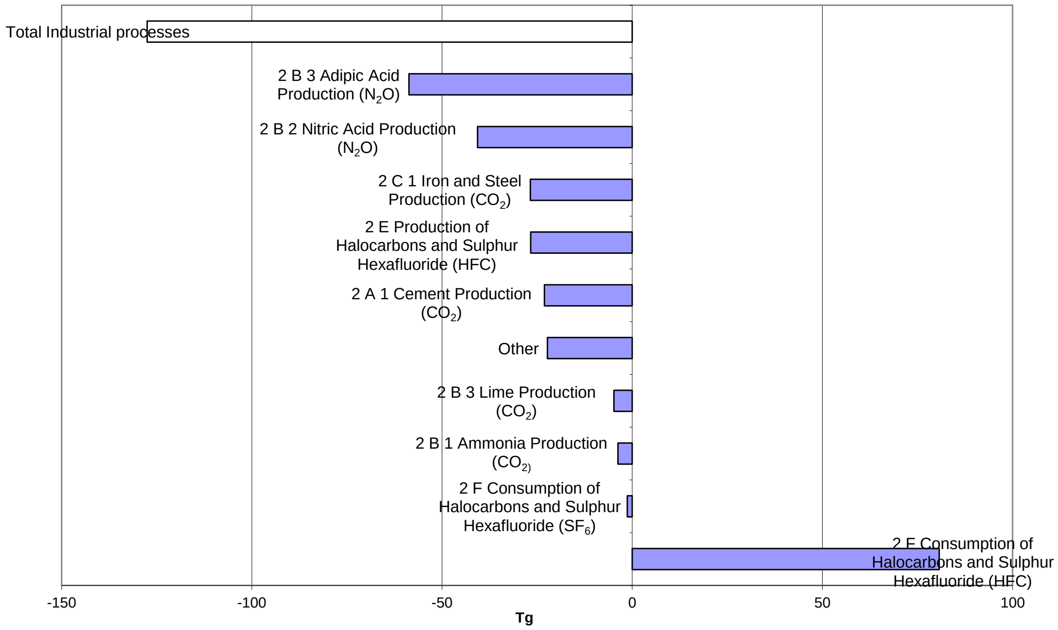
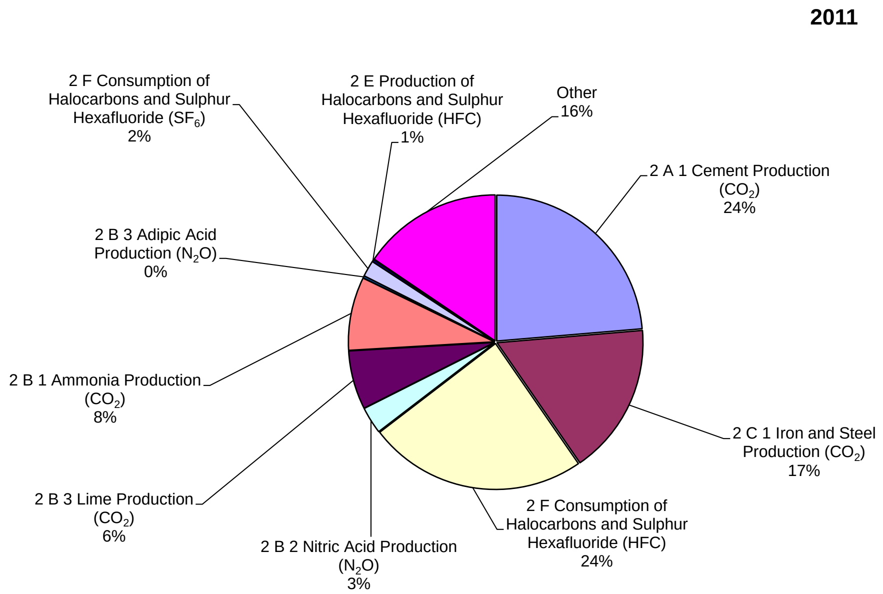


Figure 19.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs) and iron and steel production (CO_2). Additional N_2O emission reductions were achieved in nitric acid production. Large HFC emission increases can be observed from consumption of halocarbons and SF_6. The contribution of the new Member States to a possible change of the share in total process-related GHG emissions is small; again the three largest key sources account for about two thirds of total process-related GHG emissions in the EU-27 (Figure 19.2).

Figure 19.2 **CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2011 in CO_2 equivalents (Tg) and share of largest key source categories in 2011**





19.2 **Source categories (EU-27)**

19.2.1 Mineral products (CRF Source Category 2A) (EU-27)

The source category 2A Mineral Products includes three key sources: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions in cement production are reported that occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), glass manufacture, agriculture, construction or environmental pollution control.

19.2.1.1 *2A1 Cement Production*

In 2011, CO_2 emissions from 2A1 Cement production were 23 % below 1990 levels in the EU-27; for the EU-15 the decrease of CO_2 emissions from Cement production was also 23 % in the period 1990 to 2011. CO_2 emissions decreased by 1 % from 2010 to 2011 in the EU-27. In the period 2010-2011, Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania and Slovakia increased emissions from cement production, while the other new Member States decreased their emissions from cement production. In Latvia a new cement production plant started its operation in 2009. This cement production plant has a threefold maximum capacity compared to the already existing plant. This was the reason for the strong emission increase in Latvia (30% from 2010 to 2011). In Estonia, emissions increased after recovery from economic crisis in 2009/2010 (increase of 34% between 2010 and 2011).

Table 19.1 provides information on emission trends of the key source CO_2 from 2A1 Cement Production for EU-12. Among the new Member States Poland and Romania are the largest emitters accounting for 9 % and 4 %of EU-27 emissions.

Bulgaria, Romania and Lithuania had large reductions in absolute terms between 1990 and 2011. The largest drop in Romanian emissions occurred in 2008-2009, where the production of clinker decreased by 25 %. In the early nineties a significant decrease in Lithuanian emissions (-95 % during 1990 and 1993) was caused by a decrease of the production rate of clinker due to economic changes. The large drop in emissions in Bulgaria was caused by a significant reduction of clinker production – about -75 % in one of the plants, more than -50 % in other two plants and around -20% in the last two plants. In 2011 in few new MS the effects of the economic crisis prevailed such as in Bulgaria, Cyprus and Slovakia while other MS recovered from the crisis and increased cement production.

Table 19.1 2A1 Cement production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	80 174	64 493	61 581	78.5%	-2 912	-5%	-18 593	-23%		
Bulgaria	2 100	805	791	1.0%	-14	-2%	-1 310	-62%	T2	PS
Cyprus	668	555	546	0.7%	-9	-2%	-122	-18%	T1	PS
Czech Republic	2 489	1 469	1 665	2.1%	195	13%	-825	-33%	T3	PS
Estonia	483	310	416	0.5%	106	34%	-67	-14%	T2	PS
Hungary	1 797	735	564	0.7%	-172	-23%	-1 234	-69%	T2	PS
Latvia	366	431	559	0.7%	127	30%	193	53%	T2	PS
Lithuania	1 668	289	320	0.4%	31	11%	-1 348	-81%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	5 453	6 221	7 379	9.4%	1 158	19%	1 926	35%	T2,T3	CS
Romania	4 445	2 778	3 089	3.9%	311	11%	-1 356	-31%	CS,T2	PS
Slovakia	1 438	845	1 239	1.6%	394	47%	-199	-14%	T3	PS
Slovenia	482	368	316	0.4%	-52	-14%	-166	-34%	T2	CS
EU-27	**101 564**	**79 300**	**78 464**	**100.0%**	**-836**	**-1%**	**-23 100**	**-23%**		

Table 19.2 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement production in the new Member States for 1990 and 2011. The table shows that all EU-12 MS use clinker production as activity data for calculating CO_2 emissions and it also suggests that 97 % of EU-12 emissions are estimated with higher Tier methods.

The EU-27 IEF (excluding UK, as the British activity data is confidential and thus no IEF is provided) in 2010 is 0.53 t CO_2/t of clinker produced. The implied emission factors per tonne of clinker produced vary slightly from 0.51 t CO_2/t for Latvia and Hungary to 0.54 t CO_2/t for Bulgaria, Estonia, Poland, Romania and Slovenia; all new MS use country-specific and plant-specific emission factors. No significant changes of IEFs during 1990 and 2011 could be observed for any MS. Only for Hungary a decline of IEF during 1990 and 2011 could be found (-8 %). Explanations for changes of the implied emission factors are given in the following overview:

Implied Emission Factor, Hungary

- *The decrease of IEF from 2002 onwards reflects the dependency on the used limestone and produced clinker quality volume.*

Table 19.2 2A1 Cement Production: Information on methods applied and emission factors for CO_2 emissions

			1990				2011			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
			Description	(kt)			Description	(kt)		
EU15			EU15 w/o UK (91%)	136 839	0.53	72 878	EU15 w/o UK (94%)	109 023	0.53	57 486
Bulgaria	T2	PS	Clinker production	3 987	0.53	2 100	Clinker production	1 476	0.54	791
Cyprus	T1	PS	Clinker production	1 249	0.53	668	Clinker production	1 037	0.53	546
Czech Republic	T3	PS	Clinker production	4 726	0.53	2 489	Clinker production	3 132	0.53	1 665
Estonia	T2	PS	Clinker production	910	0.53	483	Clinker production	774	0.54	416
Hungary	T2	PS	Clinker production	3 210	0.56	1 797	Clinker production	1 109	0.51	564
Lithuania	T2	PS	Clinker production	3 058	0.55	1 668	Clinker production	602	0.53	320
Latvia	T2	PS	Clinker production	669	0.55	366	Clinker production	1 095	0.51	559
Malta	NA	NA		NO	NO	NO		NO	NO	NO
Poland	T2,T3	CS	Clinker production	10 309	0.53	5 453	Clinker production	13 630	0.54	7 379
Romania	CS,T2	PS	Clinker production	8 379	0.53	4 445	Clinker production	5 751	0.54	3 089
Slovenia	T2	CS	Clinker production	891	0.54	482	Clinker production	589	0.54	316
Slovakia	T3	PS	Clinker production	2 836	0.51	1 438	Clinker production	2 434	0.51	1 239
EU27			**EU27 w/o UK (93%)**	**177 062**	**0.53**	**94 269**	**EU27 w/o UK (95%)**	**140 653**	**0.53**	**74 368**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.3 summarizes the methodological information for cement production provided by EU-12 Member States in their national inventory reports. The majority of the new Member States uses data collected from plants under the EU emission trading scheme (Bulgaria, Cyprus, the Czech Republic, Hungary Poland, Slovakia and Slovenia).

Table 19.3 2A1 Cement Production: Summary of methodological information provided by Member States

Cement Production new MS	
Member State	**Methodology overview**
Bulgaria	The GHG emissions from the sector are calculated by using clinker production data and a country specific method, similar to a Tier 2 Method according to item 3.1.1 from the IPCC GPG. The aggregated national clinker production (CP) data in t/y are provided by the NSI. The above assumption for the CKD Correction Factor is based on the modern status of all 5 operational cement plants and the total (100%) recycling of their CKD as a raw material. The calculations are based on the conservative assumption that all of the lime (MeO) comes from a carbonate sources (e.g. limestone/MeCO3) in the lack of reliable data on the use of non-carbonate sources, i.e. assuming 100% calcinations of the carbonate sources present in the raw materials mixture. The 2011 CO2 emissions are taken from the operators EU ETS reports. In their reports CaCO3, MgCO3 and other carbonates content in the raw materials used is taken into account. The aggregated national clinker production (CP) data provided by the NSI and plants cover the period from 1988 to 2011. [NIR 2013]
Cyprus	For the years 2005-2011 detailed data is available via the verified EU ETS reports of the plants. The reports were prepared according to Annexes I & II of monitoring and reporting regulation (2007/589/EC). Cement producing plants also report on emissions from non-carbonate carbon (organic carbon). The average percentage of organic carbon to the raw material for 2010 was 6.1% and the respective emissions constitute the 3% of total emissions from cement production. For the period 1997-2004, the data submitted by the installations for the preparation of the National Allocation Plan 2005-2007 was used, whereas for the period 1990-1996, the emissions were estimated using the EF of 1997. For years after 2005, data submitted in the annual reports of the installations for the ETS are used. [NIR 2013]

Cement Production new MS	
Member State	**Methodology overview**
Czech Republic	Since 2006 submission methodology equal to the Tier 3 has been employed. CO2 emissions are based on data submitted by the cement kiln operators for preparation and standard operation of the EU ETS system, which includes all the cement kilns in Czech Republic. Information from individual kilns is reported to the competent authority. This data covers years 1990, 1996, 1998 - 2002 and 2005 - until most recent submission. For these years, the emission factor value was derived from individual installation data collected for EU ETS (emissions) and from CCA data (activity data about production of clinker). For other years the EFs were interpolated. The content of calcium/magnesium oxide (CaO/MgO) and composition of the limestone and dolomite are measured and independently verified. These parameters are used for calculation of the CO2 emissions and, therefore, substantial attention is devoted to their determination.For other years the EFs were interpolated. All operating cement plants in the Czech Republic are equipped with dust control technology and the dust is then recycled to the kiln. Only in one cement plant is a small part of the CKD discarded, for technical reasons. Use of dolomite or amount of magnesium carbonate in the raw material, as well as fissile carbon (C) content is known, all above mentioned variables are used for emissions estimates in the EU ETS system. Data on cement clinker production is published by the Czech Cement Association (CCA) (CCA, 2012), which associates all Czech cement producers. Clinker production data together with interpolated EF was used for years without direct data from cement kiln operators. IEF, which is calculated based on CO2 emissions and clinker production, varies from 0.5267 to 0.5534 t CO2 / t clinker. [NIR 2013]
Estonia	Emissions from cement production were calculated using Tier 2 methodology. Emission factors used in calculating the emissions from cement production are plant-specific provided by the industry. In calculating the emissions from cement production the amount of clinker produced annually is used as activity data. The clinker production data was received directly from the plant - AS Kunda Nordic Cement – throughout the time series. Emission factors from cement production are based on the actual CaO and MgO contents of clinker. Cement kiln dust and by pass dust as well as the amounts of CaO and MgO that are already calcinated before the process (and therefore do not cause emissions) are taken into account at plant. CKD correction factors were calculated by dividing the total CO2 process emissions (emissions from clinker production and cement kiln dust, but not emissions from the biological substance) with CO2 emissions from the clinker production. The total CO2 emissions from process and emissions from clinker production and cement kiln dust were provided by the plant for all of the years. Each year has a different CKD correction factor due to different amounts of cement kiln dust (calcination rate of CKD and CaO content of the clinker). [NIR 2013]
Hungary	Emissions were estimated using a country specific method similar to the IPPC Tier 2 methodology. In 2011 five factories were operating in Hungary. Production data for the whole time series were obtained directly from the factories and from the EU Emission Trading System (ETS). According to the ETS introduced by the European Union from 2005 on, the factories report their CO2 emission. This value is calculated on the basis of the derivatographic analysis of carbonate, which contains also CO2 generated from the MgCO3 content of limestone. The reported quantities of CO2 emitted between 2005 and 2011 are based on reports of the factories. This is in fact the same emission estimation methodology at plant level as before at country level, because for the preceding years, also raw material consumption was used for emission calculation (kiln input based method and the permanent stoichiometric ratios detailed above) instead of cement or clinker production. This is more accurate because cement factories have always measured the amount and composition of the raw flour. In 2000, production at one site was abandoned therefore previous production data of this factory were obtained directly from the Cement Industry Association that supplied only clinker data and the ratio of calcium-oxide to clinker. The results were corrected for cement kiln dust (CKD) in the case of wet technology only. Information on amount and carbonate content of dust released through the stack and separated by the separators were all provided by the operator. In the plants using dry technologies, the entire quantity of stack dust is recirculated into the furnace. [NIR 2013]
Latvia	Tier1 method from IPCC GPG 2000 was used to estimate clinker production data from final cement production amount when clinker / cement ratio for different types of cement is known. For CO2 emission factor as well as emission estimations IPCC GPG 2000 Tier2 method is used. The CO2 emission factor is calculated for all years of the time series 1990–2011 according to CaO content in used limestone that is measured in laboratory of cement production facility. LEGMC is able to use all laboratory measurements data from cement production plant even if it is not accredited and certified as requested in EU ETS MRG so CaO content in limestone is available to estimate CO2 emission factor for clinker. These emission factors will correspond to Tier2 emission factor estimations from IPCC GPG 2000 as CO2 emissions from Cement Production sector. For year 1996–2005 average CaO content data of years 1995 and 2006 was used in emissions calculation since data for average CaO content in produced clinker for years 1996–2003 was not available in cement production plant. Also information from plant that average CaO content of years where data is available could be used was received. For Submission 2013 the CaO content data for 2011 was requested to cement production plant. CO2 emission factor for 2011 was used according to information on CaO content in produced clinker provided by plant. [NIR 2013]
Lithuania	Cement is produced in a single company UAB “Akmenes Cementas”. For the period 1990-2004 CO2 emission s were calculated by a Tier 2 method using specific production data provided by the production company. CO2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO2. Actual CO2 emissions were calculated from the clinker production data and composition. In addition it was assumed that CO2 was released from calcinated fraction of kiln dust. The data on generation of cement kiln dust (CKD) (fraction not recycled to the kiln) were provided only for 2005-2010. An average value was used for the period when specific data were not available. According to the UAB “Akmenes Cementas”, only about 5% of the CKD is calcinated. For the period 2005-2010 CO2 emission data have been accessed via the verified EU ETS reports of the production plant using plant specific data on production of clinker and CKD, and plant specific emission factors (t CO2/ t clinker, t CO2/ t CKD). [NIR 2013]

Cement Production new MS	
Member State	**Methodology overview**
Malta	Not occuring. [NIR 2013]
Poland	CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2011 for installation of clinker production, which participate in the EU ETS [KOBiZE 2012]. Data on clinker production for the entire inventoried period was taken from [GUS 1989b-2012b]. CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2011 for installations which participate in EU ETS. For other years emissions were estimated based on clinker production and emission factors. [NIR 2013]
Romania	The method for calculating emissions of CO_2 from cement is in line with the IPCC GPG 2000 (Tier 2). The AD necessary to estimate emissions from this source category are provided by economic agents (clinker production data) and National Institute for Statistics (cement production). Activity data related to the calcinations process were collected directly from the companies: - clinker production data was provided by each company 1989-2011 period; - plant specific content of CaO (%) in clinker was provided by each company (according with laboratory analyses) starting with 2008 year; - plant specific content of MgO (%) in clinker was provided by each company (according with laboratory analyses) starting with 2008 year; - cement kiln dust (CKD) is completely recycled in the kiln. Two plants reported a correction factor for discarded amounts of dust: one of them for the period 1989-2003 and other plant for 2006 year. Starting with 2007 year there was no reported correction factor for discarded amounts of dust. The CO_2 EF has also been estimated considering the provisions in the ―Decision Tree for Estimation of CO_2 Emissions from Cement Production‖from IPCC GPG 2000 - page 3.11 and taking into account all the information provided by each cement company. For 1989-2007 the default CO_2 emission factor (EF) 0.525 t CO_2/t clinker was improved. The new specific EF was calculated considering the average between the base year 1989 implied EF (0.527 t CO_2/t clinker) and 2008 EF (the first year with laboratory analyses for plant specific CaO and MgO content in clinker), 0.530 t CO_2/t clinker. The resulted specific emission factor for 1989-2007 period is 0.53 t CO_2/t clinker. Starting with 2008, analyses have been made for CaO and MgO content and can be considered as representative in order to be used for calculating CO_2 emissions or plant specific clinker EF (plant specific content of CaO and MgO - % in clinker was provided by each company - according with laboratory analyses). [NIR 2013]
Slovak Republic	On the basis of the information provided into the verified ETS reports, Tier 2 methodology according to the IPCC 2000 Good Practice Guidance has been applied since 2002 based on plant specific information. The calculations provided by the cement clinker producers in the ETS reports balanced CO_2 emissions on the basis of cement clinker production and CaO and MgO contents. The content of CaO in cement clinker varies from 64.29% to 68.45% according to the plant specifications with the value of weighted average 66.07% in 2010. The content of MgO in cement clinker varies from 1.52% to 4.12% with the weighted average of 2.60% in 2010. On the basis of data supplied by plants and ETS reports. Correction factors provided in Table 4.5 represent the amount of non-carbonate origin of CaO and MgO (ground granulated blast-furnace slag). The correction factor includes also the CKD factor. All producers have modern technology with complete capturing of dust. The dust is returned to the kiln, then. According to the verification experiments made in one plant, efficiency of capturing dust is 99.9992%. The information was obtained also from other sources (the Statistical Office of the Slovak Republic, the Ministry of Economy, the Union of Slovak Chemical Industry, plant operators, producers, etc). The ETS reports elaborated directly from the sources included in the National Allocation Plans (I and II) have been the most important sources of activity data since 2005. The content of CaO in cement clinker varies from 64.29% to 68.45% according to the plant [NIR 2013]
Slovenia	The Tier 2 method has been applied. Activity data are data on the annual production of clinker. Clinker production data were obtained from the Statistical Office of the Republic of Slovenia for the period 1986–1998, and directly from the two plants that produce cement for the years 1999–2011. For national allocation plan purposes linked to emissions trading system more detailed data were obtained from 1999 onwards. Data on fraction of CaO and MgO in clinker from both cement works for the period 1999–2004 enabled us to determine our own emission factor. The average EF for the period 1999–2004 is 541 kg CO_2/t of clinker. As the location of quarries is the same as in the base year, we have applied this emission factor for calculating emissions from the base year 1986 to 1998. For calculating emissions for the years 1999–2004 we have used year-specific EFs. For the period 2005–2011, the EFs reported by the cement plants to the Ministry of Environment and Spatial Planning, as a competent authority in the European Union Greenhouse Gas Emission Trading System (EU ETS), are used to calculate CO_2 emissions.Data on clinker production and plant specific emission factors for both cement factories have been annually verified by independent verifiers. Cement kiln dust (CKD) is not accounted in emission calculation as in both cement factories CKD is returned into the process. [NIR 2013]

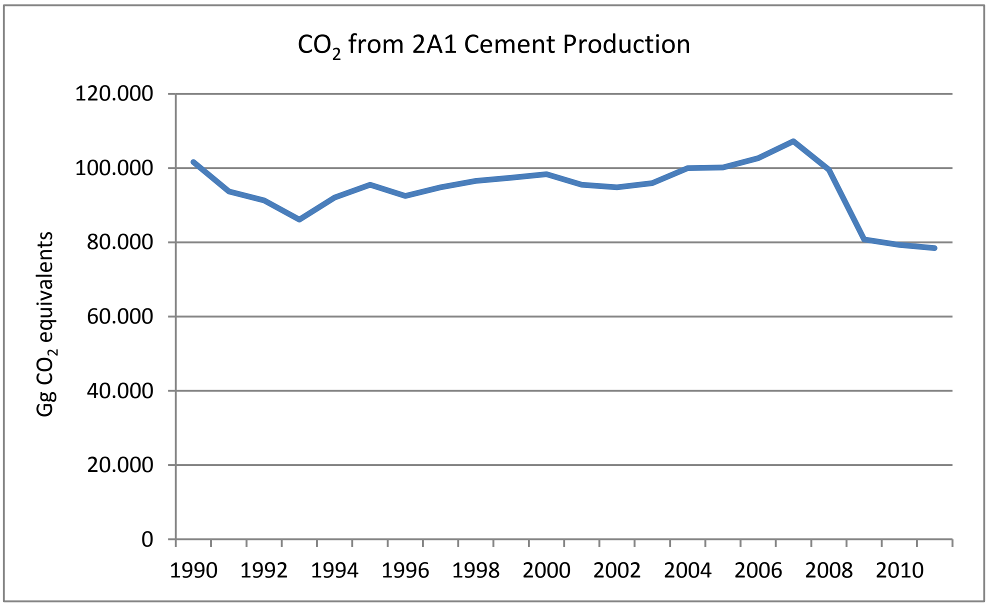
Source: NIR 2013.

19.2.1.2 *2A2 Lime Production*

CO_2 emissions from 2A2 Lime Production account for 0.5 % of EU-27 total GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from this source decreased by 18 % in the EU-27 (Table 19.4).

Poland and Romania are the largest emitters accounting for 7.2 % and 5.8 % of EU-27 emissions respectively, followed by Bulgaria (4.8 %). The decrease of CO_2 emissions between 1990 and 2011 was mainly caused by reductions occurring in in the Czech Republic (-48 %), Hungary (-73 %), Romania (-36 %) and Slovenia (-56 %), Lithuania (-82 %) and Estonia (-82 %), due to a decreased production of lime and dolomite in that period (Figure 4.3).

Figure 19.3 2A2 Lime Production: EU-27 CO_2 emissions



An increase of CO_2 emissions from lime production between 1990 and 2010 only occurred in Cyprus. Nevertheless this increase does not contribute to the emission trend due to the negligible share of Cyprus' emissions in the EU-27 emissions (Table 19.4). Five new MS significantly increased emissions from lime production between 2010 and 2011 after a large emission decrease in the years before due to the economic crisis. In absolute terms CO_2 emissions increased mostly in Poland and Bulgaria in that time period.

The table shows that about 35 % of EU-12 CO_2 emissions from 2A2 Lime Production are estimated with higher Tier methods.

Table 19.4 2A2 Lime Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	17 181	15 735	15 930	73.9%	195	1%	-1 250	-7%		
Bulgaria	1 035	906	1 037	4.8%	132	15%	2	0%	T2	D
Cyprus	4	9	7	0.0%	-2	-24%	3	89%	D	D
Czech Republic	1 337	671	691	3.2%	21	3%	-645	-48%	T1	CS
Estonia	131	18	23	0.1%	5	31%	-108	-82%	T1	PS
Hungary	653	211	178	0.8%	-33	-16%	-475	-73%	D,T2	D
Latvia	8	13	0	0.0%	-13	-100%	-8	-100%	T1	D
Lithuania	218	19	39	0.2%	19	98%	-179	-82%	T2	D
Malta	NE	NO	NO	-	-	-	-	-	NA	NA
Poland	2 453	1 379	1 561	7.2%	182	13%	-892	-36%	T1	D
Romania	2 389	1 275	1 260	5.8%	-14	-1%	-1 129	-47%	D	D
Slovakia	770	729	738	3.4%	9	1%	-33	-4%	T3	PS
Slovenia	206	90	91	0.4%	0	1%	-115	-56%	D	CS
EU-27	**26 385**	**21 054**	**21 556**	**100.0%**	**501**	**2%**	**-4 829**	**-18%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.6 summarizes the methodological information for lime production provided by EU-12 Member States in their national inventory reports. Latvia, Slovenia and Slovakia included an explicit reference to the use of plant-specific data under the EU ETS

Table 19.5 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production new MS	
Member State	**Methodology overview**
Bulgaria	The emissions from the sector are calculated using country specific data on the total amount of lime produced provided by NSI. Default emission factor is applied. The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines and using the following equation from 2000 GPG (p.3.19). Country specific data on the total lime production (quicklime) are provided by NSI. Emission factors take into account the CaO and MgO content of the lime produced. [NIR 2013]
Cyprus	The CO2 emissions from lime production were estimated using the default emission factor proposed by the revised IPCC 1996 guidelines (0.79 t CO2/ t lime) and the activity data obtained from the data collected by installations by the Department of Labour Inspection. [NIR 2013]
Czech Republic	Emissions from lime production were calculated in accordance with 2000 GPG. Only CO2 emissions generated in the process of the calcination step of lime treatment are considered under category 2A2. CO2 emissions from combustion processes (heating of kilns and furnaces) are reported under category 1A2f. National EF reflects the production of lime and quick lime (0.7884 t CO2 / t lime) (Vácha, 2004). Furthermore, it is taken into account the average purity (93%) (Vácha, 2004) of lime produced in Czech Republic. Activity data are based on statistics from the Czech Lime Association, which publishes data on pure lime production, so that these data were considered to be more accurate in comparison with data from the Czech Statistical Office, which do not differentiate between lime and hydrated lime. [NIR 2013]
Estonia	Emissions from lime production are calculated by multiplying emission factors with activity data. Activity data are collected mainly directly from the industry but in the earlier years (1990–1996) industrial statistics have also been used. Emission factors are calculated by the industry or are based on IPCC's default factors. The methods for calculating emissions from lime production are consistent with the IPCC Tier 1 level method. There are three different emission factors used to calculate emissions from lime production. Two emission factors are received directly from the plants, based on the actual CaO and MgO contents. From Limex AS emission factor has been available since 1994 (production in Limex AS started in 1994). From Nordkalk AS emission factor based on actual CaO and MgO content has been available since 2005. As this emission factor differs strongly from default emission factor, emission factors for 1990–2004 are established as a mean value from emission factors in 2005–2008. Third emission factor used is IPCC default value for quicklime. This value is applied to those companies that were closed before 1996, as no better data is available. Activity data (Table 4.4) for lime production is collected mainly directly from the industry and taken partly from industrial statistics (1990–1996). Since 1997 there have been two lime producing plants in Estonia and therefore activity data is collected directly from the industry (1997–2011). From 1990–1996 there were more producing plants and therefore industrial statistics have also been used. From 1990–1996 activity data is collected on one hand directly from plants producing lime nowadays, on the other hand industrial statistics have been used to calculate emissions from plants closed during 1990–1996.[NIR 2013]

Lime Production new MS	
Member State	**Methodology overview**
Hungary	The amount of CO2 generated by this sub-sector was calculated according to the method recommended by the Revised IPCC Guidelines. The emissions were calculated using the production data received from the manufacturers and the proper stoichiometric ratio (0.785). Naturally, the corresponding stoichiometric ratio was used for slack lime (Ca(OH)2) production data as well. [NIR 2013]
Latvia	CO2 emissions from lime production in steel production plant are estimated with Tier1 method based on total produced quicklime data and default emission factor. Default CO2 emission factor from IPCC GPG was used by steel production plant as per tonne of high calcium quicklime – 0.785 tCO2/t lime. Activity data of produced lime in steel production company is taken from plant's GHG reports within ETS. [NIR 2013]
Lithuania	The data on lime production were provided by the Statistics Lithuania. The data on hydrated lime production are provided by the Statistics Lithuania from 2002. Actual hydrated lime production data were used for emission calculation in 2002-2010 and it was assumed that hydrated lime production was zero in 1990 to 2001. CO2 emission was calculated by Tier 2 method using production data provided by the Statistics Lithuania and limestone composition data provided by the AB "Naujasis Kalcitas". CO2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO2. For determining activity data and emissions of CO2 within the sugar industry, the amounts of limestone for the production of quicklime are used. The quantities were obtained directly from the sugar producing companies for the years 1990-2011. According to the producers the used limestone consists to 97% of CaCO3. In the production of sugar, lime is used for purification of the juice. Lime is added to the raw juice and some impurities are precipitated. In the carbonisation step CO2 is bubbled through the juice and most of the remaining lime is precipitated as CaCO3. The precipitated "limestone" is sold and used within agricultural activities. It is assumed that around 90% of the lime used were precipitated as CaCO3 in the carbonation process16. Only the part of CaO which is not recovered as CaCO3 is reported as activity data.[NIR 2013]
Malta	Lime production was commonplace in Malta in the past. Nowadays the industry has stopped operating and any lime used in Malta is imported. The activity data utilised (quantity of lime produced) was compiled by Gauci from data provided by the National Office of Statistics. The CO2 emissions from this activity during the period 1995-1998 have been reported. For the years 1990 till 1994 no emissions have been reported, since at the time only two lime production plants were operational and hence the quantities of lime roduced were confidential data and were not available at the National Statistics Office. The 2006 IPCC Guidelines [3] provide two default emission factors. The Lime produced in Malta can be classified as high Calcium lime, thus an emission factor of 0.75 [ton CO2 per ton lime] is used. Production for the period 1990-1994 was obtained by back extrapolation of the production figures reported between 1995 and 1997, thus producing an estimate emission from this sector in that period. [NIR 2013]
Poland	Emission of CO2 from lime production was calculated based on data on lime production from [GUS 2011b]. The applied emission factor is estimated according to IPCC recommendations [IPCC 2000]. Emission for entire period 1988-2011 was estimated based on emission factors. Data about production was taken from statistical yearbooks [GUS 1989b-2012b]. The same value of emission factor equal 767 kg CO2/Mg of lime was used for all years. [NIR 2013]
Romania	Total CO2 emissions from lime production were estimated using production data and the emission factors, in line with the Good Practice Guidance - IPCC GPG 2000 Tier 1. The ADs necessary to estimate emissions from this source category (quicklime and dolomite lime) are provided by the National Statistics. Romania corrected estimates of CO2 emissions from Lime Production through the use of revised activity data (AD) in that calculation: dolomitic lime production (calcined/sintered dolomite and agglomerated dolomite). Anteriorly emission estimation was based on AD mentioned above and on crude dolomite production. For 1989 year and for the 1998 to 2000 period there is no data information on the production of calcined/sintered dolomite and agglomerated olomite. For these years an average percentage of dolomitic lime production excluding crude dolomite amount in total dolomitic lime production amount for years for which data on dolomitic lime production excluding crude dolomite amount is available was obtained and applied for 1989 and 1998–2000 years to total dolomitic lime production. The CO2 EF's are estimated considering the Equations 3.4, 3.5A, 3.5B, from IPCC GPG 2000, page 3.20. taking into account the default values from ―Table 3.4 - Basic Parameters for the Calculation of Emission Factors for Lime Production― – page 3.22 (IPCC GPG 2000). [NIR 2013]
Slovak Republic	In Table 4.7 the "hypothetic" CaO content is presented. It includes data on the CaO and MgO contents on the basis of stoichiometry. This approach is used because no distinguished data are available for the period 1900 – 2000. In that period the same content of CaO in the lime is assumed (91.2%). This value is based on the 2001 and 2002 data and applied on all the data available in the period 1990 – 2000. The average content of CaO in the lime is (91.2 ± 0.2)% in the period 1990 – 2002. Tier 2 according to the IPCC 2000 GPG has been applied since 2001 with the combination of plant specific activity data and emission factors estimated for each plant. The calculations are based on the data provided by the lime producers in questionnaires and in the ETS reports (produced lime and CaO and MgO contents). The implied emission factor of CO2 using the data on the purity of lime is 0.7559 t CO2/t of lime. Correction factor in Table 4.8 represents the fraction of carbonate calcinations (it is determined by analysis of CO2 in the product)[NIR 2013]
Slovenia	CO2 emission was calculated according to IPCC methodology. Similar to cement production, for allocation plan purposes more detailed data directly from producers for 1999 -2004 were obtained. Data on fraction of CaO and MgO in lime for the period 1999-2004 enabled us to determine our own emission factor. We have estimated country specific EF to be 749 kg CO2/ton of lime and applied this emission factor to calculate the CO2 emissions for 1986–1998. Emissions for the years 1999-2004 have been calculated using the year-specific EFs. The EFs for the period 2005-2011 are based on EU ETS data. They were derived from emissions and activity data on annual production of quicklime reported under EU ETS scheme. [NIR 2013]

Source: NIR 2013.

19.2.1.3 *2A3 Limestone and Dolomite Use*

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total EU-27 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions in the EU-27 decreased by 10 %. The increase of emissions in five new Member States (Poland, the Czech Republic, Slovenia, Slovakia and Hungary) offset emission reductions achieved in EU-15 MS by 25 % (Table 19.6). The Czech Republic and Poland were responsible for 12 % and 10 % of the emissions from this source respectively, followed by Romania with 4 %.

Emission reductions of more than 80 % during 1990 and 2011 occurred in some MS (Lithuania, Latvia) but due to their low share in EU-27 emissions (0.0 % and 0.2 %, respectively), no significant effect on EU-27 could be observed. Due to Romanian share of 4 % in EU-27 emissions in 2011, decreases in Romania of -62 % significantly contributed to the overall reduction (highest reduction in absolute terms); the decline was due to a significant decrease of limestone and dolomite consumption. The emission decrease was due to economic crisis. The changes of activity data contributed with 100 % to the change of the emission trends. In absolute terms the Czech Republic had the largest increase of emissions from 2A3. In this source category, the MS include limestone and dolomite used in flue gas desulphurization in power plants which participated in EU ETS between 2005 and 2010. The remaining emissions from limestone and dolomite used arose in other subcategories where these minerals are used. Table 19.6 suggests that about 83 % of EU-12 CO_2 emissions from 2A3 Limestone and Dolomite Use are estimated with higher Tier methods for 2011 (Tier 2 and Tier 3).

Table 19.6 2A3 Limestone and Dolomite Use: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7 992	5 948	5 966	63.9%	18	0%	-2 026	-25%		
Bulgaria	IE	IE	IE	-	-	-	-	-	NA	NA
Cyprus	NE	NE	NE	-	-	-	-	-	NA	NA
Czech Republic	678	1 021	1 151	12.3%	130	13%	474	70%	CS	CS
Estonia	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	202	310	346	3.7%	36	12%	143	71%	D,T2	D
Latvia	141	20	5	0.1%	-15	-76%	-136	-96%	T2,T3	D,PS
Lithuania	4	0.0	0.1	0.0%	0	400%	-4	-97%	T2	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	NA	874	972	10.4%	98	11%	972	-	T3	PS
Romania	1 061	427	399	4.3%	-28	-7%	-662	-62%	OTH	D
Slovakia	318	340	329	3.5%	-12	-3%	10	3%	T3	PS
Slovenia	27	152	165	1.8%	13	9%	139	523%	D	D
EU-27	**10 423**	**9 092**	**9 333**	**100.0%**	**241**	**3%**	**-1 090**	**-10%**		

Abbreviations explained in the Chapter 'Units and abbreviations'. Emissions of Bulgaria are included in 2A1, 2A2, 2A7 (glass and FGD) and 2C1 Emissions of Estonia are included in 2A1, 2A2 and 2A7

Table 19.3 summarizes the methodological information for limestone and dolomite use provided by EU-12 Member States in their national inventory reports. The Czech Republic, Latvia and Poland use plant-specific data reported and verified under the EU ETS.

