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Annual European Union greenhouse gas inventory 1990–2013 and inventory report 2015

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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 for emissions and removals within the area covered by its Member States (i.e. domestic emissions taking place within its territory).

The present report is the official 2015 submission under the UNFCCC, with data for the years 1990 – 2013. It does not constitute an official submission under the Kyoto Protocol, even though some of the information included may relate to the requirements under the Kyoto Protocol.

The legal basis for the compilation of the EU inventory is Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC[1].

This Regulation establishes a mechanism for:

a) ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its Member States to the UNFCCC Secretariat;
b) reporting and verifying information relating to commitments of the Union and its Member States pursuant to the UNFCCC, to the Kyoto Protocol and to decisions adopted thereunder, and evaluating progress towards meeting those commitments;
c) monitoring and reporting all anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol on substances that deplete the ozone layer in Member States;
d) monitoring, reporting, reviewing and verifying GHG emissions and other information pursuant to Article 6 of Decision No 406/2009/EC;
e) reporting the use of revenue generated by auctioning allowances under Article 3d(1) or (2) or Article 10(1) of Directive 2003/87/EC, pursuant to Article 3d(4) and Article 10(3) of that Directive;
f) monitoring and reporting on the actions taken by Member States to adapt to the inevitable consequences of climate change in a cost-effective manner;
g) evaluating progress by the Member States towards meeting their obligations under Decision No 406/2009/EC.

The new Monitoring Mechanism Regulation has enhanced the reporting rules on GHG emissions to meet the requirements arising from international climate agreements, as well as the 2009 EU climate and energy package. Starting in 2014, GHG inventory reporting takes place under this new legal instrument, which replaces and expands the previous Monitoring Mechanism Decision 280/2004/EC.

The EU GHG inventory comprises the direct sum of emissions from the national inventories compiled by the EU Member States making up the EU-28. 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).

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1448384547941&uri=CELEX:32013R0525 OJ L 165, 18.6.2013, p. 13–40e

The main institutions involved in the compilation of the EU GHG inventory are the 28 Member States, the European Commission Directorate-General for 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).

The annual process of compiling the EU GHG inventory is indicated below. Please note that in 2015, due to the delay in the availability of a functioning UNFCCC reporting software ('CRF Reporter') the annual process of compiling the EU GHG inventory has been delayed by several months.

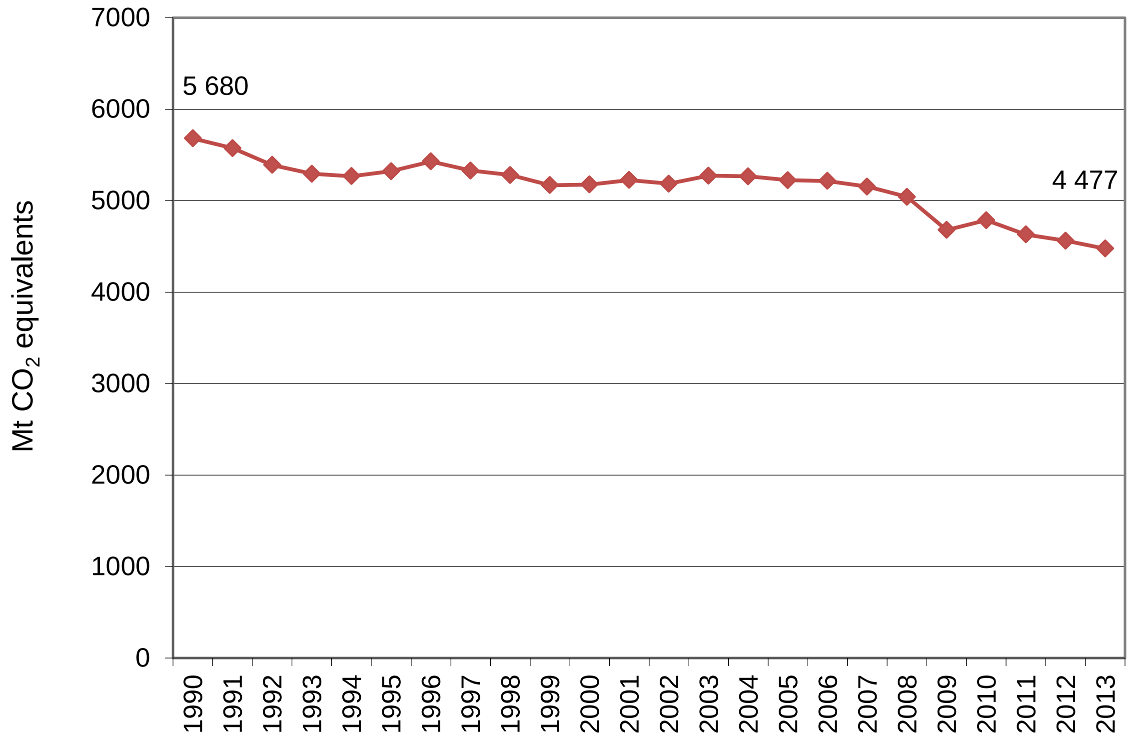
1. Member States submit their annual GHG inventories by 15 January each year (30 August in 2015) to the European Commission (DG CLIMA), with a copy to the EEA.
2. The EEA and its ETC/ACM, Eurostat, and JRC then perform initial checks on the submitted data. The draft EU GHG inventory and inventory report are circulated to Member States for review and comments by 28 February (15 October in 2015).
3. Member States check their national data and the information presented in the EU GHG inventory report, respond to specific findings from the initial QA/QC checks by the EU inventory team, send updates if necessary, and review the EU inventory report by 15 March (30 October in 2015).
4. The EEA and its ETC/ACM review final inventory submissions from Member States and their responses to the initial checks, prepare the final EU GHG inventory and inventory report by 15 April (27 November in 2015), so that they can be submitted to the UNFCCC
5. A resubmission is prepared by 27 May if needed (not applicable in 2015).

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

Total GHG emissions excluding Land Use Land Use Change and Forestry (LULUCF) amounted to 4 477 million tonnes CO_2 equivalent in 2013 (4 481 million tonnes including indirect CO_2 emissions). All EU-28 totals provided in this report will be without indirect CO_2 emissions[2].

In 2013, total GHG emissions were 21.2 % below 1990 levels and (–1203 million tonnes CO_2 equivalent). Emissions decreased by 1.9 % (86 million tonnes CO_2 equivalent) between 2012 and 2013 (Figure ES. 1).

Figure ES. 1 EU-28 GHG emissions 1990–2013 (excl. LULUCF)



Notes: GHG emission data for the EU-28 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 are 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 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

[2] According to the UNFCCC reporting guidelines, Annex I Parties may report indirect CO_2 from the atmospheric oxidation of CH_4, CO and NMVOCs. For Parties that decide to report indirect CO_2 the national totals shall be presented with and without indirect CO_2. For technical reasons in the 2015 inventory submission, the EU-28 totals shown in this report are based on national totals excluding LULUCF and excluding indirect CO_2. This does not pre-empt the inclusion of these emissions in future inventory submissions.

Main trends by source category, 1990-2013

Total GHG emissions (excluding LULUCF) in the EU-28 decreased by 1 203 million tonnes since 1990 (or 21.2 %) reaching their lowest level during this period in 2013. There has been an absolute decoupling of gross domestic product (GDP) and GHG emission compared to 1990, with an increase in GDP of about 45 % alongside a decrease in emissions of over 21 % over the 23-year period. This was partly due to growing shares of renewables, less carbon intensive fuels in the energy mix and improvements in energy efficiency. GHG emissions decreased in the majority of sectors between 1990 and 2013, with the notable exception of transport, including international transport, and refrigeration and air conditioning. At the aggregate level, reductions were largest for industrial sectors (combustion and processes), electricity and heat production, and residential combustion. A combination of factors explains lower emissions in industrial sectors, such as improved efficiency and carbon intensity as well as structural changes in the economy. The economic recession that began in the second half of 2008 and continued through to 2009 also had an impact on emissions from industrial sectors. Emissions from electricity and heat production decreased strongly since 1990. In addition to improved energy efficiency there has been a move towards less carbon intense fuels at EU level. Between 1990 and 2013, the use of solid and liquid fuels in thermal stations decreased strongly whereas natural gas consumption doubled, resulting in reduced CO_2 emissions per unit of fossil energy generated. Emissions in the residential sector also represented one of the largest reductions. Energy efficiency improvements from better insulation standards in buildings and a less carbon-intensive fuel mix can partly explain lower demand for space heating in the EU as a whole over the past 23 years.

In terms of the main GHGs, CO_2 accounts for the largest reduction in emissions since 1990. Reductions in emissions from N_2O and CH_4 have been substantial, reflecting lower levels of mining activities, lower agricultural livestock, as well as lower emissions from managed waste disposal on land and from agricultural soils.

Table ES. 1 shows those sources with the largest contribution to the change in total GHG emissions in the EU-28 between 1990 and 2013.

Table ES. 1 Overview of EU-28 source categories whose emissions increased or decreased by more than 20 million tonnes CO_2 equivalent in the period 1990–2013

Source category	Million tonnes (CO_2 equivalents)
Road Transportation (CO_2 from 1.A.3.b)	119
Refrigeration and Air conditioning (HFCs from 2.F.1)	91
Commercial/Institutional (CO_2 from 1.A.4.a)	-20
Fluorochemical Production (HFCs from 2.B.9)	-28
Direct N2O Emissions From Managed Soils (N_2O from 3.D.1)	-31
Cement Production (CO_2 from 2.A.1)	-31
Oil and Natural Gas and Other Emissions from Energy Production (CH_4 from 1.B.2)	-34
Nitric Acid Production (N_2O from 2.B.2)	-45
Adipic Acid Production (N_2O from 2.B.3)	-57
Manufacture of Solid Fuels and Other Energy Industries (CO_2 from 1.A.1.c)	-61
Enteric Fermentation (CH_4 from 3.A)	-61
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-71
Coal Mining and Handling (CH_4 from 1.B.1.a)	-74
Residential (CO_2 from 1.A.4.b)	-75
Iron and steel production (CO_2 from 1A2a +2C1)	-107
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-267
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-290
Total	**-1,203**

Notes: As the table only presents sectors whose emissions have increased or decreased by at least 20 million tonnes CO_2 equivalent, the sum for each country grouping EU-28 do not match the total change listed at the bottom of the table.

Main trends by source category, 2012–2013

Table ES. 2 shows the source categories making the largest contribution to the change in GHG emissions in the EU-28 between 2012 and 2013.

Table ES. 2 Overview of EU-28 source categories whose emissions increased or decreased by more than 3 million tonnes CO_2 equivalent in the period 2012–2013

Source category	Million tonnes (CO_2 equivalents)
Commercial/Institutional (CO_2 from 1.A.4.a)	8
Residential (CO_2 from 1.A.4.b)	6
Refrigeration and Air conditioning (HFCs from 2.F.1)	3
Coal Mining and Handling (CH_4 from 1.B.1.a)	-3
Road Transportation (CO_2 from 1.A.3.b)	-3
Manufacture of Solid Fuels and Other Energy Industries (CO_2 from 1.A.1.c)	-3
Cement Production (CO_2 from 2.A.1)	-3
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	-6
Petroleum Refining (CO_2 from 1.A.1.b)	-7
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-7
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-70
Total	**-86**

Notes: As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2 equivalent, the sum for each country grouping does not match the total change listed at the bottom of the table.

Main reasons for emission changes, 2012–2013

Total GHG emissions (excluding LULUCF) decreased by 1.9 % (86 million tonnes CO_2 equivalent) between 2012 and 2013. This significant decrease in emissions in 2013 came along with a slight increase in GDP of 0.2 % compared to 2012 where GDP had contracted by 0.5 %. The largest reduction in GHG emissions occurred in the energy sector. Over 80 % of the total GHG emissions reduction in 2013 was accounted for by lower CO_2 emissions from electricity production in thermal power stations. Primary energy consumption declined overall, with fossil emissions decreasing for all fuels and particularly for solid fuels. The consumption of renewable energy continued its long term trend of higher shares in the energy mix. The GHG emissions intensity of the EU energy system also improved as a result of the less carbon intensive fuel mix in 2013.

The 86 million tonnes (CO_2 equivalent) decrease in GHG emissions in the EU-28 between 2012 and 2013 occurred mainly in the following categories.

- **CO_2 from public electricity and heat production (- 70 million tonnes or - 6 %)**
  Emission reductions in this category were mainly caused by an increase in renewable energy, especially in a higher share of hydro electricity generation and reduced electricity demand.
- **CH_4 from managed waste disposal sites (- 7 million tonnes or - 7 %)**
  Emission reductions were mainly caused by a decline in the United Kingdom, Italy, Germany and France. In general, emissions from this source decline because the amount of biodegradable waste being landfilled is reduced every year. A second reason for the decline in 2013 compared to 2012 is an increase in CH_4 recovery from landfills.
- **CO_2 from petroleum refining (- 7 million tonnes or - 6 %)**
  Input of crude oil in refineries declined by 6 %. This reflects a decline of final energy consumption of petroleum products and an increase in imports of petroleum products from outside of the EU.
- **CO_2 from manufacturing industries (excl. iron and steel) (- 6 million tonnes or - 2 %)**
  Emission reductions were driven by a decline in industrial production. Gross value added in industry declined by 0.3 % between 2012 and 2013.
- **CO_2 from cement production (- 3 million tonnes or - 5%)**
  In the EU-28 cement production declined by 5 % which reflected the general economic and construction downturn of the last years.

Table ES. 3 GHG emissions in CO_2 equivalent (excl. LULUCF)

MEMBER STATE	1990 (million tonnes)	2013 (million tonnes)	2012–2013 (million tonnes)	Change 2012–2013 (%)	Change 1990–2013 (%)
Austria	78.7	79.6	-0.2	-0.2%	1.2%
Belgium	147.1	119.4	0.2	0.2%	-18.8%
Bulgaria	109.4	55.9	-5.3	-8.6%	-48.9%
Croatia	35.1	24.5	-1.0	-4.0%	-30.3%
Cyprus	5.6	8.3	-0.8	-8.9%	49.7%
Czech Republic	193.4	127.1	-3.5	-2.6%	-34.2%
Denmark	69.3	54.6	2.0	3.8%	-21.2%
Estonia	40.0	21.7	2.3	12.0%	-45.7%
Finland	71.1	63.0	0.6	1.0%	-11.4%
France	549.4	490.2	0.7	0.1%	-10.8%
Germany	1247.9	950.7	22.6	2.4%	-23.8%
Greece	105.0	105.1	-7.5	-6.6%	0.1%
Hungary	94.2	57.4	-2.6	-4.3%	-39.1%
Ireland	56.7	58.8	-0.8	-1.3%	3.7%
Italy	521.1	437.3	-31.6	-6.7%	-16.1%
Latvia	26.2	10.9	-0.1	-0.5%	-58.3%
Lithuania	47.8	19.9	-1.3	-6.1%	-58.3%
Luxembourg	12.9	11.1	-0.6	-5.1%	-13.5%
Malta	2.0	2.8	-0.4	-12.1%	39.4%
Netherlands	219.5	195.8	-0.5	-0.2%	-10.8%
Poland	473.9	394.9	-3.9	-1.0%	-16.7%
Portugal	60.4	65.1	-1.9	-2.8%	7.7%
Romania	253.3	110.9	-10.0	-8.3%	-56.2%
Slovakia	75.5	43.7	0.0	-0.1%	-42.2%
Slovenia	18.6	18.2	-0.7	-3.9%	-2.1%
Spain	290.7	322.0	-26.7	-7.7%	10.8%
Sweden	71.8	55.8	-1.6	-2.7%	-22.4%
United Kingdom	803.7	572.1	-13.5	-2.3%	-28.8%
EU-28	**5680.2**	**4476.8**	**-85.9**	**-1.9%**	**-21.2%**

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

Table ES. 4 gives an overview of the main trends in EU-28 GHG emissions and removals for 1990–2013. The most important GHG by far is CO_2, accounting for 82 % of total EU-28 emissions in 2013 excluding LULUCF. In 2013, EU-28 CO_2 emissions without LULUCF were 3 650 million tonnes, which was 18 % below 1990 levels. Compared to 2012, CO_2 emissions decreased by 2 %, representing 94 % in total decrease in emissions in 2013. Emissions of CH_4, SF_6 and NF_3 decreased in 2013, while N_2O, HFCs and perfluorocarbons (PFCs) increased in 2013.

Table ES. 4 Overview of EU-28 GHG emissions and removals from 1990 to 2013 in CO_2 equivalent (million tonnes)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013
Net CO_2 emissions/removals	4 185	3 903	3 836	3 952	3 607	3 459	3 402	3 320
CO_2 emissions (without LULUCF)	4 460	4 201	4 162	4 286	3 934	3 788	3 728	3 650
CH_4	751	682	621	553	494	486	480	468
N_2O	413	373	333	311	265	260	257	258
HFCs	29	44	53	71	96	99	101	104
PFCs	25	17	12	7	4	4	4	4
Unspecified mix of HFCs and PFCs	6	6	2	1	0	0	0	0
SF_6	11	15	10	8	6	6	6	6
NF_3	0.02	0.04	0.12	0.16	0.12	0.13	0.09	0.07
Total (with net CO_2 emissions/removals)	**5 421**	**5 040**	**4 866**	**4 903**	**4 472**	**4 315**	**4 250**	**4 159**
Total (without CO2 from LULUCF)	**5 696**	**5 338**	**5 192**	**5 238**	**4 799**	**4 643**	**4 576**	**4 489**
Total (without LULUCF)	**5 680**	**5 322**	**5 177**	**5 224**	**4 786**	**4 630**	**4 563**	**4 477**

More detailed information can be found in Chapter 2.

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

Table ES. 5 gives an overview of EU-28 GHG emissions in the main source categories for 1990–2013. The most important sector by far is energy (i.e. combustion and fugitive emissions), accounting for 79 % of total EU-28 emissions in 2013. The second largest sector is agriculture (10 %), followed by industrial processes (8 %). More detailed trend descriptions are included in the individual sector chapters (chapters 3-7).

Table ES. 5 Overview of EU-28 GHG emissions in the main source and sink categories 1990 to 2013 in CO_2-equivalent (million tonnes)

GHG SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2010	2011	2012	2013
1. Energy	4 356	4 088	4 018	4 115	3 798	3 650	3 604	3 524
2. Industrial Processes and Product Use	511	491	443	449	376	374	360	360
3. Agriculture	569	495	481	455	442	442	439	441
4. Land-Use, Land-Use Change and Forestry	-260	-282	-311	-321	-314	-316	-312	-318
5. Waste	244	248	235	205	170	164	159	152
6. Other	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Total (with net CO_2 emissions/removals)	**5 421**	**5 040**	**4 866**	**4 903**	**4 472**	**4 315**	**4 250**	**4 159**
Total (without LULUCF)	**5 680**	**5 322**	**5 177**	**5 224**	**4 786**	**4 630**	**4 563**	**4 477**

ES-5 SUMMARY OF EU MEMBER STATE EMISSION TRENDS

Table ES. 6 gives an overview of Member State contributions to EU GHG emissions for 1990–2013. Member States show large variations in GHG emission trends.

Table ES. 6 Overview of Member States' contributions to EU GHG emissions excluding LULUCF from 1990 to 2013 in CO_2-equivalent (million tonnes)

Member State	1990	1995	2000	2005	2010	2011	2012	2013
Austria	79	79	80	92	85	83	80	80
Belgium	147	154	149	145	133	123	119	119
Bulgaria	109	75	60	64	61	66	61	56
Croatia	35	25	27	31	28	28	26	24
Cyprus	6	7	8	10	10	10	9	8
Czech Republic	193	153	146	144	136	135	131	127
Denmark	69	77	70	65	62	57	53	55
Estonia	40	20	17	18	20	20	19	22
Finland	71	72	70	69	76	68	62	63
France	549	548	554	555	516	489	490	490
Germany	1 248	1 120	1 044	993	943	923	928	951
Greece	105	111	128	136	119	116	113	105
Hungary	94	76	74	76	65	64	60	57
Ireland	57	60	69	71	63	59	60	59
Italy	521	533	554	578	506	494	469	437
Latvia	26	13	10	11	12	11	11	11
Lithuania	48	22	20	23	21	21	21	20
Luxembourg	13	10	10	13	12	12	12	11
Malta	2	2	3	3	3	3	3	3
Netherlands	219	231	219	213	214	200	196	196
Poland	474	445	393	398	408	405	399	395
Portugal	60	71	84	88	70	69	67	65
Romania	253	184	141	147	118	123	121	111
Slovakia	76	55	50	52	47	46	44	44
Slovenia	19	19	19	20	19	19	19	18
Spain	291	331	390	441	357	355	349	322
Sweden	72	74	69	67	65	61	57	56
United Kingdom	804	755	720	698	616	570	586	572
EU-28	**5 680**	**5 322**	**5 177**	**5 224**	**4 786**	**4 630**	**4 563**	**4 477**

The overall EU GHG emission trend is dominated by the two largest emitters, Germany (21 %) and the United Kingdom (13 %), accounting for more than one third of total EU-28 GHG emissions in 2013. These 2 Member States have achieved total domestic GHG emission reductions in 2013 of 529 million tonnes of CO_2 equivalent compared to 1990, not counting carbon sinks and the use of Kyoto mechanisms.

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 were 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.

France and Italy were the third and fourth largest emitters in 2013, with a share in the EU total of 11 % and 10 % respectively. Italy's GHG emissions were 16 % below 1990 levels in 2013. Italian GHG emissions increased from 1990 onwards, primarily due to increases in road transport, electricity and heat production, and petroleum refining. However, Italian emissions decreased from 2004 with significant drops in 2009 and 2012, which were also due to the economic crisis and reductions in industrial output during these years. France's emissions were 11 % below 1990 levels in 2013. 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 2013.

Poland and Spain are the fifth and sixth largest emitters in the EU-28, accounting for 9 % and 7 % of total EU-28 GHG emissions in 2013. Spain increased emissions by 11 % between 1990 and 2013. This was largely due to emission increases from road transport, electricity and heat production, and households and services. Poland decreased GHG emissions by 17 % between 1990 and 2013. The main factors for decreasing emissions in Poland — as with 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 OTHER INFORMATION

INTERNATIONAL AVIATION AND MARITIME TRANSPORTATION

Emissions of GHGs from international aviation and shipping activities increased between 1992 and 2007. Emissions decreased between 2007 and 2010 in the EU-28 — partly reflecting the economic recession —increased in 2011 and subsequently decreased again in 2012 and 2013. EU GHG emissions from international aviation are lower than the emissions from international maritime transport, but they were increasing more rapidly until 2007. The average annual EU-28 growth rates in emissions since 1990 were 3 % for aviation and 1 % for maritime transport. CO_2 emissions from international transport reached 271 million tonnes CO_2 equivalent in 2013.

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

INFORMATION ON RECALCULATIONS

As new global warming potentials from the 2006 IPCC guidelines have been used in 2015 for CH_4, N_2O and fluorinated gases the recalculations in GHG emissions are not only the result of methodological changes and revised activity data but also reflect the new global warming potentials.

Due to recalculations based on EU Member States' GHG inventories in 2015, total EU-28 1990 GHG emissions excluding LULUCF have increased in the latest submission, compared to the previous submission, by 1.0 %. EU-28 GHG emissions for 2012 increased by 0.4 % due to recalculations.

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

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 EU ETS for preparing national GHG inventories. 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. 27 Member States indicated that they used ETS data for quality assurance / quality control purposes and checked data consistency between both sources (Section 1.4.2). Croatia joined the EU in July 2013 and has participated in the EU ETS since January 2013. For the 2015 submission, Croatia did not use any ETS data, but has plans to improve its GHG emission estimates with ETS data.

16 Member States indicated that they directly use the verified emissions reported by installations under the ETS. 23 Member States used ETS data to improve country-specific emission factors and 22 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 GHG 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 CRF source categories.

CONTENT

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

Annex 1: Key category analysis

Annex 2: Status and consistency reports

Annex 3: Summary 2

PART 1: ANNUAL INVENTORY SUBMISSION (EU-28)

1 INTRODUCTION TO THE EU GREENHOUSE GAS INVENTORY

According to Decision 13/CP.20 of the Conference of the Parties to the UNFCCC, CRF Reporter version 5.0.0 was not functioning in order to enable Annex I Parties to submit their CRF tables for the year 2015. In the same Decision, the Conference of the Parties reiterated that Annex I Parties in 2015 may submit their CRF tables after 15/April, but no longer than the corresponding delay in the CRF Reporter availability. "Functioning" software means that the data on the greenhouse emissions/removals are reported accurately both in terms of reporting format tables and XML format.

CRF reporter version 5.10 still contains issues in the reporting format tables and XML format in relation to Kyoto Protocol requirements, and it is therefore not yet functioning to allow submission of all the information required under Kyoto Protocol.

Recalling the Conference of Parties invitation to submit as soon as practically possible, and considering that CRF reporter 5.10 allows sufficiently accurate reporting under the UNFCCC (even if minor inconsistencies may still exist in the reporting tables, as per the Release Note accompanying CRF Reporter 5.10), the present report is the official submission of the European Union (EU) to the United Nations Framework Convention on Climate Change (UNFCCC) for the year 2015. The present report is not an official submission under the Kyoto Protocol, even though some of the information included may relate to the requirements under the Kyoto Protocol. The report 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 2013. The GHG inventory data of the Member States are the basis of the EU GHG inventory.

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. As the data used in the EU inventory are the aggregation of the scope-relevant data of the Member States inventories, the detailed sectoral methodologies used in the EU inventory are fully consistent with the methodologies reported by the Member States to the UNFCCC. As such, the complete details on the methodologies used by the Member States is available in the national inventory reports of the Member States, which are submitted to the UNFCCC and published in the UNFCCC website.. Note that all Member States' submissions (common reporting format (CRF) tables and inventory reports), 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 Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC[3]. Decision No 280/2004/EC has been revised in order 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. The emissions compiled in the EU GHG inventory are the sum of the respective emissions in

[3] OJ L 165, 18.06.2013, p. 13.

the respective national inventories, except for the Intergovernmental Panel on Climate Change (IPCC) reference approach for CO_2 from fossil fuels.

The EU-28 Member States are: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. Croatia is the newest Member State and accessed the EU in July 2013. All 28 Member States emissions are represented in the EU inventory under the UNFCCC Convention and the Kyoto Protocol. In addition, the European Union, its Member States and Iceland have agreed to fulfil their quantified emission limitation and reduction commitments for the second commitment period to the Kyoto Protocol, reflected in the Doha Amendment, jointly. In this context, the EU and Iceland are going to report jointly their national greenhouse gases emissions during the second commitment period of the Kyoto Protocol. This joint inventory is expected to be submitted for the first time in 2016, depending on the availability of a functioning CRF Reporter software. As described above, the present report is under the UNFCCC and as such the inventory presented here corresponds to the EU GHG inventory under this scope.

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 Regulation, 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, and with respect to EU legislation for reduction of GHG emissions[4]. For this purpose, the 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 used for the evaluation of actual progress.

The legal basis of the compilation of the EU inventory is Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (hereafter referred to as the Monitoring Mechanism Regulation or MMR) [5]. The MMR establishes a mechanism for inter alia: (1) ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its Member States to the UNFCCC Secretariat; (2) reporting and verifying information relating to commitments of the Union and its Member States pursuant to the UNFCCC, to the Kyoto Protocol and to decisions adopted thereunder and evaluating progress towards meeting those commitments; (3) monitoring and reporting all anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol on substances that deplete the ozone layer in the Member States; (4) monitoring, reporting, reviewing and verifying

[4] Decision No 406/2009/EC

greenhouse gas emissions and other information pursuant to Article 6 of Decision No 406/2009/EC; (5) evaluating progress by the Member States towards meeting their obligations under Decision No 406/2009/EC.

Under the provisions of Article 7 of the MMR, 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 I of the MMR (same as in Annex A to the Kyoto Protocol) for the year X-2, in accordance with UNFCCC reporting requirements
- data in accordance with UNFCCC reporting requirements on their anthropogenic emissions of carbon moNOxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_X) and volatile organic compounds, for the year X-2
- their anthropogenic greenhouse gas emissions by sources and removals of CO_2 by sinks resulting from LULUCF, for the year X-2, in accordance with UNFCCC reporting requirements
- any changes to the information referred to in points above relating to the years between 1990 and the year three-years previous (year X – 3);
- information from their national registry on the issue, acquisition, holding, transfer, cancellation, retirement and carry-over of AAUs, RMUs, ERUs, CERs, tCERs and lCERs for the year X-1;
- 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.

Submissions of updated or additional inventory data and complete national inventory reports by Member States shall be reported by 15 March.

Specific requirements on structure, format, submission processes under the MMR are detailed in an implementing Act since June 2014. According to the MMR and its implementing decisions the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EU and its Member States prepare the inventory according to the relevant provisions under the UNFCCC.

1.2 A description of the institutional arrangements

1.2.1 Institutional, legal and procedural arrangements

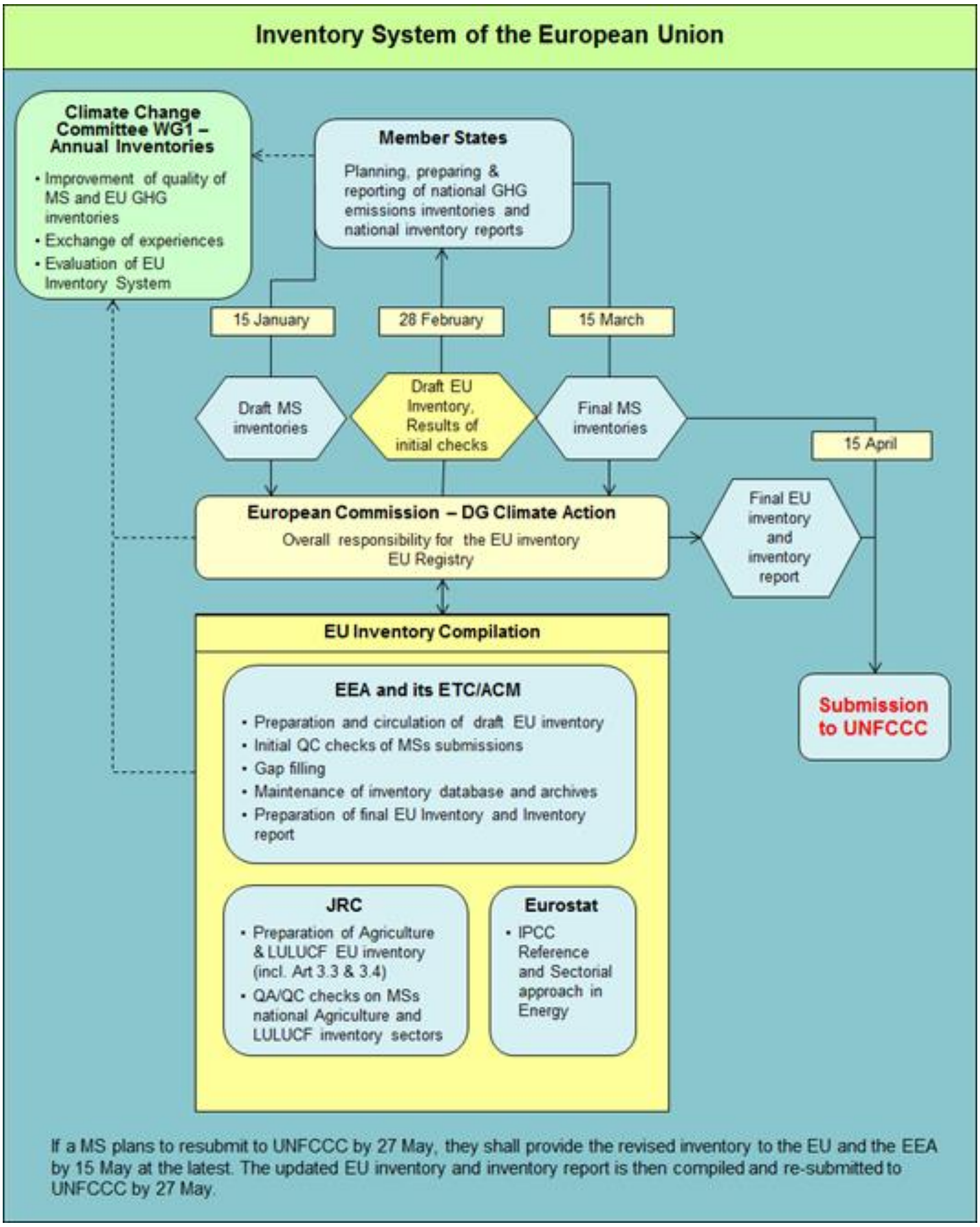
In accordance with the MMR Article 6(1), a Union Inventory system is established to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of national inventories with regard the Union greenhouse gas inventory. The Commission's Staff Working Document (SWD (2013) 308 final[6]) outlines the main elements of the Union inventory system. An overview is presented in Figure 1.1.

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

[6] http://ec.europa.eu/clima/policies/strategies/progress/monitoring/docs/swd_2013_308_en.pdf

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) [7].

In accordance with the MMR Article 6(1), a Union Inventory system is established to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of national inventories with regard the Union greenhouse gas inventory. The Commission's Staff Working Document (SWD (2013) 308 final) outlines the main elements of the Union inventory system. An overview is presented in Figure 1.1 Inventory system of the European Union



[7] 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.

Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EU inventory.

Table 1.1 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	Elisabeth Rigler Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Belgium	Peter Wittoeck Federal Department of the Environment Place Victor Horta 40, B-1060 Bru ssels
Bulgaria	Detelina Petrova Executive Environment Agency 136, Tzar Boris III Blvd. 1618 Sofia
Croatia	Davor Vešligaj Croatian Environment Agency Trg maršala Tita 8 10 000 Zagreb
Cyprus	Theodoulos Mesimeris Head of Climate Action Unit Department of Environment Ministry of Agriculture, Natural Resources and Environment 1498, Nicosia, Cyprus
Czech Republic	Ing. Eva Krtkova Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Denmark	Ole-Kenneth Nielsen Aarhus University Frederiksborgvej 399, PO Box 358, DK-4000 Roskilde
Estonia	Anne Mändmets Adviser, Climate and Radiation Department Tel. +372 626 2817 Fax +372 626 2801 Anne.Mandmets@envir.ee and Ms Ingrid Võrno Senior officer, Climate and Radiation Department Tel. +372 626 2977 Fax +372 626 2801 Ingrid.Vorno@envir.ee Ministry of the Environment Narva mnt 7a 15172 Tallinn Estonia
Finland	Riitta Pipatti Statistics Finland PB 6 A, FIN-00022 Statistics Finland

France	Frédérique Millard Direction Générale de l'Energie et du Climat (DGEC) 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 Arche de La Défense Paroi Nord 92055 La Défense CEDEX and 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	Mr. Kyriakos Psychas Ministry of Environment and Energy, Climate Change Department, 147 Patission st, 11251 Athens, Greece
Hungary	Gábor KIS-KOVACS, Hungarian Meteorological Service, Kitaibel Pál utca 1. Budapest, 1024 Hungary Máté OLTI, Ministry of National Development, Department for Climate Policy, Fő u. 44-50, Budapest, 1011 Hungary
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
Latvia	Agita Gancone Ministry of Environmental Protection and Regional Development Peldu street 25, LV-1494 Riga
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
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
Malta	Krista Rizzo Malta Resources Authority – Climate Change Unit Millennia, 2nd Floor, Aldo Moro Road, Marsa MRS 9065, Malta.

Netherlands	Wim van der Maas National Institute for Public Health and the Environment P.O. Box 1, 3720 BA Bilthoven, The Netherlands
Poland	Anna Olecka National Centre for Emissions Management Institute of Environmental Protection - National Research Institute Chmielna 132/134, 00-805 Warszawa, PL
Portugal	Eduardo Santos Agência Portuguesa do Ambiente, Departamento de Alterações Climáticas (DCLIMA) Rua da Murgueira, 9/9A, 2610-124 Amadora, Portugal
Romania	Sorin Deaconu National Environmental Protection Agency Splaiul Independentei 294, Sector 6, Cod Postal 060841, Bucharest, Romania
Slovakia	Helena Princova Ministry of the Environment of the Slovak Republic Climate Change Department (National Focal Point) Namestie L. Stura 1, 812 35 Bratislava 1, Slovak Republic 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
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 and Ms. Maria Lidén The Swedish Environmental Protection Agency Naturvårdsverket , SE-106 48 Stockholm Sweden
United Kingdom	Joanna MacCarthy, Julia Sussams Department of Energy and Climate Change 3 Whitehall Place, London SW1A 2AW, UK
European Commission	Edoardo Turano European Commission, DG Climate Action Beaulieu, BU-5 2/119, Brussels, Belgium
European Environment Agency (EEA)	Ricardo Fernandez, Spyridoula Ntemiri 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, Elisabeth Rigler 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

1.2.1.1 The Member States

All EU Member States are Annex I parties to the UNFCCC Therefore, all Member States have committed themselves to prepare individual national GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April.

In this context, all Member States are required to establish, operate and seek to continuously improve national inventory systems in accordance to Article 5 of the MMR. Detailed information on institutional arrangements/national systems of each Member State is included in the respective national inventory reports.

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 2006 IPCC Guidelines. 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.

For the EU to be able to provide the GHG inventory to the UNFCCC on time, 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.

After the submission of national GHG inventories and inventory reports, QA/QC checks are performed by the EU team. The outcome of these 'initial checks', together with the draft EU inventory report is sent to Member States for checking, reviewing and providing of comments. The Member States take part in the review and comment phase of the draft EU inventory report. 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, answer to the initial checks findings and send updates, as relevant by the 15th March. In addition, they can comment on the general aspects of the EU inventory report by the same deadline.

During the review of the Union inventory Member States are also required to provide answers related to the issues under their responsibility as soon as possible. In these cases, the issues are forwarded directly as requested by the EU team.

The inventory authorities of the Member States take part in the Working Group 1 'Annual Inventories' (WG1) of the Climate Change Committee established under the MMR. The purpose of the Climate Change Committee is to assist the European Commission in its tasks under the MMR. Information on the WG1 tasks and responsibilities can be found in the next paragraph, but the main task of the WG1 members is to ensure the coordination of inventory activities between the Union system and the national inventory systems.

1.2.1.2 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 the Monitoring Mechanism Regulation 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 26 of the MMR. 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, working groups have been established, one of which is Working Group 1 on 'Annual inventories'. 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.

1.2.1.3 The European Environment Agency

Under MMR Article 24 the role of the European Environment Agency (EEA) is defined as providing assistance to the Commission in its work. In relation to the inventories, this assistance includes the following:

(a) Compilation of the Union greenhouse gas inventory and preparation of the Union greenhouse gas inventory report
(b) Performance of the quality assurance and quality control procedures for the preparation of the Union greenhouse gas inventory
(c) Preparation of estimates for data not reported in the national greenhouse gas inventories

(d) Conduction of the reviews

The tasks of the EEA 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[8] (see http://eionet.eea.europa.eu). Member States report the information reported pursuant to Article 7 of the MMR to the Commission with a copy to the European Environment Agency, and for this reason they are making use of the EEA's ReportNet's Central Data Repository under the Eionet ('CDR', see http://cdr.eionet.europa.eu/).

Apart from the data capturing processes, and as part of its responsibility to compile the GHG inventory and prepare the Union GHG inventory report, the EEA is also performing a number of independent QA/QC checks focused on ensuring the completeness and consistency of the Union and Member States inventories.

Finally, in the end of the process the EEA is publishing the GHG inventory dataset and the EU National Inventory Report at its website. To facilitate the access of the GHG information to the general public, the EEA data viewer is also provided.

The EEA is further assisted by its 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 are further deployed in the next paragraph. I

1.2.1.4 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 2014-2018. The EEA's ETC/ACM involves 14 organisations and institutions in eight European countries. The technical annex for the 2014 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. The specific tasks undertaken by EEA's ETC/ACM include:

- Initial QA/QC checks of Member States' submissions in cooperation with Eurostat, and the JRC, up to 28 February documented in the EEA review tool and compilation of results from initial checks (status and consistency reports);
- consultation with Member States in order to clarify data and other information provided;
- preparation 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);

The EEA's ETC/ACM provides 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

[8] EEA member countries include the EU Member States, Iceland, Liechtenstein, Norway, Switzerland and Turkey.

inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission.

1.2.1.5 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) as amended by Commission Regulation (EU) No 147/2013 of 13 February 2013 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.

1.2.1.6 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://forest.jrc.ec.europa.eu/activities/lulucf/workshops/), dedicated EU-funded projects, the AFOLU database, 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.

1.2.2 Overview of inventory planning, preparation and management

1.2.2.1 A description of the process of inventory preparation

The annual process of compilation of the EU inventory is summarised in Table 1.2. The Member States submit their annual GHG inventory by 15 January each year to the European Commission’s DG Climate Action using the EEA’s Central Data Repository. Then, EEA’s 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 1.2 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	Member States	15 January	Elements listed in Article 7(1) **of**

Element	Who	When	What
(complete common reporting format (CRF) submission and elements of the national inventory report) by Member States under Council Decision No 280/2004/EC			**Regulation (EU) No 525/2013** and **Article 3 of the implementing regulation (EU) No 749/2014**
2. 'Initial checks' of Member States submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	For the Member State submission from 15 January at the latest until 28 February	Initial checks and consistency checks (by EEA). Comparison of energy data provided by Member States **in the CRF** with Eurostat energy data **(sectoral and reference approach) by Eurostat and EEA.** Check of Member States' agriculture and land use, land- use change and forestry (LULUCF) inventories by JRC (in consultation with Member States). **The findings of the initial checks will be documented.**
3. Compilation of draft EU inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft **Union** inventory and inventory report (compilation of Member State information), based on Member State inventories and additional information where needed (as submitted on 15 January).
4. Circulation of 'initial check' findings including notification of potential gap-filling	Commission (DG Climate Action) assisted by the EEA	28 February	Circulation of 'initial check' findings including notification of potential gap-filling and making available the findings
5. Circulation of draft **Union** inventory and inventory report	Commission (DG Climate Action) assisted by the EEA	28 February	Circulation of the draft **Union** inventory on 28 February to Member States. Member States check data.
6. 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 national inventory reports.
7. Member State commenting on the draft Union inventory	Member States	15 March	If necessary, provide corrected data and comments to the draft Union inventory
8. Member State responses to the 'initial checks'	Member States	15 March	Member States respond to 'initial checks' if applicable.
9. Circulation of follow-up initial check findings	Commission assisted by EEA 31 March	Commission assisted by EEA 31 March	Circulation of follow-up initial check findings and making available the findings
10. Estimates for data missing from a national inventory	Commission (DG Climate	31 March	The Commission prepares estimates for missing data by 31 March of the

Element	Who	When	What
	Action) assisted by EEA		reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
11. Comments from Member States regarding the Commission estimates for missing data	Member States	7 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
12. Member States responses to follow-up 'initial checks'	Member States	7 April	Member States provide responses to follow up of 'initial checks'.
13. Member States submissions to the UNFCCC	Member States	15 April	Submissions to the UNFCCC (with a copy to EEA)
14. Final annual Union inventory (incl. EU inventory report)	Commission (DG Climate Action) assisted by EEA	15 April	Submission to UNFCCC of the final annual Union inventory.
15. Any resubmissions by Member States	Member States	By 8 May	Member States provide to the Commission the resubmissions which they submit to the UNFCCC secretariat. The Member States must clearly specify which parts have been revised in order to facilitate the use for the **Union** resubmission. Resubmissions should be avoided to the extent possible. As the Union resubmission also has to comply with the time-limits specified in the guidelines under Article 8 of the Kyoto Protocol, the Member States have to send their resubmission, if any, to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, provided that the resubmission corrects data or information that is used for the compilation of the Union inventory.
16. **Union** inventory resubmission in response to Member States' resubmissions		27 May	If necessary, resubmission to UNFCCC of the final annual **Union** inventory.
17. 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 8 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://www.eea.europa.eu/data-and-maps/data/national-emissions-reported-to-the-unfccc-and-to-the-eu-greenhouse-gas-monitoring-mechanism-9) and the EEA GHG data viewer (http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer

Table 1.3 summarises timeliness and completeness of the EU-28 Member States' submissions in 2015. It shows that GHG inventories for 2013 were submitted by all EU-28 Member States by 3 November 2015 (cut off date for the 27 November submission).

Table 1.3 Date, mode and content of submissions of EU-28 Member States in 2015 (status 4 Nov 2015)

Country	Date	Submission mode	XML	CRF	NIR
AUT	29.06.2015	CDR	simple_8013085495378084601.xml	1990-2013	x
AUT	22.07.2015	CDR	-	-	x
AUT	30.10.2015	CDR	simple_1345698615881126647.xml	1990-2013	x
BEL	29.06.2015	CDR	simple_4473311346231660858.xml	1990-2013	x
BEL	30.10.2015	CDR	simple_3500067883939135602.xml	1990-2013	x
BEL	04.11.2015	CDR	-	-	x
BGR	27.06.2015	CDR	simple_7586118752194082909.xml	1988-2013	x
BGR	31.08.2015	CDR	simple_5203999165270277608.xml	1988-2013	x
BGR	30.10.2015	CDR	simple_8445516256508328473.xml	1988-2013	x
CYP	30.06.2015	CDR	simple_8682880898091348029.xml	1990-2013	x
CYP	30.10.2015	CDR	simple_2658845419430769631	1990-2013	
CZE	29.06.2015	CDR	simple_3492941814253666890.xml	1990-2013	x
CZE	29.10.2015	CDR	simple_4004694444855193020.xml	1990-2013	x
DEU	29.06.2015	CDR	-	Summary 2	-
DEU	03.07.2015	CDR	-	-	-
DEU	10.07.2015	CDR	simple_4008967466329003986.xml	1990-2013	x
DEU	28.08.2015	CDR	simple_5207639283477645507.xml	1990-2013	x (de)
DEU	29.10.2015	CDR	simple_3799063651507324054.xml	1990-2013	x (de)
DNM	29.06.2015	CDR	simple_5166075134874846545.xml	1990-2013	x
DNM	31.08.2015	CDR	simple_7449589042214668230.xml	1990-2013	x
DNM	30.10.2015	CDR	simple_3372092682577950862.xml	1990-2013	
EST	29.06.2015	CDR	simple_8889627521654742231.xml	1990-2013	x
EST	30.10.2015	CDR	simple_4140435107663707188.xml	1990-2013	x
ESP	29.06.2015	CDR	ES-2015-J-CRF-XML.xml	1990-2013	x (es)
ESP	28.08.2015	CDR	simple_7103359536183239690.xml	1990-2013	x (es)
ESP	30.10.2015	CDR	simple_1814098921596662932.xml	1990-2013	x (es)
FIN	26.06.2015	CDR	simple_2723711541690672585.xml	1990-2013	x
FIN	07.07.2015	CDR	-	-	-
FIN	31.08.2015	CDR	simple_7113754322726285424.xml	1990-2013	x
FIN	30.10.2015	CDR	simple_898543970408300254.xml	1990-2013	x
FRK	29.06.2015	CDR	FRK_2015_29062015_started_simple_XML.xml	1990-2013	x (fr)
FRK	28.08.2015	CDR	FRK_2015_24082015_without Mayotte.xml	-	-
FRK	26.08.2015	CDR	-	-	x
FRK	28.08.2015	CDR	-	-	-
FRK	28.08.2015	CDR	simple_2868048229955702622.xml	1990-2013	-
FRK	27.10.2015	CDR	-	-	-
FRK	27.10.2015	CDR	simple_6726714873249737575.xml	1990-2013	-
FRK	27.10.2015	CDR	-	-	x (fr)
GBE	26.06.2015	CDR	simple_8827449771880908970.xml	1990-2013	x
GBE	30.10.2015	CDR	simple_9198587891601713915.xml	1990-2013	x
GRC	30.06.2015	CDR	-	Summary 2	-
GRC	15.07.2015	CDR	simple_4183852594014087539.xml	1990-2013	-
GRC	21.07.2015	CDR	-	-	-
GRC	03.11.2015	CDR	simple_2127962130572695390.xml	1990-2013	-
HRV	30.06.2015	CDR	simple_9175387789924032459.xml	1990-2013	x
HRV	31.08.2015	CDR	simple_7808188298779801284.xml	1990-2013	-
HRV	30.10.2015	CDR	simple_3475693538732670060.xml	1990-2013	x

Country	Date	Submission mode	XML	CRF	NIR
HUN	07.07.2015	CDR	simple_3711676357573152539.xml	1986-2013	x
HUN	31.08.2015	CDR	simple_5968412547613363623.xml	1986-2013	x
HUN	30.10.2015	CDR	simple_5775527972631102764.xml	1986-2013	x
IRL	29.06.2015	CDR	simple_7239463876451387620.xml	1990-2013	-
IRL	30.10.2015	CDR	simple_7966037131739933787.xml	1990-2013	-
ITA	06.07.2015	CDR	simple_8541875910128292001.xml	1990-2013	-
ITA	04.09.2015	CDR	-	-	-
ITA	30.10.2015	CDR	-	-	x
ITA	30.10.2015	CDR	simple_3795885087537442928.xml	1990-2013	-
ITA	30.10.2015	CDR	-	-	-
LTU	30.06.2015	CDR	simple_347815947630251498.xml	1990-2013	-
LTU	31.08.2015	CDR	simple_2443220190734301947.xml	1990-2013	x
LTU	30.10.2015	CDR	simple_3312650100021755653.xml	1990-2013	x
LUX	03.07.2015	CDR	simple_9191497736021784817.xml	1990-2013	-
LUX	30.10.2015	CDR	simple_1238877449548250409.xml	1990-2013	-
LVA	30.06.2015	CDR	simple_4942955350717305469.xml	1990-2013	x
LVA	30.10.2015	CDR	simple_7055915794641420875.xml	1990-2013	x
MLT	02.07.2015	CDR	simple_1228134346519034647.xml	1990-2013	
MLT	31.08.2015	CDR	simple_2490631613950442950.xml	1990-2013	x
MLT	30.10.2015	CDR	simple_949396363594311138.xml	1990-2013	x
NLD	06.07.2015	CDR	simple_7549795155010120571.xml	2013	-
NLD	20.07.2015	CDR	simple_6211775632249572430.xml	1990-2013	
NLD	31.08.2015	CDR	simple_1287708417668215370.xml	1990-2013	x
NLD	30.10.2015	CDR	simple_4908290667307075030	1990-2013	
NLD	02.11.2015	CDR	-	-	x
POL	30.06.2015	CDR	simple_5071334679453915778.xml	1988-2013	
POL	31.08.2015	CDR	simple_8852593765628644232.xml	1988-2013	
POL	30.10.2015	CDR	simple_2418110458236086739.xml	1988-2013	x
PTR	30.06.2015	CDR	simple_938960316083731336.xml	1990-2013	x
PRT	31.08.2015	CDR	simple_8510567729766953092.xml	1990-2013	x
PRT	01.09.2015	CDR	-	-	x
PRT	30.10.2015	CDR	simple_967552555777489081.xml	1990-2013	x
ROU	01.07.2015	CDR	simple_453632191335335901.xml	1989-2013	
ROU	10.07.2015	CDR	-	-	-
ROU	22.07.2015	CDR	-	-	-
ROU	30.10.2015	CDR	-	-	-
ROU	30.10.2015	CDR	simple_2706541552709224468.xml	1989-2013	x
SWE	29.06.2015	CDR	simple_1688675901722766067.xml	1990-2013	x
SWE	29.10.2015	CDR	simple_4750648275151897473.xml	1990-2013	x
SVN	29.06.2015	CDR	SVN_simpleXML_2015.xml	1986-2013	x
SVN	30.10.2015	CDR	simple_4447569107164616026.xml	1986-2013	x
SVK	29.06.2015	CDR	simple_8569909840503106062.xml	1990-2013	x
SVK	31.08.2015	CDR	simple_1436327122206131977.xml	1990-2013	x
SVK	30.10.2015	CDR	simple_3607435682037700338.xml	1990-2013	x

Table 1.4 gives an overview on people involved in the compilation of the EU GHG inventory submission in 2015 and their individual responsibilities in this process.

Table 1.4 Responsibility list for the compilation of the EU GHG inventory submission in 2015

	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
	Edoardo Turano (DG Clima) Edoardo.TURANO@ec.europa.eu	X			Chapter 13 Changes national system	X		**QA NIR** Executive summary, chapter 1	
European Commission	Velina Pendolovska (DG Clima) velina.pendolovska@ec.europa.eu	X			Chapter 13 Changes national system	X		**QA NIR** Executive summary, chapter 1	
	Ronald Velghe (DG Clima) ronald.velghe@ec.europa.eu			Chapter 12 Kyoto units, Chapter 14 Changes to registry				SEF tables	
	Breffni Lynch (DG CLIMA) breffni.lynch@ec.europa.eu				Chapter 12 Kyoto units, Chapter 14 Changes to registry				
	Adrian Leip (JRC) adrian.leip@jrc.ec.europa.eu			3					3
	Janka Szemesova (JRC) janka.szemesova@shmu.sk				3			**QA NIR + QA initial checks sector Agriculture**	
	Gema Carmona (JRC) gema.carmona-garcia@jrc.ec.europa.eu				3				
	Giacomo Grassi (JRC) giacomo.grassi@jrc.ec.europa.eu							**QA NIR + initial checks** sector **LULUCF** and **KP-LULUCF**	
	Tibor Priwitzer (JRC) tibor.priwitzer@jrc.ec.europa.eu				LULUCF and KP LULUCF				LULUCF and KP LULUCF
	Raul Abad-Vinas (JRC) raul.abad-vinas@jrc.ec.europa.eu			LULUCF and KP LULUCF			LULUCF and KP LULUCF		
	Michael Goll (Eurostat) Michael.Goll@ec.europa.eu			1A Reference approach				1A Reference approach	

	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
EEA and ETC-ACM	Ricardo Fernandez (EEA) ricardo.fernandez@eea.europa.eu	X			1A Reference approach	X		**QA NIR** Executive summary, chapter 1	
	Spyridoula Ntemiri (EEA) spyridoula.ntemiri@eea.europa.eu	X			F-gases	X		**QA NIR** Executive summary, chapter 1,	F-gases
	David Simoens (EEA) david.simoens@eea.europa.eu				Provision of Member States compiled data files			QA/QC of MSs inventories and Union inventory compilation (consistency checks)	
	Michael Gager (ETC-ACM; UBA-V) michael.gager@umweltbundesamt.at				Data capture, provision of tools for QA/QC, inventory compilation				Inventory compilation
	Bernd Gugele (ETC-ACM, UBA-V) bernd.gugele@umweltbundesamt.at				1A1, 1A2, 1A4, 1A5			QA/QC UBA work	1A Reference approach
	Nicole Mandl (ETC-ACM, UBA-V) nicole.mandl@umweltbundesamt.at		X				X		
	Lorenz Moosmann (ETC-ACM, UBA-V lorenz.moosmann@umweltbundesamt.at			2C, 2D, 2G, 2H				2C, 2D, 2G, 2H	
	Katja Pazdernik (ETC-ACM; UBA-V) katja.pazdernik@umweltbundesamt.at							**QA initial checks** sector Waste	
	Marion Pinterits (ETC-ACM; UBA-V) marion.pinterits@umweltbundesamt.at			1B, 1C	Chapters 1 & 10, support UBA work			1B, 1C	
	Stephan Poupa (ETC-ACM; UBA-V) stephan.poupa@umweltbundesamt.at			1A2, 1A4, 1A5				1A2, 1A4, 1A5	
	Maria Purzner (ETC-ACM; UBA-V) maria.purzner@umweltbundesamt.at				2C, 2D, 2G, 2H			**QA initial checks** sector IPPU - f-gases only	2C, 2D, 2G, 2H

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
Carmen Schmid (ETC-ACM; UBA-V) carmen.schmid@umweltbundesamt.at			1A1				1A1	
Bernhard Ullrich (ETC-ACM; UBA-V) bernhard.ullrich@umweltbundesamt.at				support UBA work				
Andreas Zechmeister (ETC-ACM; UBA-V) andreas.zechmeister@umweltbundesamt.at				Chapter 1 Uncertainties			Chapter 1 Uncertainties	
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
Barbara Gschrey (ETC-ACM; Oeko Recherche) b.gschrey@oekorecherche.de			F-gases				F-gases	
Winfried Schwarz (ETC_ACM; Oeko Recherche) w.schwarz@oekorecherche.de				F-gases				F-gases
Margarethe Scheffler (ETC-ACM; Oeko) m.scheffler@oeko.de			5				5	
Anke Herold (ETC-ACM; Oeko) a.herold@oeko.de				Chapter 3.14 Coordinate Oeko work, QA/QC			QA/QC Oeko work	
Graham Anderson (ETC-ACM; Oeko) g.anderson@oeko.de			2A, 2B				2A, 2B	
Sabine Gores (ETC-ACM; Oeko) s.gores@oeko.de				1A3a + Aviation bunkers comparison with Eurocontrol				1A3a + Aviation bunkers comparison with Eurocontrol
Ralph Harthan (ETC-ACM; Oeko) r.harthan@oeko.de							**QA initial checks:** sector Energy	
Lukas Emele (ETC-ACM; Oeko) l.emele@oeko.de			EU ETS					
Kristien Aernouts (ETC-ACM; VITO) kristien.aernouts@vito.be							**QA NIR**: sector Energy	

	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
	Ils Moorkens (ETC-ACM; VITO) ils.moorkens@vito.be							**QA NIR** (IPPU) **and initial checks** sector IPPU (excl f-gases)	
	Kaat Jespers (ETC-ACM; VITO) kaat.jespers@vito.be							**QA NIR**: sector Waste	

1.2.3 Quality assurance, quality control of the European Union inventory

1.2.3.1 Quality assurance and quality control procedures in the EU

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 EU QA/QC programme is established in Chapter II of the Commission's Staff Working Document (SWD(2013) 308). In the EU QA/QC programme the general responsibilities for the QA/QC are defined as follows:

- The Member States are responsible for the quality of activity data, emission factor and other parameters used for their inventories, for adherence to the IPCC methodologies and the establishment of the national QA/QC programmes. As EU Member States inventories form part of the EU inventory submission information on the individual Member States QA/QC procedures can be found in their national inventory reports.
- The European Commission (DG Clima) is responsible for setting up the QA/QC Programme, ensuring the establishment and fulfilment of its objectives and ensuring the development of a QA/QC plan.
- The EEA, together with its ETC/ACM, are responsible for the practical implementation and coordination of QA/QC procedures for the Union inventory, as well as for the archiving and documentation.

The following part focuses on QA/QC procedure at EU level.

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 quality objectives are implemented via the QA/QC plan that, among others, aims at ensuring the consistency of the Union inventory with the sum of Member States inventories so that the inventory is complete in terms of both geographical and sectoral coverage. The QA/QC plan describes the quality control procedures that take place before the EU inventory compilation, for checking the consistency, completeness and correctness of the Member States inventories, as well as during the compilation of the EU GHG inventory, for ensuring the correctness of the EU data prior to its submission. 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 also included.

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 fulfils the requirements of EN ISO/IEC 17020 (Type A); 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 and supporting processes) of the quality management system (Table 1.5).

Table 1.5 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		

Chapter		Chapter description
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:

QUALITY CONTROL MS SUBMISSIONS

The QC activities of MS submissions include:

Completeness checks

- Check if all gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3) are available for all years
- Check correct use of notation keys related to completeness
- Check blank cells

Time series checks

- Check time series of emissions:
- Check time series of implied emission factors:
- Check if previous year values have been used in latest submission

Comparisons of implied emission factors across Member States

Check use of 'Not Estimated' and other notation keys

- Check categories where a MS report the notation key "NE" and where the current guidelines include methods/emission factors
- Check categories where MS report a notation key ("NE", "NO", "NA", "IE") and >= 20 MS report emissions
- Check categories where MS report "NE" and in the previous years they reported emissions

Recalculations

- Check recalculations at Summary 2 level compared to previous year submission
- Check recalculations at more detailed category level compared to submission of the same year

EU ETS

- Check of consistency/transparency of EU ETS data with the CRF

Eurostat energy data

- Check of consistency of Eurostat energy data with the CRF

Recommendations

- Check whether recommendations from earlier Union or UNFCCC reviews, not implemented by the Member State could potentially lead to a technical correction

Potential over- and underestimations in key categories

- Assess whether there are potential overestimations or underestimations relating to a key category in a Member State's inventory ; a guidance is needed in order to support sector experts in their conclusion on potential overestimations or underestimations

For the communication with Member States and the documentation of the observations made by sector experts during the 'initial checks' phase the EEA Emission Review Tool (EMRT; https://emrt.eea.europa.eu/) is used. For this reason Member States nominations have been made to DG Clima and the EEA. The workflow in the tool allows the implementation of the 'four-eye' principle since the questions of the 'sectoral experts' are approved by the 'quality experts' team. Issues related to 'completeness', especially the ones that might need to be followed up by 'gap filling procedures' are also highlighted. All the issues identified in the EMRT are archived and can be accessed by the future EU sectoral and quality experts in the annual QA/QC procedures, to avoid repetition of questions on known issues.

According to the timeline provided above, the checks and the communication in the EMRT is performed between 28 February and 15th March. By 15th March Member States can resubmit their inventories, also for correcting issues that came up in the initial checks. In order to follow up with the cases of increased significance, as defined in the MMR, all the tools supporting the checks are re-produced and the findings in the EMRT are followed up.

In particular, Member States are asked to check:

1. whether the status and consistency 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 and consistency reports of the Member States' submissions are included in Annex 1.3 of this report.
2. the QA/QC findings flagged in the EMRT.
3. if the correct data/information has been included in the draft CRF tables/draft inventory report.

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

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 implemented 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.
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 (see chapter 1.7.1).

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

1. Member States are required by the Monitoring Mechanism Regulation 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 and consistency 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 IX of the Implementing Regulation, the Draft EU inventory is 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. 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 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 peer 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 EU sector experts using the UNFCCC outlier tools and other QA/QC tools. 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 and consistency reports are completed. In addition it is checked if issues identified in the status and consistency 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.

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 versions 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. These checking procedures are performed by the EEA and the results are shared with the ETC/ACM and are archived. Comments to these results are then provided and used as relevant for approving the inventory prior to its submission. All the checks are carried out for the original submission by 15 April each year and for any resubmission. Two checklists from the QA/QC manual are used for this purpose: 'Inventory preparation/consistency' and 'Data file integrity'.

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. Since 2014 the EU team has also been reinforced by 'quality control' experts who have the additional task of reviewing the content and the consistency between the CRF data and tables and the NIR.

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 which 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.

EU peer 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 WG1 and normally 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.

In 2014, such activities included the identification of areas where inconsistent reporting may take place between the different Member States, in case where the 2006 IPCC Guidelines are not sufficiently clear, and discussions on how the ETS data are used in the inventories. These discussions are expected to be followed up in 2016, after analysing the first reporting of the Member States.

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 is coordinated by the EEA, and is carried out in two steps: Step 1 is implemented by the EU team and makes uses of the procedures available in the EU QA/QC system taking into account both the existing quality assurance/quality control procedures for Member States' emission inventory submissions under the MMR and the separate inventory review process occurring under the UNFCCC. The Step 2 is implemented by independent review teams comprising of lead reviewers and sector experts. This team reviews all 28 EU Member States in annual and a centralized reviews (2012, 2016 and X). In both Steps the review is coordinated by the EEA as the ESD review secretariat.

Further information on the ESD review can be found in the MMR (Article 19) and its implementing act (Chapter III)

The reviews 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 the years after.

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

Annual ESD review

From 2015 onwards the GHG emission inventories are reviewed annually in the context of the "ESD review". Decision 406/2009/EC, also called the Effort Sharing Decision (ESD) lays down emission limits for 2020 in relation to 2005 for sectors not covered by the EU emissions trading scheme in the 28 EU-Member States (MS). The MMR enhanced the reporting rules on GHG emissions to meet reporting requirements to the UNFCCC Secretariat and introduced requirements concerning the monitoring, reporting, reviewing and verifying of GHG emissions and other information pursuant to Article 6 of the Effort Sharing Decision.

The ESD and the MMR introduced an annual compliance cycle requiring a review of Member States' greenhouse gas inventories within a shorter time frame than the current UNFCCC inventory review to enable the use of flexibilities and the application of corrective action, where necessary, at the end of each relevant year.

Article 19 of the MMR establishes an EU-internal review process to ensure that compliance with annual GHG emission limits is assessed in a credible, consistent, transparent and timely manner. The reviewed inventory data will be used to check Member States' compliance with their annual ESD targets. There are two types of reviews: annual and comprehensive. Comprehensive reviews will be carried out in 2016 and 2022 – for all other years an annual review is carried out. The annual review consists of two steps. The first step verifies the transparency, accuracy, consistency, comparability and completeness of the national inventory data. The checks of step 1 are made by the same team that carries out the initial checks before the compilation of the EU GHG inventory. If the first step of the annual review reveals a significant issue as defined by Article 19(4) of the MMR, such as overestimations or underestimations relating to a key category in a Member State's inventory, a review team performs the second step checks of the national inventory data of this Member State to identify cases where inventory data is prepared in a manner which is inconsistent with UNFCCC guidance documentation or Union rules. Where appropriate, the review team calculates the resulting technical corrections, in consultation with the concerned Member State, to correct originally submitted estimates.

In 2015, due to the problems with the CRF reporting software the annual review had to be postponed to 2016. However, the European Commission decided to organize a trial review in order to support Member States in improving their GHG inventories and to gain experience organizing reviews and reviewing under the new guidelines. In 2015, step 1 checks were made for all 28 Member States whereas step 2 was carried out only for 18 Member States which volunteered to participate in step 2.

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 WG1, including identification and documentation of follow-up actions that are considered as necessary within WG1;
- 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.

Improvement plan

Based on the findings of the UNFCCC reviews, the EU peer review, and the EU ESD 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.

1.2.3.2 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.

A number of other workshops and expert meetings have been organised in recent years with a focus on sector-specific quality improvements. Table 1.6 lists the most recent workshops.

Table 1.6 Overview of workshops and expert meetings organised under the EU GHG Monitoring Mechanism

Workshop/expert meeting	Date and venue
JRC technical workshop on LULUCF reporting under the Kyoto Protocol,	26-27 May 2015 Arona (NO) Italy.
Improving national GHG inventories for the agriculture sector	5 Nov 2014, Seventh International Symposium on Non-CO_2 GHG (NCGG7), Amsterdam

Workshop/expert meeting	Date and venue
JRC technical workshop on LULUCF reporting under the Kyoto Protocol,	05-07 May 2014, Arona (NO), Italy.
II JRC technical workshop on LULUCF reporting under the Kyoto Protocol,	04-06 November 2013, Arona (NO), Italy.
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

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 Commission are all available at: http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/

Finally, in 2014 DG CLIMA launched a project to ensure the continued provision of capacity-building support to EU Member States for implementing the transition to the new 2006 IPCC Guidelines for their greenhouse gas inventory preparation in 2015.

1.2.4 Changes in the national inventory arrangements since previous annual GHG inventory submission

There have been no major changes to the structure and functioning of the EU national inventory arrangements.

1.3 Inventory preparation and data collection, processing and storage

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/CP/2013/10/Add.3), to the extent possible. In addition, the *2006 IPCC guidelines for national greenhouse gas inventories* have been applied where appropriate and feasible. Finally, for the compilation of the EU GHG inventory, the Monitoring Mechanism Regulation and its implementing legislation is applicable.

The EU-28 GHG inventory is compiled on the basis of the inventories of the 28 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 28 Member States. For the reporting under the KP, this is also valid for the base year estimate of the EU-as fixed in the initial review report. As the information the initial report for the CP2 has not been included by the time of writing this report, this information cannot be provided yet.

The reference approach is calculated for the EU-28 on the basis of Eurostat energy data (see Section 3.6) and the key category analysis (Section 1.5) is separately performed at EU-28 level[9].

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

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-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-28 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 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” or in categories that do not have standardized UIDs which then need to be included in the CRF reporter manually.

1.4 Brief general description of methodologies (including tiers used) and data sources used

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

1.4.1.1 Overview

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, based on Directive 2003/87/EC (European Community 2003). The European emissions trading

[9] 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.

system (EU ETS) covers around 11,200 installations in 31 participating countries. Besides the 28 Member States of the European Union, Norway, Iceland and Liechtenstein joined the EU ETS in 2008.

Emissions trading under the EU ETS has taken place in three ‘trading periods’ so far (2005–2007, also referred to as Phase I; 2008–2012 or Phase II; 2013–2020 or Phase III). The EU ETS Directive was amended in 2009 to improve and extend the EU ETS. The main changes in the third trading period compared to previous trading periods are:

- A single, EU-wide cap on emissions applies in place of the previous system of national caps;

- Auctioning, not free allocation, is the default method for allocating allowances. For allowances allocated for free, harmonised allocation rules apply which are based on EU-wide benchmarks of emissions performance;

- Inclusion of additional activities and gases, such as N_2O from production of nitric, adipic, glyoxal and glyoxylic acid production, PFCs and CO_2 from primary and secondary aluminium production, CO_2 from production and processing of ferrous metals and non-ferrous metals, CO_2 from manufacture of mineral wool, CO_2 from drying and calcination of gypsum or plaster boards, CO_2 emissions from carbon back production, CO_2 from ammonia production, CO_2 from bulk organic chemicals production, CO_2 from hydrogen production, CO_2 from soda ash and sodium bicarbonate production and CO_2 from CO_2 capture, transport and storage in storage sites).

- The aviation sector has been included in the EU ETS since 1 January 2012. The aviation sector, in the EU ETS context covering flights internal to the European Economic Area, has a separate cap to power stations and other fixed installations which is reduced at a slower rate. Surrender of emission allowances and reporting for 2013 is not required until 2015, and the inclusion of flights to and from countries outside the European Economic Area has been postponed until after 31st December 2016 (EU 2014);

- Regulations for accreditation and verification (EU 2012a) and for monitoring and reporting were adopted (EU 2012b).

Articles 14 and 15 of the Emission Trading Directive require Member States to ensure that emissions are monitored, reported and verified in accordance with legal requirements in the monitoring and reporting regulation (MRR) (EU 2012b) and in the accreditation and verification regulation (AVR) (EU 2012a), starting from 1 January 2013 (Phase III). All installations covered by the EU ETS have been required to monitor and report their emissions annually. Data for the installations covered by the EU ETS are reported by operators to national competent authorities based on a monitoring plan, elaborated by the operator and approved by the national competent authority, in accordance with the methodologies established in the monitoring and reporting regulation. The reported emissions for each installation are included in an annual emission report that must be verified by accredited verifiers in accordance with the provisions of the regulation on the verification of GHG emission reports (EU 2012a).

Similar to the IPCC 2006 Inventory Guidelines, the EU ETS monitoring and reporting regulation is based on a tier system which defines a hierarchy of different ambition levels for methods, activity data, calculation factors (such as emission factors, oxidation or conversion factors). The operator must, in principle, apply the highest tier level established in the MRR for his installation category, unless he can demonstrate to the competent authority that this is technically not feasible or would lead to unreasonably high costs. The operator must periodically prepare and submit to the competent authorities an improvement report, aiming at improvement of the accuracy of the greenhouse gas emissions.

Thus, the EU ETS generates an EU-28 data set on verified installation-specific emissions for the sectors covered by the scheme. For 2014 the main activities, number of entities and verified emissions reported under the EU ETS are presented in Table 1.7.

Table 1.7 Activities and emissions covered by the EU ETS in 2014

Main activity	**Activity code**	**Number of entities**	**Verified emissions ($Mt\ CO_2$-eq.)**
Combustion of fuels	20	6,629	1,218
Refining of mineral oil	21	143	127
Production of coke	22	21	10
Metal ore roasting or sintering	23	10	3
Production of pig iron or steel	24	257	114
Production or processing of ferrous metals	25	229	12
Production of primary aluminium	26	32	7
Production of secondary aluminium	27	27	1
Production or processing of non-ferrous metals	28	82	7
Production of cement clinker	29	259	119
Production of lime, or calcination of dolomite/magnesite	30	319	33
Manufacture of glass	31	360	18
Manufacture of ceramics	32	969	13
Manufacture of mineral wool	33	48	2
Production or processing of gypsum or plasterboard	34	37	1
Production of pulp	35	147	5
Production of paper or cardboard	36	619	22
Production of carbon black	37	10	1
Production of nitric acid	38	33	4
Production of adipic acid	39	3	0
Production of glyoxal and glyoxylic acid	40	1	0
Production of ammonia	41	26	20
Production of bulk chemicals	42	425	42
Production of hydrogen and synthesis gas	43	41	9
Production of soda ash and sodium bicarbonate	44	14	3
Capture of greenhouse gases under Directive 2009/31/EC	45	1	0
Other activity opted-in under Art. 24	99	466	22
All stationary installations		**11,208**	**1,813**

Source: EEA, 2015, Table A1.1, p. 36

1.4.1.2 Mapping table between EU ETS activities and CRF categories

The previous review of the EU GHG inventory recommended including in the NIR a table indicating the mapping between the EU ETS activities and the IPCC/CRF categories, with supporting comments. Such table is provided below based on the scope of the EU ETS in the third phase and the CRF categories based on the revised UNFCCC reporting guidelines (decision 24/CP.19) that implemented the 2006 IPCC Guidelines.

The legal framework defining the scope and the methodologies for the reporting of greenhouse gas emissions under the EU ETS presents differences compared to the 2006 IPCC guidelines. These differences lead to a different way of reporting emissions under the EU ETS and in the GHG inventory. Some of these differences may also prevent inventory compilers from using verified emissions reported under the EU ETS directly for emission reporting in the national GHG inventory. In order to use greenhouse gas emissions reported under the EU ETS in the national inventories, the inventory compilers need to deal with these differences.

Table 1.8 Mapping table outlining the correspondence of CRF categories related to the EU ETS activities

EU ETS activity	CRF category	Comment
20 Combustion of fuels	1.A.1.a Public electricity and heat production 1.A.1.b Petroleum refining 1.A.2.a Iron and steel 1.A.2.b Non-ferrous metals 1.A.2.c Chemicals 1.A.2.d Pulp, paper and print 1.A.2.e Food processing, beverages and tobacco 1.A.2.f Non-metallic minerals 1.A.2.g Other 1.A.3.e Other transportation (pipeline transport) 1.A.4.a Commercial/ Institutional 1.A.4.c Agriculture/ Forestry / Fisheries 1.B Fugitive emissions from fuels	• For standalone combustion installations, EU ETS covers combustion of fuels in installation with a total rated thermal input exceeding 20 MW. For GHG inventories no such threshold applies. • In the GHG inventory, emissions are classified based on the purpose of the combustion activity, while such a differentiation does not exist in the definition of EU ETS activities. • Installations for the incineration of hazardous or municipal waste are excluded in the definition of 'combustion activities' under the EU ETS, but included in GHG inventories. Installations used for research, development and testing of new products and processes are also not covered by the ETS Directive according to Annex I paragraph 1. • In the EU ETS an installation with different types of activities is classified according to the activity with predominant emissions, while in the inventory such activities should be reported in separate categories if so defined. This difference mostly applies in cases of large integrated installations. • Usually a very small share of EU ETS emission from fuel combustion falls in the category of 1.A.4.a Commercial/ Institutional and 1.a.4.c Agriculture/ Forestry/ Fisheries as installations in these sectors mostly are below the EU ETS threshold. •
21 Refining of mineral oil	1.A.1.b Petroleum refining 1.A.1.c Manufacture of solid fuels and other energy industries 1.A.2.c Chemicals 1.B.2.c Venting and flaring 1.B.2.a.iv Fugitive emissions from oil refining/ storage 2.B.8 Petrochemical and carbon black production	EU ETS activity covers CO_2 emissions from combustion and also fugitive and process emissions. Emission sources reported under these activities are allocated to different CRF categories in the inventory: • Combustion emissions →1.A.1.b Petroleum refining • Flaring emissions → 1.B.2.c Venting and flaring • Refining → 1.B.2.a.iv Oil Refining/ storage • Hydrogen production → may be reported in 1.B.2.a.iv refining/ storage or in 2.B.10 Other chemical industry • Coke production / calcination → 1.A.1.c.i Manufacture of solid fuels • Flue gas scrubbing → 1.A.1.b Petroleum refining • Gasification of heavy fuel oil, methanol production → 2.B.8 Petro-chemical and carbon black production • Production of terephtalic acid → 2.B.10 Other chemical industry • Claus plants → 1.A.1.b Petroleum refining
22 Production of coke	1.A.1.c Manufacture of solid fuels and other energy industries 1.B Fugitive emissions 1.A.2 Manufacturing Industries 2.C.2 Iron and Steel	• Scopes of EU ETS and 2006 IPCC Guidelines are generally consistent, however EU ETS emissions may be allocated to several CRF categories in the inventory. • The use of mass balance approaches in integrated iron and steel installations may complicate allocation between iron and steel categories and coke production.

EU ETS activity	CRF category	Comment
23 Metal ore roasting or sintering, including palletisation	1.A.2a Iron and steel 2.C.1 Iron and steel production 2.C.5 Lead production 2.C.6 Zinc production 2.C.7 Other metal production	• No clear separate category for this EU ETS activity in the inventory, allocation depends on the metal type • Combustion emissions should be allocated to 1.A.2a Iron and steel • Process emissions should be allocated to 2.C.1 Iron and steel production or other metal production categories under industrial processes
24 Production of pig iron or steel including continuous casting	1.A.2.a Iron and steel 2.C.1 Iron and steel production 1.B Fugitive emissions 1.A.1.c Manufacture of solid fuels and other energy industries	• Emissions are included in EU ETS only for those pig iron or steel installations with a capacity exceeding a threshold of 2.5 tonnes per hour while in GHG inventories there is no threshold. • EU ETS activity includes combustion and process emissions. • Combustion emissions should be allocated to 1.A.2a Iron and steel • Process emissions should be allocated to 2.C.1 Iron and steel production • Emissions from coke production should be allocated to 1.A.1.c Manufacture of solid fuels and other energy industries • Clear separation of combustion and process emissions is not always possible when mass balance approaches are used. • Comparability of emissions is influenced by the allocation of the transfer of CO_2 in the process gases (coke oven gas, blast furnace gas, basic oxygen furnace gas) to EU ETS activities as well as to CRF categories. Article 48 of the EU ETS MRR specifies the allocation of inherent CO_2 which results from an EU ETS activity and is contained in a gas which transferred to other installations as a fuel. If transfers of inherent CO_2 take place between EU ETS installations, the CO_2 transferred should not be counted as emissions for the installation of origin, but for the installation where it is finally emitted. However, if the transfer occurs to an installation outside the EU ETS scope, the transferring installation has to account for the emissions.

25 Production or processing of ferrous metals	1.A.2.a Iron and steel
	2.C.1. Iron and steel production
	2.C.2 Ferroalloys production
	1.A.1.c Manufacture of solid fuels and other energy industries
		• Emissions are included in EU ETS only for those ferroalloy production installations exceeding rated thermal input of 20 MW while in GHG inventories there is no threshold.
		• EU ETS scope of activity 25 covers CO_2 emissions related to the production or processing of ferrous metals from:
		  • conventional and alternative fuels,
		  • reducing agents including coke,
		  • graphite electrodes,
		  • raw materials including limestone and dolomite,
		  • carbon containing metal ores and concentrates,
		  • secondary feed materials.
		• Combustion related emissions from EU ETS activity code 25 are included in in CRF 1.A.2.a. Iron and Steel
		• Process related emissions can be included in CRF 2.C.1 Iron and steel production or 2.C.2. Ferroalloys Production

EU ETS activity	CRF category	Comment
26 Production of primary aluminium	2.C.3 Aluminium production 1.A.2.b Non-ferrous metals	• In EU ETS operators shall report emissions from the production of electrodes for primary aluminium smelting, including stand-alone-installations for the production of such electrodes. The operator shall considerCO_2 emissions from : fuels for the production of heat or steam, electrode production, reduction of Al_2O_3 during electrolysis which is related to electrode consumption, use of soda ash or other carbonates for waste gas scrubbing. • For PFC emissions resulting from anode effects the scope of the EU ETS activity and CRF category 2.C.3 are consistent. • CRF category 1.A.2.b Non-ferrous metals includes combustion emission and emission from waste gas scrubbing. • Emissions from electrode consumption in EU ETS activity code 26 are included in CRF 2.C.3 Aluminium Production. • PFC emissions are allocated to 2.C.3 Aluminium production.
27 Production of secondary aluminium	1.A.2.b Non-ferrous metals	• Emissions are included in EU ETS only for installations exceeding rated thermal input of 20 MW while in GHG inventories there is no threshold. • In secondary aluminium production no process emissions occur therefore all emissions in activity code 27 are from fuel combustion and are reported in CRF category 1.A.2.b Non-ferrous metals.
28 Production or processing of non-ferrous metals	1.A.2.b Non-ferrous metals 2.C.4 Magnesium production 2.C.5 Lead production 2.C.6 Zinc production 2.C.7 Other metal production	• Emissions are included in EU ETS only for non-ferrous metals production or processing installations exceeding rated thermal input of 20 MW (including reducing agents) while in GHG inventories there is no threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 28 are included in CRF 2.C.4 Magnesium Production, 2.C.5 Lead production, 2.C.6 Zinc Production and 2.C.7 Other metal industry. • 2006 IPCC Guidelines do not provide methodologies for metals other than iron and steel, ferroalloys, aluminium, magnesium, lead and zinc while the EU ETS has a broader scope and covers, e.g. copper production.
29 Production of cement clinker in rotary kilns	2.A.1 Cement Production 1.A.2.f Non-metallic minerals	• Emissions are included in EU ETS only for installations with production capacity exceeding 500 tonnes per day or in other furnaces with capacity exceeding 50 tonnes per day. Inventory methodology has no threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 29 are included in CRF 2.A.1 Cement Production • Combustion related emissions from ETS activity code 29 are included in CRF 1.A.2.f. Non-metallic minerals
30 Production of lime, or calcination of dolomite/magnesite in	2.A.2 Lime production 1.A.2.f Non-metallic minerals	• Emissions are included in EU ETS only for installations with production capacity exceeding 50 tonnes per day. Inventory methodology has no

EU ETS activity	CRF category	Comment
rotary kilns or in other furnaces		threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 30 are included in CRF 2.A.2 Lime Production • Combustion related emissions from EU ETS activity code 30 are included in CRF 1.A.2.f. Non-metallic minerals • Non-marketed lime production in some industries such as iron and steel or sugar refining are included in the inventory in category 2.A.2, but may be included in the EU ETS in the dominant activity, e.g. iron and steel industry or fuel combustion.

EU ETS activity	CRF category	Comment
31 Manufacture of glass including glass fibre	2.A.3 Glass production 1.A.2.f Non-metallic minerals	• Emissions are included in EU ETS only for installations with a melting capacity exceeding 20 tonnes per day. Inventory methodology has no threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 31 are included in CRF 2.A.3 Glass Production • Combustion related emissions from EU ETS activity code 31 are included in CRF 1.A.2.f. Non-metallic minerals
32 Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain	2.A.4 Other process uses of carbonates 1.A.2.f Non-metallic minerals	• Emissions are included in EU ETS only for installations with a production capacity exceeding 75 tonnes per day. Inventory methodology has no threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 32 are included in CRF 2.A.4 Other process uses of carbonates • Combustion related emissions from EU ETS activity code 32 are included in CRF 1.A.2.f. Non-metallic minerals • EU ETS method A is based on carbonate input and is equivalent to IPCC tier 1 to 3 methods. EU ETS method B based on the alkali oxide output in the product has no equivalent method in the 2006 IPCC Guidelines. IPCC Guidelines also do not provide methods to estimate emissions from additives.
33 Manufacture of mineral wool insulation material using glass, rock or slag	2.A.3 Glass production 2.A.4 Other process uses of carbonates 2.A.5 Other 1.A.2.f Non-metallic minerals	• Emissions are included in EU ETS only for installations with a melting capacity exceeding 20 tonnes per day. Inventory methodology has no threshold. • EU ETS activity includes combustion and process emissions. • 2.A.3 Glass Production includes emissions from the production of glass wool, a category of mineral wool, where the production process is similar to glass making. Where the production of rock wool is emissive these emissions should be reported under IPCC Subcategory 2A5.
34 Drying or calcination of gypsum or production of plaster boards and other gypsum products	1.A.2.f Non-metallic minerals	• EU ETS covers CO_2 emissions from this activity, where combustion units have a total rated thermal input exceeding 20 MW. For GHG inventories no such threshold applies. • EU ETS activity only includes combustion-related emissions
35 Production of pulp from timber or other fibrous materials	1.A.2.d Pulp, paper and print 2.A.4 Other process uses of carbonates (soda ash use)	• EU ETS activity includes combustion and process emissions. • Combustion related emissions from EU ETS activity code 35 are included in CRF 1.A.2.d. • Process related emissions are included in 2.A.4. Other process uses of carbonates

EU ETS activity	CRF category	Comment
36 Production of paper or cardboard	1.A.2.d Pulp, paper and print 2.A.4 Other process uses of carbonates (soda ash use)	• EU ETS activity includes combustion and process emissions. • Threshold in EU ETS: installations involved in the production of paper or card-board a production capacity exceeding 20 tonnes per day. Inventory methodology has no threshold. • Combustion related emissions from EU ETS activity code 36 are included in CRF 1.A.2.d. • Process related emissions are included in 2.A.4 Other process uses of carbonates
37 Production of carbon black involving the carbonisation of organic substances such as oils, tars, cracker and distillation residues	2.B.8 Petrochemical and carbon black production 1.A.2.c Chemicals	• EU ETS covers CO_2 emissions from this activity, where combustion units have a total rated thermal input exceeding 20 MW. For GHG inventories no such threshold applies. • EU ETS activity includes combustion and process emissions.
38 Production of nitric acid	2.B.2. Nitric acid production 1.A.2.c Chemicals	• Scopes of EU ETS and 2006 IPCC Guidelines for CO_2 emissions from nitric acid production are consistent. • EU ETS activity includes combustion and process emissions. • For EU ETS activity 38 all N_2O emissions are process-related and should be allocated to 2.B.2 Nitric acid production • CO_2 emissions in activity code 38 are from fuel combustion and should be allocated to 1.A.2.c Chemicals
39 Production of adipic acid	2.B.3. Adipic acid production (CO_2) 1.A.2.c Chemicals	• Scopes of EU ETS and 2006 IPCC Guidelines for CO_2 emissions from Adipic Acid production are consistent. • EU ETS activity includes combustion and process emissions. • For EU ETS activity 39 all N_2O emissions are process-related and should be allocated to CRF code 2.B.3 Adipic Acid Production • CO_2 emissions in activity code 38 are from fuel combustion and should be allocated to 1.A.2.c Chemicals
40 Production of glyoxal and glyoxylic acid	2.B.4. Caprolactam, glyoxal and glyoxylic acid production 1.A.2.c Chemicals	• Scopes of EU ETS and 2006 IPCC Guidelines for N_2O emissions from glyoxal production and glyoxylic acid production are consistent. • EU ETS activity includes combustion and process emissions. • N_2O emissions should be allocated to CRF code 2.B.4 Caprolactam, glyoxal and glyoxylic acid production • CO_2 emissions in activity code 40 are from fuel combustion and should be allocated to 1.A.2.c Chemicals

EU ETS activity	CRF category	Comment

41 Production of ammonia	2.B.1. Ammonia production
	CO_2 captured for urea production:
	3.H Urea Application
	1.A.3.b Road transport
	2.D.3 Other non-energy products from fuels and solvent use
		• EU ETS scope of activity code 41 ammonia production includes
		  • combustion of fuels supplying the heat for reforming or partial oxidation,
		  • fuels used as process input in the ammonia production process (reforming or partial oxidation),
		  • fuels used for other combustion processes including for the purpose of producing hot water or steam.
		• According to 2006 IPCC Guidelines to avoid double counting, fuel consumption in ammonia production should be reported under Ammonia production. In this regard EU ETS and IPCC scopes are consistent.
		• In the inventory CO_2 from ammonia production which is recovered and used for urea production is subtracted and reported by the users. Urea use can be reported in different CRF sectors, e.g. in 1.A.3.b Road transport, 3.H Urea application in agriculture, 2.D.3 Other (e.g. in industry catalysts). Under the EU ETS the CO_2 transfer via urea out of the EU ETS system cannot be deducted from ammonia production.

42 Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes	2.B.8 Petrochemical and carbon black production 2.B.10 Other chemical industry 1.A.2.c Chemicals	• Emissions are included in EU ETS only for installations with a production capacity exceeding 100 tonnes per day. Inventory methodology has no threshold. • EU ETS activity includes combustion and process emissions. • The combustion related emissions are allocated to CRF code 1.A.2.c Chemicals. • Some of the emissions reported under this EU ETS activity could be allocated to CRF category 2.B.8 Petrochemical and carbon black production (e.g. CO_2 process emissions) • Some of the emissions reported under this EU ETS activity could be allocated to CRF category 2.B.10 Other chemical industry (e.g. CO_2 emissions from flaring in chemical industry)
43 Production of hydrogen and synthesis gas by reforming or partial oxidation	1.A.2.c Chemicals 2.B.1. Ammonia production 2.B.8 Petrochemical and carbon black production 2.B.10 Other chemical industry 1.B.2.a.iv Fugitive emissions from oil refining/ storage	• Emissions are included in EU ETS only for installations with a production capacity exceeding 25 tonnes per day. IPCC methodology has no threshold. • EU ETS activity includes combustion and process emissions. • In the CRF, there is no separate reporting category for emissions from hydrogen production. Hydrogen and synthesis gas production are recognised as part of integrated chemical production. Therefore MS have chosen different approaches for the inclusion of emissions from hydrogen production (e.g. 2.B.8 or 2.B.10) • Some emissions may also be reported under CRF category 1.B.2.a.iv Fugitive emissions from oil subcategory refining/ storage

EU ETS activity	CRF category	Comment
44 Production of soda ash and sodium bicarbonate	1.A.2.c Chemicals 2.B.7 Soda ash production	• EU ETS activity includes combustion and process emissions. • Combustion related emissions from EU ETS activity code 44 for production are included in CRF 1.A.2.c Chemicals • Process related emissions are included in 2.B.7. Soda Ash Production
45 Capture of greenhouse gases under Directive 2009/31/EC	Capture of emissions would be reported under the respective inventory sector e.g. 1.A.1.a Public electricity and heat production.	• Consistent with scope and methodologies of inventory (currently no emissions reported under the EU ETS)
46 Transport of greenhouse gases by pipelines for geological storage in a storage site permitted under Directive 2009/31/EC	1.C.1 Transport of CO_2	• Consistent with scope and methodologies of inventory (currently no emissions reported under the EU ETS)
47 Geological storage of greenhouse gases in a storage site permitted under Directive 2009/31/EC	1.C.2 Injection and storage	• Consistent with scope of inventory (currently no emissions reported under the EU ETS)
99 Other activity opted-in under Art. 24 of the ETS Directive	Depending on type of activity opted-in	Article 24 allows the unilateral inclusion of additional activities and gases under the EU ETS, These activities and gases are not allocated to a specific activity, but under a separate activity code.

In the GHG inventory, the emissions are reported per CRF categories. In the EU ETS a single installation can include several ETS activities as defined in Annex I of the EU ETS Directive. In the EU ETS emissions are attributed to a specific installation, independently from the Annex I activities covered. Nevertheless, the operator must report detailed information for each source stream of the installation, and include activities classification as per Annex I, in his annual report to the competent authorities. The different approaches can lead to differences in reported emissions if ETS activities and inventory categories are compared directly.

.**Scope of activities and installation boundaries**

For several activities, the EU ETS includes installations only if they exceed certain capacity thresholds. Such capacity thresholds are not used for the inventory reporting. In addition, installation boundaries and the scope as to what constitutes an activity under the EU ETS may be different to a source category for the inventory reporting. Therefore the scope of activities and the installation boundaries need careful consideration before EU ETS data are used for inventory purposes.

Determination of tiers

Both IPCC guidelines are based on methodological tiers that require higher tier levels of accuracy for emission sources contributing to a significant extent to the total emissions in a country. In the inventory reporting, the key category analysis determines which methodological tier should be used which is 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 the same minimum tier methodology.

In the EU ETS the tiers are related to the admissible level of uncertainty for each parameter involved in the reporting. In the EU ETS tiers apply at installation level for each source stream activity data and calculation factor, and are defined in legislation on the basis of the installation emissions (thresholds are < 50 kt, ≥ 50 kt and ≤ 500 kt and > 500 kt CO_2eq). EU ETS verified emissions, if aggregated at sectoral level, may include contributions from small, medium and large emitters and are therefore based on different EU ETS tiers. When ETS data are used for key categories in the GHG inventory, it therefore has to be checked carefully whether the EU ETS tiers used for the monitoring of emissions are in conformity with the IPCC guidance related to the IPCC tiers for a particular source category.

In GHG inventories time series consistency is a mandatory requirement which has also implications on the choice of methodology. While methodological consistency is also required under the EU ETS (Article 6 of Regulation No 601/2012), the EU ETS only started in 2005 and plant-specific and measured data is often not available for the whole time series back to 1990 and it may be challenging to construct a consistent time series back to 1990.

The mapping table above shows that a direct comparison between verified emissions from EU ETS activities and emissions reported in CRF categories is not straightforward.

An analysis of data consistency between EU ETS and inventory data requires: (1) an assessment of the assignment of the detailed data reported by each individual EU ETS installation to national competent authorities with respect to the CRF categories; (2) a detailed comparison of the methodological parameters (methods, activity data, calculation parameters).

1.4.1.3 Use of EU ETS data in 2015

Under the MMR Article 7 (EU 2013), Member States are required to perform consistency checks between the emissions reported in the GHG inventories and the verified emissions reported under the EU ETS Directive. The installation-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 EU ETS emissions is complete for the respective source category and that EU ETS activities and CRF source categories follow the same definitions. If EU 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 EU 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 the latter 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 or for specific non-marketed fuels.

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. EU 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 uncertainties of data reported by installations.

Based on the information submitted in the national inventory reports (NIRs) in 2015 to the European Commission, 27 Member States indicated that they used EU ETS data at least for QA/QC purposes (see *Table 1.9*). Croatia joined the European Union in July 2013 and participates in the EU ETS since January 2013. For the NIR 2014, Croatia did not use any EU ETS data, but plans improve their calculation with EU ETS data in the future. 16 Member States indicated to directly use the verified emissions reported by installations under the EU ETS. 23 Member States used EU ETS data to improve country-specific emission factors. 23 Member States reported that they used activity data (e.g. fuel use) provided under the EU ETS in the national inventory.

Table 1.9 *Use of EU 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	✓	✓	✓	✓
Croatia	Not 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 2015 submissions of Member States

1.4.1.4 References

EC 2003: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L275, 25.10.2003, p. 32) amended by Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004, Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 and Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009.

EEA (European Environment Agency) 2015: Trends and projections in the EU ETS in 2015, Copenhagen. Available at: http://www.eea.europa.eu/publications/trends-and-projections-eu-ets-2015

EU 2012a: Commission Regulation (EU) No 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council Text with EEA relevance (OJ L 181, 12.7.2012, p. 1–29).

EU 2012b: Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council (OJ L 181, 12.7.2012, p. 1-28).

EU 2014: Regulation No 421/2014 of the European Parliament and of the Council of 16 April 2014 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emission (OJ L 129, 30.4.2014, p. 1–4).

1.4.2 Cooperation with EUROCONTROL

At the end of 2010 the European Commission signed a framework contract with EUROCONTROL, the European organization for the safety of air navigation, regarding ‘the support to the European Commission in relation to climate change policy and the implementation of the EU ETS’. This support project is organized in different Work Packages (WP) corresponding to the different areas identified in the framework contract and has been regularly continued.

One of these Work Packages pertains to the improvement of GHG and air pollutant emissions inventories submitted by the 28 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 EEA and its ETC/ACM assist DG CLIMA regarding the technical requirements.

To support the inventory process, in July 2014 MS received fuel and emissions data for the years 2005 to 2013 as calculated by EUROCONTROL using a TIER 3 methodology applying the Advanced Emissions Model (AEM) as well as a documentation on how this data has 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. It was planned that the EEA provides MS with a comparison between EUROCONTROL data and MS data on fuel consumption, CO_2 emissions and implied emission factors in the course of the initial checks of MS inventories in the first months of 2015. Due to the general delay of inventory submissions in 2015, this process did not take place as planned in 2015, it is therefore expected to be implemented in the ‘initial checks’ of 2016.

In October 2015 EUROCONTROL provided data for the year 2014 and a recalculated dataset for the years 2005 to 2013 together with a revised methodology document. A comparison between recalculated 2013 results from Tier 3b calculations from EUROCONTROL and MS inventories and time series of civil and international aviation emissions for EU-28 has been presented at a workshop which took place in November 2015. The presentations and the minutes have been shared with MS (documentation available upon request). Countries are encouraged to provide feedback to these EUROCONTROL results so that suggestions and questions could be taken into account in the next modelling exercise. For more information on the results of the comparison (see chapter 3.4).

The next step is the evaluation of an implementation of a webportal by EUROCONTROL for a user-friendly display and download of AEM results for Member States. In addition a comparison between EUROCONTROL and MS inventory data will be conducted as part of the initial checks in January 2015. 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 will provide data for the year 2015 and eventually reruns the AEM model to calculate time series for the period 2005 to 2014 in case of considerable changes in the model.

As explained in the NIR 2014, 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. In this sense, the EUROCONTROL results are used for identifying ways of checking and improving the accuracy of emission estimates for the EU and its Member States in accordance with the ARR of 2014.

1.5 Description of key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in the 2006 IPCC guidelines. 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-28 level, every Member State provides a national key category analysis which is independent from the assessment at EU-28 level. The EU-28 key category analysis is not intended to replace the key category analysis by Member States. The key category analysis at EU-28 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-28 key category analysis helps identifying those categories that 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-28, the following procedure was applied:

- Starting point for the key category identification for this report was the EEA locator database. All categories where GHG emissions/removals occur were listed, at the most disaggregated level available at EU-28 level and split by gas.
- A level assessment was carried out for the years 1990 and 2013 and a trend assessment was performed for 1990 to 2013. The assessment was carried out for emissions excluding LULUCF and including LULUCF.
- The key category analysis excluding LULUCF resulted in the identification of 55 key categories for the EU-28 and cover 96 % of total EU-28 GHG emissions in 2013. The key category analysis including LULUCF resulted in 67 key categories (see Annex 1.1).

The results of the EU-28 key category analysis including LULUCF is presented in Table 1.10.

In Chapters 3 to 7 overview tables are presented for each EU key category showing the Member States' contributions to the EU-28 key category in terms of level and trend.

Table 1.10 Key categories for the EU-28 (Gg CO_2 equivalents)

Source category (gas)	kt CO_2 equ.		Trend	Level	
	1990	2013		1990	2013
1.A.1.a Fuels: Public Electricity and Heat Production (CH_4)	680	3 294	T	0	0
1.A.1.a Fuels: Public Electricity and Heat Production (CO_2)	1 411 643	1 144 965	T	L	L
1.A.1.b Fuels: Petroleum Refining (CO_2)	122 101	118 727	T	L	L
1.A.1.c Fuels: Manufacture of Solid Fuels and Other Energy Industries (CO_2)	116 005	55 415	T	L	L
1.A.2.a Fuels: Iron and Steel (CO_2)	175 828	105 368	T	L	L
1.A.2.b Fuels: Non-Ferrous Metals (CO_2)	17 209	10 923	T	L	L
1.A.2.c Fuels: Chemicals (CO_2)	117 898	74 804	T	L	L
1.A.2.d Fuels: Pulp, Paper and Print (CO_2)	34 459	25 374	T	L	L
1.A.2.e Fuels: Food Processing, Beverages and Tobacco (CO_2)	52 401	38 182	T	L	L
1.A.2.f Fuels: Non-metallic minerals (CO_2)	129 681	78 935	T	L	L
1.A.2.g Fuels: Other Manufacturing Industries and Constructions (CO_2)	329 506	162 931	T	L	L
1.A.3.a Fuels: Domestic Aviation (CO_2)	14 444	15 530	T	L	L
1.A.3.b Fuels: Road Transportation (CH_4)	5 955	1 246	T	0	0
1.A.3.b Fuels: Road Transportation (CO_2)	710 771	829 318	T	L	L
1.A.3.b Fuels: Road Transportation (N_2O)	6 423	8 357	T	0	0
1.A.3.c Fuels: Railways (CO_2)	13 101	6 667	T	L	0
1.A.3.d Fuels: Domestic Navigation (CO_2)	24 391	15 940	T	L	L
1.A.4.a Fuels: Commercial/Institutional (CO_2)	200 608	180 117	T	L	L
1.A.4.b Fuels: Residential (CH_4)	18 150	14 164	0	L	L
1.A.4.b Fuels: Residential (CO_2)	499 513	424 333	T	L	L
1.A.4.c Fuels: Agriculture/Forestry/Fishing (CO_2)	89 402	73 656	T	L	L
1.A.5.a Biomass: Other Other Sectors (CO_2)	9 048	2 035	T	0	0
1.A.5.b Fuels: Other Other Sectors (CO_2)	13 784	4 562	T	L	0
1.B.1.a Operation: Coal Mining and Handling (CH_4)	98 416	24 514	T	L	L
1.B.2.a Operation: Oil (CH_4)	13 789	4 427	T	L	0
1.B.2.a Operation: Oil (CO_2)	9 590	11 913	T	0	L
1.B.2.b Operation: Natural Gas (CH_4)	47 258	29 196	T	L	L
1.B.2.d Operation: Other emissions from energy production (CH_4)	5 557	1 301	T	0	0
2.A.1 no classification: Cement Production (CO_2)	102 432	71 386	T	L	L
2.A.2 no classification: Lime Production (CO_2)	25 683	19 747	0	L	L
2.B.1 no classification: Ammonia Production (CO_2)	32 216	26 927	0	L	L
2.B.10 no classification: Other chemical industry (CO_2)	1 186	4 242	T	0	0
2.B.10 no classification: Other chemical industry (Unspecified mix of HFCs and PFCs)	5 567	47	T	0	0
2.B.2 no classification: Nitric Acid Production (N_2O)	49 543	4 950	T	L	0
2.B.3 no classification: Adipic Acid Production (N_2O)	57 555	605	T	L	0
2.B.8 no classification: Petrochemical and Carbon Black Production (CO_2)	14 278	15 836	T	L	L
2.B.9 no classification: Fluorochemical Production (HFCs)	29 034	678	T	L	0
2.C.1 no classification: Iron and Steel Production (CO_2)	96 293	59 459	T	L	L
2.C.3 no classification: Aluminium Production (PFCs)	20 151	431	T	L	0
2.F.1 no classification: Refrigeration and Air conditioning (HFCs)	45	90 847	T	0	L
2.F.4 no classification: Aerosols (HFCs)	2	5 828	T	0	0
3.A.1 Cattle: Enteric Fermentation (CH_4)	204 063	153 965	T	L	L
3.A.1 Dairy Cattle: Enteric Fermentation (CH_4)	79 298	57 449	T	L	L
3.A.1 Non-Dairy Cattle: Enteric Fermentation (CH_4)	86 460	73 420	T	L	L
3.A.1 Other Cattle: Enteric Fermentation (CH_4)	23 057	13 166	T	L	L
3.A.2 Other Sheep: Enteric Fermentation (CH_4)	29 864	19 927	T	L	L
3.A.2 Sheep: Enteric Fermentation (CH_4)	29 864	19 927	T	L	L
3.B.1 Farming: CH_4 Emissions (CH_4)	59 070	45 456	0	L	L

Source category (gas)	kt CO_2 equ.		Trend	Level	
	1990	2013		1990	2013
3.B.2 Farming: N_2O and NMVOC Emissions (N_2O)	31 665	22 025	T	L	L
3.D.1 Direct N_2O Emissions From Managed Soils: Agricultural Soils (N_2O)	170 332	139 750	T	L	L
3.D.2 Farming: Agricultural Soils (N_2O)	44 057	34 493	0	L	L
4 Biomass Burning Land Use: Land-Use Change and Forestry (CO_2)	11 389	3 690	T	0	0
4.A.1 Land Use: Forest Land (CO_2)	41 321	44 913	T	L	L
4.A.2 Land Use: Forest Land (CO_2)	37 233	56 639	T	L	L
4.B.1 Land Use: Cropland (CO_2)	24 985	22 279	T	L	L
4.B.2 Land Use: Cropland (CO_2)	45 879	45 025	T	L	L
4.C.1 Land Use: Grassland (CO_2)	31 679	21 035	T	L	L
4.C.2 Land Use: Grassland (CO_2)	8 814	21 198	T	0	L
4.D.1 Land Use: Wetlands (CO_2)	13 061	14 174	T	L	L
4.E.2 Land Use: Settlements (CO_2)	32 077	46 644	T	L	L
4.G Wood product: Harvested Wood Products (CO_2)	24 746	20 110	T	L	L
4.H Land Use: Other LULUCF (CH_4)	3 214	1 003	T	0	0
5.A.1 Waste: Managed Waste Disposal Sites (CH_4)	168 123	97 032	T	L	L
5.A.2 Waste: Unmanaged Waste Disposal Sites (CH_4)	24 444	14 763	T	L	L
5.B.1 Waste: Waste Composting (CH_4)	323	2 423	T	0	0
5.B.1 Waste: Waste Composting (N_2O)	316	2 882	T	0	0
5.D.1 Domestic Wastewater: Wastewater Treatment and Discharge (CH_4)	22 255	10 973	T	L	L

1.6 General uncertainty evaluation

Due to delay of the CRF-Reporter software which also caused a late reporting of all MS, it was not possible to update the uncertainty evaluation in this short period. Therefore the results of the uncertainty assessment for last years' submission can be used as an indication of general uncertainty.

In 2014 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.

Uncertainties were estimated at detailed level and aggregated to six main sectors 'Energy', 'Fugitive emissions', Industrial processes', 'Agriculture', 'LULUCF' and 'Waste' according to the IPCC 1996 GL. 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. This is a more sophisticated approach than required under the IPCC guidelines. The EU team adopted this approach in order to obtain a more accurate uncertainty estimates than with the "simple" approach included in the IPCC guidelines.

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

$Trend_{n,x} = E_{n,x}(t)-E_{n,x}(0)$ (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 1.11 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 1.11 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 1.12, 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[10].

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 1.12, 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 1.12 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.

Table 1.13 Tier 1 uncertainty estimates of EU-15 GHG emissions for the main sectors

Source category (IPCC 1996 GL)	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty	Trend uncertainty estimates based on MS uncertainty

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

					estimates	estimates
1.A Fuel combustion activities	all	3 184 033	2 851 333	-10.4%	1.1%	0.4%
1.B Fugitive emissions	all	92 101	42 770	-53.6%	12.4%	6.9%
2. Industrial processes	all	349 866	240 566	-31.2%	8.8%	7.0%
3. Solvents and other product use	all	8 353	5 401	-35.3%	36.3%	5.3%
4. Agriculture	all	442 771	372 765	-15.8%	80.0%	6.2%
6. Waste	all	170 547	101 636	-40.4%	23.6%	11.7%
5. LULUCF	all	-128 466	-177 258	38.0%	27.5%	26.5%
Total (incl LULUCF)	**all**	**4 119 206**	**3 437 214**	**-16.6%**	**8.9%**	**1.3%**
Total (excl LULUCF)	**all**	**4 247 672**	**3 614 472**	**-14.9%**	**8.3%**	**1.0%**

Note: Emissions are in Gg CO_2 equivalents

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.

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 above). 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.

Member States may only report NEs if:

1. There are no 2006 IPCC methods/EFs available.
2. Emissions are considered insignificant: below 0.05% of the NT & do not exceed 500 kt CO_2 eq. The sum of insignificant NEs shall remain below 0.1% of the NT.
    a. MS shall indicate in both the NIR and the CRF completeness table why such emissions/removals have not been estimated.
    b. MS should provide justifications for exclusion in terms of the likely level of emissions in the NIR, using approximated AD and default IPCC EFs.
3. Emissions have not been reported in a previous submission, otherwise they shall be reported in subsequent submissions.

➢ If MS report unjustified NEs (according to 1. 2. and 3. above) gapfilling rules will apply: art. 4 Delegated Act of the MMR.

In 2015 also cases where neither numeric values nor notation keys have been reported (blank cells) have been included in the checking procedure. EU experts have checked with Member States if blank cells have been caused by the new CRF reporter software or if in fact the blank cells should be replaced by notation keys or a numeric values.

1.7.2 Data gaps and gap-filling

1.7.2.1 Gap filling of emissions

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 the MMR 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 2006 IPCC guidelines[11].

1.7.2.2 Gap filling of emissions in GHG inventory submissions 2015

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

1.7.3 Geographical coverage of the European Union inventory

Table 1.14 shows the geographical coverage of the EU-15 Member States' national inventories. Note that not all Member States have signed and ratified the UNFCCC and the Kyoto Protocol with the same geographical coverage. In addition, the EU territory of a country is not always equivalent to the territory of the Party to the UNFCCC or the Kyoto Protocol. For three Member States there are differences in geographical coverage as UNFCCC Party, Kyoto Protocol Party and/or EU Member State (DK, FR and the UK).

If there are differences in geographical coverage the respective country needs to prepare several inventories. This is reflected in the country codes provided by the UNFCCC secretariat. For example Denmark uses the country code DNK for the inventory under the UNFCCC, the code DKE for the inventory under the Kyoto Protocol and the code DNM for the inventory for the EU territory.

As the EU-28inventory is the sum of the Member States' inventories, the EU-28 inventory covers the same geographical area as the inventories of the 28 Member States for their respective EU territory. Note that the inventories of Denmark and the United Kingdom used for the EU-28 inventory differ from the inventories published on the UNFCCC website. All inventories used for the EU-28 inventory are published on the website of the EEA:

[11] ETC ACC technical note on gap filling procedures, December 2006.

http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014

Table 1.14 Geographical coverage of the EU-28 inventory

Member State	Geographical coverage	EU and MS Party coverage (Kyoto Protocol, second committment period)	EU-territory coverage (UNFCCC)	Party coverage (UNFCCC)	Country code
Austria	Austria	√	√	√	AUT
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region	√	√	√	BEL
Bulgaria	Bulgaria	√	√	√	BGR
Croatia	Croatia	√	√	√	HVR
Cyprus	Area under the effective control of the Republic of Cyprus	√	√	√	CYP
Czech Republic	Czech Republic	√	√	√	CZE
Denmark	Denmark (excluding Greenland and the Faeroe Islands)	√	√		EST
Estonia	Estonia	√	√	√	DNM
Finland	Finland including Åland Islands	√	√	√	FIN
France	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas communities (Saint-Barthelemy, Saint-Martin and Mayotte), excluding the French overseas communities (French Polynesia, Wallis and Futuna, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia.	√	√		FRK
	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.			√	FRA
Germany	Germany	√	√	√	DEU
Greece	Greece	√	√	√	GRC
Hungary	Hungary	√	√	√	HUN
Ireland	Ireland	√	√	√	IRE
Italy	Italy	√	√	√	ITA
Latvia	Latvia	√	√	√	LVA
Lithuania	Lithuania	√	√	√	LTU
Luxembourg	Luxembourg	√	√	√	LUX
Malta	Malta	√	√	√	MLT
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.	√	√	√	NLD
Poland	Poland	√	√	√	POL
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.	√	√	√	PRT
Romania	Romania	√	√	√	ROU
Slovakia	Slovakia	√	√	√	SVK
Slovenia	Slovenia	√	√	√	SVN
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla	√	√	√	ESP
Sweden	Sweden	√	√	√	SWE
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).		√		GBE
	England, Scotland, Wales and Northern Ireland, the UK Overseas Territories that have ratified the Kyoto Protocol (the Cayman Islands, the Falkland Islands, Bermuda, Montserrat and Gibraltar), and the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man).	√		√	GBR
European Union	EU-28		√	√	EUA

1.7.4 Completeness of the European Union submission

1.7.4.1 National inventory report

The EU NIR follows – as far as possible - 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 Member States tables for every CRF table. Table 1.15 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.15 Explanations for exclusion of annexes as outlined in the UNFCCC reporting guidelines

Annex required in the UNFCCC reporting guidelines	Comment
Annex I: Key categories	Key category analyses Tier 1 including and excluding LULUCF
Annex II: Assessment of uncertainty	Not included in 2015 due to the delay of the CRF reporter
Annex III: Detailed methodological descriptions for individual source or sink categories	Not included in 2015 due to the delay of the CRF reporter
Annex IV: National energy balance of the most recent year	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 V: Additional information	Status and Consistency reports Summary Table 2

1.7.4.2 Activity data in the EU CRF

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-level these different types of activity data cannot be simply added up. As at EU-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.

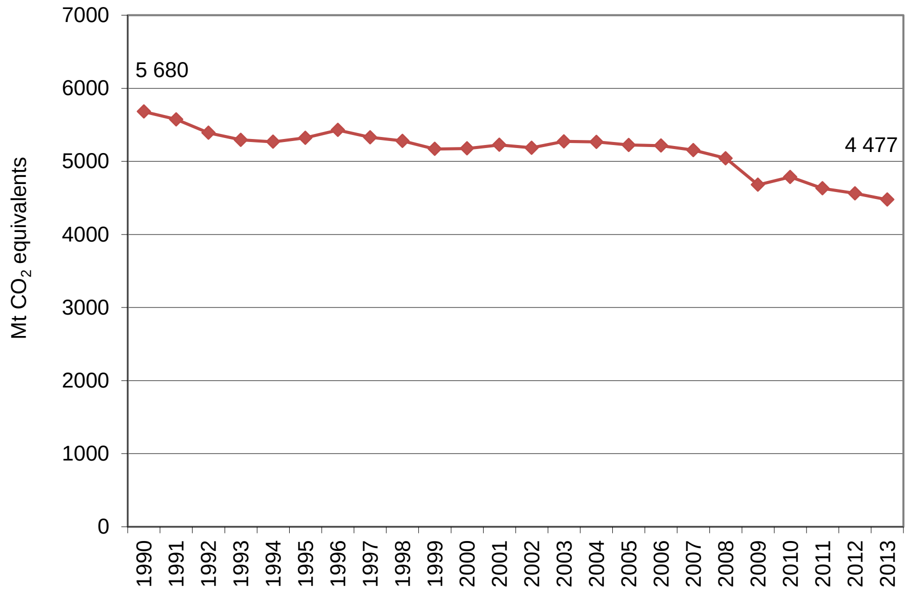
2 EU GREENHOUSE GAS EMISSION TRENDS

This chapter presents the main GHG emission trends in the EU-28. Aggregated results are described as regards total GHG and 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 2013 total GHG emissions in the EU-28, without LULUCF, were 21.2 % (-1203 million tonnes CO_2 equivalents) below 1990. Emissions decreased by 1.9 % (86 million tonnes CO_2 equivalents) between 2012 and 2013 (Figure 2.1).

Figure 2.1 EU-28GHG emissions 1990–2013 (excl. LULUCF)



Notes: GHG emission data for the EU-28 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 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

2.1.1 Main trends by source category, 1990-2013

Total GHG emissions (excluding LULUCF) in the EU-28 decreased by 1 203 million tonnes since 1990 (or 21.2 %) reaching their lowest level during this period in 2013. There has been an absolute decoupling of gross domestic product (GDP) and GHG emission compared to 1990, with an increase in GDP of about 45 % alongside a decrease in emissions of over 21 % over the 23-year period. This was partly due to growing shares of renewables, less carbon intensive fuels in the energy mix and improvements in energy efficiency. GHG emissions decreased in the majority of sectors between 1990 and 2013, with the notable exception of transport, including international transport, and refrigeration and air conditioning. At the aggregate level, reductions were largest for industrial sectors (combustion and processes), electricity and heat production, and residential combustion. A combination of factors explains lower emissions in industrial sectors, such as improved efficiency and carbon intensity as well as structural changes in the economy. The economic recession that began in the second half of 2008 and continued through to 2009 also had an impact on emissions from industrial sectors. Emissions from electricity and heat production decreased strongly since 1990. In addition to improved energy efficiency there has been a move towards less carbon intense fuels at EU level. Between 1990 and 2013, the use of solid and liquid fuels in thermal stations decreased strongly whereas natural gas consumption doubled, resulting in reduced CO_2 emissions per unit of fossil energy generated. Emissions in the residential sector also represented one of the largest reductions. Energy efficiency improvements from better insulation standards in buildings and a less carbon-intensive fuel mix can partly explain lower demand for space heating in the EU as a whole over the past 23 years. In terms of the main GHGs, CO_2 was responsible for the largest reduction in emissions since 1990. Reductions in emissions from N_2O and CH_4 have been substantial, reflecting lower levels of mining activities, lower agricultural livestock, as well as lower emissions from managed waste disposal on land and from agricultural soils.

Table 2.1 shows the source categories with the largest contributions to changes in greenhouse gas emissions between 1990 and 2013.

Table 2.1 EU-28: Overview of top decreasing/increasing source categories 1990-2013(+/- 20 Million tonnes CO_2 equivalents)

Source category	Million tonnes (CO_2 equivalents)
Road Transportation (CO_2 from 1.A.3.b)	119
Refrigeration and Air conditioning (HFCs from 2.F.1)	91
Commercial/Institutional (CO_2 from 1.A.4.a)	-20
Fluorochemical Production (HFCs from 2.B.9)	-28
Direct N2O Emissions From Managed Soils (N_2O from 3.D.1)	-31
Cement Production (CO_2 from 2.A.1)	-31
Oil and Natural Gas and Other Emissions from Energy Production (CH_4 from 1.B.2)	-34
Nitric Acid Production (N_2O from 2.B.2)	-45
Adipic Acid Production (N_2O from 2.B.3)	-57
Manufacture of Solid Fuels and Other Energy Industries (CO_2 from 1.A.1.c)	-61
Enteric Fermentation (CH_4 from 3.A)	-61
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-71
Coal Mining and Handling (CH_4 from 1.B.1.a)	-74
Residential (CO_2 from 1.A.4.b)	-75
Iron and steel production (CO_2 from 1A2a +2C1)	-107
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-267
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-290
Total	**-1 203**

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 not match the total change listed at the bottom of the table.

2.1.2 Main trends by source category, 2012-2013

Table 2.2 shows the source categories contributing the most to changes in greenhouse gas emissions between 2012 and 2013.

Table 2.2 EU-28: Overview of Top decreasing/increasing source categories 2012-2013 (+/- 3 Million tonnes CO_2 equivalents)

Source category	Million tonnes (CO_2 equivalents)
Commercial/Institutional (CO_2 from 1.A.4.a)	8
Residential (CO_2 from 1.A.4.b)	6
Refrigeration and Air conditioning (HFCs from 2.F.1)	3
Coal Mining and Handling (CH_4 from 1.B.1.a)	-3
Road Transportation (CO_2 from 1.A.3.b)	-3
Manufacture of Solid Fuels and Other Energy Industries (CO_2 from 1.A.1.c)	-3
Cement Production (CO_2 from 2.A.1)	-3
Non-metallic minerals (CO_2 from 1.A.2.f)	-6
Iron and steel production (CO_2 from 1A2a +2C1)	-6
Petroleum Refining (CO_2 from 1.A.1.b)	-7
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-7
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-70
Total	**-86**

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

Main reasons for emission changes, 2012–2013

Total GHG emissions (excluding LULUCF) decreased by 1.9 % (86 million tonnes CO_2 equivalents) between 2012 and 2013. This significant decrease in emissions in 2013 came along with a slight increase in GDP of 0.2 % compared to 2012 where GDP had contracted by 0.5 %. The largest reduction in GHG emissions occurred in the energy sector. Over 80 % of the total GHG emissions reduction in 2013 was accounted for by lower CO_2 emissions from electricity production in thermal power stations. Primary energy consumption declined overall, with fossil emissions decreasing for all fuels and particularly for solid fuels. The consumption of renewable energy continued its long term trend of higher shares in the energy mix. The GHG emissions intensity of the EU energy system also improved as a result of the less carbon intensive fuel mix in 2013.

The 86 million tonnes (CO_2 equivalents) decrease in GHG emissions in the EU-28 between 2012 and 2013 occurred mainly in the following categories.

- **CO_2 from public electricity and heat production (- 70 million tonnes or - 6 %)**
  Emission reductions in this category were mainly caused by an increase in renewable energy, especially in a higher share of hydro electricity generation and reduced electricity demand.
- **CH_4 from managed waste disposal sites (- 7 million tonnes or - 8 %)**
  Emission reductions were mainly caused by a decline in the United Kingdom, Italy, Germany and France. In general, emissions from this source decline because the amount of biodegradable waste being landfilled is reduced every year. A second reason for the decline in 2013 compared to 2012 is an increase in CH_4 recovery from landfills.

- **CO_2 from petroleum refining (- 7 million tonnes or - 6 %)**
  Input of crude oil in refineries declined by 6 %. This reflects a decline of final energy consumption of petroleum products and an increase in imports of petroleum products from outside of the EU.
- **CO_2 from manufacturing industries (excl. iron and steel) (- 6 million tonnes or - 2 %)**
  Emission reductions were driven by a decline in industrial production. Gross value added in industry declined by 0.3 % between 2012 and 2013.
- **CO_2 from cement production (- 3 million tonnes or - 5 %)**
  In the EU-28 cement production declined by 5 % which reflected the general economic and construction downturn of the last years.

Table 2.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF)

MEMBER STATE	1990 (million tonnes)	2013 (million tonnes)	2012–2013 (million tonnes)	Change 2012–2013 (%)	Change 1990–2013 (%)
Austria	78.7	79.6	-0.2	-0.2%	1.2%
Belgium	147.1	119.4	0.2	0.2%	-18.8%
Bulgaria	109.4	55.9	-5.3	-8.6%	-48.9%
Croatia	35.1	24.5	-1.0	-4.0%	-30.3%
Cyprus	5.6	8.3	-0.8	-8.9%	49.7%
Czech Republic	193.4	127.1	-3.5	-2.6%	-34.2%
Denmark	69.3	54.6	2.0	3.8%	-21.2%
Estonia	40.0	21.7	2.3	12.0%	-45.7%
Finland	71.1	63.0	0.6	1.0%	-11.4%
France	549.4	490.2	0.7	0.1%	-10.8%
Germany	1247.9	950.7	22.6	2.4%	-23.8%
Greece	105.0	105.1	-7.5	-6.6%	0.1%
Hungary	94.2	57.4	-2.6	-4.3%	-39.1%
Ireland	56.7	58.8	-0.8	-1.3%	3.7%
Italy	521.1	437.3	-31.6	-6.7%	-16.1%
Latvia	26.2	10.9	-0.1	-0.5%	-58.3%
Lithuania	47.8	19.9	-1.3	-6.1%	-58.3%
Luxembourg	12.9	11.1	-0.6	-5.1%	-13.5%
Malta	2.0	2.8	-0.4	-12.1%	39.4%
Netherlands	219.5	195.8	-0.5	-0.2%	-10.8%
Poland	473.9	394.9	-3.9	-1.0%	-16.7%
Portugal	60.4	65.1	-1.9	-2.8%	7.7%
Romania	253.3	110.9	-10.0	-8.3%	-56.2%
Slovakia	75.5	43.7	0.0	-0.1%	-42.2%
Slovenia	18.6	18.2	-0.7	-3.9%	-2.1%
Spain	290.7	322.0	-26.7	-7.7%	10.8%
Sweden	71.8	55.8	-1.6	-2.7%	-22.4%
United Kingdom	803.7	572.1	-13.5	-2.3%	-28.8%
EU-28	**5680.2**	**4476.8**	**-85.9**	**-1.9%**	**-21.2%**

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-28 GHG emissions and removals for 1990–2013. In the EU-28 the most important GHG is CO_2, accounting for 82 % of total EU-28 emissions in 2013. In 2013, EU-28 CO_2 emissions without LULUCF were 3 320 Tg, which was 21 % below 1990 levels. Compared to 2012, CO_2 emissions decreased by 2.4 %.

Table 2.4 Overview of EU-28GHG emissions and removals from 1990 to 2013 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013
Net CO_2 emissions/removals	4 185	3 903	3 836	3 952	3 607	3 459	3 402	3 320
CO_2 emissions (without LULUCF)	4 460	4 201	4 162	4 286	3 934	3 788	3 728	3 650
CH_4	751	682	621	553	494	486	480	468
N_2O	413	373	333	311	265	260	257	258
HFCs	29	44	53	71	96	99	101	104
PFCs	25	17	12	7	4	4	4	4
Unspecified mix of HFCs and PFCs	6	6	2	1	0	0	0	0
SF_6	11	15	10	8	6	6	6	6
NF_3	0.02	0.04	0.12	0.16	0.12	0.13	0.09	0.07
Total (with net CO_2 emissions/removals)	**5 421**	**5 040**	**4 866**	**4 903**	**4 472**	**4 315**	**4 250**	**4 159**
Total (without CO2 from LULUCF)	**5 696**	**5 338**	**5 192**	**5 238**	**4 799**	**4 643**	**4 576**	**4 489**
Total (without LULUCF)	**5 680**	**5 322**	**5 177**	**5 224**	**4 786**	**4 630**	**4 563**	**4 477**

Figure 2.2 CO_2 emissions 1990 to 2013 (Mt)

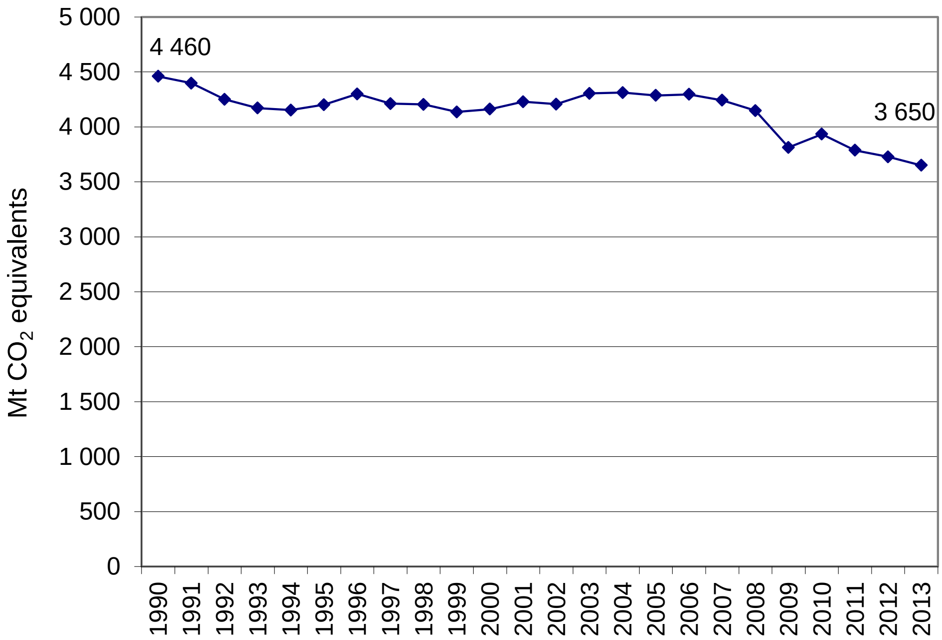
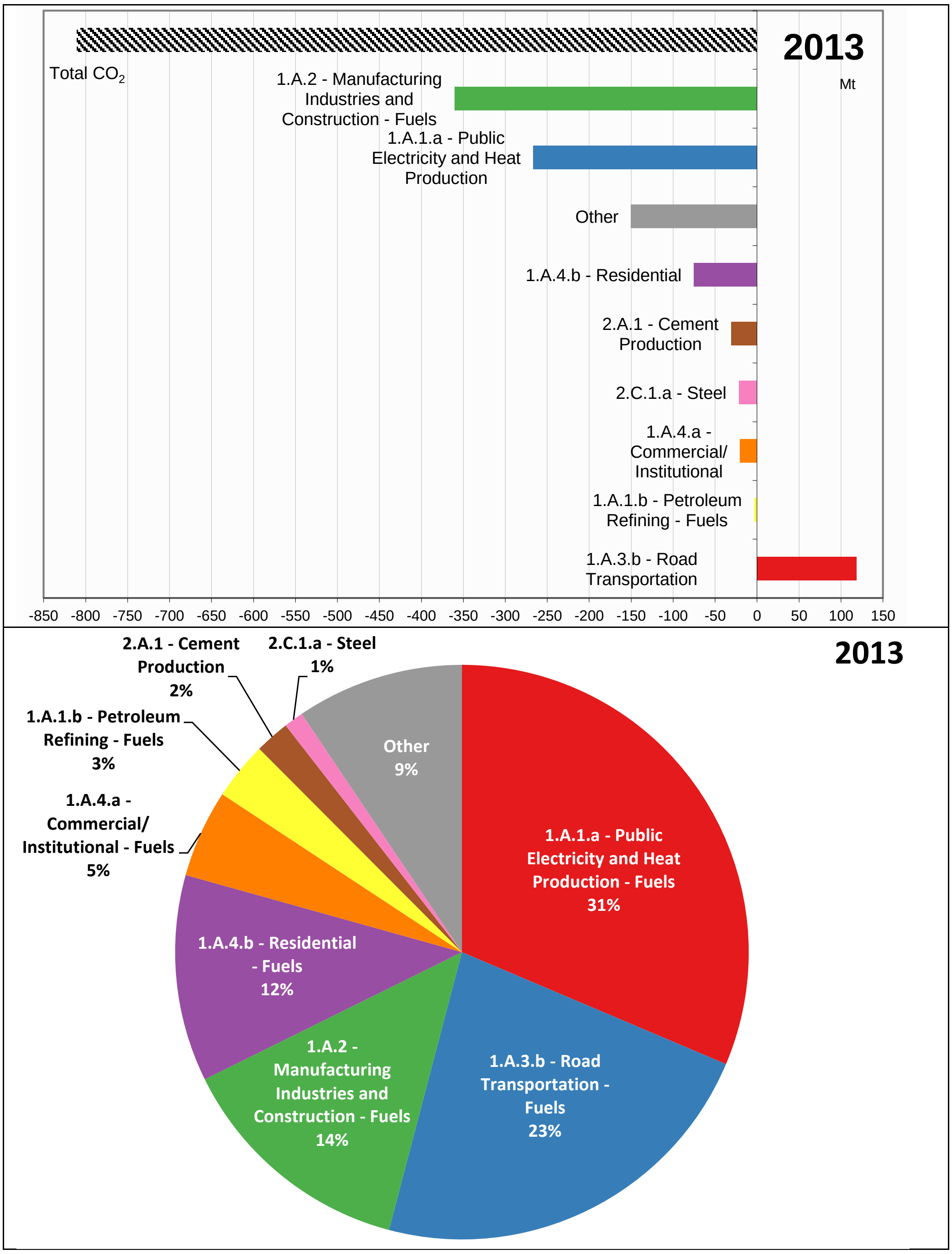


Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2013 in CO_2 equivalents (Mt) for EU-28 and share of largest key source categories in 3or EU-28



Note: Other is calculated by substracting the presented categories from the sector total

CH_4 emissions account for 10 % of total EU-28 GHG emissions in 2013 and decreased by 38 % since 1990 to 468 Tg CO_2 equivalents in 2013 (Figure 2.4). The two largest key sources account for 53 % of CH_4 emissions in 2013. Figure 2.5 shows that the main reasons for declining CH_4 emissions were reductions in coal mining and anaerobic waste.

Figure 2.4 CH_4 emissions 1990 to 2013 in CO_2 equivalents (Mt)

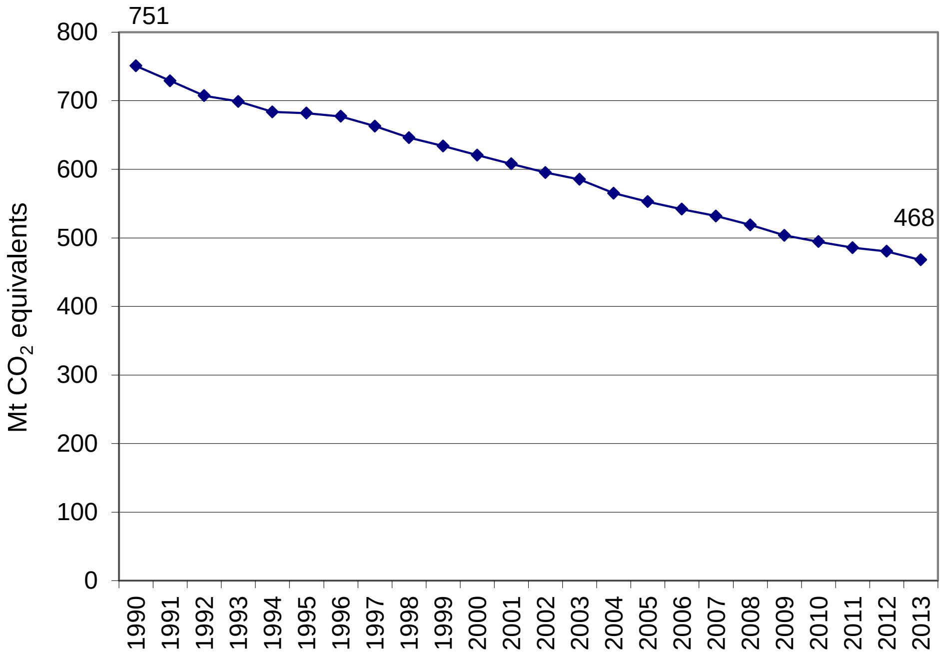
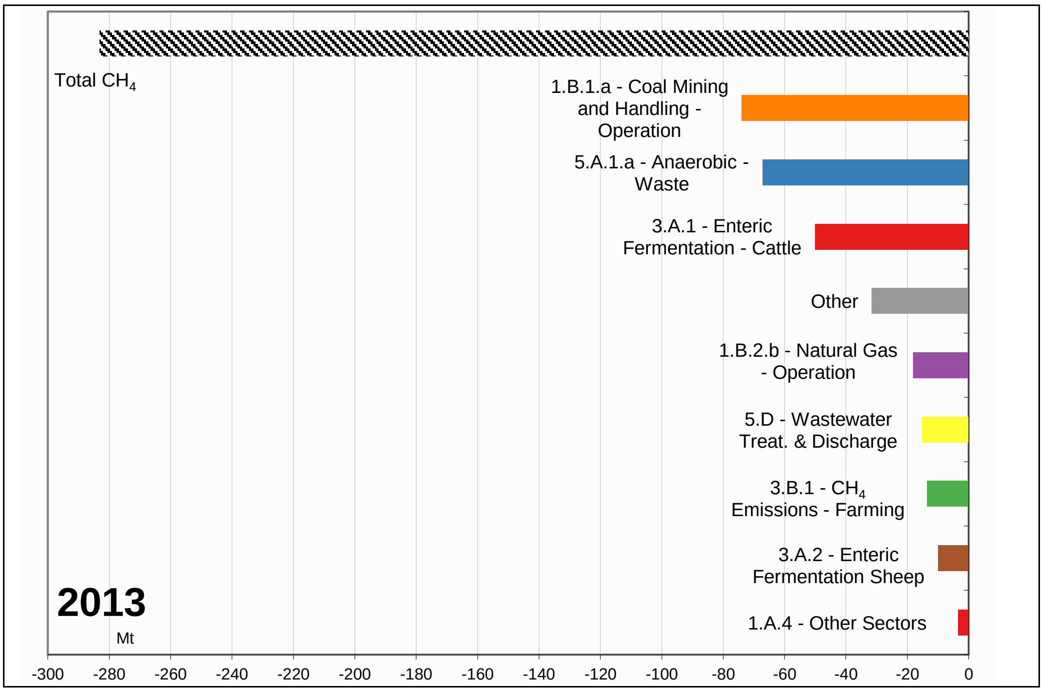
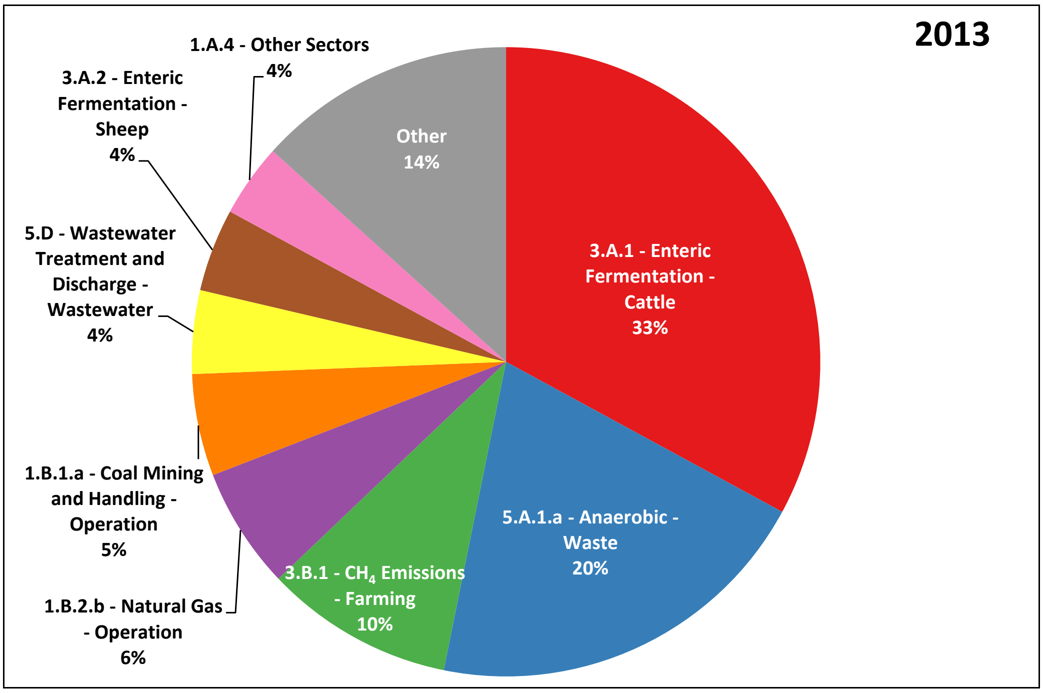


Figure 2.5 Absolute change of CH_4 emissions by large key source categories 1990 to 2013 in CO_2 equivalents (Mt) for EU-28 and share of largest source categories in 2013 for EU-28





Note: Other is calculated by substracting the presented categories from the sector total

N_2O emissions are responsible for 6 % of total EU-28 GHG emissions and decreased by 38 % to 258 Tg CO_2 equivalents in 2013 (Figure 2.6). The two largest key sources account for about 68 % of N_2O emissions in 2013. Figure 2.7 shows that the main reason for large N_2O emission cuts were reduction in chemical industry and agricultural soils.

Figure 2.6 N_2O emissions 1990 to 2013 in CO_2 equivalents (Mt)

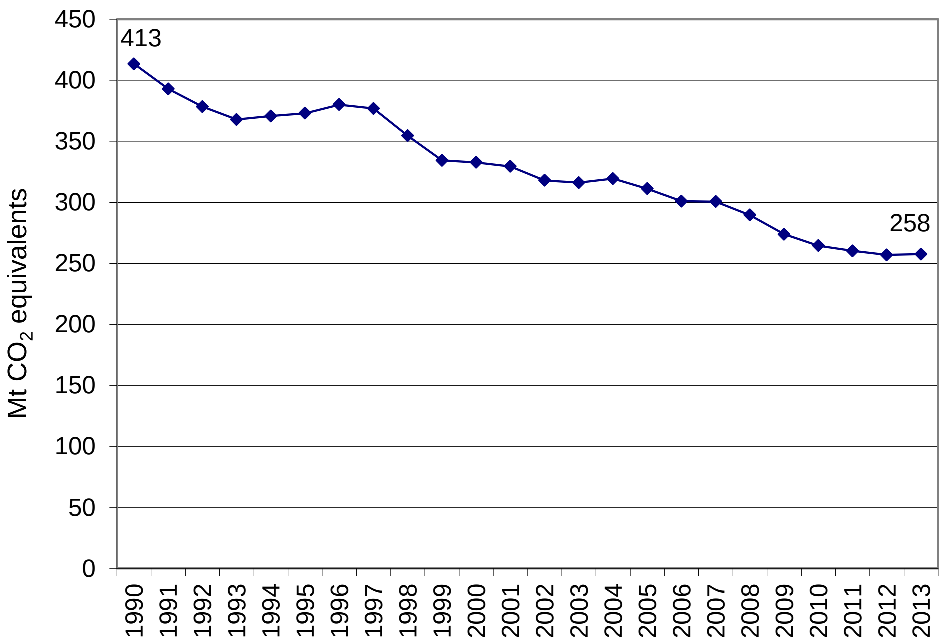
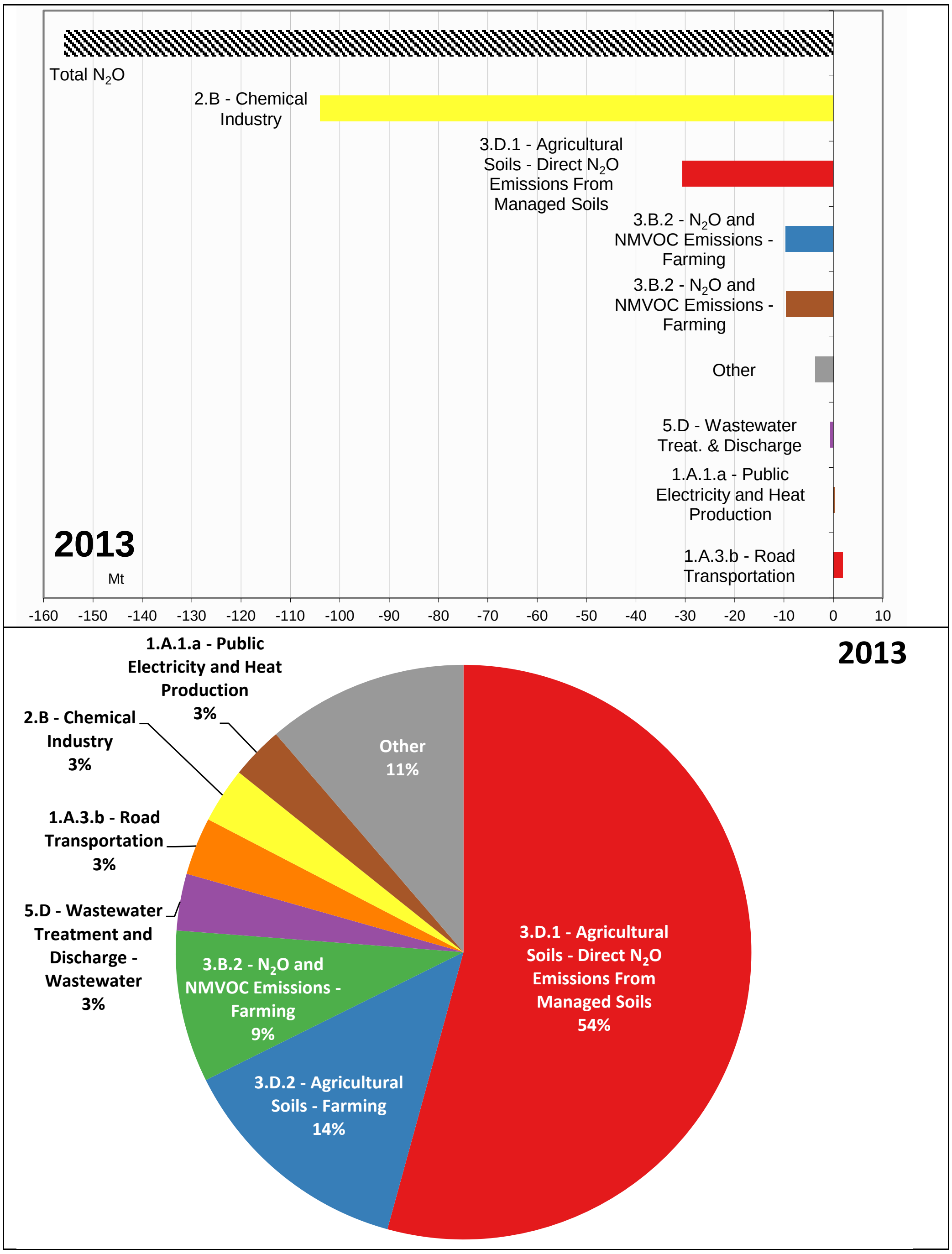


Figure 2.7 Absolute change of N_2O emissions by large key source categories 1990 to 2013 in CO_2 equivalents (Mt) for EU-28 and share of largest source categories in 2013 for EU-28



Note: Other is calculated by substracting the presented categories from the sector total

Fluorinated gas emissions account for 2.5 % of total EU-28 GHG emissions. In 2013, emissions were 114 Tg CO_2 equivalents, which was 60 % above 1990 levels (Figure 2.8). The largest key category accounts for 80 % of fluorinated gas emissions in 2013. Figure 2.9 shows that HFCs from refrigeration and air conditioning showed large increases between 1990 and 2013. 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 other decreased substantially.

Figure 2.8 Fluorinated gas emissions 1990 to 2013 in CO_2 equivalents (Mt)

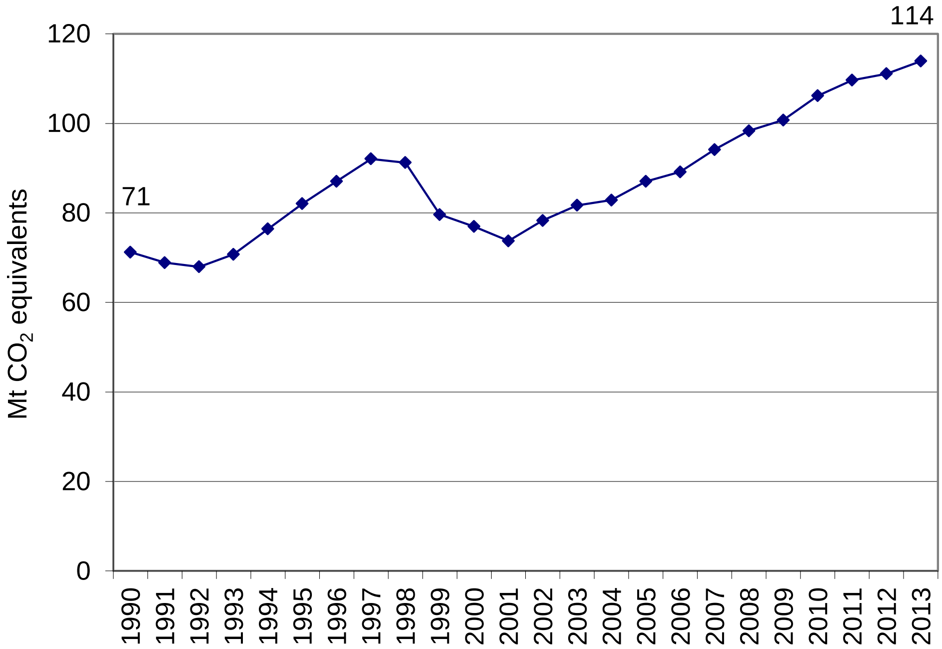
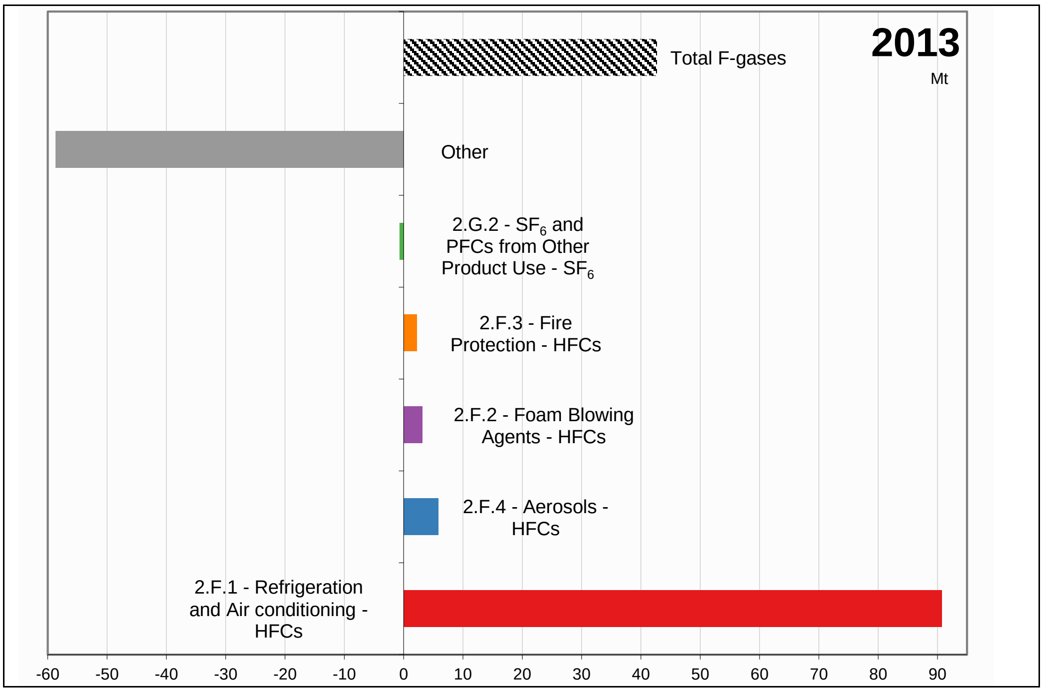
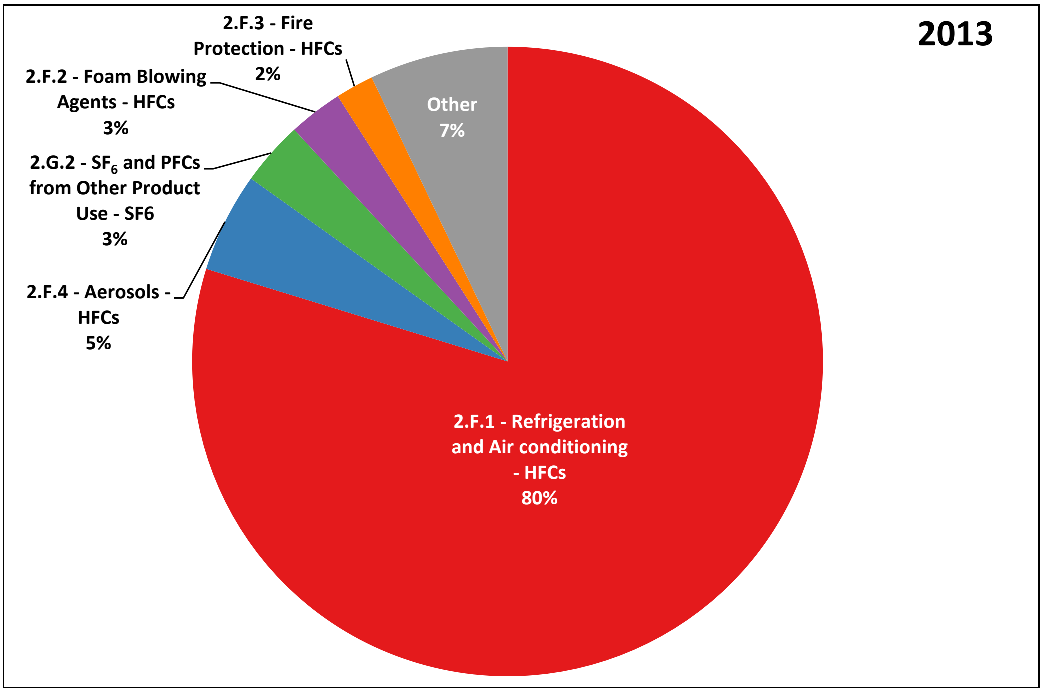


Figure 2.9 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2013 in CO_2 equivalents (Mt) for EU-28 and share of largest source categories in 2013 for EU-28





Note: Other is calculated by substracting the presented categories from the sector total

2.3 Emission trends by source

Table 2.5 gives an overview of EU-28 GHG emissions in the main source categories for 1990–2013. More detailed trend descriptions are included in chapters 3 to 9.

Table 2.5 Overview of EU-28 GHG emissions in the main source and sink categories 1990 to 2013 in CO_2 equivalents (Mt)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
1. Energy	4 356	4 088	4 018	4 115	4 115	4 050	3 976	3 696	3 798	3 650	3 604	3 524
2. Industrial Processes and Product Use	511	491	443	449	446	456	429	360	376	374	360	360
3. Agriculture	569	495	481	455	454	454	451	445	442	442	439	441
4. Land-Use, Land-Use Change and Forest	-260	-282	-311	-321	-354	-299	-337	-331	-314	-316	-312	-318
5. Waste	244	248	235	205	200	194	186	177	170	164	159	152
6. Other	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Total (with net CO_2 emissions/removals)	**5 421**	**5 040**	**4 866**	**4 903**	**4 861**	**4 854**	**4 704**	**4 347**	**4 472**	**4 315**	**4 250**	**4 159**
Total (without LULUCF)	**5 680**	**5 322**	**5 177**	**5 224**	**5 215**	**5 154**	**5 041**	**4 679**	**4 786**	**4 630**	**4 563**	**4 477**

2.4 Emission trends by Member State

Table 2.6 gives an overview of EU-28 Member States' contributions to the EU GHG emissions for 1990–2013. Member States show large variations in GHG emission trends.

Table 2.6 Overview of Member States' contributions to EU-28GHG emissions excluding LULUCF from 1990 to 2013 in CO_2 equivalents (Mt)

Member State	1990	1995	2000	2005	2010	2011	2012	2013
Austria	79	79	80	92	85	83	80	80
Belgium	147	154	149	145	133	123	119	119
Bulgaria	109	75	60	64	61	66	61	56
Croatia	35	25	27	31	28	28	26	24
Cyprus	6	7	8	10	10	10	9	8
Czech Republic	193	153	146	144	136	135	131	127
Denmark	69	77	70	65	62	57	53	55
Estonia	40	20	17	18	20	20	19	22
Finland	71	72	70	69	76	68	62	63
France	549	548	554	555	516	489	490	490
Germany	1 248	1 120	1 044	993	943	923	928	951
Greece	105	111	128	136	119	116	113	105
Hungary	94	76	74	76	65	64	60	57
Ireland	57	60	69	71	63	59	60	59
Italy	521	533	554	578	506	494	469	437
Latvia	26	13	10	11	12	11	11	11
Lithuania	48	22	20	23	21	21	21	20
Luxembourg	13	10	10	13	12	12	12	11
Malta	2	2	3	3	3	3	3	3
Netherlands	219	231	219	213	214	200	196	196
Poland	474	445	393	398	408	405	399	395
Portugal	60	71	84	88	70	69	67	65
Romania	253	184	141	147	118	123	121	111
Slovakia	76	55	50	52	47	46	44	44
Slovenia	19	19	19	20	19	19	19	18
Spain	291	331	390	441	357	355	349	322
Sweden	72	74	69	67	65	61	57	56
United Kingdom	804	755	720	698	616	570	586	572
EU-28	**5 680**	**5 322**	**5 177**	**5 224**	**4 786**	**4 630**	**4 563**	**4 477**

The overall EU GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom accounting for 34 % of total EU-28 GHG emissions in 2013. These two Member States have achieved total GHG emission reductions of 529 million tonnes CO_2--equivalents compared to 1990[12].

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 liberalizing 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.

France and Italy were the third and fourth largest emitters with a share of 13 % and 11 %, respectively. Italy's GHG emissions were 16 % below 1990 levels in 2013. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol refining. However, Italian emissions decreased significantly since 2004 with significant drops in 2009 and 2012, which were mainly due to the economic crisis and reductions in industrial output during these years. France's emissions were 11 % below 1990 levels in 2013. In France, large reductions were achieved in N_2O emissions from the chemical industry, but CO_2 emissions from road transport and HFC emissions from electronics industry and product uses as substitutes of ODS increased considerably between 1990 and 2013.

Poland is the fifth largest emitter in the EU-28, accounting for 9 % of total EU-28 GHG emissions. Spain decreased emissions by 17 % between 1990 and 2013. This was largely due to emission decreases from energy industries 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-28 between 1990 and 2013. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-85 %), followed by CO (-66 %), NMVOC (-55 %) and NO_X (-53 %).

Table 2.7 Overview of EU-28 indirect GHG and SO_2 emissions for 1990–2013 (kt)

GHG EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013
NO_x	17 799	15 075	13 140	11 940	9 429	9 085	8 738	8 391
CO	70 171	51 713	41 663	32 008	26 701	25 295	25 384	24 197
NMVOC	18 684	14 973	12 558	10 677	9 012	8 775	8 543	8 464
SO_2	24 950	15 796	9 534	7 289	4 478	4 351	4 049	3 699

Table 2.8 shows the NO_X emissions of the EU-28 Member States between 1990–2013. The largest emitters, the United Kingdom, Spain, Germany, France, Poland and Italy made up 69 % of total EU-28 NO_X emissions in 2013. All EU-28 Member States but one reduced their NO_X emissions between1990 and 2013

Table 2.8 Overview of Member States' contributions to EU-28 NO_X emissions for 1990–2013 (kt)

Party	1990	1995	2000	2005	2010	2011	2012	2013
Austria	215	193	209	233	178	168	163	161
Belgium	412	383	344	317	250	233	214	206
Bulgaria	283	174	150	164	145	152	140	124
Croatia	83	60	72	79	62	58	54	53
Cyprus	16	18	21	20	17	20	20	15
Czech Republic	738	419	384	278	238	225	210	222
Denmark	299	289	224	201	145	137	127	123
Estonia	83	42	37	35	36	36	35	35
Finland	299	252	228	198	177	163	155	150
France	2043	1882	1747	1570	1231	1168	1131	1112
Germany	2886	2168	1928	1574	1333	1309	1269	1268
Greece	329	332	365	419	324	302	243	249
Hungary	283	213	206	169	153	139	125	120
Ireland	133	129	136	135	84	75	78	78
Italia	2088	1934	1483	1259	987	973	899	829
Latvia	90	51	43	44	38	33	34	34
Lithuania	128	62	51	54	49	46	47	46
Luxembourg	42	37	42	59	40	39	35	32
Malta	8	9	9	10	10	10	10	9
Netherlands	559	463	384	328	258	241	229	222
Poland	1280	1063	844	851	861	843	819	798
Portugal	247	279	276	272	189	179	168	169
Romania	466	400	382	320	247	252	276	262
Slovakia	226	179	108	102	89	86	81	80
Slovania	62	60	52	49	47	47	46	43
Spain	1349	1421	1411	1437	971	964	929	809
Sweden	271	247	209	177	150	140	132	127
United Kingdom	2880	2315	1796	1585	1121	1049	1071	1017
EU-28	**17798.84**	**15075.28**	**13139.72**	**11939.76**	**9429**	**9085**	**8738**	**8391**

Table 2.9 shows the CO emissions of the EU-28 Member States between 1990–2013. The largest emitters, France, Germany, Italy, Poland and the United Kingdom that made up 59 % of the total CO emissions in 2013, reduced their emissions from 1990 levels substantially. But also all other EU-28 Member States reduced emissions.

Table 2.9 Overview of Member States' contributions to EU-28 CO emissions for 1990–2013 (kt)

Party	1990	1995	2000	2005	2010	2011	2012	2013
Austria	215	193	209	233	178	168	163	161
Belgium	412	383	344	317	250	233	214	206
Bulgaria	283	174	150	164	145	152	140	124
Croatia	83	60	72	79	62	58	54	53
Cyprus	16	18	21	20	17	20	20	15
Czech Republic	738	419	384	278	238	225	210	222
Denmark	299	289	224	201	145	137	127	123
Estonia	83	42	37	35	36	36	35	35
Finland	299	252	228	198	177	163	155	150
France	2043	1882	1747	1570	1231	1168	1131	1112
Germany	2886	2168	1928	1574	1333	1309	1269	1268
Greece	329	332	365	419	324	302	243	249
Hungary	283	213	206	169	153	139	125	120
Ireland	133	129	136	135	84	75	78	78
Italia	2088	1934	1483	1259	987	973	899	829
Latvia	90	51	43	44	38	33	34	34
Lithuania	128	62	51	54	49	46	47	46
Luxembourg	42	37	42	59	40	39	35	32
Malta	8	9	9	10	10	10	10	9
Netherlands	559	463	384	328	258	241	229	222
Poland	1280	1063	844	851	861	843	819	798
Portugal	247	279	276	272	189	179	168	169
Romania	466	400	382	320	247	252	276	262
Slovakia	226	179	108	102	89	86	81	80
Slovania	62	60	52	49	47	47	46	43
Spain	1349	1421	1411	1437	971	964	929	809
Sweden	271	247	209	177	150	140	132	127
United Kingdom	2880	2315	1796	1585	1121	1049	1071	1017
EU-28	**17798.84**	**15075.28**	**13139.72**	**11939.76**	**9429**	**9085**	**8738**	**8391**

Table 2.10 shows the NMVOC emissions of the EU-28 Member States between 1990–2013. The largest emitters France, Germany, the United Kingdom and Italy that made up 61 % of the total NMVOC emissions in 2013, reduced their emissions from 1990 levels, together with all other EU-28 Member States.

Table 2.10 Overview of Member States' contributions to EU-28 NMVOC emissions for 1990–2013 (kt)

Party	1990	1995	2000	2005	2010	2011	2012	2013
Austria	281	204	163	159	130	125	132	126
Belgium	390	343	276	236	205	193	189	185
Bulgaria	501	106	62	54	45	43	45	39
Croatia	128	73	79	72	59	57	54	52
Cyprus	17	15	12	12	10	8	7	6
Czech Republic	301	207	237	181	149	138	127	149
Denmark	204	204	174	149	125	119	116	114
Estonia	64	45	40	35	34	32	32	32
Finland	230	193	166	138	113	102	100	94
France	4022	3664	3244	2874	2361	2376	2300	2294
Germany	3397	2032	1604	1345	1242	1172	1140	1142
Greece	238	216	209	179	142	131	125	124
Hungary	268	195	176	146	125	118	117	120
Ireland	135	128	112	106	91	89	88	90
Italy	2006	1990	1563	1257	956	942	912	913
Latvia	144	116	102	100	89	88	89	88
Lithuania	120	94	70	76	71	68	69	65
Luxembourg	20	17	13	13	9	9	9	9
Malta	5	6	2	2	1	2	2	2
Netherlands	483	339	238	178	158	156	154	150
Poland	831	680	575	575	653	638	630	636
Portugal	286	285	266	244	193	182	182	182
Romania	356	204	266	252	241	229	237	220
Slovakia	85	106	80	94	84	90	81	83
Slovania	73	66	55	47	39	38	43	34
Spain	1047	967	983	818	640	607	562	538
Sweden	361	278	224	202	192	187	179	174
United Kingdom	2692	2201	1565	1135	855	835	823	802
EU-28	**18684.24**	**14972.7**	**12557.63**	**10677.25**	**9012**	**8775**	**8543**	**8464**

Table 2.11 shows the SO_2 emissions of the EU-28 Member States between 1990–2012. The largest emitters, the Poland, Germany, the United Kingdom and Bulgaria, that made up 55 % of the total SO_2 emissions in 2013, reduced their emissions from 1990 levels substantially, together with all other EU-28 Member States.

Table 2.11 Overview of Member States' contributions to EU-28 SO_2 emissions for 1990–2013 (Gg)

Party	1990	1995	2000	2005	2010	2011	2012	2013
Austria	74	47	32	27	19	18	17	17
Belgium	365	258	173	143	60	53	47	45
Bulgaria	479	378	336	374	412	495	431	371
Croatia	134	64	51	58	35	29	25	16
Cyprus	33	41	50	38	22	21	16	14
Czech Republic	1871	1090	257	218	169	168	157	138
Denmark	179	146	32	26	15	14	13	14
Estonia	93	43	30	23	25	26	24	25
Finland	250	105	81	69	67	61	52	48
France	1314	995	656	488	303	269	258	238
Germany	5307	1704	645	472	434	431	417	416
Greece	478	541	499	541	248	190	151	141
Hungary	826	620	428	41	31	34	31	30
Ireland	184	163	142	74	28	27	25	25
Italy	1806	1328	757	408	216	196	179	146
Latvia	99	48	15	6	3	2	2	1
Lithuania	169	69	37	31	21	23	20	19
Luxembourg	15	9	3	2	2	1	1	2
Malta	16	27	24	12	8	8	9	4
Netherlands	198	138	77	69	33	33	33	29
Poland	3210	2255	1451	1217	937	885	859	847
Portugal	323	331	263	194	70	64	59	53
Romania	854	748	526	607	365	354	290	292
Slovakia	524	245	127	89	69	68	58	53
Slovania	199	122	93	41	10	12	10	11
Spain	2165	1850	1491	1275	417	450	399	283
Sweden	106	69	42	36	32	29	28	27
United Kingdom	3679	2361	1217	709	427	391	439	393
EU-28	**24950.16**	**15795.78**	**9534.401**	**7288.839**	**4477.599**	**4351.361**	**4049.361**	**3698.737**

3 ENERGY (CRF SECTOR 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. For each EU-28 key category overview tables are presented including the Member States' contributions to the key category in terms of level and trend. The chapter includes also, the reference approach, and international bunkers.

3.1 Overview of sector

CRF Sector 1 Energy contributes 79 % to total GHG emissions and is the largest emitting sector in the EU-28. Total GHG emissions from this sector decreased by 19 % from 4356 Mt in 1990 to 3524 Mt in 2013 (Figure 3.1). In 2013, emissions decreased by 2 % compared to 2012.

The most important energy-related gas is CO_2 that makes up 76 % of the total EU-28 GHG emissions in 2013. CH_4 of the energy sector is responsible for 2 % and N_2O for 1 % of the total GHG emissions. The key categories in the energy sector are as follows.

- 1.A.1.a Fuels: Public Electricity and Heat Production (CO_2)
- 1.A.1.a Fuels: Public Electricity and Heat Production (CH_4)
- 1.A.1.b Fuels: Petroleum Refining (CO_2)
- 1.A.1.c Fuels: Manufacture of Solid Fuels and Other Energy Industries (CO_2)
- 1.A.2.a Fuels: Iron and Steel (CO_2)
- 1.A.2.b Fuels: Non-Ferrous Metals (CO_2)
- 1.A.2.c Fuels: Chemicals (CO_2)
- 1.A.2.d Fuels: Pulp, Paper and Print (CO_2)
- 1.A.2.e Fuels: Food Processing, Beverages and Tobacco (CO_2)
- 1.A.2.f Fuels: Non-metallic minerals (CO_2)
- 1.A.2.g Fuels: Other Manufacturing Industries and Constructions (CO_2)
- 1.A.3.a Fuels: Domestic Aviation (CO_2)
- 1.A.3.b Fuels: Road Transportation (CH_4)
- 1.A.3.b Fuels: Road Transportation (CO_2)
- 1.A.3.b Fuels: Road Transportation (N_2O)
- 1.A.3.c Fuels: Railways (CO_2)
- 1.A.3.d Fuels: Domestic Navigation (CO_2)
- 1.A.4.a Fuels: Commercial/Institutional (CO_2)
- 1.A.4.b Fuels: Residential (CH_4)
- 1.A.4.b Fuels: Residential (CO_2)
- 1.A.4.c Fuels: Agriculture/Forestry/Fishing (CO_2)
- 1.A.5.a Biomass: Other Sectors (CO_2)
- 1.A.5.b Fuels: Other Sectors (CO_2)
- 1.B.1.a Operation: Coal Mining and Handling (CH_4)
- 1.B.2.a Operation: Oil (CH_4)
- 1.B.2.a Operation: Oil (CO_2)
- 1.B.2.b Operation: Natural Gas (CH_4)
- 1.B.2.d Operation: Other emissions from energy production (CH_4)

Figure 3.1 CRF Sector 1 Energy: EU-28 GHG emissions in CO_2 equivalents (Mt) for 1990–2013

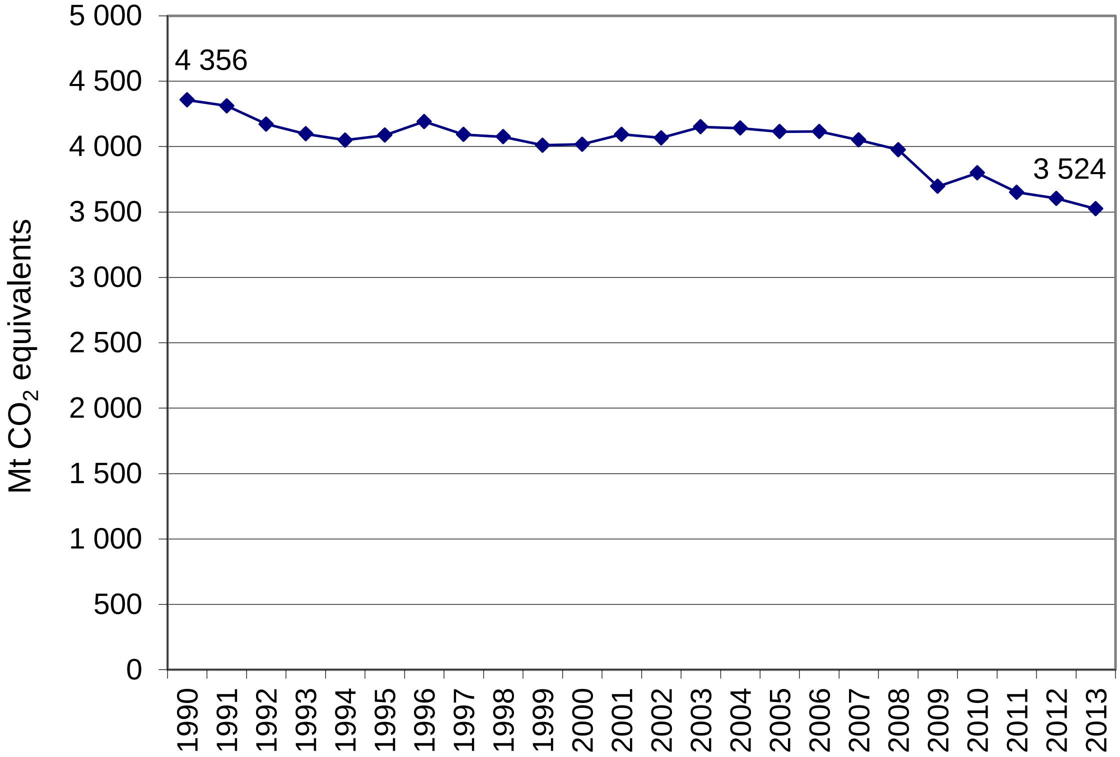
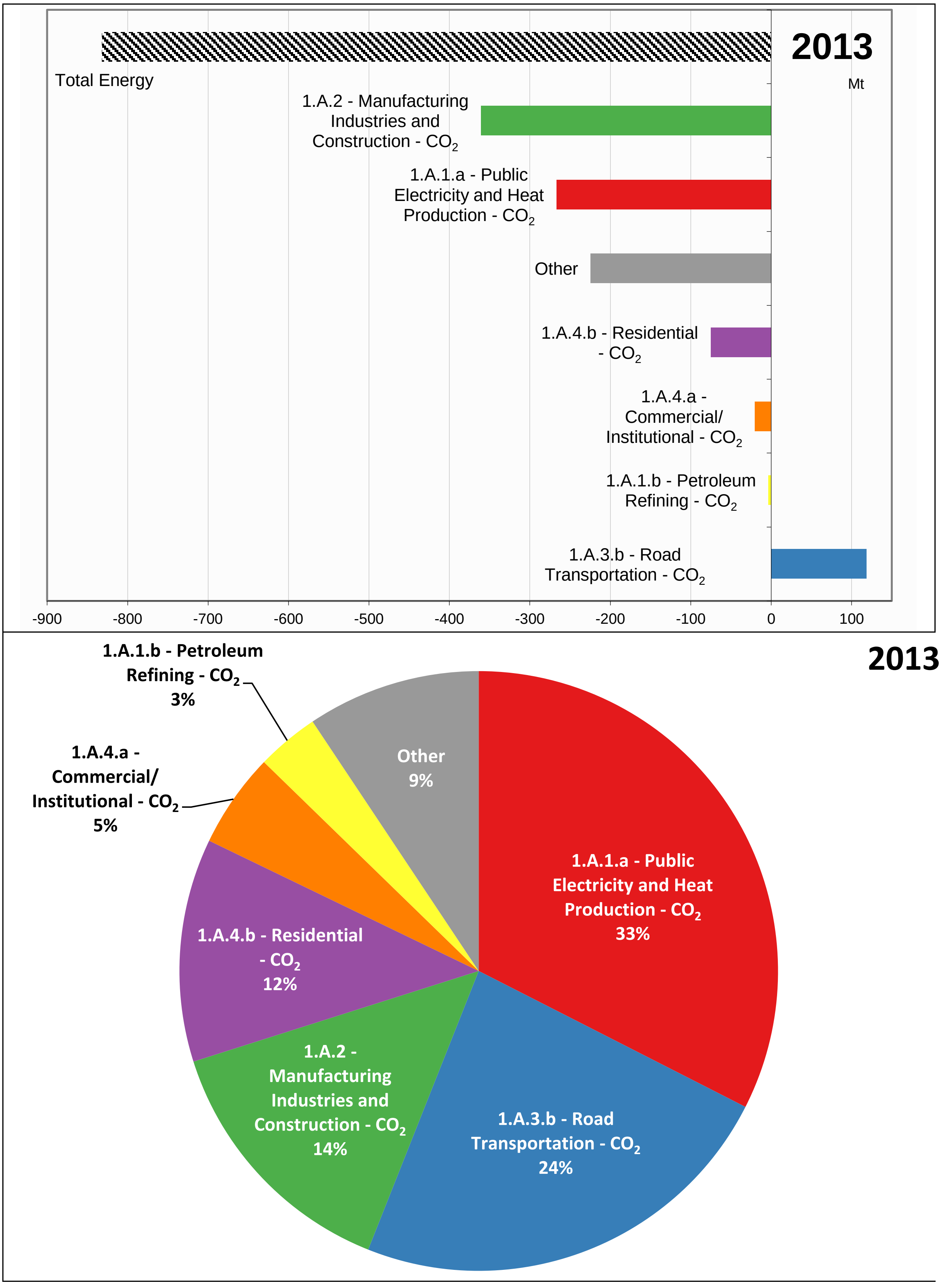


Figure 3.2 shows that CO_2 emissions from Road Transportation had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2013. The increases in road transport occurred in almost all Member States, whereas the emission reductions from Manufacturing Industries mainly occurred in Germany after the reunification. The decline of Fugitive Emissions from Fuels (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"[13] in Figure 3.2.Furthermore, Figure 3.2 shows that the six largest key categories account for more than 90 % of emissions in Sector 1.