Table 19.7 **2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States**

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Bulgaria	The emissions from the limestone and dolomite usage are reported under the specific production industries, e.i. 2A1 Cement Production, 2A2 Lime Production, 2A7.1 Glass Production, 2C1 Iron and Steel Production and 2A7 Other non-specified for desulphurisation. [NIR 2013]
Cyprus	Not occuring. [NIR 2013]
Czech Republic	CO2 emissions from sulphur removal were calculated from coal consumption for electricity production, the sulphur content and the effectiveness of sulphur removal units between 1996, when the first sulphur removal units came into operation, and 2005. In 2005, these data were verified by comparison with data from the individual power plants, which were collected for EU ETS preparation and which cover the years 1999 – 2005. The EU ETS data form has been used since 2006. Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc - production of agglomerate / sinter) and the EF value, which was derived from EU ETS CO2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO2 / t sinter). [NIR 2013]
Estonia	The emissions are reported in 2A1, 2A2 and 2A7. [NIR 2013]
Hungary	The emissions were calculated according to the IPCC Revised Guidelines using the correct stoichiometric ratios as emission factors (440 kg CO2 / ton limestone and 477 kg CO2/ ton dolomite, along with the default factor for fraction of purity of 1). Only limestone and dolomite used during various phases of iron production and limestone quantities used during flue gas desulphurization are calculated here. Activity data of the limestone and dolomite used in iron and steel industry were obtained on the basis of the data received from the manufacturers. For those years when such data were not available, the default value (250 kg dolomite/t iron mentioned in chapter 2.13.3.1 of IPCC1996 Revised Guidelines) was used. Flue gas desulphurization has been carried out in one power plant since 2002 and in another one since 2004. Activity data on the use of carbonates for SO2 scrubbing is either reported by the operators directly to the HMS or to EU ETS competent authority (In EU ETS the operators are required to report CO2 emission from the use of carbonate for scrubbing separately in their annual emission report). [NIR 2013]
Latvia	Limestone, dolomite and soda ash are used in glass production plants, steel production plant and lime production plants. All these plants are participants of EU ETS so the detailed information of used technologies, raw materials as well as emission factors are available as plants report their annual GHG reports to LEGMC. Under CRF 2.A.3 and CRF 2.A.4 sectors following CO2 emission sources are reported: - limestone and dolomite use in two glass production plants and one glass fibre production plant; - limestone and dolomite use in one iron & steel production plant; - limestone use in one lime production plant; - dolomite use in one lime production plant; - limestone use in sugar production processes; - soda ash use in one glass production plant. CO2 emissions from Limestone and Dolomite Use in Glass and Metal industry, limestone use in sugar production and Soda Ash Use in Glass Production are estimated with Tier2 method basing on plant specific activity data and default IPCC 1996 emission factors. CO2 emissions from Lime production in two direct lime production plants are calculated basing on data of carbonates – dolomite and limestone use. Purity factor from IPCC GPG 2000 is taken into account in estimation of CO2 emissions from dolomite use in lime production calculation. CO2 emissions from limestone use in lime production processes are estimated with Tier2 method based on plant specific activity data and default IPCC 1996 emission factors. Tier3 method is used in CO2 emission from dolomite use in lime production processes estimation as plant specific activity data as well as plant specific CO2 emission factors are used in estimation.[NIR 2013]
Lithuania	CO2 emission was calculated by Tier 2 method. Iron production data provided by Statistics Lithuania. Consumption of limestone flux in iron foundries was calculated as one tenth of iron production in accordance with the information provided by the foundries. CO2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) used as flux was released to the atmosphere as CO2. [NIR 2013]
Malta	Not occuring. [NIR 2013]
Poland	In this subcategory there were used only emissions from limestone and dolomite use in sulphur removal installations in power industry installation that participate in EU ETS. Emissions for this subcategory in GHG inventory correspond to emissions from the EU ETS verified reports. It should be noted that this emission constitutes only part of total emission from limestone and dolomite use. These other categories include inter alia: metal production (iron ore sinter production, pig iron in blast furnace, steel production, casting), mineral industry (glass and ceramics production). CO2 emissions concerning limestone and dolomite use in production of glass, ceramics and paper includes only the emission from installations covered by EU ETS. [NIR 2013]

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Romania	The IPCC methodology has been followed for estimating the CO2 emissions from limestone and dolomite used. The method estimates the amount of limestone and dolomite used in the iron and steel production, pulp and paper production, sugar mills production, ceramics plants, for all time series. The activity data were provided directly by the plants (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers). Each agency manages all economic agents which are in its responsibility (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers) in order to complete the needed data. The completed questionnaire has been sent to NEPA where the data are aggregated. Considering the Iron and Steel Production data there was estimated the amount of lime used for each technological process and then it was aggregated all the amount of lime used. For avoiding the double counting with Lime Production category, the total amount of lime used in the two integrated iron and steel plants, was subtracted from the total consumption of limestone provided by economic agents. The default emission factors 477 kg CO2/tonne dolomite and 440 kg CO2/tonne limestone are used. [NIR 2013]
Slovak Republic	In this sub-category the mass of consumed limestone in different industrial processes (iron and steel production, desulphurization of coal and ceramics) is included.The limestone used in the Slovak Republic often contains a small amount of MgCO3. Emissions are calculated on the basis of carbonates using Tier 3 method according to the IPCC 2000 GPG and the plant specific emission factors from 2004. Implied emission factor is based on the stoichiometry of limestone and dolomite in mixtures and it was 0.441 t per ton of used carbonate mixture in 2011. [NIR 2013]
Slovenia	This sector comprises use of limestone and dolomite in production of iron and steel, in technology for the reduction of SO2 emissions in the process of consumption of coal, in ceramics production, mineral wool production and production of TiO2. Consumption of limestone and dolomite in production of iron and steel produces CO2 emissions. Primary production from ore existed only in the 1986 and 1987, after 1990 steel production is based on utilization of scrap iron and steel. Activity data on CaCO3 consumption were obtained directly from iron and steel producers. CO2 emissions have been calculated according to IPCC methodology. Default emission factor, 440 kg CO2/ton limestone, has been applied for the whole period. CO2 emissions from scrubbing have been calculated from consumption of additive CaCO3 and appropriate emission factor. Activity data on CaCO3 consumption for the period 1995-2004 have been taken from the documents of Milan Vidmar Electroinstitute. Prior to 1995, there were no wet flue gas desulphurisation units installed for reducing emission of SO2 in Slovenia. Data on CaCO3 and MgCO3 for the period 2005–2011 have been obtained from verified ETS reports. Default emission factor, 440 kg CO2/ton limestone and 522 kg CO2/ton magnesium carbonate, were applied for the whole period. Following the ERT recommendation limestone and dolomite use in bricks and ceramics production was additionally taken into account. Activity data on CaCO3 and MgCO3 due to limestone and dolomite use in ceramics production for the period 2005–2011 have been obtained from verified ETS reports. Default emission factor, 440 kg CO2/ton limestone and 522 kg CO2/ton magnesium carbonate, were applied for the whole period. Mineral wool production: Dolomite is used as raw material in mineral wool production. Activity data have been obtained from the producer of mineral wool used for insulation purposes. Default emission factor 477 kg CO2/ton dolomite was applied for the whole period 1986-2011. Manufacture of dyes and pigments: Limestone has been used in manufacturing of TiO2 pigment for neutralization processes. Activity data on CaCO3 use for the period 1986–2011 have been obtained from the producer. Default emission factor 440 kg CO2/ton calcium carbonate has applied for the whole period. [NIR 2013]

Source: NIR 2013.

19.2.2 Chemical industry (CRF Source Category 2B) (EU-27)

CO_2 emissions from 2B1 Ammonia Production account for 0.56 % of total EU-27 GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from this source decreased by 13 %, (Table 19.8). Poland is responsible for 15 % and Romania for 11 % of emissions from ammonia production in the EU-12, followed by Lithuania (8 %). Bulgaria, Romania and Hungary had large reductions in absolute terms between 1990 and 2011.

Between 2010 and 2011, the CO_2 emissions increased by 6 % in the EU-27. The largest absolute emission increases occurred in Lithuania and Romania. In Romania the production and related natural gas consumption increased significantly. Emission reductions mainly occurred in Czech Republic.

In Lithuania, the increase of ammonia produced and natural gas consumed of more than 100 % occurred during 2006 and 2007 due to a new production line that was put into operation by the producing company. Nevertheless, a reduced demand for the product caused by the global economic crisis led to a drop in emissions in Lithuania 2008-2010, but then again to an increase of 100% in 2011 compared to 2010. Table 19.8 shows that no Member States uses default methodologies for the estimation of CO_2 emissions from ammonia production and that 69 % of EU-12 emissions are estimated with higher Tier methods for 2011 instead.

Table 19.8 2B1 Ammonia Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	18 729	16 253	15 312	56.8%	-941	-6%	-3 417	-18%		
Bulgaria	1 672	380	526	2.0%	146	38%	-1 146	-69%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	807	618	553	2.1%	-65	-11%	-254	-31%	T1	CS
Estonia	420	NO	NO	-	-	-	-420	-	NA	NA
Hungary	1 056	471	544	2.0%	73	16%	-512	-48%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 291	1 115	2 231	8.3%	1 116	100%	940	73%	T3	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	2 811	3 623	3 968	14.7%	346	10%	1 157	41%	T2	CS
Romania	3 438	2 543	3 020	11.2%	478	19%	-418	-12%	T1a	PS
Slovakia	617	485	779	2.9%	295	61%	162	26%	T2	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**30 842**	**25 487**	**26 935**	**100.0%**	**1 447**	**6%**	**-3 907**	**-13%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.5 summarizes the methodological information for ammonia production provided by EU-12 Member States in their national inventory reports.

Table 19.5 2B1 Ammonia Production: Summary of methodological information provided by Member States

Ammonia Production	
Member State	**Methodology overview**
Bulgaria	As recommended in revised 1996 IPCC Guidelines plant specific data were used to estimate CO2 emissions from ammonia production. Taking into account that good practice guidance has not yet been developed for the ammonia production (2000 IPCC GPG, p. 3.8) a higher tier method – Tier 2, is applied. Data on COF are default (1, fraction) and they are taken from Table 3.1 from 2006 IPCC Guidelines (Chapter 3, p. 3.15). All other parameter and data are plant specific. Based on plant specific data of the currently operating plants emission factors for the whole time series are estimated. An implied emission factor is used to recalculate CO2 emissions for the rest of the ammonia producing plants. For the whole time series (where available) plant specific activity data were used. An adjustment with statistical data from NSI has been made for the periods where no activity data for all the ammonia producing plants were available. In order to avoid double counting, the quantity of gas used is subtracted from the quantity reported under energy and non-energy use in the Energy Chapter. [NIR 2013]
Cyprus	NO
Czech Republic	Emissions are calculated from the corresponding amount of ammonia produced, using the technologically-specific emission factor 2.40 Gg CO2 / Gg NH3 (Markvart and Bernauer, 2005 - 2011). This emission factor was derived from the relevant technical literature - Ullman's Encyclopedia (Wiley, 2005) corresponding to the ammonia production employed in the Czech Republic, including information required for deriving the carbon dioxide emission factor: 56.25 t NH3 are produced from 44 t of residual oil containing 84.6% C. Simple stoichiometric calculation yields the value of the emission factor EF CO2 = 2.402 t CO2/t NH3. This emission factor includes the efficiency of the conversion of carbon contained in the starting material to carbon dioxide, equal to 99% (i.e. an oxidation factor of 0.99). [NIR 2013]
Estonia	Estonia uses method Tier 1a in calculating CO2 emissions from ammonia production. Emission factors were calculated by dividing CO2 emissions from technological process with amount of ammonia produced. As activity data is received directly from plant and emissions are calculated based on amount of natural gas used and carbon content of gas provided by industry, the emission factors for calculations of CO2 emissions from ammonia production are plant specific throughout time series. In Estonia, ammonia production emission factors are, depending on the year, between 1.243–1.446 t CO2/tonne NH3 produced. The annual ammonia production figures 1990–2011 have been obtained from the production plants. [NIR 2013]

Ammonia Production	
Member State	**Methodology overview**
Hungary	Initially, production data published by KSH and default value recommended by the Revised Guidelines (1.5 to CO2/t ammonia) were used for calculations. During ERT reviews (2002), it was repeatedly noted that calculation based on ammonia produced is not sufficiently accurate and natural gas-based calculations are more reliable, as also recommended in the first place by the Revised Guidelines. Therefore, we contacted the factories and the emissions were subsequently calculated using the natural gas consumption data obtained from them. The operator reports the amount of Natural gas used as feedstock separately from the Natural gas used for combustion. According to the recommendation of ERT in 2007, we indicated the natural gas quantity instead of the previously used ammonia production in the CRF Reporter. Since the input of the natural gas quantity in cubic meters was not possible, it was given in tons. [NIR 2013]
Lithuania	Ammonia production and natural gas consumption data (Figure 4-13) were provided by AB Achema company. Other fuels are not used in the ammonia production process. At the production plant, the natural gas is metered at the entrance point to the ammonia production unit, the flows for heating and mmonia production process are not separately metered. In 2011 Lithuania has revised calculation method for CO2 emissions from ammonia production. The produced has confirmed that carbon content factor used in the previous submissions were calculated back from the estimated CO2 emissions. Therefore it was decided to use ountry specific energy sector emission factor. The producer has provided complete data for the whole time series on ammonia production, natural gas consumption and lower calorific values (annual average) of natural gas. Recalculation was made for the whole time series. CO2 emissions were calculated from the total fuel requirements data using Tier 3 method (2006 IPCC Guidelines, page 3.13).Data on average annual lower calorific value of natural gas is provided by the producer for the whole time series. Data is calculated on the basis of reports from the natural gas supplier AB „Lietuvos dujos“. Calorific value of supplied natural gas is measured twice per month at Lithuania's natural gas supplier (AB "Lietuvos dujos") laboratory. The same company produces urea and dry ice. In estimating CO2 emissions from ammonia production, no account was taken for intermediate binding of CO2 in downstream manufacturing processes and products ([NIR 2013]
Latvia	Not occurring [NIR 2013]
Malta	Not occurring [NIR 2013]
Poland	CO2 emissions for ammonia production are estimated based on the data on natural gas use in this process (natural gas consumption for the years 1988-2011 was presented in Annex 3). The amount of natural gas consumption expressed in volume units was taken from [GUS 2012e]. To estimate carbon content in natural gas, the emission factor 0.525 kg C/m3 from IPCC [IPCC 1997] was used. This method was used for all years: 1988-2011. In years 1989-1990, also coke-oven gas was used for ammonia production and this fact was reflected in the inventory calculations. The coke- oven gas consumption was taken in energy units – also based on G-03 reports – and the carbon content factor is taken from IPCC [IPCC 1997]. [NIR 2013]
Romania	The CO2 emissions from ammonia production are estimated according to the Tier 1a methodology. According with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories - Industrial Processes, the relevant parameters used for estimation the CO2 emissions in line with 1a method are: - The annual amount of natural gas used as feedstock in Ammonia Production process, m3/an; - Carbon content of natural gas used as feedstock in Ammonia Production process, kg carbon/m3 gas; - The conversion factor of CO2; - CO2 emissions. Other relevant parameter than is not used in calculation of CO2 emissions in line with 1a level is annual Ammonia Production. In order to estimate de CO2 emissions have been taking into account the data provided directly from Ammonia Production plant considering the information from the questionnaires completed by all seven economic agents ammonia produces for all-time series 1989–2011. [NIR 2013]
Slovak Republic	The Tier 2 methodology according to the IPCC 2000 GPG was applied to category 2B1 ammonia production and the plant specific emission factors were used. The information on ammonia production and natural gas consumption for its production was provided directly by the company. The measured values of natural gas consumption from the plant were used for CO2 emissions estimation. The emission factor is 1.711 t CO2 per 1 t of ammonia produced and is based on plant specific data and calculated for ammonia produced by chemical reaction. The emission factor for methane and N2O are IPCC default: CH4 was 5 kg/TJ of natural gas and 0.1 kg N2O /TJ of natural gas. The consumption of natural gas in TJ was calculated based on consumption in mil m3 and annual specific net calorific vales used in energy sector. [NIR 2013]
Slovenia	Not occurring [NIR 2013]

Source: NIR 2013.

CO_2 emissions from 2B5 Other were not reported by any new MS, except for Poland that reports CO_2 emissions from ethylene production under this source category..

Table 19.9 2B5 Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	10 878	15 171	15 545	100.0%	374	2%	4 667	43%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	IE,NA	IE,NA	IE,NA	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	0.09	0.15	0.17	0.0%	0.016	11%	0.074	80%	T1	CR
Romania	NA,NE	,NE,NO	,NE,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-27	**10 878**	**15 171**	**15 545**	**100.0%**	**374**	**2%**	**4 667**	**43%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B2 Nitric acid production account for 0.3 % of total EU-27 GHG emissions in 2011. Between 1990 and 2011, N_2O emissions from this source in EU-27 decreased by 80 % (Table 19.). Romania is responsible for 12.2 % of these emissions in the EU-27, followed by Poland (8.2 %).

Hungary, Romania and Poland had large reductions in absolute terms between 1990 and 2010, followed by Bulgaria,

Between 2010 and 2011, the N_2O emissions decreased by 29 % in the EU-27. Large emission reductions could be found for Slovakia and Poland whereas a substantial increase occurred in Lithuania. In Lithuania nitric acid was produced by one company in the past. As part of a Joint Implementation project a secondary catalyst was installed in 2008. The secondary catalyst (on Al2O3 basis with active metal oxides CuO and ZnO) was installed underneath the platinum gauze which led to a decrease of the IEF. Plant specific N_2O emission factors based on the measurements in automated monitoring system (AMS) were used.

Hungary reduced its emissions since 2005; until 2005, Hungary used obsolete technology. The implementation of a new and more advanced state-of-the-art production technology was started in 2005 and installed in September 2007, resulting in drastic emission reductions. The new factory applying the EnviNO$_x$ technology reached a reduction of emissions of about 95-99%. At the same time the old production lines were closed.

The emission increase in Romania occurred due to a significant increase in production and due to the fact that the plant using SCR technology recorded a decrease in the efficiency of its abatement techniques for N_2O emissions reduction (from 85% in 2009 to 82% in 2010).

Table 19.8 suggests that only one new Member State uses default methodologies but that only 38 % of EU-12 N_2O emissions from 2B2 Nitric acid production are estimated with higher Tier methods.

Table 19.10 2B2 Nitric acid production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	35 723	9 633	5 881	59.5%	-3 752	-39%	-29 842	-84%		
Bulgaria	1 714	268	234	2.4%	-33	-12%	-1 479	-86%	T3	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 127	373	418	4.2%	45	12%	-708	-63%	T1	PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	3 214	11	13	0.1%	3	26%	-3 201	-100%	T2	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	929	578	885	9.0%	307	53%	-44	-5%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3 163	926	824	8.3%	-103	-11%	-2 340	-74%	T1	CS
Romania	3 460	1 152	1 210	12.2%	58	5%	-2 250	-65%	D	CR,D
Slovakia	1 187	904	421	4.3%	-483	-53%	-766	-65%	T2	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**50 517**	**13 845**	**9 887**	**100.0%**	**-3 958**	**-29%**	**-40 630**	**-80%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.6 summarizes the methodological information for N_2O emissions from 2B2 Nitric Acid Production provided by EU-12 Member States in their national inventory reports.

Table 19.6 2B2 Nitirc acid production: Summary of methodological information provided by Member States

Nitric Acid Production	
Member State	**Methodology overview**
Bulgaria	Taking into account the recommendations of the ERT for N2O emissions from the nitric production, plant specific data are used and a country specific emission factor was developed. Following the Decision tree for N2O emissions from nitric acid production (IPCC GPG, p. 3.32) plant specific data on N2O emissions and destruction were obtained. A higher tier method (referred as Tier 3 in 2006 IPCC Guidelines, Chapter 3, p. 3.21) is applied, which means that the N2O emissions are based on real measurement data. For completing the time series additional data from NSI were also used. For the years 2000 to 2010 a plant specific emission factor was calculated on the basis measured data from plants operators. For the period 1988 – 2000 the IEF was applied, assuming that technology and abatement types are similar. A default emission factor was applied for the third plant where no information is available and which stopped working in period 1999/2000. For the 2000 to 2010 emission data from plant operators were available; for the entire time series the production data were available. Following the recommendations of 2006 IPCC GL as a good practice in order to reduce uncertainty all activity data obtained were for 100 % HNO3. For the third plant activity data from NSI were used. [NIR 2013]
Cyprus	NO [NIR 2013]
Czech Republic	Nitrous oxide emissions from 2B2 Nitric Acid Production are generated as a by-product in the catalytic process of oxidation of ammonia. It follows from domestic studies (Markvart and Bernauer, 1999, 2000, 2003), describing conditions prior to 2004, that the resulting emission factor depends on the technology employed: higher emission factor values are usually given for processes carried out at normal pressure, while lower values are usually given for medium-pressure processes. Two types of processes were carried out in this country before 2004, at pressures of 0.1 MPa and 0.4 MPa. The amount of nitrous oxide in the exit gases is also affected by the type of process employed to remove nitrogen oxides, NOX (i.e. NO and NO2). In this country, the process of Selective Catalytic Reduction (SCR) is mostly used, which slightly increases the amount of N2O, and also to a certain degree Non-Selective Catalytic Reduction (NSCR), which also removes N2O to a considerable degree. Studies (Markvart and Bernauer, 2000, 2003) recommend the following emission factors for various types of production technology and removal processes that are given in Tab. 4-9. The emission factors for the basic process (without DENOX technology) are in accord with the principles given in the above-cited IPCC methodology. The effect of the NOX removal technology on the emission factor for N2O was evaluated on the basis of the balance calculations presented in studies (Markvart and Bernauer, 2000, 2003). Collection of activity data for HNO3 production is more difficult than for cement production because of the present legislation, which complicates the releasing of statistical data on manufactured products where the number of producers is smaller than (or equal to) three. Therefore, it was necessary to obtain them by questioning all three producers in the Czech Republic, see (Markvart and Bernauer, 2000, 2003, 2004).[NIR 2013]

Nitric Acid Production	
Member State	**Methodology overview**
Estonia	NO [NIR 2013]
Hungary	Measured emission data were not available for a long time. Therefore, during the first phase of the recalculation project, the default specific emission factor recommended by IPCC (6 kg N2O/t nitric acid) was used. In 2004, an emission measurement system was installed at one of the factories and this has resulted in fundamental changes in the previously estimated values. N2O meter is placed after the catalyst which measures emissions continuously. The regular monitoring report is based on daily average measurement data but the system is capable to provide data for shorter time period, e.g. hourly averages. The factory makes available its measured data to the inventory compiler. Therefore, on the basis of almost one year of experience with measurements, the calculated emission factors of the factories using different technologies were between 10 to 19 kg/t. For calculation of emissions of the oldest factory (established in the 1950's), which was abandoned in 1988, the highest value recommended by the Good Practice was used (19 kg N2O/t). 14.5 kg/t was used as specific emission factor for the three other abandoned factories including the one which was abandoned in September 2007. For the combined factory, a value of 10 kg/t was used. End of 2004, selective catalytic reduction was introduced in tail-gas treatment which led to emission reductions in the following years. In the second half of 2005 a new measuring instrument was installed which might partly explain the difference between IEFs. Thus, the weighted average ranges between 10.01 and 14.51 kg/t in the time series of the years before 2007, depending on the production volume. The new factory applies the EnviNOx technology consequently a drastic reduction of emission has been reached. N2O emission from nitric acid production was decreased by 99% between base year and 2009. [NIR 2013]
Lithuania	The N2O emissions from the nitric acid production were estimated based on the following data: - Annual production of nitric acid: o Data on the level of production plant (1990- 2008); o Data on the level of production units (2009-2011); - Production unit specific N2O emission factors: o Prior to installation of catalyst (2007-2008 monitoring campaign data); o After installation of catalyst (2009, 2010 and 2011); For the years 2009-2011 production unit specific N2O emission factors were obtained from the producer The emmission factors were measured and registered in automated monitoring system (AMS) by AB Achema. Annual emissions of N2O from nitric acid production were estimated : - 1990-2008: based on extrapolated unit specific activity data and the mean value of EFs of the actually operating units; - 2009-2001: based on unit-specific activity data and unit-specific EFs. 1990-2008. Production of nitric acid for each operational unit was extrapolated from the data on total annual production of nitric acid in a particular year based on information on unit-specific output (share of each production unit as % of the total production based on 2009-2010 data). Mean value of EFs of the actually operating production units is based on 2007-2008 measurements in automated monitoring system prior to installation of the catalyst. 2009-2011. N2O emissions were estimated using unit specific emission factors and unit specific production data provided by the producer. As already mentioned, in 2008 JI project for N2O emission reduction from the nitric acid plant in AB Achema has started. During the implementation of the project, substantial emission reduction was achieved as monitored in a automated monitoring system. [NIR 2013]
Latvia	Not occurring [NIR 2013]
Malta	Not occurring [NIR 2013]
Poland	Estimation of N2O emission from nitric acid production for 2011 was based on annual HNO3 production data from [GUS 2012b]. The applied country specific emission factor: 1.23 kg/Mg nitric acid was estimated based on the reports from all producers of HNO3 [KOBiZE 2012]. The N2O emission factors for years 2005-2010 were calculated also based on mentioned reports provided by installations of nitric acid production. Decrease of the N2O EF value from nitric acid roduction in 2008 and its significant drop in 2009 - 2011 are the result of the implementation of the JI projects. Activity data (i.e. HNO3 production) for estimation of nitrous oxide emissions in 2.B.2 subcategory were taken from [GUS 1989b-2012b] for the entire period 1988-2011. [NIR 2013]
Romania	Emissions have been calculated by multiplying annual Nitric Acid Production (tons HNO3 100% by each plant) by a default emission factor, which reflects the process, in line with IPCC GPG 2000 and CORINAIR Methodology. According with the Decision Tree for N2O Emissions from Adipic Acid and Nitric Acid Production from IPCC GPG 2000 – pg. 3.32, in order to use of a higher Tier calculation method it is need to collect the information regarding emissions and destruction data directly from plants, but the data on plant specific emissions there are not sufficiently documented and explained by operators, therefore the data emissions could not be used in this report 2013. Specific questionnaires have been sent to the local EPA in order to collect information on Nitric Acid Production from economic agents. [NIR 2013]
Slovak Republic	The nitric acid is produced by two providers in Slovakia. One of them produces nitric acid by two technologies: medium-pressure and high-pressure. The N2O emissions are directly measured. According to that information the emission factors were estimated annually, based on certified measurements in the plant. According to the measured data, the EFs were 10.332 kg N2O per 1 t of HNO3 for medium-pressure plant in 2006 and 2007; and 7.3; 7.6 and 7.5 kg/t in 2005, 2008 and 2009, respectively (reg. No.: SNAS 230/S-189). In 2006-2007, there was a malfunction that resulted in higher N2O emissions. The average value of this emission factor (7.5 kg / 1 t of HNO3) observed in 2005, 2008 and 2009 is used for medium pressure plant for the period 1990 – 2004, as well. The same value was also measured before technological change in 2010. According to the ERT recommendation, the same EF should be used also for the other producer in the Slovak Republic. The used technologies are very similar. The emissions factor of N2O in high-pressure plant was measured to be 9.02 kg N2O per 1 t of HNO3 in above mentioned years. This value is used for whole time series for the high-pressure technology. It is very close to the default IPCC value (kg/t). In September 2010, the producer with medium-pressure and high-pressure plant introduced the technology with secondary YARA catalyst. It resulted in significant decrease of N2O emissions. The IEF was 2.29 kg N2O/t of HNO3 in 2011 and the N2O emissions were 1 358.22 tons. [NIR 2013]
Slovenia	Emissions for the period 1997-2005 have been estimated according to IPCC methodology, applying an emission factor of 5.5 kg N2O/ton nitric acid. Data on amount of nitric acid produced have been obtained from the Statistical Office of the Republic of Slovenia. Since 2006 there is no production of nitric acid in Slovenia. No emissions of N2O have been originated from that sector since 2006. [NIR 2013]

Source: NIR 2013.

N_2O emissions from 2B3 Adipic Acid Production were not reported by any new MS in 2011, except for Poland and Romania in 1990. Romania stopped its adipic acid production in 2001 and thus suspended this activity from 2002 onwards and Poland stopped its adipic acid production already in 1994 (Table 19.1).

Table 19.11 2B3 Adipic Acid Production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	58 927	1 587	764	100.0%	-823	-52%	-58 163	-99%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	372	NO	NO	-	-	-	-372	-100%	NA	NA
Romania	574	NO	NO	-	-	-	-574	-100%	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**59 872**	**1 587**	**764**	**100.0%**	**-823**	**-52%**	**-59 109**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.05% of total EU-27 GHG emissions in 2011 and are only reported by the Czech Republic and Poland. Both MS together are responsible for 14 % of these emissions in the EU-27 and both consider N_2O emissions from the production of caprolactam under 2B5.

The increase in Czech emissions by 13 % occurred between 2005 and 2006 due to the calculation method applied. Caprolactam production data are not provided by the official Czech statistics because of confidentiality (there is only one plant in the Czech Republic). Emissions of N_2O were estimated by external experts for years 1990 to 2005 by approximating the production capacity in that time period. After consultations with the producer, the N_2O emission factor was revised, resulting in higher emissions since 2006. N_2O emissions in Poland increased steadily from 1990 to 2005 (+54 %) and decreased afterwards until 2009 and increased again from 2009 to 2011 (Table 19.7). This trend is driven by the caprolactam production in the country.

Table 19.7 2B5 Other: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4 586	2 028	2 102	86.2%	74	4%	-2 484	-54%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	84	94	94	3.9%	0.000	0%	11	13%
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	143	234	241	9.9%	7	3%	98	69%
Romania	NA,NE	A,NE,NO	A,NE,NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-27	**4 813**	**2 356**	**2 438**	**100.0%**	**81**	**3%**	**-2 376**	**-49%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

19.2.3 Metal production (CRF Source Category 2C) (EU-27)

CO_2 emissions from 2.C Metal production account for 1.4 % of the total EU-27 GHG (w/o LULUCF) emissions in 2011. Poland, the Czech Republic, Romania and Slovakia are responsible for 31 % of overall emissions from this sector. Czech Republic is responsible for 10% of the overall EU27 emissions. Most MS reported decreasing emissions in this sector.

Table 19.19.8 2C1 Iron and Steel Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	46 932	38 168	36 187	65.2%	-1 981	-5%	-10 745	-23%		
Bulgaria	1 283	53	68	0.1%	14	27%	-1 215	-95%	T2	CS
Cyprus	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Czech Republic	12 533	5 919	5 623	10.1%	-296	-5%	-6 909	-55%	T1	D
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Hungary	3 039	2 243	2 236	4.0%	-7	0%	-803	-26%	CS,T1	D
Latvia	13	11	0	0.0%	-11	-96%	-12	-96%	T2	PS
Lithuania	21	4	4	0.0%	0	-9%	-18	-83%	T1	D
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	4 860	5 085	5 466	9.9%	381	7%	606	12%	CS,T3	CS
Romania	6 154	3 003	2 632	4.7%	-371	-12%	-3 522	-57%	T2	CS,D
Slovakia	4 114	3 808	3 224	5.8%	-583	-15%	-889	-22%	T2,T3	CS
Slovenia	30	45	47	0.1%	3	6%	18	60%	T2	PS
EU-27	**78 979**	**58 340**	**55 488**	**100.0%**	**-2 852**	**-5%**	**-23 491**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.19.9 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

Member State	1990				2011			
	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Bulgaria	**Iron and steel production**		**0.30**	**1 283**	**Iron and steel production**	**0**	**0.08**	**68**
	steel production - kt	2 180	0.59	1 283	steel production - kt	859	0.08	68
	pig iron for production of steel - kt	C	NO	NO	pig iron for production of steel - kt	NO	NO	NO
	Sinter: aglomerate - kt	2 081	NO	NO	Sinter: aglomerate - kt	NO	NO	NO
	Coke: Coke at 6% wet - kt	C	NO	NO	Coke: Coke at 6% wet - kt	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Cyprus	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	Steel	0	NO	NO	Steel	0	NO	NO
	Pig Iron	0	NO	NO	Pig Iron	0	NO	NO
	Sinter	0	NO	NO	Sinter	0	NO	NO
	Coke	0	NO	NO	Coke	0	NO	NO
	Other				Other	0	0.00	NA
Czech Republic	**Iron and steel production**		**0.39**	**12 533**	**Iron and steel production**	**0**	**0.32**	**5 623**
	Steel	10 098	1.24	12 533	Steel	5 678	0.99	5 623
	Pig Iron	6 106	IE	IE	Pig Iron	4 137	IE	IE
	Sinter	8 469	IE	IE	Sinter	5 148	IE	IE
	Coke	7 285	IE	IE	Coke	2 586	IE	IE
	Other			NO	Other	0	0.00	NO
Estonia	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	(Steel)	NO	NO	NO	(Steel)	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	(Coke)	NO	NO	NO	(Coke)	NO	NO	NO
	Other			NA	Other	0	0.00	NA

Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Hungary	**Iron and steel production**		**0.53**	**3 039**	**Iron and steel production**	**0**	**0.60**	**2 236**
	Steel: crude steel	2 963	0.13	382	Steel: crude steel	1 733	0.13	223
	Pig Iron: Pig Iron production	1 697	IE	IE	Pig Iron: Pig Iron production	1 315	0.05	66
	Sinter: 0	IE	IE	IE	Sinter: 0	IE	IE	IE
	Coke: Consumption	1 040	2.55	2 657	Coke: Consumption	683	2.85	1 947
	Other			NA	Other	0	0.00	NA
Lithuania	**Iron and steel production**		**0.20**	**21**	**Iron and steel production**	**0**	**0.88**	**4**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	106	0.20	21	Pig Iron	4	0.88	4
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Latvia	**Iron and steel production**		**0.12**	**13**	**Iron and steel production**	**0**	**0.16**	**0**
	(crude steel produced from crude iron)	109	0.12	13	(crude steel produced from crude iron)	3	0.16	0
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Malta	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA

	1990				2011			
Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Poland	**Iron and steel production**		**0.24**	**4 860**	**Iron and steel production**	**0**	**0.52**	**5 466**
	Steel	IE	IE	IE	Steel	IE	IE	IE
	Pig Iron	8 657	0.17	1 430	Pig Iron	3 975	0.76	3 026
	Sinter: production	11 779	0.07	834	Sinter: production	6 513	0.24	1 564
	Coke: production	IE	IE	IE	Coke: production	IE	IE	IE
	Other			2 596	Other	0	0.00	876
Romania	**Iron and steel production**		**0.22**	**6 154**	**Iron and steel production**	**0**	**0.33**	**2 632**
	steel production (BOF and EAF)	8 946	0.06	549	steel production (BOF and EAF)	3 808	0.07	271
	pig iron production	5 916	0.95	5 605	pig iron production	1 581	1.49	2 361
	sinter used	11 357	IE	IE	sinter used	1 842	IE	IE
	coke used	2 060	IE	IE	coke used	841	IE	IE
	Other			IE	Other	0	0.00	IE
Slovenia	**Iron and steel production**		**0.05**	**30**	**Iron and steel production**	**0**	**0.07**	**47**
	Steel produced	632	0.05	30	Steel produced	687	0.07	47
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Slovakia	**Iron and steel production**		**0.43**	**4 114**	**Iron and steel production**	**0**	**0.80**	**3 224**
	Steel	3 562	1.15	4 096	Steel	3 961	0.81	3 198
	Pig Iron	3 561	IE	IE	Pig Iron	NA	IE	IE
	Sinter	151	IE	IE	Sinter	52	IE	IE
	Coke	2 340	IE	IE	Coke	NA	IE	IE
	Other			18	Other	0	0.00	27

According to the IPCC methodology, processes including auto-producers - power and heat production facilities located in iron and steel plants excluding heating of coke ovens (where usually coke oven gas is combusted) and fuel combustion (gaseous fuels and coke) in sinter plants (agglomeration of iron ores) should be taken into account in 1A2a; while processes including consumption of carbonaceous reducing agents, especially in blast furnaces, oxidation of carbon contained in a pig iron or scrap and the burning off carbonaceous electrodes should be taken into account in 2C1. Additionally, emissions coming from limestone and dolomite use in iron and steel plants should be included under 2A3 and Emissions coming from heating of coke ovens should be reported under 1A1c.

However, some EU-27 Member States do not keep this boundary for different reasons (local traditions used in history and in this context an attempt to keep consistency in data series). E. g. some Member States report emission from blast furnace gas and from converter gas under 1A2a instead of under 2C1, because they interpret it as emissions from energy supply.

Thus, for an overview of EU-27 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU-15 Member States in the combined category 1A2a + 2C1 are given in Table 19.10

Table 19.10 CO_2 Emissions of EU-27 Member States in 1A2a and 2C1 Iron and Steel

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2011	Share 2C1
	1A2a	2C1	Combined		
EU-15	103 924	36 187	140 110	79.3%	26%
Bulgaria	190	68	258	0.1%	26%
Cyprus	IE,NO	NA,NO	0	0.0%	-
Czech Republic	3 398	5 623	9 021	5.1%	62%
Estonia	0	NA,NO	0	0.0%	0%
Hungary	406	2 236	2 642	1.5%	85%
Latvia	74	0	75	0.0%	1%
Lithuania	NO	4	4	0.0%	NA
Malta	IE,NA	NA,NO	0	0.0%	-
Poland	4 445	5 466	9 911	5.6%	55%
Romania	3 695	2 632	6 327	3.6%	42%
Slovakia	4 773	3 224	7 998	4.5%	40%
Slovenia	194	47	242	0.1%	20%
EU-27	**121 100**	**55 488**	**176 587**	**100.0%**	**31%**

Table 19.11 2C1 Iron and Steel Production: Information on activity data and methods used for CO_2 emissions

Member States	Description of methods
Bulgaria	The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Data for 2010 from Bulgarian association of metallurgical industry (BAMI, http://www.bcm-bg.com/) as well as data from World Steel Association (WSA, http://worldsteel.org) are used for crosscheck. Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2009. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Thus CO_2 emissions are estimated by an approach similar to the following equation (IPCC GPG, p. 3.25): EQUATION 3.6B Emissions crude steel = (Mass of Carbon in the Crude Iron used for Crude Steel Production – Mass of Carbon in the Crude Steel) • 44/12 + Emission FactorEAF • Mass of Steel produced in EAF
Cyprus	NO there is no iron and steel production in Cyprus

Member States	Description of methods
Czech Republic	CO_2 emissions were determined for category 2C1 using a procedure corresponding to Tier 1 of the Good Practice Guidance for 2C1. This calculation was based on the amount of coke consumed in blast furnaces. The calculation was carried out using NCV = 27.77 MJ/kg in 2011 (NCV interval for period 1990 - 2010 is (27.9 - 28.8 MJ/kg) and using the carbon emission factor for coke, 29.5 t C / TJ, which is the IPCC default value (IPCC, 1997). As the final products in metallurgical processes are mostly steel and iron with very low carbon contents, the relevant correction for the amount of carbon remaining in the steel or iron was taken into account by using factor 0.98, i.e. the same factor that is standardly used for combustion of Solid Fuels (the oxidation factor).
Estonia	NO – there is no iron and steel production in Estonia
Hungary	Earlier only the emissions from carbon content reduction of the input materials during steel production and the emission from the consumption of graphite electrodes (2.C.1.1. subsector) were reported within this sector and all the other emissions were included elsewhere. In 2012 a major reallocation between sector 1.A.2.a and 2.C.1.2 (Pig Iron production) and 2.C.1.4 (Coke consumption) was performed after the recommendation of the review report of submission 2011 and also the subsector 2.C.1.1 (Steel) was recalculated. Default emission factors from the IPCC1996 Guidelines are used. In the case of consumption of coke and natural gas, both CO_2 and CH_4 emissions are reported using kg /TJ default factors from the energy sector in order to achieve more accurate results by using actual NCV data of the year. Iron and steel production data were obtained from the reports of the International Iron and Steel Institute, World Steel Association (WORLDSTEEL) and the similar European agency (EUROFER). Data on Consumption of coke and natural gas in the blast furnace is extracted from the IEA Energy Statistics of Hungary.
Latvia	IPCC 1996, IPCC GPG 2000 Tier2 and EMEP/CORINAIR are used to calculate direct and indirect GHG emissions from the 2.C Metal Production sector. There is only one Iron & Steel production plant in Latvia that produces crude steel by melting crude iron not only by melting scrap metals. The plant is participant of ETS and submits their annual GHG reports to LEGMC. It is possible to obtain more accurate and complete activity data and emission factors from enterprise that is involved in the emission trading system. CO_2 emissions were estimated only from crude iron used. In steel production plant mostly steel is produced by melting scrap metal that doesn't produce CO_2 emissions by leaking carbon. The only amount of total produced steel is reported by steel production company that means that the total amount of steel produced by using crude iron and melting scrap metal is known. Therefore it is needed to estimate the crude steel amount that is produced only by using crude iron and that caused CO_2 emissions. This amount is then used as activity data. Default emission factor – 1.5 kg carbon per tonne of steel is used because plant reported emission factor – 6 kg carbon per tonne of steel, is considered as unreliable high. For 2008 plant reported 18 kg per tonne of steel as also was assumed as incredibly high.
Lithuania	CO_2 emissions from blast furnaces were calculated from coke consumption using default emission factor 3.1 tonnes CO_2 per tonne coke (Revised 1996 IPCC Guidelines. Table 2-12, p. 2.26). Revised 1996 IPCC Guidelines do not provide emission factor for electric arc furnaces. Therefore emission factor 0,08 tonne CO_2 per tonne of steel produced is provided in 2006 IPCC Guidelines was used for evaluation of CO_2 emissions from electric arc furnace.
Malta	NO - there is no iron and steel production in Malta
Poland	Iron Ore Sinter Production Carbon dioxide process emissions from iron ore sinter production for 2011 come from the verified reports on annual emissions of CO_2 from iron ore sinter installations in EU ETS [KOBiZE 2012]. The values of annual iron ore sinter productions were also taken from production amounts indicated in the verified reports. In 2.C.1.a sub-category for 2005-2011, CO_2 emission values, consistent with total CO_2 emissions from the verified reports for sintering plants were taken (without the exclusion of coke and other fuel consummated for sinter belt heating). For that reason, the consumption of fuels in sintering plants (taken from the verified reports), which was included in energy balance as part of final energy consumption in Iron and steel sector, was subtracted from activity data in 1.A.2.a to avoid double counting. Steel Cast Production The data on CO_2 process emissions from steel cast production as well as on amount of cast steel was estimated according to the methodology given in [Holtzer 2007]. CO_2 emission estimated in

Member States	Description of methods
	mentioned study concerns only melt process of alloy since this is main sources of process emission. CO_2 emission occurring at pouring into moulding sands is not included. Iron Cast Production The data on CO_2 process emissions from iron cast production as well as on amount of cast iron was estimated according to the methodology from [Holtzer 2007]. Estimation of CO_2 emissions concerns only melting process of alloy since this is the main source of process emission. CO_2 emission occurring at pouring the liquid metal into the moulding sands was not taken into consideration. Pig Iron Production In Blast Furnaces CO_2 emission for 2011 from pig iron production was taken from the verified reports prepared by installations included in EU ETS. Pig iron is produced in the integrated steel plants, so additional information was needed for application of data from the verified reports. This additional data for separation of blast furnace process and steel production in integrated steel plants were received directly from plants. Basic Oxygen Furnace Steel Production Amount of CO_2 process emission from basic oxygen furnace steel production in 2011 was taken from the verified reports from steel plants participating in EU ETS. Like in case of sintering plants and blast furnace process also in 2.C.1.f total CO_2 emission, without excluding emission from fuels used for energy purpose of this process, was assumed. Amounts of fuels used in production of steel in basic oxygen furnaces, included in 2.C.1.f subcategory were and subtracted from activities data of 1.A.2.a to avoid the double counting. Electric Furnace Steel Production Process emissions of CO_2 from steel production in electric furnaces in 2011 were taken from the verified reports prepared by installations included in EU ETS. Emissions in 2.C.1.g include also emissions from combustion of fuels, which are classified in the sector Iron and steel production in the statistics, so the amounts of the fuels were subtracted from activity data in 1.A.2.a to avoid double counting. Coke Production Processing emission of CO_2 from coking plants in the period 1990-2011 was allocated into 1.B.1 Fugitive emission from solid fuels subcategory.
Romania	The method for calculating emissions of CO_2 from Iron and steel production is in line with the Good Practice Guidance (Tier 2 method). The recommended Tier 2 method, according to the IPCC Good Practice Guidance, is to base the calculations on the amount of reducing agent (coke oven coke) used in blast furnaces for the production of iron. Other information needed to use the Tier 2 method is the amount of pig iron produced as well as the amount used for steel production and produced steel, and the carbon content of all those parts. All these information have been collected at plant level.
Slovakia	Tier 2 methodology based on the plant specific information about activity data and emission factors was applied for the estimation of emissions from steel, pig iron production and Tier 1 approach for the estimation of emissions from limestone use. The technological emissions from iron (2C1.1) and steel (2C1.2) production, limestone use (2C1.5) and emissions from coke electrodes used by EAF steel production (2C1.5) are included in the category 2C1 iron and steel production. The CO_2 emissions originated from coke production in iron and steel industry and emissions originated from sinter production are still included in energy sector, category 1A2a in line with the IPCC2006 GL.
Slovenia	Data on the amount and carbon content of input and output material were obtained from three iron and steel producers. Average EF for the period 1999–2004 has been 47 kg CO_2/t of steel. This emission factor has been applied for calculating emissions from 1988 onwards. This EF is not appropriate for the base year because of the different type of production of steel (from ore). For the period 2005-2011 we have used precise and verified data obtained from EU ETS

PFC emissions from 2.C.3 are listed in Table 19.12. Only 4 of the new member states report PFC emissions from Aluminum Production in 2011, however, Poland is responsible for 4,3% of overall PFC emissions from this sector. All MS reported decreasing emissions, whereas Romania could achieve a reduction of nearly 100%. Only Poland could achieve a reduction of only 70%.

Table 19.12 2C3 Aluminum Production: PFC emissions of EU-27

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13 247	697	776	89.2%	79	11%	-12 471	-94%		
Bulgaria	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	271	NO	NO	-	-	-	-271	-100%	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	123	43	37	4.3%	-6	-13%	-86	-70%	T1c	D
Romania	2 116	8	11	1.3%	3	39%	-2 105	-99%	T2	D,PS
Slovakia	271	21	17	2.0%	-4	-20%	-254	-94%	T3	PS
Slovenia	257	14	29	3.3%	15	109%	-229	-89%	T3	PS
EU-27	**16 285**	**782**	**869**	**100.0%**	**87**	**11%**	**-15 416**	**-95%**		

19.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-27)

Table 19.13 shows HFC emissions of sector 2E1. No new member state reported by-product emissions, EU15 are responsible for 100% of all HFC emissions from this sector.

Table 19.13 2E1 By-Product Emissions: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	21 158	977	348	100.0%	-629	-64%	-20 810	-98%		
Bulgaria	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Cyprus	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Estonia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Hungary	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Latvia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Lithuania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Romania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-27	**21 158**	**977**	**348**	**100.0%**	**-629**	**-64%**	**-20 810**	**-98%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

19.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-27)

HFC emissions from Refrigeration and Air Conditioning account for 81% of overall HFC emissions. The major share of emissions from this sector lies with the EU-15 (85,2%), Poland, the Czech Republic and Hungary are responsible for 12% of overall emissions from this sector (Table 19.14). The high increase in absolute terms of the EU 15 between 1990 and 2011 is due to the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). Romania and the Czech Republic are the only new member states that reported a decrease in emissions between 2010 and 2011.

Table 19.14 2F1 Refrigeration and Air conditioning: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	88	54 644	56 666	85.2%	2 022	4%	56 578	64094%		
Bulgaria	NO	310	350	0.5%	40	13%	350	-	T2	D
Cyprus	NA	55	125	0.2%	70	127%	125	-	CS,T2	D
Czech Republic	NO	1 392	1 073	1.6%	-319	-23%	1 073	-	T2	D
Estonia	NO	143	149	0.2%	6	4%	149	-	T2	CS
Hungary	NO	835	861	1.3%	26	3%	861	-	T2	CS,D
Latvia	IE,NA,NE,NO	63	74	0.1%	11	18%	74	-	T2	D,OTH
Lithuania	NA,NO	179	205	0.3%	25	14%	205	-	T2	CS
Malta	NO	117	123	0.2%	6	5%	123	-	M	M
Poland	NO	5 470	6 045	9.1%	574	11%	6 045	-	,T1b,T2	D
Romania	NO	591	206	0.3%	-384	-65%	206	-	OTH	OTH
Slovakia	NO	398	415	0.6%	18	4%	415	-	D	CS
Slovenia	NO	200	210	0.3%	10	5%	210	-	T2	D
EU-27	88	64 396	66 502	**100.0%**	**2 105**	**3%**	**66 414**	**75237%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from sector 2F4, Aerosols/Metered Dose Inhalers are reported in Table 19.19.15. EU-15 are responsible for about 97% of these emissions, Poland, Czech Republic and Hungary account for 2.5% of emissions. Bulgaria, Czech Republic and Romania reported a decrease of emissions between 2010 and 2011. Cyprus (+3%), Estonia (+2%), Hungary (+2%), Lithuania (+16%), Malta (+14%) and Slovakia (+7%) reported an absolute increase of emissions.

Table 19.19.15 2F4 Aerosols/Metered Dose Inhalers: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	34	5 975	6 022	96.8%	47	1%	5 988	17661%		
Bulgaria	NO	10	9	0.1%	0	-3%	9	-	T2	D
Cyprus	0.000	0.002	0.002	0.0%	0	3%	0	-	CS	OTH
Czech Republic	NO	28	25	0.4%	-3	-9%	25	-	D	D
Estonia	NO	3	3	0.05%	0	2%	3	-	T2	CS
Hungary	NO	20	20	0.3%	0	2%	20	-	CS,D	CS
Latvia	NE,NO	2	2	0.04%	0.0	0%	2	-	T2	D
Lithuania	NA,NO	5	6	0.1%	1	16%	6	-	T1	D
Malta	NO	3	3	0.05%	0.4	14%	3	-	CS	CS
Poland	NO	111	111	1.8%	0	0%	111	-	,T1b,T2	D
Romania	NO	24	8	0.1%	-15	-65%	8	-	OTH	OTH
Slovakia	NO	7	8	0.1%	0	7%	8	-	T2	CS
Slovenia	NO	5	4	0.1%	0	-9%	4	-	T1	D
EU-27	**34**	**6 191**	**6 221**	**100.0%**	**30**	**0%**	**6 187**	**18249%**		

SF_6 emissions from sector 2F9, other are reported in Table 19.16. EU-15 are responsible for 98.2% of these emissions, only Hungary, the Czech Republic, Romania, Estonia and Lithuania and reported emissions from this sector. Whilst the EU 15 reported an increase (+2%) of emissions between 2010 and 2011, only Czech Republic as a new member state reported a decrease of about 6%. Hungary reported an increase of emissions (+151%), Lithuania of + 147% and Estonia of 46%.

Table 19.16 2F9 Other: SF_6 emissions of EU-27

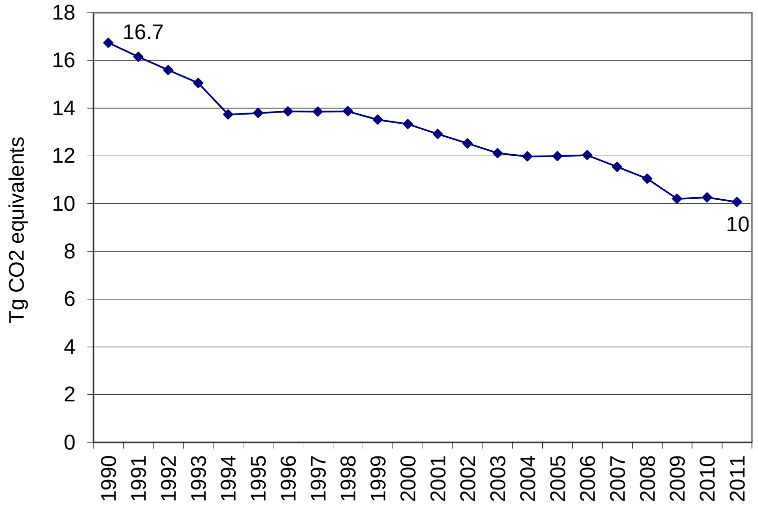
Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4 397	3 640	3 700	98.2%	60	2%	-697	-16%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	NO	4	3	0.1%	0	-6%	3	-
Estonia	NO	0.05	0.07	0.0%	0	46%	0.07	-
Hungary	NO	25	62	1.6%	37	151%	62	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	0.1	0.3	0.01%	0.2	147%	0.3	-
Malta	NO	0.00	0.00	0.0%	0.0	0%	0	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Romania	NO	NO	2	-	2	-	2	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
EU-27	**4 397**	**3 668**	**3 767**	**100.0%**	**99**	**3%**	**-630**	**-14%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

20 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

CRF Sector 3 Solvent and Other Product Use contribute 0.18 % to the total EU-27 GHG emissions (Table 20.5). The EU-27 Member States jointly achieved emission reductions of about 39 % from 16.738 Tg in 1990 to 10.203 Tg in 2011 (Figure 20.1 and Table 20.1).

Figure 20.1 Sector 3 Solvent and Other Product Use: EU-27 GHG emissions for 1990–2011 in CO_2 equivalents (Tg)



In 2011, the emissions decreased by 6 % compared to 2010 (Table 20.1).

Table 20.1 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emission

Member State	Greenhouse gas emissions (Gg CO2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
EU-15	13 212	8 790	8 098	79%	-692	-8%	-5 114	-39%
Bulgaria	898	51	48	0%	-3	-6%	-850	-95%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	765	515	506	5%	-9	-2%	-259	-34%
Estonia	26	22	18	0%	-3	-16%	-8	-30%
Hungary	226	406	340	3%	-66	-16%	114	50%
Latvia	51	44	27	0%	-17	-39%	-24	-48%
Lithuania	198	91	95	1%	4	5%	-102	-52%
Malta	2	2	2	0%	-1	-24%	-1	-36%
Poland	629	797	751	7%	-46	-6%	122	19%
Romania	541	135	122	1%	-13	-9%	-418	-77%
Slovakia	147	167	164	2%	-2	-1%	17	12%
Slovenia	43	28	31	0%	3	12%	-12	-29%
EU-27	**16 738**	**11 048**	**10 203**	**100%**	**-845**	**-8%**	**-6 535**	**-39%**

In the following table the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-15 and for all EU-27 Member States are listed as recommended in IRR 2007 (para 78) (Table 20.2).

Table 20.2 Sector 3 Solvent and Other Product Use: EU-15 and EU-27 emissions of CO_2, N_2O, NMVOC and GHG

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
		Gg			Gg CO_2 eq		Gg			Gg CO_2 eq
BG	A. Paint Application	7.72		3.51	7.72	B. Degreasing and Dry Cleaning	0.41	NA	0.18	0.41
CY		NE		1.81	NE		NE	NE	0.06	NE
CZ		96.96		30.85	96.96		27.95	NA	8.89	27.95
EE		5.63		2.56	5.63		2.32	NO	1.05	2.32
HU		33.96		12.65	33.96		0.04	NO	0.00	0.04
LV		8.47		2.89	8.47		0.02	NO	0.01	0.02
MT		NA		IE	NA		NA	NA	IE	NA
PL		346.49		IE	346.49		68.93	NA	IE	68.93
RO		10.17		3.26	10.17		26.82	NE	8.61	26.82
SI		NO		7.72	NO		NE	NE	0.05	NE
SK		58.58		20.25	58.58		17.68	NO	8.10	17.68
LT		42.50		13.64	42.50		10.98	NE	3.52	10.98
EU15		2 130.10		855.97	2 130.10		299.60	0.00	136.98	299.60
EU27		2 740.59		955.11	2 740.59		454.75	0.00	167.45	454.75
BG	C. Chemical Products, Manufacture and Processing	0.58		0.26	0.58	D. Other	13.57	0.06	6.17	32.59
CY		NE		0.02	NE		NE	NE	0.84	NE
CZ		45.03		14.33	45.03		66.97	0.75	21.31	299.47
EE		0.69		0.31	0.69		5.32	0.02	2.42	10.22
HU		NO		NO	NO		NO	0.89	NO	275.56
LV		1.69		0.58	1.69		26.18	0.02	8.93	31.14
MT		NA		IE	NA		NA	0.00	1.14	1.31
PL		83.02		IE	83.02		166.22	0.40	IE,NA	290.22
RO		NO		10.53	NO		88.62	NE	28.44	88.62
SI		NE		2.95	NE		NA	0.16	NA	49.29
SK		18.43		8.38	18.43		NO	0.24	0.17	75.85
LT		NE		NE	NE		28.80	0.01	9.24	32.46
EU15		319.10		285.56	319.10		2 821.75	7.74	1 290.84	5219.79
EU27		468.54		322.92	468.54		3 217.44	10.29	1 369.49	6406.52
BG	Total Solvent and Other Product Use	22.28	0.06	10.12	41.29					
CY		NE	NE	2.73	NE					
CZ		236.92	0.75	75.38	469.42					
EE		13.95	0.02	6.34	18.86					
HU		34.00	0.89	12.65	309.56					
LV		36.35	0.02	12.40	41.31					
MT		NA	0.00	1.14	1.31					
PL		664.67	0.40	IE,NA	788.67					
RO		125.61	NE	50.84	125.61					
SI		NA,NE,NO	0.16	10.71	49.29					
SK		94.69	0.24	36.90	170.54					
LT		82.29	0.01	26.40	85.95					
EU15		5 570.55	7.74	2 569.34	7 968.59					
EU27		6 881.32	10.29	2 814.97	10 070.40					

Table 20.3 Sector 3 Solvent and Other Product Use: EU-27 CO_2 emissions as well as their share

	Unit	1990	2011
CO_2 emission in 'Solvent and Other Product Use'	[Gg]	11 703	6 881
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 212	7 969
Share of CO_2 emission in Total GHG in 'Solvent and Other Product		*89%*	*86%*
Total National CO_2 Emissions and Removals (excluding net CO2 from LULUCF)	[Gg]	4 406 963	3 743 430
Share of CO_2 emission from 'Solvent and Other Product Use' in Total CO2 Emissions and Removals		*0.27%*	*0.18%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5 574 424	4 550 212
Share of CO_2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.21%*	*0.15%*

Table 20.4 Sector 3 Solvent and Other Product Use: EU-27 N_2O emissions as well as their share

	Unit	1990	2011
N_2O emission in 'Solvent and Other Product Use'	[Gg]	16.2	10.3
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 212	7 969
Share of N_2O emission in Total GHG in 'Solvent and Other Product Use'		*38%*	*40%*
Total National N_2O Emissions	[Gg]	1 683	1 081
Share of N_2O emission from 'Solvent and Other Product Use' in Total National N_2O Emissions		*0.97%*	*0.95%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5 574 424	4 550 212
Share of N_2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.09%*	*0.07%*

Table 20.5 Sector 3 Solvent and Other Product Use: EU-27 GHG emissions as well as their share

	Unit	1990	2011
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 212	7 969
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5 574 424	4 550 212
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.24%*	*0.18%*

21 AGRICULTURE (CRF SECTOR 4)

21.1 Overview of sector (EU-27)

Figure 21.1 **Sector 4-Agriculture: EU-27 GHG emissions for 1990–2011 in CO_2 equivalents (Tg)**

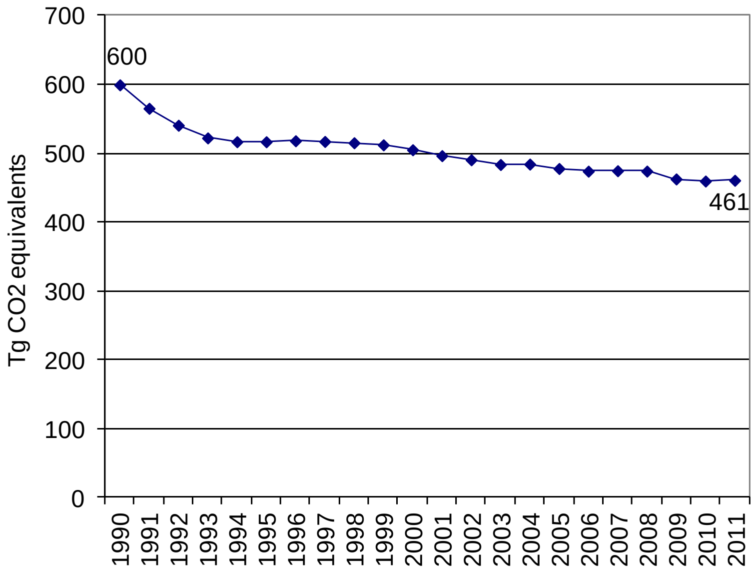
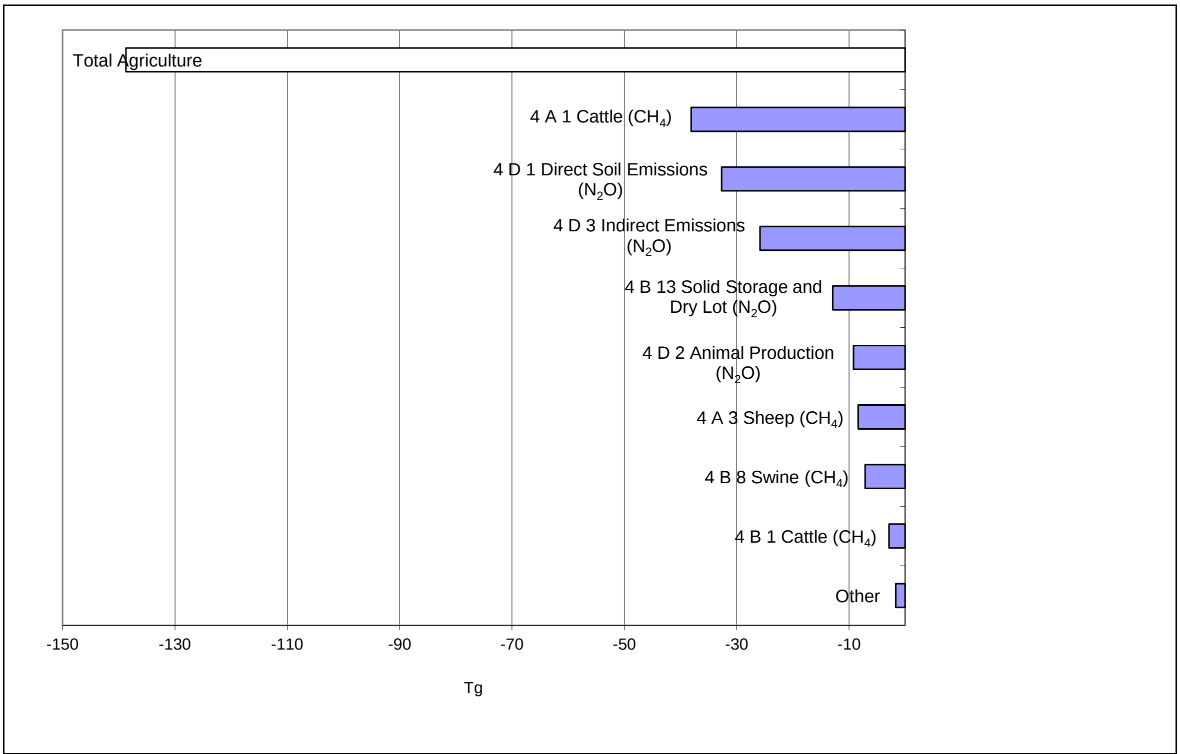
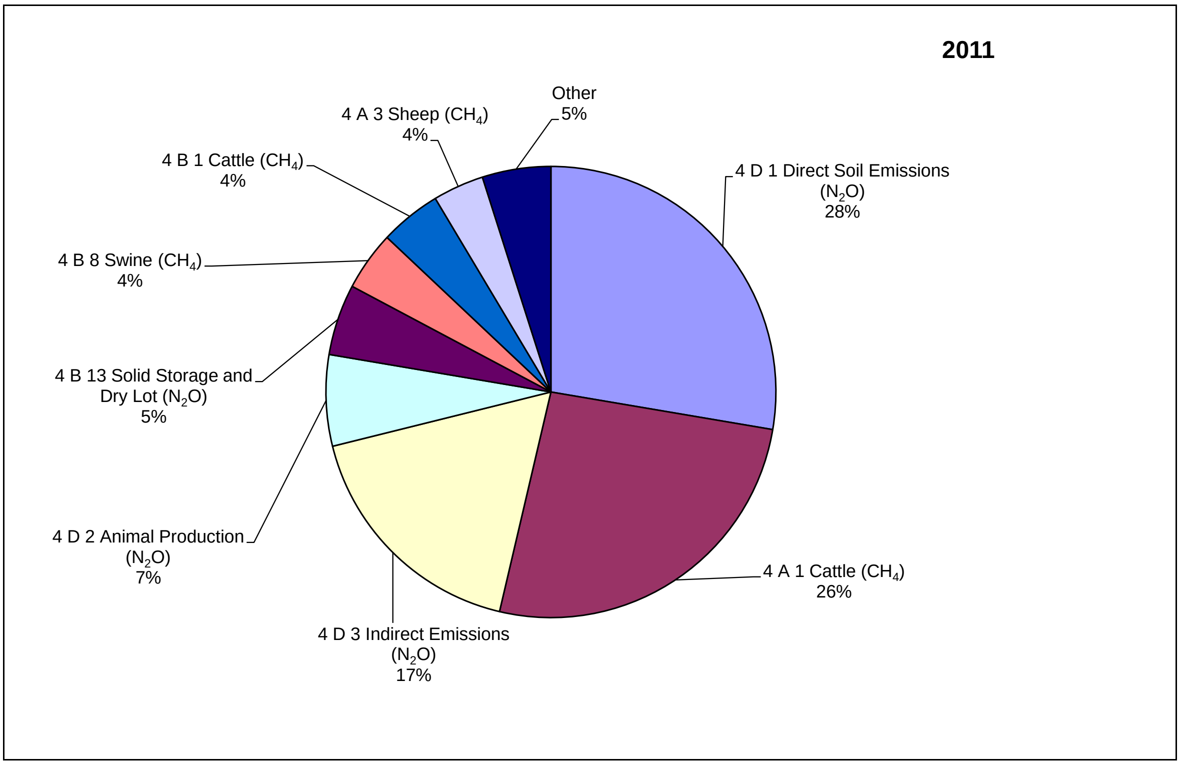


Figure 21.2 **Sector 4-Agriculture: Absolute change of GHG emissions by large key source categories 1990–2011 in CO_2 equivalents (Tg) and share of largest key source categories in 2011**





21.2 Source categories (EU-27)

21.2.1 Enteric fermentation (CRF Source Category 4A) (EU-27)

Table 21.1 4A1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	118 045	101 509	100 363	83.7%	-1 147	-1%	-17 683	-15%		
Bulgaria	2 275	941	961	0.8%	21	2%	-1 314	-58%	T2	CS
Cyprus	80	82	84	0.1%	3	4%	5	6%	T1	D
Czech Republic	3 982	1 892	1 898	1.6%	7	0%	-2 083	-52%	T2	CS
Estonia	973	381	386	0.3%	4	1%	-587	-60%	T2	CS,D
Hungary	2 528	1 154	1 146	1.0%	-8	-1%	-1 381	-55%	T2	CS
Latvia	2 064	641	643	0.5%	2	0%	-1 421	-69%	T2	CS,D
Lithuania	3 126	1 147	1 137	0.9%	-10	-1%	-1 989	-64%	T2	CS
Malta	27	22	22	0.0%	0	0%	-5	-18%	CR	CR
Poland	13 896	8 605	8 711	7.3%	106	1%	-5 186	-37%	T2	CS
Romania	8 564	3 218	3 178	2.7%	-41	-1%	-5 386	-63%	T2	CS
Slovakia	1 802	748	747	0.6%	-1	0%	-1 055	-59%	T2	CS
Slovenia	625	621	612	0.5%	-10	-2%	-14	-2%	T2	CS
EU-27	**157 987**	**120 962**	**119 889**	**100.0%**	**-1 074**	**-1%**	**-38 098**	**-24%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.2 4A3 Sheep: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16 752	13 084	12 647	74.9%	-436	-3%	-4 105	-25%		
Bulgaria	1 211	194	197	1.2%	4	2%	-1 014	-84%	T2	CS
Cyprus	49	55	60	0.4%	5	8%	11	23%	T1	D
Czech Republic	72	33	35	0.2%	2	6%	-37	-51%	T1	D
Estonia	23	13	14	0.1%	1	7%	-9	-39%	T1	D
Hungary	329	202	192	1.1%	-11	-5%	-137	-42%	T1	CS
Latvia	28	13	13	0.1%	0	4%	-14	-52%	T1	D
Lithuania	14	13	14	0.1%	1	8%	0	0%	T2	CS
Malta	1	2	2	0.0%	0	-4%	1	157%	CR	CR
Poland	677	43	42	0.3%	0	-1%	-635	-94%	T2	CS
Romania	5 959	3 510	3 557	21.1%	47	1%	-2 401	-40%	T2	CS
Slovakia	125	81	86	0.5%	5	6%	-39	-31%	T2	CS
Slovenia	3	22	20	0.1%	-2	-8%	17	492%	T1	D
EU-27	**25 243**	**17 264**	**16 880**	**100.0%**	**-384**	**-2%**	**-8 363**	**-33%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.2.2 Manure management (CRF Source Category 4B) (EU-27)

Table 21.3 4B1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	19 012	18 053	17 746	87.5%	-307	-2%	-1 266	-7%		
Bulgaria	60	26	26	0.1%	1	2%	-34	-56%	T2	CS
Cyprus	18	18	19	0.1%	0.68	4%	1	6%	T1	D
Czech Republic	644	234	232	1.1%	-2	-1%	-412	-64%	T1	D
Estonia	22	26	26	0.1%	0.11	0%	4	17%	T2	CS,D
Hungary	1 225	542	536	2.6%	-5.66	-1%	-689	-56%	T2	CS
Latvia	138	47	49	0.2%	2	4%	-88	-64%	T2	CS,D
Lithuania	425	248	250	1.2%	2	1%	-174	-41%	T2	CS
Malta	12	9	10	0.0%	0	0%	-2	-20%	CR	CR
Poland	755	899	934	4.6%	35	4%	180	24%	T2	CS
Romania	542	125	123	0.6%	-2	-1%	-419	-77%	T2	CS
Slovakia	127	38	38	0.2%	0	-1%	-89	-70%	T1	D
Slovenia	212	301	296	1.5%	-4	-1%	84	40%	T2	CS
EU-27	**23 192**	**20 567**	**20 287**	**100.0%**	**-280**	**-1%**	**-2 905**	**-13%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.4 4B8 Swine: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	15 956	16 297	15 695	80.1%	-602	-4%	-261	-2%		
Bulgaria	4 084	577	559	2.9%	-17	-3%	-3 525	-86%	T2	CS
Cyprus	58	97	92	0.5%	-5	-5%	34	58%	T1	D
Czech Republic	302	120	110	0.6%	-10	-8%	-192	-63%	T1	D
Estonia	42	17	15	0.1%	-2	-10%	-26	-63%	T2	CS,D
Hungary	1 989	762	741	3.8%	-21	-3%	-1 248	-63%	T2	CS
Latvia	118	33	32	0.2%	-1	-4%	-86	-73%	T1	D
Lithuania	636	252	216	1.1%	-36	-14%	-420	-66%	T2	CS
Malta	13	15	10	0.0%	-5	-34%	-3	-25%	CR	CR
Poland	2 140	1 835	1 631	8.3%	-204	-11%	-509	-24%	T2	CS
Romania	1 002	362	350	1.8%	-12	-3%	-653	-65%	T2	CS
Slovakia	212	58	49	0.2%	-9	-16%	-163	-77%	T1	D
Slovenia	245	113	101	0.5%	-12	-11%	-144	-59%	T1	D
EU-27	**26 796**	**20 537**	**19 600**	**100.0%**	**-937**	**-5%**	**-7 196**	**-27%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.5 4B13 Solid Storage and Dry Lot: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	19 307	14 970	14 805	63.0%	-164	-1%	-4 501	-23%		
Bulgaria	1 541	539	534	2.3%	-5	-1%	-1 007	-65%	D	D
Cyprus	126	145	146	0.6%	1	1%	20	16%	T1	D
Czech Republic	1 583	614	602	2.6%	-13	-2%	-982	-62%	T1,T2	CS,D
Estonia	303	95	96	0.4%	1	1%	-207	-68%	T2	D
Hungary	1 283	627	623	2.7%	-4	-1%	-660	-51%	T1	CS,D
Latvia	564	125	118	0.5%	-8	-6%	-447	-79%	T1	CS,D
Lithuania	847	255	248	1.1%	-6	-2%	-598	-71%	T1	D
Malta	2	2	2	0.0%	0.00	0%	-0.48	-19%	CS	CS
Poland	7 869	5 163	5 067	21.6%	-96	-2%	-2 802	-36%	T2	D,CS
Romania	1 478	780	772	3.3%	-8	-1%	-705	-48%	D	D
Slovakia	1 055	366	362	1.5%	-4	-1%	-692	-66%	T2	D
Slovenia	252	130	123	0.5%	-7	-5%	-129	-51%	D	CS,D
EU-27	**36 210**	**23 811**	**23 500**	**100.0%**	**-311**	**-1%**	**-12 710**	**-35%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.6 **4B14 Other: N_2O emissions of EU-27**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	1 871	2 787	2 800	80.7%	13	0%	929	50%
Bulgaria	0	0	0	0.0%	0.01	9%	0	-59%
Cyprus	2.166	3.745	3.549	0.1%	-0.20	-5%	1.38	64%
Czech Republic	44	33	28	0.8%	-4	-14%	-16	-36%
Estonia	NO	6	6	0.2%	0	0%	6	-
Hungary	455.285	206.394	204.824	5.9%	-1.57	-1%	-250.46	-55%
Latvia	NO	0	1	-	0.11	-	0.58	-
Lithuania	26	11	10	0.3%	-1	-7%	-16	-62%
Malta	NO	NO	NO	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Romania	579	432	416	12.0%	-16	-4%	-163	-28%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	3	2	2	0.1%	-0.18	-9%	-0.75	-29%
EU-27	**2 980**	**3 481**	**3 470**	**100.0%**	**-10**	**0%**	**490**	**16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.2.3 Agricultural soils (CRF Source Category 4D) (EU-27)

Table 21.7 **4D1 Direct soil emissions: N_2O emissions of EU-27**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	113 376	94 188	96 563	75.7%	2 375	3%	-16 813	-15%		
Bulgaria	4 309	2 069	2 058	1.6%	-11	-1%	-2 251	-52%	T1a,T1b	D
Cyprus	153	137	141	0.1%	4	3%	-12	-8%	T1,T1a	D
Czech Republic	5 484	2 890	2 989	2.3%	99	3%	-2 495	-46%	T1,T2	CS,D
Estonia	987	398	400	0.3%	3	1%	-586	-59%	T1,T1b	D
Hungary	4 166	2 833	3 031	2.4%	198	7%	-1 135	-27%	T1	D
Latvia	1 618	955	955	0.7%	0	0%	-663	-41%	T1,T1b	CS,D
Lithuania	2 703	1 858	1 901	1.5%	43	2%	-801	-30%	T1,T1b	D
Malta	14	12	11	0.0%	0	-4%	-3	-21%	T2	D
Poland	15 626	12 181	12 480	9.8%	299	2%	-3 146	-20%	T1,T1b	CS,D
Romania	9 088	5 144	5 349	4.2%	205	4%	-3 739	-41%	T1,T1b	D
Slovakia	2 450	1 269	1 286	1.0%	17	1%	-1 164	-48%	T2	CS,D
Slovenia	412	381	374	0.3%	-7	-2%	-39	-9%	D,T1,T1b	CS,D
EU-27	**160 387**	**124 314**	**127 539**	**100.0%**	**3 225**	**2.6%**	**-32 848**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.8 4D2 Pasture, Range and Paddock Manure: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	33 191	28 233	27 565	91.6%	-668	-2%	-5 626	-17%		
Bulgaria	1 081	272	276	0.9%	4	2%	-805	-74%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	248	254	0.8%	6	2%	-63	-20%	T1	D
Estonia	202	74	74	0.2%	0.92	1%	-128	-63%	T2	D
Hungary	261	221	219	0.7%	-3	-1%	-42	-16%	T1	D
Latvia	358	87	87	0.3%	0	0%	-271	-76%	T1a	D
Lithuania	494	200	199	0.7%	-0.48	0%	-295	-60%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1 317	462	460	1.5%	-3	-1%	-857	-65%	T1	D,CS
Romania	1 824	840	831	2.8%	-9	-1%	-993	-54%	T1	D
Slovakia	222	93	92	0.3%	-0.79	-1%	-130	-58%	T2	CS
Slovenia	22	53	51	0.2%	-1.71	-3%	29	132%	D	D
EU-27	**39 289**	**30 783**	**30 108**	**100.0%**	**-674**	**-2%**	**-9 180**	**-23%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.9 4D3 Indirect Emissions: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	80 529	64 349	65 623	81.5%	1 273	2%	-14 907	-19%		
Bulgaria	3 049	1 236	1 206	1.5%	-29	-2%	-1 843	-60%	T1b	D
Cyprus	132	122	124	0.2%	2	2%	-8	-6%	T1	D
Czech Republic	3 503	1 748	1 776	2.2%	28	2%	-1 727	-49%	T1	D
Estonia	572	229	235	0.3%	6	3%	-337	-59%	T1b	D
Hungary	2 715	1 781	1 859	2.3%	78	4%	-856	-32%	T1	D
Latvia	1 034	389	389	0.5%	-1	0%	-645	-62%	T1,T1a	D
Lithuania	1 889	931	940	1.2%	9	1%	-949	-50%	T1b	D
Malta	7	6	6	0.0%	0	-3%	-1.25	-18%	T1	D
Poland	5 901	4 497	4 758	5.9%	261	6%	-1 143	-19%	T1b	D
Romania	5 858	2 885	2 892	3.6%	8	0%	-2 966	-51%	T1b	D
Slovakia	995	386	406	0.5%	20	5%	-590	-59%	T2	CS
Slovenia	314	293	285	0.4%	-8	-3%	-29	-9%	D,T1a	D
EU-27	**106 499**	**78 852**	**80 499**	**100.0%**	**1 647**	**2%**	**-26 000**	**-24%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.3 Methodological issues

21.3.1 Enteric Fermentation (CRF source category 4.A)

CH_4 emissions in the source category Enteric Fermentation stem for 7 EU-12 Member States to over 85% from the sub-category "Cattle" with a maximum of 96% in Lithuania. Substantial emissions from the sub-category "Sheep" (up to 45% of emissions in category 4.A. for Romania) are reported by Bulgaria, Cyprus, Hungary, Romania). Emissions accounting for more than 5% of the emissions in this category are further reported only for the sub-category "Goats" (Cyprus, 16%).

An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EU-12-level) and also goats and swine are given in . Data are given for 2011 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe. Compared to the trend in EU-15 countries, the reduction of animal numbers for cattle, sheep and swine is much stronger in the EU-12 countries.

Table 21.10: Total CH_4 emissions in category 4A and implied Emission Factor at EU-12 level for the years 1990 and 2011

1990[1)]	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
CH_4 emissions [Gg CH_4]	1163	739	404	22	85
Animal population [1000 heads]	12777	15985	30253	1950	56850
Implied EF (kg CH_4/head/yr)	91	46	13.4	11.2	1.5

2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
CH_4 emissions [Gg CH_4]	575	355	202	26	41
Animal population [1000 heads]	5655	6975	12651	2193	27321
Implied EF (kg CH_4/head/yr)	102	51	15.9	11.8	1.5

2011 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
CH4 emissions [Gg CH4]	49%	48%	50%	119%	48%
Animal population [1000 heads]	44%	44%	42%	112%	48%
Implied EF (kg CH4/head/yr)	112%	110%	119%	106%	100%

Information source: CRF for 1990 and 2011, submitted in 2013

21.3.1.1 *Methodological Issues*

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, most Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in , even though the overall Tier-level for non-dairy cattle is with Tier 1.9 somewhat lower for EU-12 than for EU-15 (Tier 2.0). In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category “enteric fermentation”, the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States. On EU-12 level, 94% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach compared to 97% for EU-15. For EU-27, this gives 96% of emissions estimated with a Tier 2 approach.