[13] „Other" includes total emissions of Sector 1 minus 1A1a, 1A1b, 1A2, 1A3b, 1A4a and 1A4b.

Figure 3.2 *CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Mt) by large key source categories for 1990–2013 and share of largest key source categories in 2013*



3.2 Source categories and methodological issues

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-28, 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-28 between 1990 and 2013, which was mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 86 % of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 decreased by 19.8 %, between 1990 and 2013. This was mainly due to a decrease of CO_2 emission from Public Electricity and Heat Production (-267 Tg CO_2) and the manufacturing of solid fuels (-61 Tg CO_2). CO_2 emissions from petroleum refining decreased by 3 Tg in the period 1990-2013.

The decrease in fuel consumption since 2006 can be explained by the continuing effects of the economic downturn, but also increased use of renewables and energy efficiency in the newer EU Member States.

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

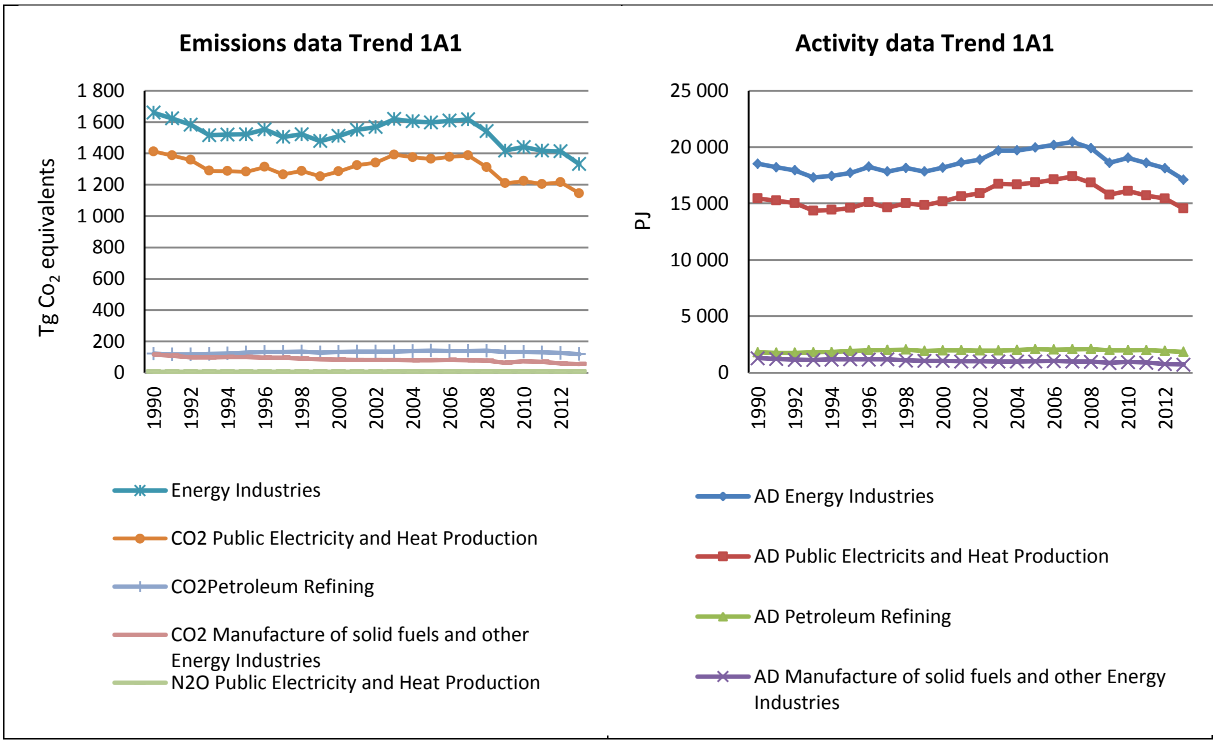


Table 3.1 summarises the information by Member State. Between 1990 and 2013, greenhouse gas emissions from energy industries increased in eight Member States and fell in twenty. The highest absolute increase was accounted for by Greece and the Netherlands. Poland, Germany and the UK

account for the largest part of reductions (-190 Tg). The change in the EU-28 was a net decrease of 329 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 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)
Austria	13 842	11 320	13 792	11 205	44	102
Belgium	30 806	21 386	30 606	21 153	180	166
Bulgaria	38 813	27 390	38 666	27 277	133	105
Croatia	7 190	5 132	7 167	5 110	17	19
Cyprus	1 767	2 839	1 761	2 830	4	7
Czech Republic	56 900	55 920	56 654	55 645	229	244
Denmark	26 248	19 006	26 146	18 768	86	98
Estonia	28 850	15 346	28 825	15 301	18	31
Finland	18 968	22 067	18 842	21 745	116	297
France	66 520	52 179	66 052	51 792	402	360
Germany	427 353	361 654	423 906	356 646	3 167	2 751
Greece	43 253	49 368	43 094	49 205	145	147
Hungary	20 910	14 093	20 833	14 009	67	62
Ireland	11 223	11 370	11 145	11 239	71	124
Italy	138 860	108 493	138 145	107 912	489	466
Latvia	6 217	1 939	6 201	1 919	11	13
Lithuania	13 550	3 867	13 519	3 830	21	23
Luxembourg	36	686	33	682	1	2
Malta	1 373	1 703	1 367	1 697	5	4
Netherlands	53 355	60 648	53 144	60 278	141	263
Poland	236 199	170 088	235 095	169 172	1 022	804
Portugal	16 349	15 221	16 297	15 110	46	98
Romania	51 412	25 453	51 205	25 346	178	95
Slovakia	19 149	8 318	19 056	8 269	85	37
Slovenia	6 375	5 774	6 348	5 745	25	26
Spain	77 665	72 284	77 355	71 561	267	513
Sweden	9 984	10 080	9 815	9 563	143	411
United Kingdom	236 781	177 675	234 678	176 098	1 912	1 361
EU-28	**1 659 947**	**1 331 298**	**1 649 749**	**1 319 106**	**9 025**	**8 629**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In terms of absolute contributions to EU-28 greenhouse gas emissions from energy industries, this sector is clearly dominated by Germany, UK and Poland. These three countries represent about half of the EU's greenhouse gas emissions from energy industries.

Public heat and electricity production is the largest source category in the EU-28, 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-28 level, 54 % of the fuel used in energy industries comes from solid fuels. Its contribution has been declining in favour of relatively cleaner natural gas, whose share amounted to 28 % in 2013 and biomass which has been constantly increasing with a share of 9% in 2013.

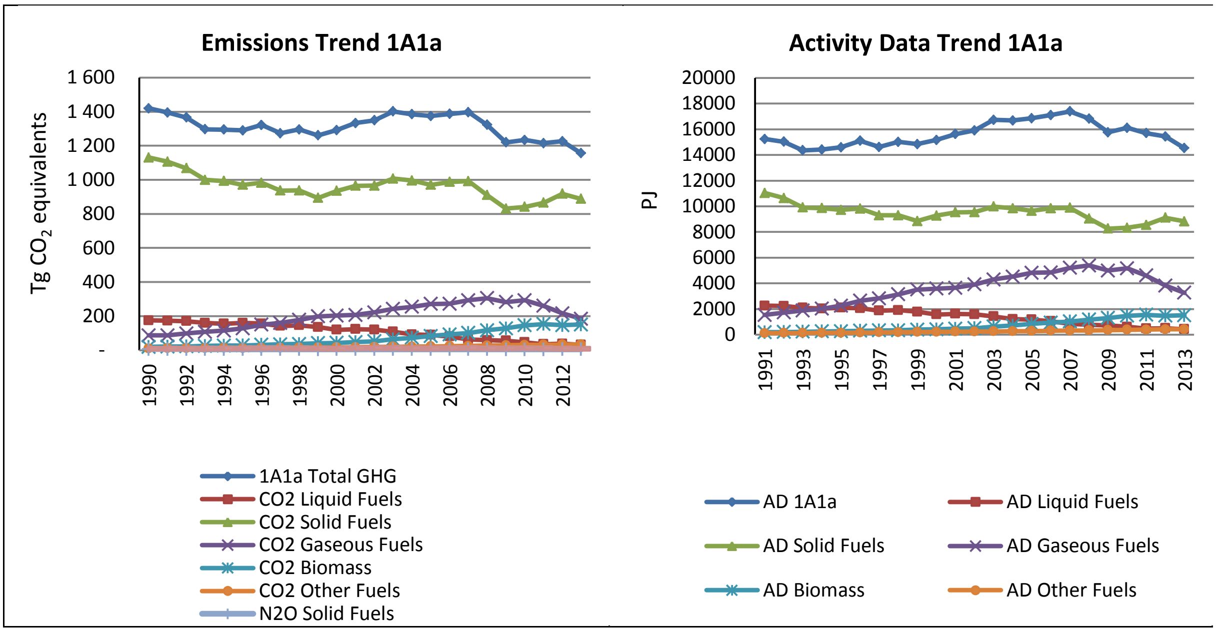
3.2.1.1 Public Electricity and Heat Production (1A1a) (EU-28)

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-28 accounting for 26 % of total greenhouse gas emissions in 2013 and for 86 % of greenhouse gas emissions of the Energy Industries Sector. Between 1990 and 2013, CO_2 emissions from electricity and heat production decreased by 6 % in the EU-28.

Figure 3.4 (left) shows the trends in emissions originating from the production of public electricity and heat by fuel in the EU-28 between 1990 and 2013. Figure 3.4 (right) shows the underlying activity data[14].

Figure 3.4 1A1a Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends



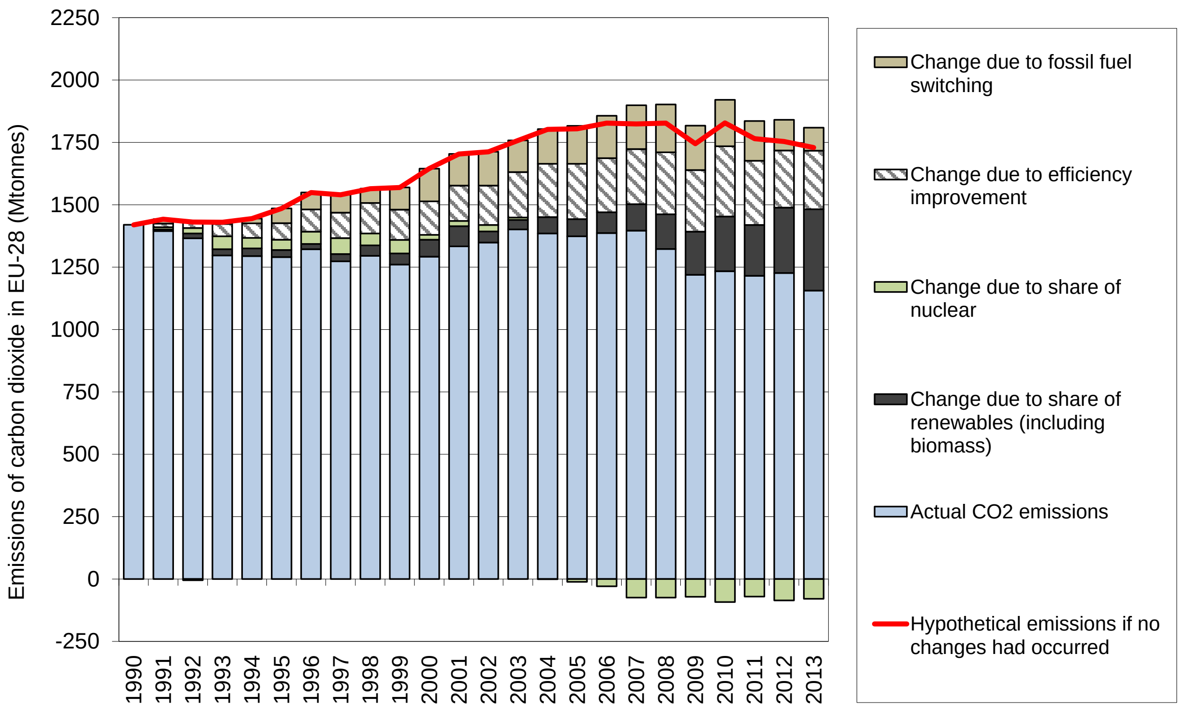
Fuel used for public electricity and heat production increased by 6 % in the EU-28 between 1990 and 2013. Solid fuels still represent almost half of the fuel used in public conventional thermal power plants, although its combustion has been declining (-21 %). Gas has increased very rapidly, by a factor of 3 between 1990 and 2010, but declined in the last years. In 2013 its share amounts to 22 % of all

[14] 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.

the fuel used for the production of heat and electricity in the EU-28. 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 10 %.

Figure 3.5 below shows the estimated impact of different factors on the reduction of CO_2 emissions from public heat and electricity generation in the EU-28 between 1990 and 2013. The main explanatory factors at the EU-28 level during the past 23 years have been improvements in energy efficiency and (fossil) fuel switching from coal to gas. However, the trend from coal to gas has reversed during the last years as a result of comparably high gas prices and lower coal prices.

Figure 3.5 Estimated impact of different factors on the reduction in emissions of CO_2 from public electricity and heat production in the EU-28 between 1990 and 2013.



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 2013, 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 6 % during 1990-2013 (blue bar), but emissions would have risen by over 21 %, if the shares of input fuels used to produce electricity and heat and the efficiency remained constant and an increase which was in line with the additional amount of electricity and heat produced (21%). The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2013 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2013, there was a 16 % 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 a 7 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2013.
- The higher combined share of nuclear (constant share) and renewable energy (increasing share) for electricity and heat production in 2013 compared to 1990[15]. During 1990-2013, the share of electricity from fossil fuels in total electricity production decreased by 14 %.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.22 (increase in electricity and heat production) X 0.84 (efficiency improvement) X 0.93 (fossil fuel switching) X 0.86 (lower nuclear-renewable share) = 0.81. The combined effect was a decrease of 18.6 % in CO_2 emissions in 2013 compared to the 1990 level.

Returning to the 2015 inventory, Table 3.2 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in six Member States, remained on the same level in one Member State, and fell in 21 compared to 1990. Of the six countries where emissions were higher in 2013 than in 1990, more than 71% of the increase was accounted for by the Netherlands and Greece. Of the eight countries, where emissions fell, more than 50% of the total reduction was accounted for by Poland (25%) the UK (21%) and Italy (11%). The change in the EU-28 between 1990 and 2013 was a net decrease of 266 Tg CO_2eq.

[15] 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. The reason for negative values of nuclear power is that - from 2004 onwards - the share of nuclear power in total electricity generation was below the share of 1990. During the period 1991-2003 the share of nuclear power was above the value of 1990 (29%) reaching a peak of 32% in 1997. Therefore during this period nuclear power contributed to lower GHG emissions compared to 1990. In the figure this is reflected in the (positive) green bars. The positive value indicates that nuclear power had a positive effect with regard to GHG emission reductions between 1990 and 2003. From 2004 onwards the picture changed: the share of nuclear power was below the value of 1990 reaching 26% in 2013. In the figure this is reflected in the (negative) green bars. The negative value indicates that nuclear power had a negative effect with regard to GHG emission reductions between 2004 and 2013. This is also reflected by the red line in the figure: the red line assumes that the share of nuclear power stays at 29% over the whole time series. Therefore from 2004 onwards the red line is below the bars.

Table 3.2 1A1a Public Electricity and Heat Production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	10 888	9 064	8 092	1%	-971	-11%	-2 795	-26%	NA	NA
Belgium	24 283	18 393	16 489	1%	-1 904	-10%	-7 794	-32%	NA,T1,T3	D,NA,PS
Bulgaria	37 443	30 482	26 231	2%	-4 251	-14%	-11 212	-30%	T1,T2	CS,D
Croatia	3 752	3 828	3 651	0%	-178	-5%	-101	-3%	T1	D
Cyprus	1 676	3 546	2 830	0%	-716	-20%	1 154	69%	CS	CS
Czech Republic	54 645	51 495	48 735	4%	-2 760	-5%	-5 910	-11%	T1,T2	CS,D
Denmark	24 695	14 117	16 477	1%	2 360	17%	-8 218	-33%	T1,T2,T3	CS,D
Estonia	28 760	12 651	14 857	1%	2 206	17%	-13 902	-48%	T1,T2,T3	CS,D,PS
Finland	16 452	17 579	18 983	2%	1 404	8%	2 531	15%	NA,T3	CS,D,NA,PS
France	49 367	40 795	40 608	4%	-187	0%	-8 759	-18%	-	-
Germany	338 451	329 153	328 385	29%	-768	0%	-10 066	-3%	CS	CS
Greece	40 617	50 902	44 100	4%	-6 802	-13%	3 484	9%	T2	CS
Hungary	17 898	14 862	12 284	1%	-2 578	-17%	-5 614	-31%	T1,T2	CS,D
Ireland	10 876	12 216	10 823	1%	-1 393	-11%	-54	0%	T3	CS,PS
Italy	107 158	91 716	78 689	7%	-13 027	-14%	-28 469	-27%	T3	CS
Latvia	6 058	1 789	1 849	0%	61	3%	-4 208	-69%	T1,T2	CS,D
Lithuania	12 012	2 938	2 372	0%	-567	-19%	-9 641	-80%	T2,T3	CS,PS
Luxembourg	33	1 035	682	0%	-353	-34%	649	1950%	T2	CS
Malta	1 367	2 052	1 697	0%	-355	-17%	330	24%	D,T1,T3	D,PS
Netherlands	39 932	48 105	48 279	4%	174	0%	8 346	21%	CS,T2	CS,D
Poland	228 055	159 944	161 366	14%	1 422	1%	-66 688	-29%	T1,T2	CS,D
Portugal	14 319	15 175	12 559	1%	-2 615	-17%	-1 760	-12%	-	-
Romania	46 782	29 048	21 857	2%	-7 191	-25%	-24 925	-53%	T1,T2	CS
Slovakia	14 864	6 075	5 613	0%	-462	-8%	-9 251	-62%	T2	CS,D
Slovenia	6 096	6 019	5 739	1%	-280	-5%	-357	-6%	T1,T2	CS,D
Spain	64 332	76 877	57 890	5%	-18 988	-25%	-6 442	-10%	T2	CS,OTH,PS
Sweden	7 737	7 535	7 307	1%	-228	-3%	-429	-6%	NA	NA
United Kingdom	203 096	157 720	146 520	13%	-11 201	-7%	-56 577	-28%	T2	CS
EU-28	**1 411 643**	**1 215 113**	**1 144 965**	**100%**	**-70 149**	**-6%**	**-266 679**	**-19%**		

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.

Finally, N_2O emissions currently represent 0.6 % of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2013, emissions increased by 3 % (Table 3.3). The largest decline in emissions from this source category were reported by Germany and Spain (-61kt CO_2eq in both countries). The biggest increases occurred in Sweden (+15 kt CO_2eq).

Table 3.3 1A1a Public Electricity and Heat Production: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	40	101	96	1%	-5	-5%	56	143%
Belgium	53	102	96	1%	-6	-6%	44	83%
Bulgaria	132	122	104	1%	-17	-14%	-27	-21%
Croatia	13	18	18	0%	0	-2%	5	35%
Cyprus	4	8	7	0%	-1	-19%	3	69%
Czech Republic	226	235	224	3%	-11	-5%	-2	-1%
Denmark	79	83	90	1%	7	8%	11	13%
Estonia	18	27	30	0%	3	10%	12	70%
Finland	100	269	272	4%	3	1%	172	172%
France	290	301	282	4%	-19	-6%	-8	-3%
Germany	2 407	2 607	2 546	34%	-61	-2%	139	6%
Greece	142	160	141	2%	-18	-11%	0	0%
Hungary	63	60	61	1%	0	1%	-2	-3%
Ireland	71	134	124	2%	-10	-7%	53	74%
Italy	306	303	295	4%	-8	-3%	-11	-4%
Latvia	11	8	12	0%	4	50%	1	13%
Lithuania	19	18	21	0%	3	15%	2	12%
Luxembourg	1	2	2	0%	0	-5%	1	58%
Malta	5	5	4	0%	-1	-19%	-1	-17%
Netherlands	133	252	245	3%	-7	-3%	112	85%
Poland	1 006	809	795	10%	-15	-2%	-211	-21%
Portugal	43	124	96	1%	-27	-22%	54	125%
Romania	174	120	92	1%	-28	-24%	-82	-47%
Slovakia	79	33	34	0%	1	3%	-45	-56%
Slovenia	25	27	26	0%	-1	-3%	1	4%
Spain	190	466	405	5%	-61	-13%	215	113%
Sweden	137	393	408	5%	15	4%	270	197%
United Kingdom	1 604	1 130	1 070	14%	-60	-5%	-534	-33%
EU-28	**7 368**	**7 918**	**7 595**	**100%**	**-323**	**-4%**	**227**	**3%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 3 % of all greenhouse gas emissions from 1A1a. Within the EU-28, emissions fell by 82 % between 1990 and 2013 (Table 3.4).

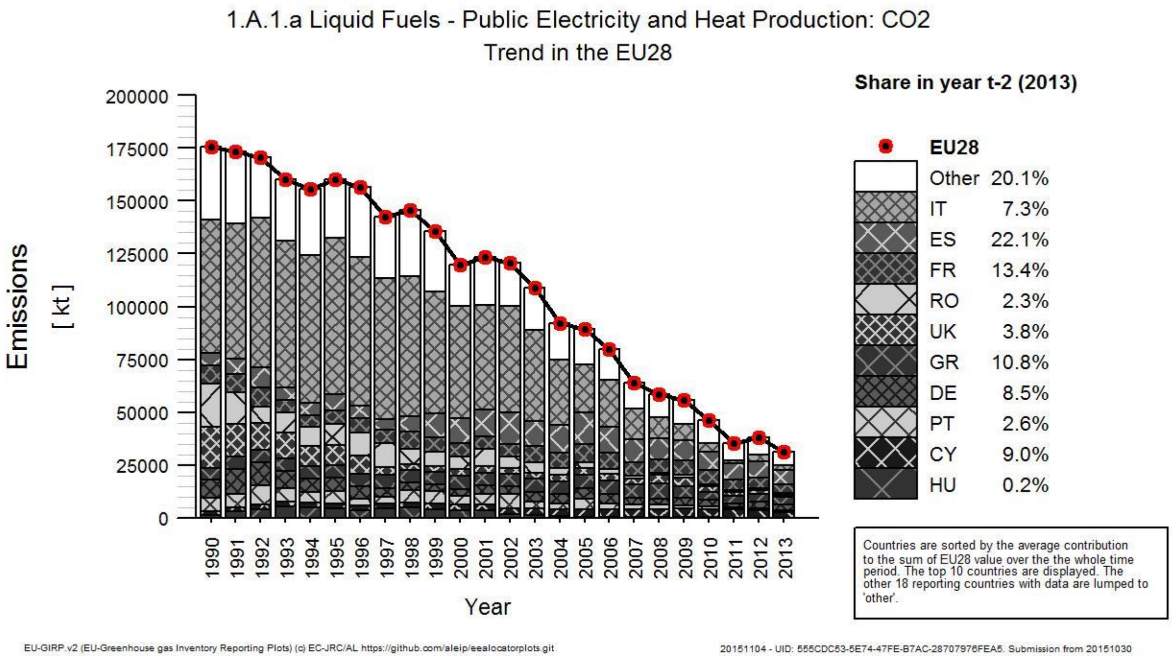
Table 3.4 1A1a Public Electricity and Heat Production, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	1 229	224	185	1%	-39	-17%	-1 044	-85%
Belgium	663	148	19	0%	-129	-87%	-644	-97%
Bulgaria	3 245	626	672	2%	46	7%	-2 573	-79%
Croatia	2 142	399	173	1%	-227	-57%	-1 970	-92%
Cyprus	1 676	3 546	2 830	9%	-716	-20%	1 154	69%
Czech Republic	1 234	131	61	0%	-70	-53%	-1 173	-95%
Denmark	951	340	274	1%	-66	-19%	-677	-71%
Estonia	4 900	340	279	1%	-61	-18%	-4 621	-94%
Finland	1 230	810	516	2%	-293	-36%	-714	-58%
France	8 254	4 945	4 199	13%	-746	-15%	-4 056	-49%
Germany	8 637	2 896	2 677	9%	-218	-8%	-5 960	-69%
Greece	5 416	3 808	3 404	11%	-403	-11%	-2 011	-37%
Hungary	1 456	178	48	0%	-130	-73%	-1 408	-97%
Ireland	1 087	153	124	0%	-28	-19%	-962	-89%
Italy	63 058	2 940	2 296	7%	-644	-22%	-60 762	-96%
Latvia	3 050	37	16	0%	-21	-58%	-3 034	-99%
Lithuania	6 021	525	247	1%	-278	-53%	-5 774	-96%
Luxembourg	NO	2	2	0%	0	-16%	2	100%
Malta	749	2 052	1 697	5%	-355	-17%	948	127%
Netherlands	207	1 042	1 027	3%	-15	-1%	820	397%
Poland	5 160	552	498	2%	-55	-10%	-4 663	-90%
Portugal	6 407	899	814	3%	-85	-9%	-5 592	-87%
Romania	20 353	998	713	2%	-285	-29%	-19 640	-96%
Slovakia	1 033	32	20	0%	-12	-37%	-1 013	-98%
Slovenia	272	25	24	0%	-1	-2%	-247	-91%
Spain	6 006	7 909	6 940	22%	-969	-12%	933	16%
Sweden	1 277	797	497	2%	-300	-38%	-780	-61%
United Kingdom	19 716	1 642	1 182	4%	-461	-28%	-18 534	-94%
EU-28	**175 429**	**37 997**	**31 434**	**100%**	**-6 562**	**-17%**	**-143 995**	**-82%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.10 shows the contribution to the emission trend for liquid fuels by the main Member States. IN 2013 Spain, France and Greece are responsible for about 45% of emissions in this category. The strongest decrease in emissions took place in Italy because fewer oil is used as a fuel in the power sector.

Figure 3.6 1A1a Public Electricity and Heat Production, liquid fuels: Emission trend and share 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-28, emissions fell by 21 % between 1990 and 2013 (Table 3.5).

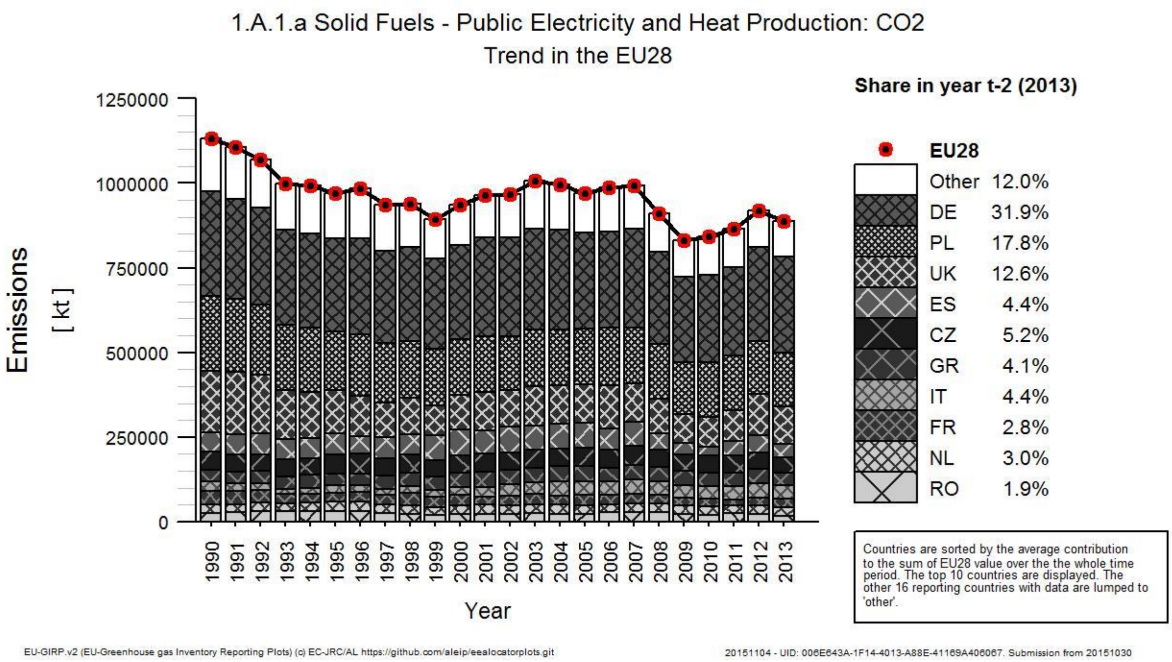
Table 3.5 1A1a Public Electricity and Heat Production, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	6 247	3 454	3 295	0%	-159	-5%	-2 952	-47%
Belgium	20 181	7 672	7 160	1%	-512	-7%	-13 022	-65%
Bulgaria	27 902	27 635	23 450	3%	-4 185	-15%	-4 452	-16%
Croatia	603	1 971	2 202	0%	231	12%	1 599	265%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	52 368	49 196	46 546	5%	-2 651	-5%	-5 823	-11%
Denmark	22 225	9 608	12 229	1%	2 621	27%	-9 997	-45%
Estonia	21 704	11 208	13 557	2%	2 349	21%	-8 147	-38%
Finland	9 281	7 453	10 416	1%	2 963	40%	1 136	12%
France	37 578	23 006	24 703	3%	1 697	7%	-12 875	-34%
Germany	307 246	279 481	282 759	32%	3 278	1%	-24 487	-8%
Greece	35 201	41 990	36 109	4%	-5 882	-14%	908	3%
Hungary	12 266	8 747	8 032	1%	-715	-8%	-4 234	-35%
Ireland	4 845	4 555	3 798	0%	-757	-17%	-1 047	-22%
Italy	28 169	42 199	39 393	4%	-2 806	-7%	11 224	40%
Latvia	218	49	40	0%	-8	-17%	-178	-82%
Lithuania	174	11	10	0%	-1	-10%	-164	-94%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	618	NO	NO	-	-	-	-618	-100%
Netherlands	25 776	25 909	26 310	3%	401	2%	534	2%
Poland	220 928	155 822	157 788	18%	1 966	1%	-63 140	-29%
Portugal	7 912	10 887	9 875	1%	-1 012	-9%	1 963	25%
Romania	26 429	22 435	16 670	2%	-5 765	-26%	-9 759	-37%
Slovakia	11 742	3 990	3 732	0%	-258	-6%	-8 010	-68%
Slovenia	5 712	5 644	5 395	1%	-249	-4%	-316	-6%
Spain	57 778	51 497	39 115	4%	-12 383	-24%	-18 663	-32%
Sweden	4 231	2 797	3 101	0%	303	11%	-1 130	-27%
United Kingdom	183 150	120 708	111 940	13%	-8 767	-7%	-71 209	-39%
EU-28	**1 130 482**	**917 923**	**887 624**	**100%**	**-30 300**	**-3%**	**-242 858**	**-21%**

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 trend of emissions for solid fuels for main contributing Member States. Germany has the largest share of emissions from solid fuels in the EU-28 (32%), followed by Poland (18%) and the United Kingdom (13%).

Figure 3.7 1A1a Public Electricity and Heat Production, solid fuels: Emission trend and share 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-28, emissions decreased by 20 % between 1990 and 2013 (Table 3.6).

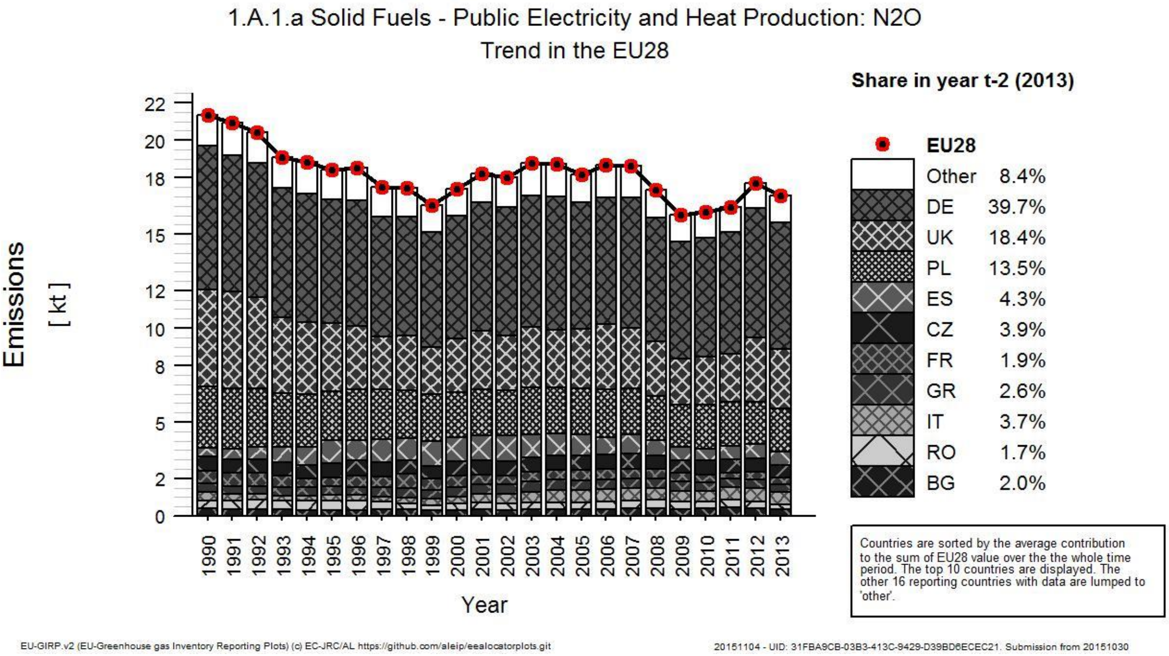
Table 3.6 1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	22	18	17	0%	-1	-4%	-5	-22%
Belgium	37	5	4	0%	-1	-12%	-33	-89%
Bulgaria	121	119	102	2%	-17	-15%	-19	-16%
Croatia	3	9	10	0%	1	12%	8	265%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	222	209	198	4%	-11	-5%	-24	-11%
Denmark	57	24	31	1%	7	28%	-26	-46%
Estonia	2	5	8	0%	2	48%	6	319%
Finland	41	49	66	1%	17	34%	25	60%
France	206	115	97	2%	-18	-16%	-109	-53%
Germany	2 275	2 058	2 020	40%	-37	-2%	-255	-11%
Greece	129	148	131	3%	-17	-11%	2	1%
Hungary	56	32	31	1%	-1	-3%	-25	-45%
Ireland	8	7	6	0%	-1	-16%	-2	-22%
Italy	133	201	187	4%	-14	-7%	54	41%
Latvia	1	0	0	0%	0	-17%	-1	-82%
Lithuania	1	0	0	0%	0	-10%	-1	-94%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	3	NO	NO	-	-	-	-3	-100%
Netherlands	104	95	99	2%	4	4%	-4	-4%
Poland	970	679	687	14%	7	1%	-284	-29%
Portugal	35	48	44	1%	-4	-9%	9	25%
Romania	127	114	85	2%	-29	-26%	-42	-33%
Slovakia	58	18	17	0%	-2	-9%	-41	-71%
Slovenia	24	25	24	0%	-1	-3%	0	-2%
Spain	140	229	219	4%	-10	-4%	79	57%
Sweden	41	53	68	1%	15	28%	27	67%
United Kingdom	1 548	1 009	935	18%	-75	-7%	-613	-40%
EU-28	**6 363**	**5 271**	**5 085**	**100%**	**-186**	**-4%**	**-1 278**	**-20%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The trend for N_2O emissions (Figures 3.12) is closely related to the emission trend of CO_2 emissions. Likewise are the main contributing Member States Germany, the United Kingdom as well as Poland.

Figure 3.8 1A1a Public Electricity and Heat Production, solid fuels: Emission trend and share for N_2O



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

CO_2 emissions from the combustion of gaseous fuels accounted for 16 % of all greenhouse gas emissions from public electricity and heat generation in 2013. Emissions increased by a factor of two in the EU-28 between 1990 and 2013 (Table 3.7).

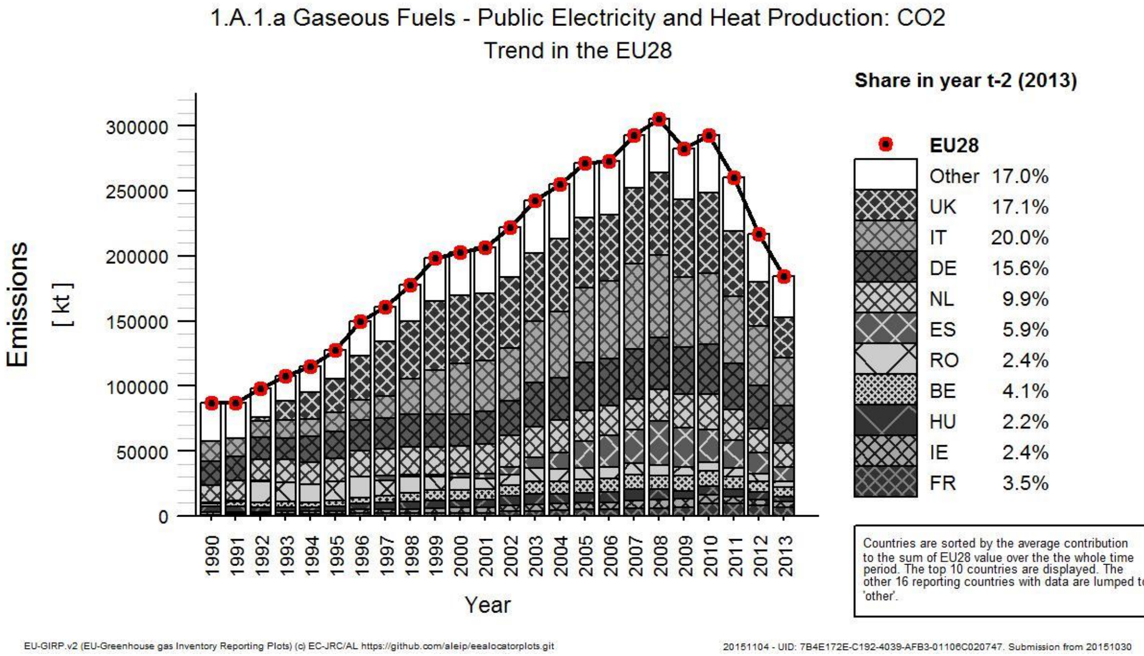
Table 3.7 1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	3 294	4 084	3 326	2%	-758	-19%	32	1%
Belgium	2 765	8 586	7 548	4%	-1 038	-12%	4 783	173%
Bulgaria	6 295	2 222	2 109	1%	-113	-5%	-4 187	-67%
Croatia	1 006	1 458	1 276	1%	-182	-12%	270	27%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 019	1 953	1 914	1%	-39	-2%	895	88%
Denmark	980	2 858	2 481	1%	-377	-13%	1 500	153%
Estonia	1 969	909	755	0%	-153	-17%	-1 213	-62%
Finland	1 989	3 517	2 976	2%	-540	-15%	988	50%
France	977	7 735	6 503	4%	-1 232	-16%	5 526	566%
Germany	18 447	32 623	28 795	16%	-3 827	-12%	10 348	56%
Greece	IE,NO	5 104	4 587	2%	-517	-10%	4 587	100%
Hungary	4 148	5 657	3 963	2%	-1 694	-30%	-185	-4%
Ireland	1 881	4 755	4 356	2%	-398	-8%	2 476	132%
Italy	15 788	46 316	36 830	20%	-9 486	-20%	21 042	133%
Latvia	2 644	1 703	1 789	1%	86	5%	-855	-32%
Lithuania	5 806	2 390	1 961	1%	-430	-18%	-3 845	-66%
Luxembourg	NO	970	615	0%	-354	-37%	615	100%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	13 348	18 559	18 147	10%	-412	-2%	4 799	36%
Poland	1 214	3 476	2 995	2%	-481	-14%	1 781	147%
Portugal	NO	3 038	1 489	1%	-1 550	-51%	1 489	100%
Romania	NO	5 616	4 474	2%	-1 142	-20%	4 474	100%
Slovakia	2 089	2 053	1 861	1%	-192	-9%	-228	-11%
Slovenia	112	334	306	0%	-28	-8%	194	173%
Spain	437	16 403	10 802	6%	-5 602	-34%	10 364	2371%
Sweden	486	867	885	0%	18	2%	399	82%
United Kingdom	16	33 344	31 413	17%	-1 931	-6%	31 397	196927%
EU-28	**86 710**	**216 529**	**184 154**	**100%**	**-32 375**	**-15%**	**97 444**	**112%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In all EU-28 Member States the consumption of gas was higher in 2013 than in 1990. Nevertheless there is a decreasing trend since 2008 which is mainly attributed to the increased prices for gas. Figure 3.13. shows the trend of emissions from gaseous fuels by the main contributing Member States which are Italy, United Kingdom and Germany.

Figure 3.9 1A1a Public Electricity and Heat Production, gaseous fuels: Emission trend and share for CO_2



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

In 2013, the share of CO_2 emissions from other fuels amount to 3 % of total greenhouse gas emissions from public electricity and heat generation. Emissions increased by 219% at EU-28 level between 1990 and 2013 and increased in all countries where 'other fuels' are used in heat and power generation. Other fuels cover mainly the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.8).

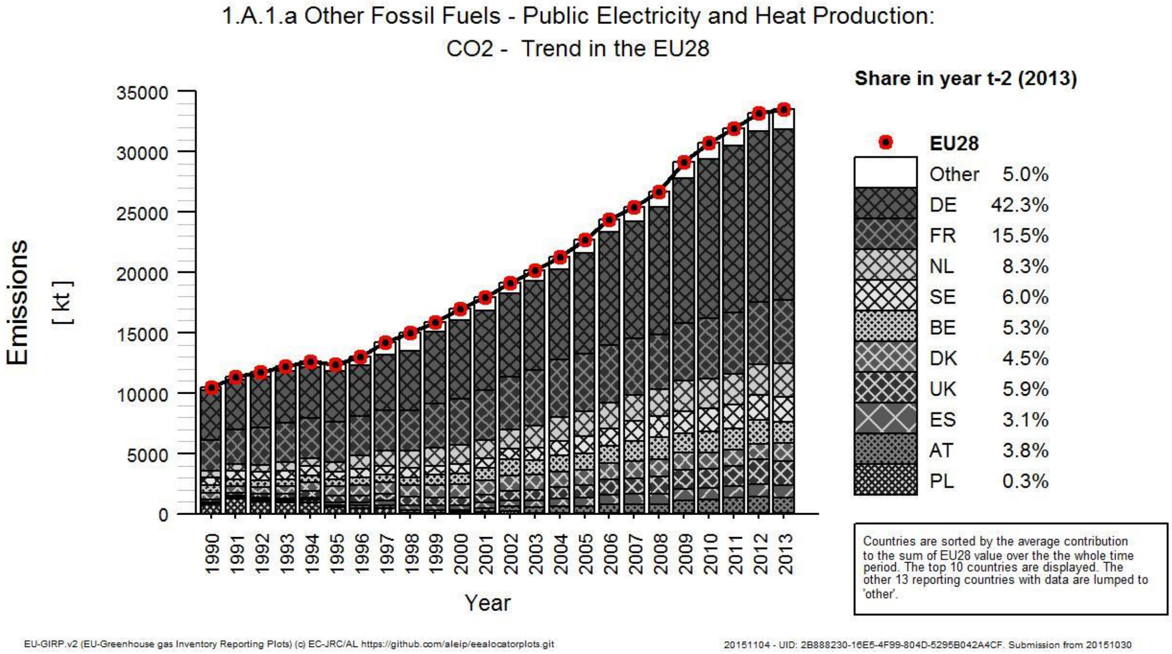
Table 3.8 1A1a Public Electricity and Heat Production, other fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	118	1 302	1 287	4%	-15	-1%	1 169	990%
Belgium	674	1 987	1 763	5%	-224	-11%	1 089	161%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	24	214	214	1%	0	0%	190	791%
Denmark	539	1 312	1 494	4%	183	14%	956	177%
Estonia	NO	NO	109	0%	109	100%	109	100%
Finland	1	249	280	1%	31	12%	279	27875%
France	2 558	5 109	5 203	16%	93	2%	2 645	103%
Germany	4 121	14 154	14 154	42%	0	0%	10 033	243%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	28	280	241	1%	-39	-14%	213	767%
Ireland	NO	80	87	0%	6	8%	87	100%
Italy	143	261	170	1%	-91	-35%	27	19%
Latvia	3	NO	NO	-	-	-	-3	-100%
Lithuania	NO	NO	107	0%	107	100%	107	100%
Luxembourg	33	64	65	0%	2	2%	32	96%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	601	2 595	2 795	8%	200	8%	2 193	365%
Poland	753	94	85	0%	-9	-9%	-668	-89%
Portugal	NO	350	382	1%	31	9%	382	100%
Romania	NO	NO	1	0%	1	100%	1	100%
Slovakia	NO	0	0	0%	0	66%	0	100%
Slovenia	NO	15	13	0%	-2	-14%	13	100%
Spain	110	1 068	1 034	3%	-35	-3%	924	839%
Sweden	570	2 033	2 026	6%	-7	0%	1 456	255%
United Kingdom	215	2 027	1 985	6%	-42	-2%	1 770	824%
EU-28	**10 491**	**33 194**	**33 494**	**100%**	**300**	**1%**	**23 002**	**219%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the largest emitters in 2013 which were Germany, France and the Netherlands which together accounted for 66.1 % of EU-28 emissions.

Figure 3.10 1A1a Public Electricity and Heat Production, other fuels: Emission trend and share for CO_2



3.2.1.2 Petroleum Refining (1A1b) (EU-28)

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 are the eight largest key category in the EU-28 accounting for 3 % of total greenhouse gas emissions in 2013. Between 1990 and 2013, EU-28 CO_2 emissions decreased by 3 % (Table 3.9). Emissions in 2013 were above 1990 levels in 17 Member States, whereas they were decreasing in 11 countries.

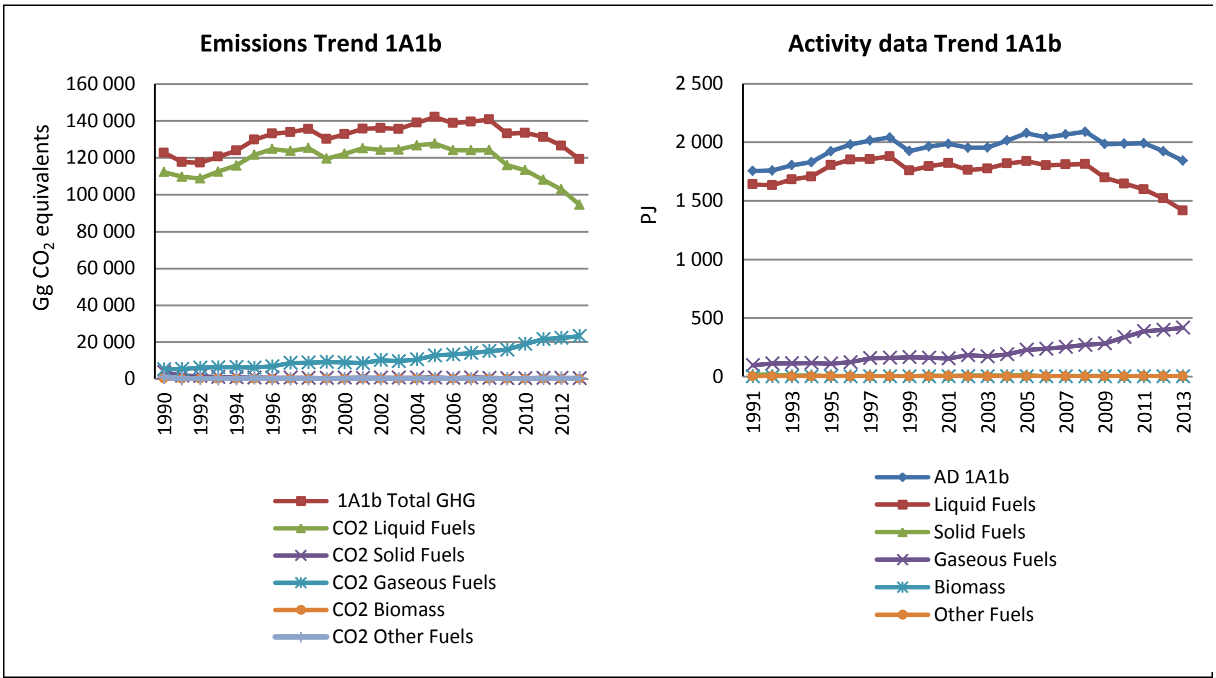
Table 3.9 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	2 394	2 836	2 827	2%	-9	0%	432	18%
Belgium	4 299	4 615	4 382	4%	-233	-5%	82	2%
Bulgaria	861	1 009	1 042	1%	33	3%	181	21%
Croatia	2 422	1 453	1 230	1%	-224	-15%	-1 192	-49%
Cyprus	86	NO	NO	-	-	-	-86	-100%
Czech Republic	493	826	702	1%	-125	-15%	209	42%
Denmark	906	972	950	1%	-23	-2%	43	5%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	2 042	2 569	2 514	2%	-55	-2%	471	23%
France	11 935	8 627	8 061	7%	-566	-7%	-3 875	-32%
Germany	20 166	18 672	17 994	15%	-678	-4%	-2 172	-11%
Greece	2 375	3 560	5 063	4%	1 504	42%	2 688	113%
Hungary	2 371	1 382	1 312	1%	-69	-5%	-1 058	-45%
Ireland	168	313	294	0%	-19	-6%	126	75%
Italy	17 190	25 936	22 162	19%	-3 774	-15%	4 973	29%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	1 498	1 418	1 442	1%	24	2%	-56	-4%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	11 051	9 761	9 277	8%	-484	-5%	-1 774	-16%
Poland	2 164	5 894	4 978	4%	-916	-16%	2 814	130%
Portugal	1 863	2 144	2 550	2%	406	19%	688	37%
Romania	4 277	1 985	2 063	2%	79	4%	-2 214	-52%
Slovakia	2 873	1 460	1 470	1%	10	1%	-1 404	-49%
Slovenia	170	NO	NO	-	-	-	-170	-100%
Spain	10 906	12 380	11 836	10%	-544	-4%	930	9%
Sweden	1 778	2 198	1 904	2%	-294	-13%	126	7%
United Kingdom	17 812	15 963	14 676	12%	-1 287	-8%	-3 137	-18%
EU-28	**122 101**	**125 974**	**118 727**	**100%**	**-7 247**	**-6%**	**-3 374**	**-3%**

Figure 3.11 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-28 between 1990 and 2013 and the activity data behind the emissions.

Fuel used for petroleum refining increased by 3 % in the EU-28 between 1990 and 2013, but shows a decreasing trend in the recent years. Liquid fuels represent 79 % of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part and their use in 2013 is more than four times higher than in 1990. There remains a small amount of solid fuels used in petroleum refining in France (blast furnace gas), Germany (lignite and coke oven gas) and Poland (hard coal).

Figure 3.11 1A1b Petroleum Refining: Total and CO_2 emission trends



1A1b Petroleum Refining - Liquid Fuels (CO_2)

CO_2 emissions from the combustion of liquid fuels used for petroleum refining accounted for 79 % of all greenhouse gas emissions from petroleum refining in 2013. Emissions decreased by 16 % between 1990 and 2013 (Table 3.10). Greece had by far the largest emission increase between 1990 and 2013 whereas France reports the largest decrease in emissions in this period.

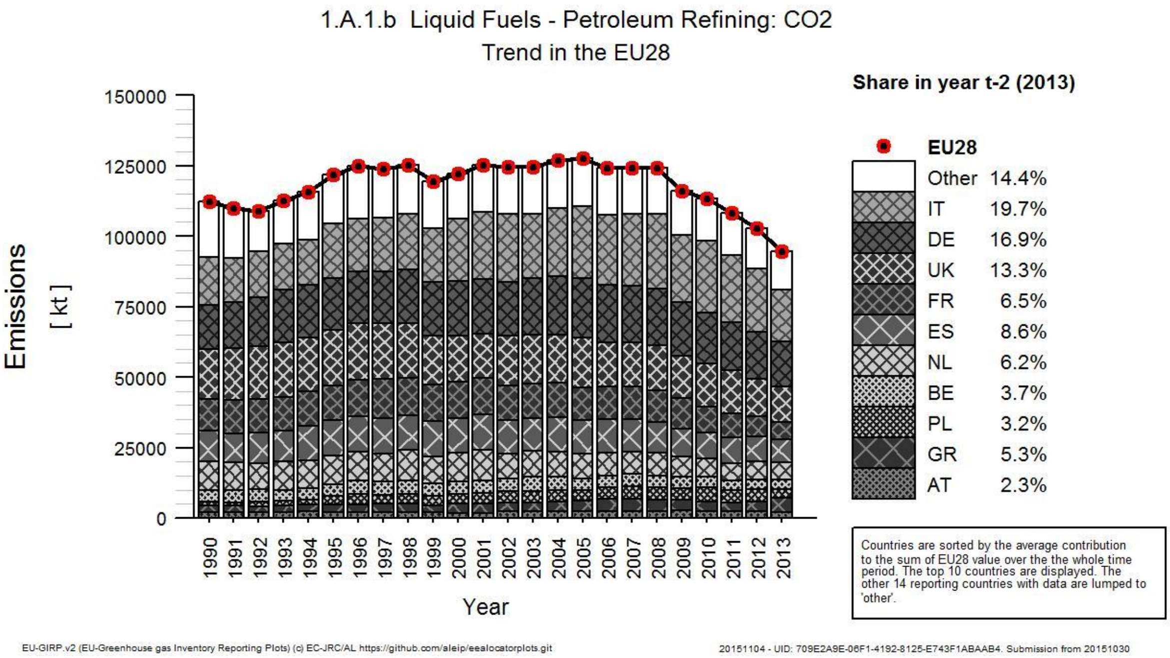
Table 3.10 1A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	1 958	2 368	2 171	2%	-197	-8%	214	11%	-	-
Belgium	4 285	3 523	3 467	4%	-56	-2%	-818	-19%	CS,T3	PS
Bulgaria	793	854	908	1%	54	6%	115	15%	T1	D
Croatia	2 408	1 444	942	1%	-502	-35%	-1 466	-61%	T1	D
Cyprus	86	NO	NO	-	-	-	-86	-100%	T1	D
Czech Republic	176	615	491	1%	-125	-20%	315	179%	T1	CS,D
Denmark	906	972	950	1%	-23	-2%	43	5%	T1,T2,T3	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 383	1 628	1 614	2%	-14	-1%	231	17%	T3	CS,PS
France	11 413	6 983	6 144	6%	-839	-12%	-5 269	-46%	-	-
Germany	15 417	16 591	15 963	17%	-628	-4%	547	4%	CS	CS
Greece	2 375	3 560	5 063	5%	1 504	42%	2 688	113%	T2	PS
Hungary	1 678	977	924	1%	-53	-5%	-754	-45%	T2	CS,D
Ireland	168	297	278	0%	-19	-7%	109	65%	T3	CS,PS
Italy	17 030	22 372	18 618	20%	-3 754	-17%	1 587	9%	T3	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 498	1 417	1 440	2%	23	2%	-57	-4%	T2,T3	CS,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	10 008	6 422	5 878	6%	-544	-8%	-4 130	-41%	T2	CS,D
Poland	1 319	4 164	3 009	3%	-1 155	-28%	1 690	128%	T1	D
Portugal	1 863	1 542	1 491	2%	-52	-3%	-372	-20%	T2	CR,D,PS
Romania	4 277	1 423	1 506	2%	83	6%	-2 771	-65%	T2	CS
Slovakia	2 786	1 222	1 226	1%	5	0%	-1 560	-56%	T3	PS
Slovenia	43	NO	NO	-	-	-	-43	-100%	T1	D
Spain	10 861	8 984	8 138	9%	-847	-9%	-2 723	-25%	T2	CS,PS
Sweden	1 778	2 167	1 849	2%	-318	-15%	71	4%	-	-
United Kingdom	17 763	13 389	12 614	13%	-775	-6%	-5 149	-29%	T2	CS
EU-28	**112 272**	**102 914**	**94 683**	**100%**	**-8 231**	**-8%**	**-17 589**	**-16%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.18 shows that Italy, Germany and the United Kingdom are most contributing countries in terms of CO_2 emissions in 2013. It also can be seen that the trend for liquid fuels is decreasing since 2009.

Figure 3.12 1A1b Petroleum Refining, liquid fuels: Emission trend and share 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 2013. There are only three countries reporting emissions in the EU-28 in 2013 (Germany, France and Poland). Poland is the only country that reports increasing emissions. EU-28 emissions fell by 88 % on average between 1990 and 2013 (Table 3.11).

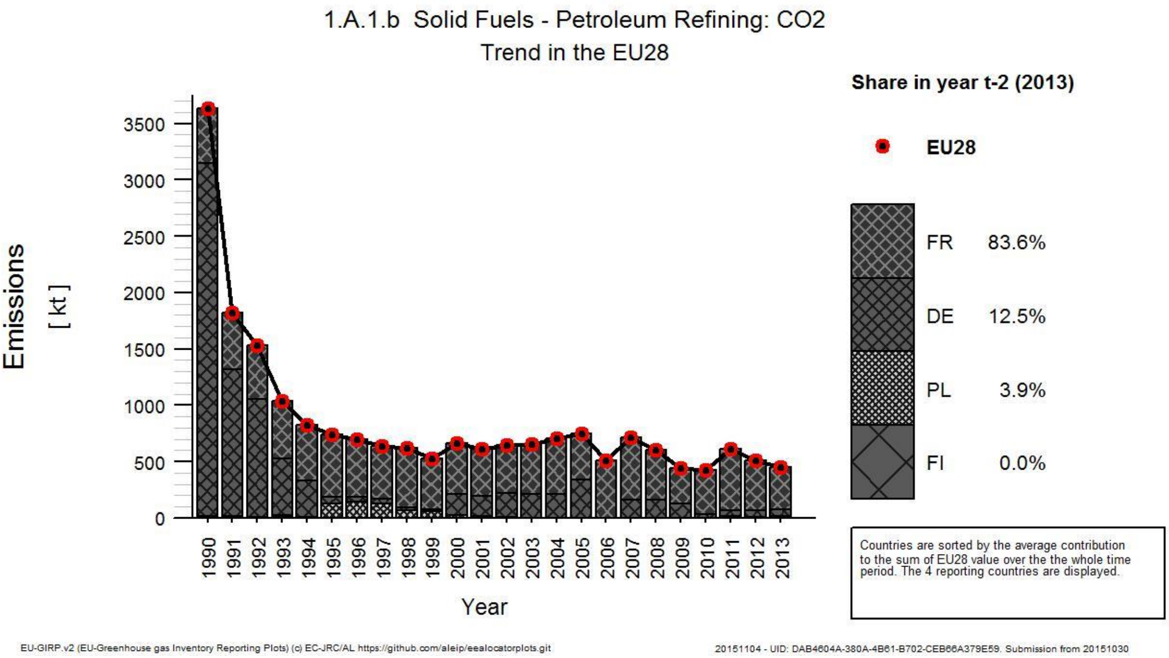
Table 3.11 1A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	12	NO	NO	-	-	-	-12	-100%	T3	CS
France	486	440	379	84%	-61	-14%	-107	-22%	-	-
Germany	3 131	55	57	13%	2	4%	-3 074	-98%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4	11	18	4%	7	60%	13	305%	T1,T2	CS,D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**3 633**	**506**	**453**	**100%**	**-53**	**-10%**	**-3 180**	**-88%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.19 shows the trend of 1A1b for solid fuels. France contributes more than 80% to the emissions in this sector, whereas Germany is responsible for the declining trend since 1990.

Figure 3.13 1A1b Petroleum Refining, solid fuels: Emission trend and share for CO_2



1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2013, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 20 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-28 increased by a factor of more than four between 1990 and 2013 (Table 3.12). Only three of the EU-28 Member States reduced their emissions: Czech Republic, Hungary and Slovenia.

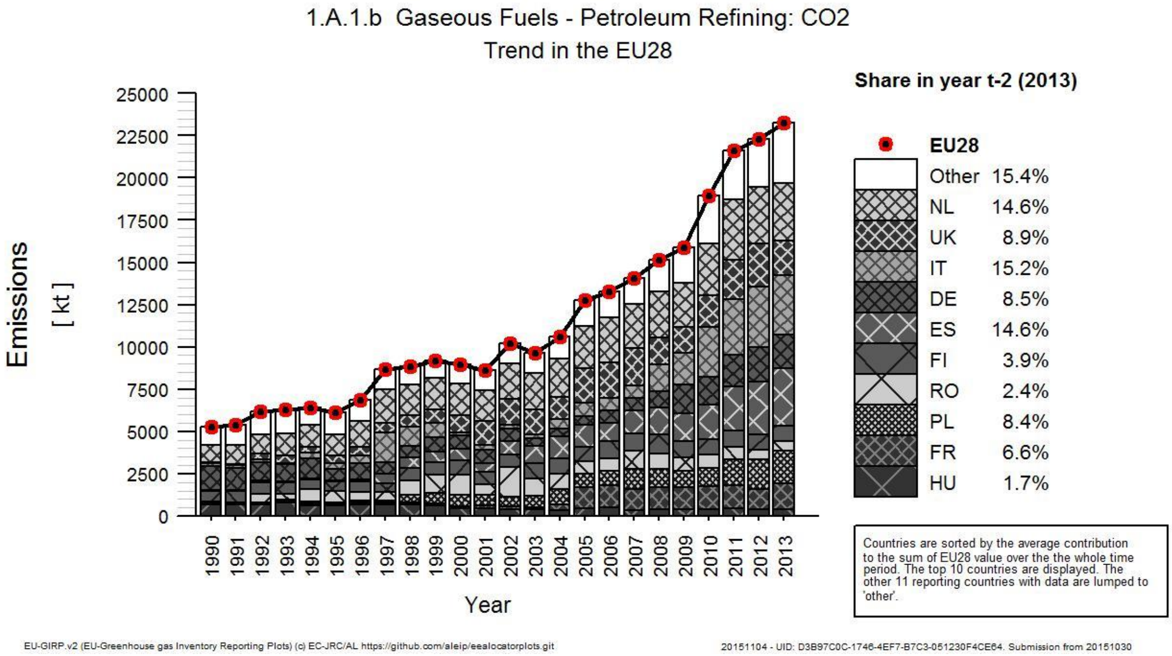
Table 3.12 1A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	437	468	655	3%	188	40%	219	50%	-	-
Belgium	14	1 091	914	4%	-177	-16%	900	6481%	CS,T3	PS
Bulgaria	69	156	135	1%	-21	-14%	66	96%	NA	NA
Croatia	14	9	288	1%	278	2980%	274	1967%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	211	211	1%	0	0%	-106	-33%	T2	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	648	941	900	4%	-41	-4%	252	39%	T3	CS
France	36	1 203	1 537	7%	334	28%	1 501	4147%	-	-
Germany	1 444	2 026	1 973	8%	-52	-3%	529	37%	CS	CS
Greece	NO	IE	IE	-	-	-	-	-	NA	NA
Hungary	693	405	388	2%	-16	-4%	-304	-44%	T1	D
Ireland	NO	16	17	0%	0	2%	17	100%	NA	NA
Italy	159	3 565	3 545	15%	-20	-1%	3 385	2125%	T3	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	1	1	0%	0	5%	1	100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 042	3 339	3 398	15%	59	2%	2 356	226%	T2	CS
Poland	94	1 719	1 951	8%	232	14%	1 857	1981%	T1	D
Portugal	NO	602	1 060	5%	458	76%	1 060	100%	NA	NA
Romania	NO	561	557	2%	-4	-1%	557	100%	NA	NA
Slovakia	88	238	244	1%	5	2%	156	178%	-	-
Slovenia	127	NO	NO	-	-	-	-127	-100%	T1	CS
Spain	45	3 113	3 387	15%	274	9%	3 342	7413%	T2	CS,PS
Sweden	NO	32	55	0%	24	75%	55	100%	NA	NA
United Kingdom	49	2 574	2 062	9%	-512	-20%	2 013	4072%	T2	CS
EU-28	**5 275**	**22 270**	**23 279**	**100%**	**1 009**	**5%**	**18 004**	**341%**		

Abbreviations explained in the Chapter 'Units and abbreviations'

Figure 3.20 shows the trend of increasing emissions from gaseous fuels in category 1.A.1.b. As can be seen Italy, Spain and the Netherlands are the largest contributors to CO_2 emissions in this sector in 2013. The largest absolute increases in 2013 were reported by Portugal, France and Spain.

Figure 3.14 1A1b Petroleum Refining, gaseous fuels: Emission trend and share for CO_2



3.2.1.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-28)

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 % of total greenhouse gas emissions in 2013. Between 1990 and 2013, CO_2 emissions fell by 52% in the EU-28 (Table 3.13). Emissions from solid fuels fell markedly during the 1990s and then were stable for a few years. Since 2007 they began to decrease again. The strong drop in 2009 was due to the drop in iron and steel production triggered by the economic crisis.

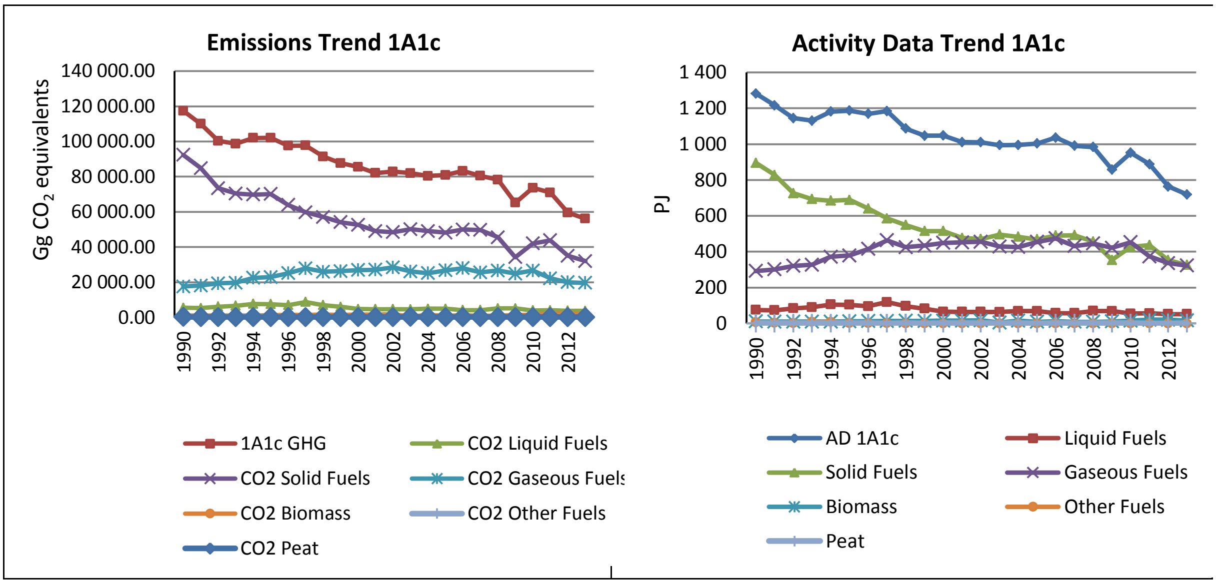
Table 3.13 1A1c Manufacture of Solid Fuels and Other Energy Industries: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	510	504	286	1%	-218	-43%	-224	-44%	NA	NA
Belgium	2 024	225	282	1%	57	25%	-1 741	-86%	NA,T1,T3	D,NA,PS
Bulgaria	362	5	4	0%	-1	-25%	-358	-99%	T1	D
Croatia	993	218	229	0%	11	5%	-764	-77%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	-	-
Czech Republic	1 516	6 628	6 208	11%	-419	-6%	4 692	309%	T1,T2	CS,D
Denmark	545	1 437	1 342	2%	-95	-7%	797	146%	T3	CS
Estonia	65	395	443	1%	48	12%	378	583%	T3	PS
Finland	347	256	248	0%	-7	-3%	-99	-28%	NA,T3	CS,NA
France	4 749	3 026	3 122	6%	97	3%	-1 627	-34%	-	-
Germany	65 289	10 651	10 267	19%	-383	-4%	-55 022	-84%	CS	CS
Greece	102	45	42	0%	-4	-8%	-60	-59%	T2	CS
Hungary	565	400	413	1%	14	3%	-152	-27%	T1,T2	CS,D
Ireland	100	104	122	0%	18	17%	22	22%	T3	CS
Italy	13 797	9 452	7 061	13%	-2 391	-25%	-6 737	-49%	T3	CS
Latvia	143	66	69	0%	3	4%	-74	-52%	T1,T2	CS,D
Lithuania	9	19	17	0%	-2	-9%	8	84%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2 161	2 563	2 722	5%	159	6%	562	26%	T2	CS
Poland	4 876	2 780	2 828	5%	48	2%	-2 048	-42%	T1,T2	CS,D
Portugal	115	NO	NO	-	-	-	-115	-100%	NA	NA
Romania	146	1 396	1 425	3%	29	2%	1 279	876%	T1,T2	CS,D
Slovakia	1 319	1 275	1 186	2%	-89	-7%	-133	-10%	T2	CS
Slovenia	82	4	6	0%	2	42%	-76	-93%	T1,T2	CS,D
Spain	2 117	1 889	1 836	3%	-53	-3%	-281	-13%	T2	CS,PS
Sweden	300	358	352	1%	-7	-2%	51	17%	NA	NA
United Kingdom	13 769	15 118	14 902	27%	-216	-1%	1 133	8%	T1,T2	CS,D
EU-28	**116 005**	**58 814**	**55 415**	**100%**	**-3 399**	**-6%**	**-60 590**	**-52%**		

Figure 3.15 shows the trends in emissions from this source category by fuel in the EU-28 between 1990 and 2013. The largest part of greenhouse gas emissions from the manufacture of solid fuels can be accounted for CO_2 emissions from solid (57 %) and gaseous (35 %) fuels.

Fuel used for manufacturing solid fuels fell by 44 % in the EU-28 between 1990 and 2013. The strongest decline was reported for solid fuels (-64%), followed by liquid fuels (-31%). On the other hand gaseous fuels and biomass increased in the period 1990 to 2013. In 2013, solid fuels and gaseous fuels represented 45 % each of all fuel used.

Figure 3.15 1A1c Manufacture of Solid Fuels and Other Energy Industries: Total and CO_2 emission and activity trends



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 35 % of total greenhouse gas emissions from this category in 2013. Emissions in the EU-28 increased by 12 % (Table 3.14) between 1990 and 2013. Anyway, in the last few years there has been a significant reduction. More than 50 % of the gross increase in EU-28 emissions between 1990 and 2010 was due to the UK only. In general, oil and natural gas production are declining since 2000, therefore also natural gas used in oil and natural gas production is declining.

The decline since 2010 was mainly driven by the UK, Italy and Denmark. In the UK there have been reductions in gas use activity in the upstream use of gas in oil and gas production and in gas use of drive compressors in the downstream UK gas distribution network. Former reductions are driven by a strong decline in UK production of oil and gas 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).

In Italy the amount of gaseous fuel consumption for this category is the sum of the natural gas fuel consumption reported in the framework of the ETS by the six relevant plants. These are coke production plants and energy power production plants producing energy prevalently for the iron and steel national integrated plants. In particular the consumption of natural gas in one of these plants (the biggest one) drives the trend of the whole category. In the last years, the use of natural gas further decreased as a consequence of a reduction in the energy demand as a result of the economic situation.

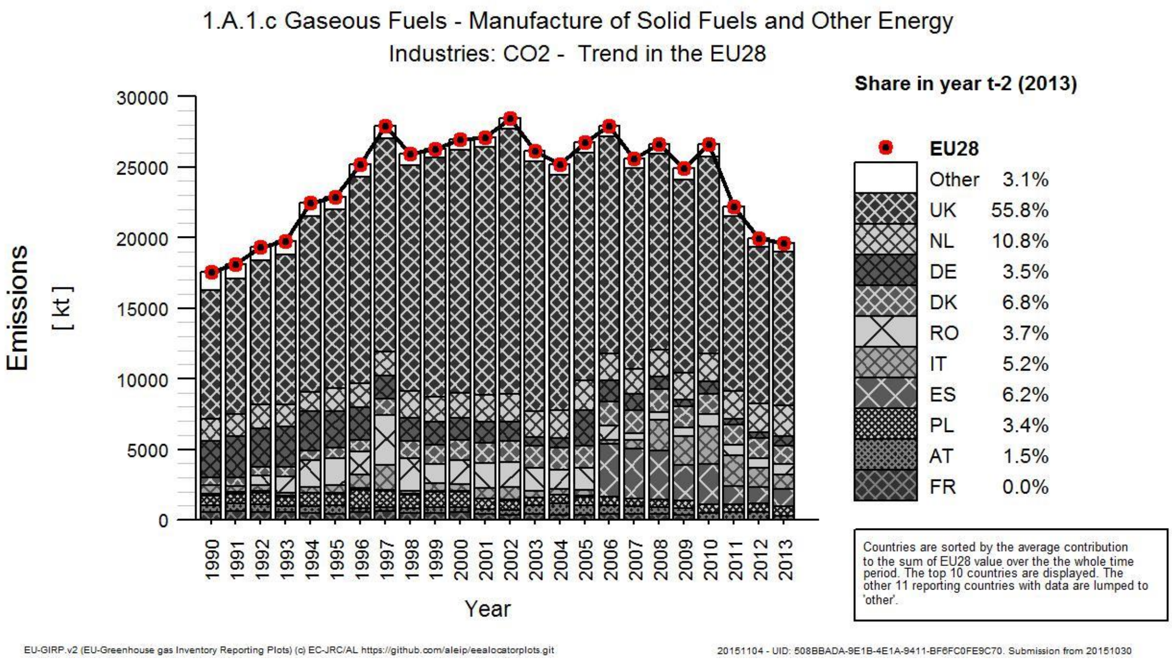
Table 3.14 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	506	504	286	1%	-218	-43%	-220	-43%
Belgium	51	NO	NO	-	-	-	-51	-100%
Bulgaria	NO	2	2	0%	0	-7%	2	100%
Croatia	748	218	229	1%	11	5%	-518	-69%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	10	8	0%	-2	-19%	8	100%
Denmark	545	1 437	1 342	7%	-95	-7%	797	146%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	531	16	8	0%	-7	-46%	-522	-98%
Germany	2 622	392	677	3%	285	73%	-1 945	-74%
Greece	102	45	42	0%	-4	-8%	-60	-59%
Hungary	362	217	218	1%	1	0%	-144	-40%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	615	1 328	1 022	5%	-306	-23%	407	66%
Latvia	45	54	50	0%	-3	-6%	6	13%
Lithuania	NO	6	3	0%	-3	-53%	3	100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	1 526	2 068	2 128	11%	60	3%	602	39%
Poland	694	629	674	3%	45	7%	-20	-3%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	686	731	4%	45	7%	731	100%
Slovakia	NO	46	44	0%	-2	-5%	44	100%
Slovenia	42	4	6	0%	2	43%	-36	-86%
Spain	82	1 196	1 207	6%	11	1%	1 125	1380%
Sweden	NO	C,NO	C,NO	-	-	-	-	-
United Kingdom	9 114	11 095	10 946	56%	-149	-1%	1 832	20%
EU-28	**17 584**	**19 954**	**19 624**	**100%**	**-330**	**-2%**	**2 040**	**12%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows the emission trend for solid fuels split by Member State. The UK is the main contributing country to CO_2 emissions in this sector.

Figure 3.16 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Emission trend and share 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 2013. Emissions in the EU-28 declined by 64%, mainly during the 1990s. This was almost driven entirely by a strong decline in emissions in Germany (-51 564 kt CO_2).

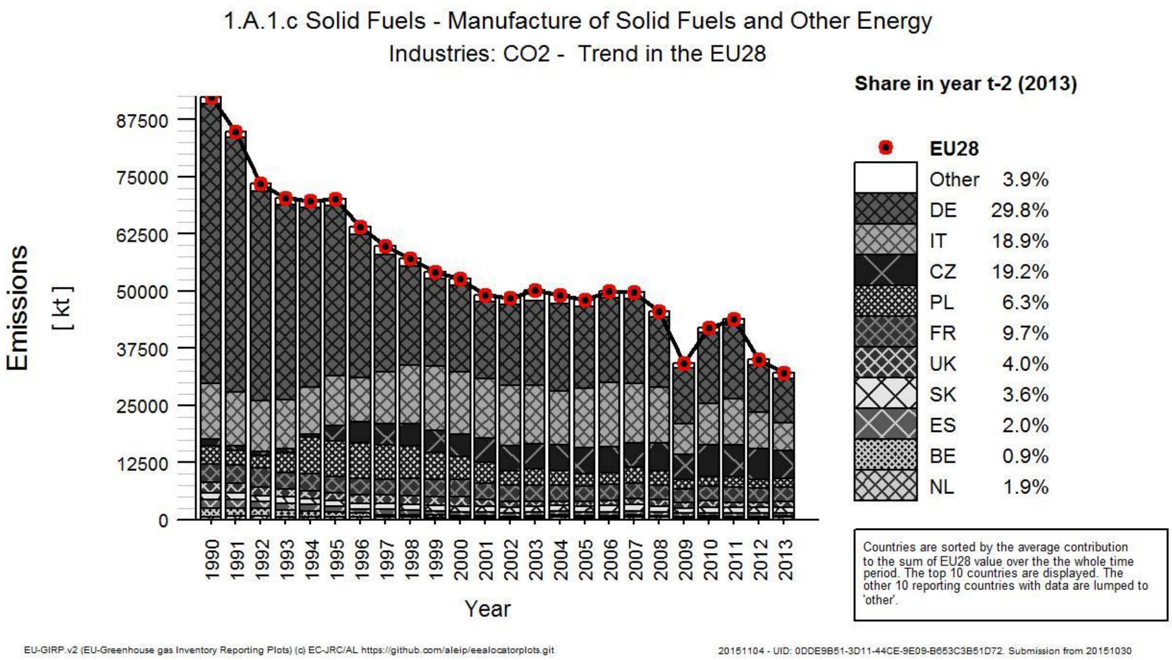
Table 3.15 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	1 969	225	282	1%	57	25%	-1 687	-86%
Bulgaria	275	3	2	0%	-1	-37%	-273	-99%
Croatia	206	NO	NO	-	-	-	-206	-100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 352	6 570	6 147	19%	-424	-6%	4 795	355%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	65	395	443	1%	48	12%	378	583%
Finland	347	256	248	1%	-7	-3%	-99	-28%
France	4 065	3 010	3 114	10%	104	3%	-951	-23%
Germany	61 101	10 203	9 537	30%	-667	-7%	-51 564	-84%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	164	182	195	1%	13	7%	32	19%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	12 240	8 123	6 037	19%	-2 086	-26%	-6 203	-51%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	633	494	593	2%	99	20%	-39	-6%
Poland	4 030	2 034	2 014	6%	-21	-1%	-2 017	-50%
Portugal	66	NO	NO	-	-	-	-66	-100%
Romania	NO	4	NO	-	-4	-100%	-	-
Slovakia	1 319	1 228	1 142	4%	-86	-7%	-177	-13%
Slovenia	37	NO	NO	-	-	-	-37	-100%
Spain	1 847	692	629	2%	-64	-9%	-1 219	-66%
Sweden	300	358	352	1%	-7	-2%	51	17%
United Kingdom	2 344	1 207	1 265	4%	59	5%	-1 079	-46%
EU-28	**92 359**	**34 987**	**32 000**	**100%**	**-2 987**	**-9%**	**-60 359**	**-65%**

Emissions of the year 1990 for the Netherlands are included in 1A2a
Abbreviations explained in the Chapter 'Units and abbreviations'.

The decline in emissions (see Figure 3.25) 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. Italy includes in this category emissions from electricity generated in the iron and steel plant sites (using coal gases and other fuels). The largest emitters in 2013 were Germany, the Czech Republic and Italy, jointly responsible for 68% of all EU-28 emissions.

Figure 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Emission trend and share 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 oven plants are reported under 1A1c. Austria reports emissions from onsite 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 and some MS are reporting emissions from refinery gas under 1A2 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 1A2g, but MS are also reporting emissions from mobile emissions under category 1A3e. Emissions from non energy fuel use (e.g. reducing agents used in blast furnaces or natural gas used for ammonia production) should be 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 Non-metallic Minerals: ISIC Division 26
- 1 A 2 g Other manufacturing industries: ISIC Divisions 17 to 20, 25, 28 to 37 and 45.

In 2013 category 1A2 contributed to 503 045 Gg CO_2 equivalents of which 98.7% CO_2, 0.9% N_2O and 0.4% CH_4.

Figure 3.18 shows the emission trends within source category 1A2, which is dominated by CO_2 from 1A2g Other contributing by 33 % and 1A2a Iron and steel contributing by 21 %. Some Member States do not allocate emissions to all sub-categories under 1A2, which is reason for 1A2g being the largest sub-category within 1A2 source category.

Croatia reports total 1A2 emissions under category 1A2g in the period from 1990 to 2000 due to lack of detailed data in the national energy balance. Greece reports emissions which should be reported in category 1A2g under category 1A2f for the whole time series.

Figure 3.18 1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends

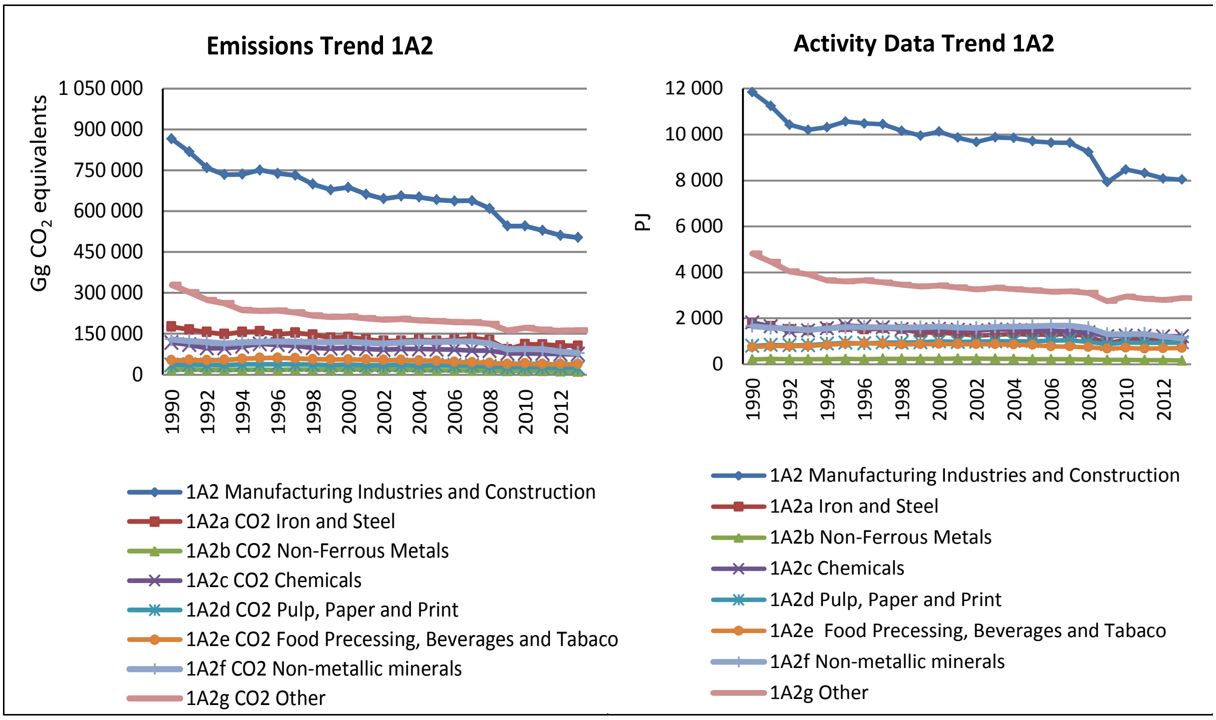


Table 3.1 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.16 1A2 Manufacturing Industries and Construction: Member States' contributions to total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)
Austria	9 881	11 147	9 803	11 002
Belgium	23 223	13 874	23 071	13 732
Bulgaria	19 161	3 186	18 933	3 112
Croatia	5 529	2 393	5 502	2 381
Cyprus	515	513	512	511
Czech Republic	51 224	11 018	50 930	10 930
Denmark	5 517	4 195	5 449	4 135
Estonia	2 488	741	2 479	732
Finland	13 681	8 662	13 497	8 509
France	86 272	63 706	85 461	63 022
Germany	186 710	126 249	185 117	125 190
Greece	9 404	5 288	9 338	5 229
Hungary	13 645	4 317	13 583	4 260
Ireland	3 962	4 231	3 943	4 209
Italy	86 175	49 978	84 535	48 725
Latvia	3 904	793	3 890	761
Lithuania	5 755	1 245	5 739	1 233
Luxembourg	6 306	1 060	6 287	1 045
Malta	59	68	59	68
Netherlands	31 100	22 980	31 006	22 897
Poland	43 298	30 093	43 015	29 820
Portugal	9 795	7 456	9 656	7 321
Romania	74 624	14 015	74 478	13 943
Slovakia	15 890	7 173	15 827	7 125
Slovenia	3 149	1 641	3 119	1 623
Spain	44 670	41 874	44 157	40 921
Sweden	11 732	8 076	11 467	7 847
United Kingdom	97 537	57 074	96 131	56 235
EU-28	**865 209**	**503 045**	**856 983**	**496 518**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the fourth largest sector in the EU-28 accounting for 11 % of total GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from manufacturing industries declined by 42.1 % in the EU-28. The emissions from this key source are caused by fossil fuel consumption in manufacturing industries and construction, which was 39 % below 1990 levels in 2013. A shift from solid and liquid fuels to mainly natural gas took place and an increase of biomass by 95% and other fossil fuels has been recorded.

Between 1990 and 2013, Germany and Romania show by far the largest emission reductions in absolute terms, followed by the United Kingdom, the Czech Republic, Italy and France. Only the two MS Austria and Malta report emission increases. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification. The main reasons for the large decline in the Czech Republic were the loss of markets and the energy saving behavior of newly privatized enterprises, following the political changes in the country in the early 1990s. Main reasons of the decline in Romania were the transition to a market economy and the reduction of energy intensive activities. The decrease of United Kingdom was mainly due to a decline in the iron and steel sector as well as a strong reduction of liquid fuel consumption in general. The decline of emissions in Italy started in 2009 with due to the effects of the economic recession. In 2010 and 2011 production levels have been restored for the iron and steel and pulp and paper sectors while the other sectors still continue to suffer from the economic crisis. In 2013 a further drop is noted for the iron and steel industry also due to environmental constraints of the main integrated iron and steel plant in Italy, located in Taranto, which had to reduce its steel production level.

Between 2012 and 2013 GHG emissions decreased by 1.5 % with category 1A2g Other showing the strongest absolute decrease of – 5 545 kt CO_2 from all sub categories.

EU-28

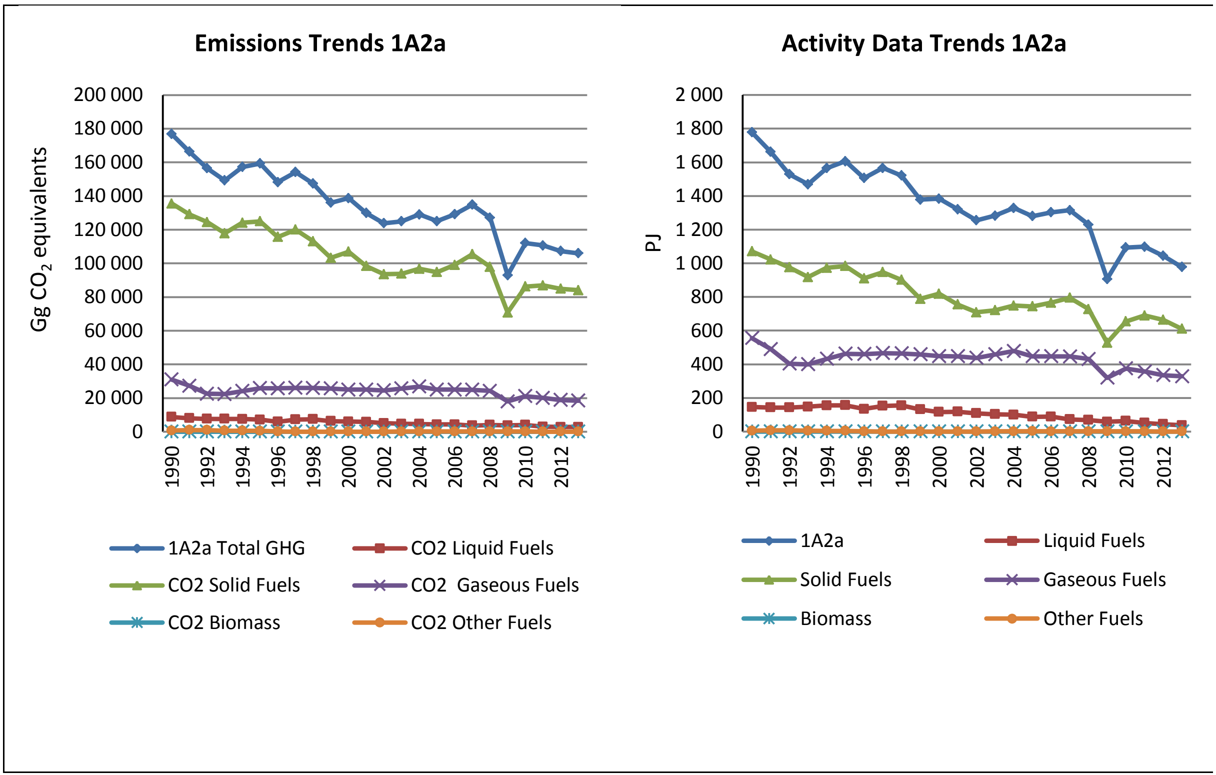
3.2.2.1 Iron and Steel (1A2a)

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 21 % of 1A2 source category and 2.4 % of total GHG emissions in 2013.

Figure 3.19 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Between 1990 to 2013 total emissions decreased by 40 %, mainly due to improved efficiency of restructured iron and steel plants and ongoing consequences of the economic crisis in 2009. The strong increase of 20% between 2009 and 2010 correlates with crude steel production which was 25% higher in 2010. Between 2012 and 2013 emissions decreased by 1.2% and crude steel production decreased by 1.3%. Between 1990 and 2013 emissions from solid fuels decreased by 38 %, emissions from liquid fuels by 68 % and emissions from gaseous fuels decreased by 40%. Some Member States report emissions from blast furnace gas under categories 1A1a or other sub-categories of 1A2 and even under 1A4a where it is used as a fuel in the respective industrial branches. Emissions from onsite coke ovens of Austrian integrated iron and steel plants are fully included in this category. Emissions from blast furnace and coke oven gas flaring without energy recovery are partly reported under category 1B1b. According to the IPCC 2006 Guidelines CO_2 emissions from reductants should be reported under category 2.C.1 which indicates that most of emissions from iron and steel production should be allocated to this category. 24 MS are reporting emissions under 2.C.1 However, the share of 1.A.2.a on total 1.A.2.a plus 2.C.1 CO_2 emissions is mostly over 50% with a range between 16% (Austria) to 90% (Italy). This indicates that not all MS are following the allocation-principle of the new Guidelines yet.

However, a main driver of category 1A2a CO_2 emissions is crude steel production which decreased from about 192 mio tonnes in 1990 to 166 million tonnes in 2013 (www.worldsteel.org statistics) as well as blast furnace production (BFI), which decreased from about 126 million tonnes to 92 million tonnes in 2013 (www.worldsteel.org statistics).

Figure 3.19   1A2a Iron and Steel: CO_2 emissions and activity data trends



Between 1990 and 2013, CO_2 emissions from 1A2a Iron and Steel decreased by 40 % in the EU-2828 (Table 3.17), mainly due to decreases in the Czech Republic, Poland, Italy, The United Kingdom and Romania. Between 2012 and 2013 emissions decreased by 1.2 % with the highest decrease reported by Italy which also correlates to a decrease in reported crude steel production..

Table 3.17 1A2a Iron and Steel: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	2 062	1 661	1 971	2%	311	19%	-90	-4%
Belgium	5 662	1 273	1 128	1%	-145	-11%	-4 533	-80%
Bulgaria	2 706	116	99	0%	-17	-15%	-2 607	-96%
Croatia	NO,IE	51	58	0%	7	14%	58	100%
Cyprus	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Czech Republic	14 861	2 650	2 812	3%	162	6%	-12 048	-81%
Denmark	107	56	71	0%	14	25%	-36	-34%
Estonia	3	0	NO	-	0	-100%	-3	-100%
Finland	2 499	2 254	2 154	2%	-100	-4%	-345	-14%
France	22 397	13 243	13 976	13%	733	6%	-8 421	-38%
Germany	35 269	31 840	34 081	32%	2 241	7%	-1 188	-3%
Greece	447	198	173	0%	-26	-13%	-275	-61%
Hungary	2 365	191	203	0%	11	6%	-2 163	-91%
Ireland	16	NO	NO	-	-	-	-16	-100%
Italy	17 225	17 038	10 597	10%	-6 441	-38%	-6 628	-38%
Latvia	395	115	39	0%	-76	-66%	-356	-90%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	5 407	292	264	0%	-28	-10%	-5 143	-95%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	3 378	3 818	3 496	3%	-322	-8%	118	4%
Poland	16 393	6 088	5 818	6%	-270	-4%	-10 575	-65%
Portugal	1 228	141	143	0%	2	2%	-1 085	-88%
Romania	8 793	2 690	2 703	3%	13	0%	-6 091	-69%
Slovakia	2 682	3 362	3 192	3%	-170	-5%	511	19%
Slovenia	421	198	202	0%	4	2%	-220	-52%
Spain	8 247	6 122	6 256	6%	134	2%	-1 990	-24%
Sweden	1 705	1 158	1 261	1%	103	9%	-444	-26%
United Kingdom	21 562	12 042	14 670	14%	2 628	22%	-6 892	-32%
EU-28	**175 828**	**106 598**	**105 368**	**100%**	**-1 230**	**-1%**	**-70 461**	**-40%**

From 1990 to 2000 Croatia includes emissions under 1.A.2.g. Cyprus reports an 'IE for liquid fuels only. Malta includes emissions under 1.A.2.g.

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2a Iron and Steel - Liquid Fuels (CO_2)

In 2013 CO_2 from liquid fuels had a share of 3 % within this category compared to 5 % in 1990. Between 1990 and 2012 emissions decreased by 68 % (Table 3.18). Significant absolute decreases have been achieved in Belgium, France, Germany and Poland..

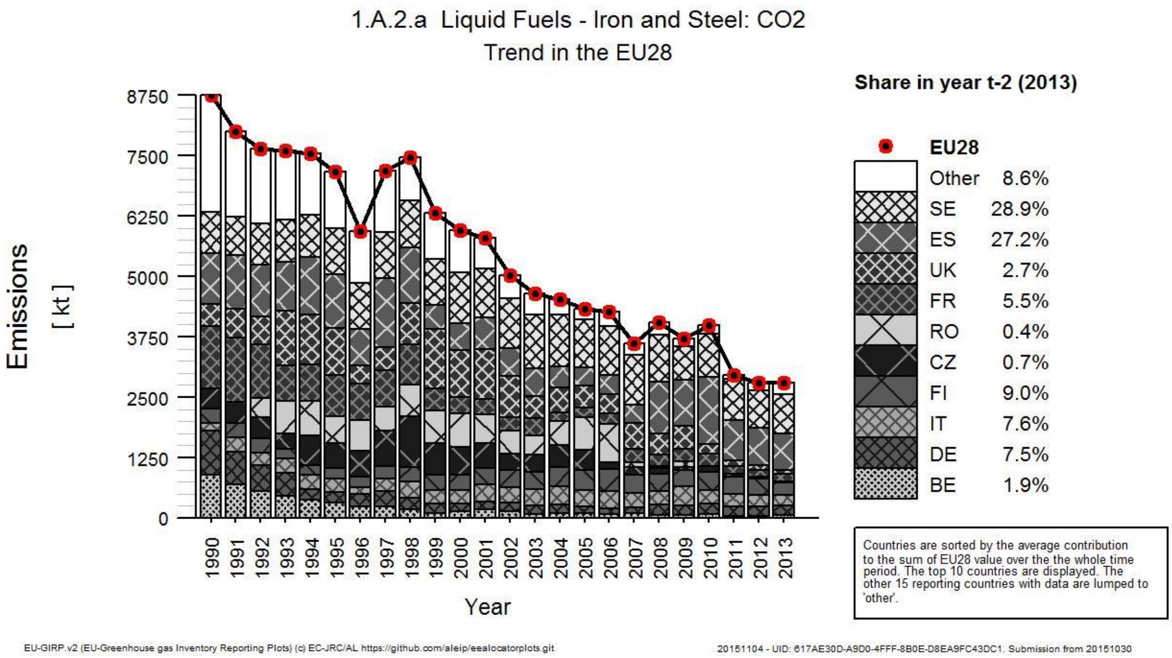
Table 3.18 1A2a Iron and Steel, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	76	29	88	3%	60	209%	12	16%	-	-
Belgium	885	46	52	2%	6	13%	-832	-94%	T1,T3	D,PS
Bulgaria	37	NO	NO	-	-	-	-37	-100%	NA	NA
Croatia	IE	15	16	1%	1	8%	16	100%	NA	NA
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	427	31	19	1%	-12	-38%	-408	-95%	T1	CS,D
Denmark	7	2	1	0%	-1	-44%	-6	-82%	T1,T2	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	305	335	253	9%	-82	-25%	-52	-17%	T3	CS
France	1 278	139	155	6%	15	11%	-1 123	-88%	-	-
Germany	916	201	210	7%	9	5%	-706	-77%	CS	CS
Greece	447	74	75	3%	1	1%	-372	-83%	T2	CS
Hungary	417	NO	3	0%	3	100%	-414	-99%	T1	D
Ireland	16	NO	NO	-	-	-	-16	-100%	T2	CS
Italy	156	226	215	8%	-12	-5%	59	38%	T2	CS
Latvia	93	NO	NO	-	-	-	-93	-100%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	48	5	5	0%	-1	-14%	-43	-90%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	21	11	16	1%	4	38%	-5	-24%	T2	CS,D
Poland	864	9	6	0%	-3	-32%	-858	-99%	T1	D
Portugal	167	4	5	0%	1	13%	-163	-97%	T2	CR,D,PS
Romania	NO	9	13	0%	3	37%	13	100%	NA	NA
Slovakia	164	9	20	1%	11	123%	-144	-88%	T2	CS
Slovenia	54	6	5	0%	-1	-17%	-49	-90%	T1	D
Spain	1 052	760	763	27%	3	0%	-289	-27%	T2	CS,PS
Sweden	856	781	812	29%	32	4%	-44	-5%	-	-
United Kingdom	462	108	76	3%	-32	-30%	-386	-84%	T2	CS
EU-28	**8 750**	**2 802**	**2 808**	**100%**	**6**	**0%**	**-5 942**	**-68%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.20 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. Liquid fuel consumption in the EU-2828 decreased by 74 % between 1990 and 2013. EU-28

Figure 3.20 1A2a Iron and Steel, Liquid fuels: Emission trend and share for CO_2



1A2a Iron and Steel - Solid Fuels (CO_2)

In 2013, CO_2 from solid fuels had a share of 79 % within this category and 77 % in 1990. Between 1990 and 2013 the emissions decreased by 38 % (Table 3.19). Between 1990 and 2013 the Czech Republic, Belgium, Poland, France, Italy, Luxembourg and the United Kingdom showed major decreases. Between 2012 to 2013 Italy shows a significant decrease while Germany and the United Kingdom show significant increases.

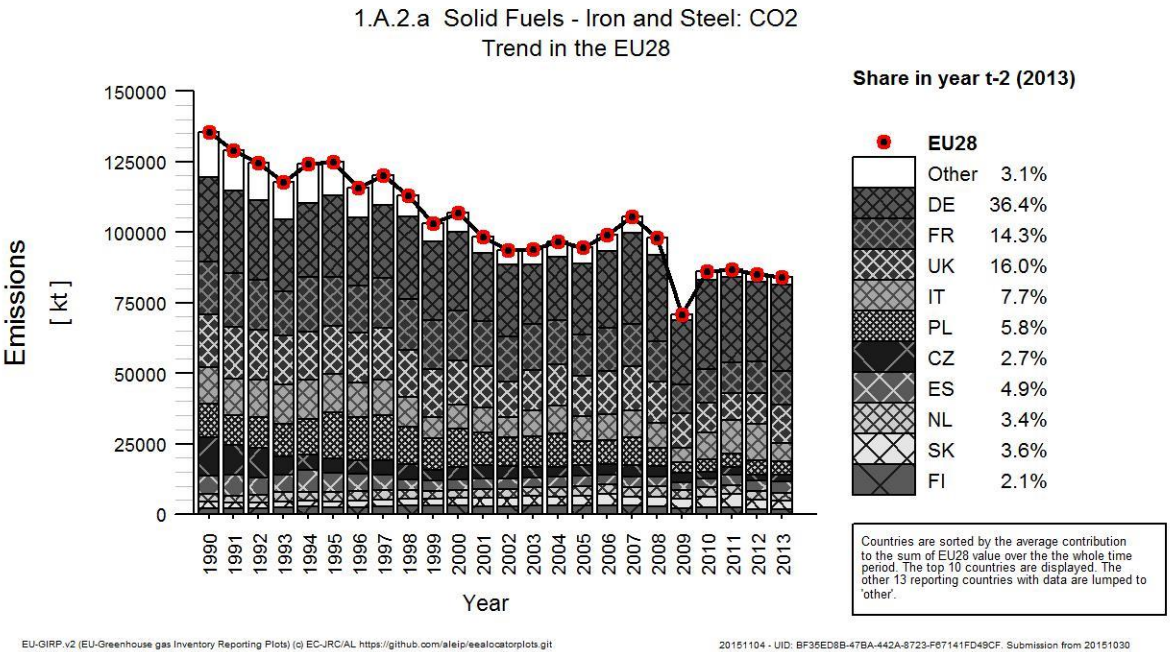
Table 3.19 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	1 335	388	542	1%	154	40%	-793	-59%	-	-
Belgium	3 284	98	23	0%	-75	-77%	-3 261	-99%	T3	PS
Bulgaria	1 631	NO	NO	-	-	-	-1 631	-100%	T1,T2	CS,D
Croatia	IE	6	12	0%	6	90%	12	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	13 709	2 096	2 251	3%	155	7%	-11 458	-84%	T2	CS,D
Denmark	5	0	0	0%	0	9%	-5	-99%	T1	D
Estonia	3	0	NO	-	0	-100%	-3	-100%	T2	CS
Finland	2 084	1 807	1 789	2%	-19	-1%	-295	-14%	T3	CS,PS
France	19 016	11 270	12 053	14%	784	7%	-6 963	-37%	-	-
Germany	29 912	28 202	30 565	36%	2 362	8%	653	2%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	625	95	72	0%	-24	-25%	-553	-89%	T1,T2	CS,D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	12 793	12 700	6 444	8%	-6 256	-49%	-6 349	-50%	T2	CS
Latvia	6	35	9	0%	-26	-75%	3	54%	T1	D
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	4 959	NO	NO	-	-	-	-4 959	-100%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	2 690	3 134	2 821	3%	-313	-10%	131	5%	T2	CS
Poland	11 980	5 131	4 901	6%	-230	-4%	-7 080	-59%	T1,T2	CS,D
Portugal	1 058	21	24	0%	2	11%	-1 034	-98%	T2	CR,D,PS
Romania	2 132	1 620	1 487	2%	-133	-8%	-646	-30%	T1,T2	CS,D
Slovakia	2 296	3 213	3 002	4%	-211	-7%	705	31%	T2	CS
Slovenia	57	24	27	0%	3	13%	-30	-52%	T1	CS,D
Spain	6 419	3 825	4 107	5%	283	7%	-2 312	-36%	T2	CS,PS
Sweden	849	378	449	1%	71	19%	-400	-47%	-	-
United Kingdom	18 637	10 876	13 470	16%	2 594	24%	-5 167	-28%	T2	CS
EU-28	**135 480**	**84 920**	**84 045**	**100%**	**-875**	**-1%**	**-51 435**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.21 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions EU-28 In the 2013 the largest emitters are France, Germany, and the UK; together they cause 67 % of the CO_2 emissions from solid fuels in 1A2a. Solid fuel combustion in the EU-28 decreased by 43 % between 1990 and 2013. EU-28

Figure 3.21 1A2a Iron and Steel, solid fuels: Emission trend and share for CO_2



1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2013 CO_2 from gaseous fuels had a share of 17 % within source category 1A2a Between 1990 and 2013 the emissions decreased by 40 % (Table 3.20). Due to confidential reasons Sweden reports emissions from gaseous fuels under liquid fuels.

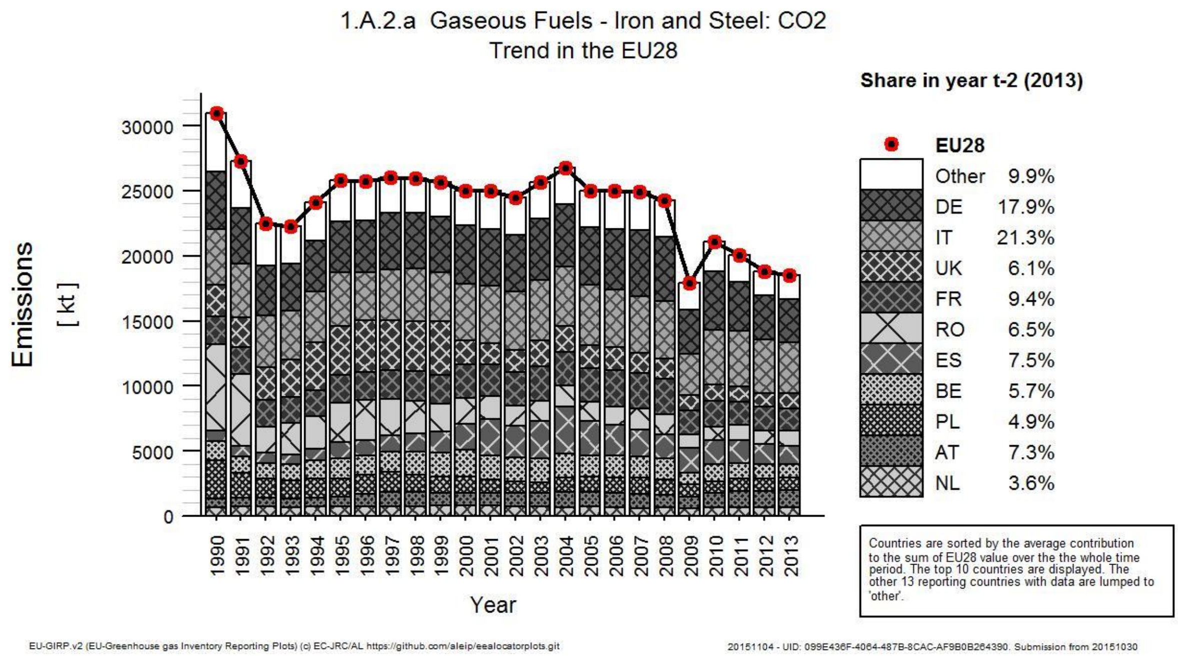
Table 3.20 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	650	1 244	1 340	7%	97	8%	690	106%	-	-
Belgium	1 493	1 128	1 053	6%	-75	-7%	-440	-29%	T1,T3	D,PS
Bulgaria	1 037	116	99	1%	-17	-15%	-938	-90%	NA	NA
Croatia	IE	30	30	0%	0	1%	30	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	724	522	542	3%	20	4%	-182	-25%	T2	CS
Denmark	96	54	69	0%	15	28%	-26	-27%	T3	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	110	112	113	1%	1	1%	3	3%	T3	CS
France	2 089	1 788	1 728	9%	-60	-3%	-361	-17%	-	-
Germany	4 442	3 437	3 306	18%	-131	-4%	-1 135	-26%	CS	CS
Greece	NO	124	98	1%	-27	-21%	98	100%	NA	NA
Hungary	1 324	96	128	1%	32	33%	-1 195	-90%	T1	D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4 276	4 112	3 939	21%	-173	-4%	-337	-8%	T2	CS
Latvia	234	80	30	0%	-50	-63%	-205	-87%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	400	286	259	1%	-27	-10%	-141	-35%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	667	673	660	4%	-13	-2%	-7	-1%	T2	CS
Poland	2 965	948	911	5%	-37	-4%	-2 054	-69%	T1	D
Portugal	NO	116	115	1%	-1	-1%	115	100%	NA	NA
Romania	6 661	1 055	1 201	6%	146	14%	-5 460	-82%	T2	CS
Slovakia	221	140	171	1%	31	22%	-50	-23%	T2	CS
Slovenia	310	167	169	1%	2	1%	-140	-45%	T2	CS
Spain	776	1 537	1 386	8%	-151	-10%	611	79%	T2	CS
Sweden	C	C	C	-	-	-	-	-	-	-
United Kingdom	2 463	1 057	1 124	6%	66	6%	-1 339	-54%	T2	CS
EU-28	**30 936**	**18 823**	**18 471**	**100%**	**-352**	**-2%**	**-12 466**	**-40%**		

Malta includes emissions under 1A2g
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.22 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributionsEU-28. The largest emissions are reported by France, Germany, Italy and Spain which contribute 59 % to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-28 decreased by 41 % between 1990 and 2013.EU-28

Figure 3.22 1A2a Iron and Steel, gaseous fuels: Emission trend and share for CO_2

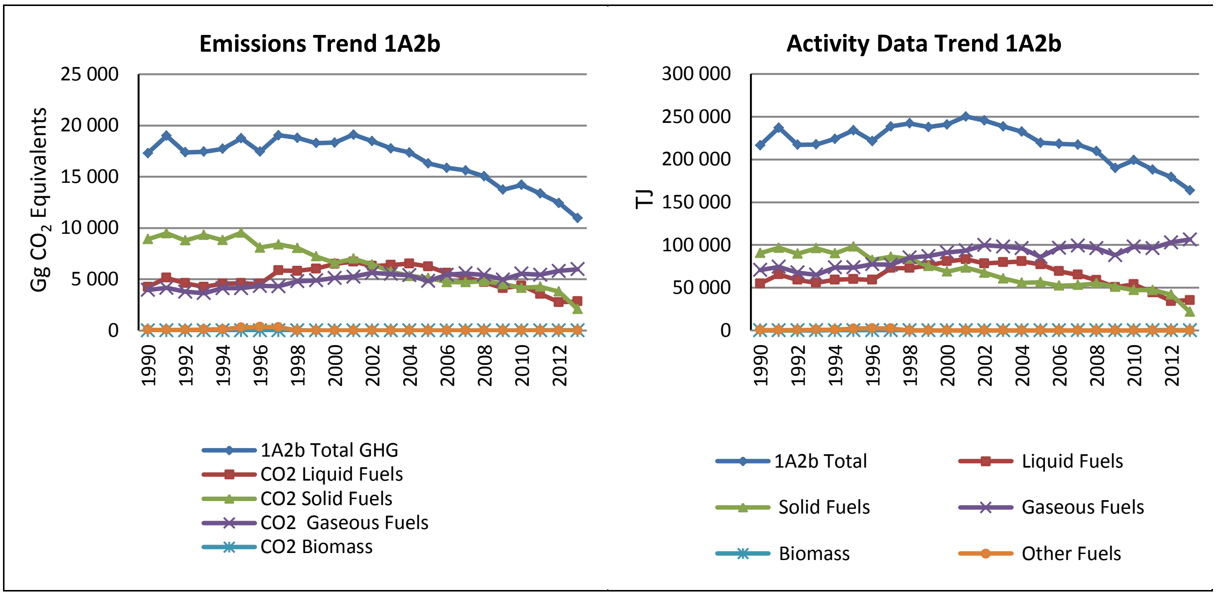


3.2.2.2 Non Ferrous Metals (1A2b)

In this chapter information is provided about emission trends, Member States contribution and activity data 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 2013.

Figure 3.23 shows the emission trend within the category 1A2b, which is in 2013 mainly dominated by CO_2 emissions from liquid and gaseous fuels. The share of solid fuels emissions decreased from 52 % in 1990 to 19 % in 2013. In 2013 total GHG emissions were 37 % below 1990 level. Increasing emissions were reported for CO_2 from gaseous fuels (+51 %) while emissions from all other fossil fuels decreased.

Figure 3.23 1A2b Non ferrous Metals: CO_2 emissions and activity data trends



EU-28 CO_2 emissions from 1A2b were 37 % below 1990 levels in 2013. In absolute terms, France ,Germany, Slovakia and the United Kingdom reported the highest decreases, while Spain, Ireland and Italy reported substantial increases in this period (Table 3.21).

Table 3.21 1A2b Non ferrous Metals: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	132	243	260	2%	17	7%	128	97%
Belgium	629	436	436	4%	-1	0%	-193	-31%
Bulgaria	438	317	326	3%	9	3%	-111	-25%
Croatia	NO,IE	20	20	0%	0	1%	20	100%
Cyprus	6	7	NO	-	-7	-100%	-6	-100%
Czech Republic	102	91	115	1%	24	27%	13	13%
Denmark	11	0	0	0%	0	-44%	-11	-100%
Estonia	NO	3	2	0%	0	-20%	2	100%
Finland	337	96	98	1%	2	2%	-239	-71%
France	2 473	975	1 175	11%	200	21%	-1 298	-52%
Germany	1 377	112	145	1%	33	29%	-1 232	-89%
Greece	582	532	772	7%	240	45%	190	33%
Hungary	242	160	172	2%	12	8%	-70	-29%
Ireland	809	1 485	1 464	13%	-21	-1%	655	81%
Italy	748	1 068	1 121	10%	53	5%	373	50%
Latvia	NO	10	7	0%	-2	-22%	7	100%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	28	51	50	0%	-1	-2%	22	78%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	216	153	159	1%	6	4%	-57	-26%
Poland	1 089	1 146	1 129	10%	-17	-1%	40	4%
Portugal	IE	IE	IE	-	-	-	-	-
Romania	79	NO,IE	NO,IE	-	-	-	-79	-100%
Slovakia	1 256	225	186	2%	-39	-17%	-1 070	-85%
Slovenia	439	92	95	1%	3	3%	-344	-78%
Spain	1 311	2 279	2 170	20%	-109	-5%	859	66%
Sweden	128	84	92	1%	7	9%	-36	-28%
United Kingdom	4 779	2 802	929	9%	-1 874	-67%	-3 851	-81%
EU-28	**17 209**	**12 388**	**10 923**	**100%**	**-1 465**	**-12%**	**-6 286**	**-37%**

From 1990 to 2000 Croatia includes emissions under 1.A.2.g. Malta and Portugal include emissions under 1.A.2.g..*Romania includes emissions under 1.A.2.a.*

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2013 CO_2 from solid fuels had a share of 19 % within source category 1A2b (compared to 52 % in 1990). Between 1990 and 2012 the emissions decreased by 77 % (Table 3.22). Greece, Malta,Portugal and Romania reported emissions as 'Included elsewhere'. Substantial decreases between 1990 and 2013 were reported by France,Germany, Slovakia and the United Kingdom.

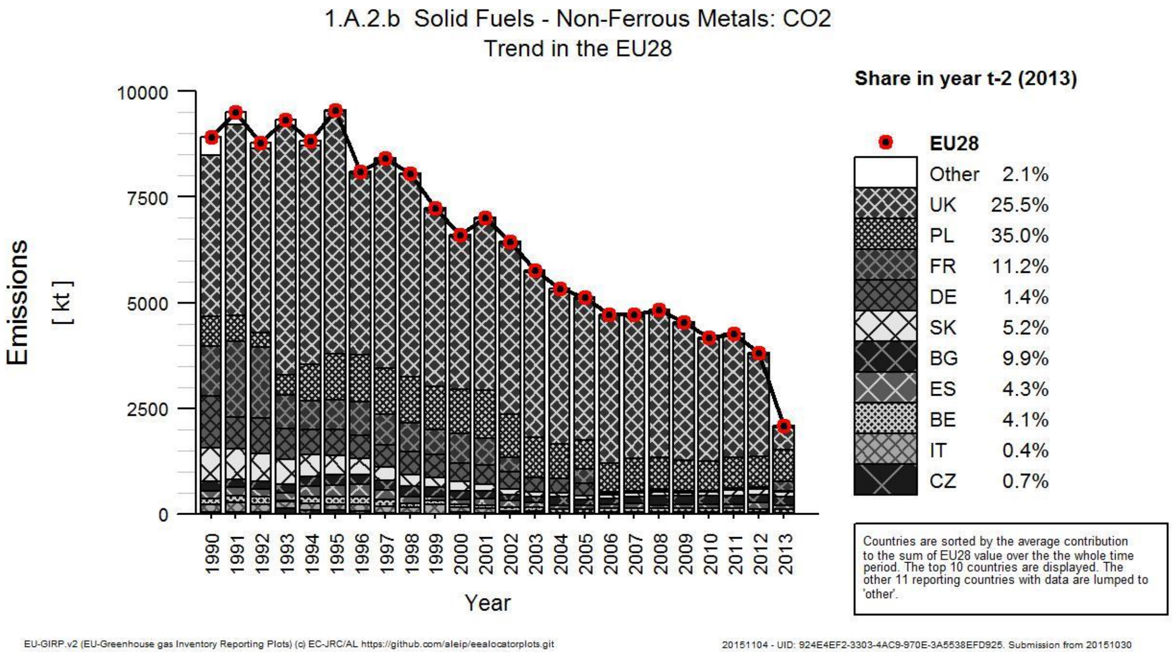
Table 3.22 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	22	7	14	1%	7	109%	-8	-38%	-	-
Belgium	147	78	86	4%	8	10%	-61	-41%	T1	D
Bulgaria	215	195	207	10%	12	6%	-7	-3%	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	46	15	15	1%	0	0%	-31	-67%	T2	CS,D
Denmark	NO	0	0	0%	0	9%	0	100%	NA	NA
Estonia	NO	2	2	0%	0	-5%	2	100%	NA	NA
Finland	155	20	24	1%	4	21%	-131	-85%	T3	CS
France	1 167	4	234	11%	230	5207%	-933	-80%	-	-
Germany	1 233	30	29	1%	-1	-2%	-1 203	-98%	CS	CS
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	9	NO	NO	-	-	-	-9	-100%	T1,T2	CS,D
Ireland	4	NA	NO	-	-	-	-4	-100%	T2	CS
Italy	172	19	9	0%	-10	-54%	-163	-95%	T2	CS
Latvia	NO	0	NO	-	0	-100%	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	0	NO	NO	-	-	-	0	-100%	T2	CS
Poland	706	737	731	35%	-6	-1%	25	3%	T1,T2	CS,D
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	79	IE	IE	-	-	-	-79	-100%	T1,T2	CS,D
Slovakia	798	132	108	5%	-25	-19%	-691	-87%	T2	CS
Slovenia	154	5	5	0%	0	1%	-149	-97%	T1	D
Spain	185	150	90	4%	-60	-40%	-95	-51%	T2	CS
Sweden	7	NO	NO	-	-	-	-7	-100%	NA	NA
United Kingdom	3 818	2 412	532	25%	-1 881	-78%	-3 286	-86%	T2	CS
EU-28	**8 918**	**3 806**	**2 085**	**100%**	**-1 721**	**-45%**	**-6 832**	**-77%**		

Portugal and Malta include emissions under 1A2g Romania includes emissions under 1.A.2.a.
Greece includes emissions in the Industrial processes sector (as non-energy use of fuels).
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Belgium, Poland, France and the United Kingdom; together they cause 82 % of the CO_2 emissions from solid fuels in 2013.Consumption of solid fuels in the EU-28 decreased by 76 % between 1990 and 2013.. The strong decline in 2013 is mainly due to a high decrease reported by the United Kingdom.

Figure 3.24 1A2b Non ferrous Metals, solid fuels: Emission trend and share for CO_2



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

In 2013 CO_2 from gaseous fuels had a share of 55 % within source category 1A2b (compared to 23 % in 1990). Between 1990 and 2013 the emissions increased by 51 % (Table 3.23). Between 1990 and 2013 the highest absolute increases occurred in Ireland, ,Italy and Spain. For confidentiality reasons Germany reports emissions in 1A2g.

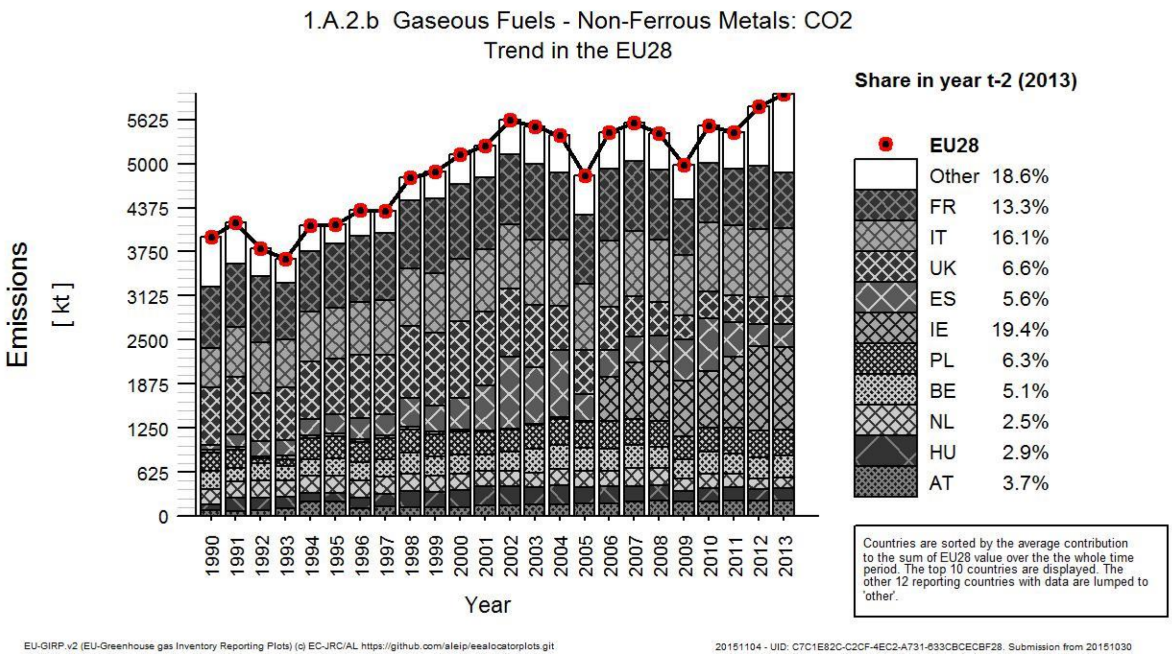
Table 3.23 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	75	215	223	4%	9	4%	148	198%	-	-
Belgium	261	300	303	5%	3	1%	42	16%	T1	D
Bulgaria	23	52	55	1%	3	6%	31	134%	NA	NA
Croatia	IE	2	2	0%	0	-18%	2	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	53	68	99	2%	31	45%	46	87%	T2	CS
Denmark	7	NO	NO	-	-	-	-7	-100%	T3	CS
Estonia	NO	0	NO	-	0	-100%	-	-	NA	NA
Finland	NO	3	3	0%	0	-2%	3	100%	NA	NA
France	871	903	794	13%	-110	-12%	-77	-9%	-	-
Germany	C	C	C	-	-	-	-	-	CS	CS
Greece	NO	504	754	13%	249	49%	754	100%	NA	NA
Hungary	87	160	172	3%	12	8%	85	97%	T1	D
Ireland	39	1 190	1 163	19%	-27	-2%	1 124	2916%	T2	CS
Italy	558	957	963	16%	6	1%	405	73%	T2	CS
Latvia	NO	9	7	0%	-2	-19%	7	100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	13	51	50	1%	-1	-2%	37	277%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	213	152	152	3%	1	1%	-61	-29%	T2	CS
Poland	258	387	376	6%	-10	-3%	118	46%	T1	D
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	IE	IE	IE	-	-	-	-	-	NA	NA
Slovakia	435	80	68	1%	-13	-16%	-367	-84%	T2	CS
Slovenia	164	60	64	1%	4	6%	-100	-61%	T2	CS
Spain	71	319	332	6%	14	4%	261	365%	T2	CS
Sweden	10	15	14	0%	-1	-5%	4	35%	-	-
United Kingdom	819	387	394	7%	7	2%	-426	-52%	T2	CS
EU-28	**3 958**	**5 815**	**5 989**	**100%**	**174**	**3%**	**2 031**	**51%**		

Portugal and Malta include emissions under 1A2g Romania includes emissions under 1.A.2.a.Germany reported emissions under 1A2g other (unspecified industrial power plants) because of confidential data.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.25 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions The largest emissions are reported by France, Ireland and Italy; together they cause around 49 % of the CO_2 emissions in 2013 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-28 rose by 65 % between 1990 and 2013. The jump in 2006 is mainly due to Ireland which reports a high increase in 2006 and Spain which reports a high decrease in 2005.

Figure 3.25 1A2b Non ferrous Metals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

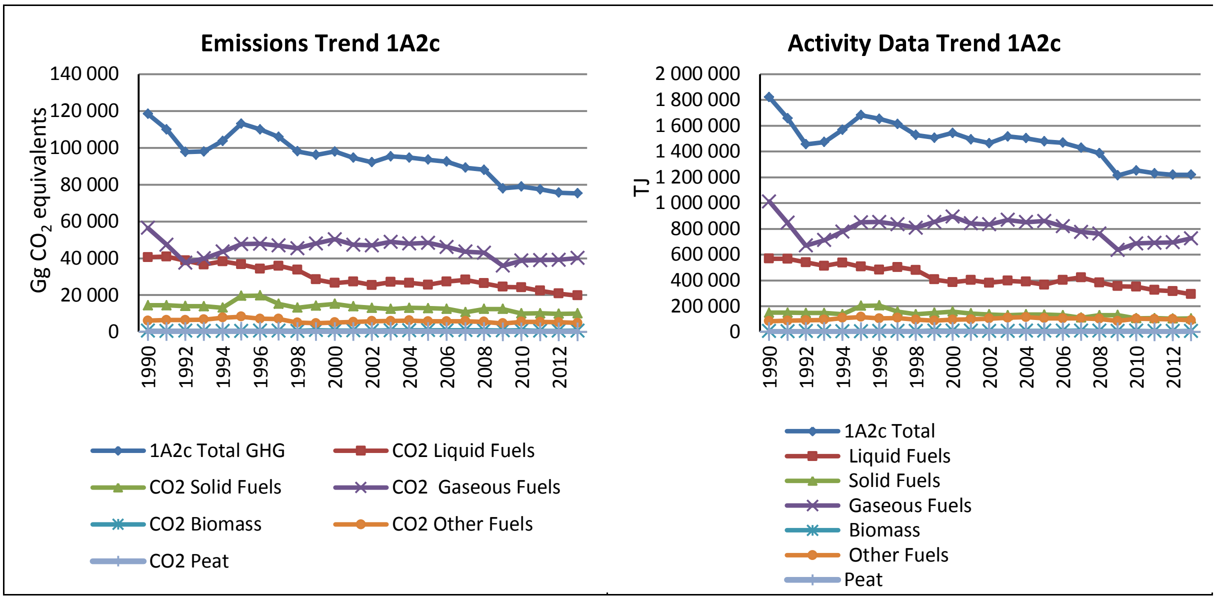


3.2.2.3 Chemicals (1A2c)

In this chapter information about emission trends, Member States contribution and activity data for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals accounted for 15 % of 1A2 category and 2 % of total GHG emissions in 2013.

Figure 3.26 shows the emission trend of category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 36 %, mainly due to decreases in emissions from liquid (-51 %) and gaseous (-29%) fuels.

Figure 3.26 1A2c Chemicals: Total and CO_2 emission and activity trends



Between 1990 and 2012, CO_2 emissions from 1A2c Chemicals decreased by 36 % in the EU-28 (Table 3.24), mainly due to decreases in Italy, Romania, the Netherlands and the United Kingdom; Poland and Spain reported substantial emission increases in this period. Between 2012 and 2013 emissions decreased substantially in France and Romania while emissions from Italy increased substantially.

Table 3.24 1A2c Chemicals: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	881	1 622	1 860	2%	238	15%	979	111%
Belgium	4 786	3 273	3 360	4%	87	3%	-1 425	-30%
Bulgaria	966	226	251	0%	25	11%	-715	-74%
Croatia	NO,IE	280	253	0%	-27	-9%	253	100%
Cyprus	2	3	3	0%	0	0%	1	45%
Czech Republic	2 996	2 052	1 936	3%	-116	-6%	-1 061	-35%
Denmark	290	341	331	0%	-10	-3%	41	14%
Estonia	799	33	91	0%	58	174%	-709	-89%
Finland	1 245	671	737	1%	65	10%	-509	-41%
France	19 660	20 010	17 993	24%	-2 018	-10%	-1 667	-8%
Germany	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Greece	808	670	343	0%	-327	-49%	-465	-58%
Hungary	1 541	189	557	1%	368	195%	-984	-64%
Ireland	410	245	233	0%	-12	-5%	-177	-43%
Italy	19 263	6 929	8 010	11%	1 081	16%	-11 253	-58%
Latvia	300	30	32	0%	1	4%	-269	-90%
Lithuania	400	207	152	0%	-56	-27%	-248	-62%
Luxembourg	170	162	157	0%	-5	-3%	-13	-8%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	17 381	12 569	12 156	16%	-412	-3%	-5 225	-30%
Poland	4 020	6 713	7 146	10%	433	6%	3 126	78%
Portugal	1 476	934	1 038	1%	105	11%	-438	-30%
Romania	19 124	3 581	2 976	4%	-604	-17%	-16 148	-84%
Slovakia	2 624	537	554	1%	17	3%	-2 070	-79%
Slovenia	209	78	78	0%	0	0%	-132	-63%
Spain	5 262	7 878	8 087	11%	209	3%	2 825	54%
Sweden	1 149	1 175	1 263	2%	88	7%	114	10%
United Kingdom	12 135	4 710	5 208	7%	498	11%	-6 927	-57%
EU-28	**117 898**	**75 118**	**74 804**	**100%**	**-314**	**0%**	**-43 094**	**-37%**

Emissions of Germany and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2c Chemicals - Liquid Fuels (CO_2)

In 2013, CO_2 from liquid fuels had a share of 26 % within source category 1A2c (compared to 34 % in 1990). Between 1990 and 2013, the emissions decreased by 51 % (Table 3.25). Several EU-28 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 1A2g.

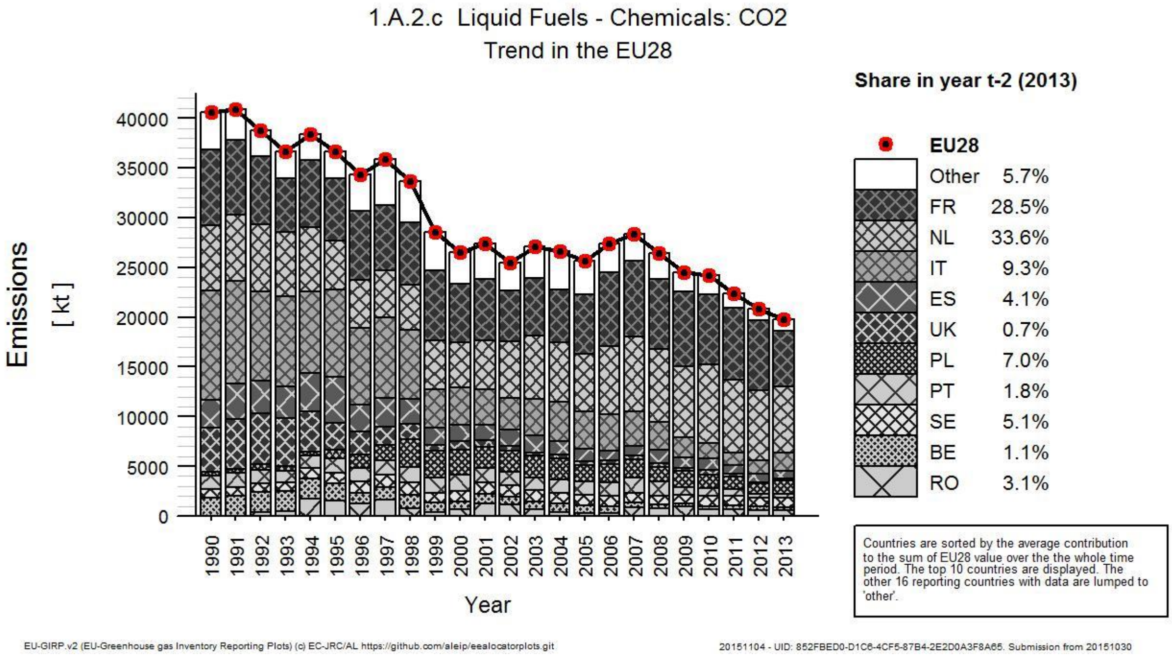
Table 3.25 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	82	130	110	1%	-20	-15%	27	33%	-	-
Belgium	1 852	336	225	1%	-111	-33%	-1 626	-88%	T1	D
Bulgaria	857	12	41	0%	29	231%	-816	-95%	T1	D
Croatia	IE	6	6	0%	-1	-10%	6	100%	NA	NA
Cyprus	2	3	3	0%	0	0%	1	45%	T1	D
Czech Republic	175	12	3	0%	-9	-75%	-172	-98%	T1	D
Denmark	188	18	15	0%	-3	-18%	-173	-92%	T1,T2	CS,D
Estonia	13	8	7	0%	-1	-9%	-6	-45%	T1,T2	CS,D
Finland	731	606	694	4%	88	14%	-37	-5%	T3	CS
France	7 606	6 988	5 628	28%	-1 360	-19%	-1 978	-26%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	639	227	38	0%	-189	-83%	-602	-94%	T2	CS
Hungary	380	NO	76	0%	76	100%	-304	-80%	T1	D
Ireland	131	76	87	0%	11	15%	-43	-33%	T2	CS
Italy	11 004	1 340	1 836	9%	497	37%	-9 168	-83%	T2	CS
Latvia	277	10	9	0%	-1	-13%	-268	-97%	T2	CS
Lithuania	69	2	2	0%	0	-5%	-67	-98%	T2	CS
Luxembourg	112	4	4	0%	0	-2%	-108	-96%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	6 598	7 103	6 630	34%	-473	-7%	32	0%	T2	CS,D
Poland	306	1 075	1 376	7%	302	28%	1 070	349%	T1	D
Portugal	1 373	347	363	2%	16	5%	-1 010	-74%	T2	CR,D
Romania	NO	601	621	3%	20	3%	621	100%	NA	NA
Slovakia	51	15	9	0%	-6	-39%	-42	-82%	T2	CS
Slovenia	32	21	20	0%	-1	-3%	-12	-37%	T1	D
Spain	2 789	820	805	4%	-15	-2%	-1 984	-71%	T2	CS
Sweden	861	917	1 001	5%	85	9%	140	16%	-	-
United Kingdom	4 450	127	141	1%	14	11%	-4 309	-97%	T2	CS
EU-28	**40 578**	**20 804**	**19 751**	**100%**	**-1 053**	**-5%**	**-20 827**	**-51%**		

Emissions of Germany and Malta are included in 1A2g
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.27 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest contributions are reported by France and the Netherlands; together they cause around 62 % of the CO_2 emissions from liquid fuels in 1A2c. Liquid fuel combustion in the EU-28 decreased by 49 % between 1990 and 2013. The decline in 1999 AD is due to the strong decrease reported by Italy.

Figure 3.27 1A2c Chemicals, liquid fuels: Emission trend and share for CO_2



1A2c Chemicals - Solid Fuels (CO_2)

In 2013, solid fuels had a share of 13 % within source category 1A2c (compared to 12 % in 1990). Between 1990 and 2013 the emissions decreased by 31 % (Table 3.26). In absolute terms the Czech Republic, Slovakia and the United Kingdom reported a significant decrease during this period while Poland reported a significant increase. Germany and Malta include emissions from this source category in source category 1A2g. For confidentiality reasons Sweden includes emissions from peat together with solid fuels.

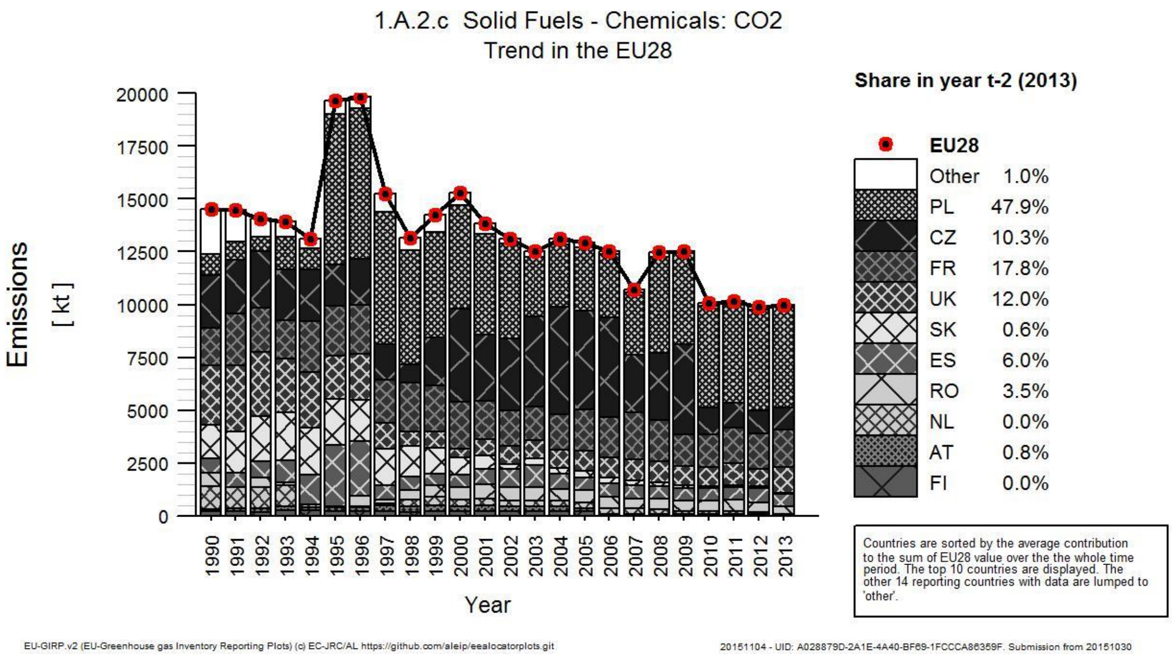
Table 3.26 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	106	71	84	1%	13	18%	-23	-21%	-	-
Belgium	402	3	3	0%	0	-7%	-398	-99%	T1	D
Bulgaria	79	NO	NO	-	-	-	-79	-100%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 487	1 086	1 026	10%	-60	-5%	-1 461	-59%	T2	CS,D
Denmark	7	3	3	0%	0	9%	-4	-54%	T1	D
Estonia	621	NO	NO	-	-	-	-621	-100%	T1,T2	CS,D
Finland	214	NO	NO	-	-	-	-214	-100%	T3	CS
France	1 765	1 677	1 777	18%	99	6%	12	1%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	169	NO	NO	-	-	-	-169	-100%	T2	CS
Hungary	96	3	3	0%	0	0%	-93	-97%	T1,T2	CS,D
Ireland	72	NA	NO	-	-	-	-72	-100%	T2	CS
Italy	489	16	9	0%	-7	-46%	-480	-98%	T2	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 087	121	NO	-	-121	-100%	-1 087	-100%	T2	CS
Poland	1 027	4 794	4 789	48%	-5	0%	3 762	366%	T1,T2	CS,D
Portugal	40	47	51	1%	4	8%	11	29%	T2	CR,D
Romania	625	455	353	4%	-102	-22%	-272	-44%	T1,T2	CS,D
Slovakia	1 584	72	64	1%	-8	-11%	-1 519	-96%	T2	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	T1,T2	CS,D
Spain	697	665	596	6%	-68	-10%	-100	-14%	T2	CS,PS
Sweden	127	40	31	0%	-9	-22%	-96	-75%	-	-
United Kingdom	2 815	825	1 204	12%	379	46%	-1 611	-57%	T2	CS
EU-28	**14 508**	**9 878**	**9 992**	**100%**	**115**	**1%**	**-4 516**	**-31%**		

Emissions of Germany and Malta are inlcuded in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.28 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland, the Czech Republic, France, Spain and the United Kingdom; together they cause 88 % of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion in the EU-28 decreased by -30 % between 1990 and 2013.

Figure 3.28 1A2c Chemicals, solid fuels: Emission trend and share for CO_2



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2013, CO_2 from gaseous fuels had a share of 53 % within source category 1A2c (compared to 48 % in 1990). Between 1990 and 2013, the emissions decreased by 29 % (Table 3.27). Between 1990 and 2013 Italy, the Netherlands and Romania reported substantial decreases while the highest increases occurred in Spain and Austria. Germany and Malta includes emissions from this source category in source category 1A2g.

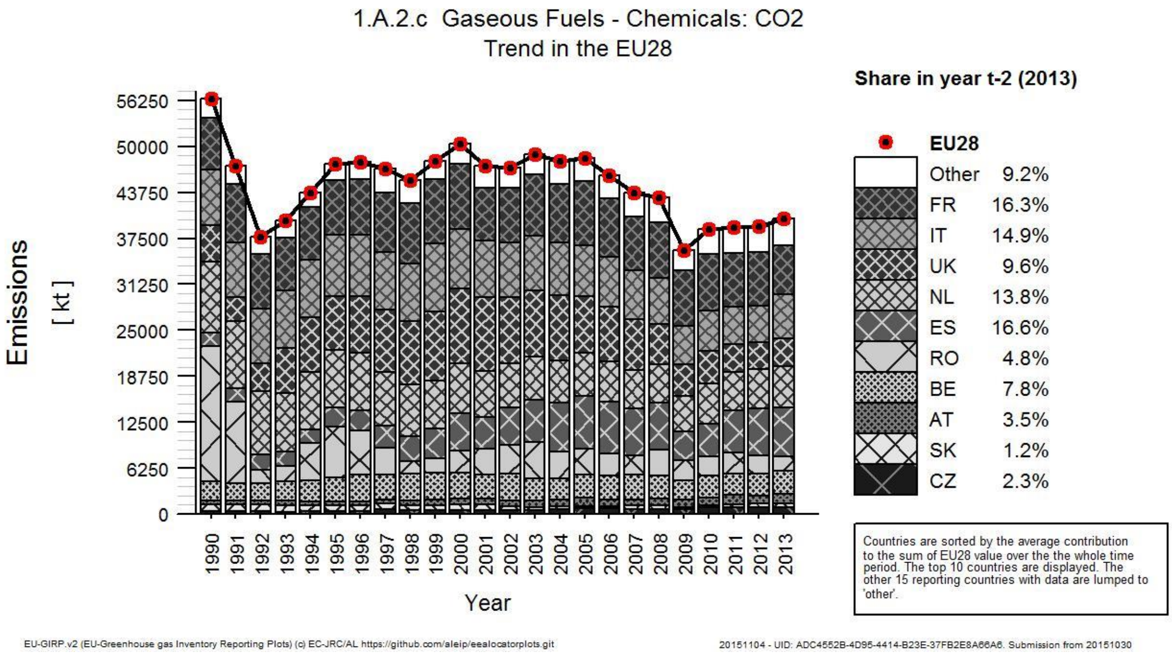
Table 3.27 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	519	1 112	1 408	4%	297	27%	889	171%	-	-
Belgium	2 532	2 927	3 124	8%	197	7%	591	23%	T1	D
Bulgaria	30	213	210	1%	-4	-2%	179	594%	NA	NA
Croatia	IE	274	248	1%	-26	-9%	248	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	334	954	906	2%	-47	-5%	572	171%	T2	CS
Denmark	96	320	313	1%	-7	-2%	218	227%	T3	CS
Estonia	166	25	84	0%	58	230%	-82	-50%	T2	CS
Finland	99	53	31	0%	-22	-42%	-68	-69%	T3	CS
France	7 051	7 373	6 558	16%	-815	-11%	-493	-7%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	443	305	1%	-137	-31%	305	100%	NA	NA
Hungary	1 065	185	478	1%	292	158%	-587	-55%	T1	D
Ireland	207	169	145	0%	-23	-14%	-62	-30%	T2	CS
Italy	7 561	4 837	5 994	15%	1 157	24%	-1 567	-21%	T2	CS
Latvia	23	20	21	0%	0	2%	-3	-11%	T2	CS
Lithuania	331	206	150	0%	-56	-27%	-182	-55%	T2	CS
Luxembourg	57	158	153	0%	-5	-3%	95	165%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	9 696	5 345	5 527	14%	182	3%	-4 169	-43%	T2	CS
Poland	297	761	824	2%	63	8%	528	178%	T1	D
Portugal	NO	490	505	1%	15	3%	505	100%	NA	NA
Romania	18 499	2 468	1 932	5%	-536	-22%	-16 567	-90%	T2	CS
Slovakia	989	450	481	1%	31	7%	-508	-51%	T2	CS
Slovenia	176	57	58	0%	1	2%	-118	-67%	T2	CS
Spain	1 777	6 393	6 686	17%	292	5%	4 908	276%	T2	CS
Sweden	155	167	174	0%	7	4%	19	13%	-	-
United Kingdom	4 870	3 758	3 863	10%	105	3%	-1 007	-21%	T2	CS
EU-28	**56 531**	**39 158**	**40 178**	**100%**	**1 019**	**3%**	**-16 354**	**-29%**		

Emissions of Germany and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.29 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause 71 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-28 decreased by 28 % between 1990 and 2013.

Figure 3.29 1A2c Chemicals, gaseous fuels: Emission trend and share for CO_2



1A2c Chemicals - Other Fossil Fuels (CO_2)

In 2013, CO_2 from other fossil fuels had a share of 6 % within source category 1A2c (compared to 5 % in 1990). Between 1990 and 2013, the emissions decreased by 20 % (Table 3.28). Several Member States reported emissions as 'Not occurring' or 'Not applicable', Germany and Malta included emissions in 1A2g. The major absolute increase was reported by France between 1990 and 2013 while Poland reports a significant decrease of emissions. Italy reports gaseous fuels resulting from the petrochemical production processes under this category.

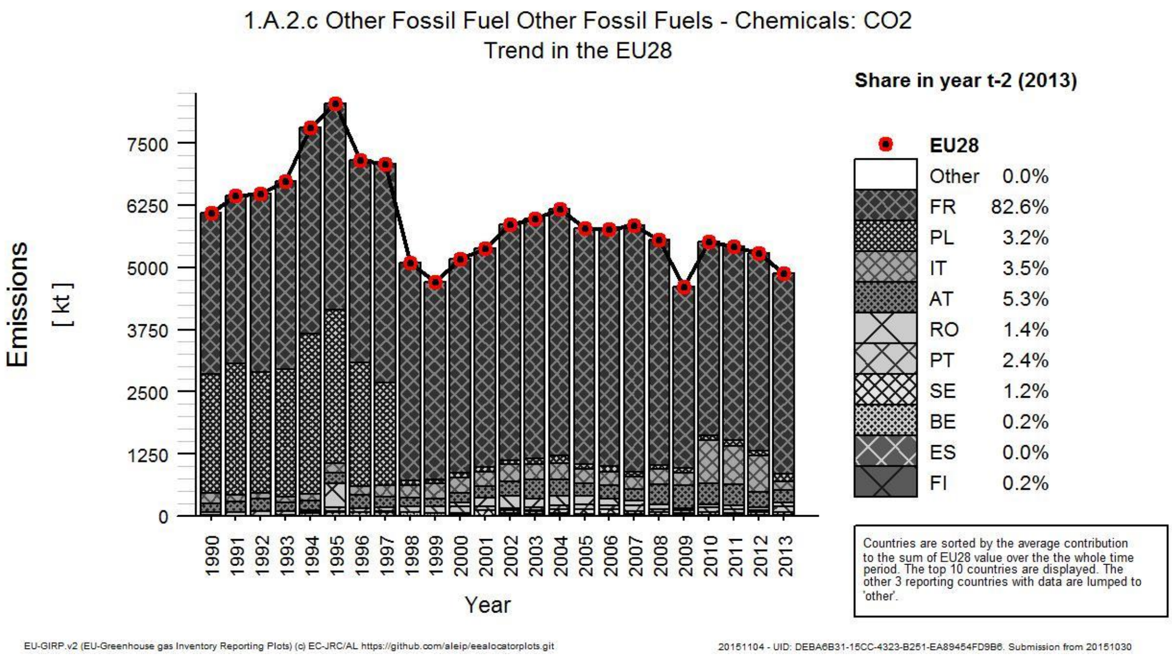
Table 3.28 1A2c Chemicals, other fossil fuels: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	174	310	258	5%	-51	-17%	85	49%
Belgium	IE	7	8	0%	1	21%	8	100%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	11	12	12	0%	0	-1%	2	15%
France	3 238	3 972	4 030	83%	58	1%	793	24%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	208	736	171	3%	-566	-77%	-37	-18%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	2 390	83	156	3%	73	88%	-2 234	-93%
Portugal	63	49	118	2%	69	139%	56	88%
Romania	NO	56	70	1%	14	25%	70	100%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	1	NA	NO	-	-	-	-1	-100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	6	52	57	1%	5	9%	51	911%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**6 089**	**5 278**	**4 881**	**100%**	**-397**	**-8%**	**-1 208**	**-20%**

Emissions of Germany and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.30 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France and Austria; together they cause 88 % of the CO_2 emissions from other fossil fuels in 1A2c. Other fuel consumption in the EU-28 increased by 7 % between 1990 and 2013.

Figure 3.30 1A2c Chemicals, other fossil fuels: Emission trend and share for CO_2

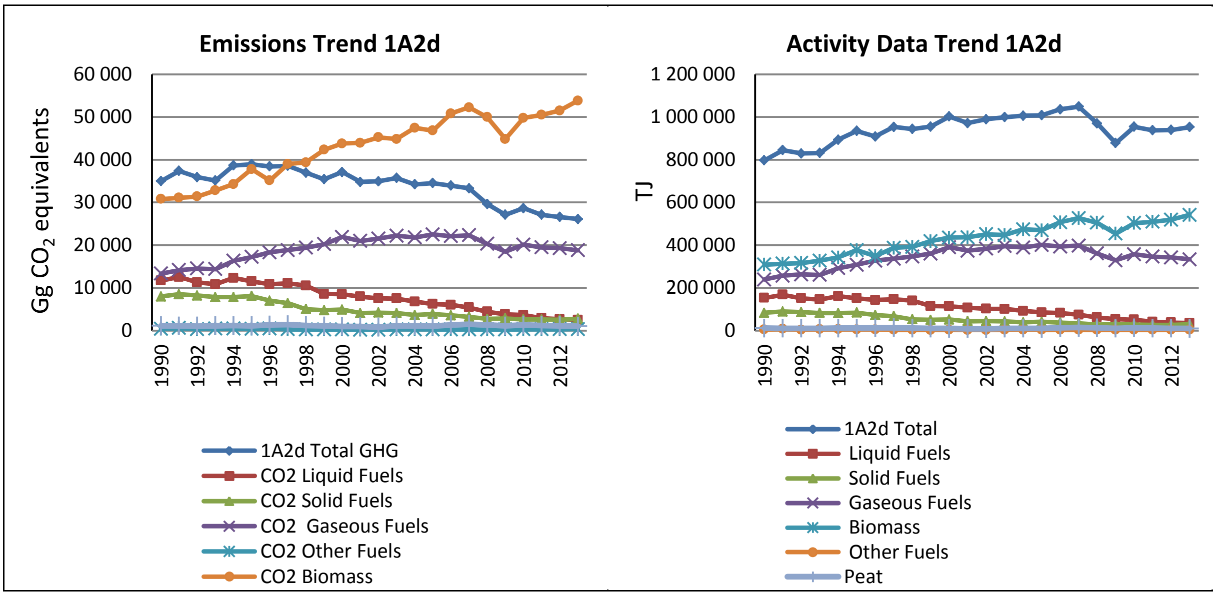


3.2.2.4 Pulp, Paper and Print (1A2d)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print accounted for 5 % of 1A2 source category and 0.6 % of total GHG emissions in 2013.

Figure 3.31 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous fuels. Total GHG emissions decreased by 25 %. The share of gaseous fuels is gradually increasing from 1990 to 2007 and slightly decreasing since the year 2010. This sector includes a high amount of biomass consumption which is also gradually increasing since 1990. The activity data shows a strong switch from liquid and solid fuels to gaseous fuels and biomass.

Figure 3.31 1A2d Pulp, Paper and Print: Total and CO_2 emission trends



Between 1990 and 2013, CO_2 emissions from 1A2d Pulp, Paper and Print decreased by 26 % in the EU-28 (Table 3.29), mainly due to decreases in the Czech Republic, Finland, France, Sweden, Slovakia and the UK. Between 2012 and 2013 emissions decreased by -2 %. Between 1990 and 1999 Luxembourg, between 1990 to 2000 Croatia and from 1990 onwards Cyprus and Malta reported emissions as 'Not occurring' and 'Included elsewhere'.

Table 3.29 1A2d Pulp, Paper and Print: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	2 214	1 975	1 478	6%	-497	-25%	-736	-33%
Belgium	644	549	547	2%	-2	0%	-97	-15%
Bulgaria	16	108	123	0%	15	14%	107	690%
Croatia	NO,IE	126	113	0%	-13	-10%	113	100%
Cyprus	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Czech Republic	2 285	517	446	2%	-71	-14%	-1 839	-80%
Denmark	342	156	151	1%	-5	-3%	-191	-56%
Estonia	NO	5	4	0%	-1	-12%	4	100%
Finland	5 351	2 834	2 830	11%	-4	0%	-2 521	-47%
France	4 856	2 672	3 249	13%	577	22%	-1 607	-33%
Germany	4	16	8	0%	-8	-52%	4	114%
Greece	306	119	138	1%	19	16%	-168	-55%
Hungary	84	156	193	1%	37	24%	109	131%
Ireland	28	17	16	0%	-1	-4%	-13	-44%
Italy	3 077	4 315	4 263	17%	-52	-1%	1 186	39%
Latvia	168	4	6	0%	1	33%	-162	-97%
Lithuania	256	44	43	0%	-1	-2%	-212	-83%
Luxembourg	NO,IE	17	16	0%	-1	-8%	16	100%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	1 743	1 101	1 014	4%	-86	-8%	-729	-42%
Poland	285	1 455	1 586	6%	131	9%	1 301	456%
Portugal	746	998	983	4%	-15	-2%	237	32%
Romania	NO	96	97	0%	1	1%	97	100%
Slovakia	2 329	302	420	2%	117	39%	-1 910	-82%
Slovenia	380	339	334	1%	-6	-2%	-46	-12%
Spain	2 546	4 998	4 457	18%	-541	-11%	1 910	75%
Sweden	2 187	1 029	890	4%	-139	-14%	-1 297	-59%
United Kingdom	4 612	1 931	1 970	8%	39	2%	-2 643	-57%
EU-28	**34 459**	**25 881**	**25 374**	**100%**	**-506**	**-2%**	**-9 085**	**-26%**

Emissions of the Luxembourg, Cyprus, Croatia and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2d Pulp, Paper and Print - Liquid (CO_2)

In 2013 CO_2 from liquid fuels had a share of 10 % within source category 1A2d (compared to 33 % in 1990). Between 1990 and 2013 the emissions decreased by 79 % (Table 3.30). Between 1990 and 2013 all Member States reported decreasing CO_2 emissions from this source category except Luxembourg (emissions were IE in 1990) and Poland.

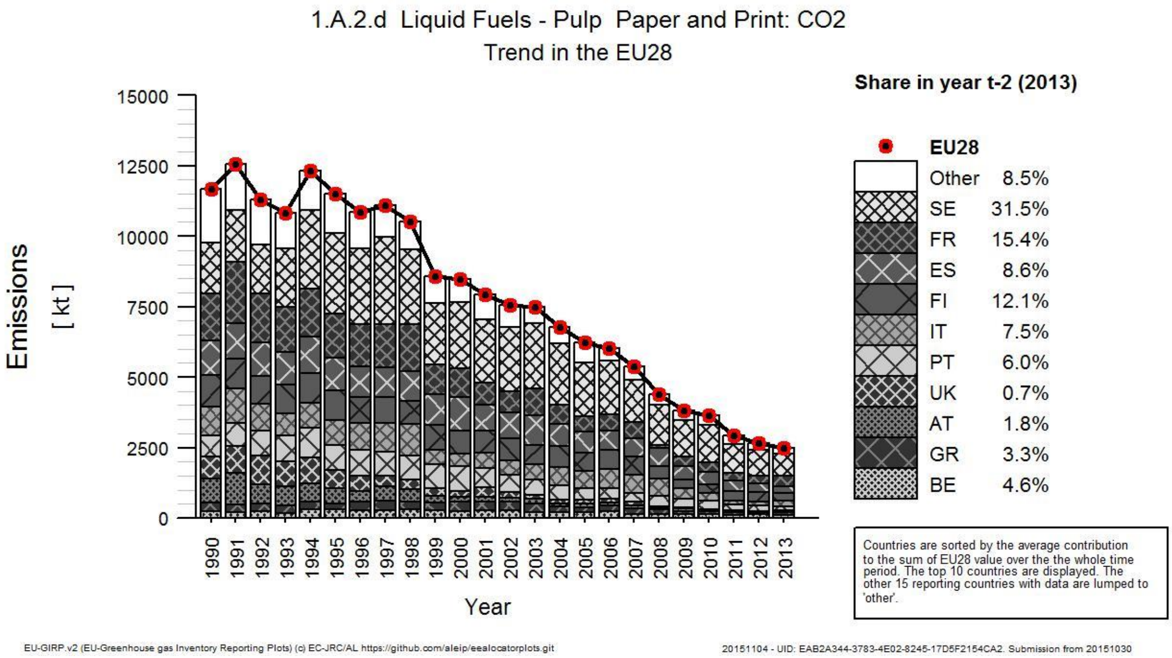
Table 3.30 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	853	38	45	2%	7	18%	-807	-95%	-	-
Belgium	235	130	115	5%	-15	-12%	-120	-51%	T1	D
Bulgaria	16	15	6	0%	-9	-60%	-9	-60%	T1	D
Croatia	IE	14	12	0%	-2	-17%	12	100%	NA	NA
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	461	20	19	1%	-1	-6%	-442	-96%	T1	CS,D
Denmark	83	4	2	0%	-2	-40%	-81	-97%	T1,T2	CS,D
Estonia	NO	1	1	0%	0	-24%	1	100%	NA	NA
Finland	1 138	360	302	12%	-58	-16%	-836	-73%	T3	CS
France	1 677	283	385	15%	103	36%	-1 292	-77%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	302	61	82	3%	21	34%	-220	-73%	T2	CS
Hungary	28	9	12	0%	3	32%	-16	-56%	T1	D
Ireland	28	8	9	0%	1	6%	-19	-68%	T2	CS
Italy	1 016	131	188	8%	57	44%	-828	-82%	T2	CS
Latvia	16	0	NO	-	0	-100%	-16	-100%	T2	CS
Lithuania	69	1	0	0%	-1	-76%	-68	-100%	T2	CS
Luxembourg	IE	1	1	0%	0	-13%	1	100%	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	20	1	1	0%	0	-5%	-19	-93%	T2	CS,D
Poland	105	136	143	6%	6	5%	38	36%	T1	D
Portugal	746	188	149	6%	-39	-21%	-597	-80%	T2	CR,D
Romania	NO	9	NO	-	-9	-100%	-	-	NA	NA
Slovakia	985	9	1	0%	-7	-85%	-983	-100%	T2	CS
Slovenia	98	4	4	0%	0	5%	-94	-96%	T1	D
Spain	1 225	298	215	9%	-83	-28%	-1 010	-82%	T2	CS,PS
Sweden	1 786	927	786	32%	-140	-15%	-999	-56%	-	-
United Kingdom	782	15	16	1%	1	7%	-766	-98%	T2	CS
EU-28	**11 667**	**2 665**	**2 496**	**100%**	**-169**	**-6%**	**-9 171**	**-79%**		

Emissions of Cyprus, Germany and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.32 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest contributions are reported by Finland, France, Spain and Sweden; together they cause 68% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-28 decreased by 77 % between 1990 and 2013.

Figure 3.32 1A2d Pulp, Paper and Print, liquid fuels: Emission trend and share for CO_2



1A2d Pulp, Paper and Print - Solid Fuels (CO_2)

In 2013 CO_2 from solid fuels had a share of 11 % within source category 1A2d (compared to 23 % in 1990). Between 1990 and 2013 the emissions decreased by 65 % (Table 3.31). Only eleven of the EU-28 Member States reported CO_2 emissions from this source category in 2013. All Member States reported decreasing emissions except Poland. For confidentiality reasons Sweden reports emissions from peat and solid fuels together with other solid fuels.

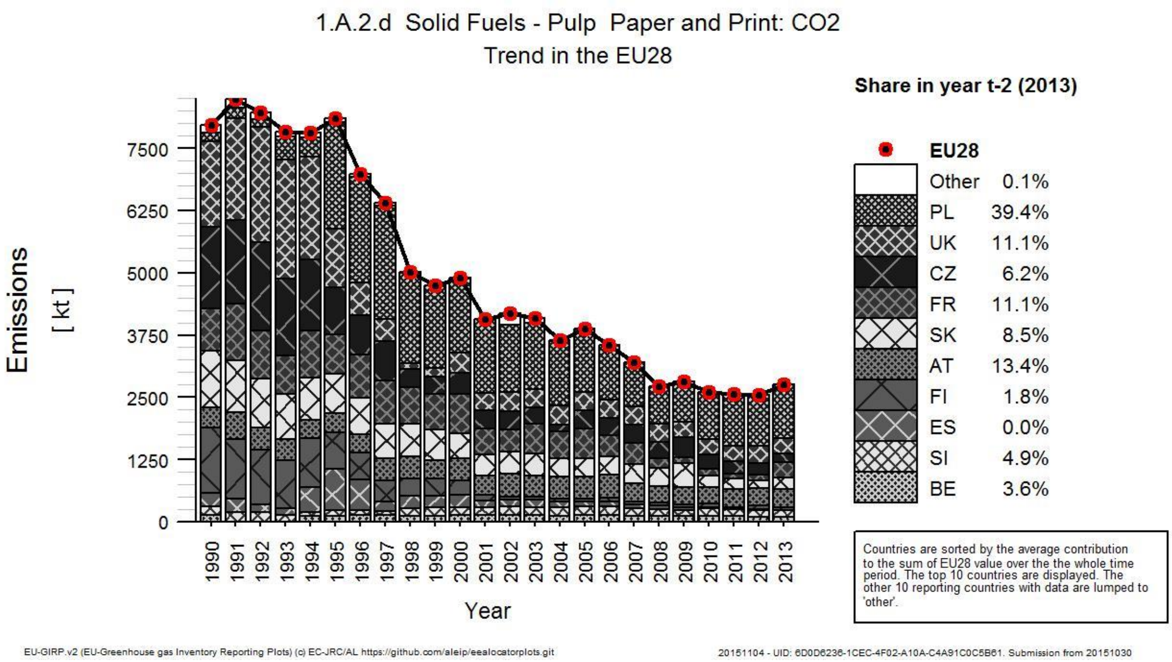
Table 3.31 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	398	348	369	13%	21	6%	-29	-7%	-	-
Belgium	128	105	100	4%	-5	-5%	-28	-22%	T1	D
Bulgaria	NO	NO	3	0%	3	100%	3	100%	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 646	234	171	6%	-63	-27%	-1 475	-90%	T2	CS,D
Denmark	125	NO	NO	-	-	-	-125	-100%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 318	80	49	2%	-31	-39%	-1 269	-96%	T3	CS
France	848	115	305	11%	191	166%	-543	-64%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	4	NO	NO	-	-	-	-4	-100%	T2	CS
Hungary	6	NO	NO	-	-	-	-6	-100%	T1,T2	CS,D
Ireland	NO	1	0	0%	-1	-88%	0	100%	NA	NA
Italy	6	NO	NO	-	-	-	-6	-100%	T2	CS
Latvia	3	NO	NO	-	-	-	-3	-100%	T1	D
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	8	NO	NO	-	-	-	-8	-100%	T2	CS
Poland	174	1 008	1 086	39%	78	8%	912	523%	T1,T2	CS,D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NO	NO	NO	-	-	-	-	-	T2	CS
Slovakia	1 142	155	235	9%	80	52%	-907	-79%	T2	CS
Slovenia	172	129	134	5%	6	5%	-38	-22%	T2	CS
Spain	272	19	NO	-	-19	-100%	-272	-100%	T2	CS,PS
Sweden	C	C	C	-	-	-	-	-	-	-
United Kingdom	1 708	348	306	11%	-42	-12%	-1 402	-82%	T2	CS
EU-28	**7 956**	**2 541**	**2 759**	**100%**	**218**	**9%**	**-5 197**	**-65%**		

Emissions of Germany and Malta are included in 1A2g. Sweden reports confidential data in other solid fuels. Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest contributions are reported by Austria, France, Poland and the United Kingdom; together they cause around 75 % of the CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption in the EU-28 decreased by 64 % between 1990 and 2013.

Figure 3.33 1A2d Pulp, Paper and Print, solid fuels: Emission trend and share for CO_2



1A2d Pulp, Paper and Print - Gaseous Fuels (CO_2)

In 2013, CO_2 from gaseous fuels had a share of 72 % within source category 1A2d (compared to 38 % in 1990). Between 1990 and 2013, the emissions increased by 41 % (Table 3.32). Germany and Malta include emissions in 1A2g.

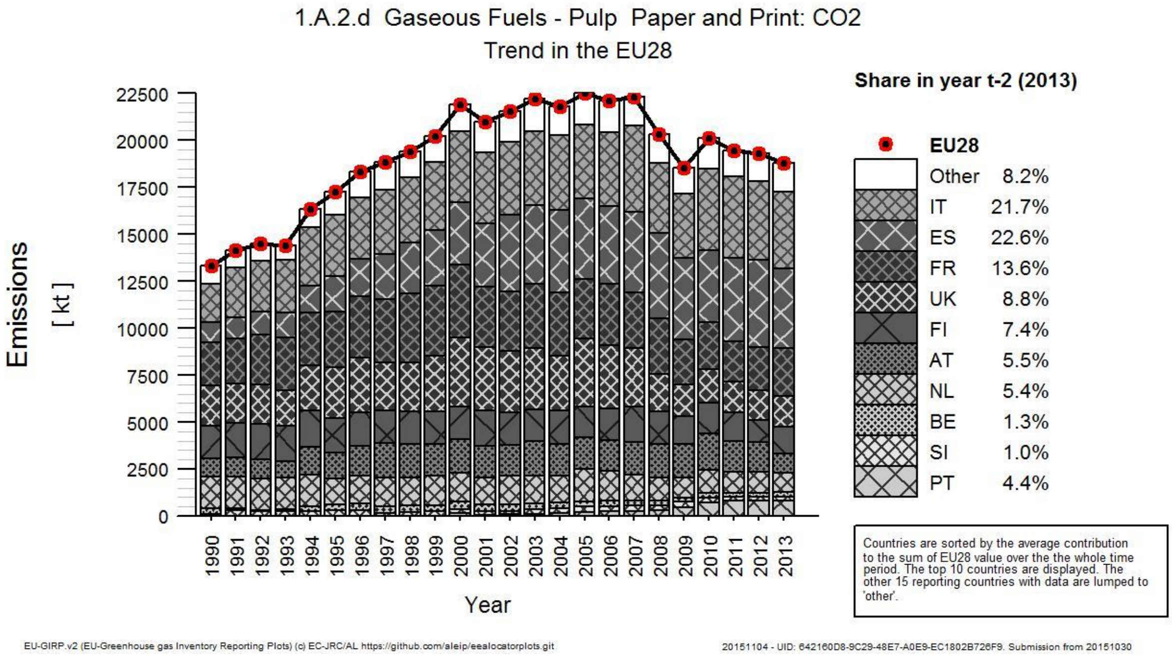
Table 3.32 1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	943	1 582	1 041	6%	-541	-34%	99	10%	-	-
Belgium	282	219	240	1%	21	10%	-42	-15%	T1	D
Bulgaria	NO	92	113	1%	21	23%	113	100%	NA	NA
Croatia	IE	112	102	1%	-10	-9%	102	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	179	262	256	1%	-6	-2%	77	43%	T2	CS
Denmark	134	152	149	1%	-4	-2%	15	11%	T3	CS
Estonia	NO	4	4	0%	0	-10%	4	100%	NA	NA
Finland	1 757	1 204	1 398	7%	194	16%	-359	-20%	T3	CS
France	2 331	2 275	2 551	14%	276	12%	220	9%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	58	56	0%	-2	-3%	56	100%	NA	NA
Hungary	50	147	181	1%	34	23%	131	261%	T1	D
Ireland	NO	7	7	0%	0	-5%	7	100%	NA	NA
Italy	2 055	4 184	4 076	22%	-109	-3%	2 021	98%	T2	CS
Latvia	149	4	6	0%	2	49%	-144	-96%	T2	CS
Lithuania	187	43	43	0%	0	0%	-144	-77%	T2	CS
Luxembourg	IE	17	15	0%	-1	-8%	15	100%	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 715	1 099	1 013	5%	-86	-8%	-703	-41%	T2	CS
Poland	6	311	352	2%	41	13%	346	6109%	T1	D
Portugal	NO	811	834	4%	23	3%	834	100%	NA	NA
Romania	NO	86	97	1%	10	12%	97	100%	NA	NA
Slovakia	203	113	128	1%	15	13%	-75	-37%	T2	CS
Slovenia	110	206	195	1%	-12	-6%	85	78%	T2	CS
Spain	1 050	4 681	4 242	23%	-439	-9%	3 192	304%	T2	CS
Sweden	66	44	41	0%	-3	-6%	-25	-37%	-	-
United Kingdom	2 122	1 568	1 647	9%	79	5%	-475	-22%	T2	CS
EU-28	**13 338**	**19 281**	**18 785**	**100%**	**-496**	**-3%**	**5 447**	**41%**		

Emissions of Germany and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.34 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Finland, France, Italy, Spain and the United Kingdom; together they cause 74 % of the CO_2 emissions from gaseous fuels in 1A2d. Gaseous fuel consumption in the EU-28 rose by 40 % between 1990 and 2013.

Figure 3.34 1A2d Pulp, Paper and Print, gaseous fuels: Emission trend and share for CO_2

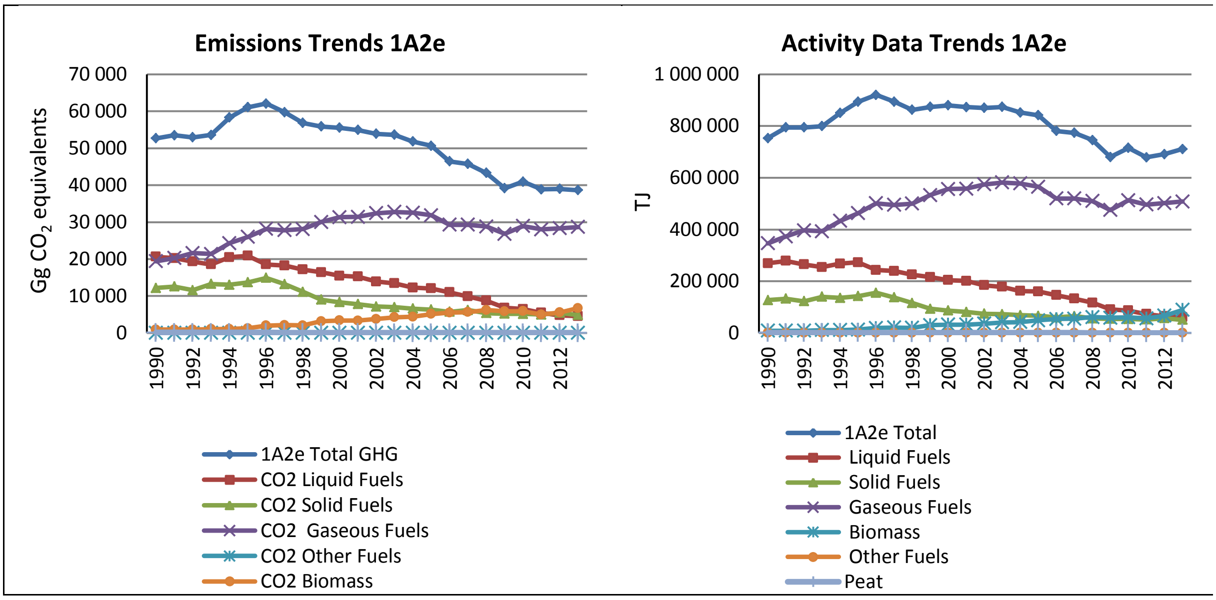


3.2.2.1 Food Processing, Beverages and Tobacco (1A2e)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 8 % of 1A2 source category and for 0.9 % of total GHG emissions in 2013.