Table 21.11: Total CH_4 emissions in category 4A and implied Emission Factor at EU-27 level for the years 1990 and 2011

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep		
	Gg CO_2-eq	b	a	b	a	b	c	a	b	c
Bulgaria	1,310	Tier 1.9	54%	Tier 2.0	19%	Tier 2.0	y	15%	Tier 2.0	y
Cyprus	190	Tier 1.0	27%	Tier 1.0	18%	Tier 1.0	y	31%	Tier 1.0	y
Czech Republic	2,003	Tier 1.5	46%	Tier 2.0	49%	Tier 1.0	y	2%	Tier 1.0	y
Estonia	411	Tier 2.0	63%	Tier 2.0	31%	Tier 2.0	y	3%	Tier 1.0	y
Hungary	1,494	Tier 1.8	43%	Tier 2.0	34%	Tier 2.0	y	13%	Tier 1.0	y
Latvia	674	Tier 2.0	60%	Tier 2.0	35%	Tier 2.0	y	2%	Tier 1.0	y
Lithuania	1,186	Tier 2.0	64%	Tier 2.0	32%	Tier 2.0	y	1%	Tier 2.0	y
Malta	29	Tier 1.0	46%	Tier 1.0	31%	Tier 1.0	y	7%	Tier 1.0	y
Poland	9,287	Tier 1.9	59%	Tier 2.0	35%	Tier 2.0	y	0%	Tier 1.0	y
Romania	7,876	Tier 1.9	28%	Tier 2.0	13%	Tier 2.0	y	45%	Tier 2.0	y
Slovakia	857	Tier 2.0	53%	Tier 2.0	34%	Tier 2.0	y	10%	Tier 2.0	y
Slovenia	653	Tier 1.9	36%	Tier 2.0	58%	Tier 2.0	y	3%	Tier 1.0	y
EU-12	**25,968**	**Tier 1.9**	**46%**	**Tier 2.0**	**29%**	**Tier 1.9**		**16%**	**Tier 1.9**	
EU-15	**120,238**	**Tier 1.9**	**37%**	**Tier 2.0**	**46%**	**Tier 2.0**		**11%**	**Tier 1.7**	
EU-27	**146,206**	**Tier 1.9**	**39%**	**Tier 2.0**	**43%**	**Tier 2.0**		**12%**	**Tier 1.8**	
EU-12: Tier 1	6%		1%		14%			9%		
EU-12: Tier 2	94%		99%		86%			91%		

a Contribution to CH_4 emissions from enteric fermentation

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 21.12: Methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	Methodology
Bulgaria	**Cattle and sheep - tier 2, other animals - tier 1**
Cyprus	**Tier 1**
Czech Republic	**Cattle: Tier 2 method, other animal types: Tier 1**
Estonia	**The Tier 2 method (IPCC, 2000) was used to estimate CH_4 emissions from enteric fermentation of dairy cattle and mature non-dairy and young cattle (bovine cattle, calves 0–6 months and 6–12 months). A disaggregation on county level of Estonia was applied. Tier 2 was used to estimate CH_4 emissions from enteric fermentation of swine. The estimation was carried out for the main sub-categories of pigs broken down by weight of animals. Tier 1 for other animals. For fur animals, Norwegian emission factor was used (0.1 kg/animal/year).**
Hungary	**In the frame of the methodological development the conversion into the Tier 2 method is in progress, but a certain part of the country-specific information pertaining to the characteristics of livestock (body mass, net energy requirements, composition of feed rations, methane conversion rate, etc.) is to be confirmed as well as to be further elaborated for the entire time series. So it was decided that the simplified Tier 1 method is kept in order to maintain the consistency of time series in the current state of the methodology development.**
Lithuania	**CH_4 emissions from enteric fermentation by dairy cattle and non-dairy cattle, pigs and sheep were calculated using the IPCC Tier 2 methodology. For other animals, Tier1 methodology was used. Data on average weight of each non-dairy cattle sub-category was based on national references and expert judgment.**
Latvia	**CH_4 emissions from Enteric Fermentation have been estimated using the Tier 1 methodology. In Tier 1 method, total emissions have been calculated by multiplying the number of the animals in each category with the IPCC default emission factor of each animal category.**
Malta	**Tier 1, a constant figure of dairy cows is being used for the 1990s, whereas reliable published statistics are available for the year 2000 and onwards. Not all households who own rabbits and poultry and are not on the farms register or not have commercial activity, have been captured during the census, since it was not considered feasible and practical to cover them during the inventory.**
Poland	**Cattle and sheep: Tier 2 method. Horses, goats, and swine: Tier 1.**
Romania	**Tier 2**
Slovenia	**Tier 2 for dairy and non-dairy cattle. Tier 1 for other animals.**

Slovakia	**Tier 2 methodology based on national data about animal number in detailed categories (for dairy, non-dairy cattle and other cattle and for sheep) and more advance characteristic about feed and milk conditions. Tier 1 methodology for other animals categories (Horses, Goats).**

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2011 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Estonia has chosen to use the option B for the classification of cattle. In order to allow the calculation of an EC implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Some information on the source of the animal numbers for the different Member States is given in Table 21.14.

Table 21.13: Animal population [1000 heads] in 2011

Member State 2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Bulgaria[1)]	308	244	1,411	349	636	15,295
Cyprus	24	34	356	290	439	3,678
Czech Republic	374	970	209	23	1,749	21,250
Estonia[1)]	96	142	84	4	366	2,033
Hungary	250	440	1,141	84	3,120	45,969
Latvia	164	217	80	13	375	4,418
Lithuania	343	355	60	15	790	8,921
Malta	6	9	12	5	46	970
Poland	2,626	3,136	251	112	13,509	143,557
Romania	1,154	814	8,533	1,236	5,364	79,842
Slovakia	201	262	394	34	580	11,376
Slovenia	109	353	120	27	347	4,007
EU-12	**5,655**	**6,975**	**12,651**	**2,193**	**27,321**	**341,316**
EU-15	**17,402**	**57,231**	**83,784**	**11,350**	**118,374**	**1,216,620**
EU-27	**23,057**	**64,205**	**96,435**	**13,543**	**145,695**	**1,557,936**

Information source: CRF for 1990 and 2011, submitted in 2013

[1)] Numbers for cattle have been calculated using the figure given under option B.

Table 21.14: Information on the source of animal population data

Member State	Methodology
Bulgaria	**Data is collected from the Agricultural Statistics Department of the Ministry of Agriculture and Food, FAO Database and National Statistics Institutes? yearbooks.**
Cyprus	**Data used for the estimation on emissions was obtained from the National Statistical Service. The number of animals used for the calculation of methane emissions is the annual average.**
Czech Republic	**The Czech Statistical Office provides detailed categorization of cattle: calves younger than 6 months of age, young cattle 6 – 12 months (young bulls, young heifers), bulls over 1 year, including bullocks (over 2 years), heifers 1 – 2 years, heifers over 2 years of age. More disaggregated sub-categories and more accurate data for numbers are given in the study by external agricultural consultants according to the national study (Hons and Mudrik, 2003) and more accurate data on numbers. Reallocation of the "Suckler cows" sub-category from Dairy cattle to Non-dairy cattle.**
Estonia	**Activity data were used from official Estonian statistics (the Statistical Office of Estonia [ESO], Estonian Animal Recording Center (EARC). Estonian statistics do not collect separately data on calve population (0–6 months), data are collected and reported on the population of calves less than 1 year old. Hence, population of calves (0–6 months) was separated from the total population**

	of calves based on the data on number of calves born in each quarter (it was applied that about 50% of the total population of calves (0–12 months) are calves less than 6 months old, for the entire time-period). the number of swine population for 1990–1998 has been reported for three sub-categories of swine (breeding sows, fattening pigs and young swine); however, the number of swine population for 1999–2008 has been reported for six sub-categories of swine.
Hungary	**Livestock population were obtained from the Department of Production Statistics, Main Department of Hungarian Central Statistical Office (HCSO). Since 2000, the HCSO has been registering the livestock three times a year (1 April, 1 August, 1 December), using a method which is equal to that of the EU.**
Lithuania	**Data on livestock number is provided by the Register of Agricultural Information and Rural Business Centre (AIRBC) and Statistics Lithuania. During the period 1990-2006 the number of livestock was obtained from the database of Statistics Lithuania (as of 1st of January). During the period 2007-2011 the average annual number of cattle and sheeps was provided by the AIRBC.**
Latvia	**The number of cattle, sheep, horses, swine and goats were obtained from the Statistical yearbooks of Latvia. The source of data on the number of livestock in state farms and statutory companies are statistical surveys while sample surveys are used to collect information from peasant farms, household plots and private subsidiary farms. The survey was first launched in 1995 and since then it is conducted twice a year. The sample for 2006 covers 15.0 thsd. farms selected by economic size and specialisation.**
Malta	**Figures were taken from the Census of Agriculture, the Farm Structure Survey, the Cattle Survey, the Pig Census the Sheep and Goats Survey, Agriculture and Fisheries 2010. 62.5% of the total cattle stock is found on farms with 100 cattle or more. The data available from the Sheep and Goats Survey 2011 shows that there were 1,374 holdings involved in sheep rearing. Just over 77% of these holdings have less than 10 sheep and amount for 31.2% of the sheep population. On the other hand, while only 22.4% of all holdings have more than 10 sheep they account for 68.8% of the sheep stock. The distribution of the goat stock is somewhat similar,**
Poland	**Activity data were obtained from national statistics of the Central Statistical Office (GUS). They were compiled on the basis of: (-) generalized results of the sample survey on land use, sown area, and livestock, conducted in June 2011 in individual farms, (-) generalized results of panel sample surveys on livestock in individual farms, i.e. the surveys on cattle, sheep and poultry in June and the surveys on pigs at the end of July, (-) statistical reports in the scope of livestock in state-owned and cooperative farms, and in companies with public and private property share, and (-) information from voivodship experts about the horses and goats stock.**
Romania	**Total animal number data are provided by Romanian National Institute for Statistics (NIS) and expert judgement . Includes data on eight different livestock types: cattle (nine different categories), buffalo (buffalo milk and other buffalo), sheep (ewes of milk and fitted, reproducers rams and other sheep), goats (female goats for milk/females by first mount and other goats), horses, mules and asses, swine (pigs under 20 kg, pigs between 20 and 50 kg, pigs fattening, boars, and breeding sows) and poultry (adult poultry for eggs, poultry for meat). Data before 2003 are available only in large aggregates and were extrapolated from the reference year 2004, based on the share of the sub-categories, based on the assumption that livestock structure did not change drastically even though the absolute numbers did. The number of mules and asses was obtained from FAO.**
Slovenia	**The majority of activity data were obtained from the Statistical Office of the Republic of Slovenia (SORS). They are also available on the web page: http://www.stat.si/eng/index.asp The agriculture statistics is on the SI-STAT data portal, under Environment and natural resources: http://www.stat.si/pxweb/Database/Environment/Environment.asp. The number of calves per cow and year, the concentration of fat in milk for the period before the year 2000 and average daily gains in fattening cattle, were obtained from Central database CATTLE that is managed by Agricultural Institute of Slovenia (reported by Božic et al., 2009).**
Slovakia	**The Ministry of Agriculture of the Slovak Republic issued annual statistics “Green Report”, part agriculture and food industry on a yearly basis. The datasets are published in the Green Reports of the Slovak Republic (www.land.gov.sk), in the statistical yearbooks and census. Detailed input data on cattle and sheep are available since 1997 on regional basis. Before 1997 extrapolation of bottom-up data was provided. Regional data are verified by district offices statistical farm information (bottom-up approach).**

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 89 kg CH_4 head^{-1} yr^{-1} (Romania) and 128 kg CH_4 head^{-1} yr^{-1} (Estonia1)) for dairy cattle, and 42 kg CH_4 head^{-1} yr^{-1} (Estonia1)) and 59 CH_4 head^{-1} yr^{-1} (Romania) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production. The IEF for the EU-12 Member States and the CH_4 conversion factors used are given in Table 6.18. For EU-12, the implied emission factor for dairy cattle in 2011 was 101.6 kg CH_4 head^{-1} yr^{-1} and lower than the value for EU-15 giving an overall IEF of 117.7 for EU-27.

More detailed information on the development of the emission factors for category 4A is given in .

Table 21.15: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr) [1)]					CH_4 conversion (%) [1)]				
2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Bulgaria[1)]	110.2	48.8	6.7	5.0	1.5	6.0	6.0	0.1	0.1	0.6
Cyprus	100.0	48.0	8.0	5.0	1.5	NA	NA	NA	NA	NA
Czech Republic	116.5	48.3	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
Estonia[1)]	128.3	42.5	8.0	5.0	1.0	6.0	5.5	6.0	5.0	0.6
Hungary	121.9	54.8	8.0	5.0	1.5	6.0	5.9	6.0	5.0	0.6
Latvia	117.8	52.2	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
Lithuania	105.7	50.4	11.0	5.0	1.1	6.0	6.0	NA	NA	NA
Malta	100.0	48.0	8.0	5.0	1.5	NE	NE	NE	NE	NE
Poland	98.8	49.5	8.0	5.0	1.5	6.0	6.0	7.0	NA	NA
Romania	89.5	59.1	19.8	17.1	1.5	6.0	6.0	7.0	5.0	0.9
Slovakia	107.7	53.0	10.4	5.0	1.5	6.0	6.0	7.0	NE	NE
Slovenia	102.9	50.7	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
EU-12	**101.6**	**50.9**	**15.9**	**11.8**	**1.5**	**6.0**	**6.0**	**6.1**	**4.0**	**0.8**
EU-15	**123.0**	**46.7**	**7.2**	**5.9**	**1.2**	**6.1**	**5.7**	**6.6**	**5.0**	**31.3**
EU-27	**117.7**	**47.1**	**8.3**	**6.9**	**1.2**	**6.1**	**5.7**	**6.5**	**4.8**	**25.6**

Information source: CRF for 1990 and 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Numbers for cattle have been calculated using the figure given under option B.

Table 21.16: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Methodology
Bulgaria	**Country specific feed intake data and energy content of food, the Agrostatistics department at the Ministry of Agriculture and Food calculates the milk production by adding up the amount of milk collected by the dairy industry directly from the farmers, weight data are based on expert judgment.Country specific feed intake data and energy content of food, the Agrostatistics department at the Ministry of Agriculture and Food calculates the milk production by adding up the amount of milk collected by the dairy industry directly from the farmers, weight data are based on expert judgment.**
Cyprus	**IPCC default. Particularly difficult was the choice of emission factor for cattle: the average annual milk production per cow for 2010 was 6440 kg/head/yr.9 which is similar to the average milk production for North America (6700kg/head/yr.), whereas the description of the sector is more similar to Western Europe.**
Czech Republic	**The activity data of milk production comes from the official statistics (CzSO). The CzSO provides population values for cows and other cattle, the numbers of animal population are based on surveys of livestock (up to 1991 as at 1.1., from 1992 to 2002 as at 1.3., since 2003 as at 1.4.). Based on the individual OMD (organic matter digestibility) values for the most common feed (e.g. corn silage, hay and straw, green fodder – alfalfa and clover, etc.) the average digestibility for cattle was estimated. The estimated average digestibility corresponds to approximately 70 % determined the conservative average digestibility values for 3 basic cattle subcategories (Dairy cattle DE = 67 %, Suckler cows DE = 62 %, Other cattle DE = 65 %).**
Estonia	**Country specific for cattle, swine and tier 1 for other animals. Calves get milk and milk substitute until the age of 3 months, which assume zero emissions from enteric fermentation; at the age of 3–6 months, calves feed on mineral fodder (Lehtsalu et al., 2010). Hence, it was assumed that methane conversion rate of calves (0–6 months) is 3%, the rate was estimated as arithmetic mean based on the rate of calves between 0 and 3 months (which is zero) and from 3 to 6 months (Ym is 6%).**
Hungary	**IPCC default for developed countries. Development of the country-specific emission factor for the entire time series will have been done by July 2007.**
Lithuania	**Estimation of the EF for dairy and non-dairy cattle gross energy was calculated using the detailed characterisation of livestock herds on the basis of feed accumulation standards indicated in the national reference book of livestock production. Feed intake for non - dairy cattle was collect from national data. The productivity of the cows is established in accordance with the data of the Department of Statistics. Milk fat data is taken of the register of the herds in control. Determining CH_4 emission from swine, gross energy was also calculated on the basis of feed accumulation standards presented in the above mentioned national reference book for animal production. Determining CH_4 emission from sheep, gross energy was calculated same methods as for**

Member State	Methodology
	cattle,based on the feed accumulation standards. IPCC default emission factors were used for remaining animal categories (Tier 1 method). As no IPCC and national default emission factors for fur-bearing animals, rabbits and nutria are available, the Norwegian emission factor for fur-bearing animals and Russian emission factors for rabbits and nutria were used in calculations.
Latvia	IPCC default for Tier 1 and tier 2. National values of GE of cattle have been used, using an equation slightly modified from 4.11 (IPCC 2000)
Malta	EF for cattle, sheep and goats, horses and swine from CORINAIR (2006). EF for poultry IPCC (1996), EF for rabbit APAT (2005)
Poland	GE was calculated for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other matured cattle (over 2 years). Country specific parameters like pregnancy, milk production, percent of fat in milk come from national statistics. DE was estimated by Walczak (2006) and change from 58.6% in 1988 through 60% in 1995 up to 62.8% in 2004 and later due to improved diets. For sheep GE factor was calculated for two subcategories: lambs up to 1 year and mature sheep above 1 year.
Romania	GE: based on an average rations, both in summer and in winter following the method of (Stoica, 1997). GE is calculated from the caloric value of the main feeding stuff categories (proteins, gat, pulp, and unnutrous substances). DE (%) is calculated using animal type specific feed rations, and considering the feed-specific coefficients of gross energy and digestable energy. For default parameters, values for developing countries and Eastern Europe were used. Ym default. For swine Ym of 0.6% is used, because GE value from our ration is similar to that given in Reference Manual (38 MJ/day for developed countries). For categories where GE value is close to 13 MJ/day (pigs under 20 kg, pigs between 20 and 50 kg), an Ym of 1.3% is used.
Slovenia	Dairy cattle: Based on data from milk recording (the monitoring service performs monthly measurements of the milk yield of every individual cow) a total of 705.860 lactation curves were calculated for the period between 01.01.2000 and 01.06.2009. On the basis of the results, typical lactation curves for the range between 3500 and 12000 kg of milk in standard lactation were calculated for the intervals of 500 kg. The proportion of concentrates in the diets for dairy cows increased and dual purpose Simmental and Brown Swiss cows were in part replaced by cows of specialized Holstein-Frisian breed.
Slovakia	Emission factors for dairy cattle, non-dairy cattle and sheep were estimated on the basis of milk production, average gross energy intake and they are specific for the Slovak Republic and calculated as annual average.

21.3.2 Manure Management CH_4 (CRF source category 4.B(a))

Table 21.17 shows in contrast to EU-15, where swine and catle contribute more or less equally to CH_4 emissions from manure management, swine are the main source of CH_4 emissions from manure management in EU-12 (72%). For cattle, the contributions of non-dairy cattle are slightly prevailing with percentages of total emissions in this category amounting to 17% and 11%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Slovenia (73%) and the Czech Republic (61%); the lowest in Hungary and Cyprus, where cattle contribute with only 41% and 15%, respectively. This is compensated with the emissions from swine manure where Hungary has a share of 57%, while swine contributes only 25% in Slovenia. For EU-12 level, CH_4 emissions from manure management have decreased significantly for cattle and swine.

Table 21.17: Total CH_4 emissions in category 4A and implied Emission Factor at EU-12 level for the years 1990 and 2011

	Dairy Cattle	Non-dairy cattle	Sw ine
	1990		
Total Emissions of CH_4 [Gg CH_4]	119	80	516
Total Population [1000 heads]	12777	15985	56850
Implied Emission Factor [kg CH_4 / head / year]	9.3	5.0	9.1

	Dairy Cattle	Non-dairy cattle	Sw ine
	2011		
Total Emissions of CH_4 [Gg CH_4]	79	42	186
Total Population [1000 heads]	5655	6975	27321
Implied Emission Factor [kg CH_4 / head / year]	14.0	6.0	6.8

	Dairy Cattle	Non-dairy cattle	Sw ine
	2011 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	66%	53%	36%
Total Population [1000 heads]	44%	44%	48%
Implied Emission Factor [kg CH_4 / head / year]	150%	120%	75%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2011, submitted in 2013

Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

21.3.2.1 *Methodological Issues*

CH_4 emissions from manure management are a key source category for cattle and swine at EU-12 level. This is true also for many Member States. Table 6.27 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reports whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management has been done as described in Chapter 6.3.2.2. and 6.4.1. Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.0 and Tier 1.8 with a Tier level for EU-12 of Tier 1.5 (corresponding to 56% of the emissions being calculated with country-specific data). Some additional information on the methodological approaches for some Member States is given in .

Table 21.18: Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine		
	Gg CO_2-eq	b	a	b	a	b	c	a	b	c
Bulgaria	627	Tier 1.8	3%	Tier 1.9	1%	Tier 1.9	y	89%	Tier 1.9	y
Cyprus	123	Tier 1.0	8%	Tier 1.0	7%	Tier 1.0	y	75%	Tier 1.0	y
Czech Republic	379	Tier 1.0	29%	Tier 1.0	32%	Tier 1.0	y	29%	Tier 1.0	y
Estonia	45	Tier 1.7	46%	Tier 1.9	12%	Tier 1.9	y	33%	Tier 1.9	y
Hungary	1,311	Tier 1.5	22%	Tier 1.8	19%	Tier 1.8	y	57%	Tier 1.0	y
Latvia	89	Tier 1.8	43%	Tier 2.0	13%	Tier 2.0	y	35%	Tier 1.3	y
Lithuania	485	Tier 1.5	35%	Tier 1.9	16%	Tier 1.9	y	45%	Tier 1.9	y
Malta	22	Tier 1.0	27%	Tier 1.0	17%	Tier 1.0	y	45%	Tier 1.0	y
Poland	2,809	Tier 1.5	27%	Tier 2.0	6%	Tier 2.0	y	58%	Tier 1.3	y
Romania	595	Tier 1.8	15%	Tier 1.8	5%	Tier 1.8	y	59%	Tier 1.8	y
Slovakia	107	Tier 1.0	16%	Tier 1.0	20%	Tier 1.0	y	46%	Tier 1.0	y
Slovenia	405	Tier 1.2	33%	Tier 1.8	41%	Tier 1.8	y	25%	Tier 1.2	y
EU-12	**6,998**	**Tier 1.5**	**24%**	**Tier 1.8**	**13%**	**Tier 1.7**		**56%**	**Tier 1.4**	
EU-15	**35,997**	**Tier 1.8**	**29%**	**Tier 1.9**	**20%**	**Tier 1.9**		**44%**	**Tier 1.8**	
EU-27	**42,995**	**Tier 1.8**	**28%**	**Tier 1.9**	**19%**	**Tier 1.9**		**46%**	**Tier 1.8**	
EU-12: Tier 1	44%		16%			28%		60%		
EU-12: Tier 2	56%		84%			72%		40%		

a Contribution to CH_4 emissions from manure management

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n)

Table 21.19: Methodology used by Member States for calculating CH_4 emissions in category 4B(a)

Member State	Methodology
Bulgaria	**Cattle (dairy and non-dairy) and swine: Tier 2 method with country-specific parameters for the systems for management and storage of manure. Other animals: Tier 1**
Cyprus	**Tier 1**
Czech Republic	**Key source, but Tier 1, because of lack of country specific data.**
Estonia	**Cattle tier 2, other animals tier 1.**
Hungary	**Tier 1, except for the Dairy Cattle and the Non-Dairy Cattle categories, where country-specific emission factors were calculated on the basis of Tier 2 method. In the Dairy Cattle category gross energy intake was determined on the basis of the data of the Hungarian Nutrition Codex, 2004.**
Lithuania	**CH_4 emissions from manure management systems of cattle, swine and sheep were calculated using Tier 2 method. CH_4 emissions from horses, goats, sheep and poultry were calculated according to the Tier1 method.**
Latvia	**Dairy cattle: Tier 2. Other animal types: Tier 1**
Malta	
Poland	**Cattle, sheep and swine: Tier 2. Goats, horses and poultry: Tier 1.**
Romania	**Tier 2**
Slovenia	**For dairy cows IPCC Tier 2, on the basis of national publication (Tomši? et al., 2000), which enables a direct estimation of the amount of excreted decomposable organic matter on the basis of annual milk yield. Other categories of bovine animals: Tier 1.**
Slovakia	**Tier 1 modified with the national approach is based on the number of animals per regions, the calculation of volatile solid excretion (VS) and methane conversion factor (MCF) as inputs to the formula for the estimation of national EFs.**

Activity Data

Table 21.20 summarizes the allocation of the produced manure over the animal wastes management systems ‘liquid systems’, ‘solid storage and dry lot’ and ‘pasture, range and paddock’ for the animal categories dairy and non-dairy cattle and swine in 2011. While in EU-15 the liquid systems dominate for swind with 66%, only 41% of swine manure is treated in liquid management systems in EU-12, however, with very large shares of 25% in Hungary and the Czech Republic. Still the share of liquid system for swine is higher than that for cattle, but differently from the situation in EU-15, more manure from non-dairy cattle (16%) are managed in liquid systems than from dairy cattle (14%). Daily spread occurs for dairy cattle onley in the Czech Republic (1%). Pasture, range and paddock ranges up to 50% and 46% (Latvia) for dairy and non-dairy cattle, respectively.

Only few countries in EU-12 report dynamic shares of manure management systems. Substantial changes are reported for cattle in Slovenia, where liquid systems increased in importance between 1990 and 2011. In the Czech Republic, the share of manure in pasture, range and paddock increased signficantly for dairy cattle from 5% in 1990 to 7%, while the contribution for non-dairy cattle remained constant.

For some countries, background information on in addition to what is reported in Table 21.20 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 6.37.

Table 21.20: Allocation to AWMS systems in 2011

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
2011	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Bulgaria	NO	NO	83%	17%	NO	NO	82%	18%	84%	NO	16%	NO
Cyprus	no	no	99%	no	NO	NO	99%	no	NO	NO	NO	NO
Czech Republic	27%	1%	65%	7%	52%	1%	27%	20%	76%	NO	23%	NO
Estonia	25%	NO	35%	40%	4%	NO	46%	40%	73%	NO	27%	0%
Hungary	5%	NO	37%	15%	10%	NO	29%	26%	25%	NO	22%	NO
Latvia	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Lithuania	20%	NO	40%	40%	24%	NO	47%	28%	84%	NO	12%	NO
Malta	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Poland	11%		79%	10%	5%		83%	12%	25%		75%	
Romania	2%	NO	48%	50%	1%	NO	53%	46%	35%	NO	17%	NO
Slovakia	5%	NO	75%	20%	5%	NO	85%	10%	86%	NO	14%	NO
Slovenia	57%	NO	31%	12%	57%	NO	31%	12%	62%	NO	25%	NO
EU-12	14%	0%	62%	22%	16%	0%	55%	27%	41%		43%	0%
EU-15	50%	1%	19%	24%	27%	2%	24%	43%	66%	1%	5%	1%
EU-27	40%	1%	31%	23%	25%	2%	28%	41%	61%	1%	13%	1%

Source of information: CRF 4.B(a) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Missing fraction belong to the category 'Other'

Table 21.21: Member State's background information on the emission factors and other parameters used for the calculation of CH_4 emissions in category 4.B(a)

Member State	Methodology
Bulgaria	**A survey conducted with the Agricultural University of Plovdiv, provided data about the distribution of AWMS. The survey provided data for 4 pillar years – 1995, 2000, 2005 and 2010.**
Cyprus	**The distribution among waste management systems was prepared in consultation with the national experts on animal waste management. Dairy, non-dairy cattle, sheep and goats are mainly stall or housed. Only for a small share of their life they are in pasture. Thus the manure produced from them is mainly managed in Solid storage and dry lot systems. The majority of swine in Cyprus remain in properly designed building infrastructures and their manure is mainly managed with liquid systems according to national legislation.**
Czech Republic	
Estonia	**The data on cattle and swine livestock population and the data on location of manure management systems (MMS) were collected by SE in the framework of Agricultural Survey. According to the information presented in the environmental permits, which were submitted by large poultry holdings to the Environmental Board, the holdings use 'solid storage MMS' for all amount of waste generated by poultry. Manure, generated by poultry kept by private holdings (farms), is stored in 'solid storage MMS'. However, in addition, in private holdings, in the summer time during solar time, poultry are kept outside of hen-house, which could be classified as 'pasture' MMS**
Hungary	**As regards manure management, Hungarian conditions were analysed on the basis of expertconsultations (Mészáros, 2000) and a paper by Ráki (2003). This paper includes theprocessing of three databases:· General Agricultural Census 2000 (HCSO),· data from the legally required registration**

Member State	Methodology
	of agricultural producers in 2000 (thisincludes data for agricultural enterprises),· a survey of animal production holdings performed in October and November 2001,which covered the capacity, capacity exploitation and the conditions of buildings andequipment. This survey allows conclusions to be drawn in connection with the entireanimal keeping sector because it covers 70% to 100% of the livestock populationsdepending on the given category.
Lithuania	The information about manure management systems is given from the institute of Water of the University of Agriculture of the Republic of Lithuania. Pasture-cowshed time estimations are based on the data of the national zoo-technical activity data. Bulls, partly calves and cows for slaughter, normally are kept in stalls all the time. Calves, heifers for breeding and milk production and beef cattle are grazed in pastures for approximately 145 days per year, the same as dairy cattle. For cattle category, the average duration of grazing on pasture periods and the average time spent in milking stalls are used to divide excrement into pasture and stable portions. In 2012 data about manure management systems were updated.
Latvia	The distribution of different manure management systems received from research made by Latvian State Institute of Agrarian Economics (2005). Manure management systems reported in the inventory are liquid system, solid storage and dry lot, pasture range and paddock and anaerobic digester.
Malta	
Poland	Country specific data on the fraction of manure managed per AWMS and animal type (Walczak 2003, 2006,2011, 2012). Cattle: annual basis for period 1988-2002 and since 2004 with interpolation for 2003. For swine estimation based on AWMS shares and pigs population for age categories for 1988 [Walczak 2006] and for since 2004. Interpolation for the years 1988-2004. For other animals permanent shares of AWMS were taken: for sheep ? 20% on pastures and 80% solid storage, for goats and horses 22% on pastures and 78% on solid storage and for poultry 11% on liquid systems and 89% on solid storage.
Romania	Distribution of AWMS according expert opinion, varying with the years. Systems considered: anaerobic lagoo, liquid slurry, daily spread, solid storage, dry lot, pasture/range/paddock, pit storage, poultry manrue with bedding, and poultry manure without bedding. For 4B(b), dry lot is reported together with solid storage, and poultry manure with/without bedding is reported together with pit storage under 'other'.
Slovenia	The fraction of individual manure management systems has been estimated on the basis of the results of a farm census done in 2000. After 2000, data on farm size and structure were reported by the Statistical Office for the years 2003, 2005 and 2007. The fraction of grazing animals and the fraction of liquid manure management systems have increased while the fraction of bovine animals in straw based systems has decreased. For poultry, floor system on bedding was assumed for broilers, and combined floor system (1/4) and battery-cage systems (3/4) were assumed for layers and allocated to the other systems.
Slovakia	Information on animal housing, pasture and production of manures and slurries was collected on the base of questioners published in national papers. Some additional information was based on expert estimation. Solid storage of manure was found as the most frequent AMWS in the conditions of the Slovak Republic. Liquid storage of slurries is also frequently used especially in category pigs. Housing on grasslands since April to October is frequent for sheep, goats and horses. The allocation to the AWMS was made by the Research Institute of Animal Production in Nitra. It is supposed that sheep, goats and horses can stay on pasture 200 days a year, 40% of dairy cattle only 150 days especially in mountainous regions. During winter period sheep and goats produce 9% of waste as slurry and 91% as manure (Brestenský et al., 1998).

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the EU-12 Member States, as shown in Table 6.32. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, as has already been observed for EU-15. The ratio of the highest and the smallest IEF used by the Member States is 18 for dairy cattle, and 27 for non-dairy cattle and 3, 4, and 21 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Slovenia with 58 kg CH_4/head/year (higher than the highest value found in EU-15) and the smallest by Bulgaria with 3.3 kg CH_4/head/year.

The two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-12 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

More detailed information on the development of the emission factors for category 4A is given in Table 21.23.

Table 21.22: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2011

Member State	Implied EF (kg CH_4/head/yr)					
2011	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Bulgaria	3.3	1.0	0.12	0.18	41.9	0.1
Cyprus	19.0	13.0	0.28	0.18	10.0	0.1
Czech Republic	14.0	6.0	0.19	0.12	3.0	0.1
Estonia	10.3	1.8	0.19	0.12	2.0	0.1
Hungary	54.1	27.3	0.19	0.12	11.3	0.0
Latvia	11.1	2.5	0.19	0.12	4.0	0.1
Lithuania	23.9	10.5	0.24	0.12	13.0	0.1
Malta	44.0	20.0	0.28	0.18	10.0	0.1
Poland	13.7	2.7	0.17	0.12	5.7	0.1
Romania	3.8	1.9	0.38	0.46	3.1	0.0
Slovakia	4.0	3.8	0.19	0.12	4.0	0.1
Slovenia	57.5	22.2	0.19	0.12	13.8	0.1
EU-12	**14.0**	**6.0**	**0.31**	**0.33**	**6.8**	**0.1**
EU-15	**28.4**	**6.2**	**0.22**	**0.23**	**6.4**	**0.1**
EU-27	**24.8**	**6.2**	**0.24**	**0.25**	**6.4**	**0.1**

Source of information: CRF 4.B(a) for 2011, submitted in 2013 Abbreviations explained in the Chapter 'Units and abbreviations'.

Note: Data for Romania are reported in a wrong unit

Table 21.23: Implied Emission factors for CH_4 emissions from manure managementMember State's inventory

2	Methodology
Bulgaria	
Cyprus	**For sheep, goats, horses and poultry, EFs for temperate developed countries, for dairy and non-dairy cattle and for swine, EFs for temperate Eastern Europe.For sheep, goats, horses and poultry, EFs for temperate developed countries, for dairy and non-dairy cattle and for swine, EFs for temperate Eastern Europe.**
Czech Republic	**Default EFs for Western Europe. New national data on the distribution of manure management practices across AWMS were collected and updated (Kvapilík J. 2010).**
Estonia	**Dairy cattle, non-dairy cattle: country-specific data and default factors. Other animals - default parameters. The country-specific module on MMS and country-specific CH_4 EFs which is higher than IPCC default CH_4 EFs for Eastern Europe , because the amount of manure stored in the liquid/slurry system. MMS usage for manure storage of mature non-dairy cattle has not changed over the whole period of reporting – tie stall housing technology with solid storage MMS was mostly applied in cattle breeding holdings. Value of Ym for calves (0–6 months) was estimated taking into account feed intake diet of animals and development conditions of rumen: namely, the development of rumen of calves is complete between the 7th and 9th week of life, but may take several additional weeks (German NIR, 2012). Ratios of feed digestibility were obtained from (Kaasik et al., 2002). CH_4 emissions from slurry treated in biogas plant were taken into consideration for the first time. Experience of Danish colleagues was implemented. Results of the study indicate that CH_4 emissions from biogas treated slurry are lower than non-biogas treated slurry: namely, from pig treated slurry emissions are lower by 40% than from untreated slurry.**
Hungary	**Available parameters of animal production systems were compared to the criteria listed for the Tier 1 factors in the IPCC Guidelines. National conditions on the basis of expert consultations (Mészáros 2000) and a paper by Ráki (2003). In the case of Non-Dairy Cattle category the default values of Rev. 1996 IPCC Guidelines were used for the Tier 2 calculations. In the case of Buffalo, Sheep, Goats, Horses, Asses & Mules, Swine, Poultry and Rabbits categories GPG Tier 1 and IPCC default emission factors were used.**
Lithuania	**Default. The emission factor for dairy cattle has increased as a result of the increasing milk yield and the changes in housing types of animals when solid manure management was replaced by slurry-based system. Animal manure treatment in a biogas device has reduced emission of CH_4, all the biogas collected and digested in the anaerobic digester and therefore, amount of CH_4 used as fuel was not included into the total emission.**
Latvia	**For animals other than dairy cattle, default values for the cool climate region were chosen because annual temperature in Latvia is 6.0 ºC (reference period 1971-2000). For dairy cattle and other cattle for period since 2000, tier 2 was used to calculate the emission factor (using equation 4.16 of IPCC GPG**

	2000).
Malta	EF for cattle, sheep and goats, horses, swine and poultry from CORINAIR (2006). EF for rabbit APAT (2005)
Poland	Country specific data for dairy and non-dairy cattle, sheep and swine
Romania	GE and DE as for enteric fermentation. Fracion of ash (vor VS calculation) is IPCC default, using the value for developed countries for developed countries for swine and cattle, and other animal categories the default values for cattle. B_0 default for Eastern European region Other parameters from IPCC (2000) for Eastern Europe.
Slovenia	The energy digestibilities for individual categories were estimated on the basis national feeding standards (Verbic and Babnik, 1999) and the expected feed intake was estimated according to Kirchgeßner et al. (2008). Since 2005, more precise average daily gains for young bovine animals for fattening have been obtained. They were calculated on the basis of data on slaughtering date and carcass weight from slaughter houses and on the basis of birth dates of individual animals which were recorded in the Central database CATTLE (Verbic and Jeretina, 2009, unpublished).
Slovakia	Methane emissions from manure management are base on country specific emission factors used constantly during time series.

21.3.3 Manure Management N_2O (CRF source category 4.B(b))

Generally, GHG emissions (in $CO_{2\text{-eq}}$) from manure management are predominantly as CH_4 rather than as N_2O. For four countries in EU-12 (Slovakia, Estonia, Latvia, Poland), emissions from manure management are higher for N_2O than for CH_4. In Poland, the CH_4/N_2O ratio is 0.8. As Poland accounts for 54% of N_2O emissions and 40% of CH_4 emissions from manure management, the average ratio for EU-12 countries is 1.1 compared to the values of EU-15 (2.8) and EU-27 (2.2). In the EU-12 countries, only Slovenia and Malta are above the EU-15 average with ratios of 4.5 and 8.7, respectively.

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.46.

Table 6.46 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 2011 with a 0.5% decrease of the IEF for solid systems and no change 0% for liquid systems.

Table 21.24: **Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-12 level for the years 1990 and 2011**

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	1	55
Total Nitrogen excreted [Gg N]	156	385	1734
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	2.00%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2011		
Total Emissions of N_2O [Gg N_2O-N]	0	0	28
Total Nitrogen excreted [Gg N]	45	234	891
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	2.00%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2011 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	29%	60%	51%
Total Nitrogen excreted [Gg N]	29%	61%	51%
Implied Emission Factor [kg N2O-N / kg N]	100%	100%	100%

21.3.3.1 *Methodological Issues*

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems, this is even more true for EU-12 countries (92%) than for EU-15 countries (76%); however, the range is large in EU-12 with lowest share of 54% in Malte, followed by 92% in Estonia and highest share of 99% in Poland.

Table 6.47 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that ‘solid storage’ is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates are calculated from the Nex factor and the emission factor as described in Section 6.3.3.2 and 6.4.1.3.

Most countries use default factors for both nitrogen excretion rates for most animals and emission factors with the exception of Slovakia for the IEFs, and several countries for N-excretion rates; for all EU-12 countries, a level of Tier 2.0 is obtained for N excretion and Tier 1.0 for the emission factors. Thus, the overall quality level is Tier 1.5 for N_2O emissions from manure management in EU-12 countries. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used.

Additional background information on the methodology, if available, is summarised in Table 6.48.

Table 21.25: **Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems**

	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Bulgaria	536	Tier 1.7	100%	Tier 1.7	y	0%	Tier 1.7
Cyprus	150	Tier 1.4	98%	NO	y	0%	Tier 1.4
Czech Republic	664	Tier 1.6	91%	Tier 1.4	y	5%	Tier 1.6
Estonia	105	Tier 1.6	92%	Tier 1.7	y	3%	Tier 1.6
Hungary	833	Tier 1.4	75%	Tier 1.7	y	1%	Tier 1.2
Latvia	122	Tier 1.1	96%	Tier 1.3	y	3%	Tier 1.1
Lithuania	268	Tier 1.6	93%	Tier 1.7	y	4%	Tier 1.6
Malta	4	NO	54%	NO	y	46%	NO
Poland	5,109	Tier 1.7	99%	Tier 1.7	y	1%	Tier 1.7
Romania	1,208	Tier 1.8	64%	Tier 1.7	y	0%	Tier 1.7
Slovakia	369	Tier 1.7	98%	Tier 1.7	y	2%	Tier 1.7
Slovenia	134	Tier 1.5	92%	Tier 1.7	y	7%	Tier 1.5
EU-12	**9,501**	**Tier 1.7**	**92%**	**Tier 1.6**		**1%**	**Tier 1.7**
EU-15	**19,579**	**Tier 1.6**	**76%**	**Tier 1.1**		**10%**	**Tier 1.7**
EU-27	**29,081**	**Tier 1.7**	**81%**	**Tier 1.1**		**7%**	**Tier 1.7**
EU-12: Tier 1	31%		31%			38%	
EU-12: Tier 2	69%		69%			62%	

a Contribution to N_2O emissions from manure management
b Quality level (between Tier 1 and Tier 2)
c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 21.26: **Member State's background information on the methodology for estimating N_2O emissions in category 4.B(b)**

Member State	Methodology
Bulgaria	**Tier 1**
Cyprus	**Tier 1**
Czech Republic	**Key source, tier 2 methodology is used for emission estimation for the cattle category (tier 1 for other animals).**
Estonia	**Cattle and swine tier 2. Other animals tier 1**
Hungary	**Tier 1**
Lithuania	**Tier 1**
Latvia	**Tier 1 and local expert assumptions.**
Malta	**Tier 2 for cattle, swine and poultry. Tier 1 for other animal types**
Romania	
Slovenia	**Tier 1 with national specifications.**
Slovakia	**The methodology used for the estimation of manure management is based on tier 2 IPCC methodology using country specific parameters and activity data.**

Activity Data

In EU-12, a total of 1,632 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2011. Together with the 7,872 Gg N from EU-15 countries, this gives a total of 9,505 Gg N for EU-27. The largest share of this manure-nitrogen was managed in solid storage systems (891 Gg N in EU-12), followed by liquid systems (234 Gg N) and manure excreted by grazing animals (261 Gg N). Compared with 1990, this was a decrease of manure-nitrogen by 50%. The decreases were similar for the different manure management systems. The decrease of nitrogen was particularly pronounced in Latvia and Bulgaria, where in 2011 only about 30% of manure was excreted as compared to 1990.