Figure 3.35 shows the emission trend within the category 1A2e, which is dominated by CO_2 emissions from gaseous fuels. Total GHG emissions decreased by 27 % between 1990 and 2013. Emissions from gaseous fuels increased by 48 %, whereas emissions from liquid and solid fuels significantly decreased. The use of biomass is increasing continuously within this category. For confidentiality reasons Sweden reports emissions from peat and solid fuels together with liquid fuels.

Figure 3.35 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2013, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco decreased by 27 % in the EU-28 (Table 3.33). Between 2012 and 2013 emissions decreased by 1 %. Emissions of Malta are included in 1A2g.

Table 3.33 1A2e Food Processing, Beverages and Tobacco: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	870	982	940	2%	-42	-4%	70	8%
Belgium	3 023	2 082	2 261	6%	178	9%	-763	-25%
Bulgaria	454	290	289	1%	-1	0%	-164	-36%
Croatia	NO,IE	430	388	1%	-42	-10%	388	100%
Cyprus	53	53	40	0%	-12	-24%	-13	-25%
Czech Republic	2 988	939	947	2%	8	1%	-2 041	-68%
Denmark	1 466	1 195	1 165	3%	-30	-3%	-300	-20%
Estonia	457	5	5	0%	0	5%	-452	-99%
Finland	828	221	234	1%	13	6%	-594	-72%
France	9 014	8 633	8 305	22%	-328	-4%	-709	-8%
Germany	2 016	262	304	1%	42	16%	-1 712	-85%
Greece	917	511	568	1%	58	11%	-348	-38%
Hungary	2 022	513	669	2%	155	30%	-1 353	-67%
Ireland	1 017	804	854	2%	49	6%	-164	-16%
Italy	3 857	3 532	3 532	9%	0	0%	-325	-8%
Latvia	1 075	141	136	0%	-5	-4%	-940	-87%
Lithuania	677	298	280	1%	-18	-6%	-397	-59%
Luxembourg	13	42	35	0%	-7	-16%	23	182%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	4 079	3 421	3 286	9%	-135	-4%	-793	-19%
Poland	3 734	4 209	4 038	11%	-170	-4%	304	8%
Portugal	822	861	819	2%	-42	-5%	-3	0%
Romania	123	954	818	2%	-136	-14%	695	563%
Slovakia	1 140	296	310	1%	14	5%	-831	-73%
Slovenia	221	87	87	0%	0	0%	-134	-61%
Spain	2 935	2 964	2 919	8%	-45	-2%	-16	-1%
Sweden	948	492	455	1%	-38	-8%	-493	-52%
United Kingdom	7 651	4 425	4 497	12%	72	2%	-3 153	-41%
EU-28	**52 401**	**38 643**	**38 182**	**100%**	**-461**	**-1%**	**-14 219**	**-27%**

Emissions of Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2e Food Processing, Beverages and Tobacco - Liquid (CO_2)

In 2013 CO_2 from liquid fuels decreased to a share of 12 % within source category 1A2e (compared to 39 % in 1990). Between 1990 and 2013, the emissions decreased by 78 % (Table 3.34). Between 1990 and 2013 all Member States showed a reduction of emissions except for Poland. Emissions of Malta are included in 1A2g. For confidentiality reasons Sweden reports emissions from peat and solid fuels together with liquid fuels.

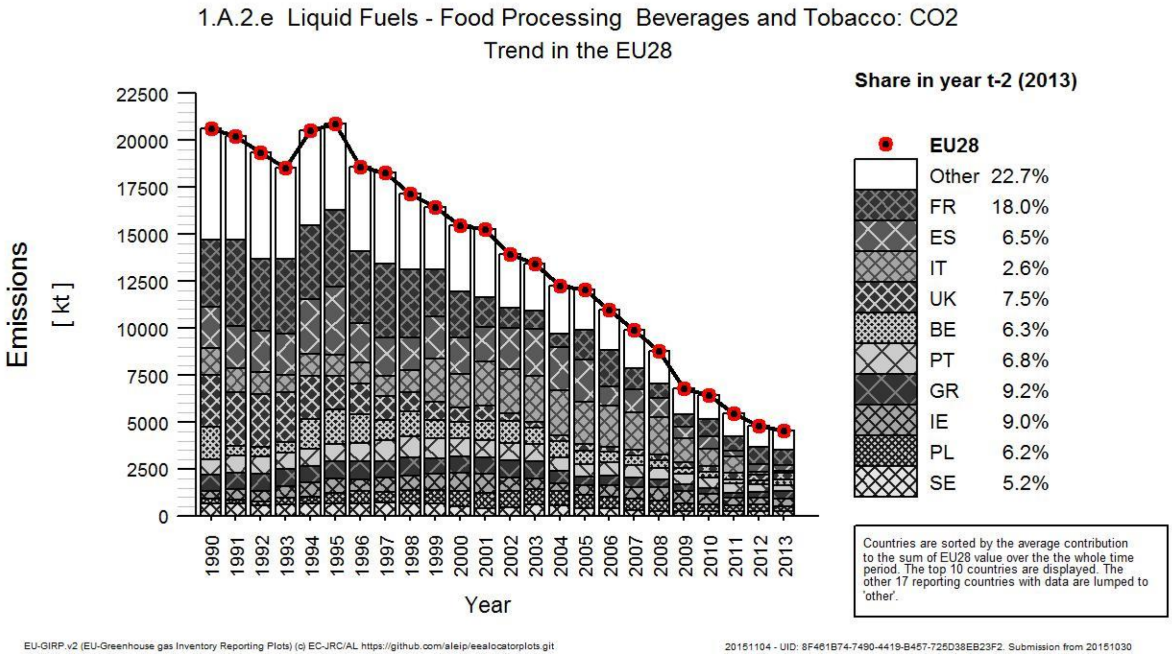
Table 3.34 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	345	198	192	4%	-6	-3%	-153	-44%	-	-
Belgium	1 689	177	286	6%	109	62%	-1 403	-83%	T1	D
Bulgaria	409	46	24	1%	-22	-47%	-385	-94%	T1	D
Croatia	IE	73	63	1%	-10	-13%	63	100%	NA	NA
Cyprus	53	53	40	1%	-12	-24%	-13	-25%	T1	D
Czech Republic	472	18	12	0%	-6	-34%	-460	-97%	T1	CS,D
Denmark	601	252	226	5%	-27	-11%	-376	-62%	T1,T2	CS,D
Estonia	438	1	1	0%	0	-7%	-437	-100%	T1,T2	CS,D
Finland	365	85	88	2%	3	4%	-277	-76%	T3	CS
France	3 580	899	816	18%	-83	-9%	-2 765	-77%	-	-
Germany	908	86	127	3%	42	49%	-781	-86%	CS	CS
Greece	863	326	418	9%	92	28%	-445	-52%	T2	CS
Hungary	597	12	36	1%	24	196%	-561	-94%	T1	D
Ireland	433	348	407	9%	59	17%	-26	-6%	T1,T2	CS,D
Italy	1 423	150	120	3%	-30	-20%	-1 303	-92%	T2	CS
Latvia	798	36	33	1%	-3	-8%	-765	-96%	T1,T2	CS,D
Lithuania	174	42	37	1%	-5	-11%	-137	-79%	T2	CS
Luxembourg	9	7	3	0%	-4	-53%	-6	-64%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	235	32	7	0%	-25	-79%	-228	-97%	T2	CS,D
Poland	231	367	283	6%	-84	-23%	52	23%	T1	D
Portugal	821	424	307	7%	-118	-28%	-514	-63%	T2	CR,D
Romania	NO	151	110	2%	-42	-28%	110	100%	NA	NA
Slovakia	359	0	1	0%	0	1472%	-358	-100%	T2	CS
Slovenia	146	32	31	1%	-1	-4%	-115	-79%	T1	D
Spain	2 198	429	294	6%	-134	-31%	-1 904	-87%	T2	CS
Sweden	686	243	236	5%	-6	-3%	-450	-66%	-	-
United Kingdom	2 793	309	341	8%	32	10%	-2 452	-88%	T2	CS
EU-28	**20 627**	**4 795**	**4 539**	**100%**	**-256**	**-5%**	**-16 087**	**-78%**		

Emissions of Malta are included in 1A2g
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.36 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Portugal, Greece, Ireland and the United Kingdom; together they cause 50 % of the CO_2 emissions from liquid fuels in 1A2e. Fuel consumption in the EU-28 decreased by 77 % between 1990 and 2013.

Figure 3.36 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Emission trend and share for CO_2



1A2e Food Processing Beverages and Tobacco - Solid (CO_2)

In 2013 solid fuels had a share of 13 % within source category 1A2e (compared to 23 % in 1990). Between 1990 and 2013 the emissions decreased by 60 % (Table 3.35) and all Member States reported decreasing CO_2 emissions from this source category. For confidentiality reasons Sweden reports emissions from solid fuels together with liquid fuels. Emissions of Malta are included in 1A2g.

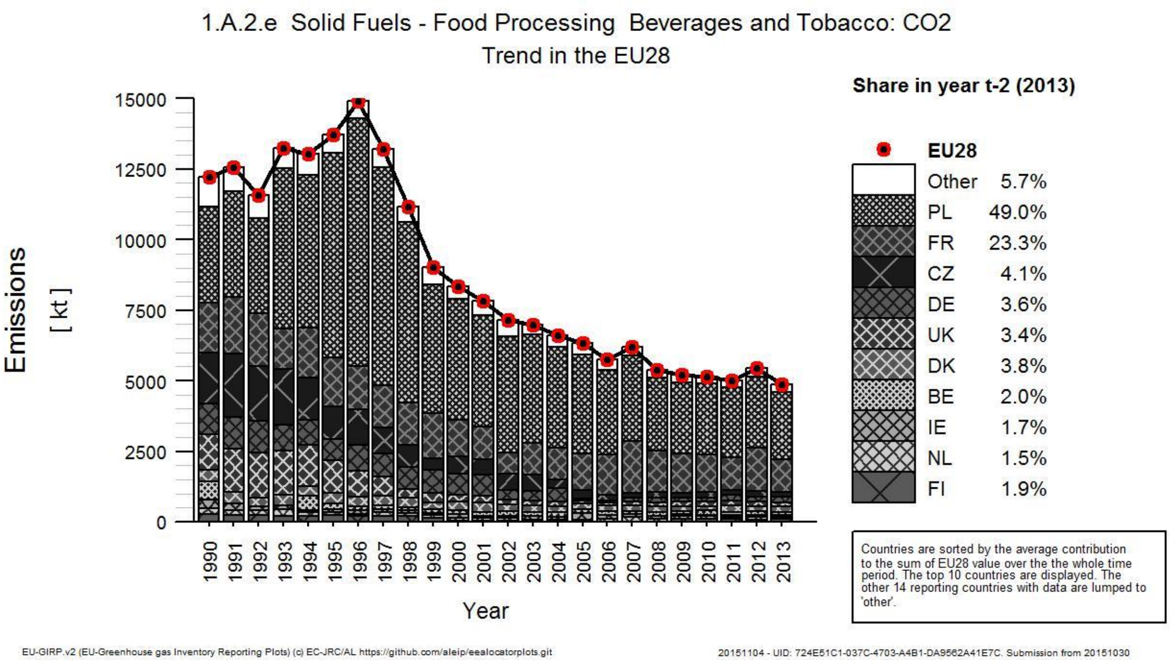
Table 3.35 1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	18	17	16	0%	-1	-5%	-2	-13%	-	-
Belgium	651	125	97	2%	-28	-22%	-553	-85%	T1	D
Bulgaria	33	4	10	0%	6	134%	-23	-69%	NA	NA
Croatia	IE	83	70	1%	-13	-16%	70	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 789	209	197	4%	-12	-6%	-1 592	-89%	T2	CS,D
Denmark	402	171	182	4%	12	7%	-219	-55%	T1	D
Estonia	5	0	0	0%	0	0%	-4	-96%	T1,T2	CS,D
Finland	257	84	94	2%	10	12%	-163	-63%	T3	CS
France	1 776	1 537	1 132	23%	-404	-26%	-644	-36%	-	-
Germany	1 108	176	177	4%	0	0%	-931	-84%	CS	CS
Greece	54	7	5	0%	-2	-25%	-49	-91%	T2	PS
Hungary	185	13	10	0%	-2	-20%	-175	-95%	T1,T2	CS,D
Ireland	292	62	82	2%	20	33%	-210	-72%	T2	CS
Italy	88	49	49	1%	0	0%	-38	-44%	T2	CS
Latvia	103	3	2	0%	0	-7%	-101	-98%	T1	D
Lithuania	33	10	11	0%	1	9%	-22	-66%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	227	100	75	2%	-25	-25%	-153	-67%	T2	CS
Poland	3 392	2 512	2 382	49%	-130	-5%	-1 010	-30%	T1,T2	CS,D
Portugal	1	NO	NO	-	-	-	-1	-100%	NA	CR,D
Romania	123	49	34	1%	-16	-32%	-90	-73%	T1,T2	CS,D
Slovakia	312	33	38	1%	5	16%	-274	-88%	T2	CS
Slovenia	9	NO	NO	-	-	-	-9	-100%	T1,T2	CS,D
Spain	92	47	32	1%	-15	-32%	-60	-65%	T2	CS
Sweden	C	C	C	-	-	-	-	-	-	-
United Kingdom	1 254	164	163	3%	0	0%	-1 090	-87%	T2	CS
EU-28	**12 203**	**5 454**	**4 860**	**100%**	**-594**	**-11%**	**-7 343**	**-60%**		

Emissions of Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.37 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland and France which contribute 72 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-28 decreased by 77 % between 1990 and 2013.

Figure 3.37 1A2e Food Processing, Beverages and Tobacco, solid fuels: Emission trend and share for CO_2



1A2e Food Processing Beverages and Tobacco - Gaseous (CO_2)

In 2013 CO_2 from gaseous fuels had a share of 74 % within source category 1A2e (compared to 37 % in 1990). Between 1990 and 2013 the emissions increased by 48 % (Table 3.36). Between 1990 and 2013 most Member States reported increasing CO_2 emissions from this source category. Major absolute increases occurred in Belgium, France, Poland and Spain. For confidentiality reasons Germany reports emissions in 1A2g. Emissions of Malta are included in 1A2g.

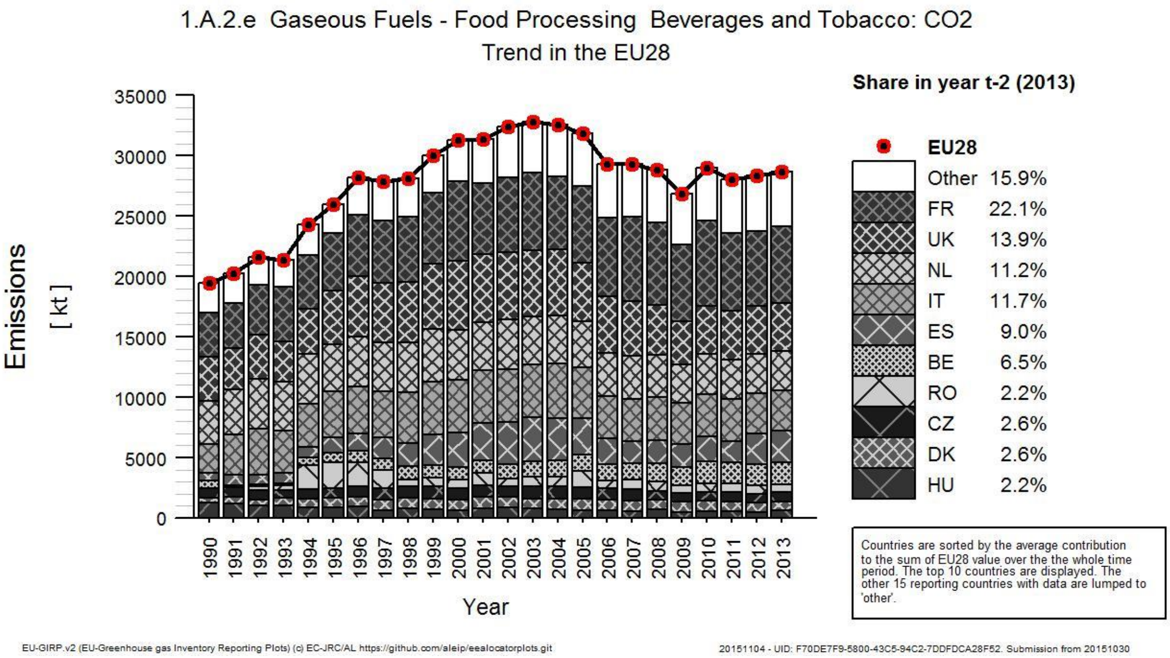
Table 3.36 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	507	766	732	3%	-35	-5%	225	44%	-	-
Belgium	684	1 780	1 878	7%	97	5%	1 193	174%	T1	D
Bulgaria	11	239	254	1%	15	6%	243	2127%	NA	NA
Croatia	IE	274	255	1%	-19	-7%	255	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	727	711	738	3%	27	4%	11	1%	T2	CS
Denmark	463	772	757	3%	-15	-2%	294	64%	T3	CS
Estonia	15	3	4	0%	0	8%	-11	-75%	T2	CS
Finland	67	15	15	0%	1	4%	-52	-77%	T3	CS
France	3 658	6 198	6 348	22%	150	2%	2 690	74%	-	-
Germany	C	C	C	-	-	-	-	-	CS	CS
Greece	NO	178	146	1%	-32	-18%	146	100%	NA	NA
Hungary	1 239	489	622	2%	134	27%	-617	-50%	T1	D
Ireland	293	392	363	1%	-29	-7%	70	24%	T2	CS
Italy	2 347	3 333	3 363	12%	29	1%	1 016	43%	T2	CS
Latvia	174	100	98	0%	-2	-2%	-76	-44%	T2	CS
Lithuania	469	244	231	1%	-13	-6%	-239	-51%	T2	CS
Luxembourg	4	35	32	0%	-3	-9%	28	746%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	3 617	3 290	3 205	11%	-85	-3%	-412	-11%	T2	CS
Poland	111	1 330	1 373	5%	43	3%	1 263	1142%	T1	D
Portugal	NO	437	513	2%	76	17%	513	100%	NA	NA
Romania	NO	727	626	2%	-101	-14%	626	100%	NA	NA
Slovakia	470	263	271	1%	8	3%	-199	-42%	T2	CS
Slovenia	65	55	56	0%	1	2%	-10	-15%	T2	CS
Spain	644	2 488	2 592	9%	104	4%	1 948	302%	T2	CS
Sweden	254	250	218	1%	-31	-13%	-35	-14%	-	-
United Kingdom	3 605	3 953	3 993	14%	40	1%	388	11%	T2	CS
EU-28	**19 424**	**28 323**	**28 682**	**100%**	**359**	**1%**	**9 258**	**48%**		

Emissions of Germany and Malta are included in 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause about 68 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-28 rose by 46 % between 1990 and 2013.

Figure 3.38 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Emission trend and share for CO_2

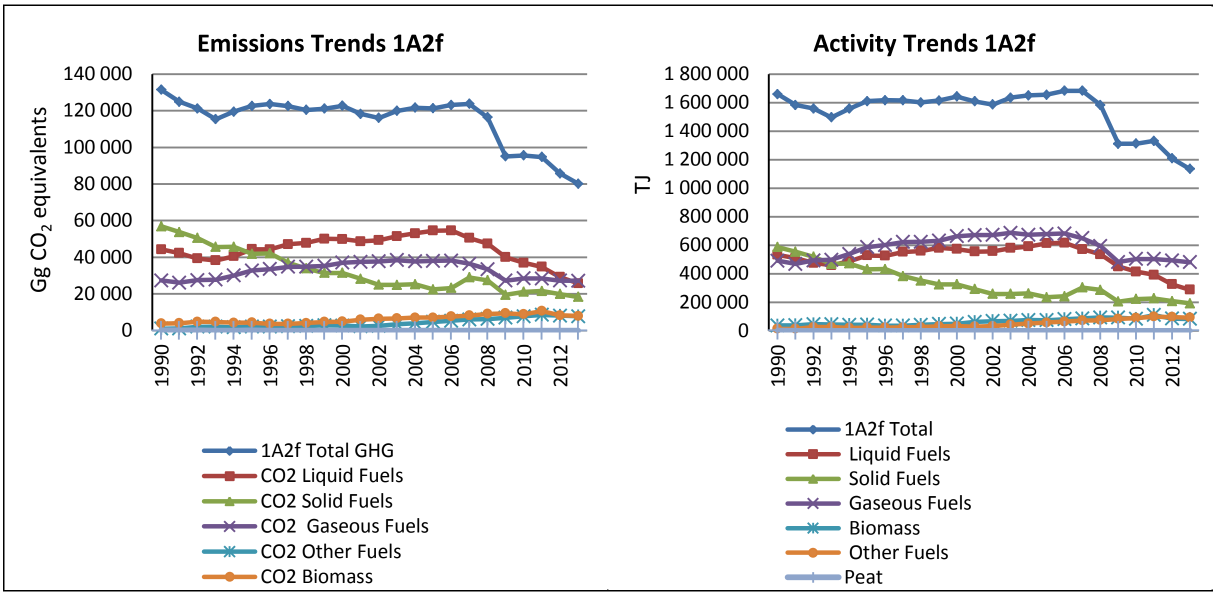


3.2.2.5 Non-metallic Minerals (1A2f)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Non-metallic Minerals accounted for 16 % for 1A2 source category and for 2 % of total GHG emissions in 2013.

Figure 3.39 shows the emission trend within the category 1A2f, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels; the decrease from 2008 to 2009 by -18% was due to a decline of production data (cement production decreased by 19%) in all Member states. Between 1990 and 2013 total GHG emissions decreased by 39 %, mainly due to decreases in emissions from solid (-68 %) and liquid (-42 %) fuels while emissions from other fossil fuels (non-renewable waste) increased by 629% and emissions of biomass (renewable waste) increased by 108%. From 2012 to 2013 emissions decreased by another 7% which is also reflected in the decrease of cement production (-5 %).

Figure 3.39 1A2f Non-metallic Minerals : Activity data and CO_2 emission trends



Between 1990 and 2013, CO_2 emissions from 1A2f Non-metallic Minerals decreased by 39 % in the EU-28 (Table 3.37), showing significant decreases for almost all Member States. Malta includes emissions in category 1A2g. For reasons of confidentiality Sweden reports emissions in 1A2g. Greece includes emissions from 1A2g under this category.

Table 3.37 1A2f Non-metallic Minerals : Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	1 669	1 530	1 552	2%	22	1%	-117	-7%
Belgium	5 525	4 033	3 676	5%	-356	-9%	-1 849	-33%
Bulgaria	2 649	1 247	1 245	2%	-2	0%	-1 404	-53%
Croatia	NO,IE	100	97	0%	-3	-3%	97	100%
Cyprus	407	336	417	1%	81	24%	11	3%
Czech Republic	4 527	2 495	2 213	3%	-282	-11%	-2 314	-51%
Denmark	1 293	1 017	992	1%	-25	-2%	-301	-23%
Estonia	940	513	449	1%	-64	-13%	-491	-52%
Finland	1 368	646	631	1%	-15	-2%	-737	-54%
France	14 948	10 562	9 805	12%	-757	-7%	-5 143	-34%
Germany	18 507	12 957	13 073	17%	116	1%	-5 435	-29%
Greece	6 278	3 428	3 235	4%	-193	-6%	-3 044	-48%
Hungary	2 391	828	866	1%	38	5%	-1 526	-64%
Ireland	934	890	916	1%	26	3%	-18	-2%
Italy	21 225	14 146	13 193	17%	-952	-7%	-8 032	-38%
Latvia	604	348	310	0%	-38	-11%	-294	-49%
Lithuania	3 211	538	602	1%	64	12%	-2 608	-81%
Luxembourg	537	399	344	0%	-55	-14%	-192	-36%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	2 336	1 248	1 113	1%	-135	-11%	-1 224	-52%
Poland	10 433	7 680	7 250	9%	-430	-6%	-3 183	-31%
Portugal	3 217	2 753	2 817	4%	64	2%	-400	-12%
Romania	278	2 310	1 945	2%	-365	-16%	1 667	599%
Slovakia	3 118	1 103	1 231	2%	128	12%	-1 887	-61%
Slovenia	296	382	416	1%	34	9%	120	41%
Spain	15 920	10 795	8 222	10%	-2 573	-24%	-7 698	-48%
Sweden	IE,NO	IE,NO	IE,NO	-	-	-	-	-
United Kingdom	7 069	2 197	2 325	3%	128	6%	-4 744	-67%
EU-28	**129 681**	**84 480**	**78 935**	**100%**	**-5 545**	**-7%**	**-50 746**	**-39%**

Malta and Sweden includs emissions under 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2f Other - Liquid Fuels (CO_2)

In 2013 liquid fuels had a share of 32 % within source category 1A2f (compared to 34 % in 1990). Between 1990 and 2013 the emissions decreased by 42 % (Table 3.38). Between 1990 and 2013 the highest absolute decreases were achieved by France, Italy, Lithuania and Spain

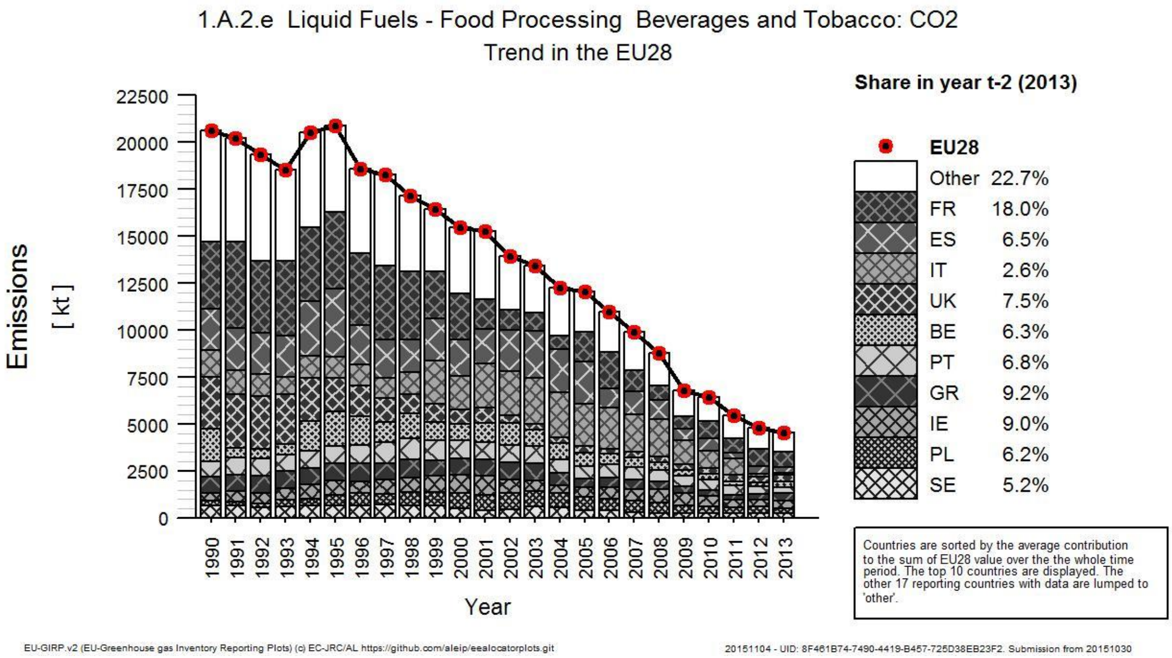
Table 3.38 1A2f Non-metallic Minerals , liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	510	169	169	1%	1	1%	-340	-67%	-	-
Belgium	1 509	683	466	2%	-217	-32%	-1 043	-69%	T1,T3	D,PS
Bulgaria	666	468	470	2%	2	0%	-196	-29%	NA	NA
Croatia	IE	6	1	0%	-5	-85%	1	100%	NA	NA
Cyprus	175	331	409	2%	78	24%	234	134%	CS	CS
Czech Republic	1 029	47	40	0%	-7	-14%	-989	-96%	T1	CS,D
Denmark	478	649	580	2%	-69	-11%	102	21%	T1,T2	CS,D
Estonia	140	4	1	0%	-3	-69%	-138	-99%	T1,T2	CS,D
Finland	437	284	301	1%	16	6%	-136	-31%	T3	CS
France	6 646	4 003	3 572	14%	-431	-11%	-3 074	-46%	-	-
Germany	2 663	1 173	1 539	6%	366	31%	-1 124	-42%	CS	CS
Greece	2 914	2 955	2 885	11%	-70	-2%	-29	-1%	T2	CS
Hungary	488	321	322	1%	2	1%	-166	-34%	T1	D
Ireland	312	523	506	2%	-17	-3%	194	62%	T1,T2	CS,D
Italy	11 367	7 301	6 635	26%	-666	-9%	-4 732	-42%	T2	CS
Latvia	274	22	22	0%	0	2%	-252	-92%	T1,T2	CS,D
Lithuania	2 750	17	14	0%	-3	-18%	-2 737	-99%	T2	CS
Luxembourg	23	2	2	0%	0	-13%	-21	-91%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	506	85	34	0%	-51	-60%	-472	-93%	T2	CS
Poland	392	267	247	1%	-20	-7%	-145	-37%	T1	D
Portugal	1 287	1 413	1 501	6%	88	6%	214	17%	T2,T3	CR,D,PS
Romania	NO	967	799	3%	-168	-17%	799	100%	NA	NA
Slovakia	1 216	176	198	1%	22	13%	-1 018	-84%	T2	CS
Slovenia	63	90	150	1%	60	66%	87	138%	T1	D
Spain	8 366	6 936	4 547	18%	-2 390	-34%	-3 819	-46%	T2	CS,M
Sweden	IE	IE	IE	-	-	-	-	-	NA	NA
United Kingdom	127	288	309	1%	22	8%	182	143%	T2	CS
EU-28	**44 339**	**29 179**	**25 721**	**100%**	**-3 457**	**-12%**	**-18 617**	**-42%**		

Malta and Sweden includes emissions under 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.40 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Greece, Ireland and Portugal; together they cause 43 % of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption in the EU-28 decreased by 46 % between 1990 and 2013.

Figure 3.40 1A2f Non-metallic Minerals, liquid fuels: Emission trend and share for CO_2



1A2f Non-metallic Minerals - Solid (CO_2)

In 2013 CO_2 from solid fuels had a share of 23 % within source category 1A2f (compared to 43 % in 1990). Between 1990 and 2013 the emissions decreased by 68 % (Table 3.39). Between 1990 and 2013 almost all Member States reported decreases of emissions; the highest absolute decreases were reported by Germany, Poland, Spain and the UK. Between 2012 and 2013 EU-28 emissions decreased by 8 %.

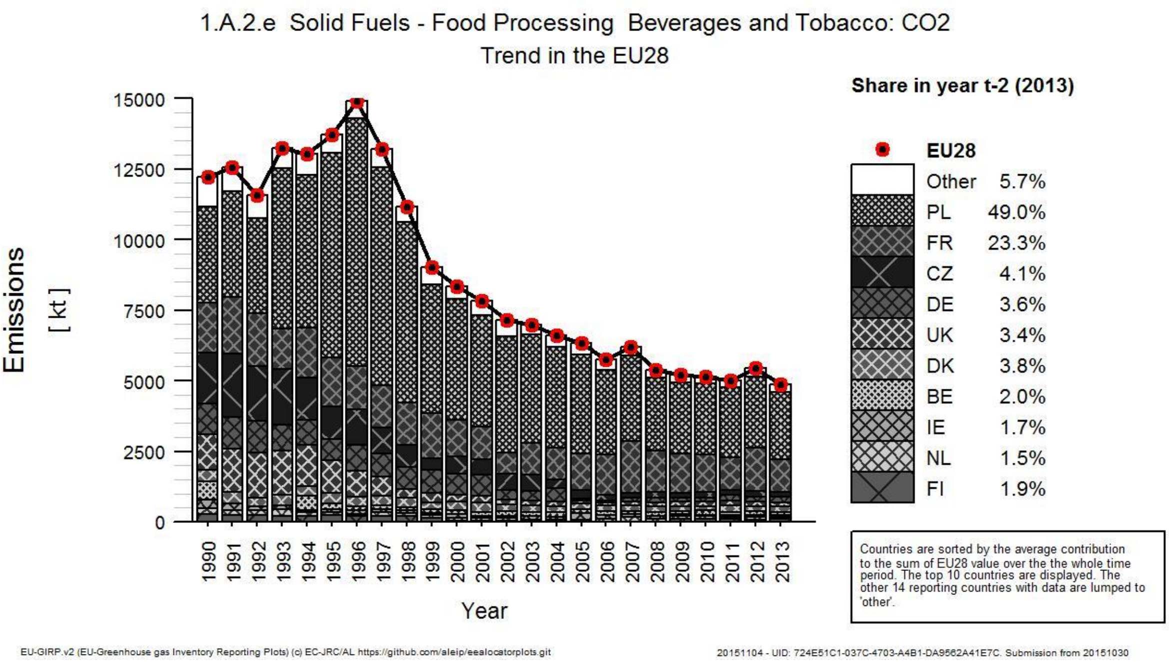
Table 3.39 1A2f Non-metallic Minerals, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	535	293	262	1%	-32	-11%	-274	-51%	-	-
Belgium	2 466	1 549	1 582	9%	32	2%	-885	-36%	T1,T3	D,PS
Bulgaria	298	294	273	1%	-22	-7%	-26	-9%	NA	NA
Croatia	IE	2	NO	-	-2	-100%	-	-	NA	NA
Cyprus	232	2	2	0%	0	0%	-230	-99%	CS	CS
Czech Republic	2 209	947	809	4%	-138	-15%	-1 400	-63%	T2	CS,D
Denmark	574	126	141	1%	15	12%	-433	-76%	T1	D
Estonia	744	353	258	1%	-95	-27%	-486	-65%	T1,T2	CS,D
Finland	806	246	216	1%	-30	-12%	-590	-73%	T3	CS
France	4 164	2 586	2 207	12%	-379	-15%	-1 958	-47%	-	-
Germany	12 053	5 223	5 150	28%	-73	-1%	-6 903	-57%	CS	CS
Greece	3 364	238	211	1%	-27	-12%	-3 154	-94%	T2	PS
Hungary	230	133	75	0%	-57	-43%	-154	-67%	T1,T2	CS,D
Ireland	489	274	243	1%	-31	-11%	-247	-50%	T2	CS
Italy	3 947	1 229	1 041	6%	-188	-15%	-2 906	-74%	T2	CS
Latvia	16	181	123	1%	-58	-32%	106	648%	T1	D
Lithuania	60	462	532	3%	70	15%	472	793%	T2	CS
Luxembourg	312	165	157	1%	-8	-5%	-156	-50%	T1	D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	346	152	128	1%	-25	-16%	-219	-63%	T2	CS
Poland	8 653	2 938	2 539	14%	-400	-14%	-6 114	-71%	T1,T2	CS,D
Portugal	1 919	7	1	0%	-6	-92%	-1 918	-100%	T2,T3	CR,D,PS
Romania	278	570	379	2%	-191	-33%	101	36%	T1,T2	CS,D
Slovakia	1 360	407	424	2%	18	4%	-936	-69%	T2	CS
Slovenia	113	90	72	0%	-17	-19%	-41	-36%	T1,T2	CS,D
Spain	5 126	136	145	1%	9	6%	-4 981	-97%	T2	CS
Sweden	IE	IE	IE	-	-	-	-	-	NA	NA
United Kingdom	6 630	1 308	1 349	7%	41	3%	-5 280	-80%	T2	CS
EU-28	**56 925**	**19 911**	**18 317**	**100%**	**-1 594**	**-8%**	**-38 608**	**-68%**		

Malta and Sweden includes emissions under 1A2g.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.41 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland and France; together they cause about 72 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-28 decreased by 67 % between 1990 and 2013.

Figure 3.41   1A2f Non-metallic Minerals, solid fuels: Emission trend and share for CO_2



1A2f Other - Gaseous (CO_2)

In 2013 CO_2 from gaseous fuels had a share of 34 % within source category 1A2f (compared to 21 % in 1990). Between 1990 and 2013, the emissions increased by 1 % (Table 3.40). Between 1990 and 2013 Hungary and Bulgaria showed the highest absolute increases while Germany, Poland and Spain showed the highest absolute decreases.

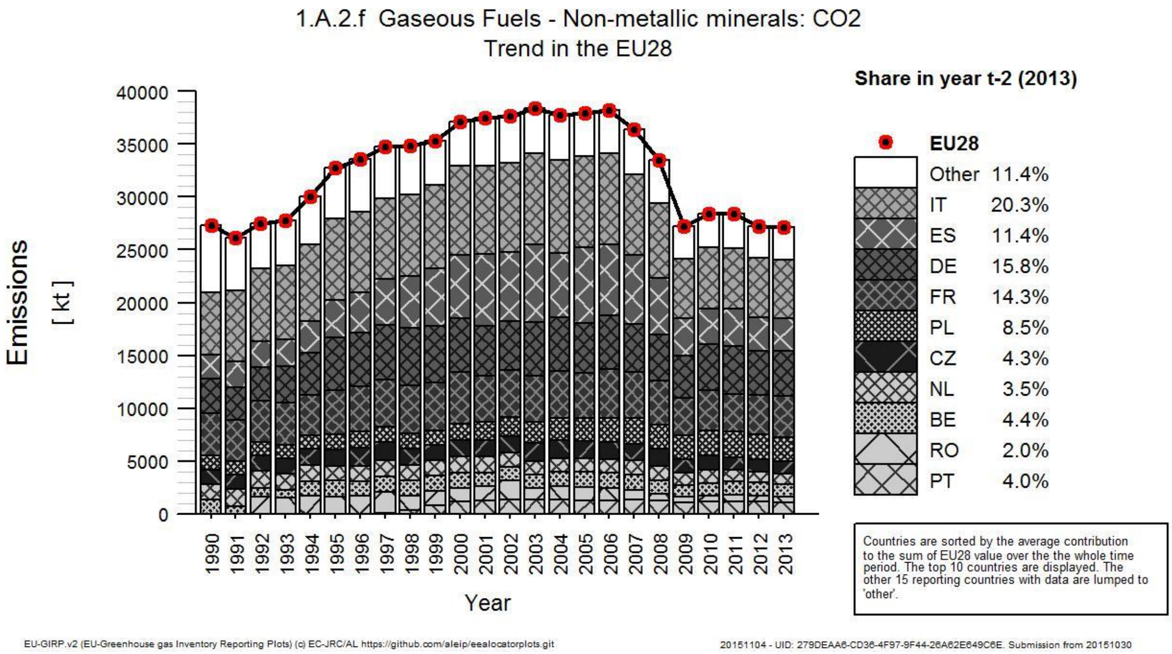
Table 3.40 1A2f Non-metallic Minerals, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	559	585	629	2%	44	8%	70	13%	-	-
Belgium	1 364	1 270	1 206	4%	-64	-5%	-158	-12%	T1	D
Bulgaria	1 684	484	502	2%	18	4%	-1 182	-70%	NA	NA
Croatia	IE	92	96	0%	3	4%	96	100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 289	1 176	1 167	4%	-10	-1%	-123	-10%	T2	CS
Denmark	241	178	175	1%	-3	-2%	-66	-27%	T3	CS
Estonia	46	41	40	0%	-1	-2%	-6	-13%	T2	CS
Finland	126	66	61	0%	-5	-8%	-65	-52%	T3	CS
France	3 997	3 682	3 877	14%	195	5%	-121	-3%	-	-
Germany	3 265	4 175	4 297	16%	122	3%	1 031	32%	CS	CS
Greece	NO	220	118	0%	-102	-46%	118	100%	NA	NA
Hungary	1 673	287	388	1%	101	35%	-1 284	-77%	T1	D
Ireland	132	36	35	0%	-1	-3%	-97	-73%	T2	CS
Italy	5 911	5 616	5 517	20%	-99	-2%	-394	-7%	T2	CS
Latvia	314	71	73	0%	2	3%	-242	-77%	T2	CS
Lithuania	383	56	52	0%	-3	-6%	-331	-86%	T2	CS
Luxembourg	201	181	133	0%	-48	-27%	-69	-34%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 484	1 011	951	4%	-60	-6%	-533	-36%	T2	CS
Poland	1 379	2 376	2 295	8%	-81	-3%	917	66%	T1	D
Portugal	NO	1 140	1 079	4%	-61	-5%	1 079	100%	NA	NA
Romania	NO	575	556	2%	-19	-3%	556	100%	NA	NA
Slovakia	542	328	376	1%	49	15%	-166	-31%	T2	CS
Slovenia	115	161	146	1%	-15	-10%	31	27%	T2	CS
Spain	2 309	3 192	3 085	11%	-107	-3%	776	34%	T2	CS
Sweden	IE	IE	IE	-	-	-	-	-	NA	NA
United Kingdom	311	265	280	1%	15	6%	-31	-10%	T2	CS
EU-28	**27 326**	**27 263**	**27 132**	**100%**	**-131**	**0%**	**-194**	**-1%**		

Malta and Sweden include emissions under 1A2g.

Abbreviations explained in the Chapter 'Units and abbreviations'.Figure 3.42 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany, Italy, Spain and the France; together they cause 62 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-28 decreased by 2% between 1990 and 2013.

Figure 3.42 1A2f Non-metallic Minerals, gaseous fuels: Emission trend and share for CO_2



1A2f Other – Other Fossil Fuels (CO_2)

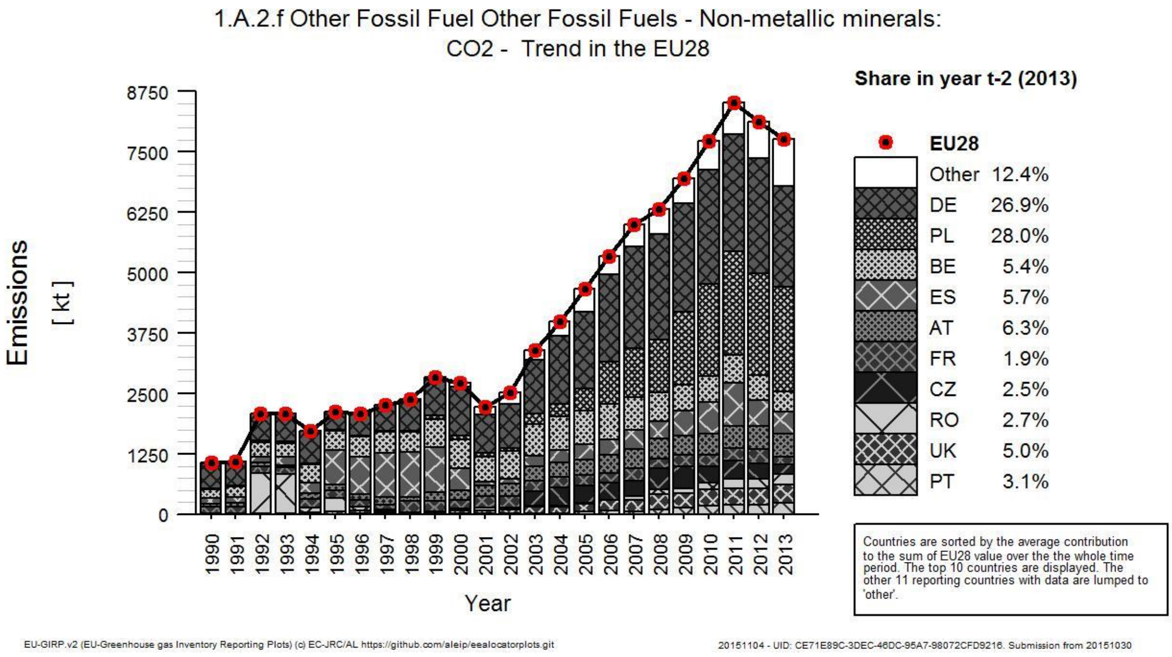
In 2013 CO_2 from other fossil fuels had a share of 10 % within source category 1A2f (compared to 1 % in 1990). Between 1990 and 2013, the emissions increased by 629 % (Table 3.41). Between 1990 and 2013 Germany and Poland showed the highest absolute increases. Most member states report emissions from industrial waste (co-) incineration and particularly incineration of municipal waste (e.g. Spain) under this category, especially from cement kilns. Examples of industrial wastes are: waste tyres, waste oil/lubricants, solvents, plastics waste and paper waste.

Table 3.41 1A2f Non-metallic Minerals, other fossil fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	66	483	492	6%	9	2%	426	651%
Belgium	186	530	422	5%	-108	-20%	236	127%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	3	6	0%	3	95%	6	100%
Czech Republic	NO	324	197	3%	-127	-39%	197	100%
Denmark	NO	64	96	1%	32	50%	96	100%
Estonia	NO	115	149	2%	34	30%	149	100%
Finland	NO	50	54	1%	3	7%	54	100%
France	140	292	149	2%	-142	-49%	10	7%
Germany	526	2 386	2 087	27%	-299	-13%	1 561	297%
Greece	NO	15	21	0%	6	39%	21	100%
Hungary	NO	87	80	1%	-8	-9%	80	100%
Ireland	NO	57	133	2%	76	133%	133	100%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	75	93	1%	17	23%	93	100%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	51	53	1%	2	3%	53	100%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	10	2 099	2 169	28%	70	3%	2 159	22207%
Portugal	12	193	237	3%	44	23%	225	1858%
Romania	NO	198	211	3%	13	7%	211	100%
Slovakia	NO	193	232	3%	39	20%	232	100%
Slovenia	5	41	48	1%	7	18%	44	931%
Spain	120	530	446	6%	-84	-16%	326	273%
Sweden	NO	IE	IE	-	-	-	-	-
United Kingdom	1	336	386	5%	50	15%	385	35818%
EU-28	**1 064**	**8 124**	**7 761**	**100%**	**-363**	**-4%**	**6 696**	**629%**

Figure 3.43 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany and poland; they cause 55 % of the CO_2 emissions from other fossil fuels in 1A2f.

Figure 3.43 1A2f Non-metallic Minerals, other fossil fuels: Emission trend and share for CO_2



3.2.2.6 Other (1A2g)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2g by fuels. CO_2 emissions from 1A2g Other accounted for 33 % for 1A2 source category and for 4 % of total GHG emissions in 2013.

This category includes emissions from stationary combustion but also may include emissions from mobile sources (e.g. construction machinery). Some Member States use this category to report emissions which cannot be allocated to the categories 1A2a to 1A2f due to lack of detailed data, e.g. IEA data provides fuel consumption of Industrial Auto-producers (Electricity, CHP, Heat) for total industry only. The following Table 42 presents 1A2g GHG emissions and the share of mobile machinery (off road vehicles) by Member State. Only 14 Member States are reporting emissions from off road vehicles separately.

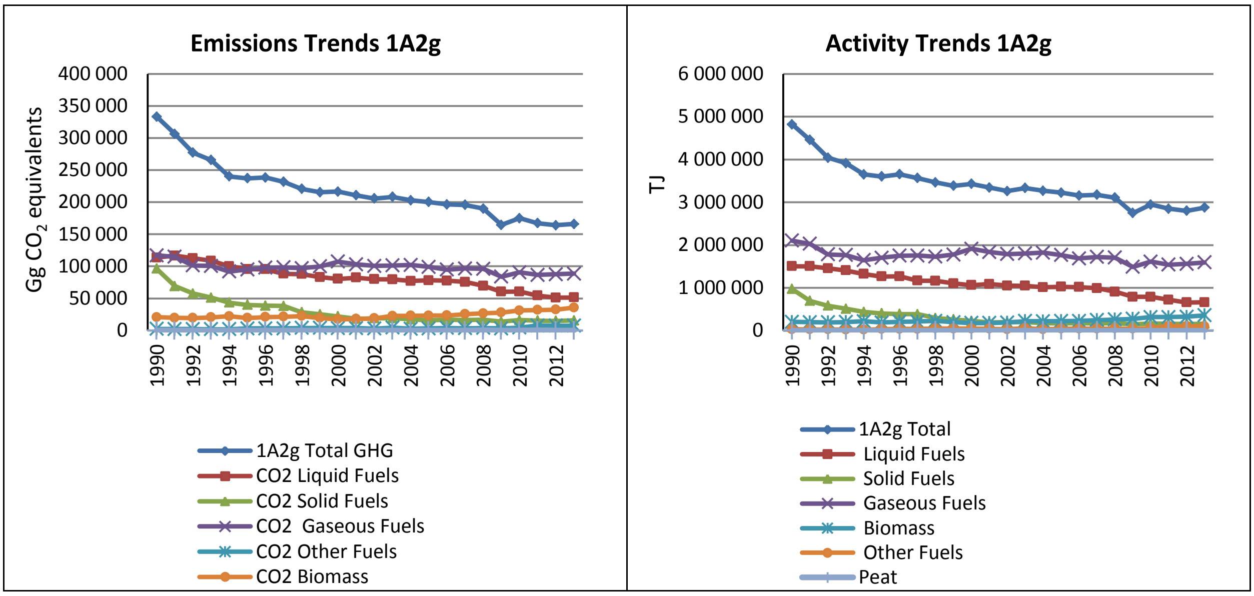
Table 42: 1A2g Other: CO_2, CH_4 and N_2O emissions

Member State		Emissions		
		CO2	CH4	N2O
AUT	g. Other	2942	0.154	0.302
	1.A.2.g.vii Off-road vehicles and other machinery	1124	0.024	0.172
BEL	g. Other	2324	0.186	0.049
	1.A.2.g.vii Off-road vehicles and other machinery	484	0.097	0.037
BGR	g. Other	778	0.122	0.162
	1.A.2.g.vii Off-road vehicles and other machinery	386	0.022	0.149
HRV	g. Other	1451	0.145	0.022
	1.A.2.g.vii Off-road vehicles and other machinery	328	0.013	0.003
CYP	g. Other	51	0.002	0.000
CZE	g. Other	2461	0.323	0.043
DNM	g. Other	1425	0.127	0.095
	1.A.2.g.vii Off-road vehicles and other machinery	1025	0.034	0.044
EST	g. Other	181	0.039	0.006
FIN	g. Other	1825	0.485	0.050
	1.A.2.g.vii Off-road vehicles and other machinery	1381	0.108	0.024
FRK	g. Other	8519	2.004	1.097
DEU	g. Other	77580	6.930	1.787
	1.A.2.g.vii Off-road vehicles and other machinery	2862	0.070	0.118
GRC	g. Other	IE	IE,NO	IE,NO
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
HUN	g. Other	1602	0.091	0.155
	1.A.2.g.vii Off-road vehicles and other machinery	386	0.021	0.147
IRL	g. Other	726	0.143	0.019
ITA	g. Other	8008	0.256	1.236
LVA	g. Other	232	0.393	0.052
	1.A.2.g.vii Off-road vehicles and other machinery	3	0.003	0.000
LTU	g. Other	155	0.091	0.012
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
LUX	g. Other	178	0.029	0.037
	1.A.2.g.vii Off-road vehicles and other machinery	87	0.005	0.034
MLT	g. Other	68	0.003	0.001
NLD	g. Other	1672	0.488	0.043
POL	g. Other	2854	0.877	0.119
PRT	g. Other	1521	0.092	0.038
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
ROU	g. Other	5404	0.448	0.062
SVK	g. Other	1231	0.105	0.013
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
SVN	g. Other	412	0.063	0.036
	1.A.2.g.vii Off-road vehicles and other machinery	73	0.004	0.028
ESP	g. Other	8809	7.486	0.279
	1.A.2.g.vii Off-road vehicles and other machinery	2386	0.022	0.103
SWE	g. Other	3886	0.734	0.215
	1.A.2.g.vii Off-road vehicles and other machinery	1508	0.099	0.064
GBE	g. Other	26637	2.226	2.265
	1.A.2.g.vii Off-road vehicles and other machinery	4878	0.778	1.726

Figure 3.47 shows the emission trend within the category 1A2f, which is mainly dominated by CO_2 emissions from gaseous, liquid and solid fuels; the decrease in the early 1990s was mainly due to a

decline of solid fuel consumption. Total GHG emissions decreased by 50 %, mainly due to decreases in emissions from solid (-84 %) and liquid (-55 %) fuels.

Figure 3.44 1A2g Other: Total and CO_2 emission trends



Between 1990 and 2013, CO_2 emissions from 1A2f Other decreased by 50 % in the EU-28 (Table 3.43). Romania, Germany, the Czech Republic, Bulgaria, Italy and the UK report significant decreases of GHG emissions while Austria and Spain report the highest increases since 1990.

Malta reports almost all emissions from categories 1A2a to 1A2f under this category. Sweden includes emissions from 1A2f under this category and Croatia reports emissions from 1A2a-1A2f for the years 1990 to 2000 under this category. Greece reports emissions of 1A2g together with category 1A2f.

Table 3.43 1A2g Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	1 976	3 042	2 942	2%	-100	-3%	966	49%	NA	NA
Belgium	2 803	2 531	2 324	1%	-207	-8%	-479	-17%	CS,NA,T1,T3	D,NA
Bulgaria	11 705	825	778	0%	-47	-6%	-10 927	-93%	T1,T2	CS,D
Croatia	5 502	1 403	1 451	1%	49	3%	-4 050	-74%	T1	D
Cyprus	45	60	51	0%	-10	-16%	6	14%	T1	D
Czech Republic	23 171	2 547	2 461	2%	-86	-3%	-20 709	-89%	T1,T2	CS,D
Denmark	1 941	1 457	1 425	1%	-32	-2%	-516	-27%	CR,M,T1,T2,T3	CS,D
Estonia	280	203	181	0%	-22	-11%	-98	-35%	T1,T2	CS,D
Finland	1 869	1 819	1 825	1%	5	0%	-44	-2%	M,T3	CS,D
France	12 113	7 891	8 519	5%	628	8%	-3 594	-30%	-	-
Germany	127 944	74 548	77 580	48%	3 032	4%	-50 364	-39%	CS	CS
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	4 939	1 073	1 602	1%	528	49%	-3 337	-68%	T1,T2	CS,D
Ireland	727	715	726	0%	12	2%	-1	0%	T1,T2	CS,D
Italy	19 141	8 303	8 008	5%	-294	-4%	-11 133	-58%	T2	CS
Latvia	1 347	283	232	0%	-51	-18%	-1 115	-83%	T1,T2	CS,D
Lithuania	1 196	171	155	0%	-16	-9%	-1 040	-87%	T2	CS
Luxembourg	133	195	178	0%	-17	-9%	45	34%	T1,T2	CS,D
Malta	59	73	68	0%	-5	-7%	9	14%	T1	D
Netherlands	1 871	1 726	1 672	1%	-55	-3%	-200	-11%	NA,T2	CS,NA
Poland	7 061	2 756	2 854	2%	97	4%	-4 208	-60%	T1,T2	CS,D
Portugal	2 166	1 672	1 521	1%	-151	-9%	-645	-30%	T2	D,OTH
Romania	46 080	5 336	5 404	3%	67	1%	-40 677	-88%	T1,T2	CS,D
Slovakia	2 677	1 117	1 231	1%	114	10%	-1 446	-54%	T2	CS
Slovenia	1 153	452	412	0%	-40	-9%	-741	-64%	T1,T2	CS,D
Spain	7 936	10 456	8 809	5%	-1 647	-16%	874	11%	T2	CS,M,OTH,PS
Sweden	5 350	4 223	3 886	2%	-337	-8%	-1 464	-27%	NA	NA
United Kingdom	38 323	26 141	26 637	16%	496	2%	-11 685	-30%	T1,T2,T3	CS,D
EU-28	**329 506**	**161 019**	**162 931**	**100%**	**1 913**	**1%**	**-166 575**	**-51%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2g Other – Liquid Fuels (CO_2)

In 2013 CO_2 from liquid fuels decreased to a share of 31 % within source category 1A2g (compared to 34 % in 1990). Between 1990 and 2013, the emissions decreased by 55 % (Table 3.44). Between 1990 and 2013 all Member States showed a reduction of emissions except for Austria, Cyprus, Malta and Luxembourg. Fuel consumption in the EU-28 decreased by 56 % between 1990 and 2013.

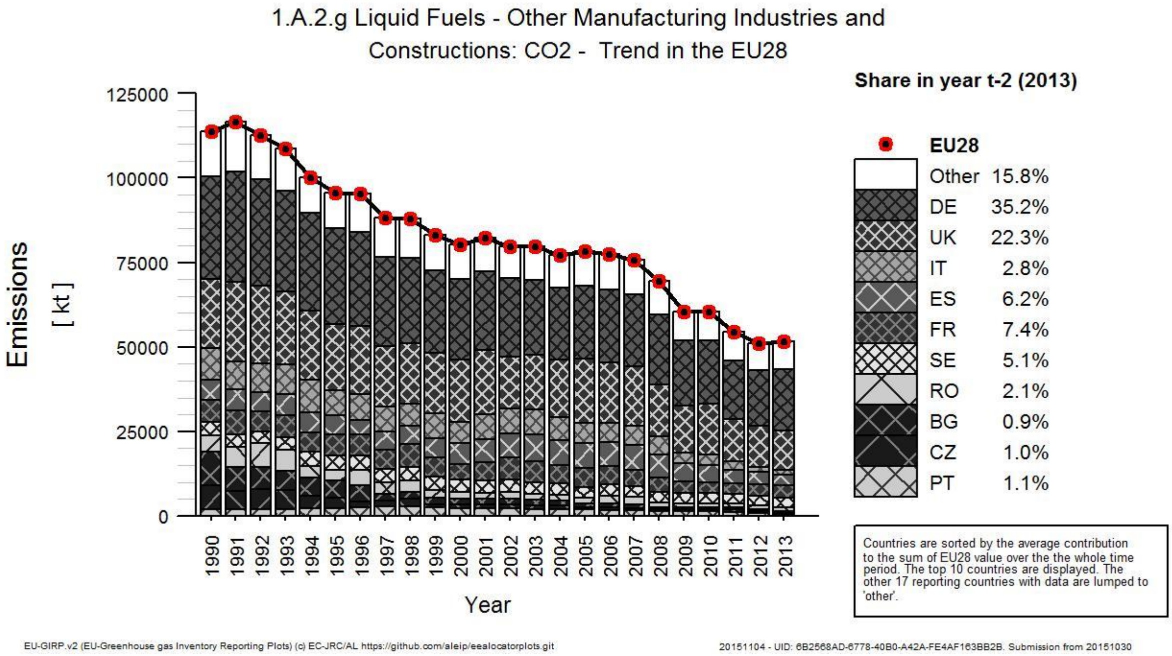
Table 3.44 1A2g Other, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	866	1 621	1 589	3%	-32	-2%	723	83%
Belgium	1 566	985	886	2%	-99	-10%	-680	-43%
Bulgaria	9 743	488	457	1%	-31	-6%	-9 287	-95%
Croatia	2 158	724	859	2%	135	19%	-1 299	-60%
Cyprus	45	60	51	0%	-10	-16%	6	14%
Czech Republic	7 041	754	522	1%	-232	-31%	-6 519	-93%
Denmark	1 317	1 059	1 052	2%	-7	-1%	-265	-20%
Estonia	188	157	138	0%	-19	-12%	-50	-27%
Finland	1 707	1 568	1 554	3%	-13	-1%	-153	-9%
France	6 691	3 345	3 835	7%	490	15%	-2 857	-43%
Germany	30 326	16 454	18 150	35%	1 696	10%	-12 176	-40%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	1 659	385	470	1%	85	22%	-1 189	-72%
Ireland	512	370	400	1%	29	8%	-112	-22%
Italy	9 462	1 458	1 438	3%	-20	-1%	-8 024	-85%
Latvia	796	124	122	0%	-2	-2%	-674	-85%
Lithuania	439	17	18	0%	0	2%	-421	-96%
Luxembourg	89	99	96	0%	-2	-2%	7	8%
Malta	59	73	68	0%	-5	-7%	9	14%
Netherlands	203	69	69	0%	-1	-1%	-135	-66%
Poland	1 026	674	614	1%	-60	-9%	-412	-40%
Portugal	2 115	761	571	1%	-190	-25%	-1 544	-73%
Romania	4 805	1 245	1 071	2%	-174	-14%	-3 734	-78%
Slovakia	69	10	12	0%	2	15%	-58	-83%
Slovenia	647	162	155	0%	-8	-5%	-492	-76%
Spain	5 868	3 730	3 184	6%	-546	-15%	-2 684	-46%
Sweden	3 943	2 741	2 642	5%	-99	-4%	-1 301	-33%
United Kingdom	20 256	11 989	11 479	22%	-510	-4%	-8 776	-43%
EU-28	**113 596**	**51 123**	**51 501**	**100%**	**377**	**1%**	**-62 095**	**-55%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.45 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France. Germany, Spain and the United Kingdom; together they cause 71 % of the CO_2 emissions from liquid fuels in 1A2g.

Figure 3.45 1A2g Other, liquid fuels: Emission trend and share for CO_2



1A2g Other – Solid Fuels (CO_2)

In 2013 CO_2 from solid fuels decreased to a share of 9 % within source category 1A2g (compared to 29 % in 1990). Between 1990 and 2013, the emissions decreased by 84 % (Table 3.45). Between 1990 and 2013 all Member States showed a reduction of emissions except for Italy. Fuel consumption in the EU-28 decreased by 83 % between 1990 and 2013.

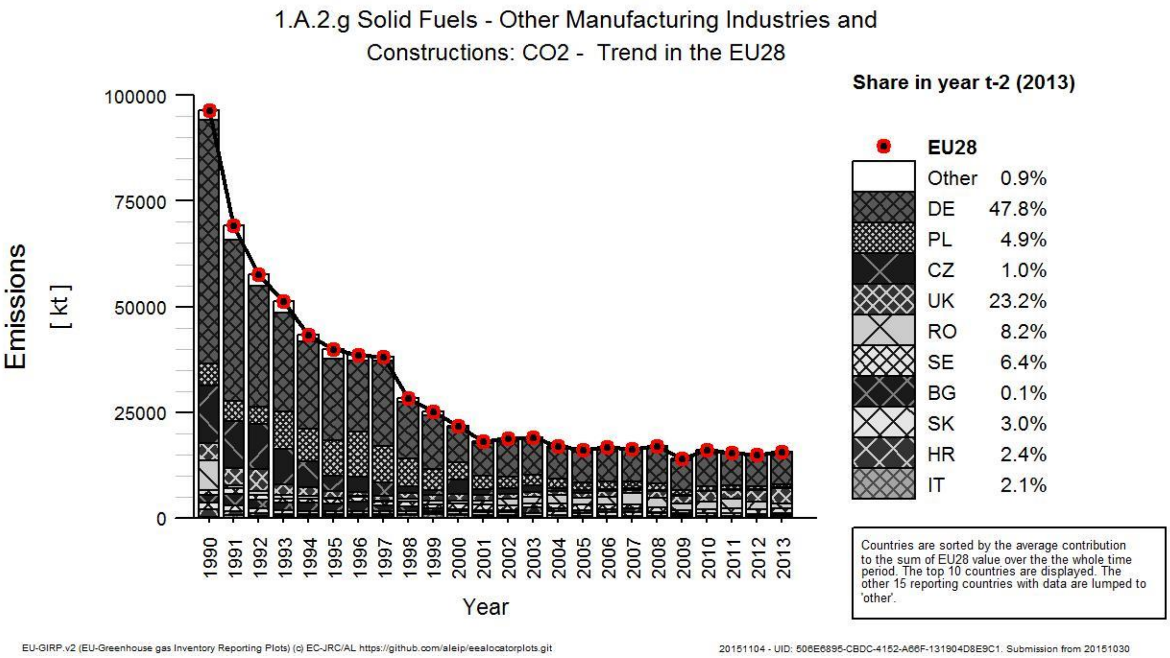
Table 3.45 1A2g Other, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	91	NO	1	0%	1	100%	-90	-99%
Belgium	33	11	14	0%	2	20%	-19	-59%
Bulgaria	1 873	13	13	0%	0	2%	-1 860	-99%
Croatia	1 703	426	382	2%	-44	-10%	-1 320	-78%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	13 750	147	159	1%	12	8%	-13 592	-99%
Denmark	326	58	56	0%	-2	-4%	-270	-83%
Estonia	38	NO	0	0%	0	100%	-37	-99%
Finland	8	NO	NO	-	-	-	-8	-100%
France	577	2	NO	-	-2	-100%	-577	-100%
Germany	57 580	7 252	7 471	48%	219	3%	-50 109	-87%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	677	22	34	0%	12	56%	-643	-95%
Ireland	14	6	1	0%	-5	-88%	-14	-95%
Italy	299	106	324	2%	218	206%	25	8%
Latvia	27	3	5	0%	2	85%	-23	-83%
Lithuania	79	6	6	0%	0	-7%	-73	-93%
Luxembourg	20	19	8	0%	-11	-60%	-13	-62%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	41	17	17	0%	0	0%	-24	-59%
Poland	5 154	781	765	5%	-16	-2%	-4 390	-85%
Portugal	51	IE,NO	IE,NO	-	-	-	-51	-100%
Romania	6 852	1 795	1 275	8%	-520	-29%	-5 576	-81%
Slovakia	1 537	460	476	3%	17	4%	-1 061	-69%
Slovenia	89	1	1	0%	0	17%	-88	-99%
Spain	253	NO	NO	-	-	-	-253	-100%
Sweden	1 229	1 129	992	6%	-136	-12%	-237	-19%
United Kingdom	4 086	2 690	3 617	23%	927	34%	-469	-11%
EU-28	**96 388**	**14 941**	**15 615**	**100%**	**674**	**5%**	**-80 773**	**-84%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.46 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany, Romania and the United Kingdom; together they cause 79 % of the CO_2 emissions from liquid fuels in 1A2g.

Figure 3.46   1A2g Other, solid fuels: Emission trend and share for CO_2



1A2g Other – Gaseous Fuels (CO_2)

In 2013 CO_2 from gaseous fuels increased to a share of 53 % within source category 1A2g (compared to 35 % in 1990). Between 1990 and 2013, the emissions decreased by 24 % (Table 3.46). Between 1990 and 2013 Romania shows the most significant decrease (-91 %) while Germany (+20 %) and Spain (+210 %) show the most significant increase of emissions.

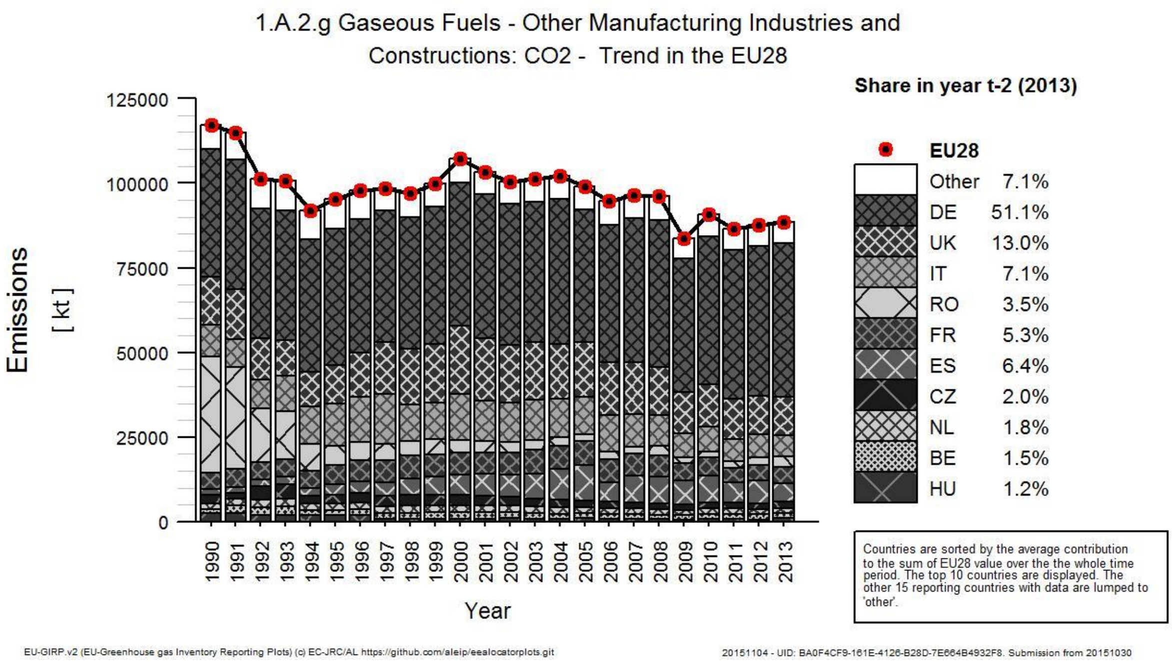
Table 3.46 1A2g Other, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	1 014	1 377	1 322	1%	-55	-4%	308	30%
Belgium	1 204	1 491	1 364	2%	-127	-9%	160	13%
Bulgaria	89	285	257	0%	-28	-10%	168	189%
Croatia	1 641	204	158	0%	-46	-23%	-1 483	-90%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	2 379	1 647	1 781	2%	134	8%	-598	-25%
Denmark	297	340	317	0%	-23	-7%	19	7%
Estonia	54	46	43	0%	-3	-7%	-11	-20%
Finland	41	33	32	0%	-1	-2%	-9	-22%
France	4 832	4 527	4 667	5%	140	3%	-164	-3%
Germany	37 693	44 078	45 189	51%	1 112	3%	7 496	20%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	2 603	667	1 098	1%	431	65%	-1 505	-58%
Ireland	202	339	326	0%	-13	-4%	124	62%
Italy	9 380	6 739	6 247	7%	-492	-7%	-3 133	-33%
Latvia	524	154	105	0%	-50	-32%	-420	-80%
Lithuania	678	122	107	0%	-15	-12%	-571	-84%
Luxembourg	24	78	75	0%	-3	-4%	51	213%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	1 627	1 640	1 586	2%	-54	-3%	-41	-3%
Poland	878	1 291	1 461	2%	169	13%	583	66%
Portugal	IE,NO	900	941	1%	41	5%	941	100%
Romania	34 424	2 295	3 057	3%	762	33%	-31 367	-91%
Slovakia	1 071	648	744	1%	96	15%	-327	-31%
Slovenia	417	285	252	0%	-33	-12%	-165	-40%
Spain	1 815	6 727	5 625	6%	-1 101	-16%	3 810	210%
Sweden	178	236	180	0%	-56	-24%	2	1%
United Kingdom	13 981	11 463	11 541	13%	78	1%	-2 440	-17%
EU-28	**117 044**	**87 610**	**88 474**	**100%**	**864**	**1%**	**-28 570**	**-24%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.47 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany, Italy, Spain and the United Kingdom; together they cause 78 % of the CO_2 emissions from gaseous fuels in 1A2g. Fuel consumption in the EU-28 decreased by 24 % between 1990 and 2013.

Figure 3.47 1A2g Other, gaseous fuels: Emission trend and share for CO_2



1A2g Other – Other fossil fuels (CO_2)

In 2013 CO_2 from other fossil fuels increased to a share of 4 % within source category 1A2g (compared to 1 % in 1990). Between 1990 and 2013, the emissions increased by 198 % (Table 3.47). Only 13 Member States reported emissions from this source and all of these Member States also reported an increase of emissions between 1990 and 2013. The trend and absolute values of emissions are dominated by Germany.

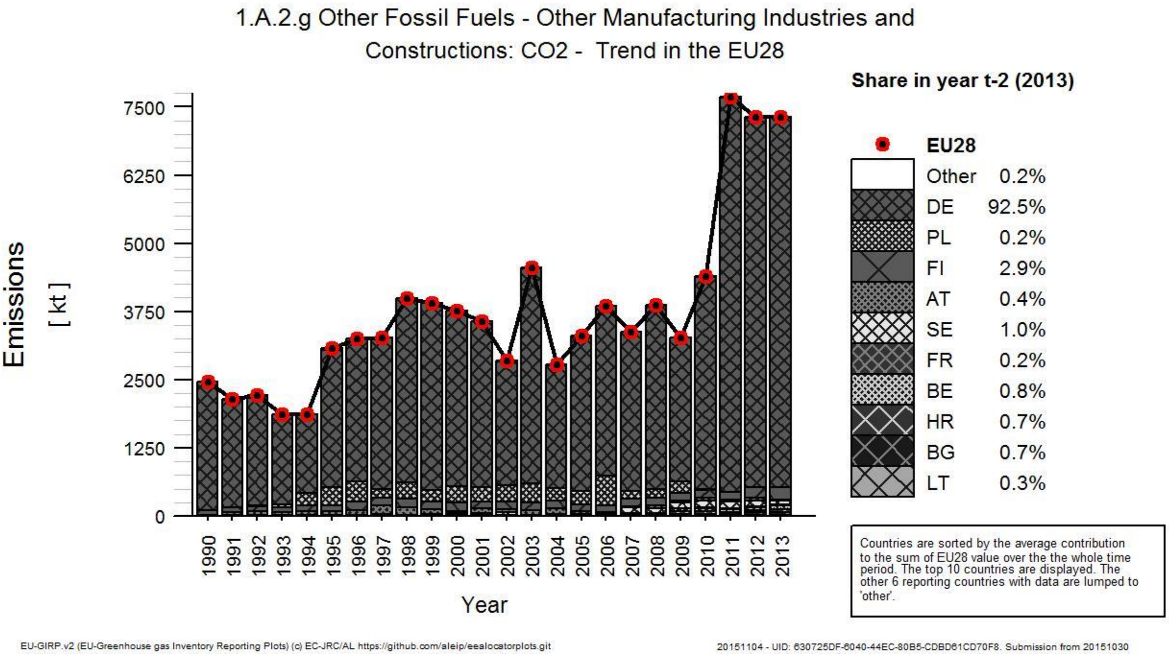
Table 3.47 1A2g Other, other fossil fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	5	44	30	0%	-14	-31%	25	524%
Belgium	NO,IE	43	60	1%	17	39%	60	100%
Bulgaria	NO	40	52	1%	12	30%	52	100%
Croatia	NO	49	52	1%	4	8%	52	100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	1	NO	NO	-	-	-	-1	-100%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	91	194	214	3%	20	10%	123	135%
France	12	17	17	0%	0	-2%	4	37%
Germany	2 344	6 764	6 769	93%	5	0%	4 425	189%
Greece	-	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	2	NO	-	-2	-100%	-	-
Lithuania	NO	23	22	0%	0	0%	22	100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	3	10	14	0%	4	42%	11	345%
Portugal	IE,NO	11	9	0%	-2	-15%	9	100%
Romania	NO	0	0	0%	0	-21%	0	100%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	4	4	0%	1	19%	4	100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	117	71	1%	-46	-39%	71	100%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**2 457**	**7 316**	**7 315**	**100%**	**-1**	**0%**	**4 858**	**198%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.48 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The emission level is dominated by Germany which covers 93% of the CO_2 emissions from other fossil fuels in 1A2g. Fuel consumption in the EU-28 increased by 204 % between 1990 and 2013.

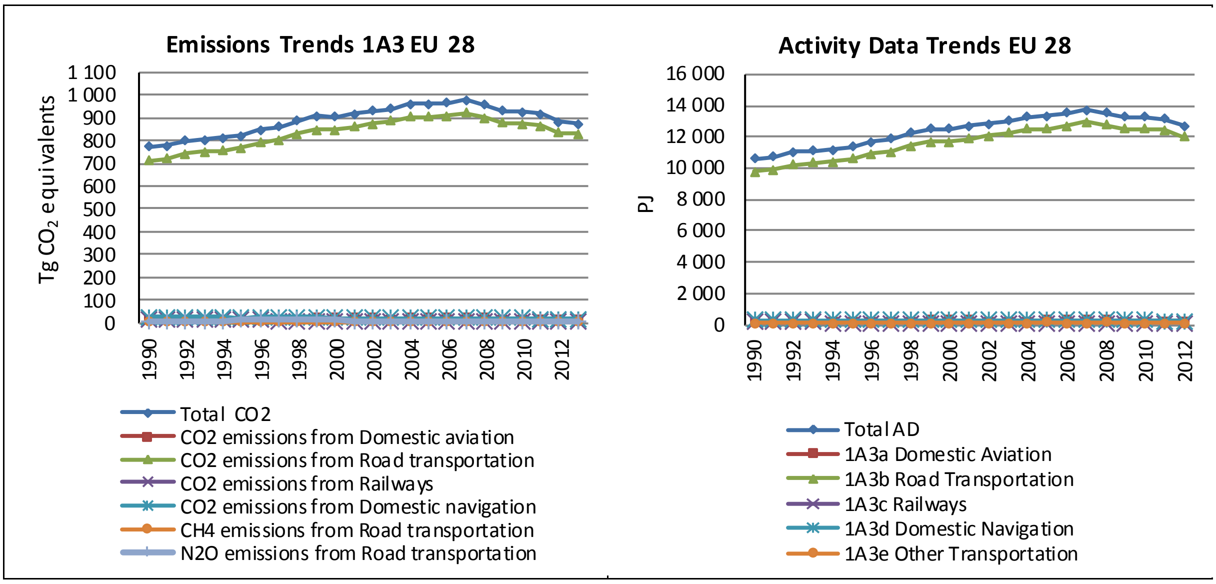
Figure 3.48 1A2g Other, other fossil fuels: Emission trend and share for CO_2



3.2.3 Transport (CRF Source Category 1A3) (EU-28)

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.49. CO_2 emissions from this source category account for 20%, CH_4 for 0.03 %, N_2O for 0.2 % of total GHG emissions. Between 1990 and 2013, GHG from transport increased by 13 % in the EU-28.

Figure 3.49 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Tg) and Activity Data in PJ



This source category includes six key categories:

- 1 A 3 a Domestic Aviation (CO_2)
- 1 A 3 b Road Transportation (CH_4)
- 1 A 3 b Road Transportation (CO_2)
- 1 A 3 b Road Transportation (N_2O)
- 1 A 3 c Railways (CO_2)
- 1 A 3 d Domestic Navigation (CO_2)

Table 3.48 shows total GHG, CO_2, CH_4 and N_2O emissions from 1A3 Transport.

Table 3.48 1A3 Transport: Member States' contributions to CO_2 emissions, CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	13 974	22 809	13 777	22 603	133	194	65	11
Belgium	20 847	24 736	20 511	24 461	214	258	121	17
Bulgaria	6 783	7 433	6 605	7 347	107	62	70	24
Croatia	4 032	5 750	3 937	5 680	54	56	41	14
Cyprus	1 213	1 861	1 189	1 819	23	39	2	2
Czech Republic	7 284	16 650	7 032	15 996	214	631	39	23
Denmark	10 749	11 939	10 586	11 802	107	125	57	12
Estonia	2 479	2 242	2 418	2 210	38	28	23	4
Finland	12 101	12 099	11 826	11 999	163	77	113	23
France	120 975	131 743	118 990	130 062	977	1 489	1 008	192
Germany	164 477	159 272	161 954	157 634	1 193	1 481	1 329	157
Greece	14 536	17 932	14 152	17 651	273	197	111	84
Hungary	8 740	10 062	8 540	9 927	131	108	69	27
Ireland	5 135	11 068	5 022	10 935	65	115	48	17
Italy	103 241	103 434	101 307	102 277	955	918	980	240
Latvia	3 031	2 827	2 930	2 772	80	50	20	5
Lithuania	7 704	4 584	7 385	4 494	267	74	53	16
Luxembourg	2 689	6 310	2 659	6 259	19	49	11	2
Malta	350	524	342	516	5	6	2	2
Netherlands	29 137	35 601	28 812	35 282	136	251	189	67
Poland	20 594	43 990	20 284	43 352	193	536	118	103
Portugal	10 020	15 465	9 828	15 290	89	144	103	30
Romania	12 439	15 088	12 059	14 851	285	200	94	38
Slovakia	6 838	6 843	6 702	6 760	106	67	31	16
Slovenia	2 733	5 459	2 666	5 396	38	56	29	8
Spain	59 144	79 449	58 231	78 597	536	762	377	90
Sweden	19 455	18 504	19 054	18 299	177	143	224	62
United Kingdom	115 191	113 813	113 233	112 749	1 198	1 000	759	64
EU-28	**785 891**	**887 484**	**772 029**	**877 018**	**7 777**	**9 114**	**6 086**	**1 352**

Abbreviations explained in the Chapter 'Units and abbreviations'.

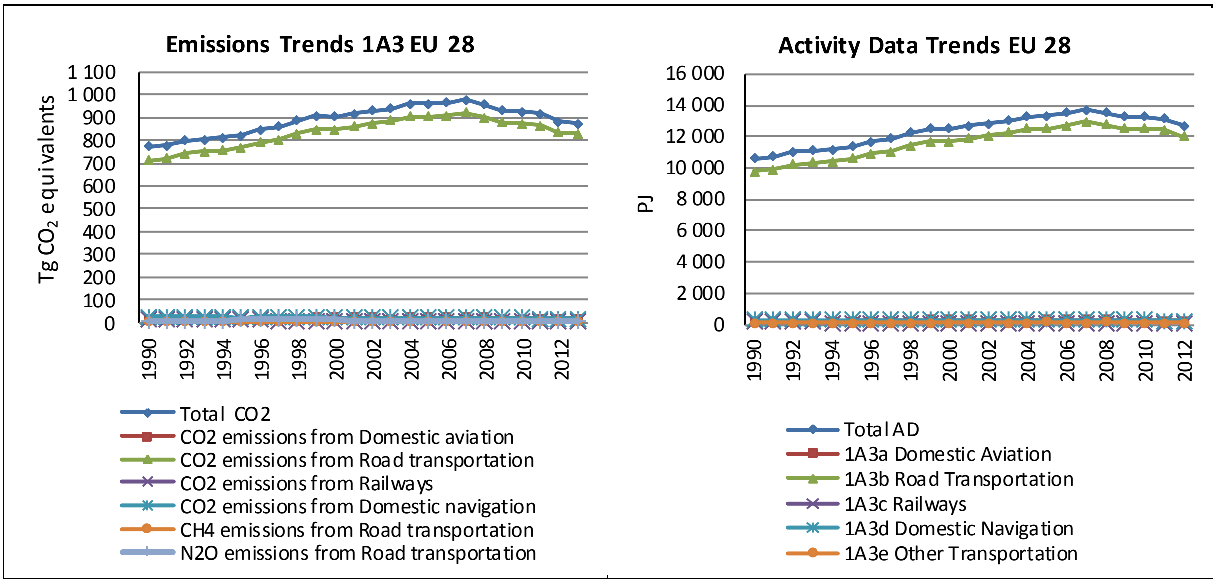
3.2.3.1 Civil Aviation (1A3a) (EU-28)

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 2013. Between 1990 and 2013, CO_2 emissions from civil aviation increased by 8 % in the EU-28 (Table 3.49, Figure 3.50).

CO_2 emissions from Jet Kerosene account for 99 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2012 and 2013, CO_2 emissions from civil aviation decreased by 6 % in the EU-28 (Table 3.49, Figure 3.50).

Figure 3.50 1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Tg) and Activity data in PJ



The Member States France, Germany, Italy and Spain alone contributed 74 % to the emissions from this source. Most Member States (15 in total) increased emissions from civil aviation between 1990 and 2013 (Table 3.49).

Table 3.49 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	32	55	55	0%	0	0%	23	71%
Belgium	13	27	30	0%	3	10%	17	129%
Bulgaria	135	34	37	0%	3	9%	-98	-73%
Croatia	156	96	104	1%	8	9%	-52	-33%
Cyprus	19	29	28	0%	-1	-5%	8	42%
Czech Republic	139	7	8	0%	0	2%	-132	-95%
Denmark	258	146	140	1%	-6	-4%	-117	-46%
Estonia	6	3	1	0%	-2	-65%	-4	-79%
Finland	385	224	192	1%	-32	-14%	-193	-50%
France	4 238	5 012	4 997	32%	-15	0%	758	18%
Germany	2 463	2 212	2 069	13%	-143	-6%	-395	-16%
Greece	319	490	431	3%	-59	-12%	112	35%
Hungary	1	1	1	0%	0	14%	0	29%
Ireland	51	11	10	0%	-1	-12%	-41	-80%
Italy	1 613	2 167	1 939	12%	-228	-11%	326	20%
Latvia	0	2	3	0%	1	50%	3	5046%
Lithuania	8	2	2	0%	0	0%	-6	-79%
Luxembourg	0	0	0	0%	0	-4%	0	120%
Malta	1	1	0	0%	-1	-64%	0	-35%
Netherlands	83	41	40	0%	-2	-4%	-43	-52%
Poland	67	174	149	1%	-25	-14%	82	122%
Portugal	229	369	332	2%	-37	-10%	104	45%
Romania	25	121	135	1%	14	11%	110	444%
Slovakia	8	5	5	0%	0	-7%	-3	-40%
Slovenia	1	2	1	0%	0	-23%	0	23%
Spain	1 995	3 136	2 625	17%	-511	-16%	630	32%
Sweden	673	515	517	3%	2	0%	-156	-23%
United Kingdom	1 525	1 673	1 678	11%	4	0%	153	10%
EU-28	**14 444**	**16 558**	**15 530**	**100%**	**-1 028**	**-6%**	**1 086**	**8%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2013 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 99 % of CO_2 emissions in 1A3a. Within the EU-28 the emissions increased between 1990 and 2013 by 8 % (Table 3.50). By far the largest absolute increase occurred in France. Between 2012 and 2013, the emissions decreased by 6 %.

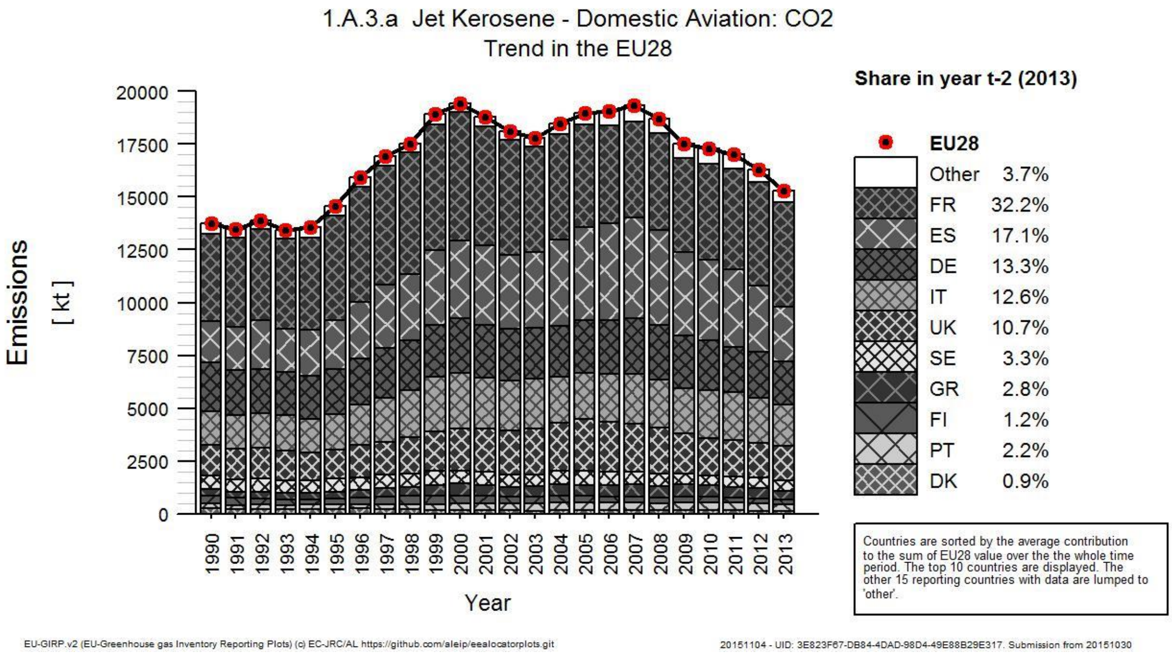
Table 3.50 1A3a Civil Aviation, jet kerosene: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	24	47	46	0%	0	-1%	22	92%	-	-
Belgium	5	25	28	0%	3	11%	23	470%	T1	D
Bulgaria	114	31	34	0%	3	10%	-80	-70%	T1	D
Croatia	156	94	103	1%	9	9%	-54	-34%	T1	D
Cyprus	19	29	28	0%	-1	-5%	8	42%	T1	D
Czech Republic	1	1	1	0%	0	14%	0	3%	T1	D
Denmark	249	141	135	1%	-6	-4%	-114	-46%	CR,M,T2	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	377	222	190	1%	-32	-14%	-187	-50%	M	CS
France	4 133	4 938	4 926	32%	-11	0%	793	19%	-	-
Germany	2 292	2 173	2 034	13%	-139	-6%	-259	-11%	CS	CS
Greece	307	484	425	3%	-59	-12%	118	38%	T2	D
Hungary	1	1	1	0%	0	14%	0	30%	T1	D
Ireland	48	9	7	0%	-2	-20%	-41	-85%	T3	CS
Italy	1 579	2 140	1 933	13%	-207	-10%	354	22%	T1,T2	CS
Latvia	0	2	3	0%	1	76%	3	5568%	T1	D
Lithuania	7	0	1	0%	0	33%	-7	-92%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	0	1	0	0%	-1	-69%	0	7%	T1	D
Netherlands	72	36	35	0%	-1	-3%	-36	-51%	T2	D
Poland	42	158	136	1%	-22	-14%	95	226%	T1	D
Portugal	227	368	331	2%	-37	-10%	104	46%	T3	D
Romania	25	118	132	1%	14	12%	107	432%	T1	D
Slovakia	7	5	4	0%	0	-6%	-3	-37%	T1	D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 960	3 120	2 625	17%	-495	-16%	664	34%	T2	D
Sweden	658	509	511	3%	2	0%	-147	-22%	-	-
United Kingdom	1 456	1 626	1 636	11%	11	1%	180	12%	T3	CS
EU-28	**13 762**	**16 278**	**15 308**	**100%**	**-971**	**-6%**	**1 546**	**11%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 86 % of CO_2 emissions and for 86 % of activity data from jet kerosene in 2013 (Figure 3.51). Table 3.50 shows that the majority of emissions from Civil Aviation jet kerosene were calculated using a higher tier method.

Figure 3.51   1A3a Civil Aviation, jet kerosene: Emission trend and share for CO_2



3.2.3.2 Road Transportation (1A3b) (EU-28)

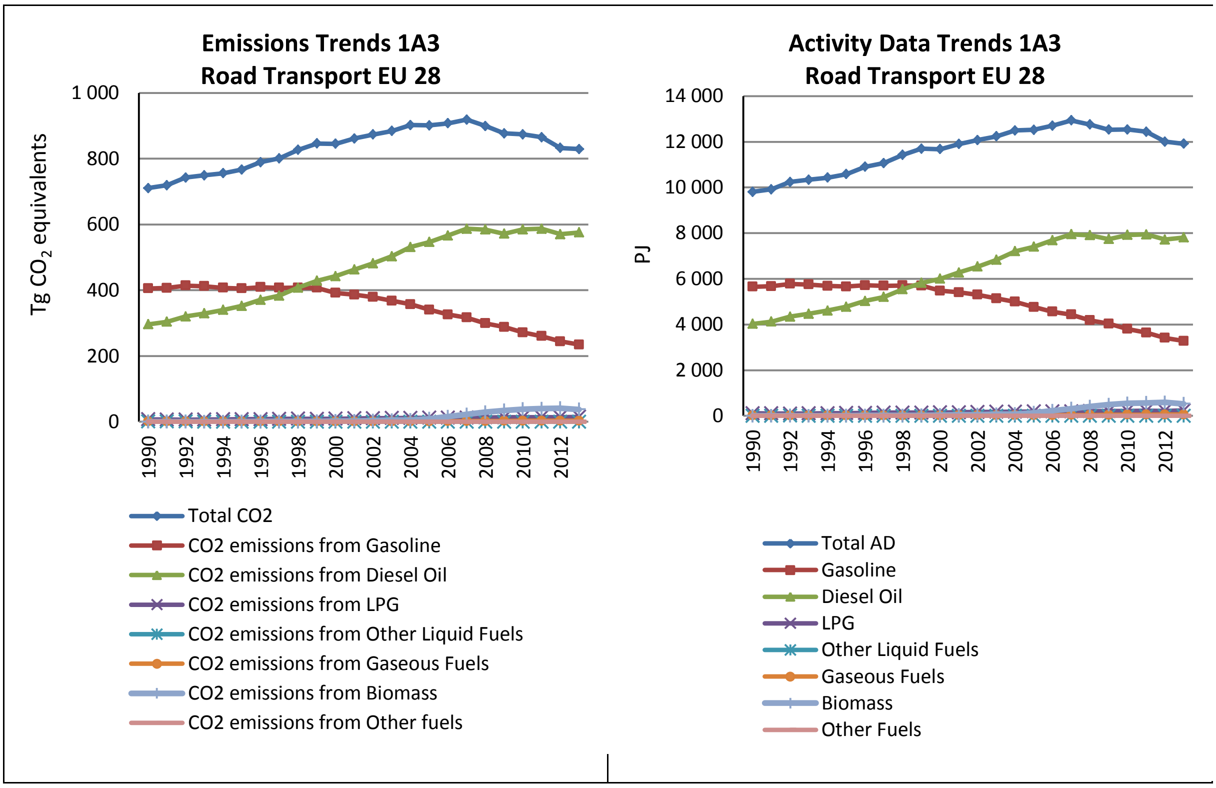
CO_2 emissions from 1A3b Road Transportation

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-28 accounting for 19 % of total GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from road transportation increased by 14 % in the EU-28 (Table 3.51). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 22% between 1990 and 2013.

Figure 3.52 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-28 Member States.

Figure 3.52 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 (67 %). All Member States, except for Estonia (-5%), Lithuania (-22%), Sweden (-2%) and the United Kingdom (-1%), show increased emissions from road transportation between 1990 and 2013. The Member States with the highest increases in absolute terms were Poland, Spain, France and Czech Republic. The countries with the lowest increase in relative terms were Finland and Italy (Table 3.51).

Table 3.51 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	13 328	20 815	21 815	3%	1 000	5%	8 488	64%	NA	NA
Belgium	19 663	23 885	23 685	3%	-200	-1%	4 022	20%	M,NA,T1,T3	NA,OTH
Bulgaria	5 959	7 770	6 858	1%	-913	-12%	899	15%	T1,T2	CR,D
Croatia	3 506	5 300	5 380	1%	80	2%	1 874	53%	NA,T1	D,NA,NO
Cyprus	1 170	2 009	1 792	0%	-217	-11%	622	53%	T1	D
Czech Republic	6 177	15 742	15 619	2%	-123	-1%	9 442	153%	NA,T1	D,NA
Denmark	9 284	11 239	11 021	1%	-218	-2%	1 737	19%	CR,M,T2	CS
Estonia	2 236	2 155	2 115	0%	-40	-2%	-121	-5%	NA,T2	CS,NA
Finland	10 806	11 296	11 225	1%	-71	-1%	419	4%	M,NA	CS,NA
France	112 401	123 505	122 716	15%	-789	-1%	10 316	9%	NA	NA
Germany	151 861	146 828	151 348	18%	4 520	3%	-513	0%	CS,NA,T1	CS,D,NA
Greece	11 826	13 714	15 757	2%	2 043	15%	3 931	33%	T2	CS
Hungary	7 718	10 278	9 685	1%	-594	-6%	1 967	25%	T1,T2	CS,D
Ireland	4 690	10 254	10 483	1%	229	2%	5 793	124%	T2,T3	CS,M
Italy	93 379	97 622	95 514	12%	-2 108	-2%	2 135	2%	NA,T3	CS,NA
Latvia	2 398	2 473	2 520	0%	47	2%	122	5%	NA,T1,T2	CS,D,NA
Lithuania	5 247	4 050	4 078	0%	28	1%	-1 169	-22%	T1,T2	CS
Luxembourg	2 632	6 411	6 248	1%	-162	-3%	3 616	137%	NA,T2	CS,NA
Malta	333	497	491	0%	-5	-1%	158	47%	T3	CR
Netherlands	25 278	32 560	31 418	4%	-1 141	-4%	6 141	24%	T2	CS
Poland	18 429	44 928	42 005	5%	-2 924	-7%	23 576	128%	T2	CS
Portugal	9 164	14 904	14 681	2%	-222	-1%	5 518	60%	T2	D
Romania	10 366	14 148	14 043	2%	-105	-1%	3 677	35%	NA,T1	NA,OTH
Slovakia	4 503	6 403	6 181	1%	-222	-3%	1 678	37%	M,NA	D,NA
Slovenia	2 599	5 665	5 362	1%	-303	-5%	2 763	106%	M,NA	M,NA
Spain	50 614	73 428	73 863	9%	435	1%	23 249	46%	T3	M
Sweden	17 336	17 434	16 925	2%	-509	-3%	-411	-2%	NA	NA
United Kingdom	107 870	107 344	106 489	13%	-856	-1%	-1 381	-1%	T3	CS
EU-28	**710 771**	**832 657**	**829 318**	**100%**	**-3 339**	**0%**	**118 547**	**17%**		

1A3b Road Transportation – Diesel Oil (CO_2)

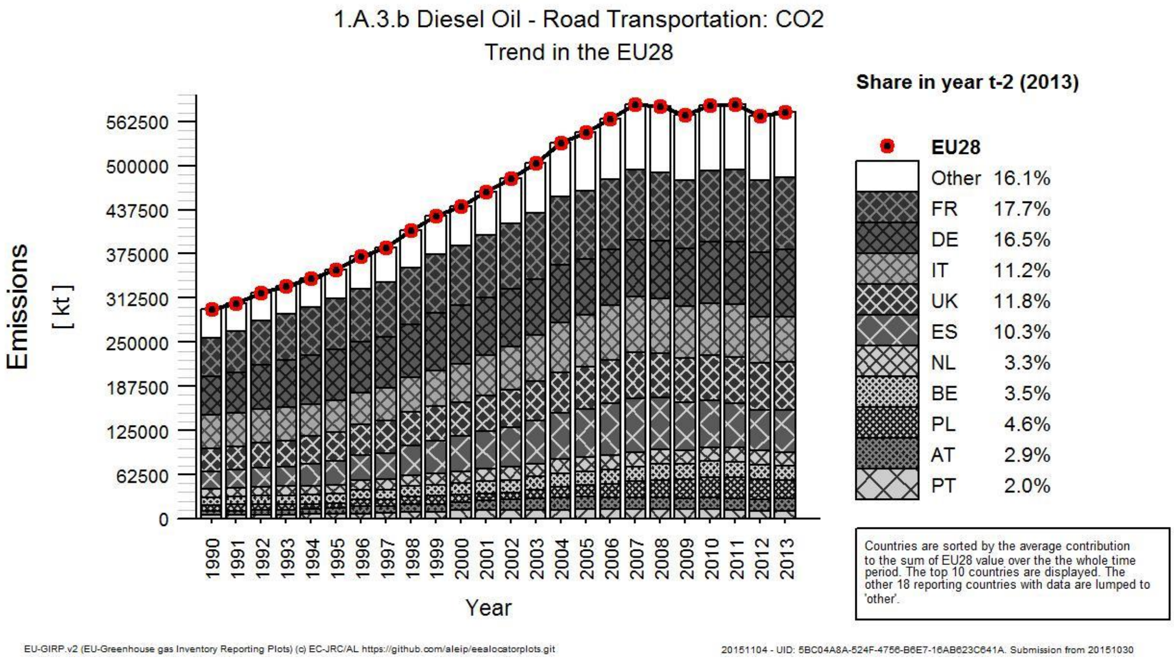
CO_2 emissions from Diesel oil account for 69 % of CO_2 emissions from 1A3b Road Transport in 2013 (Figure 3.52). All Member States show increased emissions from Diesel oil between 1990 and 2013 (Table 3.52). Member States with the highest increase in per cent were Slovenia, Czech Republic, Ireland and Luxembourg. Some of these increases are due to fuel bought in the respective countries but consumed abroad (fuel tourism).

Table 3.52 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	5 378	15 775	16 876	3%	1 101	7%	11 498	214%
Belgium	10 986	20 301	20 094	3%	-207	-1%	9 108	83%
Bulgaria	1 550	4 987	4 216	1%	-771	-15%	2 667	172%
Croatia	1 159	3 372	3 489	1%	116	3%	2 330	201%
Cyprus	669	867	720	0%	-147	-17%	51	8%
Czech Republic	2 690	10 683	10 843	2%	160	1%	8 153	303%
Denmark	4 436	7 227	7 180	1%	-47	-1%	2 744	62%
Estonia	697	1 386	1 391	0%	5	0%	694	100%
Finland	4 923	7 146	7 057	1%	-89	-1%	2 133	43%
France	54 203	101 966	101 968	18%	2	0%	47 765	88%
Germany	54 458	90 555	95 151	17%	4 596	5%	40 693	75%
Greece	4 297	4 790	6 742	1%	1 952	41%	2 445	57%
Hungary	2 388	6 527	6 169	1%	-358	-5%	3 780	158%
Ireland	1 914	6 527	6 973	1%	446	7%	5 059	264%
Italy	47 776	65 912	64 203	11%	-1 709	-3%	16 427	34%
Latvia	616	1 662	1 742	0%	79	5%	1 126	183%
Lithuania	2 134	2 919	3 028	1%	109	4%	894	42%
Luxembourg	1 351	5 329	5 265	1%	-64	-1%	3 913	290%
Malta	150	265	259	0%	-7	-2%	109	73%
Netherlands	11 818	19 376	18 752	3%	-623	-3%	6 934	59%
Poland	8 615	29 113	26 757	5%	-2 355	-8%	18 143	211%
Portugal	5 009	11 386	11 260	2%	-126	-1%	6 251	125%
Romania	3 648	10 024	10 147	2%	123	1%	6 499	178%
Slovakia	3 123	4 580	4 453	1%	-126	-3%	1 331	43%
Slovenia	904	4 018	3 889	1%	-129	-3%	2 984	330%
Spain	24 504	57 436	59 559	10%	2 122	4%	35 055	143%
Sweden	4 572	9 349	9 292	2%	-56	-1%	4 720	103%
United Kingdom	32 771	66 905	68 116	12%	1 211	2%	35 344	108%
EU-28	**296 740**	**570 382**	**575 591**	**100%**	**5 209**	**1%**	**278 851**	**94%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 68 % of CO_2 emissions and for 68 % of activity data from diesel oil in 2013 (Figure 3.53). Figure 3.53 1A3b Road Transport, diesel oil: Emission trend and share for CO_2



1A3b Road Transportation – Gasoline (CO_2)

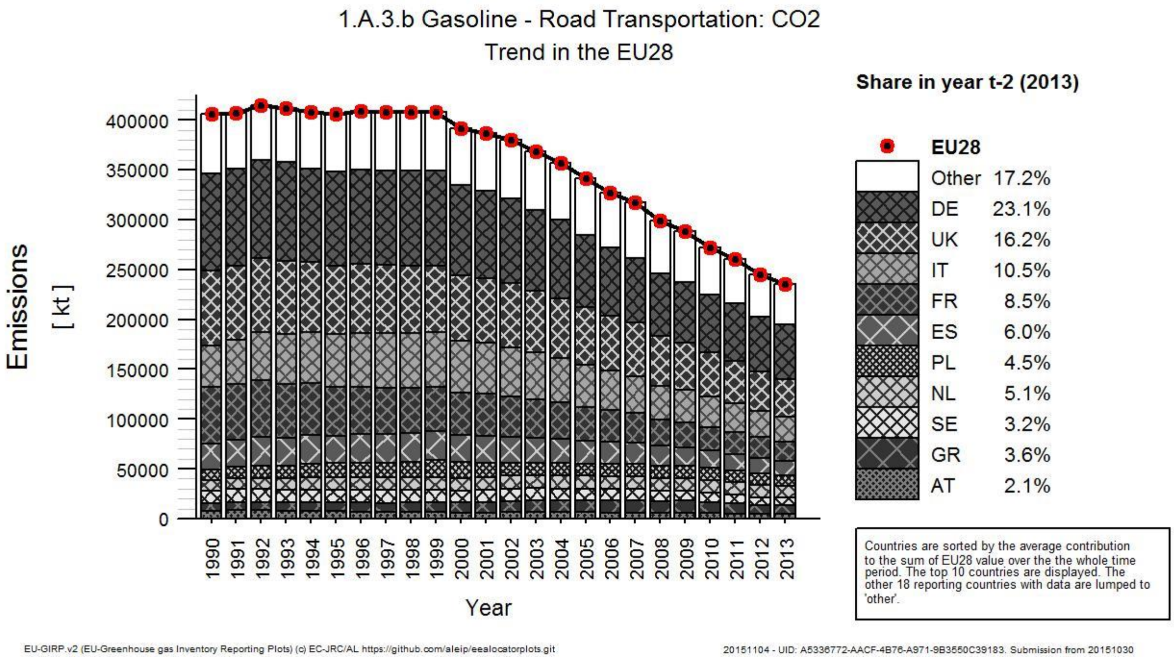
Between 1990 and 2013, CO_2 emissions from gasoline decreased by 42 % in the EU-28 (Table 3.53).

Table 3.53 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	7 923	4 964	4 861	2%	-103	-2%	-3 063	-39%
Belgium	8 507	3 459	3 473	1%	15	0%	-5 034	-59%
Bulgaria	4 409	1 609	1 358	1%	-251	-16%	-3 052	-69%
Croatia	2 347	1 787	1 745	1%	-42	-2%	-602	-26%
Cyprus	500	1 142	1 071	0%	-71	-6%	571	114%
Czech Republic	3 487	4 817	4 527	2%	-290	-6%	1 040	30%
Denmark	4 838	4 012	3 841	2%	-171	-4%	-998	-21%
Estonia	1 530	769	723	0%	-46	-6%	-807	-53%
Finland	5 883	4 141	4 162	2%	21	1%	-1 720	-29%
France	57 707	20 744	19 985	9%	-759	-4%	-37 722	-65%
Germany	97 217	54 232	54 147	23%	-84	0%	-43 070	-44%
Greece	7 438	8 739	8 421	4%	-317	-4%	983	13%
Hungary	5 329	3 686	3 427	1%	-259	-7%	-1 902	-36%
Ireland	2 758	3 725	3 507	1%	-218	-6%	749	27%
Italy	41 094	25 806	24 721	11%	-1 085	-4%	-16 373	-40%
Latvia	1 724	690	626	0%	-64	-9%	-1 098	-64%
Lithuania	3 053	705	638	0%	-66	-9%	-2 415	-79%
Luxembourg	1 272	1 077	981	0%	-97	-9%	-291	-23%
Malta	183	231	232	0%	1	0%	49	27%
Netherlands	10 806	12 445	11 966	5%	-479	-4%	1 159	11%
Poland	9 814	11 200	10 669	5%	-531	-5%	855	9%
Portugal	4 154	3 400	3 296	1%	-104	-3%	-859	-21%
Romania	6 591	3 972	3 756	2%	-216	-5%	-2 834	-43%
Slovakia	1 380	1 714	1 605	1%	-109	-6%	224	16%
Slovenia	1 695	1 622	1 438	1%	-183	-11%	-257	-15%
Spain	26 031	15 735	14 018	6%	-1 717	-11%	-12 013	-46%
Sweden	12 761	7 959	7 507	3%	-452	-6%	-5 254	-41%
United Kingdom	75 099	40 165	38 096	16%	-2 069	-5%	-37 003	-49%
EU-28	**405 532**	**244 546**	**234 799**	**100%**	**-9 747**	**-4%**	**-170 733**	**-42%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 64 % for CO_2 emissions and for 55 % of activity data from gasoline in 2013 (Figure 3.54). Figure 3.54 1A3b Road Transport, gasoline: Emission trend and share for CO_2



1A3b Road Transportation –LPG (CO_2)

Between 1990 and 2013, CO_2 emissions from LPG increased by 17 % in the EU-28. Two Member States report emissions as ‘Not occurring’. Between 2012 and 2013 EU-28 emissions increased by 7 % (Table 3.54).

Table 3.54 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	26	58	57	0%	-1	-2%	30	114%
Belgium	170	124	116	1%	-8	-6%	-54	-32%
Bulgaria	NO	1 022	1 098	7%	76	7%	1 098	100%
Croatia	NO	139	143	1%	4	3%	143	100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO,IE	215	209	1%	-6	-3%	209	100%
Denmark	9	0	0	0%	0	-25%	-9	-99%
Estonia	9	0	0	0%	0	38%	-9	-95%
Finland	NO,NA	NO,NA	NO,NA	-	-	-	-	-
France	150	346	307	2%	-39	-11%	157	104%
Germany	9	1 539	1 544	10%	5	0%	1 535	16961%
Greece	91	151	562	4%	411	272%	472	520%
Hungary	NO	62	86	1%	24	38%	86	100%
Ireland	19	3	3	0%	1	30%	-15	-81%
Italy	4 026	4 092	4 655	30%	563	14%	629	16%
Latvia	37	116	148	1%	32	27%	111	300%
Lithuania	60	419	402	3%	-17	-4%	342	568%
Luxembourg	9	4	3	0%	-1	-32%	-6	-70%
Malta	NO,IE	0	0	0%	0	484%	0	100%
Netherlands	2 653	684	638	4%	-45	-7%	-2 015	-76%
Poland	NO	4 616	4 578	30%	-37	-1%	4 578	100%
Portugal	0	90	96	1%	6	7%	96	157497%
Romania	NO	151	139	1%	-12	-8%	139	100%
Slovakia	NO	92	101	1%	9	10%	101	100%
Slovenia	NO	24	33	0%	9	37%	33	100%
Spain	79	79	94	1%	15	19%	15	19%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	NO	274	277	2%	3	1%	277	100%
EU-28	**7 347**	**14 300**	**15 290**	**100%**	**990**	**7%**	**7 943**	**108%**

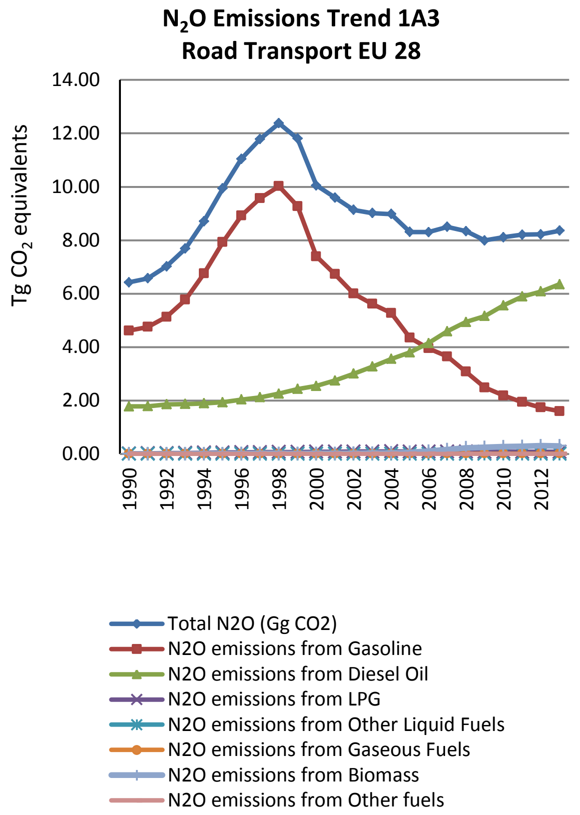
Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 45 % of CO_2 emissions, whereas Poland accounts for 30 % of CO_2 emissions from LPG in 2013 (Table 3.54).

N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.2 % of total EU-28 GHG emissions in 2013. Figure 3.55 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 3.55 1A3b Road Transport: N_2O Emissions Trend



N_2O emissions increased between 1990 and 2013 by 23 % (Table 3.57). 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-28 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.).

Table 3.55: 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 3.56.

Table 3.56: N_2O and CH_4 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 3.57 1A3b Road Transport: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	114	164	181	2%	18	11%	68	59%	NA	NA
Belgium	196	241	245	3%	4	2%	50	25%	M,NA,T3	CS,NA,OTH
Bulgaria	54	63	56	1%	-7	-10%	3	5%	T1,T2	CR,D
Croatia	39	46	46	1%	0	0%	7	18%	NA,T3	CR,NA,NO
Cyprus	23	42	39	0%	-4	-9%	16	69%	T1	D
Czech Republic	137	614	599	7%	-15	-2%	463	338%	NA,T1,T2	CS,NA
Denmark	87	112	113	1%	1	1%	26	30%	CR,M,T3	CR
Estonia	22	18	18	0%	0	2%	-3	-15%	NA,T1,T3	CS,D,NA
Finland	154	70	70	1%	1	1%	-84	-54%	M,NA	D,NA
France	913	1 354	1 419	17%	65	5%	507	56%	NA	NA
Germany	1 114	1 346	1 427	17%	81	6%	313	28%	NA,T2,T3	CS,M,NA
Greece	118	106	113	1%	7	7%	-4	-4%	M	D,M
Hungary	69	97	91	1%	-6	-6%	22	32%	T1,T3	D,M
Ireland	48	94	98	1%	5	5%	50	104%	T3	M
Italy	845	864	854	10%	-10	-1%	10	1%	NA,T3	M,NA
Latvia	19	20	20	0%	0	2%	1	7%	NA,T1,T2	CR,D,NA
Lithuania	39	35	35	0%	0	1%	-4	-9%	T3	CR
Luxembourg	16	48	48	1%	1	1%	32	202%	NA,T3	M,NA
Malta	5	6	6	0%	0	6%	1	22%	T3	CR
Netherlands	96	204	209	2%	5	2%	113	118%	T2	CS
Poland	180	564	532	6%	-32	-6%	352	196%	T1	D
Portugal	64	142	136	2%	-6	-4%	72	111%	T3	CR
Romania	227	141	140	2%	-2	-1%	-87	-38%	NA,T1	NA,OTH
Slovakia	56	56	55	1%	-1	-3%	-1	-3%	M,NA	D,NA
Slovenia	31	53	52	1%	-1	-2%	21	69%	M,NA	M,NA
Spain	474	732	720	9%	-12	-2%	246	52%	T3	M
Sweden	151	124	126	2%	3	2%	-24	-16%	NA	NA
United Kingdom	1 137	865	906	11%	42	5%	-230	-20%	T3	CR
EU-28	**6 423**	**8 220**	**8 357**	**100%**	**136**	**2%**	**1 933**	**30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 2013. Between 1990 and 2013 N_2O emissions from Diesel oil increased in all Member States, except for Finland (decrease by 29 %) and Slovakia (decrease by 13 %); within the EU-28 the emission increased by 257 %. The smallest increase in absolute terms was reported by Cyprus, Estonia, Lithuania and Malta. Between 2012 and 2013, EU-28 emissions rose by 4 % (Table 3.58).

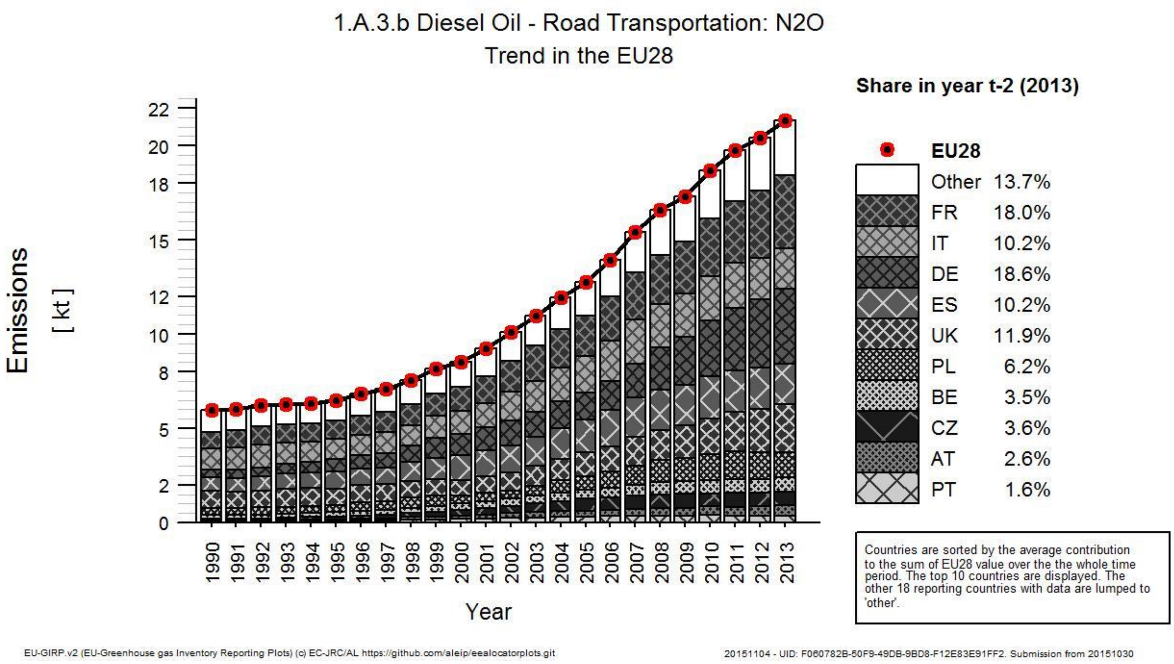
Table 3.58 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	13	147	166	3%	19	13%	153	1167%
Belgium	59	215	221	3%	6	3%	161	273%
Bulgaria	13	30	26	0%	-4	-13%	13	102%
Croatia	10	28	29	0%	1	2%	19	184%
Cyprus	10	14	11	0%	-2	-17%	1	8%
Czech Republic	30	221	226	4%	5	2%	196	653%
Denmark	31	81	86	1%	5	6%	55	178%
Estonia	7	12	13	0%	1	11%	6	80%
Finland	65	44	46	1%	2	4%	-19	-29%
France	255	1 068	1 142	18%	74	7%	887	347%
Germany	119	1 078	1 180	19%	102	9%	1 061	889%
Greece	39	39	48	1%	9	22%	8	21%
Hungary	21	60	60	1%	-1	-2%	38	181%
Ireland	13	68	75	1%	7	10%	62	474%
Italy	339	651	651	10%	0	0%	312	92%
Latvia	6	12	13	0%	1	8%	7	134%
Lithuania	19	20	21	0%	1	6%	2	9%
Luxembourg	3	44	45	1%	1	3%	42	1586%
Malta	2	3	4	0%	0	10%	2	64%
Netherlands	21	128	133	2%	5	4%	112	528%
Poland	113	422	394	6%	-27	-7%	282	250%
Portugal	16	104	102	2%	-2	-2%	86	540%
Romania	31	95	97	2%	2	2%	66	214%
Slovakia	41	38	36	1%	-2	-4%	-5	-13%
Slovenia	11	40	41	1%	1	2%	31	289%
Spain	201	651	646	10%	-5	-1%	445	221%
Sweden	12	77	85	1%	7	9%	73	621%
United Kingdom	278	693	757	12%	64	9%	479	172%
EU-28	**1 780**	**6 082**	**6 352**	**100%**	**270**	**4%**	**4 572**	**257%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 69 % of N_2O emissions and for 68 % of activity data from diesel oil in 2013 (Figure 3.56).

Figure 3.56 1A3b Road Transport, diesel oil: Emission trend and share 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 2013. Between 1990 and 2013, N_2O emissions from gasoline decreased by 65 % in the EU-28 with a peak in 1998. As explained above, this peak is due to the implementation of the catalytic converter in the early Euro vehicles and mainly Euro 1. Emissions decreased thereafter with the introduction of Euro 2 and later vehicle technologies. Between 2012 and 2013, all Member States, except for Slovakia (emissions remained almost constant), showed a decreasing trend. The EU-28 total N_2O emissions dropped by 8 % (Table 3.59).

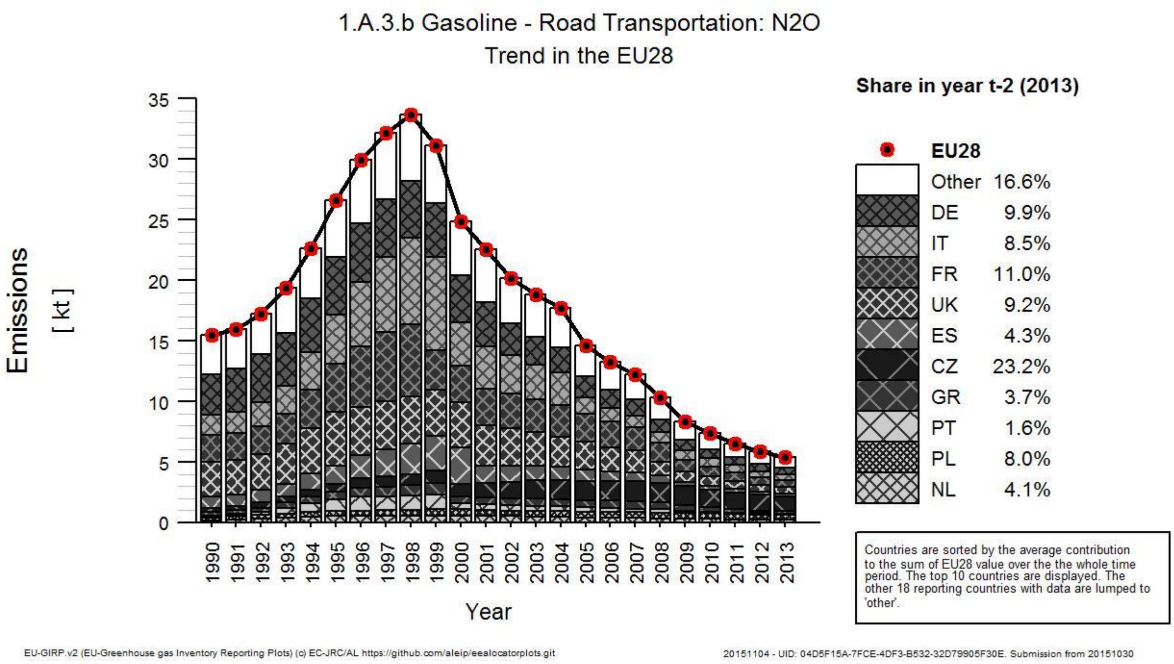
Table 3.59 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	100	17	15	1%	-2	-10%	-85	-85%
Belgium	135	13	12	1%	-1	-10%	-123	-91%
Bulgaria	41	18	14	1%	-4	-20%	-26	-65%
Croatia	29	16	15	1%	-1	-5%	-14	-49%
Cyprus	12	28	26	2%	-2	-6%	14	114%
Czech Republic	107	391	371	23%	-20	-5%	264	247%
Denmark	56	24	20	1%	-4	-15%	-36	-64%
Estonia	14	6	5	0%	-1	-14%	-9	-62%
Finland	88	22	20	1%	-2	-9%	-69	-78%
France	654	191	177	11%	-15	-8%	-477	-73%
Germany	994	173	158	10%	-14	-8%	-836	-84%
Greece	78	63	59	4%	-4	-6%	-19	-25%
Hungary	48	31	26	2%	-5	-16%	-22	-45%
Ireland	35	23	21	1%	-3	-11%	-14	-41%
Italy	502	146	136	8%	-10	-7%	-365	-73%
Latvia	13	5	5	0%	-1	-15%	-8	-65%
Lithuania	19	9	9	1%	-1	-6%	-10	-54%
Luxembourg	13	4	3	0%	-1	-16%	-10	-75%
Malta	3	2	2	0%	0	-1%	0	-16%
Netherlands	58	66	66	4%	0	-1%	8	13%
Poland	67	132	128	8%	-4	-3%	61	90%
Portugal	48	29	25	2%	-3	-11%	-23	-48%
Romania	196	34	32	2%	-3	-8%	-164	-84%
Slovakia	15	15	15	1%	0	0%	0	2%
Slovenia	20	8	5	0%	-3	-36%	-15	-73%
Spain	273	77	69	4%	-8	-10%	-204	-75%
Sweden	139	24	20	1%	-4	-18%	-119	-86%
United Kingdom	858	170	148	9%	-22	-13%	-711	-83%
EU-28	**4 616**	**1 739**	**1 602**	**100%**	**-136**	**-8%**	**-3 014**	**-65%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom accounted for 42 % of N_2O emissions, whereas Czech Republic accounts for 23 % of N_2O emissions from gasoline in 2013 (Figure 3.57).

Figure 3.57 1A3b Road Transport, gasoline: Emission trend and share for N_2O emissions

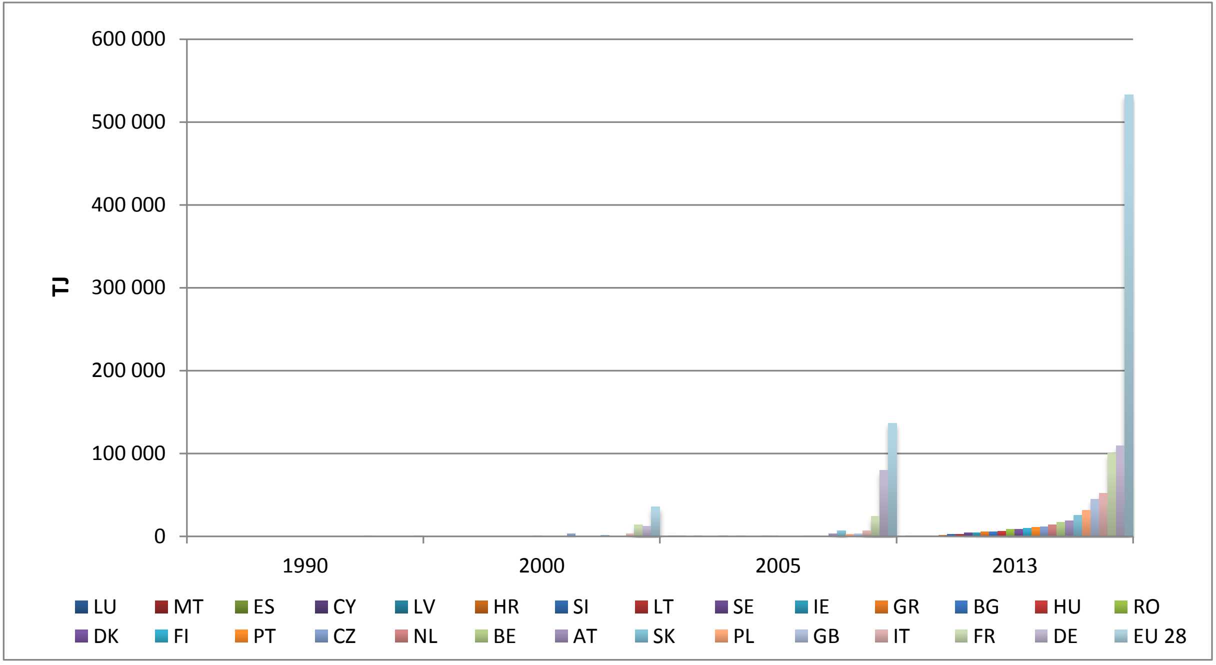


1A3b Road Transportation – Activity Data Biofuels

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 5.8 %, 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 2013, activity data of biofuels increased from 41.12 TJ to 528 004 TJ in the EU-28 (Figure 3.58). Germany still reports most of total amount of biofuels (20,3 % of total EU-28 activity in 2013 vs. 20,1 % in 2012) over the last years, followed by France (19 %). All Member States but Luxembourg report biofuels activity data under 1A3b for 2013.

Figure 3.58   1A3b Road Transport, biofuels: Trend of Activity data of biofuels

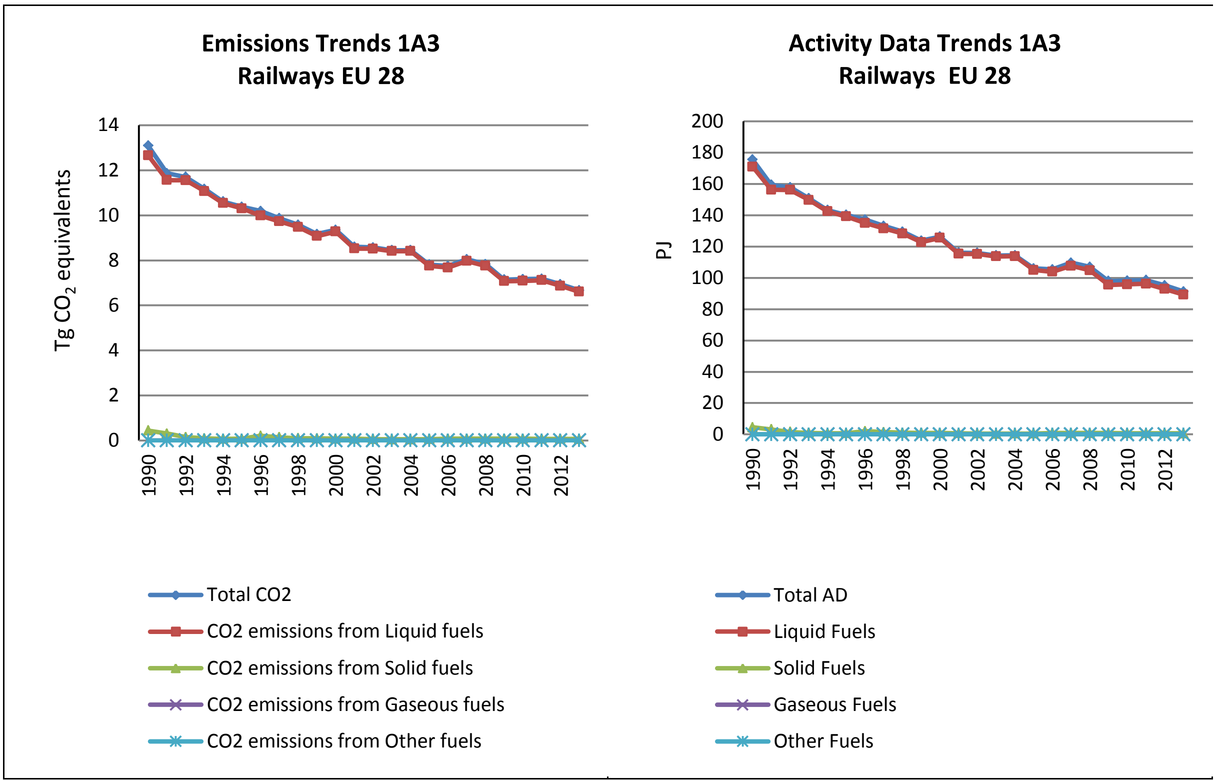


3.2.3.3 Railways (1A3c) (EU-28)

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 0.1 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from rail transportation decreased by 49 % in the EU-28. The total trend is dominated by CO_2 emissions from liquid fuels (Figure 3.59). The emissions from this key category are due to fossil fuel consumption in rail transport, which decreased by 49 % between 1990 and 2013.

Figure 3.59 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 (52 %). Between 1990 and 2013, Germany had by far the highest decreases in absolute terms (Table 3.60).

Table 3.60 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	178	124	114	2%	-10	-8%	-64	-36%
Belgium	222	115	114	2%	-2	-1%	-109	-49%
Bulgaria	323	69	47	1%	-22	-32%	-276	-85%
Croatia	140	78	74	1%	-4	-6%	-66	-47%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	654	277	271	4%	-6	-2%	-383	-59%
Denmark	297	249	248	4%	-2	-1%	-49	-16%
Estonia	154	92	81	1%	-11	-12%	-73	-47%
Finland	191	95	93	1%	-2	-3%	-98	-51%
France	1 070	529	529	8%	1	0%	-541	-51%
Germany	2 900	1 031	999	15%	-32	-3%	-1 901	-66%
Greece	199	78	56	1%	-22	-28%	-143	-72%
Hungary	524	128	149	2%	22	17%	-375	-72%
Ireland	133	118	118	2%	0	0%	-16	-12%
Italy	441	44	60	1%	16	36%	-381	-86%
Latvia	531	248	223	3%	-25	-10%	-308	-58%
Lithuania	350	181	166	2%	-15	-8%	-184	-52%
Luxembourg	25	10	9	0%	-1	-14%	-16	-64%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	91	82	83	1%	1	1%	-8	-9%
Poland	1 638	347	322	5%	-26	-7%	-1 317	-80%
Portugal	175	33	30	0%	-3	-10%	-146	-83%
Romania	452	573	509	8%	-64	-11%	57	13%
Slovakia	377	72	88	1%	17	23%	-288	-77%
Slovenia	65	38	32	0%	-6	-17%	-34	-52%
Spain	414	254	239	4%	-15	-6%	-175	-42%
Sweden	101	58	56	1%	-2	-4%	-46	-45%
United Kingdom	1 455	2 017	1 958	29%	-58	-3%	503	35%
EU-28	**13 101**	**6 941**	**6 667**	**100%**	**-273**	**-4%**	**-6 434**	**-49%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2013, CO_2 emissions from liquid fuels decreased by 49 % in the EU-28. Between 2012 and 2013, EU-28 emissions decreased by 4 % (Table 3.61).

Table 3.61 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

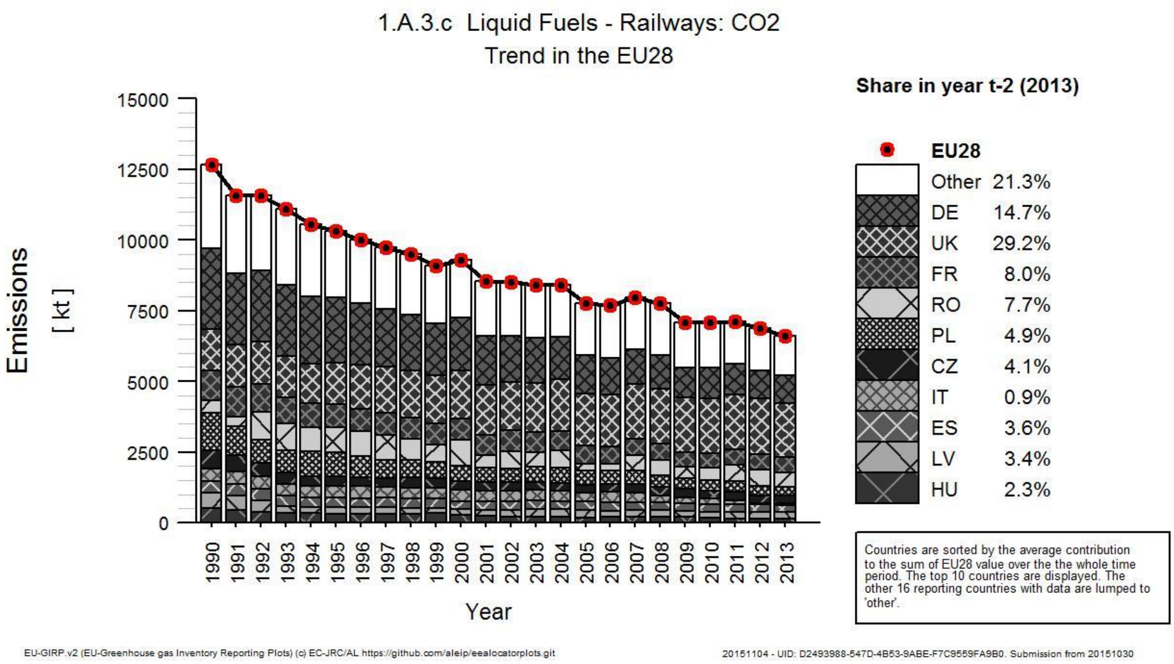
Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	171	123	114	2%	-10	-8%	-58	-34%	-	-
Belgium	222	115	114	2%	-2	-1%	-109	-49%	T1	CS,D
Bulgaria	323	69	47	1%	-22	-32%	-276	-85%	NA	NA
Croatia	119	78	74	1%	-4	-6%	-45	-38%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	654	277	271	4%	-6	-2%	-383	-59%	T1	D
Denmark	297	249	248	4%	-2	-1%	-49	-16%	CR,T2	CS
Estonia	143	92	81	1%	-11	-12%	-61	-43%	T2	CS
Finland	191	95	93	1%	-2	-3%	-98	-51%	M	CS
France	1 070	529	529	8%	1	0%	-541	-51%	-	-
Germany	2 846	1 000	969	15%	-32	-3%	-1 877	-66%	CS	CS
Greece	199	78	56	1%	-22	-28%	-143	-72%	T2	CS
Hungary	520	128	149	2%	22	17%	-370	-71%	T1	D
Ireland	133	118	118	2%	0	0%	-16	-12%	T2	CS
Italy	441	44	60	1%	16	36%	-381	-86%	T2	CS
Latvia	531	248	223	3%	-25	-10%	-308	-58%	T2	CS
Lithuania	350	181	166	3%	-15	-8%	-184	-52%	T2	CS
Luxembourg	25	10	9	0%	-1	-14%	-16	-64%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	91	82	83	1%	1	1%	-8	-9%	T2	CS
Poland	1 332	347	322	5%	-26	-7%	-1 011	-76%	T1	D
Portugal	175	33	30	0%	-3	-10%	-145	-83%	T1	D
Romania	420	573	509	8%	-64	-11%	89	21%	T1,T2	CS,D
Slovakia	377	72	88	1%	17	23%	-288	-77%	T1	D
Slovenia	65	38	32	0%	-6	-17%	-34	-52%	T1	D
Spain	414	254	239	4%	-15	-6%	-175	-42%	T2	M
Sweden	101	58	56	1%	-2	-4%	-46	-45%	-	-
United Kingdom	1 455	1 979	1 926	29%	-53	-3%	471	32%	T2	CS
EU-28	**12 665**	**6 871**	**6 604**	**100%**	**-268**	**-4%**	**-6 061**	**-48%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 57 % of CO_2 emissions and for 56 % of activity data from liquid fuels in 2013 (Figure 3.60).

Table 3.61 shows that the majority of CO_2 emissions from the combustion of liquid fuels in railways were calculated using a higher tier method.

Figure 3.60 1A3c Railways, liquid fuels: Emission trend and share for CO_2

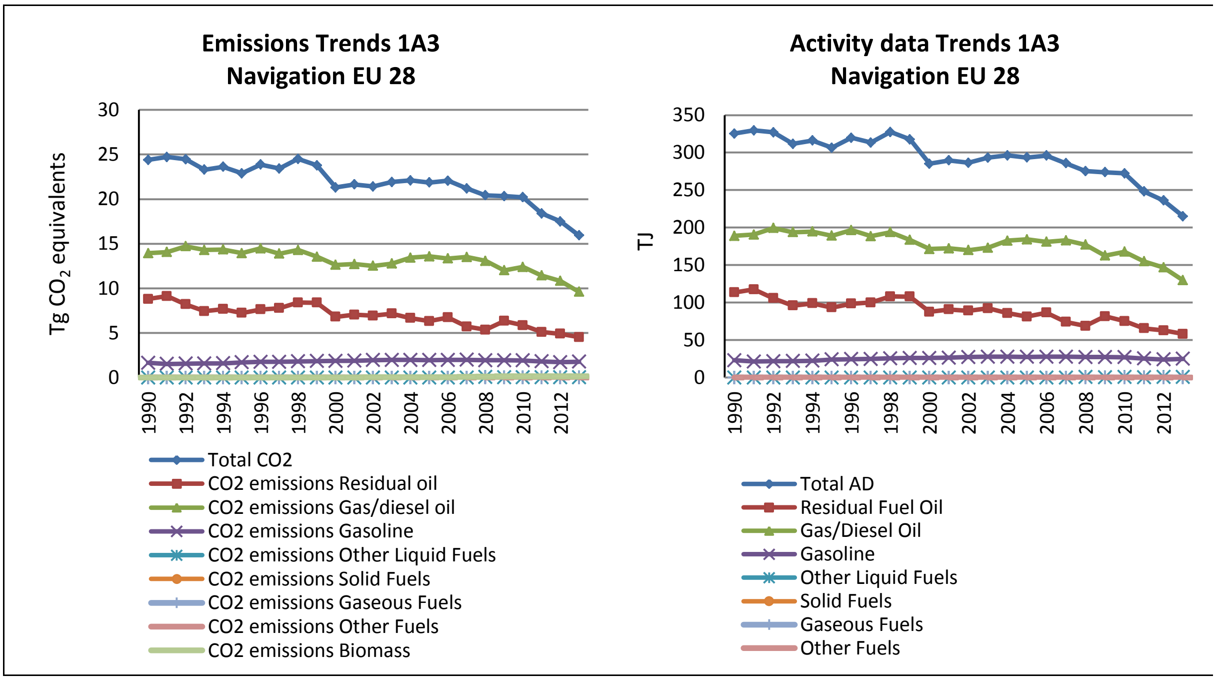


3.2.3.1 Navigation (1A3d) (EU-28)

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 0.4 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from navigation decreased by 35 % in the EU-28 (Table 3.62). 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 3.61).

Figure 3.61 1A3d Navigation: CO_2 Emission Trend and Activity Data



Five Member States (Germany, Greece, Italy, Spain and the United Kingdom) contributed the most to the emissions from this source (70 %). Most Member States had decreasing emissions from navigation between 1990 and 2013. The Member States with the highest decreases in absolute terms were Germany, Italy and Spain (Table 3.62).

Table 3.62 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	15	12	12	0%	0	0%	-2	-17%
Belgium	388	454	442	3%	-12	-3%	55	14%
Bulgaria	56	8	7	0%	-1	-15%	-49	-87%
Croatia	134	112	122	1%	10	9%	-13	-9%
Cyprus	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Czech Republic	57	16	6	0%	-10	-60%	-50	-89%
Denmark	748	398	393	2%	-5	-1%	-355	-47%
Estonia	22	13	13	0%	0	0%	-9	-42%
Finland	441	479	476	3%	-3	-1%	34	8%
France	1 070	1 317	1 329	8%	12	1%	259	24%
Germany	3 644	1 742	1 748	11%	6	0%	-1 896	-52%
Greece	1 809	1 676	1 394	9%	-282	-17%	-414	-23%
Hungary	209	19	16	0%	-3	-17%	-193	-93%
Ireland	85	182	176	1%	-6	-3%	91	107%
Italy	5 466	4 320	4 104	26%	-216	-5%	-1 363	-25%
Latvia	1	13	25	0%	13	99%	24	2429%
Lithuania	15	15	14	0%	-1	-4%	-1	-8%
Luxembourg	1	1	1	0%	0	-3%	0	-2%
Malta	8	32	24	0%	-9	-27%	15	185%
Netherlands	739	1 056	1 119	7%	63	6%	380	51%
Poland	150	11	12	0%	1	11%	-137	-92%
Portugal	260	225	247	2%	22	10%	-13	-5%
Romania	1 151	134	154	1%	21	15%	-997	-87%
Slovakia	0	1	3	0%	2	210%	3	15214%
Slovenia	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Spain	5 187	2 649	1 565	10%	-1 084	-41%	-3 622	-70%
Sweden	577	364	371	2%	7	2%	-206	-36%
United Kingdom	2 158	2 240	2 165	14%	-74	-3%	7	0%
EU-28	**24 391**	**17 488**	**15 940**	**100%**	**-1 548**	**-9%**	**-8 451**	**-35%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from residual oil account for 28 % of CO_2 emissions from 1A3d Navigation in 2013. Between 1990 and 2013, CO_2 emissions from residual oil decreased by 35 % in the EU-28. The countries with the highest decrease in absolute terms were Spain and United Kingdom. 16 Member States reported emissions as 'Not Occurring' (Table 3.63) for 2013, 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 3.63 1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

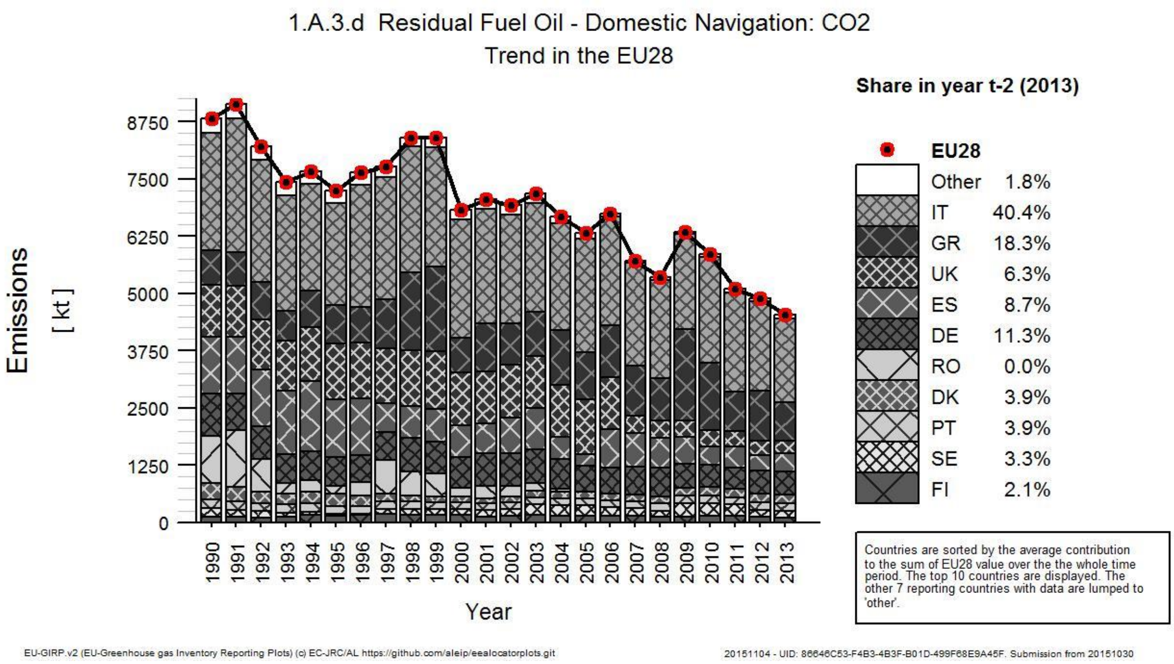
Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	IE	IE	IE	-	-	-	-	-	NA	NA
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	7	6	NO	-	-6	-100%	-7	-100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	357	184	176	4%	-7	-4%	-180	-51%	CR,T2	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	123	129	96	2%	-33	-26%	-27	-22%	M	CS
France	156	74	78	2%	4	6%	-78	-50%	-	-
Germany	935	513	510	11%	-3	-1%	-425	-45%	CS	CS
Greece	746	1 082	828	18%	-254	-23%	82	11%	T1	CS
Hungary	3	NO	NO	-	-	-	-3	-100%	T1	D
Ireland	63	NO	NO	-	-	-	-63	-100%	T2	CS
Italy	2 574	1 947	1 832	40%	-115	-6%	-742	-29%	T1,T2	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	70	1	2	0%	1	111%	-68	-97%	T1	D
Portugal	188	163	178	4%	16	10%	-9	-5%	T2	D
Romania	1 025	NO	NO	-	-	-	-1 025	-100%	T2	CS
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 234	333	395	9%	62	19%	-839	-68%	T1	CS,M
Sweden	194	153	151	3%	-3	-2%	-44	-23%	-	-
United Kingdom	1 134	313	284	6%	-29	-9%	-849	-75%	T3	CS
EU-28	**8 807**	**4 898**	**4 530**	**100%**	**-367**	**-7%**	**-4 277**	**-49%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Greece, Italy and Spain account for 78 % of CO_2 emissions and for 79 % of activity data from residual oil in 2013 (Figure 3.62).

Table 3.64 shows, that the majority of CO_2 emissions from the combustion of residual oil in navigation were calculated using a higher tier method.

Figure 3.62 1A3d Navigation, residual oil: Emission trend and share for CO_2



1A3d Navigation – Gas/Diesel Oil (CO_2)

CO_2 emissions from Gas/Diesel oil account for 60 % of CO_2 emissions from 1A3d Navigation in 2013 (Table 3.64). The CO_2 emissions from Gas/Diesel oil decreased by 31 % between 1990 and 2013.

Table 3.64 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

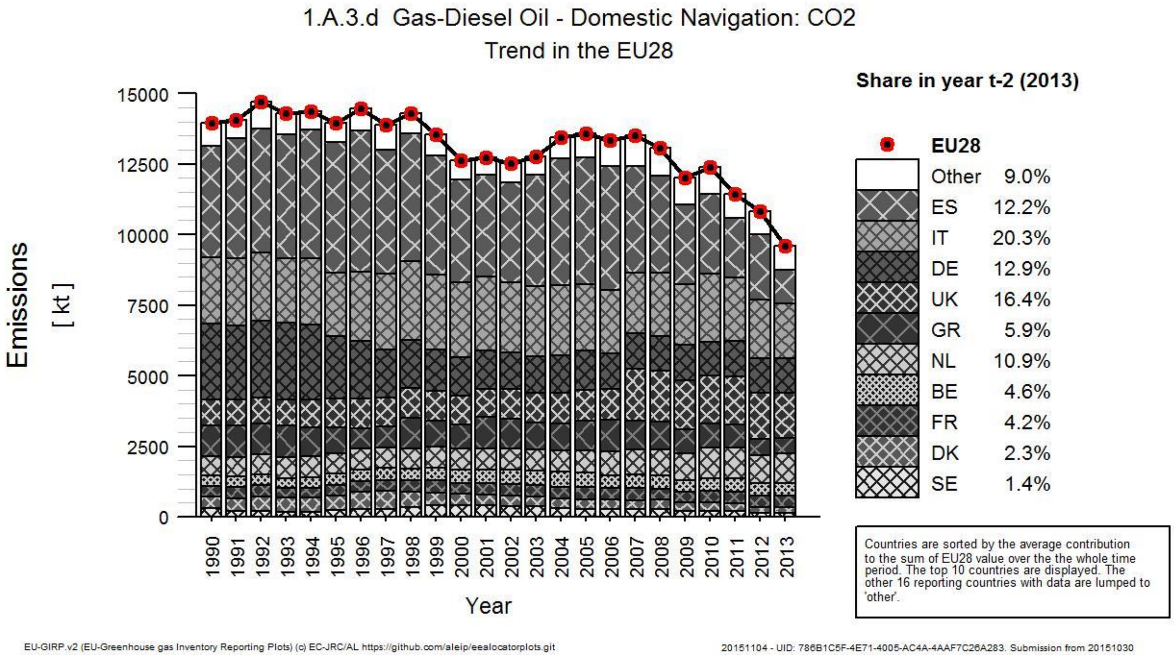
Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	5	5	5	0%	0	2%	0	-6%	-	-
Belgium	388	454	442	5%	-12	-3%	55	14%	T1,T3	CS,D
Bulgaria	56	8	7	0%	-1	-15%	-49	-87%	NA	NA
Croatia	128	106	122	1%	16	15%	-6	-4%	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	57	16	6	0%	-10	-60%	-50	-89%	T1	D
Denmark	391	214	217	2%	2	1%	-174	-45%	CR,M,T2	CS
Estonia	22	13	13	0%	0	0%	-9	-42%	T2	CS
Finland	186	220	241	3%	20	9%	54	29%	CS,M,T2,T3	CS
France	382	398	399	4%	1	0%	17	4%	-	-
Germany	2 709	1 229	1 238	13%	9	1%	-1 471	-54%	CS	CS
Greece	1 063	595	566	6%	-28	-5%	-497	-47%	T1	CS
Hungary	28	19	16	0%	-3	-17%	-12	-44%	T1	D
Ireland	22	182	176	2%	-6	-3%	153	690%	T2	CS
Italy	2 324	2 053	1 953	20%	-100	-5%	-372	-16%	T1,T2	CS
Latvia	1	13	25	0%	13	100%	24	2920%	T2	CS
Lithuania	15	15	14	0%	-1	-4%	-1	-8%	T2	CS
Luxembourg	1	1	1	0%	0	-3%	0	17%	T2	CS
Malta	8	32	23	0%	-8	-26%	15	180%	D,T1	D
Netherlands	693	987	1 051	11%	64	6%	358	52%	T2	CS
Poland	80	10	10	0%	0	2%	-69	-87%	T1	D
Portugal	72	63	69	1%	6	10%	-4	-5%	T2	D
Romania	125	132	129	1%	-3	-2%	3	3%	T2	CS
Slovakia	0	1	3	0%	2	210%	3	15214%	T1	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
Spain	3 953	2 316	1 170	12%	-1 145	-49%	-2 783	-70%	T1	CS,M
Sweden	306	122	131	1%	10	8%	-175	-57%	-	-
United Kingdom	921	1 627	1 573	16%	-54	-3%	653	71%	T2	CS
EU-28	**13 937**	**10 829**	**9 601**	**100%**	**-1 229**	**-11%**	**-4 337**	**-31%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Greece, Italy, Spain and the United Kingdom account for 67 % of the CO_2 emissions and for 68 % of activity data from gas/diesel oil in 2013 (Figure 3.63).

Table 3.64 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 3.63 1A3d Navigation, gas/diesel oil: Emission trend and share for CO_2



3.2.3.4 Other (1A3e) (EU-28)

CO_2 emissions from 1A3e Other account for 0.2 % of total EU-28 GHG emissions in 2013. 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 decreased by 7 % between 1990 and 2013. A fuel shift occurred from oil to gas.

Germany contributed 15 % and the Netherlands 27 % to the EU-28 emissions from this source in 2013 (Table 3.65). Between 1990 and 2013 the EU-28 emissions decreased by 7 %. Seven Member States report emissions as 'Not occurring'. Latvia reports emissions as "Included elsewhere" and more specifically, emissions from pipeline transport are included under 1.A.4.a.i Commercial/Institutional.

Table 3.65 1A3e Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	224	394	607	6%	213	54%	383	170%	NA	NA
Belgium	225	184	189	2%	5	3%	-36	-16%	CS,T3	D
Bulgaria	132	470	398	4%	-72	-15%	266	202%	T1	D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	5	89	92	1%	3	3%	87	1601%	NA,T1	CS,NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	2	17	13	0%	-4	-21%	11	510%	NA,T1	CS,NA
France	212	534	490	5%	-44	-8%	279	132%	NA	NA
Germany	1 087	1 238	1 471	15%	233	19%	384	35%	NA,T2	CS,NA
Greece	NO	11	13	0%	2	16%	-	-	NA	NA
Hungary	88	82	76	1%	-6	-8%	-12	-14%	T1	D
Ireland	62	142	149	2%	7	5%	86	139%	T2	CS
Italy	407	708	660	7%	-48	-7%	253	62%	NA,T2	CS,NA
Latvia	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Lithuania	1 764	247	234	2%	-13	-5%	-1 530	-87%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2 622	2 654	2 622	27%	-32	-1%	0	0%	NA	NA
Poland	NO	606	864	9%	258	42%	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	66	24	9	0%	-15	-61%	-56	-86%	T1,T2	CS,D
Slovakia	1 814	405	482	5%	77	19%	-1 332	-73%	T2	CS
Slovenia	NO	1	0	0%	-1	-60%	-	-	NA	NA
Spain	20	284	305	3%	21	7%	285	1405%	T2	CS
Sweden	367	427	429	4%	2	0%	62	17%	NA	NA
United Kingdom	225	444	459	5%	15	3%	234	104%	T3	CS
EU-28	**9 322**	**8 961**	**9 563**	**100%**	**603**	**7%**	**-636**	**-7%**		

Abbreviations explained in the Chapter 'Units and abbreviation

3.2.4 Other Sectors (CRF Source Category 1A4)

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, deep sea and international fishing. Emissions from transportation of agricultural goods are reported under category 1A3 Transport.

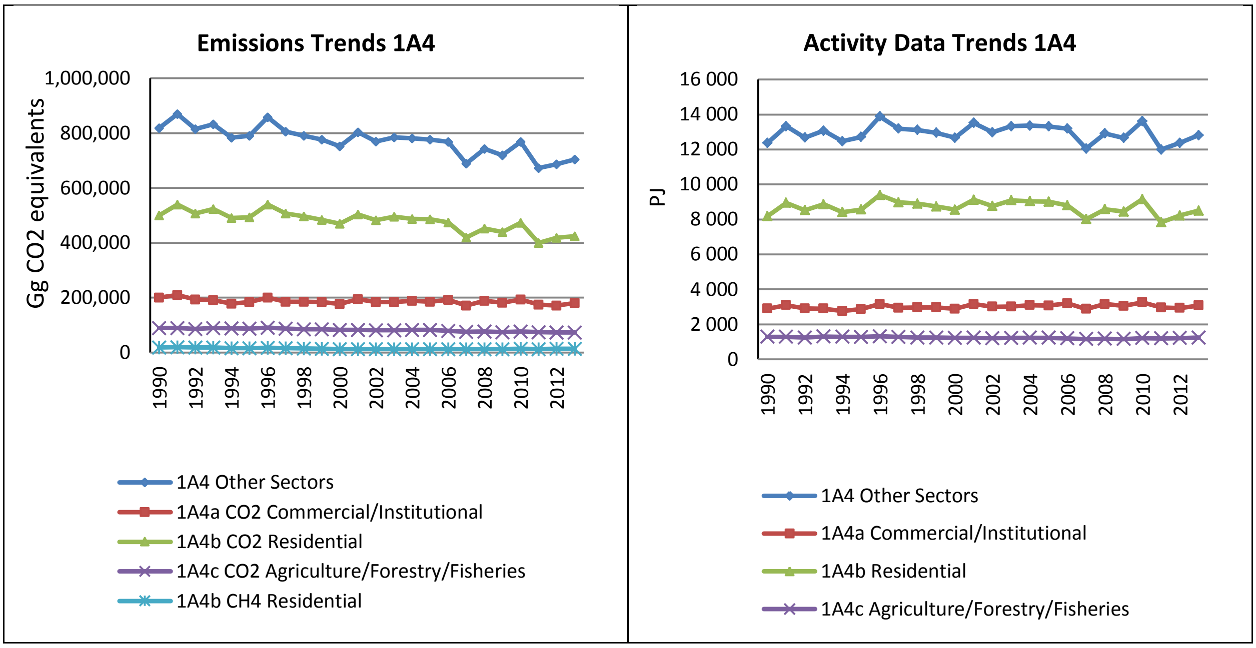
The following enumeration shows the correspondence of 1A4 sub categories and ISIC 3.1 rev codes:

- 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 2013 category 1A4 contributed to 703 899 Gg CO_2 equivalents of which 96.3 % CO_2, 2.5 % CH_4 and 1.2 % N_2O.

Figure 3.64 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 2013. Between 1990 and 2013 emissions from 1A4 decreased by 14 %. Between 2012 to 2013 emissions increased by 2.5 % (17 Mt CO_2 equivalents) which is mainly due to an increase of category 1A4a CO_2 emissions which increased by 4.9 % (+8 Mt CO_2) and category 1A4b CO_2 emissions which increased by 1.5 % (+6 Mt CO_2). The significant increase of 1A4a CO_2 emissions in the year 2013 is mostly influenced by Germany (+5.6 Mt CO_2), France (+ 2.1 Mt CO_2) and the United Kingdom (+1.3 Mt CO_2). The trend of 1A4b CO_2 emissions in the year 2013 is mostly influenced by Germany (+9.2 Mt CO_2), Belgium (+ 1.6 Mt CO_2) and Greece (-3.4 Mt CO_2).

Figure 3.64 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



In 2013 GHG emissions from source category 1A4 accounted for 16 % of total GHG emissions. This source category includes eleven key sources which contributed to 98% of total 1A4 GHG emissions in 2013. The following list shows the key sources and their contribution to total 1A4 GHG emissions for the year 2013:

- 1 A 4 a Commercial/Institutional: Liquid Fuels - CO_2 (6.2 %)
- 1 A 4 a Commercial/Institutional: Solid Fuels - CO_2 (0.7 %)
- 1 A 4 a Commercial/Institutional: Gaseous Fuels - CO_2 (18 %)
- 1 A 4 a Commercial/Institutional: Other Fuels – CO_2 (0.6 %)
- 1 A 4 b Residential: Liquid Fuels - CO_2 (15.9 %)
- 1 A 4 b Residential: Solid Fuels - CO_2 (5.8 %)
- 1 A 4 b Residential: Gaseous Fuels - CO_2 (38.4 %)
- 1 A 4 b Residential: Biomass - CH_4 (1.4 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels - CO_2 (8 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels - CO_2 (0.6 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels - CO_2 (1.8 %)

Table 3.66 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2013 CO_2 emissions from 1A4 Other Sectors decreased by 14 %, CH_4 decreased by 17 % and N_2O emissions increased by 2 %.

Table 3.66 1A4 Other Sectors: Member States' contributions to total GHG, CO_2 and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	14 471	9 238	13 785	8 807	461	242
Belgium	27 970	27 045	27 551	26 496	317	441
Bulgaria	8 108	2 082	7 629	1 686	286	309
Croatia	3 860	2 935	3 643	2 780	186	132
Cyprus	442	509	438	503	3	4
Czech Republic	31 187	12 991	29 651	12 254	1 387	636
Denmark	9 196	5 236	8 969	4 990	158	162
Estonia	2 038	672	1 881	504	103	125
Finland	7 574	4 379	7 266	4 017	223	295
France	100 373	99 296	94 214	96 102	4 704	1 575
Germany	207 205	150 990	203 098	149 101	3 131	1 366
Greece	8 512	5 087	8 066	4 903	102	110
Hungary	22 129	11 828	21 046	11 331	857	340
Ireland	10 586	9 025	10 031	8 756	451	190
Italy	78 974	86 374	76 933	81 487	583	2 432
Latvia	5 859	1 519	5 536	1 247	275	233
Lithuania	5 836	1 358	5 599	1 143	207	183
Luxembourg	1 331	1 708	1 316	1 687	11	11
Malta	97	135	96	134	0	0
Netherlands	37 419	40 330	36 825	38 681	545	1 600
Poland	57 220	60 476	53 733	55 864	2 811	3 652
Portugal	4 719	4 498	4 062	4 078	414	248
Romania	11 427	10 546	10 954	9 362	426	1 020
Slovakia	11 762	5 796	11 263	5 575	461	190
Slovenia	1 718	1 544	1 646	1 479	14	16
Spain	26 304	41 507	25 093	39 990	906	1 108
Sweden	10 792	3 085	10 341	2 708	293	279
United Kingdom	111 565	103 713	108 857	102 441	1 787	672
EU-28	**818 673**	**703 899**	**789 523**	**678 106**	**21 102**	**17 572**

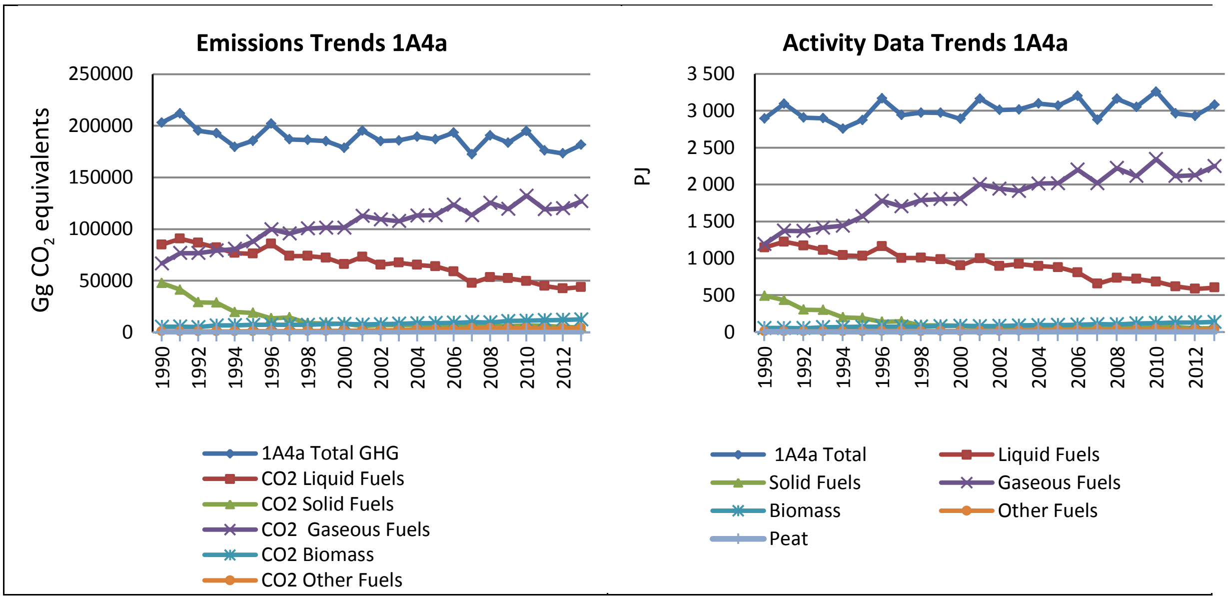
Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.4.1 Commercial/Institutional (1A4a)

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 3.9 % of total GHG emissions in 2013.

Figure 3.65 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Between 1990 and 2013 GHG emissions decreased by 6 %, mainly due to decreases in CO_2 emissions from solid (-89 %) and liquid (-48 %) fuels while CO_2 emissions from gaseous fuels increased by 90 % and showed an continuous uptrend for the whole time series until 2013. Between 2012 and 2013 the CO_2 emissions increased by 4.9 %, mainly driven by an increase in gaseous and liquid fuel consumption.

Figure 3.65 1A4a Commercial/Institutional: Total and CO_2 emission and activity trends



Between 1990 and 2013, CO_2 emissions from 1A4a decreased by 10 % in the EU-28 (Table 3.70). 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 increased by 4 % between 1990 and 2013 and biomass consumption increased by 150%

France, Germany, Italy and the United Kingdom contributed the most to the CO_2 emissions from this source (67 %). 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 and the Czech Republic (Table 3.67).

Table 3.67 1A4a Commercial/Institutional: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	2 569	1 425	1 016	1%	-408	-29%	-1 553	-60%	NA	NA
Belgium	4 288	5 696	6 226	3%	530	9%	1 938	45%	NA,T1	D,NA
Bulgaria	3 085	310	273	0%	-37	-12%	-2 811	-91%	T1	D
Croatia	779	542	509	0%	-33	-6%	-270	-35%	T1	D
Cyprus	83	102	90	0%	-12	-12%	7	8%	T1	D
Czech Republic	10 024	3 302	3 438	2%	136	4%	-6 586	-66%	T1,T2	CS,D
Denmark	1 486	915	919	1%	4	0%	-567	-38%	CR,M,T1,T2,T3	CS,D
Estonia	47	35	64	0%	30	86%	17	36%	T1,T2	CS,D
Finland	2 257	1 123	1 055	1%	-69	-6%	-1 202	-53%	M,T1,T3	CS,D
France	28 439	25 532	27 673	15%	2 141	8%	-767	-3%	-	-
Germany	64 198	34 918	40 557	23%	5 639	16%	-23 641	-37%	CS	CS
Greece	519	1 353	829	0%	-524	-39%	310	60%	T2	CS
Hungary	2 691	3 177	3 401	2%	223	7%	710	26%	T1,T2	CS,D
Ireland	2 319	2 105	1 936	1%	-169	-8%	-382	-16%	T2	CS
Italy	16 187	27 871	27 507	15%	-364	-1%	11 319	70%	T2	CS
Latvia	2 759	446	434	0%	-12	-3%	-2 325	-84%	T1,T2	CS,D
Lithuania	2 827	323	351	0%	29	9%	-2 476	-88%	T2	CS
Luxembourg	637	607	678	0%	71	12%	41	6%	T2	CS
Malta	62	68	65	0%	-3	-4%	3	5%	T1	D
Netherlands	8 379	11 401	11 858	7%	457	4%	3 479	42%	T2	CS,D
Poland	9 838	9 387	8 659	5%	-728	-8%	-1 179	-12%	T1	D
Portugal	745	1 083	1 059	1%	-24	-2%	315	42%	T1	D
Romania	NO	2 006	2 061	1%	55	3%	2 061	100%	NA	NA
Slovakia	4 148	1 831	2 407	1%	576	31%	-1 741	-42%	T2	CS
Slovenia	503	416	453	0%	38	9%	-50	-10%	T1,T2	CS,D
Spain	3 804	12 326	12 027	7%	-299	-2%	8 223	216%	NA,T2	CS,M,NA
Sweden	2 533	493	395	0%	-98	-20%	-2 138	-84%	NA	NA
United Kingdom	25 403	22 901	24 178	13%	1 276	6%	-1 225	-5%	T2	CS
EU-28	**200 608**	**171 694**	**180 117**	**100%**	**8 423**	**5%**	**-20 491**	**-10%**		

1A4 a Commercial/Institutional – Liquid Fuels (CO_2)

In 2013 CO_2 emissions from liquid fuels had a share of 24 % within source category 1A4a (compared to 42 % in 1990). Between 1990 and 2013, the emissions decreased by 48 % (Table 3.68). Seven Member States had increases in this period, with the highest absolute increase in Poland and Spain. The highest absolute decreases were achieved in France, Germany, Italy and the United Kingdom. Between 2012 and 2013 EU-28 total emissions increased by 3 %. 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).

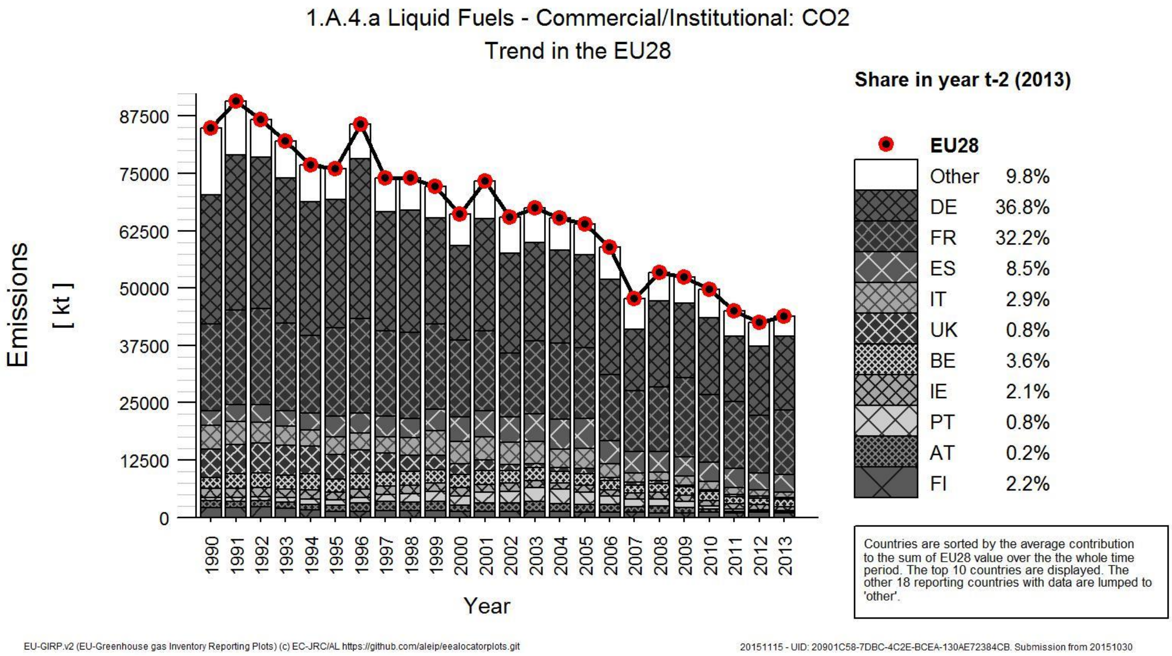
Table 3.68 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	1 422	188	77	0%	-110	-59%	-1 344	-95%
Belgium	2 315	1 439	1 560	4%	121	8%	-755	-33%
Bulgaria	2 986	107	73	0%	-33	-31%	-2 912	-98%
Croatia	531	224	190	0%	-34	-15%	-341	-64%
Cyprus	83	102	90	0%	-12	-12%	7	8%
Czech Republic	2 116	43	40	0%	-3	-8%	-2 076	-98%
Denmark	1 081	380	368	1%	-12	-3%	-713	-66%
Estonia	19	2	5	0%	4	228%	-14	-73%
Finland	2 196	1 027	958	2%	-69	-7%	-1 238	-56%
France	18 880	12 476	14 097	32%	1 621	13%	-4 783	-25%
Germany	28 226	15 159	16 141	37%	981	6%	-12 085	-43%
Greece	499	1 032	539	1%	-493	-48%	40	8%
Hungary	1 106	82	124	0%	42	51%	-983	-89%
Ireland	1 957	1 105	941	2%	-164	-15%	-1 016	-52%
Italy	5 199	1 332	1 280	3%	-52	-4%	-3 919	-75%
Latvia	1 007	136	142	0%	6	4%	-865	-86%
Lithuania	933	9	9	0%	0	-4%	-924	-99%
Luxembourg	467	237	229	1%	-9	-4%	-239	-51%
Malta	62	68	65	0%	-3	-4%	3	5%
Netherlands	619	252	308	1%	56	22%	-310	-50%
Poland	IE,NO	1 619	1 303	3%	-316	-20%	1 303	100%
Portugal	745	396	368	1%	-28	-7%	-377	-51%
Romania	NO	227	233	1%	6	3%	233	100%
Slovakia	384	7	8	0%	1	12%	-375	-98%
Slovenia	270	386	380	1%	-6	-2%	110	41%
Spain	3 254	3 753	3 744	9%	-10	0%	490	15%
Sweden	2 447	262	193	0%	-69	-26%	-2 254	-92%
United Kingdom	6 150	429	349	1%	-80	-19%	-5 801	-94%
EU-28	**84 954**	**42 480**	**43 815**	**100%**	**1 335**	**3%**	**-41 139**	**-48%**

From 1990 to 1993 Poland does not report any liquid fuels for stationary sources and reports liquid fuels from 'Off-road vehicles and other machinery' under category 1A3 and therefore the notation key 'IE, NO' is reported.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.66 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Germany and Spain; together they cause 78 % of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-28 decreased by 47 % between 1990 and 2013. The dip in activity data 2007 is mainly due to Germany due to reasons explained earlier in this chapter.

Figure 3.66 1A4a Commercial/Institutional, liquid fuels: Emission trend and share for CO_2



1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2013, CO_2 from solid fuels had a share of 3 % within source category 1A4a (compared to 23 % in 1990). Between 1990 and 2013 the emissions decreased by 89 % (Table 3.69). Twelve Member States report emissions as ‘Not occurring’ in 2013; all other Member States reduced emissions between 1990 and 2012 except Estonia, Romania and Spain. Between 2012 and 2013 EU-28 emissions decreased by 2 %.

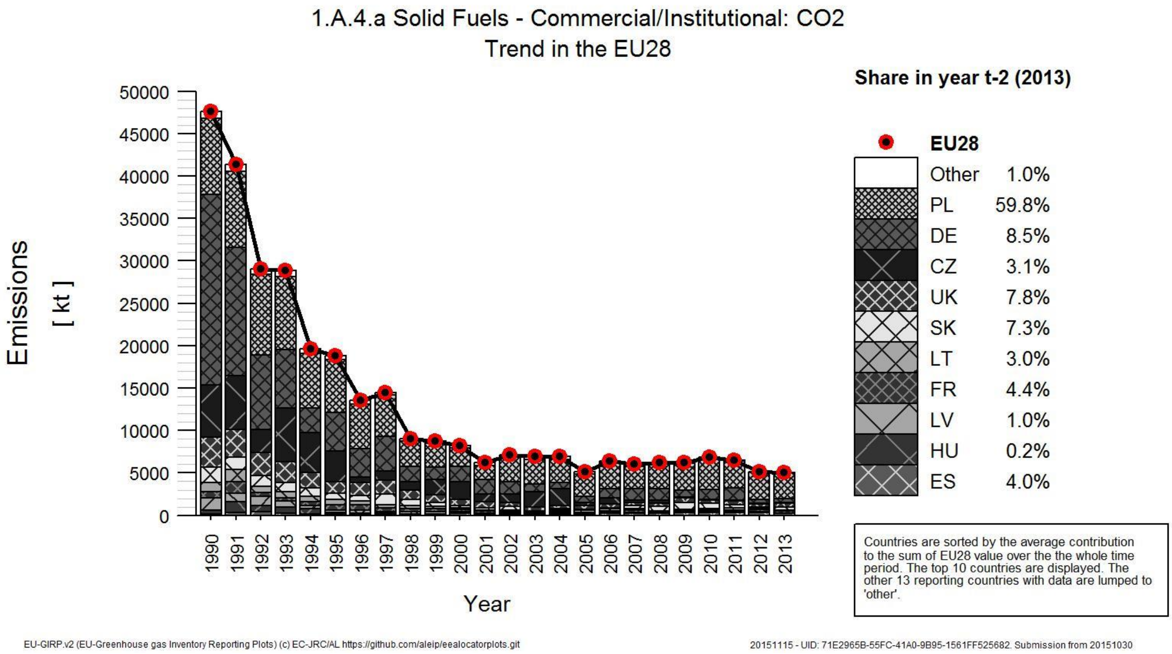
Table 3.69 1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	91	15	15	0%	0	1%	-76	-83%
Belgium	9	1	NO	-	-1	-100%	-9	-100%
Bulgaria	60	15	19	0%	5	31%	-41	-68%
Croatia	88	8	1	0%	-7	-86%	-87	-99%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	6 237	129	155	3%	26	20%	-6 082	-98%
Denmark	8	NO	NO	-	-	-	-8	-100%
Estonia	5	NO	8	0%	8	100%	4	82%
Finland	NO	NO	NO	-	-	-	-	-
France	693	278	220	4%	-58	-21%	-473	-68%
Germany	22 426	393	428	9%	35	9%	-21 999	-98%
Greece	20	IE,NO	IE,NO	-	-	-	-20	-100%
Hungary	475	3	10	0%	6	187%	-465	-98%
Ireland	3	NO	NO	-	-	-	-3	-100%
Italy	219	NO	NO	-	-	-	-219	-100%
Latvia	1 411	33	49	1%	16	47%	-1 362	-97%
Lithuania	1 173	124	151	3%	27	22%	-1 022	-87%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	128	5	5	0%	0	0%	-123	-96%
Poland	8 992	3 226	3 006	60%	-220	-7%	-5 987	-67%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	1	2	0%	1	50%	2	100%
Slovakia	1 729	171	364	7%	194	114%	-1 364	-79%
Slovenia	203	NO	NO	-	-	-	-203	-100%
Spain	154	353	199	4%	-154	-44%	45	29%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	3 530	366	392	8%	26	7%	-3 138	-89%
EU-28	**47 655**	**5 122**	**5 026**	**100%**	**-97**	**-2%**	**-42 629**	**-89%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.67 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland, Germany, Slovakia and the United Kingdom in 2013; together they cause 83 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-28 decreased by 89 % between 1990 and 2013.

Figure 3.67 1A4a Commercial/Institutional, solid fuels: Emission trend and share for CO_2



1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2013 CO_2 from gaseous fuels had a share of 70 % within source category 1A4a (compared to 33 % in 1990). Between 1990 and 2013, the emissions increased by 90 % (Table 3.70). All Member States except Latvia and Lithuania reported increasing emissions. The highest absolute increases occurred in Germany, France, Italy, Spain and the United Kingdom. Between 2012 and 2013 EU-28 emissions increased by 6 %.

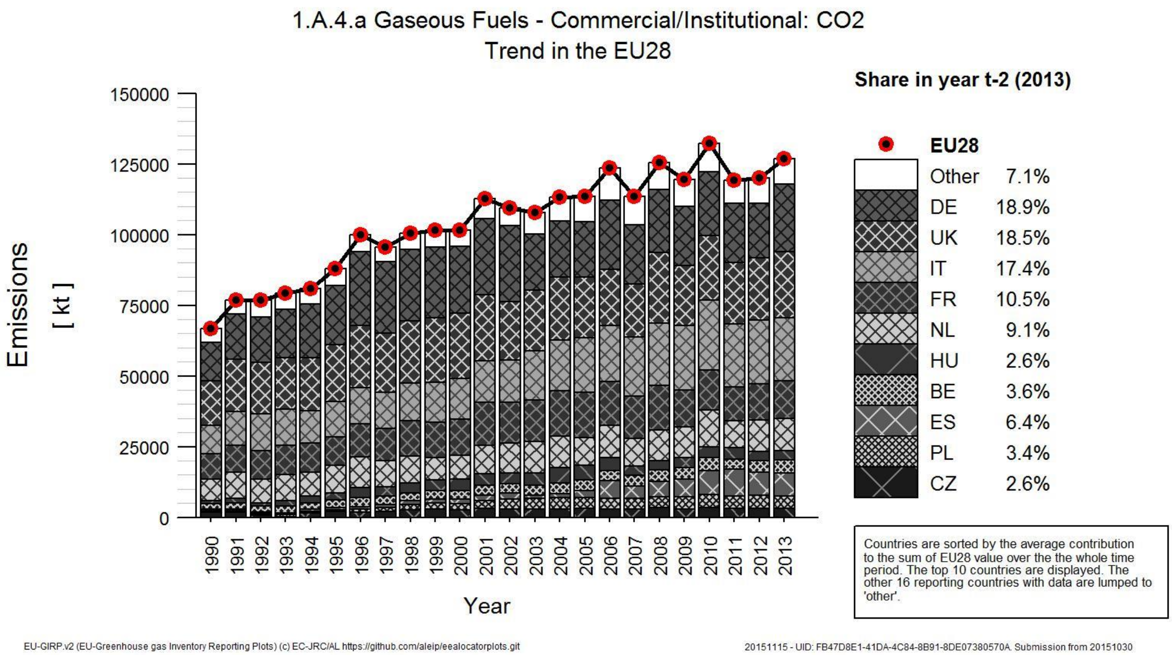
Table 3.70 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	707	1.219	919	1%	-301	-25%	212	30%
Belgium	1.934	4.182	4.564	4%	382	9%	2.630	136%
Bulgaria	39	189	181	0%	-8	-4%	142	364%
Croatia	160	310	318	0%	7	2%	158	99%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1.670	3.130	3.243	3%	113	4%	1.573	94%
Denmark	363	520	538	0%	18	3%	175	48%
Estonia	20	33	50	0%	17	53%	30	147%
Finland	45	83	85	0%	2	2%	40	88%
France	8.866	12.778	13.355	11%	577	5%	4.490	51%
Germany	13.547	19.366	23.989	19%	4.622	24%	10.442	77%
Greece	IE,NO	321	290	0%	-31	-10%	290	100%
Hungary	1.110	3.072	3.249	3%	177	6%	2.139	193%
Ireland	223	1.001	995	1%	-5	-1%	772	345%
Italy	10.243	22.633	22.105	17%	-527	-2%	11.862	116%
Latvia	274	273	243	0%	-30	-11%	-32	-12%
Lithuania	709	146	147	0%	0	0%	-562	-79%
Luxembourg	170	370	449	0%	79	21%	279	165%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	7.632	11.145	11.545	9%	400	4%	3.913	51%
Poland	773	4.538	4.292	3%	-246	-5%	3.518	455%
Portugal	NO	687	691	1%	4	1%	691	100%
Romania	NO	1.778	1.826	1%	48	3%	1.826	100%
Slovakia	2.035	1.653	2.034	2%	381	23%	-1	0%
Slovenia	29	29	73	0%	44	149%	44	152%
Spain	395	8.219	8.084	6%	-135	-2%	7.689	1945%
Sweden	86	231	202	0%	-29	-13%	116	134%
United Kingdom	15.723	22.106	23.436	18%	1.330	6%	7.713	49%
EU-28	**66.753**	**120.012**	**126.902**	**100%**	**6.890**	**6%**	**60.148**	**90%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.68 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Germany, Italy, the Netherlands and the UK; together they cause 74 % of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion in the EU-28 rose by 87 % between 1990 and 2013.

Figure 3.68 1A4a Commercial/Institutional, gaseous fuels: Emission trend and share for CO_2



1A4a Commercial/Institutional – Other Fossil Fuels (CO_2)

Under this key source Member States report CO_2 emissions from waste incineration plants with energy recovery, whose main economic activity is the treatment of waste.

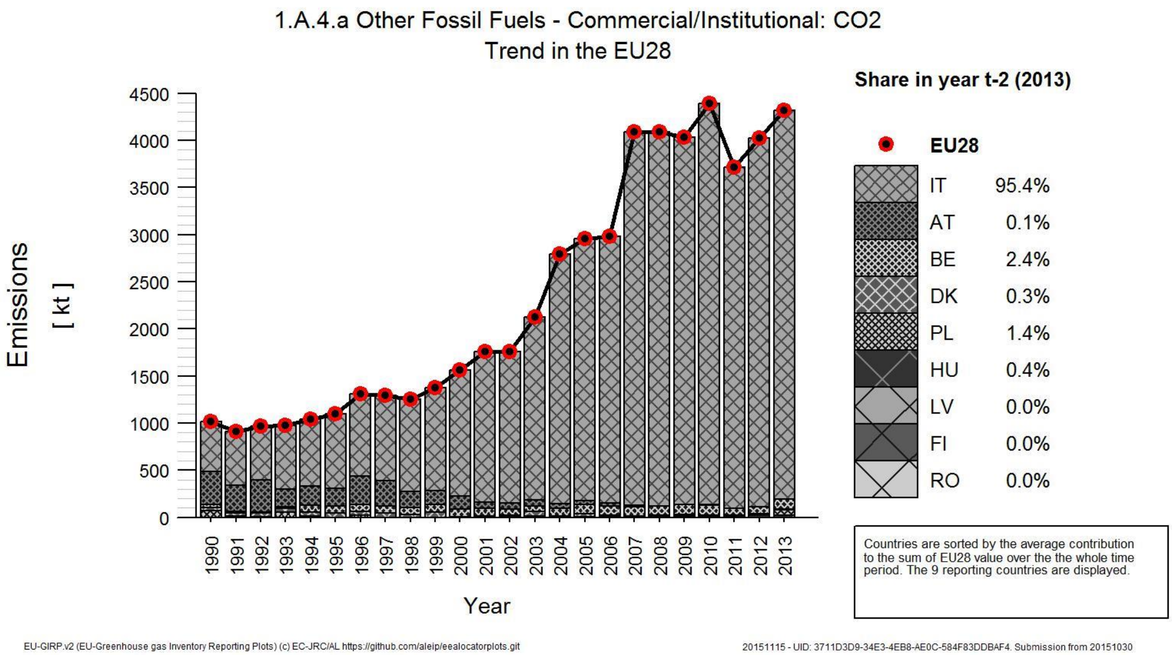
In 2013, CO_2 from other fossil fuels had a share of 4 %. Between 1990 and 2013 the emissions increased by 326 % (Table 3.71). 21 Member States report emissions as 'Not occurring' in 2013; all other Member States reduced emissions between 1990 and 2013 except Italy and Belgium. Between 2012 and 2013 EU-28 emissions increased by 7 %. Emissions trend and emissions level are strongly dominated by Italy.

Table 3.71: 1A4a Commercial/Institutional, other fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	350	3	5	0%	2	93%	-345	-99%
Belgium	31	74	102	2%	28	38%	71	232%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	34	14	13	0%	-2	-12%	-21	-63%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	0	NO	NO	-	-	-	0	-100%
France	NO	NO	NO	-	-	-	-	-
Germany	NA	NA	NA	-	-	-	-	-
Greece	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Hungary	NO	20	18	0%	-2	-9%	18	100%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	526	3 906	4 121	95%	215	6%	3 595	683%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	72	4	59	1%	55	1418%	-14	-19%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	0	0%	0	100%	0	100%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**1 013**	**4 021**	**4 318**	**100%**	**297**	**7%**	**3 305**	**326%**

Figure 3.69 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Italy; it causes 95 % of the CO_2 emissions from other fuels in 1A4a.

Figure 3.69 1A4a Commercial/Institutional, other fuels: Emission trend and share for CO_2

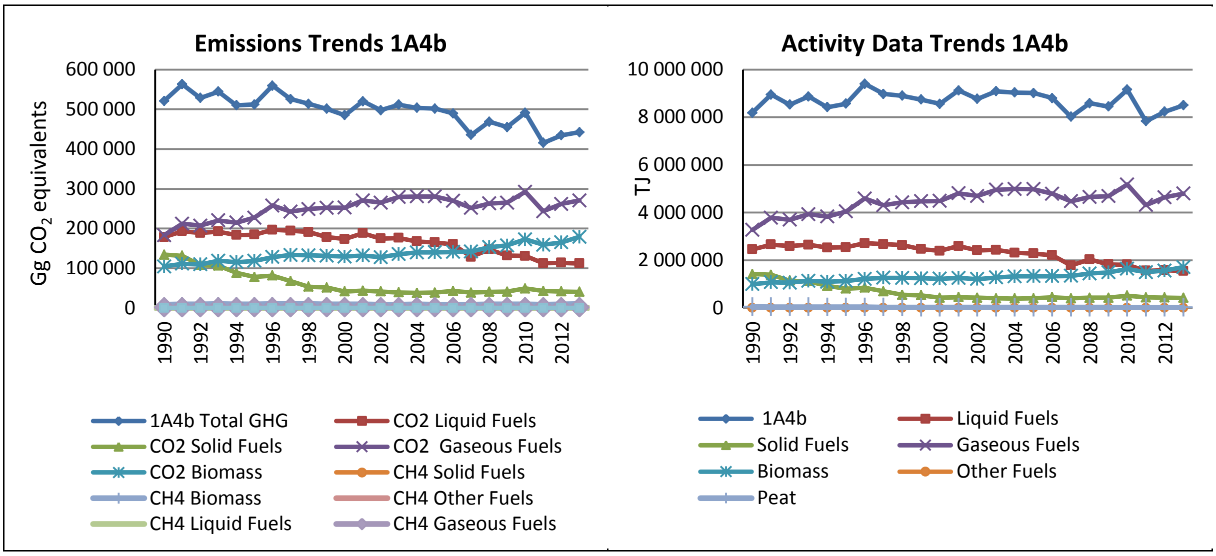


3.2.4.2 Residential (1A4b)

In this chapter information about emission trends, Member States' contribution and activity data is provided for category 1A4b by fuels. CO_2 emissions from 1A4b Residential are the sixth largest key category of GHG emissions in the EU-28 and account for 9.5 % of total GHG emissions in 2013.

Figure 3.70 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 15% since 1990, although CO_2 emissions from gaseous fuels increased strongly (+48 %) which was counterbalanced by decreasing emissions from other fossil fuels. Biomass consumption had a share of 20% in the year 2013

Figure 3.70 1A4b Residential: Total, CO_2 and CH_4 emission and activity trends



CO_2 emissions from 1A4b Residential

Between 1990 and 2013, CO_2 emissions from households decreased by 15 % in the EU-28 (Table 3.27). 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 building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) the use of district heating. Fossil fuel consumption of households decreased by 6 % between 1990 and 2013, with a fuel shift from coal and oil to natural gas.

Between 1990 and 2013, the largest reduction in absolute terms was reported by Germany reducing emissions by 25.7 million tonnes. Only seven 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 2012and 2013 8 Member States show an increase in emissions with the largest increase reported by Germany (+9.2 Mt CO_2).

Table 3.72 1A4b Residential: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	9 963	6 898	6 977	2%	79	1%	-2 986	-30%	NA	NA
Belgium	20 468	16 636	18 234	4%	1 599	10%	-2 234	-11%	CS,NA,T1,T3	D,NA
Bulgaria	2 891	1 138	934	0%	-204	-18%	-1 958	-68%	T1,T2	CS,D
Croatia	2 029	1 750	1 636	0%	-114	-7%	-393	-19%	NA,T1	D,NA
Cyprus	300	406	337	0%	-69	-17%	37	12%	T1	D
Czech Republic	15 837	7 235	7 572	2%	337	5%	-8 265	-52%	NA,T1,T2	CS,D,NA
Denmark	5 004	2 323	2 151	1%	-171	-7%	-2 852	-57%	CR,M,T1,T2,T3	CS,D
Estonia	1 338	205	193	0%	-11	-6%	-1 145	-86%	T1,T2	CS,D
Finland	3 147	1 642	1 476	0%	-166	-10%	-1 671	-53%	M,NA,T1,T3	CS,D,NA
France	54 966	55 928	56 942	13%	1 014	2%	1 976	4%	-	-
Germany	128 638	93 700	102 892	24%	9 192	10%	-25 746	-20%	CS	CS
Greece	4 654	7 014	3 588	1%	-3 425	-49%	-1 065	-23%	T1,T2	CS,D
Hungary	15 717	7 417	6 675	2%	-742	-10%	-9 042	-58%	T1,T2	CS,D
Ireland	7 052	6 051	6 203	1%	152	3%	-849	-12%	T2	CS
Italy	52 371	47 547	47 193	11%	-354	-1%	-5 178	-10%	T2	CS
Latvia	1 198	456	436	0%	-20	-4%	-762	-64%	T1,T2	CS,D
Lithuania	2 362	744	698	0%	-46	-6%	-1 664	-70%	T2	CS
Luxembourg	663	984	956	0%	-28	-3%	293	44%	T1,T2	CS,D
Malta	35	50	49	0%	-1	-2%	14	41%	T1	D
Netherlands	19 495	17 942	19 019	4%	1 077	6%	-476	-2%	T2	CS,D
Poland	35 383	38 079	37 049	9%	-1 030	-3%	1 666	5%	T1	D
Portugal	1 656	2 031	1 949	0%	-82	-4%	294	18%	-	-
Romania	8 956	6 539	6 314	1%	-225	-3%	-2 642	-29%	T1,T2	CS,D
Slovakia	7 070	3 070	3 065	1%	-6	0%	-4 005	-57%	T2	CS
Slovenia	809	940	818	0%	-122	-13%	9	1%	NA,T1,T2	CS,D,NA
Spain	12 979	16 637	15 852	4%	-785	-5%	2 873	22%	NA,T2	CS,M,NA,OTH
Sweden	6 286	874	863	0%	-11	-1%	-5 423	-86%	NA	NA
United Kingdom	78 247	73 975	74 261	18%	286	0%	-3 986	-5%	T1,T2,T3	CS,D
EU-28	**499 513**	**418 210**	**424 333**	**100%**	**6 123**	**1%**	**-75 181**	**-15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2013 CO_2 from liquid fuels had a share of 25 % within source category 1A4b (compared to 34 % in 1990). Between 1990 and 2013 emissions decreased by 37 % (Table 3.73). The highest absolute increases showed Poland, Ireland and the United Kingdom. The highest absolute decreases were reported by Germany, France, Italy and Sweden. Between 2012 and 2013 EU-28 emissions decreased by 1 %. 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).

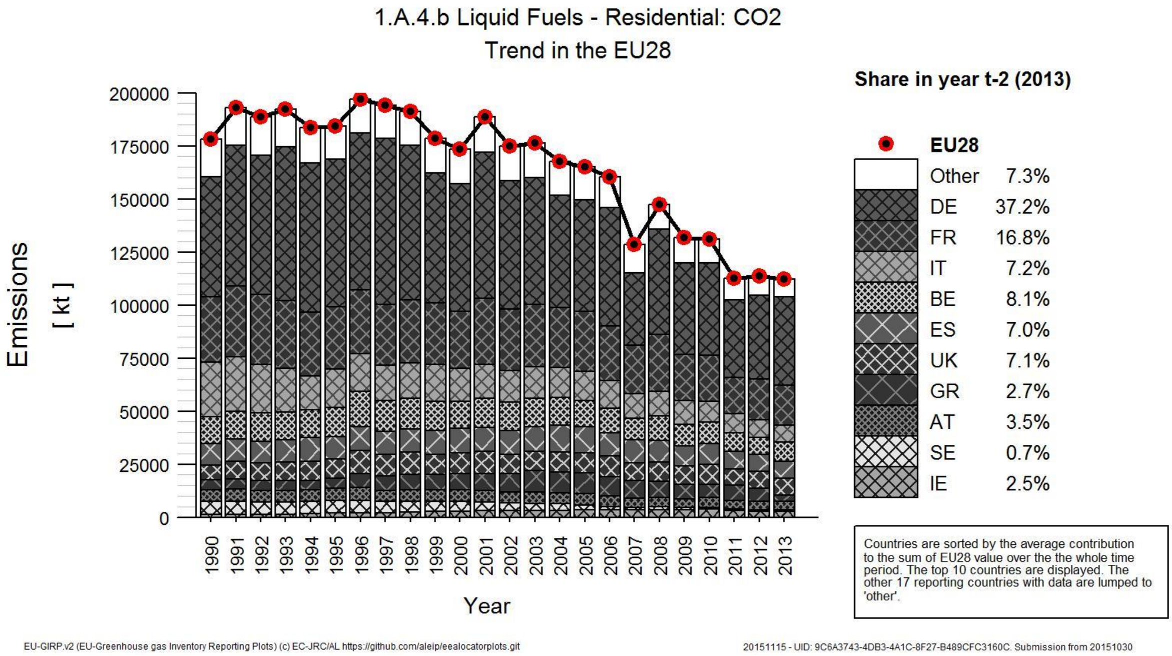
Table 3.73 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	5 605	3 893	3 930	4%	37	1%	-1 675	-30%
Belgium	12 798	8 181	9 117	8%	936	11%	-3 681	-29%
Bulgaria	158	67	64	0%	-3	-5%	-94	-60%
Croatia	1 137	532	472	0%	-60	-11%	-665	-58%
Cyprus	300	406	337	0%	-69	-17%	37	12%
Czech Republic	239	12	12	0%	0	0%	-227	-95%
Denmark	3 944	712	557	0%	-156	-22%	-3 387	-86%
Estonia	545	39	37	0%	-3	-7%	-508	-93%
Finland	3 022	1 545	1 390	1%	-155	-10%	-1 632	-54%
France	30 979	19 352	18 816	17%	-535	-3%	-12 162	-39%
Germany	56 384	39 389	41 629	37%	2 241	6%	-14 755	-26%
Greece	4 565	6 290	3 044	3%	-3 246	-52%	-1 521	-33%
Hungary	3 459	264	39	0%	-225	-85%	-3 420	-99%
Ireland	1 175	2 734	2 754	2%	20	1%	1 578	134%
Italy	25 540	8 324	8 020	7%	-304	-4%	-17 520	-69%
Latvia	330	154	154	0%	0	0%	-176	-53%
Lithuania	397	165	138	0%	-27	-16%	-259	-65%
Luxembourg	467	509	529	0%	19	4%	61	13%
Malta	35	50	49	0%	-1	-2%	14	41%
Netherlands	737	265	265	0%	0	0%	-473	-64%
Poland	107	1 730	1 621	1%	-110	-6%	1 514	1409%
Portugal	1 656	1 426	1 375	1%	-51	-4%	-281	-17%
Romania	922	529	541	0%	12	2%	-381	-41%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	439	667	552	0%	-115	-17%	113	26%
Spain	9 971	7 863	7 893	7%	30	0%	-2 077	-21%
Sweden	6 200	784	764	1%	-20	-3%	-5 436	-88%
United Kingdom	7 097	7 834	7 952	7%	118	2%	855	12%
EU-28	**178 208**	**113 718**	**112 050**	**100%**	**-1 668**	**-1%**	**-66 157**	**-37%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.71 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Belgium, France, Germany, Italy, Spain and the United Kingdom; together they cause 76 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-28 decreased by 37 % between 1990 and 2013.

Figure 3.71 1A4b Residential, liquid fuels: Emission trend and share for CO_2



1A4b Residential –Solid Fuels (CO_2)

In 2013 CO_2 from solid fuels had a share of 9 % within source category 1A4b (compared to 26 % in 1990). Between 1990 and 2013 the emissions decreased by 70 % (Table 3.74). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the United Kingdom, the Czech Republic, Hungary and Slovakia. Between 2012 and 2013 EU-28 emissions decreased by 2 %. Cyprus, Malta, Sweden and Portugal report emissions as 'Not occurring'.

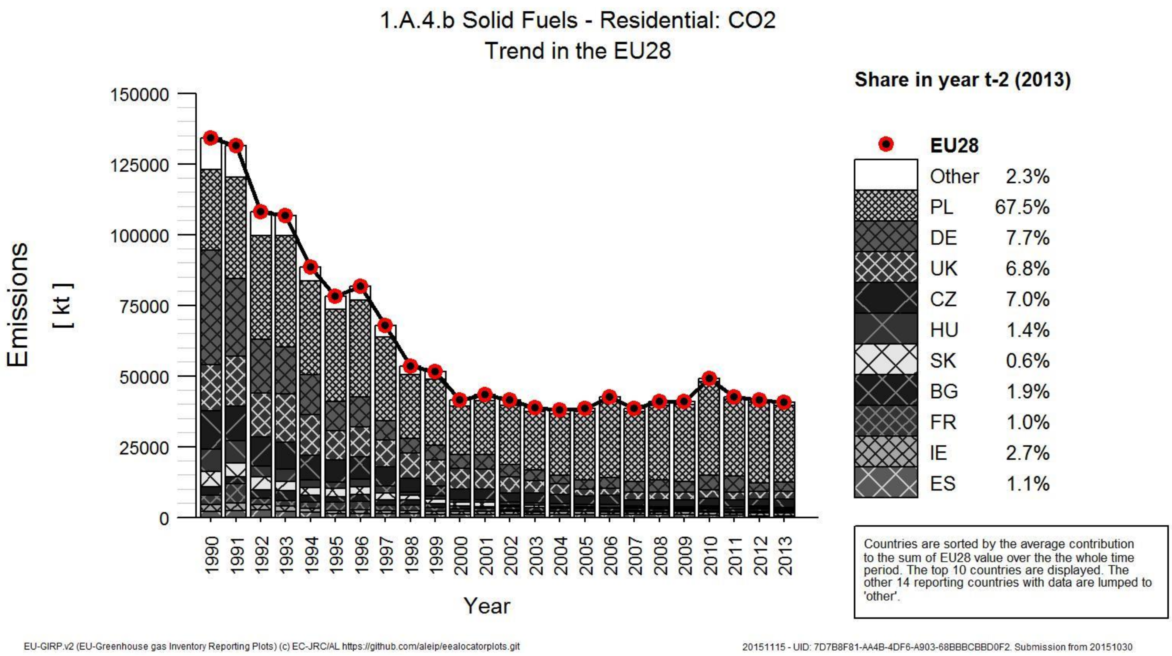
Table 3.74 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	2 511	149	148	0%	0	0%	-2 362	-94%
Belgium	1 796	309	369	1%	60	19%	-1 428	-79%
Bulgaria	2 734	947	766	2%	-181	-19%	-1 968	-72%
Croatia	436	13	17	0%	4	31%	-420	-96%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	13 500	2 538	2 850	7%	312	12%	-10 650	-79%
Denmark	72	2	2	0%	-1	-22%	-70	-98%
Estonia	338	23	23	0%	0	0%	-315	-93%
Finland	33	1	1	0%	0	-13%	-32	-96%
France	3 327	500	396	1%	-104	-21%	-2 931	-88%
Germany	40 661	3 063	3 134	8%	71	2%	-37 527	-92%
Greece	89	2	4	0%	2	123%	-85	-96%
Hungary	8 107	650	576	1%	-74	-11%	-7 530	-93%
Ireland	2 483	972	1 099	3%	127	13%	-1 385	-56%
Italy	707	12	12	0%	0	0%	-695	-98%
Latvia	606	55	50	0%	-4	-8%	-556	-92%
Lithuania	1 440	187	198	0%	10	6%	-1 242	-86%
Luxembourg	26	2	3	0%	1	42%	-24	-90%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	61	18	18	0%	0	0%	-43	-70%
Poland	28 420	28 417	27 396	67%	-1 021	-4%	-1 025	-4%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	2 810	91	85	0%	-6	-7%	-2 725	-97%
Slovakia	5 441	396	248	1%	-149	-38%	-5 194	-95%
Slovenia	345	2	1	0%	-1	-42%	-344	-100%
Spain	2 091	537	460	1%	-77	-14%	-1 631	-78%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	16 196	2 642	2 748	7%	106	4%	-13 449	-83%
EU-28	**134 229**	**41 526**	**40 601**	**100%**	**-925**	**-2%**	**-93 628**	**-70%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.72 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland, Germany, the Czech Republic and the United Kingdom; together they cause 89 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-28 decreased by 70 % between 1990 and 2013.

Figure 3.72 1A4b Residential, solid fuels: Emission trend and share for CO_2



1A4b Residential – Gaseous Fuels (CO_2)

In 2013, CO_2 from gaseous fuels had a share of 61 % within source category 1A4b (compared to 35 % in 1990). Between 1990 and 2013, the emissions increased by 48 % (Table 3.75). All Member States except Lithuania reported increasing emissions. The highest absolute increase occurred in Germany, France, the United Kingdom, Spain and Italy. Between 2012 and 2013, EU-28 emissions increased by 3 %.

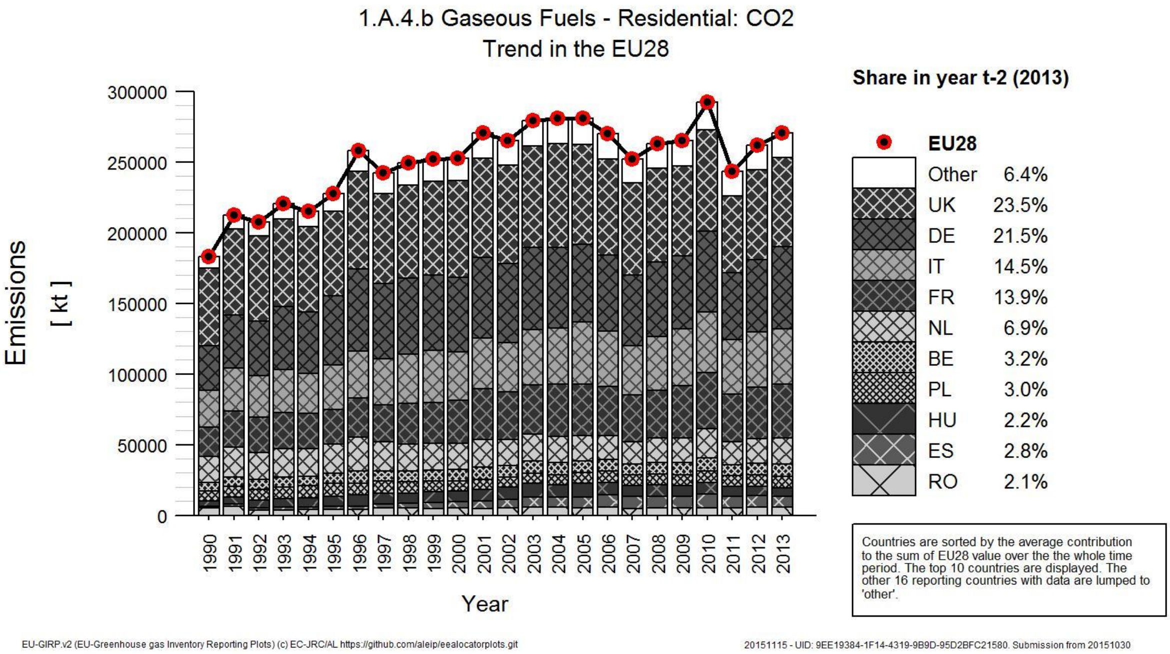
Table 3.75 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	1 847	2 855	2 897	1%	42	1%	1 050	57%
Belgium	5 874	8 146	8 749	3%	603	7%	2 875	49%
Bulgaria	NO	124	104	0%	-19	-16%	104	100%
Croatia	456	1 205	1 147	0%	-58	-5%	691	152%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	2 098	4 685	4 710	2%	25	1%	2 612	124%
Denmark	988	1 608	1 593	1%	-15	-1%	605	61%
Estonia	116	126	117	0%	-9	-7%	1	1%
Finland	25	75	66	0%	-8	-11%	41	162%
France	20 660	36 077	37 730	14%	1 653	5%	17 069	83%
Germany	31 564	51 248	58 129	21%	6 881	13%	26 565	84%
Greece	IE,NO	722	541	0%	-182	-25%	541	100%
Hungary	4 152	6 503	6 060	2%	-443	-7%	1 909	46%
Ireland	270	1 430	1 421	1%	-9	-1%	1 151	427%
Italy	26 124	39 211	39 161	14%	-50	0%	13 037	50%
Latvia	220	247	231	0%	-16	-6%	12	5%
Lithuania	510	313	285	0%	-28	-9%	-225	-44%
Luxembourg	170	472	425	0%	-48	-10%	255	150%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	18 696	17 659	18 736	7%	1 077	6%	40	0%
Poland	6 856	7 932	8 033	3%	100	1%	1 177	17%
Portugal	NO	605	574	0%	-31	-5%	574	100%
Romania	5 225	5 919	5 689	2%	-230	-4%	464	9%
Slovakia	1 628	2 674	2 817	1%	143	5%	1 188	73%
Slovenia	25	271	265	0%	-7	-2%	240	955%
Spain	918	8 237	7 499	3%	-738	-9%	6 582	717%
Sweden	86	90	99	0%	9	10%	13	15%
United Kingdom	54 478	63 452	63 514	23%	62	0%	9 036	17%
EU-28	**182 986**	**261 887**	**270 593**	**100%**	**8 706**	**3%**	**87 607**	**48%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.73 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Germany, Italy and the United Kingdom; together they cause 73 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-28 rose 47 % between 1990 and 2013.

Figure 3.73 1A4b Residential, gaseous fuels: Emission trend and share for CO_2



CH_4 emissions from 1A4b Residential

CH_4 emissions mainly occur from incomplete biomass and coal combustion in the EU-28.CH_4 emissions from 1A4b Residential accounted for 0.3 % of total GHG emissions in 2013. Between 1990 and 2013, CH_4 emissions from households decreased by 22 % in the EU-28 (Table 3.76). France and the United Kingdom reported the highest decrease in emissions and Italy reported the highest increase in emissions. Between 2012 and 2013 EU-28 emissions increased by 7 %.

Table 3.76 1A4b Residential: Member States' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	450	219	220	2%	0	0%	-230	-51%	NA	NA
Belgium	270	243	270	2%	27	11%	0	0%	CS,NA,T1,T3	CR,D,NA
Bulgaria	262	311	295	2%	-16	-5%	33	13%	T1	D
Croatia	181	134	127	1%	-7	-5%	-53	-30%	NA,T1	D,NA
Cyprus	2	3	3	0%	0	-14%	1	43%	T1	D
Czech Republic	1 226	567	615	4%	48	8%	-611	-50%	NA,T1	D,NA
Denmark	118	129	117	1%	-12	-9%	-1	-1%	CR,M,T1,T2,T3	CS,D,OTH
Estonia	95	125	122	1%	-4	-3%	27	29%	T1	D
Finland	198	296	271	2%	-26	-9%	73	37%	M,NA,T1,T3	CS,D,NA
France	4 596	1 456	1 477	10%	22	1%	-3 119	-68%	-	-
Germany	1 445	730	751	5%	21	3%	-695	-48%	T3	CS,M
Greece	92	98	97	1%	0	0%	5	5%	T1	D
Hungary	827	290	288	2%	-3	-1%	-540	-65%	T1	D
Ireland	443	165	176	1%	11	7%	-267	-60%	T1	D
Italy	523	1 264	2 283	16%	1 019	81%	1 760	337%	T2	CR
Latvia	203	215	187	1%	-28	-13%	-16	-8%	T1	D
Lithuania	175	174	169	1%	-5	-3%	-6	-4%	T1,T2	CS,D
Luxembourg	9	8	10	0%	1	16%	1	10%	T1	D
Malta	0	0	0	0%	0	-3%	0	54%	T1	D
Netherlands	434	449	471	3%	23	5%	37	9%	T1,T2	CS,D
Poland	2 445	3 155	3 071	22%	-84	-3%	626	26%	T1	D
Portugal	410	239	244	2%	5	2%	-166	-40%	-	-
Romania	416	1 053	997	7%	-56	-5%	582	140%	T1	D
Slovakia	452	196	173	1%	-23	-12%	-279	-62%	T1	D
Slovenia	11	16	15	0%	0	-1%	5	45%	NA,T1	D,NA
Spain	879	913	915	6%	2	0%	37	4%	NA,T2	CR,NA
Sweden	283	250	239	2%	-10	-4%	-44	-15%	NA	NA
United Kingdom	1 704	556	559	4%	3	0%	-1 145	-67%	T1,T2,T3	CS,D
EU-28	**18 150**	**13 255**	**14 164**	**100%**	**910**	**7%**	**-3 985**	**-22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2013 CH_4 from biomass had a share of 2.3 % within source category 1A4b (compared to 1.7 % in 1990). Between 1990 and 2013 the emissions decreased by 17 % (Table 3.77). France reported the highest absolute decrease, while Italy's CH_4 emissions increased significantly (+416 %). Between 2012 and 2013, EU-28 emissions increased by 11 %.

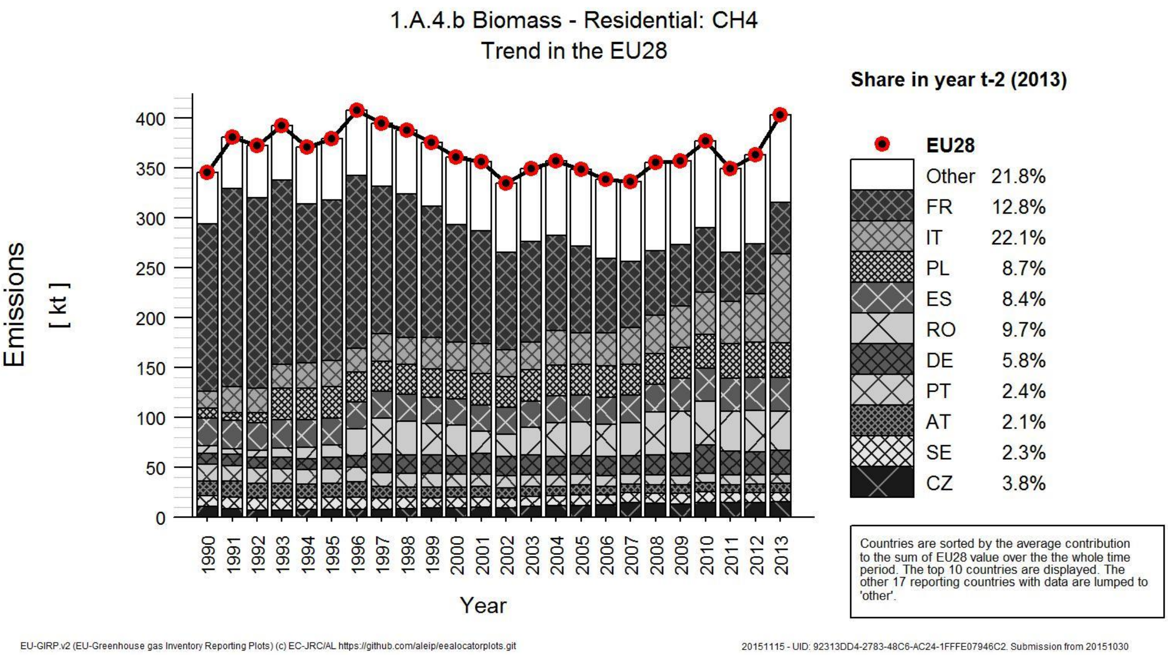
Table 3.77 1A4b Residential, biomass: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	374	214	214	2%	0	0%	-160	-43%
Belgium	71	172	190	2%	18	11%	119	167%
Bulgaria	54	238	235	2%	-3	-1%	181	335%
Croatia	143	129	122	1%	-7	-5%	-21	-15%
Cyprus	1	2	2	0%	0	-12%	1	69%
Czech Republic	254	360	382	4%	22	6%	128	50%
Denmark	109	119	110	1%	-9	-8%	1	1%
Estonia	40	122	118	1%	-3	-3%	78	195%
Finland	181	286	261	3%	-25	-9%	80	44%
France	4 179	1 266	1 294	13%	28	2%	-2 886	-69%
Germany	280	577	589	6%	12	2%	309	110%
Greece	91	96	96	1%	0	1%	5	6%
Hungary	186	227	232	2%	5	2%	46	24%
Ireland	14	9	9	0%	0	3%	-5	-36%
Italy	432	1 208	2 228	22%	1 020	84%	1 796	416%
Latvia	150	209	181	2%	-27	-13%	31	21%
Lithuania	58	153	147	1%	-6	-4%	88	151%
Luxembourg	5	5	7	0%	1	24%	2	39%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	98	130	134	1%	3	3%	35	36%
Poland	258	876	876	9%	0	0%	619	240%
Portugal	409	238	243	2%	5	2%	-165	-40%
Romania	181	1 031	976	10%	-55	-5%	796	440%
Slovakia	36	159	151	1%	-8	-5%	115	319%
Slovenia	10	15	15	0%	0	0%	5	46%
Spain	695	836	848	8%	12	1%	153	22%
Sweden	277	246	235	2%	-10	-4%	-41	-15%
United Kingdom	56	155	183	2%	28	18%	127	225%
EU-28	**8 643**	**9 077**	**10 078**	**100%**	**1 002**	**11%**	**1 435**	**17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.74 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Poland, Italy, Romania and Spain; together they cause 62 % of the CH_4 emissions from biomass fuels in 1A4b. Biomass fuel consumption in the EU-28 rose by 71 % between 1990 and 2013.

Figure 3.74 1A4b Residential, biomass: Emission trend and share for CH_4

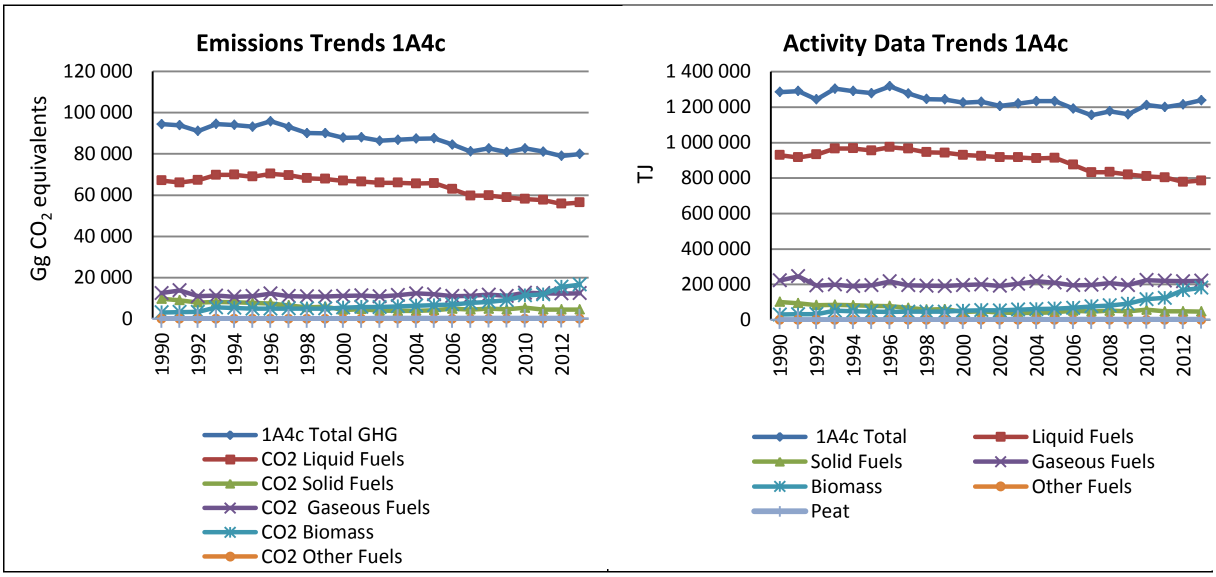


3.2.4.1 Agriculture/Forestry/Fisheries (1A4c)

In this chapter information about emission trends, Member States' contribution and activity data is provided for category 1A4c by fuels. CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries accounted for 2 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 18 % in the EU-28 (Table 3.78).

Figure 3.75 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 15 %, mainly due to decreases in CO_2 emissions from liquid fuels (-16 %).

Figure 3.75 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



Only five Member States, France, Poland, Italy, the Netherlands and Spain together contributed 66 % to the emissions from this source in 2013. Spain and Poland were the Member State with the highest increase in absolute terms between 1990 and 2013, while the highest decreases were achieved in the Czech Republic, Germany, Greece and Italy.

Table 3.78 1A4c Agriculture/Forestry/Fisheries: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	1 253	819	814	1%	-4	-1%	-438	-35%	NA	NA
Belgium	2 795	1 934	2 036	3%	102	5%	-759	-27%	CS,NA,T1,T3	D,NA
Bulgaria	1 653	489	478	1%	-11	-2%	-1 175	-71%	T1	D
Croatia	835	649	635	1%	-14	-2%	-200	-24%	NA,T1	D,NA
Cyprus	55	79	76	0%	-3	-4%	21	37%	T1	D
Czech Republic	3 790	1 209	1 244	2%	35	3%	-2 546	-67%	NA,T1,T2	CS,D,NA
Denmark	2 479	1 876	1 919	3%	43	2%	-560	-23%	CR,M,T1,T2,T3	CS,D
Estonia	496	251	246	0%	-5	-2%	-249	-50%	NA,T1,T2	CS,D,NA
Finland	1 863	1 528	1 486	2%	-41	-3%	-377	-20%	M,NA,T1,T3	CS,D,NA
France	10 809	10 959	11 488	16%	529	5%	679	6%	NA	NA
Germany	10 262	5 323	5 652	8%	328	6%	-4 610	-45%	CS,NA	CS,NA
Greece	2 893	890	486	1%	-404	-45%	-2 407	-83%	T2	CS,NO
Hungary	2 638	885	1 254	2%	370	42%	-1 384	-52%	T1,T2	CS,D
Ireland	660	691	616	1%	-75	-11%	-44	-7%	NA,T1,T2	CS,D,NA
Italy	8 375	6 862	6 787	9%	-74	-1%	-1 588	-19%	T2	CS
Latvia	1 579	377	378	1%	1	0%	-1 201	-76%	NA,T1,T2	CS,D,NA
Lithuania	410	100	94	0%	-5	-5%	-315	-77%	NA,T2	CS,NA
Luxembourg	16	53	53	0%	0	0%	38	239%	T2	CS
Malta	NE,IE	23	20	0%	-2	-10%	20	100%	NA	NA
Netherlands	8 951	7 843	7 804	11%	-39	0%	-1 147	-13%	T2	CS,D
Poland	8 512	10 406	10 156	14%	-250	-2%	1 644	19%	T1	D
Portugal	1 661	1 033	1 069	1%	36	3%	-592	-36%	T1	D
Romania	1 998	1 151	987	1%	-164	-14%	-1 011	-51%	NA,T1,T2	CS,D,NA
Slovakia	45	87	103	0%	16	18%	58	128%	NA,T1,T2	CS,D,NA
Slovenia	334	211	208	0%	-3	-1%	-126	-38%	NA,T1	D,NA
Spain	8 310	11 607	12 110	16%	503	4%	3 800	46%	T2,T3	CS,M
Sweden	1 522	1 465	1 450	2%	-15	-1%	-72	-5%	NA	NA
United Kingdom	5 208	4 108	4 003	5%	-106	-3%	-1 205	-23%	T1,T2,T3	CS,D
EU-28	**89 402**	**72 909**	**73 656**	**100%**	**748**	**1%**	**-15 745**	**-18%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4c Agriculture/Forestry/Fisheries – Liquid Fuels (CO_2)

In 2013 CO_2 from liquid fuels had a share of 71 % within source category 1A4c (compared to 71 % in 1990). Between 1990 and 2013 the emissions decreased by 16 % (Table 3.79). Only nine Member States reported increasing emissions with the highest increases in absolute terms in Spain and Poland. Between 2012 and 2013 EU-28 emissions increased by 1 %.

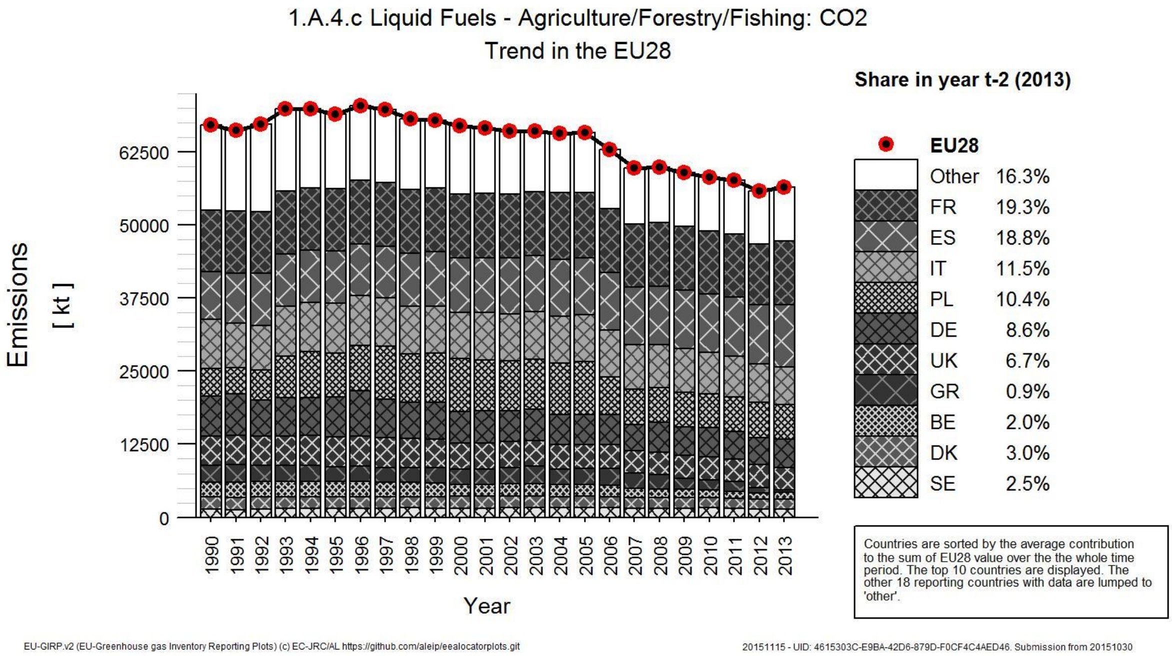
Table 3.79 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	1 181	783	778	1%	-5	-1%	-403	-34%
Belgium	2 515	1 090	1 138	2%	48	4%	-1 378	-55%
Bulgaria	1 498	420	404	1%	-16	-4%	-1 094	-73%
Croatia	788	610	595	1%	-15	-2%	-193	-24%
Cyprus	55	79	76	0%	-3	-4%	21	37%
Czech Republic	1 655	1 049	1 052	2%	3	0%	-602	-36%
Denmark	2 114	1 648	1 664	3%	17	1%	-450	-21%
Estonia	476	249	245	0%	-4	-1%	-231	-48%
Finland	1 777	1 305	1 258	2%	-48	-4%	-520	-29%
France	10 429	10 382	10 902	19%	520	5%	473	5%
Germany	6 918	4 681	4 863	9%	183	4%	-2 055	-30%
Greece	2 882	890	482	1%	-408	-46%	-2 400	-83%
Hungary	2 067	661	1 002	2%	341	52%	-1 065	-52%
Ireland	660	691	616	1%	-75	-11%	-44	-7%
Italy	8 323	6 554	6 479	11%	-75	-1%	-1 845	-22%
Latvia	695	314	317	1%	3	1%	-378	-54%
Lithuania	99	32	30	0%	-2	-6%	-69	-69%
Luxembourg	16	53	53	0%	0	0%	38	238%
Malta	NE,IE	23	20	0%	-2	-10%	20	100%
Netherlands	1 621	650	706	1%	56	9%	-915	-56%
Poland	4 714	5 998	5 839	10%	-158	-3%	1 126	24%
Portugal	1 661	1 004	1 036	2%	32	3%	-625	-38%
Romania	9	975	805	1%	-170	-17%	796	8503%
Slovakia	3	3	3	0%	0	0%	0	1%
Slovenia	334	211	208	0%	-3	-1%	-126	-38%
Spain	8 267	10 120	10 589	19%	469	5%	2 323	28%
Sweden	1 332	1 447	1 432	3%	-15	-1%	100	8%
United Kingdom	4 976	3 891	3 800	7%	-90	-2%	-1 176	-24%
EU-28	**67 068**	**55 812**	**56 397**	**100%**	**584**	**1%**	**-10 671**	**-16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.76 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Germany, Italy, Poland and Spain; together they cause 67 % of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-28 decreased by 16 % between 1990 and 2013.

Figure 3.76 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Emission trend and share for CO_2



1A4c Agriculture/Forestry/Fisheries – Solid Fuels (CO_2)

In 2013 CO_2 from solid fuels had a share of 6 % within source category 1A4c (compared to 10 % in 1990). Between 1990 and 2013the emissions decreased by 53 % (Table 3.80). Fourteen member states reported CO_2 emissions from this source category as 'Not occurring' or 'Included elsewhere' in 2013. All Member States except for Poland and Slovakia reported decreasing emissions between 1990 and 2013. Between 2012 and 2013 EU-28 emissions decreased by 1 %, mainly due to decreases reported by Poland. The strong decrease in 1990 to 1992 emissions is due to the reporting of Germany.

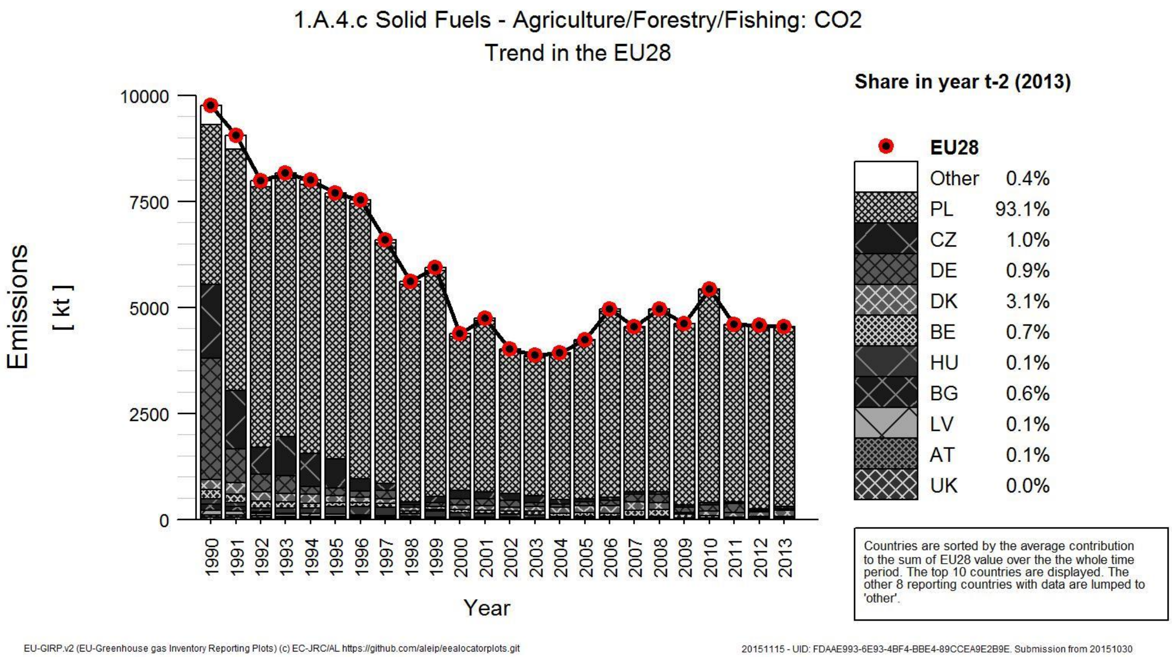
Table 3.80 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	51	3	3	0%	0	1%	-48	-94%
Belgium	212	31	31	1%	0	0%	-181	-85%
Bulgaria	152	18	27	1%	9	52%	-124	-82%
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 730	43	44	1%	1	1%	-1 687	-97%
Denmark	238	111	140	3%	29	26%	-98	-41%
Estonia	16	NO	NO	-	-	-	-16	-100%
Finland	13	10	8	0%	-1	-15%	-5	-39%
France	NO	NO	NO	-	-	-	-	-
Germany	2 861	39	41	1%	2	5%	-2 820	-99%
Greece	11	NO	4	0%	4	100%	-7	-62%
Hungary	134	2	4	0%	2	119%	-130	-97%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	102	5	2	0%	-2	-50%	-100	-98%
Lithuania	148	2	3	0%	2	94%	-144	-98%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	3 773	4 307	4 232	93%	-75	-2%	459	12%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	69	NO	NO	-	-	-	-69	-100%
Slovakia	1	1	4	0%	3	324%	3	205%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	37	NO	NO	-	-	-	-37	-100%
Sweden	157	NO	NO	-	-	-	-157	-100%
United Kingdom	50	4	NO	-	-4	-100%	-50	-100%
EU-28	**9 756**	**4 575**	**4 545**	**100%**	**-31**	**-1%**	**-5 211**	**-53%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.77 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. Fuel consumption in the EU-28 decreased by 53 % between 1990 and 2013.

Figure 3.77 1A4c Agriculture/Forestry/Fisheries, solid fuels: Emission trend and share for CO_2



1A4c Agriculture/Forestry/Fisheries –Gaseous Fuels (CO_2)

In 2013, CO_2 from gaseous fuels had a share of 16 % within source category 1A4c (compared to 13 % in 1990). Between 1990 and 2013 the emissions decreased by 1 % (Table 3.81). The highest increase occurred in Spain (+24 603 %). Between 2012 and 2013EU-28 emissions increased by 1 %.

This source is dominated by the Netherlands were natural gas is used for greenhouse horticulture.

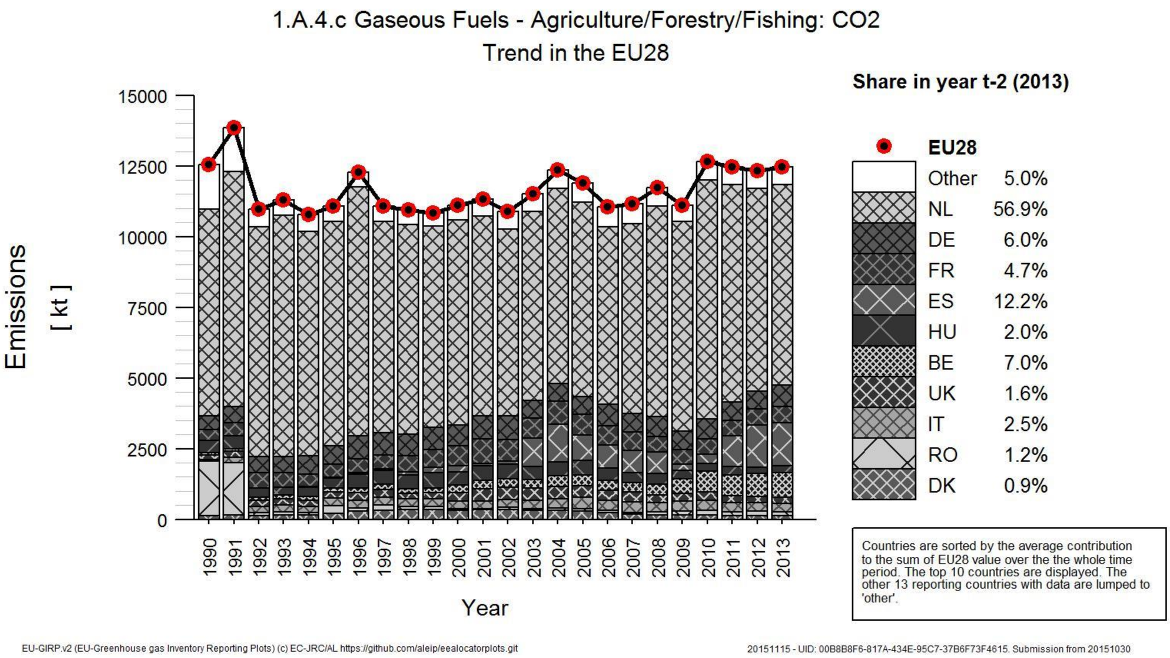
Table 3.81 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	20	32	33	0%	0	1%	13	62%
Belgium	67	813	867	7%	54	7%	800	1187%
Bulgaria	3	52	47	0%	-5	-9%	44	1347%
Croatia	48	39	40	0%	1	1%	-8	-16%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	405	117	149	1%	32	27%	-257	-63%
Denmark	126	118	115	1%	-3	-3%	-12	-9%
Estonia	4	2	1	0%	-1	-54%	-3	-76%
Finland	32	10	9	0%	-1	-13%	-23	-72%
France	380	577	586	5%	9	2%	206	54%
Germany	483	603	747	6%	144	24%	264	55%
Greece	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Hungary	437	222	249	2%	27	12%	-188	-43%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	52	308	309	2%	1	0%	257	498%
Latvia	779	58	58	0%	0	0%	-721	-93%
Lithuania	163	64	58	0%	-5	-8%	-104	-64%
Luxembourg	NO	0	0	0%	0	32%	0	100%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	7 330	7 194	7 098	57%	-95	-1%	-232	-3%
Poland	25	101	84	1%	-17	-16%	59	235%
Portugal	NO	29	33	0%	4	14%	33	100%
Romania	1 919	174	146	1%	-28	-16%	-1 773	-92%
Slovakia	41	83	96	1%	13	15%	55	135%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	6	1 487	1 521	12%	34	2%	1 515	24603%
Sweden	33	18	18	0%	0	0%	-15	-46%
United Kingdom	182	214	202	2%	-12	-5%	20	11%
EU-28	**12 534**	**12 314**	**12 465**	**100%**	**151**	**1%**	**-69**	**-1%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.78 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by the Netherlands and Spain, accounting for 69 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-28 decreased by 1 % between 1990 and 2013.

Figure 3.78 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Emission trend and share for CO_2



3.2.5 Other (CRF Source Category 1A5)

Source category 1A5 Other includes emissions from stationary and mobile military fuel use including air craft. In 2013 category 1A5 contributed to 6719 Gg CO_2 equivalents of which 98 % CO_2, 0.4 % CH_4 and 1.4 % N_2O.

Table 3.82 provides an overview of Member States' source allocation to Source Category 1A5 Other as reported in CRF Table1.A(a)s4.

Table 3.82 1A5 Other: Member States' allocation of sources

Member State	Source allocation to 1A5 Other
Austria	Stationary: Emissions are 'Not occuring' Mobile: Military use
Belgium	Stationary: Emissions are 'Not occuring' Mobile: Military use
Bulgaria	Emissions are 'Not occuring'
Croatia	Emissions are 'Not occuring'
Cyprus	Stationary: Other (not specified elsewhere)
Czech Republic	Mobile; Other mobile sources not included elsewhere. Agriculture and Forestry and Fishing
Estonia	Mobile (no further specification)
Denmark	Mobile: Military use
Finland	Stationary: Other non-specifiedMobile: other non-specified: Emissions are ‚Not occurring' or 'Confidential'
France	Emissions are 'Not occuring'
Germany	Military: stationary and mobile
Greece	No data
Hungary	Emissions are 'Not occuring'
Ireland	Emissions are 'Included elsewhere'
Italy	Stationary: Emissions are 'Not occuring' Mobile (no further specification)
Latvia	Mobile (no further specification)
Lithuania	Mobile: Military use
Luxembourg	Emissions are 'Not occuring'

Member State	Source allocation to 1A5 Other
Malta	No data
Netherlands	Stationary: Emissions are 'Not occuring' Mobile: military use
Poland	Stationary: Emissions are 'Included elsewhere' Mobile: Emissions are 'Not occuring'
Portugal	Stationary (no further specification): Emissions are reported for 1990-1994 and 'Not occuring' from 1995 on. Mobile: Military aviation
Romania	Stationary (no further specification) Mobile: Emissions are 'Not occuring'
Slovakia	Stationary: Other Mobile: Military use Jet Kerosene
Slovenia	Stationary: Emissions are 'Not occuring' Mobile: Military use of fuels
Spain	Emissions are 'Included elsewhere'
Sweden	Stationary: Emissions are 'Not occuring'Mobile: Military use
United Kingdom	Stationary: Emissions are 'Included elsewhere' Mobile: Military aviation and naval shipping

Figure 3.79 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 71 % between 1990 and 2013. Germany has the most influence to the overall trend, it reports minus 91 % CO_2 emissions since 1990 and contributes to 52 % 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 35 % to CO_2 emissions in 2013. The United Kingdom reports military aircraft and naval vessels within this category.

Figure 3.79 1A5 Other: Total and CO_2 emission and activity trends

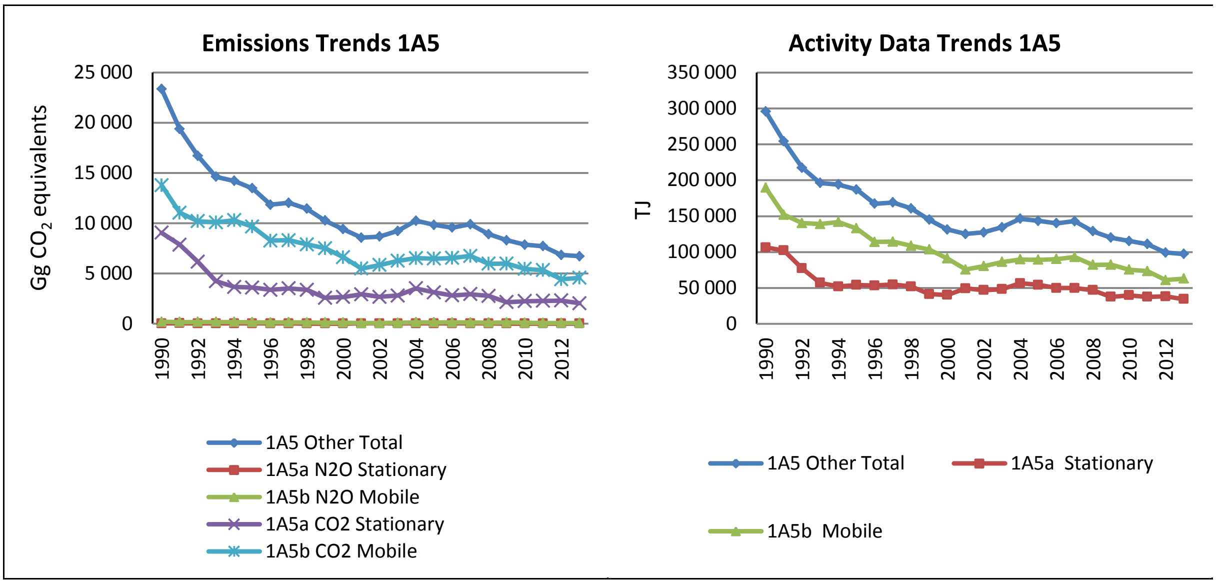


Table 3.83 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.1 % of total GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from this source decreased by 73 % in the EU-28. Between 1990 and 2013, the largest reduction in

absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.83 1A5 Other: Member States' contributions to CO_2 emissions

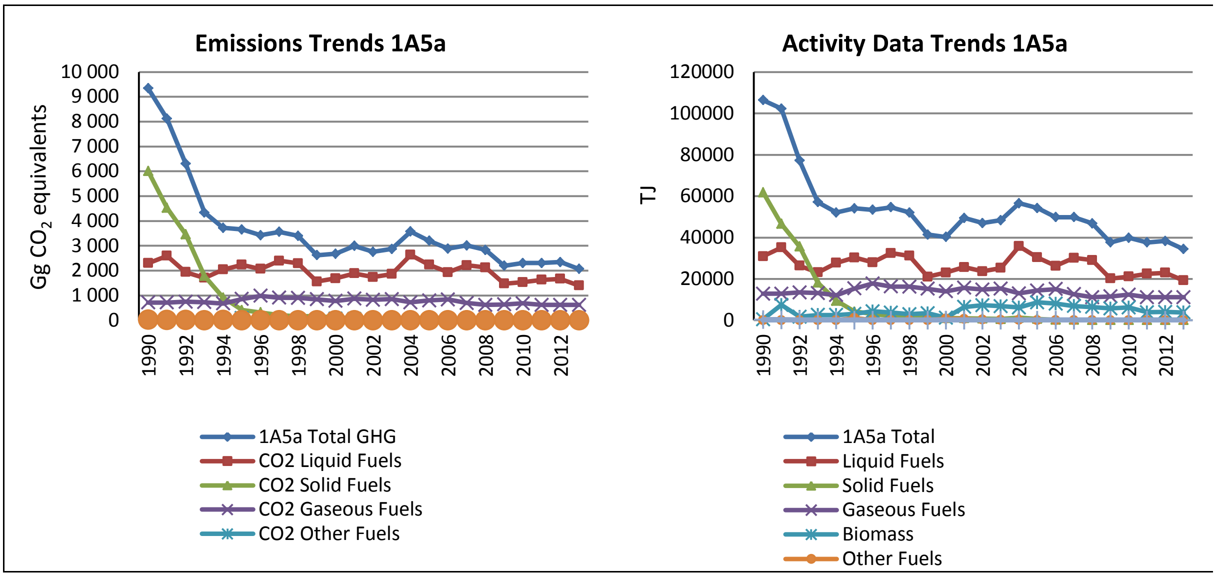
Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)
Austria	36	49	35	48
Belgium	169	82	167	81
Bulgaria	30	0	30	NO
Croatia	0	0	NO	NO
Cyprus	16	21	15	21
Czech Republic	0	309	NO	300
Denmark	170	242	167	239
Estonia	44	33	43	32
Finland	1 139	1 032	1 127	1 021
France	0	0	NO	NO
Germany	12 133	1 044	11 792	1 039
Greece	0	0	-	-
Hungary	0	0	NO	NO
Ireland	0	0	IE	IE
Italy	1 142	626	1 070	584
Latvia	0	7	NO,NE	6
Lithuania	0	17	0	17
Luxembourg	29	0	27	NO
Malta	0	0	-	-
Netherlands	455	238	447	234
Poland	0	0	NO,IE	NO,IE
Portugal	105	59	104	58
Romania	1 241	444	1 232	423
Slovakia	415	55	413	54
Slovenia	32	3	32	3
Spain	0	0	IE	IE
Sweden	863	151	846	149
United Kingdom	5 336	2 307	5 285	2 285
EU-28	**23 353**	**6 719**	**22 831**	**6 597**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.5.1 Stationary (1A5a)

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-28 GHG emissions in 2013. Figure 3.80 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 78 %, mainly due to decreases in emissions from solid fuels (-99.8 %) and liquid fuels (-39.1 %).

Figure 3.80 1A5a Stationary: Total and CO_2 emission and activity trends



Only five Member States (Cyprus, Germany,Finland, Romania and Slovakia) reported emissions from this key source in 2013 (Table 3.84). Between 1990 and 2013, Finland had a decrease of 9 %, Slovakia of -87 %, Romania of -66 % and Germany of 92 %. Cyprus reported a decrease of 35 %. Portugal reports emissions from 1990 to 1994 only. Luxembourg reports emissions 1990 to 2003 only. This led to an EU-28 decrease of 78 %. Between 2012 and 2013 CO_2 emissions increased by 12 %.

Table 3.84 1A5a Stationary: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	30	NO	NO	-	-	-	-30	-100%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	15	21	21	1%	0	0%	5	35%	T1	D
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 127	1 147	1 021	50%	-126	-11%	-105	-9%	T1	CS
France	NO	NO	NO	-	-	-	-	-	-	-
Germany	6 227	516	517	25%	1	0%	-5 710	-92%	CS	CS,M
Greece	-	-	-	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	-	-	-	-	-	-	-	-	-	-
Luxembourg	3	NO	NO	-	-	-	-3	-100%	T2	CS
Malta	-	-	-	-	-	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	IE	IE	IE	-	-	-	-	-	-	-
Portugal	9	NO	NO	-	-	-	-9	-100%	-	-
Romania	1 232	558	423	21%	-135	-24%	-809	-66%	T1,T2	CS,D
Slovakia	406	65	53	3%	-12	-19%	-353	-87%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	IE	IE	IE	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28	**9 048**	**2 307**	**2 035**	**100%**	**-272**	**-12%**	**-7 013**	**-78%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2013 CO_2 from solid fuels had a share of 0.7 % within source category 1A5a (compared to 64 % in 1990). Between 1990 and 2013, the emissions decreased by nearly 100 % (Table 3.85). In 2013 only Cyprus, Germany and Slovakia reported emissions for this key source.

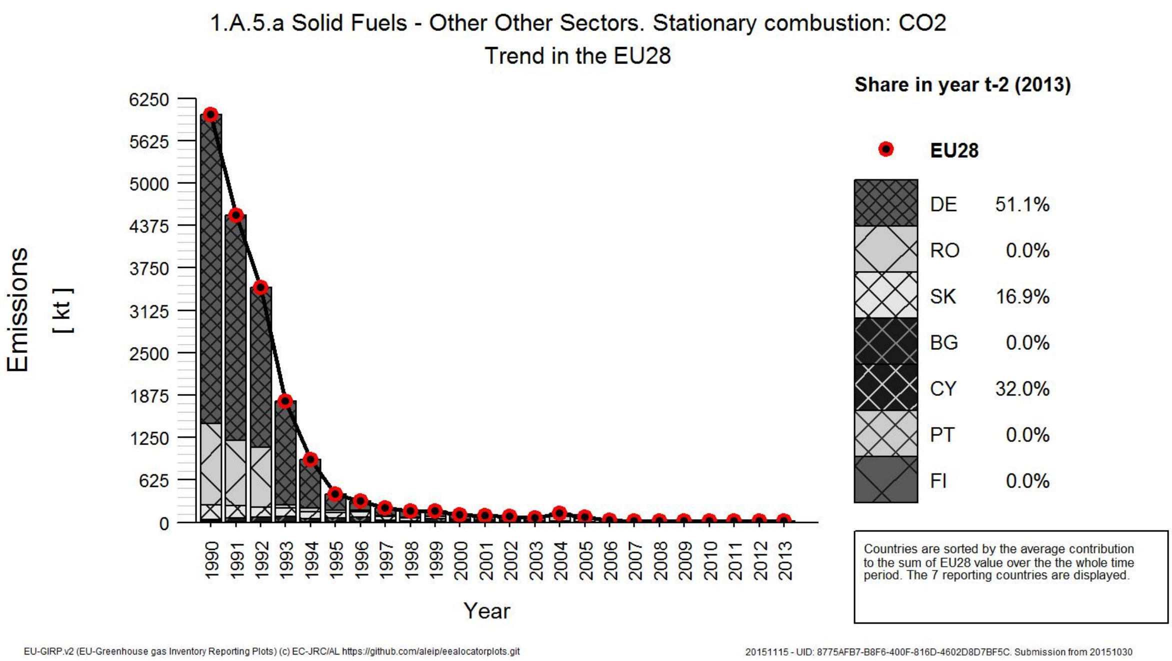
Table 3.85 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	30	NO	NO	-	-	-	-30	-100%
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	4	5	5	32%	0	0%	0	10%
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	-	-	-	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	1	NO	NO	-	-	-	-1	-100%
France	NO	NO	NO	-	-	-	-	-
Germany	4 553	8	8	51%	0	-1%	-4 545	-100%
Greece	-	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	-	-	-	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	-	-	-	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	IE	IE	IE	-	-	-	-	-
Portugal	9	NO	NO	-	-	-	-9	-100%
Romania	1 195	NO	NO	-	-	-	-1 195	-100%
Slovakia	216	3	3	17%	0	-12%	-214	-99%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-28	**6 008**	**15**	**15**	**100%**	**0**	**-3%**	**-5 993**	**-100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.81 shows CO_2 emissions for EU-28 and the Member States. Germany accounts for 51 % of EU-28 CO_2 emissions from this source category since 1995. Fuel combustion in the EU-28 decreased by 99.8 % between 1990 and 2013.

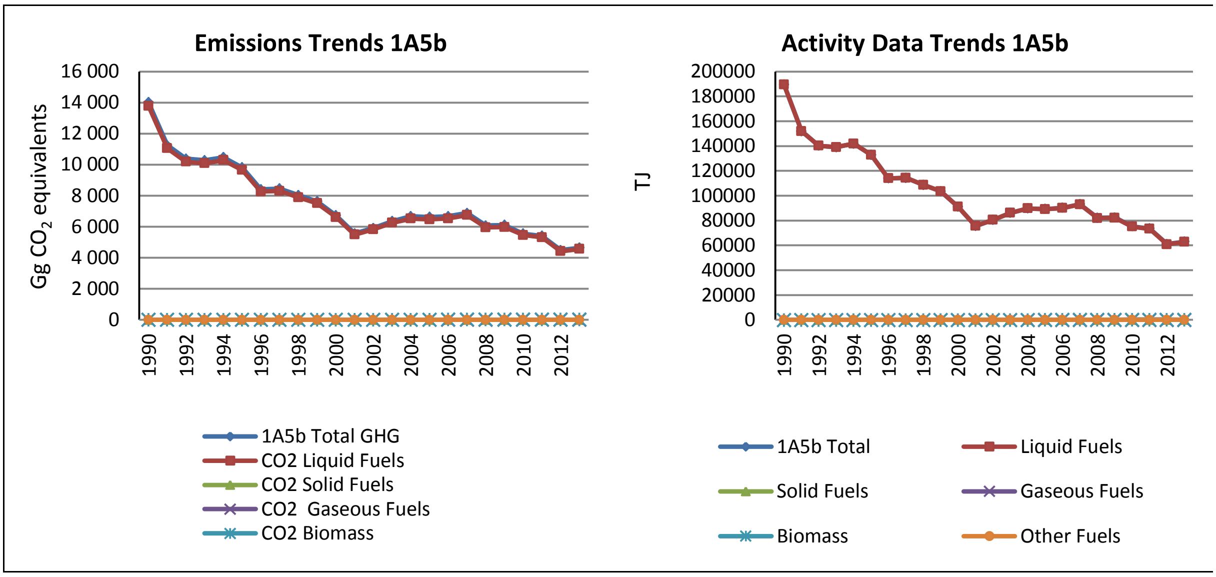
Figure 3.81 1A5a Stationary, solid fuels: Emission trend and share for CO_2



3.2.5.2 Mobile (1A5b)

In this chapter information about emission trends, Member States' contribution and activity data is provided for category 1A5a by fuels. CO_2 emissions from 1A5b Mobile accounted for 0.1 % of total EU-28 GHG emissions in 2013. Figure 3.82 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 67 %.

Figure 3.82 1A5b-Mobile: Total and CO_2 emission trends



Nine Member States reported emissions as 'Not occurring' or "Included elsewhere". The United Kingdom had the highest emissions in 2013 and – together with Germany - decreased the most in absolute terms between 1990 and 2013. Between 2012 and 2013 the United Kingdom had the highest absolute decrease. The EU-28 emissions increased by 3 % between 2012 and 2013 (Table 3.86).

Table 3.86 1A5b Mobile: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	35	47	48	1%	1	1%	13	37%	NA	NA
Belgium	167	35	81	2%	46	129%	-86	-51%	T1	D
Bulgaria	NO	NO	NO	-	-	-	-	-	T1,T2	CS,D
Croatia	-	-	-	-	-	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-	-	-
Czech Republic	NO	306	300	7%	-6	-2%	300	100%	NA	NA
Denmark	167	214	239	5%	25	11%	72	43%	CR,T2	CS
Estonia	43	21	32	1%	11	50%	-11	-26%	T2	CS
Finland	C,NO	C,NO	C,NO	-	-	-	-	-	T1	CS
France	NO	NO	NO	-	-	-	-	-	-	-
Germany	5 565	487	522	11%	36	7%	-5 043	-91%	CS	CS,M
Greece	-	-	-	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-	-	-
Italy	1 070	334	584	13%	250	75%	-486	-45%	T2	CS
Latvia	NO,NE	7	6	0%	-1	-12%	6	100%	NA	NA
Lithuania	0	9	17	0%	8	93%	17	4680%	T2	CS
Luxembourg	24	NO	NO	-	-	-	-24	-100%	T2	CS
Malta	-	-	-	-	-	-	-	-	-	-
Netherlands	447	218	234	5%	15	7%	-213	-48%	T2	D
Poland	NO	NO	NO	-	-	-	-	-	-	-
Portugal	95	48	58	1%	10	20%	-37	-39%	-	-
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	7	1	1	0%	0	-3%	-6	-80%	T2	D
Slovenia	32	3	3	0%	0	-11%	-29	-91%	T1	D
Spain	IE	IE	IE	-	-	-	-	-	NA	NA
Sweden	846	164	149	3%	-15	-9%	-697	-82%	NA	NA
United Kingdom	5 285	2 519	2 285	50%	-234	-9%	-2 999	-57%	T1	CS
EU-28	**13 784**	**4 417**	**4 562**	**100%**	**144**	**3%**	**-9 222**	**-67%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2012, CO_2 from liquid fuels had a share of 98 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2013 the emissions decreased by 67 % (Table 3.87). Bulgaria, Finland, France, Hungary, Ireland, Luxembourg, Romania and Spain report emissions as 'Not occurring', 'Included Elsewhere' or 'Confidential'. The highest decrease in absolute terms was achieved in Germany (-91 %) and the United Kingdom (-57%), while the Czech Republic had the largest increases.

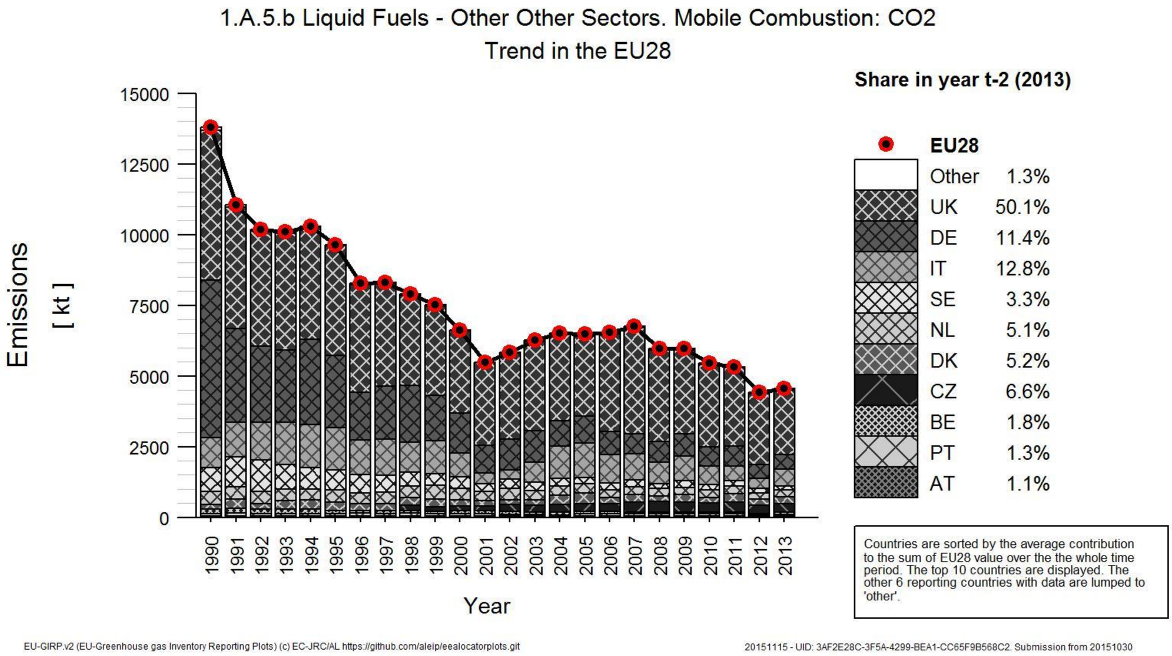
Table 3.87 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	35	47	48	1%	1	1%	13	37%
Belgium	167	35	81	2%	46	129%	-86	-51%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	-	-	-	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	306	300	7%	-6	-2%	300	100%
Denmark	167	214	239	5%	25	11%	72	43%
Estonia	43	21	32	1%	11	50%	-11	-26%
Finland	C	C	C	-	-	-	-	-
France	NO	NO	NO	-	-	-	-	-
Germany	5 565	487	522	11%	36	7%	-5 043	-91%
Greece	-	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	1 070	334	584	13%	250	75%	-486	-45%
Latvia	NE	7	6	0%	-1	-12%	6	100%
Lithuania	0	9	17	0%	8	93%	17	4680%
Luxembourg	24	NO	NO	-	-	-	-24	-100%
Malta	-	-	-	-	-	-	-	-
Netherlands	447	218	234	5%	15	7%	-213	-48%
Poland	NO	NO	NO	-	-	-	-	-
Portugal	95	48	58	1%	10	20%	-37	-39%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	7	1	1	0%	0	-3%	-6	-80%
Slovenia	32	3	3	0%	0	-11%	-29	-91%
Spain	IE	IE	IE	-	-	-	-	-
Sweden	846	164	149	3%	-15	-9%	-697	-82%
United Kingdom	5 285	2 519	2 285	50%	-234	-9%	-2 999	-57%
EU-28	**13 784**	**4 417**	**4 562**	**100%**	**144**	**3%**	**-9 222**	**-67%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.83 shows CO_2 emissions for EU-28 and the Member States. The largest emissions are reported by Germany, Italy and the United Kingdom; together they cause 74 % of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-28 decreased by 67 % between 1990 and 2013.

Figure 3.83 1A5b Mobile, liquid fuels: Emission trend and share for CO_2

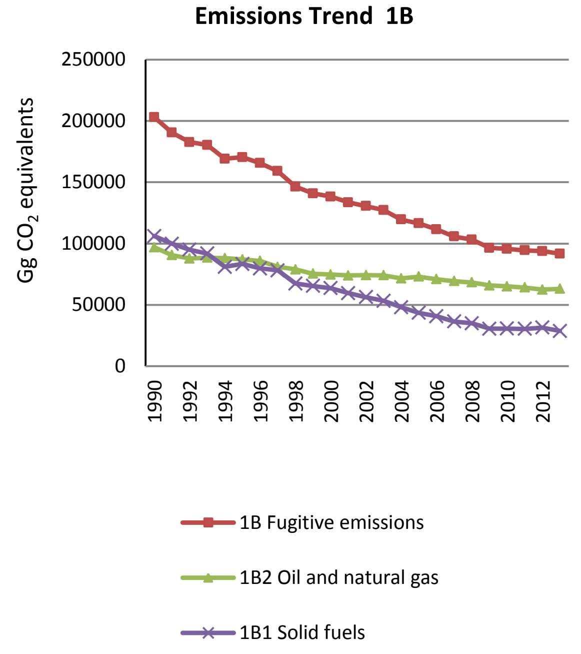


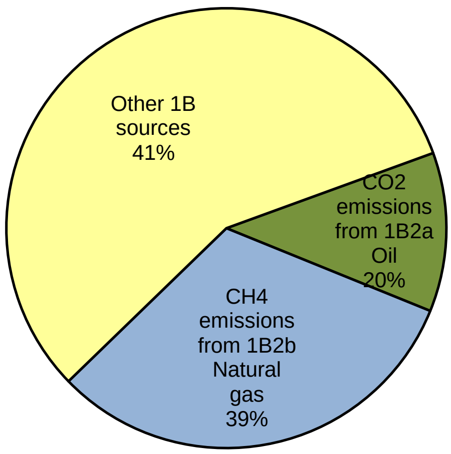
3.2.6 Fugitive emissions from fuels (CRF Source Category 1.B)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In the 2006 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 (2006 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2013, in terms of CO_2 equivalents, about 70% of emissions from source category 1B were fugitive CH_4 emissions while about 29% were fugitive CO_2 emissions. Together, they represented 2 % of total GHG emissions in the EU-28. Fugitive GHG emissions have been steadily declining (Figure 3.84). Between 1990 and 2013, the total fugitive GHG emissions decreased by 55 %. This was mainly due to the decrease in underground mining activities: underground mining activity decreased by 78 % since 1990 (Figure 3.87) and decreases CH_4 emissions from category 1B1a i underground mines are responsible for 78% of the total decrease of fugitive emissions. Between 1990 and 2013, GHG emissions from 1B1 Solid Fuels decreased by 78 % Figure 3.85), while emissions from 1B2 Oil and Natural Gas decreased only by 35 % (Figure 3.85). 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 31 % of total fugitive emissions in 2013 (Figure 3.84).

Figure 3.84 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 and handling (CH_4)

- 1B2a Oil (CO_2)
- 1B2a Oil (CH_4
- 1B2b Natural Gas (CH_4)

The two largest key sources (CH_4 emissions from 1B2b Natural Gas and CO_2 emissions from 1B2a (Oil) account together for 59 % of total fugitive GHG emissions (Figure 3.84).

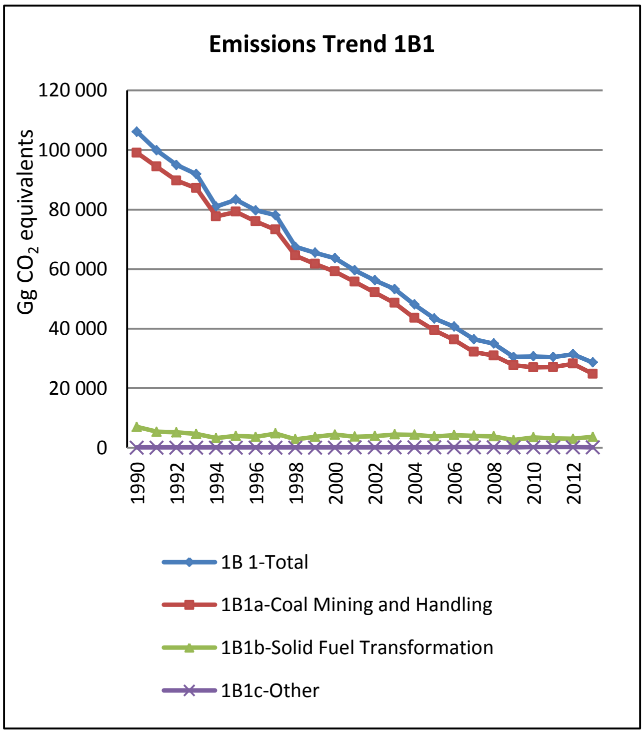
3.2.6.1 Fugitive emissions from Solid Fuels (1B1)

In the 2006 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions from solid fuels are defined as the intentional or unintentional release of greenhouse gases that may occur during the extraction, processing and delivery of fossil fuels to the point of final use. 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. Five member States (Denmark, Estonia, Finland, Latvia and Lithuania) have peat extraction but no coal mining.

In 2013 fugitive emissions from solid fuels accounted for 0.6 % of the total GHG emissions in the EU-28 and 31 % of total fugitive emissions:

- 86 % 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.
- 1 % of these emissions were 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 3.85 1B1 Fugitive Emissions from Solid Fuels: Trend



In 2013 three countries, Poland, Germany and Czech Republic represented 77 % of total fugitive GHG emissions from solid fuels (Table 3.88).

Table 3.88 1B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	333	0	NO,NA	NO,NA	333	NO,NA
Belgium	392	4	NO,NA	NO,NA	392	4
Bulgaria	1 943	803	NO	NO	1 943	803
Croatia	60	0	NO	NO	60	NO
Cyprus	0	0	NO	NO	NO	NO
Czech Republic	9 576	3 355	456	195	9 120	3 160
Denmark	0	0	NO	NO	NO	NO
Estonia	0	0	NO	NO	NO	NO
Finland	0	0	NO	NO	NO	NO
France	4 810	20	NA,NO	NA,NO	4 810	20
Germany	27 386	4 287	1 833	707	25 553	3 580
Greece	1 130	1 174	NO	NO	1 130	1 174
Hungary	896	67	7	NO,NA,IE	889	67
Ireland	56	20	NO	NO	56	20
Italy	151	53	0	0	151	53
Latvia	0	0	NO	NO	NO	NO
Lithuania	0	0	NO	NO	NO	NO
Luxembourg	0	0	NO	NO	NO	NO
Malta	0	0	NO,NA	NO,NA	NO,NA	NO,NA
Netherlands	406	633	403	633	4	NO
Poland	28 150	14 348	2 561	1 900	25 589	12 449
Portugal	99	10	10	1	89	9
Romania	3 899	699	NA,NO	NA,NO	3 899	699
Slovakia	699	426	19	18	680	408
Slovenia	459	420	98	153	361	267
Spain	2 181	453	18	4	2 164	450
Sweden	5	3	5	3	0	0
United Kingdom	23 487	1 862	1 699	175	21 788	1 686
EU-28	**106 119**	**28 638**	**7 109**	**3 789**	**99 010**	**24 849**

Abbreviations explained in the Chapter 'Units and abbreviations'

Between 1990 and 2013 fugitive CH_4 emissions from solid fuels decreased by 73 % (Table 3.92). Large reductions (in absolute terms) were observed in Germany, Poland and in the United Kingdom, while emissions actually increased in the Netherlands (+56%) and Greece (+4%) (Table 3.88).

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).
- abandoned underground mines

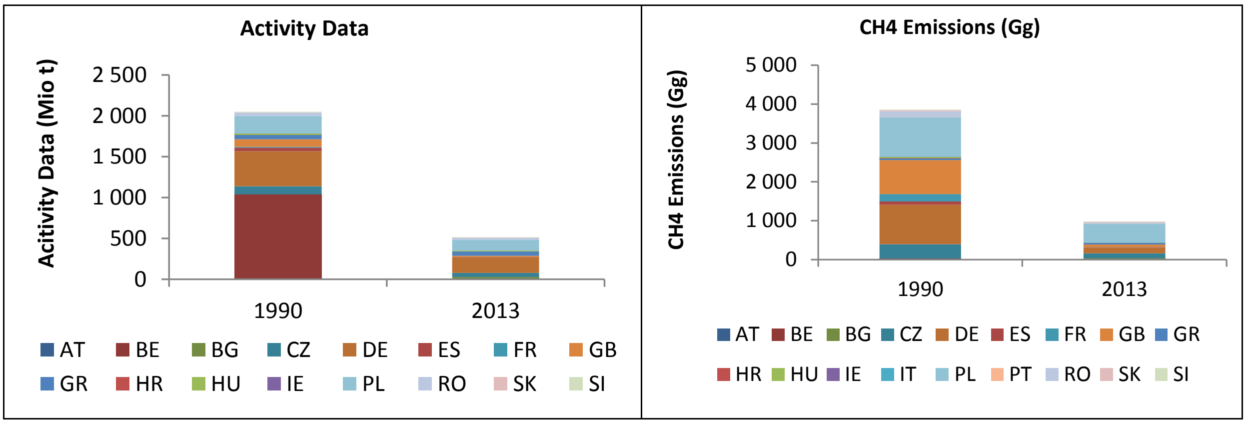
CH_4 emissions from 1B1a coal-mining accounted for 0.5 % of total GHG emissions in 2013 and for 27 % of all fugitive emissions in the EU-28. CH_4 emissions from this source decreased by 75 % in the EU-28 between 1990 and 2013 and also decreased by 12 % between 2012 and 2013 due to decreases in German, Czech Republic and the United Kingdom (Table 3.89). In 2013 Poland, Germany Czech Republic accounted together for 77 % of CH_4 emissions from 1B1a. They had substantially reduced their emissions between 1990 and 2013 due to the decline of coal mining (Figure 3.90).

Table 3.89 1B1a Coal Mining: Member States contribution to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	333	NO,NA	NO,NA	-	-	-	-333	-100%
Belgium	356	NO	NO	-	-	-	-356	-100%
Bulgaria	1 927	951	800	3%	-151	-16%	-1 127	-58%
Croatia	60	NO	NO	-	-	-	-60	-100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	9 119	3 962	3 155	13%	-807	-20%	-5 964	-65%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	4 780	12	13	0%	2	15%	-4 767	-100%
Germany	25 494	4 054	3 521	14%	-533	-13%	-21 974	-86%
Greece	1 130	1 371	1 174	5%	-197	-14%	44	4%
Hungary	889	70	67	0%	-4	-5%	-822	-93%
Ireland	56	20	20	0%	0	-2%	-35	-64%
Italy	71	22	20	0%	-2	-9%	-51	-72%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	25 307	12 679	12 254	50%	-425	-3%	-13 053	-52%
Portugal	89	9	9	0%	0	-2%	-80	-90%
Romania	3 857	964	699	3%	-265	-27%	-3 158	-82%
Slovakia	680	399	405	2%	6	1%	-275	-40%
Slovenia	361	289	267	1%	-22	-8%	-94	-26%
Spain	2 136	593	436	2%	-158	-27%	-1 701	-80%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	21 770	2 434	1 674	7%	-759	-31%	-20 096	-92%
EU-28	**98 416**	**27 831**	**24 514**	**100%**	**-3 316**	**-12%**	**-73 902**	**-75%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

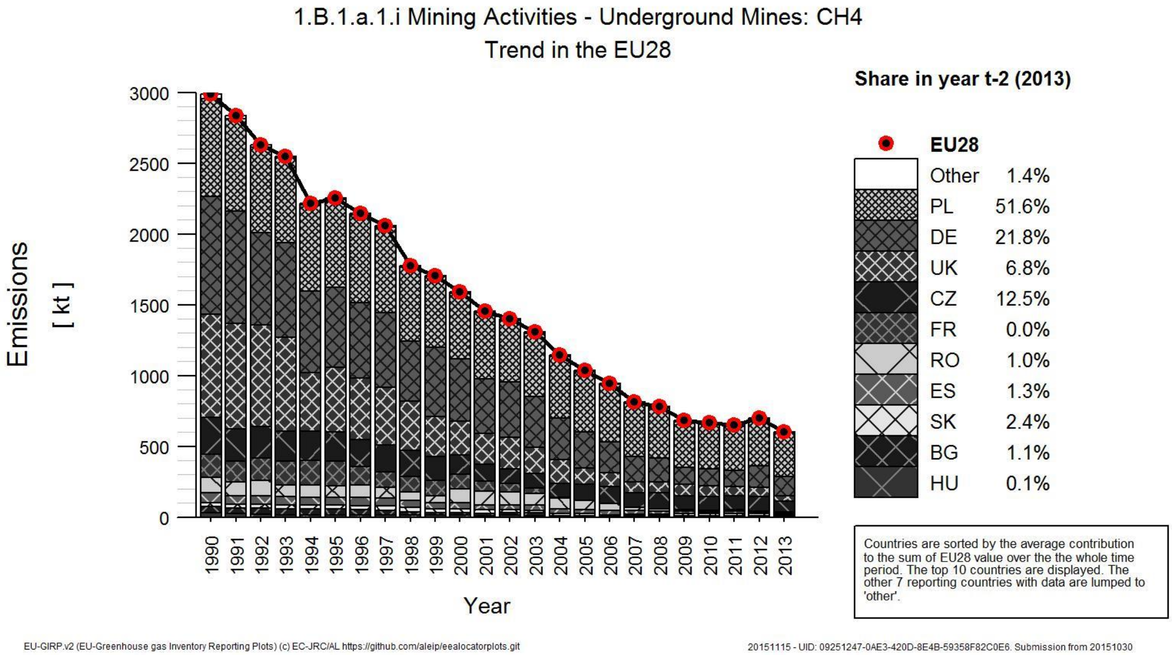
Figure 3.86 1B1a Coal Mining and Handling: Contribution of MS to CH_4 Emission and Activity Data



Please note that the AD for Hungary does not represent the data submitted in the CRF tables as they were submitted in the wrong unit. Data was corrected for this graphs.

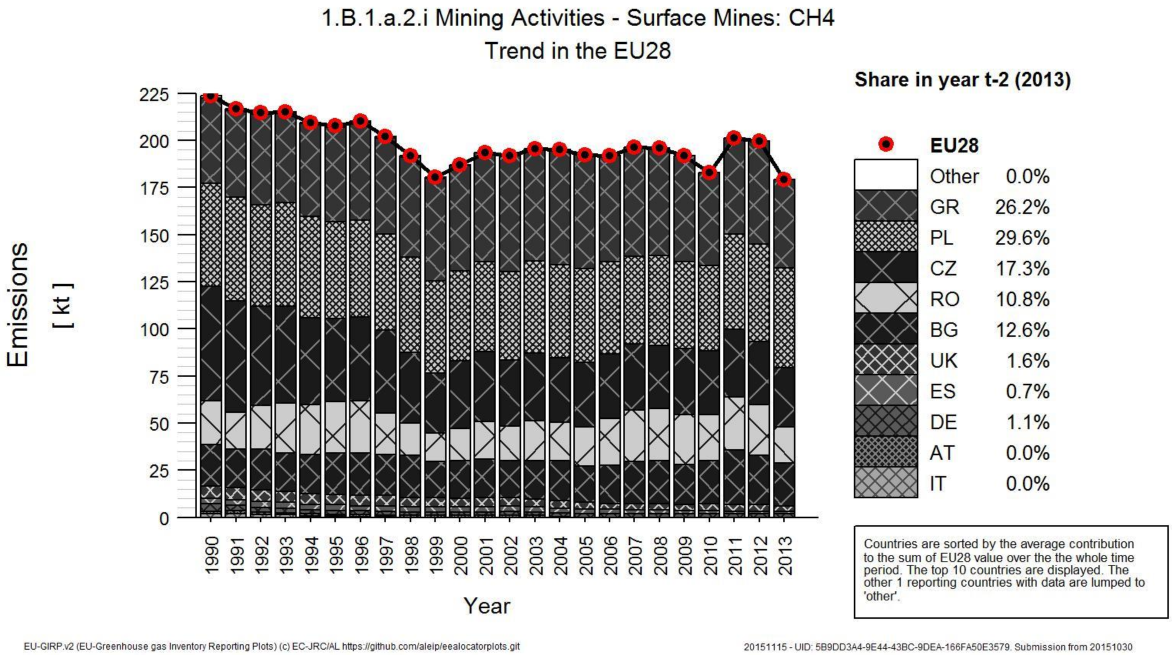
In 2013 most fugitive emissions from coal mines were due to underground mines. Within the EU-28 coal mining in underground mines decreased substantially (78 %) (Figure 3.87). Poland, Germany and Czech Republic are the biggest contributors to this sector.

Figure 3.87 1B1ai Underground Mines: Emission trend and share for EU-28 and the emitting countries of CH_4



Overall, in the coal production from surface mines decreased by 20 % between 1990 and 2013 (Figure 3.88). Coal mining in surface mines decreased in all Member States except in Greece. (Figure 3.88).

Figure 3.88 1B1aii Surface Mines: Emission trend and share for the emitting countries of CH_4



Emissions from Other (1B1c)

Two member states report CH_4 emissions in this sector, three are also reporting CO_2 emissions. The description of the subcategories are presented in Table 3.90.

Table 3.90 Description of subcategories in sector 1B1c for CO_2- and CH_4-emissions for reporting Member States

Member state	Emission	Subcategory
Poland	CO_2, CH_4	Emisson from Coke Oven Gas Subsystem
Slovenia	CO_2	SO_2 scrubbing
Sweden	CO_2, CH_4	Flaring of gas

3.2.6.2 Fugitive emissions from oil and natural gas (1B2)

Fugitive emissions from oil and natural gas correspond to the total fugitive emissions from oil and natural gas activities. Fugitive emissions may arise from equipment leaks, evaporation losses, venting, flaring and accidental releases (2006 IPCC Guidelines for National Greenhouse Gas Inventories).

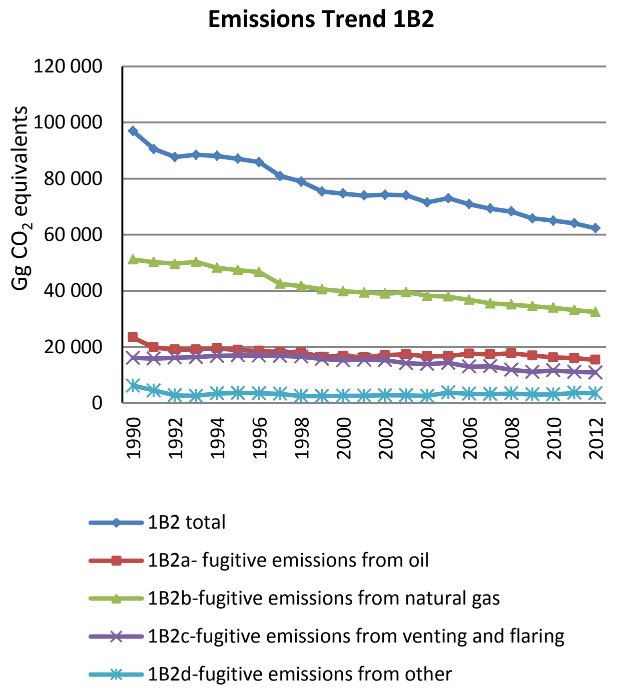
Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and handling of oil and natural gas. They account for 1.4 % of the total GHG emissions in 2013 and for 69 % (Figure 3.89) of all fugitive emissions in the EU-28.

Of all fugitive emissions from oil and natural gas, in 2013:

- 46% were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution)
- 19 % were CO_2 emissions from oil (exploration, production, transport, refining and storage and distribution)
- 2 % were CO_2 emissions due to Other emissions from energy production

- This source category includes four key source categories:
- CO_2 from1B2a Oil
- CH_4 from1B2a Oil
- CH_4 from1B2b Natural Gas

Figure 3.89 1B2-Fugitive Emissions Oil and Natural Gas: Trend



Fugitive emissions from oil and natural gas arose in all Member States (Table 3.91). Total greenhouse gas emissions from 1B2 decreased by 35 % between 1990 and 2013 (Figure 3.88). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 38 % over that period.

In 2013, 75% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: Germany, Italy, Romania and the United Kingdom (Table 3.91). The largest reductions (in absolute terms) were observed in the Romania and in the United Kingom (both mainly CH_4 emissions), while emissions increased most in Poland (mainly CH_4 emissions) (Table 3.91).

Table 3.91 1B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	369	532	102	251	266	281
Belgium	714	555	85	108	629	448
Bulgaria	274	228	4	14	270	214
Croatia	4 233	1 913	971	656	3 261	1 258
Cyprus	0	0	NO,NE	NO,NE	0	NO,NE
Czech Republic	1 082	634	2	6	1 080	628
Denmark	516	387	341	238	123	107
Estonia	47	21	0	0	47	21
Finland	123	120	111	79	11	40
France	5 819	4 175	4 328	3 118	1 465	1 042
Germany	11 902	9 943	2 231	2 277	9 670	7 666
Greece	79	105	43	4	36	101
Hungary	1 750	774	478	150	1 271	623
Ireland	156	24	NO	NO	156	24
Italy	12 745	8 429	4 013	2 678	8 720	5 742
Latvia	248	101	0	0	248	101
Lithuania	178	317	1	4	177	313
Luxembourg	19	41	0	0	19	41
Malta	0	0	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE
Netherlands	2 731	1 867	775	1 060	1 956	807
Poland	1 075	4 475	83	2 018	992	2 456
Portugal	302	1 766	254	1 570	46	193
Romania	29 962	10 751	1 213	901	28 746	9 848
Slovakia	1 714	1 236	5	1	1 708	1 234
Slovenia	50	37	0	0	50	37
Spain	2 387	4 277	1 656	3 555	730	722
Sweden	383	815	292	746	91	68
United Kingdom	18 152	9 508	5 778	3 790	12 333	5 687
EU-28	**97 010**	**63 030**	**22 766**	**23 224**	**74 102**	**39 703**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 and CH_4 from Oil (1B2a)

Fugitive emissions from oil correspond to fugitive emissions from all sources associated with the exploration, production, transmission, upgrading and refining of crude oil and the distribution of crude oil products (2006 IPCC Guidelines for National Greenhouse Gas Inventories).

CO_2 emissions from 1B2a 'Fugitive CO_2 emissions from oil' account for 0.3 % of total EU-28 GHG emissions in 2013 and for 13 % of all fugitive emissions. Between 1990 and 2013, CO_2 emissions from this source increased by 24 % in the EU-28 (Table 3.92). By contrast, during the same period 1990-2013, CH_4 emissions of this source category were reduced by 68 %.

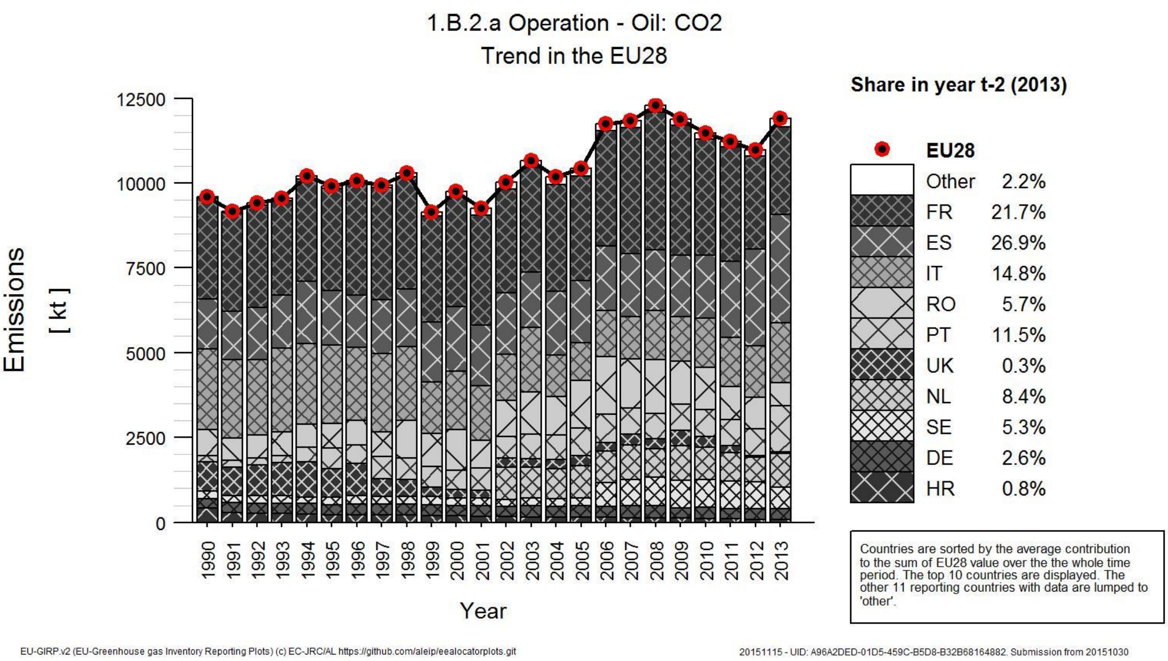
Together France, Italy, Portugal and Spain accounted for 75 % of the EU-28 total CO_2 emissions of 1B2a 'Fugitive CO_2 emissions from oil' (Table 3.92, Figure 3.90). During the period 1990-2013, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Portugal and in Spain (Table 3.92).

Table 3.92 1B2a Fugitive CO_2 emissions from oil: Member States' contributions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	0.004	0.005	0.005	0.00004%	0.00005	1%	0.001	16%
Belgium	0.01	0.02	0.02	0.0001%	-0.002	-13%	0.001	10%
Bulgaria	1	0.3	0.3	0.003%	0.04	17%	-0.3	-53%
Croatia	411	92	92	1%	0.1	0.1%	-320	-78%
Cyprus	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Czech Republic	0.02	0.05	0.05	0.0004%	-0.001	-2%	0.03	169%
Denmark	5	0	3	0.03%	3	51971%	-2	-35%
Estonia	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	2 951	2 743	2 585	22%	-157	-6%	-366	-12%
Germany	282	301	311	3%	10	3%	29	10%
Greece	0.00004	0.000005	0.000004	0.00000003%	-0.000001	-26%	0	-91%
Hungary	5	0.4	0.4	0.004%	0.02	6%	-5	-92%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	2 368	1 501	1 761	15%	260	17%	-607	-26%
Latvia	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Lithuania	0.05	0.03	0.04	0.0004%	0.02	66%	-0.004	-9%
Luxembourg	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Malta	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Netherlands	0	728	996	8%	267	37%	996	5532932%
Poland	42	177	253	2%	76	43%	211	508%
Portugal	201	801	1 365	11%	564	70%	1 164	579%
Romania	769	932	674	6%	-257	-28%	-95	-12%
Slovakia	0.03	0.01	0.01	0.0001%	0.0004	6%	-0.02	-71%
Slovenia	0.01	0.02	0.02	0.0002%	-0.001	-4%	0.01	128%
Spain	1 477	2 870	3 201	27%	331	12%	1 724	117%
Sweden	219	801	630	5%	-171	-21%	411	188%
United Kingdom	859	35	41	0.3%	6	16%	-818	-95%
EU-28	**9 590**	**10 982**	**11 913**	**100%**	**931**	**8%**	**2 323**	**24%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.90 1B2a Oil: Emission trend and share for the emitting countries of CO_2



CH_4 emissions from 1B2a 'Fugitive CO_2 emissions from oil' account for 0.1 % of total EU-28 GHG emissions in 2013 and for 5 % of all fugitive emissions. Between 1990 and 2013, CH_4 emissions from this source decreased by 68 % in the EU-28 (Table 3.92).

Together Romania and Croatia accounted for 73 % of the EU-28 total CO_2 emissions of 1B2a 'Fugitive CO_2 emissions from oil' (Table 3.93). During the period 1990-2013, the largest decreases in CH_4 emissions (in absolute terms) were observed in Croatia and Romania, while emissions increased most in the Poland (Table 3.93).

Table 3.93 1B2a Fugitive CH_4 emissions from oil: Member States' contributions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	7	8	8	0%	0	2%	1	9%
Belgium	11	7	6	0%	-1	-8%	-5	-45%
Bulgaria	9	5	6	0%	0	2%	-4	-42%
Croatia	2 556	569	570	13%	1	0%	-1 986	-78%
Cyprus	0	NO,NE	NO,NE	-	-	-	0	-100%
Czech Republic	23	11	6	0%	-5	-45%	-17	-74%
Denmark	31	38	35	1%	-3	-9%	3	11%
Estonia	NO,NA	NO	NO	-	-	-	-	-
Finland	6	9	9	0%	0	4%	3	43%
France	189	57	51	1%	-6	-10%	-138	-73%
Germany	402	230	235	5%	5	2%	-167	-42%
Greece	10	13	13	0%	0	-3%	3	31%
Hungary	179	40	37	1%	-3	-7%	-141	-79%
Ireland	0	0	0	0%	0	-7%	0	57%
Italy	295	293	293	7%	0	0%	-2	-1%
Latvia	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Lithuania	11	9	10	0%	0	4%	-1	-12%
Luxembourg	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Malta	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Netherlands	20	22	11	0%	-11	-51%	-9	-46%
Poland	27	76	94	2%	18	24%	67	247%
Portugal	45	48	52	1%	4	7%	7	15%
Romania	9 370	2 669	2 676	60%	6	0%	-6 695	-71%
Slovakia	15	8	8	0%	1	8%	-7	-44%
Slovenia	0	NO	NO	-	-	-	0	-100%
Spain	69	46	55	1%	9	19%	-14	-20%
Sweden	25	27	23	1%	-4	-16%	-2	-9%
United Kingdom	488	242	230	5%	-12	-5%	-258	-53%
EU-28	**13 789**	**4 428**	**4 427**	**100%**	**-1**	**0%**	**-9 363**	**-68%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 from Natural gas (1B2b)

Fugitive emissions from natural gas correspond to emissions from all fugitive sources associated with the exploration, production, processing, transmission, storage and distribution of natural gas (associated and non-associated gas) (2006 IPCC Guidelines for National Greenhouse Gas Inventories).

CH_4 emissions from 1B2b 'Fugitive CH_4 emissions from natural gas' account for 0.7 % of total EU-28 GHG emissions in 2013 and for 35 % of all fugitive emissions in the EU-28. Between 1990 and 2013, CH_4 emissions from this source decreased by 38 % (Table 3.94).

In 2013, 82% of the EU-28 CH_4 emissions from 1B2b were emitted by four Member States: Germany, Italy, Romania and the United Kingdom (Table 3.94, Figure 3.91). The emission decreases between 1990 and 2013 observed in Romania (-59 %), the United Kingdom (-57 %), Germany (-20%) and in

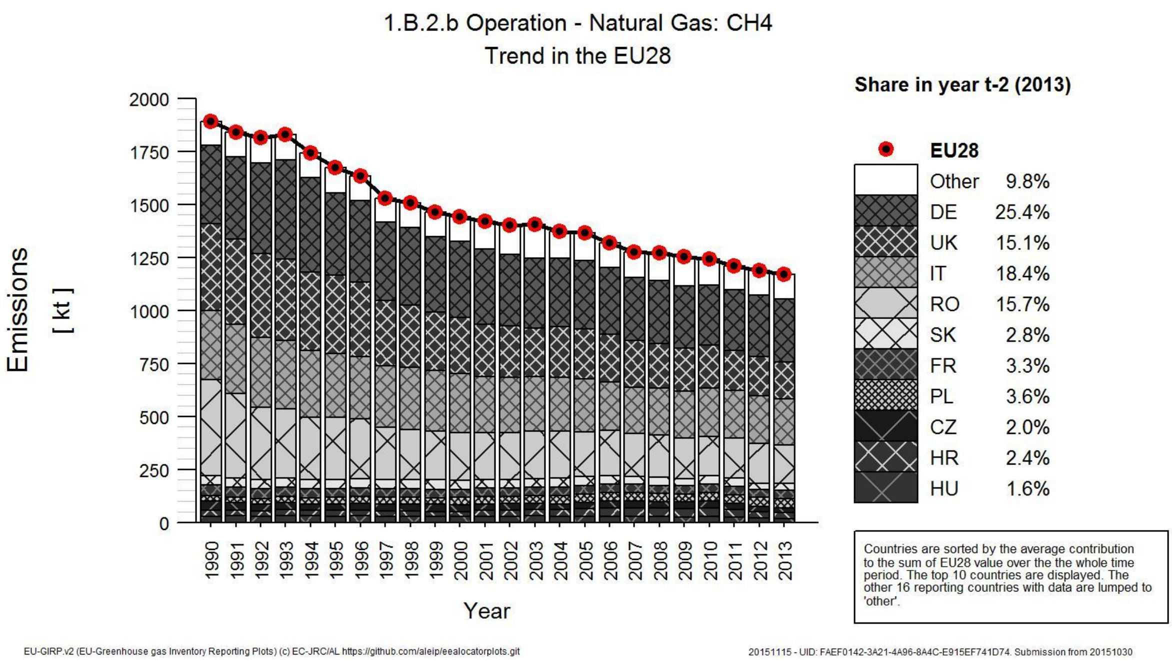
Italy (-35 %) contributed most significantly to the overall reduction in the EU-28 between 1990 and 2013.

Table 3.94 1B2b Fugitive CH_4 emissions from natural gas: Member States' contributions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	259	283	272	1%	-11	-4%	13	5%
Belgium	618	446	441	2%	-4	-1%	-177	-29%
Bulgaria	245	203	200	1%	-2	-1%	-45	-18%
Croatia	705	742	688	2%	-54	-7%	-18	-2%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 045	628	583	2%	-45	-7%	-461	-44%
Denmark	61	57	48	0%	-9	-16%	-13	-21%
Estonia	47	20	21	0%	1	3%	-26	-56%
Finland	4	32	31	0%	-1	-4%	27	627%
France	1 201	945	968	3%	23	2%	-233	-19%
Germany	9 266	7 306	7 429	25%	123	2%	-1 837	-20%
Greece	9	76	69	0%	-6	-8%	60	651%
Hungary	735	516	458	2%	-58	-11%	-277	-38%
Ireland	156	28	23	0%	-5	-18%	-133	-85%
Italy	8 235	5 595	5 370	18%	-225	-4%	-2 865	-35%
Latvia	177	57	82	0%	26	45%	-95	-54%
Lithuania	166	292	302	1%	9	3%	136	82%
Luxembourg	19	48	41	0%	-7	-15%	21	110%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	445	482	485	2%	4	1%	41	9%
Poland	678	1 064	1 058	4%	-6	-1%	380	56%
Portugal	NO	140	139	0%	-1	-1%	139	100%
Romania	11 306	4 722	4 591	16%	-131	-3%	-6 715	-59%
Slovakia	1 103	704	804	3%	100	14%	-300	-27%
Slovenia	42	33	32	0%	-1	-3%	-11	-25%
Spain	500	583	617	2%	35	6%	118	24%
Sweden	66	52	45	0%	-6	-12%	-21	-31%
United Kingdom	10 168	4 584	4 397	15%	-187	-4%	-5 771	-57%
EU-28	**47 258**	**29 638**	**29 196**	**100%**	**-441**	**-1%**	**-18 062**	**-38%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.91 1B2b Natural Gas: Emission trend and share for the emitting countries of CH_4



Emissions from Other (1B2d)

Five member states report CO_2 emissions in this sector, four are reporting CH_4 emissions, three are also reporting N_2O emission. The description of the subcategories are presented in Table 3.95.

Table 3.95 Description of subcategories in sector 1B2d for CO_2-, N_2O- and CH_4-emissions for reporting Member States

Member state	Emission	Subcategory
Finland	CO_2, CH_4	Distribution of town gas
Greece	CO_2, N_2O	LPG transport
Hungary	CH_4, CO_2	Groundwater extraction and CO_2 mining
Italy	CH_4, CO_2, N_2O	Flaring in refineries
Portugal	CO_2	Geothermal
Romania	CH_4	Other Leakage - at industrial plants and power stations
United Kingdom	N_2O	Natural gas exploration: N_2O emissions

Table 3.96 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

1.B.2.b Fugitive CH4 Emissions from Natural gas			1990					2013				
Member State		GHG source category	Activity data			Implied emission factor (kg/unit)	CH4 emissions (kt)	Activity data			Implied emission factor (kg/unit)	CH4 emissions (kt)
			Description	Unit	Value			Description	Unit	Value		
AUT	Austria	**Natural Gas**					**10.36**					**10.90**
		1. Exploration	Mm3 natural gas	Mm3	248.09	NA	NA	Mm3 natural gas	Mm3	335.87	NA	NA
		2. Production	Mm3 natural gas	Mm3	1288.00	4478.94	5.77	Mm3 natural gas	Mm3	1467.00	3668.03	5.38
		3. Processing	Mm3 natural gas	Mm3	1288.00	IE	IE	Mm3 natural gas	Mm3	1467.00	IE	IE
		4. Transmission and storage	km pipeline length	km	3628.00	718.43	2.61	km pipeline length	km	7176.71	551.71	3.96
		5. Distribution	km distribution network length	km	11672.00	170.22	1.99	km distribution network length	km	29416.76	53.01	1.56
		6. Other	Mm3 natural gas stored	Mm3	1500.00	NO	NO	Mm3 natural gas stored	Mm3	5747.07	NO	NO
BEL	Belgium	**Natural Gas**					**24.71**					**17.65**
		1. Exploration	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		2. Production	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		3. Processing	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		4. Transmission and storage	Natural gas PJ	PJ	341.02	5979.07	2.04	Natural gas PJ	PJ	591.65	4444.83	2.63
		5. Distribution	Natural Gas PJ	PJ	341.02	66474.22	22.67	Natural Gas PJ	PJ	591.65	25379.70	15.02
		6. Other	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
BGR	Bulgaria	**Natural Gas**					**9.82**					**8.01**
		2. Exploration	0	NA	IE	IE	IE	0	NA	IE	IE	IE
		3. Production	0	106m3	14.00	1340.00	0.02	0	106m3	277.00	1340.00	0.37
		4. Processing	0	106m3	14.00	590.00	0.01	0	106m3	277.00	590.00	0.16
		5. Transmission and storage	0	106m3	8789.55	273.00	2.40	0	106m3	15810.00	273.00	4.32
		6. Distribution	0	106m3	6717.00	1100.00	7.39	0	106m3	2871.00	1100.00	3.16
		7. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
CYP	Cypress	**Natural Gas**					**NO**					**NO**
		2. Exploration	0	0	NO	NO	NO	0	0	NO	NO	NO
		3. Production	0	0	NO	NO	NO	0	0	NO	NO	NO
		4. Processing	0	0	NO	NO	NO	0	0	NO	NO	NO
		5. Transmission and storage	0	0	NO	NO	NO	0	0	NO	NO	NO
		6. Distribution	0	0	NO	NO	NO	0	0	NO	NO	NO
		7. Other	0	0	NO	NO	NO	0	0	NO	NO	NO
CZE	Czech Republic	**Natural Gas**					**41.80**					**23.34**
		2. Exploration	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		3. Production	(e.g. PJ gas produced)	PJ	7.84	39365.45	0.31	(e.g. PJ gas produced)	PJ	8.58	38649.05	0.33
		4. Processing	0	PJ	NO	NA	NA	0	PJ	NO	NA	NA
		5. Transmission and storage	(e.g. PJ gas consumed)	PJ	1357.98	9296.21	12.62	(e.g. PJ gas consumed)	PJ	1194.12	5664.59	6.76
		6. Distribution	(e.g. PJ gas consumed)	PJ	55.77	517563.35	28.86	(e.g. PJ gas consumed)	PJ	143.42	113257.56	16.24
		7. Other	(e.g. PJ gas consumed)	PJ	29.68	IE	IE	(e.g. PJ gas consumed)	PJ	160.33	IE	IE

DEU	**Germany**	**Natural Gas**					**370.65**					**297.16**
		3. Exploration	0	number	IE	IE	IE	0	number	IE	IE	IE
		4. Production	0	1000 m³	15262000.00	0.38	5.80	0	1000 m³	9786280.49	0.19	1.89
		5. Processing	0	1000 m³	15262000.00	0.37	5.61	0	1000 m³	9786280.49	0.13	1.27
		6. Transmission and storage	0	km	22696.00	3267.87	74.17	0	km	35575.00	3723.85	132.48
		7. Distribution	0	km	282612.00	905.55	255.92	0	km	487165.00	275.45	134.19
		8. Other	0	TJ	893519.00	32.62	29.15	0	TJ	1488689.00	18.36	27.34
DNM	**Denmark**	**Natural Gas**					**2.43**					**1.93**
		3. Exploration	0	m3	2892051.56	0.01	0.03	0	m3	102.05	0.01	0.00
		4. Production	Gas produced	10^6 m3	5137.00	380.00	1.95	Gas produced	10^6 m3	4704.00	380.00	1.79
		5. Processing	Gas produced	10^6 m3	5137.00	NA	NA	Gas produced	10^6 m3	4704.00	NA	NA
		6. Transmission and storage	Gas transmission	10^6 m3	2739.00	69.45	0.19	Gas transmission	10^6 m3	4886.00	3.30	0.02
		7. Distribution	Gas distributed	10^6 m3	1749.06	147.44	0.26	Gas distributed	10^6 m3	2662.00	45.93	0.12
		8. Other	Incl. In transmission	m3	NO	NO	NO	Incl. In transmission	m3	NO	NO	NO
ESP	**Spain**	**Natural Gas**					**19.99**					**24.69**
		3. Exploration	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		4. Production	PJ gas produced (NCV)	PJ	51.17	70657.76	3.62	PJ gas produced (NCV)	PJ	2.37	72080.01	0.17
		5. Processing	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE
		6. Transmission and storage	PJ gas (NCV)	PJ	198.09	837.17	0.17	PJ gas (NCV)	PJ	1062.43	1180.15	1.25
		7. Distribution	PJ gas consumed (NCV)	PJ	205.50	78856.89	16.21	PJ gas consumed (NCV)	PJ	1070.31	21737.49	23.27
		8. Other	(e.g. PJ gas consumed)	PJ	NE	NE	NE	(e.g. PJ gas consumed)	PJ	NE	NE	NE
EST	**Estonia**	**Natural Gas**					**1.89**					**0.84**
		4. Exploration	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		5. Production	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		6. Processing	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		7. Transmission and storage	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		8. Distribution	Amount of natural gas distributed	PJ	51.23	36960.00	1.89	Amount of natural gas distributed	PJ	22.78	36960.00	0.84
		9. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO
FIN	**Finland**	**Natural Gas**					**0.17**					**1.24**
		4. Exploration	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		5. Production	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		6. Processing	0	NA	NO	NO	NO	0	NA	NA	NA	0.00
		7. Transmission and storage	PJ gas consumed	PJ	91.58	1856.22	0.17	PJ gas consumed	PJ	119.05	1278.43	0.15
		8. Distribution	PJ gas distributed	NO	NO	NO	NO	PJ gas distributed	NO	6.91	156922.32	1.08
		9. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
FRK	**France**	**Natural Gas**					**48.04**					**38.72**
		4. Exploration	NO	PJ	NO	NO	NO	NO	PJ	NO	NO	NO
		5. Production	NO	PJ	IE	IE	IE	NO	PJ	IE	IE	IE
		6. Processing	Gas processed	PJ	309.00	2372.14	0.73	Gas processed	PJ	51.54	133.13	0.01
		7. Transmission and storage	Gas consumed	PJ	1055.46	13469.65	14.22	Gas consumed	PJ	1622.15	9256.75	15.02
		8. Distribution	Gas consumed	PJ	1055.46	31352.55	33.09	Gas consumed	PJ	1622.15	14610.56	23.70
		9. Other	NO	PJ	NO	NO	NO	NO	PJ	NO	NO	NO

GBE	United Kingdom	**Natural Gas**					**406.73**					**175.87**
		5. Exploration	Exploration drilling: fuel use	t	225517.62	15.66	3.53	Exploration drilling: fuel use	t	36366.39	45.00	1.64
		6. Production	Gas produced	PJ	1709.37	IE	IE	Gas produced	PJ	1374.26	IE	IE
		7. Processing	Gas produced	PJ	1709.37	12756.72	21.81	Gas produced	PJ	1374.26	2049.26	2.82
		8. Transmission and storage	Natural gas supply	GWh	387730.56	23.58	9.14	Natural gas supply	GWh	563139.34	9.65	5.43
		9. Distribution	Natural gas supply	GWh	387730.56	960.08	372.25	Natural gas supply	GWh	563139.34	294.76	165.99
		10. Other	0	0	NO	NO	NO	0	0	NO	NO	NO
GRC	Greece	**Natural Gas**					**0.37**					**2.77**
		5. Exploration	0	0	NO	NO	NO	0	0	NO	NO	NO
		6. Production	0	mil_m3	123.00	1930.00	0.24	0	mil_m3	6.00	1930.00	0.01
		7. Processing	0	mil_m3	123.00	IE	IE	0	mil_m3	6.00	IE	IE
		8. Transmission and storage	0	mil m3	123.00	298.00	0.04	0	mil m3	3842.00	298.00	1.14
		9. Distribution	0	mil m3	86.24	1100.00	0.09	0	mil m3	1468.59	1100.00	1.62
		10. Other	0	0	IE	IE	IE	0	0	IE	IE	IE
HRV	Croatia	**Natural Gas**					**28.21**					**27.51**
		5. Exploration	0	NA	NA	NA	NA	0	NA	NA	NA	NA
		6. Production	gas produced	1000000 m3	1982.30	12190.88	24.17	gas produced	1000000 m3	1856.10	12190.88	22.63
		7. Processing	gas produced	1000000 m3	1982.30	252.40	0.50	gas produced	1000000 m3	1856.10	252.40	0.47
		8. Transmission and storage	marketable gas	1000000 m3	2686.60	1066.50	2.87	marketable gas	1000000 m3	2809.90	1066.50	3.00
		9. Distribution	utility sales	1000000 m3	379.30	1800.00	0.68	utility sales	1000000 m3	788.30	1800.00	1.42
		10. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
HUN	Hungary	**Natural Gas**					**29.39**					**18.33**
		6. Exploration	0	NA	IE	IE	IE	0	NA	IE	IE	IE
		7. Production	Gas production (million m3)	million m3	4874.00	1340.00	6.53	Gas production (million m3)	million m3	1960.00	1340.00	2.63
		8. Processing	Sweet gas plants-raw gas feed (million m3	million m3	1593.00	940.86	1.50	Sweet gas plants-raw gas feed (million m3)	million m3	565.00	986.25	0.56
		9. Transmission and storage	Marketable gas (million m3)	million m3	11278.00	674.50	7.61	Marketable gas (million m3)	million m3	10136.00	298.00	3.02
		10. Distribution	Utility sales (million m3)	million m3	12507.10	1100.00	13.76	Utility sales (million m3)	million m3	11026.86	1100.00	12.13
		11. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
IRL	Ireland	**Natural Gas**					**6.24**					**0.93**
		6. Exploration	Natural gas exploration	PJ	IE	IE	IE	Natural gas exploration	PJ	IE	IE	IE
		7. Production	0	PJ	78.58	14330.75	1.13	0	PJ	6.32	1109.19	0.01
		8. Processing	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE
		9. Transmission and storage	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE
		10. Distribution	0	PJ	23.85	214519.35	5.12	0	PJ	68.36	13507.19	0.92
		11. Other	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
ITA	Italy	**Natural Gas**					**329.41**					**214.80**
		6. Exploration	Wells explored	Number	36.00	158.15	0.01	Wells explored	Number	1.00	334.43	0.00
		7. Production	Gas produced	Mm3	17296.39	1726.36	29.86	Gas produced	Mm3	7704.86	906.01	6.98
		8. Processing	Gas produced	Mm3	17296.39	773.26	13.37	Gas produced	Mm3	7704.86	405.75	3.13
		9. Transmission and storage	Gas transported	Mm3	45683.58	822.12	37.56	Gas transported	Mm3	69010.00	498.21	34.38
		10. Distribution	Gas distributed	Mm3	20632.00	12049.80	248.61	Gas distributed	Mm3	34551.92	4929.16	170.31
		11. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO

LTU	Lithuania	**Natural Gas**					**6.63**						**12.07**
		7. Exploration	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		8. Production	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		9. Processing	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		10. Transmission and storage	Length of transmission pipeline, thous.km	thous.km	1.35	3500000.00	4.73	Length of transmission pipeline, thous.km	thous.km	2.01	3500000.00	7.02
		11. Distribution	Length of distribution pipeline, thous.km	thous.km	3.10	615000.00	1.91	Length of distribution pipeline, thous.km	thous.km	8.20	615000.00	5.04
		12. Other	0	thous.km	IE	IE	IE	0	thous.km	IE	IE	IE
LUX	Luxembourg	**Natural Gas**					**0.77**					**1.63**
		7. Exploration	gas exploration	NA	NO	NO	NO	gas exploration	NA	NO	NO	NO
		8. Production	gas produced	NA	NO	NO	NO	gas produced	NA	NO	NO	NO
		9. Processing	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		10. Transmission and storage	gas consumed	TJ	17933.32	13.12	0.24	gas consumed	TJ	37284.50	13.26	0.49
		11. Distribution	gas consumed	TJ	17933.32	30.07	0.54	gas consumed	TJ	37284.50	30.39	1.13
		12. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO
LVA	Latvia	**Natural Gas**					**7.09**					**3.29**
		7. Exploration	0	m3	NO	NO	NO	0	m3	NO	NO	NO
		8. Production	0	m3	NO	NO	NO	0	m3	NO	NO	NO
		9. Processing	0	m3	NO	NO	NO	0	m3	NO	NO	NO
		10. Transmission and storage	0	m3	125172.00	0.69	0.09	0	m3	44871.00	0.69	0.03
		11. Distribution	0	m3	694188.00	0.69	0.48	0	m3	694188.00	0.69	0.48
		12. Other	0	m3	12435406.00	0.52	6.53	0	m3	4061563.00	0.69	2.79
MLT	Malta	**Natural Gas**					**NO**					**NO**
		8. Exploration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		9. Production	gas produced	NO	NO	NO	NO	gas produced	NO	NO	NO	NO
		10. Processing	NO	no	NO	NO	NO	NO	no	NO	NO	NO
		11. Transmission and storage	gas consumed	NO	NO	NO	NO	gas consumed	NO	NO	NO	NO
		12. Distribution	gas consumed	NO	NO	NO	NO	gas consumed	NO	NO	NO	NO
		13. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
NLD	Netherlands	**Natural Gas**					**17.79**					**19.41**
		8. Exploration	number of wells drilled/tested	number	NA	IE	IE	number of wells drilled/tested	number	NA	IE	IE
		9. Production	gas produced	PJ	2300.00	IE	IE	gas produced	PJ	2409.00	IE	IE
		10. Processing	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE
		11. Transmission and storage	gas transported	PJ	2648.08	2137.02	5.66	gas transported	PJ	3250.52	2156.89	7.01
		12. Distribution	natural gas distribution network	10^3 km	99.98	121283.21	12.13	natural gas distribution network	10^3 km	124.47	99629.80	12.40
		13. Other	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE
POL	Poland	**Natural Gas**					**27.10**					**42.32**
		8. Exploration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		9. Production	Production	PJ	99.56	66879.91	6.66	Production	PJ	160.07	66879.91	10.71
		10. Processing	0	PJ	99.56	29950.57	2.98	0	PJ	160.07	29950.57	4.79
		11. Transmission and storage	gas consumed	PJ	374.21	13957.55	5.22	gas consumed	PJ	574.67	13957.55	8.02
		12. Distribution	gas consumed	PJ	374.21	31986.04	11.97	gas consumed	PJ	574.67	31986.04	18.38
		13. Other	NA	PJ	374.21	726.96	0.27	NA	PJ	574.67	726.96	0.42

PRT	**Portugal**	**Natural Gas**					**NO**					**5.56**
		9. Exploration	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		10. Production	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		11. Processing	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		12. Transmission and storage	0	ton NG Impor	NO	NO	NO	0	n NG Imported	3481.17	1596.46	5.56
		13. Distribution	0	ton NG Distrib	NO	NO	NO	0	G Distributued	1695.76	NO	NO
		14. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
ROU	**Romania**	**Natural Gas**					**452.23**					**183.64**
		9. Exploration	gas produced	0	IE	IE	IE	gas produced	0	IE	IE	IE
		10. Production	gas produced	0	28336.00	12190.00	345.42	gas produced	0	10854.00	12190.00	132.31
		11. Processing	gas produced and processed	0	IE	IE	IE	gas produced and processed	0	IE	IE	IE
		12. Transmission and storage	gas produced	0	35667.00	633.00	22.58	gas produced	0	12317.00	633.00	7.80
		13. Distribution	gas supplied	0	35667.00	1800.00	64.20	gas supplied	0	12317.00	1800.00	22.17
		14. Other	gas consumed	0	143.63	139500.00	20.04	gas consumed	0	153.14	139500.00	21.36
SVK	**Slovakia**	**Natural Gas**					**44.14**					**32.15**
		9. Exploration	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		10. Production	Production/Processing	mil m3	444.00	2300.00	1.02	Production/Processing	mil m3	124.00	2300.00	0.29
		11. Processing	0	mil m3	444.00	1030.00	0.46	0	mil m3	124.00	1030.00	0.13
		12. Transmission and storage	Transfer	mil m3	73600.00	480.00	35.33	Transfer	mil m3	52780.00	480.00	25.33
		13. Distribution	Distribution	mil m3	6666.00	1100.00	7.33	Distribution	mil m3	5820.00	1100.00	6.40
		14. Other	Storage	mil m3	1.00	25.00	0.00	Storage	mil m3	132.00	25.00	0.00
SVN	**Slovenia**	**Natural Gas**					**1.70**					**1.27**
		10. Exploration	0	1000 m3	NO	NO	NO	0	1000 m3	NO	NO	NO
		11. Production	Gas production	1000 m3	23631.00	12.19	0.29	Gas production	1000 m3	2997.56	1.34	0.00
		12. Processing	0	1000 m3	NO	NO	NO	0	1000 m3	NO	NO	NO
		13. Transmission and storage	Marketable gas	1000 m3	892000.60	0.48	0.43	Marketable gas	1000 m3	850029.50	0.39	0.33
		14. Distribution	Utility sale	1000 m3	892000.60	1.10	0.98	Utility sale	1000 m3	850029.50	1.10	0.94
		15. Other	0	1000 m3	NO	NO	NO	0	1000 m3	NO	NO	NO
SWE	**Sweden**	**Natural Gas**					**2.65**					**1.81**
		10. Exploration	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		11. Production	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		12. Processing	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		13. Transmission and storage	Length of gas transmission network	km	320.00	6.74	0.00	Length of gas transmission network	km	620.00	115.93	0.07
		14. Distribution	0	NA	NA	NA	2.65	0	NA	NA	NA	1.74
		15. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO

3.2.7 CO_2 capture and storage (1.C)

CO_2 capture and storage is not an EU key category (see Annex 1.1). In 2015 the only Member State that reports CO_2 emissions under this category is Finland.

3.3 Uncertainties

For information on uncertainties please refer to chapter 1.6.

3.4 Sector-specific quality assurance and quality control

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). This review also covered the energy sector of the MS GHG inventories (peer review). In 2015, a few Member States volunteered to be reviewed under step 2 of the ESD trial review for the sector energy.

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 1.4.1). During the ESD review 2012 and during the initial checks and the ESD trial review 2015 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 and during the ESD review Eurostat energy data is used for cross checking the sectoral and reference approach of the MS submissions. This cross check between 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[16]. The energy statistics regulation was adopted as part of the energy package and 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

[16] REGULATION (EC) No 1099/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2008 on energy statistics as amended by Commission Regulation (EU) No 147/2013 of 13 February 2013.

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:

- ensures a stable and institutional basis for energy statistics in the EU,
- guarantees long-term availability of energy data for EU policies,
- reinforces available resources for the production of the basic energy statistics at national level.

The energy statistics regulation helps improving the QA/QC of the EU inventory as it:

- makes available more detailed energy statistics by fuel,
- allows the estimation of CO_2 emissions from energy with the reference and sectoral approach,
- assures the quality of the underlying energy statistics,
- improves timeliness of energy statistics,
- provides 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'.

In addition, Article 7(1)(m)(iii) of the MMR in conjunction with Article 12 of the implementing regulation requires Member States to report to the European Commission textual information on the comparison between the reference approach calculated on the basis of the data included in the greenhouse gas inventory and the reference approach calculated on the basis of the data reported pursuant to the Energy Statistics Regulation. Member States with differences of more than +/- 2% in the total national apparent fossil fuel consumption have to provide quantitative information and explanations for the year X-2 in accordance with the tabular format set out in Annex VI of the implementing regulation.

Eurocontrol data

Since 2010 there are framework contracts in place between the European Commission and EUROCONTROL, the European organization for the safety of air navigation, pertaining to the improvement of GHG and air pollutant emissions inventories submitted by the 28 Member States and the European Union to the UNFCCC and to the UNECE. EU Member States shall be assisted to 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. For this, the European Environment Agency and its European Topic Centre on Air Pollution and Climate Change Mitigation is preparing comparisons between EUROCONTROL results and MS inventory data and is promoting discussions between EUROCONTROL and EEA Member States related to these results. For more information on the process refer to chapter 1.4.2

- In July 2014 EUROCONTROL provided results on fuel consumption, emissions of CO_2, CH_4 and N_2O and other air pollutants for domestic and international aviation for the years 2005 to 2013 by Member States. This data has been revised with the data delivery of October 2015 for the time series 2005 to 2014. Recalculations took place to reflect i.a. changes in the geographical scope (inclusion of Mayotte), corrections of aircraft types and their relation to engine types and corrections of the calculation of PM and NO_X. In addition, results for other EEA member countries (Iceland, Liechtenstein, Switzerland, Norway and Turkey) have been included into the annual delivery.

- The calculation of EUROCONTROL is a bottom-up modelling, applying the Advanced Emissions Model (AEM). This is a tier 3b approach basing on EUROCONTROL information on flight plan data and flight trajectories (detailed documentation available upon request). Flight plan data is only available for flights under Instrumental Flight Rules. Flights which take place under Visual Flight Rules (VFR) are generally not included in the dataset of EUROCONTROL.

- The comparison of EUROCONTROL results and MS inventory data for the year 2013 has been prepared by the European Environment Agency and its European Topic Centre on Air Pollution and Climate Change Mitigation in November 2015 at a workshop with Member States and EUROCONTROL. Results have been presented for aviation gasoline and kerosene consumption, domestic splits for kerosene and implied emission factors for CO_2, N_2O and CH_4.

- Due to the exclusion of flights under VFR in EUROCONTROL's calculations, the results for the consumption of aviation gasoline (which mainly takes place in smaller aircrafts under VFR) are considerably lower for most Member States in EUROCONTROL calculations than in inventories. In addition most Member States allocate the total consumption of aviation gasoline to domestic aviation, following the recommendation of the IPCC 2006 guidelines, whereas EUROCONTROL displays some small amounts of aviation gasoline consumption for international aviation, too.

- EU-28 kerosene consumption in 2013 resulting from EUROCONTROL calculations is 3 % lower for domestic aviation and 4 % lower for international aviation compared to the aggregation of Member State results from inventories. The domestic split (as the share of kerosene consumption for domestic aviation on total kerosene consumption) for EU-28 is nearly identical between EU inventory and EUROCONTROL results. For domestic aviation the difference in CO_2 emissions is 0.2 Mt CO_2 in 2013. With this, the actual difference is considerably lower than the one which has been calculated in the very first exercise to compare EUROCONTROL results with MS data in 2007 (see EU NIR 2014). Obviously both the reporting of Member States but also the calculation of EUROCONTROL improved considerably during the years.

- The development of kerosene consumption along the time series 2005 to 2013 for EU-28 shows the same trends for both domestic and international aviation following EUROCONTROL results and EU inventory numbers. Differences are slightly higher in the years 2005 to 2007 due to different underlying datasets in EUROCONTROL calculations. Implied emission factors for N_20 and CH_4 for EU-28 are considerable higher with EUROCONTROL results, the methodology for the calculation of these gases will have to be checked before the next calculation run.

- Absolute differences in kerosene consumption are partly higher for single Member States, especially for domestic aviation. The reasons for these differences are mainly due to the fact, that respective Member States are basing their estimates on fuel sales statistics and on different estimates of domestic splits. In addition there are several general sources of possible differences: First there is the fact, that the consideration of flight trajectories for the calculation of cruise emissions is a method exclusively applied by EUROCONTROL. Furthermore the use of different sources for flight statistics for bottom up modelling, the allocation of aircraft types and engines to flights in statistics and the use of different emission factors for cruise and LTO lead to different results.

- Due to the delay of the inventory submission and recalculated EUROCONTROL results, the reasons for considerable differences on MS level have not been followed up as planned in initial checks 2015. This will take place during initial checks in 2016. In addition further improvements are planned for the bottom-up calculation from EUROCONTROL in 2016.

3.5 Sector-specific recalculations

For information on recalculations please refer to chapter 10.

3.6 Comparison between the sectoral approach and the reference approach

The IPCC reference approach for CO_2 from fossil fuels for the EU-28 is based on Eurostat energy data (Eurostat database, November 2015). This submission includes the reference approach tables for 1990–2013.

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 provides the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EU-28 as a whole.

The Eurostat data for the EU-28 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-28 level is a three-step process.

- The Energy Statistics Regulation (Regulation EC/1099/2008) is the basis for MS reporting of energy data to Eurostat as well as the basis for the EU's IPCC Reference Approach. For each of the 28 Member States, annual data on energy production, imports, exports, international bunkers and stock changes by fuel are available from Eurostat's database http://ec.europa.eu/eurostat/data/database The energy data used for the Reference Approach in the EU's 2015 inventory submission, and reported in table 1.A(b), corresponds to the sum of its 28 MS.
- The energy data in Eurostat's database can be exported in mass or volume units or in Terajoules. The latter is based on the calorific values reported by MS in the energy questionnaires, on a net basis. Table 1.A(b) was reported in Terajoules. The data was downloaded in November 2015.
- The carbon emission factors are those from the IPCC 2006 Guidelines http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
- The carbon excluded from table 1.A(b) is fully consistent with the sum of MS fuel quantities and CO_2 emissions from non-energy use reported in table 1.A(d) of their national inventory submissions.
- The fractions of carbon oxidised reported in table 1.A(b) are the default 2006 IPCC factors of 1, thus assuming complete oxidation of emissions.

Table 3.97 compares EU-28 CO_2 emissions calculated with the IPCC reference approach based on Eurostat data and the sectoral approach available from Member States for 1990 and 2013. The percentage differences for energy consumption are very low whereas the percentage differences for CO_2 are higher. The higher differences for CO_2 are due to the reporting of non-energy use of fuels which follows the new guidelines for the first time this year. MS had problems filling-in these tables which is also reflected at EU level. This will be improved in the next submission.

Table 3.97 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-28

FUEL TYPES	1990		2013	
	Energy consumption	CO_2 emissions	Energy consumption	CO_2 emissions
	(%)	(%)	(%)	(%)
Liquid fuels (excluding international bunkers)	-3.05	8.41	-4.38	11.86
Solid fuels (excluding international bunkers)	1.61	-0.10	2.36	0.01
Gaseous fuels	1.93	4.78	0.35	1.81
Other fossil fuels	-43.12	-39.75	-33.06	-20.88
Peat	0.45	-1.24	-1.52	-3.60
Total	***-0.58***	***3.87***	***-1.62***	***4.76***

Table 3.98 provides an overview for EU-28 Member States on differences between the Eurostat and national reference approach for 2013. The table shows that for EU-28 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 the largest differences are as follows:

Estonia – liquid fuels: different treatment of shale oil in the Eurostat energy balances compared to the CRF reference approach.

Cyprus – solid fuels: Cyprus was contacted on this issue during the initial checks and indicated to analyse this issue further.

Table 3.98 Comparison between Eurostat and national reference approach for apparent consumption for EU-28 for 2013 (CRF 1.A) [17]

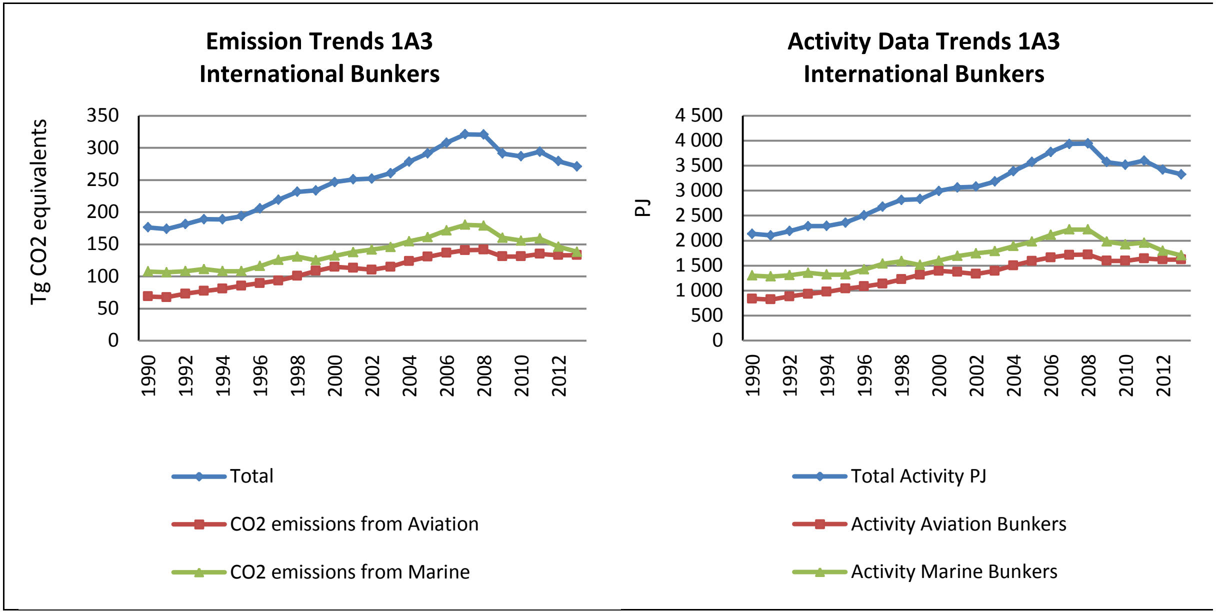
	Total gaseous			Total liquid			Total solid		
MS	**Eurostat TJ**	**Crf TJ**	**Difference %**	**Eurostat TJ**	**Crf TJ**	**Difference %**	**Eurostat TJ**	**Crf TJ**	**Difference %**
AT	293,567	293,566	0.0%	482,250	493,829	2.4%	139,367	140,755	1.0%
BE	602,704	599,690	-0.5%	913,301	911,396	-0.2%	134,939	134,877	0.0%
BG	99,978	99,977	0.0%	137,719	146,501	6.4%	247,776	247,802	0.0%
CY	- -	- -	0.0%	75,626	76,107	0.6%	5	12	138.0%
CZ	290,833	291,435	0.2%	346,357	337,918	-2.4%	681,837	681,939	0.0%
DE	3,051,547	3,178,642	4.2%	4,210,707	4,305,143	2.2%	3,416,796	3,414,158	-0.1%
DK	138,834	138,833	0.0%	247,590	254,029	2.6%	131,491	132,832	1.0%
EE	23,233	23,083	-0.6%	17,536	19,336	10.3%	183,498	183,496	0.0%
ES	1,092,027	1,093,235	0.1%	1,956,150	1,916,288	-2.0%	451,204	460,311	2.0%
FI	119,611	119,622	0.0%	310,135	328,430	5.9%	158,589	159,107	0.3%
FR	1,633,145	1,629,936	-0.2%	3,025,398	3,054,542	1.0%	513,121	554,445	8.1%
GR	135,496	135,497	0.0%	446,084	446,632	0.1%	292,268	300,741	2.9%
HR	95,537	95,537	0.0%	127,943	128,196	0.2%	28,247	28,252	0.0%
HU	322,602	322,601	0.0%	230,731	236,714	2.6%	98,086	97,680	-0.4%
IE	161,940	162,109	0.1%	253,986	247,936	-2.4%	55,457	55,417	-0.1%
IT	2,402,667	2,401,333	-0.1%	2,281,540	2,361,810	3.5%	585,896	579,515	-1.1%
LT	90,624	90,608	0.0%	98,092	100,875	2.8%	9,493	9,524	0.3%
LU	37,258	37,258	0.0%	100,833	100,552	-0.3%	1,965	2,006	2.1%
LV	50,438	50,544	0.2%	53,757	51,147	-4.9%	2,972	2,958	-0.5%
MT	- -	22	0.0%	30,210	32,131	6.4%	- -	- -	0.0%
NL	1,383,983	1,396,200	0.9%	1,242,217	1,223,066	-1.5%	339,711	341,960	0.7%
PL	574,674	574,674	0.0%	909,624	913,930	0.5%	2,204,608	2,231,006	1.2%
PT	157,250	157,799	0.3%	391,159	396,399	1.3%	110,949	111,071	0.1%
RO	410,051	410,052	0.0%	340,879	327,811	-3.8%	240,617	238,918	-0.7%
SE	39,996	39,996	0.0%	469,243	502,572	7.1%	83,201	83,202	0.0%
SI	28,966	28,967	0.0%	99,225	99,300	0.1%	56,544	56,171	-0.7%
SK	201,571	201,628	0.0%	120,972	128,990	6.6%	144,624	144,528	-0.1%
UK	2,750,037	2,756,655	0.2%	2,382,202	2,432,345	2.1%	1,555,795	1,567,499	0.8%

[17] Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

3.7 International bunker fuels (EU-28)

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[18]. Between 1990 and 2013, greenhouse gas emissions from international bunker fuels increased by 54 % in the EU-28. CO_2 emissions from "Marine bunkers" account for 51 % of total greenhouse gas emissions from international bunkers in 2013, CO_2 from "Aviation bunkers" accounts for 49 % (Figure 3.92).

Figure 3.92 International bunker fuels: GHG emission trend and activity data



3.7.1 Aviation bunkers (EU-28)

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 % of total GHG emissions in 2013 but are not included in the national total of GHG emissions (Table 3.99).

The Member States France, Germany, Spain and the United Kingdom contributed more than 60 % to the EU-28 emissions from this source. Most Member States (22 in total) increased emissions from Aviation bunkers between 1990 and 2013.

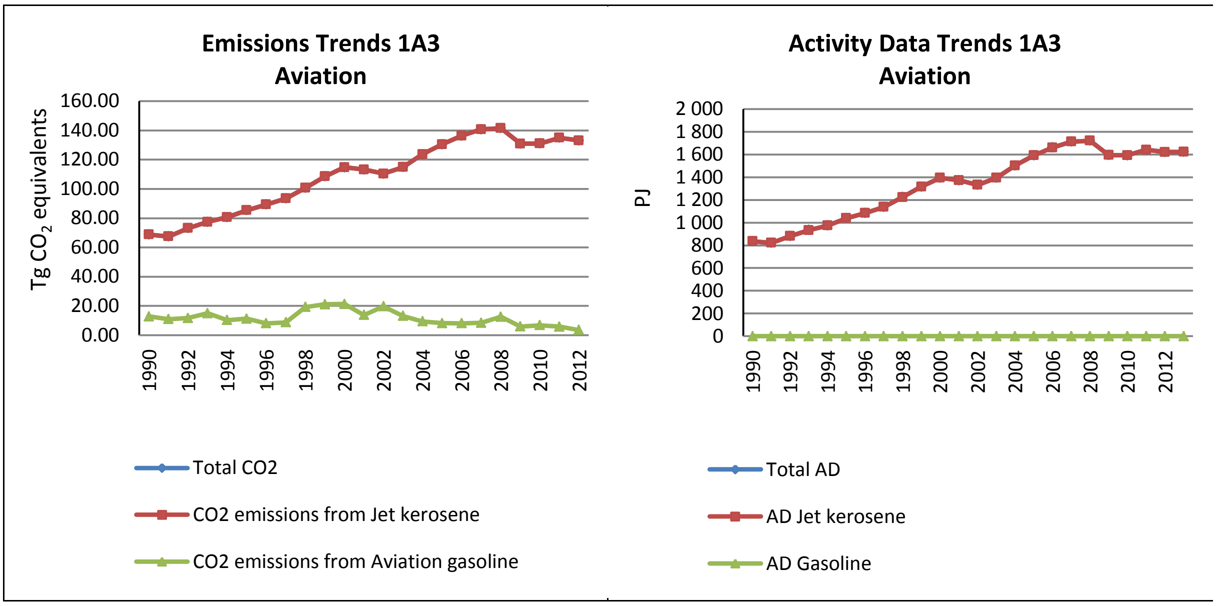
[18] The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within 'one country". This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers 'national fuel statistics' for domestic aviation. As the EU is neither a country nor a nation, the EU's interpretation of the good practice guidance is that the emission estimate at EU 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 3.99 Aviation bunkers: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	886	2 073	1 975	1%	-97	-5%	1 089	123%
Belgium	3 126	4 075	3 995	3%	-80	-2%	869	28%
Bulgaria	713	489	477	0%	-12	-3%	-237	-33%
Croatia	347	262	291	0%	29	11%	-56	-16%
Cyprus	725	803	713	1%	-90	-11%	-11	-2%
Czech Republic	524	884	853	1%	-31	-4%	329	63%
Denmark	1 721	2 496	2 473	2%	-23	-1%	752	44%
Estonia	108	114	88	0%	-26	-23%	-19	-18%
Finland	1 008	1 889	1 949	1%	61	3%	941	93%
France	8 657	16 167	16 031	12%	-136	-1%	7 374	85%
Germany	11 870	24 973	25 413	19%	440	2%	13 543	114%
Greece	2 439	2 514	2 472	2%	-42	-2%	33	1%
Hungary	480	502	489	0%	-12	-2%	9	2%
Ireland	1 070	1 742	1 803	1%	62	4%	734	69%
Italy	4 161	9 316	9 221	7%	-95	-1%	5 060	122%
Latvia	221	363	375	0%	12	3%	154	70%
Lithuania	399	190	211	0%	21	11%	-188	-47%
Luxembourg	403	1 139	1 144	1%	5	0%	741	184%
Malta	209	314	333	0%	20	6%	124	59%
Netherlands	4 540	10 211	10 433	8%	221	2%	5 892	130%
Poland	635	1 533	1 514	1%	-19	-1%	879	138%
Portugal	1 465	2 727	2 798	2%	71	3%	1 333	91%
Romania	790	400	491	0%	90	23%	-299	-38%
Slovakia	63	89	84	0%	-5	-6%	21	33%
Slovenia	48	66	73	0%	7	10%	25	52%
Spain	5 572	13 506	13 185	10%	-321	-2%	7 613	137%
Sweden	1 335	2 163	2 237	2%	75	3%	902	68%
United Kingdom	15 356	32 126	31 900	24%	-226	-1%	16 544	108%
EU-28	**68 871**	**133 126**	**133 022**	**100%**	**-104**	**0%**	**64 151**	**93%**

CO_2 emissions from jet kerosene account for 100 % of total emissions from "Aviation bunkers" in 2013 (Figure 3.93). All Member States but Bulgaria, Croatia, Cyprus, Estonia, Lithuania and Romania increased emissions from jet kerosene between 1990 and 2013. Member States with the highest increase between 1990 and 2013 in percent were Austria, Luxembourg, Poland and Spain.

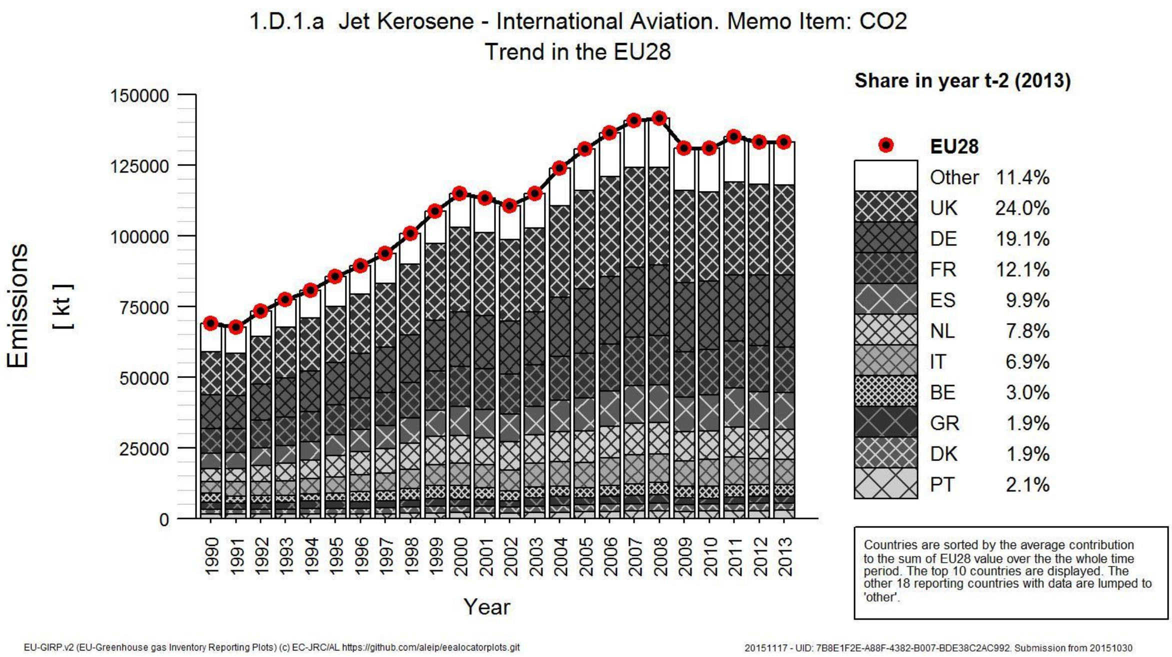
Figure 3.93 Aviation bunkers: Trend of CO_2 Emissions and Activity Data



3.7.1.1 Aviation Bunkers – Jet Kerosene (CO_2)

Figure 3.94 provides an overview of emissions for EU-28 and those Member States contributing most to EU-28 emissions. France, Germany, Spain and the United Kingdom are the Member States that contributed more to the EU-28 emissions. Fuel combustion of EU-28 increased by 93 % between 1990 and 2013.

Figure 3.94 Aviation bunkers, Jet kerosene: Emission trend and share for CO_2



3.7.2 Marine bunkers (EU-28)

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 3 % of total GHG emissions in 2013 and are also not included in the national total of GHG emissions. Between 1990 and 2013, CO_2 emissions from Marine bunkers increased by 28 % in the EU-28 (Table 3.100).

The Member States Belgium, the Netherlands and Spain contributed most to the emissions from this source (63 %) in 2013. Between 1990 and 2013, most Member States increased emissions from Marine bunkers. The Member States with the highest increase in absolute terms were Belgium, the Netherlands and Spain.

Table 3.100 Marine bunkers: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	49	64	70	0%	6	10%	21	42%
Belgium	13 313	19 811	20 159	15%	347	2%	6 846	51%
Bulgaria	183	200	284	0%	84	42%	101	55%
Croatia	147	NO	NO	-	-	-	-147	-100%
Cyprus	183	620	755	1%	135	22%	573	313%
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	3 012	1 513	1 886	1%	373	25%	-1 127	-37%
Estonia	553	1 220	1 278	1%	58	5%	726	131%
Finland	1 832	349	371	0%	22	6%	-1 461	-80%
France	7 892	7 959	7 253	5%	-706	-9%	-639	-8%
Germany	6 405	7 430	6 620	5%	-811	-11%	215	3%
Greece	8 041	7 341	7 096	5%	-245	-3%	-944	-12%
Hungary	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Ireland	57	397	440	0%	43	11%	384	675%
Italy	4 426	6 320	4 991	4%	-1 329	-21%	566	13%
Latvia	1 500	762	743	1%	-19	-2%	-757	-50%
Lithuania	302	384	279	0%	-106	-28%	-24	-8%
Luxembourg	0	0	0	0%	0	-5%	0	52%
Malta	260	3 693	3 888	3%	195	5%	3 629	1398%
Netherlands	34 235	44 163	42 252	31%	-1 911	-4%	8 017	23%
Poland	1 258	460	446	0%	-14	-3%	-813	-65%
Portugal	1 386	2 076	2 188	2%	112	5%	802	58%
Romania	NO	44	129	0%	85	193%	129	100%
Slovakia	65	9	13	0%	4	39%	-52	-80%
Slovenia	NO,NA	161	198	0%	38	23%	198	100%
Spain	11 527	26 645	22 890	17%	-3 755	-14%	11 363	99%
Sweden	2 228	5 769	5 453	4%	-316	-5%	3 225	145%
United Kingdom	8 721	8 765	8 532	6%	-232	-3%	-189	-2%
EU-28	**107 575**	**146 158**	**138 215**	**100%**	**-7 943**	**-5%**	**30 640**	**28%**

CO_2 emissions from residual fuel oil account for 84 % of total emissions from “Marine bunkers” in 2013 (Figure 3.95). Between 1990 and 2013, CO_2 emissions from residual fuel oil increased by 39 % in the EU-28. Bulgaria, Croatia, Denmark, Finland, France, Greece, Latvia, Lithuania and Poland decreased their emissions, all other Member states increased emissions from residual oil between 1990 and 2013. Member States with the highest increase in percent were Malta, Estonia, Spain and Sweden.

CO_2 emissions from gas/diesel oil account for 16 % of total emissions from "Marine bunkers" in 2013. Between 1990 and 2013, CO_2 emissions from gas/diesel oil decreased by 8 % in the EU-28.

Figure 3.95 Marine bunkers: Trend of CO_2 Emissions and Activity Data

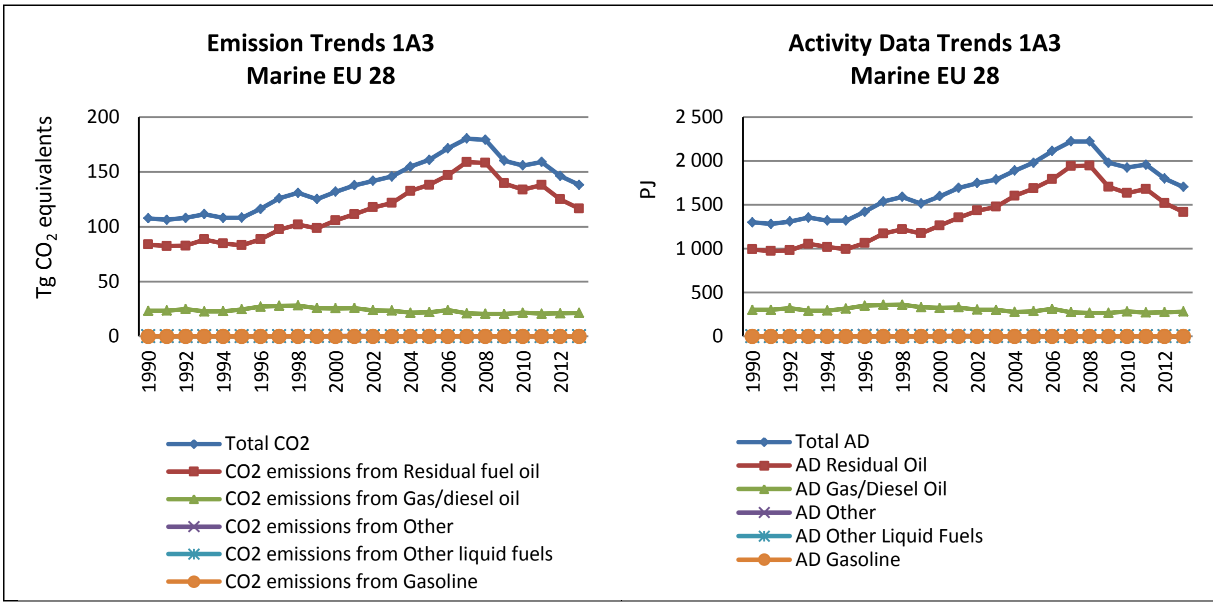
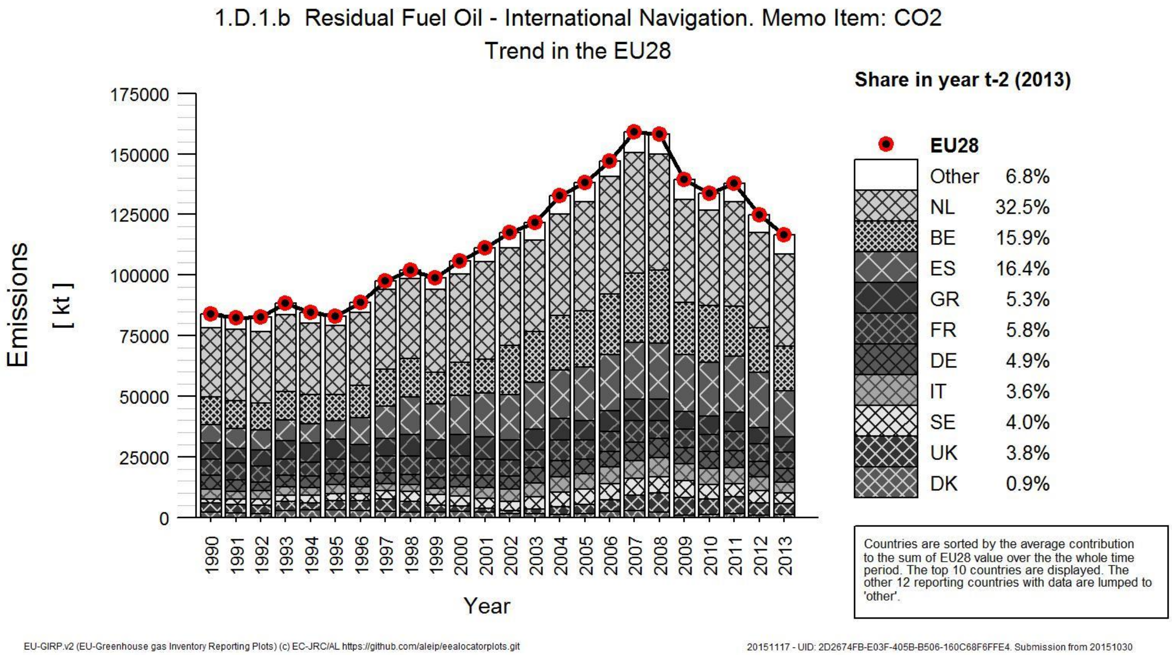


Figure 3.96 and Figure 3.97 provide an overview of emissions for residual oil and gas/diesel oil for EU-28 and those Member States contributing most to EU-28 emissions.

3.7.2.1 Marine Bunkers – Residual Oil (CO_2)

Combustion of residual oil in the EU-28 increased by 39 % between 1990 and 2013.