The nitrogen managed in the various manure management systems in 2011 is given in Table 6.49. Nitrogen excretion data per head will be discussed below. Some information on the source of the animal numbers for the different Member States is given in Table 21.14.

Table 21.27: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2011

Member State 2011	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Bulgaria	5	0		55	0	28	88
Cyprus				15	7		22
Czech Republi		70	1	62	12	26	170
Estonia		6		10	1	8	24
Hungary		10		64	36	22	132
Latvia		8		12	1	9	30
Lithuania	0	20		25	5	20	71
Malta							
Poland		86		519		47	652
Romania	40	2	37	79	102	85	345
Slovakia		14		37		9	61
Slovenia		18		13	1	5	37
EU-12	**45**	**234**	**38**	**891**	**165**	**261**	**1,632**
EU-15	**20**	**2,456**	**145**	**1,729**	**688**	**2,835**	**7,872**
EU-27	**64**	**2,690**	**183**	**2,619**	**853**	**3,095**	**9,505**

Information source: CRF Table 4.B(b) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As all countries are using IPCC default values for the IEF or values that are close to it (with the exception of the IEFs used by Slovakia (both liquid and solid systems) and Hungary for liquid systems. Poland is the largest source of excreted manure in EU-12 accounting for 21% of nitrogen in manure for EU-12. An overview of the implied emission factors is given in .

Table 21.28: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory 2011

Member State	Implied EF (kg N_2O-N / kg N)			
2011	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Bulgaria	0.100%	0.100%	2.0%	0.1%
Cyprus	NO	NO	2.0%	0.1%
Czech Republic	NO	0.100%	2.0%	0.5%
Estonia	NO	0.100%	2.0%	2.0%
Hungary	NO	0.100%	2.0%	1.2%
Latvia	NA	0.100%	2.0%	0.10%
Lithuania	0.100%	0.100%	2.0%	0.4%
Malta	NO	NE,NO	NE,NO	NO
Poland	NO	0.098%	2.0%	NO
Romania	0.100%	0.100%	2.0%	0.8%
Slovakia	NO	0.100%	2.0%	NO
Slovenia	NO	0.100%	2.0%	0.3%
EU-12	**0.100%**	**0.101%**	**2.0%**	**0.8%**
EU-15	**0.100%**	**0.164%**	**1.8%**	**0.8%**
EU-27	**0.100%**	**0.159%**	**1.8%**	**0.8%**

Information source: CRF Table 4.B(b) for 2011, submitted in 2013
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is nitrogen excretion rate per head and year, which is given in Table 6.51 for EU12-countries and the main animal types. The table shows a range by a factor of up to 4.5 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range of about 80 kg N head^{-1} y^{-1} from 54 kg N head^{-1} y^{-1} used in many countries to 134 kg N head^{-1} y^{-1} for Czech Republic. Very large ranges are found for non-dairy cattle with values between 38 (Romania) and 69 kg N head^{-1} y^{-1} (Czech Republic) and sheep with values between 4.5 kg N head^{-1} y^{-1} (Romania) and 20.0 kg N head^{-1} y^{-1} (Czech Republic).

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.52. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 6.53.

Table 21.29: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 2011

Member State 2011	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Bulgaria	71.5	40.5	14.6	8.5	0.9	50.0	17.0	25.0	42.5
Cyprus	100.0	50.0	12.0	16.0	0.6	NO	15.5	40.0	IE
Czech Republic	133.8	69.2	20.0	20.0	0.6	NO	25.0	25.0	NO
Estonia	116.1	42.1	16.0	10.5	0.6	NA	25.0	25.0	NA
Hungary	114.2	39.8	20.0	8.0	0.6	70.0	18.0	60.0	25.0
Latvia	70.0	50.0	13.0	10.0	0.6	NA	13.0	48.0	NA
Lithuania	103.0	50.0	16.0	10.9	0.6	NO	16.0	25.0	NO
Malta	NE	NE	NE	NE	NE	NO	NE	NE	NE
Poland	86.7	57.8	6.9	13.6	0.3	NO	6.7	28.0	NO
Romania	53.6	38.2	4.5	17.7	1.1	53.6	5.3	55.4	36.5
Slovakia	100.0	60.0	16.0	16.0	0.7	NO	16.0	25.0	NO
Slovenia	110.4	42.5	20.0	12.2	0.6	NO	25.0	25.0	NO
EU-12	**85.4**	**52.4**	**8.1**	**13.8**	**0.6**	**54.4**	**9.8**	**43.3**	**41.1**
EU-15	**117.0**	**50.5**	**8.2**	**9.4**	**0.6**	**94.6**	**12.2**	**49.6**	**36.7**
EU-27	**109.3**	**50.7**	**8.2**	**10.2**	**0.6**	**91.0**	**11.8**	**48.0**	**38.1**

Information source: CRF Table 4.B(b) for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.30: **Member State's background information on the emission factor for calculation of N_2O emissions in category 4.B(b)**

Member State	Methodology
Bulgaria	Default IPCC for Eastern Europe
Czech Republic	Default EFs for Western Europe.
Hungary	The factors were selected on the basis of expert consultations (Gundel 2004, Várhegyi 2004) and the relevant literature (Walther et al. 1994; Várhegyiné et al. 1999; Babinszky et al. 2002; Borka 2003).
Romania	EF for other systems: pit storage 0.001; poultry manure with bedding 0.02; poultry manure without bedding 0.005.
Slovakia	Tier 1 with national specifications regarding pasture.

Table 21.31: **Member State's background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)**

Member State	Methodology
Bulgaria	Default
Cyprus	
Czech Republic	Revised the Nex values for dairy and non-dairy cattle and change of distribution ratio of manure per AWMS according to the national conditions based on expert judgment. Other animals - default Nex
Estonia	Nitrogen excretion rates for cattle livestock are calculated based on nitrogen balance. Nitrogen excretion rates for swine livestock were used from country-specific literature (Keskkonnaministri määrus nr 48, 5.12.2008). Other animals IPCC default.
Hungary	National data from source: HCSO (2000), Mészáros (2000), Ráki (2003). On the basis of expert consultations (Gundel 2004, Várhegyi 2004, Fébel 2007) and literature data (Várhegyiné et al. 1999, Babinszky et al. 2002, Fébel and Gundel 2007) it was asserted that production level and feeding technology of animal breeding in Hungary are close to the Western European standards, therefore the default IPCC factors for Western Europe were used.
Lithuania	
Latvia	Annual N excretion per animal until 2004 obtained from national studies. Since 2005, annual N excretion per animal is corrected according to results of newest studies on development of manure normative and livestock units carried out by the State Ltd." Agrochemical Research Centre". N excretion by farm livestock was estimated with the mass balance approach (N intake- N products).National studies showed that average Nex for sheep and goats in Latvia is very low as compared to IPCC default value. The reason is (i) sheep and goats nutrition is as they receive usually no feed additions; (ii) mainly local breeds are used which are not very productive. Commercial pig production in Latvia mainly includes four or five phases, to take account of changes in nutrient requirements with increasing age of the pig: piglets with live weight 7-30 kg, fattening pigs 30-100 kg or 7-100 kg, young breeding sows and breeding sows. There are no data on N excretion by young pigs with live weight 20-50 kg. N excretion for breeding sows is calculated taken into account N excretion by sucking piglets. In average, swine excretion is 10 kg N/animal?year, around half the IPCC default values.
Malta	Country-specific values for cattle, swine and poultry from Sustech (2008)
Poland	Nitrogen excretion rate for cattle, horses and swine were calculated with the use of SFOm model, where the amount of animals manure were determined for livestock categories and utility subgroups based on quantity, sort and digestibility of fodder applied. Then the nitrogen content in livestock manure was assessed based on manure management systems of collection and storage used [Jadczyszyn i in. 2000]. For goats the weighted mean value estimated for sheep in 1988-2010 was used. For poultry Nex parameters come from publication [Jadczyszyn et al 2009]. Country specific Nex values are in line with parameters published in [UNECE 2001].
Slovenia	The nitrogen excretion rates for cattle and pigs were harmonized with the methodology for ammonia emissions (Verbic, 2004). In dairy cows the nitrogen excretion has been linked to productivity, i.e. milk production. N excretion rates from Menzi, 1997 for cattle and EMEP/CORINER for swine.
Slovakia	

21.3.4 Agricultural Soils - N_2O (Source category 4.D)

For EU-12, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.63). This was most significant for emission related to manure application or manure excretion on pasture, range and paddock and is a direct consequence of decreasing animal numbers. The implied emission factor remains constant for all sub-categories and decreases only slightly for direct emissions from mineral fertilizer and manure application.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 34% for synthetic fertilizer application, 47% for application of manure, 8% of the area of histosols cultivated and 58% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 46% and of the amount of nitrogen leached by 42%.

Table 21.32: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-12 level in 2011 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	67	40	14	20	13	70
Total Nitrogen input [Gg N]	3432	2064	11162	626	853	1791
Implied Emission Factor [kg N_2O-N / kg N]	1.25%	1.25%	8.0	2.00%	1.00%	2.50%

2011	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	44	21	13	8	7	41
Total Nitrogen input [Gg N]	2250	1092	10296	261	457	1039
Implied Emission Factor [kg N_2O-N / kg N]	1.25%	1.24%	8.0	2.00%	1.00%	2.50%

2005 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	66%	53%	92%	42%	54%	58%
Total Nitrogen input	66%	53%	92%	42%	54%	58%
Implied Emission Factor	100%	100%	100%	100%	100%	100%

Source of information: Tables 4.D for 1990 and 2011, submitted in 2013

1) Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

21.3.4.1 *Methodological Issues*

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). In contrast to EU-15 countries, default factors are used also to estimate the emissions from indirect emissions. Table 6.64 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. Thus, the vast majority of the emissions are calculated with the Tier 1 approach with the important exception of the emission factor from synthetic fertilizer in Poland. Direct N_2O fluxes from synthetic fertilizer in Poland are the single largest emission flux in this category for EU-12 (13% of total emissions).

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology described in Section 6.4.1.5. and 6.3.5.2. As a result, we estimate that a minimum of

17% of the emissions reported in category 4D are estimated with country-specific information. Highest share of country-specific calculations is obtained for direct N_2O emissions (19%). All countries in EU-12 use IPCC default methodology.

Table 21.33: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year .

	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Bulgaria	3,540	Tier 1.1	58%	Tier 1.1	y	8%	Tier 1.4	y	34%	Tier 1.1	y	5%	Tier 1.0	29%	Tier 1.1
Cyprus	265	Tier 1.4	53%	Tier 1.8	y		NE	y	47%	Tier 1.1	y	9%	Tier 1.0	38%	Tier 1.1
Czech Republic	5,019	Tier 1.1	60%	Tier 1.1	y	5%	Tier 1.3	y	35%	Tier 1.1	y	6%	Tier 1.0	30%	Tier 1.1
Estonia	710	Tier 1.2	56%	Tier 1.2	y	10%	Tier 1.7	y	33%	Tier 1.1	y	5%	Tier 1.0	28%	Tier 1.1
Hungary	5,109	Tier 1.0	59%	Tier 1.0	y	4%	Tier 1.2	y	36%	Tier 1.1	y	5%	Tier 1.0	31%	Tier 1.1
Latvia	1,430	Tier 1.2	67%	Tier 1.3	y	6%	Tier 1.0	y	27%	Tier 1.0	y	4%	Tier 1.0	23%	Tier 1.0
Lithuania	3,041	Tier 1.2	63%	Tier 1.2	y	7%	Tier 1.4	y	31%	Tier 1.1	y	5%	Tier 1.0	26%	Tier 1.1
Malta	17	NE	66%	NE	y		NE	y	34%	NE	y	25%	NE	9%	NE
Poland	17,698	Tier 1.2	71%	Tier 1.2	y	3%	Tier 1.4	y	27%	Tier 1.1	y	3%	Tier 1.0	24%	Tier 1.1
Romania	9,072	Tier 1.2	59%	Tier 1.2	y	9%	Tier 1.4	y	32%	Tier 1.1	y	5%	Tier 1.0	26%	Tier 1.1
Slovakia	1,784	Tier 1.3	72%	Tier 1.3	y	5%	Tier 1.4	y	23%	Tier 1.1	y	6%	Tier 1.0	17%	Tier 1.1
Slovenia	709	Tier 1.2	53%	Tier 1.3	y	7%	Tier 1.2	y	40%	Tier 1.1	y	7%	Tier 1.0	33%	Tier 1.1
EU-12	**48,395**	**Tier 1.2**	**64%**	**Tier 1.2**	**y**	**5%**	**Tier 1.4**	**y**	**31%**	**Tier 1.1**	**y**	**5%**	**Tier 1.0**	**26%**	**Tier 1.1**
EU-15	**190,824**	**Tier 1.3**	**51%**	**Tier 1.3**	nr	14%	**Tier 1.5**	nr	34%	**Tier 1.3**	nr	6%	**Tier 1.4**	28%	**Tier 1.3**
EU-27	**239,219**	**Tier 1.3**	**53%**	**Tier 1.3**	y	13%	**Tier 1.5**	y	34%	**Tier 1.3**	y	6%	**Tier 1.4**	28%	**Tier 1.2**
EU-12: Tier 1	83%		81%			63%			90%			100%		89%	
EU-12: Tier 2	17%		19%			37%			10%			0%		11%	

a Contribution to N2O emissions from agricultural soils
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Activity Data

For the estimation of N_2O emissions from N-fixing crops and crop residues, most Member States use the amount of N input (in Gg N) as activity data in the CRF table; but some countries give the emission factor in kilogram of nitrogen emitted per kg of dry crop production (N-fixing crop or other crops, respectively). Therefore, the data given in Table 6.66 in the respective columns are not comparable.

Additional background information on the source of the data used in the Member States’s inventories is given in Table 6.67.

Table 21.34: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D

Member States	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
2011	Direct						Indirect	
Bulgaria	173	48	1	116	NO	28	37	84
Cyprus	5	24	0	1	NE	NO	5	8
Czech Republic	215	115	33	128	NO	26	58	123
Estonia	27	13	7.8	4	213	8	8	16
Hungary	272	87	28	111	NO	22	57	130
Latvia	54	17	0	6	1,246	9	12	27
Lithuania	132	29	5	31	1,792	20	29	66
Malta	0	1	NE	NE	NO	NO	1	0
Poland	982	484	19	113	6,978	47	119	343
Romania	282	207	269	120	NO	85	100	197
Slovakia	84	41	19	68	NO	9	21	25
Slovenia	24	26	2	5	69	5	10	19
EU-12	**2,250**	**1,092**	**384**	**702**	**10,296**	**261**	**457**	**1,039**
EU-15	**7,637**	**3,552**	**785**	**2,524**	**21,481**	**2,784**	**2,386**	**4,467**
EU-27	**9,887**	**4,644**	**1,169**	**3,226**	**31,778**	**3,045**	**2,844**	**5,506**

Source of information: Tables 4.D for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.35: Member State's background information on the activity data used for the calculation of N_2O emissions in category 4.D

Member State	Methodology
Bulgaria	**The synthetic fertilisers quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Food Supplies.** **Annual crop production data is provided by the Agrostatistics department at the Ministry of Agriculture and Food and is cross-checked with FAO database and National Statistics Institute?s yearbooks.**
Cyprus	**The data regarding the annual quantities of synthetic fertilisers consumed in the country has been collected from the Statistical Service.**
Czech Republic	**Annual amount of nitrogen applied in the form of industrial nitrogen fertilisers.** **All crop statistics were taken from the Statistical Yearbooks of the Czech Republic.**
Estonia	**Activity data for fertilisers and the production of N-fixing crops were used from official Estonian statistics (the Statistical Office of Estonia [ESO]).** **Activity data on amount of synthetic fertilizers applied on agricultural fields, crop production in Estonia were obtained from the datasets of SE. The data on amounts of sludge used on agricultural lands were used from the EEIC. The data on areas of histosols under cultivation in Estonia were obtained in the framework of National Forest Inventory (Chapter LULUCF).**
Hungary	**Activity data for the sector (total harvested production of plants, N-fertiliser) were obtained from the Agricultural Statistics Yearbook of HCSO.**
Lithuania	**Data about consumption of synthetic fertilisers were collected from different sources: for the period 1990-1994 data was obtained from Statistics Lithuania; for the period 1995-2006 from International fertiliser Industry Association (IFA) and for the period 2007-2011 from UAB Agrochema.** **Data on harvested crops (thous. tonnes) by type of crop was provided by database of Statistics Lithuania.**
Latvia	**There are differences between Central Statistical Bureau of Latvia (CSB) and FAO data about N synthetic fertiliser use. CSB officially submitted data on fertiliser application to FAO starting from year 2005. Information for other years was probably taken by FAO from other Latvian instititutions. Calculations of CSB are more precise (they have been the ones used in inventory and should not be revised).**
Malta	The activity data on nitrogen based fertiliser use per year (FSN) in kg N was obtained as follows: · for 1990 to 1994: FAOSTAT – Nitrogenous Fertiliser Consumption; **· for 1995 to 2011: Nitrogen fertiliser Import figures, as provided by the National Statistics Office.**
Poland	Data regarding consumption of mineral fertilisers are elaborated on the basis of reporting from production and trade units, statistical **reports of agricultural farms: state-owned, co-operatives and companies with share of public and private sector, expert's estimates as well as Central Statistical Office estimates.**

Member State	Methodology
Romania	**The amount of synthetic fertiliser applied to soils data are provided by Romanian National Institute for Statistics (NIS) Statistical Yearbooks.**
Slovenia	**The consumption of nitrogen from mineral fertilisers on agricultural soil in Slovenia has been obtained from the Statistical Yearbook. SORS collect data on fertilisers used in enterprises, companies and co-operatives involved in crop production.Likewise, they are taking into account the data on import, export, and production. The difference between all fertilisers sold in this country and the amount that is used by enterprises, is the consumption of mineral fertilisers on family farms. fertilisers that are not appropriate for agricultural production (mineral fertilisers for balcony flowers, lawns and similar) are not included.**
Slovakia	**According to Statistical Yearbook and Green Report of Slovak Republic it is not possible to split fodder crops and grasslands into year subcategories. The crop and root residuals were observed from 29 crop species on three to seven different soil-climate sites in the Slovak Republic (partly on the small parcels production and partly an the large scale production. The sampling was provided according the plant specification (numbers of plants per hectare). This analysis based on the questionnaires from 222 agricultural subjects showa that 14.7% of total agricultural land is cultivated and 15.2% is arable land.**

Emission Factors and other parameters

Table 6.68 and Table 6.69 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2011 in EU-12 countries. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. Poland, Malte, Lithuana, and Cyprus use a different emission factor for synthetic fertilizer nitrogen and applied manure than IPCC default, Estonia only for synthetic fertilizer. Indirect emissions are estimated with default values for both volatilization/leaching fractions and emission factors, with the exception of $Frac_{GASM}$ in Slovakia.

Table 21.36: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2011

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
2011	Direct						Indirect	
Bulgaria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Cyprus	1.12%	0.95%	1.25%	1.25%	NE	NO	1.00%	2.50%
Czech Republic	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Estonia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Hungary	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Latvia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Lithuania	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Malta	1.00%	2.00%	NE	NE	NO	NO	1.00%	0.75%
Poland	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Romania	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Slovakia	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Slovenia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
EU-12	**1.25%**	**1.24%**	**1.25%**	**1.25%**	**8.0**	**2.0%**	**1.00%**	**2.50%**
EU-15	**1.2%**	**1.24%**	**1.25%**	**1.25%**	**7.7**	**2.0%**	**1.00%**	**2.48%**
EU-27	**1.24%**	**1.24%**	**1.25%**	**1.25%**	**7.8**	**2.0%**	**1.00%**	**2.48%**

Source of information: Tables 4.D for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.37: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2011

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Bulgaria	3%		10.0%	20%	25%	30%	3.0%	1.5%	50%
Cyprus	10%	NA	10.0%	20%	NA	30%	NA	NA	50%
Czech Republic	NO	NO	10.0%	20%	15%	30%	3.0%	1.5%	45%
Estonia	NO	NO	10.0%	20%	32%	30%	3.0%	1.5%	
Hungary	NO	NO	10.0%	20%	17%	30%	2.8%	0.7%	NO
Latvia	NO	NO	10.0%	20%	29%	30%	2.0%	3.0%	45%
Lithuania	NO	NO	10.0%	20%	29%	30%	3.0%	2.0%	45%
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE
Poland	3%	NO	10.0%	20%	7%	30%	2.6%	1.4%	53%
Romania	10.0%	NO	10.0%	20%	25%	30%	2.7%	1.6%	NA
Slovakia	NO	NO	10.0%	20%	16%	30%	NA	NA	NE
Slovenia	NO	NO	10.0%	20%	14%	30%	2.9%	0.7%	47%
EU-12	NA	NA	10.0%	20%	21%	30%	2.8%	1.7%	48%
EU-15	NA	NA	5.7%	22%	33%	25%	2.6%	1.2%	57%
EU-27	NA	NA	7.8%	21%	27%	27%	2.7%	1.5%	53%

Source of information: Tables 4.D for 2011, submitted in 2013. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Arithmetic average over the MS that reported.

22 LULUCF (CRF SECTOR 5, EU-27)

EU-12 new MS have in place functional national systems. Ability of reporting GHG inventories of the new MS is higher for forest land and lower for all the other land use categories, this explains generally low completeness when looking to LULUCF sector. The lack of an EU-27 fully harmonized GHG inventory system is mostly caused by historical differences in data type availability and different principles of resources management under different economic and political orientation, and also because of different economic progress over last two decades. Nevertheless, the new 12 MS benefit on experience gained in EU-15 MS by various common programs and direct support projects (e.g. COST, JRC workshops, and European Commission support projects).

Activity data is available especially in forms of statistics and the data are often not suitable for direct use in the GHG estimation (e.g. net data are only available, without land conversion information). For other pools, especially on soils, data are generally limited to C stocks or some relevant proxies, with very poor information of C stock changes. Dead organic matter, but especially litter pool is particularly poorly estimated and often reported under Tier 1 (i.e. assumed in balance under forest land). Efforts for developing integrated systems for resources assessment, like statistic national forest inventories, are slow but ongoing, however several countries have already finished or they are performing currently the first national forest inventory cycle.

The contribution of LULUCF to total emission of each of EU-12 MS varies according the sink size and country's total emissions (Table 22.1). EU-12 aggregated LULUCF offset 13% of total national emissions from other sector, ranging among countries from only 2% to over 149 %. These estimates have to be considered under the current completeness. Note that within EU-15, Germany and Netherlands have reported LULUCF sector for 2011 as a net source of emissions.

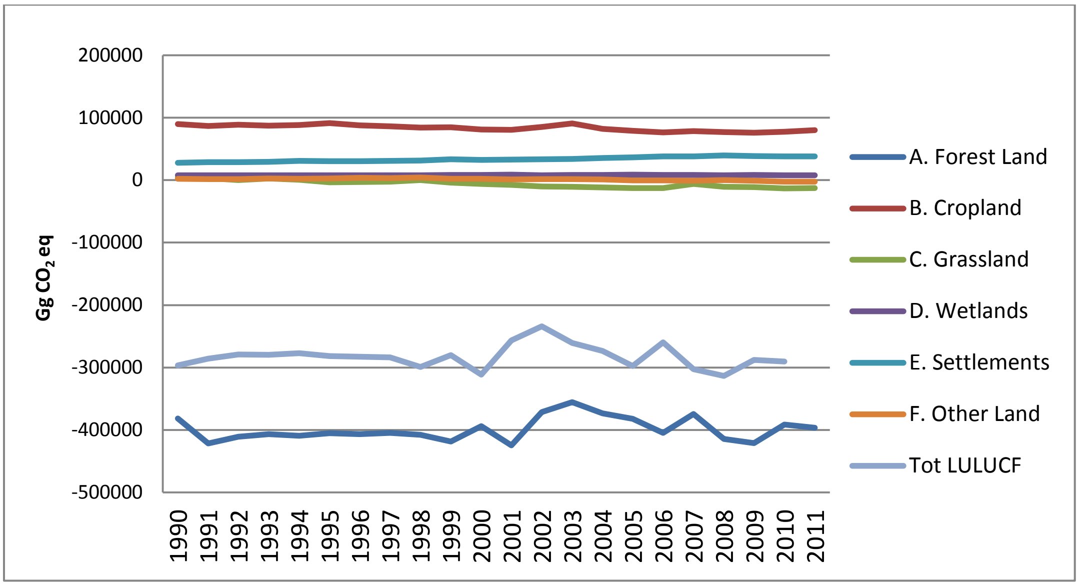
Table 22. 1 Sector 5 LULUCF contributions to total national emissions of EU-27 (GgCO_2eq)

MS	LULUCF sector	Total National emissions (without LULUCF)	Share of emissions offset by LULUCF sector
Total EU-15	-174.086	363.4521	-5%
Bulgaria	-7.979	66.133	-12%
Czech Republic	-7.959	133.496	-6%
Estonia	-4.263	20.956	-20%
Hungary	-3.787	66.148	-6%
Lithuania	-10.483	21.612	-49%
Latvia	-17.179	11.494	-149%
Malta	-60	3021	-2%
Poland	-21.912	399.390	-5%
Romania	-25.305	123.346	-21%
Slovakia	-7.467	45.297	-16%
Slovenia	-9.619	19.509	-49%
Total EU-12	**-116.015**	**910.401**	**-13%**
Total EU-27	**-290.101**	**4.544.922**	**-6%**

22.1 Overview of the sector (EU-27)

At the EU-27 level, the LULUCF sector is a net sink with values ranging around 280.000 Gg CO_2 eq for 1990-2011 (Figure 22.1), with a similar structure of removals and emissions as in EU-15. Overall for EU-27, only forest land (5A) and grassland (5C) are sinks. Compared to 1990 the annual removal increased 4 % on forest land and 100 % for grassland (which turned from source to sink). Emissions form cropland (5B) decreased by 10%. Emissions from wetland (5D) increased by 5% and from settlements (5E) by 27 %.

Figure 22.1 Sector 5 LULUCF: EU-27 net CO_2 emissions for 1990–2011 from CRF tables in CO_2 eq. (Gg)



Most of the methodological considerations expressed for EU-15 are also valid for the new 12 MS, with 5A, 5B and 5C best reported in comparison with other land categories where mostly conversions are reported (Table 22.2).

Table 22.2 Sector 5 LULUCF: Coverage of CO_2 emissions and removals of the new MS in the various subcategories for the year 2011

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5A1 F-F	5A2 L-F	5B1 C-C	5B2 L-C	5C1 G-G	5C2 L-G	5D1 W-W	5D2 L-W	5E1 S-S	5E2 L-S	5F1 O-O	5F2 L-O
Bulgaria	R	R	E	E		R		E		E		
Cyprus	R							E				
Czech R.	R	R	E	E	E	R		E		E		
Estonia	R	R	E	E	E	R	E	E		E		E
Hungary	R	R	R	E	E	R		E		E		
Latvia	R	R	E	E	E		E	E		E		
Lithuania	R	R	E	E	E	R	E	E				
Malta	R		R									
Poland	R	R	E	E	E	R	E	E	R	E		
Romania	R	R	R	E	E	E		R		E		E
Slovakia	R	R	R	E		R				E		E
Slovenia	R	R	E	E		E		E		E		E

Legend: R: net Removal; E: net Emission; empty cells can be: NE-not estimated /NO-not occurring/NA-not applicable/IE-included elsewhere

Furthermore, most new MS reported less sub-categories and pools (Table 7.73) than most of the EU-15 MS because of the lack of national data or often because of lack of both national capacity of processing existing data (e.g. rich data related to forest management) as adaptation and develop the data according reporting requirements.

Actions that the new MS have taken include: improving the coverage of activity data to include more land uses and land use changes; adjusting and improve the NFI to reporting needs; improving the methodology of converting activity data to emissions and removals by using the appropriate factors (e.g. BEFs); frequent recalculations due to improved data, implementation of research projects on reported pools (e.g. litter pool); efforts for estimating uncertainties and improving the transparency of the reporting; and active participation in European projects and actions aimed at improving the reporting. Several new MS indicate that additional changes and improvements are under way and will be implemented in their supplementary report under the Kyoto Protocol.

The current reported pools are shown in the (Table 7.7.3) further, information on data and methods for estimations are reported in the (Table 22.4)

The following subcategories of the LULUCF sector are usual key categories in the inventory of new EU 12 MS (slightly different from MS to another):

- 5A1 Forest Land remaining Forest Land: CO_2
- 5A2 Land converted to Forest Land: CO_2
- 5B1 Cropland remaining Cropland: CO_2
- 5B2 Land converted to Cropland: CO_2
- 5C1 Grassland remaining Grassland: CO_2
- 5C2 Land converted to Grassland: CO_2

Table 22.3 Sector 5 LULUCF: Reporting of carbon pools for the major land sub-categories for the year 2011

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org
Bulgaria	R				R	R	E		E		R		R		E						E		R	
Cyprus	R																							
Czech R.	R				R		R		R		R		E	E	E				R		R	E	R	
Estonia	R	R	R	E	R	R	E	E	E		R	E	E		E	E	E	E		E	R	E	R	E
Hungary	R				R				R		R		R	E	E				E		E	E	R	
Latvia	R	R		E	R	R		E				E	E	E	E	E				E				
Lithuania	R	R		E				E	R			E	E		E	E				E	R		R	E
Malta	R								R															
Poland	R	R	R	E	R	R	R	E	E		E	E			E				E	E			R	
Romania	R				R	R	R		R	R	R		E		E								R	
Slovakia	R				R	R	R		R		R		E	E	E						R	E	R	
Slovenia	R	R			R		R		E		R													

Pools: DOM – dead organic matter, LB –living biomass, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other keys), assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")

Table 22.4 Sector 5 LULUCF: Method for reporting of carbon pools by the new 12 MS for the most important categories for the year 2011, as derived from Table 5A, 5B and 5C of the CRF tables 2013

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM (1)	SOC Min	SOC Org (2)	LB	DOM	SOC Min	SOC Org (2)	LB (3)	DOM	SOC Min (4)	SOC Org (2)	LB (5)	DOM	SOC Min	SOC Org (2)	LB	DOM	SOC Min (4)	SOC Org (2)	LB	DOM	SOC Min	SOC Org (2)
BG	CS	D	D	NO	CS	D	CS	NO	CS,D	CS	CS	NO	CS,D	NO	CS	NO	NO	NO	NO	NO	CS,D	NO	CS	NO
CY	CS	D	D	NE	NE	D	NE	NO	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CZ	CS	D	D	NO	CS	D	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO
EE	CS	CS,D	D	CS,D	CS	CS	NE	CS,D	CS	NE	NE	CS,D	IE,NO	NO	NE	CS,D	CS,D	CS	NE	CS,D	CS	CS	NE	CS,D
HU	CS	D	D	NO	CS	D	D	NO	D	NO	D,D	NO	CS,D	D	D	NO	D	D	D,D	NO	CS	CS	D	NO
LV	CS	D	D	CS	CS	D	NE	CS	NO	NO	NO	D	CS,NO	CS	CS	CS	NE	NO	NO	D	NO	NO	NE	IE
LT	CS	CS	CS	CS	CS	D	NE	NE	D	NA	NA	CS	D	NA	D	NA	NA	NA	NA	CS	D	NA	D	CS
MT	CS	D	D	NE	NO	NO	NO	NO	D	NE	NE	NE	CS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
PL	CS	D	CS	CS	CS	CS	CS	CS	D	D	CS	CS	NA,NO	NO	CS	NO	NO	NO	CS	CS	NO	NO	CS	IE
RO	CS	D	D	NE	NE	D	NE	NE	D	CS	CS	D	NO	NO	CS	NO	NO	NO	NO	NE	NO	NO	CS	NO
SK	CS	D	D	NO	CS	D	CS	NO	D	D	NO	NO	CS,D	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
SV	CS	CS	D	NO	CS	CS	CS	NO	CS	D	CS	CS	CS	CS	CS	NA,NO	D	D	NA	CS	CS	CS	CS	NA

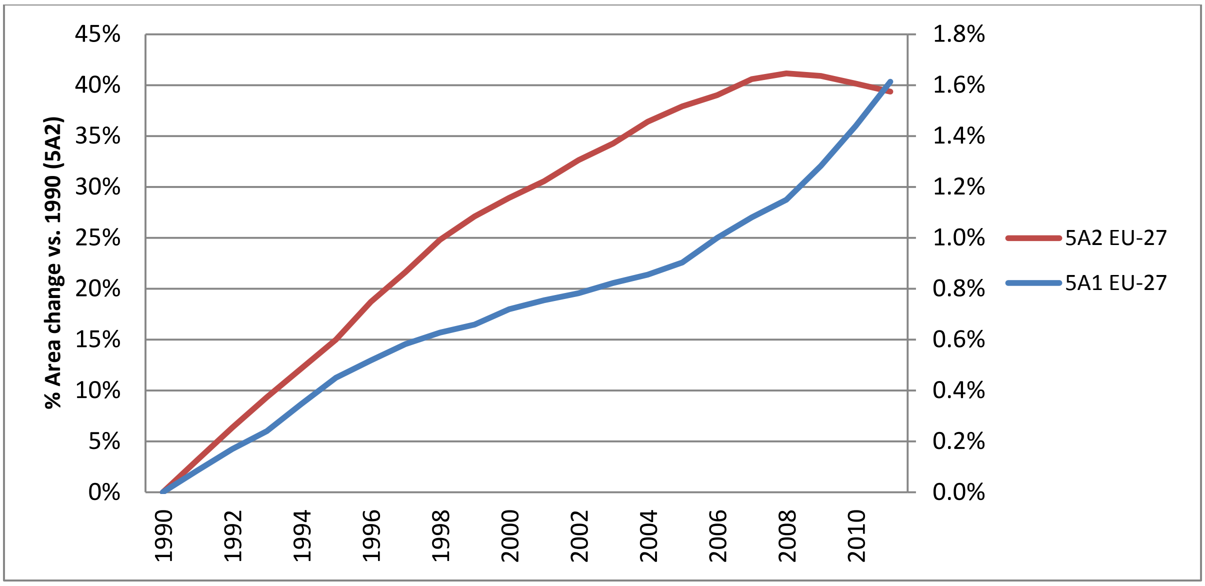
(D: default; CS: country specific; NA: not applicable; NE – not estimated; NO- not occurring)
Source: CRFs 2013
"CS" country specific data, associated either with IPCC method (tier 2) or country-specific method (tier 3, if data are highly disaggregated). Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken by IPCC). However it is expected that if "CS" is reported, the most important parameters are truly "CS
"D" means that the default IPCC emission factors are used in the estimation. D is typically associated with IPCC default method (tier 1).
"NE" means either country assumes the emission/removal is negligible or not enough data is available for estimation
"NO" means emissions or removals "not occurring" in a country (it includes also "NA" - not applicable)
(1) for DOM under "FL r FL" the 2 notations separated by a comma mean: first one refers to DW (dead wood), second to LT (litter)
(2) for ORGANIC SOIL any notation key reported for a country showing some activity data of org soil for any land (sub)category is assumed as NE. D refers to the use of IPCC default emissions factors
(3) BIOMASS C stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed zero C stock change by definition.
(4) for SOC MIN on CL and GL the 2 notation keys separated by comma mean that the country uses IPCC default method (which is tier 1 if associated with D data or tier 2 if associated with CS data); in this case, the first notation key refers to "reference C stock", and second to "C stock change factor" (see IPCC-GPG for details). A cell with a single "CS" indicate a country-specific method and data (i.e. tier 3 if data are highly disaggregated)
(5) for BIOMASS under L - CL, "conversion to cropland", the 2 notation keys used mean: first one refers to FL-CL and second to GL-CL
Grey heading means that for these pools IPCC TIER 1 allows to assume no change in C stock (note that if the category is a key category, in theory higher tiers should be used)

22.2 Source and sink categories (EU-27)

22.2.1 Forest land (5A; EU-27)

According to the latest submissions, EU-27 has a forest area of about 156675 kha, out of which 34787 kha are in the new EU-12 MS territories (22 % of total EU-27 forest land). Since 1990, all new 12 MS have reported increase of forest land area, with an overall increase of some 4 % as compared to 1990 (Figure 22.1).

Figure 22.1 The percentage increase compared to 1990 of the forest land area between 1990 and 2011 in the EU-27 (axis on the right % shows increase for 5A1)



From new EU MS, the largest area of forest are reported by Poland and Romania. As in EU-15, the category 5A has the major contribution to the LULUCF sector GHG balance in the new MS. In 2011, EU-27's 5A1 is a net sink of some 339887 GgCO_2 eq, 4% less than in 1990 and 2% higher than 2010 (Table 22.5). Within the group of the new EU member states, for 5A1 category only Czech Republic, Lithuania and Slovenia reported an increased sink compared to 1990, while notable decreases of the annual removal by 5A1 are reported by Bulgaria, Estonia and Latvia. Overall, new EU MS report a sink of some 112000 GgCO_2 in 2011.

Table 22.5 5A1 Forest Land remaining Forest Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	-230 592	-216 692	-227 508	66.9%	-10 816	5%	3 084	-1%		
Bulgaria	-13 718	-9 637	-9 622	2.8%	15	0%	4 096	-30%	T1,T2	CS,D
Cyprus	-156	-169	-94	0.0%	75	-44%	62	-40%	D	D
Czech Republic	-4 777	-5 243	-7 635	2.2%	-2 392	46%	-2 858	60%	CS,T1,T2	CS,D
Estonia	-9 203	-6 823	-5 162	1.5%	1 661	-24%	4 042	-44%	T1,T2	D
Hungary	-2 249	-1 995	-1 855	0.5%	140	-7%	394	-18%	T1,T2	CS,D
Latvia	-23 058	-14 867	-15 366	4.5%	-499	3%	7 692	-33%	T1,T2	CS,D
Lithuania	-6 795	-9 743	-10 048	3.0%	-305	3%	-3 253	48%	T1,T2	CS,D
Malta	-49	-49	-49	0.0%	0	0%	0	0%	CS	D
Poland	-25 618	-27 923	-24 553	7.2%	3 370	-12%	1 065	-4%	D,T2	CS,D
Romania	-21 956	-22 257	-20 292	6.0%	1 965	-9%	1 664	-8%	T1,T2	CS,D
Slovakia	-7 238	-5 623	-6 126	1.8%	-503	9%	1 112	-15%	T2	CS,D
Slovenia	-10 336	-11 576	-11 578	3.4%	-2	0%	-1 242	12%	CS,D,T1,T2,T3	CS,D
EU-27	**-355 746**	**-332 596**	**-339 887**	**100.0%**	**-7 291**	**2%**	**15 859**	**-4%**		

For lands under conversion to forest, the rate of annual removals has doubled compared to 1990. All new MS except one, reported increase of removal from 5A2, with only Slovakia reporting a decreasing annual removal under less area converted to forest land over last decade (Table 22.6). Largest sinks are estimated by Poland and Romania.

Table 22.6 5A2 Land converted to Forest Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	-22 045	-46 659	-43 744	75.1%	2 915	-6%	-21 698	98%		
Bulgaria	-656	-648	-655	1.1%	-7	1%	1	0%	T2	CS
Cyprus	0.00	0.00	0.0	0.0%	0.00	-	0.00	-		
Czech Republic	-280	-308	-329	0.6%	-21	7%	-49	18%	T1,T2	CS,D
Estonia	-9	-28	-22	0.0%	6	-20%	-14	158%	T1,T2	D,OTH
Hungary	-312	-1 155	-1 110	1.9%	45	-4%	-798	256%	T1,T2	CS,D
Latvia	-11	-923	-884	1.5%	38	-4%	-873	7853%	T2	CS
Lithuania	-1 024.87	-1 112.02	-1 096.09	1.9%	15.93	-1%	-71.22	7%	T1,T2	CS,D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Poland	-222	-6 097	-6 466	11.1%	-370	6%	-6 244	2811%	D,T2	CS,D
Romania	-153	-2 498	-3 061	5.3%	-563	23%	-2 908	1895%	T1,T2,T3	CS
Slovakia	-2 890	-461	-442	0.8%	18	-4%	2 448	-85%	T2	CS
Slovenia	-465	-465	-465	0.8%	0.00	0%	0.00	0%	D,T1,T2,T3	CS,D
EU-27	**-28 069**	**-60 351**	**-58 274**	**100.0%**	**2 077**	**-3%**	**-30 205**	**108%**		

Concerning the methods applied, countries mainly use Tier 2, where country specific methods and own data sources dominate in both subcategories, by other hand default data values remain still in use used for Root-to-shoot ratios, biomass expansion factors and wood densities. Regarding the methods, 5 of MS use "stock change" and other 5 use "gain loss" method (Table 22.7). Noteworthy, many rely on non-NFI (i.e. non-systematic grid forest inventory, but based on other principles) data sources like stand wise forest inventory as management planning database.