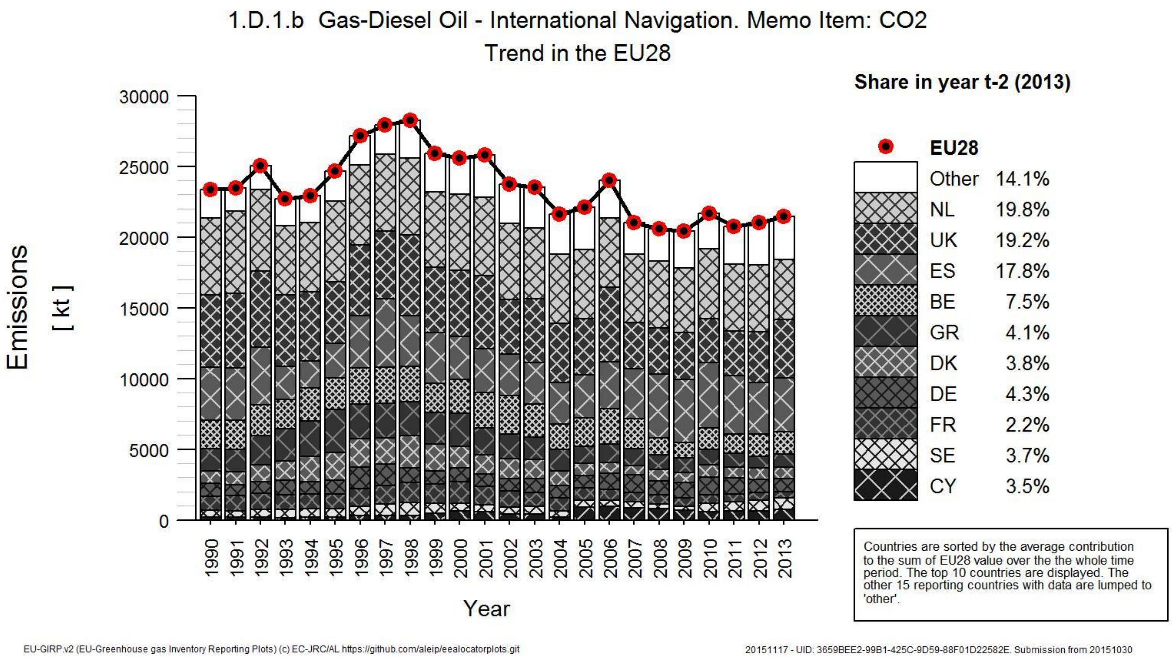
Figure 3.96 Marine bunkers' – Residual Oil: Emission trend and share for CO_2



3.7.2.2 Marine Bunkers – Gas/Diesel Oil (CO_2)

Combustion of gas/diesel oil in the EU-28 decreased by 8 % between 1990 and 2013.

Figure 3.97 Marine bunkers, Gas/Diesel Oil: Emission trend and share for CO_2



3.7.3 QA/QC activities

For more information on QA/QC activities refer to chapter 3.4

3.8 Feedstocks and non-energy use of fuels

Following a recommendation of the expert review team the EU 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 all fuels and for the complete time series from 1990-2013.

Table 3.101 provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.101 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. **Lubricants** manufacture: emissions are assumed to be included in total emissions from category *1.A.1.b* petroleum refinery. use: 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. **Naphtha** manufacture: naphta is produced in the oil refinery and transferred to a petrochemical plant. Residues from the petrochemical plants are transferred back to the oil refinery steam cracker. use: Naphta is used for plastics production (e.g. ethylene). **Petroleum coke** In [IEA JQ 2014] 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. **Residual fuel oil** use: Considerable amounts of residual fuel are used in blast furnaces. Emissions are considered in *2.C.1*. **Coking coal, Bituminous coal, Coke oven coke, Coal Tar** manufacture: emissions from the production of coke are considered in category *1.A.2.a*. use: CO_2 emissions from coal, coke and coal tar used in iron and steel industry are reported under *2.C*. **Natural Gas** use: 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*). **Plastics waste** manufacture: Emissions from manufacture of plastics are considered in category *2.B.* use: plastics waste is used as a reductant in blast furnaces. Emissions are considered in *2.C.1*. Disposal: Any emissions from waste disposal are considered in category 5.A. Waste incineration with energy use is considered in *1.A – other fuels* and waste incineration without energy recovery is considered in category *5.C*.	Austria's National Inventory Report 2015 Oct 2015 p. 68f

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 2B1, 2B8 and 2B10. During the 2015 submission a reallocation of the offgas-emissions/recovered fuels from cracking units (biggest part) plus some other processes (non-energy use) emissions (reported in the category 1A2c / other fuels before), were moved to the category 2B8b Industrial Processes and Product Use / Chemical Industry / Petrochemical and Carbon Black Production / Ethylene during this submission as prescribed in the new IPCC 2006 guidelines. 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 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. In our opinion, the guidelines are also not very clear on the allocation of the resulting emissions: in the CRF table 1.AD, 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 why this sector 2B8b is a key source for the trend assesment). 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 2B8. This is the largest source of CO_2 emissions. This includes the recovered fuels in the steam cracking units in the 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] and from emission estimates from 2013 on, these emissions are taken over from the reported emissions via the ETS-Directive. 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 2B10). These CO_2 emissions result from the same surveys in the chemical sector in Flanders as those reported under 2B8 and are taken over from the reported emissions via the ETS-Directive from emission estimates from 2013 on.. Emissions of flaring activities in the chemical industry are allocated to the category 5C1.2.b (Waste Incineration / Non-biogenic / Other / Flaring in the chemical industry) during this submission. 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 5C) or under the sector of energy (category 1A1a), depending whether or not energy recuperation takes place during the process.	Belgium´s Greenhouse Gas Inventory 1990-2013 Oct 2015 p. 60f

MS	Information on feedstocks and non-energy use of fuels	Source
Bulgaria	Non-energy use of fuels is reported for the following fuels: • Anthracite • Coke Oven Coke • Other bituminous coal • Lubricants • Bitumen • Naphtha • Paraffin waxes • White spirit • Residual Fuel Oil • Other Oil Products • Petroleum Coke • Natural Gas as Feedstock There are some fluctuations of the reported consumption of some of the fuels during the time series due to changes in the industrial production – differences in production volume, decommissioning of installations or shift from one fuel type to another. Some discrepancies with the quantities of fuels reported as non-energy use exist in the Energy balance – for some fuels only for the latest years is reported non-energy use, in addition some industrial plants do not properly report their non-energy use of fuels. In order to improve the consistency, additional data was collected from several chemical plants regarding the annual production of ammonia, soda ash and calcium carbide. The amounts of energy and non-energy use of natural gas, anthracite, other bituminous coal and coke oven coke we reallocated according to the quantities of fuels considered as emission sources in the Industrial Processes sector. The non-energy use of fuels is on average 8.06% of the total apparent energy consumption during the period 1988-2013 and 5.40% for 2013. The apparent consumption is calculated according to Equation 6.2 in Vol. 2, Ch. 6 of the 2006 IPCC Guidelines. In general, most of the non-energy use of fuels is attributed to the industrial sector (lubricants, paraffin waxes), chemical and petrochemical industry (anthracite, natural gas, naphtha, white spirit and other petroleum products) and construction (bitumen). All sources of emissions due to non-energy use of fuels (natural gas) are reported under category 2B Chemical Industry. The quantities of waste oils, which are used with energy recovery in the non-metallic minerals and other industrial plants, are reported as other fuels under category 1.A.2.g Other industries.	National Inventory Report 2015 Oct 2015 p. 87ff
Cyprus	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 oxidised 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 from burning of products should be reported under the waste sector or energy sector (as long as energy exploitation takes place). In the case of Cyprus the products are used in the energy sector (it is assumed that 100% is collected and converted to fuel that is then consumed).	Cyprus National Greenhouse Gases Inventory Report 1990-2013 Oct 2015 p. 71
Croatia	Non-energy fuel consumptions (fuels used as feedstock) and appropriate emissions, where one part or even the whole carbon is stored in product for a longer time and the other part oxidizes and goes to atmosphere, are described here. The feedstock use of energy carriers occurs in chemical industry (natural gas consumption for ammonia production, production of naphtha, ethane, paraffin and wax), construction industry (bitumen production), and other products such as motor oil, industrial oil, grease etc. As a result of non-energy use of bitumen in construction industry there is no CO_2 emission because all carbon is bound to the product.	National Inventory Report 2015 Oct 2015 p. 107
Denmark	In the revised CRF format the consumption for non-energy purposes is sub-tracted in the reference approach, because non-energy use of fuels is includ-ed in other sectors (Industrial processes and Solvent use) in the Danish na-tional approach. Three fuels are used for non-energy purposes: lubricants, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 11.6 PJ in 2013. The CO_2 emission from oxidation of lube oil during use was 32 Gg in 2013 and this emission is reported in the sector industrial processes and product use (sector 2.D). The reported emission corresponds to 20 % of the CO_2 emis-sion from lube oil consumption assuming full oxidation. This is in agree-ment with the methodology for lube oil emissions in the 2006 IPCC Guide-lines (IPCC, 2006). Methodology and emission data for lube oil are shown in NIR Chapter 4.5.2. For white spirit the CO_2 emission is indirect as the emissions occur as NMVOC emissions from the use of white spirit as a solvent. The indirect CO_2 emission from solvent use was 68 Gg in 2013. The methodology and emission data for white spirit are included in NIR Chapter 4.5.4. The CO_2 emission from bitumen is included in sector 2.D.3, Road paving with asphalt and Asphalt roofing. The total CO_2 emissions for these sectors are 0.16 Gg. Methodology and emission data for non-energy use of bitumen are shown in NIR Chapter 4.5.6.	Denmark's National Inventory Report 2015 Sept 2015 p. 264ff

MS	Information on feedstocks and non-energy use of fuels	Source
Estonia	The following fuels are reported under CRF source category 1.AD Feedstocks and non–energy use of fuels: 1.AD.2 Lubricants 1.AD.3 Bitumen 1.AD.5 Natural Gas 1.AD.10 Other/Oil Shale Activity data on lubricants and bitumen consumption is received from Statistics Estonia (Joint Questionnaire that Statistics Estonia send to IEA annually). Data on natural gas use for non-energy use is taken from national energy balance sheet. Activity data on oil shale reported in the CRF 1.AD is calculated (see Annex 3). This is oil shale semi coke – the by-product of shale oil production and contains a small amount of organic matter (carbon). Oil shale semi-coke is stored in the oil shale waste dumps (carbon stored). Natural gas for non-energy purposes are used for ammonia production and are reported in the CRF source category 2.B.1. In 2012 the ammonia production factory was reopened. In 2010 and 2011 it was temporarily closed down due to low ammonia price in the Word market. Lubricants are used in energy sector for lubricating (mainly in transport and manufacturing sub-sectors). Some used lubricants (waste oils) are incinerated and corresponding emissions are taken into account in the CRF 1.A.2.f/Other fuels.	Greenhouse Gas Emissions in Estonia 1990-2013 Oct 2015 p. 62
Finland	The emissions from the non-specified burning of feedstocks are calculated by a separate module in ILMARI. The ILMARI system includes point source (bottom-up) data on feedstock combustion in the petrochemical industry and these emissions are reported in corresponding subcategories of 1.A 2. These specified energy uses of feedstock are subtracted from the corresponding total amounts of feedstock. For the rest of the feedstock 100% of carbon is estimated to be stored in products (mainly plastics). Residual fuel oil and coke oven gas coke is used as a feedstock in the metal industry and corresponding amount is subtracted from the reference approach. All (100%) of this carbon is estimated to be released as CO_2 during the process and emissions are reported in category 2.C 1 (see section 4.4.2). Natural gas is used as feedstock in the hydrogen production process and the carbon is subtracted from reference approach and emissions are reported in sector 2.B.10 (see section 4.3.5). From the carbon of other oil products only carbon from paraffin waxes are estimated to oxidise and these emissions are reported in sector 2.D 2 (section 4.5.3). In the Finnish inventory lubricants contain waste oil as well as 2-strike and 4-strike oil. The ILMARI system includes point source (bottom-up) data also on waste oil combustion in different branches of industry, and these emissions are reported in corresponding subcategories of 1.A 2. 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 2.D 1 (section 4.5.2).	Greenhouse Gas emissions in Finland 1990-2013, Oct 2015 p. 69
France	The fossil fuels are consumed for different purposes, for energy use and non-energy use (raw material, intermediate material as well as reducing agent). Emissions can occur in the sector of fuel combustion and industrial process. However, it is not always possible, partly for practical reasons, to separately report these two types of emissions. In the IPCC Guidelines, 2006, the following rule is formulated: Combustion emissions from fuels, directly or indirectly obtained from the feedstocks to a method falling within industrial processes and product use will normally be assigned to the portion of the source category in which the process occurs. These sources categories are normally 2B and 2C. However, if the derived fuels are transferred for combustion in another source category, the emissions should be reported in the corresponding part of the Energy Sector source categories (normally 1A1 or 1A2). In the French inventory, in order to preserve the coherence of the inventory of greenhouse gas emissions (under the UNFCCC) and the inventory of atmospheric pollutants (under the UNECE) on the one hand, and between the sectoral approach and the reference approach, on the other hand, it was decided to maintain the distinction between energy uses (reported in CRF 1A) and non-energy (in CRF 2). Finally, to ensure the completeness of the inventory, a feedback on total final consumption (energy + non-energy) energy balance is assured. With regard to the consumption of solid fuels (coal and coke coal) the energy balance accounts all types of use of these fuels as energy consumption and they are well distinguished after energy use and non-energy use in the inventory as well. The solid fuels which are used as reducing agents as well as intermediate material are considered in the CRF category 2C in steel and ferro-alloys production. The petroleum products for non-energy use are principally consumed on site of petrochemical installations. This usage is well investigated by an exhaustive survey conducted by the national statistics authority. According to the survey approximately 14% of the consumption of petroleum products is used for non-energy use, mainly as primary material. This survey defines the quantities of different oil products that are consumed in steam crackers reported under CRF 2B5. Emissions which are related to the combustion of motor oil are considered in CRF category 1A3. The emissions of recovered oil which is combusted during cement production are reported under category CRF 1A2. Those which are burned in waste incinerators are reported under CRF 6. The non-energy use of natural gas is occurring in the ammoniac, hydrogen and hydrocyanic acid production and is reported under CRF 2B.	Rapport National D'Inventaire pour la France Oct 2015 p.88f translation

MS	Information on feedstocks and non-energy use of fuels	Source
Germany	The great majority of the coal, oil and gas that Germany uses is used for energy-related purposes. The remainder of the coal, oil and gas is used as feedstock for production processes. This consumption enters into the balance as "non-energy use" (NEU). In the German Energy Balance, this consumption is listed separately, in line 43. The chemical industry is the leading user of fossil fuels for non-energy-related purposes. In that industry,fossil fuels are used in crackers, reforming processes and production of synthetic gases. In crackers and reforming, the most important products resulting from such processes are ethylene, propylene, 1,3-butadiene, benzene, toluene and xylene; in production of synthetic gases, the most important such products are ammonia and methanol. Bitumen, lubricants and paraffin waxes are produced in refineries. Bitumen is used in a range of applications, including road surfaces and bitumen sheeting for roofs. Lubricants are used in road vehicles and machines (inter alia). Other use consists of production of graphite electrodes. Table 384 (see below) presents a comparison of a) the consumption listed in Energy Balance line 43 and b) emissions, as reported in the inventory, of CO_2 and NMVOC from use of fossil fuels in non-energy-related applications. In the interest of complete accounting, the carbon quantities stored in the relevant fossil fuel products were taken into account. The correlation between material-related applications and products and the various relevant fuels is oriented to Table 1.3 from Volume 3 of the 2006 IPCC GL, and is based on information provided by relevant associations, producers and experts. In some cases, we had to make our own estimates of the applicable correlation with individual fuels. The produced quantities of the listed products have been obtained from data reported by the Federal Statistical Office and by the Federal Office of Economics and Export Control (BAFA) and have been converted into CO_2 equivalents. For methanol, ethylene, propylene, 1,3- butadiene, benzene, toluene and xylene, the conversions were carried out via the molar masses of the relevant products and the molar mass of CO_2. The pertinent CO_2 equivalent emissions were split among the three feedstocks used in Germany (naphta, LP gas and other petroleum products), in keeping with (internal) data provided by associations. Below, conversion into CO_2 equivalents is illustrated with the example of ethylene (C2H4): M (CO_2) = 44 g/mol M (C2H4) = 28 CO_2 equivalent = AR *2*44/28. In the case of carbon black, the product is assumed to consist of pure carbon. That carbon was also converted into CO_2 equivalents. The production quantities for bitumen, lubricants and paraffin waxes have been taken from the official Mineral Oil Statistics, and they have been converted into CO_2 equivalents with the help of the following IPCC standard values (Table 1.2 and Table 1.4 from Vol. 2 of the 2006 IPCC GL). For the year 2013, the sum of the carbon from the pertinent emissions and of the carbon stored in products amounts to 94 % of the non-energy-related consumption given in line 43 of the Energy Balance. Consequently, the relevant material-related use can clearly be shown to include the quantities listed in the Energy Balance as non-energy-related consumption. No gaps in determination of non-energy-related CO_2 emissions are apparent in the inventory.	National Inventory Report for the German Greenhouse Gas Inventory 1990-2013 Nov 2015 p. 793f

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 The calculation of carbon dioxide emissions from non-energy use of fuels is based on the relevant consumption by fuel type (Table 3.9) and the fraction of the carbon stored by fuel type (Table 3.10). 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 industrial processes 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 t 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 2014 p.79ff
Hungary	IPCC2006 Guidebook introduced significant changes regarding feedstocks and non-energy use of fuels. It is good practice now to report all the feedstock and non-energy use of fuels in the IPPU Sector within the source category in which the process occurs (and not in 2G source category as in the case of previous inventory submissions of Hungary). In addition, also chapter1.2 of Volume 2 states: "Combustion emissions from fuels obtained directly or indirectly from the feedstock for an IPPU process will normally be allocated to the part of the source category in which the process occurs. These source categories are normally 2B and 2C." So, in present submission all the fuels regarded as NEU in IEA Energy Statistics are allocated into IPPU sectors and also some amount from the quantities regarded as energy use in order to follow the suggestion of IPCC2006. This is the case by Natural Gas use in sector 2B1 – Ammonia, Naphtha use in 2.B.8 Petrochemical and the Coke used in 2C1 – Iron and steel. Therefore the Fuel quantities for NEU reported in CRF Table 1.A.(d) and QA/QC check Table for NEU included in Annex of the NIR are higher than the actual quantity reported in IEA Energy Statistics. However the differences are well-known and documented. Carbon content of all fuels which are allocated under the Industrial Processes sector is taken as stored carbon in the 1.AD sector (and in the reference approach), however the calculation of emission in the IPPU sector is not based on a default carbon-stored approach, but usually plant-specific (EU ETS) data, except for Lubricant and Paraffin wax use source categories.	National Inventory Report for 1985-2013 Oct 2015 p. 46f

MS	Information on feedstocks and non-energy use of fuels	Source
Ireland	This category includes fossil fuels used for non-energy purposes; without the combustion and oxidation process. There are a number of fuel types applicable in Ireland: • Lubricants – IPCC default oxidation value of 0.2 is used, see category 2.D.1; • Bitumen – IPCC default value of 1.0 is used for the proportion of carbon stored; • Paraffin wax – IPCC oxidation value of 0.9 is used for candles and 0.2 for all other paraffin wax, see category 2.D.2; • White spirit – IPCC default value of 1.0 is used for the proportion of carbon stored; • Natural Gas– a significant amount of natural gas feedstock was used in ammonia production from 1990-2003. Emissions from the non-energy use of fossil fuels have been included in the Industrial Processes and Product Use sector, CRF Category 2.D (Chapter 4 of this report).	Ireland National Inventory Report 2015 Nov 2015 p. 76
Italy	3.8.1 Source category description In Table 3.36 and 3.37 detailed data on petrochemical and other non-energy use for the year 2013 are given. The tables refer to all products produced starting from fossil fuels, solid, gas or liquid, and used for “non energy” purposes. A national methodology is used for the reporting and estimation of avoided emissions. 3.8.2 Methodological issues The quantities of fuels stored in products in the petrochemical plants are calculated on the basis of information contained in a detailed yearly report, the petrochemical bulletin, by Ministry of Economic development (MSE, several years [b]). The report elaborates results from a detailed questionnaire that all operators in Italy fill out monthly. The data are more detailed than those normally available by international statistics and refer to: • input to plants; • quantities of fuels returned to the market; • fuels used internally for combustion; • quantities stored in products. National petrochemical balance includes information on petrochemical input entering the process and used for the production of petrochemical products, and petrochemical plants output, returns to the market, losses and internal consumption. Due to chemical reactions in the petrochemical transformation process, the output quantity of some fuels could be greater than the input quantity; in particular it occurs for light products as LPG, gasoline and refinery gas, and for fuel oil. Therefore for these fuels it is possible to have negative values of the balance. For this matter, with the aim to allow the reporting on CRF tables, these fuels have been added to naphta. The amount of fuels recovered from the petrochemical processes and returning on the market are considered as an output, because consumed for transportation or in the industrial sectors, and no carbon is stored. In Table 3.36 and Table 3.37 the overall results and details by product are reported respectively. In Table 3.36 the breakdown of total petrochemical process is reported; the percentages referring to the “net” input are calculated on the basis of the total input subtracting the quantity of fuels as gasoil, LPG, fuel oil and gasoline which return on the market because produced from the petrochemical processes. In Table 3.37 the input to the petrochemical processes in petrochemical plants and the relevant losses, internal consumption and return to the market are reported, at fuel level, allowing the calculation of the quantity stored in products, subtracting the output (returns to the market, losses and internal consumption) from the input (petrochemical input). Carbon stored, for all the fuels, is therefore calculated from the amounts of fuels stored (in tonnes) multiplied by the relevant emission factors (tC/t) reported in Table 3.37. An attempt was made to estimate the quantities stored in products according to the IPCC 1996 Guidelines, Reference Manual, ch1, tables 1-5 (IPCC, 1997), multiplying the IPCC percentage values in tables 1-5 of the Guidelines by the amount of fuels reported as “petrochemical input” in Table 3.37. The resulting estimate of about 4,600 Gg of products, for the year 2013, is almost 50% bigger than the quantities reported, 3,067 Gg. Non-energy products amount stored from refineries, and other manufacturers, are reported in the National Energy Balance (MSE, several years [a]) and the carbon stored is estimated with emission factors reported in Table 3.38. For lubricants the net carbon stored results from the difference between the amount of lubricants and the amount of recovered lubricant oils. The energy content has been calculated on the basis of the IPCC default values. Minor differences in the overall energy content of these products occur if the calculation is based on national parameters instead of IPCC default values. In the CRF tables the fuel input amount is reported so that the fractions of carbon stored could be derived. As these fractions are derived from actual measurements they do not correspond to any default values and may vary over time. At national level, this methodology seems the most precise according to the available data. The European Project “Non Energy use-CO_2 emissions” ENV4-CT98-0776 has analysed our methodology performing a mass balance between input fuels and output products in a sample year. The results of the project confirm the reliability of the reported data (Patel and Tosato, 1997).	Italian Greenhouse Gas Inventory 1990-2013 Oct 2015 p.108ff

MS	Information on feedstocks and non-energy use of fuels	Source
Latvia	There are no emissions produced in this sector. Emissions from non-energy use of paraffin waxes, lubricants, bitumen and white spirits are included in CRF 4 – Industrial processes and product use sector.	Latvia´s National Inventory Report Oct 2015 p. 98
Lithuania	Feedstocks and non-energy use of fuel are included in national Energy balances (see Annex III). Use of fuels for feedstocks and non-energy use is dominated by natural gas (Figure 3-14). In 2013, natural gas amounted about 81,5% in the structure of feedstocks and non-energy use of fuels. The natural gas is used for ammonia, calcium ammonium nitrate, organic products and nitric acid production in the JSC Achema. JSC Achema is a leading manufacturer of nitrogen fertilizers and chemical products in Lithuania and the Baltic states. The previous ERT recommended to cross-check the data reported as non-energy use in the energy sector and the data reported under the industrial processes as the calculated CO_2 non-emitted from the use of natural gas for non-energy purpose differs from CO_2 emissions from ammonia production. A cross-check between the natural gas data used in industrial processes and the data reported as non-energy use in the energy sector showed that difference occur due to the use of different calorific values for the natural gas. In the industrial processes sector a specific calorific value is based on average annual lower calorific value of natural gas which is calculated on the basis of reports from the natural gas supplier AB Lietuvos dujos, which measure the calorific value twice a month. In the energy sector calculations are based on the data provided by the Lithuanian Statistics where fuel consumption is calculated in terms of tonnes of oil equivalent and terajoules using the net calorific value. The data reported as non-energy use in the energy sector and the data reported under the industrial processes also differs because the data reported as non-energy use in the energy sector accounts not only feedstocks for ammonia production, but also feedstocks for calcium ammonium nitrate, organic products and nitric acid production. The amounts of excluded carbon were calculated in accordance with the methodology provided in 2006 IPCC Guidelines (page 6.7). The amounts of excluded carbon are reported in CRF 1.AD Feedstocks, reductants and other non-energy use of fuels and linked to the CRF 1.AB Fuel Combustion - Reference Approach as excluded carbon.	Lithuania´s National Inventory Report 2015 Oct 2015 p. 82ff

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 1990-2012 Mar 2014 p. 24f
Malta	Non energy products from fuel and solvent use: • Lubricant use (2D1) – p. 62 • Paraffin wax use (2D2) – p.64 • Solvent use (2D3) – p.66 • Other (2D4) – p.67	National Greenhouse Gas Emissions and Removals Inventory for Malta 2015 Oct 2015

MS	Information on feedstocks and non-energy use of fuels	Source
Netherlands	Table 3.2 shows that a large share of the gross national consumption of petroleum products was used in non-energy applications. These fuels were mainly used as feedstock (naphta) in the petro-chemical industry and in products in many applications (bitumen, lubricants, etc.). Also a fraction of the gross national consumption of natural gas (mainly in ammonia production) and coal (mainly in iron and steel production) was used for non-energy applications and hence not directly oxidized. In many cases, these products are finally oxidized in waste incinerators or during use (e.g. lubricants in two-stroke engines). In the reference approach, these product flows are excluded from the calculation of CO_2 emissions.	Greenhouse Gas Emissions in the Netherlands 1990-2013 Nov 2015 p. 63
Poland	As the use of energy products for non-energy purposes can lead to emissions, Poland such emissions and report them under category 2D Non-energy products from fuels and h saosl vceanlctu ulastee. d For more description see chapter 4.5	Poland´s National Inventory Report 2015 Oct 2015 p. 47
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 1990-2012 Oct 2015 p. 3-208
Romania	The Energy Balance provides information concerning the non-energy use of the fuels. In response of ERT recommendation, “Romania further investigate and elaborate on the non-energy use of fuels reported in the energy balance, which is not reported in the energy sector, and assess whether the country specific carbon storage factors are appropriate”, Romania investigated the non-energy use of fuels reported in the energy balance; consequently, Romania subtracted the non-energy use from the Sectoral Approach and the corresponding quantities non-energy use of the products from the Reference Approach. In the same time, the consumption reported as energy consumption in line with the Energy Balance completion methodology, in fact being used in industrial processes, was accounted as non-energy use and subtracted from the sectoral approach and consequently from the Reference Approach; it is the case of coke_oven_coke which is used as reduction agent in Blast Furnaces and petroleum coke, which is used as catalyst coke and is deposited on the catalyst during refining processes. **Methodology** Non-energy use of fuels is reported in the Energy balance for the following fuels: Lubricants; Bitumen; Naphtha; LPG; Refinery gas; Motor Gasoline; Kerosene Type Jet Fuel; Other Kerosene; Gas-Diesel Oil; Petroleum Coke; Residual Fuel Oil; Natural Gas as Feedstock; Other Products; Paraffin waxes; White spirit; Lignite; Brown Coal; Coal Oil and Tars (from coking coal); Other Bituminous Coal. For the liquid fuels reported on the EU-ETS, the national parameter of the NCVs were determined and used to calculate the non-energy use of the fuels: annualy for the EU-ETS period (2007-2012 years) and average of the EU-ETS period for the rest of the time series; it is the case of the following fuels: Transport Diesel, Refinery Gas, Petroleum Coke, Residual Fuel Oil, Heating and Other Gasoil. The following type of fuels have been added to the Table1.A(d), “Feedstocks, reductants and other non-energy use of fuels - Other fuels” category: Refinery gas, Motor Gasoline, Paraffin waxes, White spirit. There are some fluctuations of the reported consumption of some of the fuels during the time series – unstable trends in the exports imports, or production. The non-energy use of fuels is on average 9% of the total apparent energy consumption during the period 19 The most significant fuels used as feedstock are natural gas, bitumen, naphtha and lubricants. Also, the Coke_Oven_Coke used as reduction agent in Blast Furnace, the associated emissions being accounted in Industrial Processes sector, represents an important non-energy use quantity. For coal oil and tars the assumption suggested in the methodology (5.91 % from the coking coal consumption is assumed to be stored in products) was applied. 89-2013, and 7% for 2013.	Romania´s Greenhouse Gas Inventory 1989-2013 Oct 2015 p.152ff

MS	Information on feedstocks and non-energy use of fuels	Source
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. Main sources are information directly from the plant or industry association about the use of fossil fuels, such as non-energy inputs following the sector/process to determine types of fuels, determined types of fuels from the quantity consumed for this purpose as retention carbon products, such as CO_2 emissions versus its complementing and replacing the figures reported in the above mentioned sources . Following sectors / processes - in most cases on individual plant level - are investigated: i) sodium carbonate; ii) calcium carbide and silicon ; iii) silicon ; iv) ferroalloys (ferrosilicon, ferromanganese and silicon manganese); v) ammonia ; vi) glass; vii) electrical steel mills ; viii) aluminum (anode manufacture); ix) hydrogen in the refining industry emplaced x) refinery plants. The exploitation of this information has led to a revision in the inventory figures for natural gas, petroleum coke, coal coke and coal (anthracite) and other fuels whose registered consumption for non-energy use is minor , such as coking coal , diesel , LPG, fuel oil, gas and refinery steel or wood.	Emisiones de gases de efecto invernadero 1990-2013 June 2014 Annex 4, p. A4.3 translation
Slovenia	The biggest fraction of non-energy usage of fuels was the consumption of natural gas for the production of methanol, amounting to 89,475 Sm3 of natural gas in 2010, when this production stopped, and there has been no methanol production in Slovenia since 2011. The remaining amount of non-energy use of natural gas is used in the chemical industry also as a row material for production of organic and inorganic chemicals and plastics. The detailed data on non energy use of natural gas are presented in the Table 3.2.8. **Oil and Lubricants** According to the Statistical data all lubricants in Slovenia have been used for non-energy purpose only. Data about different types of use are not available. Likely, the largest applications for lubricants are in the form of motor oil. After the end of use, the lubricants which have been used in the engines are collected and mostly used as a fuel. Data and corresponding stored CO_2 are presented in the table 3.2.9. A small portion of collected waste oils has also been incinerated (procedure R9) or reformed and then reused (procedure D10). We reported these emissions in waste sector under waste incineration in submission 2010 for the first time. No other use of lubricants as a fuel has been recorded in Slovenia until now. **Other fuels** Before 1997, amount of coke, used for production of iron and steel, ferroalloys and carbide was reported as fuel consumption in relevant sectors. After 1997, this fuel started to be collected separately, but it took a while that all non-energy used fuel was reported correctly. Energy and non-energy use of fuel in industry have been presented separately in statistical data since 2000. There are also other uses of fuel in chemical processes not emitting any GHGs, therefore no explanation is included in the CRF tables. In 2013, a small amount of fuel oil, LPG and white spirit was used, mostly for production of lacquers, paintings and other coatings. The same is valid also for bitumen which is used for road paving and for production of roofing material and during this use no GHG emissions occur.	Slovenia´s National Inventory Report 2015 Oct 2015 p. 43ff
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 (NEU) 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). Net calorific values and carbon emission factors are the same as in CRF 1AB. The parameter "fraction of carbon stored" has been set to 1.00 for all fuels, which is in line with the 2006 IPCC Guidelines. Emissions from use of fuels reported in CRF 1B or CRF 2 is reported as "CO_2 emissions from the NEU reported in the inventory" in the CRF-tables.	National Inventory Report 2015 Sweden Mar 2014 p.123

MS	Information on feedstocks and non-energy use of fuels	Source
United Kingdom	The methodology for estimating emissions from fuels used for non-energy purposes is set out in the relevant sections of this NIR. A summary of the method, including all non-energy uses is included in Annex 3. The UK energy statistics (DUKES, 2014) contain an allocation for non-energy use for each fuel in the commodity balance tables. The UK inventory estimates emissions from fuels, including emissions arising from non-energy uses. In some cases, the inventory estimate for non-energy use does not agree with the DUKES allocation, and reallocations are made between energy and non-energy use for inventory reporting. In 2013, the Inventory Agency carried out research into non-energy uses of fuels; this was followed up by the DECC energy statistics team during 2014, and a series of revised allocations are now included in the UK energy balance (DUKES 2014), bringing the inventory more closely into line with the energy statistics. The energy balance for the UK is set out in Annex 4. The evidence that the Inventory Agency uses to make estimates for NEU 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); • Periodic surveys or research by trade associations / research organisations / environmental regulators, such as to assess the fate of coal tars and benzoles, petroleum coke or waste oils, or the impact of regulations on solvents, waste, product design and use; • Information on the estimated split of stored:emitted carbon from feedstock chemicals in literature sources, including other country NIRs, where UK-specific information is not available. In many cases the energy statistics allocate fuels to non-energy use that are used in chemical and petrochemical production processes where either: • Fossil carbon-containing off-gases are used for combustion in facility boilers; or • Products containing the “stored” carbon are subsequently used / partly combusted / disposed and degraded with some proportion of the “stored carbon” in products ultimately emitted to atmosphere. In other instances, the allocation of fuels to “non-energy use” in the UK energy balance is contrary to other statistical evidence from industry or surveys that the Inventory Agency has access to in the compilation of the national inventory. For example, in the UK the allocation of petroleum coke to domestic and commercial combustion sources in the energy balance are missing for all years in the time series, whereas evidence from environmental reporting and research indicates that several industries use petroleum coke directly as a fuel or process input (e.g. cement kilns, power stations, domestic fuel manufacture).	UK Greenhouse Gas Inventory, 1990 to 2013 Sept 2015 pp. 113f

4 INDUSTRIAL PROCESSES AND PRODUCT USE (CRF SECTOR 2)

This chapter starts with an overview on emission trends in CRF Sector 2 Industrial processes and Product Use. This chapter comprises the categories formerly reported under CRF Sector 2 (Industrial Processes) and Sector 3 (Solvents), which are now split as follows:

- Mineral Industry (CRF Source Category 2.A)
- Chemical Industry (CRF Source Category 2.B)
- Metal Industry (CRF Source Category 2.C)
- Non-Energy Products from Fuels and Solvent Use (CRF Source Category 2.D)
- Electronics Industry (CRF Source Category 2.E)
- Product Uses As Substitutes for Ozone Depleting Substances (CRF Source Category 2.F)
- Other Product Manufacture and Use (CRF Source Category 2.G)
- Other (CRF Source Category 2.H)

For each EU-28 key source, overview tables are presented including the Member States' contributions to the key source in terms of level and trend, and information on methodologies and emission factors.

4.1 Overview of sector

CRF Sector 2 Industrial Processes and Product Use is the third largest sector contributing 9 % to total EU-28 GHG emissions in 2013. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (3 %) and N_2O (0.3 %). According to the IPCC 2006 guidelines, which have been applicable since the inventory compilation for 2014 (data for 2013), this sector now also entails the use of solvents and other product use. 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.

The emissions from the sector Industrial Processes and Product Use sector decreased by 29 % from 511 Tg in 1990 to 360 Tg in 2013 (*Figure 4.1*). In 2013, the emissions decreased by 0.1 % compared to 2012. Factors for declining emissions in the early 1990s were low er economic activity in several sectors. The 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. In 2010 emissions increased again, *inter alia* due to the recovery of steel production

The key sources in this sector are:

- 2 A 1 Cement Production: (CO_2)
- 2 A 2 Lime Production: (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.8 Petrochemical and Carbon Black Production (CO_2)
- 2.B.9 Fluorochemical Production (HFCs)
- 2.B.10 Other chemical industry (CO_2)
- 2 C 1 Iron and Steel Production: (CO_2)

- 2 C 3 Aluminium production: (PFC)
- 2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)
- 2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)

Figure 4.1: CRF Sector 2 Industrial Processes and Product Use: EU-28 GHG emissions for 1990–2013 in CO_2 equivalents (Mt)

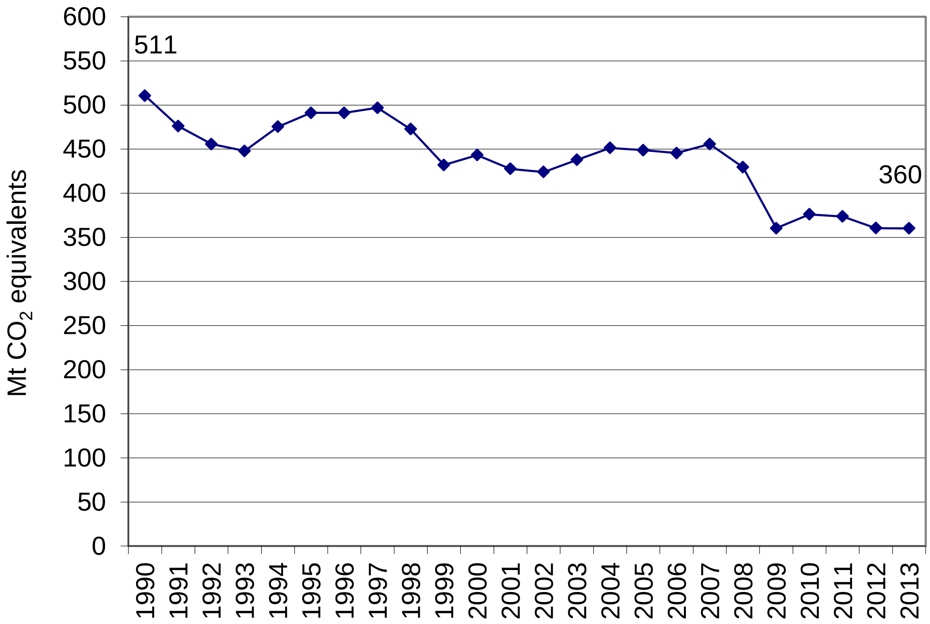
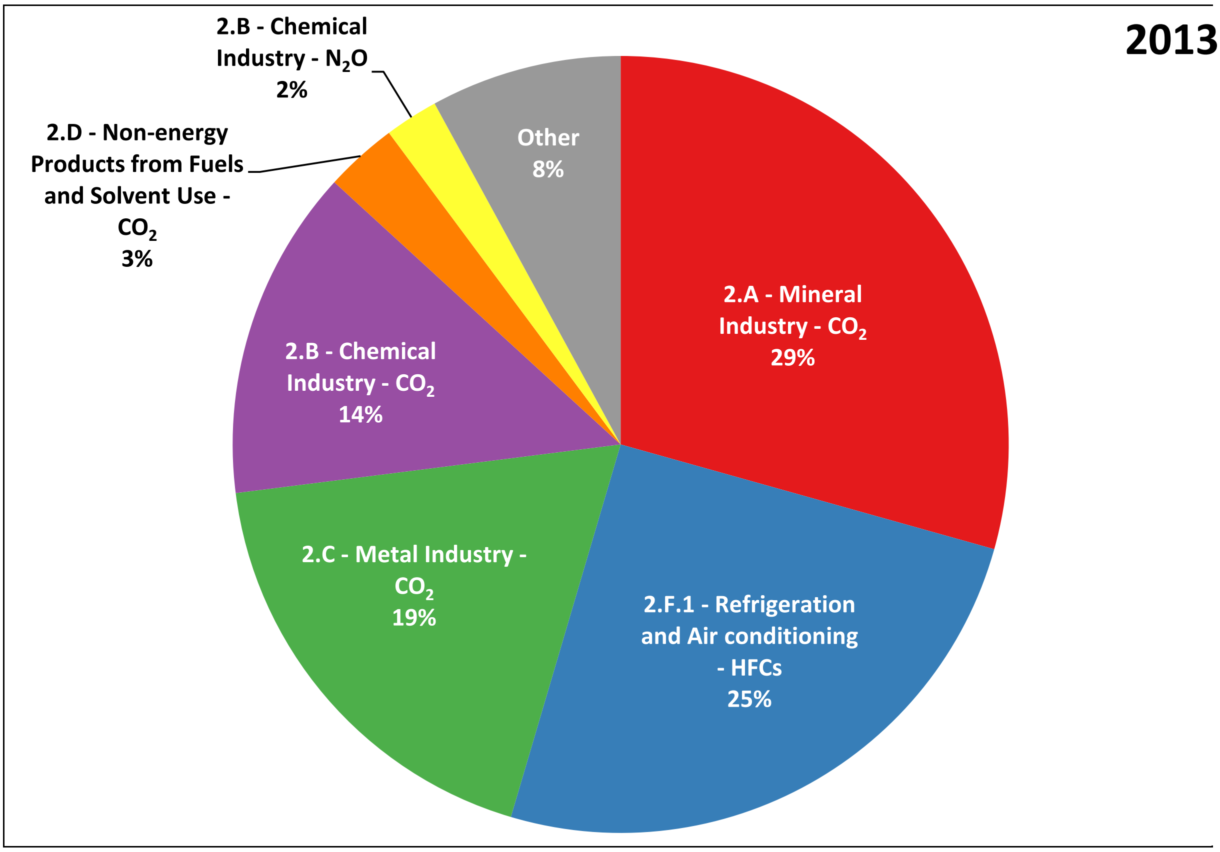
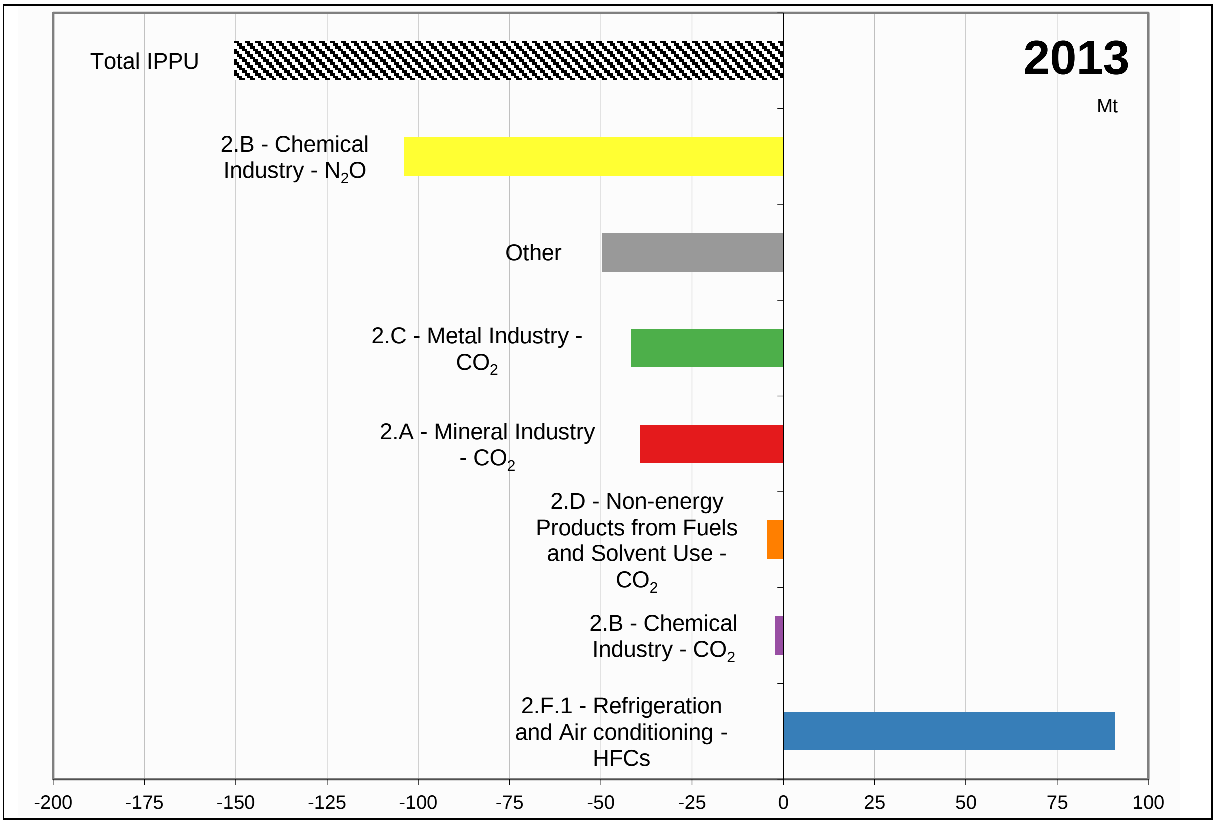


Figure 4.2: CRF Sector 2 Industrial processes and Product Use: Absolute change of GHG emissions by large key source categories 1990–2013 in CO_2 equivalents (Mt) and share of largest key source categories in 2013




2013
Mt
Total IPPU
2.B - Chemical Industry - N2O
Other
2.C - Metal Industry - CO2
2.A - Mineral Industry - CO2
2.D - Non-energy Products from Fuels and Solvent Use - CO2
2.B - Chemical Industry - CO2
2.F.1 - Refrigeration and Air conditioning - HFCs
-200
-175
-150
-125
-100
-75
-50
-25
0
25
50
75
100

4.2 Source categories and methodological issues

4.2.1 Mineral industry (CRF Source Category 2A)

The source category 2A Mineral industry includes two key categories: CO_2 from 2A1 Cement production and CO_2 from 2A2 Lime production CO_2. 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 in limestone or dolomite for lime production.

Table 4.1 summarises Member States' emissions from Mineral industry in 1990 and 2013. CO_2 emissions from Mineral industry have decreased by 3 % since 2012 and by 27 % since 1990. A large part of this fall has been since 2007, due to the decrease in cement production due to the economic crisis. Notwithstanding the overall decrease, six Member States (Croatia, Cyprus, Estonia, Ireland, Poland and Sweden), have higher CO_2 emissions in 2013 compared to their 1990 levels.

Table 4.1 2A Mineral industry: Member States total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)
Austria	3 092	2 720	3 092	2 720
Belgium	5 323	4 504	5 323	4 504
Bulgaria	3 243	1 914	3 243	1 914
Croatia	1 281	1 291	1 281	1 291
Cyprus	759	780	759	780
Czech Republic	4 103	2 156	4 103	2 156
Denmark	1 078	995	1 078	995
Estonia	614	695	614	695
Finland	1 178	1 026	1 178	1 026
France	16 463	11 608	16 463	11 608
Germany	22 780	18 513	22 780	18 513
Greece	6 788	4 286	6 788	4 286
Hungary	2 773	966	2 773	966
Ireland	1 117	1 302	1 117	1 302
Italy	20 714	12 290	20 714	12 290
Latvia	589	550	589	550
Lithuania	2 142	517	2 142	517
Luxembourg	623	409	623	409
Malta	1	0	1	0
Netherlands	1 248	1 077	1 248	1 077
Poland	8 792	9 255	8 792	9 255
Portugal	3 586	3 550	3 586	3 550
Romania	6 530	3 966	6 530	3 966
Slovakia	2 714	2 132	2 714	2 132
Slovenia	706	477	706	477
Spain	15 157	10 372	15 157	10 372
Sweden	1 687	1 936	1 687	1 936
United Kingdom	9 812	6 429	9 812	6 429
EU-28	**144 893**	**105 713**	**144 893**	**105 713**

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-28 GHG emissions in 2013. In 2012, CO_2 emissions from Cement production were 30 % below 1990 levels in the EU-28 (Figure 4.3).

Figure 4.3 2A1 Cement production: EU-28 CO_2 emissions

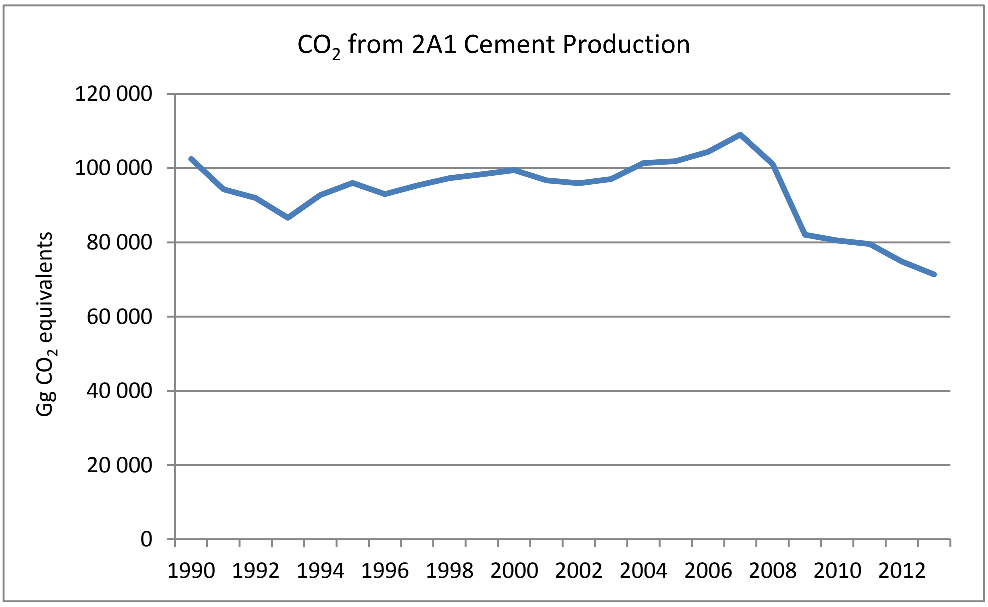


Table 4.2 provides information on emission trends of the key source CO_2 from 2A1 Cement production by Member State. In 2013, Germany, Italy and Spain were the largest emitters accounting for 17 %, 12 % and 11 % respectively of EU-28 cement related emissions. Emissions from 2A1 Cement production declined significantly after 2007 in all Member States due to the economic crisis which reduced construction activities in all countries. In 2013 CO_2 emissions decreased by 5 % across the EU-28. Compared to 2012, only Greece, United Kingdom, Portugal and Cyprus had significant increases in emissions from Cement production.

Table 4.2 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	2 033	1 673	1 659	2%	-14	-1%	-375	-18%	-	-
Belgium	2 824	2 643	2 541	4%	-101	-4%	-282	-10%	T3	PS
Bulgaria	2 100	998	897	1%	-101	-10%	-1 203	-57%	T2	CS
Croatia	1 086	1 017	1 141	2%	124	12%	55	5%	T2	CS
Cyprus	697	505	752	1%	248	49%	55	8%	CS	CS
Czech Republic	2 489	1 517	1 332	2%	-185	-12%	-1 157	-46%	T3	PS
Denmark	882	871	867	1%	-4	0%	-15	-2%	T2	PS
Estonia	483	407	399	1%	-8	-2%	-84	-17%	T2	PS
Finland	734	500	486	1%	-14	-3%	-248	-34%	T2	CS
France	10 937	7 502	7 300	10%	-202	-3%	-3 638	-33%	-	-
Germany	15 146	13 028	12 258	17%	-770	-6%	-2 888	-19%	T2	CS
Greece	5 762	3 099	3 639	5%	540	17%	-2 123	-37%	CS	OTH
Hungary	1 636	678	516	1%	-163	-24%	-1 120	-68%	CS	CS
Ireland	884	1 177	1 112	2%	-65	-6%	228	26%	T3	PS
Italy	15 846	10 071	8 877	12%	-1 194	-12%	-6 969	-44%	T2	CS,PS
Latvia	371	572	538	1%	-35	-6%	167	45%	T2	PS
Lithuania	1 668	395	461	1%	66	17%	-1 207	-72%	T2	PS
Luxembourg	570	375	365	1%	-9	-3%	-204	-36%	T2	CS,PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	416	308	274	0%	-34	-11%	-142	-34%	CS	PS
Poland	5 453	6 384	5 874	8%	-510	-8%	421	8%	T1	D
Portugal	3 176	2 550	2 814	4%	264	10%	-362	-11%	T3	OTH
Romania	4 445	3 150	2 695	4%	-456	-14%	-1 751	-39%	CS,T2	PS
Slovakia	1 464	1 096	1 135	2%	39	4%	-329	-22%	T2	CS
Slovenia	482	316	391	1%	75	24%	-91	-19%	T2	CS
Spain	12 279	8 754	7 642	11%	-1 112	-13%	-4 637	-38%	T2	CS
Sweden	1 272	1 479	1 392	2%	-87	-6%	120	9%	-	-
United Kingdom	7 295	3 724	4 029	6%	305	8%	-3 266	-45%	T2	CS
EU-28	**102 432**	**74 790**	**71 386**	**100%**	**-3 404**	**-5%**	**-31 045**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement production for 1990 and 2013. Almost all EU-28 Cement production emissions are estimated with higher Tier methods and most MS use plant-specific emission factors.

The implied emission factors per tonne of clinker produced range from 0.45 t CO_2/t of clinker produced for Netherlands to 0.60 t CO_2/t of clinker produced for the United Kingdom. Except for Portugal and Greece, all MS use country-specific and plant-specific emission factors and have comparable types of activity data (clinker production). In 2013 the EU-28 IEF remained at 0.53 t CO_2/t of clinker produced, the same as for the previous year when an IEF was calculated using the same approach.

In the period 1990 to 2013 only Denmark, Netherlands and Luxembourg have noticeable decrease in the IEF. The IEF for the Netherlands changes after 2005 due to the use of an average EF for the earlier years and plant-specific parameters. There is no significant change in the IEFs for the other member states.

The EF in Denmark decreased primarily during 1990 and 1996 (-18 %) which is due to the ratio of white/grey cement and the ratio rapid cement (GKL-clinker)/basis cement (FHK-clinker)/low alkali cement (SKL-RKL-clinker). The ratio of white/grey cement is known from 1990-1997 with maximum in 1990 and thereafter decreasing.

Table 4.3 2A1 Cement production: Information on methods applied and emission factors for CO_2 emissions

Member State	Method applied	Emission factor	1990				2013			
			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	-	-	Cement clinker	3694	0.55	2033	Cement clinker	3156	0.5255	1659
Belgium	T3	PS	Clinker production	5292	0.53	2824	Clinker production	4694	0.541	2541
Bulgaria	T2	CS	Clinker production	3987	0.53	2100	Clinker production	1676	0.54	897
Croatia	T2	CS	Clinker production	2062	0.53	1086	Clinker production	2196	0.520	1141
Cyprus	CS	CS	Clinker production	1249	0.56	697	Clinker production	1418	0.53	752
Czech Republic	T3	PS	Clinker production	4726	0.53	2489	Clinker production	2472	0.539	1332
Denmark	T2	PS	Clinker production	1406	0.63	882	Clinker production	1613	0.54	867
Estonia	T2	PS	Clinker production	790	0.61	483	Clinker production	691	0.58	399
Finland	T2	CS	Clinker production	1470	0.50	734	Clinker production	973	0.499	486
France	-	-	Clinker production	20854	0.52	10937	Clinker production	13778	0.530	7300
Germany	T2	CS	Clinker production	28577	0.53	15146	Clinker production	23128	0.530	12258
Greece	CS	OTH	Clinker production	10645	0.54	5762	Clinker production	6915	0.5262	3639
Hungary	CS	CS	Clinker production	3210	0.51	1636	Clinker production	1018	0.5067	516
Ireland	T3	PS	Clinker production	1610	0.55	884	Clinker production	2065	0.54	1112
Italy	T2	CS,PS	Clinker production	29786	0.53	15846	Clinker production	16902	0.525	8877
Latvia	T2	PS	Clinker production	669	0.55	371	Clinker production	1055	0.51	538
Lithuania	T2	PS	Clinker production	3058	0.55	1668	Clinker production	855	0.539092	461
Luxembourg	T2	CS,PS	Clinker production	1048	0.54	570	Clinker production	743	0.49	365
Malta	NA	NA	-	0	NO	NO	-	0	NO	NO
Netherlands	CS	PS	Clinker production	770	0.54	416	Clinker production	610	0.45	274
Poland	T1	D	Clinker production	10309	0.53	5453	Clinker production	10855	0.541	5874
Portugal	T3	OTH	Clinker production	6128	0.52	3176	Clinker production	5427	0.52	2814
Romania	CS,T2	PS	Clinker production	8379	0.53	4445	Clinker production	5040	0.535	2695
Slovakia	T2	CS	Cement clinker	2836	0.52	1464	Cement clinker	2161	0.525	1135
Slovenia	T2	CS	Clinker production	891	0.54	482	Clinker production	743	0.53	391
Spain	T2	CS	Clinker production	23212	0.53	12279	Clinker production	14615	0.523	7642
Sweden	-	-	Clinker production	2348	0.54	1272	Clinker production	2599	0.536	1392
United Kingdom	T2	CS	Clinker production	13199	0.55	7295	Clinker production	6712	0.6003	4029
EU-28			**EU-28**	**192203**	**0.53**	**102432**	**EU 28**	**134112**	**0.532**	**71386**

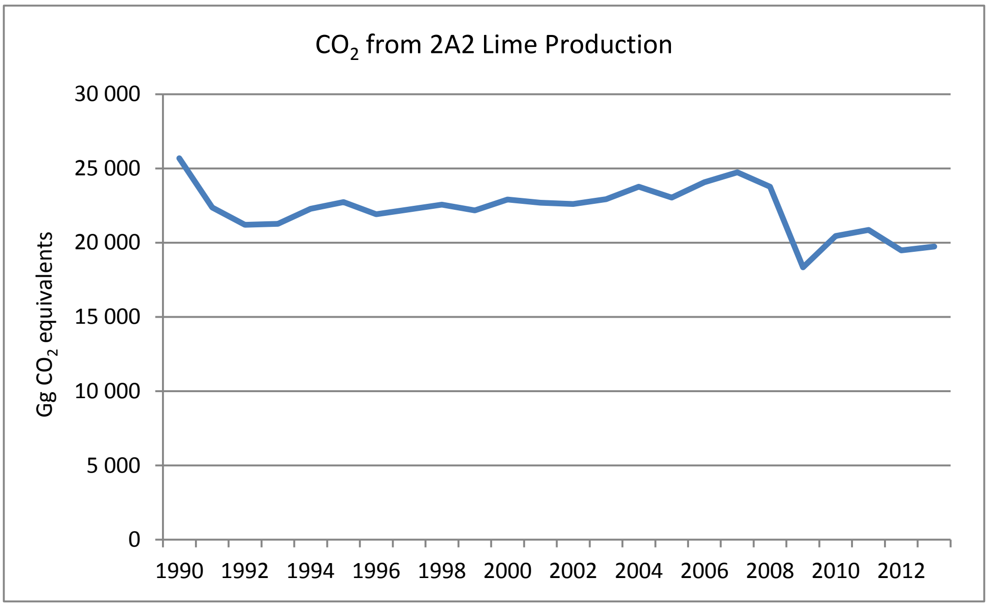
Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.2 2A2 Lime production

CO_2 emissions from 2A2 Lime production account for 0.4 % of total GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from this source decreased by 23 % in the EU-28. Germany, France and Italy are the largest emitters contributing 24 %, 13 % and 10 % respectively of EU-28 emissions from the sector.

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 (Figure 4.4). In 2013 lime production increased by 1 % compared to the previous year.

Figure 4.4 2A2 Lime production: EU-28 CO_2 emissions



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 economic factors and development of competing and substitute products. In 2013, ten Member States have increased their emissions since 1990 and eighteen Member States have decreased emissions from this source category (Table 4.4).

Table 4.4 2A2 Lime production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	396	569	587	3%	18	3%	191	48%	-	-
Belgium	2 097	1 612	1 629	8%	17	1%	-468	-22%	T3	PS
Bulgaria	371	184	203	1%	18	10%	-168	-45%	T2	D
Croatia	153	107	97	0%	-10	-9%	-57	-37%	T2	CS
Cyprus	5	3	3	0%	-1	-20%	-3	-49%	T1	D
Czech Republic	1 337	597	606	3%	9	1%	-731	-55%	T1	CS
Denmark	105	57	54	0%	-2	-4%	-51	-48%	T1	D
Estonia	130	49	47	0%	-1	-3%	-82	-64%	T1,T2	D,PS
Finland	383	403	401	2%	-2	0%	18	5%	T2	CS
France	2 743	2 232	2 470	13%	239	11%	-273	-10%	-	-
Germany	5 987	4 712	4 811	24%	99	2%	-1 175	-20%	T2	D
Greece	404	209	294	1%	85	41%	-110	-27%	CS	OTH
Hungary	614	140	131	1%	-9	-6%	-483	-79%	CS	CS
Ireland	214	216	190	1%	-26	-12%	-24	-11%	T3	PS
Italy	1 877	2 038	1 892	10%	-146	-7%	15	1%	T2	CS,PS
Latvia	149	2	0	0%	-1	-84%	-149	-100%	T1,T2,T3	D,PS
Lithuania	223	37	29	0%	-8	-22%	-193	-87%	T2	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	1	NO	NO	-	-	-	-1	-100%	D	D
Netherlands	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2 461	1 352	1 274	6%	-77	-6%	-1 187	-48%	T1	D
Portugal	197	318	312	2%	-5	-2%	115	58%	T3	OTH
Romania	1 898	925	901	5%	-25	-3%	-997	-53%	T2	CS,D
Slovakia	795	736	662	3%	-73	-10%	-133	-17%	T2	CS
Slovenia	201	74	59	0%	-15	-21%	-142	-71%	T3	CS
Spain	1 146	1 240	1 350	7%	110	9%	204	18%	D	CS,D,PS
Sweden	335	489	504	3%	16	3%	170	51%	-	-
United Kingdom	1 462	1 178	1 239	6%	61	5%	-223	-15%	T3	CS
EU-28	**25 683**	**19 477**	**19 747**	**100%**	**270**	**1%**	**-5 936**	**-23%**		

Emissions of the Netherlands are included in 2D2 Food industries.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.5 shows information on methods applied and emission factors for CO_2 emissions from 2A2 Lime production for 1990 to 2013. All EU-28 MS that report emissions from lime production use lime production as activity data for calculating CO_2 emissions, The IEF in 2013 is 0.75 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced range from 0.55 for Latvia to 0.80 for Belgium. Seventeen MS estimate emissions using higher tier methodologies (country-specific, Tier 2 and Tier 3) which accounts for more than 80 % of emissions from this category.

Table 4.5 2A2 Lime production: Information on methods applied, activity data, emission factors for CO_2 emissions

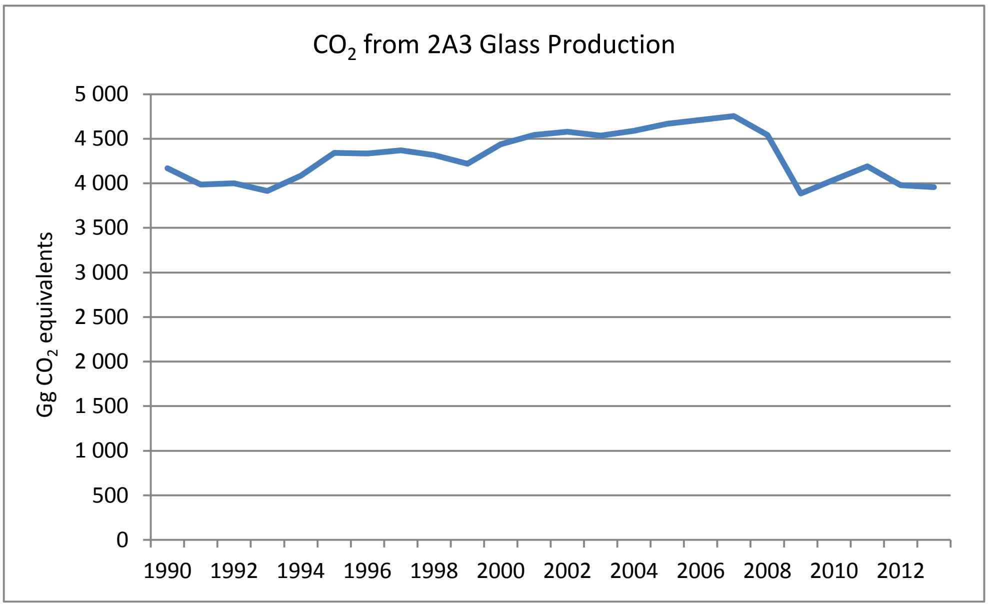
Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2013 Activity data Description	2013 Activity data (kt)	2013 Implied emission factor (t/t)	2013 CO_2 emissions (Gg)
Austria	-	-	Lime Production	513	0.77	396	Lime Production	779	0.7538	587
Belgium	T3	PS	Lime Production	2660	0.79	2097	Lime Production	2035	0.801	1629
Bulgaria	T2	D	Lime Production	490	0.76	371	Lime Production	274	0.74	203
Croatia	T2	CS	Lime Production	232	0.66	153	Lime Production	127	0.762	97
Cyprus	T1	D	Lime Production	7	0.75	5	Lime Production	4	0.75	3
Czech Republic	T1	CS	Lime Production	1823	0.73	1337	Lime Production	799	0.758	606
Denmark	T1	D	Lime Production	134	0.78	105	Lime Production	69	0.78	54
Estonia	T1,T2	D,PS	Lime Production	185	0.70	130	Lime Production	70	0.68	47
Finland	T2	CS	Lime Production	488	0.78	383	Lime Production	511	0.785	401
France	-	-	Lime Production	3589	0.76	2743	Lime Production	3647	0.677	2470
Germany	T2	D	Lime Production	7927	0.76	5987	Lime Production	6414	0.750	4811
Greece	CS	OTH	Lime Production	491	0.82	404	Lime Production	0	0.0000	294
Hungary	CS	CS	Lime Production	831	0.74	614	Lime Production	175	0.7520	131
Ireland	T3	PS	Lime Production	255	0.84	214	Lime Production	251	0.75	190
Italy	T2	CS,PS	Lime Production	2583	0.73	1877	Lime Production	2647	0.715	1892
Latvia	T1,T2,T3	D,PS	Lime Production	225	0.66	149	Lime Production	0	0.55	0
Lithuania	T2	D	Lime Production	288	0.77	223	Lime Production	38	0.773393	29
Luxembourg	NA	NA	Lime Production	0	NO	NO	Lime Production	0	NO	NO
Malta	D	D	Lime Production	2	0.75	1	Lime Production	0	NO	NO
Netherlands	NA	NA	Lime Production	0	IE,NO	IE	Lime Production	0	IE,NO	IE
Poland	T1	D	Lime Production	3464	0.71	2461	Lime Production	1761	0.724	1274
Portugal	T3	OTH	Lime Production	291	0.68	197	Lime Production	476	0.66	312
Romania	T2	CS,D	Lime Production	2414	0.79	1898	Lime Production	1128	0.798	901
Slovakia	T2	CS	Lime Production	1076	0.74	795	Lime Production	849	0.780	662
Slovenia	T3	CS	Lime Production	275	0.73	201	Lime Production	80	0.74	59
Spain	D	CS,D,PS	Lime Production	1601	0.72	1146	Lime Production	1866	0.724	1350
Sweden	-	-	Lime Production	443	0.75	335	Lime Production	674	0.749	504
United Kingdom	T3	CS	Lime Production	2067	0.71	1462	Lime Production	1712	0.7237	1239
EU-28			**EU-28**	**34355**	**0.75**	**25683**	**EU 28**	**26385**	**0.748**	**19747**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.3 2A3 Glass production

CO_2 emissions from 2A3 Glass production contributed only 0.1 % of total GHG emissions in 2013. Emissions from glass production in 2013 are 5 % lower than 1990 levels. Between 1990 and 2007, CO_2 emissions from this source increased by 14 %. In 2013 emissions were 17 % lower than the 2007 peak (Figure 4.5).

Figure 4.5 2A3 Glass production: EU-28 CO_2 emissions



In 2013, Germany was responsible for 22 %, Italy for 14 % and France for 13 % of the emissions from this source. The largest absolute reduction in since 1990 was in France (-287 kt or -36%).

Table 4.6 2A3 Glass production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	39	37	39	1%	2	6%	1	1%	-	-
Belgium	266	188	167	4%	-22	-12%	-100	-37%	T3	CS,PS
Bulgaria	138	65	63	2%	-2	-3%	-76	-55%	T1	CS
Croatia	36	30	29	1%	0	0%	-6	-18%	T3	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	124	109	116	3%	7	6%	-8	-6%	T1	D
Denmark	20	10	7	0%	-3	-28%	-13	-65%	T1	D
Estonia	1	10	11	0%	2	16%	10	828%	T1	D
Finland	21	2	2	0%	0	26%	-19	-90%	T3	CS
France	797	523	510	13%	-13	-2%	-287	-36%	-	-
Germany	780	823	875	22%	52	6%	95	12%	T2	CS
Greece	20	16	17	0%	1	7%	-4	-18%	CS	CS
Hungary	75	54	52	1%	-2	-4%	-22	-30%	CS	CS
Ireland	13	NO	NO	-	-	-	-13	-100%	T1,T3	D,PS
Italy	453	547	546	14%	-1	0%	92	20%	T2	CS,PS
Latvia	0	4	3	0%	-1	-20%	3	746%	T1	D
Lithuania	12	7	8	0%	1	12%	-4	-31%	T2	D
Luxembourg	54	60	43	1%	-17	-28%	-10	-19%	CS	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	142	97	84	2%	-13	-14%	-58	-41%	CS	CS
Poland	106	265	266	7%	0	0%	160	151%	T1	D
Portugal	84	155	157	4%	2	1%	73	88%	T3	OTH
Romania	150	62	62	2%	0	0%	-88	-58%	T2	CS,D
Slovakia	8	11	13	0%	2	15%	5	68%	T3	PS
Slovenia	3	10	9	0%	-1	-12%	6	175%	T3	D
Spain	374	464	474	12%	9	2%	99	26%	D	CS,D,PS
Sweden	45	48	17	0%	-31	-65%	-28	-63%	-	-
United Kingdom	408	382	389	10%	7	2%	-19	-5%	T2	CS
EU-28	**4 169**	**3 980**	**3 959**	**100%**	**-21**	**-1%**	**-211**	**-5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.7 provides information on methods applied, activity data, emission factors for CO_2 emissions from 2A3 Glass production for 1990 to 2013. The table shows that almost all MS (except Finland, Ireland and Slovakia) use production as activity data for calculating CO_2 emissions, and the different EFs reflect this. 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 4.7 2A3 Glass production: Information on methods applied, activity data, emission factors for CO_2 emissions

			1990				2013			
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	-	-	Glass Production	399	0.10	39	Glass Production	487	0.0801	39
Belgium	T3	CS,PS	Glass Production	1971	0.14	266	Glass Production	1547	0.108	167
Bulgaria	T1	CS	Glass Production	818	0.17	138	Glass Production	452	0.14	63
Croatia	T3	CS	Glass Production	275	0.13	36	Glass Production	303	0.097	29
Cyprus	NA	NA	Glass Production	0	NO	NO	Glass Production	0	NO	NO
Czech Republic	T1	D	Glass Production	1237	0.10	124	Glass Production	1158	0.100	116
Denmark	T1	D	Glass Production	200	0.10	20	Glass Production	96	0.07	7
Estonia	T1	D	Glass Production	12	0.10	1	Glass Production	84	0.14	11
Finland	T3	CS	Used carbonates	48	0.43	21	Used carbonates	5	0.398	2
France	-	-	Glass Production	4307	0.19	797	Glass Production	2581	0.198	510
Germany	T2	CS	Glass Production	6562	0.12	780	Glass Production	7407	0.118	875
Greece	CS	CS	Glass Production	135	0.15	20	Glass Production	114	0.1454	17
Hungary	CS	CS	Glass Production	418	0.18	75	Glass Production	437	0.1201	52
Ireland	T1,T3	D,PS	carbonate use	64	0.21	13	carbonate use	0	NO	NO
Italy	T2	CS,PS	Glass Production	3779	0.12	453	Glass Production	4771	0.114	546
Latvia	T1	D	Glass Production	44	0.01	0	Glass Production	16	0.18	3
Lithuania	T2	D	Glass Production	66	0.18	12	Glass Production	56	0.145831	8
Luxembourg	CS	PS	Glass Production	377	0.14	54	Glass Production	304	0.14	43
Malta	NA	NA	-	0	NO	NO	-	0	NO	NO
Netherlands	CS	CS	Glass Production	1095	0.13	142	Glass Production	1286	0.07	84
Poland	T1	D	Glass Production	1058	0.10	106	Glass Production	2656	0.100	266
Portugal	T3	OTH	Glass Production	614	0.14	84	Glass Production	1702	0.09	157
Romania	T2	CS,D	Glass Production	926	0.16	150	Glass Production	374	0.167	62
Slovakia	T3	PS	Used Carbonates	18	0.44	8	Used Carbonates	31	0.423	13
Slovenia	T3	D	Glass Production	25	0.13	3	Glass Production	70	0.13	9
Spain	D	CS,D,PS	Glass Production	2866	0.13	374	Glass Production	4405	0.107	474
Sweden	-	-	Glass Production	0	NE	45	Glass Production	0	NE	17
United Kingdom	T2	CS	Glass Production	3232	0.13	408	Glass Production	3305	0.1178	389
EU-28			**EU-28**	**30545**	**0.14**	**4169**	**EU 28**	**33648**	**0.118**	**3959**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.4 2A4 Other process uses of carbonates

Table 4.8 2A4 Other process uses of carbonates: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	624	425	434	4%	9	2%	-190	-30%
Belgium	136	173	167	2%	-6	-3%	32	23%
Bulgaria	633	791	751	7%	-40	-5%	118	19%
Croatia	6	38	24	0%	-14	-36%	18	318%
Cyprus	57	19	24	0%	5	25%	-32	-57%
Czech Republic	153	107	103	1%	-5	-4%	-50	-33%
Denmark	71	56	67	1%	11	19%	-3	-5%
Estonia	0	203	237	2%	33	16%	236	77421%
Finland	41	177	137	1%	-39	-22%	97	239%
France	1 986	1 283	1 328	13%	45	4%	-658	-33%
Germany	867	544	568	5%	25	5%	-299	-34%
Greece	602	419	336	3%	-82	-20%	-266	-44%
Hungary	448	274	266	3%	-8	-3%	-182	-41%
Ireland	5	1	0	0%	0	-44%	-5	-94%
Italy	2 537	1 061	975	9%	-86	-8%	-1 562	-62%
Latvia	69	8	9	0%	2	20%	-60	-87%
Lithuania	240	16	18	0%	2	15%	-221	-92%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	0	0	0	0%	0	0%	0	-56%
Netherlands	690	770	719	7%	-51	-7%	29	4%
Poland	771	1 860	1 841	17%	-19	-1%	1 069	139%
Portugal	128	340	266	3%	-74	-22%	138	108%
Romania	37	189	309	3%	119	63%	272	732%
Slovakia	447	378	322	3%	-56	-15%	-125	-28%
Slovenia	20	17	18	0%	1	8%	-2	-11%
Spain	1 358	1 065	906	9%	-159	-15%	-452	-33%
Sweden	36	20	22	0%	2	11%	-14	-38%
United Kingdom	647	777	772	7%	-5	-1%	125	19%
EU-28	**12 608**	**11 010**	**10 622**	**100%**	**-389**	**-4%**	**-1 987**	**-16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2 Chemical industry (CRF Source Category 2B)

The key categories in the chemical industry include: 2B1 Ammonia production, 2B2 Nitric acid production, 2B3 Adipic acid production, 2.B.8 Petrochemical and Carbon black production, 2.B.9 Fluorochemical Production (HFCs) and 2B10 Other chemical industry.

The 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. At plants using this process CO_2 is primarily released during regeneration of the CO_2 scrubbing solution, with additional but relatively minor emissions resulting from condensate stripping. The 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 4.9 summarises information on Member States' emissions from the chemical industry in 1990 and 2013 for CO_2, CH_4, N_2O and total CO_2e. Between 1990 and 2013 CO_2e emissions from 2B Chemical Industry decreased markedly due to the significant reduction in N_2O emissions which decreased by 93 %. The greatest absolute decreases in N_2O emissions were in UK, France and Germany.

Table 4.9 2B Chemical Industry: Member States' contributions total GHG and CO_2, N_2O and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	1 555	696	643	599	877	48	35	49
Belgium	10 060	8 222	2 590	6 543	3 791	1 252	0	5
Bulgaria	4 532	1 439	2 880	1 316	1 647	123	5	0
Croatia	1 532	727	772	486	754	240	6	0
Cyprus	0	0	NO	NO	NO	NO	NO	NO
Czech Republic	2 944	1 879	1 783	1 546	1 125	286	36	46
Denmark	1 003	1	1	1	1 003	NA,NO	NA,NO	NA,NO
Estonia	419	154	419	154	NO	NO	NO	NO
Finland	1 861	1 121	269	910	1 592	211	NO,NA	NO,NA
France	33 188	3 677	3 752	2 641	23 648	853	93	51
Germany	35 730	10 759	8 021	9 201	21 557	819	334	464
Greece	2 931	538	681	517	1 066	21	1	NA,NO
Hungary	4 867	2 224	1 759	2 145	3 090	38	18	41
Ireland	1 986	0	990	NO	995	NO	NO	NO
Italy	10 546	3 139	2 577	1 336	6 418	222	61	6
Latvia	0	0	NO	NO	NO	NO	NO	NO
Lithuania	2 178	2 009	1 280	1 673	893	336	5	NO
Luxembourg	0	0	NO	NO	NO	NO	NO	NO
Malta	0	0	NO	NO	NO	NO	NO	NO
Netherlands	17 367	6 333	4 552	4 410	6 821	1 223	387	409
Poland	7 944	6 677	4 368	5 517	3 536	1 110	40	50
Portugal	1 170	159	658	90	498	57	14	12
Romania	7 494	1 667	3 309	1 148	4 135	508	50	12
Slovakia	2 020	1 601	878	1 470	1 142	130	0	1
Slovenia	70	45	66	45	NO	NO	4	NO,NA
Spain	9 133	3 867	3 156	3 062	2 788	439	149	141
Sweden	906	185	102	130	803	55	1	1
United Kingdom	44 792	5 047	6 377	4 740	23 797	45	214	104
EU-28	**206 227**	**62 168**	**51 884**	**49 680**	**111 975**	**8 017**	**1 453**	**1 391**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.1 2B1 Ammonia production

CO_2 emissions from 2B1 Ammonia production account for 0.6 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CO_2 emissions from this source decreased by 16 % (Figure 4.6). Germany is responsible for 25 % of these emissions. The next largest contributors, Poland and Netherlands contribute 16 % and 14 % respectively. Bulgaria, Ireland, Italy, Romania and France had large reductions in absolute terms between 1990 and 2013. The reasons for these reductions include changes to low emitting technology and production decreases and the cessation of production in Ireland. The largest growth in emissions between 1990 and 2013 were in Germany, Poland and Belgium.

Figure 4.6 2B1 Ammonia production: CO_2 emissions

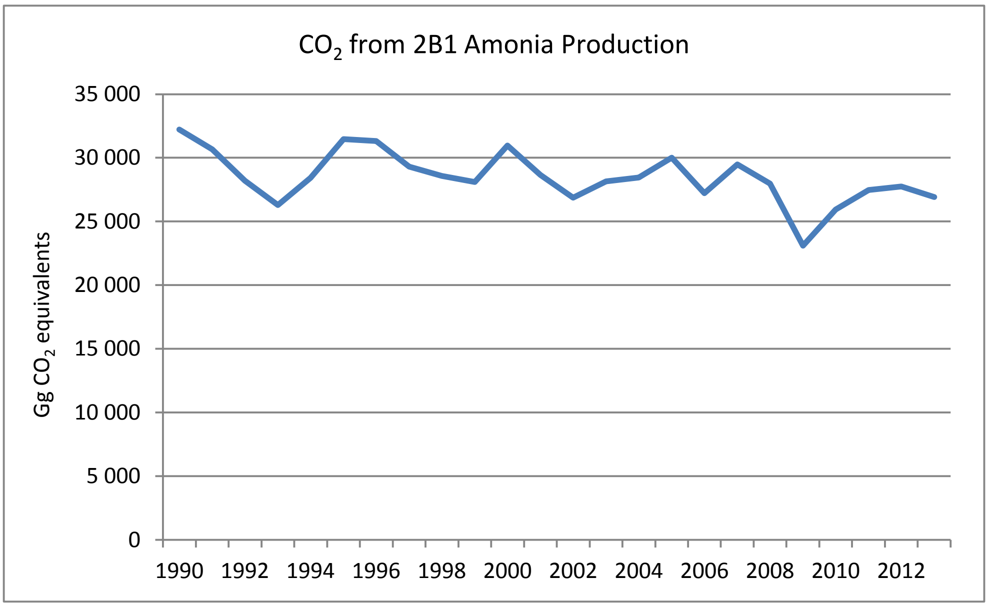


Table 4.10 2B1 Ammonia production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	467	471	423	2%	-48	-10%	-45	-10%	-	-
Belgium	423	1 128	1 247	5%	118	10%	824	195%	T3	D,PS
Bulgaria	2 508	758	802	3%	45	6%	-1 705	-68%	T2	CS
Croatia	552	479	486	2%	7	1%	-66	-12%	T3	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	991	654	601	2%	-53	-8%	-390	-39%	T1	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	419	25	154	1%	129	519%	-265	-63%	T3	PS
Finland	93	NO	NO	-	-	-	-93	-100%	T1	D
France	2 016	1 054	1 118	4%	64	6%	-898	-45%	-	-
Germany	6 025	6 862	6 739	25%	-123	-2%	714	12%	T3	PS
Greece	652	179	212	1%	33	19%	-440	-67%	T1a	CS
Hungary	1 255	974	875	3%	-99	-10%	-380	-30%	T3	D
Ireland	990	NO	NO	-	-	-	-990	-100%	T1	CS
Italy	1 892	624	643	2%	19	3%	-1 249	-66%	T1	CR
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 256	2 118	1 673	6%	-445	-21%	417	33%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 730	3 627	3 760	14%	132	4%	30	1%	T1b	CS
Poland	2 910	4 473	4 403	16%	-69	-2%	1 493	51%	T2	CS
Portugal	569	NO	NO	-	-	-	-569	-100%	T2	PS
Romania	2 423	1 517	1 081	4%	-436	-29%	-1 342	-55%	T2	PS
Slovakia	332	546	674	3%	129	24%	343	103%	T3	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	709	701	652	2%	-49	-7%	-57	-8%	D	PS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	2 004	1 574	1 383	5%	-190	-12%	-621	-31%	T3	CS
EU-28	**32 216**	**27 763**	**26 927**	**100%**	**-836**	**-3%**	**-5 289**	**-16%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.11 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia production for 1990 to 2013. The table shows that all MS except for Ireland and

Romania use Ammonia production as activity data for this emissions category. It will be possible to calculate an IEF gap filling the activity of these MS. The table also shows that about 70 % of EU-28 emissions are estimated with higher Tier methods.

Table 4.11 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)	2013 Activity data Description	2013 Activity data (kt)	2013 Implied emission factor (t/t)	2013 CO_2 emissions (Gg)
Austria	-	-	Ammonia Production	461	1.01	467	Ammonia Production	435	0.9716	423
Belgium	T3	D,PS	Ammonia Production	360	1.17	423	Ammonia Production	1083	1.151	1247
Bulgaria	T2	CS	Ammonia Production	0	C	2508	Ammonia Production	0	C	802
Croatia	T3	PS	Ammonia Production	345	2.24	552	Ammonia Production	418	2.017	486
Cyprus	NA	NA	Ammonia Production	0	NO	NO	Ammonia Production	0	NO	NO
Czech Republic	T1	CS	Ammonia Production	336	3.27	991	Ammonia Production	184	3.273	601
Denmark	NA	NA	Ammonia Production	0	NO	NO	Ammonia Production	0	NO	NO
Estonia	T3	PS	Ammonia Production	294	1.43	419	Ammonia Production	121	1.28	154
Finland	T1	D	Ammonia Production	28	3.27	93	Ammonia Production	0	NO	NO
France	-	-	Ammonia Production	1928	1.05	2016	Ammonia Production	1035	1.080	1118
Germany	T3	PS	Ammonia Production	2705	2.41	6025	Ammonia Production	3198	2.353	6739
Greece	T1a	CS	Ammonia Production	313	2.08	652	Ammonia Production	128	1.6555	212
Hungary	T3	D	Ammonia Production	25334	0.06	1255	Ammonia Production	16303	0.0561	875
Ireland	T1	CS	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	0	NO	NO
Italy	T1	CR	Ammonia Production	1455	1.30	1892	Ammonia Production	555	1.159	643
Latvia	NA	NA	Ammonia Production	0	NO	NO	Ammonia Production	0	NO	NO
Lithuania	T3	CS	Ammonia Production	568	2.27	1256	Ammonia Production	842	2.110860	1673
Luxembourg	NA	NA	Ammonia Production	0	NO	NO	Ammonia Production	0	NO	NO
Malta	NA	NA	-	0	NO	NO	-	0	NO	NO
Netherlands	T1b	CS	Ammonia Production	0	C	3730	Ammonia Production	0	C	3760
Poland	T2	CS	Ammonia Production	1532	1.90	2910	Ammonia Production	2228	1.976	4403
Portugal	T2	PS	Ammonia Production	0	C	569	Ammonia Production	0	NA,NO	NO
Romania	T2	PS	Natural Gas Consumption	1511	1.60	2423	Natural Gas Consumption	700	1.543	1081
Slovakia	T3	PS	Ammonia Production	360	1.71	332	Ammonia Production	475	1.870	674
Slovenia	NA	NA	Ammonia Production	0	NO	NO	Ammonia Production	0	NO	NO
Spain	D	PS	Ammonia Production	573	1.24	709	Ammonia Production	531	1.228	652
Sweden	NA	NA	Ammonia Production	0	NO	NO	Ammonia Production	0	NO	NO
United Kingdom	T3	CS	Ammonia Production	1328	1.51	2004	Ammonia Production	957	1.4454	1383
EU-28			**EU-28**	**39861**	**0.81**	**32216**	**EU 28**	**29193**	**0.922**	**26927**

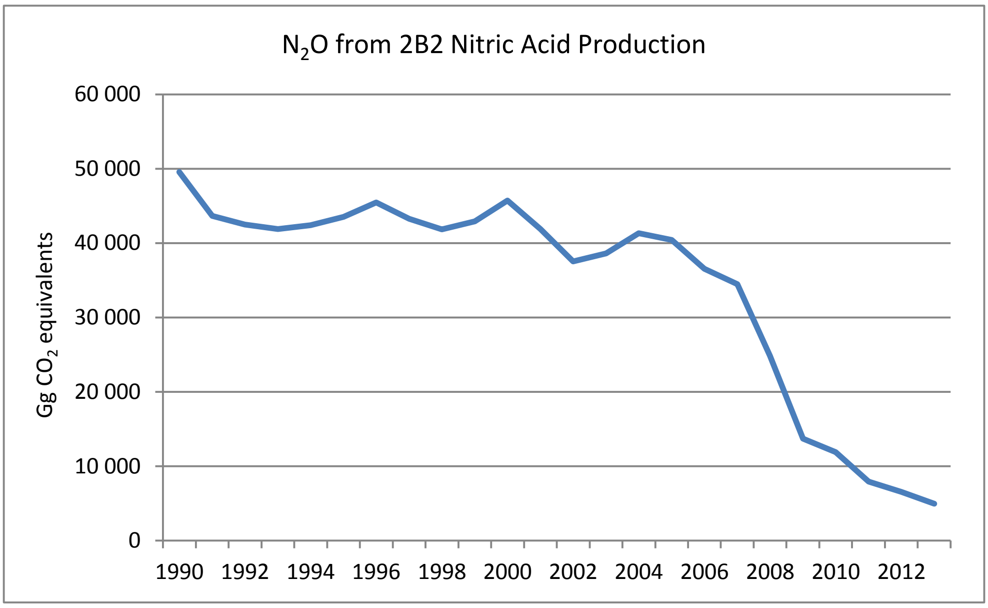
Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.2 2B2 Nitric acid production

N_2O emissions from 2B2 Nitric acid production account for 0.1 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, N_2O emissions from this source decreased by 90 % (Table 4.12). All Member States had reductions from this source between 1990 and 2013. The Netherlands and

France had the greatest reductions in absolute terms, due to the implementation of technical measures at all Dutch nitric acid plants and due to the improvement of the process and catalyst efficiency in France. production stopped in Denmark (middle of 2004) and ceased in Ireland in 2002 due to the insolvency of Irish Fertiliser Industries.

Figure 4.7 2B2 Nitric acid production: EU-28 N_2O emissions



The substantial decrease in N_2O emissions since 2006 is largely due to technical measures that have been implemented at all nitric acid plants. Special catalysts and improvement of the process efficiency led to a continuation of the trend in emissions. This trend of declining N_2O emissions continued between 2012 and 2013 with emissions decreasing by -25 %. Seven Member States reported small emission increases in this period.

Table 4.12 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	877	51	48	1%	-3	-5%	-829	-95%	-	-
Belgium	3 424	654	555	11%	-99	-15%	-2 869	-84%	T3	PS
Bulgaria	1 647	125	123	2%	-2	-2%	-1 524	-93%	T1,T3	D,PS
Croatia	754	652	240	5%	-412	-63%	-514	-68%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 050	378	212	4%	-166	-44%	-838	-80%	T1	PS
Denmark	1 003	NO	NO	-	-	-	-1 003	-100%	T1	PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 592	160	211	4%	51	32%	-1 381	-87%	T2	PS
France	6 316	481	444	9%	-37	-8%	-5 872	-93%	-	-
Germany	3 258	399	480	10%	82	20%	-2 778	-85%	T3	PS
Greece	1 066	295	21	0%	-274	-93%	-1 045	-98%	D	D
Hungary	3 090	22	38	1%	17	75%	-3 051	-99%	CS	PS
Ireland	995	NO	NO	-	-	-	-995	-100%	T1	PS
Italy	2 005	143	112	2%	-31	-22%	-1 894	-94%	T2	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	893	573	336	7%	-237	-41%	-557	-62%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	6 085	254	274	6%	20	8%	-5 811	-96%	T2	PS
Poland	3 041	780	884	18%	104	13%	-2 157	-71%	T1	CS
Portugal	498	63	57	1%	-6	-10%	-441	-88%	D	PS
Romania	3 473	999	508	10%	-491	-49%	-2 965	-85%	T2	D
Slovakia	1 142	290	129	3%	-161	-55%	-1 012	-89%	T3	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	2 692	155	186	4%	31	20%	-2 506	-93%	T2	CS,PS
Sweden	782	65	48	1%	-17	-26%	-734	-94%	-	-
United Kingdom	3 860	39	43	1%	4	10%	-3 817	-99%	T3	CS
EU-28	**49 543**	**6 578**	**4 950**	**100%**	**-1 628**	**-25%**	**-44 594**	**-90%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.13 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric acid production for 1990 to 2013. The table shows that all MS report Nitric acid production as activity data; for some MS this information is confidential The decrease of the IEF between 1990 and 2013 is mainly due to the implementation of improved abatement technologies in the different MS and the closure of some older plants. The table also shows that almost all emissions are estimated with higher tier methods.

Table 4.13 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 CO_2 emissions (Gg)	2013 Activity data Description	2013 Activity data (kt)	2013 Implied emission factor (t/t)	2013 CO_2 emissions (Gg)
Austria	-	-	Nitric Acid Production	530	0.01	877	Nitric Acid Production	475	0.0003	48
Belgium	T3	PS	Nitric Acid Production	1436	0.01	3424	Nitric Acid Production	1960	0.001	555
Bulgaria	T1,T3	D,PS	Nitric Acid Production	0	C	1647	Nitric Acid Production	0	C	123
Croatia	T2	PS	Nitric Acid Production	332	0.01	754	Nitric Acid Production	298	0.003	240
Cyprus	NA	NA	Nitric Acid Production	0	NO	NO	Nitric Acid Production	0	NO	NO
Czech Republic	T1	PS	Nitric Acid Production	530	0.01	1050	Nitric Acid Production	515	0.001	212
Denmark	T1	PS	Nitric Acid Production	450	0.01	1003	Nitric Acid Production	0	NO	NO
Estonia	NA	NA	Nitric Acid Production	0	NO	NO	Nitric Acid Production	0	NO	NO
Finland	T2	PS	Nitric Acid Production	549	0.01	1592	Nitric Acid Production	635	0.001	211
France	-	-	Nitric Acid Production	3200	0.01	6316	Nitric Acid Production	2386	0.001	444
Germany	T3	PS	Nitric Acid Production	1698	0.01	3258	Nitric Acid Production	2559	0.001	480
Greece	D	D	Nitric Acid Production	511	0.01	1066	Nitric Acid Production	174	0.0004	21
Hungary	CS	PS	Nitric Acid Production	732	0.01	3090	Nitric Acid Production	518	0.0002	38
Ireland	T1	PS	Nitric Acid Production	339	0.01	995	Nitric Acid Production	0	NO	NO
Italy	T2	D,PS	Nitric Acid Production	1037	0.01	2005	Nitric Acid Production	433	0.001	112
Latvia	NA	NA	Nitric Acid Production	0	NO	NO	Nitric Acid Production	0	NO	NO
Lithuania	T2	PS	Nitric Acid Production	355437	0.00	893	Nitric Acid Production	1049172	0.000001	336
Luxembourg	NA	NA	Nitric Acid Production	0	NO	NO	Nitric Acid Production	0	NO	NO
Malta	NA	NA	-	0	NO	NO	-	0	NO	NO
Netherlands	T2	PS	Nitric Acid Production	0	C	6085	Nitric Acid Production	0	C	274
Poland	T1	CS	Nitric Acid Production	1577	0.01	3041	Nitric Acid Production	2280	0.001	884
Portugal	D	PS	Nitric Acid Production	0	C	498	Nitric Acid Production	0	C	57
Romania	T2	D	Nitric Acid Production	1261	0.01	3473	Nitric Acid Production	950	0.002	508
Slovakia	T3	PS	Nitric Acid Production	401	0.01	1142	Nitric Acid Production	612	0.001	129
Slovenia	NA	NA	Nitric Acid Production	0	NO	NO	Nitric Acid Production	0	NO	NO
Spain	T2	CS,PS	Nitric Acid Production	1329	0.01	2692	Nitric Acid Production	664	0.001	186
Sweden	-	-	Nitric Acid Production	374	0.01	782	Nitric Acid Production	251	0.001	48
United Kingdom	T3	CS	Nitric Acid Production	2408	0.01	3860	Nitric Acid Production	1015	0.0001	43
EU-28			**EU-28**	**374131**	**0.13**	**49543**	**EU 28**	**1064895**	**0.005**	**4950**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.3 2B3 Adipic acid production

N_2O emissions from 2B3 Adipic acid production account for 0.01 % of total emissions in 2013. Between 1990 and 2013, N_2O emissions from this source decreased by 99 % (Figure 4.8). Only France, Germany and Italy 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-28 N_2O emissions

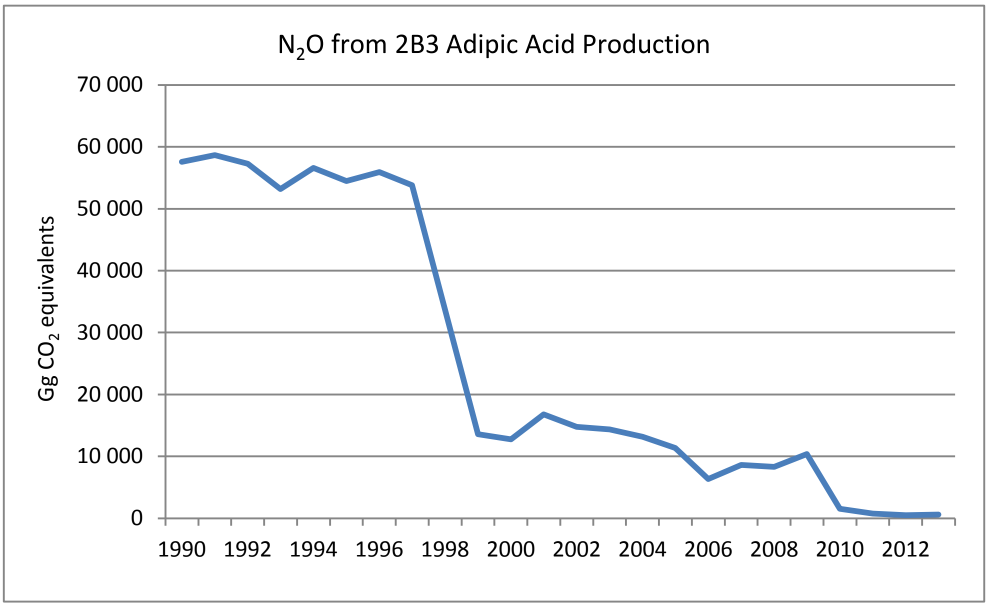


Table 4.14 2B3 Adipic acid production: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	14 232	70	157	26%	88	126%	-14 075	-99%	-	-
Germany	18 077	357	338	56%	-18	-5%	-17 738	-98%	T3	PS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4 402	83	110	18%	27	33%	-4 292	-97%	T2	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	358	NO	NO	-	-	-	-358	-100%	T1	D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	552	NO	NO	-	-	-	-552	-100%	D	D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	19 935	NO	NO	-	-	-	-19 935	-100%	T3	CS
EU-28	**57 555**	**509**	**605**	**100%**	**97**	**19%**	**-56 949**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.15 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic acid production for 1990 to 2013. The table shows that in 2013 adipic acid was produced in only three MS. Adipic acid production is used as activity data but the information is confidential in France and Germany. 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 2013. The table shows that in 2013 100 % of EU-28 emissions are estimated with higher Tier methods.

Table 4.15 2B3 Adipic acid production: Information on methods applied, activity data, emission factors for N_2O emissions

			1990				2013			
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	NA	NA	Adipic Acid Production	0	NO,NA	NO	Adipic Acid Production	0	NO,NA	NO
Belgium	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Bulgaria	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Croatia	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Cyprus	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Czech Republic	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Denmark	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Estonia	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Finland	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
France	-	-	Adipic Acid Production	0	C	14232	Adipic Acid Production	0	C	157
Germany	T3	PS	Adipic Acid Production	0	C	18077	Adipic Acid Production	0	C	338
Greece	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Hungary	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Ireland	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Italy	T2	D,PS	Adipic Acid Production	49	0.30	4402	Adipic Acid Production	80	0.005	110
Latvia	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Lithuania	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Luxembourg	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Malta	NA	NA	-	0	NO	NO	-	0	NO	NO
Netherlands	NA	NA	Adipic Acid Production	0	NA,NO	NO	Adipic Acid Production	0	NO	NO
Poland	T1	D	Adipic Acid Production	4	0.30	358	Adipic Acid Production	0	NO,NA	NO
Portugal	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Romania	D	D	Adipic Acid Production	6	0.30	552	Adipic Acid Production	0	NO	NO
Slovakia	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Slovenia	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Spain	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
Sweden	NA	NA	Adipic Acid Production	0	NO	NO	Adipic Acid Production	0	NO	NO
United Kingdom	T3	CS	Adipic Acid Production	0	C	19935	Adipic Acid Production	0	NO	NO
EU-28			**EU-28**	**59**	**89.40**	**57555**	**EU 28**	**80**	**1.37**	**605**

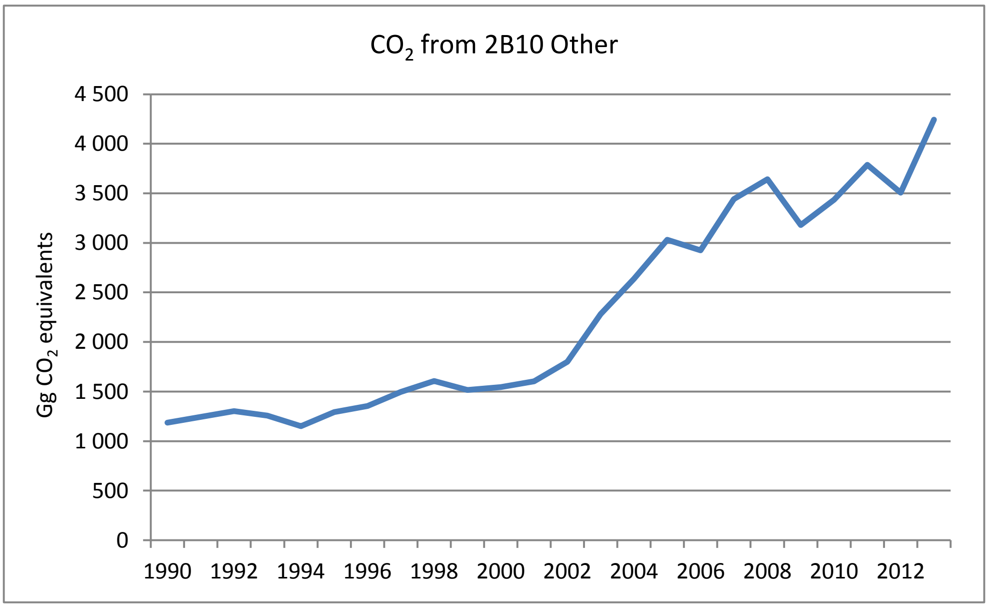
Note: Some member states report AD and IEF as confidential. Only the data from countries which reported all data are being used for the calculation of the IEF. Therefore the IEF in this table is not necessarily an accurate representation of the IEF for this category.

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.4 2B10 Other chemical industry

Eleven Member States report CO_2, CH_4 or N_2O emissions in this category (Table 4.16). This category contributed 4.2 Mt of CO_2 in 2013. Between 1990 and 2013, CO_2 emissions from this source increased significantly by 3.1 Mt or 258 % (Figure 4.9). Belgium is responsible for 37 % of these emissions, followed by Finland (21 %) and France (19 %). Between 1990 and 2013 Belgium had the largest growth of emissions in absolute terms. Between 2012 and 2013, CO_2 emissions from this source increased by 21 % with Belgium contributing the largest increase.

Figure 4.9 2B10 Other: CO_2 emissions



This category contains a wide heterogeneity of emissions and sources across Member States as shown in Table 4.16.

Table 4.16 2B10 Other: CO_2, CH_4 and N_2O emissions – emission trends between 1990 and 2013 and MS contribution

Member State	2.B.10 Other	CO_2 emissions [kt]	CO2 emissions [kt]	CH4 emissions [kt]	CH4 emissions [kt]	N2O emissions [kt]	N2O emissions [kt]
		1990	2013	1990	2013	1990	2013
AUT	Other	138.56	128.140101	0.29	0.2374	NA	NA
	CO2 from Nitric Acid Production	0.41	0.341	NA	NA	NA	NA
	Other chemical bulk production	138.15	127.799101	0.29	0.2374	NA	NA
BEL	Other	285.15	230.84979	NA	0.118548	0.03	0.03101588
	Other non-specified	285.15	230.84979	NA	0.118548	0.03	0.03101588
BGR	Other						
CYP	Other						
CZE	Other	IE	IE	IE	IE	NO	NO
DEU	Other	NA	NA	NA	NA	IE	IE
	production amount of dicarbonic acid	NA	NA	NA	NA	IE	IE
DNM	Other	0.85	1.3496	NA	NA	NA	NA
	Production of catalysts	0.85	1.3496	NA	NA	NA	NA
ESP	Other	NA	NA	0.71	0.583792	NA	NA
	Other No-Specify	NA	NA	0.71	0.583792	NA	NA
EST	Other	NO	NO	NO	NO	NO	NO
FIN	Other	176.18	909.902362	NO	NO	NO	NO
	Chemicals Production	NO	NO	NO	NO	NO	NO
	Phosphoric Acid Production	24.54	41.5566296	NO	NO	NO	NO
	Hydrogen Production	116.22	793.277578	NO	NO	NO	NO
	Limestone and Dolomite Use	35.42	75.0681547	NO	NO	NO	NO
FRK	Other	358.2	801.620525	0.02	0.0285257	1.76	0.3474408
GBE	Other	NO	NO	7.43	2.656844	0.01	0.005119
	Chemical industry - other	NO	NO	7.43	2.656844	0.01	0.005119
GRC	Other	NA,NO	304.781935	NA	NA	NA	NA
	Sulfuric acid	NA	NA	NA	NA	NA	NA
	Hydrogen production	NO	304.781935	NA	NA	NA	NA
HRV	Other	NO	NO	NO	NO	NO	NO
HUN	Other	NO	NO	NO	NO	NO	NO
IRL	Other						
ITA	Other	IE	IE	IE,NA	IE,NA	IE,NA	IE,NA
	other (indirect emissions)	IE	IE	IE	IE	IE	IE
	Soda Ash (CO emissions only)	IE	IE	NA	NA	NA	NA
LTU	Other	NO	NO	NO	NO	NO	NO
	Sulfuric acid production	NO	NO	NO	NO	NO	NO
LUX	Other	NO	NO	NO	NO	NO	NO
LVA	Other	NO	NO	NO	NO	NO	NO
MLT	Other	NO	NO	NO	NO	NO	NO
NLD	Other	NA	NA	NA	NA	NA	NA
	process emissions precursors chemical industry	NA	NA	NA	NA	NA	NA
POL	Other						
PRT	Other	19.78	21.2163749	NO	NO	NO	NO
	2.B.10.a Sulphuric Acid	NO	NO	NO	NO	NO	NO
	2.B.10.b Ammonium Sulphate	0.05	0.00507491	NO	NO	NO	NO
	2.B.10.c Explosives	NO	NO	NO	NO	NO	NO
	2.B.10.d Solvent use in plastic products manufacturi	19.73	21.2113	NO	NO	NO	NO
ROU	Other	NO	NO	NO	NO	NO	NO
	Other - non-specified	NO	NO	NO	NO	NO	NO
SVK	Other	116.99	369.29	0	0.00664478	0	0.00066448
	Hydrogen Production	116.99	369.29	0	0.00664478	0	0.00066448
SVN	Other	NO	NO	NO	NO	NO	NO
SWE	Other	90.08	118.775603	0.03	0.0315909	0.07	0.02219983
	Other inorganic chemical products	52.4	64.6010117	0	0.0025909	0.01	0.00218
	Other non-specified	NA	NA	NE	NE	NE	NE
	Other organic chemical products	37.68	54.1745913	0.03	0.029	NA	NA
	Pharmaceutical industry	NA	NA	NE	NE	0.05	0.02
	Sulphuric acid production	NA	NA	NA	NA	NA	NA
	Base chemicals for plastic industry	NA	NA	NE	NE	0.01	1.9833E-05

Table 4.16 provides an overview of change between 1990 and 2013 at a disaggregated level. Due to the heterogeneity of emission sources in this category, it is not possible to interpret trends in a meaningful way.

Table 4.17 2B10 Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	139	142	128	3%	-14	-10%	-10	-8%
Belgium	285	972	1 587	37%	614	63%	1 301	456%
Bulgaria	-	-	-	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	IE	IE	IE	-	-	-	-	-
Denmark	1	1	1	0%	0	0%	0	58%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	176	834	910	21%	76	9%	734	416%
France	358	743	802	19%	59	8%	443	124%
Germany	NA	NA	NA	-	-	-	-	-
Greece	NA,NO	323	305	7%	-19	-6%	305	100%
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-
Italy	IE	IE	IE	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-
Portugal	20	21	21	1%	0	0%	1	7%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	117	357	369	9%	12	3%	252	216%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	90	113	119	3%	6	5%	29	32%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**1 186**	**3 507**	**4 242**	**100%**	**735**	**21%**	**3 056**	**258%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B10 Other account for 0.003 % of total emissions in 2013. Between 1990 and 2013, N_2O emissions from this source decreased by 77 % (Table 4.18). The Netherlands, Belgium and France are responsible for almost all of these emissions. Between 2012 and 2013, N_2O emissions from this source increased by 23 % with most of the increase in France.

Figure 4.10 2B10 Other: N_2O emissions

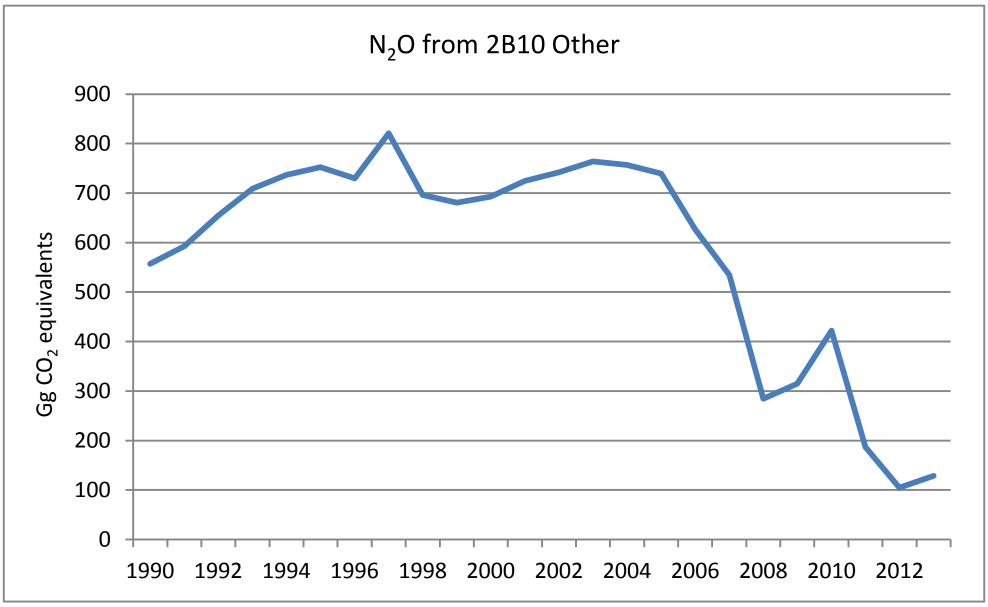


Table 4.18 2B10 Other: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NA	NA	NA	-	-	-	-	-
Belgium	9	19	17	13%	-2	-11%	8	87%
Bulgaria	-	-	-	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	NA	NA	NA	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	526	78	104	81%	26	33%	-422	-80%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-
Italy	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	0	0	0	0%	0	3%	0	224%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	21	6	7	5%	0	7%	-14	-68%
United Kingdom	2	2	2	1%	0	-10%	0	-15%
EU-28	**557**	**105**	**129**	**100%**	**24**	**23%**	**-429**	**-77%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.19 provides an overview of all sources reported under 2B10 Other Chemical Industry by EU-28 Member States for the year 2013 and for all gases. The largest contributors to the total EU-28 emissions are France and Finland.

Table 4.19 2B10 Other: Overview of sources reported under this source category for 2013

Member State	2.B.10 Other Chemical Industry	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-28 Total
Austria	Other, CO2 from Nitric Acid Production, Other chemical bulk production	128	0.2	NA	134	4%
Belgium	Other, Other non-specified	231	0.1	0.03	243	8%
Bulgaria	Other				-	-
Croatia	Other	NO	NO	NO	-	-
Cyprus	Other				-	-
Czech Republic	Other	IE	IE	NO	-	-
Denmark	Other, Production of catalysts	1	NA	NA	1	0.04%
Estonia	Other	NO	NO	NO	-	-
Finland	Other, Chemicals Production, Phosphoric Acid Production, Hydrogen Production, Limestone and Dolomite Use	910	NO	NO	910	29%
France	Other	802	0.03	0.3	906	29%
Germany	Other, production amount of dicarbonic acid	NA	NA	IE	-	-
Greece	Other, Sulfuric acid, Hydrogen production	305	NA	NA	305	10%
Hungary	Other	NO	NO	NO	-	-
Ireland	Other				-	-
Italy	Other, other (indirect emissions), Soda Ash (CO emissions only)	IE	IE,NA	IE,NA	-	-
Latvia	Other	NO	NO	NO	-	-
Lithuania	Other, Sulfuric acid production	NO	NO	NO	-	-
Luxembourg	Other	NO	NO	NO	-	-
Malta	Other	NO	NO	NO	-	-
Netherlands	Other, process emissions precursors chemical industry	NA	NA	NA	-	-
Poland	Other				-	-
Portugal	Other, 2.B.10.a Sulphuric Acid, 2.B.10.b Ammonium Sulphate, 2.B.10.c Explosives, 2.B.10.d Solvent use in plastic products manufacturing	21	NO	NO	21	0.7%
Romania	Other, Other - non-specified	NO	NO	NO	-	-
Slovakia	Other, Hydrogen Production	369	0.01	0.0007	370	12%
Slovenia	Other	NO	NO	NO	-	-
Spain	Other, Other No-Specify	NA	0.6	NA	-	-
Sweden	Other, Other inorganic chemical products, Other non-specified, Other organic chemical products, Pharmaceutical industry, Sulphuric acid production, Base chemicals for plastic industry	119	0.03	0.02	126	4%
United Kingdom	Other, Chemical industry - other	NO	3	0.01	-	-
EU 28 - Total		**2886**	**3.66**	**0.41**	**3099**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.5 Non-key sources

The following categories will be assessed and included in the 2016 NIR with a suitable level of detail as appropriate:

2B4 Caprolactam, glyoxal and glyoxylic acid production

2B5 Carbide production

2B6 Titanium dioxide production

2B7 Soda ash production

4.2.3 Metal Industry (CRF Source Category 2C)

This source category includes two key sources, namely CO_2 emissions from 2C1 Iron and Steel Production and PFC emissions from 2C3 Aluminium Production.

Table 4.20 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2013, CO_2 emission from 2C Metal Production decreased by approx. 39 %. The absolute decrease of CO_2 emissions was largest in Germany, Romania and Poland.

Table 4.20 2C Metal Industry: Member States' contributions to total GHG, CO_2, PFC and SF_6 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	PFC emissions in 1990 (kt CO2 equivalents)	PFC emissions in 2013 (kt CO2 equivalents)	SF6 emissions in 1990 (kt CO2 equivalents)	SF6 emissions in 2013 (kt CO2 equivalents)
Austria	8 177	10 232	6 787	10 223	1 149	NO	242	9
Belgium	10 400	3 965	10 400	3 949	-	-	-	-
Bulgaria	1 439	33	1 413	33	-	-	-	-
Croatia	1 583	17	339	17	1 240	NO	NO	NO
Cyprus	0	0	NO	NO	-	-	-	-
Czech Republic	9 668	7 058	9 653	6 625	NO	NO	NO	NO
Denmark	60	0	30	0	NO	NO	30	NO
Estonia	0	0	NO	NO	NO	NO	NO	NO
Finland	1 976	2 095	1 976	2 095	NO	NO	NO	C,NO
France	8 463	3 459	4 113	3 269	3 567	98	781	92
Germany	28 147	15 204	25 073	15 024	2 889	108	180	34
Greece	1 190	1 153	1 000	1 070	190	83	NO	NO
Hungary	3 699	728	3 316	725	376	NO	NO	NO
Ireland	0	0	NO	NO	-	-	-	-
Italy	5 921	1 244	3 878	1 192	1 975	NO	NO	NO
Latvia	13	1	13	1	NO	NO	NO	NO
Lithuania	15	2	15	2	NO	NO	NO	NO
Luxembourg	985	102	985	102	NO	NO	NO	NO
Malta	0	0	NO,NA	NO,NA	-	-	NO,NA	NO,NA
Netherlands	5 351	1 261	2 714	1 251	2 638	11	NO	NO
Poland	6 201	2 452	6 037	2 434	142	NA,NO	NA,NO	4
Portugal	128	82	122	66	-	-	-	-
Romania	13 848	3 318	11 372	3 308	2 455	6	NO,NE	NO,NE
Slovakia	4 901	4 204	4 586	4 194	315	10	NO	NO
Slovenia	551	223	343	208	208	15	-	-
Spain	4 443	2 946	3 397	2 883	1 021	44	NA,NO	NA,NO
Sweden	3 722	2 783	3 246	2 723	434	49	23	11
United Kingdom	9 431	5 235	7 392	5 013	1 553	7	387	146
EU-28	**130 311**	**67 798**	**108 198**	**66 406**	**20 151**	**431**	**1 642**	**296**

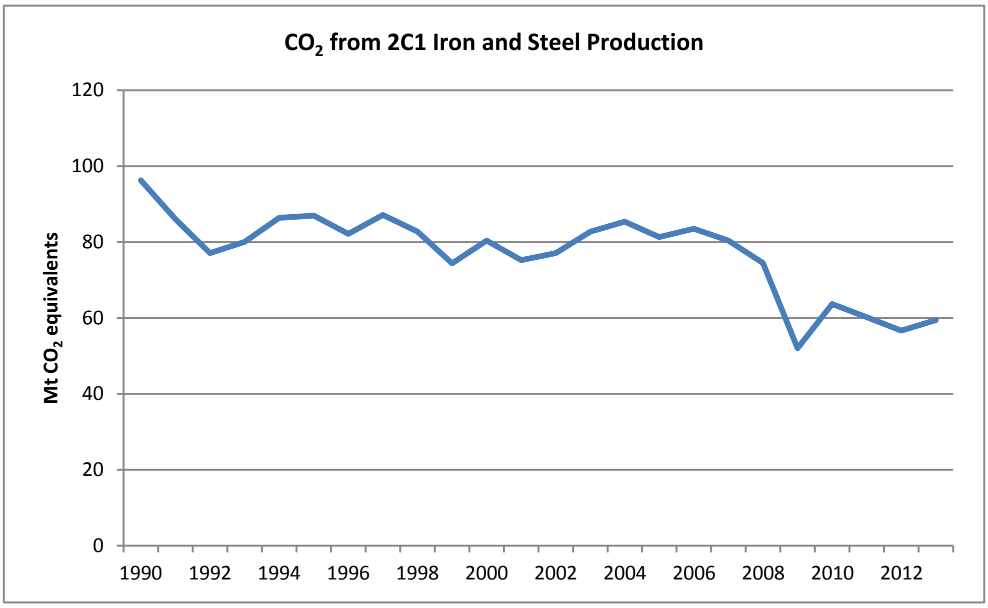
4.2.3.1 2C1 Iron and steel production

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, using coke or other forms of carbon as fuel and reducing agent. In most iron furnaces, the process is aided by the use of carbonate fluxes (limestone). Additional emissions occur as the limestone or dolomite flux releases CO_2 during reduction of pig iron in the blast furnace. Carbon plays the dual role of fuel and reducing agent. Member States use different methods for the allocation of emissions that are described in Table 4.22.

CO_2 emissions from 2C1 Iron and Steel Production amounted to approx. 2.2 % of total GHG emissions (without LULUCF) in 2013. Germany accounts for 23.5 % of these emissions in the EU-28. Germany had the largest decrease in absolute terms between 1990 and 2013 while increases were encountered in Austria, Finland and (on a small scale) Slovenia.

The overall emission trend between 1990 and 2013 roughly follows the trend of emissions from Germany that fluctuates due to varying production figures. Between 1990 and 2013, overall CO_2 emissions from iron and steel production decreased by 38 % (Table 4.21). Between 2012 and 2013 emissions increased by 5 %.

Figure 4.11 2C1 Iron and Steel Production: CO_2 emissions



CO_2 emissions from iron and steel industry are reported by all Member States except Cyprus, Estonia, Ireland and Malta. All follow higher-tier methods and most use country or plant specific methods (see Table **4.21**).

Table 4.21 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 kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2	%	kt CO2	%		
Austria	6 610	9 850	10 191	17%	341	3%	3 581	54%	NA	NA
Belgium	10 278	3 627	3 799	6%	172	5%	-6 479	-63%	CS,T3	PS
Bulgaria	1 283	50	33	0%	-18	-35%	-1 251	-97%	T1,T2	CS,D
Croatia	46	2	17	0%	15	843%	-29	-64%	NA,T2	CS,NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	9 643	5 752	6 543	11%	791	14%	-3 099	-32%	CS,T2	D,PS
Denmark	30	NO	NO	-	-	-	-	-	T1,T2	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 967	2 264	2 073	3%	-191	-8%	107	5%	CS,T3	CS
France	2 877	1 925	2 337	4%	413	21%	-540	-19%	NA	NA
Germany	22 810	14 290	13 978	24%	-312	-2%	-8 832	-39%	NA,T2	CS,NA
Greece	93	83	66	0%	-17	-20%	-26	-28%	CS,NA	CS,NA
Hungary	3 153	1 200	725	1%	-475	-40%	-2 428	-77%	NA,T3	NA,PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	3 124	1 291	1 157	2%	-134	-10%	-1 967	-63%	T2	CR,CS,PS
Latvia	13	3	1	0%	-2	-67%	-12	-93%	NA,T2	D,NA,PS
Lithuania	15	3	2	0%	-1	-23%	-12	-84%	T2	D
Luxembourg	985	100	102	0%	1	1%	-883	-90%	CS,NA,T2	CS,NA
Malta	NO,NA	NO,NA	NO,NA	-	-	-	-	-	NA	NA
Netherlands	2 266	1 240	1 083	2%	-157	-13%	-1 183	-52%	NA,T2	CS,NA
Poland	5 343	1 683	1 862	3%	179	11%	-3 481	-65%	T1,T2	CS
Portugal	122	62	66	0%	4	6%	-56	-46%	T2	D,OTH,PS
Romania	10 781	2 852	2 933	5%	81	3%	-7 848	-73%	NA,T3	CS,NA
Slovakia	4 168	3 860	3 763	6%	-97	-3%	-405	-10%	T2	PS
Slovenia	44	48	49	0%	2	4%	6	13%	NA,T2	NA,PS
Spain	2 428	1 375	1 483	2%	108	8%	-945	-39%	T2	CS,PS
Sweden	2 632	2 179	2 249	4%	70	3%	-383	-15%	NA	NA
United Kingdom	5 583	2 918	4 945	8%	2 027	69%	-637	-11%	NA,T2	CS,NA
EU-28	**96 293**	**56 656**	**59 459**	**100%**	**2 803**	**5%**	**-36 805**	**-38%**		

For this category, it is not useful to give an average IEF across the Member States because of their varying emission allocation (the split between process and combustion related emissions for pig iron production, which is an important sub-category). Activity data, implied implied emission factors and CO_2 emissions for the various Member States and sub-categories are provided in Table 4.22.

Figure 4.12   2C1 Iron and Steel Production: Implied emission factors

1990					2013				
Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (kt)	Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (kt)
	Description	(kt)				Description	(kt)		
Austria	**Iron and steel production**			6610	Austria	**Iron and steel production**			10191
	Steel	3921	1.68	6591		Steel	7290	1	10151
	Pig Iron	3444	NA,IE	IE		Pig Iron	6144	NA,IE	IE
	Direct reduced iron	0	NO,NA	NO		Direct reduced iron	NO	NO,NA	NO
	Sinter	0	NO,NA	NO		Sinter	NO	NO,NA	NO
	Pellet	0	NO,NA	NO		Pellet	NO	NO,NA	NO
	Other			20		Other			40
	Electric Furnace Steel	370	0.05	20		Electric Furnace Steel	664	0.06	40
Belgium	**Iron and steel production**			10278	Belgium	**Iron and steel production**			3799
	Steel	11570	0.75	8689		Steel	6829	0.5	3731
	Pig Iron	9415	NA,IE	IE		Pig Iron	3892	NA,IE	IE
	Direct reduced iron	0	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	13075	0.12	1589		Sinter	5349	0.01	64
	Pellet	0	IE,NO	IE		Pellet	NO	NO	NO
	Other			IE		Other			4
	Use of electrodes	NA	NO, IE	IE		Use of electrodes	1178	0.004	4
Bulgaria	**Iron and steel production**			1283	Bulgaria	**Iron and steel production**			33
	Steel	2180	0.59	1283		Steel	541	0.06	33
	Pig Iron	1143	NO,IE	IE		Pig Iron	NO	NO	NO
	Direct reduced iron	IE	NO,IE	IE		Direct reduced iron	NO	NO	NO
	Sinter	C	NO,IE	IE		Sinter	NO	NO	NO
	Pellet	IE	NO,IE	IE		Pellet	NO	NO	NO
	Other					Other			
Croatia	**Iron and steel production**			46	Croatia	**Iron and steel production**			17
	Steel	171	0.27	46		Steel	58	0.3	17
	Pig Iron	209	IE,NO	IE		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Cyprus	**Iron and steel production**			NO	Cyprus	**Iron and steel production**			NO
	Steel	NO	NO	NO		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other					Other			
Czech Republic	**Iron and steel production**			9643	Czech Republic	**Iron and steel production**			6543
	Steel	8190	NA,IE	IE		Steel	5222	NA,IE	IE
	Pig Iron	6106	NA,IE	IE		Pig Iron	4040	NA,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	8469	NA,IE	IE		Sinter	5543	NA,IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			9643		Other			6543
	Metallurgical coke	7125	1.29	9180		Metallurgical coke	2489	2.27	5660
	Use of limestone and dolomite	891	0.52	462		Use of limestone and dolomite	1080	0.82	883
Denmark	**Iron and steel production**			30	Denmark	**Iron and steel production**			NO
	Steel	614	0.05	30		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other					Other			
Estonia	**Iron and steel production**			NO	Estonia	**Iron and steel production**			NO
	Steel	NO	NO	NO		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

	1990					2013			
Member State	**Activity data**		**Implied emission factor (t/t)**	**CO2 emissions (kt)**	**Member State**	**Activity data**		**Implied emission factor (t/t)**	**CO2 emissions (kt)**
	Description	**(kt)**				**Description**	**(kt)**		
Finland	**Iron and steel production**			1967	**Finland**	**Iron and steel production**			2073
	Steel	2861	0.69	1967		Steel	3517	0.6	2073
	Pig Iron	NO	NO,IE	IE		Pig Iron	NO	NO,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
	Coke	487	NO	NO		Coke	878	NO	NO
France	**Iron and steel production**			2877	**France**	**Iron and steel production**			2337
	Steel	19073	0.09	1643		Steel	15692	0.09	1407
	Pig Iron	14088	0.09	1234		Pig Iron	10241	0.09	930
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	IE	IE	IE		Sinter	IE	IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Germany	**Iron and steel production**			22810	**Germany**	**Iron and steel production**			13978
	Steel	43939	0.52	22810		Steel	42645	0.3	13978
	Pig Iron	32263	IE,NO	IE		Pig Iron	27176	IE,NO	IE
	Direct reduced iron	IE	IE	IE		Direct reduced iron	IE	IE	IE
	Sinter	IE	IE	IE		Sinter	IE	IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Greece	**Iron and steel production**			93	**Greece**	**Iron and steel production**			66
	Steel	999	0.09	93		Steel	1030	0.1	66
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Hungary	**Iron and steel production**			3153	**Hungary**	**Iron and steel production**			725
	Steel	2963	0.12	346		Steel	883	0.12	105
	Pig Iron	1697	1.65	2427		Pig Iron	628	2	429
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	72	5.28	380		Sinter	36	5	191
	Pellet	IE	IE	IE		Pellet	IE	IE	IE
	Other			NO		Other			NO
Ireland	**Iron and steel production**			NO	**Ireland**	**Iron and steel production**			NO
	Steel	NO	NO	NO		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Italy	**Iron and steel production**			3124	**Italy**	**Iron and steel production**			1157
	Steel	25467	0.05	1346		Steel	24080	0.03	604
	Pig Iron	11852	0.15	1778		Pig Iron	6933	0	553
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	13577	NA	NA		Sinter	8175	NA	NA
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Latvia	**Iron and steel production**			13	**Latvia**	**Iron and steel production**			1
	Steel	550	0.02	13		Steel	193	0	1
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

1990					2013				
Member State	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO2 emissions (kt)	Member State	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO2 emissions (kt)
Lithuania	**Iron and steel production**			15	Lithuania	**Iron and steel production**			2
	Steel	NO	NO	NO		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			15		Other			2
	Cast Iron	106	0.14	15		Cast Iron	3	0.7	2
Luxembourg	**Iron and steel production**			985	Luxembourg	**Iron and steel production**			102
	Steel	3506	0.12	404		Steel	2089	0.05	102
	Pig Iron	2645	0.08	200		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	4804	0.08	380		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Malta	**Iron and steel production**			NO,NA	Malta	**Iron and steel production**			NO,NA
	Steel	NO	NO	NO		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NA		Other			NA
Netherlands	**Iron and steel production**			2266	Netherlands	**Iron and steel production**			1083
	Steel	5162	0.01	43		Steel	6800	0.00	15
	Pig Iron	0	IE,NO	IE		Pig Iron	NA	IE,NO	IE
	Direct reduced iron	0	NA	1		Direct reduced iron	NA	NA	0
	Sinter	0	IE,NO	IE		Sinter	NA	IE,NO	IE
	Pellet	0	IE,NO	IE		Pellet	NA	IE,NO	IE
	Other			2223		Other			1068
	Other non specified	11691	0.19	2223		Other non specified	NA	NA	1068
Poland	**Iron and steel production**			5343	Poland	**Iron and steel production**			1862
	Steel	0	IE	IE		Steel	IE	IE	IE
	Pig Iron	8657	0.16	1427		Pig Iron	4012	0	636
	Direct reduced iron	0	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	11779	0.07	841		Sinter	6854	0	355
	Pellet	0	NO	NO		Pellet	NO	NO	NO
	Other			3075		Other			870
	Open-hearth Steel	3945	0.52	2060		Open-hearth Steel	NO	NA,NO	NO
	Basic Oxygen Furnace Steel	7207	0.13	929		Basic Oxygen Furnace Steel	4520	0.14	645
	Electric Furnace Steel	2309	0.04	85		Electric Furnace Steel	3679	0.06	225
Portugal	**Iron and steel production**			122	Portugal	**Iron and steel production**			66
	Steel	621	0.07	42		Steel	1998	0.0	66
	Pig Iron	308	0.00004	0		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	338	0.24	80		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Romania	**Iron and steel production**			10781	Romania	**Iron and steel production**			2933
	Steel	9959	1.08	10781		Steel	3118	0.94	2933
	Pig Iron	5916	NO,IE	IE		Pig Iron	1604	NO,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	11357	NO,IE	IE		Sinter	2111	NO,IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Slovakia	**Iron and steel production**			4168	Slovakia	**Iron and steel production**			3763
	Steel	3562	1.17	4150		Steel	4344	0.9	3709
	Pig Iron	17	NO,IE	IE		Pig Iron	14	NO,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	IE	NO,IE	IE		Sinter	IE	NO,IE	IE
	Pellet	IE	NO,IE	IE		Pellet	IE	NO,IE	IE
	Other			18		Other			54
	EAF production of steel	311	0.06	18		EAF production of steel	711	0.08	54

1990					2013				
Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (kt)	Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (kt)
	Description	(kt)				Description	(kt)		
Slovenia	**Iron and steel production**			44	Slovenia	**Iron and steel production**			49
	Steel	632	0.07	44		Steel	663	0.07	49
	Pig Iron	NO	NO,NA	NO		Pig Iron	NO	NO,NA	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Spain	**Iron and steel production**			2428	Spain	**Iron and steel production**			1483
	Steel	13163	0.07	979		Steel	14446	0.05	672
	Pig Iron	C	C	246		Pig Iron	C	C	295
	Direct reduced iron	IE	NA,IE	IE		Direct reduced iron	IE	NA,IE	IE
	Sinter	C	C	538		Sinter	C	C	190
	Pellet	IE	NA,IE	IE		Pellet	IE	NA,IE	IE
	Other			666		Other			326
	Flaring in iron and steel production	C	C	C		Flaring in iron and steel production	C	C	326
Sweden	**Iron and steel production**			2632	Sweden	**Iron and steel production**			2249
	Steel	1755	0.09	156		Steel	1446	0.12	167
	Pig Iron	2736	0.77	2094		Pig Iron	2896	0.63	1813
	Direct reduced iron	109	1.19	129		Direct reduced iron	113	1.45	164
	Sinter	1058	0.20	212		Sinter	NA	NA	NA
	Pellet	9919	0.004	41		Pellet	24115	0.004	106
	Other					Other			
United Kingdom	**Iron and steel production**			5583	United Kingdom	**Iron and steel production**			4945
	Steel	17485	0.01	224		Steel	11769	0.01	140
	Pig Iron	12463	0.15	1837		Pig Iron	9471	0.22	2115
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	C	C	3522		Sinter	C	C	2690
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

It can be seen from the table that several Member States use IE for some categores. This can be explained by the fact that they make use of carbon balances and several processes occur within the same industrial site, which makes differentiation into the various subcategories difficult. For example, several countries include emissions from the production of pig iron (which occurs at integrated iron and steel production sites) under “steel production”.

According to the 2006 IPCC guidelines, all emissions from iron and steel production should be reported under category 2.C.1, irrespective of their role as reducing agent or fuel.

However, e. g. some Member States report emissions from blast furnace gas and from converter gas under 1A2a instead of 2C1 because this can be interpreted as emissions from energy supply.

Thus, for an overview of total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for this combined category are given in Table 4.22.

Table 4.22 CO_2 Emissions of from iron and steel production: 1A2a, 2C1 and combined (sum of both categories). The column "Share 2C1" denotes the ratio of emissions under 2C1 and combined emissions.

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2013	Share 2C1
	1A2a	2C1	Combined		
Austria	1,971	10,191	12,162	7%	84%
Belgium	1,128	3,799	4,927	3%	77%
Bulgaria	99	33	132	0%	25%
Croatia	58	17	75	0%	22%
Cyprus	NO,IE	NO	-	-	-
Czech Republic	2,812	6,543	9,355	6%	70%
Denmark	71	NO	71	0%	-
Estonia	NO	NO	-	-	-
Finland	2,154	2,073	4,227	3%	49%
France	13,976	2,337	16,314	10%	14%
Germany	34,081	13,978	48,059	29%	29%
Greece	173	66	239	0%	28%
Hungary	203	725	928	1%	78%
Ireland	NO	NO	-	-	-
Italy	10,597	1,157	11,754	7%	10%
Latvia	39	1	40	0%	2%
Lithuania	NO	2	2	0%	100%
Luxembourg	264	102	365	0%	28%
Malta	IE	NO,NA	-	-	-
Netherlands	3,496	1,083	4,579	3%	24%
Poland	5,818	1,862	7,680	5%	24%
Portugal	143	66	209	0%	31%
Romania	2,703	2,933	5,636	3%	52%
Slovakia	3,192	3,763	6,956	4%	54%
Slovenia	202	49	251	0%	20%
Spain	6,256	1,483	7,739	5%	19%
Sweden	1,261	2,249	3,511	2%	64%
United Kingdom	14,670	4,945	19,615	12%	25%
EU-28	**105368**	**59459**	**164826**	**100%**	**36%**

It can be seen that the ratio of emissions under 2C1 and combined emissions (see column "Share 2C1" in Table **4.22**) varies across Member States. This indicates that the boundary between 1A2a and 2C1 is not uniformly interpreted by Member States. The eight Member States with largest CO_2 emissions from iron and steel production allocate their emissions in the following ways:

- Germany: Approx. 29 % of emissions are reported under 2C1. This category comprises process-related CO_2 emissions (including emissions from carbonate use). However, emissions from energy-related use of top gas and converter gas are reported under the respective sub-categories of sector 1.
- United Kingdom: Major share of emissions (75 %) is reported under 1A2a. Emissions from sintering (coke breeze and carbonates), from flared blast furnace gas and from electric and ladle arc furnances are reported under 2C1.
- France: Major share of emissions (86 %) is reported under 1A2a. Emissions from sinter production are reported under 1A2a.
- Austria: 84 % of emissions are reported under 2C1. Generally, all emissions from iron and steel production are reported under this category, irrespective of their role as reducing agent or fuel,

but emissions related to the coke oven and to on-site power plants are reported under category 1A2a.

- Italy: Major share of emissions (90 %) is reported under 1A2a. CO_2 emissions due to the consumption of coke, coal and other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector. In sector 2C1, emissions are reported from carbonates used in sinter plants and in basic oxygen furnaces, emissions related to steel and pig iron scraps and emissions from graphite electrodes consumed in electric arc furnaces.
- Czech Republic: 70 % of emissions are reported under category 2C1. It also includes emissions from limestone and dolomite use.
- Spain: Major share of emissions (81 %) is reported under 1A2a, including emissions from coke production.
- Poland: 76 % of emissions are reported under 1A2a. Generally, all fuels are reported under this category, but CO_2 emissions from coke in the blast furnace are reported under category 2C1.

4.2.3.2 2C3 Aluminium production

This category includes PFC emissions from aluminium production. Two PFCs, tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6), are known to be emitted from the process of primary aluminium smelting. These PFCs are formed during the phenomenon known as the anode effect, when the aluminium oxide concentration in the reduction cell electrolyte is low.

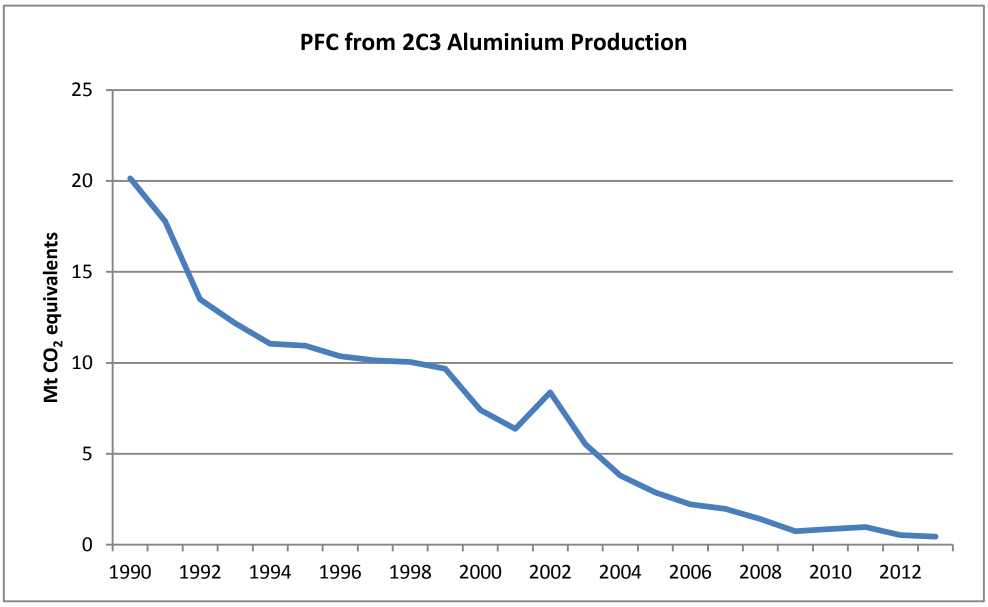
Table 4.23 summarises information by Member States on emission trends for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.01 % of total EU-28 GHG emissions (without LULUCF) in 2013. Between 1990 and 2013, PFC emissions from this source decreased by 98 %. In 2013, Germany contributed the highest share among the EU-28, amounting to 25 % of overall emissions. Of the ten Member States reporting PFC emissions under this category in 2013, seven use plant or country-specifc emission factors.

Table 4.23 2C3 Aluminium Production: Member States' contributions to PFC emissions and information on method applied and emission factor

Member State	PFCs emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	1 149	NO	NO	-	-	-	-1 149	-100%	NA	NA
Belgium	-	-	-	-	-	-	-	-	-	-
Bulgaria	-	-	-	-	-	-	-	-	-	-
Croatia	1 240	NO	NO	-	-	-	-1 240	-100%	NA,T1	D,NA
Cyprus	-	-	-	-	-	-	-	-	-	-
Czech Republic	-	-	-	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	3 567	134	98	23%	-36	-27%	-3 469	-97%	NA	NA
Germany	2 889	87	108	25%	20	23%	-2 781	-96%	CS,NA	CS,NA
Greece	190	58	83	19%	24	42%	-108	-57%	T3	PS
Hungary	376	NO	NO	-	-	-	-376	-100%	T2	D
Ireland	-	-	-	-	-	-	-	-	-	-
Italy	1 975	39	NO	-	-39	-100%	-1 975	-100%	T1	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	-	-	-	-	-	-	-	-	NA	NA
Malta	-	-	-	-	-	-	-	-	-	-
Netherlands	2 638	18	11	3%	-7	-39%	-2 627	-100%	NA	NA
Poland	142	NO	NO	-	-	-	-142	-100%	NA,T1c	CS,NA
Portugal	-	-	-	-	-	-	-	-	-	-
Romania	2 455	7	6	1%	-1	-17%	-2 449	-100%	T1,T1b	D
Slovakia	315	26	10	2%	-16	-62%	-305	-97%	T2	PS
Slovenia	208	18	15	4%	-3	-15%	-192	-93%	NA,T3	CS,D,NA
Spain	1 021	45	44	10%	-1	-2%	-976	-96%	NA,T3	NA,PS
Sweden	434	76	49	11%	-27	-35%	-384	-89%	-	-
United Kingdom	1 553	16	7	2%	-9	-58%	-1 546	-100%	CS	CS,PS
EU-28	**20 151**	**524**	**431**	**100%**	**-94**	**-18%**	**-19 720**	**-98%**		

All Member States reduced their emissions from this source between 1990 and 2013. France, Germany, the Netherlands and Romania had the largest decreases in absolute terms. The decreasing trend of PFC emissions from this key source between 1990 and 2013 is due to production stop or decline and due to process improvements.The emission peak in 2002 (see Figure 4.13) can be explained by technological changes and sub-optimal conditions of operation (in France and in the Netherlands).

Figure 4.13   2C3 Aluminium Production: PFC emissions



4.2.4 Electronics Industry (CRF Source Category 2.E)

2.E Electronics Industry comprises emissions which were formerly reported under 2.F.7 Semiconductor Manufacture,

4.2.5 Product uses as substitutes for ODS (CRF Source Category 2F) (EU-28)

This category is similar to the former category 2.F Consumption of Halocarbons and SF_6, except that the former subcategory 2.F.7 Electronics Industry is now reported under 2.E and the former subcategories 2.F.8 Electrical Equipment and 2.F.9 Other sources of SF_6 are now reported under 2.G. Emissions related to the consumption of Halocarbons (HFCs, PFCs) and Sulphur Hexafluoride (SF_6) are reported under this source category. HFCs are predominantly serving as alternatives to ozone depleting substances (ODS) that are being phased out under the Montreal Protocol, and have been introduced to the EU market first at the end of 1990. The main applications of halocarbons include refrigeration and air conditioning, foam blowing, fire protection, aerosols, solvents as well as some other applications. Primary uses of SF_6 include gas insulated switch gear for transportation and distribution of electric power and several other applications. Like SF_6, PFCs had been used already before 1990, especially in semiconductor manufacture.

For 2.F Product uses as substitutes for ODS, Table 4.24 summarizes information by Member States on emission trends of total GHG emissions as well as on HFCs, PFCs and SF_6 individually.

Table 4.24 2F Product uses as substitutes for ODS: Member States' and EU-28 total GHG, HFC, PFC, SF_6, NF_3 and Unspecified Mix of HFC and PFC emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	HFC emissions in 1990 (kt CO2 equivalents)	HFC emissions in 2013 (kt CO2 equivalents)	PFC emissions in 1990 (kt CO2 equivalents)	PFC emissions in 2013 (kt CO2 equivalents)	NF3 emissions in 1990 (kt CO2 equivalents)	NF3 emissions in 2013 (kt CO2 equivalents)	SF6 emissions in 1990 (kt CO2 equivalents)	SF6 emissions in 2013 (kt CO2 equivalents)	Unspec. Mix of HFC and PFC emissions in 1990 (kt CO2 equivalents)	Unspec. Mix of HFC and PFC in 2013 (kt CO2 equivalents)
Austria	0	1 672	NO	1 672	NO	NO	-	-	-	-	-	-
Belgium	0	2 529	NO	2 527	NO	2	NO	NO	NO	NO	NO	NO
Bulgaria	0	898	NO	898	NO	0	NO	NO	NO	NO	NO	NO
Croatia	0	578	NO	578	NO	0	NO	NO	NO	NO	NO	NO
Cyprus	0	544	NE,NO	544	-	-	-	-	-	-	-	-
Czech Republic	0	2 673	NO	2 667	NO	6	NO	NO	NO	NO	NO	NO
Denmark	0	789	NO	782	NO	7	-	-	-	-	-	-
Estonia	0	204	NO	204	NO	NO	NO	NO	NO	NO	NO	NO
Finland	0	1 559	0	1 555	NO	4	NO	NO	NO	NO	NO	NO
France	0	19 569	NO	19 569	-	-	-	-	-	-	-	-
Germany	0	10 523	C,NA,NO	10 514	C,NA	9	-	-	-	-	NO	NO
Greece	0	5 734	NO	5 645	NO	90	-	-	-	-	-	-
Hungary	0	1 281	NO	1 279	NO	2	NO	NO	NO	NO	NO	NO
Ireland	0	1 273	NO	1 273	-	-	-	-	-	-	-	-
Italy	0	11 503	NO	11 503	-	-	-	-	-	-	-	-
Latvia	0	107	NO,NE	107	NO	NO	NO,NA	NO,NA	NO,NA	NO,NA	NO	NO
Lithuania	0	314	NO,NA	314	NO,NA	NO	NO,NA	NO	NO,NA	NO	NO	NO
Luxembourg	0	58	0	58	-	-	-	-	-	-	-	-
Malta	0	214	NO,NE,IE	214	NO	NO	-	-	-	-	-	-
Netherlands	0	2 015	IE,NA,NO	2 015	NO	NO	IE	IE	NO	NO	NO	NO
Poland	0	9 621	NO	9 607	NO	15	-	-	-	-	-	-
Portugal	0	1 728	NE,NA	1 728	NE	0	NO	NO	-	-	-	-
Romania	0	1 299	0	1 299	NO	NO	NO	NO	NO	NO	NO	NO
Slovakia	0	535	NO	535	NO	NO	NO	NO	NO	NO	-	-
Slovenia	0	278	NO	278	NO	NO	NO	NO	NO	NO	NO	NO
Spain	42	8 477	42	8 474	NO	3	NO	NA,NO	NO	NA,NO	NO	NO
Sweden	5	854	5	852	NO	2	-	-	-	-	-	-
United Kingdom	161	16 087	161	16 087	NO	NO	NO	NO	NO	NO	NO	NO
EU-28	**208**	**102 917**	**208**	**102 778**	**0**	**139**	**0**	**0**	**0**	**0**	**0**	**0**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2.F Product uses as substitutes for ODS account for about 2% of total EU-28 GHG emissions (w/o LULUCF) in 2013. HFC emissions in 2013 were about 500 times higher than in 1990. The main reason for this is the phase-out of ODS such as chlorofluorocarbons (CFCs) under the Montreal Protocol and the replacement of these substances by HFCs (mainly in refrigeration, air conditioning, foam production, fire protection and as aerosol propellants).

Table 4.25 shows the sub-categories of HFC emissions from 2.F Product uses as substitutes for ODS by Member State. It shows that 2.F.1 Refrigeration and Air Conditioning is by far the largest sub-category accounting for 88% of HFC emissions in this source category; 2.F.4 Aerosols/Metered Dose Inhalers and 2.F.3 Fire Extinguishers account for 6% and 2% respectively.

Table 4.25 2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2013 (Gg CO_2 equivalents)

Member State	**Product uses as substitutes for ODS**	Refrigeration and air conditioning	Foam blowing agents	Fire protection	Aerosols	Solvents	Other applications
Austria	**1 672**	1 619	17	13	24	NO	-
Belgium	**2 527**	2 371	61	12	83	NO	NO
Bulgaria	**898**	863	20	5	11	-	-
Croatia	**578**	564	NO	4	9	-	-
Cyprus	**544**	537	4	4	-	-	-
Czech Republic	**2 667**	2 607	3	41	12	4	-
Denmark	**782**	704	61	-	18	-	-
Estonia	**204**	195	2	3	3	NO	NO
Finland	**1 555**	1 477	12	C,NA,NO	66	NO	NO
France	**19 569**	16 516	616	166	1 910	121	241
Germany	**10 514**	9 301	597	49	567	C	-
Greece	**5 645**	5 373	191	36	45	-	-
Hungary	**1 279**	1 072	146	7	55	NO	NO
Ireland	**1 273**	1 124	-	35	115	-	-
Italy	**11 503**	10 172	594	225	512	-	-
Latvia	**107**	103	0	0	4	NO	NO
Lithuania	**314**	292	13	2	7	NO	NO
Luxembourg	**58**	55	1	-	2	-	-
Malta	**214**	209	0	2	3	NO	NO
Netherlands	**2 015**	1 805	IE,NA,NO	IE,NO	IE,NO	IE,NO	211
Poland	**9 607**	9 279	141	61	125	0	-
Portugal	**1 728**	1 673	41	7	7	-	-
Romania	**1 299**	1 265	0	4	29	NO	NO
Slovakia	**535**	505	2	19	9	NO	-
Slovenia	**278**	269	2	1	5	-	-
Spain	**8 474**	7 081	112	1 248	33	NO	NO
Sweden	**852**	769	35	17	31	-	-
United Kingdom	**16 087**	13 048	493	268	2 146	22	110
EU-28	**102 778**	**90 847**	**3 164**	**2 230**	**5 828**	**147**	**562**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.26 to Table 4.29 show the contribution of each MS to EU-28 HFC emissions from the most important sub-sources 2F1, 2F2, 2F3 and 2F4 respectively.

Table 4.26 2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFCs emissions in kt CO2 equiv.				Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	1995	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	38	1 603	1 619	2%	16	1%	1 619	100%	NA	NA
Belgium	NO	99	2 349	2 371	3%	22	1%	2 371	100%	NA	NA
Bulgaria	NO	3	713	863	1%	150	21%	863	100%	NO	NO
Croatia	NO	57	557	564	1%	7	1%	564	100%	NA	NA
Cyprus	NO	NO	554	537	1%	-17	-3%	537	100%	NA	NA
Czech Republic	NO	0	2 369	2 607	3%	238	10%	2 607	100%	NA	NA
Denmark	NO	43	707	704	1%	-3	0%	704	100%	NA	NA
Estonia	NO	10	185	195	0%	11	6%	195	100%	NA	NA
Finland	0	24	1 401	1 477	2%	76	5%	1 477	10833183%	T2	D
France	NO	568	15 939	16 516	18%	577	4%	16 516	100%	NA	NA
Germany	NA	572	9 152	9 301	10%	149	2%	9 301	100%	NA	NA
Greece	NO	42	4 807	5 373	6%	566	12%	5 373	100%	IE	IE
Hungary	NO	26	987	1 072	1%	85	9%	1 072	100%	NA	NA
Ireland	NO	12	975	1 124	1%	149	15%	1 124	100%	NA	NA
Italy	NO	265	9 665	10 172	11%	508	5%	10 172	100%	NA	NA
Latvia	NO,NE	0	86	103	0%	17	20%	103	100%	NA	NA
Lithuania	NO	2	265	292	0%	27	10%	292	100%	NA	NA
Luxembourg	0	3	54	55	0%	1	2%	55	76967291%	T2	CS
Malta	NO,IE	0	192	209	0%	17	9%	209	100%	NA	NA
Netherlands	NA,NO	72	1 776	1 805	2%	29	2%	1 805	100%	NA	NA
Poland	NO	80	8 950	9 279	10%	329	4%	9 279	100%	NA	NA
Portugal	NE,NA	13	1 682	1 673	2%	-9	-1%	1 673	100%	NA	NA
Romania	NO	2	1 146	1 265	1%	120	10%	1 265	100%	NA	NA
Slovakia	NO	8	500	505	1%	6	1%	505	100%	NA	NA
Slovenia	NO	5	269	269	0%	0	0%	269	100%	NA	NA
Spain	42	269	7 081	7 081	8%	0	0%	7 039	16848%	NA	NA
Sweden	3	141	802	769	1%	-33	-4%	766	24151%	NA	NA
United Kingdom	NO	850	12 982	13 048	14%	67	1%	13 048	100%	NA	NA
EU-28	**45**	**3 205**	**87 745**	**90 847**	**100%**	**3 102**	**4%**	**90 802**	**201935%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2013, HFC emissions from 2F1 were about 28 times higher than in 1995 (Figure 4.14). France, Germany, Italy and the UK are responsible for 53% of total EU-28 emissions from this source. Between 2012 and 2013 EU-28 emissions increased by 3.5%. The largest increase of HFC emissions from 2F1 between these years was in Bulgaria (21%). Cyprus, Portugal and Sweden reported in 2013 decreasing emissions compared to the previous year.

Figure 4.14 2F1 Refrigeration and Air conditioning: EU-28 HFC emissions

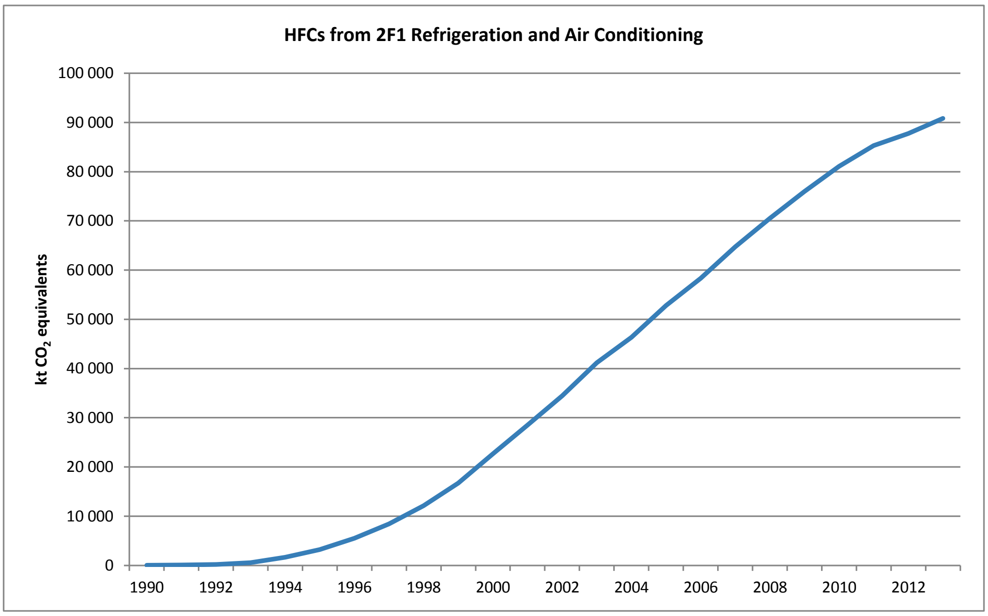


Table 4.27 2F2 Foam Blowing: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFCs emissions in kt CO2 equiv.				Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	1995	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	301	17	17	1%	0	-1%	17	100%	NA	NA
Belgium	NO	357	90	61	2%	-29	-32%	61	100%	NA	NA
Bulgaria	NO	NO	24	20	1%	-4	-18%	20	100%	NO	NO
Croatia	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO,NE	NO,NE	4	4	0%	0	-1%	4	100%	NA	NA
Czech Republic	NO	0	3	3	0%	0	-5%	3	100%	NA	NA
Denmark	NO	200	73	61	2%	-12	-16%	61	100%	NA	NA
Estonia	NO	18	2	2	0%	0	-10%	2	100%	NA	NA
Finland	NO	1	16	12	0%	-4	-25%	12	100%	NA	NA
France	NO	NO	611	616	19%	5	1%	616	100%	NA	NA
Germany	C,NA	1 666	721	597	19%	-124	-17%	597	100%	NA	NA
Greece	NO	NO	169	191	6%	23	14%	191	100%	NA	NA
Hungary	NO	NO	138	146	5%	8	5%	146	100%	NA	NA
Ireland	-	-	-	-	-	-	-	-	-	NA	NA
Italy	NO	NO	577	594	19%	17	3%	594	100%	NA	NA
Latvia	NO	NO,NE	0	0	0%	0	0%	0	100%	NA	NA
Lithuania	NO	NO	12	13	0%	1	10%	13	100%	NA	NA
Luxembourg	NO	13	1	1	0%	0	8%	1	100%	NA	NA
Malta	NO,NE	NO,NE	0	0	0%	0	7%	0	100%	NA	NA
Netherlands	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-	NA	NA
Poland	NO	NO	101	141	4%	40	39%	141	100%	NA	NA
Portugal	NE	1	42	41	1%	-1	-2%	41	100%	NA	NA
Romania	NO	NO	16	0	0%	-16	-99%	0	100%	NA	NA
Slovakia	NO	NO	3	2	0%	0	-15%	2	100%	NA	NA
Slovenia	NO	30	2	2	0%	0	-4%	2	100%	NA	NA
Spain	NO	NO	166	112	4%	-54	-32%	112	100%	NA	NA
Sweden	NO	NO	33	35	1%	2	6%	35	100%	NA	NA
United Kingdom	NO	184	489	493	16%	4	1%	493	100%	NA	NA
EU-28	**0**	**2 769**	**3 310**	**3 164**	**100%**	**-145**	**-4%**	**3 164**	**-**		

In 2013, HFC emissions from 2F2 (Table 4.27) decreased by 4% compared to 2012 – and slightly increased by 14% compared to 1995. The biggest contributors to this sector are Germany (19%), France (19%), Italy (19%) and UK (16%), those four countries account for 73% of the share in EU-28 emissions in this sector. France, Greece, Hungary, Italy, Lithuania, Luxembourg, Malta, Poland, Sweden and the UK reported an increase in emissions compared to 2012.

Table 4.28 2F3 Fire extinguishers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFCs emissions in kt CO2 equiv.				Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	1995	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	13	13	1%	0	0%	13	100%	NA	NA
Belgium	NO	1	12	12	1%	0	4%	12	100%	NA	NA
Bulgaria	NO	NO	5	5	0%	1	13%	5	100%	NA	NA
Croatia	NO	0	4	4	0%	1	17%	4	100%	NA	NA
Cyprus	NO,NE	NO,NE	4	4	0%	0	-1%	4	100%	NA	NA
Czech Republic	NO	NO	37	41	2%	4	10%	41	100%	NA	NA
Denmark	-	-	-	-	-	-	-	-	-	-	-
Estonia	NO	NO	3	3	0%	0	2%	3	100%	NA	NA
Finland	NO	NO	C,NA,NO	C,NA,NO	-	-	-	-	-	NA	NA
France	NO	5	162	166	7%	4	2%	166	100%	NA	NA
Germany	NO	NO	44	49	2%	5	12%	49	100%	NA	NA
Greece	NO	NO	34	36	2%	2	6%	36	100%	NA	NA
Hungary	NO	NO	8	7	0%	-1	-7%	7	100%	NA	NA
Ireland	NO	NO	35	35	2%	0	0%	35	100%	NA	NA
Italy	NO	NO	212	225	10%	14	6%	225	100%	NA	NA
Latvia	NO,NE	NO,NE	0	0	0%	0	15%	0	100%	NA	NA
Lithuania	NO	NO	2	2	0%	0	5%	2	100%	NA	NA
Luxembourg	-	-	-	-	-	-	-	-	-	-	-
Malta	NE	NE	3	2	0%	-1	-21%	2	100%	NA	NA
Netherlands	IE,NO	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Poland	NO	NO	55	61	3%	7	13%	61	100%	NA	NA
Portugal	NE	NO	7	7	0%	0	-2%	7	100%	NA	NA
Romania	NO	NO	4	4	0%	0	5%	4	100%	NA	NA
Slovakia	NO	2	19	19	1%	0	-2%	19	100%	NA	NA
Slovenia	NO	NO	1	1	0%	0	1%	1	100%	NA	NA
Spain	NO	3	1 265	1 248	56%	-17	-1%	1 248	100%	NA	NA
Sweden	NO	NO	16	17	1%	1	4%	17	100%	NA	NA
United Kingdom	NO	1	264	268	12%	3	1%	268	100%	NA	NA
EU-28	**0**	**12**	**2 207**	**2 230**	**100%**	**23**	**1%**	**2 230**	**-**		

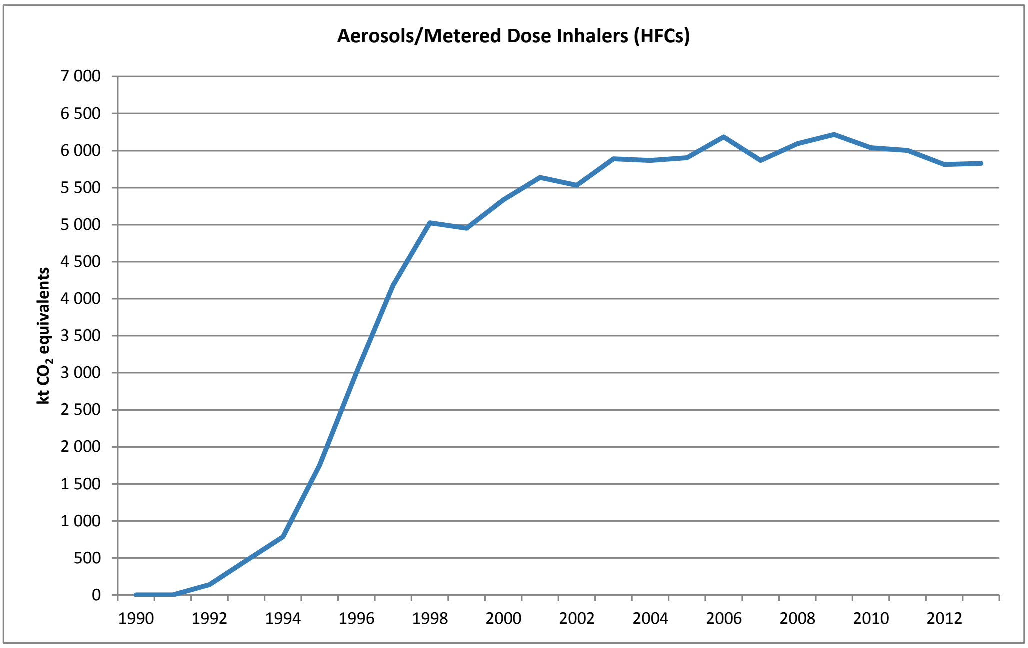
In 2013, HFC emissions from 2F3 (Table 4.28) increased by 1% compared to 2012 – and by 18583% compared to 1995. The biggest contributors to this sector are Spain (56%), UK (12%), and Italy (10%), those three countries account for 78% of the share in EU-28 emissions in this sector. Cyprus, Hungary, Malta, Portugal, Slovakia and Spain reported a decrease in emissions compared to 2012.

Table 4.29 2F4 Aerosols/ Metered Dose Inhalers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFCs emissions in kt CO2 equiv.				Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	1995	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	9	20	24	0%	3	16%	24	100%	NA	NA
Belgium	NO	41	87	83	1%	-4	-5%	83	100%	NA	NA
Bulgaria	NO	NO	10	11	0%	0	5%	11	100%	NO	NO
Croatia	NO	NO	4	9	0%	5	104%	9	100%	NA	NA
Cyprus	-	-	-	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	17	12	0%	-5	-28%	12	100%	NA	NA
Denmark	NO	NO	17	18	0%	0	1%	18	100%	NA	NA
Estonia	NO	0	3	3	0%	0	5%	3	100%	NA	NA
Finland	NO	2	53	66	1%	13	24%	66	100%	NA	NA
France	NO	610	2 027	1 910	33%	-116	-6%	1 910	100%	NA	NA
Germany	C,NA,NO	342	552	567	10%	14	3%	567	100%	NA	NA
Greece	NO	0	48	45	1%	-4	-8%	45	100%	NA	NA
Hungary	NO	15	51	55	1%	4	7%	55	100%	NA	NA
Ireland	NO	27	123	115	2%	-8	-7%	115	100%	NA	NA
Italy	NO	NO	390	512	9%	122	31%	512	100%	NA	NA
Latvia	NO,NE	NO,NE	3	4	0%	1	38%	4	100%	NO	NO
Lithuania	NO	1	6	7	0%	1	14%	7	100%	NA	NA
Luxembourg	NO	2	2	2	0%	0	-2%	2	100%	NA	NA
Malta	NE,NO	NE,NO	4	3	0%	-1	-26%	3	100%	NA	NA
Netherlands	IE,NO	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Poland	NO	18	126	125	2%	-1	-1%	125	100%	NA	NA
Portugal	NE	17	7	7	0%	0	-2%	7	100%	NA	NA
Romania	0	1	31	29	0%	-2	-7%	29	15959%	NA,T2	D,NA
Slovakia	NO	NO	8	9	0%	0	5%	9	100%	NA	NA
Slovenia	NO	NO	5	5	0%	0	6%	5	100%	NA	NA
Spain	NO	2	33	33	1%	0	-1%	33	100%	NA	NA
Sweden	1	7	30	31	1%	0	1%	29	2050%	NA	NA
United Kingdom	IE,NO	660	2 155	2 146	37%	-9	0%	2 146	100%	NA	NA
EU-28	**2**	**1 754**	**5 814**	**5 828**	**100%**	**14**	**0%**	**5 826**	**361620%**		

In 2013, HFC emissions from 2F4 were 3.3 times higher than in 1995 (Figure 4.15). France and UK are responsible for 68% of total EU-28 emissions from this source. Between 2012 and 2013 EU-28 emissions increased by 2.4%. The relative decrease between these years was largest in Czech Republic; the biggest increase was reported in Croatia (Table 4.29).

Figure 4.15 2F4 Aerosols/Metered Dose Inhalers: EU-28 HFC emissions



4.3 Other product manufacture and use (CRF Source Category 2G) (EU-28)

The former subcategories 2.F.8 Electrical Equipment and 2.F.9 Other sources of SF_6 are now reported under 2.G.Other product manufacture and use.

Table 4.32 shows that all Member States report GHG emissions in 2G Other product manufacture and use for the year 2013. SF_6 emissions from electrical equipment (2.G.1) are reported by Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Portugal, Spain, Sweden, Great Britain, Bulgaria, Cyprus, Czech Republic, Estonia, Croatia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia. Other subcategories included in 2.G. comprise soundproof windows (SF_6), Accelerators (SF_6), adiabatic properties: Shoes and tyres (SF_6, PFCs), military applications (SF_6), Unspecified mix of PFCs, Other (SF_6; HFCs).

Table 4.30 2G Other: Overview of sources reported under this source category for 2013

Member State	2.G Other product manufacture and use	HFC emissions [kt CO_2 equivalents]	PFC emissions [kt CO_2 equivalents]	SF_6 emissions [kt CO2 equivalents]	NF_3 emissions [kt CO2 equivalents]	Unspecified mix of HFCs and PFCs [kt CO2 equivalents]	Total emissions [kt CO_2 equivalents]	Share in EU-28 Total
AUT	Electrical equipment (SF6); Soundproof windows (SF6); Other (SF6)		NO	266.11			266.11	4.19%
BEL	Electrical equipment (SF6); Soundproof windows (SF6); Other (C6F14)	NO	0.22	113.44	NO	NO	113.66	1.79%
DNM	Electrical equipment (SF6); Soundproof windows (SF6); Other (SF6)			130.58			130.58	2.06%
FIN	Electrical equipment (SF6)	NO	NO	10.02	NO	NO	10.02	0.16%
FRK	Electrical equipment (SF6); Accelerators (SF6); Other (SF6, Unspecified mix of PFCs)	0.11	478.03	483.01	NA	NO	961.15	15.14%
DEU	Electrical equipment (SF6); Military applications (SF6 => Notation Key C); Accelerators (SF6); Soundproof windows (SF6); Adiabatic properties: shoes and tyres (SF6; C3F8 => Notation Key C); Other (SF6, C10F18)	7.12	C,NA	3107.63			3114.75	49.07%
GRC	Electrical equipment (SF6)		NO	5.15			5.15	0.08%
IRL	Electrical equipment (SF6); Soundproof windows (SF6); Adiabatic properties: shoes and tyres (SF6); Other (SF6)	NO	NO	21.52	NO	NO	21.52	0.34%
ITA	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	372.85	NO	NA	372.85	5.87%
LUX	Electrical equipment (SF6); Soundproof windows (SF6), Other (HFC-43-10mee)	2.56		8.05			10.61	0.17%
NLD	Other (SF6)	NO	NA,NO	132.26	IE	NO	132.26	2.08%
PRT	Electrical equipment (SF6)		NO	55.25	NO		55.25	0.87%
ESP	Electrical equipment (SF6)	NA,NO	NA,NO	212.62	NA,NO	NO	212.62	3.35%
SWE	Electrical equipment (SF6); Soundproof windows (SF6); Adiabatic properties: shoes and tyres (C3F8; SF6)		2.43	40.12			42.55	0.67%
GBE	Electrical equipment (SF6); Military applications (SF6); Accelerators (SF6); Other (CF4, C2F6, C3F8, c-C4F8, SF6)	NO	134.27	455.37	NO	NO	589.64	9.29%
BGR	Electrical equipment (SF6)		NO	19.72			19.72	0.31%
CYP	Electrical equipment (SF6)			0.03			0.03	0.00%
CZE	Electrical equipment (SF6); Soundproof windows (SF6)			16.42			16.42	0.26%
EST	Electrical equipment (SF6); Soundproof windows (SF6)	NO	NO	2.00	NO	NO	2.00	0.03%
HRV	Electrical equipment (SF6)	NO	NO	6.58	NO	NO	6.58	0.10%
HUN	Electrical equipment (SF6)	NO	NO	122.92	NO	NO	122.92	1.94%
LVA	Electrical equipment (SF6), Other (HFC-134a)	1.84	NO,NA	8.50	NO,NA	NO	10.34	0.16%
LTU	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	0.39	NO	NO	0.39	0.01%
MLT	Electrical equipment (SF6), Other (SF6, C3F8)		0.00	2.68			2.68	0.04%
POL	Electrical equipment (SF6)			35.01			35.01	0.55%
ROU	Electrical equipment (SF6)	NO	NO	57.08	NO	NO	57.08	0.90%
SVK	Electrical equipment (SF6)	NO	NO	22.30	NO		22.30	0.35%
SVN	Electrical equipment (SF6)	NO	NO	13.28	NO	NO	13.28	0.21%
EU-28	**TOTAL**	**11.63**	**614.95**	**5 720.91**	**0.00**	**0.00**	**6347.49**	**100.00%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.31 summarizes information by Member State on emissions for the key source SF_6 from 2G Other sources of SF_6. The emission trend is mainly driven by the emission trend in Germany.

Figure 4.16 2G Other: EU-28 SF_6 emissions

Table 4.31 2G Other: Member States' contributions to SF_6 emissions

Member State	SF6 emissions in kt CO2 equiv.				Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	1995	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	132	268	268	266	5%	-1	-1%	135	102%
Belgium	88	134	109	113	2%	5	5%	26	30%
Bulgaria	4	5	19	20	0%	0	2%	16	434%
Croatia	10	11	9	7	0%	-3	-29%	-4	-37%
Cyprus	NO,NE	NO,NE	0	0	0%	0	-1%	0	100%
Czech Republic	16	16	25	16	0%	-9	-35%	1	5%
Denmark	14	68	112	131	2%	19	17%	117	847%
Estonia	NO	3	2	2	0%	0	7%	2	100%
Finland	45	27	10	10	0%	0	3%	-35	-78%
France	1 252	1 482	541	483	8%	-58	-11%	-769	-61%
Germany	4 050	6 072	2 987	3 108	54%	121	4%	-942	-23%
Greece	3	3	5	5	0%	0	2%	2	76%
Hungary	11	52	120	123	2%	3	2%	112	1029%
Ireland	33	38	19	22	0%	3	13%	-12	-36%
Italy	294	550	396	373	7%	-23	-6%	79	27%
Latvia	NO,NA,NE	0	8	9	0%	1	9%	9	100%
Lithuania	NO	0	0	0	0%	0	-9%	0	100%
Luxembourg	1	1	8	8	0%	0	5%	7	819%
Malta	0	1	0	3	0%	2	493%	3	25094%
Netherlands	208	274	187	132	2%	-55	-29%	-76	-36%
Poland	NO	13	36	35	1%	-1	-3%	35	100%
Portugal	NE,NO	15	53	55	1%	3	5%	55	100%
Romania	0	1	51	57	1%	6	12%	57	11917%
Slovakia	0	10	21	22	0%	1	5%	22	38112%
Slovenia	10	12	14	13	0%	-1	-7%	3	35%
Spain	64	101	218	213	4%	-6	-3%	149	235%
Sweden	80	93	36	40	1%	5	13%	-40	-50%
United Kingdom	892	877	479	455	8%	-23	-5%	-437	-49%
EU-28	**7 204**	**10 128**	**5 733**	**5 721**	**100%**	**-12**	**0%**	**-1 483**	**-21%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.3.1 Other (CRF Source Category 2H)

Table 4.32 shows that eight Member States report GHG emissions under 2H Other for the year 2013. Under this category, Belgium reports CO_2 emissions from the Flemish region, which were included in the inventory to reflect the extended scope of the EU ETS. Bulgaria includes emissions from the domestic use of pharmaceutical products and the production of vegetable oil. Finland reports emissions of fluorinated gases, which were grouped in this category for reasons of confidentiality. Lithuania includes CO_2 emission from carbonates use in flue gas desulphurisation and CO_2 from the pulp and paper as well as food and beverage industry.

The Netherlands report CO_2 emissions from the food and beverage industry. Portugal includes CO_2 from the food and beverage industry and from wood chipboard production. Sweden reports CO_2 emissions from the use of limestone and dolomite in mineral wool production. In addition, CH_4 and N_2O emissions from the combustion of spent cooking liquor from the pulp and paper industry are reported under category 2.H. The UK reports CH_4 emissions from the manufacture of fletton bricks (a type of brick using Lower Oxford Clay).