Table 22.7 Estimation method and parameters used by new 12 MS for the C stock change in Living Biomass pool. In italics there are non-NFI based estimation methods.

MS	Estimation method	BEF	R	D
Bulgaria	*Stock change method based on FMP database*	*CS*	*D*	*CS*
Czech Republic	*Gain-loss method based on FMP database and harvest statistics*	*CS*	*D*	*nr*
Estonia	*Stock change method based on FMP database (before 1993) and NFI data*	*D*	*D*	*D*
Hungary	*Stock change method based on FMP database*	*nr*	*D*	*CS*
Latvia	*Gain-loss method based on FMP (before 2004), NFI and harvest statistics*	*nr*	*D*	*D*
Lithuania	*Stock change method based on FMP (before 2000) and NFI data*	*CS*	*D*	*D*
Poland	*Gain-loss method based on FMP database and harvest statistics*	*D*	*D*	*CS*
Romania	*Gain-loss method based on FMP database, national statistics and harvest statistics*	*nr*	*CS*	*CS*
Slovakia	*Gain-loss method based on FMP database, harvest statistics and firewood estimate*	*CS*	*CS*	*CS*
Slovenia	Stock change method based on NFI data	D	D	D

D- default factor/ CS - country specific factor/ nr- no relevant (e.g. countries using BECF do not need to use D since it is already included)

Information on the data sources used for estimation of 5A1 and 5A2 (Table 7.13.8) shows a wide range of methods and approaches.

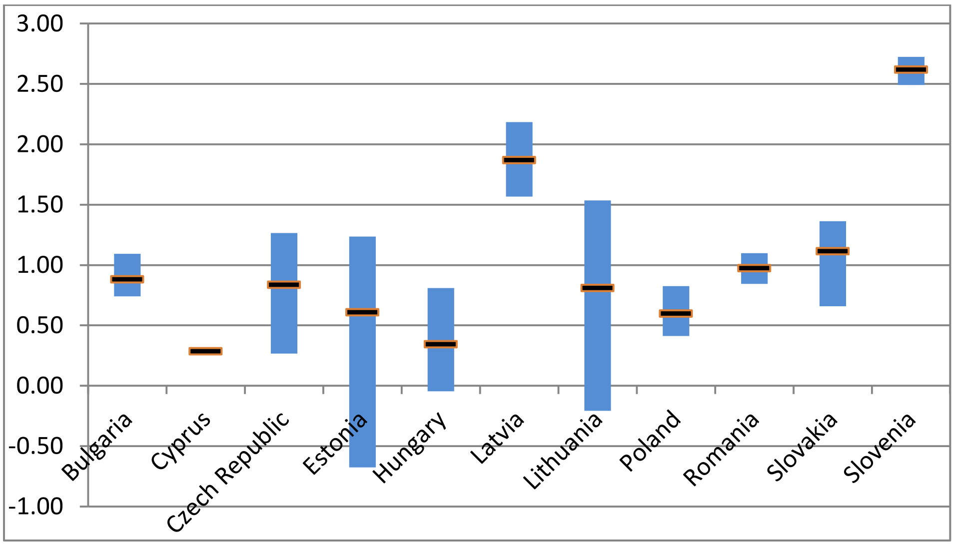
Table 22. 8 Relevant information on the Forest Inventories in the 12 MS (FMP - Forest management plan database, NFI - national forest inventory)

Country	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, stand measurement plot area	Cycle length	Frequency / First NFI in …	Data source for 1990	Data source for 2008-2012
Bulgaria	Forest management planning purpose assessment of the whole territory of the country is carried out within 10 years with data collected annually and statistics updated annually (i.e. area) or every 5 years (i.e. standing stock).	10	-	FMP database	FMP database
Czech republic	Forest management planning database aggregated up in the permanent inventory and covering entire country in 10 years cycles. Grid cell of 2x2km with two 500m2 circular plots covering entire country.	10	Stand wise forest inventory since '50. First NFI 2001-2004	FMP database	FMP database
Estonia	Systematic sampling without pre-stratification Continuous inventory with 1/5 plots measured in a year in 5x5km grid. 25 % of the 800m side squares clusters with permanent plot of 10m radius and temporary with 7m radius. NFI follows FL conversions.	5	First NFI 1999-2002	FMP database (10 years cycles)	NFI 2011-2013
Hungary	Forest Inventory and Planning System is a GIS-based system contains geographical information on the distribution of existing forests, broad tree species categories, forest soils, designated nature and landscape areas, river catchments and archaeological sites.	10	Stand wise forest inventory database since 1970.	FMP database	FMP database
Latvia	Sampling inventory 4x4km grid of permanent clusters with four sampling plots and 2x2km grid temporary clusters with eight plots (temporary plots are 1/3 of total). Temporary clusters area is 4x that of permanent plots. Each year one fifth of the plots in the permanent sample plots are assessed. Conversions are followed. Plot consists in three concentric areas and a band within a total of 500m2.	5	First NFI 2004–2008.	FMP database	NFI 2011–2013
Lithuania	Continuous, multistage sampling and GIS technology based inventory since 1998. 4x4km systematic grid with a random starting point. 1/3 if plots are temporary. Four permanent plots are settled in cluster of 6250m2 and temporary plots are 4x larger. Plot consists in two concentric areas with a total of 500 m2.	5	Stand wise forest inventory database since 1922. First sampling based inventory in 1967–1969.	FMP database	NFI 2008-2013
Poland	Permanent sample plots in "L" shape clusters in 4x4km nationwide grid. A group of 5 clusters are further grouped into blocks, with one cluster measured annually. Plots consist in two concentric plots with max area of 500m2.	5	FMP database since 1946. First sampling based inventory in 1983	FMP database	NFI 2008-2013

Country	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, stand measurement plot area	Cycle length	Frequency / First NFI in …	Data source for 1990	Data source for 2008-2012
Romania	Forest management planning database aggregated up in 1985 and covering entire country in 10 years cycles. Continuous forest inventory with a 5-years cycle covering entire country in a year. 4 plots clustered in a grid is 4x4km grid (in plain areas 2x2 km). Plot consists in three concentric area of 2000 m2. Some 15 % of plots are temporary.	6	First statistic NFI 2007-2013	FMP in 1985 (for C stock change factors) and national statistics (for activity data)	National statistics (for activity data) and NFI 2007-2013 (for C stock change factors)
Slovakia	Forest management planning database aggregated up in the permanent inventory and covering entire country in 10 years cycles. Sample based forest inventory in a grid of 4x4 km. Plot consists in three concentric area of 500 m2.	2	First statistic NFI 2005-2006	FMP database	FMP database
Slovenia	Cluster of two/four of 6-tree sample plots on 8x8km/16k16km grid and one concentric permanent sample plot. Inventory is annually on the 16x16km grid and periodically on the 4x4km grid.	1/5–10 years	First statistic sampling 1985	Forest Ecosystem Condition Survey 2000	Forest Ecosystem Condition Survey 2013

For the new EU-12 MS, the average C stock change factor for the net change in living biomass is in the range reported by the EU-15. The highest net change in biomass is reported by Slovenia under close to nature extensive forest management practiced. The smallest values are shown by Cyprus and Hungary (Figure 22.3 Implied net C stock change factor (average, min and max over 1990-2011) for the net change in living biomass C pool (5A1) in the EU-12). IEF is negative, suggesting a source, in case of Lithuania (in 1996), Hungary (in 2000) and Estonia (under high harvesting volume about twice higher than usual between 1999 and 2004 and wildfires in 2006 and 2008).

Figure 22.3 Implied net C stock change factor (average, min and max over 1990-2011) for the net change in living biomass C pool (5A1) in the EU-12. (MgC ha-1yr-1)



For 5A1, dead organic matter is practically reported by only few of the new MS with values ranging from 0.07 to 0.2 MgC ha-1yr-1. Estimations are based on stock-change method (i.e. Estonia, Latvia, Lithuania, Poland and Slovenia).

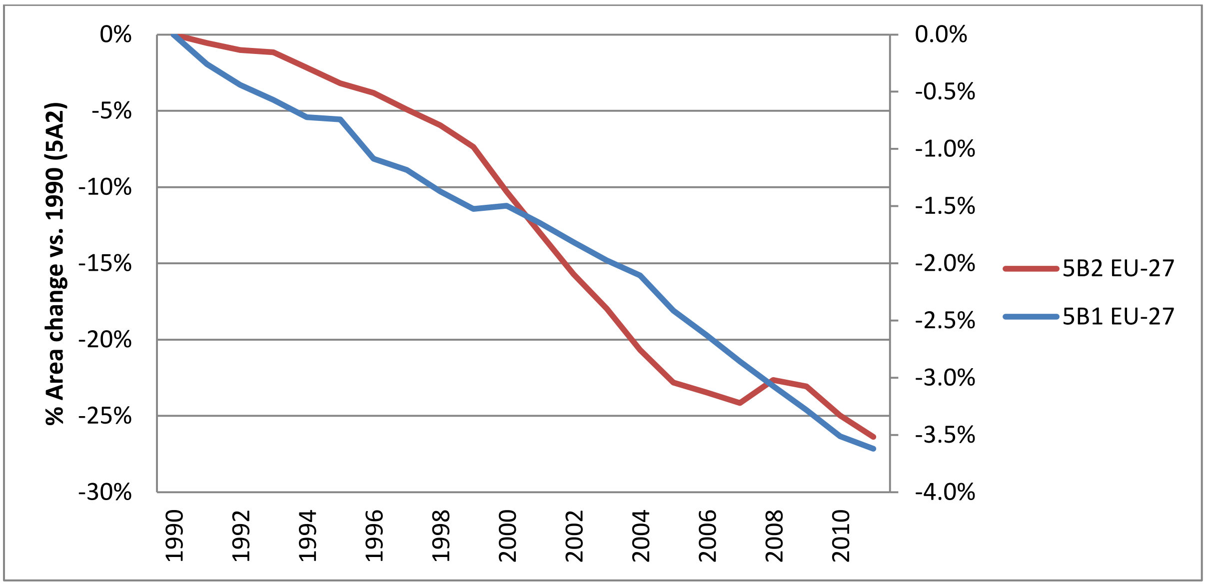
C stock change in the mineral soils is poorly reported with only 2 countries showing values: Estonia and Poland reported IEFs values of around 0.25 MgC ha-1yr-1 for the entire time series 1990-2011.

Range of values for IEF for C stock change in organic soils is -0.26 to-0.68 MgCha-1yr-1. For this pool only Estonia, Latvia, Lithuania and Poland have reported values. For first time, Poland reports emissions from areas of organic soils under 5A1 (issue highlighted by EU QA/QC procedure).

22.2.2 Cropland (5B; EU-27)

In the EU-27, cropland area (5B) decreased by 4% since 131363 in 1990 to 126056 kha in 2011. In EU-12, all MS report decreases of cropland area compared to 1990. In absolute terms, the highest reductions of cropland areas within new MS are in Latvia (some 590 kha) and Poland (481 kha). Area of land under conversion to cropland decreased over 1990-2011 followed by sharp increase at the end on time series (Figure 22.4).

Figure 22.4 The percentage increase compared to 1990 of the cropland area between 1990 and 2011 in the EU-27. (axis on the right shows % increase for 5B1)



Subcategory 5B1, cropland remaining cropland is a source of GHGs of about 41341 GgCO_2 for EU-27 (Table 22.9), which is 8% more than in 1990 and 9% more than in 2010. Within new 12 MS, Bulgaria reports a significant increase of emissions compared to 1990, while Hungary, Slovakia and Romania report it as a sink in 2011. The methodologies are still largely based on Tier 1 in subcategory 5B1 and most new MS are still weak in reporting the emissions from subcategory 5B2 (i.e. other than conversions from forest land which is completely reported).

Table 22.9 **5B1 Cropland remaining Cropland: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	37 829	37 947	42 056	101.7%	4 109	11%	4 227	11%		
Bulgaria	354	1 164	1 304	3.2%	140	12%	950	268%	T1,T2	CS,D
Cyprus	NA	NA	NA	-	-	-	-	-	NA	NA
Czech Republic	1 089	38	61	0.1%	23	61%	-1 028	-94%	CS,T1	D
Estonia	125	111	99	0.2%	-12	-11%	-27	-21%	T1,T2	D
Hungary	223	-1 619	-1 585	-3.8%	33	-2%	-1 808	-812%	T1,T2	CS,D
Latvia	338	219	226	0.5%	6	3%	-112	-33%	D,T1,T2	CS,D
Lithuania	509	31	35	0.1%	3	11%	-475	-93%	T1	D
Malta	-8	-10	-11	0.0%	-0.80	8%	-3	40%	D	D
Poland	3 511	3 115	3 216	7.8%	101	3%	-295	-8%	D,T1,T2	CS,D
Romania	-4 895	-2 336	-3 223	-7.8%	-887	38%	1 672	-34%	T1,T2	CS
Slovakia	-911	-905	-898	-2.2%	7.02	-1%	13	-1%	T1,T2	CS,D
Slovenia	61	61	61	0.1%	0	0%	0	0%	D,T1	CS,D
EU-27	**38 226**	**37 817**	**41 341**	**100.0%**	**3 524**	**9%**	**3 115**	**8%**		

Lands under conversion to cropland are reported as small source, but 25% less in 2011 than in 1990 and 2% less than previous year. Lithuania reported highest emissions across new 12 MS (Table 22.10).

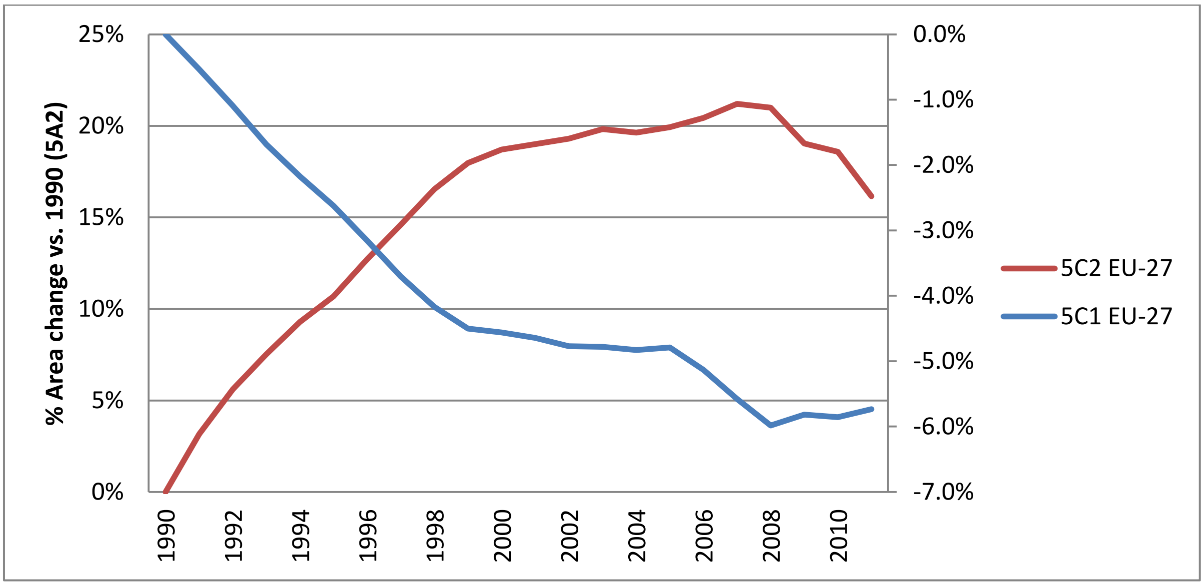
Table 22.10 **5B2 Land converted to Cropland: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	40 626	30 792	30 145	83.9%	-647	-2%	-10 481	-26%		
Bulgaria	509	836	855	2.4%	19.52	2%	346.83	68%		
Cyprus	0.00	0.00	0.00	0.0%	0.00	-	0.00	-		
Czech Republic	226	95	86	0.2%	-8	-8%	-140	-62%	T1,T2	CS,D
Estonia	NO	83	77	0.2%	-6	-7%	77	-	T1,T2	D
Hungary	118	301	309	0.9%	9	3%	192	163%	T1,T2	CS,D
Latvia	265	173	143	0.4%	-30	-17%	-122	-46%	T2	CS
Lithuania	5 263	3 638	3 666	10.2%	27	1%	-1 597	-30%	T1	CS,D
Malta	NO	-1	NO	-	1	-100%	-	-	NA	NA
Poland	NA,NO	100	100	0.3%	0	0%	100	-	T1	D
Romania	-17	18	20	0.1%	2	11%	38	-217%	T1	CS
Slovakia	756	136	139	0.4%	3	2%	-617	-82%	T2	CS
Slovenia	325	370	372	1.0%	2.36	1%	48	15%	D,T1,T2	CS,D
EU-27	**48 070**	**36 541**	**35 914**	**100.0%**	**-627**	**-2%**	**-12 156**	**-25%**		

22.2.3 Grassland (5C; EU-27)

Grassland area (5C) has decreased by 2 % compared to 1990 within EU-27, while an increase of 5 % of the total grassland area is reported for EU-12. The highest decrease is shown by Bulgaria (227 kha), while highest increase of the total grassland area is shown by Latvia (394 kha) and Romania (291 kha) (Figure 22.5).

Figure 22.5 **The percentage increase compared to 1990 of the grassland area between 1990 and 2011 in the EU-27 (axis on the right shows % increase for 5B1)**



Subcategory 5C1, grassland remaining grassland, is reported as a very small source, with a total emission of about 12500 GgCO_2 in 2011, 44 % less than in 1990 and 5% more compared to previous year (Table 22.11). For EU-12, methodologies are largely based on Tier 1, using default data with country specific values available only by few new MS.

Table 22.11 **5C1 Grassland remaining Grassland: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	20 945	10 643	11 090	88.8%	446	4%	-9 855	-47%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	0	0	0	0.0%	0.00	-	0.00	-		
Czech Republic	59	2	2	0.0%	0	-15%	-57	-97%	CS,T1	CS,D
Estonia	93	235	400	3.2%	165	70%	308	333%	T1,T2	OTH
Hungary	72	438	431	3.4%	-8	-2%	359	496%	T2	CS,D
Latvia	40	64	63	0.5%	-2	-3%	22	56%	T1,T2	CS,D
Lithuania	87	76	80	0.6%	4	5%	-7	-8%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	804	441	410	3.3%	-31	-7%	-394	-49%	D,T1,T2	CS,D
Romania	30	26	15	0.1%	-11	-42%	-15	-51%	D,T1	D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-	NA	NA
EU-27	**22 129**	**11 926**	**12 491**	**100.0%**	**565**	**5%**	**-9 638**	**-44%**		

Land conversion to grassland is mainly reported as removal thus compensating largely emissions from 5C1, for entire time series since 1990 (Table 22.122.2). For EU-12, only Slovenia and Romania report it as a net source of GHG.

Table 22.122.2 5C2 Land converted to Grassland: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	-14 920	-20 418	-20 739	82.1%	-321	2%	-5 819	39%		
Bulgaria	-787	-787	-787	3.1%	0.00	0%	0.00	0%	T1	CS
Cyprus	0	0	0	0.0%	0.00	-	0.00	-		
Czech Republic	-187	-373	-331	1.3%	43	-11%	-144	77%	T1,T2	CS,D
Estonia	14	-74	-118	0.5%	-43.68	59%	-132	-	T1,T2	D,OTH
Hungary	-29	-273	-233	0.9%	40	-15%	-204	704%	T1,T2	CS,D
Latvia	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Lithuania	-2 449	-3 385	-3 219	12.8%	166	-5%	-770	31%	T1	CS,D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	-49	-190	-189	0.7%	0	0%	-140	283%	T2	CS,D
Romania	-673	130	118	-0.5%	-12	-10%	791	-118%	T1	CS
Slovakia	-350	-344	-384	1.5%	-40	12%	-34	-	T2	CS
Slovenia	264	615	633	-2.5%	18.32	3%	369	140%	D,T1,T2,T3	CS,D
EU-27	**-19 165**	**-25 099**	**-25 249**	**100.0%**	**-150**	**1%**	**-6 084**	**32%**		

22.3 Wetlands, Settlements and Other land

Activity data is reported for all land uses as derived from national scale land matrices for each of EU-12 MS. Wetland area in 2011 is around 22736 kha as reported by EU-27 showing a slightly decrease as compared to 1990. Within EU-12, total wetland area (5D) is large in Poland (1369 kha), Estonia (some 512 kha) and Romania (841 kha). Area of conversions to wetland is some 5% of the total land use category of the EU-27.

EU-27 reports a total settlements area of 26517 Kha. Area of conversion to settlements is some 19% of the total land use category. Mainly, areas under this conversion come from other land, from cropland and from forest Land. Within EU-12, highest area of the total category is reported by Poland (2120 Kha) and by Romania (1126 Kha).

Area reported under Other Land is 24179 kha as reported by EU-27. Area under conversion to other lands is 10% of the total category. Within EU-12 the highest other land area is reported by Bulgaria (617 kha) and Slovakia (9154 kha)

Emissions of any GHG are mainly computed based on IPCC default factors, especially for conversions, with best estimated land subcategory being 5E2. Meanwhile for other land uses they are mainly reported as NE (planned to be estimated) or NO. In case of conversion from forest land, emissions from biomass are often estimated based on country specific values.

In the year 2011, in the EU-27 emissions are 8094 $GgCO_2$ eq. on 5D, 37968 $GgCO_2$eq. on 5E and a removals of 2328 $GgCO_2$eq on 5F.

22.4 Non-CO_2 GHG emissions from land use

Direct N_2O emissions from N fertilization of Forest Land and Other are mainly reported and justified as NO, as activities of fertilization on forest land do not occur in the new 12 EU MS.

Non-CO_2 emissions from drainage of soils and wetlands are reported as NO (i.e. Bulgaria) or not estimated in case of drainage of peatland (i.e. Estonia, Latvia and Lithuania). The largest area is reported by Latvia, while the other report partial area under drainage (often NE is also reported for the activity data). Nevertheless, they mainly report NE under missing method for estimation (especially for CH_4). All reporting MS use IPCC default emission factor for the emission estimation.

N_2O emissions from disturbance associated with land-use conversion to cropland are reported by Bulgaria as occurring on significant area (312 kha) under conversion of grassland to cropland. An inconsistency was highlighted by the EU QAQC regarding the areas reported under conversion from forest land or grassland to cropland were identified (i.e. Estonia). They all use IPCC default emission factor for the emission estimation.

CO_2 emissions from agricultural lime application are mainly reported as NO. Czech Republic, Estonia, Hungary, Latvia, Poland and Slovenia provide estimates. They all use IPCC default emission factor for the emission estimation.

All new MS report estimates from **biomass burning** on wild and controlled fire (despite often the areas are very small). Emissions from Biomass Burning are reported by Bulgaria as occurring on 7164ha, Poland on 5354 ha in 2011. Other new EU MS report based on dry matter of biomass burnt (then difficult to compare).

22.5 Recalculations

Changes in activity data occurred for several new EU MS, resulting in a smaller amount for entire LULUCF of about 15000 $GgCO_2$. Largest recalculation of entire time series of LULUCF was performed by Poland (which decreased substantially the sink previously estimated), as well as Lithuania.

Table 22.13 Quantitative recalculations in LULUCF by EU-15 MS (absolute difference between 2013 and 2012 submissions, for specified years), in Gg CO_2 eq.

MS	1990	1995	2000	2005	2010
Bulgaria	-156	-214	-50	144	522
Czech republic	0	0	0	0	30
Estonia	500	-1039	-3032	4053	-2184
Hungary	-72	226	-292	-722	-713
Latvia	-6295	-4696	-4754	-625	736
Lithuania	2005	410	-1657	-1959	1317
Poland	7143	7208	9944	14954	17858
Romania	-73	-73	-72	-65	-22
Slovakia	276	196	-431	-821	-827
Slovenia	-1854	-1739	-2707	-1369	-1161

Under cropland category Lithuania reported big recalculations based on new activity data. Estonia, Hungary and Slovenia reported the largest recalculations of the grassland category based on new activity data and parameters, as well.

Under forest land category the largest recalculation of the entire time series is reported by Poland which reports a much smaller sink by almost a third in year 2010 under current submission, while Estonia increased the sink for 2010.

Table 22.14 Quantitative recalculations in 5A by EU-15 MS (absolute difference between 2013 and 2012 submissions, for specified years), in Gg CO_2 eq.

MS	1990	1995	2000	2005	2010
Bulgaria	454	414	417	377	603
Czech republic	0	0	0	0	30
Estonia	77	-1.194	-3.179	3.691	-2.838
Hungary	-133	-57	-86	-9	-31
Latvia	-6.144	-4.340	-2.460	1.307	2.277
Lithuania	-612	-1.378	-1.072	-35	1.449
Poland	6.820	6.991	10.005	15.196	18.076
Romania	207	99	-479	-748	-751
Slovakia	207	99	-479	-748	-751
Slovenia	-1.417	-1.401	-2.454	-989	-903

23 WASTE (CRF SECTOR 6)

23.1 Overview of sector (EU-27)

CRF Sector 6 Waste is the fourth largest sector in the EU-27, contributing 2.9 % to total EU-27 GHG emissions. Total emissions from Waste have been decreasing by 35 % from 204 Tg in 1990 to 133 Tg in 2011 (Figure 23.1).

Figure 23.1 **Sector 6 Waste: EU-27 GHG emissions 1990–2011 from CRF in CO_2 equivalents (Tg)**

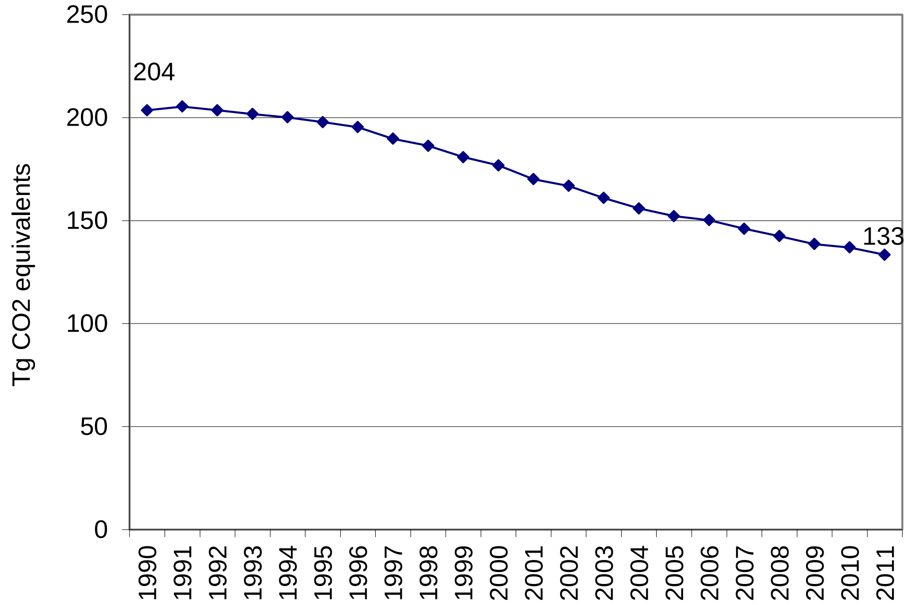
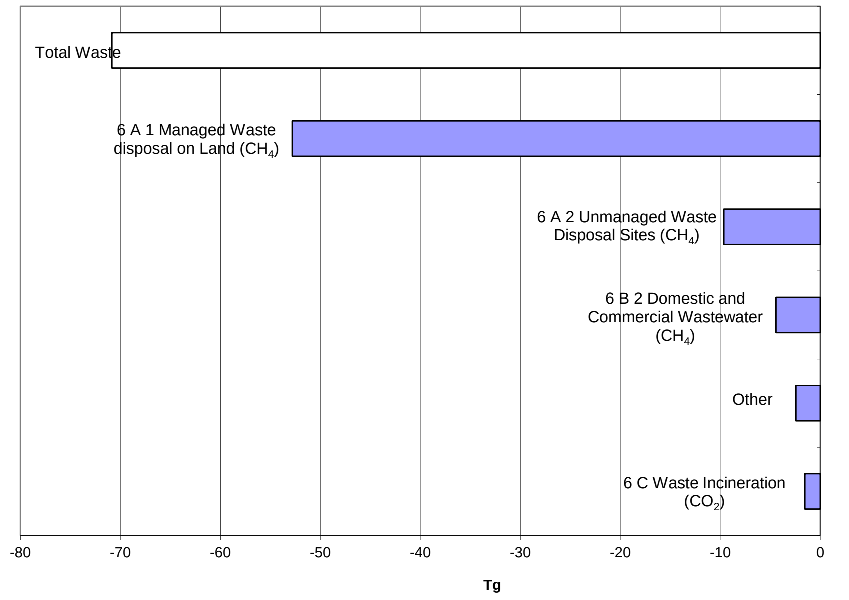
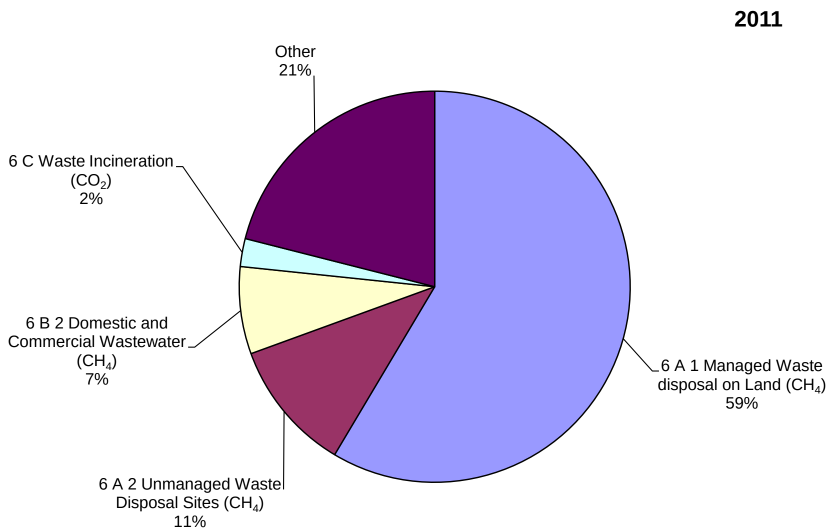


Figure 23.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 59 % of waste-related GHG emissions in the EU-27.

Figure 23.2 Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2011 in CO_2 equivalents (Tg) and share of largest key source categories in 2011





23.2 **Source categories (EU-27)**

23.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-27)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. The twenty largest EU key categories cover more than 75 % of total GHG emissions, one of which is the managed waste disposal on land (CRF 6A1). More information on this category in the EU-27 is provided in the following.

Table 22. provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by member state. CH_4 emissions from this source account for 1.8 % of total EU-27 GHG emissions. Between 1990 and 2011, CH_4 emissions from managed landfills declined by 41 % in the EU-27.

Between 1990 and 2011, eleven out of the 27 Member States reduced their emissions from this source, France, Greece, Italy, Portugal, Spain, Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Romania, Slovakia and Slovenia did not. In 2011, CH_4 emissions from landfills decreased by 4 % compared to 2010. A main driving force for CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by 38 % between 1990 and 2011. CH_4 emissions from landfills are also influenced by the amount of CH_4 recovered and utilized or flared. Compared to last year's inventory, the share of CH_4 recovery increased in all EU-12 Member States, except for the Bulgaria, Latvia and Slovenia. Figure 23.7 gives an overview of CH_4 recovery in EU-27 member states.

EU-12 member states contributing most to CH_4 emissions from this source were Hungary, the Czech Republic and Poland, accounting for 10 % of EU-27 emissions. Thus the new member states only have a minor contribution to total EU-27 GHG emissions in 2011. No EU-12 member state reduces its emissions between 1990 and 2011. Large emission increases are found for Poland and the Czech Republic. In both countries, a significant increase of waste deposited on managed landfills occurred during this period. In the case of Poland, this was also due to a corresponding decrease of landfilling on unmanaged waste disposal sites.

Hungary, responsible for 3.6 % of total EU-27 emissions from managed solid waste disposal on land steadily increased its emissions until 2006 and managed to reduce its emissions until now. This is due to the fact that, in recent years, the amount of waste deposited on managed landfills decrease, whereas CH_4 recovery increased.

Almost all new MS used higher tier methodologies for estimating CH_4 emissions; the table suggests that 99 % of CH_4 emissions from managed waste disposal on land are calculated with higher tier methodologies.

Table 23.1 **6A1 Managed Waste Disposal on Land: CH_4 emissions of EU-27**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	125 386	69 149	66 887	85.6%	-2 261	-3%	-58 499	-47%		
Bulgaria	NO	372	404	0.5%	32	9%	404	-	T2	CS,D
Cyprus	360	495	454	0.6%	-42	-8%	94	26%	D	D
Czech Republic	1 663	2 708	2 745	3.5%	36	1%	1 082	65%	T2	CS,D
Estonia	NO	271	254	0.3%	-17	-6%	254	-	T2	D
Hungary	2 264	2 936	2 791	3.6%	-145	-5%	527	23%	T2	D
Latvia	NO	99	117	0.2%	18	18%	117	-	T2	D
Lithuania	575	637	587	0.8%	-51	-8%	12	2%	T2	D
Malta	NA	69	77	0.1%	8	12%	77	-	M	M
Poland	1 014	2 307	2 210	2.8%	-97	-4%	1 196	118%	OTH	D
Romania	NO	652	239	0.3%	-412	-63%	239	-	T2	CS,D
Slovakia	IE	984	998	1.3%	14	1%	998	-	T2	CS
Slovenia	345	356	366	0.5%	10	3%	21	6%	T2	CS,D
EU-27	**131 606**	**81 035**	**78 128**	**100.0%**	**-2 907**	**-4%**	**-53 477**	**-41%**		

Note: OTH as method applied from Poland is considered a higher tier method as Poland states in its NIR that emissions from solid waste disposals were calculated using the IPCC Waste Model (Tier2) published in [IPCC 2006].
Abbreviations explained in the Chapter 'Units and abbreviations'.

Although it is good practice to calculate the emissions for key sources using the First Order Decay (FOD) method (Tier 2), one MS uses a lower tier methodology. For Cyprus, there are no sufficient historical data series available to estimate the amount of the collected waste. Table 23.2 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 23.2 **6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions in the new member states**

Managed Waste Disposal on Land new member states	
Member State	**Description of methods**
Bulgaria	Emissions from solid waste disposal on land have been calculated using the First Order Decay (FOD) method, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance. Activity data for the whole period (1950-2011) stems from NSI.
Cyprus	Methane emissions were calculated using the default method proposed by the IPCC 1996 Guidelines. IPCC default values have been applied. Data on quantities of solid waste generated, waste sent to managed or unmanaged landfills and per capita solid waste generation, is provided by the Statistical Service for the years 1990-2007 and by the Waste management sector of the Ministry of Interior for the years 2008-2011. For managed waste disposal on land, Methane Conversion Factor (MCF) was assumed as 1, while for unmanaged waste disposal on land MCF was assumed as 0.4 (default values from IPCC1996 Guidelines).
Czech Republic	The method used for the estimation of methane emissions from this source category is the Tier 2 FOD approach (first-order decay model). The first-order decay (FOD) model assumes gradual decomposition of waste disposed in landfills. GHG emissions were calculated using the spreadsheet for estimating methane emissions from solid waste disposal sites, which is part of the IPCC 2006 Guidelines.
Estonia	In order to estimate CH_4 emissions from solid waste disposal on landfills, the First Order Decay (the FOD) approach was employed, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance. Due to obtainable waste disposal activity data for the current inventory year and available waste disposal activity data for previous years, however country-specific key parameters are not available, the FOD method with default parameters and country-specific activity data were used.
Hungary	Emissions were calculated using a first order decay methodology, as response to the recommendations of the ERT in 2007. For the calculations, the IPCC Waste Model from the 2006 IPCC Guidelines was used. The FOD method produces a time-dependent emission profile which may better reflect the true pattern of the degradation process as it is claimed by the IPCC GPG. From 1990, yearly data in mass units published by the central

	statistical office was used. From 2006, data from the Waste Management Information System maintained by the Ministry of Environment and Water were analyzed and used for calculations.
Latvia	IPCC Good Practice Guidance (tier 2) method is used for CH_4 emissions calculation.
Lithuania	CH_4 emissions from solid waste disposal sites were estimated using FOD model provided in the 2006 IPCC Guidelines. Parameters required for calculation are provided in the GHG 2000, however certain reservations concerning their use are provided in the guidelines. Therefore, the parameters provided in the GHG2000 were compared to parameters provided in the 2006 IPCC guidelines.
Malta	The IPCC 2006 Tier 2 First Order Decay (FOD) spreadsheet model has been used to work out methane emissions from the solid waste category. This Tier 2 method uses IPCC default parameters as well as country-specific activity data. Prior to 1997 no weighing bridges were available at the Maltese landfills. Hence, the available solid waste statistics prior to 1997 may at best be considered as indicative. In the IPCC 2006 waste model, 1950 was chosen as the starting year for waste deposition into landfills.
Poland	The methane emissions from solid waste disposals were calculated using the IPCC Waste Model (Tier 2) published in the IPCC 2006 Guidelines. The model establishes multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH_4 is diminished by recapturing of this gas. IPCC default values have been applied, only methane recovery was taken from a national study.
Romania	CH_4 emissions from managed and unmanaged SWDS were calculated using the First Order Decay method, in accordance with the IPCC Good Practice Guidance. To estimate methane emissions from managed landfills historical data were not necessary, because the first managed landfill was opened in 1995. For unmanaged SWDS methane emissions were estimated based on data for 1950 to 2011, according to the IPCC Good Practice Guidance.
Slovak Republic	The estimation of methane emissions from SWDSs by the FOD method were calculated using a spreadsheet model. The methane emissions for MSW are included into category Managed waste disposal on land (6A1) from 2001, before this year the waste disposal sites were uncategorized and emissions were included in category Other municipal waste uncategorized (6A3). [NIR 2012]
Slovenia	The First Order Decay (FOD) method is used to calculate emissions.

Source: NIR 2013, NIR 2012

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following section an overview of the most important parameters and methodological aspects of the FOD method applied by member states is presented. The main factors influencing the quantity of CH_4 produced are the amount of waste disposed of on land and the concentration of biodegradable C in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the new member states are summarised in Table 23.3.