Table 4.32 2H Other: Overview of sources reported under this source category for 2013

Member State	Type of source	CO2 emissions in 2013 (kt)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)	HFC emissions in 2013 (kt CO2 equivalents)	PFC emissions in 2013 (kt CO2 equivalents)	SF6 emissions in 2013 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	Share in EU28 emissions in 2013
Austria	NA	NA	NA	NA	-	-	-	-	-
Belgium	2.H.3 Other	172	NO,NA	NO,NA	NO	NO	NO	172	46%
Bulgaria	Domestic Use of Pharmaceutical Products, Vegetable Oil	5	NO,NA,IE	NO,NA,IE	-	-	-	5	1%
Croatia	NA	NA	NA	NA	-	-	-	-	-
Cyprus		-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	NO	NO	NO	NO	-	-
Denmark	NA	NA	NA	NA	-	-	-	-	-
Estonia	NO	NO	NO	NO	NO	NO	NO	-	-
Finland	2.H.3 Other	NO	NO	NO	2	3	21	25	7%
France	NA	NA	NA	NA	-	-	-	-	-
Germany	NA	NA	NA	NA	-	-	-	-	-
Greece	NA	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	NO	NO	NO	NO	-	-
Ireland	NO	NO	NO	NO	NO	NO	NO	-	-
Italy	NO	NO	NO	NO	-	-	-	-	-
Latvia	NO,NA	NO,NA	NO,NA	NO,NA	NA	NA	NA	-	-
Lithuania	2.H.2 Food and beverages industry, Consumption of carbonates in flue gas desulphurisation	12	NO	NO	NO	NO	NO	12	3%
Luxembourg	NO	NO	NO	NO	NO	NO	NO	-	-
Malta		-	-	-	-	-	-	-	-
Netherlands	2.H.2 Food and beverages	27	NO	NO	NO	NO	NO	27	7%
Poland	NO	NO	NO	NO	NO	NO	NO	-	-
Portugal	2.H.2 Food and beverages industry, 2.H.3.a Chipboard	31	NO	NO	-	-	-	31	8%
Romania	NO,NE	NO,NE	NO,NE	NO,NE	NO	NO	NO	-	-
Slovakia	NO,NA	NO	NO,NA	NO,NA	NO	NO	NO	-	-
Slovenia	NA	NA	NA	NA	-	-	-	-	-
Spain	NA	NA	NA	NA	NA	NA	NA	-	-
Sweden	Mineral wool production	11	81	8	-	-	-	99	26%
United Kingdom	Mineral Industry CH4 emissions (fletton bricks)	IE,NE,NO	NO	5	-	-	-	5	1%
EU-28		**257**	**81**	**12**	**2**	**3**	**21**	**376**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.4 Uncertainties

For information on uncertainties please refer to chapter 1.6.

4.5 Sector-specific quality assurance and quality control

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 were 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 were 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 plant-specific data was available from the EU Emission Trading Scheme (EU ETS) for the first time. This information was used by EU Member States for quality checks and as an input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in the 2005 report (see Section 1.4.2). During the ESD review 2012 consistency checks were carried out between EU ETS data and the inventory estimates.

In 2013 two workshops were organized in the context of the MS assistance project with the aim of supporting Member States in improving their inventories related to the use of EU ETS data and related to F-gases. Both workshops were very well attended.

In 2014, the initial checks for F-gases were extended: (1) the time series of HFC emissions of the EU Member States was checked at 3-digit level (2.F.1, 2.F.2,…) and at 4-digit level for 2.F.1 (i.e. 2.F.1.1, 2.F.1.2,…); (2) time series and comparability across EU Member States was checked for per capita HFC emissions of category 2-F.1 and its subcategories (2.F.1.1, 2.F.1.2, …). As a result of the checks, 74 issues were clarified with EU Member States. Furthermore, in 2014 additional quality checks of the EU NIR chapter waste were carried out in order to improve the consistency between the CRF tables and the EU NIR and consistency of tables and figures with text in the EU NIR.

4.6 Sector-specific recalculations

For information on recalculations please refer to chapter 10.

5 AGRICULTURE (CRF SECTOR 3)

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[19].

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 Agricultural 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

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[19] http://ec.europa.eu/agriculture/envir/index_en.htm

- "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.

In 2013, the Council of the EU Agriculture Ministers adopted four Basic Regulations for a reformed CAP following a CAP Health Check[20] in 2008 and a Commission Communication on the CAP towards 2020[21] in 2011. The four legislative texts that regulate the post-2013 CAP are:

- Rural Development: Regulation 1305/2013[22]
- "Horizontal" issues such as funding and controls: Regulation 1306/2013[23]
- Direct payments for farmers: Regulation 1307/2013[24]
- Market measures: Regulation 1308/2013[25]

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 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 fertilizers is prohibited; (ii) capacity of and facilities for storage of animal manure; and (iii) limits to the amounts of animal manure and fertilizers 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 soils 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 at farm and field level with the N-excretion data from FAS (Faculty of Agricultural Sciences). The N figures also include the quantities of mineral fertilizers bought and sold. Suppliers of

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20 http://ec.europa.eu/agriculture/healthcheck/index_en.htm

21 http://ec.europa.eu/agriculture/cap-post-2013/communication/index_en.htm

22 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:en:PDF

23 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0549:0607:en:PDF

24 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0608:0670:en:PDF

25 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0671:0854:en:PDF

mineral fertilizers 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 fertilizer has more than halved since 1990.

In the Netherlands, manure and fertilizer 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 poultry production rights (ceilings for total animal numbers) by the government and lowering the maximum nutrient application standards for manure and fertilizer. 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[26]) 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[27]), 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 (Directive 2008/1/EC[28]), which was established in 1996, and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2 000 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 rationalizations 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

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26 http://www.unece.org/env/lrtap/multi_h1.html

27 http://ec.europa.eu/environment/air/pollutants/ceilings.htm

28 http://ec.europa.eu/environment/air/pollutants/stationary/ippc/summary.htm

Union in 1995 and the acreages of land for hay and silage has increased. Organic farming increased from 3% of the arable land area in 1995 to 17% in 2007.

5.1 Overview of sector

In the year 2013, CH_4, N_2O and CO_2 emissions from source category 3 Agriculture were 50.8%, 78.5%, and 0.24% of total EU28 CH_4, N_2O, and CO_2 emissions, respectively. Total emissions from agriculture were 441 Mt CO_2-eq with contributions from CH_4, N_2O, and CO_2 of 235 Mt CO_2-eq, 197 Mt CO_2-eq and 8.9 Mt CO_2-eq, respectively.

Thus, CH_4, N_2O, and CO_2 contributed with 0.2 %, 5.3 % and 4.4 % on total EU28 GHG emissions. They make 53.3%, 44.7% and 2% of total agricultural emissions.

Figure 5.1 shows the development of total GHG emissions from agriculture from 1990 to 2013 and the considerably decrease in EU28. The decrease was most pronounced for CO_2 with a decrease of 34.8%, followed by CH_4 with a decrease of 24% and CO_2 with a decrease of 20.2%

Figure 5.2 shows that largest reductions occurred in the largest key sources CH_4 from 3.A.1: Cattle and N_2O from 3.D.1: Direct emissions from managed soils. The main reasons for this are decreasing use of fertiliser and manure and declining cattle numbers in most Member States.

Figure 5.1: EU-28 GHG emissions for 1990-2013 from CRF Sector 3: 'Agriculture' in CO_2 equivalents (Mt)

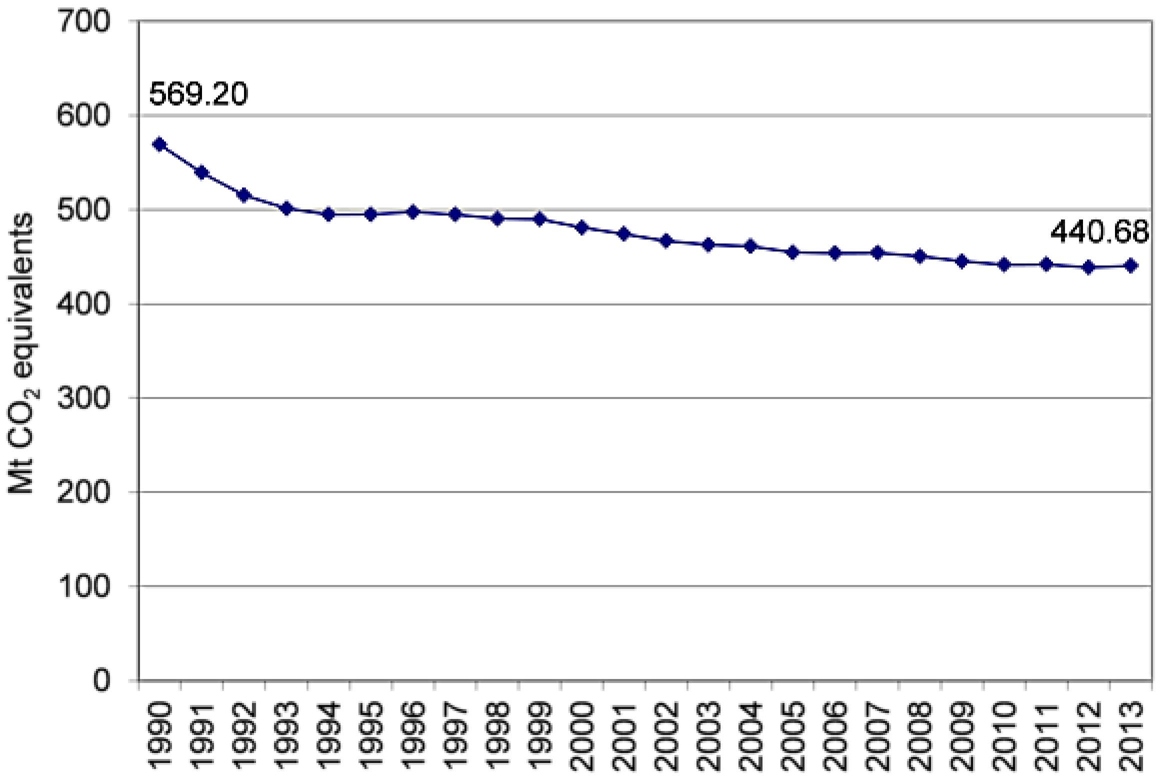
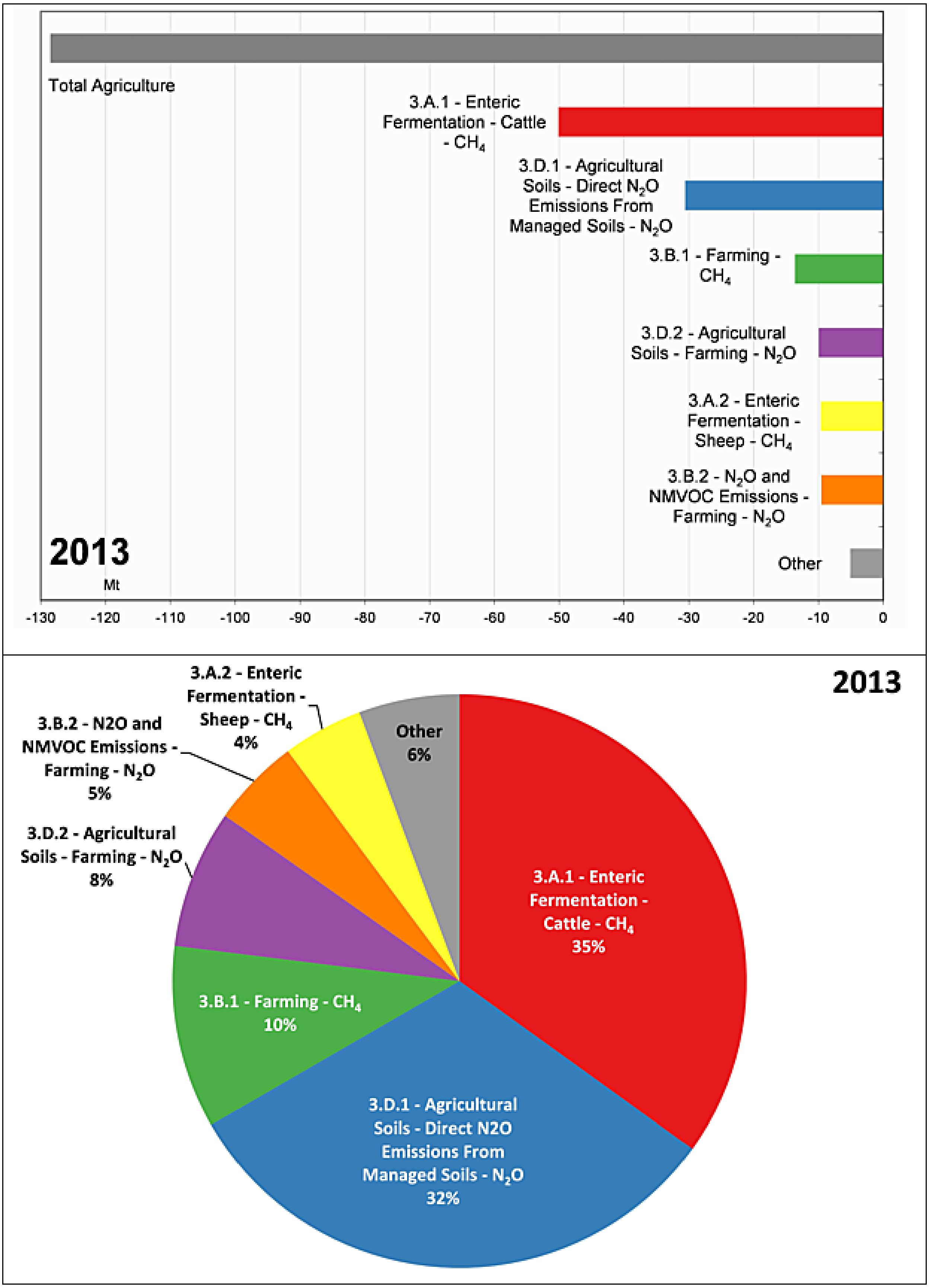


Figure 5.2: Absolute change of GHG emissions by large key source categories 1990-2013 in CO_2 equivalents (Mt) in CRF Sector 3: 'Agriculture' and share of largest key source categories in 2013



5.2 Source categories and methodological issues

In this section we present the information relevant for EU28 key source categories in the sector 3 Agriculture.

Sources categories considered are:

- CH_4 emissions from source category 3A1 - Cattle
- CH_4 emissions from source category 3A2 - Sheep
- CH_4 emissions from source category 3B11 - Cattle
- CH_4 emissions from source category 3B13 - Swine
- N_2O emissions from source category 3B11 - Cattle
- N_2O emissions from source category 3B15 - Indirect emissions
- N_2O emissions from source category 3B14 - Other Livestock (mainly Poultry)
- N_2O emissions from source category 3D11 - Direct N_2O emissions from managed soils from inorganic N fertilizers
- N_2O emissions from source category 3D12 - Direct N_2O emissions from managed soils from organic N fertilizers
- N_2O emissions from source category 3D21 - Indirect Emissions from Managed Soils, Atmospheric Deposition
- N_2O emissions from source category 3D22 - Indirect Emissions from Managed Soils, Nitrogen leaching and run-off

Other source categories are not contributing to a key source analysis at EU28 level and are therefore not further discussed here.

For each of the above-mentioned source categories, data on the countries contributing most to EU28 emissions and to EU28 emissions trend are provided, as well as information on relevant activity data and IEFs and other parameters, if relevant.

Many countries recognize 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.
- 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 3.A and which determines N and C excretion rates relevant for category 3.B and also 3.D. Data are available at district (Landkreis, livestock characterisation, housing systems, manure management systems) and regional (Bundesland) level. N-emissions are considered within an N-flow concept (Daemmgen and Hutchings, 2005). In the N-flow concept, only remaining 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 Agricultural 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 another 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.

5.2.1 Enteric fermentation (CRF Source Category 3A)

CH_4 emissions from source category 3.A Enteric Fermentation are 4.1% of total EU28 GHG emissions and 40% of total EU28 CH_4 emissions. They make 41.9% of total agricultural emissions. It is thus the largest GHG source in agriculture and the largest source of CH_4 emissions. The main sub-categories are 3.A.1 (Cattle) and 3.A.2 (Sheep) as shown in Figure 5.4. Total GHG and CH_4 emissions by Member States from 3.A Enteric Fermentation are shown in Table 5.2. Between 1990 and 2013, CH_4 emission from Enteric Fermentation decreased by 25% or 61.1 Mt CO_2-eq. The decrease was largest in Croatia in relative terms (66%) and in Germany in absolute terms (29% or 9.9 Mt CO_2-eq). From 2012 to 2013 emissions increased by 0.3%.

Figure 5.4: Share of source category 3.A on total EU28 agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emission in the year 2013.

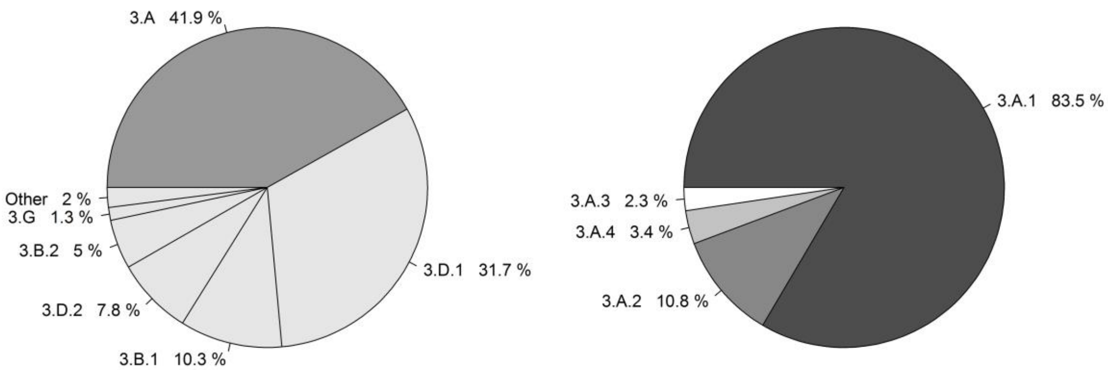


Table 5.2 3.A - Enteric Fermentation: Member States' contributions to total GHG and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	4 821	4 103	4 821	4 103
Belgium	5 535	4 589	5 535	4 589
Bulgaria	5 475	1 865	5 475	1 865
Croatia	2 501	840	2 501	840
Cyprus	242	264	242	264
Czech Republic	5 023	2 412	5 023	2 412
Denmark	3 799	3 467	3 799	3 467
Estonia	1 250	555	1 250	555
Finland	2 425	2 063	2 425	2 063
France	36 561	33 189	36 561	33 189
Germany	34 652	24 713	34 652	24 713
Greece	4 017	4 067	4 017	4 067
Hungary	3 579	1 848	3 579	1 848
Ireland	11 357	10 554	11 357	10 554
Italy	15 743	13 849	15 743	13 849
Latvia	2 282	804	2 282	804
Lithuania	4 236	1 544	4 236	1 544
Luxembourg	433	406	433	406
Malta	22	33	22	33
Netherlands	9 227	8 139	9 227	8 139
Poland	21 554	11 712	21 554	11 712
Portugal	3 343	3 338	3 343	3 338
Romania	19 299	9 679	19 299	9 679
Slovakia	2 398	1 047	2 398	1 047
Slovenia	936	889	936	889
Spain	13 238	11 921	13 238	11 921
Sweden	3 629	3 122	3 629	3 122
United Kingdom	27 932	23 416	27 932	23 416
EU-28	**245 509**	**184 426**	**245 509**	**184 426**

Total GHG and CH_4 emissions by Member States from 3.A.1 - Cattle Enteric Fermentation are shown in Table 5.3. Between 1990 and 2013, CH_4 emission from Cattle decreased by 25% or 50.1 Mt CO_2-eq. The decrease was largest in Croatia in relative terms (71%) and in Germany in absolute terms (29% or 9.7 Mt CO_2-eq). From 2012 to 2013 emissions increased by 0.3%.

Table 5.3 3.A.1 - Cattle: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	4 579	3 850	3 861	3%	11	0%	-719	-16%	-	-
Belgium	5 234	4 333	4 288	3%	-45	-1%	-946	-18%	T2	CS
Bulgaria	3 519	1 458	1 489	1%	31	2%	-2 030	-58%	T2	CS
Croatia	2 344	739	686	0%	-52	-7%	-1 658	-71%	T2	CS
Cyprus	144	156	153	0%	-2	-2%	9	7%	T1,T2	CS,D
Czech Republic	4 740	2 292	2 290	1%	-1	0%	-2 450	-52%	T2	CS
Denmark	3 422	2 973	3 001	2%	28	1%	-421	-12%	T2	CS,D
Estonia	1 193	496	526	0%	30	6%	-667	-56%	T2	CS,D
Finland	2 226	1 862	1 864	1%	2	0%	-362	-16%	T2	CS
France	33 079	30 364	30 502	20%	138	0%	-2 577	-8%	-	-
Germany	33 252	23 162	23 557	15%	395	2%	-9 696	-29%	T2,T3	CS,D
Greece	1 178	1 239	1 273	1%	35	3%	96	8%	T2	CS,D
Hungary	2 788	1 385	1 430	1%	46	3%	-1 357	-49%	T2	CS
Ireland	10 101	9 589	9 758	6%	169	2%	-343	-3%	CS,T2	CS
Italy	13 167	10 925	10 982	7%	57	1%	-2 185	-17%	T2	CS
Latvia	2 178	738	765	0%	27	4%	-1 413	-65%	T2	CS
Lithuania	4 118	1 506	1 481	1%	-26	-2%	-2 637	-64%	T2	CS
Luxembourg	428	389	398	0%	10	3%	-30	-7%	T2	CS
Malta	14	26	26	0%	-1	-2%	11	77%	T2	D
Netherlands	8 191	6 959	7 229	5%	269	4%	-962	-12%	T2	CS
Poland	19 547	11 474	11 152	7%	-322	-3%	-8 394	-43%	T2	CS
Portugal	2 335	2 745	2 730	2%	-15	-1%	395	17%	T2	CS
Romania	11 019	4 119	4 134	3%	14	0%	-6 886	-62%	T2	CS
Slovakia	2 145	919	919	1%	0	0%	-1 226	-57%	T2	CS
Slovenia	904	857	850	1%	-7	-1%	-54	-6%	T2	CS
Spain	7 173	7 448	7 296	5%	-152	-2%	122	2%	CS,T2	CS,D
Sweden	3 236	2 706	2 713	2%	7	0%	-523	-16%	T2	CS
United Kingdom	21 806	18 853	18 610	12%	-243	-1%	-3 196	-15%	T2	D
EU-28	**204 063**	**153 562**	**153 965**	**100%**	**403**	**0%**	**-50 098**	**-25%**		

Total GHG and CH_4 emissions by Member States from 3.A.2 - Sheep Enteric Fermentation are shown in Table 5.4. Between 1990 and 2013, CH_4 emission from Sheep decreased by 33% or 9.9 Mt CO_2-eq. The decrease was largest in Poland in relative terms (95%) and in Romania in absolute terms (36% or 2.4 Mt CO_2-eq). From 2012 to 2013 emissions increased by 0.4%.

Table 5.4 3.A.2 - Sheep: Member States' contributions to total GHG and CH_4 emissions

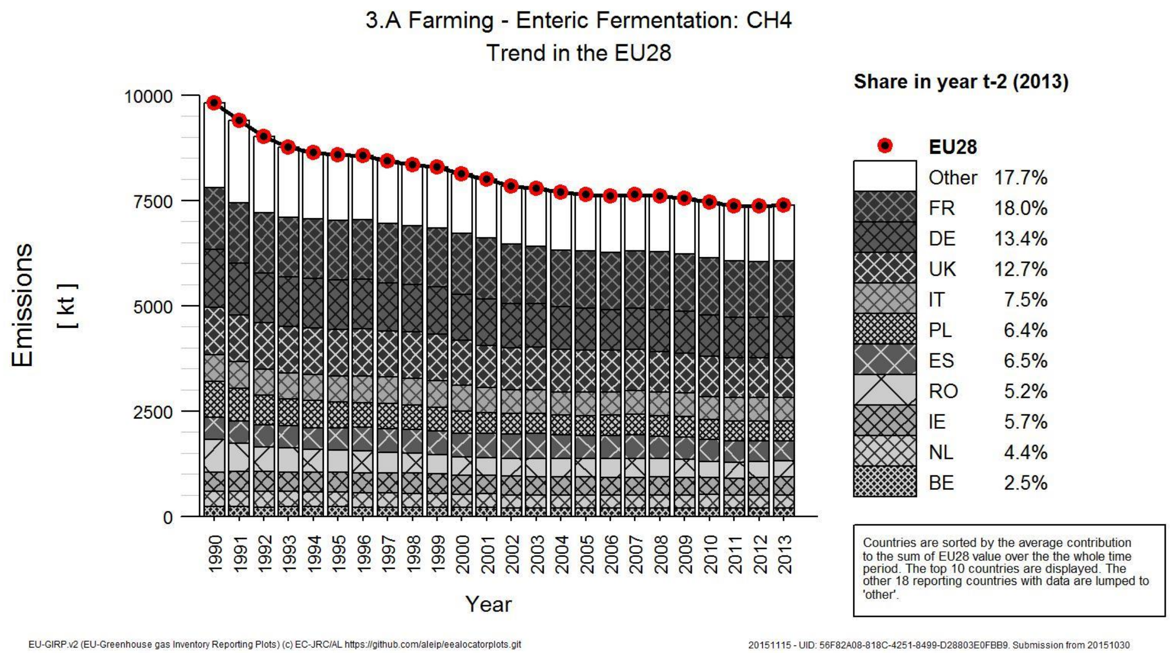
Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	62	73	71	0%	-1	-2%	10	15%	-	-
Belgium	38	21	21	0%	0	0%	-17	-45%	T1	D
Bulgaria	1 569	261	258	1%	-3	-1%	-1 311	-84%	T2	CS
Croatia	94	130	120	1%	-9	-7%	26	28%	T2	CS
Cyprus	58	69	63	0%	-7	-10%	5	8%	T1	D
Czech Republic	86	44	44	0%	0	0%	-42	-49%	T1	D
Denmark	39	38	37	0%	-1	-2%	-1	-4%	T2	D
Estonia	32	18	17	0%	-2	-9%	-15	-48%	D,T1	D
Finland	18	27	28	0%	1	4%	11	62%	CS	CS
France	2 580	1 772	1 717	9%	-55	-3%	-863	-33%	-	-
Germany	506	305	292	1%	-14	-5%	-214	-42%	T1	CS,D
Greece	2 054	2 087	2 086	10%	-1	0%	32	2%	T2	CS,D
Hungary	392	228	242	1%	14	6%	-150	-38%	T1	D
Ireland	1 176	695	696	3%	1	0%	-480	-41%	T1	D
Italy	1 748	1 403	1 436	7%	33	2%	-311	-18%	T1	D
Latvia	33	17	17	0%	0	1%	-16	-48%	T1	D
Lithuania	17	24	29	0%	5	20%	13	76%	T2	CS
Luxembourg	1	1	1	0%	0	5%	0	18%	T2	CS
Malta	0	2	2	0%	0	-7%	2	424%	T1	D
Netherlands	340	209	207	1%	-2	-1%	-134	-39%	T1	D
Poland	832	53	45	0%	-9	-16%	-787	-95%	T1	D
Portugal	737	491	456	2%	-36	-7%	-282	-38%	T2	CS
Romania	6 587	4 071	4 212	21%	141	3%	-2 375	-36%	T2	CS
Slovakia	148	100	96	0%	-4	-4%	-52	-35%	T2	CS
Slovenia	4	17	16	0%	-1	-5%	12	290%	T1	D
Spain	5 082	3 529	3 468	17%	-61	-2%	-1 614	-32%	CS,T2	CS,D
Sweden	81	122	115	1%	-7	-6%	34	42%	-	-
United Kingdom	5 550	4 040	4 134	21%	94	2%	-1 416	-26%	T1	CS,D
EU-28	**29 864**	**19 850**	**19 927**	**100%**	**77**	**0%**	**-9 937**	**-33%**		

Trends in Emissions and Activity Data

3.A - Enteric Fermentation - Emissions

Emissions in source category 3.A - Enteric Fermentation decreased considerably in EU28 by 25% or 61.1 Mt CO_2-eq. Figure 5.5 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 82.3% of enteric Fermentation CH_4 emissions. Emissions decreased in 25 countries and increased in three countries. The three countries with the largest decreases were Germany, Poland and Romania with a total absolute decrease of 29.4 Mt CO_2-eq. Emissions increased in Malta, Cyprus and Greece with a total absolute increase of 82 kt CO_2-eq.

Figure 5.5: 3.A: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.A.1 - Cattle - Emissions

Emissions in source category 3.A.1 - Cattle decreased considerably in EU28 by 25% or 50.1 Mt CO_2-eq. Figure 5.6 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 82.8% of cattle CH_4 emissions. Emissions decreased in 23 countries and increased in five countries. The three countries with the largest decreases were Germany, Poland and Romania with a total absolute decrease of 25 Mt CO_2-eq. The three countries with the largest increases were Greece, Spain and Portugal with a total absolute increase of 613 kt CO_2-eq.

3.A.1 - Cattle - Population

The main driver for the decrease was the decrease in animal numbers shown in Figure 5.7[29].

Cattle population decreased strongly in EU28 by 28% or 30.5 mio heads. Figure 5.7 shows the trend of cattle population indicating the countries contributing most to EU28 total. The ten countries with highest population together accounted for 84.7% of Cattle population. Population decreased in 21 countries and increased in six countries. The three countries with the largest decreases were Germany, Poland and Romania with a total absolute decrease of 14.6 mio heads. Largest increases occurred in Portugal and Spain with a total absolute increase of 801 thousand heads.

[29] No population data were reported from the UK

Figure 5.6: 3.A.1: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

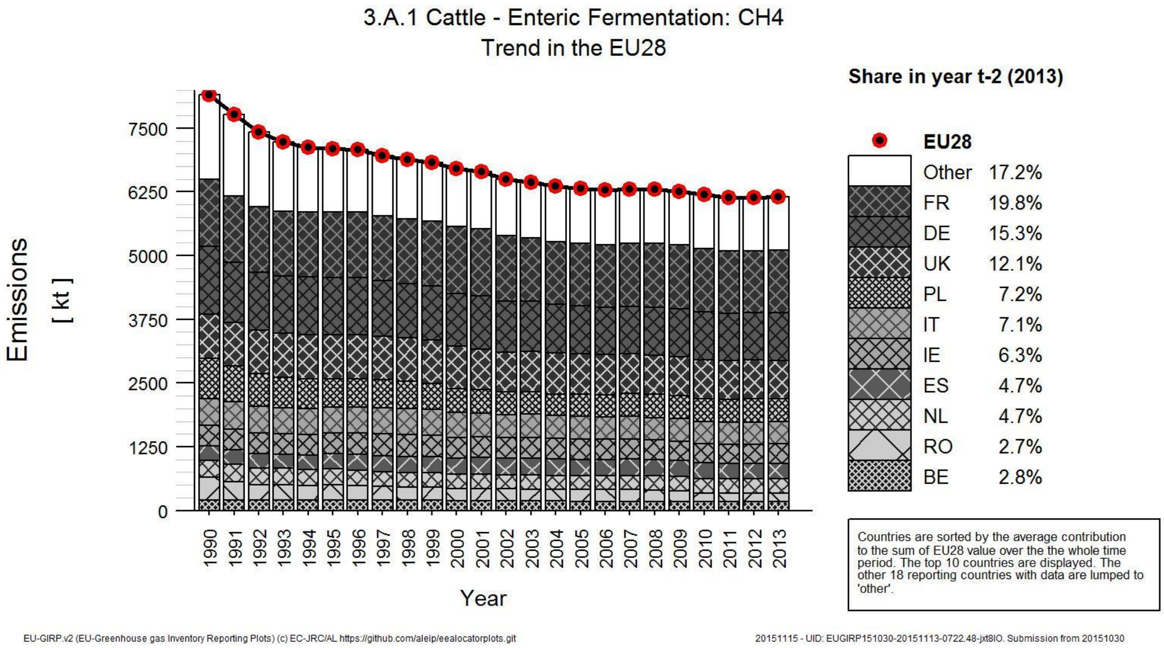
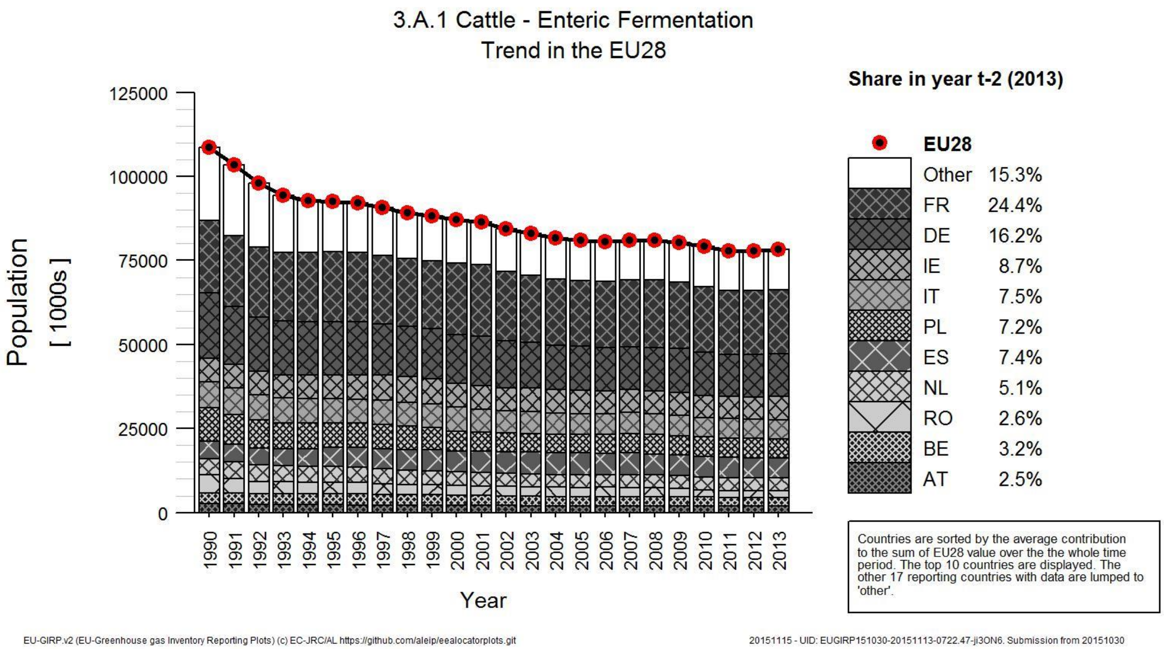


Figure 5.7: 3.A.1: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.A.2 - Sheep - Emissions

Emissions in source category 3.A.2 - Sheep decreased strongly in EU28 by 33% or 9.9 Mt CO_2-eq. Figure 5.8 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 94.1% of sheep CH_4 emissions. Emissions decreased in 18 countries and increased in ten countries. The four countries with the largest decreases were Romania, Spain, United Kingdom and Bulgaria with a total absolute decrease of 6.7 Mt CO_2-eq. The three countries with the largest increases were Croatia, Greece and Sweden with a total absolute increase of 93 kt CO_2-eq.

3.A.2 - Sheep - Population

The main driver for the decrease was the decrease in animal numbers shown in Figure 5.9.

Sheep population decreased strongly in EU28 by 33% or 48.4 mio heads. Figure 5.9 shows the trend of sheep population indicating the countries contributing most to EU28 total. The ten countries with highest population together accounted for 94.1% of Sheep population. Population decreased in 19 countries and increased in nine countries. The four countries with the largest decreases were United Kingdom, Spain, Bulgaria and Romania with a total absolute decrease of 31.5 mio heads. The three countries with the largest increases were Slovenia, Greece and Sweden with a total absolute increase of 377 thousand heads.

Figure 5.8: 3.A.2: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

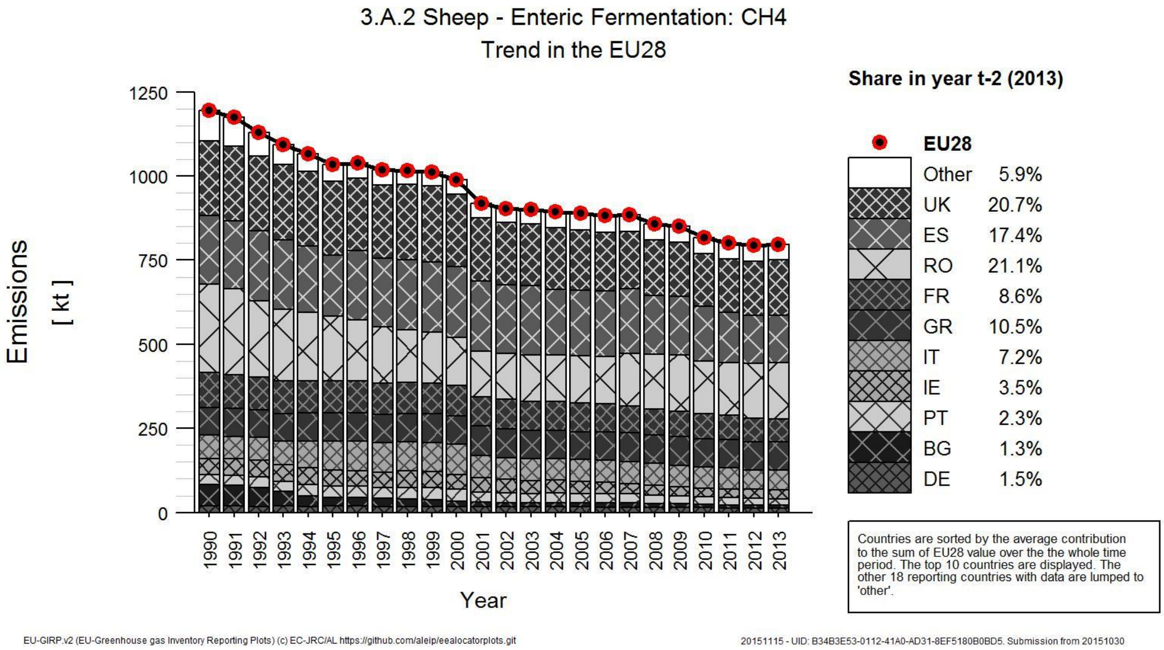
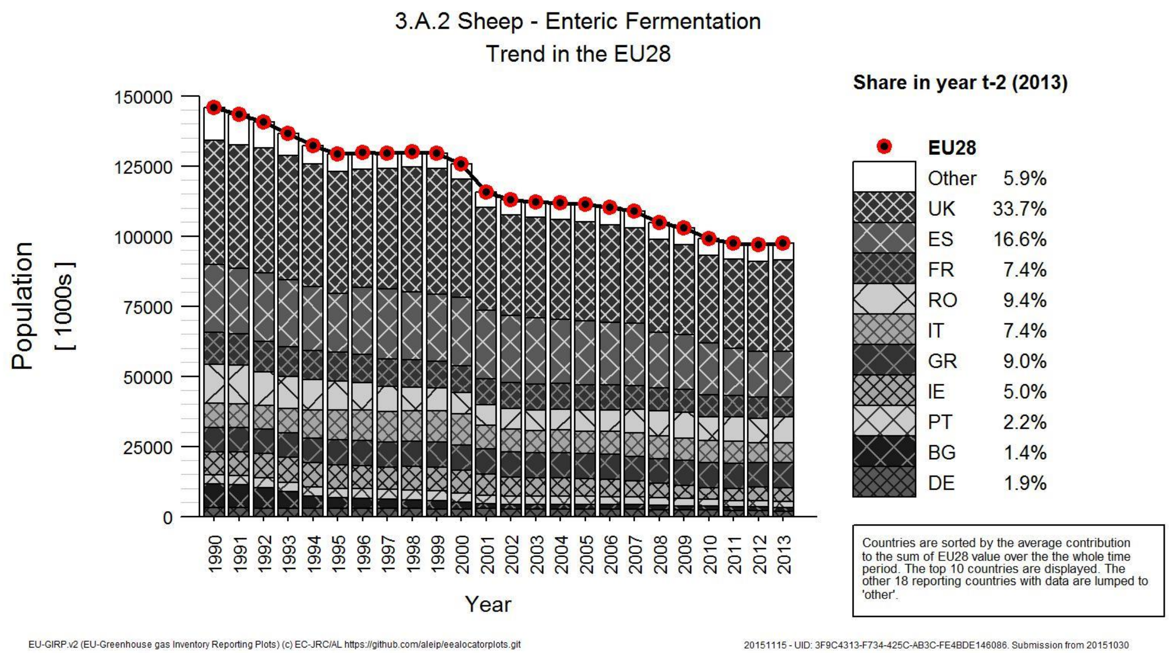


Figure 5.9: 3.A.2: Trend in population in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



Implied EFs and Methodological Issues

Information for cattle, sheep and swine are reported using national classification of the animals. For example, it is possible to report Cattle numbers using one of three options.

- Option A distinguishes 'Dairy Cattle' and 'Non-Dairy Cattle'.
- Option B distinguished 'Mature Dairy Cattle', 'Other Mature Cattle' and 'Growing Cattle'.
- Option C allows for any national classification.

To obtain values that can be aggregated to EU28 level, data reported under Option B and Option C were converted to Option A categories. 'Mature Dairy Cattle' is taken for 'Dairy Cattle' and the other two categories under Option B are used for 'Non-Dairy Cattle'. Also in Option C, dairy cattle can be identified (e.g. 'Dairy Cows', 'Other dairy cattle' etc.) and all other cattle category have been grouped to the animal type 'Non-Dairy Cattle'.

In case data were aggregated, this was done on the basis of a weighted average using population data as weighting factors.

No population data were available for the United Kingdom, and therefore data could not be aggregated or used.

In the cases for 'Sheep' and 'Swine', all animal types reported by countries are aggregated to one single parent category using the same approach.

In this section we discuss the Implied Emission Factor for the main animal types. Furthermore, we present data on the Average Gross Energy Intake and - for Dairy Cattle - also the Milk Yield.

3.A.1 - Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.A.1 - Cattle increased in EU28 slightly by 3.2% or 2.17 kg/head/year between 1990 and 2013. Figure 5.10 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.5 shows the implied emission factor for CH_4 emissions in source category 3.A.1 - Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in five countries and increased in 22 countries. The largest decrease occurred in Croatia with an absolute decrease of 50 kg/head/year. The three countries with the largest increases were Slovakia, Estonia and Czech Republic with a mean absolute increase of 18 kg/head/year.

Figure 5.10: 3.A.1 - Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

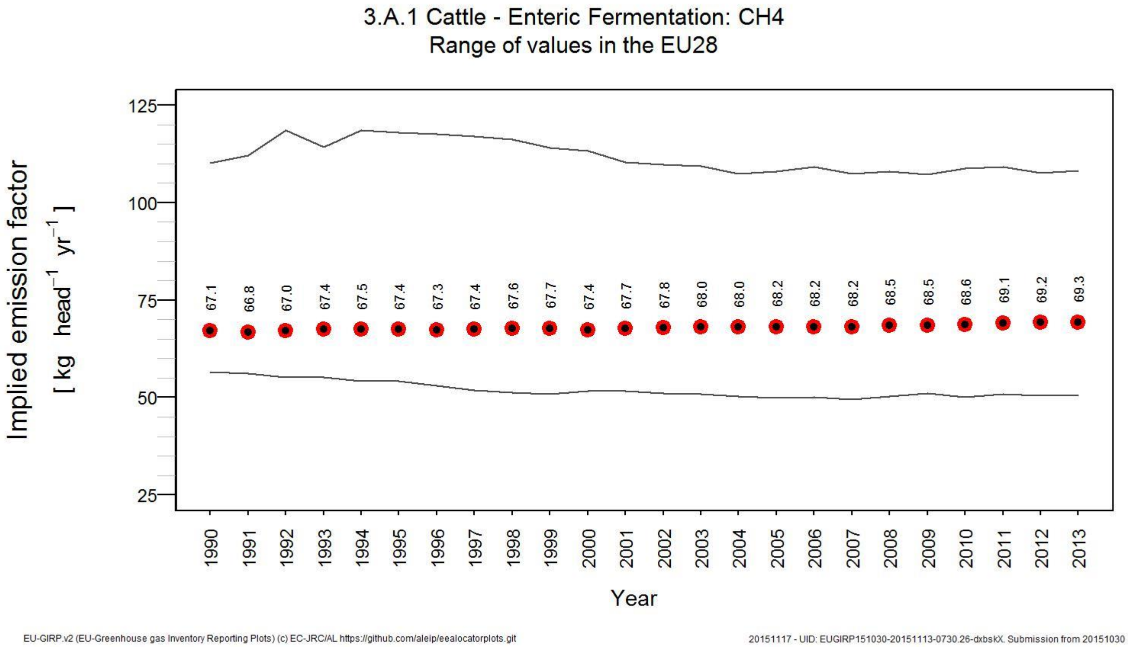


Table 5.5 3.A.1 - Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	71	79	|	Italy	68	75
Belgium	64	69	|	Lithuania	71	83
Bulgaria	88	108	|	Luxembourg	78	82
Cyprus	105	107	|	Latvia	61	75
Czech Republic	54	68	|	Malta	56	67
Germany	68	74	|	Netherlands	67	72
Denmark	61	74	|	Poland	78	80
Estonia	63	80	|	Portugal	68	73
Spain	56	51	|	Romania	83	83
Finland	65	82	|	Sweden	75	73
France	61	64	|	Slovenia	68	74
Greece	68	72	|	Slovakia	55	79
Croatia	110	60	|	United Kingdom		
Hungary	69	75	|	**EU28**	**67**	**69**
Ireland	59	57	|			

3.A.1 - Dairy Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.A.1 - Dairy Cattle increased in EU28 considerably by 16.4% or 17.5 kg/head/year between 1990 and 2013. Figure 5.11 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.6 shows the implied emission factor for CH_4 emissions in source category 3.A.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in two countries and increased in 24 countries. It was in 2013 at the level of 1990 in one country. No data were available for one country. The largest decrease occurred in Croatia with an absolute decrease of 56 kg/head/year. The four countries with the largest increases were Slovakia, Czech Republic, Estonia and Portugal with a mean absolute increase of 36 kg/head/year.

Figure 5.11: 3.A.1 - Dairy Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

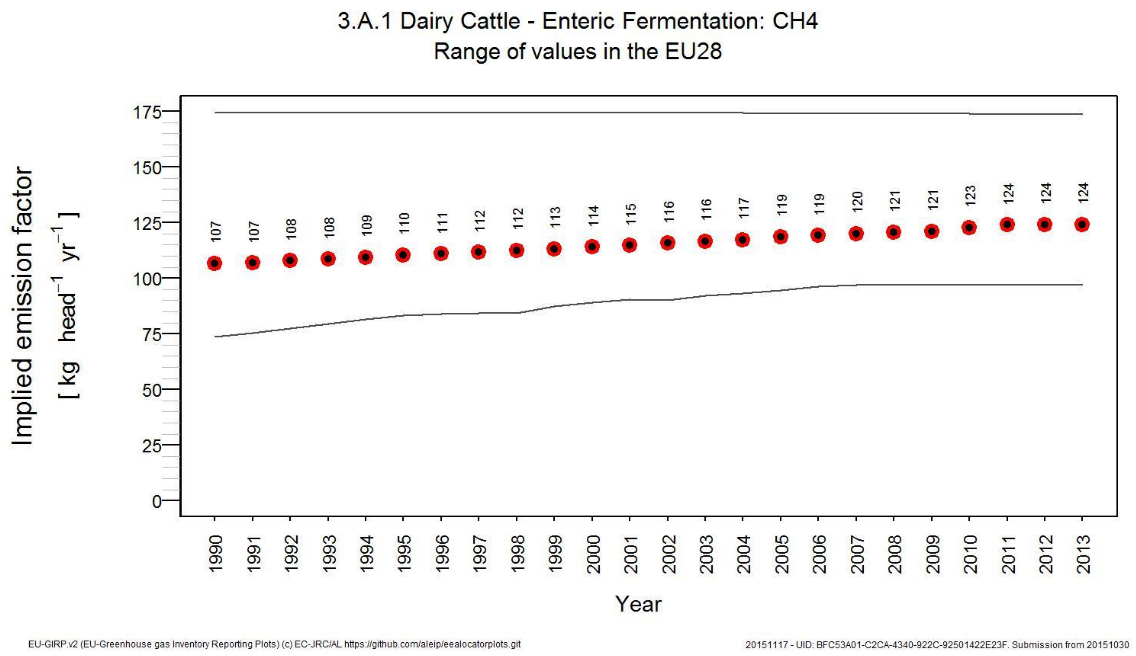


Table 5.6 3.A.1 - Dairy Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013	Member State	1990	2013
Austria	105	129	Italy	111	134
Belgium	114	143	Lithuania	101	120
Bulgaria	148	148	Luxembourg	120	136
Cyprus	174	174	Latvia	99	125
Czech Republic	82	119	Malta	93	118
Germany	120	135	Netherlands	110	128
Denmark	116	136	Poland	108	117
Estonia	102	141	Portugal	97	130
Spain	77	103	Romania	97	97
Finland	112	146	Sweden	120	132
France	99	118	Slovenia	92	119
Greece	93	121	Slovakia	74	108
Croatia	159	104	United Kingdom	0	0
Hungary	106	123	**EU28**	**107**	**124**
Ireland	101	112			

3.A.1 - Dairy Cattle - Average gross energy intake

The average gross energy intake, a parameter used for calculating CH_4 emissions in source category 3.A.1 - Dairy Cattle, increased in EU28 considerably by 20.2% or 50.6 MJ/head/day between 1990 and 2013. Figure 5.12 shows the trend of the Average gross energy intake in EU28 indicating also the range of values used by the countries. Table 5.7 shows the average gross energy intake in source category 3.A.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. Average gross energy intake decreased in two countries and increased in 25 countries. It was in 2013 at the level of 1990 in one country. Decreases occurred in Croatia and Cyprus with a mean absolute decrease of 39 MJ/head/day. The four countries with the largest increases were Czech Republic, Slovakia, Estonia and Spain with a mean absolute increase of 91 MJ/head/day.

Figure 5.12: 3.A.1 - Dairy Cattle: Trend in average gross energy intake in the EU28 and range of values reported by countries

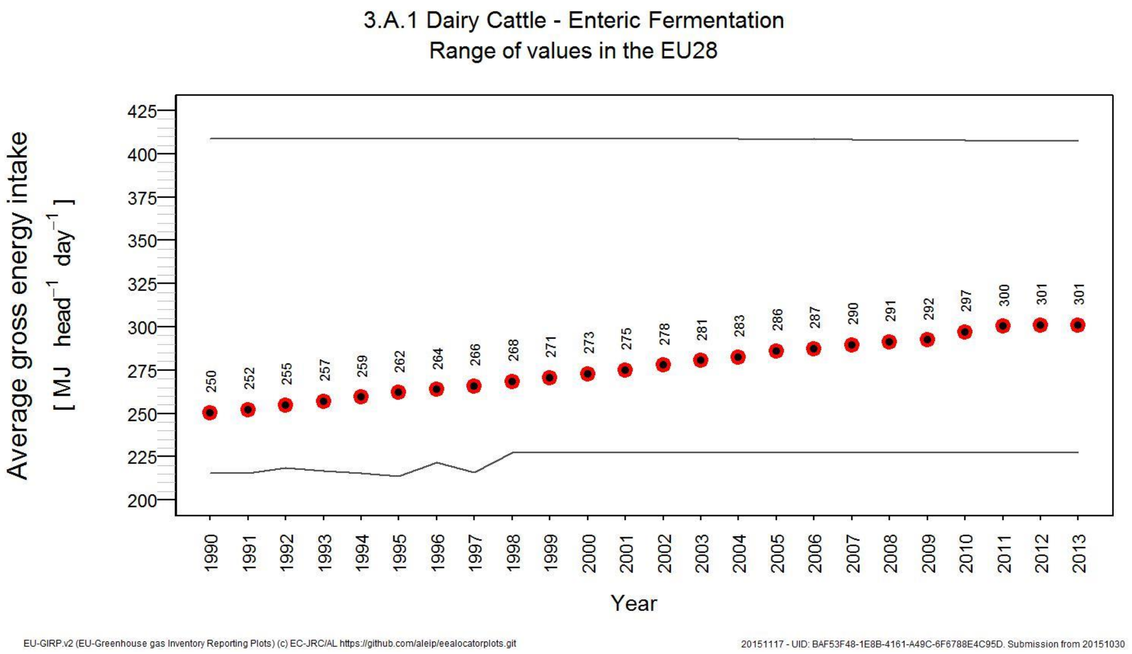


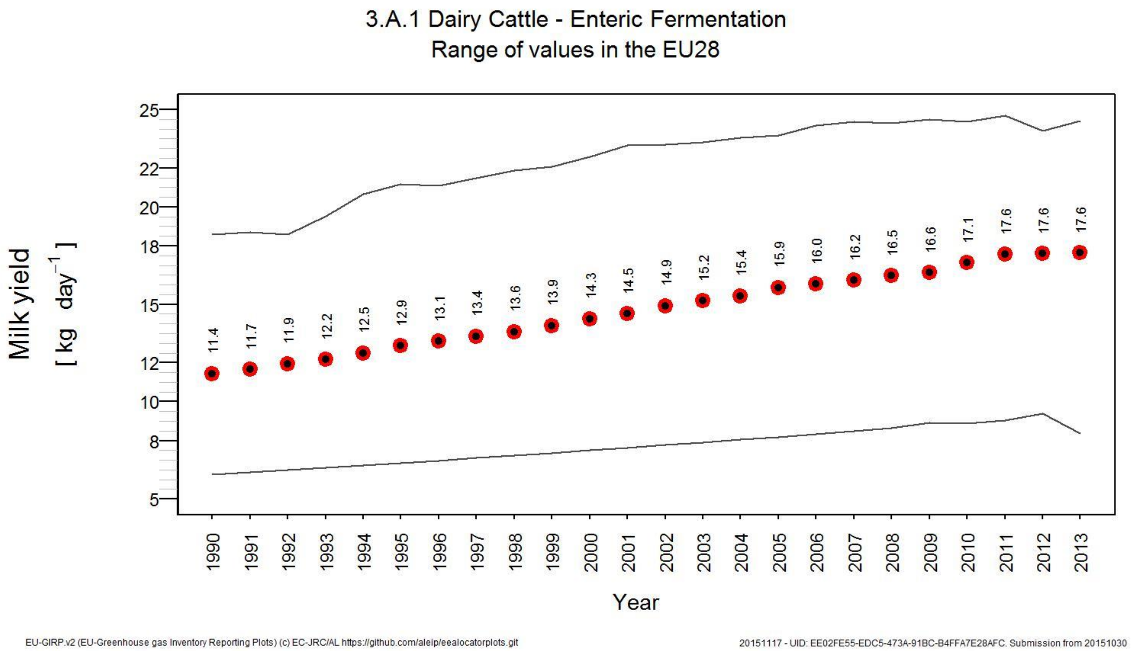
Table 5.7 3.A.1 - Dairy Cattle: Member States' and EU28 Average gross energy intake (MJ/head/day)

Member State	1990	2013		Member State	1990	2013
Austria	247	303	|	Italy	261	315
Belgium	279	350	|	Lithuania	238	281
Bulgaria	321	322	|	Luxembourg	280	318
Cyprus	409	407	|	Latvia	232	293
Czech Republic	209	304	|	Malta	215	276
Germany	260	322	|	Netherlands	280	334
Denmark	278	346	|	Poland	254	275
Estonia	241	332	|	Portugal	227	300
Spain	225	310	|	Romania	227	227
Finland	264	343	|	Sweden	276	326
France	242	293	|	Slovenia	215	280
Greece	217	283	|	Slovakia	211	306
Croatia	324	247	|	United Kingdom	237	296
Hungary	255	299	|	**EU28**	**250**	**301**
Ireland	222	247	|			

3.A.1 - Dairy Cattle - Milk yield

The milk yield, a parameter used for calculating CH_4 emissions in source category 3.A.1 - Dairy Cattle, increased in EU28 very strongly by 54.2% or 6.19 kg/head/day between 1990 and 2013. Figure 5.13 shows the trend of the Milk yield in EU28 indicating also the range of values used by the countries. Table 5.8 shows the milk yield in source category 3.A.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. Milk yield decreased in one country and increased in 24 countries. It was in 2013 at the level of 1990 in one country. No data were available for one country. Decreases occurred in Bulgaria with an absolute decrease of 0.014 kg/head/day. The four countries with the largest increases were Slovakia, Spain, Greece and Slovenia with a mean absolute increase of 9 kg/head/day.

Figure 5.13: 3.A.1 - Dairy Cattle: Trend in milk yield in the EU28 and range of values reported by countries[30]



30 Note that data from Luxembourg are not included in the plot as they are reported in a different unit.

Table 5.8 3.A.1 - Dairy Cattle: Member States' and EU28 Milk yield (kg/head/day)

Member State	1990	2013	Member State	1990	2013
Austria	10.4	17.7	Ireland	11.5	14.4
Belgium	11.2	20.6	Italy	11.5	17.4
Bulgaria	11.9	11.9	Lithuania	10.2	14.6
Cyprus	12.2	17.0	Luxembourg		
Czech Republic	10.7	20.4	Latvia	9.4	15.1
Germany	12.9	20.1	Malta	12.1	18.1
Denmark	16.5	23.7	Poland	8.9	14.0
Estonia	11.4	21.9	Portugal	12.2	21.9
Spain	9.9	21.4	Romania	10.0	10.0
Finland	15.7	22.5	Sweden	18.6	24.4
France	13.1	18.1	Slovenia	7.6	14.9
Greece	7.6	15.5	Slovakia	6.3	16.1
Croatia	6.3	8.4	United Kingdom	14.1	20.6
Hungary	13.8	19.5	**EU28**	**11.4**	**17.6**

3.A.1 - Non-Dairy Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.A.1 - Non-Dairy Cattle increased in EU28 slightly by 2.9% or 1.36 kg/head/year between 1990 and 2013. Figure 5.14 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.9 shows the implied emission factor for CH_4 emissions in source category 3.A.1 - Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in five countries and increased in 22 countries. No data were available for one country. The largest decrease occurred in Croatia with an absolute decrease of 13 kg/head/year. The largest increases occurred in Finland and Slovakia with a mean absolute increase of 13 kg/head/year.

Figure 5.14: 3.A.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

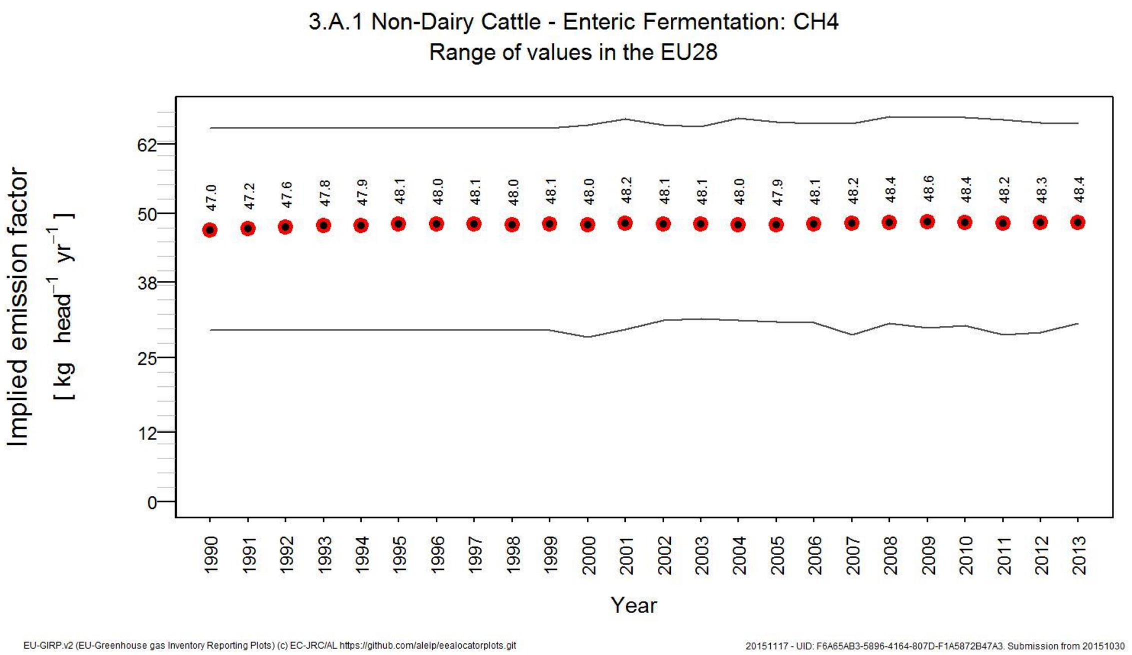


Table 5.9 3.A.1 - Non-Dairy Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013	Member State	1990	2013
Austria	52	60	Italy	46	48
Belgium	47	52	Lithuania	54	54
Bulgaria	51	62	Luxembourg	63	65
Cyprus	57	57	Latvia	38	41
Czech Republic	39	48	Malta	30	31
Germany	43	44	Netherlands	40	37
Denmark	33	39	Poland	49	51
Estonia	40	44	Portugal	56	62
Spain	47	42	Romania	65	64
Finland	39	53	Sweden	53	55
France	49	51	Slovenia	50	60
Greece	57	61	Slovakia	45	56
Croatia	44	31	United Kingdom	0	0
Hungary	49	51	**EU28**	**47**	**48**
Ireland	49	46			

3.A.1 - Non-Dairy Cattle - Average gross energy intake

The average gross energy intake, a parameter used for calculating CH_4 emissions in source category 3.A.1 - Non-Dairy Cattle, increased in EU28 slightly by 3.5% or 4.15 MJ/head/day between 1990 and 2013. Figure 5.15 shows the trend of the Average gross energy intake in EU28 indicating also the range of values used by the countries. Table 5.10 shows the average gross energy intake in source category 3.A.1 - Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. Average gross energy intake decreased in four countries and increased in nineteen countries. It was in 2013 at the level of 1990 in two countries. No data were available for three countries. The three countries with the largest decreases were Croatia, Netherlands and Ireland with a mean absolute decrease of 7 MJ/head/day. The largest increase occurred in Finland with an absolute increase of 32 MJ/head/day.

Figure 5.15: 3.A.1 - Non-Dairy Cattle: Trend in average gross energy intake in the EU28 and range of values reported by countries

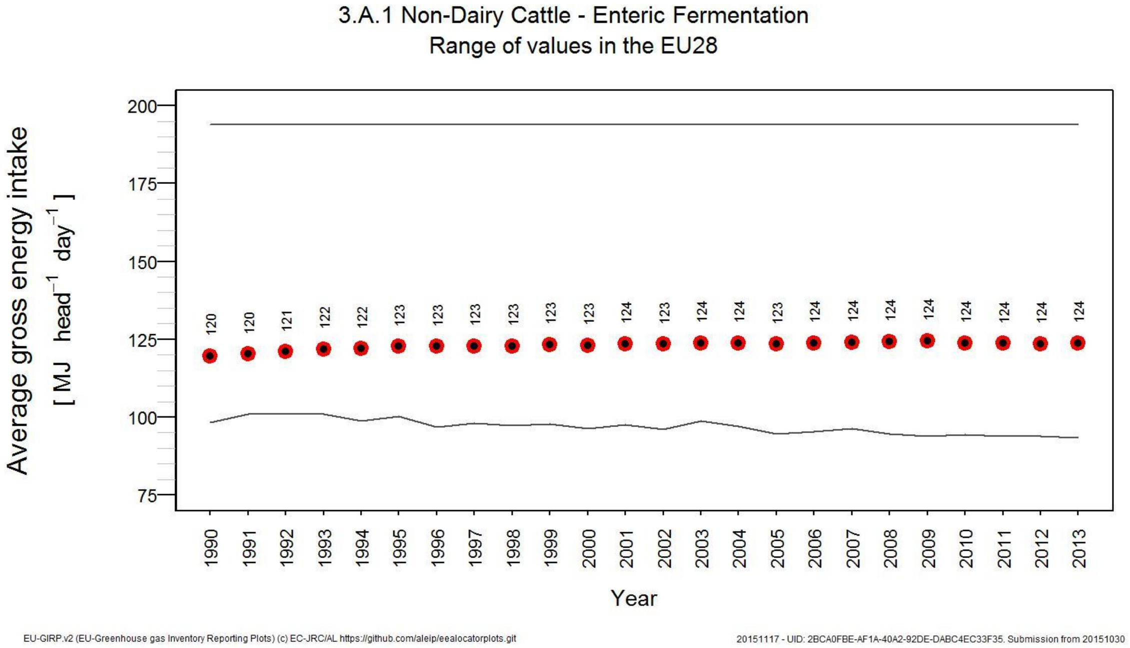


Table 5.10 3.A.1 - Non-Dairy Cattle: Member States' and EU28 Average gross energy intake (MJ/head/day)

Member State	1990	2013	Member State	1990	2013
Austria	123	141	Ireland	132	126
Belgium	119	132	Italy	141	142
Bulgaria	115	138	Lithuania	127	127
Czech Republic	100	123	Luxembourg	146	153
Germany	103	104	Latvia	101	107
Denmark	107	130	Netherlands	98	93
Estonia	105	107	Poland	114	119
Spain	124	123	Portugal	139	153
Finland	92	124	Romania	194	194
France	116	120	Sweden	181	181
Greece	134	142	Slovenia	111	132
Croatia	112	101	Slovakia	122	145
Hungary	134	138	**EU28**	**120**	**124**

3.A.2 - Sheep - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.A.2 - Sheep decreased in EU28 barely by 0.099% or 0.0081 kg/head/year between 1990 and 2013. Figure 5.16 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.11 shows the implied emission factor for CH_4 emissions in source category 3.A.2 - Sheep for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in nine countries and increased in nine countries. It was in 2013 at the level of 1990 in ten countries. The three countries with the largest decreases were Portugal, Ireland and Slovakia with a mean absolute decrease of 0.3 kg/head/year. The largest increase occurred in Croatia with an absolute increase of 3 kg/head/year.

Figure 5.16: 3.A.2 - Sheep: Trend in implied emission factor in the EU28 and range of values reported by countries

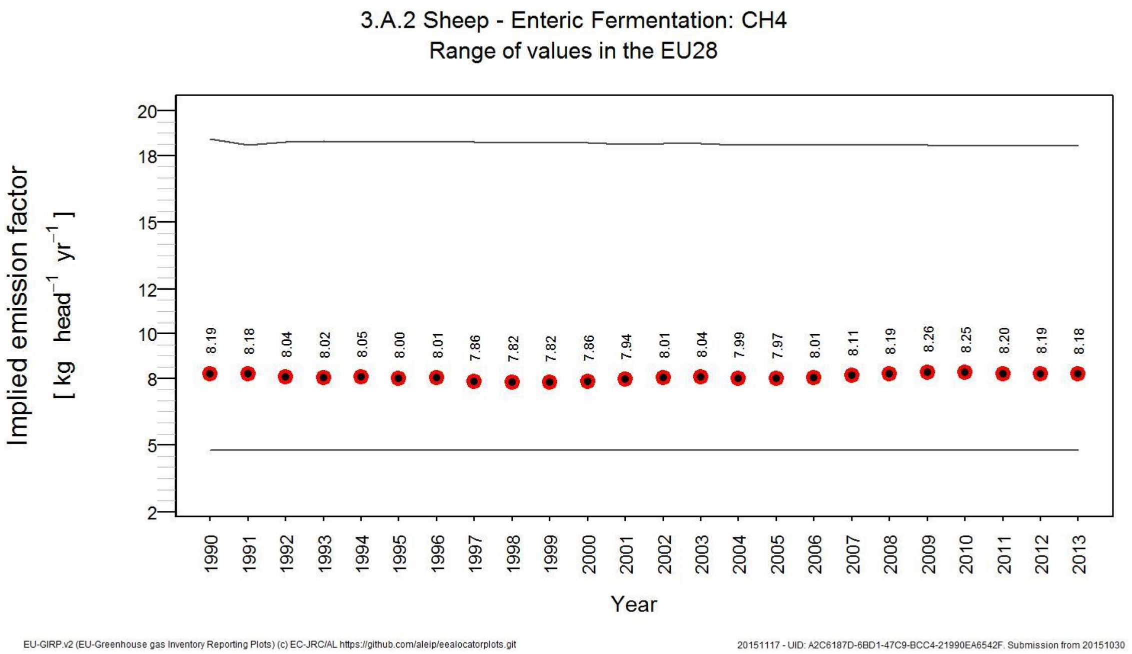


Table 5.11 3.A.2 - Sheep: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	8.0	8.0	|	Italy	8.0	8.0
Belgium	8.0	8.0	|	Lithuania	11.8	11.8
Bulgaria	7.5	7.6	|	Luxembourg	4.8	4.8
Cyprus	8.0	8.0	|	Latvia	8.0	8.0
Czech Republic	8.0	8.0	|	Malta	8.0	8.0
Germany	6.2	6.2	|	Netherlands	8.0	8.0
Denmark	6.7	6.7	|	Poland	8.0	8.0
Estonia	8.0	8.0	|	Portugal	9.0	8.6
Spain	8.5	8.6	|	Romania	18.7	18.4
Finland	6.8	8.4	|	Sweden	8.0	8.0
France	9.1	9.5	|	Slovenia	8.0	8.0
Greece	9.5	9.5	|	Slovakia	9.9	9.6
Croatia	5.0	7.8	|	United Kingdom	5.0	5.0
Hungary	8.0	8.0	|	**EU28**	**8.2**	**8.2**
Ireland	5.9	5.7	|			

3.A.2 - Sheep - Average gross energy intake

The average gross energy intake, a parameter used for calculating CH_4 emissions in source category 3.A.2 - Sheep, increased in EU28 slightly by 2.6% or 0.66 MJ/head/day between 1990 and 2013. Figure 5.17 shows the trend of the Average gross energy intake in EU28 indicating also the range of values used by the countries. Table 5.12 shows the average gross energy intake in source category 3.A.2 - Sheep for the years 1990 and 2013 for all Member States and EU28. Average gross energy intake decreased in three countries and increased in two countries. It was in 2013 at the level of 1990 in six countries. No data were available for seventeen countries. Decreases occurred in Portugal, Greece and Ireland with a mean absolute decrease of 0.3 MJ/head/day. Increases in Spain and Bulgaria with a mean absolute increase of 0.2 MJ/head/day.

Figure 5.17: 3.A.2 - Sheep: Trend in average gross energy intake in the EU28 and range of values reported by countries

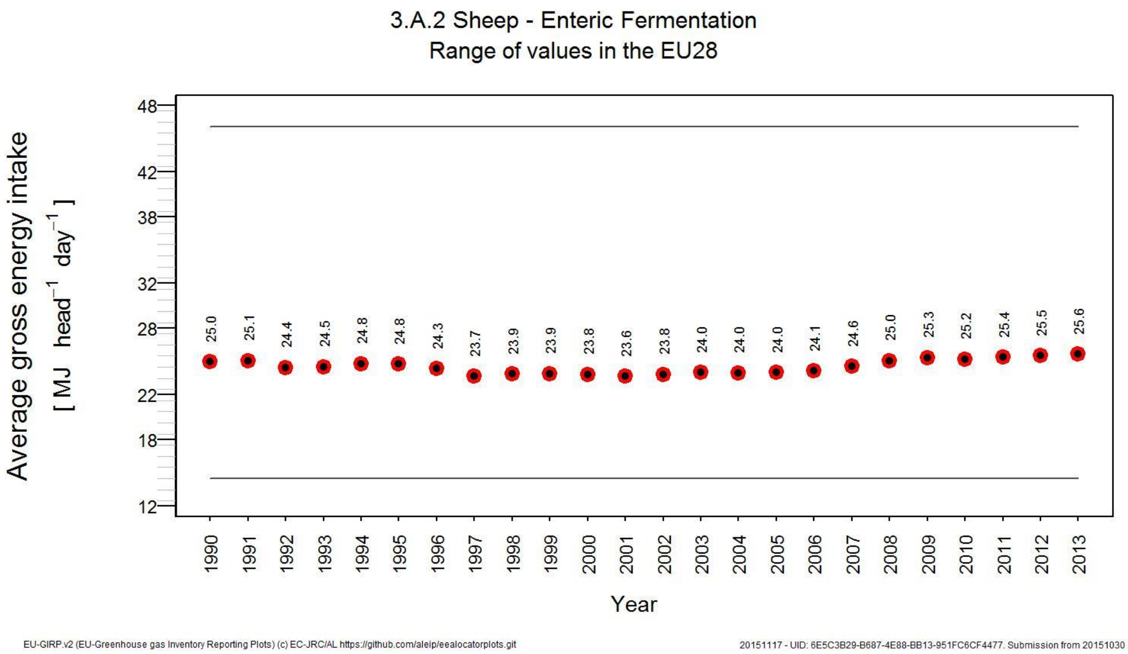


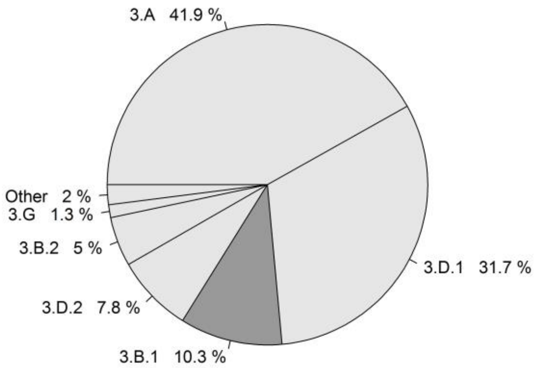
Table 5.12 3.A.2 - Sheep: Member States' and EU28 Average gross energy intake (MJ/head/day)

Member State	1990	2013		Member State	1990	2013
Bulgaria	17	17	|	Lithuania	29	29
Germany	20	20	|	Luxembourg	14	14
Denmark	20	20	|	Portugal	22	21
Spain	19	19	|	Romania	46	46
Greece	23	23	|	Sweden	20	20
Ireland	20	20	|	**EU28**	**25**	**26**

Manure Management - CH_4 (CRF Source Category 3B1)

CH_4 emissions from source category 3.B.1 Manure Management are 1% of total EU28 GHG emissions and 9.8% of total EU28 CH_4 emissions. They make 10.3% of total agricultural emissions. The main sub-categories are 3.B.1.1 (Cattle) and 3.B.1.3 (Swine) as shown in Figure 5.18. Total GHG and CH_4 emissions by Member States from 3.B.1 Manure Management are shown in Table 5.13. Between 1990 and 2013, CH_4 emission from Manure Management decreased by 23% or 13.6 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (87%) and also in absolute terms (87% or 3.4 Mt CO_2-eq). From 2012 to 2013 emissions decreased by 1.9%.

Figure 5.18: Share of source category 3.B.1 on total EU28 agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emission in the year 2013.



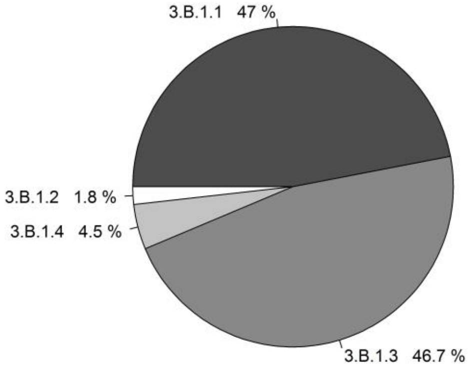


Table 5.13 3.B.1 - Manure Management: Member States' contributions to total GHG and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	991	842	453	445	537	397
Belgium	2 827	2 598	979	730	1 849	1 868
Bulgaria	4 751	870	883	358	3 868	511
Croatia	677	318	324	141	353	178
Cyprus	454	410	325	253	129	157
Czech Republic	4 261	1 759	2 981	1 195	1 280	564
Denmark	2 707	2 673	978	755	1 729	1 918
Estonia	265	142	157	73	107	69
Finland	652	740	284	285	368	455
France	8 490	8 135	3 178	2 602	5 312	5 533
Germany	13 188	10 255	5 114	3 912	8 073	6 344
Greece	1 190	1 152	305	329	884	824
Hungary	2 634	1 361	819	403	1 816	958
Ireland	1 838	1 760	496	518	1 342	1 242
Italy	6 798	5 348	2 864	2 198	3 934	3 149
Latvia	714	248	305	111	409	137
Lithuania	1 229	441	544	167	685	274
Luxembourg	97	99	45	39	52	60
Malta	34	33	6	7	28	27
Netherlands	6 351	4 751	530	419	5 821	4 332
Poland	5 960	3 845	3 163	1 994	2 797	1 851
Portugal	1 664	1 380	249	208	1 415	1 172
Romania	5 854	2 382	1 400	762	4 454	1 620
Slovakia	1 807	626	1 246	447	561	179
Slovenia	587	359	164	96	423	263
Spain	7 451	9 173	1 293	1 511	6 157	7 662
Sweden	507	510	262	249	246	261
United Kingdom	6 757	5 271	2 317	1 822	4 440	3 449
EU-28	**90 735**	**67 481**	**31 665**	**22 025**	**59 070**	**45 456**

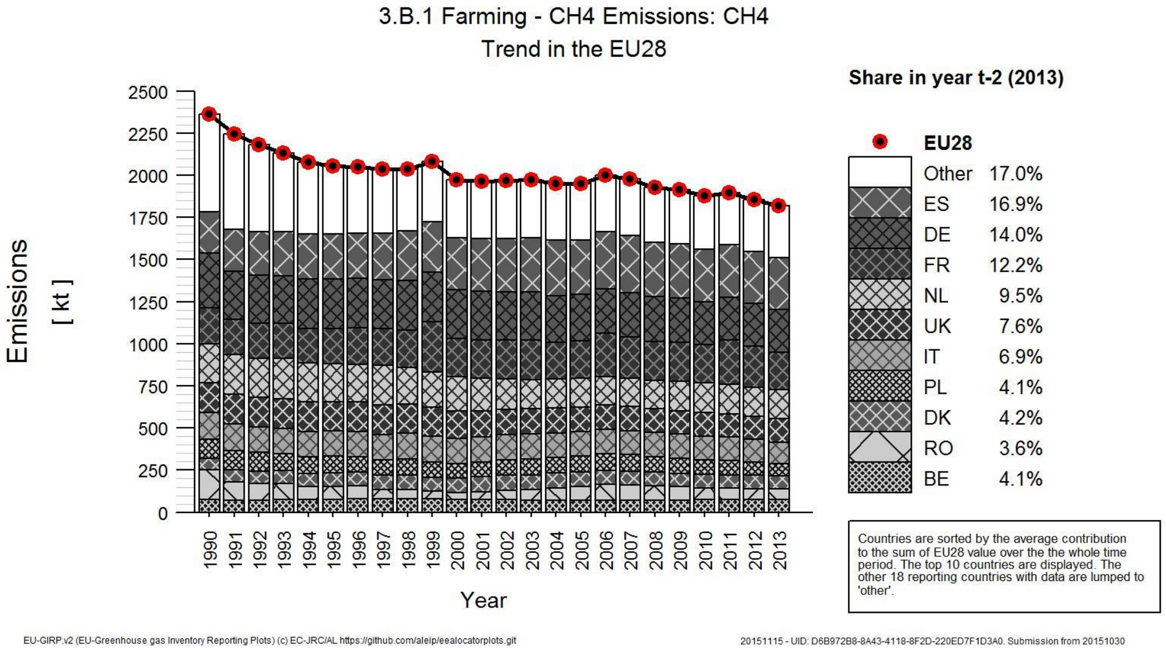
Trends in Emissions and Activity Data

3.B.1 - Manure Management - Emissions

Emissions in source category 3.B.1 - Manure Management decreased considerably in EU28 by 23% or 13.6 Mt CO_2-eq. Figure 5.19 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 83% of manure

Management CH_4 emissions. Emissions decreased in 20 countries and increased in eight countries. The three countries with the largest decreases were Bulgaria, Romania and Germany with a total absolute decrease of 7.9 Mt CO_2-eq. Largest increases occurred in France and Spain with a total absolute increase of 1.7 Mt CO_2-eq.

Figure 5.19: 3.B.1: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.B.1.1 - Cattle - Emissions

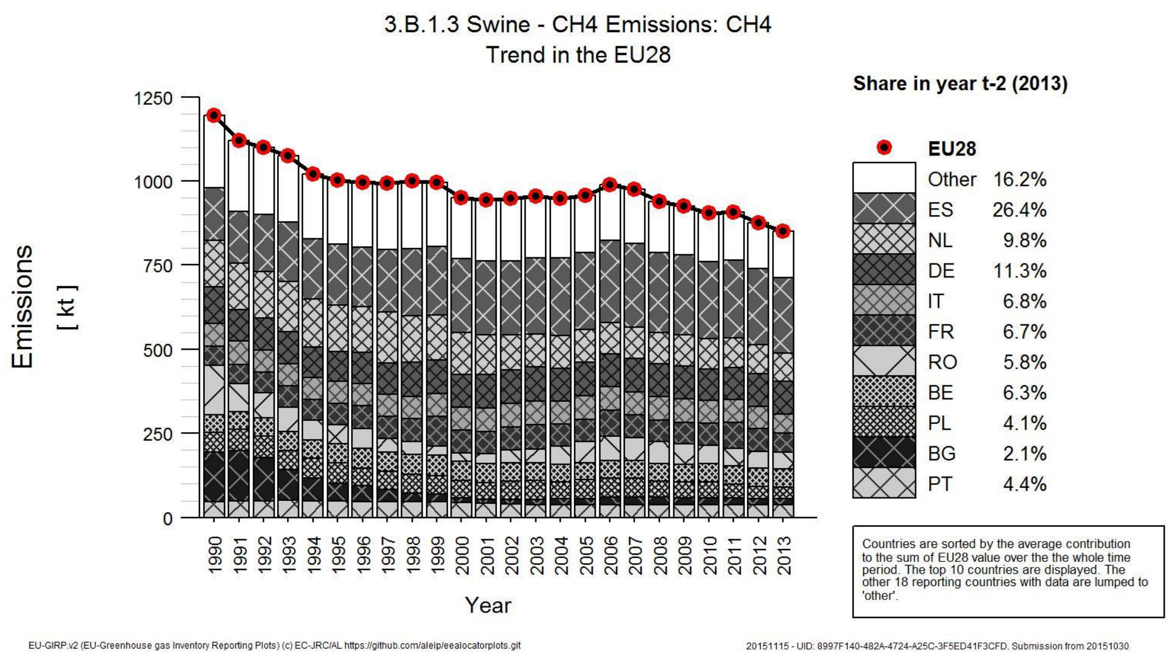
CH_4 emissions in source category 3.B.1.1 - Cattle are 0.48% of total EU28 GHG emissions and 4.6% of total EU28 CH_4 emissions. They make 4.8% of total agricultural emissions.

Total GHG and CH_4 emissions by Member States from 3.B.1.1 Manure Management are shown in Table 5.14. Between 1990 and 2013, CH_4 emission from Cattle decreased by 17% or 4.3 Mt CO_2-eq. The decrease was largest in Romania in relative terms (68%) and in Germany in absolute terms (28% or 1.5 Mt CO_2-eq). From 2012 to 2013 emissions decreased by 1.1%. Figure 5.20 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 87.3% of cattle CH_4 emissions. Emissions decreased in 15 countries and increased in thirteen countries. The three countries with the largest decreases were Germany, Italy and United Kingdom with a total absolute decrease of 2.6 Mt CO_2-eq. The three countries with the largest increases were Denmark, France and Netherlands with a total absolute increase of 610 kt CO_2-eq.

Table 5.14 3.B.1.1 - Cattle: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	89	87	0%	-2	-3%	-62	-42%	-	-
Belgium	1 346	1 348	1 348	6%	0	0%	2	0%	T2	CS
Bulgaria	3 664	450	441	2%	-9	-2%	-3 223	-88%	T2	CS
Croatia	59	39	39	0%	-1	-2%	-20	-35%	T2	CS
Cyprus	96	135	123	1%	-12	-9%	26	27%	T1	D
Czech Republic	359	118	119	1%	1	0%	-240	-67%	T1	D
Denmark	798	882	868	4%	-14	-2%	70	9%	CS,T2	D
Estonia	56	21	21	0%	0	-1%	-34	-62%	T2	CS,D
Finland	66	106	108	1%	1	1%	42	63%	T2	CS
France	1 416	1 734	1 431	7%	-303	-17%	15	1%	-	-
Germany	2 685	2 426	2 403	11%	-23	-1%	-282	-10%	T2	CS,D
Greece	398	346	346	2%	0	0%	-52	-13%	T1	D
Hungary	1 034	550	551	3%	1	0%	-483	-47%	T2	CS
Ireland	160	193	190	1%	-3	-1%	30	19%	T2	CS,D
Italy	1 705	1 645	1 444	7%	-202	-12%	-261	-15%	T2	CS
Latvia	224	57	58	0%	2	3%	-166	-74%	T1	D
Lithuania	355	127	120	1%	-8	-6%	-236	-66%	T2	CS
Luxembourg	11	12	11	0%	0	-3%	1	5%	T2	CS
Malta	15	11	12	0%	1	9%	-3	-20%	T1	D
Netherlands	3 489	2 156	2 086	10%	-70	-3%	-1 403	-40%	T2	CS
Poland	1 436	911	866	4%	-45	-5%	-570	-40%	T2	CS
Portugal	1 196	930	938	4%	9	1%	-257	-22%	T2	CS
Romania	3 661	1 253	1 235	6%	-19	-2%	-2 426	-66%	T2	CS
Slovakia	252	63	64	0%	1	1%	-188	-75%	T1	D
Slovenia	197	45	44	0%	-1	-2%	-153	-78%	T1	D
Spain	3 886	5 640	5 612	26%	-28	0%	1 727	44%	-	-
Sweden	59	44	44	0%	1	1%	-15	-25%	-	-
United Kingdom	1 090	583	633	3%	50	9%	-457	-42%	T2	CS,D
EU-28	**29 863**	**21 916**	**21 242**	**100%**	**-674**	**-3%**	**-8 621**	**-29%**		

Figure 5.20: 3.B.1.1: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.B.1.1 - Cattle - Activity Data

The main Activity Data for CH_4 emissions from Manure Management - Cattle are the animal numbers. Cattle numbers are already discussed under source category 3.A Enteric Fermentation and therefore not further discussed here.

Other relevant activity data are:

- Allocation by Climate Region (Tier 1)
- Allocation by MMS.

3.B.1.3 - Swine - Emissions

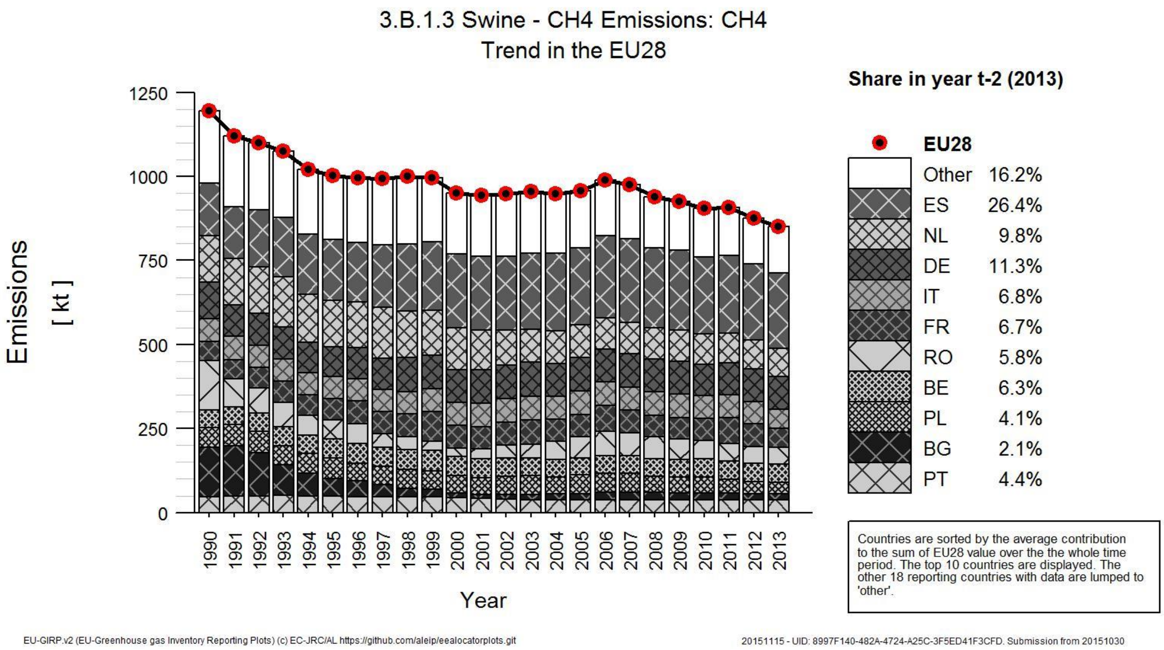
CH_4 emissions in source category 3.B.1.3 - Swine are 0.47% of total EU28 GHG emissions and 4.6% of total EU28 CH_4 emissions. They make 4.8% of total agricultural emissions.

Total GHG and CH_4 emissions by Member States from 3.B.1.3 Manure Management are shown in Table 5.15. Between 1990 and 2013, CH_4 emission from Swine decreased by 29% or 8.6 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (88%) and also in absolute terms (88% or 3.2 Mt CO_2-eq). From 2012 to 2013 emissions decreased by 3.1%. Figure 5.21 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 85.8% of Swine emissions. Emissions decreased in 20 countries and increased in eight countries. The three countries with the largest decreases were Bulgaria, Romania and Netherlands with a total absolute decrease of 7.1 Mt CO_2-eq. Largest increases occurred in Spain with a total absolute increase of 1.7 Mt CO_2-eq.

Table 5.15 3.B.1.3 - Swine: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	89	87	0%	-2	-3%	-62	-42%	-	-
Belgium	1 346	1 348	1 348	6%	0	0%	2	0%	T2	CS
Bulgaria	3 664	450	441	2%	-9	-2%	-3 223	-88%	T2	CS
Croatia	59	39	39	0%	-1	-2%	-20	-35%	T2	CS
Cyprus	96	135	123	1%	-12	-9%	26	27%	T1	D
Czech Republic	359	118	119	1%	1	0%	-240	-67%	T1	D
Denmark	798	882	868	4%	-14	-2%	70	9%	CS,T2	D
Estonia	56	21	21	0%	0	-1%	-34	-62%	T2	CS,D
Finland	66	106	108	1%	1	1%	42	63%	T2	CS
France	1 416	1 734	1 431	7%	-303	-17%	15	1%	-	-
Germany	2 685	2 426	2 403	11%	-23	-1%	-282	-10%	T2	CS,D
Greece	398	346	346	2%	0	0%	-52	-13%	T1	D
Hungary	1 034	550	551	3%	1	0%	-483	-47%	T2	CS
Ireland	160	193	190	1%	-3	-1%	30	19%	T2	CS,D
Italy	1 705	1 645	1 444	7%	-202	-12%	-261	-15%	T2	CS
Latvia	224	57	58	0%	2	3%	-166	-74%	T1	D
Lithuania	355	127	120	1%	-8	-6%	-236	-66%	T2	CS
Luxembourg	11	12	11	0%	0	-3%	1	5%	T2	CS
Malta	15	11	12	0%	1	9%	-3	-20%	T1	D
Netherlands	3 489	2 156	2 086	10%	-70	-3%	-1 403	-40%	T2	CS
Poland	1 436	911	866	4%	-45	-5%	-570	-40%	T2	CS
Portugal	1 196	930	938	4%	9	1%	-257	-22%	T2	CS
Romania	3 661	1 253	1 235	6%	-19	-2%	-2 426	-66%	T2	CS
Slovakia	252	63	64	0%	1	1%	-188	-75%	T1	D
Slovenia	197	45	44	0%	-1	-2%	-153	-78%	T1	D
Spain	3 886	5 640	5 612	26%	-28	0%	1 727	44%	-	-
Sweden	59	44	44	0%	1	1%	-15	-25%	-	-
United Kingdom	1 090	583	633	3%	50	9%	-457	-42%	T2	CS,D
EU-28	**29 863**	**21 916**	**21 242**	**100%**	**-674**	**-3%**	**-8 621**	**-29%**		

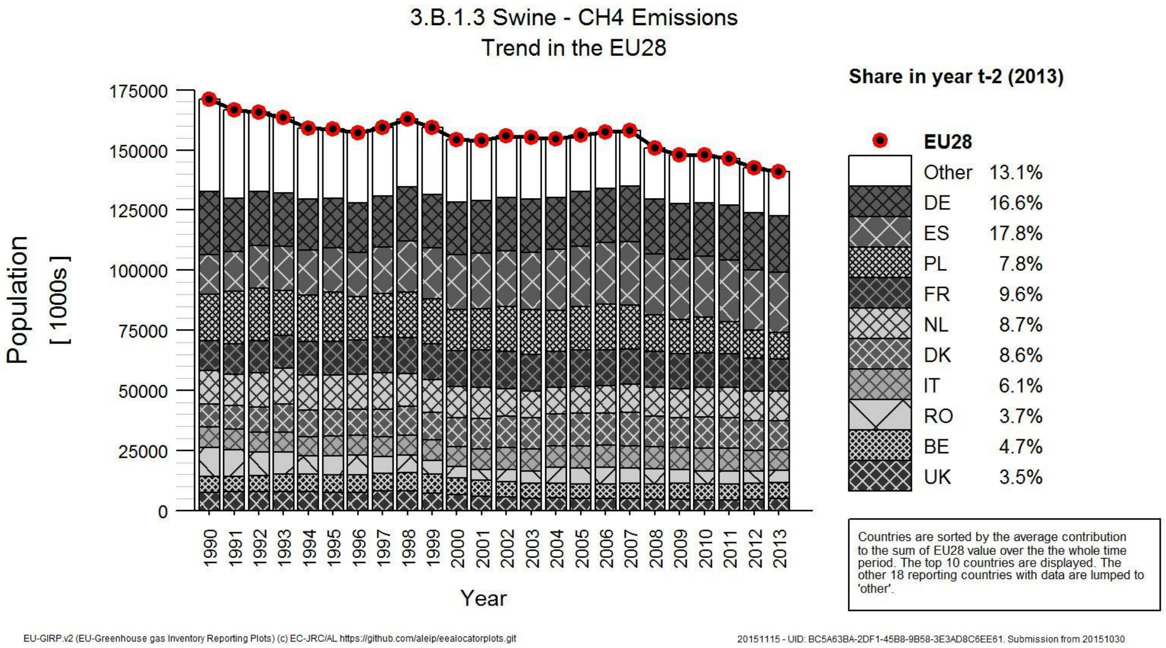
Figure 5.21: 3.B.1.3: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.B.1.3 - Swine - Population

Main Activity Data for CH_4 emissions from Manure Management - Swine are the animal numbers. As Swine are not a main animal type in the source category 3.A Enteric Fermentation their population data are discussed here. Swine population decreased considerably in EU28 by 18% or 30.2 mio heads. Figure 5.22 shows the trend of swine population indicating the countries contributing most to EU28 total. The ten countries with highest population together accounted for 86.9% of Swine population. Population decreased in 21 countries and increased in seven countries. The three countries with the largest decreases were Poland, Romania and Hungary with a total absolute decrease of 21.1 mio heads. Largest increases occurred in Denmark and Spain with a total absolute increase of 11.3 mio heads.

Figure 5.22: 3.B.1.3: Trend in population in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



Implied EFs and Methodological Issues

In this section we discuss the Implied Emission Factor for the main animal types. Furthermore, we present data on the Typical Animal Mass as reported in CRF Tables 3B(a)s1 and average VS daily excretion.

3.B.1.1 - Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.B.1.1 - Cattle increased in EU28 considerably by 15.9% or 1.32 kg/head/year between 1990 and 2013. Figure 5.23 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.16 shows the implied emission factor for CH_4 emissions in source category 3.B.1.1 - Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in seven countries and increased in twenty countries. The three countries with the largest decreases were Spain, Romania and Croatia with a mean absolute decrease of 2 kg/head/year. The four countries with the largest increases were Estonia, Latvia, Finland and Lithuania with a mean absolute increase of 4 kg/head/year.

Figure 5.23: 3.B.1.1 - Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

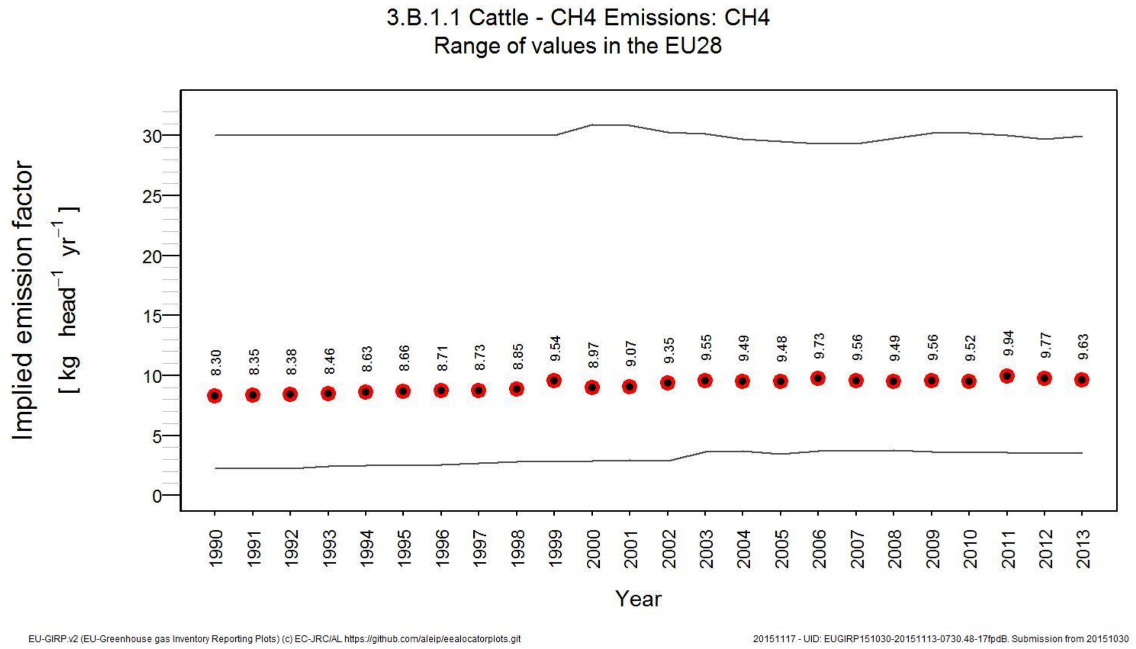


Table 5.16 3.B.1.1 - Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	5.8	6.0	|	Italy	10.0	9.0
Belgium	6.0	8.0	|	Lithuania	4.4	7.1
Bulgaria	3.0	3.6	|	Luxembourg	7.4	9.9
Cyprus	19.8	20.0	|	Latvia	2.8	6.9
Czech Republic	9.8	11.8	|	Malta	30.0	30.0
Germany	10.8	11.8	|	Netherlands	14.9	21.4
Denmark	15.0	22.8	|	Poland	4.6	6.3
Estonia	2.2	6.7	|	Portugal	3.0	3.6
Spain	16.1	12.9	|	Romania	4.2	3.5
Finland	6.9	12.0	|	Sweden	3.6	4.9
France	6.7	8.0	|	Slovenia	13.2	16.8
Greece	5.5	5.4	|	Slovakia	7.0	7.9
Croatia	13.1	11.6	|	United Kingdom		
Hungary	17.0	18.9	|	**EU28**	**8.3**	**9.6**
Ireland	6.1	5.4	|			

3.B.1.1 - Dairy Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.B.1.1 - Dairy Cattle increased in EU28 strongly by 47.8% or 6.8 kg/head/year between 1990 and 2013. Figure 5.24 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.17 shows the implied emission factor for CH_4 emissions in source category 3.B.1.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in five countries and increased in twenty countries. It was in 2013 at the level of 1990 in two countries. No data were available for one country. The three countries with the largest decreases were Romania, Italy and Bulgaria with a mean absolute decrease of 1 kg/head/year. The four countries with the largest increases were Estonia, Latvia, Portugal and Finland with a mean absolute increase of 9 kg/head/year.

Figure 5.24: 3.B.1.1 - Dairy Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

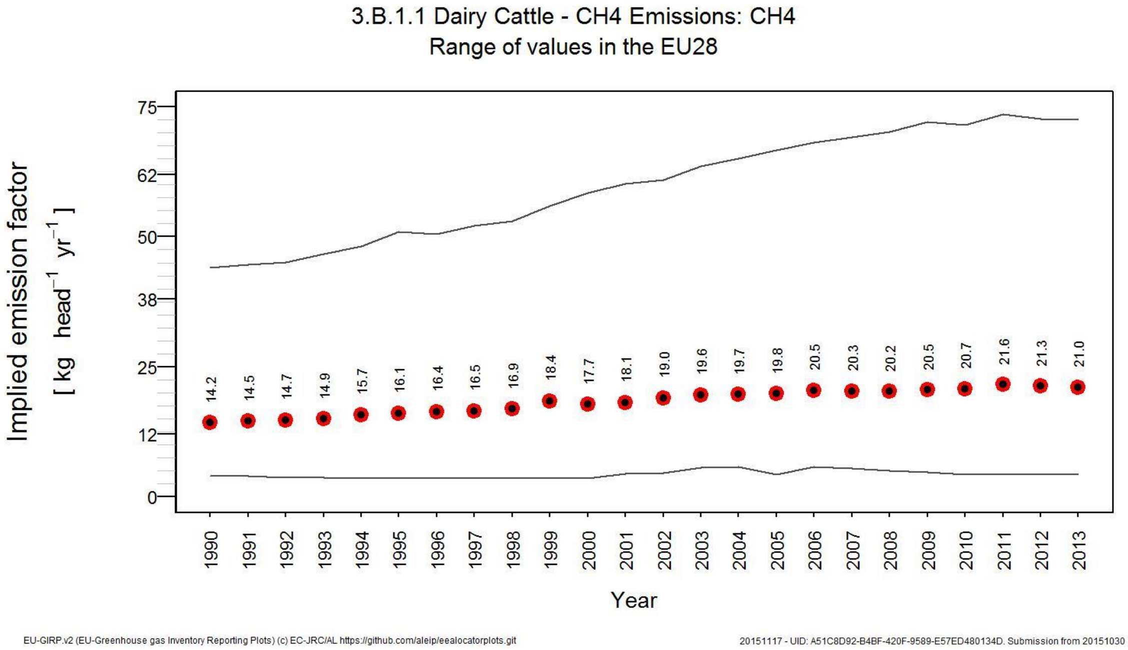


Table 5.17 3.B.1.1 - Dairy Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013	Member State	1990	2013
Austria	9.9	10.4	Italy	15.0	13.4
Belgium	14.1	27.6	Lithuania	6.1	9.2
Bulgaria	5.5	5.2	Luxembourg	14.5	24.8
Cyprus	28.1	28.0	Latvia	5.0	13.2
Czech Republic	13.1	20.0	Malta	44.0	44.0
Germany	16.7	21.2	Netherlands	26.4	41.5
Denmark	26.2	39.4	Poland	7.3	11.4
Estonia	4.0	12.8	Portugal	5.1	11.1
Spain	41.7	72.5	Romania	5.2	4.3
Finland	12.5	26.0	Sweden	6.6	8.8
France	14.1	21.2	Slovenia	21.0	32.3
Greece	10.4	13.5	Slovakia	12.5	13.0
Croatia	16.9	16.9	United Kingdom	0.0	0.0
Hungary	24.5	29.8	**EU28**	**14.2**	**21.0**
Ireland	10.6	10.2			

3.B.1.1 - Dairy Cattle - Typical animal mass

The typical animal mass, a parameter used for calculating CH_4 emissions in source category 3.B.1.1 - Dairy Cattle, increased in EU28 slightly by 3.1% or 17.9 kg between 1990 and 2013. Figure 5.25 shows the trend of the Typical animal mass in EU28 indicating also the range of values used by the countries. Table 5.18 shows the typical animal mass in source category 3.B.1.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The reported typical animal mass in 2013 was at the level of 1990 in fourteen countries and increased in all other ten countries. The three countries with the largest increases were Finland, Slovenia and United Kingdom with a mean absolute increase of 91 kg.

Figure 5.25: 3.B.1.1 - Dairy Cattle: Trend in typical animal mass in the EU28 and range of values reported by countries

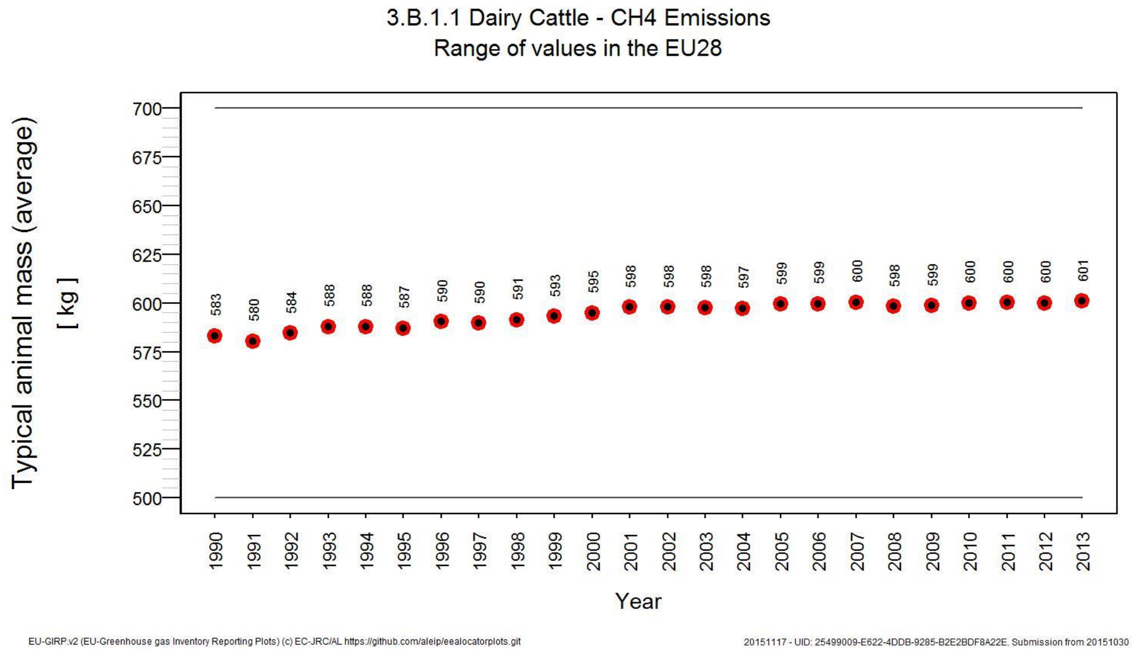


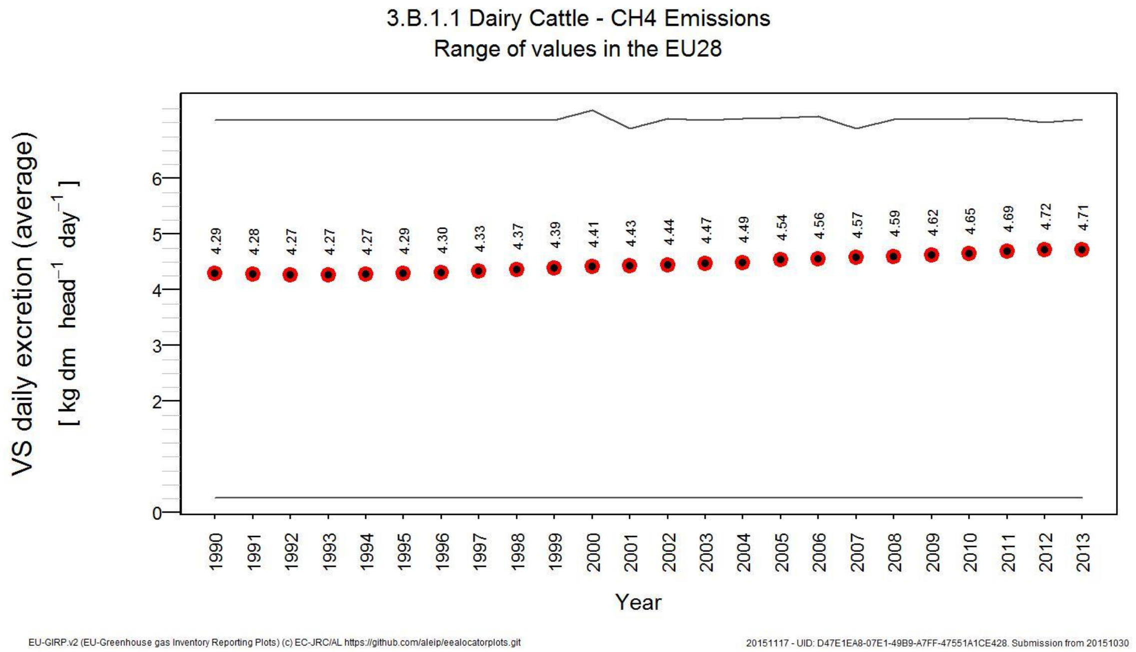
Table 5.18 3.B.1.1 - Dairy Cattle: Member States' and EU28 Typical animal mass (kg)

Member State	1990	2013		Member State	1990	2013
Austria	700	700	|	Italy	603	603
Belgium	600	600	|	Lithuania	575	596
Bulgaria	588	588	|	Luxembourg	650	650
Cyprus	550	550	|	Latvia	550	580
Germany	608	646	|	Poland	500	500
Denmark	550	580	|	Portugal	600	600
Estonia	545	548	|	Romania	650	650
Spain	598	647	|	Sweden	600	600
Finland	520	647	|	Slovenia	510	599
Greece	600	600	|	Slovakia	550	550
Croatia	563	563	|	United Kingdom	564	620
Hungary	633	641	|	**EU28**	**583**	**601**
Ireland	535	535	|			

3.B.1.1 - Dairy Cattle - VS daily excretion

The VS daily excretion, a parameter used for calculating CH_4 emissions in source category 3.B.1.1 - Dairy Cattle, increased in EU28 moderately by 9.9% or 0.425 kg dm/head/day between 1990 and 2013. Figure 5.26 shows the trend of the VS daily excretion in EU28 indicating also the range of values used by the countries. Table 5.19 shows the VS daily excretion in source category 3.B.1.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. VS daily excretion decreased in one country and increased in 22 countries. It was in 2013 at the level of 1990 in three countries. No data were available for two countries. Decreases occurred in Poland with an absolute decrease of 0.1 kg dm/head/day. The four countries with the largest increases were Czech Republic, Estonia, Portugal and Spain with a mean absolute increase of 1 kg dm/head/day.

Figure 5.26: 3.B.1.1 - Dairy Cattle: Trend in VS daily excretion in the EU28 and range of values reported by countries[31]



31 Note that data from Sweden are not included in the plot as they are reported in a different unit.

Table 5.19 3.B.1.1 - Dairy Cattle: Member States' and EU28 VS daily excretion (kg dm/head/day)

Member State	1990	2013	Member State	1990	2013
Austria	4.03	4.31	Italy	6.37	6.37
Belgium	4.01	5.02	Lithuania	4.63	5.47
Bulgaria	7.05	7.06	Luxembourg	4.75	5.40
Czech Republic	3.95	5.69	Latvia	4.51	5.70
Germany	3.47	4.01	Netherlands	3.84	4.69
Denmark	5.66	6.43	Poland	5.69	5.59
Estonia	4.44	6.12	Portugal	3.47	4.67
Spain	3.90	5.14	Romania	4.09	4.09
Finland	4.47	5.81	Sweden	1865.87	1944.92
France	3.46	4.04	Slovenia	4.51	5.17
Greece	3.68	4.80	Slovakia	6.40	6.82
Croatia	0.27	0.27	United Kingdom	3.48	4.35
Hungary	4.41	5.10	**EU28**	**4.29**	**4.71**
Ireland	2.76	2.99			

3.B.1.1 - Non-Dairy Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.B.1.1 - Non-Dairy Cattle decreased in EU28 barely by 0.19% or 0.0102 kg/head/year between 1990 and 2013. Figure 5.27 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.20 shows the implied emission factor for CH_4 emissions in source category 3.B.1.1 - Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in seven countries and increased in nineteen countries. It was in 2013 at the level of 1990 in one country. No data were available for one country. The largest decrease occurred in Spain with an absolute decrease of 2 kg/head/year. The four countries with the largest increases were Estonia, Latvia, Sweden and Lithuania with a mean absolute increase of 2 kg/head/year.

Figure 5.27: 3.B.1.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

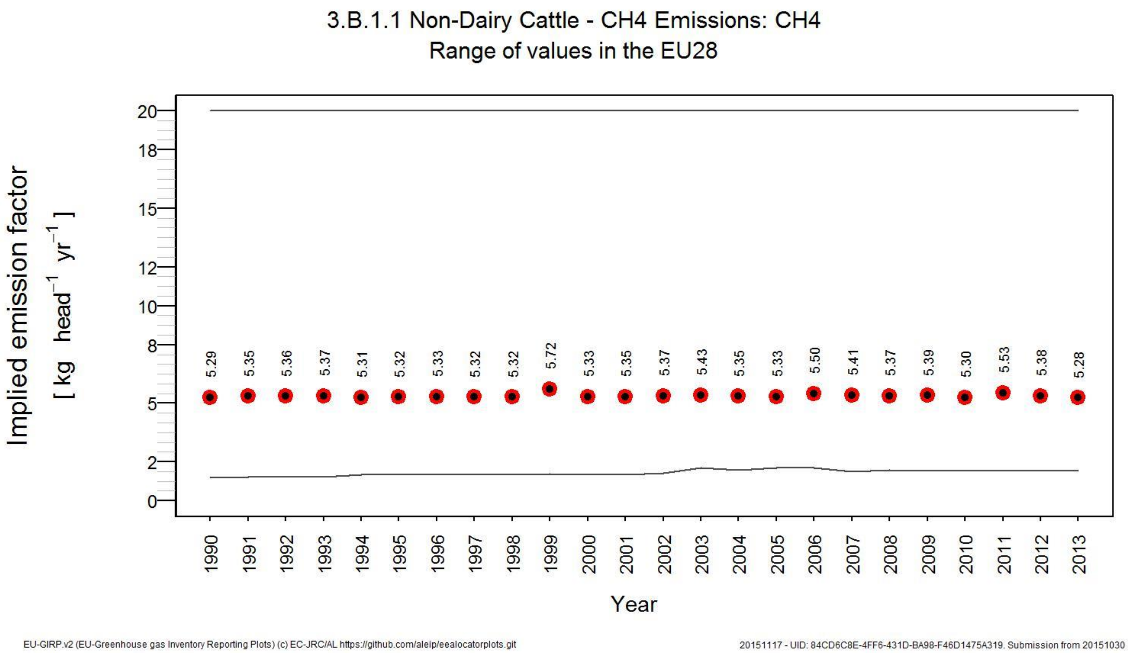


Table 5.20 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013	Member State	1990	2013
Austria	3.6	4.4	Italy	7.5	7.0
Belgium	3.1	3.5	Lithuania	3.4	5.5
Bulgaria	1.4	1.6	Luxembourg	4.9	5.2
Cyprus	13.9	13.9	Latvia	1.5	2.7
Czech Republic	8.0	8.7	Malta	20.0	20.0
Germany	7.9	7.1	Netherlands	7.8	8.6
Denmark	9.4	13.5	Poland	2.0	2.3
Estonia	1.2	3.0	Portugal	2.1	2.2
Spain	4.2	2.7	Romania	2.9	2.5
Finland	3.7	5.7	Sweden	2.1	3.7
France	4.2	4.8	Slovenia	7.4	11.9
Greece	3.3	3.5	Slovakia	4.0	4.1
Croatia	8.1	8.1	United Kingdom	0.0	0.0
Hungary	13.0	13.6	**EU28**	**5.3**	**5.3**
Ireland	5.0	4.4			

3.B.1.1 - Non-Dairy Cattle - Typical animal mass

The typical animal mass, a parameter used for calculating CH_4 emissions in source category 3.B.1.1 - Non-Dairy Cattle, increased in EU28 moderately by 6.7% or 24.9 kg between 1990 and 2013. Figure 5.28 shows the trend of the Typical animal mass in EU28 indicating also the range of values used by the countries. Table 5.21 shows the typical animal mass in source category 3.B.1.1 - Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. Typical animal mass decreased in one country and increased in twenty countries. It was in 2013 at the level of 1990 in three countries. No data were available for four countries. Decreases occurred in Ireland with an absolute decrease of 10 kg. The largest increase occurred in Finland with an absolute increase of 111 kg.

Figure 5.28: 3.B.1.1 - Non-Dairy Cattle: Trend in typical animal mass in the EU28 and range of values reported by countries

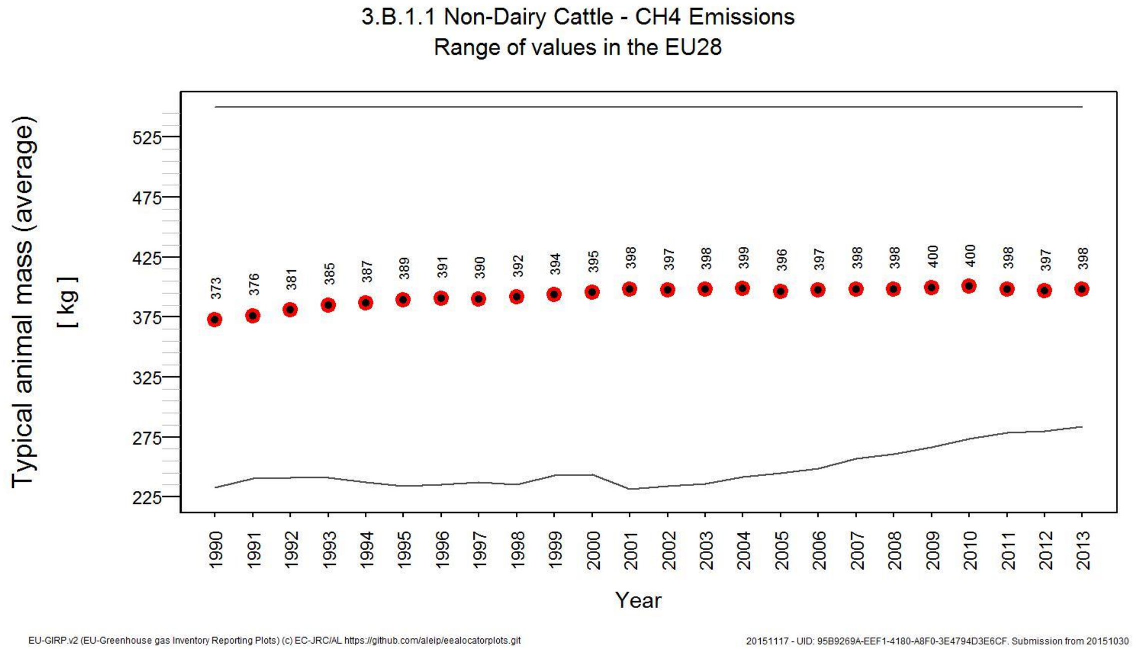


Table 5.21 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28 Typical animal mass (kg)

Member State	1990	2013	Member State	1990	2013
Austria	364	420	Ireland	349	339
Belgium	381	410	Italy	376	385
Bulgaria	314	390	Lithuania	326	330
Cyprus	350	350	Luxembourg	405	417
Germany	339	367	Latvia	387	422
Denmark	290	320	Poland	311	329
Estonia	233	283	Portugal	355	407
Spain	395	433	Romania	482	482
Finland	278	390	Sweden	550	550
France	428	435	Slovenia	289	346
Greece	374	411	Slovakia	313	328
Croatia	331	334	**EU28**	**373**	**398**
Hungary	327	352			

3.B.1.1 - Non-Dairy Cattle - VS daily excretion

The VS daily excretion, a parameter used for calculating CH_4 emissions in source category 3.B.1.1 - Non-Dairy Cattle, increased in EU28 barely by 0.28% or 0.00556 kg dm/head/day between 1990 and 2013. Figure 5.29 shows the trend of the VS daily excretion in EU28 indicating also the range of values used by the countries. Table 5.22 shows the VS daily excretion in source category 3.B.1.1 -

Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. VS daily excretion decreased in four countries and increased in twenty countries. It was in 2013 at the level of 1990 in two countries. No data were available for two countries. The three countries with the largest decreases were Spain, Ireland and Netherlands with a mean absolute decrease of 0.2 kg dm/head/day. The largest increases occurred in Finland and Denmark with a mean absolute increase of 1 kg dm/head/day.

Figure 5.29: 3.B.1.1 - Non-Dairy Cattle: Trend in VS daily excretion in the EU28 and range of values reported by countries[32]

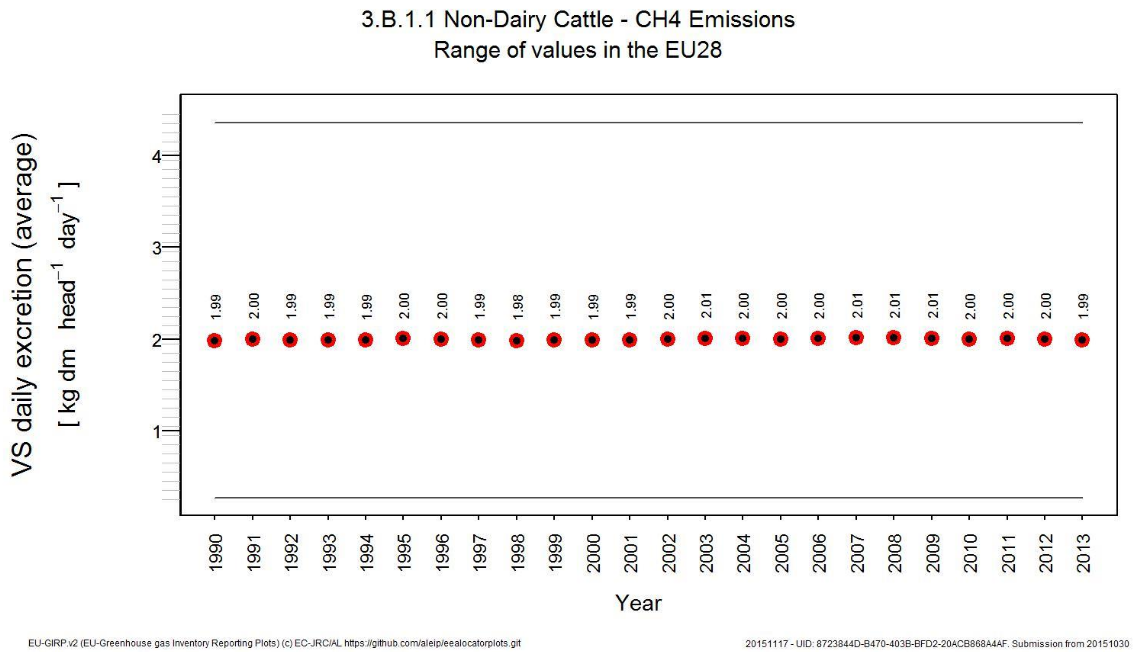


Table 5.22 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28 VS daily excretion (kg dm/head/day)

Member State	1990	2013	Member State	1990	2013
Austria	1.55	1.92	Italy	2.80	2.93
Belgium	1.69	1.87	Lithuania	2.47	2.47
Bulgaria	2.52	3.04	Luxembourg	2.48	2.60
Czech Republic	2.28	2.67	Latvia	1.96	2.07
Germany	1.37	1.38	Netherlands	1.37	1.26
Denmark	2.37	3.26	Poland	2.04	2.09
Estonia	1.94	2.21	Portugal	2.89	3.17
Spain	2.53	2.28	Romania	4.36	4.36
Finland	1.55	2.15	Sweden	547.16	532.75
France	1.87	1.91	Slovenia	2.14	2.53
Greece	2.61	2.77	Slovakia	3.05	3.12
Croatia	0.27	0.27	United Kingdom	2.78	2.85
Hungary	2.54	2.64	**EU28**	**1.99**	**1.99**
Ireland	1.43	1.31			

32 Note that data from Sweden are not included in the plot as they are reported in a different unit.

3.B.1.3 - Swine - Implied emission factor

The implied emission factor for CH_4 emissions in source category 3.B.1.3 - Swine decreased in EU28 clearly by 13.6% or 0.952 kg/head/year between 1990 and 2013. Figure 5.30 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.23 shows the implied emission factor for CH_4 emissions in source category 3.B.1.3 - Swine for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in eighteen countries and increased in seven countries. It was in 2013 at the level of 1990 in three countries. The three countries with the largest decreases were Slovenia, Netherlands and Austria with a mean absolute decrease of 4 kg/head/year. The largest increases occurred in Finland and Hungary with a mean absolute increase of 2 kg/head/year.

Figure 5.30: 3.B.1.3 - Swine: Trend in implied emission factor in the EU28 and range of values reported by countries

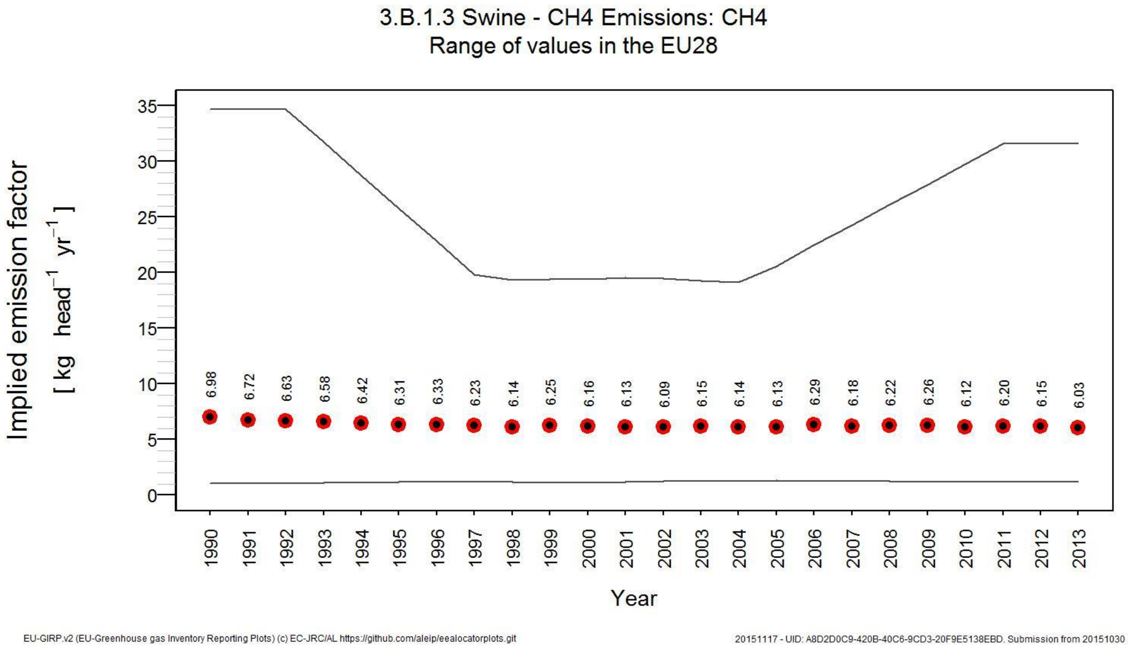


Table 5.23 3.B.1.3 - Swine: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013	Member State	1990	2013
Austria	1.6	1.2	Italy	8.1	6.7
Belgium	8.0	8.1	Lithuania	5.8	6.3
Bulgaria	34.7	31.6	Luxembourg	5.8	5.2
Cyprus	13.9	13.7	Latvia	6.4	6.4
Czech Republic	3.0	3.0	Malta	10.0	10.0
Germany	4.1	4.1	Netherlands	10.0	6.8
Denmark	3.4	2.9	Poland	3.0	3.1
Estonia	2.6	2.4	Portugal	18.9	18.7
Spain	9.5	8.9	Romania	12.2	9.5
Finland	1.9	3.3	Sweden	1.0	1.3
France	4.6	4.2	Slovenia	13.4	6.1
Greece	16.0	16.0	Slovakia	5.0	4.0
Croatia	3.0	2.9	United Kingdom	5.8	5.2
Hungary	4.8	7.5	**EU28**	**7.0**	**6.0**
Ireland	5.2	5.0			

3.B.1.3 - Swine - Typical animal mass

The typical animal mass, a parameter used for calculating CH_4 emissions in source category 3.B.1.3 - Swine, decreased in EU28 slightly by 3.8% or 2.87 kg between 1990 and 2013. Figure 5.31 shows the trend of the Typical animal mass in EU28 indicating also the range of values used by the countries. Table 5.24 shows the typical animal mass in source category 3.B.1.3 - Swine for the years 1990 and 2013 for all Member States and EU28. Typical animal mass decreased in nine countries and increased in five countries. It was in 2013 at the level of 1990 in three countries. No data were available for eleven countries. The three countries with the largest decreases were Ireland, Belgium and Croatia with a mean absolute decrease of 6 kg. The three countries with the largest increases were Denmark, Estonia and Italy with a mean absolute increase of 4 kg.

Figure 5.31: 3.B.1.3 - Swine: Trend in typical animal mass in the EU28 and range of values reported by countries

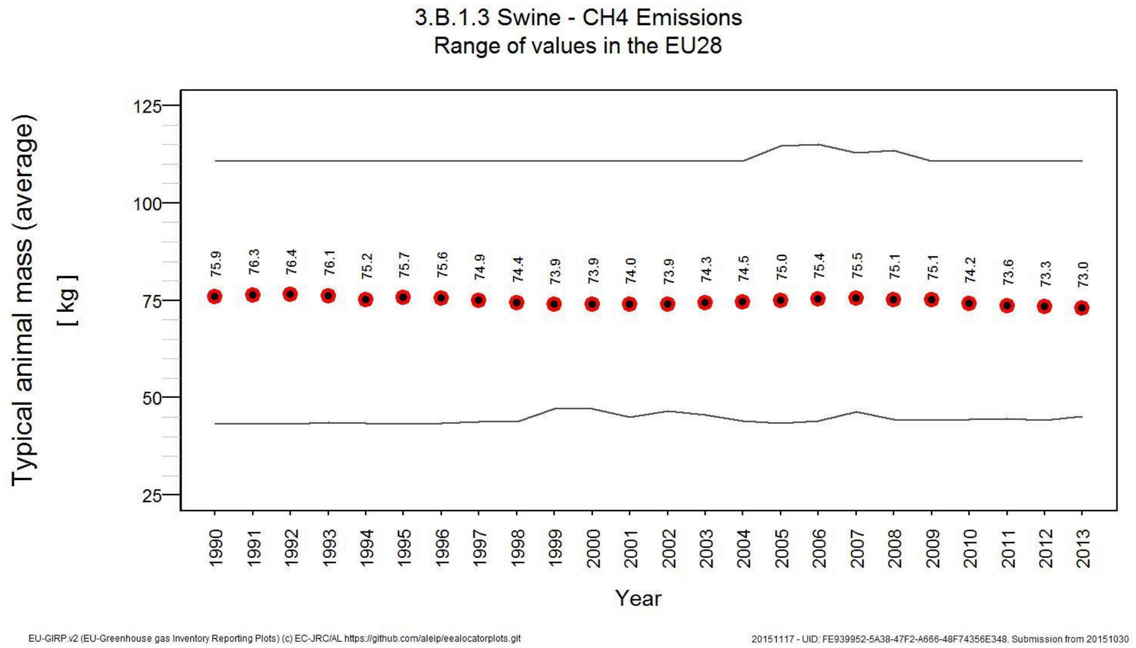


Table 5.24 3.B.1.3 - Swine: Member States' and EU28 Typical animal mass (kg)

Member State	1990	2013		Member State	1990	2013
Belgium	69	64	|	Hungary	63	65
Bulgaria	109	104	|	Ireland	63	58
Cyprus	68	65	|	Italy	79	81
Germany	67	63	|	Lithuania	63	60
Denmark	98	107	|	Luxembourg	92	86
Estonia	43	45	|	Portugal	62	58
Spain	62	63	|	Romania	111	111
Greece	50	50	|	Sweden	52	52
Croatia	88	81	|	**EU28**	**76**	**73**

3.B.1.3 - Swine - VS daily excretion

The VS daily excretion, a parameter used for calculating CH_4 emissions in source category 3.B.1.3 - Swine, decreased in EU28 clearly by 11.7% or 0.0406 kg dm/head/day between 1990 and 2013. Figure 5.32 shows the trend of the VS daily excretion in EU28 indicating also the range of values used by the countries. Table 5.25 shows the VS daily excretion in source category 3.B.1.3 - Swine for the years 1990 and 2013 for all Member States and EU28. VS daily excretion decreased in eleven countries and increased in five countries. It was in 2013 at the level of 1990 in three countries. No data were available for nine countries. The largest decrease occurred in Netherlands with an absolute decrease of 0.2 kg dm/head/day. The three countries with the largest increases were Germany, Sweden and Estonia with a mean absolute increase of 3 kg dm/head/day.

Figure 5.32: 3.B.1.3 - Swine: Trend in VS daily excretion in the EU28 and range of values reported by countries[33]

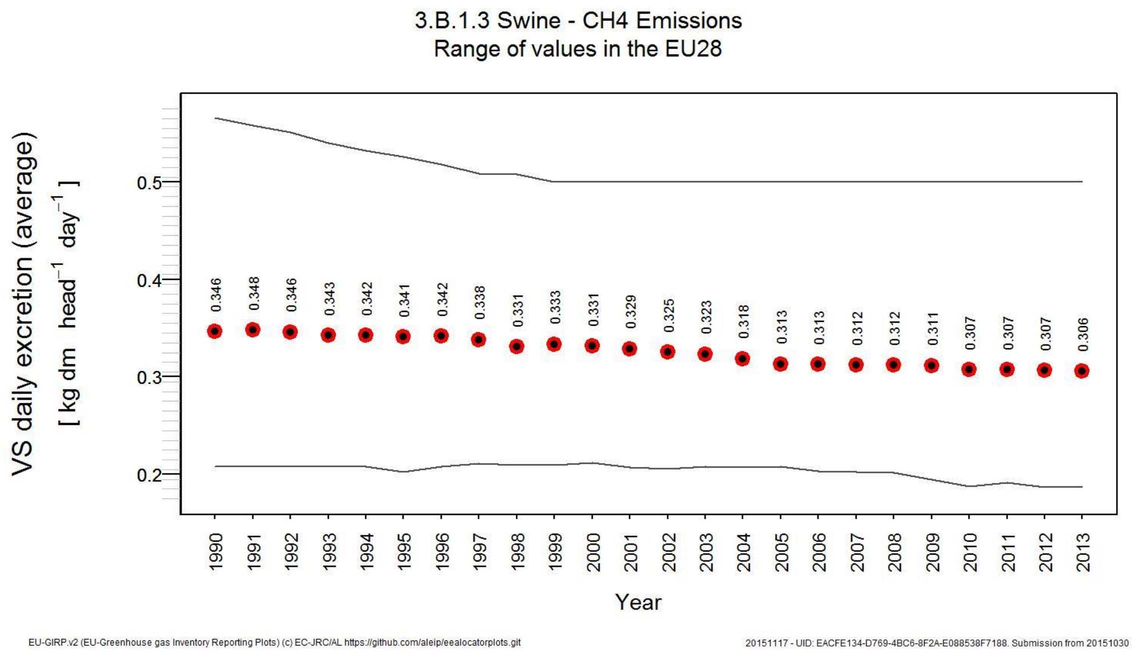


Table 5.25 3.B.1.3 - Swine: Member States' and EU28 VS daily excretion (kg dm/head/day)

Member State	1990	2013		Member State	1990	2013
Austria	0.27	0.27	|	Ireland	0.28	0.27
Belgium	0.39	0.40	|	Italy	0.37	0.34
Bulgaria	0.49	0.49	|	Lithuania	0.38	0.38
Germany	0.26	0.30	|	Luxembourg	0.32	0.31
Denmark	0.24	0.19	|	Netherlands	0.57	0.37
Estonia	0.26	0.27	|	Portugal	0.28	0.27
Spain	0.30	0.29	|	Romania	0.28	0.28
Finland	0.21	0.21	|	Sweden	104.07	112.21
Croatia	0.36	0.35	|	Slovenia	0.32	0.31
Hungary	0.50	0.50	|	**EU28**	**0.35**	**0.31**

33 Note that data from Sweden are not included in the plot as they are reported in a different unit.

5.2.2 Manure Management - N_2O (CRF Source Category 3B2)

N_2O emissions from source category 3.B.2 - Manure Management are 0.49% of total EU28 GHG emissions and 8.8% of total EU28 N_2O emissions. They make 5% of total agricultural emissions. The main sub-categories are 3.B.2.1 (Cattle), 3.B.2.5 (Indirect Emissions) and 3.B.2.4 (Other Livestock) as shown in Figure 5.33.

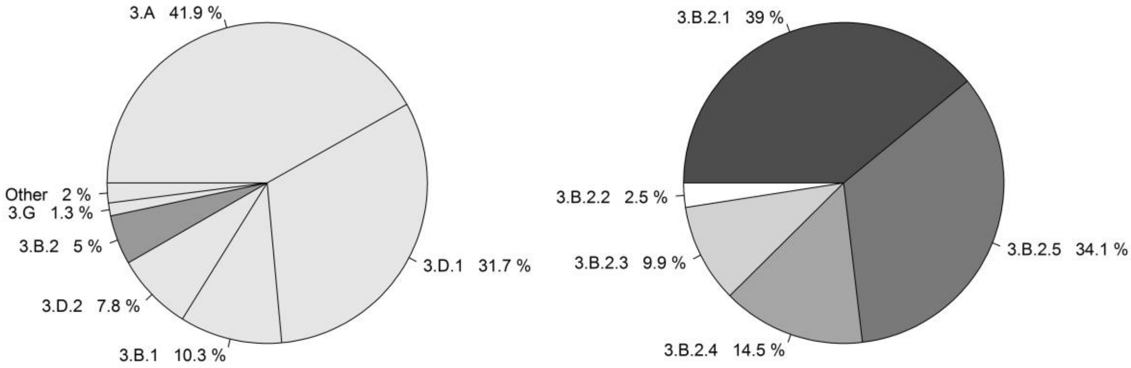


Figure 5.33: Share of source category 3.B.2 on total EU28 agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emission in the year 2013.

Total GHG and N_2O emissions by Member States from 3.B.2 Manure Management are shown in Table 5.26. Between 1990 and 2013, N_2O emission from Manure Management decreased by 30% or 9.6 Mt CO_2-eq. The decrease was largest in Lithuania in relative terms (69%) and in Czech Republic in absolute terms (60% or 1.8 Mt CO_2-eq). From 2012 to 2013 emissions decreased by 0.4%.

Table 5.26 3.B.2 - Manure Management: Member States' contributions to total GHG and N_2O emissions

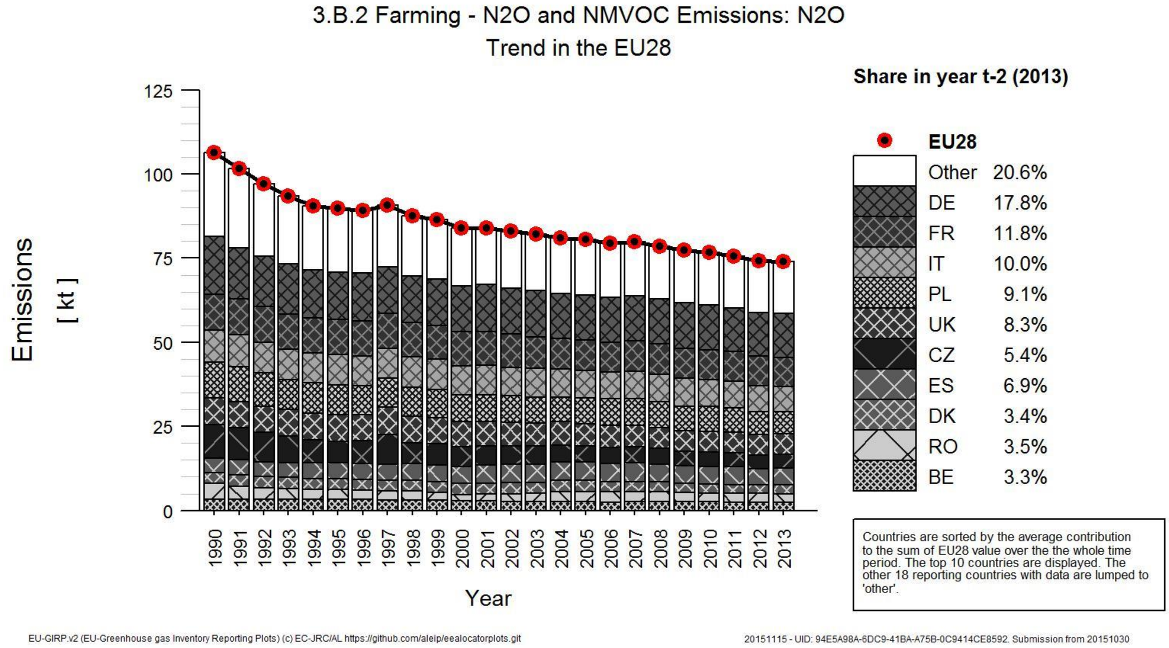
Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	991	842	453	445	537	397
Belgium	2 827	2 598	979	730	1 849	1 868
Bulgaria	4 751	870	883	358	3 868	511
Croatia	677	318	324	141	353	178
Cyprus	454	410	325	253	129	157
Czech Republic	4 261	1 759	2 981	1 195	1 280	564
Denmark	2 707	2 673	978	755	1 729	1 918
Estonia	265	142	157	73	107	69
Finland	652	740	284	285	368	455
France	8 490	8 135	3 178	2 602	5 312	5 533
Germany	13 188	10 255	5 114	3 912	8 073	6 344
Greece	1 190	1 152	305	329	884	824
Hungary	2 634	1 361	819	403	1 816	958
Ireland	1 838	1 760	496	518	1 342	1 242
Italy	6 798	5 348	2 864	2 198	3 934	3 149
Latvia	714	248	305	111	409	137
Lithuania	1 229	441	544	167	685	274
Luxembourg	97	99	45	39	52	60
Malta	34	33	6	7	28	27
Netherlands	6 351	4 751	530	419	5 821	4 332
Poland	5 960	3 845	3 163	1 994	2 797	1 851
Portugal	1 664	1 380	249	208	1 415	1 172
Romania	5 854	2 382	1 400	762	4 454	1 620
Slovakia	1 807	626	1 246	447	561	179
Slovenia	587	359	164	96	423	263
Spain	7 451	9 173	1 293	1 511	6 157	7 662
Sweden	507	510	262	249	246	261
United Kingdom	6 757	5 271	2 317	1 822	4 440	3 449
EU-28	**90 735**	**67 481**	**31 665**	**22 025**	**59 070**	**45 456**

Trends in Emissions and Activity Data

3.B.2 - Manure Management - Emissions

Emissions in source category 3.B.2 - Manure Management decreased strongly in EU28 by 30% or 9.6 Mt CO_2-eq. Figure 5.34 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 79.4% of manure Management N_2O emissions. Emissions decreased in 23 countries and increased in five countries. The three countries with the largest decreases were Czech Republic, Germany and Poland with a total absolute decrease of 4.2 Mt CO_2-eq. Largest increases occurred in Spain with a total absolute increase of 218 kt CO_2-eq.

Figure 5.34: 3.B.2 Manure Management: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.B.2.1 - Cattle - Emissions

N_2O emissions in source category 3.B.2.1 - Cattle are 0.19% of total EU28 GHG emissions and 3.4% of total EU28 N_2O emissions. They make 2% of total agricultural emissions.

Total GHG and N_2O emissions by Member States from 3.B.2.1 Manure Management are shown in Table 5.27. Between 1990 and 2013, N_2O emission from Cattle decreased by 37% or 5 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (69%) and in Germany in absolute terms (33% or 1 Mt CO_2-eq). From 2012 to 2013 emissions decreased by 0.9%. Figure 5.35 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 80.2% of cattle N_2O emissions. Emissions decreased in 20 countries and increased in seven countries. The four countries with the largest decreases were Germany, Czech Republic, Slovakia and Italy with a total absolute decrease of 3.2 Mt CO_2-eq. The four countries with the largest increases were Finland, Ireland, Greece and Spain with a total absolute increase of 95 kt CO_2-eq.

Main Activity Data for N_2O emissions from Manure Management - Cattle are the animal numbers. Cattle numbers are already discussed under source category 3.A Enteric Fermentation and therefore not further discussed here.

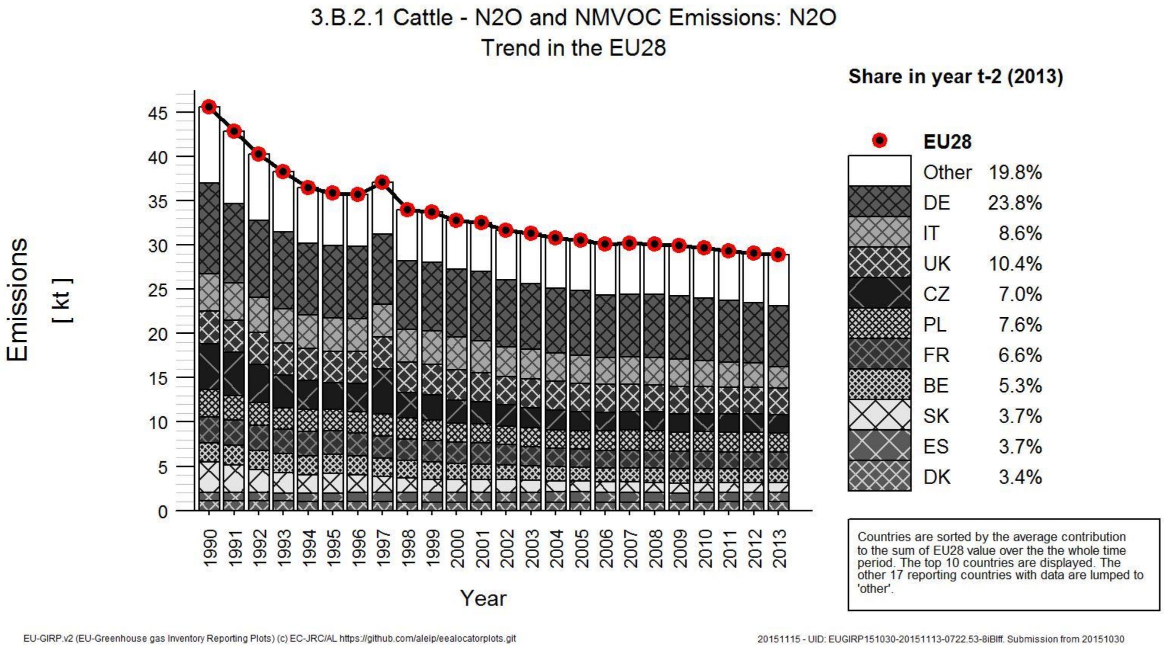
Other activity Data is:

- N-allocation by MMS.

Table 5.27 3.B.2.1 - Cattle: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	258	264	264	3%	1	0%	6	2%
Belgium	651	457	457	5%	0	0%	-194	-30%
Bulgaria	572	257	260	3%	3	1%	-312	-55%
Croatia	92	34	34	0%	0	-1%	-58	-63%
Cyprus	9	9	9	0%	0	-2%	0	3%
Czech Republic	1 525	606	602	7%	-3	-1%	-922	-60%
Denmark	326	292	295	3%	2	1%	-32	-10%
Estonia	55	26	27	0%	1	5%	-28	-51%
Finland	128	142	140	2%	-1	-1%	12	9%
France	877	563	564	7%	1	0%	-313	-36%
Germany	3 052	2 015	2 042	24%	27	1%	-1 009	-33%
Greece	57	73	74	1%	2	2%	17	31%
Hungary	281	146	150	2%	5	3%	-130	-46%
Ireland	241	253	258	3%	5	2%	17	7%
Italy	1 267	826	738	9%	-88	-11%	-529	-42%
Latvia	125	47	49	1%	2	5%	-75	-60%
Lithuania	204	74	74	1%	0	0%	-131	-64%
Luxembourg	22	17	18	0%	1	3%	-4	-16%
Malta	2	2	2	0%	0	-1%	1	44%
Netherlands	IE	IE	IE	-	-	-	-	-
Poland	918	680	655	8%	-25	-4%	-263	-29%
Portugal	62	54	53	1%	-1	-2%	-9	-15%
Romania	214	101	102	1%	1	1%	-112	-52%
Slovakia	1 032	324	321	4%	-3	-1%	-711	-69%
Slovenia	48	23	22	0%	-1	-2%	-26	-54%
Spain	271	321	320	4%	-1	0%	49	18%
Sweden	179	161	168	2%	6	4%	-11	-6%
United Kingdom	1 107	905	898	10%	-7	-1%	-209	-19%
EU-28	**13 573**	**8 671**	**8 596**	**100%**	**-75**	**-1%**	**-4 976**	**-37%**

Figure 5.35: 3.B.2.1 - Cattle: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.B.2.1 - Cattle - Emissions

Main Activity Data for N_2O emissions from Manure Management - Cattle are the animal numbers. Cattle numbers are already discussed under source category 3.A Enteric Fermentation and therefore not further discussed here.

Other activity Data:

- N-allocation by MMS.

3.B.2.5 - Manure Management - Indirect Emissions - Emissions

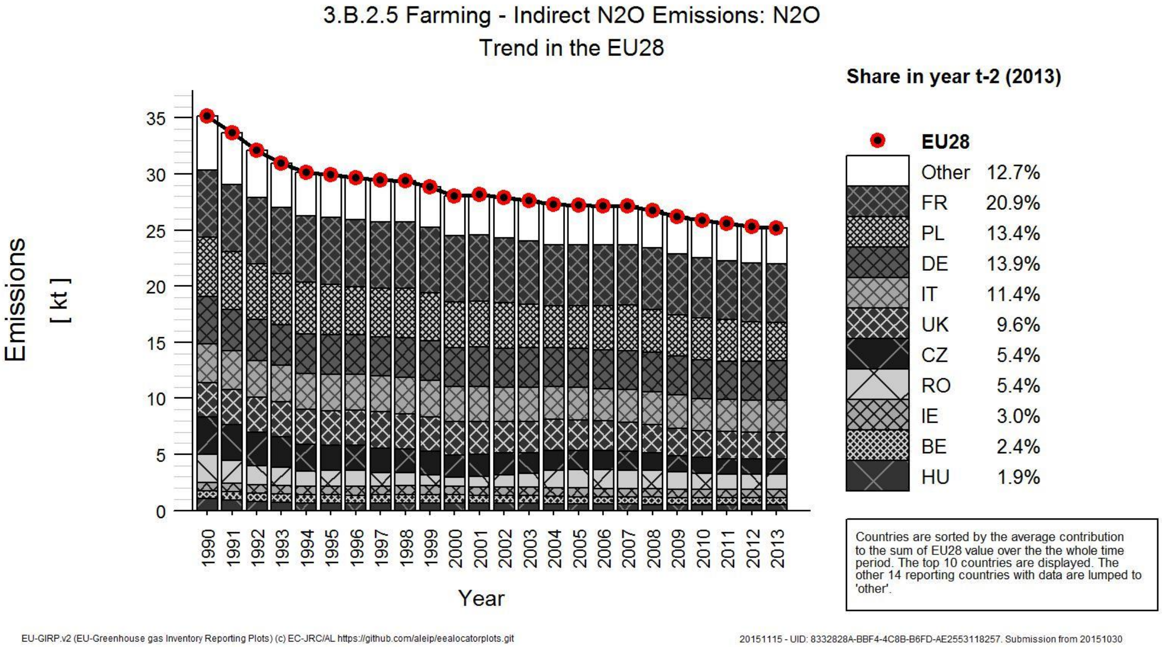
N_2O emissions in source category 3.B.2.5 - Manure Management - Indirect Emissions are 0.17% of total EU28 GHG emissions and 3% of total EU28 N_2O emissions. They make 1.7% of total agricultural emissions.

Total GHG and N_2O emissions by Member States from 3.B.2.5 Manure Management - Indirect Emissions are shown in Table 5.28. Between 1990 and 2013, N_2O emission from Manure Management - Indirect Emissions decreased by 28% or 3 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (72%) and in Czech Republic in absolute terms (59% or 583 kt CO_2-eq). From 2012 to 2013 emissions decreased by 0.4%. Figure 5.36 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 87.6% of indirect N_2O emissions. Emissions decreased in 20 countries and increased in four countries. The three countries with the largest decreases were Czech Republic, Poland and Romania with a total absolute decrease of 1.5 Mt CO_2-eq. The three countries with the largest increases were Austria, Ireland and Greece with a total absolute increase of 23 kt CO_2-eq. Note that Figure 5.36 shows the then countries contributing most to EU28 total over the whole time period with Hungary contributing with 1.9% while the number above refers to the year 2013 with Greece contributing with 2.2% explaining the slight deviation in the presented numbers.

Table 5.28 3.B.2.5 - Manure Management - Indirect Emissions: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	107	111	111	1%	0	0%	4	4%
Belgium	218	187	181	2%	-5	-3%	-37	-17%
Bulgaria	3	1	1	0%	0	0%	-2	-72%
Croatia	192	93	94	1%	1	1%	-97	-51%
Cyprus	61	54	49	1%	-5	-10%	-13	-20%
Czech Republic	985	398	402	5%	4	1%	-583	-59%
Denmark	197	152	140	2%	-11	-8%	-57	-29%
Estonia	68	29	30	0%	1	2%	-38	-56%
Finland	99	91	91	1%	0	0%	-8	-8%
France	1 797	1 565	1 568	21%	3	0%	-229	-13%
Germany	1 242	1 035	1 044	14%	9	1%	-199	-16%
Greece	157	166	167	2%	2	1%	10	6%
Hungary	309	145	145	2%	0	0%	-164	-53%
Ireland	216	223	225	3%	3	1%	9	4%
Italy	1 035	852	856	11%	4	0%	-179	-17%
Latvia	142	46	48	1%	2	4%	-95	-67%
Lithuania	230	83	82	1%	-2	-2%	-148	-65%
Luxembourg	21	17	18	0%	0	2%	-3	-14%
Malta	3	3	3	0%	0	-2%	0	14%
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	1 579	1 045	1 008	13%	-37	-4%	-571	-36%
Portugal	110	91	91	1%	-1	-1%	-20	-18%
Romania	745	408	405	5%	-3	-1%	-340	-46%
Slovakia	IE	IE	IE	-	-	-	-	-
Slovenia	43	28	28	0%	0	-1%	-15	-35%
Spain	NE	NE	NE	-	-	-	-	-
Sweden	IE	IE	IE	-	-	-	-	-
United Kingdom	923	716	723	10%	8	1%	-200	-22%
EU-28	**10 483**	**7 538**	**7 509**	**100%**	**-29**	**0%**	**-2 973**	**-28%**

Figure 5.36: 3.B.2.5 - Manure Management - Indirect Emissions: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.B.2.4 - Other Livestock - Emissions

N_2O emissions in source category 3.B.2.4 - Other Livestock are 0.071% of total EU28 GHG emissions and 1.3% of total EU28 N_2O emissions. They make 0.72% of total agricultural emissions.

Total GHG and N_2O emissions by Member States from 3.B.2.4 Manure Management are shown in Table 5.29. Between 1990 and 2013, N_2O emission from Other Livestock decreased by 8% or 289 kt CO_2-eq. The decrease was largest in Croatia in relative terms (63%) and in Bulgaria in absolute terms (62% or 125 kt CO_2-eq). From 2012 to 2013 emissions increased by 2.8%. Figure 5.37 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 85.7% of other Livestock N_2O emissions. Emissions decreased in 17 countries and increased in eleven countries. The four countries with the largest decreases were Bulgaria, Romania, Netherlands and Poland with a total absolute decrease of 450 kt CO_2-eq. Largest increases occurred in Italy and Spain with a total absolute increase of 231 kt CO_2-eq.

Table 5.29 3.B.2.4 - Other Livestock: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	24	26	26	1%	0	0%	2	7%
Belgium	10	15	15	0%	0	1%	5	49%
Bulgaria	202	82	77	2%	-5	-6%	-125	-62%
Croatia	21	9	8	0%	-1	-12%	-13	-63%
Cyprus	246	212	188	6%	-24	-11%	-58	-23%
Czech Republic	83	54	61	2%	7	12%	-23	-27%
Denmark	46	57	62	2%	5	9%	17	36%
Estonia	12	5	6	0%	1	13%	-6	-51%
Finland	29	38	38	1%	1	1%	10	33%
France	354	371	376	12%	5	1%	22	6%
Germany	198	215	218	7%	3	1%	21	10%
Greece	30	29	29	1%	0	0%	-1	-3%
Hungary	34	26	24	1%	-1	-5%	-10	-29%
Ireland	10	12	12	0%	-1	-5%	1	13%
Italy	292	378	380	12%	2	0%	88	30%
Latvia	22	9	10	0%	1	9%	-12	-57%
Lithuania	8	7	7	0%	0	5%	-1	-7%
Luxembourg	0	1	1	0%	0	-4%	0	32%
Malta	0	0	0	0%	0	-5%	0	-40%
Netherlands	530	411	419	13%	8	2%	-111	-21%
Poland	157	61	58	2%	-3	-6%	-99	-63%
Portugal	60	55	54	2%	0	0%	-6	-9%
Romania	264	143	149	5%	6	4%	-115	-44%
Slovakia	66	54	51	2%	-3	-5%	-15	-23%
Slovenia	34	26	26	1%	0	0%	-8	-23%
Spain	660	718	803	25%	85	12%	143	22%
Sweden	40	45	46	1%	1	2%	6	16%
United Kingdom	45	43	44	1%	1	2%	0	-1%
EU-28	**3 477**	**3 102**	**3 188**	**100%**	**86**	**3%**	**-289**	**-8%**

3.B.2.4.7 - Poultry - Emissions

Largest contribution to emissions comes from sub-category Poultry with 52% of total N_2O emissions. Other animal types with high emissions are Other Other Livestock with a share of 32% and Horses with a share of 11%. Here only the most important animal type Poultry is discussed.

Emissions in source category 3.B.2.4.7 - Poultry decreased clearly in EU28 by 12% or 224 kt CO_2-eq. Figure 5.38 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 91.1% of poultry N_2O emissions. Emissions decreased in 17 countries and increased in nine countries. The three countries with the largest decreases were Bulgaria, Romania and Cyprus with a total absolute decrease of 279 kt CO_2-eq. The three countries with the largest increases were Italy, Germany and Spain with a total absolute increase of 157 kt CO_2-eq.

3.A.4.7 - Poultry - Population

As population data for Poultry have not yet been discussed, this will be done here. Poultry population decreased slightly in EU28 by 3.9% or 51.8 mio heads. Figure 5.39 shows the trend of poultry population indicating the countries contributing most to EU28 total. The ten countries with highest population together accounted for 85.5% of Poultry population. Population decreased in 13 countries and increased in fourteen countries. The four countries with the largest decreases were Poland, Romania, Hungary and Bulgaria with a total absolute decrease of 184 mio heads. The four countries with the largest increases were Italy, Spain, United Kingdom and Germany with a total absolute increase of 146 mio heads.

Other activity Data:

- N on MMS

Figure 5.37: 3.B.2.4 - Other Livestock: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

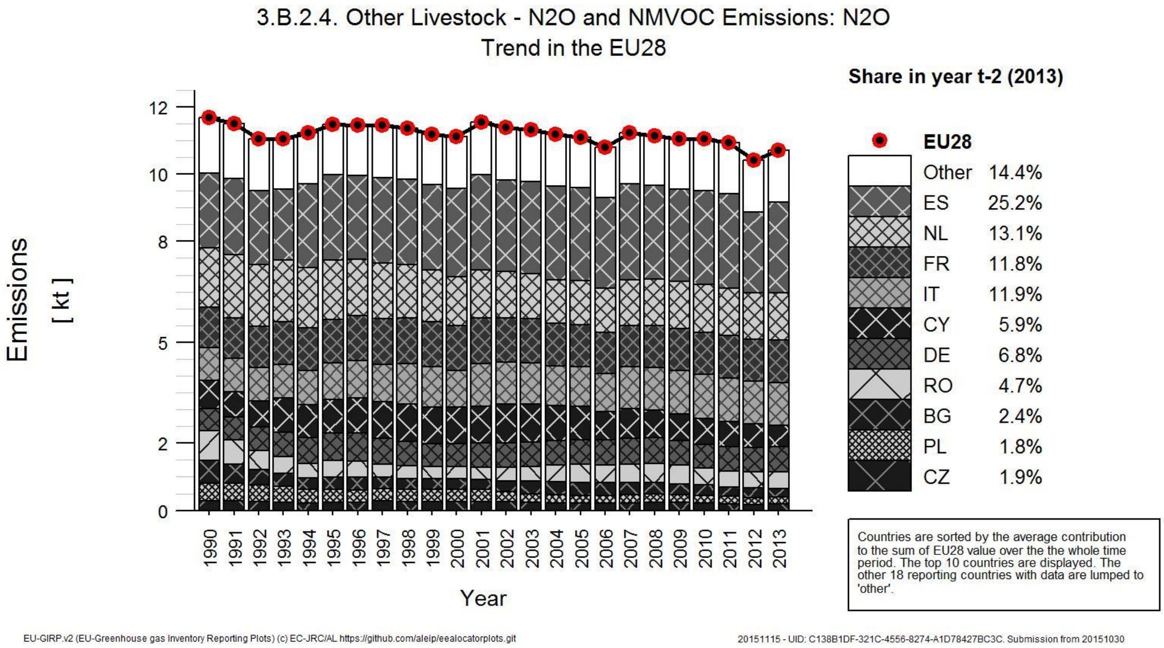


Figure 5.38: 3.B.2.4.7 - Poultry: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

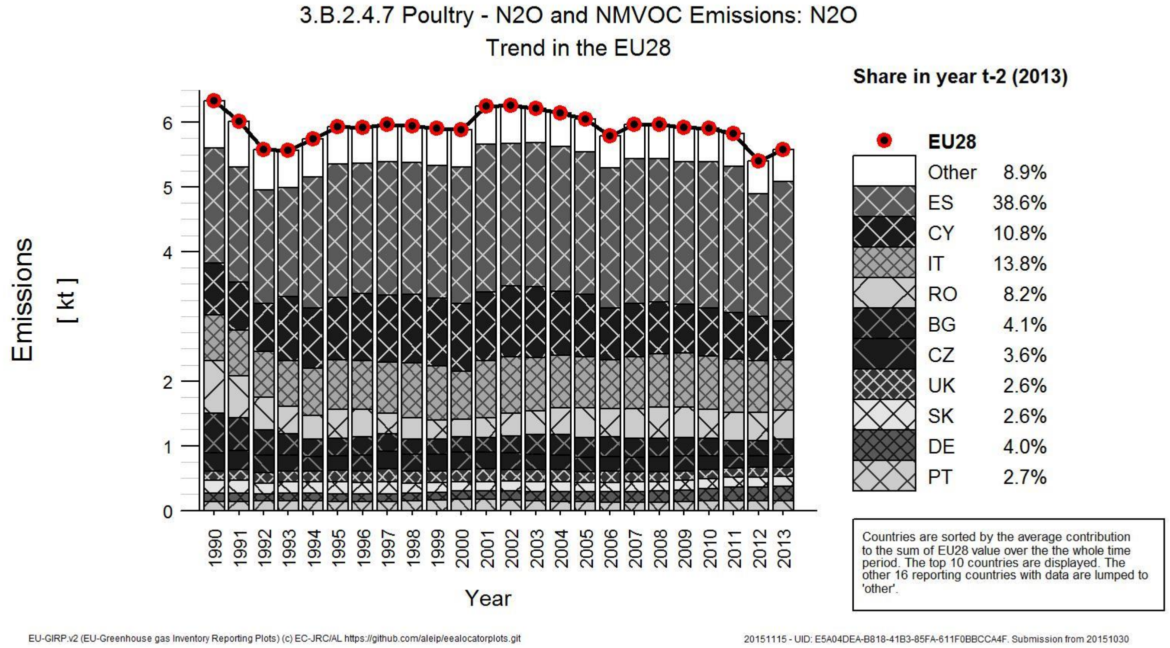
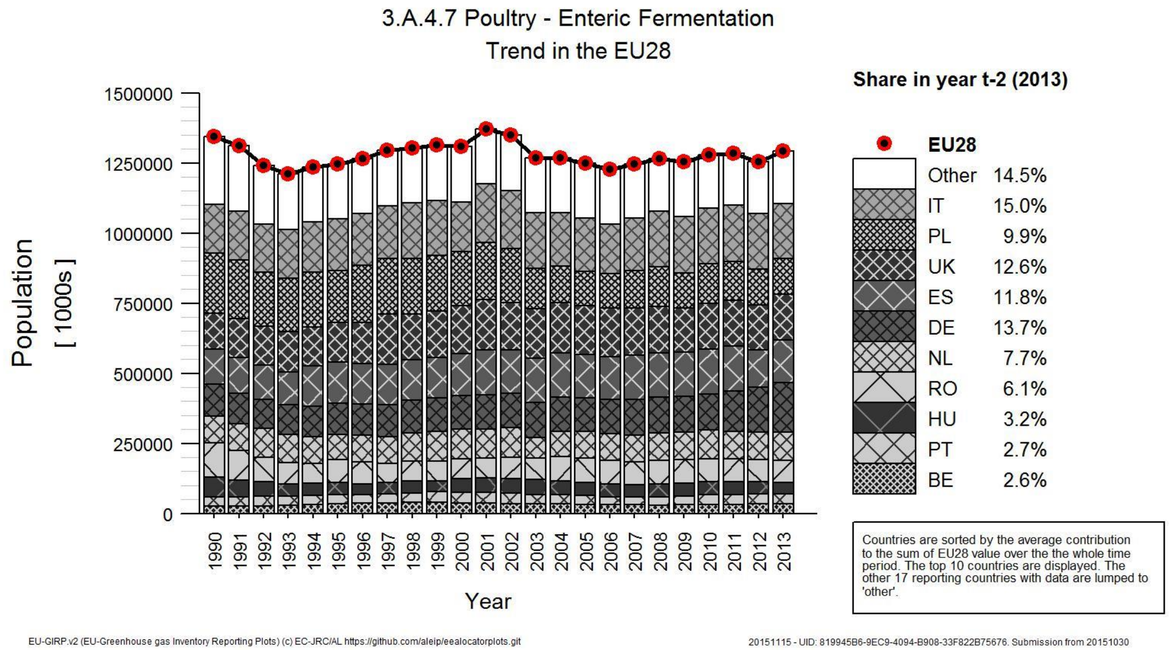


Figure 5.39: 3.A.4.7 - Poultry: Trend in population in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



Implied EFs and Methodological Issues

In this section we discuss the Implied Emission Factor for the main animal types. Furthermore, we present data on the Nitrogen Excretion Rate.

3.B.2.1 - Cattle - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.B.2.1 - Cattle decreased in EU28 clearly by 13.6% or 0.0549 kg/head/year between 1990 and 2013. Figure 5.40 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.30 shows the implied emission factor for N_2O emissions in source category 3.B.2.1 - Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in nine countries and increased in seventeen countries. No data were available for one country. The three countries with the largest decreases were Slovenia, Croatia and France with a mean absolute decrease of 0.1 kg/head/year. The four countries with the largest increases were Finland, Latvia, Estonia and Austria with a mean absolute increase of 0.1 kg/head/year.

Figure 5.40: 3.B.2.1 - Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

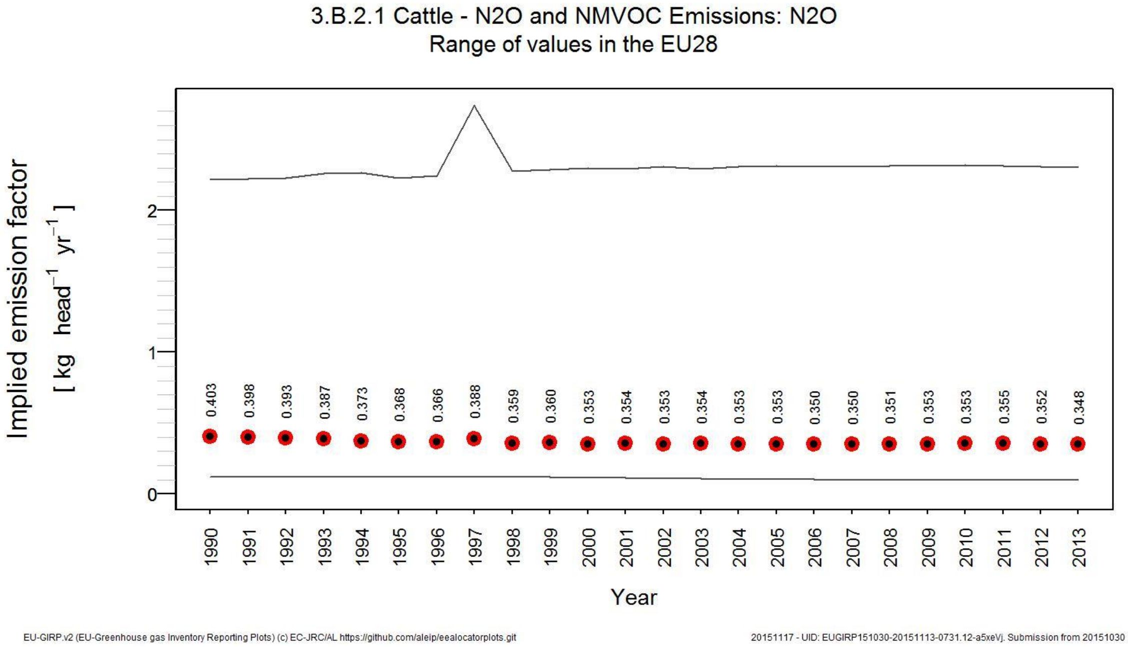


Table 5.30 3.B.2.1 - Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	0.34	0.453	|	Ireland	0.12	0.126
Belgium	0.67	0.620	|	Italy	0.55	0.424
Bulgaria	1.20	1.585	|	Lithuania	0.30	0.346
Cyprus	0.54	0.538	|	Luxembourg	0.33	0.312
Czech Republic	1.46	1.494	|	Latvia	0.29	0.409
Germany	0.53	0.540	|	Malta	0.86	0.844
Denmark	0.49	0.612	|	Poland	0.31	0.393
Estonia	0.25	0.344	|	Portugal	0.15	0.118
Spain	0.18	0.187	|	Romania	0.14	0.171
Finland	0.32	0.516	|	Sweden	0.35	0.376
France	0.14	0.099	|	Slovenia	0.30	0.161
Greece	0.28	0.352	|	Slovakia	2.22	2.305
Croatia	0.36	0.247	|	United Kingdom		
Hungary	0.58	0.659	|	**EU28**	**0.40**	**0.348**

3.B.2.1 - Dairy Cattle - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.B.2.1 - Dairy Cattle increased in EU28 slightly by 1.6% or 0.01 kg/head/year between 1990 and 2013. Figure 5.41 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.31 shows the implied emission factor for N_2O emissions in source category 3.B.2.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in eight countries and increased in seventeen countries. No data were available for three countries. The largest decreases occurred in France and Croatia with a mean absolute decrease of 0.1 kg/head/year. The four countries with the largest increases were Spain, Greece, Portugal and Finland with a mean absolute increase of 0.3 kg/head/year.

Figure 5.41: 3.B.2.1 - Dairy Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

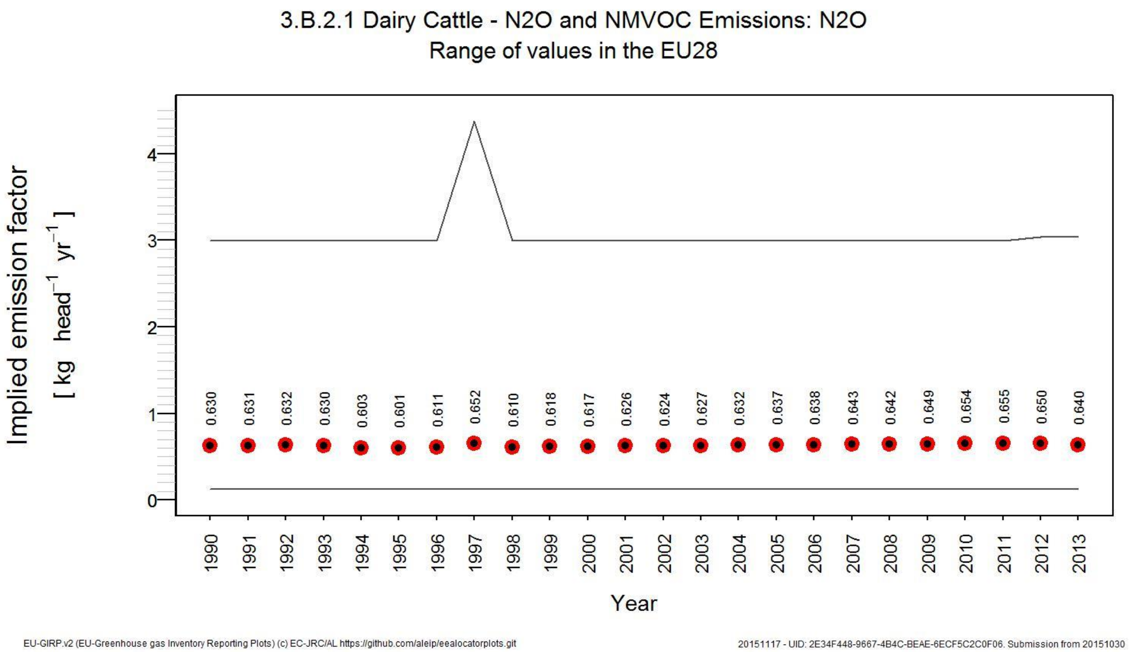


Table 5.31 3.B.2.1 - Dairy Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	0.44	0.69	|	Ireland	0.13	0.12
Belgium	0.93	0.75	|	Italy	0.87	0.68
Bulgaria	1.74	1.98	|	Lithuania	0.39	0.48
Cyprus	0.82	0.79	|	Luxembourg	0.65	0.68
Czech Republic	2.38	3.04	|	Latvia	0.47	0.71
Germany	0.83	0.80	|	Poland	0.40	0.58
Denmark	0.88	1.03	|	Portugal	0.33	0.53
Estonia	0.38	0.55	|	Romania	0.17	0.21
Spain	0.41	0.90	|	Sweden	0.63	0.75
Finland	0.48	0.77	|	Slovenia	0.32	0.32
France	0.23	0.15	|	Slovakia	2.99	2.99
Greece	0.36	0.73	|	United Kingdom	0.00	0.00
Croatia	0.39	0.28	|	**EU28**	**0.63**	**0.64**
Hungary	0.88	1.06	|			

3.B.2.1 - Dairy Cattle - Nitrogen excretion rate

The nitrogen excretion rate, a parameter used for calculating N_2O emissions in source category 3.B.2.1 - Dairy Cattle, increased in EU28 considerably by 17.1% or 15.7 kg/head/year between 1990 and 2013. Figure 5.42 shows the trend of the Nitrogen excretion rate in EU28 indicating also the range of values used by the countries. Table 5.32 shows the nitrogen excretion rate in source category 3.B.2.1 - Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. Nitrogen excretion rate decreased in one country and increased in 21 countries. It was in 2013 at the level of 1990 in five countries. No data were available for one country. Decreases occurred in Netherlands with an absolute decrease of 25 kg/head/year. The four countries with the largest increases were Greece, Spain, Finland and Portugal with a mean absolute increase of 40 kg/head/year.