Table 23.3 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data in new MS

Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
Bulgaria	The main source of activity data is NSI. Data on the waste generation rate and on the quantity of MSW disposed to SWDSs etc. are available as well as other data (such as waste composition with differing data quality depending on the year). Following the IPCC Good Practice Guidance, the historical amount of waste disposal was estimated assuming it to be proportional to population for the period 1950-1998 (based on review recommendations). After 1999, the source of information is NSI, which applies new methodology for collecting waste data and thus increase the quality of collecting and analysing information on waste generated and disposed. From this year, the respondents to submit the required information are municipalities that are primarily responsible for waste management at municipal level.
Cyprus	Annual solid waste production data was obtained from the National Statistical Service and for the years 2008-2011 from the Waste Management unit of the Ministry of Interior. The National Statistical Service revised their estimates for per capita generation and composition of waste in 2012. Data for solid waste disposed land for

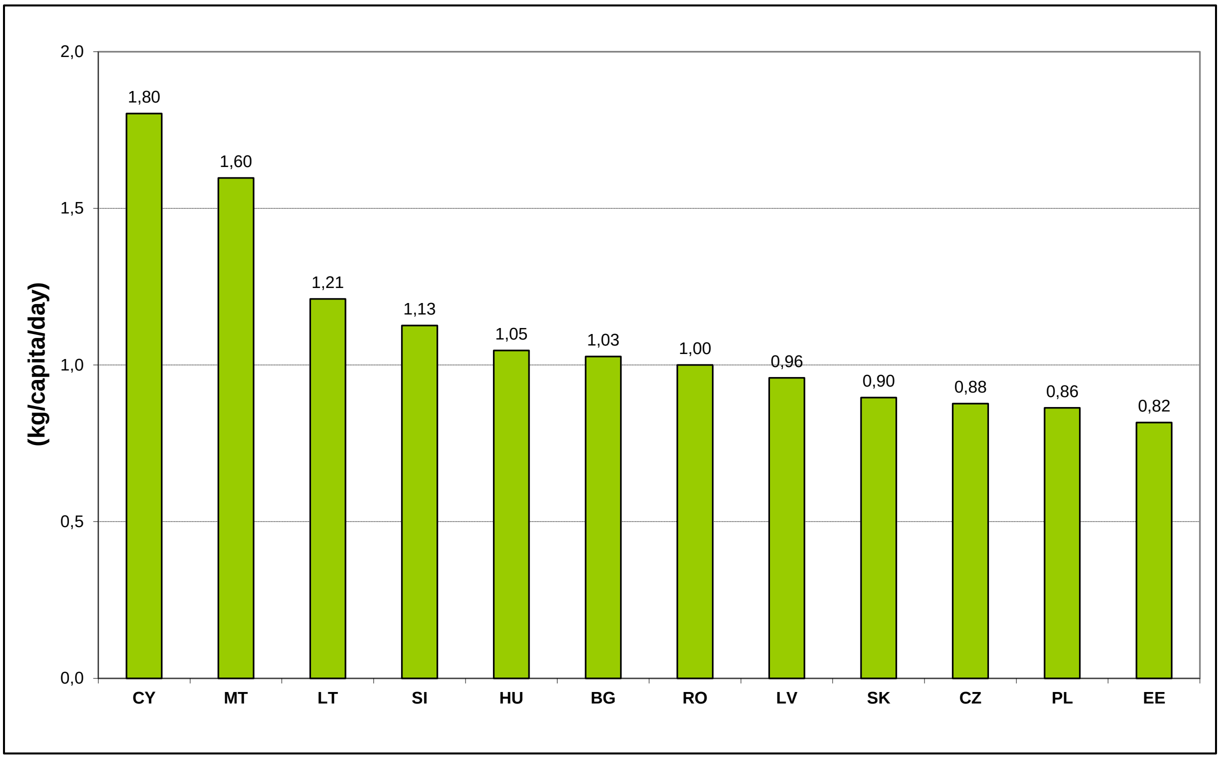
Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
	1996-2007 was available from the National Statistical Service. For 1990-1995, the trend of 1996-2007 was used to estimate the portion of the total solid waste production that is disposed of on land. For the years 2008-2011 data was available from the Waste Management unit of the Ministry of Interior. The composition of waste disposed on land was available for the period 1994-2010. For the years 1990-1993, it was assumed that the composition of the waste is the same as 1994 and for 2011 it was assumed the same as 2010. For 1990-2006, the estimation of the portion of solid waste disposed on land going to managed disposal sites, it was assumed that all waste from urban areas were going to managed disposal sites, whereas the waste produced by rural population was going to unmanaged disposal sites.
Czech Republic	Key activity data consists in the amount of waste disposed in landfills. Data for annual disposal are from mixed sources because correct application of the FOD model requires data from 1950 to the present day. These data are not available in the country and therefore assumptions about the past must have been used. These assumptions are described in a working paper, but the method can be simply described as interpolation and extrapolation between points in time; waste production was correlated with the social product (predecessor of current GDP) as a test method. The higher of the two estimates was used in the quantification. Data used for present dates are based on information system of waste management (ISOH) managed by CENIA – Czech Environmental Information Agency. The system contains bottom up data from about 60,000 respondents and reporting obligation to this system is based on national legislation.
Estonia	For calculating emissions from solid waste disposal sites, the total amount of municipal and industrial waste generated and deposited in 2011 (collected from Estonian Environment Information Centre (EEIC)) and amount of methane recovered (obtained from the EEIC Air bureau) are used as activity data. Since 1992 the EEIC has started to collect data in accordance with the Estonian waste classification, however in 1999 the adapted classification system was changed and the European Waste Catalogue was employed. The data for 1990–1991 were interpolated based on the data of 1992–1998. The forecast function of the Excel software was used to calculate the quantities of waste generated in the period 1990–1991.
Hungary	For activity data collection, the main data sources were the following: from 1975: Statistical Yearbooks; 1990-2002: Statistical Yearbooks, Environmental Statistical Yearbooks, Eurostat; 2003-2006: Data provision by the Ministry of Environment and Water, Statistical yearbooks, Eurostat; 2006 onwards: Waste Management Information System, Statistical Yearbooks, Eurostat. As the eldest data which can be found in statistical publications are for 1975, extrapolation had to be made.
Latvia	The amount of waste stems from different sources. Historical ata from national statistics are partly available, all other years are estimated according to these figures. Disposed amount are estimated according to GDP and population changes. Landfills from 1970 – 2001 are estimated as unmanaged. Disposed amount are divided between rural and urban areas, according population proportion between these areas. Data about waste disposal on land for 2002 - 2011 are taken from database “3-Wastes”. Starting from year 2002, according to data base information, biggest sites could be estimated as managed sites (polygons) and MCF-1 is starting to use. For each year (2002- 2011) in polygons disposed amount are determined according to disposing site profile from “3-Wastes” data base.
Lithuania	Data on waste generation and disposal were collected in Lithuania only from 1991, data on disposal before 1991 are not available. The data is provided by the Lithuanian Environmental Protection Agency (EPA), which is responsible for environmental statistics in Lithuania. The amount of waste disposed of in landfills in 1950-1989 was evaluated on the basis of the several considerations.
Malta	Prior to 1997 no weighing bridges were available at the Maltese landfills. Hence, the available solid waste statistics prior to 1997 may at best be considered as indicative. For the years prior to 1997, activity data was extrapolated using GDP and population, and waste/capita, waste/GDP data available. The data was back extrapolated to 1950.
Poland	Generated municipal solid waste – for the years 1970 – 2004 data was extrapolated according to the amount of collected municipal solid waste. For 2011, statistical data is available of the shares of waste treatment as follows: 1% incineration, 4% biological treatment, 79% landfills, 16% recycling). Distribution of solid waste disposal sites for managed and unmanaged landfills until 2001 was made following a national study. According to this publication, 14% of disposal sites are managed, 86% are unmanaged.
Romania	For 2003-2010, the data on the amounts of MSW disposed to managed and unmanaged SWDS were provided by Waste Directorate from National Environmental Protection Agency, as a result of surveys conducted each year by NEPA and National Institute for Statistics (NIS). For 2011, the statistical survey on waste has not yet been finalised; therefore data estimated based on the waste generation rate was used. The historical data on MSW storage were estimated in the context of a study in 2011.

Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
Slovak Republic	The Statistical office of the Slovak Republic publishes data on MSW generation and disposal since 1993. Although this creates a timeline of 15 years, this is not sufficient for the use of FOD method. A longer timeline of data is needed, thus it was decided to generate a MSW data from 1960, i.e. for 48 years. Latest indication on MSW generation in the Slovak Republic was found for 1960 and 1970. Since 1992, data from annual monitoring are available. Annual MSW generation was interpolated. [NIR 2012]
Slovenia	There are no data on the amount of waste prior to 1995. The first regulated municipal solid waste disposal site started its operation in 1964. An estimate for the period 1964-1994 was made based on the assumption that in 1964, 50% of the population was included in a municipal waste collection system and that this share increased to 60% in 1977 and 76% in 1995. The amount of waste in the period 1995-2000 is provided by the SURS. The total annual amount of municipal waste and the fraction of landfilled municipal waste between 2001 and 2011 stems from the Environmental Agency of the Republic of Slovenia, which on a regular basis collects data on the formation and handling of all types of waste in Slovenia.

Source: NIR 2013, NIR 2012

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability; neither the UNFCCC reporting guidelines, nor the CRF, nor the IPCC Guidelines provide an exact definition which waste types and waste streams should be included in the estimation of the waste generation rate. Therefore Figure 23.3 provides an overview for EU-12 based on data derived from EUROSTAT. To conform to the Regulation on waste statistics (EC) No. 2150/2002, amended by Commission Regulation (EU) No. 849/2010, data on the generation and treatment of waste is collected from the member states and prepared in a homogenous way.

Figure 23.3 6A1 Managed Waste Disposal: Waste Generation Rate for EU-12

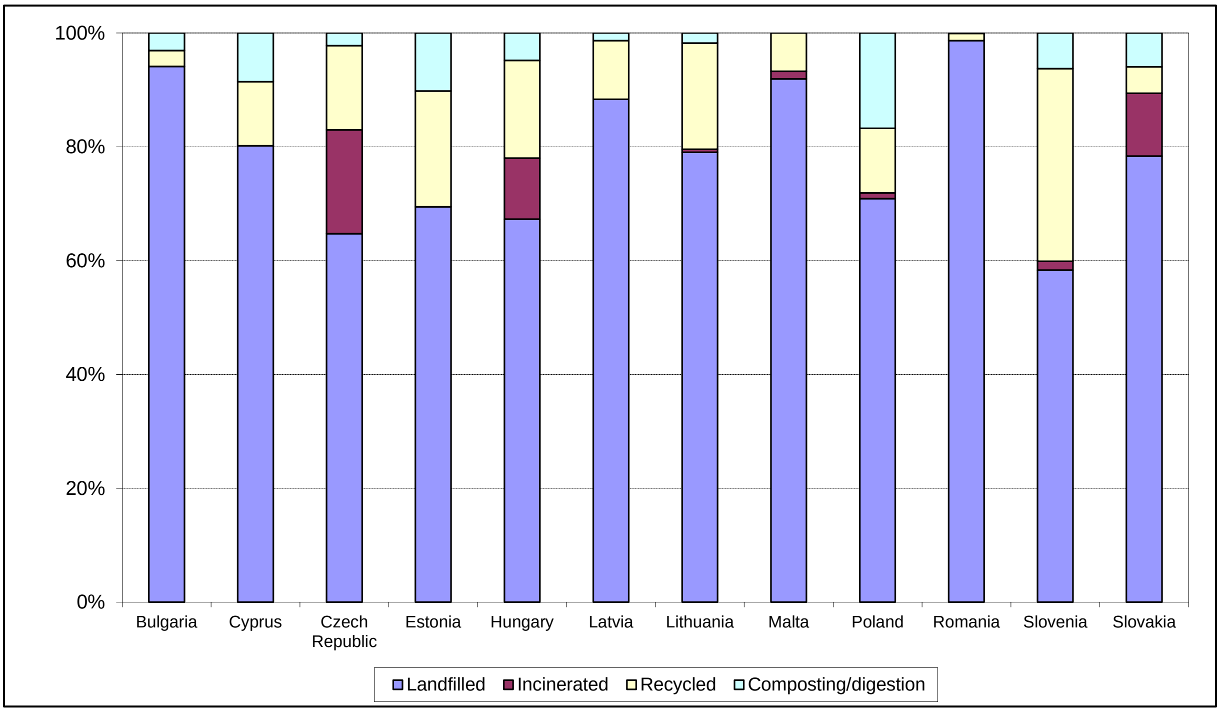


Source: EUROSTAT 2013

The waste generation rate per capita varies significantly among the new member states (0.82 kg/capita/day for Estonia to 1.80 kg/capita/day for Cyprus).

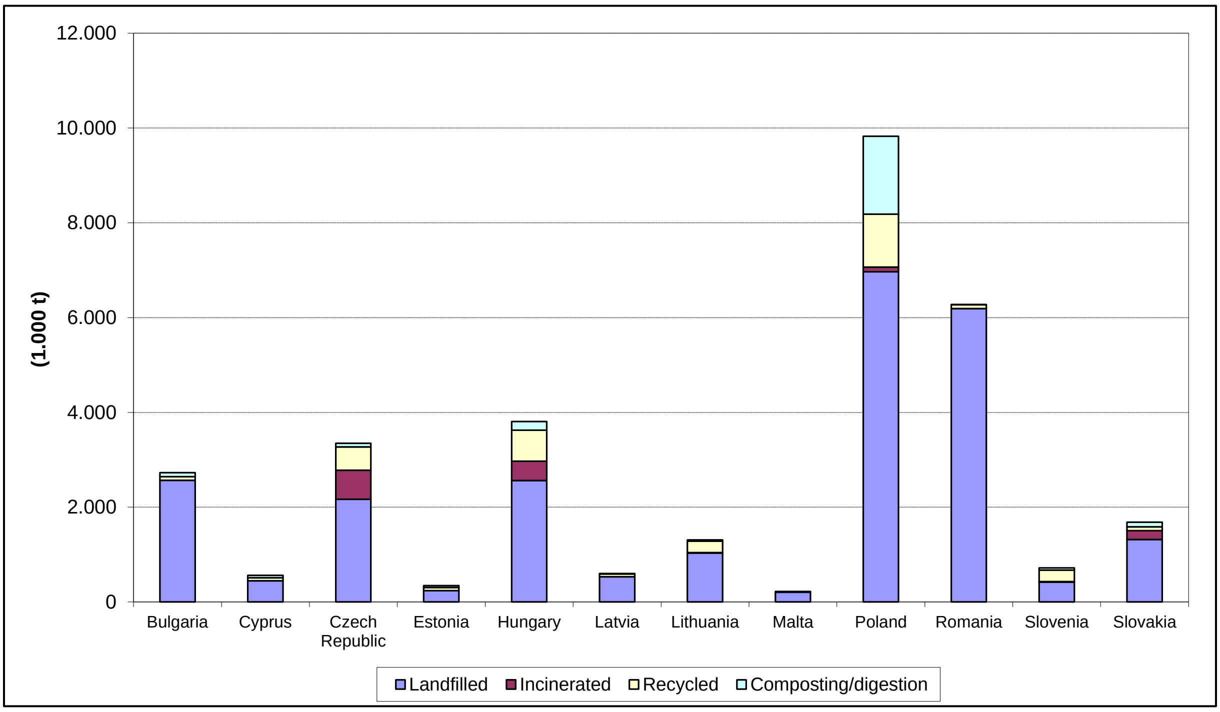
The amount of waste generated on SWDS is strongly influenced by the waste management practices or the share of waste incinerated, recycled and composted (Figure 23.4). Compared to the management practices in EU-15, recycling is still of minor importance in the new MS, only 10 % of municipal waste was recycled in EU-12 MS, compared to 27 % for the EU-15. The recycling rate of waste is highest in Slovenia (34 % of treated waste) and thus higher than the average rate for EU-27 (25 %). Figure 23.5 shows absolute values for waste management practices.

Figure 23.4 6A1 Managed Waste Disposal: Waste management practices for the new EU-12 MS (shares) in 2011



Source: EUROSTAT 2013

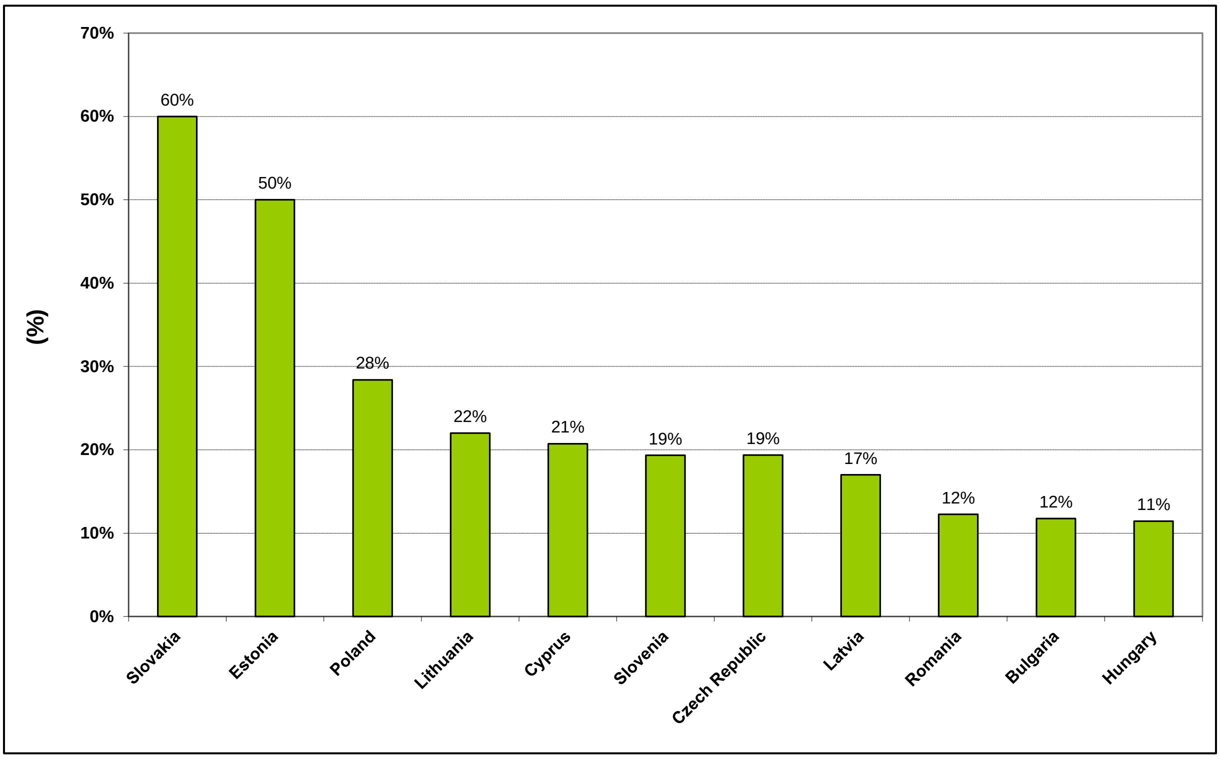
Figure 23.5 **6A1 Managed Waste Disposal: Waste management practices for the new EU-12 MS (absolute values) in 2011**



Source: EUROSTAT 2013

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. The DOC is likely to vary due to the strong influence of waste management practices and policies, whereas the first three parameters do not vary strongly among the member states. The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream; different countries are known to have MSW with widely differing waste compositions. Figure 23.6 illustrates the average DOC value in MSW for EU-12.

Figure 23.6 **6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW for EU-12**

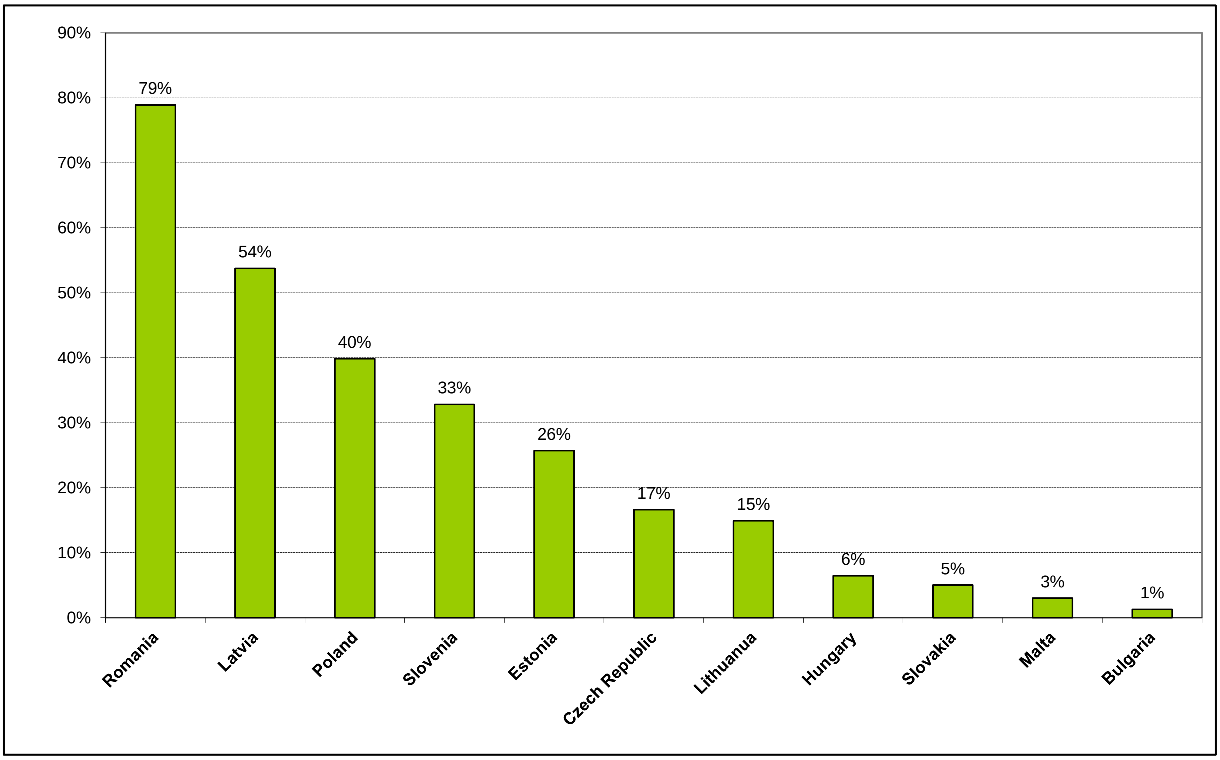


Source: CRF 2013 Table 6A,C Additional information.

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills. The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered varies among the member states, tending to be low in the new member states, except for Romania, Latvia and Poland. Compared to last year's inventory, two new member states significantly increased its recovery (Romania: +44.8 %, Poland: +23.8 %[51]). Romania collects data on methane recovery from operators. In 2011, nine managed sites recovered methane for flaring. In Latvia, according to Latvia's Waste Management plan 2006-2012, CH_4 recovery from landfills is one of the priorities in waste management. In 2010, in three waste facilities CH_4 recovery was available.

[51] Values refer to percentage points.

Figure 23.7 6A1 Managed Solid Waste Disposal: Methane recovery for EU-12



*CH_4 recovery in % = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100*
Source: CRF 2013 Table 6A,C

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.34 % of total EU-27 GHG emissions in 2011. Between 1990 and 2011, CH_4 emissions from this source in the EU-12 decreased in most new member states, except for Cyprus, Malta and Romania. In the case of Romania, despite a significant increase of waste disposal on managed landfills since 1990, waste disposal on unmanaged landfills received larger amounts of waste than managed landfills until 2009. Due to the kinetics of anaerobic decay, increasing CH_4 emissions from unmanaged landfills can therefore be explained.

Thus the overall reduction of CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land for the EU-27 was lower than for EU-15 (-59 %), amounting to -40 % between 1990 and 2011 (Table 23.4). Emission reductions both in absolute and relative terms were highest in Poland and Bulgaria. In Bulgaria, this was due to the decrease in population and a corresponding decrease in waste generation and the increasing quantity of waste deposited on managed sites. In Poland, waste generation was also reduced significantly since 1990 and managed landfills receive larger shares of waste than unmanaged landfills since 2004.

The share in EU-27 emissions 2011 was highest for Poland (24 %) and Bulgaria (17 %). Romania had the largest increase in absolute terms between 1990 and 2011. Table 23.4 suggests that 99 % of CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land are calculated with higher tier methodologies.

Table 23.4 6A2 Unmanaged Waste Disposal on Land: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13 948	5 975	5 651	38.9%	-324	-5%	-8 297	-59%		
Bulgaria	3 326	2 569	2 496	17.2%	-73	-3%	-830	-25%		
Cyprus	73	95	88	0.6%	-8	-8%	15	20%	D	D
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NA,NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	330	336	322	2.2%	-15	-4%	-8	-3%	T2	CS,D
Lithuania	252	216	194	1.3%	-21	-10%	-58	-23%	T2	D
Malta	14	34	32	0.2%	-2	-5%	19	133%	M	M
Poland	4 983	3 769	3 510	24.2%	-259	-7%	-1 472	-30%	OTH	D
Romania	1 292	2 274	2 236	15.4%	-38	-2%	944	73%	T2	CS,D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**24 218**	**15 268**	**14 529**	**100.0%**	**-739**	**-5%**	**-9 688**	**-40%**		

Note: OTH as method applied from Poland is considered a higher tier method as Poland states in its NIR that emissions from solid waste disposals were calculated using the IPCC Waste Model (Tier2) published in [IPCC 2006].

Abbreviations explained in the Chapter 'Units and abbreviations'.

23.2.2 Wastewater handling (CRF Source Category 6B) (EU-27)

CH_4 emissions from 6B2 Domestic and Commercial Wastewater account for 0.21 % of total EU-27 GHG emissions. Between 1990 and 2011, EU-27 emissions decreased by 32 %. Large decreases in absolute terms are reported from Hungary, Romania and Poland, only Slovenia reported an increase of emissions (by 10%) (Table 23.3). Emissions reductions in Romania are due to a significant reduction of the organic load in domestic and commercial wastewater since 1990.

Romania, Poland and Bulgaria are responsible for 37 % of the EU-27 emissions from this source in 2011. Between 2010 and 2011, CH_4 from 6B2 Domestic and Commercial Wastewater remained almost constant for the EU-27.

Table 23.5 also shows that only three member states used higher tier methodologies to calculate CH_4 emissions from 6B2 Domestic and Commercial Wastewater which corresponds to 5.6 % of total EU-12 emissions (Czech Republic and Latvia: tier 2, Hungary: country-specific).

Table 23.5 **6B2 Domestic and commercial wastewater: CH_4 emissions of EU-27**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	8 337	4 965	4 974	51.7%	9	0%	-3 363	-40%		
Bulgaria	515	501	503	5.2%	2	0%	-12	-2%	D	D
Cyprus	7	3	3	0.0%	0	3%	-4	-56%	D	D
Czech Republic	214	194	196	2.0%	1	1%	-18	-9%	T1,T2	CS,D
Estonia	8	1	1	0.0%	0	0%	-7	-91%	T1	D
Hungary	757	325	302	3.1%	-23	-7%	-455	-60%	CS	D
Latvia	98	73	49	0.5%	-24	-32%	-49	-50%	T2	D
Lithuania	174	103	102	1.1%	-1	-1%	-72	-41%	T1	D
Malta	12	11	3	0.0%	-8	-74%	-9	-75%	D	CS
Poland	1 134	905	918	9.5%	14	2%	-216	-19%	D	CS,D
Romania	2 370	2 013	2 110	21.9%	97	5%	-259	-11%	D	CS
Slovakia	388	353	344	3.6%	-10	-3%	-44	-11%	T1	CS
Slovenia	107	115	118	1.2%	2	2%	11	10%	T1	CS,D
EU-27	**14 119**	**9 562**	**9 622**	**100.0%**	**60**	**1%**	**-4 498**	**-32%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 6B2 Domestic and Commercial wastewater account for 0.27 % of total EU-27 GHG emissions. Between 1990 and 2011, EU-27 emissions remained almost constant (Table 23.6). Six out of twelve new member states increased their emissions in that period (Cyprus, the Czech Republic, Malta, Poland, Romania and Slovenia), but these member states are responsible for only 17 % of EU-27 N_2O from 6B2 Domestic and Commercial wastewater in 2011.

Romania's emissions increased since 1990 (with few exceptions) due to a significant increase in daily protein intake. The new member states contributed to keeping total emissions in EU-27 stable. Largest reductions in absolute terms could be found for Bulgaria, Slovakia and Hungary. Poland's share in EU-27 emissions in 2011 is highest among EU-12. The member states neither increased nor decreased its emissions significantly during the time series. No new member states calculated N_2O emissions from domestic and commercial wastewater by applying higher tier methodologies.

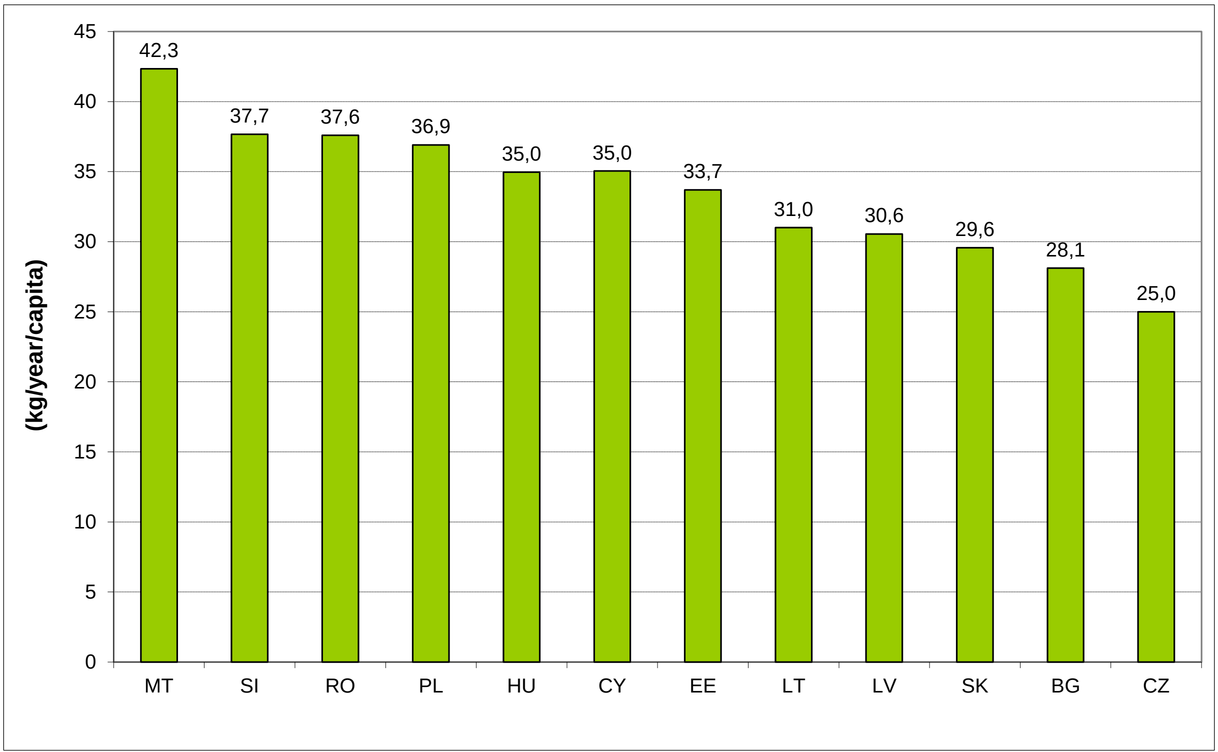
Table 23.6 6B2 Domestic and Commercial Wastewater: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011		Method applied	Emission factor
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	9 537	9 520	9 500	77.9%	-20	0%	-37	0%		
Bulgaria	224	164	161	1.3%	-4	-2%	-64	-28%	D	D
Cyprus	17	23	24	0.2%	1	3%	7	40%	D	D
Czech Republic	162	205	205	1.7%	0	0%	43	27%	D	CS,D
Estonia	46	35	34	0.3%	-0.30	-1%	-11	-25%	T1	D
Hungary	309	273	272	2.2%	-1	0%	-37	-12%	D	D
Latvia	64	53	49	0.4%	-3.91	-7%	-14	-22%	D	D
Lithuania	80	74	73	0.6%	-0.89	-1%	-7	-8%	T1	D
Malta	12	14	14	0.1%	-0.05	0%	2	17%	D	D
Poland	1 099	1 108	1 108	9.1%	0.24	0%	9	1%	D	D
Romania	601	629	627	5.1%	-1	0%	27	4%	D	D
Slovakia	119	78	71	0.6%	-7	-9%	-48	-40%	T1	D
Slovenia	60	60	60	0.5%	0.16	0%	1	1%	T1	D
EU-27	**12 329**	**12 237**	**12 199**	**100.0%**	**-38**	**0%**	**-130**	**-1%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Emissions are mainly driven by the annual per capita protein consumption, being one relevant component for the calculation of nitrous oxide emissions from household wastewater according to the IPCC method. An overview of daily protein intake by member state is given in Figure 23.8.

Figure 23.8 6B Waste Water Handling: Protein consumption



Source: CRF 2013, Table 6 B

23.2.3 Waste incineration (CRF Source Category 6C) (EU-27)

This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture. Table 23.7 summarizes greenhouse gas emission trends by Member State. CO_2 emissions from waste incineration account for 0.07 % of total EU-27 GHG emissions.

Between 1990 and 2011, CO_2 emissions from waste incineration decreased by 33 % in the EU-27. The Czech Republic, Hungary, Lithuania, Malta, Romania and Slovenia increased their CO_2 emissions from waste incineration between 1990 and 2011. The largest increase in absolute terms could be found for the Czech Republic contributing the second most to EU-12 emissions (6.1 % of EU-27 emissions in 2011). This increase could be explained by the increased amount of municipal solid waste being incinerated (+709 % between 1990 and 2011). Consequently there is a significant share of waste going to waste incineration (18% in 2011, compare Figure 23.4).

Between 1990 and 2011, Poland and Slovakia had the largest decreases in absolute terms. Poland, has the largest share in EU-12 emissions, see Table 23.7. In Slovakia, the reduction in emissions was caused by the decrease of the number of incineration plants due to the expiration of transition period for selected incinerators in 2006, as defined in the EU accession agreement.

Table 23.7 6C Waste incineration: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2011	Change 2010-2011		Change 1990-2011	
	1990	2010	2011		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4 071	2 779	2 532	82.2%	-247	-9%	-1 539	-38%
Bulgaria	20	14	10	0.3%	-5	-32%	-11	-53%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	23	180	187	6.1%	8	4%	164	709%
Estonia	0	NO	NO	-	-	-	0	-100%
Hungary	NA	84	93	3.0%	9	10%	93	-
Latvia	NO	0	0	0.0%	0	-4%	0	-
Lithuania	4	2	7	0.2%	5	262%	3	62%
Malta	0.37	0.52	0.69	0.0%	0	32%	0	85%
Poland	447	222	226	7.3%	4	2%	-221	-49%
Romania	NE,NO	11	11	0.3%	0	-3%	11	-
Slovakia	63	37	10	0.3%	-28	-74%	-53	-85%
Slovenia	1	5	5	0.2%	0	0%	4	293%
EU-27	**4 630**	**3 335**	**3 081**	**100.0%**	**-254**	**-8%**	**-1 549**	**-33%**

Abbreviations explained in the Chapter 'Units and abbreviations'

24 OTHER (CRF SECTOR 7)

The 2011 GHG inventory does not include any GHG emissions in CRF sector 7.

25 RECALCULATIONS AND IMPROVEMENTS

25.1 Explanations and justifications for recalculations

Table 25.1 to Table 25.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2010 for each Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 Gg). For more details see the information provided by the Member States' submissions in Annex 2.12.

Table 25.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	France	-506	-0,8	Les émissions de CO_2, sur 1990-2004, ont été recalculées à partir des FE moyens, par combustible, déterminés sur la période 2005-2011.
1A1_Energy Industries CO_2	UK	-1.030	-0,4	Updated emission factor for combustion at gas separation plant under 1A1c.
1A2_Manufacturing Industries and Construction CO_2	France	2.489	3,0	La prise en compte des données individuelles pour le calcul des émissions de CO_2, CH_4 et N_2O dans différents secteurs de la combustion pour les procédés énergétiques avec contact, afin d'obtenir des facteurs d'émission rapportés à la consommation de combustibles et non plus à la production. Ce travail nécessite d'être affiné l'année prochaine.
1A2_Manufacturing Industries and Construction CO_2	UK	2.212	2,2	Liquid fuels: Addition of estimates of emissions from combustion of byproducts at ethylene crackers following UNFCCC review.
1A2_Manufacturing Industries and Construction CO_2	Portugal	588	6,4	Emission factor update for glass production, due to an in-depth revision of estimation procedures for this sector. Fuel consumption update for glass production, due to an in-depth revision of estimation procedures for this sector. Update for the Natural Gas consumption in a Pulp/Paper installation. Revision of fuel consumption in iron and steel production.
1A3_Transport CO_2	Spain	759	1,4	A transcription error in the applied figure on total aviation fuel sales has been corrected for 2010, affecting consumption estimates of all fuel types (aviation gasoline and jet kerosene) and all traffic segments (domestic and international aviation). The recalculations for road transportation/gasoline, LPG, natural gas is due to the introduction of the CO_2 emissions from lubricant oil consumption. The recalculation for road transportation/diesel oil is due to the introduction of the CO_2 emissions from lubricant oil consumption and the change of the activity data. The information reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. The information for navigation/residual oil reported by a railway operator system regarding fuel consumed for traction (and auxiliaries) by the railways undertakings that operate on the managed network, has been modified on the basis of updated data provided by this operator and by the main national railways company. Revision of fuel consumption with the updated information provided by compressor stations of natural gas

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
4A_Enteric fermentation CH_4	Germany	2.890	10,8	New national method in 4.A Enteric Fermentation \ Cattle \ Option A \ Dairy Cattle Re-allocation within the cattle category in 4.A Enteric Fermentation \ Cattle \ Option A \ Non-Dairy Cattle Updated "piglets per sow" ratio in 4.A Enteric Fermentation \ Swine.
4B_Manure management CH_4	Spain	1.242	31,6	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4B_Manure management CH_4	France	-3.979	-32,4	Les séries statistiques de 1990 à 2011 portant sur les effectifs animaux ont été modifiées suite au Recensement Agricole de 2010. Ces modifications ont eu un impact sur les données d'activités et sur les facteurs d'émissions pour les catégories animales agrégées. Les VS des bovins ont été mis à jour suite à la livraison des premiers résultats de l'étude MONDFERENT. Cette mise à jour méthodologique permet d'améliorer la transparence de la méthode et s'accompagne d'une mise en cohérence des calculs d'émissions de méthane entérique et de méthane liées à la gestion des déjections. Les valeurs utilisées pour le paramètre FCM ont été modifiées, passant d'un climat « tempéré » à un climat « froid » pour la métropole, suite à la revue ESD de l'année 2012.
4B_Manure management N_2O	Germany	1.348	52,5	New emission factor in 4.B Manure Management \ Solid storage and dry lot. Digesters are now part of liquid systems in 4.B Manure Management \ Liquid system
4B_Manure management N_2O	Spain	-916	-40,5	New national methodology for Cattle introduced that also includes new information regarding manure management systems.
4D_Agricultural soils N_2O	UK	606	1,8	Activity Data: Fraction of livestock N excretion in excrements burned for fuel was expressed as a fraction of poultry N as opposed to all livestock groups, now corrected
6B_Waste water handling CH_4	UK	1.398	502,4	Consultation with water companies has lead to updated data.
6B_Waste water handling CH_4	Spain	-681	-54,8	New information available about domestic and commercial wastewater

Table 25.2 Main recalculations by source category for 2010 and Member States' explanations for recalculations given in the CRF or in the NIR

		2010		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	Czech Republic	2.642	4,7	Reallocation of AD between 1A1c and 1A2.
1A2_Manufacturing Industries and Construction CO_2	Czech Republic	-4.346	-18,4	Error correction for activity data for liquid fuels. Reallocation of AD between 1A1c and 1A2.
1A2_Manufacturing Industries and Construction CO_2	Romania	-5.354	-29,0	Coaking Coal - Correction of the CO_2 EF (Country Specific EF becames default);Coke_Oven_Coke - Correction of the CO_2 EF (Default EF becames Country Specific). Coking Coal activity data correction provided through the Energy Balance.
1A3_Transport CO_2	Poland	-599	-1,2	Correction of AD.
1A4_Other sectors CO_2	Poland	1.106	1,9	For the years 1990-2010 AD of Other petroleum products and related GHG emissions were corrected to double counting avoid, that arose due to change in aggregation way of fuel consumption data in current energy balances (mentioned adjustments were made for the years, where this fuel was appeared); For the years 1990-2010 diesel oil consumed by road tractors used in agriculture (classified into 1.A.3 in Polish GHG inventory) was corrected; previously this consumption was covered by fuel attributed to agriculture sector; presently it was determined, that diesel oil use for mentioned purpose is included in fuel consumption in road transport what caused the increase activity and emission values in 1.A.4.c.ii subsector (oil consumed by road tractors used in agriculture is no longer subtracted from fuels use in agriculture sector – 1.A.4).
1B2_Oil and natural gas CO_2	Poland	992	524,6	Reallocation of emission from refineries and flaring from 2.G.
2C_Metal production CO_2	Poland	-1.623	-22,7	Reallocation of coke production into 1.B.1.
2F_Consumption of halocarbons HFC	Poland	-1.068	-15,8	EmissioEmission of HFC152a from consumption of halocarbons and SF_6 (2.F) in 2010 was corrected due to editorial error identified during 2012 review.
4D_Agricultural soils N_2O	Romania	987	12,5	No explanation available.
6A_Solid waste disposal on land CH_4	Poland	1.535	25,1	Correction of error in estimation of emisison from unmanaged SWDS.
6A_Solid waste disposal on land CH_4	Bulgaria	-861	-22,7	Recalculations of CH_4 emissions from solid waste disposal are made due to TERT recommendations (according to ESD) during the in country review in July 2012. During the technical review, Bulgaria provided the revised estimates, based on change of activity data, concerning waste generation rate for period (1950-1998). GPG gives the opportunity to estimate the historical waste disposal assuming it to be proportional to population. Calculations have been made for the whole period, using TIER 2 (FOD model). Corrections in Solid waste disposal on land have been accepted on 4 July 2012 by TERT.
6B_Waste water handling CH_4	Cyprus	-750	-96,7	Data for wine production was revised for 1990-2011 The per average annual per capita protein consumption was not multiplied by 365 in NIR2012 to be converted from kg/person/day to kg/person/yr – this was corrected in the current submission.