Figure 5.42: 3.B.2.1 - Dairy Cattle: Trend in nitrogen excretion rate in the EU28 and range of values reported by countries

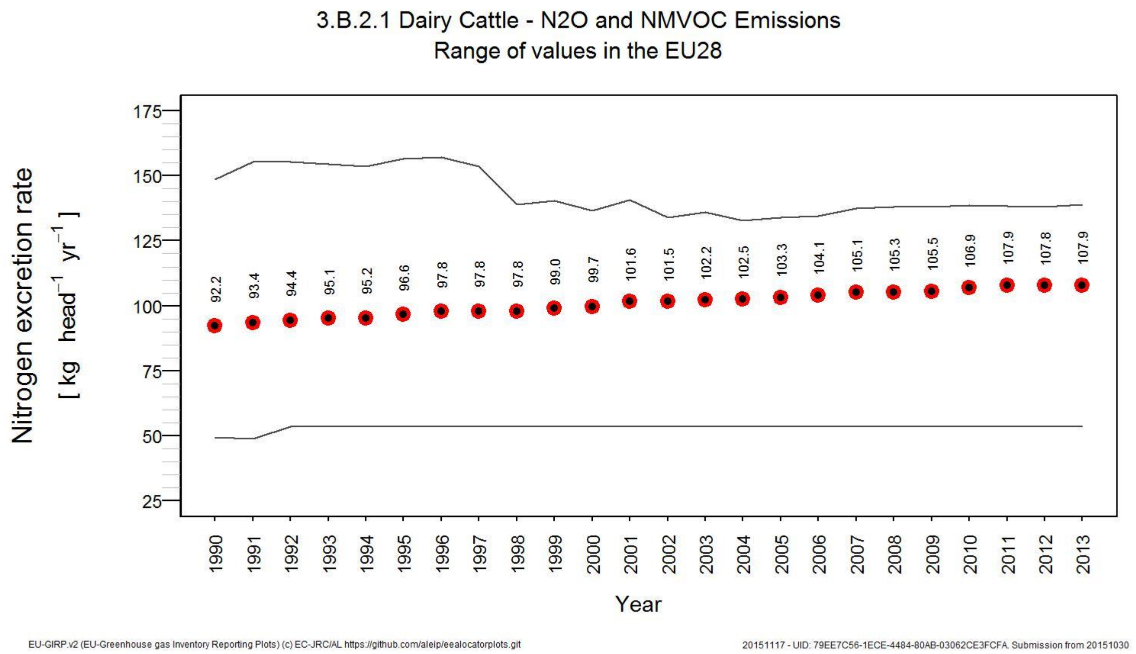


Table 5.32 3.B.2.1 - Dairy Cattle: Member States' and EU28 Nitrogen excretion rate (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	77	101	|	Ireland	96	101
Belgium	114	118	|	Italy	116	116
Bulgaria	100	100	|	Lithuania	82	101
Cyprus	96	96	|	Luxembourg	110	126
Czech Republic	102	136	|	Latvia	100	118
Germany	98	117	|	Netherlands	149	123
Denmark	129	139	|	Poland	65	83
Estonia	85	115	|	Portugal	86	117
Spain	69	110	|	Romania	54	54
Finland	91	129	|	Sweden	105	126
France	102	112	|	Slovenia	82	110
Greece	49	101	|	Slovakia	100	100
Croatia	70	88	|	United Kingdom	97	124
Hungary	83	102	|	**EU28**	**92**	**108**

3.B.2.1 - Non-Dairy Cattle - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.B.2.1 - Non-Dairy Cattle decreased in EU28 considerably by 16.8% or 0.0486 kg/head/year between 1990 and 2013. Figure 5.43 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.33 shows the implied emission factor for N_2O emissions in source category 3.B.2.1 - Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in eleven countries and increased in fourteen countries. It was in 2013 at the level of 1990 in one country. No data were available for two countries. The three countries with the largest decreases were Slovenia, Portugal and Croatia with a mean absolute decrease of 0.1 kg/head/year. The four countries with the largest increases were Finland, Estonia, Austria and Bulgaria with a mean absolute increase of 0.1 kg/head/year.

Figure 5.43: 3.B.2.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28 and range of values reported by countries

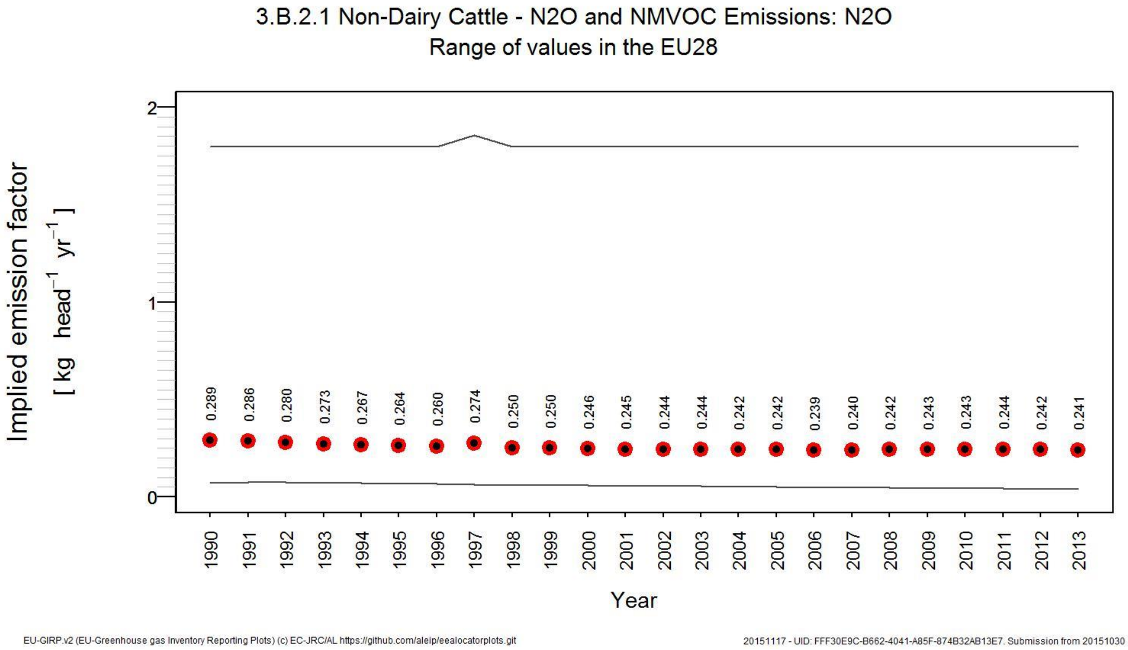


Table 5.33 3.B.2.1 - Non-Dairy Cattle: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	0.277	0.363	|	Ireland	0.116	0.127
Belgium	0.581	0.589	|	Italy	0.384	0.306
Bulgaria	0.865	1.126	|	Lithuania	0.243	0.243
Cyprus	0.356	0.345	|	Luxembourg	0.211	0.199
Czech Republic	0.976	0.917	|	Latvia	0.184	0.203
Germany	0.377	0.410	|	Malta	0.861	0.844
Denmark	0.292	0.378	|	Poland	0.215	0.244
Estonia	0.169	0.224	|	Portugal	0.078	0.041
Spain	0.071	0.065	|	Romania	0.092	0.117
Finland	0.223	0.402	|	Sweden	0.209	0.264
France	0.105	0.087	|	Slovenia	0.290	0.112
Greece	0.240	0.264	|	Slovakia	1.796	1.796
Croatia	0.323	0.227	|	United Kingdom	0.000	0.000
Hungary	0.422	0.468	|	**EU28**	**0.289**	**0.241**

3.B.2.1 - Non-Dairy Cattle - Nitrogen excretion rate

The nitrogen excretion rate, a parameter used for calculating N_2O emissions in source category 3.B.2.1 - Non-Dairy Cattle, increased in EU28 slightly by 4.8% or 2.25 kg/head/year between 1990 and 2013. Figure 5.44 shows the trend of the Nitrogen excretion rate in EU28 indicating also the range of values used by the countries. Table 5.34 shows the nitrogen excretion rate in source category 3.B.2.1 - Non-Dairy Cattle for the years 1990 and 2013 for all Member States and EU28. Nitrogen excretion rate decreased in four countries and increased in twenty countries. It was in 2013 at the level of 1990 in four countries. The largest decrease occurred in Netherlands with an absolute decrease of 17 kg/head/year. The largest increase occurred in Finland with an absolute increase of 16 kg/head/year.

Figure 5.44: 3.B.2.1 - Non-Dairy Cattle: Trend in nitrogen excretion rate in the EU28 and range of values reported by countries

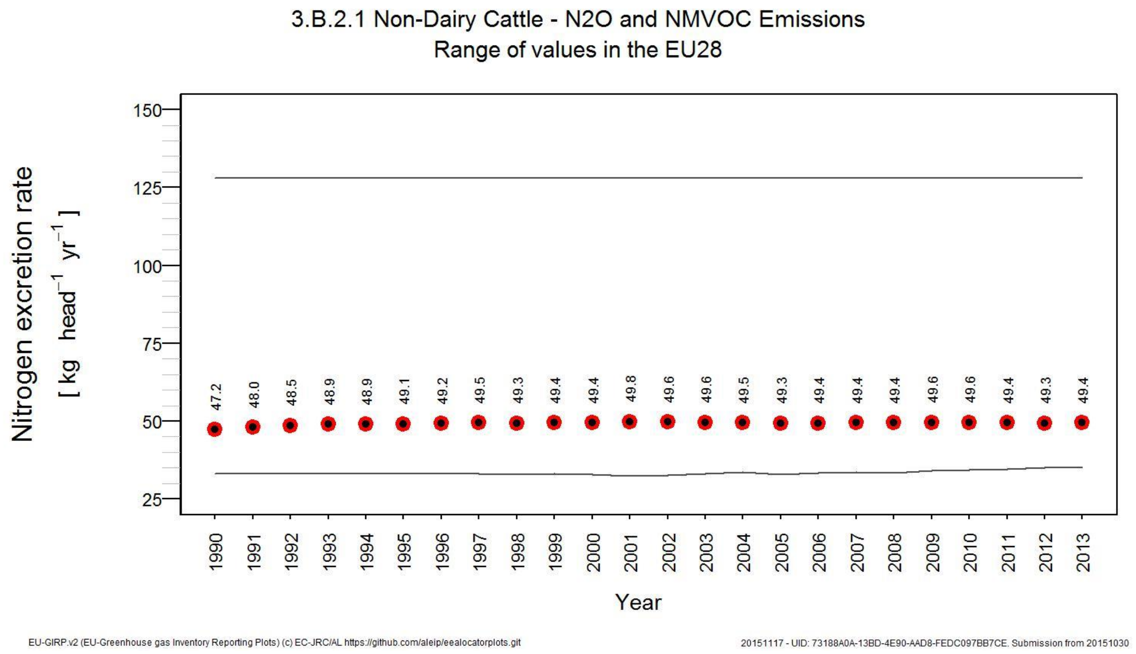


Table 5.34 3.B.2.1 - Non-Dairy Cattle: Member States' and EU28 Nitrogen excretion rate (kg/head/year)

Member State	1990	2013	Member State	1990	2013
Austria	40	46	Italy	50	51
Belgium	54	54	Lithuania	41	41
Bulgaria	50	57	Luxembourg	47	50
Cyprus	42	42	Latvia	43	46
Czech Republic	59	69	Malta	128	128
Germany	41	43	Netherlands	57	40
Denmark	36	44	Poland	33	35
Estonia	38	41	Portugal	44	50
Spain	43	43	Romania	38	38
Finland	34	51	Sweden	39	42
France	57	59	Slovenia	35	42
Greece	48	53	Slovakia	60	60
Croatia	55	50	United Kingdom	53	54
Hungary	44	50	**EU28**	**47**	**49**
Ireland	49	51			

3.B.2.5 - Atmospheric deposition from Manure Management - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.B.2.5 - Atmospheric deposition from Manure Management decreased in EU28 barely by 0.22% or 3.53e-05 kg N_2O/kg N between 1990 and 2013. Figure 5.45 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.35 shows the implied emission factor for N_2O emissions in source category 3.B.2.5 - Atmospheric deposition from Manure Management for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in three countries and increased in five countries. It was in 2013 at the level of 1990 in sixteen countries. No data were available for four countries. Decreases occurred in Poland, Germany and Bulgaria with a mean absolute decrease of 2.3e-06 kg N_2O/kg N. The largest increase occurred in Malta with an absolute increase of 0.0037 kg N_2O/kg N.

Figure 5.45: 3.B.2.5 - Atmospheric deposition from Manure Management: Trend in implied emission factor in the EU28 and range of values reported by countries

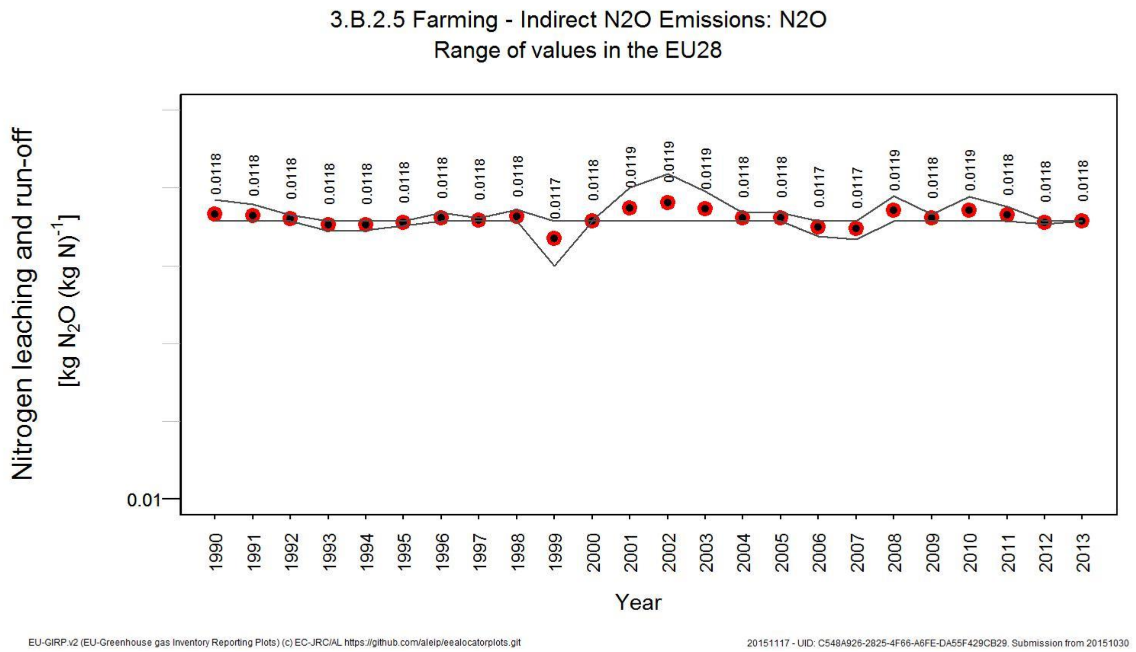


Table 5.35 3.B.2.5 - Atmospheric deposition from Manure Management: Member States' and EU28 Implied emission factor (kg N_2O/kg N)

Member State	1990	2013	Member State	1990	2013
Austria	0.016	0.016	Ireland	0.016	0.016
Belgium	0.016	0.016	Italy	0.016	0.016
Bulgaria	0.016	0.016	Lithuania	0.016	0.016
Cyprus	0.016	0.016	Luxembourg	0.016	0.016
Czech Republic	0.016	0.016	Latvia	0.016	0.016
Germany	0.016	0.016	Malta	0.012	0.016
Denmark	0.016	0.016	Poland	0.016	0.016
Estonia	0.016	0.016	Portugal	0.016	0.016
Finland	0.016	0.016	Romania	0.016	0.016
France	0.016	0.016	Slovenia	0.016	0.016
Greece	0.016	0.016	United Kingdom	0.016	0.016
Croatia	0.025	0.025	**EU28**	**0.016**	**0.016**
Hungary	0.016	0.016			

3.B.2.4.7 - Poultry - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.B.2.4.7 - Poultry decreased in EU28 moderately by 7.7% or 0.000392 kg/head/year between 1990 and 2013. Figure 5.46 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.36 shows the implied emission factor for N_2O emissions in source category 3.B.2.4.7 - Poultry for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in seventeen countries and increased in eight countries. It was in 2013 at the level of 1990 in one country. No data were available for two countries. The three countries with the largest decreases were Finland, Latvia and Denmark with a mean absolute decrease of 0.00096 kg/head/year. The largest increase occurred in Luxembourg with an absolute increase of 0.0013 kg/head/year.

Figure 5.46: 3.B.2.4.7 - Poultry: Trend in implied emission factor in the EU28 and range of values reported by countries

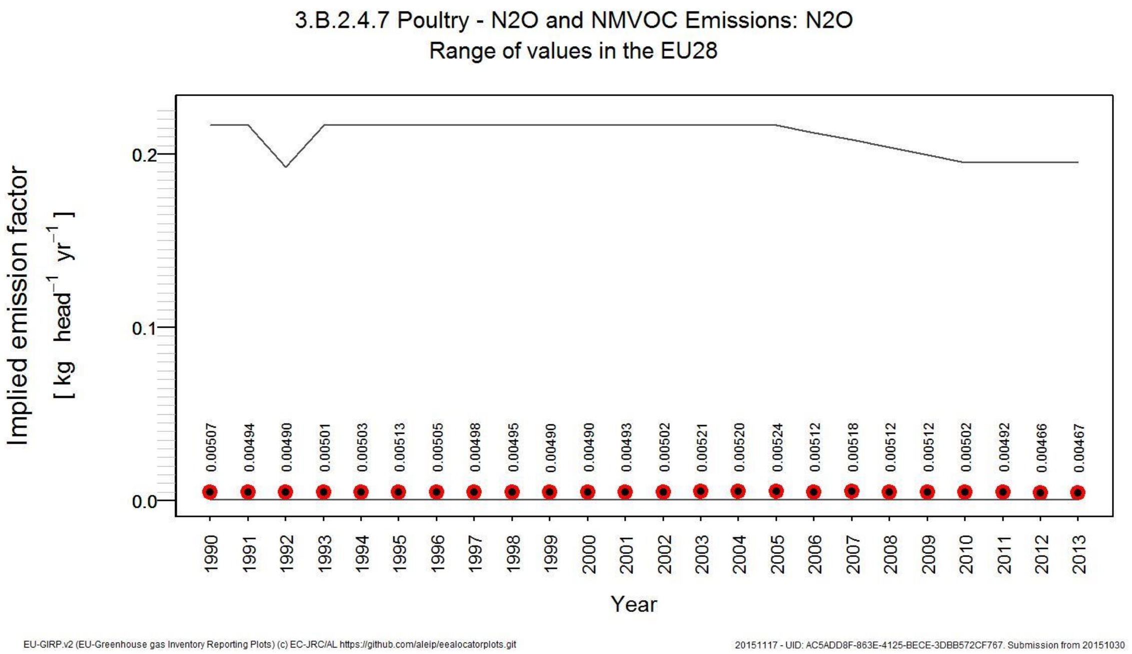


Table 5.36 3.B.2.4.7 - Poultry: Member States' and EU28 Implied emission factor (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	0.00462	0.00393	|	Italy	0.00409	0.00397
Belgium	0.00094	0.00095	|	Lithuania	0.00053	0.00060
Bulgaria	0.01585	0.01605	|	Luxembourg	0.00431	0.00560
Cyprus	0.21681	0.19515	|	Latvia	0.00377	0.00233
Czech Republic	0.00872	0.00872	|	Malta	0.00107	0.00106
Germany	0.00110	0.00125	|	Poland	0.00078	0.00076
Denmark	0.00112	0.00082	|	Portugal	0.00435	0.00432
Estonia	0.00337	0.00332	|	Romania	0.00662	0.00574
Spain	0.01424	0.01410	|	Sweden	0.00435	0.00399
Finland	0.00288	0.00173	|	Slovenia	0.00999	0.01091
Greece	0.00085	0.00085	|	Slovakia	0.01205	0.01344
Croatia	0.00507	0.00438	|	United Kingdom	0.00113	0.00089
Hungary	0.00135	0.00142	|	**EU28**	**0.00507**	**0.00467**
Ireland	0.00109	0.00102	|			

3.B.2.4.7 - Poultry - Nitrogen excretion rate

The nitrogen excretion rate, a parameter used for calculating N_2O emissions in source category 3.B.2.4.7 - Poultry, decreased in EU28 slightly by 4.9% or 0.031 kg/head/year between 1990 and 2013. Figure 5.47 shows the trend of the Nitrogen excretion rate in EU28 indicating also the range of values used by the countries. Table 5.37 shows the nitrogen excretion rate in source category 3.B.2.4.7 - Poultry for the years 1990 and 2013 for all Member States and EU28. Nitrogen excretion rate decreased in ten countries and increased in ten countries. It was in 2013 at the level of 1990 in seven countries. No data were available for one country. The three countries with the largest decreases were Denmark, United Kingdom and Netherlands with a mean absolute decrease of 0.1

kg/head/year. The largest increase occurred in Luxembourg with an absolute increase of 0.2 kg/head/year.

Figure 5.47: 3.B.2.4.7 - Poultry: Trend in nitrogen excretion rate in the EU28 and range of values reported by countries

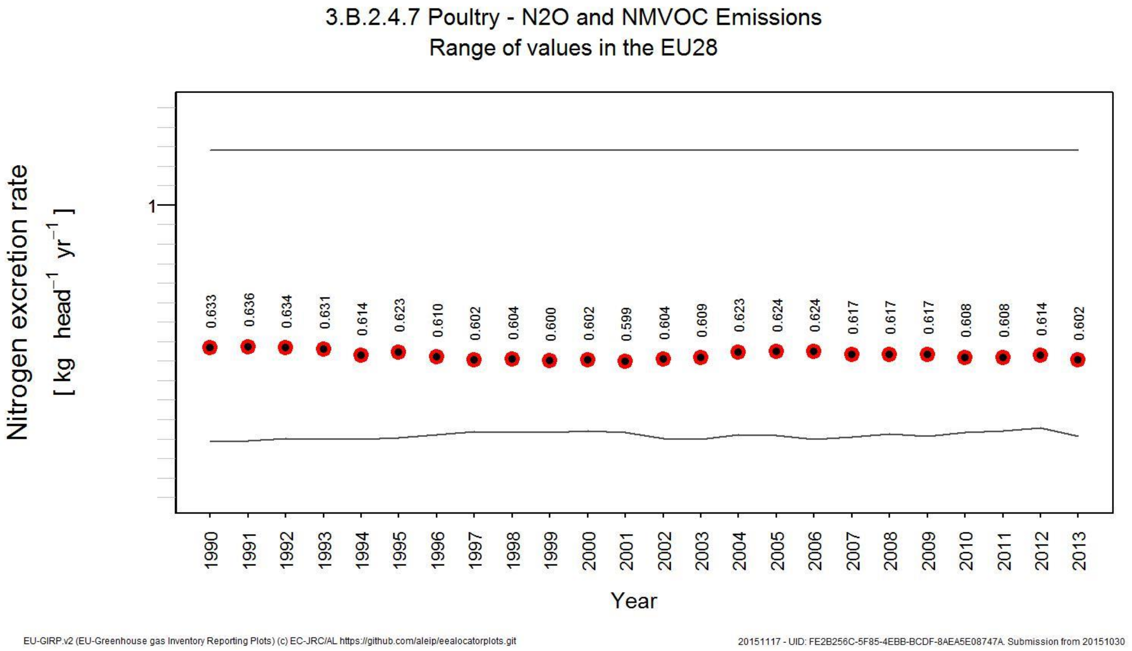


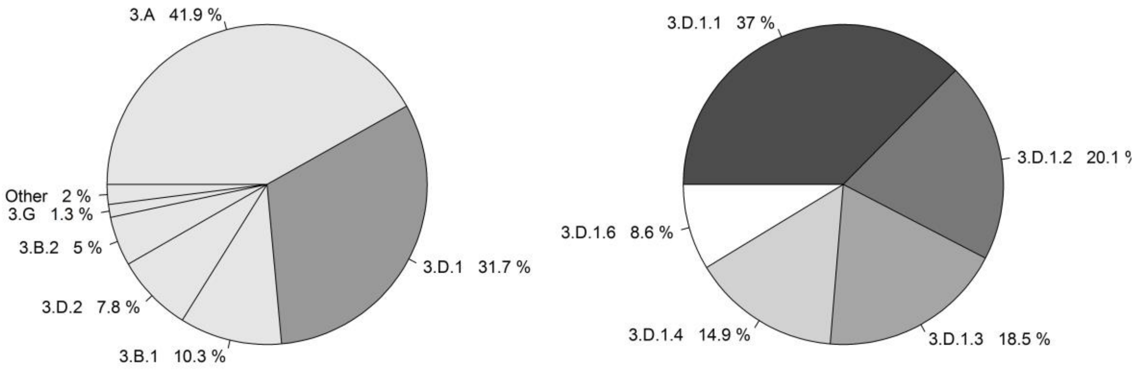
Table 5.37 3.B.2.4.7 - Poultry: Member States' and EU28 Nitrogen excretion rate (kg/head/year)

Member State	1990	2013		Member State	1990	2013
Austria	0.59	0.54	|	Italy	0.52	0.51
Belgium	0.60	0.60	|	Lithuania	0.39	0.41
Bulgaria	0.94	0.93	|	Luxembourg	0.55	0.71
Cyprus	0.91	0.91	|	Latvia	0.60	0.60
Czech Republic	0.60	0.60	|	Malta	0.87	0.87
Germany	0.69	0.71	|	Netherlands	0.68	0.61
Denmark	0.63	0.50	|	Poland	0.50	0.53
Estonia	0.44	0.43	|	Portugal	0.55	0.56
Spain	0.45	0.45	|	Romania	1.14	1.14
Finland	0.50	0.55	|	Sweden	0.46	0.42
Greece	0.50	0.50	|	Slovenia	0.47	0.51
Croatia	0.85	0.85	|	Slovakia	0.74	0.76
Hungary	0.48	0.56	|	United Kingdom	0.73	0.58
Ireland	0.60	0.54	|	**EU28**	**0.63**	**0.60**

5.2.3 Direct Emissions from Managed Soils - N_2O (CRF Source Category 3D1)

N_2O emissions from source category 3.D.1 Direct N_2O Emissions From Managed Soils are 3.1% of total EU28 GHG emissions and 56% of total EU28 N_2O emissions. They make 31.7% of total agricultural emissions. The main sub-categories are 3.D.1.1 (Inorganic N Fertilizers), 3.D.1.2 (Organic N Fertilizers) and 3.D.1.3 (Urine and Dung Deposited by Grazing Animals) as shown in Figure 5.48.

Figure 5.48: Share of source category 3.D.1 on total EU28 agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emission in the year 2013.



Total GHG and N_2O emissions by Member States from 3.D.1 Direct N_2O Emissions From Managed Soils are shown in Table 5.38. Between 1990 and 2013, N_2O emission from Direct N_2O Emissions From Managed Soils decreased by 18% or 30.6 Mt CO_2-eq. The decrease was largest in Cyprus in relative terms (70%) and in Netherlands in absolute terms (40% or 3 Mt CO_2-eq). From 2012 to 2013 emissions increased by 1.3%.

Table 5.38 3.D.1 - Direct N_2O Emissions From Managed Soils : Member States' contributions to total GHG and N_2O emissions

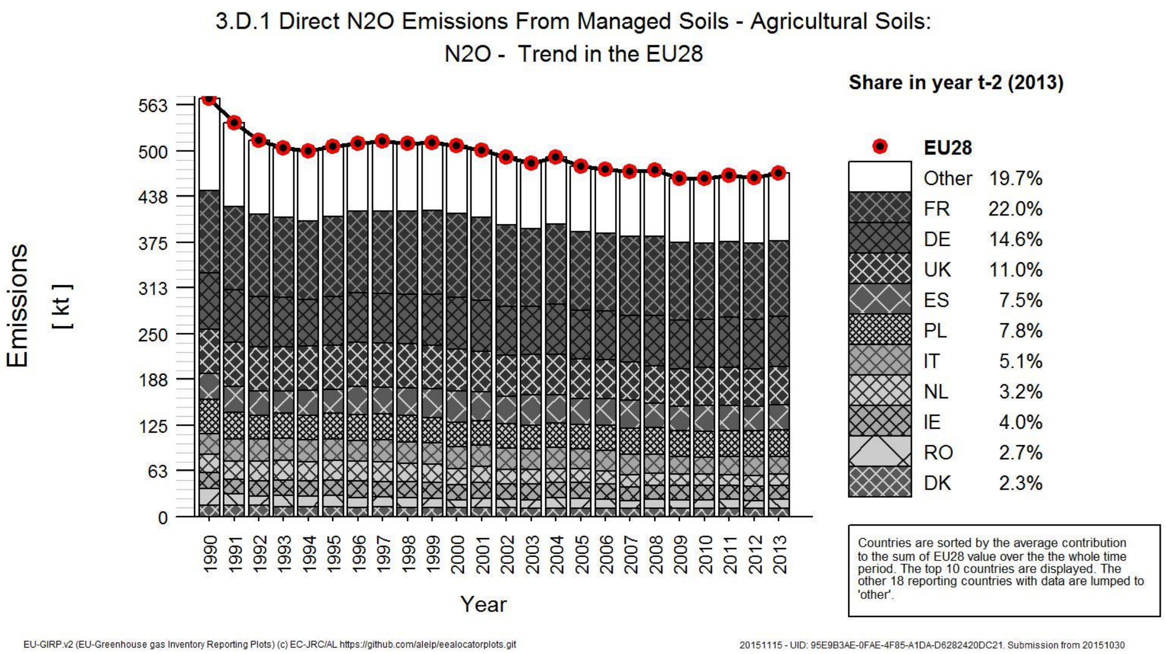
Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	1 717	1 472	1 452	1%	-19	-1%	-265	-15%	NA	NA
Belgium	3 332	2 527	2 552	2%	25	1%	-780	-23%	T1	D
Bulgaria	4 214	2 112	2 368	2%	257	12%	-1 846	-44%	T1	D
Croatia	1 162	901	828	1%	-73	-8%	-334	-29%	T1	D
Cyprus	63	27	19	0%	-8	-31%	-44	-70%	T1	D
Czech Republic	3 852	2 124	2 220	2%	97	5%	-1 631	-42%	T1,T2	CS,D
Denmark	4 500	3 175	3 277	2%	102	3%	-1 223	-27%	CS,D,T1,T2	D
Estonia	854	454	439	0%	-16	-3%	-415	-49%	CS,T1,T2	D
Finland	3 277	2 947	2 958	2%	12	0%	-319	-10%	T1,T2	CS,D
France	33 678	31 006	30 755	22%	-252	-1%	-2 923	-9%	NA	NA
Germany	22 927	20 279	20 422	15%	143	1%	-2 505	-11%	T1	D
Greece	3 554	2 430	2 468	2%	38	2%	-1 086	-31%	T1	D
Hungary	3 253	2 493	2 769	2%	276	11%	-484	-15%	T1	D
Ireland	6 581	5 872	5 633	4%	-238	-4%	-948	-14%	T1	D
Italy	8 482	7 627	7 088	5%	-539	-7%	-1 394	-16%	CS,T1	CS,D
Latvia	1 794	1 043	1 059	1%	16	1%	-735	-41%	T1	D
Lithuania	2 486	2 023	2 001	1%	-22	-1%	-484	-19%	T1	D
Luxembourg	148	118	120	0%	2	2%	-28	-19%	T1	D
Malta	14	14	14	0%	0	1%	0	-1%	T1	D
Netherlands	7 479	4 498	4 518	3%	20	0%	-2 961	-40%	T1,T1b,T2	CS,D
Poland	13 795	10 653	10 950	8%	298	3%	-2 845	-21%	T1	CS,D
Portugal	1 833	1 649	1 735	1%	86	5%	-98	-5%	T1	D
Romania	6 715	3 110	3 760	3%	649	21%	-2 955	-44%	T1	D
Slovakia	2 569	1 357	1 425	1%	68	5%	-1 144	-45%	T1b,T2	CS,D
Slovenia	324	314	312	0%	-2	-1%	-12	-4%	T1	D
Spain	10 546	9 843	10 419	7%	575	6%	-127	-1%	CS,T1a,T1b	D
Sweden	3 109	2 550	2 819	2%	269	11%	-290	-9%	NA	NA
United Kingdom	18 077	15 287	15 368	11%	81	1%	-2 708	-15%	T1,T1a	D
EU-28	**170 332**	**137 906**	**139 750**	**100%**	**1 844**	**1%**	**-30 583**	**-18%**		

Trends in Emissions and Activity Data

3.D.1 - Direct N_2O Emissions From Managed Soils - Emissions

Emissions in source category 3.D.1 - Direct N_2O Emissions From Managed Soils decreased considerably in EU28 by 18% or 30.6 Mt CO_2-eq. Figure 5.49 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 80.3% of direct N_2O emissions. Emissions decreased in all 28 countries. The three countries with the largest decreases were Netherlands, Romania and France with a total absolute decrease of 8.8 Mt CO_2-eq.

Figure 5.49: 3.D.1 Direct N_2O Emissions From Managed Soils: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 25% and 16% below 1990 levels in 2013, 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).

3.D.1.1 - Direct N_2O Emissions From Managed Soils Inorganic N Fertilizers - Emissions

Emissions in source category 3.D.1.1 - Direct N_2O Emissions From Managed Soils Inorganic N Fertilizers decreased strongly in EU28 by 26% or 17.7 Mt CO_2-eq. Figure 5.50 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 81.4% of direct N_2O emissions. Emissions decreased in 26 countries and increased in two countries. The three countries with the largest decreases were Germany, France and United Kingdom with a total absolute decrease of 6.8 Mt CO_2-eq. Emissions increased in Slovenia and Malta with a total absolute increase of 2 kt CO_2-eq.

3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers - N input from application of inorganic fertilizers to cropland and grassland

N input from application of inorganic fertilizers to cropland and grassland decreased strongly in EU28 by 25% or 3.7 kt N/year. Figure 5.51 shows the trend of N input from application of inorganic fertilizers to cropland and grassland indicating the countries contributing most to EU28 total. The ten countries with highest N input from application of inorganic fertilizers to cropland and grassland together accounted for 81.5% of Direct N_2O Emissions From Managed Soils N input from application of inorganic fertilizers to cropland and grassland. N input from application of inorganic fertilizers to cropland and grassland decreased in 26 countries and increased in two countries. The three countries with the largest decreases were Germany, France and United Kingdom with a total absolute decrease of 1.4 kt N/year. N input from application of inorganic fertilizers to cropland and grassland increased in Slovenia and Malta with a total absolute increase of 0.4 kt N/year.

Figure 5.50: 3.D.1.1 - Direct N_2O Emissions From Managed Soils Inorganic N Fertilizers: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

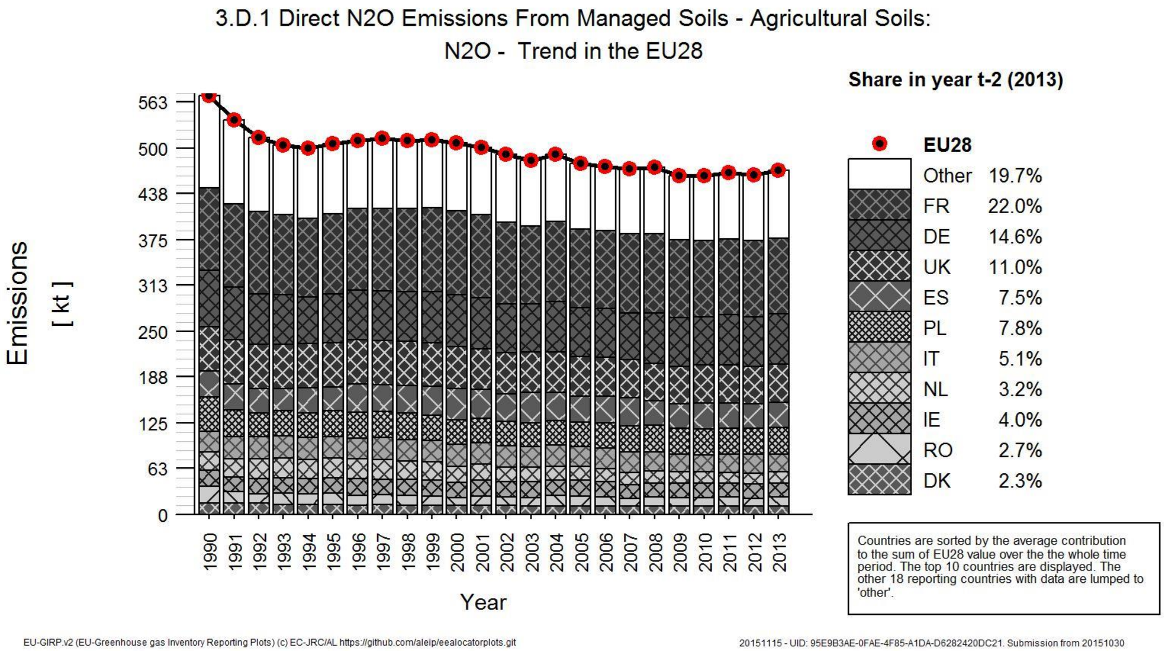
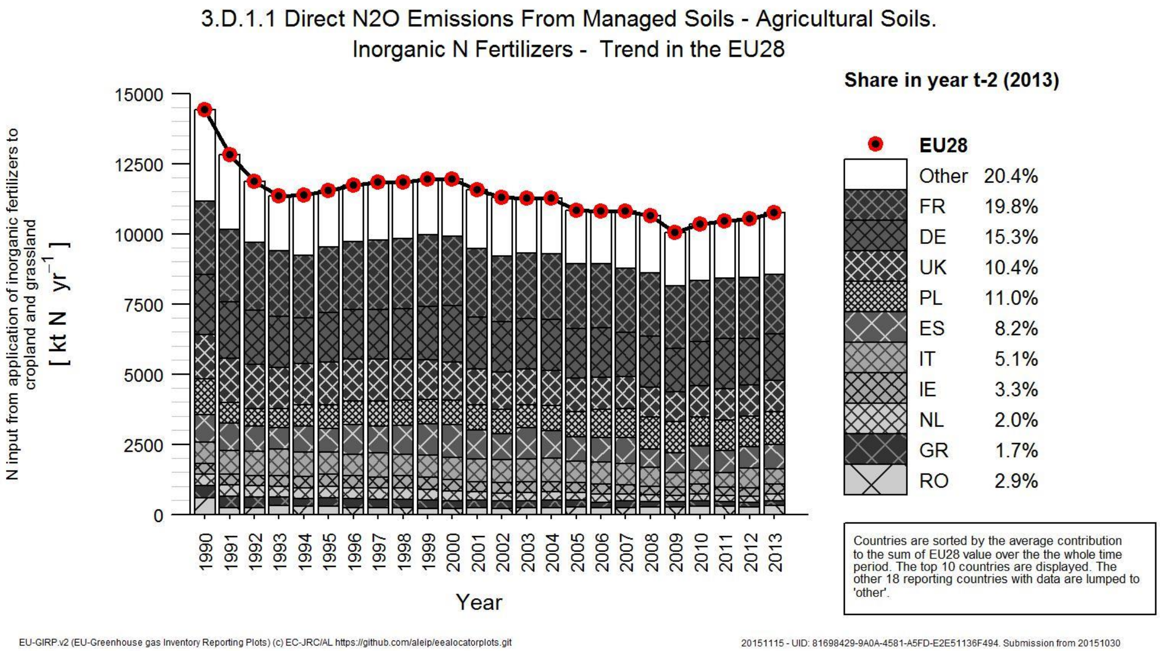


Figure 5.51: 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers: Trend in N input from application of inorganic fertilizers to cropland and grassland in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.D.1.2 - Direct N_2O Emissions From Managed Soils Organic N Fertilizers - Emissions

Emissions in source category 3.D.1.2 - Direct N_2O Emissions From Managed Soils Organic N Fertilizers decreased clearly in EU28 by 13% or 4.3 Mt CO_2-eq. Figure 5.52 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 84.7% of direct N_2O emissions. Emissions decreased in 21 countries and increased in six countries. The five countries with the largest decreases were Romania, Poland, France, Bulgaria and Czech Republic with a total absolute decrease of 3.5 Mt CO_2-eq. The three countries with the largest increases were Germany, Netherlands and Spain with a total absolute increase of 1.2 Mt CO_2-eq.

3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers - N input from organic N fertilizers to cropland and grassland

N input from organic N fertilizers to cropland and grassland decreased considerably in EU28 by 16% or 988 kt N/year. Figure 5.52 shows the trend of N input from organic N fertilizers to cropland and grassland indicating the countries contributing most to EU28 total. The ten countries with highest N input from organic N fertilizers to cropland and grassland together accounted for 81.1% of Direct N_2O Emissions From Managed Soils N input from organic N fertilizers to cropland and grassland. N input from organic N fertilizers to cropland and grassland decreased in 22 countries and increased in five countries. The four countries with the largest decreases were Romania, Poland, Netherlands and Bulgaria with a total absolute decrease of 604 kt N/year. Largest increases occurred in Germany and Spain with a total absolute increase of 141 kt N/year.

Figure 5.52: 3.D.1.2 - Direct N_2O Emissions From Managed Soils Organic N Fertilizers: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

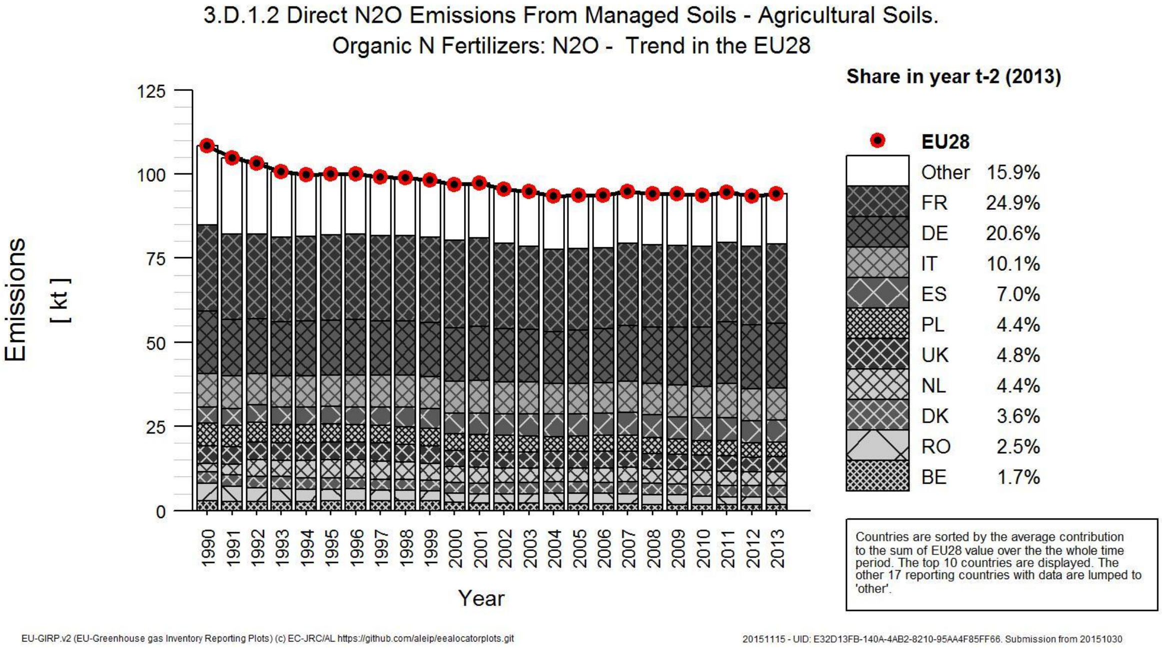
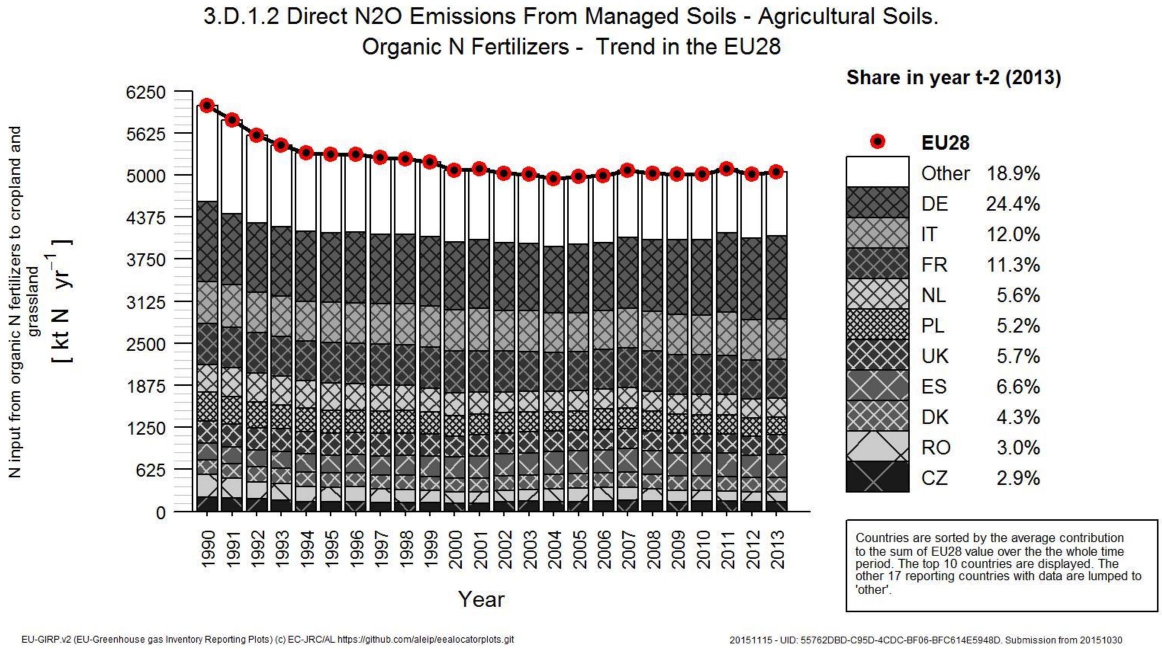


Figure 5.53: 3.D.1.2 - Direct N_2O Emissions From Managed Soils Organic N Fertilizers: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.D.1.3 - Urine and Dung Deposited by Grazing Animals Grazing Animals - Emissions

N_2O emissions in source category 3.D.1.3 - Urine and Dung Deposited by Grazing Animals Grazing Animals are 0.58% of total EU28 GHG emissions and 10% of total EU28 N_2O emissions. They make 5.9% of total agricultural emissions.

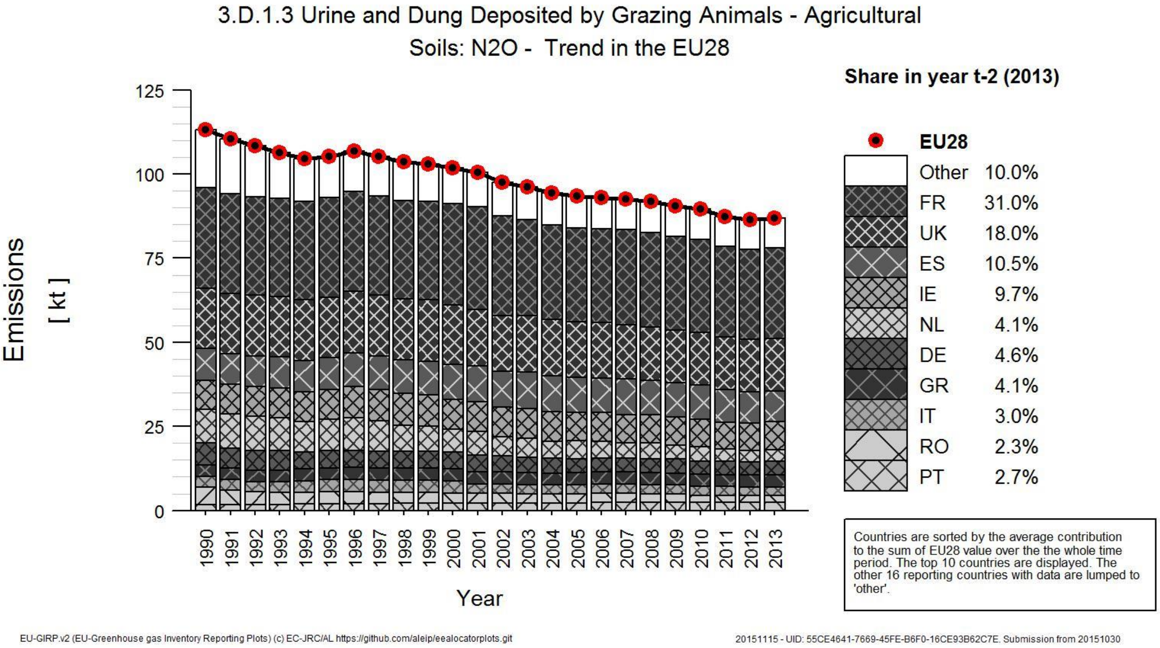
Total GHG and N_2O emissions by Member States from 3.D.1.3 Grazing Animals are shown in Table 5.39. Between 1990 and 2013, N_2O emission from Urine and Dung Deposited by Grazing Animals decreased by 23% or 7.8 Mt CO_2-eq. The decrease was largest in Latvia in relative terms (76%) and in Netherlands in absolute terms (65% or 2 Mt CO_2-eq). From 2012 to 2013 emissions increased by

0.4%. Figure 5.54 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 90% of urine and Dung Deposited by Grazing Animals N_2O emissions. Emissions decreased in 23 countries and increased in three countries. The three countries with the largest decreases were Netherlands, Romania and France with a total absolute decrease of 3.7 Mt CO_2-eq. Largest increases occurred in Slovenia and Portugal with a total absolute increase of 178 kt CO_2-eq.

Table 5.39 3.D.1.3 - Urine and Dung Deposited by Grazing Animals Grazing Animals: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Change 1995-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	73	72	0%	-1	-1%	-77	-52%	-59	-45%	-	-
Belgium	711	508	495	2%	-13	-3%	-216	-30%	-237	-32%	T1	D
Bulgaria	585	150	148	1%	-2	-1%	-436	-75%	-159	-52%	T1	D
Croatia	155	85	77	0%	-8	-10%	-78	-51%	-16	-17%	T1	D
Cyprus	NE	NE	NE	-	-	-	-	-	-	-	NA	NA
Czech Republic	262	224	227	1%	3	1%	-36	-14%	8	4%	T1	D
Denmark	299	182	185	1%	3	2%	-114	-38%	-128	-41%	T1	D
Estonia	182	69	72	0%	3	5%	-110	-60%	-19	-21%	CS,T2	D
Finland	151	110	109	0%	-1	-1%	-42	-28%	-18	-14%	T1	D
France	8 866	7 983	8 032	31%	49	1%	-834	-9%	-763	-9%	-	-
Germany	1 909	1 176	1 192	5%	16	1%	-717	-38%	-322	-21%	T1	D
Greece	1 049	1 048	1 051	4%	3	0%	2	0%	-11	-1%	T1	D
Hungary	193	103	108	0%	5	5%	-86	-44%	0	0%	T1	D
Ireland	2 540	2 433	2 501	10%	68	3%	-39	-2%	-136	-5%	T1	D
Italy	934	767	786	3%	19	2%	-148	-16%	-260	-25%	T1	CS,D
Latvia	368	92	87	0%	-4	-5%	-281	-76%	-69	-44%	T1	D
Lithuania	422	179	174	1%	-4	-2%	-248	-59%	-55	-24%	T1	D
Luxembourg	23	23	23	0%	0	1%	-1	-2%	0	1%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Netherlands	3 028	1 005	1 052	4%	47	5%	-1 976	-65%	-1 729	-62%	T1	D
Poland	1 048	351	338	1%	-14	-4%	-710	-68%	-270	-44%	T1	CS,D
Portugal	538	701	696	3%	-5	-1%	158	29%	125	22%	T1	D
Romania	1 522	602	607	2%	4	1%	-915	-60%	-489	-45%	T1	D
Slovakia	213	91	89	0%	-1	-2%	-124	-58%	-51	-36%	T1b	D
Slovenia	19	39	39	0%	0	-1%	20	110%	13	51%	T1	D
Spain	2 809	2 795	2 715	10%	-80	-3%	-94	-3%	-98	-3%	CS,T1a,T1b	D
Sweden	366	356	350	1%	-6	-2%	-16	-4%	-38	-10%	-	-
United Kingdom	5 383	4 645	4 655	18%	10	0%	-727	-14%	-714	-13%	T1	D
EU-28	**33 724**	**25 787**	**25 878**	**100%**	**91**	**0%**	**-7 846**	**-23%**	**-5 496**	**-21%**		

Figure 5.54: 3.D.1.3 - Urine and Dung Deposited by Grazing Animals Grazing Animals: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



Implied EFs and Methodological Issues

In this section we discuss the Implied Emission Factor for the main N sources contributing to direct N_2O emissions from managed soils.

3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers decreased in EU28 barely by 0.029% or 3.03e-06 kg N_2O-N/kg N between 1990 and 2013. Figure 5.55 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.40 shows the implied emission factor for N_2O emissions in source category 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in six countries and increased in four countries. It was in 2013 at the level of 1990 in eighteen countries. The three countries with the largest decreases were Netherlands, Cyprus and France with a mean absolute decrease of 1e-04 kg N_2O-N/kg N. The three countries with the largest increases were Romania, Belgium and Spain with a mean absolute increase of 3.3e-06 kg N_2O-N/kg N.

Figure 5.55: 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers: Trend in implied emission factor in the EU28 and range of values reported by countries

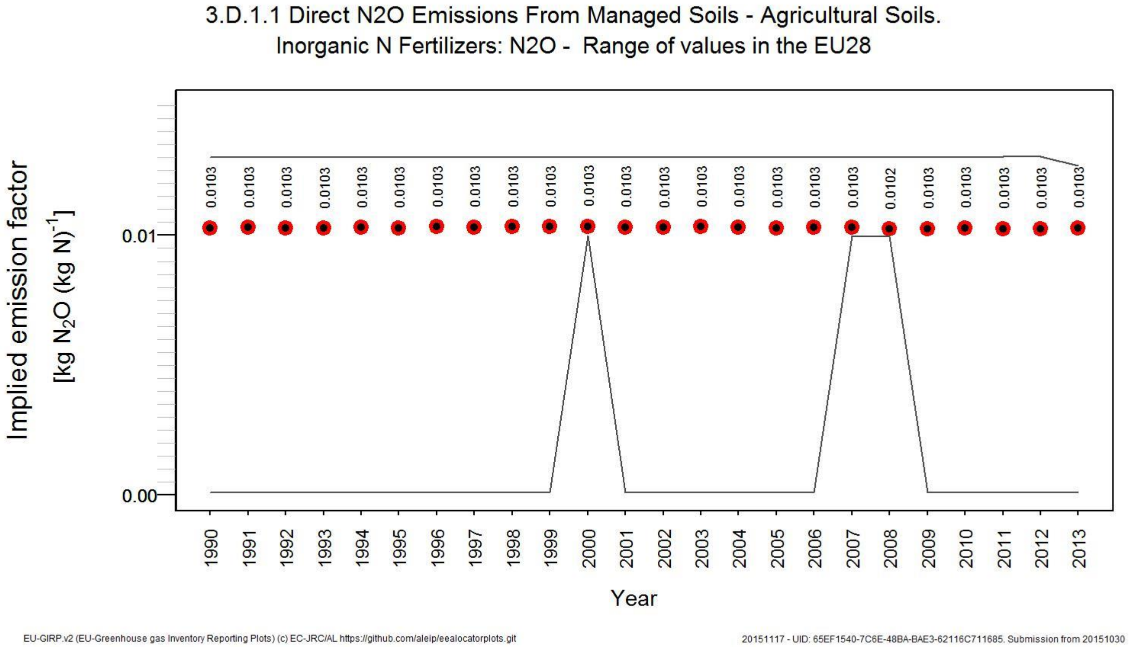


Table 5.40 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers: Member States' and EU28 Implied emission factor (kg N_2O-N/kg N)

Member State	1990	2013		Member State	1990	2013
Austria	0.0100	1.0e-02	|	Italy	0.0100	1.0e-02
Belgium	0.0100	1.0e-02	|	Lithuania	0.0100	1.0e-02
Bulgaria	0.0100	1.0e-02	|	Luxembourg	0.0100	1.0e-02
Cyprus	0.0001	9.9e-05	|	Latvia	0.0100	1.0e-02
Czech Republic	0.0100	1.0e-02	|	Malta	0.0100	1.0e-02
Germany	0.0100	1.0e-02	|	Netherlands	0.0130	1.3e-02
Denmark	0.0100	1.0e-02	|	Poland	0.0100	1.0e-02
Estonia	0.0100	1.0e-02	|	Portugal	0.0100	1.0e-02
Spain	0.0125	1.3e-02	|	Romania	0.0100	1.0e-02
Finland	0.0100	1.0e-02	|	Sweden	0.0100	1.0e-02
France	0.0100	1.0e-02	|	Slovenia	0.0100	1.0e-02
Greece	0.0100	1.0e-02	|	Slovakia	0.0125	1.2e-02
Croatia	0.0100	1.0e-02	|	United Kingdom	0.0100	1.0e-02
Hungary	0.0100	1.0e-02	|	**EU28**	**0.0103**	**1.0e-02**
Ireland	0.0100	1.0e-02	|			

3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers increased in EU28 slightly by 3.8% or 0.000434 kg N_2O-N/kg N between 1990 and 2013. Figure 5.56 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.41 shows the implied emission factor for N_2O emissions in source category 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in six countries and increased in four countries. It was in 2013 at the level of 1990 in seventeen countries. No data were available for one country. The largest decrease occurred in Czech Republic with an absolute decrease of 0.0036 kg N_2O-N/kg N. The largest increase occurred in Netherlands with an absolute increase of 0.0054 kg N_2O-N/kg N.

Figure 5.56: 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers: Trend in implied emission factor in the EU28 and range of values reported by countries

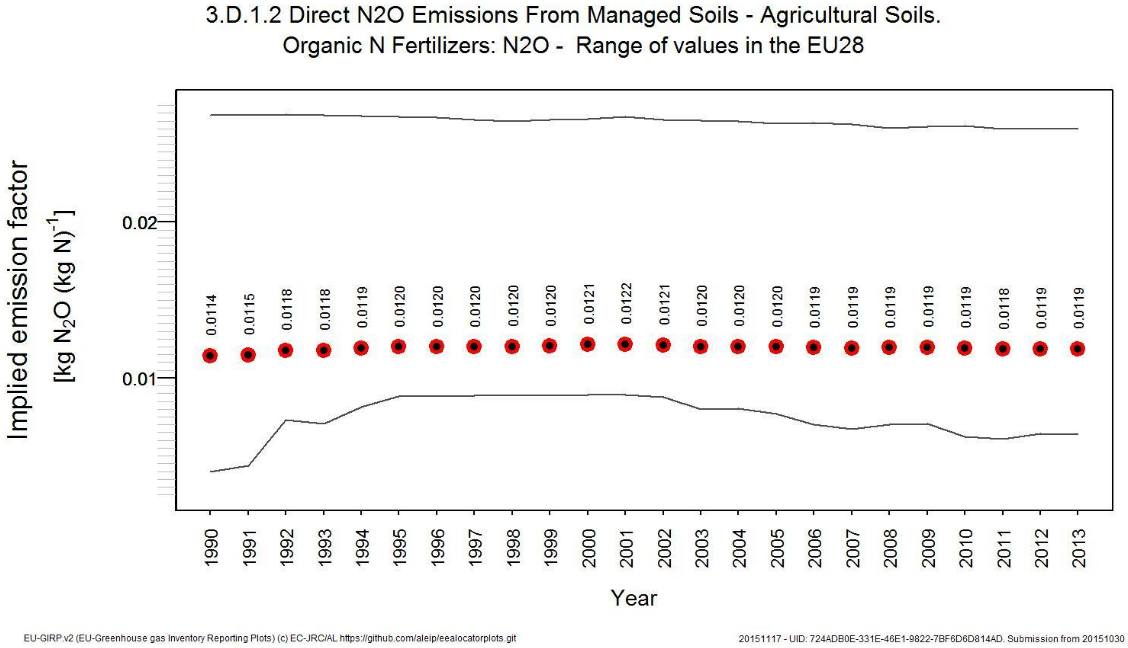


Table 5.41 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers: Member States' and EU28 Implied emission factor (kg N_2O-N/kg N)

Member State	1990	2013		Member State	1990	2013
Austria	0.010	0.0100	|	Italy	0.010	0.0100
Belgium	0.010	0.0100	|	Lithuania	0.010	0.0100
Bulgaria	0.010	0.0100	|	Luxembourg	0.010	0.0100
Czech Republic	0.010	0.0064	|	Latvia	0.010	0.0100
Germany	0.010	0.0100	|	Malta	0.010	0.0100
Denmark	0.010	0.0100	|	Netherlands	0.004	0.0094
Estonia	0.010	0.0100	|	Poland	0.010	0.0100
Spain	0.013	0.0125	|	Portugal	0.010	0.0100
Finland	0.010	0.0100	|	Romania	0.010	0.0100
France	0.027	0.0260	|	Sweden	0.010	0.0100
Greece	0.010	0.0100	|	Slovenia	0.010	0.0100
Croatia	0.010	0.0100	|	Slovakia	0.012	0.0125
Hungary	0.010	0.0100	|	United Kingdom	0.010	0.0100
Ireland	0.010	0.0100	|	**EU28**	**0.011**	**0.0119**

3.D.1.3 - Urine and Dung Deposited by Grazing Animals - Implied emission factor

The implied emission factor for N_2O emissions in source category 3.D.1.3 - Urine and Dung Deposited by Grazing Animals could not be evaluated at EU28 level. Table 5.42 shows the implied emission factor for N_2O emissions in source category 3.D.1.3 - Urine and Dung Deposited by Grazing Animals for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in thirteen countries and increased in ten countries. It was in 2013 at the level of 1990 in two countries. No data were available for three countries. The three countries with the largest decreases were Romania, Austria and Slovenia with a mean absolute decrease of 0.002 kg N_2O-N/kg N. The three countries with the largest increases were Portugal, Bulgaria and Poland with a mean absolute increase of 0.0013 kg N_2O-N/kg N.

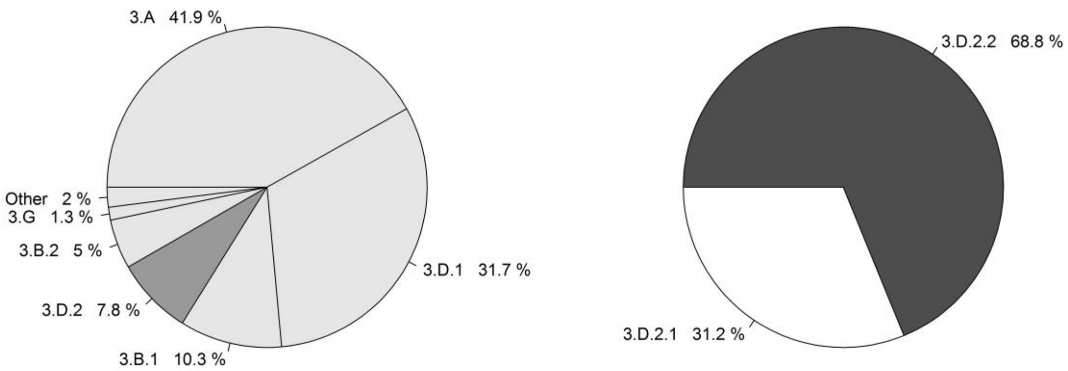
Table 5.42 3.D.1.3 - Urine and Dung Deposited by Grazing Animals: Member States' and EU28 Implied emission factor (kg N_2O-N/kg N)

Member State	1990	2013		Member State	1990	2013
Austria	0.018	0.016	|	Ireland	0.018	0.019
Belgium	0.020	0.020	|	Italy	0.011	0.011
Bulgaria	0.011	0.012	|	Lithuania	0.019	0.019
Czech Republic	0.017	0.018	|	Luxembourg	0.010	0.010
Germany	0.019	0.019	|	Latvia	0.020	0.019
Denmark	0.019	0.018	|	Netherlands	0.000	0.000
Estonia	0.019	0.019	|	Poland	0.018	0.019
Spain	0.020	0.020	|	Portugal	0.016	0.018
Finland	0.018	0.017	|	Romania	0.017	0.015
France	0.018	0.019	|	Sweden	0.017	0.017
Greece	0.010	0.011	|	Slovenia	0.018	0.017
Croatia	0.016	0.015	|	Slovakia	0.020	0.020
Hungary	0.014	0.014	|	United Kingdom	0.016	0.016

5.2.4 Indirect Emissions from Managed Soils - N_2O (CRF Source Category 3D2)

N_2O emissions from source category 3.D.2 Indirect Emissions from Managed Soils are 0.77% of total EU28 GHG emissions and 14% of total EU28 N_2O emissions. They make 7.8% of total agricultural emissions. The main sub-categories are 3.D.2.2 (Nitrogen Leaching and Run-off), and 3.D.2.1 (Atmospheric Deposition) as shown in Figure 5.58.

Figure 5.58: Share of source category 3.D.2 on total EU28 agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emission in the year 2013.



Total GHG and N_2O emissions by Member States from 3.D.2 Indirect Emissions from Managed Soils are shown in Table 5.43. Between 1990 and 2013, N_2O emission from Indirect Emissions from Managed Soils decreased by 22% or 9.6 Mt CO_2-eq. The decrease was largest in Cyprus in relative terms (71%) and in Netherlands in absolute terms (61% or 1.2 Mt CO_2-eq). From 2012 to 2013 emissions increased by 1.9%.

Table 5.43 3.D.2 - Indirect Emissions from Managed Soils: Member States' contributions to total GHG and N_2O emissions

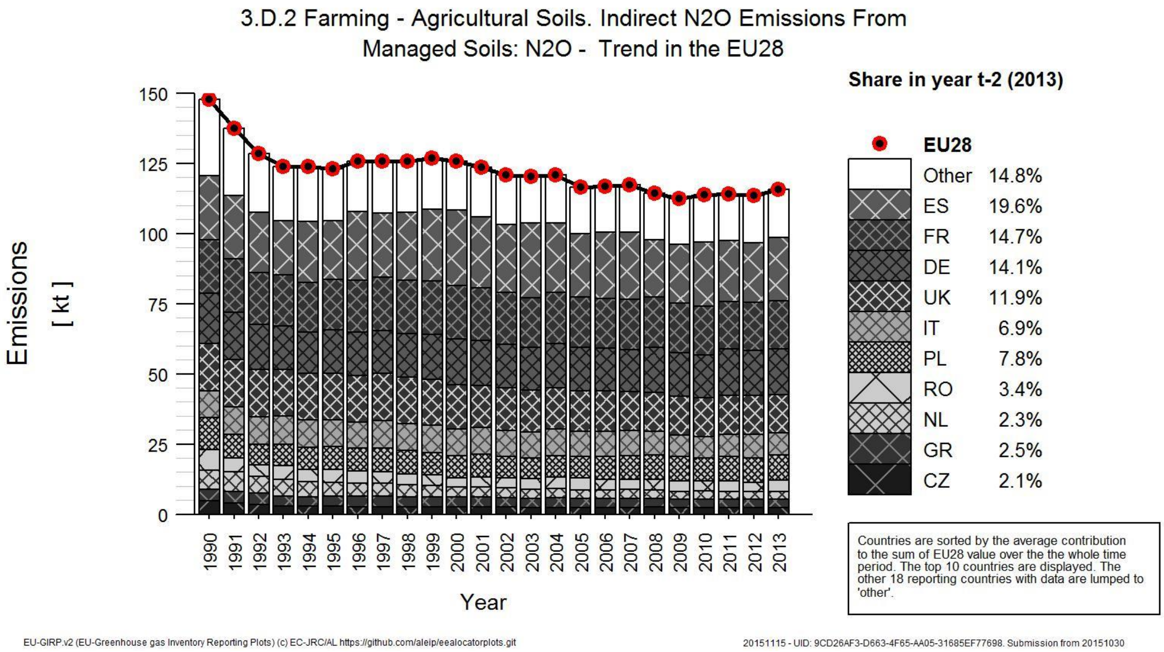
Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Change 1995-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	334	303	301	1%	-3	-1%	-33	-10%	-41	-12%	NA	NA
Belgium	470	250	251	1%	1	0%	-219	-47%	-203	-45%	T1	D
Bulgaria	1 422	647	713	2%	66	10%	-710	-50%	80	13%	T1	D
Croatia	377	288	262	1%	-27	-9%	-115	-31%	-20	-7%	T1	D
Cyprus	20	8	6	0%	-3	-31%	-14	-71%	-17	-75%	T1	D
Czech Republic	1 398	712	736	2%	23	3%	-663	-47%	-122	-14%	T1	D
Denmark	862	493	481	1%	-12	-2%	-381	-44%	-281	-37%	T2	D
Estonia	228	111	109	0%	-2	-2%	-119	-52%	17	18%	D,T1	D
Finland	479	378	379	1%	0	0%	-100	-21%	-78	-17%	T1	D
France	5 685	5 129	5 069	15%	-60	-1%	-615	-11%	-292	-5%	-	-
Germany	5 366	4 777	4 857	14%	79	2%	-510	-9%	259	6%	T1	D
Greece	1 238	866	878	3%	12	1%	-360	-29%	-209	-19%	T1	D
Hungary	272	153	168	0%	15	10%	-104	-38%	0	0%	T1	D
Ireland	559	496	480	1%	-16	-3%	-79	-14%	-59	-11%	T1	CS,D
Italy	2 813	2 542	2 363	7%	-178	-7%	-450	-16%	-491	-17%	T1	CS,D
Latvia	389	175	182	1%	7	4%	-208	-53%	78	75%	T1	D
Lithuania	615	415	411	1%	-3	-1%	-204	-33%	172	72%	T1	D
Luxembourg	54	44	45	0%	1	2%	-9	-17%	-6	-12%	T1	D
Malta	2	3	3	0%	0	-2%	0	16%	-2	-45%	T1	D
Netherlands	2 039	804	800	2%	-4	-1%	-1 239	-61%	-625	-44%	T1	D
Poland	3 438	2 567	2 674	8%	107	4%	-764	-22%	251	10%	T1	D
Portugal	508	417	439	1%	21	5%	-69	-14%	-48	-10%	T1,T2	CS,D
Romania	2 151	991	1 160	3%	169	17%	-991	-46%	-222	-16%	T1	D
Slovakia	957	420	399	1%	-21	-5%	-558	-58%	39	11%	T1	D
Slovenia	111	105	104	0%	-1	-1%	-7	-6%	-10	-9%	T1	D
Spain	6 776	6 308	6 756	20%	448	7%	-20	0%	570	9%	CS,T1a,T1b	D
Sweden	470	357	360	1%	3	1%	-110	-23%	-71	-17%	-	-
United Kingdom	5 025	4 087	4 109	12%	22	1%	-915	-18%	-841	-17%	T1	D
EU-28	**44 057**	**33 849**	**34 493**	**100%**	**644**	**2%**	**-9 565**	**-22%**	**-2 175**	**-6%**		

Trends in Emissions and Activity Data

3.D.2 - Indirect Emissions from Managed Soils - Emissions

Emissions in source category 3.D.2 - Indirect Emissions from Managed Soils decreased considerably in EU28 by 22% or 9.6 Mt CO_2-eq. Figure 5.59 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 85.2% of indirect N_2O emissions. Emissions decreased in 27 countries and increased in one country. Largest decreases occurred in Netherlands and Romania with a total absolute decrease of 2.2 Mt CO_2-eq. Emissions increased in Malta with a total absolute increase of 0.4 kt CO_2-eq.

Figure 5.59: 3.D.2 Indirect Emissions from Managed Soils: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.D.2.1 - Atmospheric Deposition - Emissions

Emissions in source category 3.D.2.1 - Atmospheric Deposition decreased strongly in EU28 by 28% or 4.1 Mt CO_2-eq. Figure 5.60 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 83% of atmospheric Deposition N_2O emissions. Emissions decreased in 26 countries and increased in two countries. Largest decreases occurred in Netherlands with a total absolute decrease of 944 kt CO_2-eq. Largest increases occurred in Spain with a total absolute increase of 44 kt CO_2-eq.

3.D.2.1 - Indirect N_2O Emissions From Atmospheric Deposition - Volatilized N from agricultural inputs of N

Volatilized N from agricultural inputs of N decreased strongly in EU28 by 28% or 872 kt N/year. Figure 5.61 shows the trend of volatilized N from agricultural inputs of N indicating the countries contributing most to EU28 total. The ten countries with highest volatilized N from agricultural inputs of N together accounted for 83% of Atmospheric Deposition volatilized N from agricultural inputs of N. Volatilized N from agricultural inputs of N decreased in 26 countries and increased in two countries. Largest decreases occurred in Netherlands with a total absolute decrease of 199 kt N/year. Largest increases occurred in Spain with a total absolute increase of 9 kt N/year.

Figure 5.60: 3.D.2.1 - Atmospheric Deposition: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

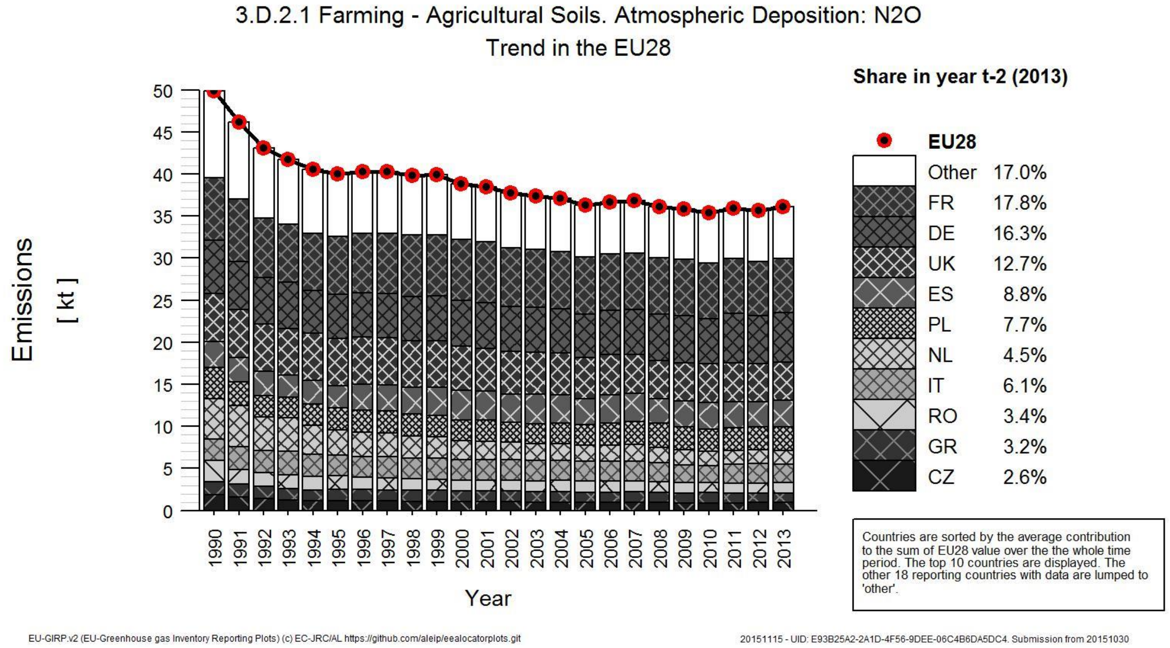
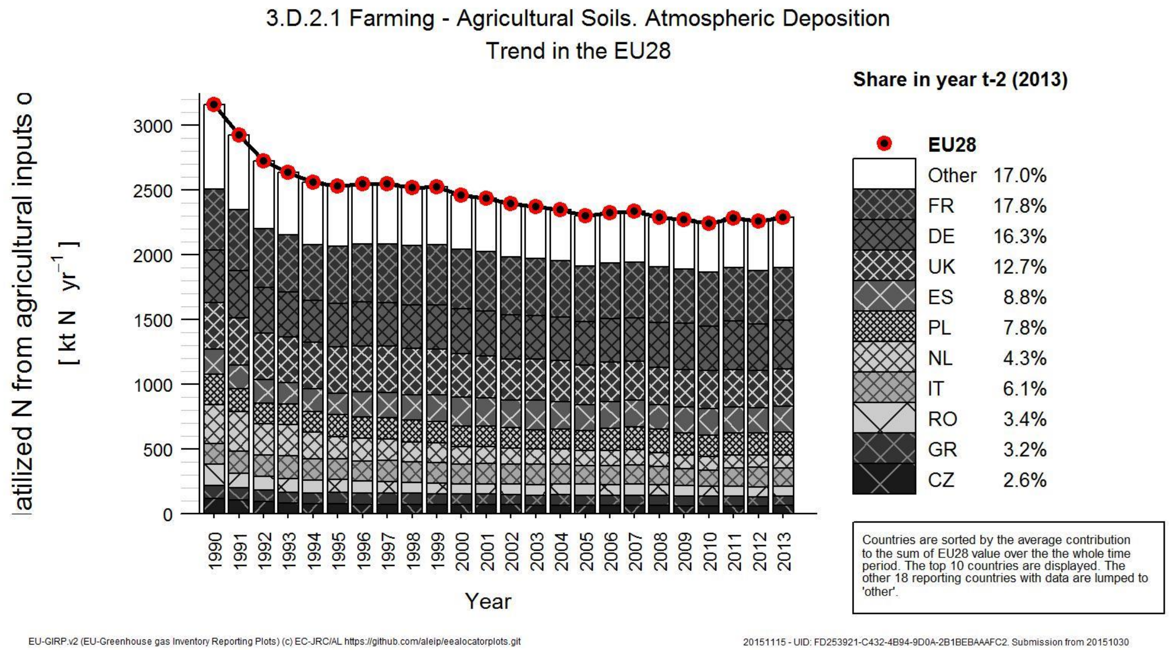


Figure 5.61: 3.D.2.1 - Atmospheric Deposition: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



3.D.2.2 - Nitrogen leaching and run-off - Emissions

Emissions in source category 3.D.2.2 - Nitrogen leaching and run-off decreased considerably in EU28 by 19% or 5.5 Mt CO_2-eq. Figure 5.62 shows the trend of emissions indicating the countries contributing most to EU28 total. The ten countries with highest emissions together accounted for 87.1% of nitrogen leaching and run-off N_2O emissions. Emissions decreased in 27 countries and increased in one country. Largest decreases occurred in Romania and United Kingdom with a total absolute decrease of 1.2 Mt CO_2-eq. Emissions increased in Malta with a total absolute increase of 0.3 kt CO_2-eq.

3.D.2.2 - Indirect N_2O Emissions From Nitrogen leaching and run-off - N from fertilizers and other agricultural inputs that is lost through leaching and run-off

N from fertilizers and other agricultural inputs that is lost through leaching and run-off decreased considerably in EU28 by 21% or 1.6 kt N/year. Figure 5.63 shows the trend of N from fertilizers and other agricultural inputs that is lost through leaching and run-off indicating the countries contributing most to EU28 total. The ten countries with highest N from fertilizers and other agricultural inputs that is lost through leaching and run-off together accounted for 84.1% of Nitrogen leaching and run-off N from fertilizers and other agricultural inputs that is lost through leaching and run-off. N from fertilizers and other agricultural inputs that is lost through leaching and run-off decreased in 27 countries and increased in one country. Largest decreases occurred in Romania and United Kingdom with a total absolute decrease of 333 kt N/year. N from fertilizers and other agricultural inputs that is lost through leaching and run-off increased in Malta with a total absolute increase of 0.1 kt N/year.

Figure 5.62: 3.D.2.2 - Nitrogen leaching and run-off: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013

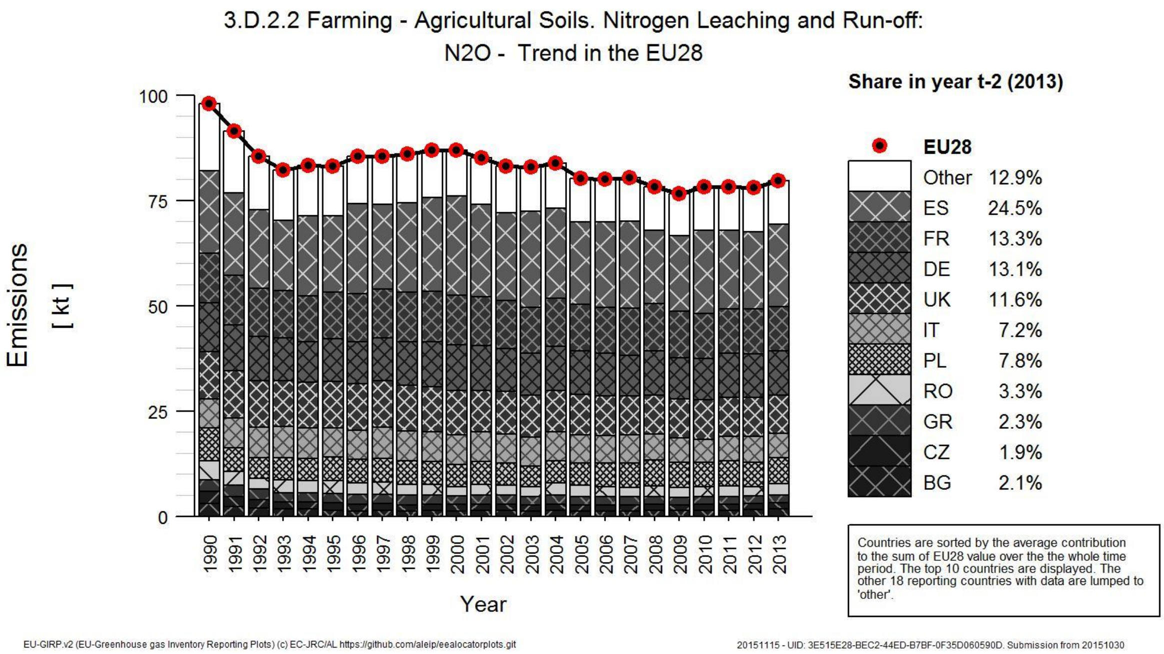
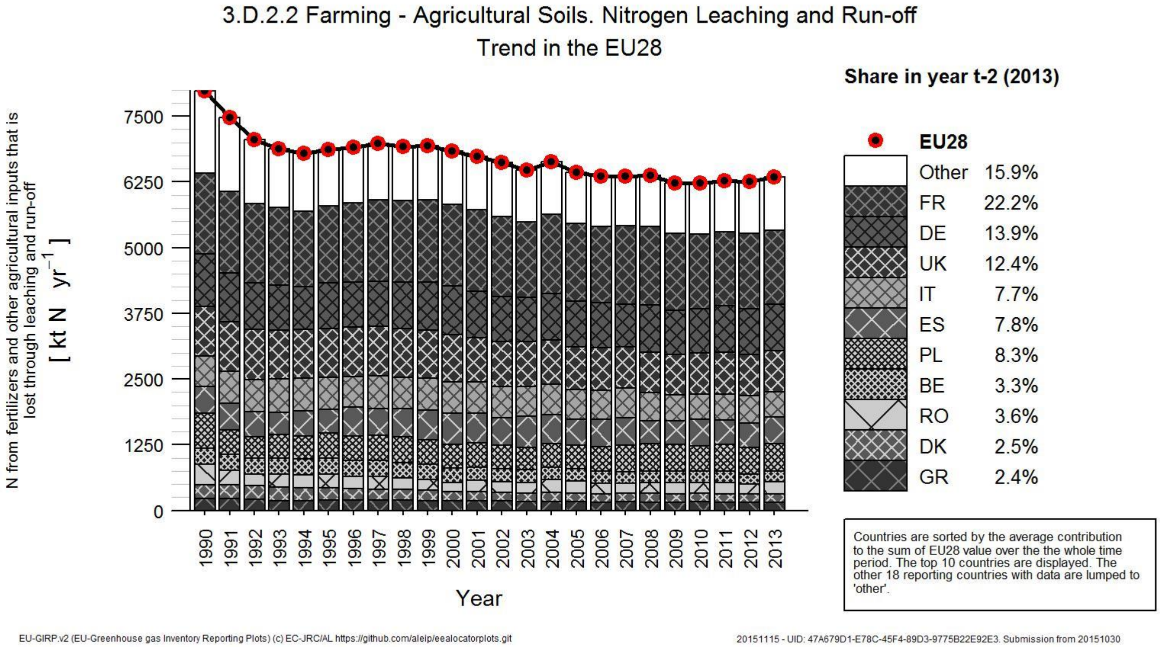


Figure 5.63: 3.D.2.2 - Nitrogen leaching and run-off: Trend in emissions in the EU28 and the countries contributing most to EU28 values including their share to EU28 emissions in 2013



Implied EFs and Methodological Issues

In this section we discuss the Implied Emission Factor for the main N sources contributing to indirect N_2O emissions from managed soils. Furthermore, we present data on the relevant fractions:

- $Frac_{GASF}$: Fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_X
- $Frac_{GASM}$: Fraction of livestock N excretion that volatilises as NH_3 and NO_X
- $Frac_{LEACH}$: Fraction of N input to managed soils that is lost through leaching and run-off.

3.D.2.1 - Indirect N_2O Emissions From Atmospheric Deposition

The implied emission factor for N_2O emissions in source category 3.D.2.1 - Indirect N_2O Emissions From Atmospheric Deposition decreased in EU28 barely by 0.042% or 4.24e-06 kg N_2O-N/kg N between 1990 and 2013. Figure 5.64 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.44 shows the implied emission factor for N_2O emissions in source category 3.D.2.1 - Indirect N_2O Emissions From Atmospheric Deposition for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in six countries and increased in four countries. It was in 2013 at the level of 1990 in eighteen countries. The three countries with the largest decreases were Lithuania, Cyprus and Portugal with a mean absolute decrease of 9.6e-05 kg N_2O-N/kg N. The three countries with the largest increases were Netherlands, Malta and Slovenia with a mean absolute increase of 9.1e-05 kg N_2O-N/kg N.

Figure 5.64: 3.D.2.1 - Indirect N_2O Emissions From Atmospheric Deposition: Trend in implied emission factor in the EU28 and range of values reported by countries

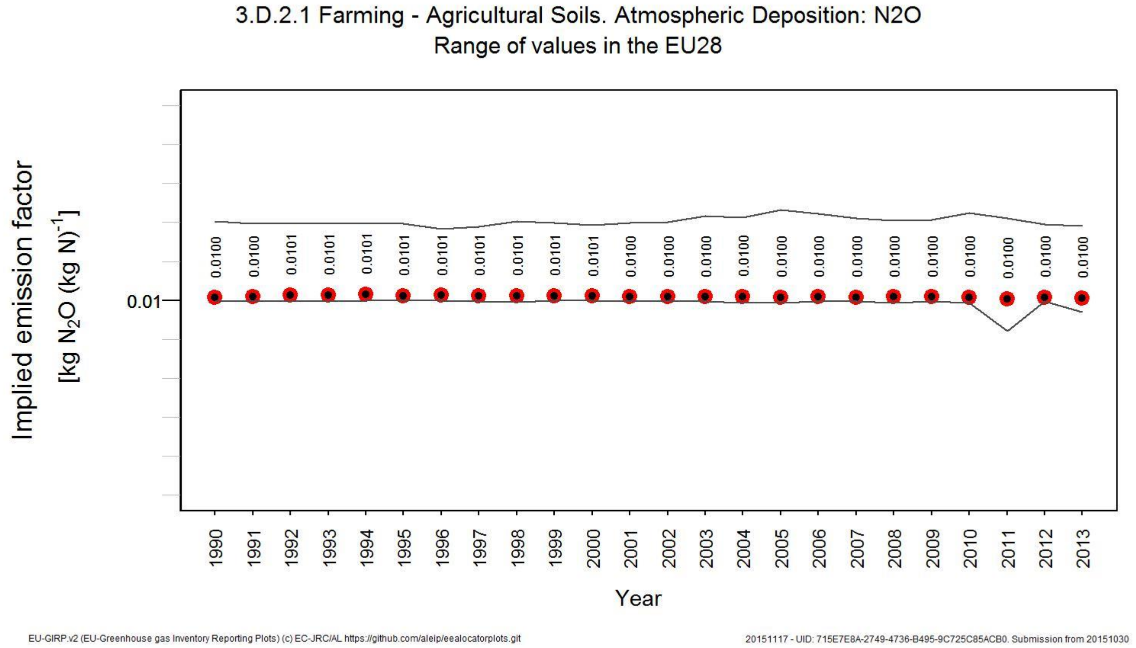


Table 5.44 3.D.2.1 - Indirect N_2O Emissions From Atmospheric Deposition: Member States' and EU28 Implied emission factor (kg N_2O-N/kg N)

Member State	1990	2013		Member State	1990	2013
Austria	0.010	0.0100	|	Italy	0.010	0.0100
Belgium	0.010	0.0100	|	Lithuania	0.010	0.0098
Bulgaria	0.010	0.0100	|	Luxembourg	0.010	0.0100
Cyprus	0.010	0.0099	|	Latvia	0.010	0.0100
Czech Republic	0.010	0.0100	|	Malta	0.010	0.0100
Germany	0.010	0.0100	|	Netherlands	0.010	0.0106
Denmark	0.010	0.0100	|	Poland	0.010	0.0100
Estonia	0.010	0.0100	|	Portugal	0.011	0.0110
Spain	0.010	0.0100	|	Romania	0.010	0.0100
Finland	0.010	0.0100	|	Sweden	0.010	0.0100
France	0.010	0.0100	|	Slovenia	0.010	0.0100
Greece	0.010	0.0100	|	Slovakia	0.010	0.0100
Croatia	0.010	0.0100	|	United Kingdom	0.010	0.0100
Hungary	0.010	0.0100	|	**EU28**	**0.010**	**0.0100**
Ireland	0.010	0.0100	|			

3.D.2.1 - Indirect emissions from atmospheric deposition - Fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_X

The fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_X, a parameter used for calculating N_2O emissions in source category 3.D.2.1 - Indirect emissions from atmospheric deposition, could not be evaluated at EU28 level. Table 5.45 shows the fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_X in source category 3.D.2.1 - Indirect emissions from atmospheric deposition for the years 1990 and 2013 for all Member States and EU28. Fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_X decreased in four countries and increased in seven countries. It was in 2013 at the level of 1990 in fifteen countries. No data were available for two countries. The largest decreases occurred in Ireland and Hungary with a mean absolute decrease of 0.018. The largest increases occurred in Austria and Germany with a mean absolute increase of 0.019.

Table 5.45 3.D.2.1 - Indirect emissions from atmospheric deposition: Member States' and EU28 Fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_X (-)

Member State	1990	2013		Member State	1990	2013
Austria	0.026	0.0400	|	Hungary	0.093	0.0659
Belgium	0.065	0.0783	|	Ireland	0.028	0.0188
Bulgaria	0.100	0.1000	|	Italy	0.087	0.1026
Cyprus	0.100	0.1000	|	Lithuania	0.100	0.1000
Czech Republic	0.100	0.1000	|	Luxembourg	0.100	0.1000
Germany	0.061	0.0851	|	Latvia	0.100	0.1000
Denmark	0.047	0.0431	|	Poland	0.100	0.1000
Estonia	0.100	0.1000	|	Portugal	0.071	0.0746
Spain	0.086	0.0881	|	Romania	0.100	0.1000
Finland	0.015	0.0146	|	Sweden	0.011	0.0095
France	0.100	0.1000	|	Slovenia	0.072	0.0780
Greece	0.100	0.1000	|	Slovakia	0.100	0.1000
Croatia	0.100	0.1000	|	United Kingdom	0.100	0.1000

3.D.2.2 - Indirect emissions from atmospheric deposition - Fraction of livestock N excretion that volatilises as NH_3 and NO_X

The fraction of livestock N excretion that volatilises as NH_3 and NO_X, a parameter used for calculating N_2O emissions in source category 3.D.2.2 - Indirect emissions from atmospheric deposition, could not be evaluated at EU28 level. Table 5.46 shows the fraction of livestock N excretion that volatilises as NH_3 and NO_X in source category 3.D.2.2 - Indirect emissions from atmospheric deposition for the years 1990 and 2013 for all Member States and EU28. Fraction of livestock N excretion that volatilises as NH_3 and NO_X decreased in six countries and increased in six countries. It was in 2013 at the level of 1990 in thirteen countries. No data were available for three countries. The largest decreases occurred in Denmark and Belgium with a mean absolute decrease of 0.1. The largest increase occurred in Hungary with an absolute increase of 0.025.

Table 5.46 3.D.2.2 - Indirect emissions from atmospheric deposition: Member States' and EU28 Fraction of livestock N excretion that volatilises as NH_3 and NO_X (-)

Member State	1990	2013		Member State	1990	2013
Austria	0.269	0.288	|	Ireland	0.076	0.078
Belgium	0.266	0.162	|	Italy	0.230	0.219
Bulgaria	0.200	0.200	|	Lithuania	0.200	0.200
Czech Republic	0.200	0.200	|	Luxembourg	0.200	0.200
Germany	0.195	0.171	|	Latvia	0.200	0.200
Denmark	0.137	0.083	|	Poland	0.200	0.200
Estonia	0.200	0.200	|	Portugal	0.146	0.127
Spain	0.353	0.360	|	Romania	0.200	0.200
Finland	0.075	0.088	|	Sweden	0.329	0.331
France	0.200	0.200	|	Slovenia	0.393	0.355
Greece	0.200	0.200	|	Slovakia	0.200	0.200
Croatia	0.200	0.200	|	United Kingdom	0.200	0.200
Hungary	0.101	0.126	|			

3.D.2.2 - Indirect N_2O Emissions From Nitrogen leaching and run-off

The implied emission factor for N_2O emissions in source category 3.D.2.2 - Indirect N_2O Emissions From Nitrogen leaching and run-off increased in EU28 slightly by 2.3% or 0.00018 kg N_2O-N/kg N between 1990 and 2013. Figure 5.67 shows the trend of the IEF in EU28 indicating also the range of values used by the countries. Table 5.47 shows the implied emission factor for N_2O emissions in source category 3.D.2.2 - Indirect N_2O Emissions From Nitrogen leaching and run-off for the years 1990 and 2013 for all Member States and EU28. The IEF decreased in five countries and increased in seven countries. It was in 2013 at the level of 1990 in sixteen countries. The largest decrease occurred in Hungary with an absolute decrease of 0.0075 kg N_2O-N/kg N. The three countries with the largest increases were Belgium, Netherlands and Cyprus with a mean absolute increase of 0.00016 kg N_2O-N/kg N.

Figure 5.67: 3.D.2.2 - Indirect N_2O Emissions From Nitrogen leaching and run-off: Trend in implied emission factor in the EU28 and range of values reported by countries

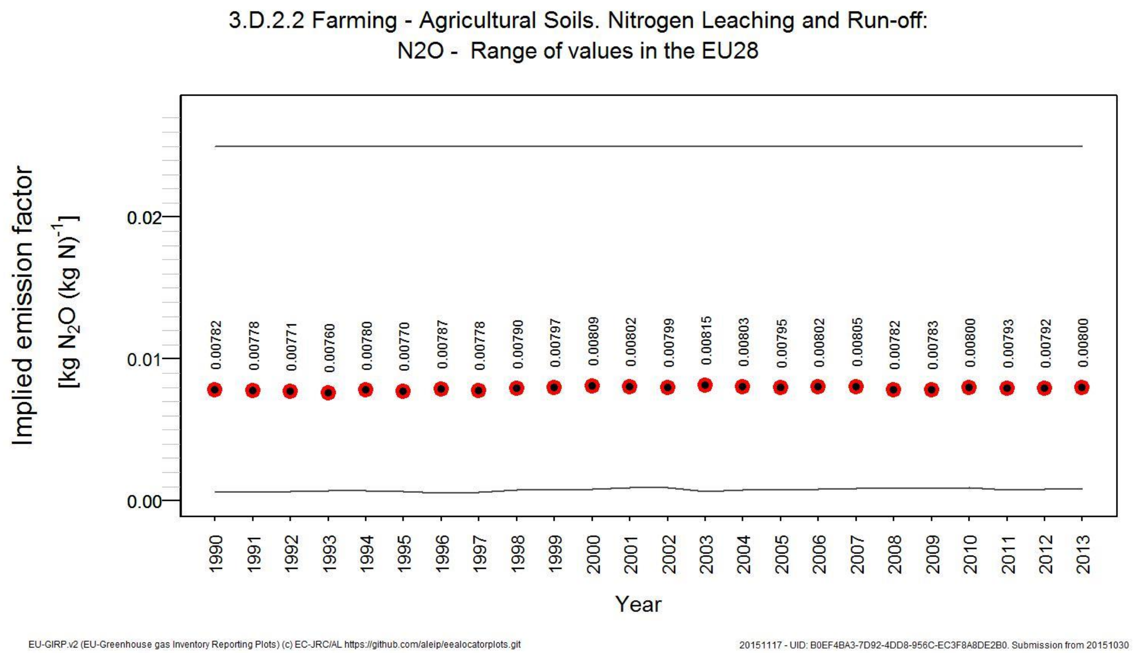


Table 5.47 3.D.2.2 - Indirect N_2O Emissions From Nitrogen leaching and run-off: Member States' and EU28 Implied emission factor (kg N_2O-N/kg N)

Member State	1990	2013		Member State	1990	2013
Austria	0.00750	0.0075	|	Italy	0.00750	0.0075
Belgium	0.00065	0.0008	|	Lithuania	0.00750	0.0075
Bulgaria	0.00750	0.0075	|	Luxembourg	0.00750	0.0075
Cyprus	0.00750	0.0075	|	Latvia	0.00750	0.0075
Czech Republic	0.00750	0.0075	|	Malta	0.00750	0.0075
Germany	0.00750	0.0075	|	Netherlands	0.00832	0.0086
Denmark	0.00439	0.0044	|	Poland	0.00750	0.0075
Estonia	0.00750	0.0075	|	Portugal	0.00750	0.0075
Spain	0.02500	0.0250	|	Romania	0.00750	0.0075
Finland	0.00750	0.0075	|	Sweden	0.00750	0.0075
France	0.00480	0.0048	|	Slovenia	0.00225	0.0022
Greece	0.00750	0.0075	|	Slovakia	0.02500	0.0250
Croatia	0.00750	0.0075	|	United Kingdom	0.00749	0.0075
Hungary	0.00750	0.0000	|	**EU28**	**0.00782**	**0.0080**
Ireland	0.00750	0.0075	|			

3.D.2.2 - Indirect emissions from nitrogen leaching and run-off - Fraction of N input to managed soils that is lost through leaching and run-off

The fraction of N input to managed soils that is lost through leaching and run-off, a parameter used for calculating N_2O emissions in source category 3.D.2.2 - Indirect emissions from nitrogen leaching and run-off, could not be evaluated at EU28 level. Table 5.48 shows the fraction of N input to managed soils that is lost through leaching and run-off in source category 3.D.2.2 - Indirect emissions from nitrogen leaching and run-off for the years 1990 and 2013 for all Member States and EU28.

Fraction of N input to managed soils that is lost through leaching and run-off decreased in three countries and increased in one country. It was in 2013 at the level of 1990 in 22 countries. No data were available for two countries. The largest decrease occurred in Hungary with an absolute decrease of 0.0099. There was an increase in Belgium with an absolute increase of 0.02.

Table 5.48 3.D.2.2 - Indirect emissions from nitrogen leaching and run-off: Member States' and EU28 Fraction of N input to managed soils that is lost through leaching and run-off (-)

Member State	1990	2013		Member State	1990	2013
Austria	0.1515	0.15	|	Hungary	0.0099	0.00
Belgium	0.0870	0.11	|	Ireland	0.1000	0.10
Bulgaria	0.3000	0.30	|	Italy	0.3000	0.30
Cyprus	0.3000	0.30	|	Lithuania	0.3000	0.30
Czech Republic	0.3000	0.30	|	Luxembourg	0.3000	0.30
Germany	0.3000	0.30	|	Latvia	0.3000	0.30
Denmark	0.3277	0.27	|	Poland	0.3000	0.30
Estonia	0.3000	0.30	|	Portugal	0.3000	0.30
Spain	0.3000	0.30	|	Romania	0.3000	0.30
Finland	0.3000	0.30	|	Sweden	0.1560	0.12
France	0.3000	0.30	|	Slovenia	0.3000	0.30
Greece	0.3000	0.30	|	Slovakia	0.3000	0.30
Croatia	0.3000	0.30	|	United Kingdom	0.3000	0.30

5.3 Uncertainties

For information on uncertainties please refer to chapter 1.6.

5.4 Sector-specific quality assurance and quality control and verification

5.4.1 Introduction

This section gives an overview of the QA/QC procedures applied specifically for the agriculture sector of the EU GHG inventory. It first gives an overview of the development of the agriculture QA/QC system with an outlook of further improvements to be discussed and/or implemented in coming years. A brief description of the QA/QC procedures used to process the data and interact with the Member States is given.

This is followed by brief summaries of selected activities that have been carried out in the past to improve and/or verify national and EU wide GHG emissions from agriculture in the frame of the EU GHG inventory system. The list is not comprehensive.

5.4.2 Improvements

Brief overview of the development of the QA/QC in the agriculture sector

A major revision of the present chapter on methodological issues and uncertainty in the sector agriculture was done for the submission in 2006 giving for the first time a complete overview of all relevant parameters required for the estimation of GHG emissions and 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 included (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, several errors identified in the background tables of the Member States could be eliminated, thus improving the calculation of EU-wide background information. Further details were added to the inventory report for the submission in 2008, based on recommendations by the Expert Review Team of the in-country review in 2007. For the submissions in 2009 through 2014, background information was further developed.

In 2008, 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.

Over the time, several sections were added describing specific QA/QC and verification activities (see also sections below), such as:

- Summary of the workshop on 'Inventories and Projections of Greenhouse Gas Emissions from Agriculture' (2003)
- Summary of the findings of the GGELS project (Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS).
- A comparison between submissions and data from the FAO GHG database (2014)
- An analysis on the share of manure excretion by IPCC climate zones with EU wide independent data
- A description of the Survey on agricultural production methods (SAPM 2010)
- A summary of the LiveDate project on Nitrogen Excretion factors
- Workshop on improving national inventories for agriculture (2013)
- Comparison of Cultivated Organic Soil at the FAO GHG database and JRC calculations

Main improvements in 2015

For the current submission (2015) the QA/QC system for the EU GHG inventory was thoroughly revised. While this is true for the whole EU GHG inventory, this is particularly true for the agriculture sector. The following specific issues with GHG inventory in the agriculture sector were identified to require improvements:

- The chapter contained many information and details which could not be kept after the increase of the number of countries to be covered. Many methodological details included in the agriculture chapter EU-GHG inventory report 2014 did not have a significant relevance for EU total emissions and thus 'diluted' the relevant information provided. Even though the chapter was consistently structured, some details that were added (e.g. as response to reviews) lead to an overall imbalance of the information provided.

- The agricultural chapter applied a specific methodology to calculate "Tier levels" and aggregated uncertainties to more accurately account for correlation between the uncertainty estimates of the individual countries. The methodology was developed for the EU GHG inventory and published in peer-reviewed literature[34]. While this method was shown to provide additional insight for the uncertainty assessment of the EU GHG inventory, it was of no practical relevance for the overall GHG inventory, as a different method was used for other sectors. It was therefore decided to be not continued.
- One major drawback of previous GHG inventories was the difficulties to account for 'other' animal types or nitrogen inputs. With the new data processing framework[35], *all* data are now available so that a comprehensive analysis is possible
- Streamlining with other sector chapters was improved, not the least by using of harmonized plots to present trend-data at EU level while also showing data from those countries contributing most to EU values
- Due to the quantities of data to be processed some remaining inconsistencies in the agriculture chapter of the EU GHG inventory report persisted, despite the highly automated procedures[36] and considerably efforts made to detect remaining inconsistencies. The newly implemented data processing system should help avoiding further inconsistencies.

In the current submission, therefore, a new system has been developed and introduced as describe in the section QA/QC system in the agriculture sector

Further improvements

The current submission (2015) brought a complete revision of the approach taken for the EU GHG inventory report in general and for the agriculture chapter in particular, driven by the need to adapt to new CRF software, increased number of countries to describe, and a series of new communication softwares (e.g. EEA review tool, EU-GIRP).

The agriculture chapter reflects these changes as described in the next section. Improvements will regard:

- Addition of sector-specific checks that could not be performed for the current submission
- Further streamlining with other sectoral chapter, where possible and useful
- Improved analysis of the data, e.g. with regard to time series
- General streamlining of the data processing

[34] Leip, A., 2010. Quantitative quality assessment of the greenhouse gas inventory for agriculture in Europe. Clim. Change. 103, 245-261. *doi:http://dx.doi.org/10.1007/s10584-010-9915-5*.

[35] EU-GIRP: EU-Greenhouse gas Inventory Reporting and Plots, see *https://github.com/aleip/eealocatorplots.git*

[36] For an overview of the QA/QC system of the agriculture sector for the 2013 GHG inventory see presentation given for the ICR2013 at *https://prezi.com/f1d3elxzd4qn/20131002_icr_agri/*

5.4.3 QA/QC system in the agriculture sector

Quality checks

Several quality checks are performed in the EU-GIRP[37] software. They are documented in various modules of EU-GIRP and can be examined in the open source repository. The checks include:

- **Check on NEs**[38] and empty cells has been done by extracting all reported 'NE's from the data base. The results were compared with the data contained in the file NE_checks_20150903.xlsx provided which also contained a list of empty cells.
- **Outliers in activity data and emissions**: Data were checked on outliers in AD and emissions. For each source category the share of AD and emissions by the countries to total EU28 values were determined. A share above 95% was further assessed and in case this was not linnked to a source category which is dominated by single countries (such as emissions from buffalo, which are dominated by Italy) the country was notified
- **Check on erroneous units**: In several case, countries report background data using different units (e.g. fractions insteat of percent values or vice versa; values per day instead of per year of vice versa; absolute values instead of values per head etc.). While these inconsistencies do not influence the reported emission estimates, a harmonization (at EU28 level) is important to ensure correct comparison of countries' values adn a correct calculation of EU28 background data. An automated check[39] is carried out detecting *seven* cases which can easily be recognised. Other 'mistakes' in units used were detected following the outlier analysis (see below). The countries were notified via the review tool and in many cases corrections have already been implemented.
- **Within-country outliers**: within-country outliers in IEFs and other parameters are detected on the basis of the distribution of the values provided[40]. We used the method based on the mean values and the standard deviation. Specifically, those values were identified as outliers which were more distant from than 1.5 time the standard deviation in the data from the mean (both in positive and negative direction). As an additional criterium, the relation to the median was used. In case the value was within 10% of the median it was not considered as an outlier. This removed cases where a country uses a country-specific parameter while most countries use the default value.
- **Identification of potentially significant issues**: For each of the outliers identified it was determined whether or not this could be a potentially significant issue based on the criterium of a share of 0.5% of national total GHG emissions. The 'size' of the possible over- or under-estimation was quantified comparing the reported value with an estimate using the median IEF

37 EU-GIRP: EU-Greenhouse gas Inventory Reporting and Plots, see *https://github.com/aleip/eealocatorplots.git*

38 *https://github.com/aleip/eealocatorplots/blob/master/eugirp_checknes.r*

39 *https://github.com/aleip/eealocatorplots/blob/master/eugirp_checkunits.r*

40 *https://github.com/aleip/eealocatorplots/blob/master/eugirp_checkoutliers.r*

or parameter as reported by all countries[41]. All outliers were 'manually' cross-checked and analysed. Countries were notified on the results of the analysis.

- **Time series outliers**: Time series outliers were detected on the basis of the same method as also used for the within-country-outlier check. Basis for the underlying distribution of data in this case, however, was not the values reported from all countries during the whole time series, but only the data reported by the country assessed. Only growth rates larger than ±3% could qualify as 'outliers'. However, this generated a large number of potential outliers which require further asseessment, which was not possible for the submission in 2015.
- **Sector-specific checks**: Several checks were performed tailored to the reporting in the sector agriculture [42][43]. First, the data are checked on consistency in reporting of activity data throughout the tables. Furhter, several other tests are performed:
  - Difference between the sum of nitrogen excreted and reported in the different manure management system (MMS) versus the total reported nitrogen excreted
  - Difference between the total nitrogen excreted and the product of animal population and nitrogen excretion rate
  - Difference of the sum of N handled in MMS over animal type vs. total N handled in each MMS
  - Check of the reported IEF per MMS with the total N excreted and the reported emissions
  - Calculation and evaluation of the IEF in category 3.B.2 by animal type and in relation to the total N excreted
  - Check that the sum of manure allocated to climate regions adds up to 100% over all MMS and climate regions
- **Recalculation**[44]: Countries were asked for justifications of recalculations of more than 0.5% of national total emissions (excluding LULUCF) and above or below the mean recalculations across all MS ±1.5 standard deviations.

Calculation of EU background data

EU-wide background data were calculated as weighted averages of the parameters provided by the countries, using activity data (animal numbers in category 3A and 3B and N input in category 3D) as weighting factors[45].

Care is being taken to not include in the calculation erroneous values:

- Data which had been identified as being reported with a different unit than the values reported by other countries (see above) were *converted* into the appropriate unit before calculating EU28 weighted averages
- Data which *obviously* wrong (very large outliers) but for which no clear correction could be identified were *eliminated* from the calcuation of the EU28 weighted averages to avoid biases in

[41] See function `ispotentialissue()` in the file https://github.com/aleip/eealocatorplots/blob/master/eugirp_functions.r

[42] https://github.com/aleip/eealocatorplots/blob/master/agrichecks1ADs.r

[43] https://github.com/aleip/eealocatorplots/blob/master/agrichecks2Nex.r

[44] File: Recalculations_Sep15_Nov14_14Sep2014_2_agri.xlsx

[45] https://github.com/aleip/eealocatorplots/blob/master/eugirp_euweightedaverages.r

the results. Therefore, the EU28 weighted averages - in some cases - could not represent 100% of EU28 activity data.

Compilation of the chapter agriculture for the EU-GHG inventory report

The agriculture chapter of the EU-GHG inventory report takes advantage of the data base generated by EU-GIRP. All numeric data presented in the chapter are calculated directly using the processed data as described above, thus eliminating the risk of transcription or copy errors. This does not eliminate the possibilty of mistakes completely. Therefore, all values are cross-checked.

5.1.2 Workshops and activities to improve the quality of the inventory in agriculture

Workshop on 'Inventories and Projections of Greenhouse Gas Emissions from Agriculture' (2003)

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.

The workshop report including the Recommendations formulated at the workshop are available *here*[46]

Survey on agricultural production methods (SAPM 2010)

The Survey on agricultural production methods, abbreviated as SAPM, is a once-only survey carried out in 2010 to collect data at farm level on agri-environmental measures. EU Member States could choose whether to carry out the SAPM as a sample survey or as a census survey. Data were collected on tillage methods, soil conservation, landscape features, animal grazing, animal housing, manure application, manure storage and treatment facilities and irrigation. With reference to irrigation, Member States were asked to provide estimation (possibly by means of models) of the volume of water used for irrigation on the agricultural holding.

The characteristics that were collected are given in the Regulation (EC) No 1166/2008 of the European Parliament and of the Council 19 November 2008 on farm structure surveys[47] and the survey on agricultural production methods and further defined in the Commission Regulation (EC) No 1200/2009 of 30 November 2009 implementing Regulation (EC) No 1166/2008 of the European

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46 Leip, A., 2005. N_2O emissions from agriculture. Report on the expert meeting on 'improving the quality for greenhouse gas emission inventories for category 4D', Joint Research Centre, 21-22 October 2004, Ispra. Office for Official Publication of the European Communities, Luxembourg. *doi:http://dx.doi.org/10.13140/RG.2.1.4706.7607*.

47 *http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32008R1166*

Parliament and of the Council on farm structure surveys and the survey on agricultural production methods, as regards livestock unit coefficients and definitions of the characteristics[48].

A list of characteristics of potential relevance for the quantification of GHG emissions is given in Table 5.49.

Table 5.49 Selected characteristics included in the 'Survey on agricultural production methods' (SAPM)

Characteristic			Units/categories
Animal Grazing	Grazing on holding	Area grazed during the last year	ha
		Amount of time when aminals are outdoors on pasture	Month per year
	Common land grazing	Total number of animals grazing on common land	Head
		Amount of time when aminals are grazing on common land	Month per year
Animal housing	Cattle	Stanchion-tied table - with solid dung and liquid manure	Places
		Stanchion-tied table - with slurry	Places
		Loose housing - with solid dung and liquid manure	Places
		Loose housing - with slurry	Places
		Other	Places
	Pigs	On partially slatted floors	Places
		On completely slatted floors	Places
		On straw beds (deep litter housing)	Places
		Other	Places
	Laying hens	On straw beds (deep litter housing)	Places
		Battery cage (all types)	Places
		Battery cage with manure belt	Places
		Battery cage with deep pit	Places
		Battery cage with stilt house	Places
		Other	Places
Manure application	Used agricultural area on which solid/farmyard manure is applied	Total	UAA % band (2)
	Used agricultural area on which solid/farmyard manure is applied	With immediate incorporation	UAA % band (2)
	Used agricultural area on which slurry is applied	Total	UAA % band (2)
	Used agricultural area on which slurry is applied	With immediate incorporation	UAA % band (2)
	Percent of the total produced manure exported from the holding		Percentage band (3)

48 http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1448050507039&uri=CELEX:32009R1200

Manure storage and treatment facilities	Storage facilities for:	Solid dung	Yes/No
		Liqued manure	Yes/No
		Slurry: Slurry tank	Yes/No
		Slurry: Lagoon	Yes/No
	Are the storage facilities covered?	Solid dung	Yes/No
		Solid dung	Yes/No
		Slurry	Yes/No

Note 1: Utilised agricultural area (UAA) percentage band: (0), (> 0-< 25), (=25-< 50), (=50-< 75), (=75)

Note 2: Percentage band: (0), (> 0-< 25), (=25-< 50), (=50-< 75), (=75).

The LiveDate project on Nitrogen Excretion factors

The key indicator 'Gross Nutrient Balance' (GNB) is part of the set of agri-environmental indicators defined in the Commission Communication on the "Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy"[49]. The Eurostat/OECD Methodology and Handbook on Nutrient Budgets has been updated and amended in 2013[50]. Nitrogen excretion coefficients have been identified of a major source of uncertainty for the estimation of the GNB, with high relevance for other reporting obligations, including the nitrate directive, reporting of ammonia emissions under the CLRTAP and the NEC directive, as well (and importantly) for the quantification of N_2O emissions from manure management and agricultural soils. An expert workshop was therefore organized on 28/03/2014 at Eurostat to discuss the possibility to improve the quality of N-excretion data by using a common improved methodology. A recommendation on such a common methodology served of the basis for discussion. The workshop was co-organized by JRC under the WG on Annual GHG inventories under the EU Climate Change Committee and was attended by agricultural experts of the EU GHG inventory system.

The following gives some information on the project that prepared the recommendations, as extracted from the report from Oenema et al. (2014)[51].

The general objective of the study "Nitrogen and phosphorus excretion coefficients for livestock; Methodological studies in the field of Agro-Environmental Indicators; Lot1" (2012/S 87-142068) is "to bring clarity into the issue of excretion coefficients so that a recommendation on a single, common methodology to calculate N and P excretion coefficients can be identified". The recommendation for a uniform and standard methodology for estimating N and P excretion coefficients must be based on a thorough analysis of the strength and weaknesses of the existing methodologies and on the data availability and quality in the Member States.

The specific objectives of the study were:

[49] http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/introduction

[50] http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/documents/Nutrient_Budgets_Handbook_%28CPSA_AE_109%29_corrected3.pdf

[51] Oenema, O., Sebek, L., Kros, H., Lesschen, J.P., van Krimpen, M., Bikker, P., van Vuuren, A., Velthof, G., 2014. Guidelines for a common methodology to estimate nitrogen and phosphorus excretion coefficients per animal category in eu-28. final report to eurostat, in: Eurostat (Ed.), Methodological studies in the field of Agro-Environmental Indictors. Eurostat, Luxembourg, pp. 1?108.

- To create an overview of the different methodologies used in Europe to calculate excretion factors for N and P, and analyse their strengths and weaknesses;
- To set up a database with the excretion factors presently used in different reporting systems and describe the main factors that cause distortion within a country and across the EU;
- To provide guidelines for a coherent methodology, consistent with IPCC and CLTRP guidelines, for calculating N and P excretion factors, and taking into consideration the animal balance and taking into account different methodologies identifies under the first bullet point;
- To create default P-excretion factors that can be used by the countries who do not have yet own factors calculated;

The recommendations of the LiveDate project from the authors of the report were:

- It is recommended to use the mass balance as a common and universally applicable method to estimate N and P excretion coefficients per animal category across EU-28:
  - $N_{excretion} = N_{intake} - N_{retention}$
  - $P_{excretion} = P_{intake} - P_{retention}$
- We recommend that the European Commission encourages Member States to invest in Tier 2 and 3 methods for key animal categories (and hence in country-specific, region-specific and/or year-specific excretion coefficients).
- We recommend that the European Commission encourages Member States to use a 3-Tier approach for the collection of data and information needed to estimate N and P excretion coefficients, so as to address differences between countries in livestock production and data collecting/processing infrastructure, and to economize on data collection/processing efforts. The three Tiers differ in the origin, scale and frequency of data and information collection.
- We recommend that the European Commission encourages Member States to use a Tier 3 approach for all key animal categories when livestock density in a country is > 2 livestock units per ha (>2 LSU per ha), equivalent to an excretion of about > 200 kg N or the inter-annual variation in N excretion by key animal categories is relatively large due to the effects of changing weather conditions and market prices.
- We recommend that the European Commission encourages Member States to use a Tier 2 approach for all main animal categories when livestock density in a country is between 0.5 and 2 LSU per ha (equivalent to an excretion of between about 50 and 200 kg N, under the condition that the inter-annual variation in N excretion by key animal categories is relatively small.
- We recommend that the European Commission reviews the current default N and P excretion coefficients of all animal categories and decides on a list of N and P excretion coefficients. Member States are recommended to use this list as a Tier 1 approach for all animal categories within a country when livestock density is <0.5 livestock units per ha (<0.5 LSU per ha, also at regional levels), which is equivalent to about 50 kg N and 10 kg P per ha agricultural land per year.
- We recommend that the European Commission encourages Member States to use region-specific N and P excretion coefficients when N and P excretion coefficients of the main animal categories differ significantly (>20%) between regions.
- We recommend that the European Commission makes computer programs available to Member States to encourage the calculation of the N and P excretion per animal category at regional and national levels in a uniform way. It is also recommended to provide training courses for the use of these programs and the calculation of the N and P excretion coefficients.

- We recommend that the European Commission encourages Member States to have well-documented and accessible methods for the estimation of N and P excretion coefficients per animal category. These reports should be updated once every 3-5 years and reviewed by external experts.
- We recommend that the European Commission encourages Member States to harmonise the various animal categories in formal policy reporting. We recommend that the FSS categorization is taken as the main list of animal categories for policy reporting, also because the inventory of the number of animals takes place regularly according to the FSS list of animal categories. We recommend also that a transparent scheme and computer program is developed for translating the inventory data of FSS into the animal categories of secondary databases (e.g., UNFCCC/IPCC-2006, EMEP/EEA, Nitrates Directive, FAO and OECD). The development of a uniform nomenclature for animal categories would be useful too, which should include definitions about key, main, minor, primary, secondary, functional categories
- We recommend that the European Commission encourages Member States to conduct a secondary animal categorization for key animal categories (e.g., cattle, pigs and poultry), when more than 20% of the animals are in ?another? system and when the N and/or P excretion coefficients differ by more than 20% from the overall mean N and P excretion coefficients. We recommend that the following aspects are considered for distinguishing different production systems:
  - Fast-growing and heavy breeds vs slow-growing breeds
  - Organic production systems vs common production systems
  - Housed ruminants vs grazing ruminants
  - Caged poultry vs free-range poultry
- Equally important is that the excretion coefficients can be translated in a transparent and well-documented manner from such secondary categories to the main categories of the FSS.
- We recommend that the European Commission conducts a review of the diversity of production systems and feeding practices within a country for the main animal categories cattle, pigs and poultry once in 5 yrs, so as to trace changes in production systems, including organic versus conventional systems, housed vs grazing ruminants, caged versus free range poultry, and fast growing breeds versus slow growing breeds.
- We recommend that the European Commission encourages Member States to review and update the N and P retention coefficients for all animal categories once in 5-10 yrs. All data should be stored in a database accessible by all Member States.
- We recommend that the European Commission conducts a review and adjusts/modifies/updates the classification system of livestock units (as presented also in Table 5 of this report), and livestock density, so as to better reflect the diversity of animals within an category and more in general the impact of livestock on the environment.

Regionalization of the Gross Nutrient Budget with the CAPRI model

The JRC was cooperating with EUROSTAT on a methodology to use the CAPRI model[52] 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

52 http://www.capri-model.org/

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.

The Working Group (WG) on agri-environmental indicators (AEI, February 2012) and the subsequent Standing Committee for Agricultural Statistics (CPSA, May 2012) decided to start a pilot projects on regionalising Gross Nitrogen Balance (GNB) with the CAPRI model. The objective of the pilot project is to evaluate differences between national GNB and the GNB calculated with CAPRI at the country and the NUTS2 scale. Italy, France, Germany and Hungary volunteered for this pilot project. The RegNiBal project (Regionalisation of Nitrogen Balances with the CAPRI Model - Pilot Project) started in February 2013. The overall goal was to use the CAPRI model to provide (operationally) regional GNB data to complement the national Eurostat/OECD GNBs.

Four countries volunteered to share their national GNB estimates with the CAPRI team which were analyzed on differences with CAPRI estimates and recommendations were formulated to improve both national methods and the CAPRI model:

- France
- Germany
- Italy
- Hungary

The conclusions formaulated in the final RegNiBal report[53] included:

A total of 31 'issues' were identified that were related to major discrepancies between the methods and warranted further assessment. At the end of the project, 12 of the identified issues were solved, one was partially solved and 18 could not be solved, but some progress was achieved and concrete recommendations were made for almost all of them. The results and achievements of RegNiBal are summarised in Annex 12.

At the start of the RegNiBal project CAPRI data was generally judged to be more reliable than national data. The situation has changed with the improvements described above; at present, further analysis is needed to see whether CAPRI or national data is ?better? with regard to the remaining unresolved issues.

Overall, N excretion by swine and N removal by grass are considered the most important unresolved issues because of their considerable impact on N-input and N-output. The animal budget analysis for swine of DE and FR shows that CAPRI estimates higher feed intake than the national methodologies. Countries are not always sufficiently accurate in estimating and/or using the average number of animals and N-excretion coefficients in N manure excretion estimations. For the estimates of dry matter yields of grassland, the differentiation of permanent grassland according to the proposal of the GRASSDATE project (Velthof et al 2014)[54] would likely help (grassland out of production but maintained, unimproved grassland (including

[53] Özbek, F.S., Leip, A., Weiss, F., Grassart, L., Hofmeier, M., Kukucka, M., Pallotti, A., Patay, A., Thuen, T., 2015. Regionalisation of Nitrogen Balances with the CAPRI Model (RegNiBal) Pilot project in support of the Eurostat Working Group on Agri-Environmental Indicators. Publications Office of the European Union, Luxembourg. doi: *http://dx.doi.org/10.2788/078406*.

[54] Velthof, G.L., Lesschen, J.P., Schils, R.L.M., Smit, A., Elbersen, B.S., Hazeu, G.W., Mucher, C.A., Oenema, O., 2014. Grassland areas , production and use. Lot 2. Methodological studies in the field of Agro-Environmental Indicators. Alterra Wageningen UR, Wageningen, The Netherlands.

both sole use and common land) and improved grassland (by N-input levels <50, 50-100, >100 kg N/ha/yr, sole use and common land).

The CAPRI model is very strong in several parts of GNB calculations, and the RegNiBal project enabled us to identify several possible improvements in national data and methods. The use of the animal budget to estimate N excretion is a major asset in the CAPRI methodology, but runs the risk of outliers if the use of feed in the statistical sources is overestimated. There is large uncertainty in grass yield and other (non marketable) fodder yield and their N content. This affects the accuracy of national data as well. The other major areas of difficulties for the CAPRI model are the following: (i) Seed and planting materials should be explicit in the CAPRI GNB; (ii) N from organic fertilisers (other than manure) and manure withdrawal, stocks, and import estimations are not considered in the CAPRI model.

The CAPRI model can be used to calculate both land N budgets (GNB) and farm N budgets. The possibility of comparing the GNB with the farm N-budget helps to constrain the N-surplus results. For the farm N-budget, feed and fodder produced in the country (or region) and manure excreted and applied within the country (or region) are considered as ?internal flows? and thus do not need to be estimated to quantify the N-surplus; data on ?imported? feed and ?exported? animal products are needed instead (for details on the comparison of the two approaches, see Leip et al 2011[leip2011nbudgets]). In the CAPRI model, data on animal products and imported feeds are available from statistical sources and are thus more reliable than the data on the N intake of fodder and manure excretion, which would not be required. Generally, the RegNiBal project showed that the CAPRI model could be adequate to provide national (and later regional and spatially explicit) GNBs. However, for the four countries assessed, additional work needs to be carried out to understand residual disagreements in the data.

Workshop on improving national inventories for agriculture (2014)

Under the WG1 on Annual GHG inventories under the EU Climate Change Committee a workshop on improving GHG inventories in the sector agriculture was organized by the Joint Research Centre as part of the 7th Non-CO_2 Greenhouse Gas Conference (NCGG7), held November 5-7, 2014 Amsterdam, the Netherlands[55]. The workshop was co-organized by CEH in support of the UK greenhouse gas inventory programme.

The session raised a high interest, contained high quality presentations and allowed scientists, IPCC and FAO representatives and country delegates to discuss about greenhouse accounting methods, their difficulties and challenges to use IPCC guidelines, to select the appropriate tier methods and to design country-specific methodologies which allow reducing uncertainties. From a total attendance of about 200 conference participants and five parallel sessions, this session was temporary attended by almost 100 scientists.

The workshop focused on N_2O emissions from agricultural soils, as they are highly uncertain yet are often estimated with default methodology in lack of country-specific data of sufficient quality. N_2O emissions from agricultural soils are dominating the uncertainty of the total GHG emissions for many countries. The programme included presentations covering the whole range of aspects of N_2O emission estimates: the availability of flux data in Europe and network design strategies (Rene Dechow, Thuenen Institute, DE), use of process-based models in GHG inventories (Steve del Grosso, USDA) to inverse methods to estimated national total N_2O emissions (Rona Thompson, NILU, NO). Further presentation gave national examples on GHG improvements, such as UK (general), NZ (pasture emissions), Thailand (emissions from rice), Norway (emissions from dairy farms) and on the link to IPCC guidelines and the IPCC Emission Factor Database (Kiyoto Tanabe (see below) and

55 http://www.ncgg.info/

Baasansuren Jamsranjav, IPCC TFI TSU). A broader picture was given on the basis of the FAOSTAT GHG Database (FrancescoTubiello) and the CAPRI model (Carmona and Leip: The calculation of greenhouse gas emissions in the European agricultural sector; how much does the method matter?). Introduction and expectations were formulated by a presentation from Velina Pendolovska (DG Climate Action).

A final brainstorming exercise was done about how modelling and measurements could be improved in a way to reduce uncertainties, improve accuracy of measures and optimise resources. There was a debate around whether new models are needed or focusing on reducing the uncertainty in current models would be preferable, for example using the results of inverse modelling to contrast results. There is an agreement on the acceptability of simple models or inverse models for emission accounting at high scales, while more complex process-based models are needed when designing mitigation options. The problem of nitrogen surplus was pointed out as a proxy of N_2O emissions, which also informs about other additional pollution problems. About the estimation of uncertainties, the group agreed on the need, first of all, to improve their estimation. It seemed a general impression that uncertainties are usually overestimated, but it is difficult to quantify objectively. Another point that needs attention is the activity data: statistics do not always match at national level, and sometimes models demand a high quantity of data which is not available. Getting better activity data is important prior to focus on emission estimations.

As a conclusion, the combination of an expert meeting in support of the EU GHG inventory system and an international scientific conference was very successful, as it provided a high density of expertise that country delegates could use. The NCGG conference series is ideal for this purpose.

5.1.3 Verification

Comparison of national inventories with EU-wide calculations with the CAPRI model

An in-depth comparison between GHG emission estimates as calculated with the CAPRI model and national GHG emission inventories had been done in the frame of the GGELS project[56].

A brief summary of the report was included in previous submissions of the EU GHG emission inventories in the agriculture chapter. This summary is available from the JRC website[57].

Allocation to climate regions

In the year 2013, an analysis was performed to compare the allocation of livestock over the IPCC climate regions at the national scale between data available at high spatial resolution at the Joint Research Centre and data provided in the national GHG inventory reports.

For the submission in the year 2014, this section had been updated and is available at the JRC website[58]

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56 *ftp://mars.jrc.ec.europa.eu/Afoludata/Public/DOCU236/*

57 *ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/leip_weiss2014.ggels_summary.pdf*

58 *ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/koeble_leip2014.livestockallocation.pdf*

Comparison of Cultivated Organic Soil at the FAO GHG database and JRC calculations

A comparison of the area of cultivated organic soils as reported by the FAO, in the national IRs with calculations done at the JRC has been performed by JRC in October 2013.

The FAO (FAO, 2103) provides area of cultivated organic soils on country level. The analysis is based on the Harmonized World Soil Database - HWSD - (FAO/IIASA/ISRIC/ISSCAS/JRC, 2009) and the Global Land Cover data set for the year 2000 (GLC2000).

At JRC the area of cultivated organic soils for the single countries in EU27 has been derived from overlaying the HWSD with the CORINE Land Use/Cover data set - CLC2006 (EEA, 2011) for the year 2006 (for some countries 2000). Both data sets have been resampled to a 1km by 1km raster cell size.

Definition of organic soils as given in IPCC (2006) based on FAO (1998): Soils are organic if they satisfy the requirements 1 and 2, or 1 and 3 below (FAO, 1998):

1. Thickness of 10 cm or more. A horizon less than 20 cm thick must have 12 percent or more organic carbon when mixed to a depth of 20 cm;
2. If the soil is never saturated with water for more than a few days, and contains more than 20 percent (by weight) organic carbon (about 35 percent organic matter);
3. If the soil is subject to water saturation episodes and has either: (i) at least 12 percent (by weight) organic carbon (about 20 percent organic matter) if it has no clay; or (ii) at least 18 percent (by weight) organic carbon (about 30 percent organic matter) if it has 60 percent or more clay; or (iii) an intermediate, proportional amount of organic carbon for intermediate amounts of clay (FAO, 1998).

FAO gave larger area of organic soils cultivated compared to JRC results for all countries except Germany Figure 5.69. This was mainly due to different source data sets for delineation of cropland area and the assumptions regarding the land use classification.

In the JRC approach Soil Typological Units (STU) of the HWSD are defined as 'organic soils'

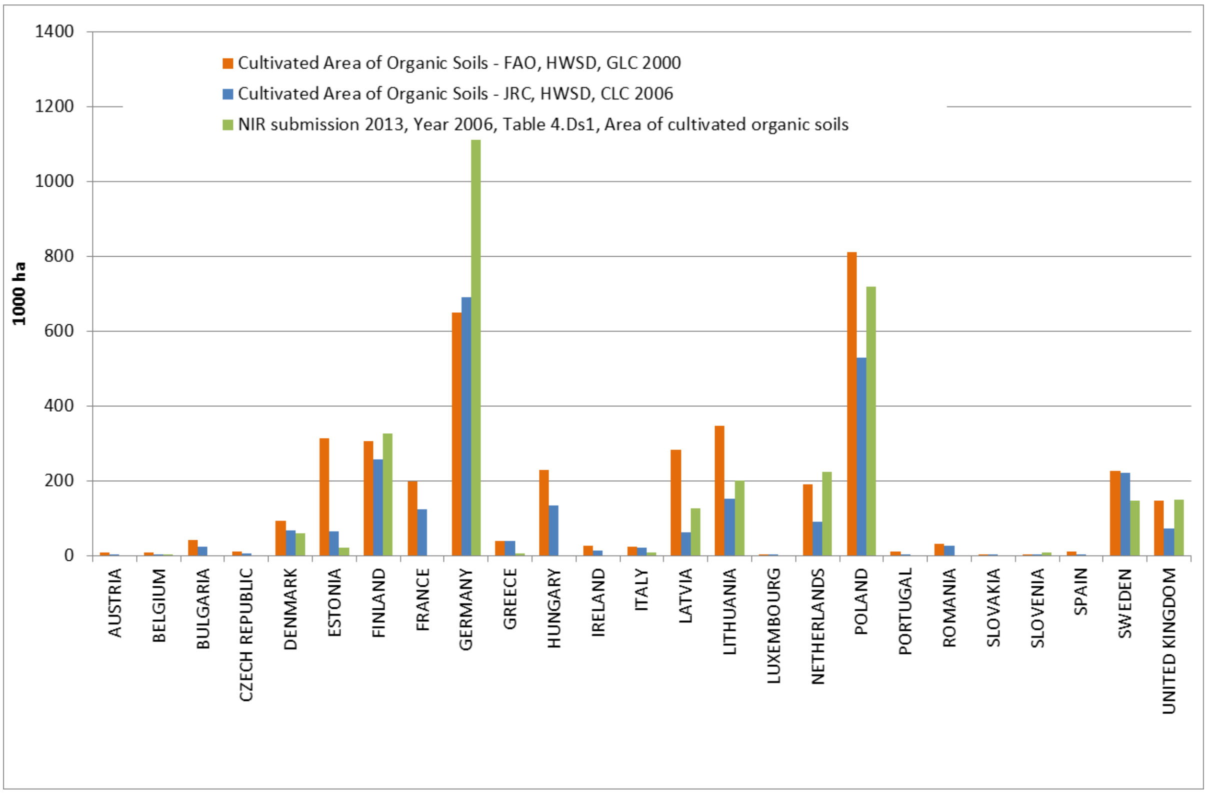
(1) if the topsoil organic carbon content is > 18% or

(2) if the topsoil organic carbon content is higher than the topsoil clay content * 0.1 + 12. All STUs in the EU27 of the HWSD which have been classified as 'organic soils' showed a organic carbon content of >30%, thus de facto only criterion (1) was applied.

To delineate 'cropland area' in the land use/cover map, FAO considers pure cropland classes as well as mixed cropland/other land use classes. For the latter, assumptions were made on the share of cropland within these mixed classes. However, the JRC approach takes assumes that in case of mixed land use classes the probability of the different land uses happening on organic soils are not the same, in contract to the approach of the FAO, which distribute land cover proportionally. As some crops do not grow well on organic soils it might occur that the land uses are not distributed equally on the mineral and organic soilbut that 100% of the forest is grown an organic soil and the crops are cultivated only on mineral soils.

In the JRC analysis mixed land use classes are not taken into account as the shares of cropland within these classes are given as ranges in the legend of CORINE. The cropland/other land use shares in the mixed land use classes might also vary between regions. Thus, by excluding mixed land use classes, the estimate of cropland area on organic soils can be considered as conservative compared to the FAO approach.

Figure 5.69: Area of cultivated organic soils based on two studies and the values given in the National Inventory Reports (2013) for the year 2006



Comparison of activity data in the FAO GHG database on the national inventory reports

A comparison between the activity data in the global FAO GHG data base[59] and the data reported in the national GHG inventories has been carried out for the submission in 2014.

This exercise could not be repeated for the current submission.

The corresponding chapter of the submission in 2014[60] has been extracted and is available here[61].

5.5 Sector-specific recalculations, including changes in response of to the review process and impact on emission trend

For information on recalculation please refer to chapter 10.

59 *http://faostat3.fao.org/browse/G1/*/E*

60 Chapter 6.7.3 in: EEA, 2014. Annual European Union greenhouse gas inventory 1990 - 2012 and inventory report 2014 Submission to the UNFCCC Secretariat. Technical report No 09/2014. European Environment Agency, Copenhagen, Denmark. Available at: *http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014*

61 *ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/carmona_leip2014.comparison_fao_nir.pdf*

6 LULUCF (CRF SECTOR 4)

Complying with relevant EU provisions (i.e. Regulation No 525/2013), Sector 4 LULUCF (Land Use, Land Use Change and Forestry) of the European Union (EU) GHG inventory is a compilation of the inventories submitted by individual EU´ Member States (MS). MS' submissions for 2015 are used as the primary source of data and information, unless otherwise specified and referenced through the text.

This chapter provides the general trends of GHG emissions and CO_2 removals from LULUCF at EU level, provides information on the methods used by different MS, and describes the efforts carried out to harmonize and improve the quality of EU GHG inventory. More detailed information can be found in individual national inventory reports (NIR) and common reporting format tables (CRF) of MS submissions.

In particular, this chapter includes: an overview of LULUCF sector including overall trends, the contribution of land use changes, the completeness of reporting, the key categories analysis of the EU GHG inventory, some general methodological information, the trends of net emissions and activity data for each land use 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.

6.1 Overview of the sector

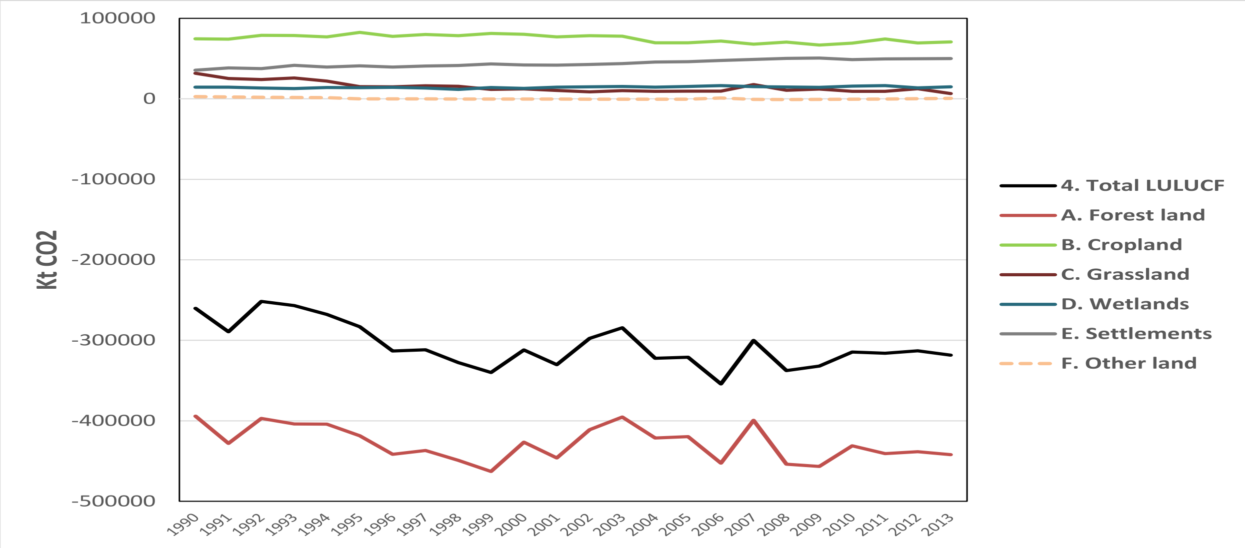
With almost all lands under more or less intensive management, Europe is a fine-grained mosaic of different land uses, resulting in a highly fragmented landscape. The EU agricultural and environmental policies have been the major driver of land use and land use change in Europe especially since 1990. 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 also the increase of forest and woodlands area under conservation regime with the purpose of preserving biodiversity and landscapes. Currently, at EU level, around 25% of total forest and woodland areas are excluded from harvesting. 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.

6.1.1 Trends by land use categories

Sector 4 LULUCF of the EU GHG inventory is a net carbon sink, resulting from higher removals by sinks than emissions from sources. Overall, the only carbon sink is represented by Forest land category. Cropland is the larger source of emissions, and Grasslands represents a small source. In 2013, the LULUCF sector of the EU results in total net sink of -317.624 kt CO_2eq resulting in an increase of 22% as compared to net sink in 1990 (Figure 6.17). Emissions of CH_4 and N_2O offset about 4% of these annual removals. Harvested wood product carbon pool, as reported in CRF table 4, represents a net sink of 21.612 kt CO_2.

Finally, within the EU, few MS reported in the CFR table 4, under the category "Other", additional emissions from sinks, or removals from sources, not reported in the sectorial background CRF tables for LULUCF. For instance, France reports CO_2 and CH_4 emissions form dam of Petit-Saut French Guiana, and biogenic NMVOC emissions from managed forest and methane removals from forest soil.

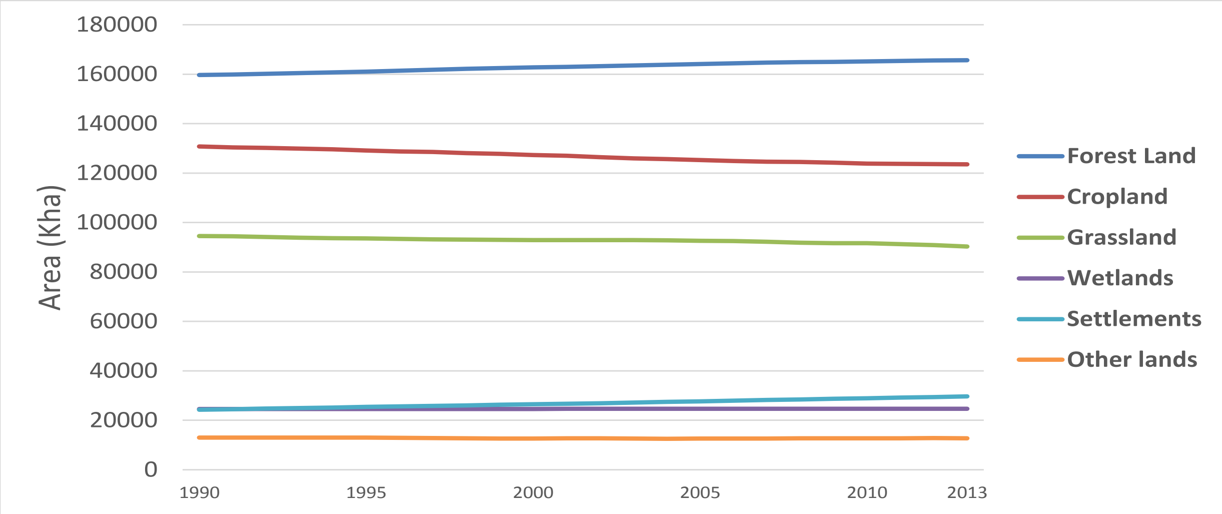
Figure 6.17 Sector 4 LULUCF: EU GHG net emissions (+) / removals (-) for 1990–2013, in CO_2 eq. (kt), for all land use categories.



Overall there is an increasing trend, since 1990, in the LULUCF sink. The most relevant trend in GHG net emissions and removals for the EU inventory is related to Forest land category. An increase of the forest sink occurred during the '90s, mainly due to forest area expansion. It has been 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 sink from 4A.1 subcategory sink by Germany, all occurring in a single year due to the stock-difference method used. Inter-annual variations of the forest sink are mainly related to disturbances. Major wind storms in central-western Europe (e.g. 1999 and 2007) and wildfires (e.g. forest fires in 1990, 2003 and 2007) in Mediterranean countries.

The total reported land area of the different land use categories in 2013 is 446.585 kha. The trends in Figure 6.18 confirms the trends known from other EU 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 the main changes in area from 1990 to 2013 are from Settlements (+22%), Croplands (-6%), Forest land (+4%), Grassland (-4%), Other lands (-2%) and Wetlands (+1%).

Figure 6.18 EU total land area for each of the LULUCF categories (kha), as reported in the MS' GHGI 2013



Although EU reports a net sink in the LULUCF sector in 2013, which is increasing since 1990 (Table 6.1), it should be noted that the estimates reported by individual MS range from sources (e.g. Denmark, Netherlands, Ireland) to small sinks (e.g. Belgium, Estonia) or large sinks (e.g. France, Finland, Poland, Romania). Compared to 1990, some MS report large increase in their sink (e.g. Italy, Spain) whiles other reduced it substantially (i.e. Austria, Bulgaria, and Germany).

Table 6.1 Sector 4 LULUCF: MS' contributions to net CO_2 removals in 2013 (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	-13 057	-6 035	-4 998	2%	1 037	-17%	8 059	-62%
Belgium	-2 350	-3 940	-3 855	1%	84	-2%	-1 505	64%
Bulgaria	-14 146	-9 155	-9 317	3%	-162	2%	4 829	-34%
Croatia	-5 543	-5 112	-5 139	2%	-27	1%	405	-7%
Cyprus	-614	-645	-652	0%	-7	1%	-39	6%
Czech Republic	-6 461	-7 123	-6 822	2%	302	-4%	-360	6%
Denmark	6 726	2 220	2 311	-1%	91	4%	-4 415	-66%
Estonia	-7 639	-1 471	-337	0%	1 133	-77%	7 302	-96%
Finland	-18 601	-30 048	-22 555	7%	7 493	-25%	-3 953	21%
France	-39 105	-50 276	-48 110	15%	2 166	-4%	-9 005	23%
Germany	-34 365	-17 516	-17 481	5%	36	0%	16 885	-49%
Greece	-2 439	-2 842	-3 333	1%	-491	17%	-893	37%
Hungary	-3 371	-4 420	-3 504	1%	916	-21%	-133	4%
Ireland	3 903	4 804	2 930	-1%	-1 874	-39%	-973	-25%
Italy	-7 419	-22 237	-34 318	10%	-12 081	54%	-26 899	363%
Latvia	-9 782	-1 441	-1 195	0%	246	-17%	8 587	-88%
Lithuania	-3 916	-8 954	-9 998	3%	-1 044	12%	-6 082	155%
Luxembourg	326	-447	-450	0%	-3	1%	-777	-238%
Malta	-3	-3	-3	0%	0	-1%	0	16%
Netherlands	5 665	6 087	6 142	-2%	55	1%	477	8%
Poland	-26 962	-34 546	-37 627	11%	-3 081	9%	-10 666	40%
Portugal	1 037	-10 698	-9 909	3%	789	-7%	-10 946	-1056%
Romania	-21 358	-25 264	-25 554	8%	-290	1%	-4 195	20%
Slovakia	-9 110	-7 345	-7 924	2%	-580	8%	1 186	-13%
Slovenia	-3 205	-4 775	-4 760	1%	15	0%	-1 555	49%
Spain	-23 775	-34 109	-34 291	10%	-182	1%	-10 516	44%
Sweden	-42 534	-44 876	-43 406	13%	1 469	-3%	-872	2%
United Kingdom	2 886	-5 770	-5 988	2%	-218	4%	-8 874	-307%
EU-28	**-275 212**	**-325 934**	**-330 143**	**100%**	**-4 209**	**1%**	**-54 931**	**20%**

Overall, at EU level, in the year 2013 the LULUCF sector offsets about 7% of the total emissions ("without LULUCF"), with big differences among MS (Table 6.2, column a). The most important LULUCF category, Forest Land, in 2013 was a net sink for all MS (Table 6.2, column b), offsetting about 10% of emissions from other sectors for the whole EU. The most significant contributors to total net sink are France, Germany and Sweden (Table 6.2 column c).

Table 6.2 Sector 4 LULUCF: Contribution of Sector 4 (column a) and Category 5A (column b) to total MS emissions (without LULUCF) and MS contribution to EU Category 5A (column c)

Member States	LULUCF over total inventory excluding LULUCF	Category 4A over total inventory excluding LULUCF	MS contribution to total category 4A
	(a) %	(b) %	(c) %
Austria	-6.3%	-5.5%	1.0%
Belgium	-2.5%	-2.7%	0.9%
Bulgaria	-16.7%	-19.8%	2.5%
Croatia	-20.9%	-22.4%	1.2%
Cyprus	-7.8%	-7.8%	0.1%
Czech Republic	-5.3%	-5.8%	1.7%
Denmark	4.4%	-4.2%	0.5%
Estonia	-1.5%	-7.5%	0.4%
Finland	-32.4%	-42.0%	6.0%
France	-9.5%	-13.4%	14.9%
Germany	-1.7%	-5.9%	12.8%
Greece	-3.2%	-1.8%	0.4%
Hungary	-6.0%	-5.6%	0.7%
Ireland	6.6%	-5.8%	0.8%
Italy	-7.8%	-8.5%	8.4%
Latvia	-1.4%	-29.5%	0.7%
Lithuania	-50.0%	-56.1%	2.5%
Luxembourg	-4.0%	-4.6%	0.1%
Malta	-0.1%	-0.1%	0.0%
Netherlands	3.2%	-1.4%	0.6%
Poland	-9.5%	-10.5%	9.4%
Portugal	-14.4%	-19.1%	2.8%
Romania	-22.2%	-24.2%	6.1%
Slovakia	-18.1%	-15.6%	1.5%
Slovenia	-26.1%	-39.4%	1.6%
Spain	-10.6%	-10.6%	7.7%
Sweden	-74.5%	-84.7%	10.7%
United Kingdom	-0.9%	-3.0%	3.9%
EU	-7.1%	-9.8%	100.0%

Source: MS' submissions 2015, CRF Table10s1and Table10s6.

6.1.2 Contribution of land use changes

Emissions from conversion of lands at EU level reached 5%, while in some categories their share is more that 50% of the total emissions in the corresponding category (Table 6.3). Entire land use change area represents 9% of the total reported land area in EU. The sink on conversions to Forest land and Grassland is balanced by emissions from conversions to Cropland and Settlements.

Table 6.3 Contribution of land use changes in 2013 for EU, in terms of area (columns a-b) and net CO_2 (columns c-d) (as aggregation of data from CRF Table 4.)

Land conversions	a) land area (Kha)	b) % of area of the corresponding category[1]	c) emissions (+) and removals (-) (Kt CO2)	d) % of net emissions of the corresponding category[1,2]
5A2. Land converted to Forest Land	8,406	5%	-56,151	12%
5B2. Land converted to Cropland	10,940	9%	45,240	67%
5C2. Land converted to Grassland	13,302	15%	-21,416	2194%
5D2. Land converted to Wetlands	1,430	6%	-674	5%
5E2. Land converted to Settlements	6,486	22%	46,890	94%
5F2. Land converted to Other Land	784	6%	563	100%
Total land use changes	**41,348**	**9%**	**14451**	**5%**

1 The corresponding category is 4A (Forest land) for 4A2, 4B (Cropland) for 4B2 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 4A2)/(abs 4A1+ abs 4A2) x 100.

On average, in 2013, from total area under conversion, 32% is conversion to Grassland, 26% is conversions to Cropland, 20% is conversions to Forest land, 16 % is conversions to Settlements, and 3% and 2% conversions to Wetlands and Other lands respectively.

6.1.3 Completeness of the sector

Table 6.4 illustrates the current coverage of reporting for the various land use sub-categories in the year 2013. The three main land uses categories are in most of the MS fully covered.

Table 6.4 Sector 4 LULUCF: Coverage of CO_2 emissions and removals for each of the LULUCF land use sub-categories for the year 2013, as derived from 2015 GHGI submissions

MS	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. F-F	5.A.2. L-F	5.B.1. C-C	5.B.2. L-C	5.C.1. G-G	5.C.2. L-G	5.D.1. W-W	5.D.2. L-W	5.E.1. S-S	5.E.2. L-S	5.F.1. O-O	5.F.2. L-O
Austria	R	R	R	E	E	E		E		E		E
Belgium	R	R	R	E	R	R		R		E		
Bulgaria	R	R	E	E		R		E		E		
Croatia	R	R	E	E	E	R		E		E		
Cyprus	R											
Czech Republic	R	R	R	E	R	R		E		E		
Denmark	R	E	E	R	E	E	E	E		E		
Estonia	R	R	E	E	E	R	E	E		E		E
Finland	R	R	E	E	E	E	E	E		E		
France	R	R	E	E	E	R		R		E		E
Germany	R	R	E	E	E	E	E	R	E	E		
Greece	R	R	R	E	E	R		E		E		E
Hungary	R	R	R	E	R	R	R	E		E		E
Ireland	E	R	R		E	E	E	E		E		E
Italy	R	R	E	E	R	R				E		
Latvia	R	R	E	E	E	R	E		R	E		
Lithuania	R	R	E	E	E	R	E			E		E
Luxembourg	R	R	E	E		R		E		E		E
Malta	R		R									
Netherlands	R	R	E	E	E	E		E	E	E		E
Poland	R	R	R	E	E	R	E		R	E		
Portugal	R	R	R	E	R	E		E		E		R
Romania	R	R	R	R	R	E		E		E		E
Slovakia	R	R	R	E		R				E		E
Slovenia	R	R	E	E		E		E		E		E
Spain	R	R	R	E	E	E		R		E		E
Sweden	R	R	E	E	R	E	E		R	E		
United Kingdom	R	R	E	E	R	R	E		E	E		E

R = the pool C stock change results in net Removals; E = the pool C stock change results in a net Emissions
Empty cells = the pool was not reported, included elsewhere or reported with no net C stock changes.

In general, the reporting of Wetlands, Settlements and Other lands categories involves lower tiers methods in comparison to the major land use categories. Carbon stocks changes in “land remaining in the same category” are often assumed in equilibrium for these categories while, there is a quite complete reporting on emissions and removals from land converted to them. Table 6.5 shows the completeness of reporting on carbon stock changes by carbon pools for the three most important land use categories in 2013. Compared to the previous submissions, several MS have increased the number of pools estimated and reported. As for Table 6.4, empty cells in Table 6.5 represent pools which are not reported with quantitative estimates (in some cases based on Tier 1 assumptions and in some cases providing also demonstration that they are not a net source of emissions). In most cases, efforts are ongoing by MS to prepare estimates for these pools in future submissions.

Table 6.5 Sector 4 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2013 (from Tables 4A, 4B and 4C of MS's GHGI 2015 submissions)

MS	Reporting category																							
	Forest land								Cropland								Grassland							
	5.A.1. F-F				5.A.2. L-L				5.B.1. C-C				5.B.2. L-C				5.C.1. G-G				5.C.2. L-G			
	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg
Austria	R	R	E		R	R	R		E		R		R	E	E				R	E	E	E	R	
Belgium	R	E	R		R		R		R		R	E	E	E	E				R	E	E	E	R	
Bulgaria	R				R	R	E		E		R		E		E						E		R	
Croatia	R				R		R		E		R	E	R		E					E	E		R	
Cyprus	R																							
Czech Rep	R				R		R		R		R		E	E	E				R		R	E	R	
Denmark	R	E		E	E	E	R	E	E		E	E	E	E	R	E	E			E	E	E	E	
Estonia	E	R	R	E	R	R	E	E	E		R	E	E	E	E	E	E	R		E	E	E	R	E
Finland	R		R	E	R		R	E	R		R	E	E	E	E	E	R			E	E	E	R	E
France	R	E			R	R	R	E					E	E	E	E					E	E	R	E
Germany	R	E	R	E	R	R	E	E				E	E	E	E	E	R		E	E	E	E	R	E
Greece	R				R				R			E	E	E	E		E						R	
Hungary	R			E	R		R		E		R		R	E	E				R		R	E	R	
Ireland	E	R		E	R	R		E	R		R								R	E	E	E		E
Italy	R	R			R	R	R		E			E			E		R	R			E		R	
Latvia	R	R		E	R	R		E	R	R		E			E	E	R	R		E			R	E
Lithuania	R	R			R	R			R		R	E	E		E	E				E			R	E
Luxembou	R				R		R		E		R		R	E	E						E	E	R	
Malta	R								R															
Netherland	R	R			R		E	E				E	E	E	E	E				E	E	E	R	E
Poland	R		R	E	R		R	E	R		E	E			E				E	E	R		R	
Portugal	R	E	R		R	E	R		R		R		E	E	E				R		E	E	E	
Romania	R			E	R	R	R		R	E	R	E	R	E	R		R			R	E	E	R	
Slovakia	R				R	R	R		R		R		E	E	E						E	E	R	
Slovenia	R	E			R		R		R		E	E	E	E	E						E	E	E	
Spain	R				R	R	R		E		R		R	E	E						E	E	R	
Sweden	R	R	R	E	R	R	E	E	R	R	E	E	E	E	E	E	R	R	R	E	E	E	R	E
UK	R	R	R	R	R	R	R	R			E	E	E	E	E	E			R		E	E	R	E

Pools: DOM – dead organic matter, LB –living biomass, SOCmin –soil organic carbon in mineral soils, SOCorg –soil organic carbon in organic soils
R: net Removal;
E: net Emission
Empty cells = the pool was not reported or reported as zero, because it is: assumed "in balance" (following IPCC tier 1), stock changes are "not occurring", or the pool is not present.

6.1.4 Data and methods

This section provides an overview of the information on methods and data used for reporting emissions and removals from the three main land use categories. Detailed information regarding methodological issues is included as an annex of this report.

Given the heterogeneity of the MS in terms of ecological and socio-economic conditions, there are no unique definitions of land use categories. Methods used to estimate GHG emissions and CO_2 removals from the LULUCF sector also vary considerably among MS and land use categories. This heterogeneity is of course a richness in terms of biodiversity, but also, the implementation of country-specific data and methods (if in accordance with IPCC) that reflect national circumstances are likely to be more accurate than if they were prepared using and EU single approach.

Table 6.6 is a summary of relevant information on methodologies applied for each individual pool in the GHG inventory 2015 for the LULUCF sector. Usually, for reporting lands remaining in the same category a single data source is used which facilitate the categorization of the methods under one single tier, while multiple data sources are often used to estimate emissions from lands under conversions.

Because of different underlying methods applied by each MS, and their own national circumstances, the comparison of absolute levels or trends of emissions across MS should be done carefully to prevent erroneous interpretations. Indeed, in some cases, large differences may be attributable to the different estimating methodologies. For example, the gain-loss and stock-difference methods may lead to different trends in the short term. Some implied carbon stock change factors may be significantly affected by new areas entering in a given category or, time series for land conversions do not sum up for each reported year a 20-years transition period (e.g. dataset on land conversions started in 1990). Furthermore, the fact that not all MS use the 20-year default transition period for all pools or land conversions suggest that the corresponding carbon stock change factors are not fully comparable across MS.

Table 6.6 Summary of methods and carbon stock change factors used by MS to calculate CO_2 emissions and removals of different carbon pools in the LULUCF sector, as reported in the GHGI 2015 submissions

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)
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
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
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
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
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
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
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
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,NO	NO
HR	CS	D	NO	NO	CS	D	CS	NO	CS,D	NO	CS	D	CS	NO	CS	NO	NO	NO	NO	D	CS,D	NO	CS	NO
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
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
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
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
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
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
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
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
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
RO	CS	D	D	NE	CS	D	NE	NE	D	CS	CS	D	NO	NO	CS	NO	NO	NO	NO	NE	NO	NO	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
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
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

Source: CRFs 2015

(D: default; CS: country specific; NA: not applicable; NE: not estimated; NO: not occurring)

"CS" country specific data, associated either with IPCC method tier 2 or country-specific method tier 3, if data are highly disaggregated or derivate using models. Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken from IPCC GPG). However it is expected that if "CS" is reported in table 6.7, 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 insignificant emission/removal 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: dead wood and litter respectively

(2) for SOCorg any notation key used under carbon stock changes estimation, if areas of organic soils are reported, should, in principle, be seen as NE. D refers to the use of IPCC default emissions factors

(3) for LB carbon stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed in balance

(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 factors" (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 LB 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)

6.1.5 Key categories

The following LULUCF subcategories of the EU GHG inventory were found to be key categories (Table 6.7) for the trend (T) and the level assessment (L).

Table 6.7 Key category analysis for the EU (LULUCF sector excerpt)

Source category gas	kt CO2 equ.		Trend	Level	
	1990	2013		1990	2013
4 Biomass Burning Land Use: Land-Use Change and Forestry (CO2)	11,389	3,690	T	0	0
4.A.1 Land Use: Forest Land (CO2)	41,321	44,913	T	L	L
4.A.2 Land Use: Forest Land (CO2)	37,233	56,639	T	L	L
4.B.1 Land Use: Cropland (CO2)	24,985	22,279	T	L	L
4.B.2 Land Use: Cropland (CO2)	45,879	45,025	T	L	L
4.C.1 Land Use: Grassland (CO2)	31,679	21,035	T	L	L
4.C.2 Land Use: Grassland (CO2)	8,814	21,198	T	0	L
4.D.1 Land Use: Wetlands (CO2)	13,061	14,174	T	L	L
4.E.2 Land Use: Settlements (CO2)	32,077	46,644	T	L	L
4.G Wood product: Harvested Wood Products (CO2)	24,746	20,110	T	L	L
4.H Land Use: Other LULUCF (CH4)	3,214	1,003	T	0	0

6.2 Categories and methodological issues

6.2.1 Forest land (CRF 4A)

6.2.1.1 Overview of the Forest land category

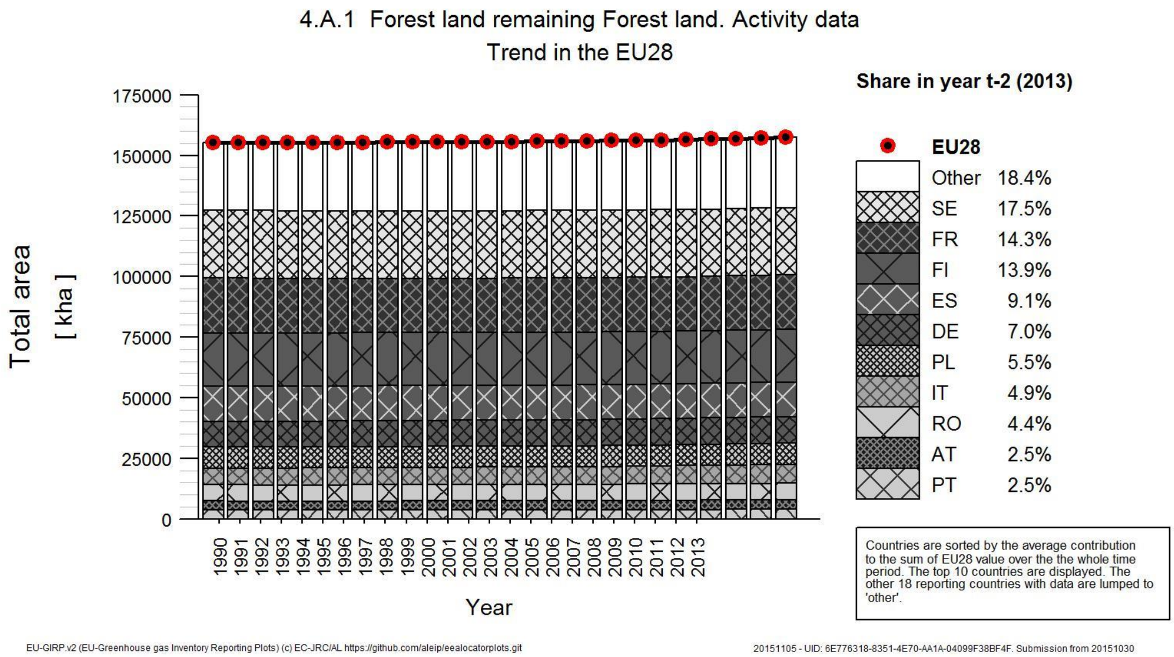
Forests land is the leading category in the LULUCF sector, and represents 37% of total EU area. According to the data provided by MS in their 2015 submissions, total forest area in EU increased from 159.644 kha in 1990 to 165.708 kha in 2013, which represent an increase of 4%. About 5% of this forest area is represented by land under conversion to forest land. This trend, reflected in official statistics of the EU, is due to the decreasing grazing pressure and decreasing agricultural activities on marginal lands, which promoted natural forest expansion, but also due to the promotion of national afforestation programs (including grant-aid). The largest forest area in 2013 is reported by Sweden, France and Finland. While, deforestation does not appear to be a major issue in Europe; it may be relevant for specific countries, nevertheless, the absolute area under conversion from forest is highly compensated by that of new planting and forest expansion.

6.2.1.2 Forest Land remaining Forest Land (CRF 4A1)

Overview of Forest Land remaining Forest Land category

The area of Forest Land remaining Forest Land slightly increased by 1% at EU level since 1990 with large differences among MS (e.g., UK +33%, Netherlands -11%) (Figure 6.19, Table 6.8).

Figure 6.19 Trend of activity data in the "Forest land remaining Forest Land" subcategory of EU MS (kha, 1990-2013)



For the year 2013, the total land area reported at EU level under the category 4.A1 reached 157.302 Kha of which 82% corresponds to the 10 MS with higher contribution.

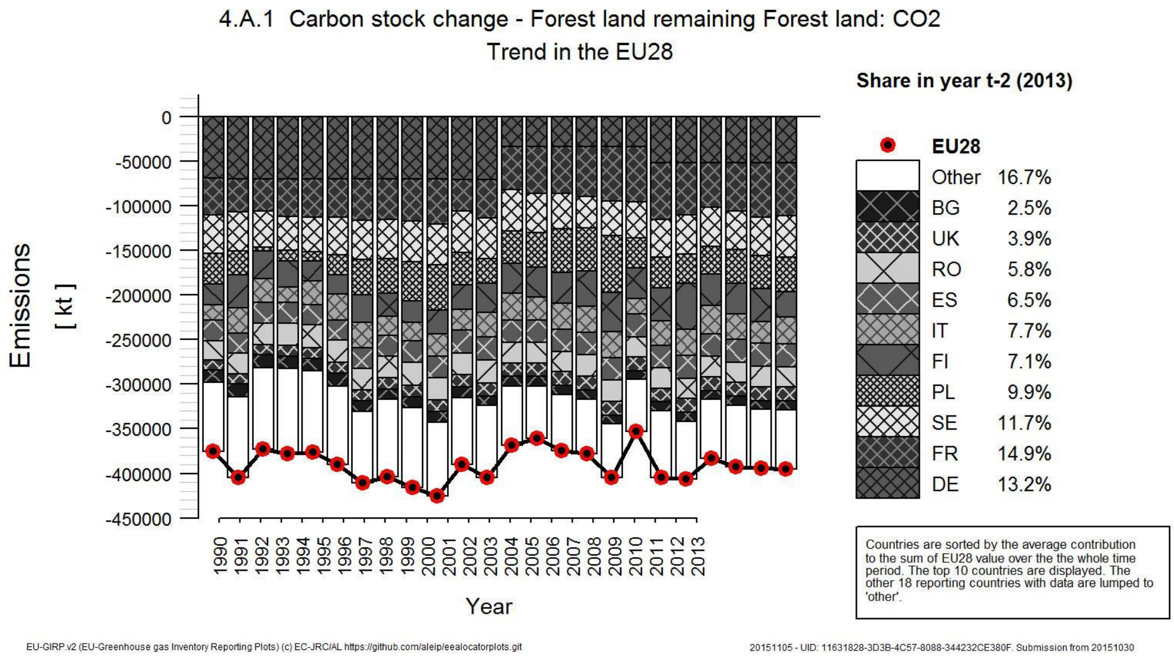
At EU level, Forest Land remaining Forest Land is a net sink of -392 649 kt CO_2 in 2013, increasing 6% as compared in 1990, and similar to the sink reported for the year 2012 (Table 6.8).

Table 6.8 4A1 Forest Land remaining Forest Land: MS' contributions to net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	-7 849	-2 542	-2 561	1%	-19	1%	5 288	-67%
Belgium	-2 930	-3 690	-3 689	1%	2	0%	-759	26%
Bulgaria	-14 279	-10 019	-10 004	3%	15	0%	4 274	-30%
Croatia	-5 589	-5 230	-5 291	1%	-61	1%	298	-5%
Cyprus	-614	-645	-652	0%	-7	1%	-39	6%
Czech Republic	-4 635	-7 182	-7 117	2%	65	-1%	-2 482	54%
Denmark	253	-2 899	-2 384	1%	515	-18%	-2 637	-1043%
Estonia	-8 763	-1 262	-115	0%	1 147	-91%	8 648	-99%
Finland	-22 882	-36 490	-27 963	7%	8 527	-23%	-5 081	22%
France	-38 987	-60 478	-58 885	15%	1 593	-3%	-19 897	51%
Germany	-69 436	-52 198	-52 270	13%	-71	0%	17 166	-25%
Greece	-1 176	-1 579	-1 776	0%	-198	13%	-601	51%
Hungary	-2 971	-2 719	-2 013	1%	706	-26%	959	-32%
Ireland	-2 720	267	74	0%	-193	-72%	2 794	-103%
Italy	-17 644	-24 515	-30 354	8%	-5 839	24%	-12 710	72%
Latvia	-15 040	-3 918	-3 603	1%	316	-8%	11 438	-76%
Lithuania	-7 150	-8 757	-10 491	3%	-1 734	20%	-3 342	47%
Luxembourg	239	-434	-444	0%	-10	2%	-684	-286%
Malta	-2	-2	-2	0%	0	0%	0	0%
Netherlands	-1 949	-2 063	-2 366	1%	-303	15%	-417	21%
Poland	-33 561	-36 838	-39 131	10%	-2 293	6%	-5 570	17%
Portugal	-2 214	-8 438	-8 880	2%	-442	5%	-6 666	301%
Romania	-21 590	-22 909	-22 966	6%	-57	0%	-1 376	6%
Slovakia	-6 088	-5 922	-6 481	2%	-559	9%	-394	6%
Slovenia	-4 248	-6 276	-6 321	2%	-45	1%	-2 073	49%
Spain	-23 089	-25 677	-25 714	7%	-37	0%	-2 625	11%
Sweden	-43 752	-43 267	-46 075	12%	-2 807	6%	-2 322	5%
United Kingdom	-11 005	-15 098	-15 174	4%	-76	1%	-4 169	38%
EU-28	**-369 670**	**-390 781**	**-392 649**	**100%**	**-1 868**	**0%**	**-22 979**	**6%**

For 2013, with the exception of Ireland, all the MS report a sink in Forest Land remaining Forest Land. The largest change in absolute terms reported by MS as compared with 1990 correspond to a significant increase of the sink reported by France. In a good match with the share in total areas, the 10 MS with the largest contribution to total sink account for about 83% of the EU sink reported for the year 2013.

Figure 6.20 Trend of emissions in the "Forest land remaining Forest Land" subcategory of EU MS (kha, 1990-2013)



In many cases, CO_2 emissions from biomass burning are implicitly included in CRF table 4.A, as a loss of carbon stock, while related non-CO_2 emissions are reported in CRF table 4(V). The main types of disturbances across EU are forest fires (mainly in Southern European countries) and wind storms (mainly in central Europe), while other type of disturbances generally have a localized effects and low magnitude. They are difficult to quantify in terms of biomass loss (e.g. insect outbreaks), thus they are practically not mentioned in the MS reports. Estimation of emissions from forest fires is made with Tier 1 method in case of small emissions or with higher tiers where such annual emissions are significant (e.g. Portugal, Spain).

Large inter-annual variability in GHG estimates that affect the EU trend is driven by natural disturbances:

- Forest fires (e.g. Portugal in 1990, 2003 and 2005; Italy in 1990, 1993 and 2007). For instance, Spain reports areas burnt ranging between 20 – 250 kha annually;
- Windstorms (e.g. France in 1999 and 2009, and Denmark in 2000, Sweden in 2005);

Or by the estimation method:

- For instance, Germany uses the stock-difference method between subsequent forest inventories. This method is accurate for estimating carbon stock changes over a time period but it may results in discontinuities in trends, i.e. "steps" in single years (e.g. 2002), because the significant decrease of the sink which occurred over a period since the previous forest inventory is counted in a single year when carbon stocks of the more recent inventory are integrated in the calculation.

Methodological issues for Forest Land remaining Forest Land category

Forest land definitions are reported by almost all EU MS in their submissions with the exception of Cyprus. (Table 6.9, Table 6.10). The consistency of these definitions with the land representation system is ensured within the MS in terms of time and space. The forest definitions among MS, slightly differ in terms of quantitative parameters (i.e., crown cover, tree height and minimum land area). In general, these forest definitions are consistent with definitions used under other international processes (i.e. Global Forest Resources Assessments 2005, 2010 FRA (FAO)). For forest administration purposes, lands without tree cover, may be included or not within forest land, thus, additional qualitative criteria complement the forest definition provided (i.e. treatment of forest roads, nurseries, willow crops, etc.). Few MS have changed their forest definition since 1990, but these changes do not affect consistency of the time series on activity data. Greece has a new forest definition applied from 2003. Denmark changed from a questionnaire based forestry information system to NFI but implemented methods for ensuring the consistency of the time series (i.e. reassessment of base year data based on earth observation information).