25.2 **Implications for emission levels**

In the EU-27, 1990 GHG emissions excluding LULUCF have decreased by 8 703 Gg (-0.16 %). For 2010, they decreased by -15 605 Gg (-0.3 %) (Table 25.3).

Table 25.3 Overview of recalculations of EU-27 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total CO_2 equivalent emissions including LULUCF (absolute)	22 439	5 093	5 825	1 192	3 915	9 713	7 263	7 328	7 106	18 809	-3 079	11 847	8 094
Total CO_2 equivalent emissions including LULUCF (percent)	0.4%	0.1%	0.1%	0.0%	0.1%	0.2%	0.1%	0.2%	0.1%	0.4%	-0.1%	0.3%	0.2%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-8 703	-17 970	-11 672	-15 807	-15 857	-14 382	-16 292	-19 556	-15 427	-19 942	-21 975	-16 437	-15 605
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0.16%	-0.3%	-0.2%	-0.3%	-0.3%	-0.3%	-0.3%	-0.4%	-0.3%	-0.4%	-0.4%	-0.4%	-0.3%

Table 25.4 and Table 25.5 give an overview of absolute and percentage changes of new Member States' emissions due to recalculations for 1990 and 2010. Large recalculations in absolute terms were made in Bulgaria, Cyprus, Czech Republic, Poland and Romania. Recalculations in relative terms of more than 2 % were made in Bulgaria, Cyprus, Estonia, Lithuania, Malta and Romania.

Table 25.4 Contribution of Member States to EU-27 recalculations of total GHG emissions without LULUCF for 1990–2010 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	5 159	-2 986	-1695	-7 561	-3 600	-8 416	-9 743	-8 997	-7 388
Bulgaria	-4 757	-5 696	-3 391	-2 612	-2 837	-2 420	-1661	-1090	-1075
Cyprus	-377	-2 533	-1534	-1770	-1936	-1610	-1340	-1299	-1322
Czech Republic	217	335	111	-1067	-1410	-1223	-1516	-1236	-1735
Estonia	-315	-155	-78	-87	-71	-82	-87	-129	-528
Hungary	1671	1476	1170	-33	292	391	297	516	266
Latvia	-232	-28	-176	-149	-71	-90	-162	-80	-42
Lithuania	-679	134	284	425	434	714	588	464	311
Malta	-22	-43	-61	-35	-27	-21	-33	-37	-37
Poland	-423	-66	636	1314	1277	730	-1125	-1183	805
Romania	-8 930	-8 464	-6 994	-7 329	-6 912	-7 542	-6 204	-3 088	-4 733
Slovakia	7	-8	-40	-616	-537	-351	-964	-235	-85
Slovenia	-23	64	97	-35	-29	-22	-24	-43	-40
EU-27	**-8 703**	**-17 970**	**-11 672**	**-19 556**	**-15 427**	**-19 942**	**-21 975**	**-16 437**	**-15 605**

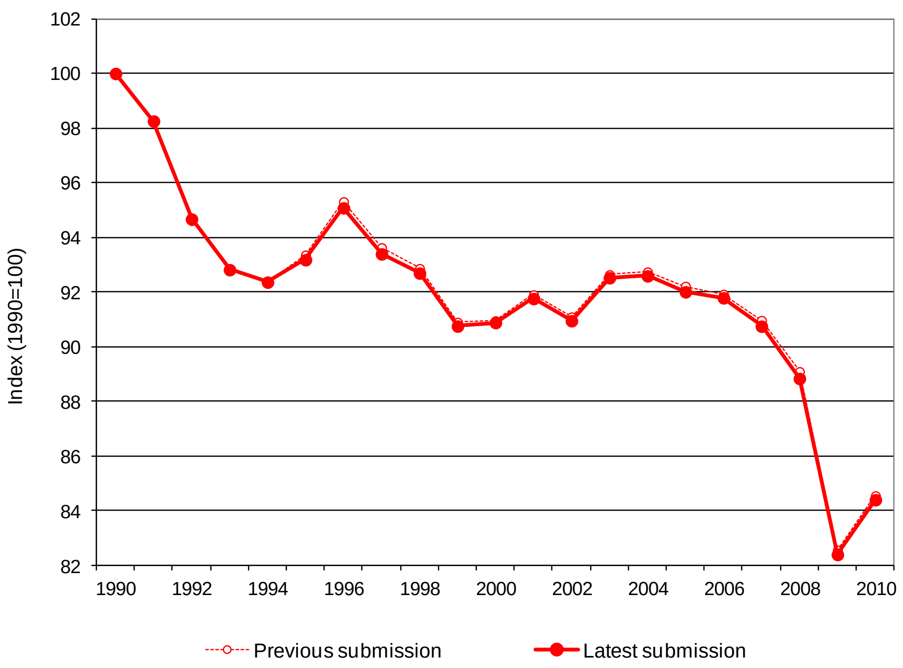
Table 25.5 **Contribution of Member States to EU-27 recalculations of total GHG emissions without LULUCF for 1990–2009 (difference between latest submission and previous submission in percentage)**

	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	0,1	-0,1	0,0	-0,2	-0,1	-0,2	-0,2	-0,2	-0,2
Bulgaria	-4,2	-7,0	-5,4	-3,9	-4,2	-3,4	-2,4	-1,9	-1,7
Cyprus	-5,8	-25,3	-15,2	-16,0	-16,8	-14,1	-11,7	-11,7	-12,3
Czech Republic	0,1	0,2	0,1	-0,7	-0,9	-0,8	-1,1	-0,9	-1,2
Estonia	-0,8	-0,8	-0,5	-0,5	-0,4	-0,4	-0,4	-0,8	-2,6
Hungary	1,7	1,9	1,5	0,0	0,4	0,5	0,4	0,8	0,4
Latvia	-0,9	-0,2	-1,7	-1,3	-0,6	-0,7	-1,4	-0,7	-0,4
Lithuania	-1,4	0,6	1,5	1,9	1,9	2,8	2,4	2,3	1,5
Malta	-1,1	-1,8	-2,4	-1,2	-0,9	-0,7	-1,1	-1,2	-1,2
Poland	-0,1	0,0	0,2	0,3	0,3	0,2	-0,3	-0,3	0,2
Romania	-3,5	-4,7	-5,0	-4,9	-4,5	-5,0	-4,2	-2,5	-3,9
Slovakia	0,0	0,0	-0,1	-1,2	-1,1	-0,7	-1,9	-0,5	-0,2
Slovenia	-0,1	0,3	0,5	-0,2	-0,1	-0,1	-0,1	-0,2	-0,2
EU-27	**-0,2**	**-0,3**	**-0,2**	**-0,4**	**-0,3**	**-0,4**	**-0,4**	**-0,4**	**-0,3**

25.3 Implications for emission trends, including time series consistency

As the recalculations were made for across all years in a similar order of magnitude, the trend was not affected by the recalculations. In the EU-27, the trend of GHG excluding LULUCF between 1990 and 2010 was – 15.4 % in the previous submission and -15.6 % in the latest submission (Figure 25.1).

Figure 25.1 **Comparison of EU-27 GHG emission trends 1990–2010 (excl. LULUCF) of the latest and the previous submission**



25.4 **Recalculations, including in response to the review process, and planned improvements to the inventory**

25.4.1 EU response to UNFCCC review

The EU-27 inventory has not been reviewed.

25.4.2 Member States' responses to UNFCCC review

Since the improvement of the EU inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 25.6 provides an overview of Member States' responses to the UNFCCC review (52). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 25.6 Improvements made by new Member States in response to the UNFCCC review

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Bulgaria **(late availability of 2012 ARR)**	The ERT identified the following cross-cutting issues for improvement: (a) Addressing recommendations from the previous expert review in relation to transparency, accuracy, completeness, consistency and comparability of its annual submission;	In General: TACCC is improved per sector.
	(b) Transparency in relation to improved documentation of category-level methodologies, AD, EFs and other parameters used to estimate emissions, references to sources of AD and the rationale for selecting a methodology;	In General: Revision of the activity data per sector and use of the entire time series by using statistical and plant specific data. Default emission factors from the Revised 1996 IPCC Guidelines are used Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive. [NIR, April 2012, written under subchapters of source specific recalculation]
	(c) Transparency in relation to the use of EU ETS data in the inventory and information demonstrating how its use is in line with the IPCC good practice guidance;	"Update of the National QA/QC Plan due to the newly implemented institutional, legal and procedural arrangements within the BGNIS. A new System for sector experts workflow organization, documentation and archiving has been implemented in the ExEA. Intensive cross-check with ETS, EPRTR, IPPC permits was undertaken. The relevant data was incorporated into the GHG inventory. " [NIR, April 2012, Implementation Action Plan, p. 427]
	(d) Transparency in relation to providing information that demonstrates that the use of an EF from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines) instead of a corresponding EF from the Revised 1996 IPCC	In General: Revision of the activity data per sector and use of the entire time series by using statistical and plant specific data. Default emission factors from the Revised 1996 IPCC Guidelines are used Improvements with regard to transparency, documentation and archiving of all

(52) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	Guidelines and/or the IPCC good practice guidance better suits national circumstances;	information required in NIR, Background documentation and archive. [NIR, April 2012, written under subchapters of source specific recalculation]
	(e) Accuracy in relation to reporting the uncertainty analysis in line with the requirements of the UNFCCC reporting guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF, including reporting of uncertainty estimates for KP-LULUCF;	" See Chapter 7.9 BG NIR 2011" " [NIR, April 2012, Implementation Action Plan, p. 434]
	(f) Exploring higher-tier methods for key categories;	Not yet addressed.
	(g) Consistency in relation to the inventory time series of some emission estimates (e.g. F-gases);	"Contract with external consultants Denkstatt For the NIR 2010 a complete new and changed estimation was carried out for CRF 2.F (F-gases) (complete time series). Incorporated results from completed Project 4 "F-gases" (CRF tables and NIR) Improved documentation and archiving of the inventory, including work sheets Adequately planned and implemented in 2010." [NIR, April 2012, Implementation Action Plan, p. 431]
	(h) Consistency in relation to addressing discrepancies between the NIR and CRF tables, including expanding QA/QC procedures to include explicit provisions for this activity;	"Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory." [NIR, April 2012, Implementation Action Plan, p. 430]
	(i) Comparability in relation to ensuring that the allocation of emissions is in line with the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance (e.g. for limestone and dolomite use and soda ash use);	"Recalculated emissions based on revised AD in accordance with plant specific data submitted under EPRTR and ETS for productions of CRF 2.B.1 Ammonia, CRF 2.B.2, Nitric acid, CRF 2.A.1Cement, CRF 2.C.1 Iron and steel, 2.A.7 Glass and Bricks. Sector specific QA/QC procedures were implemented in 2010 submission. QA procedures have been performed by the Sector expert in the MoEW (Order № RD-218/05.03.2010 by the Minister of Environment and Water). Improved documentation and archiving of the inventory, including work sheets." [NIR, April 2012, Implementation Action Plan, p. 430]
	(j) Definition of the role and responsibilities of the many 'actors' in the QA/QC system, and to consider the outcomes of the key category analysis, uncertainty analysis and QA/QC procedures in the revision of the inventory improvement plan. (**FCCC/ARR/2010/BGR, para 60)**	"Update of the National QA/QC Plan due to the newly implemented institutional, legal and procedural arrangements within the BGNIS A new System for sector experts workflow organization, documentation and archiving has been implemented in the ExEA Intensive cross-check with ETS, EPRTR, IPPC permits was undertaken. The relevant data was incorporated into the GHG inventory." [NIR, April 2012, Implementation Action Plan, p. 427]
Cyprus	Not reviewed.	
Czech Republic **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The maintenance and enhancement of the capacity of the national system, in particular through: (i) The improved coordination of QA/QC procedures; and the updating and full implementation of the QA/QC plan, including the provision of enhanced documentation on the sectoral QA/QC procedures in the energy, industrial processes and waste sectors;	"Within the UNFCCC Review recommendations (v6) it is written that during the review, the Czech Republic explained that those improvements are included in its inventory improvement plan. Work on an updated QA/QC plan has been completed (see Chapter 1); the improvement plan, which includes also gradual implementation of higher Tiers, is presented in this chapter, together with an overview of the main improvements implemented so far in comparison with the 2011 submission." [NIR 2012, p. 268]
	(ii) The allocation of resources for the application of higher-tier methods for the key categories in all	See comment above.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	sectors;	
	(iii) Ensuring the transition of expertise and the provision of training for newly appointed experts in the industrial processes sector;	Not mentioned in the NIR.
	(iv) The improvement of the archiving system by assembling all relevant information together in a centralized location;	"…Due to financial limitations and employment difficulties, development of the new archiving system has been delayed. However, during the improvement plan generation period in 2011 a new archiving scheme emerged. Full implementation is planned after April 2012 (the end of submission period)." [NIR 2012, p. 24]
	(v) The maintenance of an improvement plan prioritized by the key category and uncertainty analyses, and reviewed and managed through the coordination meetings of the national inventory system;	"Development of Improvement plan focused on gradual implementation of higher tiers methods." [NIR 2012, Tab. 10-9].
	(b) The improvement of the completeness of the inventory submission by completing CRF table 8(b);	"Information on recalculation provided not only in NIR, but also in CRF, Table 8(b)." [NIR 2012, Tab. 10-9].
	(c) The enhancement of the documentation on the expert judgement used for the uncertainty analysis; and the improvement of the quantitative uncertainty estimates for all categories. **(FCCC/ARR/2011/CZE, para 193)**	Only mentioned in the sub chapters of the sector agriculture. [NIR 2012, p. 175, 181, 187]
Estonia	<u>Completeness:</u> Estimate mandatory pools and related emissions and removals. **(para 10)**	"In the 2013 annual submission, all estimates, including emissions and removals from mineral soils are provided. In case of missing or insufficient country-specific data, emission factors from Sweden 2012 submission were mplemented with the agreement of ERT." [NIR 2013, Table 10.9, p. 394.]
	<u>National system.</u> Allocate the necessary resources in order to ensure a smooth transition period, in particular ensuring that the TUT energy expert will allocate enough time to support the preparation and quality checking of the 2013 energy sector. **(para 17)** Explore the possibility of strengthening the links between the GHG inventory compilers and Statistics Estonia, which would facilitate the preparation of the inventory for the energy sector. **(para 19)**	"Quality assurance of energy sector was carried out by TUT expert in the 2013 inventory submission." [NIR 2013, Table 10.9, p. 394.] "MoE and experts are working in close cooperation with Statistics Estonia. Quality control of activity data takes place on both side (e.g. energy expert highlights any error in energy balance and SE carries out QA of energy inventory). The need for futher cooperation with SE was discussed in annual meeting of GHG inventory experts. Experts confirmed that there is no need for special agreement and that data needed for inventory preparation is available from electronical database of SE. Concrete steps for strengthening the links between the GHG inventory compilers and SE will be made if necessary." [NIR 2013, Table 10.9, p. 394 - 395.]
	<u>Key category analysis.</u> Use the key category analysis to prioritize improvements of its inventory. **(para 21)**	"Estonia plans to revise the uncertainty estimates for solid fuels from public electricity and heat production for the next submission." [NIR 2013, Table 10.9, p. 395.]
	<u>Uncertainty analysis:</u> Revise the uncertainty assessment and include explanations for the changes in the uncertainty estimates compared with the previous NIR and include explanations or	"Estonia plans to revise the uncertainty estimates for solid fuels from public electricity and heat production for the next submission."

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	justifications for selected uncertainty values used for each category. **(para 21, 24 and 25)**	"Explanations for the differences in the uncertainty estimates when the results are compared with previous submission are included in the NIR 2013." "The justification of the uncertainty values used has been improved." [NIR 2013, Table 10.0, p. 395.]
	Recalculations: Provide transparent explanations for all recalculations in the next NIR. **(para 29)**	"Estonia has provided transparent explanations for all recalculations." [NIR 2013, Table 10.9, p. 395.]
	QA/QC: Perform on an annual basis the additional QA procedures for key categories and the checks between EU ETS data and the inventory. **(para 31)** Improve the documentation of the overall QA/QC checks made by the QA/QC coordinator and of the cross-checks with EU ETS data. **(para 32)**	"EU ETS data has been used for verification purposes of the 2013 inventory. QA procedures will be revised and the focus on the key categories will be strengthened." "The documentation of overall checks made by the QA/QC coordinator and of cross-checks with the EU ETS data was improved for the 2013 inventory submission." "Estonia improved its QA/QC plan for the 2013 inventory. The updated plan states that inventory will be annually sent to Statistics Estonia for quality checking. Energy chapter of the 2013 inventory was sent to Statistics Estonia for quality checking." [NIR 2013, Table 10.9, p. 396.]
	Transparency: Provide clearer information on all sectors in order to improve the transparency of the reporting. **(para 34)**	To improve the transparency additional information is provided per sector in the 2013 submission. [NIR 2013, Table 10.9.]
	Archiving: Ensure that all relevant material (also relevant material from the ftp site) is stored in the archive. **(para 35) (FCCC/ARR/2012/EST, Table 6)**	"Estonia improved its archiving system for the 2013 inventory. The archiving structure was modified the way that all relevant materials (e.g. XML files provided by the inventory compilers to the producers of the CRF tables, also relevant material from the ftp site) will be stored in the archive. Materials used in the 2013 inventory submission will be archived according to the improved archiving system." [NIR 2013, Table 10.9, p. 396.]
Hungary (late availability of 2012 ARR)	The ERT identifies the following cross-cutting issues for improvement: (a) The review of the elements of the national system that would enable the timely submission of the annual submission, and the submission of the next annual submission by 15 April 2012 (see para. 6 above);	Submission was not in time. *NIR 2013 was submitted in time.*
	(b) The provision of a transparent overview of the annual inventory preparation process in the NIR of the next annual submission, including information on the responsibilities of the institutions involved in the preparation of the inventory and the provision of a timeline for the application of QA/QC procedures during the inventory preparation process (see para. 16 above);	Table with timeline and institution is presented. "The inventory cycle can be summarized with the following table based on our QA/QC plan:" [NIR, April 2012, p. 15]
	(c) The allocation of CO_2 emissions from non-energy use of fuels/feedstocks and coke as a reducing agent under the industrial processes sector in line with the IPCC good practice guidance and the UNFCCC reporting guidelines, taking into account the reporting of CO_2 emissions from combustion of secondary fuels under the relevant stationary combustion categories in the energy sector, and the inclusion of information, where relevant, on how the calculation and allocation of the CO_2 emissions was performed (see para. 61 above);	"Following the recommendations of the ERT, three main changes occurred in this source category: · Coke used as reducing agent has been removed from the energy sector and allocated to the industrial processes sector; · Emissions from coke oven gas has been added, where necessary; · We started the report emissions by non-ferrous metals separately from iron and steel. More details in chapter 10.2.2 and 10.2.3." [NIR, April 2012, p. 53]
	(d) The further improvement of the transparency of the inventory by including, where relevant, further information on the methodological tiers	*"Since 2013 JAN submission Hungary applies a more reliable and complete activity data time serie and Tier2 method for estimation of emissions from Fire extinguishers.*

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	used, and justification and references for country-specific parameters and EFs, in particular for F-gas emissions under the industrial processes sector (see paras. 65, 66, and 67 above);	*All the details and description of new method are included in NIR of 2013 MARCH submission."* *[NIR 2013, Annex 8, p. A84]*
	(e) The completion of the uncertainty analysis by including quantitative estimates for all categories, in particular for categories under the LULUCF sector;	New chapter '11.3.1.5 Uncertainty estimates' is included in the NIR, April 2012 p. 316- 323 with detailed descriptions.
	(f) The finalization of the archiving manual and reporting on the progress made thereon in the next annual submission (see para. 32 above);	*"Notation keys 'NE' were corrected to the required emissions under information items in CRF Table 5. (See also para. 97 below). Uncertainty analysis is now complete for the LULUCF sector. (See also para 21.) The main issues of the archiving manual have been finalized in the new general record management regulation of the HMS (see also para. 31)." [NIR 2012, May, Annex 8, A78]*
	(g) The inclusion, in annex 8 to the NIR or in the relevant section, a table describing Hungary's responses and follow-up actions to the recommendations of previous review reports. (**FCCC/ARR/2011/HUN, para 156)**	*Implementation of table "Annex 8 Responses to the review of the 2012 inventory submission" [NIR 2012 and NIR 2013, Annex 8]*
Latvia **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Improve the use of notation keys in the CRF tables;	"7.2.7 Category-specific recalculations No recalculations were done in this category except minor updates in the notation keys." [NIR, April 2012, p. 252]
	(b) Resolve inconsistencies in the NIR and between the NIR and the CRF tables, as part of the implementation of the QA/QC procedures;	Under the chapters source-specific QA/QC and verification mentioned: "If errors or inconsistencies are found they are documented and corrected. The QC checklist is used during the inventory." [NIR, April 2012, p. 224, 230, 258, 263, 270]
	(c) Improve the use of country-specific EFs and parameters and move to higher tier methods for some categories, including energy (CH_4 emissions from oil and natural gas), industrial processes (CO_2 emissions from cement production, and HFCs and SF_6 from the production and use of fire extinguishers, consumption of halocarbons and SF_6), agriculture (CH_4 emissions from enteric fermentation, N_2O emissions from manure management, direct N_2O emissions from soils), and LULUCF (CO_2 emissions/removals from forest land remaining forest land, CO_2 emissions from cropland remaining cropland);	For agriculture: "As the milk yield is higher (according to national statistic) then ERT (2009) recommended using higher tier method for estimating emissions for dairy cattle. Latvia provided ERT with some background information available in country and therefore ERT recommended that Latvia utilize the available information to estimate the country specific EF that permit the use of a higher tier method in order to improve the accuracy of estimates. " [NIR, April 2012, p.216]
	(d) Improve transparency and provide further clarification for the methods and trends in emissions for subcategories in the following sectors: energy (road transportation: liquid fuels – CO_2 and N_2O, and stationary combustion: all fuels – CO_2, navigation: liquid fuels – CO_2, CH_4 and N_2O and civil aviation: liquid fuels – CO_2, CH_4 and N_2O); industrial processes (lime production and limestone and dolomite use – CO_2); agriculture (enteric fermentation – CH_4 , manure management – CH_4); LULUCF (cropland remaining cropland – CO_2, land converted to forest land – CO_2, grassland remaining grassland – CO_2); and waste (solid waste disposal on land – CH_4, wastewater handling – CH_4);	Details are described under chapter 10.4., Table 10.4, NIR, April 2012.
	(e) Improve the completeness and the transparency of the inventory in the LULUCF sector and for	"11.3.1.4 Changes in data and methods since the previous

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	KP-LULUCF, specifically: report all mandatory categories in LULUCF and pools from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (paying particular attention to the consistent representation of land area and changes in carbon stocks and emissions/removals from different pools);	submission (recalculations) Two types of changes are included into this KP LULUCF reporting: updates of values, like use of the same number of decimal signs in representation of land areas in different years; correction of notation keys, setting of NE instead of NO in the land use categories, where absence of the emissions / removals are scientifically approved and where research work is initiated to obtain necessary values. Changes made to the KP LULUCF reporting are relevant to those implemented under the Convention reporting. More detailed information is available in section 7.2.7. Category specific recalculations." [NIR, April 2012, p. 313]]
	(f) Implement a qualitative key category assessment; (g) Include the list of key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and demonstrate that these key categories have been identified according to the IPCC good practice guidance for LULUCF;	"Article 3.3 Deforestation (CO_2): The associated UNFCCC subcategory CO_2 emissions from deforestation have been identified as key category. Total CO_2 emissions and removals from deforestation (Art. 3.3) is larger than the smallest UNFCCC key category. Therefore D is stated to be a key category. " [NIR, April 2012, p. 317]
	(h) Provide tier 2 uncertainty estimates;	*"The tier 2 uncertainty estimation will be elaborated for the whole NIR (all categories) until the next inventory. The implementation of the Tier 2 uncertainty estimation is subordinated to available funding to contract external experts." [NIR 2013, Table 10.4, p.334]*
	(i) Conduct and report the uncertainty assessment associated with estimates of changes in carbon stocks in pools and emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;	"Latvia is still developing methods for estimation of emissions and removals of greenhouse gases and their uncertainties. For that reason, the estimates presented in this submission for 2008-2009 might change for the final report of the commitment period." [NIR, April 2012, Chapter 11.3.1.6, p. 314]
	(j) Elaborate on changes in Regulation No. 157 in order to include activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, as well as QA/QC updates and other changes which improve the national system;	Not yet addressed.
	(k) Explore further steps in implementing the provisions under Article 3, paragraph 14, of the Kyoto Protocol and report on how Latvia is striving to implement its commitments under Article 3, paragraph 14, of the Kyoto Protocol;	Not yet addressed.
	(l) Enhance the reporting of changes in the national registry since the last annual submission, in accordance with section I.G of the annex to decision 15/CMP.1 by clearly stating whether each item was changed or not compared with information reported the previous year. (**FCCC/ARR/2010/LVA, para 27)**	"No significant technical, functional or documentary changes were made in Latvia's ETR during 2011." [NIR, April 2012, Chapter 14, p. 320]
Lithuania	<u>Key category analysis:</u> Use the key category analysis to prioritize the development and improvement of the inventory. **(para 19 and 50)**	"In 2013 submission prioritization of inventory improvements using key category assessment results are described in Chapter 1.5 and 1.7" [NIR 2013, Annex VIII, p. 635] "Recalculation of CH_4 and N_2O at new Tier 2 method for Civil aviation during 2006-2011 was done. Recalculation of Road transport emissions of CH_4 and N_2O at new Tier 3 method for LPG was done. Lithuania investigated the possibility to apply Tier 2 for railways transport. It was concluded that data is not complete to improve the accuracy and reduce uncertainty." [NIR 2013, Annex VIII, p. 640]
	<u>Uncertainties:</u> Perform the uncertainty analysis for each category for all gases combined and improve	"Responding to ERT recommendations uncertainty analysis is reported according to GPG 2000 Tier 1 (table

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	the consistency of the information. **(para 22)**	6.1) and for each category for all gases combined. Results of combined uncertainty were the same as Tier 1 and enable us to identify subcategories for national GHG inventory improvements. Solvent and other product use sector is included in the uncertainty analysis and reported in annex II of the NIR. Typing error in page 48 in the NIR is corrected." [NIR 2013, Annex VIII, p. 635]
	Information on Kyoto Protocol units: Implement the recommendations contained in the standard independent assessment report **(para 161)**	"The only recommendation was related to the reporting of discrepancies. The R-2 table is submitted as a part of this NIR." [NIR 2013, Annex VIII, p. 636]
	Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol: Report any changes in its information provided under Article 3, paragraph 14, in accordance with decision 15/CMP.1, annex, chapter I.H, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" **(para 170) (FCCC/ARR/2012/LTU, Table 6)**	"In this submission only changes to information on minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol comparing to previous NIR were reported" [NIR 2013 Annex VIII, p. 636]
Malta	Inventory planning: Provide more detailed information on the inventory preparation process. **(para 10)**	"The Annexes provide more detailed information regarding specific topics and issues asset out in the Guidelines." [NIR, April 2013, p. xiii]
	Inventory preparation: Use the results of the key category analysis to prioritize the development and improvement of the inventory, and include information on this process in the next inventory submission. **(para 13)**	Not yet addressed.
	Uncertainties: Report two uncertainty analyses, one including and one excluding the emissions from the land use, land-use change and forestry (LULUCF) sector, improve the transparency of the uncertainty analysis and provide information to explain how the uncertainty analysis is used to prioritize further inventory improvements. **(para 14)**	Not yet addressed.
	Quality assurance/quality control (QA/QC): Develop a QA/QC plan, in particular tier 1 QC procedures, such as that described in the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (the IPCC good practice guidance), and provide information on the QA/QC plan in the national inventory report (NIR). **(para 17)**	"The need for a standardised Quality Assurance/Quality Control (QA/QC) system within the national inventory system is recognised and is acknowledged as being an important aspect to be addressed in the ongoing development of the system in general. Work specifically aimed at developing a QA/QC system is formed part of the national inventory system team's work plan for 2012, to ensure the quality and reliability of the activity data, emission factors and emission estimates, in line with the principles of transparency, accuracy, consistency, comparability and completeness. Quality assurance and quality control methods are continuously being developed." [NIR, April 2013, chapter 1.6.1, p. 30]
	Verification: Improve the QA/QC and verification procedures. **(para 18)**	Not yet addressed.
	Transparency: Improve the transparency of the information on the QA/QC procedures and uncertainty analysis. **(para 19)**	Not yet addressed.
	Inventory management: Provide further information on archiving, including internal documentation on QA/QC procedures, external and internal reviews, documentation on annual key categories and key category identification and planned inventory improvements**. (para 20)** **(FCCC/ARR/2012/MLT, Table 3)**	Not yet addressed
Poland	Key categories: Provide a key category analysis for the base year (based on submission data).	Not yet addressed.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(para 16)	
	Overview: Update the structure of the national inventory report (NIR) (include land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (KP-LULUCF) in the overview sections, provide details on recalculations, quality assurance/quality control QA/QC), uncertainties, planned improvements at the category-specific level for all sectors; report PFCs and SF_6 from aluminium production under metal production). **(para 22, 25, 36, 61, 62, 82, 117)** Implement pending recommendations from previous review reports. **(para 14, 42)** Summarize implemented recommendations and include in the NIR a road map of planned actions to address previous recommendations with clear priorities and a time line for implementation. **(para 14)**	KP-LULUCF : Not yet addressed. Report of recalculations, quality assurance/quality control QA/QC), uncertainties, planned improvements at the category-specific level for all sectors: Implemented. Report PFCs and SF_6 from aluminium production under metal production: implemented Improving the NIR (para 14): Not yet addressed. Improving the energy sector (para 42): not yet addressed. Planned improvements: Not yet addressed.
	Uncertainty: Calculate and report the overall uncertainty (with and without LULUCF). **(para 19)** Correct uncertainty values across the NIR**. (para 20)** Improve the uncertainty analysis (e.g. for fluorinated gases (F-gases), LULUCF) and its reporting and explain how the uncertainty analysis serves to prioritize inventory improvements. **(para 21, 63, 104)**	Not yet addressed.
Poland	Recalculations and time-series consistency. Improve reporting on recalculations with justification and information on the impact of the recalculations at category-specific level. **(para 22, 59, 78, 98, 135)** Ensure time series consistency and include further information on the measures for ensuring time-series consistency. **(para 24, 39)** Strengthen the QA/QC procedures and improve reporting of sectoral QA/QC. **(para 25, 41, 118)** Improve the transparency of reporting trends, justifying country-specific emission factors (EFs) and assumptions, correcting notation key use. **(para 26, 38, 48, 61, 62, 83, 100, 101)** **(FCCC/ARR/2012/POL, Table 6)**	Reporting on recalculations and time series consistency: Partly done. Improve the transparency of reporting trends, justifying country-specific emission factors: not yet addressed.
	CPR: Report consistent commitment period reserve in the NIR **(para 146)**	"The new value of reserves - 2 012 046 833 tons of eq. CO_2 has been calculated on the basis of 2010 emissions (402 409 367 tones of eq. CO_2), which were approved during the review in 2012." [NIR 2013, chapter 12.5, p. 234]
	National systems: Include information on actions taken and planned to address previous recommendations **(para 147)**	Not yet addressed.
	Article 3, paragraph 14: Report any changes in the information provided under Article 3, paragraph	"According to chapter I.H of the annex to the decision 15/CMP.1 and recommendation of ERT from

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	14 **(para 149)** (**FCCC/ARR/2012/POL, Table 6)**	2011 below Poland provides new information (since the last NIR 2012) on how it is implementing its commitment under Article 3.14 of the Kyoto Protocol related to striving to implement its commitment under Article 3.1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries." [NIR 2013, chapter 15, p.239]
Romania	<u>Completeness:</u> Enhance the completeness of the inventory by providing estimates for the soil carbon stock changes for the missing pools **(para 11, 119 and 148)**	Not yet addressed.
	<u>Inventory improvement plans:</u> Continue efforts to implement the planned studies and increase the quality of the inventory **(para 15, 27, 40, 48, 61, 67 and 111)**	Not yet addressed.
	<u>Uncertainties:</u> Update the uncertainty analysis and include uncertainty estimates for all categories under the LULUCF sector and for all KP-LULUCF activities **(para 27, 49, 113, 132, 135 and 145)**	Not yet addressed.
	<u>Recalculations:</u> Enhance the reporting of the recalculations in CRF table 8(b) **(para 29, 47 and 60)**	Not yet addressed.
	<u>QA/QC:</u> Strengthen QC procedures **(para 22, 33, 50, 52, 57, 67, 70, 73, 74, 82, 90, 91, 112, 116, 131, 133 and 153)**	Not yet addressed.
	<u>National registry: Publicly available information:</u> Update the reports posted on the public website with complete and up-to-date data and remove duplicate or outdated links **(para 161)**	Not yet addressed.
Slovakia **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The development of procedures and institutional arrangements in order to ensure the consistency of and harmonization between the AD used in the inventory, national statistical data and data reported under other international obligations and a reliable data flow for the preparation of the inventory (see paras. 21(b) and (e) above);	"Questions of implementation on national system and QA/QC procedures and two adjustments were identified by the ERT during the review. In the conclusions and recommendations summarized in the draft ARR the ERT concludes that the inventory submission has been prepared and reported mostly in accordance with the UNFCCC reporting guidelines but the national system of Slovakia does not fully comply with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (annex to decision 19/CMP.1). The annual submission is complete in terms of geographical coverage, years and sectors, as well as mostly complete in terms of categories and gases." [NIR, 2012, p. 268]
	(b) The establishment of clear communication channels with regard to the principles, purposes and procedures of the UNFCCC reporting guidelines and the review processes with external experts, ensuring that these experts fully understand the formal requirements of these guidelines and the importance of the timely submission of their contributions (see para. 21(d) above);	"During the 6 weeks period, sectoral expert for energy (Profing, Mr. Judak), national coordinator and the colleagues from the Dpt. of Climate Change Policy (Ministry of Environment) in cooperation with the Statistical Office of the Slovak Republic (SO SR) provided several comparisons of the national energy statistics, international energy statistics (IEA) and the fuel balance in the National Emission Information System (NEIS). The following steps were taken in order to increase transparency, consistency and comparability of the national reporting in energy sector." [NIR, 2012, Tab. 10.5, p. 269]
	(c) The implementation of a fully operational QA/QC system, including all the provisions of the	"In response to the ERT recommendation Slovakia prepared during the 6-weeks period detailed plan of action

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	QA/QC plan, and independent checks of the resulting emission estimates involving experts from collaborating institutions, particularly data providers and different data sources (e.g. EU ETS, NEIS, statistical data), prior to the submission of the inventory (see para. 21(a) and 38 above);	with proposed measures and deadlines to deliver results. Prioritizing the key sources, tier 2 key categories analyses were performed. updating QA/QC plan mostly for agriculture and LULUCF sectors" [NIR, 2012, Tab. 10.5, p. 269]
	(d) The improvement of the transparency of the emission estimates in the energy sector, in particular the information on the parameters and assumptions of the COPERT IV model methodology and the information on AD (e.g. by providing an energy balance in the NIR), and in the industrial processes sector, in particular with regard to the provision of a carbon mass balance covering activities related to the iron and steel category and clear information on the use of F-gases under the category consumption of halocarbons and SF_6 (see paras. 49, 57, 69 and 73 above). **(FCCC/ARR/2011/SVK, para 230)**	For the sector energy, road transport: please see under (b) and "New estimation of N_2O emissions for CNG fuel in the category 1.A.3b - Road Transportation using default EF. " [NIR, 2012, Tab. 10.5, p. 269] For the industrial processes: not yet addressed. For the use of F-gases: "New estimation of actual emissions HFC245ca and HFC365mfc f rom PUR foam in the category 2IIA.F.2.1 – Consumption of halocarbons and SF_6 (hard foam)." [NIR, 2012, Tab. 10.5, p. 269]
Slovenia **(late availability of 2012 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The maintenance of time-series consistency when performing recalculations due to methodological improvements;	"All improvements have been done for the submission 2012. See relevant chapters in the NIR." [NIR 2012, Table 10.7, p. 266]
	(b) The improvement of QC procedures in order to minimize inconsistencies in the CRF tables and the NIR, and between them;	"All improvements have been done for the submission 2012. See relevant chapters in the NIR." [NIR 2012, Table 10.7, p. 266]
	(c) The further improvement of the transparency of the NIR (see para. 24 above). **(FCCC/ARR/2011/SVN, para 123)**	"See para 41, 42, 44, 59, 60, 67, 78, 80, 81, 82, 89, and 92. See relevant chapters in the NIR". [NIR 2012, Table 10.7, p. 265]

Note: Review findings of submission 2011, which were also commented in the NIR 2013 were added in italics.

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UNITS AND ABBREVIATIONS

t	1 tonne (metric) = 1 megagram (Mg) = 106 g
Mg	1 megagram = 106 g = 1 tonne (t)
Gg	1 gigagram = 109 g = 1 kilotonne (kt)
Tg	1 teragram = 1012 g = 1 megatonne (Mt)
TJ	1 terajoule

AWMS	animal waste management systems
BEF	biomass expansion factor
BKB	lignite briquettes
C	confidential
CCC	Climate Change Committee (established under Council Decision No 280/2004/EC)
CH_4	methane
CO_2	carbon dioxide
COP	conference of the parties
CRF	common reporting format
CV	calorific value
EC	European Community
EEA	European Environment Agency
EF	emission factor
Eionet	European environmental information and observation network
EMAS	Ecomanagement and Audit Scheme
ETC/ACC	European Topic Centre on Air and Climate Change
ETS	European Emissions Trading System
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations

GHG	greenhouse gas
GPG	good practice guidance and uncertainty management in national greenhouse gas inventories (IPCC, 2000)
GWP	global warming potential
HFCs	hydrofluorocarbons
JRC	Joint Research Centre
F-gases	fluorinated gases (HFCs, PFCs, SF_6)
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LULUCF	land-use, land-use change and forestry
MNP	Milieu-en Natuurplanbureau
MS	Member State
MRG	monitoring and reporting guidelines
N	nitrogen
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA	quality assurance
QA/QC	quality assurance/quality control
QM	quality management
QMS	quality management system
RIVM	National Institute of Public Health and the Environment (The Netherlands)
SF_6	sulphur hexafluoride

SNE	Single National Entity
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile Organic Compounds

Abbreviations in the source category tables in Chapters 3 to 9 and 18-24

Methods applied	**EF: methods applied for determining the emission factor**	**AD: methods applied for determining the activity data**	**Estimate: assessment of completeness**	**Quality: assessment of the uncertainty of the estimates**
C — Corinair	C — Corinair	AS — associations, business organizations	All — full	H — high
CS — country-specific	CS — country-specific	IS — international statistics	F — full	M — medium
COPERT X — Copert Model X = version	D — default	NS — national statistics	Full — full	L — low
D — default	M — model	PS — plant specific data	IE — included elsewhere	
M — model	MB — mass balance	Q — specific questionnaires, surveys	NE — not estimated	
NA — not applicable	PS — plant-specific	RS — regional statistics	NO — not occurring	
RA — reference approach			P — partial	
T1 — IPCC Tier 1			Part — partial	
T1a — IPCC Tier 1a				
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				
T2 — IPCC Tier 2				
T3 — IPCC Tier 3				