Table 6.9 Values for forest definitions thresholds as selected by MS

Member State	NIR 2015			
	Crown cover (%)	Height (m)	Area (ha)	Minimal width (m)
Austria	30	2	0.05	10
Belgium	20	5	0.5	-
Bulgaria	10	5	0.1	10
Croatia	10	2	0.1	-
Cyprus	-	-	-	-
Czech Republic	30	2	0.05	-
Denmark	10	5	0.5	20
Estonia	30	2	0.5	-
Finland	10	5	0.25 (0.5) for Southern (Northern) Finland	20
France	10	5	0.5	20
Germany	10	5	0.1	-
Greece	25	2	0.3	-
Hungary	30	5	0.5	-
Ireland	20	5	0.1	20
Italy	10	5	0.5	-
Latvia	20	5	0.1	20
Lithuania	30	5	0.1	-
Luxembourg	10	5	0.5	-
Netherlands	20	5	0.5	30
Malta	30	5	1	-
Poland	10	2	0.1	10
Portugal	10	5	0.5	20
Romania	10	5	0.25	20
Slovakia	20	5	0.3	20
Slovenia	10	5	0.25	-
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 carbon stock changes at EU level is difficult to assess, as it depends on several 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 (e.g. strict implementation of FRA 2005 criteria for forest and other woody lands against national thresholds would lead to 1-2% larger forests area as highlighted by Estonia's NIR).

Table 6.10 Additional qualitative criteria for defining "Forest land"

Member State	Forest land definition
Bulgaria	Areas of natural forest regeneration outside urban areas with a size of more than 0.1 ha also represent "forest". Forests are also: areas which are in a process of recovering and are still under the parameters, but it is expected to reach forest crown cover over 10% and tree height 5 meters; areas, which as the result of anthropogenic factors or natural reasons are temporarily deforested, but will be reforested; protective forest belts, as well as tree lines with an area over 0.1 ha and width over 10 meters; cork oak stands. City parks with trees, forest shelter belts, and single row trees do not fall under the category "forests.
Czech Republic	Forests excludes the areas of permanently unstocked cadastral forest land, such as forest roads, forest nurseries and land under power transmission lines.
Denmark	Temporarily non wooded areas, fire breaks, and other small open areas inside the Forest land, including Christmas tree crops.
Estonia	All temporarily unstocked forest areas and regeneration areas which have yet to reach a crown density of 30 per cent and a tree height of 2 meters are also included as forest, as are areas which are temporarily unstocked as a result of human intervention such as harvesting, or natural causes (fires, etc.) but which are expected to revert to forest.
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 France'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.
Hungary	„Forest land" (includes FL-FL, L-FL sub-categories) includes areas covered by trees, as well as roads and other areas that are under forest management but that are not covered by trees.
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.
Latvia	Young natural stands and all plantations established for the forestry purposes, which have to reach a crown density of 20 % or tree height of 5 m are considered under forest land; as well as the areas normally forming part of the forest area, which are temporarily unstocked as a result of human intervention or natural causes, but which are expected to revert to forest.
Lithuania	Tree lines up to 10 meters of width in fields, at roadsides, water bodies, in living areas and cemeteries or planted at the railways protection zones as well as single trees and bushes, parks planted and grown by man in urban and rural areas are not defined as forests.
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.
Poland	Young stands and all plantations that have yet to reach a crown density of 10 percent or a tree height of 2 m are included under forest. Areas normally forming part of the forest area that are temporarily un-stocked as a result of human intervention, such as harvesting or natural causes such as wind-throw, but which are expected to revert to forest are also included.
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.
Romania	It comprises deciduous forest, coniferous forest, mixt forests, clear-cut areas and nurseries, as defined by presence of deciduous trees, coniferous trees, deciduous and resinous trees, dead trees, clear-cuts and forest nursery.
Slovakia	This category includes the land covered by all tree species serving for the fulfilment of forest functions and the lands on which the forest stands were temporarily removed with aim of their regeneration or establishment of forest nurseries or forest seed plantation.
Slovenia	It includes abandoned agricultural land with natural expansion of forest. Abandoned agricultural land on area more than 0.5 ha, which have been abandoned for more than 20 years, with minimal tree height 5.00 m and have a tree crown cover between up to 75 % are defined as forests.
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.
United Kingdom	Forestry statistics definition used for GHG inventory includes integral open space and felled areas that are awaiting restocking.

National Forest Inventories (NFIs) provide fundamental input data both for forest land and conversions to and from forest land areas, as well as, for the estimation of carbon stock changes in various pools. Nevertheless, this information is also taken from Forest management plan databases in some cases, especially, the information used for the base year (e.g. Slovakia). Data collection in NFIs is typically based on repeated measurements in permanent sampling plots, but the sampling design differs among MS in terms of spatial density and frequency of field surveys (e.g. Austria 3 years, Spain 10 years).

In recent years, the EU' MS have made considerable efforts to adjust their forest inventories to the specific requirements of UNFCCC/KP reporting, but also steps toward slight harmonization at European scale (e.g. COST E43 Action)[62]. Efforts have been made also to adjust the timing of inventory cycles to the timeline of first commitment period of the Kyoto Protocol. Time series of annual activity data are usually obtained by interpolation and extrapolation of available non-annual datasets. The main data source for forest area are the national forest inventories which often do not provide annual nationwide data. Other sources are national statistics or remote sensing products (satellite images, aerial photographs) including their derivatives products such as Corine Land Cover maps.

Furthermore, MS usually breakdown forest land area in various subdivisions according to available datasets. Breakdown criteria differ across MS, although they are consistent across time series: e.g. by groups of species or forest types (i.e. broadleaves/coniferous; evergreen/deciduous; species based

[62] http://www.metla.fi/eu/cost/e43

classification – beech, oak, pine, spruce, etc.); by climate (i.e. temperate, tropical); by soil and site type (e.g. lowland, organic or mineral soils), administrative or geographical boundaries, and management type (e.g. coppice, high stands).

For Forest land category, the carbon pools definitions are reported by most of the MS (Table 6.11). Among them, there are slight variations, however the impact on the estimates of such variability, even if difficult to assess in quantitative terms, is considered small. For instance, forest inventories define above-ground biomass carbon 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 below-ground biomass, the information on what exactly is includes on this pool is sparse. Dead wood mostly differs in terms of decay time and thresholds of diameters and height/length of pieces included in the pool. Litter is either independently assessed or included with soils. In soils organic matter, carbon stock changes are computed according to various soil depths. Usually, carbon stock in understory biomass is only accounted in principle for estimating forest fires emissions (although such information is often not transparently reported in the NIR).

Table 6.11 Forest carbon pools definitions in the GHG inventories of the 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
Hungary	The total biomass above the stump, including all branches and bark, of trees taller than two meters.
Lithuania	Above ground biomass refers to all living biomass above the soil including stem, stump, bark, branches, seeds and foliage.
Ireland	Modeled individual cycle of living biomass (but not the understory and annual/perennial non woody vegetation).
Italy	Trees with DBH over 3 cm.
Lithuania	Above ground biomass refers to all living biomass above the soil including stem, stump, bark, branches, seeds and foliage.
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).
Slovakia	Merchantable volume, defined as tree stem and branch volume under bark with a minimum diameter threshold of 7 cm.
Slovenia	Volume over bark of all living trees more than 9.99 cm in diameter at breast height (1.3 m). Includes the stem from ground to a top diameter of 6.99 cm, and also branches to a minimum diameter of 6.99 cm.
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).
United Kingdom	Modeled living woody biomass (complete individual cycle of trees, it does not include understory and annual/perennial non woody vegetation).
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.
Hungary	The total biomass of the above trees minus their above-ground biomass.
Czech Republic, Italy, Poland,	Applies a country specific "root- to-shoot" factor.
Lithuania	Below-ground biomass refers to all living biomass of live roots.
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.
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).
Slovakia	The litter pool definition used in the inventory includes all non-living biomass with a size less than the minimum diameter defined for dead wood (1 cm). The small-sized lying dead wood (diameter between 1 and 7 cm), in various states of decomposition above the mineral soil are not a part of litter, because they are included in dead wood. The litter includes the surface organic layer (L, F, H horizons) as usually defined in soil profile description and classification. Live fine roots above the mineral or organic soil (of less than the minimum diameter limit chosen for below-ground biomass) are included in litter.
Slovenia	The carbon stock in Ol, Of and Oh sub horizon. Volume of roots and coarse fragments (soil skeleton > 2 mm) is not included.
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.
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.
Lithuania	Dead wood includes total standing and lying volume of dead tree stems.
Slovakia	The dead wood carbon pool contains dead trees from standing, stumps, coarse lying dead wood and small-sized lying dead wood not included in litter or soil carbon pools.
Slovenia	Dead wood content is all non-living woody biomass not contained in the litter, either standing, lying on the ground. According to definition from NFI 2007, dead wood in Slovenia includes: dead trees (DBH > 10 cm); stumps (D > 10 cm and H > 20 cm); snags (D > 10 cm and H > 50 cm); coarse woody debris (D > 10 cm and L > 50 cm).
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.
Soil Organic Carbon	
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.
Bulgaria	Organic carbon in 0-40 cm top soil, includes also the C stock of the litter layer (humus layer).
Croatia	Organic carbon in 0-40 cm top soil.
Czech Republic	Soil organic carbon in 0-30 cm, including the upper organic horizon.
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).
Hungary	The soil carbon stocks were determined from humus content (Hu) values (Filep, 1999) that were measured for the uppermost 30 cm of the soil.
Slovakia	Organic carbon in the mineral soils 0-20 cm.
Slovenia	Carbon stock in mineral part of soil (SOM) in 0–40 cm soil depth.
Spain	Organic carbon in the mineral soils down to 100 cm.
Estonia, 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.

For inventory completeness purpose, it should be considered that what is not reported under a pool is reported under another one (e.g., fine roots are reported either as litter or as soil organic matter), so that no bias in estimation are expected to occur.

Inventory estimates follow 2006 IPPC GL by estimating the changes in the forest carbon pools. For Living Biomass carbon pool the methods are based either on the "stock change" or "gain-loss" (Table 6.12)

Table 6.12 Estimation methods used by MS for C stock changes in Living Biomass carbon pool.

MS	Estimation method
Austria	Gain-loss
Belgium	Stock change/Gain-loss (Walloon/Flemish region)
Bulgaria	Stock change
Croatia	Gain-loss
Cyprus	Gain-loss
Czech Republic	Gain-loss
Denmark	Stock change
Estonia	Stock change
Finland	Gain-loss
France	Gain-loss
Germany	Stock change
Greece	Stock change
Hungary	Stock change
Ireland	Gain-loss
Italy	Gain-loss
Latvia	Gain-loss
Lithuania	Stock change
Luxemburg	Gain-loss
Malta	Gain-loss
Netherlands	Gain-loss
Poland	Gain-loss
Portugal	Gain-loss
Romania	Gain-loss
Slovakia	Gain-loss
Slovenia	Stock change
Spain	Stock change
Sweden	Stock change
UK	Gain-loss

Data sources for the estimation of carbon stock changes in living biomass also differ across MS, upon data availability. Actually, NFI represents the primary source of information for most of MS, while others rely on forestry statistics and yield tables. In addition, forest fire statistics complement both sources. Data collection and data analysis programs are ongoing in most of the MS to further improve the completeness and quality of the estimates, primarily of carbon stock changes.

In 2015 submissions, the implied carbon stock change factors for net carbon stock changes in biomass range from 2.33 to -0.23 T C ha^{-1} among MS (Table 6.13).Generally, low values of IEF are shown by MS with most intensive forest exploitation or with less favorable climatic conditions (i.e. lower growth and also more losses by natural disturbances); while higher values are for MS where planting is the main instrument to ensure forest regrowth.

Table 6.13 Implied net carbon stock change factor for living biomass pool in 4A1 (T C ha-1 year-1) reported in EU' MS GHGI 2015.

Member States	Net carbon stock change in living biomass per area
AUT	0.31
BEL	0.94
BGR	0.75
CYP	1.15
CZE	0.57
DEU	1.03
DNM	1.61
ESP	0.49
EST	-0.08
FIN	0.33
FRK	0.75
GBR	1.04
GRC	0.15
HRV	0.62
HUN	0.30
IRL	-0.23
ITA	1.04
LTU	1.37
LUX	1.34
LVA	0.36
MLT	2.33
NLD	1.89
POL	1.13
PRT	0.70
ROU	0.92
SVK	0.89
SVN	1.54
SWE	0.35

Changes of organic carbon stored in mineral soils and dead organic matter are mostly reported applying Tier 1 methods which assumes that these pools are in equilibrium and therefore no net carbon stock changes occur. In these cases, the notation key NO (or NE) is used in the corresponding CRF table (see also Table 6.5 on completeness). When they are estimated, MS mainly rely on data collected by NFI. The large use of the Tier 1 methods is due to the lack of appropriate data (and the high costs to set up a system that allows the proper collection of data) or the very high uncertainty of existing data. Nevertheless, in most cases, MS document the ongoing efforts to estimate emissions and removals from these pools. Existing data are either directly used for estimating carbon stock change by using stock difference or gain-loss methods, or integrated in models. According to available datasets, carbon stock changes in dead organic matter are often disaggregated between dead wood (DW) and litter (LT).

Carbon stock changes in dead organic matter are estimated by 18 MS. Some of them includes this pool within soil organic carbon (e.g. Finland). In overall, when reported, dead wood is mainly reported as a sink while Litter is either reported as a sink or source for most of MS (Table .614).

Table .614 Implied net carbon stock change factors in DOM pool in 4A1 (T C ha-1 yr-1) reported in EU' MS GHGI 2015.

Member States	Net carbon stock change in dead wood per area	Net carbon stock change in litter per area
AUT	0.06	NE,IE
BEL	-0.01	0.00
DNM	0.04	-0.31
FIN	IE	IE
FRK	-0.04	NO
DEU	-0.05	-0.01
GRC	NA,NO	NA,NO
IRL	IE	0.51
ITA	0.01	0.01
LUX	0.00	0.00
NLD	0.02	NE
PRT	IE	0.00
ESP	NE	NE
SWE	0.09	-0.07
GBE	IE	0.22
BGR	NO	NO
CYP	NO	NO
CZE	NO	NO
EST	0.02	NO
HRV	NO	NO
HUN	NO	NO
LVA	0.33	NO
LTU	0.01	NO
MLT	0.00	0.00
POL	NO	NO
ROU	NO	NO
SVK	NO	NO
SVN	0.00	NO

Carbon stock changes in mineral soils are quantitative estimated by 10 MS. Mineral soil is generally reported as a small net sink of carbon (i.e. with the exception of Austria) or assumed in balance under the Tier 1 assumption (Table 6.15). 11 MS reports CO_2 emissions from organic soils associated with managed forests (e.g. drainage of soils to establish plantations). Others MS report insignificant areas of organic soils under Forest land and, only UK reports a sink from organic soils in this category.

Table 6.15 Implied net carbon stock change factors in mineral and organic soils in 4A1 (T C ha-1 yr-1) reported in EU' MS GHGI 2015.

Member States	Net carbon stock change in mineral soils per area	Net carbon stock change in organic soils per area
AUT	-0.18	NO
BEL	0.53	NO
DNM	NA	-2.60
FIN	0.14	-0.30
FRK	NO	NO
DEU	0.41	-2.61
GRC	NA,NO	NA,NO
IRL	NO	-0.48
ITA	NA,NO	NO
LUX	NO	NO
NLD	NE	NE
PRT	0.01	NO
ESP	NE	NO
SWE	0.16	-0.38
GBE	0.33	1.84
BGR	NO	NO
CYP	NO	NO
CZE	NA	NA
EST	0.16	-0.28
HRV	NO	NO
HUN	NO	-2.60
LVA	NO	-2.60
LTU	NO	IE
MLT	0.00	NO
POL	0.12	-0.68
ROU	NO	-0.68
SVK	NO	NO
SVN	NO	NO

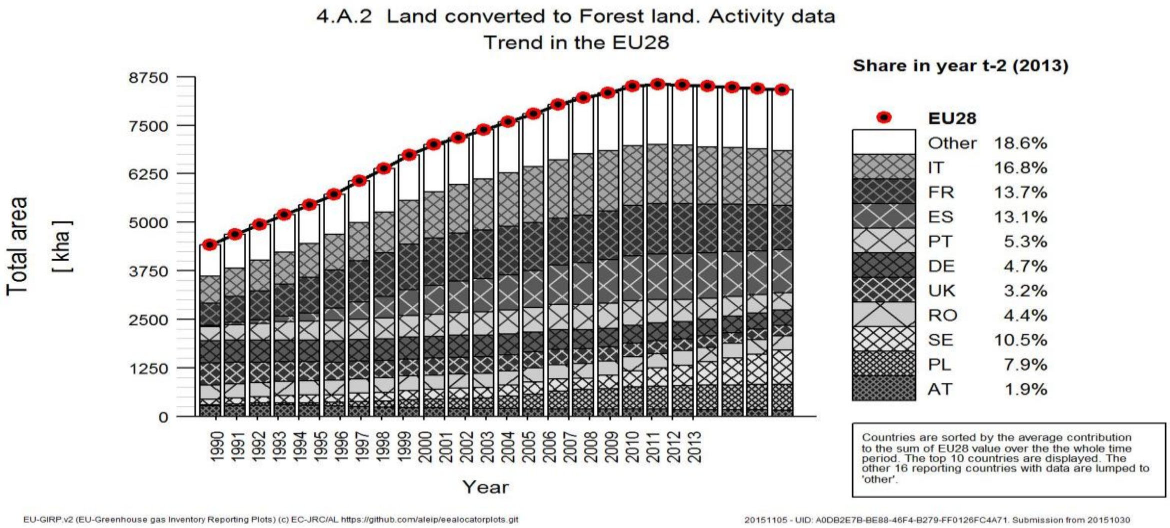
6.2.1.3 Land converted to Forest Land (CRF 4A2)

Overview of Land converted to Forest Land category

In 2013, the area reported under the subcategory 4A.2 represent 5.1% of the total Forest Land area, and increased by about 90% from 1990 (Figure 6.21). Largest conversions occur from Grasslands and Cropland. Estimated net removals for this subcategory represent 12% of total net removals of Forest land.

For 2013, Italy, France and Spain together contribute for 45% of areas reported under this subcategory while the 10 largest contributors account for around 82% of the total EU area under 4A.2.

Figure 6.21 Trend of activity data in subcategory 4A2 – Land converted to Forest Land – in EU MS (kha, 1990-2013)

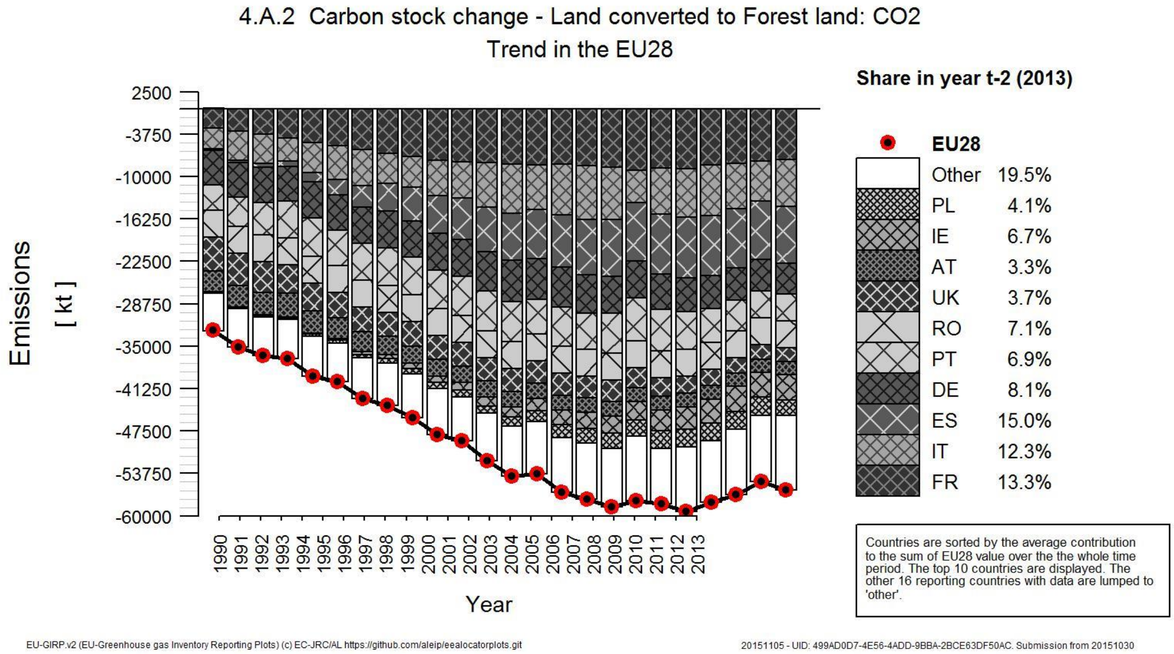


At EU level, in 2013, 4A.2 is a net sink for all the MS and it reached an EU total of -55 903 kt CO_2, which represent an increase of 72% compared with 1990 and 2% more than in 2012 (Table 6.16,Figure 6.22).

Table 6.16 4A2 Land converted to Forest Land: MS' contributions to EU28 net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	-3 081	-1 879	-1 825	3%	54	-3%	1 256	-41%
Belgium	-17	-287	-294	1%	-8	3%	-277	1592%
Bulgaria	-545	-755	-1 052	2%	-296	39%	-507	93%
Croatia	-39	-181	-201	0%	-19	11%	-161	411%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	-221	-340	-357	1%	-17	5%	-136	62%
Denmark	79	475	40	0%	-435	-92%	-39	-49%
Estonia	-1	-1 436	-1 523	3%	-87	6%	-1 522	296552%
Finland	-155	-485	-448	1%	37	-8%	-293	189%
France	-2 839	-7 765	-7 491	13%	274	-4%	-4 652	164%
Germany	-5 101	-4 603	-4 563	8%	40	-1%	539	-11%
Greece	NE,NO	-143	-164	0%	-21	15%	-164	100%
Hungary	-329	-1 238	-1 234	2%	5	0%	-905	275%
Ireland	27	-3 679	-3 747	7%	-68	2%	-3 774	-13847%
Italy	-3 105	-5 828	-6 885	12%	-1 057	18%	-3 780	122%
Latvia	0	-339	-368	1%	-29	9%	-368	504566%
Lithuania	-1 034	-1 144	-1 142	2%	1	0%	-108	10%
Luxembourg	-158	-81	-72	0%	9	-11%	86	-55%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	59	-306	-309	1%	-2	1%	-368	-620%
Poland	-141	-2 717	-2 291	4%	427	-16%	-2 150	1526%
Portugal	-3 571	-3 785	-3 730	7%	55	-1%	-159	4%
Romania	-3 978	-3 976	-3 975	7%	0	0%	2	0%
Slovakia	-2 210	-343	-353	1%	-9	3%	1 858	-84%
Slovenia	-838	-838	-838	1%	0	0%	0	0%
Spain	-162	-8 500	-8 379	15%	122	-1%	-8 216	5060%
Sweden	-132	-2 295	-2 617	5%	-322	14%	-2 485	1876%
United Kingdom	-4 974	-2 184	-2 085	4%	99	-5%	2 889	-58%
EU-28	**-32 465**	**-54 652**	**-55 903**	**100%**	**-1 251**	**2%**	**-23 438**	**72%**

Figure 6.22 Trend of emissions in the “Land converted to Forest Land” subcategory of EU MS (kha, 1990-2013)



In 2013, about 50% of total removals at EU level from subcategory 4A.2 were reported by France, Italy Spain and Germany, while the 10 MS with the larger contribution represent about the 80% of the total EU sink.

Methodological issues for Land converted to Forest Land category

Methods used to identify and represent the areas under conversion to forest, as well as to report GHG emissions and CO_2 removals, are generally the same used for category 4A.1. MS have developed land identification systems that are able to identify and track land use conversions to and from forest. Estimates of GHG emissions and CO_2 removals are usually reported at tier 2. Nevertheless, the heterogeneity in the approaches used by MS for subcategory 4A.2 suggests caution in interpreting differences in the implied carbon stock change factors. For instance, possible reasons of differences may include the length of the time series on activity data and their starting point, the use of time averaged on annual biomass growth, the estimated CO_2 emissions from previous land use, including lagged emissions. On top of that, due to the different methods applied, concerning changes in the carbon stock of soils, there is a high variability among MS on the carbon reference values considered in the estimations and the depth to which that values are associated. In general, this pool is estimated either at tier 2 or at tier 3 level by using soil carbon models (e.g. Denmark, UK).

6.2.2 Cropland (CRF 4B)

6.2.2.1 Overview of the Cropland category

Subject to intensive agriculture, Cropland category is an important contributor to European Union GHG budget. This category includes arable lands for annual crops and permanent crops, set aside lands or cultivated areas in ‘dehesa’ and rice-fields. Based on the MS submissions, Cropland area in EU covers

123.537 kha in 2013 (6% less than in 1990), and is equal to 28% of the total EU area. In 2013, 8.9% of the Cropland area is reported as land under conversion to Cropland.

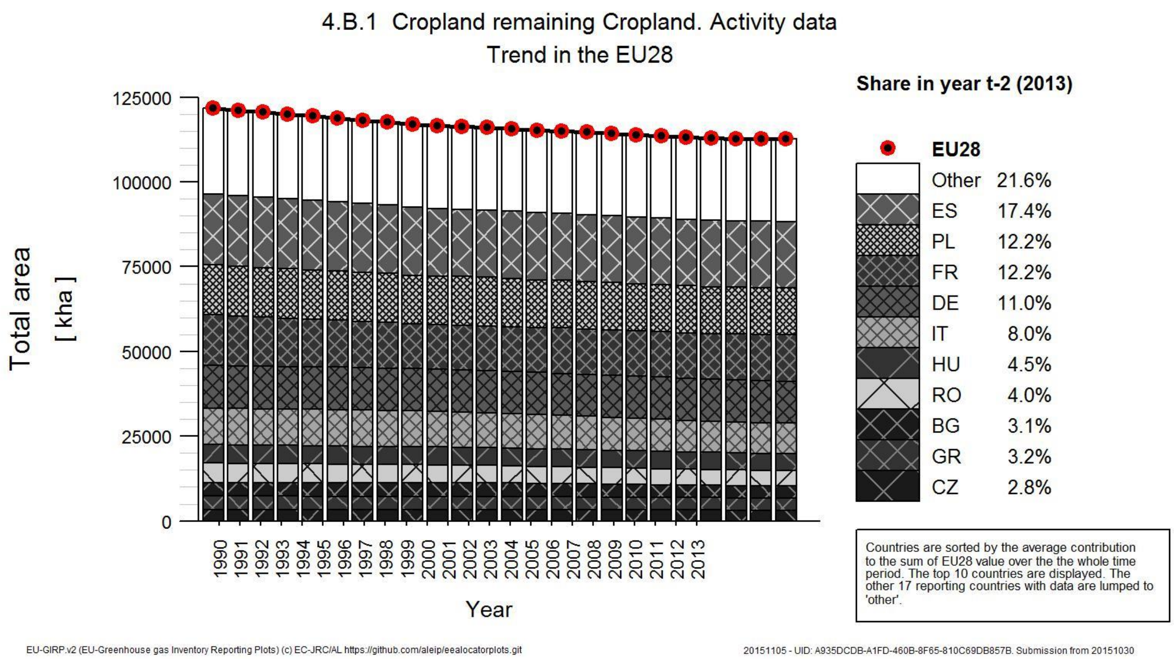
6.2.2.2 Cropland remaining Cropland (CRF 4B1)

Overview of Cropland remaining Cropland category

As reported by MS, the area of Cropland remaining Cropland constantly decreased (Figure 6.23). From 121.660 Kha in 1990 to 112.598 kha in 2013, which represent a decrease of 7%. With the exception of UK, Malta, Luxembourg and Slovakia all MS report a net decrease of Cropland area as compared with 1990.

At EU level, the 10 MS with the larger areas reported under this subcategory represent about 78% of its total EU area. Specifically, Spain, Poland and France report about 40% of the total EU area reported under 4B.1

Figure 6.23 Trend of activity data in the "Cropland remaining Cropland" subcategory of EU MS (kha, 1990-2013)



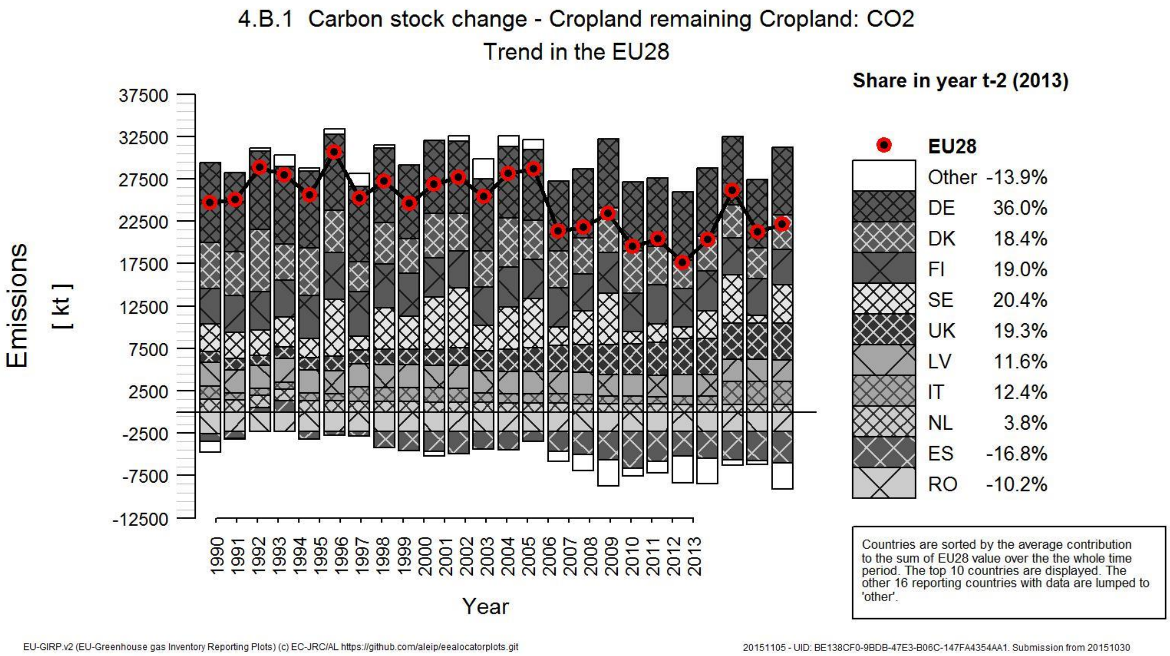
At EU level, in 2013 subcategory 4B.1 was a net source of 22 223 kt CO_2 that represent a decrease of 10% compared to 1990 (Table 6.17)

Table 6.17 4B1 Cropland remaining Cropland: MS contributions to net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	-261	-61	-55	0%	6	-10%	205	-79%
Belgium	239	-897	-880	-4%	17	-2%	-1 119	-469%
Bulgaria	524	695	695	3%	0	0%	171	33%
Croatia	195	149	113	1%	-36	-24%	-81	-42%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	-19	-17	-15	0%	1	-9%	3	-18%
Denmark	5 450	3 688	4 072	18%	384	10%	-1 378	-25%
Estonia	84	69	57	0%	-12	-18%	-27	-32%
Finland	4 160	4 343	4 222	19%	-120	-3%	62	1%
France	0	0	0	0%	0	#DIV/0!	0	#DIV/0!
Germany	9 419	8 055	7 990	36%	-65	-1%	-1 429	-15%
Greece	-982	-272	-231	-1%	41	-15%	750	-76%
Hungary	39	-900	-813	-4%	87	-10%	-851	-2211%
Ireland	-1 525	1 458	-364	-2%	-1 822	-125%	1 160	-76%
Italy	1 638	2 776	2 803	13%	27	1%	1 165	71%
Latvia	2 754	2 555	2 567	12%	12	0%	-187	-7%
Lithuania	537	92	84	0%	-8	-9%	-453	-84%
Luxembourg	-6	3	2	0%	-1	-42%	8	-131%
Malta	-1	-1	-1	0%	0	-3%	0	52%
Netherlands	1 467	880	853	4%	-28	-3%	-615	-42%
Poland	800	386	-665	-3%	-1 052	-272%	-1 466	-183%
Portugal	21	-203	-203	-1%	-1	0%	-225	-1064%
Romania	-2 569	-2 265	-2 263	-10%	2	0%	306	-12%
Slovakia	-955	-962	-874	-4%	89	-9%	82	-9%
Slovenia	41	63	63	0%	0	-1%	22	53%
Spain	-929	-3 516	-3 733	-17%	-217	6%	-2 803	302%
Sweden	3 303	900	4 528	20%	3 628	403%	1 226	37%
United Kingdom	1 299	4 268	4 273	19%	5	0%	2 974	229%
EU-28	**24 724**	**21 286**	**22 223**	**100%**	**937**	**4%**	**-2 501**	**-10%**

This subcategory is mainly reported as net source of emissions but some MS report 4B.1 as a net sink of CO_2 (e.g. Spain, Romania, Hungary, Belgium) due to large areas of woody crops (i.e. olive groves, vineyards). In spite of that, overall emissions are dominated by MS with cultivated areas on organic soils (e.g. Germany, Finland, and Denmark) (Figure 6.24).

Figure 6.24 Trend of emissions in the Cropland remaining Cropland" subcategory of EU MS (kha, 1990-2013)



6.1.1.1.1 Methodological issues for Cropland remaining Cropland category

Lands included under this subcategory generally have a well match with the IPCC definition (Table 6.18) although there may be small national particularities (e.g. treatment of some woody crops). Quite often, because of the management practices, croplands may not be clearly separated from grasslands, and their reporting approach may vary amongst MS.

Table 6.18 Information on Cropland definitions

Member State	Definition
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.
Bulgaria	Cropland consists of annual crops (cornfields and kitchen gardens) and perennials (vineyards, fruit and berry plantation and nurseries). Arable land is the land worked regularly, generally under a system of crop rotation - area with annual crops, set - aside area as well as area with seeds and seedlings. Perennial crops include fruit and berry plantation, vineyards and other permanent crops, nurseries for wine, fruits, ornamental plants, forest trees etc. The orchard is a uniformly kept plantation (by annual pruning and regular treatment for protection from diseases and insects) of fruit trees (pip- trees, stone-trees and nut-trees).
Croatia	Cropland category includes non-irrigated arable land, permanently irrigated arable land, vineyards, fruit trees and berry plantations, olive groves, annual crops associated with permanent crops (Complex cultivation patterns.
Cyprus	No definition is provided in the NIR
Czech Republic	Cropland is predominantly represented by arable land (92.6%), while the remaining area includes hop-fields, vineyards, gardens and orchards.
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.
Estonia	Cropland is arable land, area where annual or perennial crops are growing (incl. fallow, orchards, short-term and long-term cultural grasslands and temporary greenhouses). It does not include built garden land under 0.3 ha (that is included in Settlements). Abandoned cropland is classified as cropland until it has not lost arable land features – changes in soil and vegetation have not taken place and the land is still usable as cropland without the implementation of specific treatments.
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.
Hungary	Cropland contains arable lands, vegetable gardens, orchards and the vineyard areas, as well as set-aside croplands. Arable lands are any land area under regular cultivation irrespective of the rate or method of soil cultivation and whether the area is under crop production or not due to any reason, such as temporary inland waters or fallow. Areas under tree nurseries (including ornamental and orchard tree nurseries, vineyard nurseries, forest tree nurseries excluding those for the own requirements of forestry companies grown in the forest), permanent crops (e.g. alfalfa and strawberries), herbs and aromatic crops are included. Vegetable gardens are areas around residential houses where, in addition to meeting the owners' demand, may produce some surplus of low amount which is usually traded. Orchards are land under fruit trees and bushes that may include several fruit species (e.g.: apples, pears, cherries, etc.). Included are non-productive orchards and orchards of systematic layout in vegetable gardens if the area is 200 m² or above in case of berries and 400 m² or above in case of fruit trees. Vineyards are areas where grapes are planted in equal row width and planting space, and include non-productive areas and vineyards in vegetable gardens (e.g. trellises) if grapes are planted in equal row width and planting space, and the size of the area is at least 200 m². Set-aside cropland is land that is abandoned but not converted to any other land use.
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).
Latvia	The cropland refers to the area of arable land, including orchards and extensively managed arable lands. Cropland also includes animal feeding glades, which according to national land use classification belong to forest land.
Lithuania	The area of cropland comprises of the area under arable crops as well as orchards and berry plantations. Arable land is continuously managed or temporary unmanaged land, used and suitable to use for cultivation of agricultural crops, also fallows, inspects, plastic cover greenhouses, strawberry and raspberry plantations, areas for production of flowers and decorative plants. Arable land set aside to rest for one or several years (<5 years) before being cultivated again as part of an annual crop-pasture rotation is still included under cropland. Orchards and berry plantations are areas planted with fruit trees and fruit bushes (apple-trees, pear-trees, plum-trees, cherry-trees, currants, gooseberry, quince and others).
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
Malta	In Malta cropland can be split into three types: arable area which is cultivated under a system of crop rotation; kitchen gardens that include small plots of cultivated land, in which most of the products are intended for consumption by the farmer; land under permanent crops where the crop occupies the same land for a period of time, normally 5 years or more. For inventory purposes, local cropland was split into two: annual crops and perennial woody crops. The main perennial crops considered for this inventory are vines, being the most cultivated crop.
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).
Poland	Agricultural land considered as cropland consists of: arable land includes land which is cultivated, i.e. sowed and fallow land. Arable land should be maintained in good agricultural condition. Cultivated arable land is understood as land sowed or planted with agricultural or horticultural products, willow and hops plantations, area of greenhouses, area under cover and area of less than 1000 m^2, planted with fruit trees and bushes, as well as green manure, fallow land includes arable land which are not used for production purposes but are maintained in good agricultural condition; orchards include land with the area of at least 1000 m^2, planted with fruit trees and bushes.
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
Romania	Cropland includes agricultural lands, i.e. lands covered or temporary uncovered by agricultural crops (major crops and horticultural plants cultures). It includes 3 groups (non-woody crops, woody crops and other wooded land and trees outside forests (which do not meet the forest definition parameters, e.g. forest belts which are narrower than 20m) with 9 categories: orchard, vineyard, shrubs, cultivated land agricultural, temporary fallow land, deciduous tree, coniferous tree, deciduous and resinous trees and dead trees.
Slovakia	Cropland includes lands for growing cereals, root-crops, industrial crops, vegetables and other kinds of agricultural crops; perennial woody crops; lands temporary overgrown with grass or used for growing of fodder lasting several years; hotbeds and greenhouses if they are built up on the arable land; fallow land which is arable land left for regeneration for one growing season during which were not sow specific crops or just crops for green manure, eventually it is covered by spontaneous vegetation, which would be ploughed in.
Slovenia	Annual: arable land breed more than 2 meters and grow the non-woody vegetation (cereals, potatoes, forage crops, vegetable crops, oilseed, ornamental plants, herbs, strawberries, hop fields...) and agricultural fallow ground. Also temporary meadows and greenhouses. Perennial: permanent crops on arable land such as vineyards, extensive and intensive orchards, olive groves, nursery (for grapevines, fruit and forest trees), forest plantations and forest trees on agricultural land.
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.

Quantitative estimates are reported mainly for soils, and living biomass for perennial woody crops (i.e. orchards, vineyards, Christmas trees, fruits, bushes, and plantations). For soil organic matter, the definitions vary among MS, mainly in terms of the soil depth considered in the estimation of the carbon content (e.g. 30 cm in Finland and 100 cm in Spain) although in some cases the depth is not specified when MS used modeled approaches.

Carbon stock change factors for living biomass of permanent crops vary within a very narrow range, depending by the types of crops and management practices across Europe, from North (i.e. bush-type currant crops) to South (i.e. olives crops and agro-forestry systems) (Table 6.19).

Usually a net source of emissions in this category is associated with a decrease of area of woody crops. In few countries, the carbon stock in crops biomass is assumed at equilibrium and therefore reported by notation keys (e.g. Germany, UK), or is not estimated (by Netherlands).

Table 6.19 Implied net carbon stock change factor for carbon pools in 4B1 (T C ha-1 yr-1) reported in EU' MS GHGI 2015.

Member States	Net carbon stock change in living biomass per area	Net carbon stock change in dead organic matter per area	Net carbon stock change in mineral soils per area	Net carbon stock change in organic soils per area
AUT	-0.03	NO	0.04	NO
BEL	0.00	NO	0.30	-10.00
DNM	-0.01	NO	-0.14	-9.30
FIN	0.00	NE	0.04	-6.55
FRK	0.00	NO	NO	NO
DEU	NO	NO	NO	-8.10
GRC	0.04	NO	NE	-10.00
IRL	0.01	NO	0.13	NO
ITA	-0.06	NO	NO	-10.00
LUX	-0.01	NO	0.00	NO
NLD	NE	NE	NO	-3.99
PRT	0.02	NO	0.01	NO
ESP	0.00	NE	0.05	NO
SWE	0.03	0.00	-0.18	-6.22
GBE	NO	NO	-0.33	IE
BGR	-0.05	NO	0.00	NO
CYP				
CZE	0.00	NO	0.00	NA
EST	0.00	NO	0.09	-5.00
HRV	0.00	NO	0.00	-10.00
HUN	0.00	NO	0.04	NO
LVA	0.00	0.00	NO	-7.90
LTU	0.00	NO	0.02	-5.00
MLT	0.24	0.00	0.00	NO
POL	0.05	NO	0.00	-1.00
ROU	0.09	0.00	0.06	-2.50
SVK	0.15	NO	0.01	NO
SVN	0.04	NA,NO	0.00	-10.01

Carbon stock changes in dead organic matter are mainly reported using Tier 1 method so they are assumed in equilibrium and, in consequence, MS used the notation key NO (Table 6.19). In some case the notation key NE was also used when the Tier 1 assumption was applied. (e.g. Spain)

For the estimation of carbon stock changes in mineral soils, most MS apply IPCC default methodology along with default or country-specific data on emission factors (i.e. Tier 1 or 2). Few MS use Tier 3 methodologies based on models (e.g. C-tool by Denmark and ICBM by Sweden). In many cases, Tier 2 methods applied consist on country-specific soil organic carbon reference values along with IPCC default values for relative change factors (i.e. for Fmg, Flu, Fi). In some cases IPCC default factors have been slightly modified to adapt them; but changes rely more on expert judgment than on a statistical analysis of measurements. There is one exception, Austria derived own factors by close comparison with IPCC similar strata.

Overall, carbon stock changes in mineral soils are reported as a net sink of emissions, with implied carbon stock changes factors ranging from -0.33 to 0.30t C/ha (Table 6.19).

Carbon stock changes in organic soils on croplands are mostly reported applying Tier 1, or Tier 2 when country-specific emission factors are available (e.g. Finland, Sweden). Some countries developed a set of EF stratified by type of crops or soil status (e.g. Denmark on soil management type).

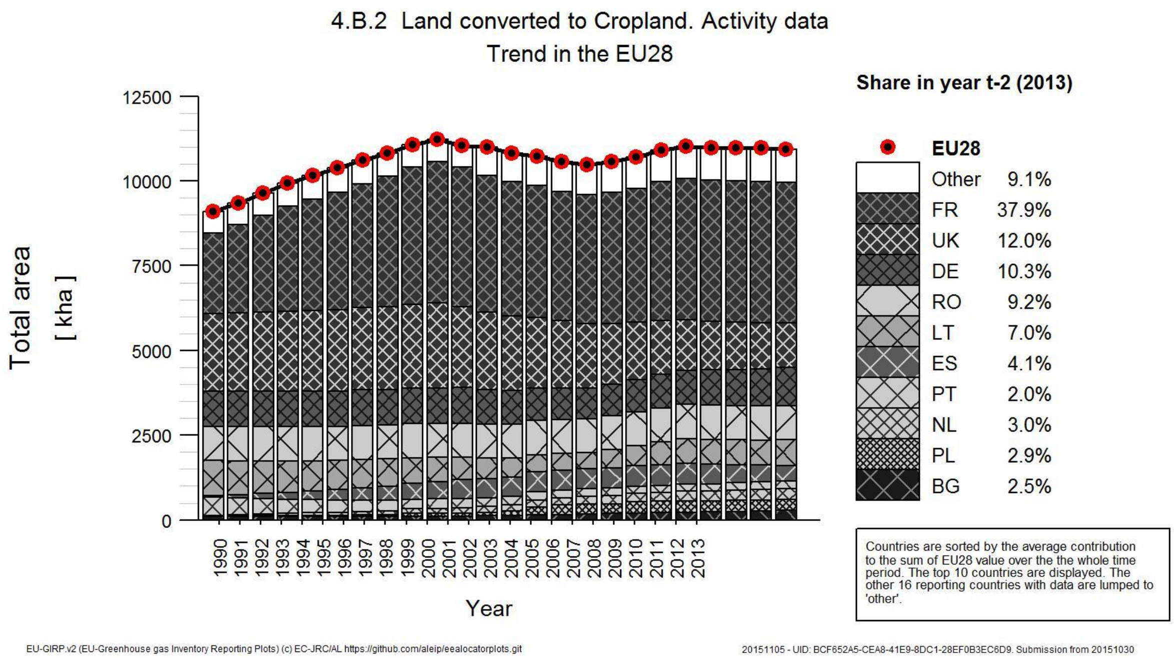
6.2.2.3 Land converted to Cropland (CRF 4B2)

Overview of Land converted to Cropland category

Area reported under subcategory 4B.2 increased by 20% since 1990. From 9.094 kha reported in 1990 to 10.940 Kha in 2013 (Figure 6.25). Overall, the area under conversions to croplands represents 9% of total Cropland area at EU level, and represents 67% of total annual emissions in Cropland category.

Largest conversions occur from Grassland and Forest land. Together, UK, France and Germany report 60% of total area of land converted to Cropland that is mostly associated with cultural rotation of crops and grasses on the same land.

Figure 6.25 Trend of activity data in the Land converted to Cropland subcategory of EU MS (kha, 1990-2013)



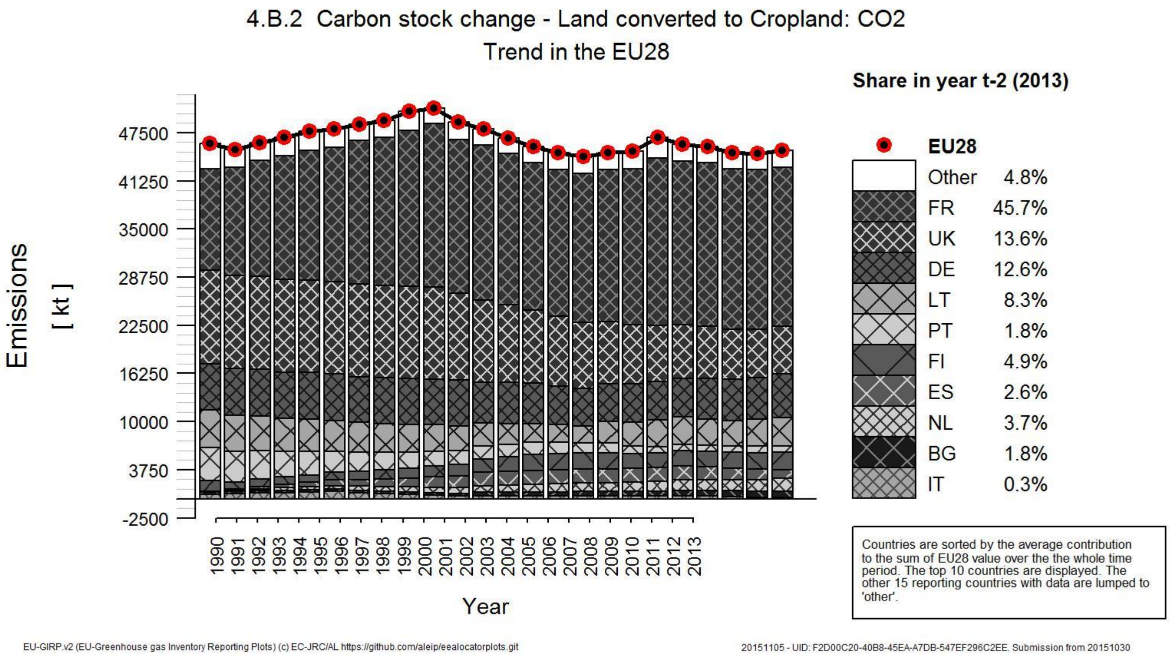
With the exception of Romania, all the MS reported emissions for the subcategory 4B.2. Total emissions in 4B.2 represent 45 210 kt CO_2. A decrease of 2% as compared with 1990 (Table 6.20).

Table 6.20 4B2 Land converted to cropland: MS' contributions to net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	192	180	185	0%	5	3%	-7	-3%
Belgium	63	555	557	1%	1	0%	493	781%
Bulgaria	290	770	795	2%	25	3%	505	174%
Croatia	23	42	47	0%	5	12%	24	102%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	109	82	85	0%	3	4%	-24	-22%
Denmark	10	-104	-2	0%	102	-99%	-12	-115%
Estonia	NO	96	89	0%	-7	-7%	89	100%
Finland	1 311	2 167	2 208	5%	41	2%	898	69%
France	13 209	20 748	20 680	46%	-68	0%	7 471	57%
Germany	6 056	5 378	5 681	13%	303	6%	-374	-6%
Greece	0	0	2	0%	2	461%	2	2529%
Hungary	132	312	293	1%	-19	-6%	162	122%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	534	197	132	0%	-66	-33%	-402	-75%
Latvia	495	153	134	0%	-19	-13%	-361	-73%
Lithuania	4 847	3 504	3 734	8%	230	7%	-1 113	-23%
Luxembourg	52	25	25	0%	1	2%	-26	-51%
Malta	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Netherlands	167	1 527	1 684	4%	156	10%	1 516	907%
Poland	345	229	229	1%	0	0%	-116	-34%
Portugal	4 314	804	802	2%	-2	0%	-3 512	-81%
Romania	1 091	-249	-249	-1%	0	0%	-1 340	-123%
Slovakia	466	72	74	0%	2	3%	-392	-84%
Slovenia	243	283	284	1%	2	1%	41	17%
Spain	-47	1 318	1 174	3%	-144	-11%	1 221	-2606%
Sweden	51	371	423	1%	52	14%	372	735%
United Kingdom	12 116	6 327	6 141	14%	-186	-3%	-5 975	-49%
EU-28	**46 070**	**44 789**	**45 210**	**100%**	**421**	**1%**	**-861**	**-2%**

In 2013, as well as, in 1990, the largest emissions from lands converted to Cropland are reported by France. In 2013, France reports almost half of total EU emissions under 4B.2 (Figure 6.26) that are associated with land conversions from Grassland to Croplands.

Figure 6.26 Trend of emissions in the land converted to Cropland subcategory of EU MS (kt CO_2, 1990-2013)



Methodological issues for Land converted to Cropland

IPCC default methodology is generally used, either along with country-specific data or by using IPCC default factors, for estimating and reporting carbon stocks changes in this subcategory. Data sources used by MS for estimating carbon stock changes are the same than those involved in the collection of data for estimating "land remaining in" and they depend on which land is converted to Cropland. Generally, it is assumed that the carbon stored in living biomass and dead organic matter is lost in the year of the conversion, while for soil organic carbon in mineral soils, following IPPC methodology, MS apply a 20 years transition period before the carbon stock of the soils converted to Cropland reach and equilibrium.

6.2.3 Grassland (CRF 4C)

6.2.3.1 Overview of Grassland category (CRF 4C)

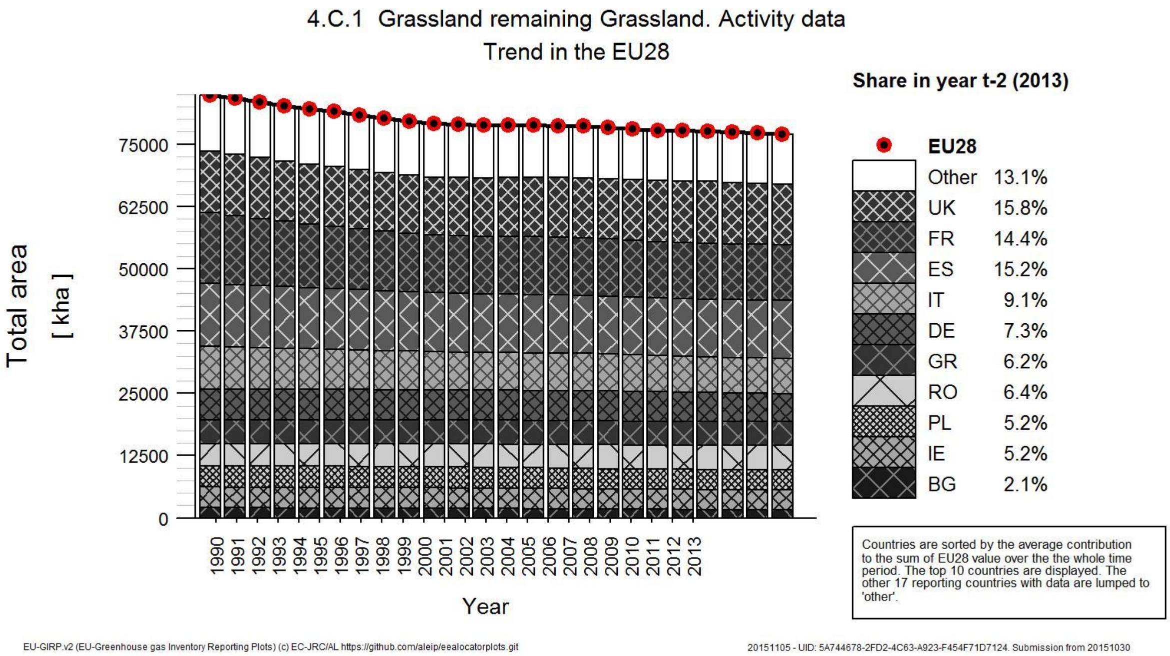
According to MS submissions, in 2013 the total Grassland area was 90.309 kha that represents 20% of total EU area, and a slightly decrease of 4% as compared with 1990. In terms of emissions, the category 4C, for the year 2013, represents a small net source of emissions of 976 kt CO_2 with a significant decrease of 94% compared with 1990.

6.2.3.2 Grassland remaining Grassland (CRF 4C1)

Overview of Grassland remaining Grassland category

In 2013, total area reported at EU level under the category 4C.1 reached 77.006 Kha, which represent 9% less compared to 1990 (Figure 6.27). Three MS (i.e. UK, France and Spain) reported about 45% of the total 4C.1 area, while the 10 MS with the larger contribution account for 87 % of the total EU area reported under this subcategory.

Figure 6.27 **Trend of activity data in Grassland remaining Grassland subcategory in EU MS (kha, 1990-2013)**



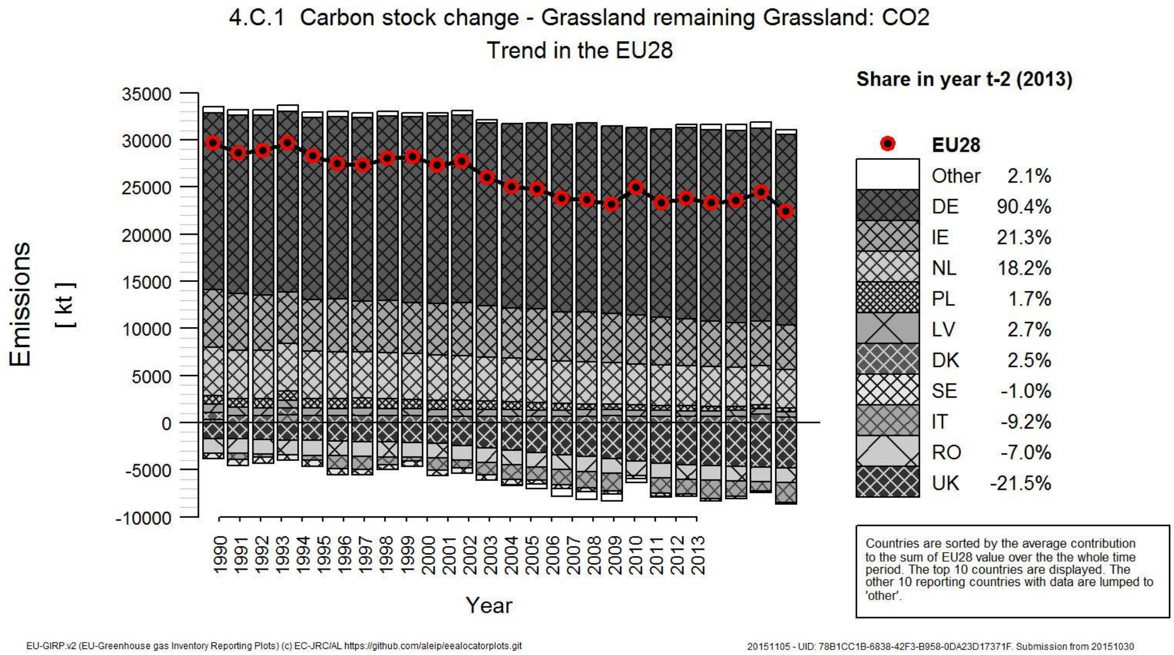
Category 4C.1 was a net source of 22 864 kt CO_2 emissions in 2013, which represents a decrease of 34% smaller than in 1990 (Table 6.21). In overall, significant emissions from this subcategory are related to MS with managed organic soils on Grassland areas (e.g. Netherlands, Germany, Ireland) while big sinks reported under this subcategory are related with woody biomass reported under Grassland category (e.g. Italy, Romania) or with mineral soils (e.g. UK)

Table 6.21 4C1 Grassland remaining Grassland: MS' contributions to net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	2	4	4	0%	0	3%	2	75%
Belgium	-43	-190	-189	-1%	1	-1%	-145	336%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	2	2	2	0%	0	0%	0	0%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	6	-1	-1	0%	0	2%	-7	-122%
Denmark	799	883	563	2%	-320	-36%	-236	-30%
Estonia	-42	673	456	2%	-216	-32%	498	-1191%
Finland	621	385	382	2%	-2	-1%	-239	-38%
France	0	0	0	0%	0	-	0	-
Germany	18 784	20 421	20 233	88%	-188	-1%	1 448	8%
Greece	0	0	0	0%	0	-99%	0	-99%
Hungary	51	1	-3	0%	-4	-456%	-54	-106%
Ireland	6 067	4 761	4 763	21%	2	0%	-1 304	-21%
Italy	5 272	3 271	-1 620	-7%	-4 891	-150%	-6 892	-131%
Latvia	851	597	601	3%	4	1%	-250	-29%
Lithuania	81	81	82	0%	1	1%	1	1%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	5 195	4 120	4 065	18%	-54	-1%	-1 129	-22%
Poland	979	440	409	2%	-31	-7%	-570	-58%
Portugal	NO	-270	-270	-1%	0	0%	-270	100%
Romania	-1 562	-1 562	-1 562	-7%	0	0%	0	0%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Spain	NE,NO	NO,NE	NO,NE	-	-	-	-	-
Sweden	-620	-234	-230	-1%	5	-2%	391	-63%
United Kingdom	-1 680	-4 745	-4 821	-21%	-76	2%	-3 140	187%
EU-28	**34 762**	**28 634**	**22 864**	**100%**	**-5 770**	**-20%**	**-11 898**	**-34%**

The largest contributor to the overall source at EU level on Grassland remaining Grassland is Germany reporting large emissions from organic soils (Figure 6.28). UK reports a significant sink on mineral soils under this category. Some MS report notation keys under the assumption of no net carbon stock changes under tier 1 methods (e.g. living biomass) or justified by the assumption of no changes in managed practices of mineral soils. Additionally, some MS report areas of unmanaged grasslands (e.g. Ireland, UK).

Figure 6.28 Trend of emissions in the Grassland remaining Grassland subcategory of EU MS (1990-2013)



6.1.1.1.2 Methodological issues for Grassland remaining Grassland category

Definitions provided by MS of Grassland areas show good match with the IPCC land use definition, despite different eco-regions and management approaches across the EU (Table 6.22)

Table 6.22 Definition of Grassland category

Member State	Definition
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.
Bulgaria	Grassland includes the permanent grasslands – natural meadows, low productive grasslands, permanent lawns and grassland which are not used for production purposes.
Croatia	Grassland includes pastures, land principally occupied by agriculture, with significant areas of natural vegetation, natural grasslands, moors and heathland, sclerophyllous vegetation.
Cyprus	No definition is provided in the NIR
Czech Republic	Grassland as defined in this inventory is mostly used as pastures for cattle and meadows for growing feed. Additionally, the fraction of permanently unstocked cadastral FL is also included under Grassland. This is because it predominantly has the attributes of Grassland (such as land under power transmission lines).
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".
Estonia	Grassland includes rangelands and pasture, land that is not considered cropland nor forest land: land with perennial grasses that is proper for mow and pasture, smaller fallows and former cultural grasslands that have lost arable land features and grassland from wild lands (natural grassland). Overgrown wooded pasture with canopy cover between 30 and 50% is classified as grassland or forest, depending on the main land-use purpose. The national land cover class 'bushes' (area covered with natural or wildered cultivated bush and shrub species where canopy cover is over 50%) is included into GL.
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.
Hungary	Grassland includes meadows, i.e., land under grass (artificial planting included) where the production is utilized by cutting, irrespective of whether it is used for grazing sometimes, and pasture, i.e., land under grass (artificial planting included) that is utilized for grazing irrespective of whether it is used for cutting sometimes. Grassland includes areas with trees which are utilized for grazing and unmanaged grasslands which are not in use for agricultural purposes.
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.
Latvia	The grassland category consists of lands used as pastures, as well as glades and bush-land which do not fit to forest definition, vegetated areas on non-forest lands complying to forest definition where land use type can be easily switched back to grassland without legal requirement of transformation of the land use, but except grassland used in forage production and extensively managed cropland.
Lithuania	Grassland includes meadows and natural pastures planted with perennial grasses or naturally developed, on a regular basis used for moving and grazing. Grasslands cultivated for less than 5 years, in order to increase ground vegetation, still remain grasslands.
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.
Malta	This category is split into other grassland and maquis. On the basis of expert judgement it was decided that maquis will be included in this category. The data of this category was derived from the Corine Land Cover 1996, 2000, 2006 under the sclerophyllous vegetation and 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.
Poland	Grassland consists of: permanent meadow and pastures include land permanently covered with grass, but does not include arable land sown with grass as part of crop rotation; permanent meadow are understood as the land permanently covered with grass and mown in principle in mountain area; also the area permanent pastures are understood as the land permanently covered with grass not mown but grazed in principle in mountain area; also the area of grazed pastures and meadows.
Portugal	Lands covered by permanent herbaceous cover.
Romania	Grassland includes land whose destination is grazing or mowing hay for livestock production, as well as other wooded land and trees outside forests (which do not meet forest definition parameters, e.g. forest belts which are narrower than 20m). It includes pastures, hayfields in hilly and mountainous areas and meadows in lowlands.
Slovakia	This category includes permanent grasslands and meadows used for the pasture or hay production, which is not considered as cropland.
Slovenia	Agricultural areas grown by grass and other herbs that are regularly cut or grazed. These areas are not in tillage or fallow ground. Included are areas covered with some of forest trees (less than 50 trees/ha) and the alpine pastures too. In this class there are swamp pastures and meadows on organic or mineral-organic soils, where the groundwater rises few times in the year. It includes also uncultivated agriculture land.
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.

Distinguishing among Grassland and Cropland is challenging because of cultural systems with rotation of crops and grasses (indeed conversions of Cropland to Grassland and Grassland to Cropland cover around 50 % of the total EU area under land use conversion), for this reason several data sources are usually involved in the identification of these lands.

In terms of methods, there is widespread use of Tier 1 methods as compared with methods used for reporting of Forest land and Cropland.

Table 6.23 Implied net carbon stock change factors for carbon pools in 4C1 (T C ha-1 yr-1) reported in EU' MS GHGI 2015.

Member States	Net carbon stock change in living biomass per area	Net carbon stock change in dead organic matter per area	Net carbon stock change in mineral soils per area	Net carbon stock change in organic soils per area
AUT	NO	NO	0.00	-0.25
BEL	NO	NO	0.10	-2.50
DNM	-0.05	NO	NO	-8.40
FIN	0.39	NE	NO	-3.50
FRK	0.00	NO	NO	NO
DEU	0.03	NO	0.00	-6.79
GRC	0.00	NO	NO	NO
IRL	NO	NO	0.01	-3.64
ITA	0.08	0.00	NA,NO	NO
LUX	NO	NO	NO	NO
NLD	NE	NE	NE,NO	-4.55
PRT	NO	NO	0.18	NO
ESP	NE	NE	NE	NO
SWE	0.09	0.20	0.01	-1.56
GBE	NO	NO	0.11	NO,IE
BGR	NO	NO	NO	NO
CYP				
CZE	NO	NO	0.00	NO
EST	-0.35	0.01	NO	-0.86
HRV	NO	NO	NO	-2.50
HUN	NO	NO	0.00	NO
LVA	0.02	0.00	NO	-6.10
LTU	NO	NO	NO	-0.25
MLT	NO	NO	NO	NO
POL	NO	NO	-0.02	-0.25
ROU	0.09	NO	NO	0.25
SVK	NO	NO	NO	NO
SVN	NA	NA	NA	NA

Carbon stock changes in living biomass of Grassland category is reported by 10 MS and, most of them reported a net source of CO_2 due to the existence of woody biomass under these areas. While many other, as occurring also for dead organic matter carbon pool, report the notation key NO (NE) under the Tier 1 assumption of no carbon changes in these pools (Table 6.23).

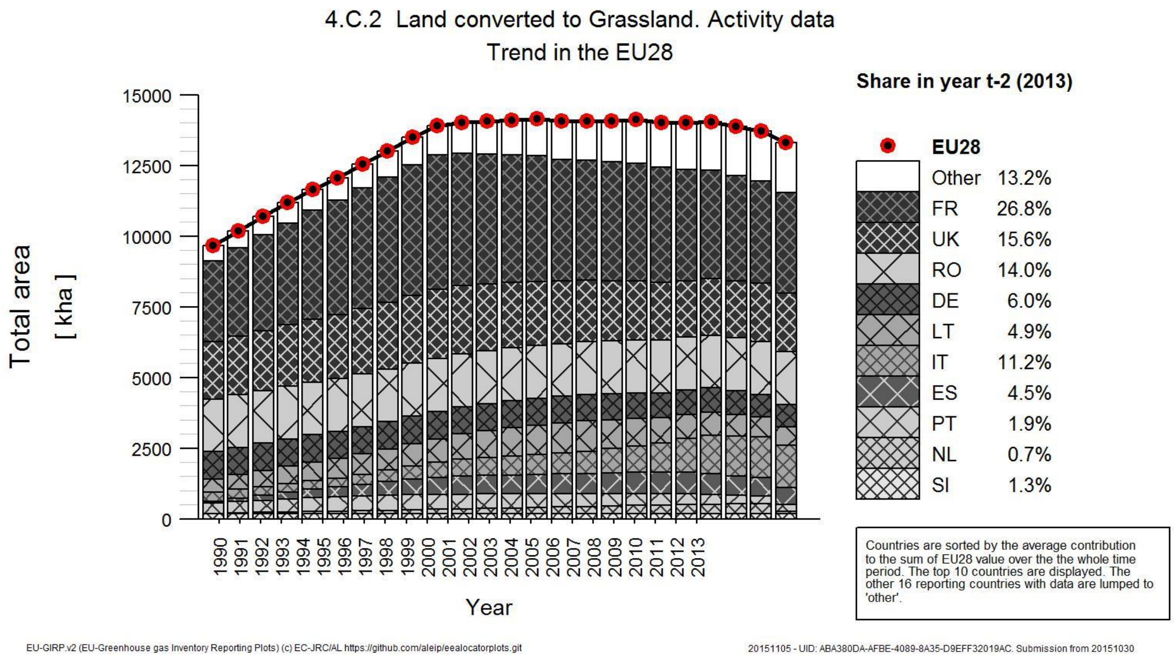
For reporting mineral soils, most of the MS use Tier 1, or Tier 2 methods. Often, MS use specific values of organic soil carbon from field data collection schemes and, then implement, in a second step, default values for relative stock changes factor values. For MS with managed organic soils under this category, the final net estimate result in most of the cases in a net source of emissions.

6.2.3.3 Land converted to Grassland (CRF 4C2)

Overview of Land converted to Grassland category

The total area of Land converted to Grassland represents 13.302 kha which is 15% of the total Grassland area at EU level. Lands converted to Grassland increased by 38 % in 2013 as compared with 1990. Most of the areas converted to Grasslands derived from Cropland and Forest land. France, UK and Romania reported more that 50% of the total are converted to Grassland (Figure 6.29).

Figure 6.29 Trend of activity data in the "Land converted to Grassland" subcategory4C2 in EU MS (kha, 1990-2013)



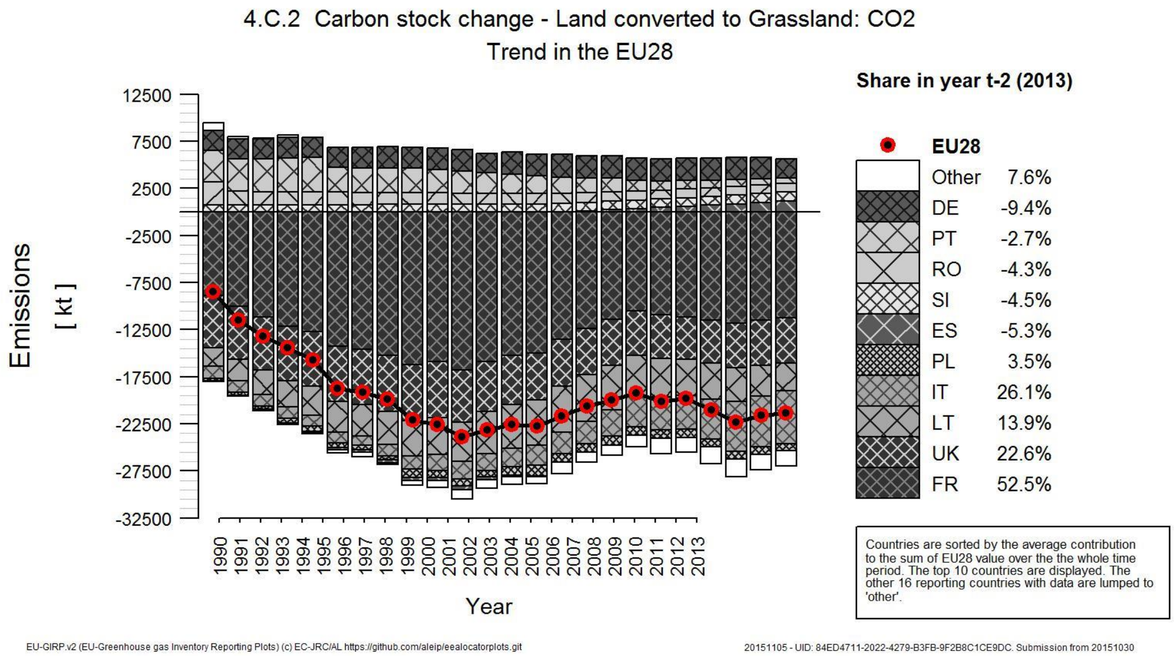
In term of emissions, the conversions to Grassland in the EU represent a total net sink of 21 151 kt CO_2 that results in an increase of about 149% compared to the net sink reported for the year 1990 (Table 6.24, Figure 6.30). In overall, the net sink reported under this subcategory is comparable to the net source of emissions reported under the subcategory 4C.1

Table 6.24 4C2 Land converted to Grassland: MS' contributions to the net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	322	41	47	0%	6	14%	-276	-86%
Belgium	85	-285	-283	1%	2	-1%	-368	-435%
Bulgaria	-158	-432	-466	2%	-34	8%	-308	195%
Croatia	-106	-137	-106	0%	31	-23%	0	0%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	-141	-306	-321	2%	-15	5%	-180	128%
Denmark	21	108	16	0%	-92	-85%	-6	-26%
Estonia	14	-99	-53	0%	47	-47%	-67	-465%
Finland	242	232	225	-1%	-7	-3%	-17	-7%
France	-8 857	-11 481	-11 221	53%	260	-2%	-2 364	27%
Germany	2 098	2 279	2 005	-9%	-274	-12%	-93	-4%
Greece	0	-917	-1 055	5%	-138	15%	-1 055	-3640469%
Hungary	-34	-169	-242	1%	-73	43%	-207	603%
Ireland	3	38	59	0%	21	57%	57	2086%
Italy	-1 275	-5 440	-5 583	26%	-143	3%	-4 309	338%
Latvia	0	-426	-413	2%	14	-3%	-413	18756533%
Lithuania	-2 025	-3 198	-2 983	14%	215	-7%	-958	47%
Luxembourg	35	-46	-43	0%	3	-6%	-78	-225%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	257	147	342	-2%	196	133%	85	33%
Poland	-266	-781	-757	4%	24	-3%	-492	185%
Portugal	3 336	651	573	-3%	-79	-12%	-2 763	-83%
Romania	2 474	921	921	-4%	0	0%	-1 553	-63%
Slovakia	-202	-217	-204	1%	13	-6%	-2	1%
Slovenia	735	958	970	-5%	12	1%	234	32%
Spain	-19	997	1 141	-5%	144	14%	1 160	-6239%
Sweden	491	790	864	-4%	74	9%	373	76%
United Kingdom	-5 522	-4 631	-4 585	22%	46	-1%	936	-17%
EU-28	**-8 492**	**-21 404**	**-21 151**	**100%**	**253**	**-1%**	**-12 659**	**149%**

The highest sink from conversion to Grassland in 2013 was reported by France, Italy and UK that estimates a significant amount of removals in mineral soils from the conversion of Cropland to Grassland.

Figure 6.30 Trend of emissions in the Land converted to Grassland subcategory of EU MS (kt CO_2, 1990-2013)



Methodological issues for Land converted to Grassland category

The methods and data sources for estimating CO_2 emissions and removals from this land subcategory are fully consistent with those used for 4C.1, both for activity data and carbon stock changes estimation. In overall, MS apply IPCC approach for estimating carbon stock changes in this subcategory along with, country-specific or default factors, depending on the pool that is being estimated and on the land use category involved in the conversion.

6.2.4 Wetlands, Settlements and Other land (CRF Tables 4D, 4E, 4F)

6.2.4.1 Wetlands (CRF 4D)

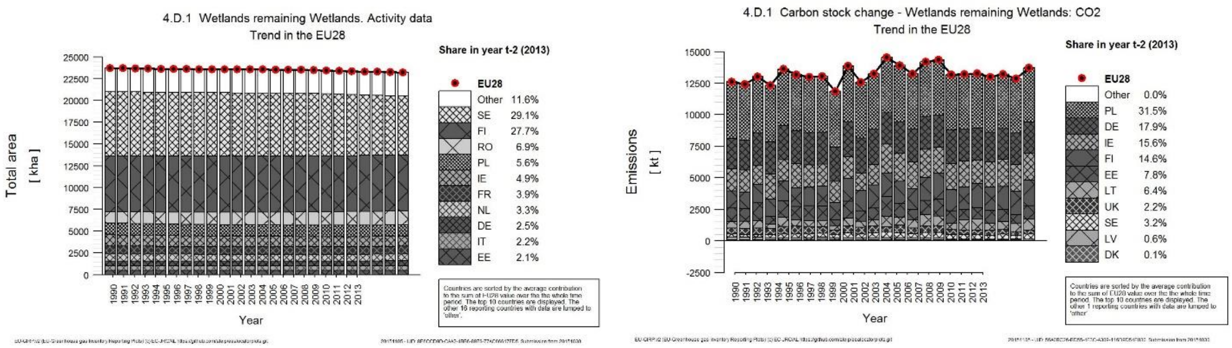
At EU level, Wetlands areas represent 24.648 kha that is 6% of total EU area reported in 2013. As compared with 1990, these areas have slightly increased by 1% (Figure 6.31). The largest areas have been reported in Finland and Sweden which together report more than 50% of total Wetlands areas in EU. Within this category, areas of lands converted to Wetlands represent only 6% of the total category.

Under 4D.1, total emissions reported at EU level represent 13.711 kt CO_2. Under Wetlands, MS include different lands that not always are subject to management activities (Table 6.25). This explain why MS with the largest share on areas at EU level not always report the largest emissions. In general this happens when large areas within wetlands include flooded lands or other wetlands that are not subject to management activities (e.g. Romania). The main driver of emissions in this subcategory is represented by peat extraction which, even if affecting small areas, has a big impact on final emissions. (e.g. Estonia, Lithuania).

Table 6.25 Definitions of land included by MS under the category 4D Wetlands

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.
Bulgaria	Wetlands category - wetlands surface water areas are included (wetlands) – covered with water or water saturated lands (throughout the year or partially in the year) which does not fall in the other categories. These are natural or artificial water-courses serving as water drainage channels, natural or artificial stretches of water, coastal lagoons, wetlands areas and peatbogs.
Croatia	Inland marshes, salt marshes, salines, intertidal flats, water courses, water bodies, coastal lagoons
Cyprus	No definition is provided
Czech Republic	Category Wetlands includes riverbeds, and water reservoirs such as lakes and ponds, wetlands and swamps.
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).
Estonia	Land permanently saturated by water and/or areas where the peat layer is at least 30 cm and the minimum potential tree height does not conform to the forest land definition. It does include smaller bog holes.
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: CO2 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.
Hungary	Wetland includes the wetlands and water bodies as defined by the CORINE land-cover databases and contain inland marshes (low-lying land usually flooded in winter, and more or less saturated by water all year round), peat bogs (peat land consisting mainly decomposed moss and vegetable matter), water courses (natural or artificial water-courses including those serving as water drainage) and water bodies (natural or artificial lakes, ponds etc.).
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.
Latvia	Wetlands category includes all inland water bodies (rivers, ponds, lakes), swamps (constantly wet areas where height of trees cannot reach more than 5 m in height and ground vegetation consists mostly of sphagnum and different sword grasses), flood-lands (small areas) and alluvial lands (larger flood-lands).
Lithuania	Wetlands include peat extraction areas and peat lands which do not fulfil the definition of other categories. Water bodies and swamps (bogs) are also included under this category. Peat extraction areas are considered as managed land.
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.
Malta	In the Maltese islands wetlands are mostly saline.
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.
Poland	Wetland consists of: marine internal; surface flowing waters, which covers land under waters flowing in rivers, mountain streams, channels, and other water courses, permanently or seasonally and their sources as well as land under lakes and artificial water reservoirs. from or to which the water course flow; land under surface lentic water which covers land under water in lakes and reservoirs other than those described above, land under ponds including water reservoirs (excluding lakes and dam reservoirs for water level adjustment) including ditches and areas adjacent and related to ponds; land under ditches including open ditches acting as land improvement facilities for land used.
Portugal	Inland wetlands, coastal wetlands, salt marshes, saline and intertidal flats.
Romania	Wetlands includes all lands covered by water (rivers, ponds, dams, swimming pools, etc.) and land affected by humidity (caused by water stagnation, marshy areas, etc.), with the exception of agricultural land. It contains two sections (waters and wetlands) and 11 categories (permanent streams, temporary streams, lakes, dams, floating vegetation, hydrophilic vegetation (stubble etc.), harbors, temporarily flooded areas, bogs, channels and piers.
Slovakia	The wetlands include artificial reservoirs and dam lakes, natural lakes, rivers and swamps.
Slovenia	Wetlands are fens and raised bogs. Vegetation is higher than swamp pastures and meadows and there is no cutting of the grass or grazing. There are the areas with reeds and low placed areas frequently floated. All that areas are not in agricultural use. In this class there are the inland water bodies (major rivers, lakes and water reservoirs) too.
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).
United Kingdom	Includes sites currently registered for commercial extraction where extraction activity is visible on recent aerial/ satellite photographs or by field visits.

Figure 6.31 Trend of activity data and emissions in “Wetlands remaining Wetlands” subcategory of EU MS (kha, 1990-2013)

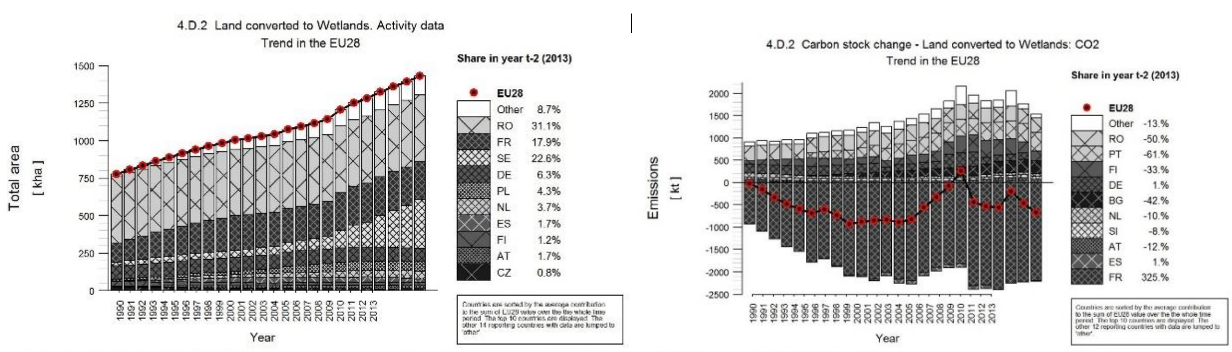


In 2013, 1.430 Kha are reported under Land converted to Wetlands that represent an increase of 84% as compared with 1990 (Figure 6.32). Conversion to Wetlands are mainly reported by Romania, France and Sweden. In term of emissions, this subcategory is reported at EU level as a small sink of 674 kt CO_2.

Lands reported under wetlands have different definitions among MS. Differences mostly relay on if wetland areas are subject to economic activities (Northern countries).

Category 4D.2 is often subject to conversions to natural water regime and wetlands in general established in areas of organic soils on Grasslands. Under 4D.2 MS report either a source or sink depending on the previous land use category that is converted to Wetlands. Generally, emissions and removals from this category are related to soils carbon pools (e.g. France reports significant removals on organic soils from the conversion of Grassland to other wetlands) of with living biomass if the conversion is related to deforestation (e.g. Romania)

Figure 6.32 Trend of activity data and emissions in “lands converted to Wetlands” subcategory of EU MS (kha, 1990-2013)



6.2.4.2 Settlements (CRF 4E)

At EU level, the total reported Settlements area in 2013 is 29.653 Kha. Settlements represent 7% of the total EU area, and increased by 22% as compared with 1990. All the MS report increasing areas under this land category. In overall, Land converted to Settlements represent 22% of the total area reported under 4E and it is mainly due to conversions from Cropland, Grassland or Forest lands.

Definitions of lands included under this category vary across MS (Table 6.26).

Table 6.26 Definitions of land reported by MS under land category 4E Settlements

Member State	Definition
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.
Bulgaria	The Settlements refer to all classes of urban formation. These are areas that are functionally or administratively associated with public or private land in cities, villages or other settlement types.
Croatia	Continuous and discontinuous urban fabric area, industrial or commercial units, road and rail networks and associated land, port areas, airports, mineral extraction sites, dump sites, construction sites, green urban areas, sport and leisure facilities.
Cyprus	No definition is provided
Czech Republic	Settlements includes two categories built-up areas and courtyards and other lands. Other lands includes all types of land-use were included with the exception of "unproductive land", which corresponds to category 4.F Other Land. Hence, the Settlements category also includes all land used for infrastructure, as well as that of industrial zones and city parks.
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).
Estonia	Built-up areas, with roads, streets and squares, traffic and power lines, urban parks, industrial and manufacturing land, sports facilities, airports, legal waste down points, construction sites and buildings with up to 0.3 ha of garden yard (including permanent greenhouses), and open cast areas (except peat extraction areas) are included into this land-use category
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.
Hungary	Settlements comprises the urban areas, industrial, commercial and transport units, as well as mines, dump and construction sites and artificial non-agricultural vegetated areas.
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.
Latvia	According to national definitions settlements include: land under buildings including yards and gardens as well as land necessary to maintain and to access those buildings; land under roads including buffer zones; forest infrastructure excluding ditches and other wetlands, but including seed orchards, forest nurseries and fire-breaks; other infrastructure – buffer zones of industrial networks, quarries etc.
Lithuania	All urban territories, power lines, traffic lines and roads are included under this category as well as orchards and berry plantations planted in small size household areas and only used for householders' meanings.
Luxemburg	Developed land, including transportation and any size of human settlement unless already included under other category.
Malta	The land-use category Settlements includes all classes of urban tree formations, namely trees grown along roads and streets, in public and private gardens, and in cemeteries, airports, construction sites, dumpsites, industrial or commercial units, port areas and sport and leisure facilities.
Netherlands	Developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.
Poland	Settlements consists of: residential areas include land not used for agricultural and forest production, put under dwelling buildings, devices functionally related to dwelling buildings (yards, drives, passages, playgrounds adjacent to houses), as well as gardens adjacent to houses; industrial areas include land put under buildings and devices serving the purpose of industrial production; other built-up areas include land put under buildings and devices related to administration; undeveloped urbanised areas include land that is not built over, allocated in spatial management plans to building development and excluded from agricultural and forest production; recreational and resting areas comprise the following types of land not put under buildings; areas of recreational centres,. children playgrounds, beaches, arranged parks, squares, lawns (outside street lanes); areas of historical significance: ruins of castles, strongholds, etc.; sport grounds: stadiums, football fields, ski-jumping take-offs, toboggan-run, sports rifleranges, public baths etc.; area for entertainment purposes: amusement, grounds, funfairs etc.; zoological and botanical gardens; areas of non-arranged greenery, not listed under woodlands or land planted with trees or shrubbery; transport areas including land put under: roads; stopping yards next to railway stations, bus stations and airports, maritime and river ports and other ports, as well as universal accesses to unloading platforms and storage yards; railway grounds; other transport grounds.
Portugal	Artificial areas such as urban, industrial, commerce and transport units, mines, dump and construction sites and artificial non-agricultural vegetated areas.
Romania	Settlements has 3 groups (urban/rural, buildings and infrastructure) and includes: fenced and constructed areas, sealed lands (e.g. car parks, roundabouts, platforms), urban/rural lawns, playgrounds in green areas, beach lawn and other areas with lawn, dwellings, industrial and administration buildings (e.g. banks, churches, railway stations, restaurants), warehouses, huts, ruins, greenhouses, graveyards, dirt roads, trails, rail roads and roads (street, sidewalk, square), bridges and dams.
Slovakia	The settlements include all developed land, including transportation infrastructure and human settlements of any size.
Slovenia	Settlements are all piece of land where the buildings, roads, parking places, mines, stone pits and all other infrastructure are in human use.
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.
United Kingdom	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.

In terms of emissions, most of the MS report carbon stock change in the subcategory 4E.1 using notation keys under the Tier 1 assumption of equilibrium for carbon pools on these areas.

In overall, at EU level, Settlements remaining Settlements is reported as a source of 2.838 kt CO_2, mainly due to emissions reported in mineral soils by UK, or emissions from disturbed organic soils reported by Germany or Netherlands (Figure 6.33,Figure 6.34). Few MS report removals from Living biomass on Settlements remaining Settlements. (e.g. Latvia, Poland)

Figure 6.33 Trend of activity data and emissions in "Settlements remaining Settlements" subcategory of EU MS (kha, 1990-2013)

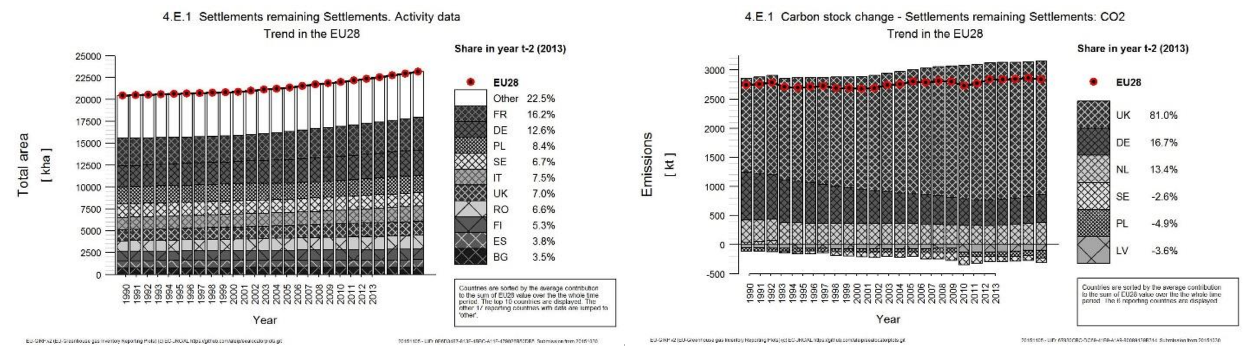
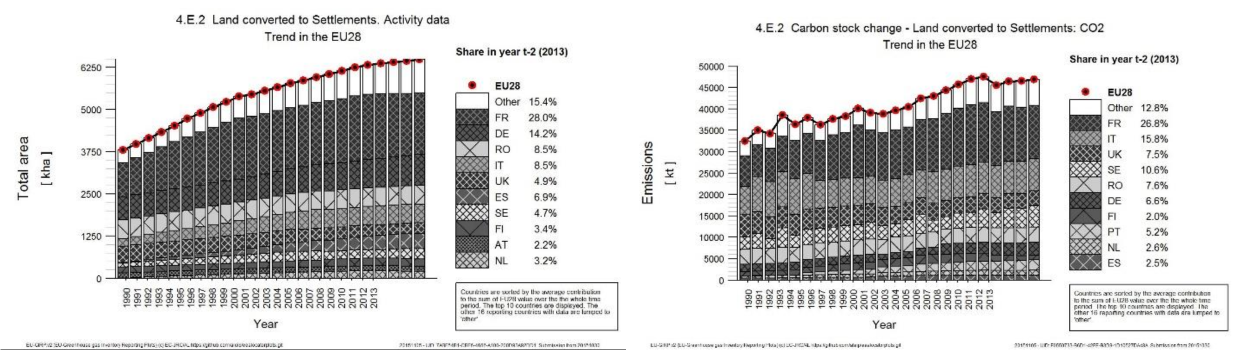


Figure 6.34 Trend of activity data and emissions in "Land converted to Settlements" subcategory of EU MS (kha, 1990-2013)



Annual emissions from conversions to Settlements have increased by 44% since 1990 (Table 6.27). In 2013 this subcategory was reported as a net source of emissions of 46.859 kt CO_2

From conversions of major land categories the reporting on carbon pools is almost complete, the most significant emissions are due to disturbed mineral soils (UK, Italy, and France). Conversion from Forest land to Settlements is an important component of the total deforestation, being around 30% of total area reported as deforested and 16% of the conversion to Settlements. While conversions to Wetlands and Other land may be caused by natural effects, conversions to Settlement is always, by definition, the result of human actions. Generally, carbon pools are not uniformly disturbed over the whole area converted; usually only part of converted area is sealed, trees or upper soils layer is removed and, carbon stored in dead organic matter and soil organic matter diminish significantly. Generally, carbon stock changes associated with deforestation are reported by using country-specific data.

Table 6.27 **4E2 Land converted to Settlements: MS' contributions to the net CO_2 emissions (CRF table 4)**

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	385	135	215	0%	80	59%	-169	-44%
Belgium	236	595	593	1%	-2	0%	357	151%
Bulgaria	678	948	978	2%	30	3%	300	44%
Croatia	240	535	546	1%	11	2%	305	127%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	84	99	83	0%	-16	-16%	-1	-1%
Denmark	13	91	74	0%	-17	-19%	61	472%
Estonia	0	342	353	1%	11	3%	352	118245%
Finland	976	1 091	947	2%	-143	-13%	-28	-3%
France	7 110	12 747	12 550	27%	-197	-2%	5 439	76%
Germany	1 728	2 942	3 104	7%	161	5%	1 375	80%
Greece	6	25	11	0%	-14	-56%	4	70%
Hungary	115	219	232	0%	13	6%	118	103%
Ireland	74	259	55	0%	-204	-79%	-19	-26%
Italy	6 641	7 419	7 425	16%	6	0%	784	12%
Latvia	163	1 071	1 107	2%	36	3%	944	578%
Lithuania	NO	277	318	1%	40	15%	318	100%
Luxembourg	150	79	75	0%	-3	-4%	-74	-50%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	509	1 133	1 205	3%	72	6%	696	137%
Poland	461	515	400	1%	-115	-22%	-60	-13%
Portugal	30	2 348	2 428	5%	80	3%	2 397	7863%
Romania	3 550	3 550	3 550	8%	0	0%	0	0%
Slovakia	96	81	96	0%	15	18%	0	0%
Slovenia	730	871	877	2%	6	1%	148	20%
Spain	411	1 139	1 152	2%	13	1%	741	180%
Sweden	2 854	4 487	4 955	11%	468	10%	2 100	74%
United Kingdom	5 219	3 541	3 530	8%	-11	0%	-1 690	-32%
EU-28	**32 462**	**46 539**	**46 859**	**100%**	**320**	**1%**	**14 397**	**44%**

For reporting dead organic matter it is generally assumed that the entire carbon stock in this pool is instantaneously oxidized in the moment of conversion from Forest land to Settlements. It is also assumed that there is no dead wood and litter on Settlements. Emissions are estimated based on per area average carbon stock of these carbon pools determined either at national or regional scale or specific to each deforestation site.

For reporting soils organic matter different assumptions have been implemented by MS, generally based on expert judgment or, occasionally, from some scientific studies. For instance, in Sweden carbon stock in Settlements is estimated as the weighted average of carbon stocks in two strata: unsealed and sealed. Unsealed area is usually considered to cover 40-60% of national Settlements or conversion to

Settlements area (e.g. Austria, Luxembourg), going down to 2-3% in cities (i.e. Bulgaria). Associated carbon stocks are derived from one of the following options (depending on MS):

- data from measurements in green area of the city (from scientific studies);
- same carbon stock as under 'GL remaining GL' (assuming that under national circumstances GL is the source of land for Settlement's expansion);
- lowest carbon stock value among the major land categories Forest land, Cropland and Grassland (assuming limited change of carbon stock in the soil under construction);
- applying a factor against carbon stock in previous land use (e.g. constant loss of 50% by FR).

6.2.4.3 Other land (CRF 4F)

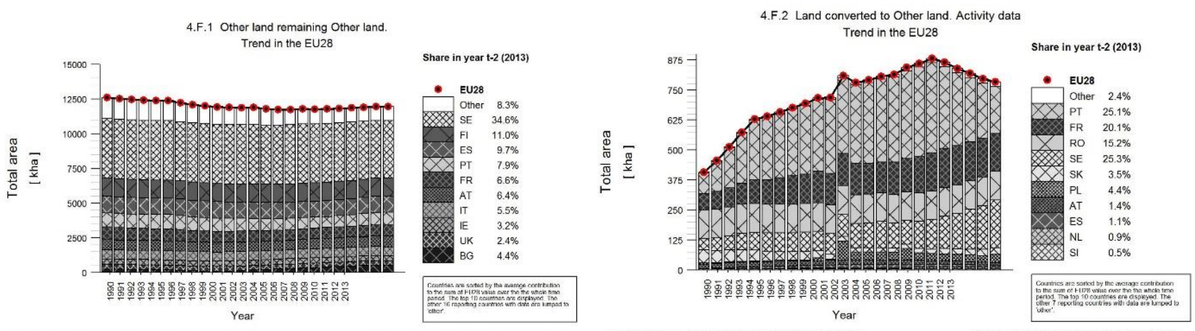
The area of the category Other land covers at EU level 12.730 kha in 2013, which is 2% less than in 1990 and 3% of the total reported EU area. Area under conversion in this category shares the 6% of the total area. Definitions implemented to report such lands are close amongst MS and match IPCC general description (Table 6.28). In some cases, this category is used to ensure that total reported area is consistent along the time series and match official country area by the inclusion of all the areas that do not fall into any other land use category.

Table 6.28 Definition for the categorization of lands under 4F - 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.
Bulgaria	Other land category includes bare soil, rock and all area that do not fall into any of other five land-use categories.
Croatia	Definition is not available in NIR 2015.
Cyprus	Definition is not available in NIR 2015.
Czech Republic	Other Land represents unmanaged (unmanageable) land areas, matching the IPCC (2006) default definition.
Denmark	Unmanaged area like moors, fens, beaches, sand dunes, lakes and other areas without human interference.
Estonia	Land areas that do not fall into any of the other five land-use categories.
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).
Hungary	Other Land includes comprises any area not included in another categories.
Ireland	Natural grasslands not in use for agricultural purposes. Water bodies, bare rocks.
Italy	Definition is not available in NIR 2015.
Latvia	According to the national land use statistics other lands include unmanaged lands, wetlands and settlements (1 459.3 mill. ha in 2008). Instead of the official statistics since 2009 the NFI is used to estimate area of other lands. It is assumed that other lands are dunes not covered by woody vegetation.
Lithuania	All other land which is not assigned to any other category such as quarries, sand - dunes and rocky areas is defined as Other 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.
Malta	This category includes bare soil, rock, and all unmanaged land areas that do not fall into any of the other five categories. Mineral extraction sites in Malta are included under this land-use category.
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).
Poland	Definition is not available in NIR 2015.
Portugal	Beaches, dunes, sand plains and bare rocks and shrub land.
Romania	Other land includes following categories: rocky areas, excavations, stone quarries (active, closed), stony debris, gravel/sand/earth pits, drilling perimeters and locally degraded lands.
Slovakia	Other land represents bare soil, rock and all unmanaged land areas that do not fall into any of the other categories.
Slovenia	Other land includes non-forest land covered with vegetation lover than 2 m or covered less than 75%, which is not used in agriculture. There are inbuilt areas with little or no vegetation as rocks, sands, sand banks (bigger than 5000 m2), waste and other opened areas. This is all land that is not classified in other land use definitions.
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.
United Kingdom	Inland rock, standing water and canals and rivers and streams.

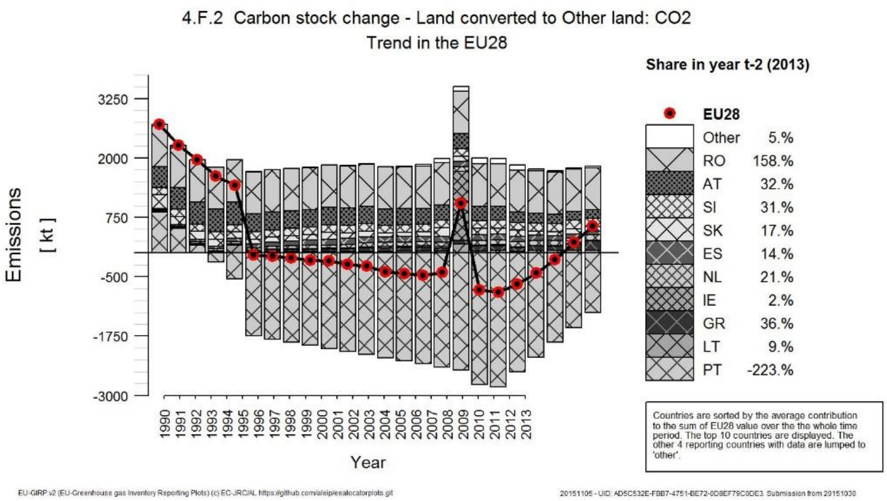
In overall, the largest area reported in this category is reported by Sweden that report about one third of the total EU area (Figure 6.35). Conversions to other lands are mainly reported by Portugal, France, Sweden and Romania, without a defined pattern about the land of origin.

Figure 6.35 Trend of activity data and emissions in "Other land category" subcategory of EU MS (kha, 1990-2013)



In terms of emissions, in 2013, the subcategory 4E.2 represent a net source of 563 kt CO_2 (Figure 6.36). Mainly due to a decrease of the removals reported by Portugal in mineral soils due to abandonment of agricultural lands. Other MS report emissions from these conversions as a result of the conversion from forests (e.g. Romania, Austria). Emissions reported by Ireland for the year 2006 are the result of forest conversion to other lands although apparently they seems to be due to a typo in the IEF used.

Figure 6.36 Trend of emissions and emissions in "Land converted to Other lands" subcategory of EU MS (kha, 1990-2013)



6.2.5 Other source of emissions: Tables 4(I)-4(V)

6.2.5.1 Direct nitrous oxide (N_2O) emissions from nitrogen (N) inputs to managed soils (CRF Table 4(I))

This source category covers direct N_2O emissions from organic and inorganic fertilizers applied to soils managed. The majority of MS report that there is no fertilization of Forest land, while if any, emissions from fertilization of other land categories is often reported under agriculture sector using corresponding notation keys in the CRF table 4(I) (Table 6.29). Only Finland, Sweden and the UK report N_2O emissions under this source category due to forest fertilization. Sweden actually reports the highest amount of N_2O emissions from N fertilization occasionally applied to increase the wood production in older forest stands on mineral soils.

Table 6.29 **Direct nitrous oxide (N_2O) emissions from nitrogen (N) inputs to managed soils (kt)**

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Denmark	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	21	12	13	42%	2	13%	-8	-37%
France	NO	NO	NO	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Hungary	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Ireland	NO,NE,IE	NO,NE,IE	NO,NE,IE	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Romania	IE	IE	IE	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	49	32	17	54%	-15	-48%	-32	-66%
United Kingdom	5	1	1	4%	0	-19%	-3	-76%
EU-28	**74**	**45**	**31**	**100%**	**-14**	**-31%**	**-43**	**-58%**

For reporting this category, activity data result from national or sectorial 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). IPCC default emission factor are applied. The IEF of the N_2O-N emissions per unit of fertilizer applied is around 0.01 kg N_2O-N/kg N yr^{-1}.

N_2O emissions from this source category are 58% and 31% less in 2013 as compared to 1990 and 2012 respectively. Total EU emissions from fertilization of managed soils in 2013 from this category is 31 kt CO_2eq.

6.2.5.2 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (CRF Table 4(II))

This source category covers CO_2, CH_4 and N_2O emissions from drainage, rewetting and other management practices of soils. Emissions in kt CO_2 eq. for 2013 were reported respectively as 6 777, 3 673, 3 040 kt CO_2 eq.

Just in few cases CO_2 emissions from this source are reported in CRF table 4(II) since, when occurring, they use to be already covered in CRF tables 4A-4F. UK reports 77 % of the CO_2 emissions included in the CRF table 4 (II) from organic soil in Cropland and Grassland categories. Most countries do not report them also because those emissions are considered negligible (NO or NE), although few transparently report drained area. Overall, annual CO_2 emissions reported for 2013 practically did not change over time (Table 6.30).

Table 6.30 CO_2 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (kt)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	IE	IE	IE	-	-	-	-	-
Estonia	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Finland	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
France	NO	NO	NO	-	-	-	-	-
Germany	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	2	7	7	0%	0	0%	5	316%
Ireland	197	165	165	2%	0	0%	-31	-16%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	1 017	883	936	14%	53	6%	-81	-8%
Lithuania	406	430	431	6%	1	0%	25	6%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	E,NA,NE,NO	E,NA,NE,NO	E,NA,NE,NO	-	-	-	-	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
United Kingdom	5 238	5 238	5 238	77%	0	0%	0	0%
EU-28	**6 859**	**6 724**	**6 777**	**100%**	**53**	**1%**	**-82**	**-1%**

Table 6.31 N_2O Emissions and removals from drainage and rewetting and other management of organic and mineral soils (kt)

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	35	35	35	1%	0	0%	0	-1%
Estonia	1	2	2	0%	0	0%	0	17%
Finland	1 216	1 208	1 208	33%	0	0%	-8	-1%
France	NO	NO	NO	-	-	-	-	-
Germany	370	362	366	10%	4	1%	-4	-1%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	0	1	1	0%	0	0%	1	825%
Ireland	105	182	182	5%	0	0%	77	73%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	572	589	594	16%	4	1%	22	4%
Lithuania	27	27	27	1%	0	0%	0	0%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	27	27	27	1%	0	0%	0	0%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	1 056	1 170	1 185	32%	15	1%	129	12%
United Kingdom	45	46	46	1%	0	0%	1	3%
EU-28	**3 454**	**3 649**	**3 673**	**100%**	**24**	**1%**	**219**	**6%**

Concerning N_2O and CH_4 emissions, Finland and Sweden report the largest emissions from this source (Table 6.31,Table 6.32). In Finland a Tier 2 methodology is used, with directly measured emissions factors for CO_2, N_2O and CH_4, while the activity data (annual area of peatlands with active extraction, set aside peat lands, industrial stocks) are compiled from statistics.

Table 6.32 CH_4 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (kt)

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	10	7	7	0%	0	-4%	-3	-27%
Estonia	0	0	0	0%	0	0%	0	17%
Finland	1 535	922	921	30%	0	0%	-614	-40%
France	NO	NO	NO	-	-	-	-	-
Germany	848	846	845	28%	-1	0%	-3	0%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	344	463	467	15%	5	1%	124	36%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	276	322	337	11%	15	5%	61	22%
Lithuania	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	449	460	462	15%	1	0%	13	3%
United Kingdom	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
EU-28	**3 461**	**3 020**	**3 040**	**100%**	**20**	**1%**	**-422**	**-12%**

6.2.5.3 Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic resulting from change of land use or management of mineral soils (CRF Table 4(III))

Changes of land use (usually from Forest land, Cropland, Grassland and Wetlands) or management practices, causes the loss of carbon stored in mineral soils due to the mineralization of organic matter (so emissions of both CO_2 and N_2O) followed by the stabilization of the carbon content in soil at a lower level.

At the EU level, N_2O emissions reported in table CRF Table 4(III) represent 2 999 kt CO_2eq. in 2013, with the highest contribution on total emissions reported by UK, Romania and Germany (Table 6.33). These emissions are reported mainly under land converted to Settlement, Grassland, and land converted to Croplands. (N_2O emissions in Cropland remaining Cropland are already covered under Agriculture sector). Overall, N_2O emissions from this source decreased by 27% in 2013 as compared with 1990.

Table 6.33 Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matte resulting from change of land use or management of mineral soils.

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	15	19	20	1%	1	4%	5	34%
Belgium	9	98	98	3%	0	0%	89	939%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	5	10	10	0%	1	7%	6	121%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	8	5	5	0%	0	-2%	-4	-42%
Denmark	0	9	38	1%	29	313%	38	10938%
Estonia	NA,NO	5	5	0%	0	0%	5	100%
Finland	23	30	29	1%	-1	-3%	6	24%
France	NO	NO	NO	-	-	-	-	-
Germany	494	457	468	16%	11	2%	-25	-5%
Greece	0	0	0	0%	0	-72%	0	853%
Hungary	24	46	45	1%	-1	-3%	20	84%
Ireland	20	140	139	5%	-1	-1%	120	613%
Italy	45	17	11	0%	-6	-33%	-34	-75%
Latvia	4	99	101	3%	2	2%	96	2375%
Lithuania	7	5	5	0%	0	0%	-1	-21%
Luxembourg	4	4	4	0%	0	-1%	-1	-13%
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	6	88	94	3%	6	7%	88	1570%
Poland	883	1	1	0%	0	0%	-882	-100%
Portugal	507	340	341	11%	1	0%	-167	-33%
Romania	850	617	586	20%	-31	-5%	-264	-31%
Slovakia	60	8	8	0%	0	0%	-52	-86%
Slovenia	13	13	13	0%	0	0%	0	-1%
Spain	17	159	144	5%	-15	-9%	127	753%
Sweden	66	177	186	6%	8	5%	120	181%
United Kingdom	1 019	660	648	22%	-12	-2%	-371	-36%
EU-28	**4 080**	**3 008**	**2 999**	**100%**	**-9**	**0%**	**-1 082**	**-27%**

6.2.5.4 Indirect nitrous oxide (N_2O) emissions from managed soils (CRF Table 4(IV))

This source category cover indirect N_2O emissions from managed soils. Indirect emissions from nitrogen inputs on Cropland and Grassland area reported in agriculture sector, as well as, indirect emissions related to N mineralization in Cropland remaining Cropland. Therefore, since it is under these land categories where more direct N_2O emissions are reported in CRF table 4 (I) and 4 (III); MS often used the notation key IE to report related indirect emissions in CRF table (IV). Emissions from this source category reported under LULUCF represent 119 kt CO_2eq and they are mainly reported by Germany (Table 6.34).

Table 6.34 Indirect nitrous oxide (N_2O) emissions from managed soils

Member State	N20 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	IE	IE	IE	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	IE	IE	IE	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	8	5	5	4%	0	-2%	-4	-42%
Denmark	IE	IE	IE	-	-	-	-	-
Estonia	NE	NE	NE	-	-	-	-	-
Finland	2	3	3	2%	0	-4%	1	27%
France	NO	NO	NO	-	-	-	-	-
Germany	111	103	105	89%	2	2%	-6	-5%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	IE	IE	IE	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	NO, NE	NO, NE	NO, NE	-	-	-	-	-
Latvia	0.2	3	3	3%	0	5%	3	1753%
Lithuania	IE	IE	IE	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Portugal	IE	IE	IE	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	IE	IE	IE	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO, NE	NO, NE	NO, NE	-	-	-	-	-
Sweden	8	5	3	2%	-2	-48%	-5	-66%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-28	**129**	**119**	**119**	**-**	**0**	**0%**	**-11**	**-8%**

6.2.5.5 CO_2, CH_4 & N_2O emissions from Biomass Burning (CRF Table 4(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. In general, CO_2 emissions from forest fires are reported under 4A Forest land, while CO_2 and non-CO_2 emissions from fires affecting other categories are reported in table 4(V).

Controlled burning on managed land is not common practice in the EU, with few exceptions (.e.g. Finland, Sweden, UK for forest land and UK, Spain for Grassland) for confined areas. For most of the MS, emissions from fires are indeed negligible. 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 mainly used for estimation of CH_4 and N_2O emissions.

Overall, emissions from biomass burning decreased compared to 1990. CO_2 emissions from burning biomass are reported as NO or IE when they are already covered under 4A. Overall, CO_2 emissions have decreased by 68% since 1990 (Table 6.35). The CH_4 emissions decreased by 51% (Table 6.36) and those of N_2O by 59% (Table 6.37), nevertheless, their real trends are related to wildfire incidence, which is characterized by a large inter-annual variability.

Table 6.35 CO_2 emissions from Biomass Burning (in kt CO_2)

Member State	CO2 emissions in kt			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2	%	kt CO2	%
Austria	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Belgium	5	NO	NO	-	-	-	-5	-100%
Bulgaria	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Croatia	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Cyprus	1	9	3	0%	-6	-66%	2	434%
Czech Republic	1 056	641	594	16%	-47	-7%	-462	-44%
Denmark	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Estonia	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	-
Finland	4	1	5	0%	4	363%	1	31%
France	1 596	269	104	3%	-165	-61%	-1 491	-93%
Germany	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Greece	154	217	17	0%	-200	-92%	-136	-89%
Hungary	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Ireland	554	74	551	15%	478	649%	-3	-1%
Italy	5 020	4 216	504	14%	-3 712	-88%	-4 516	-90%
Latvia	256	84	83	2%	0	0%	-173	-67%
Lithuania	4	1	1	0%	0	-16%	-4	-87%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Netherlands	3	4	4	0%	0	1%	1	37%
Poland	546	403	103	3%	-301	-75%	-443	-81%
Portugal	2 037	1 662	1 325	36%	-337	-20%	-712	-35%
Romania	4	11	12	0%	1	5%	8	207%
Slovakia	7	52	8	0%	-44	-84%	1	16%
Slovenia	21	39	3	0%	-35	-92%	-18	-85%
Spain	4	115	57	2%	-58	-51%	53	1460%
Sweden	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
United Kingdom	118	485	316	9%	-168	-35%	198	168%
EU-28	**11 389**	**8 282**	**3 690**	**100%**	**-4 592**	**-55%**	**-7 699**	**-68%**

Table 6.36 CH_4 emissions from Biomass Burning (in kt CH_4)

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0.5	0.1	0.2	0%	0	64%	0	-55%
Belgium	1	NO	NO	-	-	-	-1	-100%
Bulgaria	4	46	12	1%	-34	-75%	8	219%
Croatia	1	39	2	0%	-37	-95%	1	57%
Cyprus	0.04	0.7	0.2	0%	0	-66%	0	434%
Czech Republic	115	70	65	3%	-5	-7%	-50	-44%
Denmark	1	0.03	0.04	0%	0	43%	-1	-94%
Estonia	0.3	0.01	0.002	0%	0	-67%	0	-99%
Finland	5	1	1	0%	1	112%	-4	-77%
France	1 319	1 062	1 097	58%	35	3%	-222	-17%
Germany	7	1	1	0%	0	-25%	-6	-84%
Greece	49	62	13	1%	-49	-79%	-36	-73%
Hungary	23	36	12	1%	-24	-67%	-11	-48%
Ireland	131	16	132	7%	116	714%	1	1%
Italy	1 673	1 204	199	11%	-1 005	-84%	-1 475	-88%
Latvia	28	10	11	1%	2	18%	-16	-59%
Lithuania	3	1	1	0%	0	-21%	-2	-73%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0.2	0.3	0.3	0%	0	1%	0	39%
Poland	44	32	37	2%	5	16%	-7	-16%
Portugal	205	174	154	8%	-21	-12%	-52	-25%
Romania	0	1	1	0%	0	5%	1	207%
Slovakia	7	12	9	0%	-3	-26%	2	21%
Slovenia	3	5	0.5	0%	-5	-92%	-3	-85%
Spain	206	175	91	5%	-84	-48%	-115	-56%
Sweden	2	1	3	0%	2	160%	1	43%
United Kingdom	21	68	36	2%	-32	-48%	15	70%
EU-28	**3 849**	**3 017**	**1 877**	**100%**	**-1 140**	**-38%**	**-1 972**	**-51%**

Table 6.37 N_2O emissions from Biomass Burning (in kt N_2O)

Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0.3	0.1	0.1	0%	0	64%	0	-55%
Belgium	5	NO	NO	-	-	-	-5	-100%
Bulgaria	1	8	2	1%	-6	-75%	1	219%
Croatia	1	27	1	1%	-25	-95%	1	72%
Cyprus	0.03	0.4	0.1	0%	0	-66%	0	434%
Czech Republic	9	6	5	2%	0	-7%	-4	-44%
Denmark	0.4	0.03	0.04	0%	0	32%	0	-90%
Estonia	0.04	0.002	0.0004	0%	0	-83%	0	-99%
Finland	0	0	0	0%	0	113%	0	-77%
France	175	120	116	49%	-4	-3%	-59	-33%
Germany	4	1	1	0%	0	-25%	-4	-84%
Greece	4	5	1	0%	-4	-79%	-3	-73%
Hungary	15	32	8	3%	-24	-75%	-7	-46%
Ireland	22	3	23	10%	20	751%	0	2%
Italy	260	218	26	11%	-192	-88%	-234	-90%
Latvia	3	1	1	1%	0	16%	-2	-55%
Lithuania	3	1	1	0%	0	-18%	-2	-71%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0.1	0.2	0.2	0%	0	1%	0	38%
Poland	10	8	2	1%	-6	-75%	-8	-80%
Portugal	34	29	25	11%	-3	-12%	-8	-25%
Romania	0.1	0.4	0.4	0%	0	5%	0	207%
Slovakia	5	8	6	3%	-2	-26%	1	21%
Slovenia	0.4	1	0.1	0%	-1	-92%	0	-85%
Spain	17	14	7	3%	-7	-48%	-9	-56%
Sweden	0.2	0.1	0.2	0%	0	162%	0	46%
United Kingdom	13	39	8	4%	-30	-79%	-5	-36%
EU-28	**583**	**521**	**236**	**100%**	**-285**	**-55%**	**-346**	**-59%**

6.2.6 Emissions from Harvested Wood Products in the EU GHG inventory

This carbon pool covers emissions and removals resulting from carbon stock changes in harvested wood products (HWP). According to the 2006 IPCC Guidelines, HWP includes all wood material (including bark) that leaves harvest sites. Slash and other material left at harvest sites should be regarded as dead organic matter in the associated land use category and not as HWP.

Harvested wood products represent at EU level a net sink of about -21.612 kt CO_2 in 2013 (). Most of the MS reported this pool as a net sink but for 5 MS this carbon pool resulted in a net source of emissions in 2013. The largest contributor of CO_2 removals was Sweden, Finland, Germany and Latvia, while Czech

Republic, Belgium, Portugal and Netherlands reported a net source of emissions from HWP. Five MS did not report quantitative estimates for this pool in CRF table 4.

The methods and data sources for estimating this carbon pool are consistent with methodologies provided by 2006 IPCC GL. MS providing estimates in CRF table 4 used mainly IPCC Approach B (production approach) that allows to consistently estimate and report the HWP contribution, both under the Convention as well as under KP reporting; few of them used Approach A (stock change approach) and none of them used Approach C (Atmospheric flow).

Generally, MS reported carbon stock changes in this pool considering individual estimates for the semi-finished wood products categories of: Solid wood (disaggregated in Sawnwood and wood panels) and Paper and paperboard.

Activity data has been often collected from FAOSTAT database, from the TIMBER database of the United Nations Economic Commission for Europe (UNECE, 2011), national statistics or in specific cases from surveying the wood industries.

Table 6.38 Net carbon stock change and approach implemented by MS for Harvested Wood Products

MS	Net CO2 emissions/removals (kt)	GHG source and sink categories		Approach A	Approach B	Approach C
Austria	-1265.50	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NO			
Belgium	336.31	1. Solid wood	x	x		
		2. Paper and paperboard	NA			
		3. Other	NO			
Bulgaria	-545.01	1. Solid wood	x		x	
		2. Paper and paperboard	NA			
		3. Other				
Croatia	-264.12	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NA			
Cyprus	NO	1. Solid wood				
		2. Paper and paperboard				
		3. Other				
Czech Republic	791.82	1. Solid wood	x	x		
		2. Paper and paperboard	x			
		3. Other	NO			
Denmark	-88.86	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NO			
Estonia	-726.47	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	x			
Finland	-4356.63	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NA			
France	-1652.60	1. Solid wood	NO		x	
		2. Paper and paperboard	NO			
		3. Other	x			
Germany	-2588.00	1. Solid wood	IE		x	
		2. Paper and paperboard	x			
		3. Other	x			
Greece	-324.19	1. Solid wood	x		x	
		2. Paper and paperboard	NO			
		3. Other	NO			
Hungary	47.90	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NA			
Ireland	-691.95	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other				
Italia	-234.89	1. Solid wood	x	x		
		2. Paper and paperboard	x			
		3. Other	NO			
Latvia	-2141.52	1. Solid wood	x	x		
		2. Paper and paperboard	x			
		3. Other	NO			
Lithuania	-955.24	1. Solid wood	x	x		
		2. Paper and paperboard	x			
		3. Other	NA			
Luxembourg	NO	1. Solid wood	NO			
		2. Paper and paperboard	NO			
		3. Other	NO			
Malta	NO	1. Solid wood	NO			
		2. Paper and paperboard	NO			
		3. Other	NO			
Netherlands	105.72	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other				
Poland	NA	1. Solid wood	x			
		2. Paper and paperboard	x			
		3. Other				
Portugal	220.00	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NO			
Romania	-234.48	1. Solid wood	NO,NA,NE,IE	x		
		2. Paper and paperboard	x			
		3. Other	NA,NO			
Slovakia	-278.08	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other				
Slovenia	-25.37	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other				
Spain	NE	1. Solid wood	NE			
		2. Paper and paperboard	NE			
		3. Other	NE			
Sweden	-5620.22	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other	NA			
United Kingdom	-1120.63	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other				

6.2.7 Emissions from organic soils in the EU GHG inventory

At EU level, organic soils on 4A, 4B and 4C cover some 16.928 kha, mostly located in Northern MS. Total emissions from organic soils from these categories was, in 2013, 88.185 kt CO_2 which represents 27% of total EU net removals from LULUCF 2013 (Table 6.40). Emissions from organic soils in these land categories decreased by 7% as compared with 1990. Finland and Sweden report respectively 37% and 27% of the total area of organic soil in these categories.

Definitions of organic soils reported by MS are presented in Table 6.198 presumably other MS apply the FAO definition as suggested in the 2006 IPCC GL.

Table 6.198 Elements to define C pool in organic soils

MS	Definition
Austria	>17% of organic matter in top 30cm of soil
Belgium	Definition of organic soils is not available in the NIR 2015
Croatia	Definition of organic soils is not available in the NIR 2015
Czech Republic	The organic soils occur only in the areas of the Spruce sub-category on FL remaining FL. They represent protected peat areas in mountainous regions dominated by spruce stands, with no or specific management practices.
Denmark Ireland	>20% of organic matter in top 30cm of soil
Estonia	Definition of organic soils is not available in the NIR 2015
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
France	Definition of organic soils is not available in the NIR 2015
Germany	Soils with a minimum organic carbon content of 9% (15% soil organic matter) in the mixed sample the top 20 cm
Hungary	Definition of organic soils is not available in the NIR 2015
Latvia	Soils are considered organic as defined in the NFI: a soil is classified as organic if the organic layer (H horizon) is at least 20 cm deep.
Lithuania	Organic soils are identified with peat and peaty soil layer equal to or being more than 30 cm of the total thickness. Drained organic soils are defined as organic soils identified with peat and peaty soil layer equal to or being more than 20 cm of the total thickness.
Netherlands	Previously, only peat soils, which have a peat layer of at least 40 cm within the first 120 cm, were included, but with the new definition from the 2006 IPCC guidelines also the peaty soils, in Dutch called 'moerige gronden', which have a peat layer of 5-40 cm within the first 80 cm, are included.
Poland	Definition of organic soils is not available in the NIR 2015
Romania	Organic soils on FL are represented by drained hydromorphic mineral soils (under excess of groundwater for at least part of the year), showing high clay and organic matter content. Organic soil on CL includes histic soil types, like „gleiosoils" and „distric and eutric histosols". Definition used is consistent with FAO/IPCC definition.
Slovenia	Definition of organic soils is not available in the NIR 2015
Sweden	Organic soils are classified as histosols. Definition used is consistent with FAO/IPCC definition.
United kingdom	Modeled based on habitat explicit soil C content database assuming 1 m depth (without implementing any threshold between mineral and organic soils)

Area of forest organic soils is mainly estimated using country-specific values, while countries having a small share of organic soils report carbon stock changes for this pool by using IPCC default factors. Overall, in the EU, most of organic soils area is under Forest land use, but most of the emissions are due to managed organic soil in Grassland and Croplands (Table 6.40).

In Finland, organic soils activity data were derived from NFI database and geo-referenced soil database across all land uses. In Sweden, data is also provided by NFI combined with Swedish Forest Soil Inventory. Emission factors are derived based on a continuous monitoring system.

Organic soils in Forest land show the lowest IEF values due to the fact that not the entire area of organic soils under forest land is drained, at the same time under Forest land UK report removals in organic soils.

Table 6.40 Area, CO_2 emissions and average implied C stock change factors in the EU reported for 2013

Land use subcategory	Area (Kha)	ICECF (tC/ha)	CO2 emissions (Kt CO2)
4A1	12169	[-2.61-1.84]	-19421
4A2	878		-1798
4B1	1439	[-10.01-0.0]	-25848
4B2	209		-5166
4C1	1863	[-8.4-0.0]	-32081
4C2	370		-5884

6.3 Uncertainties

For information on uncertainties please refer to chapter 1.6.

6.4 Sector-specific quality assurance and quality control and verification

6.4.1 Time series consistency

EU GHG inventory is compiled by aggregation of national GHG inventories, thus its consistency strictly depends on MS inventory consistency. Time series consistency is annually checked for all MS submissions as part of quality control procedures implemented under the EU GHG Monitoring Mechanism Regulation. Consistency is checked, in terms of land categories definitions and land representation across time and over space (e.g. the sum of all land use areas should be constant over time and match the official MS area), as well as trends and outliers in datasets. MS provide early submissions to the European Commissions that is in charge to implement a set of quality checks and to provide suggestions on how to solve any detected problem.

One of the key features of the methodologies implemented by MS national systems is to ensure full consistency in definitions, parameters and datasets used for preparing the LULUCF sector. The main challenge is to ensure consistency when historical data are used and they are not fully adequate to the reporting requirements; mainly for the reporting of initial years of the time series.

Land use category and subcategory definitions are not fully consistent across the EU' MS (in the sense of identical quantitative thresholds), but they are consistent with IPCC definitions for each individual MS (2006 IPCC GL). 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 available databases.

Following the improvements made within the national systems over recent years, in 2015 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). Such small differences are justified as due to data updating and to the mapping systems (e.g. measurement errors, increase of land area or coastal erosion). In general, the land reported under UNFCCC varies by 1-2% than official geographical area, so there are small risks that some emissions have not been counted.

6.4.2 Quality Assurance and Quality control

GHG inventories of the EU' MS are under double QA/QC checks: one at the country level, and another one performed at EU level by the Joint Research Centre of the European Commission in collaboration with MS in the context of the EU GHG Monitoring Mechanism Regulation.

At the EU level, the main activity is the annual checking of early versions of national GHG inventories. The checks focus on completeness, calculation errors and time series inconsistencies. QA/QC procedures are implemented by interacting with national experts to get clarifications and to plan possible improvements. During the analysis of the 2015 submissions, around 160 findings (i.e. possible problems) were communicated to the MS on: use and justifications of notations keys, inconsistency in land representation, inconsistent reporting of activity data amongst CRF tables and between CRF tables and NIR, and outliers in IEFs values for all categories.

Specific, completeness and consistency checks are applied to time series of estimates reported under Convention and under KP, as follows (non-exhaustive list):

1. Completeness check: the use of the notation key "NE", but also possible inappropriate use of "NA" or "NO", whenever IPCC methods are available, is carefully monitored and followed up where necessary with the relevant MS;
2. 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. Discontinuities in time series for any land subcategory and subdivisions.
    c. The share of the land category "Other land" on the total area reported;
3. Checks of the time series of emissions factors (for each land subcategory and subdivision, and each pool)
    a. Comparison of IEF with IPCC default factors;
    b. Discontinuities in IEFs along the time series;
    c. Comparison among IEF of other MS, with taking into consideration of eco-regions, soil type and method used for each estimate, and any information provided in the latest NIR, including the definition of the pool;
    d. Comparison with other data sources (country's official submission under other international processes, e.g. FAO);
    e. Comparison of CO_2 and N_2O emissions to check consistency of C/N ratio
4. Check the consistency within annual submissions
    a. Between GHG inventory tables; e.g. activity data for the estimation of N_2O emissions from mineral soils in land under conversion from Forest land and Grassland to Cropland)
5. Check the consistency between KP and GHG inventory tables (land area between UNFCCC and KP: 4A2 with AR; sum of area of 4B2.1; 4C2.1; 4D2.1; 4E2.1; 4D2.1 with D; 4A1 with FM). It is expected that AR area equals conversion to forest in 2009 (only if a 20 years transition is implemented and all conversion to forest are directly human induced) or that FM area is smaller or equal to 4A1 area any time, with explanation to be provided in NIR.
6. Consistency within KP tables
    a. Area reported under activity tables matches NIR2;

b. NIR2 is consistent across 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? Is the final area reported for an activity in the year X equal to the initial area reported for the same activity in the year X+1?);
c. For each activity, data reported in NIR table-2 are identical to data reported in the activity-tables;
d. For KP CRF 1990 data relevant for net-net accounting of elected activities are provided.

7. Consistency with the 2006 IPCC GL, ERT recommendations and reporting requirements set under decision 2/CMP7.
    a. Is a key category? If so, is a higher tier implemented?
    b. Pools omitted from accounting under the KP: is documentation provided demonstrating that the pool is "not a source"?
    c. Transparency and documentation: description of data sources, methods, assumptions, inferences used.
    d. Are reported values supported by adequate information on uncertainties?
    e. Are rationales, methodological changes and quantitative effects of recalculations explained in the NIR?
8. Accounting tables: check of the CRF reporting tool settings (e.g. is 3.3 offset option activated for countries that elected FM?)

Additional activities at EU level are meant to improve reporting and the quality of both national GHG inventories of the MS and EU, as follows:

- Starting 2010, the EU has implemented an internal review, as an annual exercise, which focuses 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. For example, in 2012 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 MS 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 2010, 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 experiences amongst MS, and also for the harmonization of methods for estimation of the sector, 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, 26-27 may 2015 Arona (NO), Italy.
- JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 05-07 May 2014, Arona (NO), Italy.
- II JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 04-06 November 2013, Arona (NO), Italy.
- JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 27 February-1 March 2013, Ispra (VA), Italy.
- "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in Brussels, November 21, 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 (VA), Italy. 27-28 January 2010.
- Technical workshop on LULUCF reporting issues under the Kyoto Protocol, Ispra (VA), Italy. November 13-14, 2008.
- "Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol" Ispra (VA), Italy. 27-29 November 2006).
- "Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector". Ispra (VA), Italy. September 22-23, 2005.

For further information on these workshops, see:
http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/.

The JRC's AFOLU DATA web site 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. Unfortunately at this moment due to technical

6.4.3 Verification

It is not in the EU GHG inventory scope to provide independent verification of LULUCF estimates; however, the EU ran 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 had a component aimed at modeling the forest net C stock changes for all MS, based on NFI data. The output of this modeling are offered for comparison by MS with their own estimates as a verification exercise. Another exercise on comparison has been implemented by the EU JRC for biomass burning data, carrying out a comparison of the data reported by some MS with the data provided by the European Forest Fire Information system

Finally, the JRC recommended to national LULUCF experts to verify, where available data allow, the gain-loss methodology applied for estimating their forest land with an alternative estimate prepared by applying the stock-difference method and vice versa

6.5 Sector-specific recalculations, including changes in response of to the review process and impact on emission trend

6.5.1 Recalculations

For information on recalculations please refer to chapter 10.

7 WASTE (CRF SECTOR 5)

This chapter starts with an overview on emission trends in CRF Sector 5 Waste for EU-28 Member States. For each EU-28 key category, overview tables are presented including the Member states contributions to the key category in terms of level and trend.

7.1 Overview of sector

CRF Sector 5 Waste is the fourth largest sector in the EU-28, after energy, agriculture and industrial processes, contributing 3 % to total GHG emissions. Total emissions from waste have been decreasing by 38 % from 244 Mt in 1990 to 152 Mt in 2013 (Figure 7.1). In 2013, emissions decreased by 4.8 % compared to 2012. The key sources in this sector are:

- 5 A 1 Managed Waste disposal on Land (CH_4)
- 5 A 2 Unmanaged Waste Disposal Sites (CH_4)
- 5 B 1 Composting (CH_4)
- 5 B 1 Composting (N_2O)
- 5 D 1 Domestic Wastewater Treatment and Discharge (CH_4)

Figure 7.1 Sector 5 Waste: EU-28 GHG emissions, 1990-2013

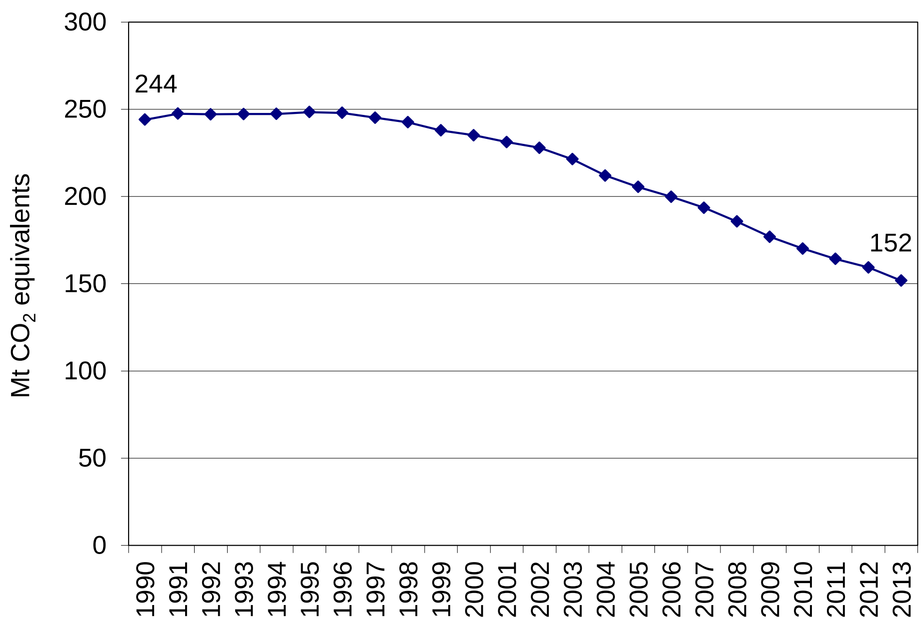
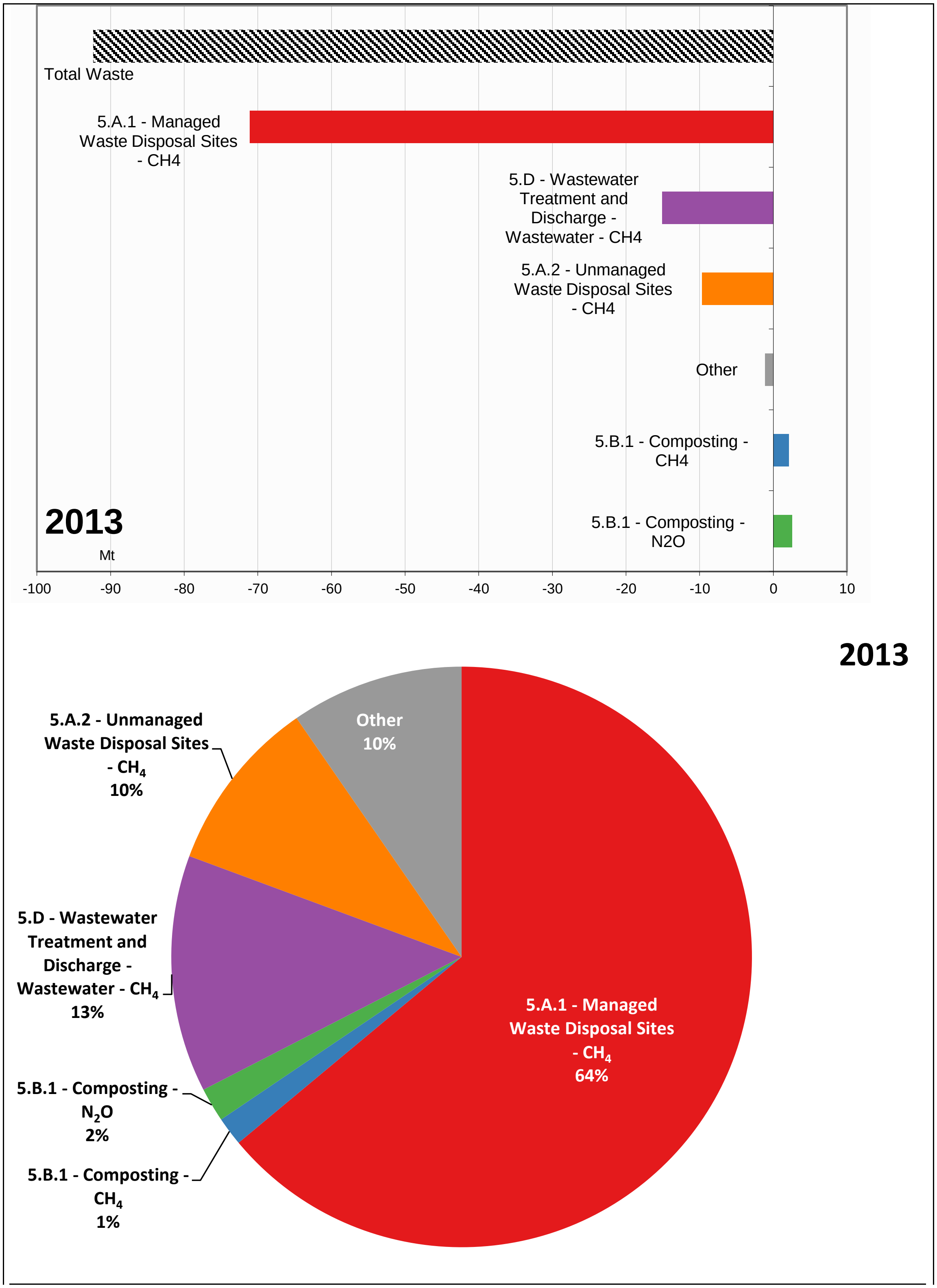


Figure 7.2 shows that CH_4 emissions from 5A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 64 % of waste-related GHG emissions in the EU-28 in 2013.

Figure 7.2 Sector 5 Waste: Absolute change of GHG emissions (in CO_2 equivalents) by large key source categories, 1990–2013, and share of largest key source categories in 2013

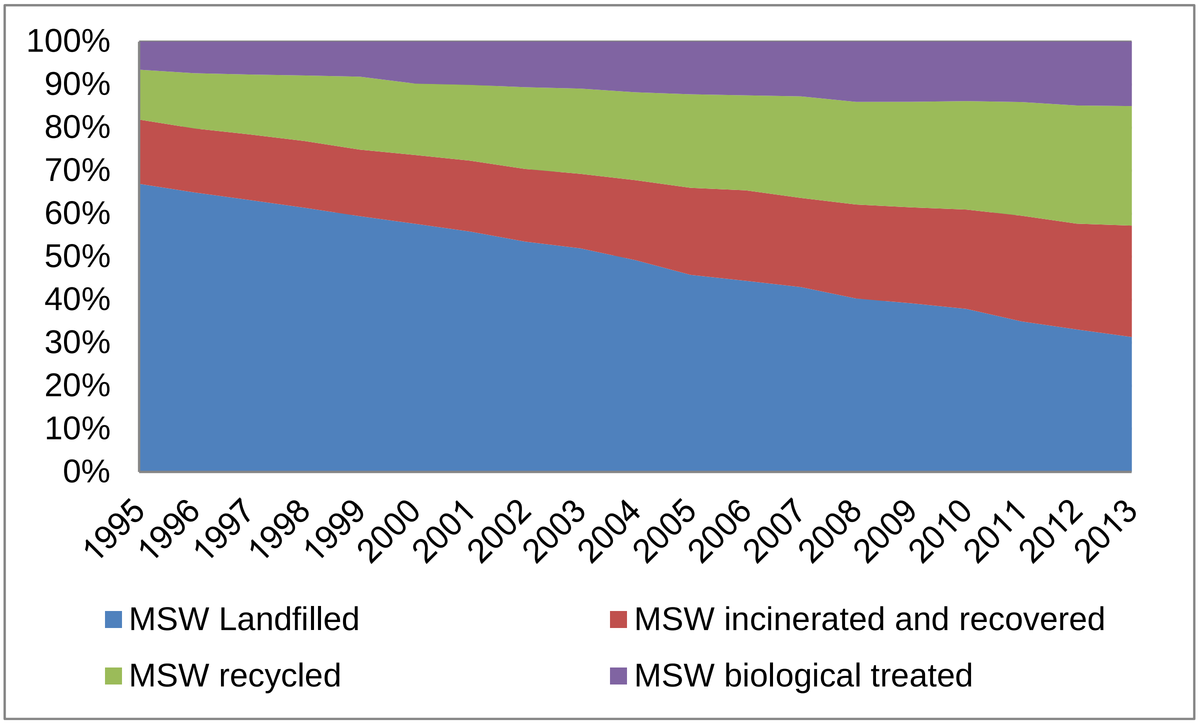


GHG emissions in the waste sector are generated from the treatment and disposal of liquid and solid waste. According to the IPCC 2006 Guidelines emission estimates in the waste sector need to be carried out for four subcategories:

- 5.A Solid waste disposal
- 5.B Biological treatment of solid waste
- 5.C Incineration and open burning
- 5.E Wastewater treatment and discharge.

Of the above, the first three categories mainly refer to possible routes for treatment and disposal of solid waste. Solid waste can be recycled, landfilled, incinerated and biological treated. The decrease of total GHG emissions in the waste sector is mainly driven by the development of the different waste treatment routes. Figure 7.3 shows the share of the waste treatments over the time series 1990 to 2013 based on activity data. The figure is based on Eurostat data as information on waste recycling is also included and there is a common definition for the reporting of waste. 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. While the amount of waste landfilled is continuously decreasing in the EU Member States the share of waste treated with waste treatment methods like recycling or biological treatment of waste increases. In 1990 67 % of waste has been landfilled, 15 % was incinerated, 12 % recycled and only 7 % of the waste has been biologically treated. In 2013 the share of waste landfilled decreased to 31 % of total waste treated while incineration including energy recovery increased to 26 %, recycling increased to 28 % and biological treatment of waste makes up 15 % of total solid waste treated in 2013.

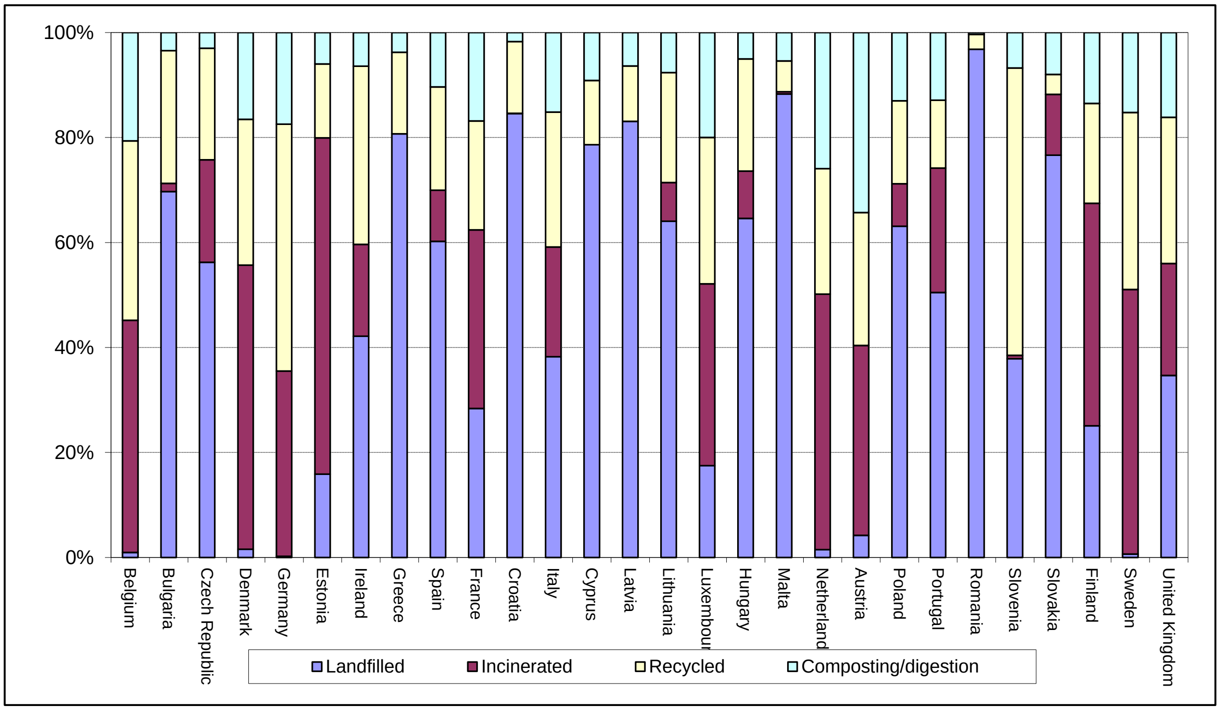
Figure 7.3 Sector 5 Waste: Development of waste treatment in the EU-28



Source: EUROSTAT 2015, own calculation

The share of the single waste treatment routes differs significantly among Member States in 2013, compare Figure 7.4.

Figure 7.4 : Waste management practices in the EU-28 (shares) in 2013



Source: EUROSTAT 2015, 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 with biological treatment differ significantly between the Member States. For example, disposing waste on SWDS is the predominant waste disposal route in Greece, Croatia, Latvia, Malta and Romania with correspondingly fewer quantities of waste incinerated, recycled or with biological treatment. In Belgium, Denmark, Germany, Estonia, Luxemburg, the Netherlands, Austria, Finland and Sweden, (see Figure 7.4) it is vice versa. Since 2005, landfills in Germany remaining in operation may only store waste that conforms to strict categorization 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 (also in Belgium), 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.

7.2 Source categories and methodological issues

This chapter includes information on emission levels and emission trends for all 28 Member States. Additionally information on national methods and circumstances which are available in the member states' national inventory reports will be provided in the next submission. The focus is laid on the reporting categories 5A1 CH_4 emissions from managed solid waste disposal sites and 5A2 CH_4 emissions from unmanaged solid waste disposal sites since they are EU-28 key categories and contribute 2 % and 0.3 % of total GHG emissions, respectively. CH_4 emissions from the reporting category 5D1 Domestic Wastewater Treatment and Discharge are a key source in the EU-28 as well and is also comprehensively analysed. CH_4 and N_2O emissions from composting are a key category in trend changes and therefore also included in the analysis. Emissions from source categories 5B, 5C and 5E are also included.

7.2.1 Solid waste disposal on land (CRF Source Category 5A)

Source category 5A Solid waste disposal on land includes two key sources: CH_4 from 5A1 Managed waste disposal on land and CH_4 from 5A2 Unmanaged waste disposal on land. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 5A1 Managed waste disposal on land includes CH_4 emission arising from managed solid waste landfills. Source category 5A2 comprises corresponding CH_4 emissions from unmanaged landfills. Under 5A3 CH_4 emissions from uncategorized landfills are reported, but only Estonia and Poland report emissions from this category. As this is no EU key category no further information on 5A3 is included in the following chapters.

The EU-28 reports CH_4 emissions from managed solid waste landfills in source category 5A1. The methane recovery that takes place in those managed solid waste landfills is also reported in CRF-table 5A but those amounts are not included in the reported CH_4-emissions, as prescribed by the IPCC guidelines. In the unmanaged solid waste landfills, no CH_4-recovery is taken place. Only Ireland and Latvia report CH_4 recovery from unmanaged landfills for a few years in the time series, as there were no managed landfills in Ireland at this time.

Table 7.1 provides total greenhouse gas and CH_4 emissions by Member state from 5A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 42 % between 1990 and 2013 in the EU-28. Fifteen EU-28 Member states reduced their emissions from this source, while Croatia, Cyprus, the Czech Republic, Estonia, France, Greece, Hungary, Latvia, Malta, Portugal, Romania, Slovakia and Spain did not.

Table 7.1 5A Solid Waste Disposal on Land: Member states' contributions to total GHG emissions and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	3 946	1 333	3 946	1 333
Belgium	3 053	1 141	3 053	1 141
Bulgaria	3 960	3 516	3 960	3 516
Croatia	289	947	289	947
Cyprus	0	475	IE,NO	475
Czech Republic	1 979	3 324	1 979	3 324
Denmark	1 774	844	1 774	844
Estonia	214	243	214	243
Finland	4 328	1 952	4 328	1 952
France	12 679	14 705	12 679	14 705
Germany	33 525	9 850	33 525	9 850
Greece	2 244	3 104	2 244	3 104
Hungary	2 840	3 347	2 840	3 347
Ireland	1 396	1 106	1 396	1 106
Italy	18 158	13 872	18 158	13 872
Latvia	393	533	393	533
Lithuania	1 029	900	1 029	900
Luxembourg	80	31	80	31
Malta	17	42	17	42
Netherlands	14 299	3 383	14 299	3 383
Poland	10 366	8 547	10 366	8 547
Portugal	2 728	4 004	2 728	4 004
Romania	1 372	3 307	1 372	3 307
Slovakia	670	1 033	670	1 033
Slovenia	433	366	433	366
Spain	6 057	13 336	6 057	13 336
Sweden	3 422	1 193	3 422	1 193
United Kingdom	62 479	16 499	62 479	16 499
EU-28	**193 728**	**112 932**	**193 728**	**112 932**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.1.1 Managed waste disposal sites (CRF Source Category 5A1)

Emissions and trends

Table 7.2 provides information on emission trends of the key source CH_4 from 5A1 Managed Waste Disposal on Land by Member state. CH_4 emissions from this source account for 2 % of total EU-28 GHG emissions. Between 1990 and 2013, CH_4 emissions from managed landfills declined by 42 % in the EU-

28. Twelve EU-28 Member states reduced their emissions from this source during that period, Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, France, Greece, Hungary, Ireland, Italy, Latvia, Malta, Portugal, Romania, Slovakia and Spain did not or reported no emissions from managed landfills in 1990. In 2013, CH_4 emissions from managed landfills decreased by 7 % compared to 2012. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. According to the CRF Tables submitted in 2015 total municipal waste disposal on managed landfills declined by 55 % between 1990 and 2013. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilized or flared. The share of CH_4 recovery has increased significantly in EU-28 since 1990 (see Figure 7.7).

The Member States with most emissions from this source in 2013 were the United Kingdom, Germany, Spain, Italy and France. These MS account for 68 % of EU-28 emissions in 2013. The largest reductions in absolute terms between 1990 and 2013 were reported by Germany and the United Kingdom. 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 7.2 *5A1 Managed Waste Disposal on Land: Member states' contributions to CH_4 emissions and information on method applied and emission factor*

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	3 946	1 430	1 333	1%	-97	-7%	-2 613	-66%	NA	NA
Belgium	3 053	1 259	1 141	1%	-119	-9%	-1 913	-63%	T2	D
Bulgaria	NO	676	702	1%	26	4%	702	100%	NA	NA
Croatia	14	656	701	1%	45	7%	687	4802%	T2	CS
Cyprus	NO	475	475	0%	0	0%	475	100%	NA	NA
Czech Republic	1 979	3 298	3 324	3%	27	1%	1 345	68%	T1	CS,D
Denmark	1 774	879	844	1%	-35	-4%	-930	-52%	T2	CS,D
Estonia	NO	281	243	0%	-38	-14%	243	100%	NA	NA
Finland	4 328	2 068	1 952	2%	-116	-6%	-2 376	-55%	T2	CS,D
France	12 679	15 286	14 705	15%	-581	-4%	2 026	16%	-	-
Germany	33 525	10 575	9 850	10%	-725	-7%	-23 675	-71%	T2	CS
Greece	81	1 248	1 357	1%	108	9%	1 276	1578%	T2	CS,D
Hungary	2 840	3 545	3 347	3%	-198	-6%	507	18%	T2	D
Ireland	NO	788	959	1%	171	22%	959	100%	NA	NA
Italy	11 974	14 194	12 268	13%	-1 925	-14%	294	2%	T2	CS
Latvia	NO	171	187	0%	15	9%	187	100%	NA	NA
Lithuania	879	854	806	1%	-48	-6%	-73	-8%	T2	D
Luxembourg	80	31	31	0%	0	-1%	-49	-62%	T2	D
Malta	NO	23	5	0%	-18	-77%	5	100%	NA	NA
Netherlands	14 299	3 570	3 383	3%	-187	-5%	-10 915	-76%	T2	CS
Poland	4 614	4 358	4 466	5%	108	2%	-148	-3%	T2	D
Portugal	722	3 171	3 003	3%	-168	-5%	2 281	316%	T2	CS,D
Romania	NO,NE	774	965	1%	191	25%	965	100%	NA	NA
Slovakia	NO	584	622	1%	38	6%	622	100%	NA	NA
Slovenia	433	393	366	0%	-26	-7%	-67	-15%	T1	CS,D
Spain	5 003	12 307	12 307	13%	0	0%	7 304	146%	T2	CS,D,OTH
Sweden	3 422	1 303	1 193	1%	-110	-8%	-2 229	-65%	NA	NA
United Kingdom	62 479	20 274	16 499	17%	-3 776	-19%	-45 980	-74%	T2	CS
EU-28	**168 123**	**104 469**	**97 032**	**100%**	**-7 438**	**-7%**	**-71 092**	**-42%**		

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) (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.

Figure 7.5 provides an overview of the relevant trends of the most important Member States.

CH_4 emissions in Spain increased almost continuously from 1990 and 2009 due to a growth of the annual municipal solid waste going to solid waste disposal sites. Key drivers are a growing population and the shift of waste disposal from unmanaged to managed landfills. CH_4 recovery and flaring of CH_4 has already been practiced in earlier years of the time series 1990-2013. Very high amounts of CH_4 recovery could be found from 2006-2008, while in the most recent years CH_4 recovery was declining again.

Portugal, contributing with 3 % to EU-28 emissions in 2013, showed an increasing trend of CH_4 emissions from solid waste disposal on managed landfills until 2011. Key drivers for this trend have been increased waste generation due to population growth and urbanization. Since 2004 the share of CH_4 recovery and flaring constantly increased and from 2012 onwards Portugal managed to slow down the increasing trend of CH_4 emissions from managed landfills.

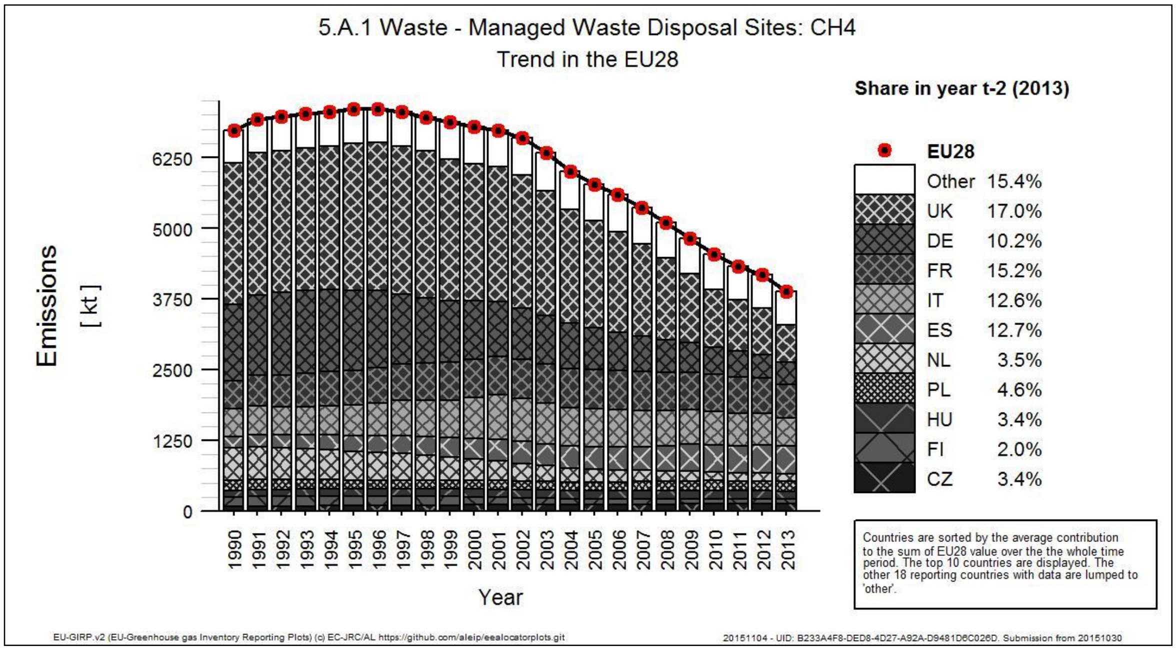
France, contributing with 15 % to EU-28 emissions in 2013 increased its emissions from managed solid waste disposal sites steadily until 2003; followed by rather stable emissions until 2008 and a slight decrease thereafter. Emissions followed the increased amount of municipal waste going to landfills until 2000, which decreased afterwards. Small amounts of CH_4 have been flared and recovered already in 1990, while very high amounts of CH_4 recovery could be found from 2009 onwards.

The UK has the highest share of CH_4 emissions from managed landfills among Member States with 17 % in 2013. From 1996 onwards CH_4 emission decreased continuously due to a reduction of the amount of waste landfilled and also due to very high amounts of CH_4 recovery from 2003 onwards.

Italy, contributing with 13 % to EU-15 emissions in 2013, 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 landfilled until 2000 and a decrease thereafter. Also, CH_4 recovery has increased throughout the time series. The key drivers for the fall in emissions are the national policy diverting solid waste from landfill to waste incineration plants and waste diversion measures. Composting and mechanical and biological treatment have shown a remarkable rise due to the enforcement of legislation.

Germany, contributing with 10 % to EU-28 emissions in 2013, managed to reduce CH_4 emissions steadily until now from 1995 onwards. The amount of waste disposed on landfills shows a strong decrease from 1990 onwards, while in parallel CH_4 recovery increased. The highest share of CH_4 recovery could be found in 2002 and declined thereafter due to a decreasing amount of waste landfilled.

Figure 7.5 5A1 Managed waste disposal on land: CH_4 emissions (Trend in relevant MS)

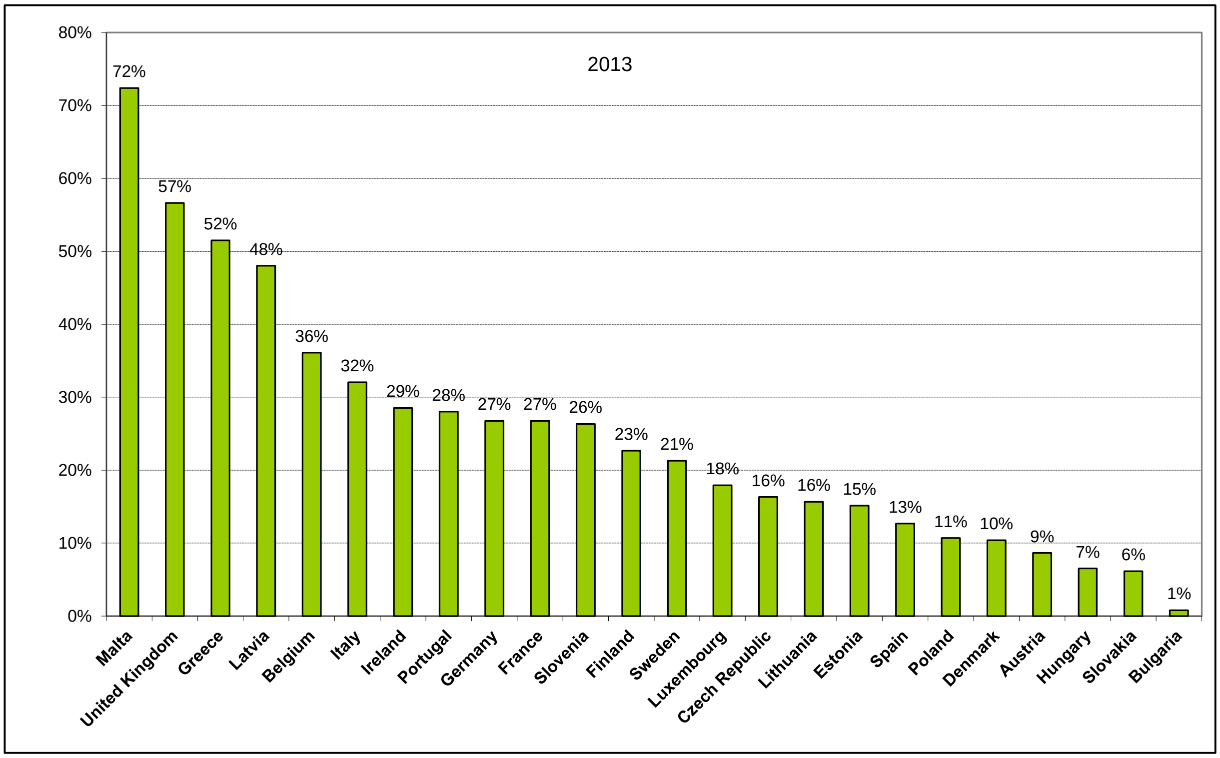


Methane recovery

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.

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, in Figure 7.6, varies among the member states between 1 % in Bulgaria and 72 % in Malta and depends - amongst other - on the share of solid waste disposal sites where flaring or recovery installations exist. In Malta methane recovery from managed sites increased drastically through the implementation of gas recovery at ghallies. Since Ghallies is the major active managed landfill in operation locally, gas recovery from this one landfill has a very high effect on the % methane recovered. Croatia, Cyprus, the Netherlands and Romania do not report any CH_4 recovery, but Croatia and Romania report flaring of CH_4 in their CRF tables.

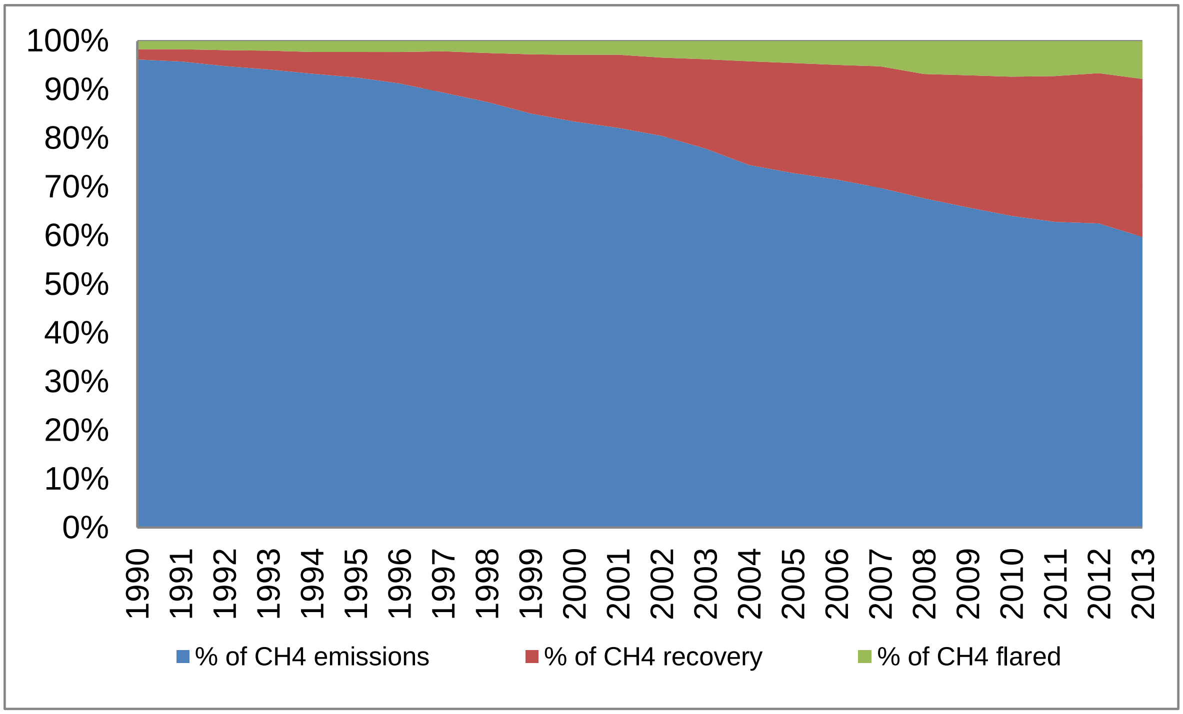
Figure 7.6 5A1 Managed Solid Waste Disposal: Methane recovery rates for 2013



CH_4 recovery in % = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 flared + CH_4 emissions 5A1 in Gg)
CH_4 emissions from 5A2 unmanaged landfills are not included in this calculation
Source: CRF 2015 Table 5A

Compared to 2012 the methane recovery in 2013 increased for eleven member states, out of which for two with a significant absolute increase (Italy and France). In 12 Member States the amount of CH_4 recovery decreased in comparison to 2012.

Figure 7.7 *5A1 Managed Solid Waste Disposal: Development of the share of methane recovery, methane flared and CH_4 emissionson total CH_4 produced in managed landfills in the EU 28*



CH_4 recovery in EU-28 increased from 2 % of total CH_4 emissions from managed landfills in 1990 to 32% of generated CH_4 from managed SWDS (only 5A1) in 2013. 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. Compared to 2012, CH_4 recovery of generated CH_4 for the EU-28 increased by 2.2% in 2013.

Moreover, Member States use different methods to determine CH_4 recovery. Several member states combine different methods and sources to estimate the amounts of CH_4 recovered for flaring of energy purposes, some member states are using only one method. Data on landfill gas recovery can be based on measured plant specific data, questionnaires and survey or can be taken from the energy statistics.

Methodological issues

For key sources in the source category 5A it is good practice to use the First Order Decay (FOD) method to calculate the emissions and to display emissions trends over time. According to Table 7.2 the Czech Republic and Slovenia apply a Tier 1 method to estimate CH_4 emissions from solid waste disposal on managed landfills. Giving the IPCC 2006 Guidelines for National Greenhouse Gas Inventories a First Order Decay (FOD) method that accounts for the fact that the degradable organic components decay slowly over decades has to be applied for all Tier levels. The Tier 1 method applies mainly default parameters and default activity data. The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. Historical waste disposal data for 10 years or more should be based on country-specific statistics, surveys or other similar sources. In the following, a short overview of the most important parameters and methodological aspects of the FOD method 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.

Municipal Waste landfilled

The amount of waste disposed on SWDS depends on the total amount of waste generated and on the per capita waste generation rate, respectively. The total amount of waste disposed can be calculated by using total population numbers, waste generation rate per capita and the share of waste disposed. However, in many EU Member States solid waste disposal is not estimated based on the per capita waste generation rate and a share of waste landfilled, but on direct measurements. The restructured CRF tables contain only data on the total amount of annual waste disposed at the solid waste disposal sites in kt.

The FOD method requires historic data on waste generation and the share of waste landfilled 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 will be summarized in the Annex in the next submission.

Industrial waste

Data on industrial waste may be difficult to obtain in many countries, as there are only very few default values available. Only industrial waste that contains organic or fossil carbon fractions needs to be included in the inventory. Further information on the reporting of industrial waste by the Member States will be summarized in the Annex in the next submission.

Waste composition

The amount of methane generated on SWDS depends strongly on the waste composition. Disposing waste with no or hardly degradable carbon (e.g. metal or plastics) does not contribute to CH_4 emissions, but the disposal of paper or food waste with large degradable organic carbon fractions leads to high CH_4 emissions. The composition of the waste landfilled is strongly influenced by waste management practices, such as recycling or composting. Country specific information on waste composition will be provided in the Annex in the next submission.

Emission factors and parameters

Besides information on the amount of waste landfilled and the waste composition further parameters are relevant for the calculation of CH_4 emissions from waste disposal. The fraction of dissolved organic carbon (DOC) dissimilated in the individual waste fractions and the methane generation rate constant that reflects the years which the degradable organic carbon needs to decompose are the most relevant parameters for calculating CH_4 emissions. Further parameters included in the calculation are the methane correction factor (MCF), the fraction of DOC that decomposes the fraction of CH_4 in generated landfill gas, methane recovery rate and the oxidation factor.

Fraction of Dissolved Organic Carbon (DOC) in MSW: There are default IPCC values for DOC of the different waste fractions available (paper, food waste etc.). Some countries have conducted own chemical analysis on the DOC value of different waste fractions. The DOC content of total 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. If large amounts of organic waste is composted and waste is pretreated before disposed on landfills the average DOC is very low, even if still a high amount of waste is disposed. As waste composition varies over time and single DOC values are used for individual waste fractions the DOC-values also vary over time. 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 5A 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.

The restructured CRF tables do not include information on the average DOC anymore. Within the next submission a table in the Annex will be provided that contains corresponding detailed information on the DOC values extracted from the NIR.

Methane generation rate constant: CH_4 is emitted on SWDS over a long period of time rather than instantaneously. The FOD model can be used to model landfill gas generation rate curves for individual landfills 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. The restructured CRF tables do not include information on the methane generation rate constant anymore. Within the next submission a table in the Annex will be provided that contains corresponding detailed information on the methane generation rate constant extracted from the NIR.

7.2.1.2 Unmanaged waste disposal sites (CRF Source Category 5A2)

Emissions and Trends

CH_4 emissions from 5A2 Unmanaged Waste Disposal on Land account for 0.3 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CH_4 emissions from this source decreased by 40 % (Table 7.3). 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. Only Romania showed an increase of CH_4 emissions from unmanaged landfills until 2012, while from 2012 between 2012 and 2013 CH_4 emissions decreased by 3 %.

Not all member states reported emissions from this source since all waste disposal sites in the countries are managed (Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Luxembourg, the Netherlands, Slovenia, Sweden and the United Kingdom) or they are included elsewhere (Cyprus, Hungary). Bulgaria, Greece, Italy, Poland and Romania are responsible for about 78 % of the total EU-28 emissions from unmanaged waste disposal sites. Italy and Poland show large absolute reductions between 1990 and 2013. In these two countries, waste is not disposed on unmanaged landfill sites any more (in Italy since 2000, in Poland since 2012). In Romania solid waste disposal on unmanaged landfills is still practiced, but the amount of waste disposed is considerably decreasing since 2000. While in the year 2000 more than 6,000 kt have been disposed on unmanaged landfills only 769 kt were disposed in 2013 (see *Figure **7.8***). 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 is 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.

Poland's CH_4 emissions from the disposal of solid waste on unmanaged landfills are decreasing from 2001 onwards. Key drivers for this decrease are the implementation of the landfill directive 1999/31/EC and the introduction of new waste treatment technologies that reduce the amount of waste disposed on unmanaged landfills.

Table 7.3 shows that 100 % of the EU-28 emissions are estimated using higher tier methodologies.

Table 7.3 5A2 Unmanaged Waste Disposal on Land: Member states' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	3 960	2 925	2 813	19%	-112	-4%	-1 146	-29%	T2	CS,D
Croatia	275	282	246	2%	-35	-13%	-28	-10%	T2	CS
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	IE	NO	NO	-	-	-	-	-	NA	NA
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	2 163	1 813	1 748	12%	-65	-4%	-415	-19%	T2	CS,D
Hungary	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	1 396	158	147	1%	-10	-7%	-1 249	-89%	T2	CS,D
Italy	6 184	1 683	1 604	11%	-79	-5%	-4 580	-74%	T2	CS
Latvia	393	363	346	2%	-16	-5%	-47	-12%	T2	CS,D
Lithuania	150	103	95	1%	-8	-8%	-55	-37%	T2	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	17	37	36	0%	0	-1%	20	118%	M	M
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4 806	3 187	2 943	20%	-244	-8%	-1 863	-39%	T2	D
Portugal	2 007	1 074	1 002	7%	-73	-7%	-1 005	-50%	-	-
Romania	1 372	2 405	2 343	16%	-63	-3%	971	71%	T2	CS,D
Slovakia	670	436	411	3%	-25	-6%	-259	-39%	T2	CS,D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 054	1 081	1 029	7%	-52	-5%	-25	-2%	T2	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**24 444**	**15 545**	**14 763**	**100%**	**-782**	**-5%**	**-9 682**	**-40%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure ***7.8*** shows the relevant trends for the amount of waste disposed on unmanaged landfills, where the highest reductions in waste disposal between 1990 and 2013 are find for Italy and Poland. *Figure* ***7.9*** shows that even if the amount of waste disposal (*Figure* ***7.8***) is rather drastic CH_4 emissions from unmanaged landfills show only a moderate decrease during the time series.

Figure 7.8 5A2 Waste disposal on unmanaged landfills: Total waste disposed on unmanaged landfills (Trend in relevant MS)

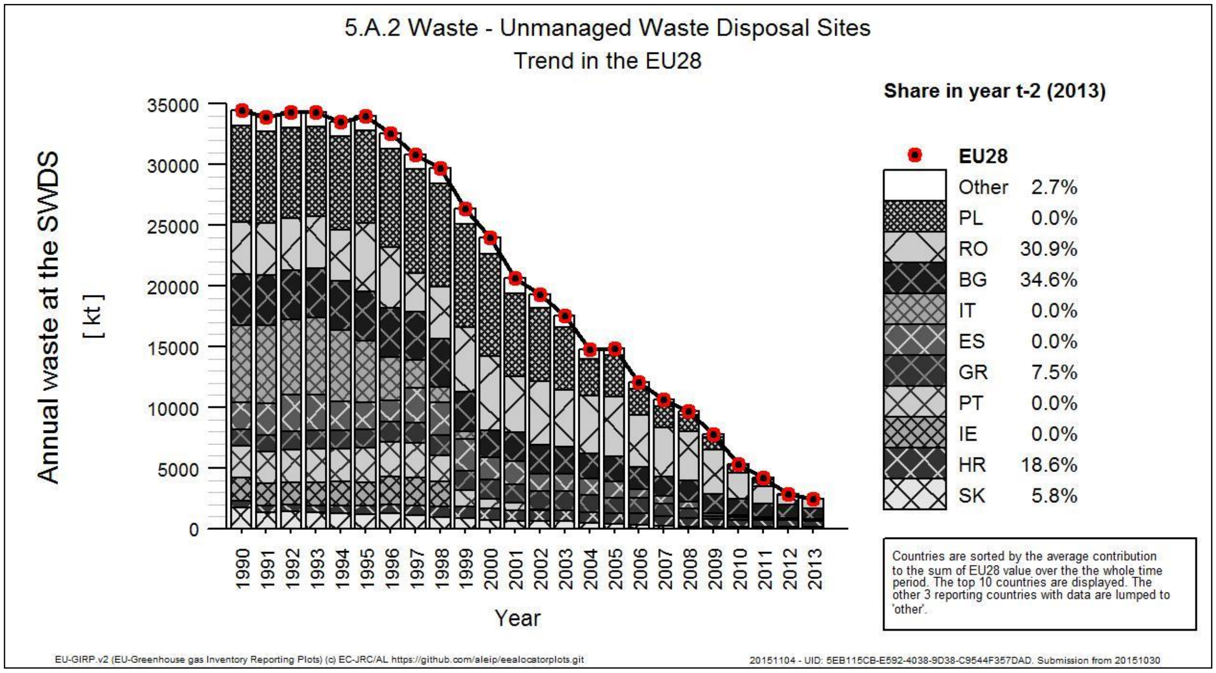
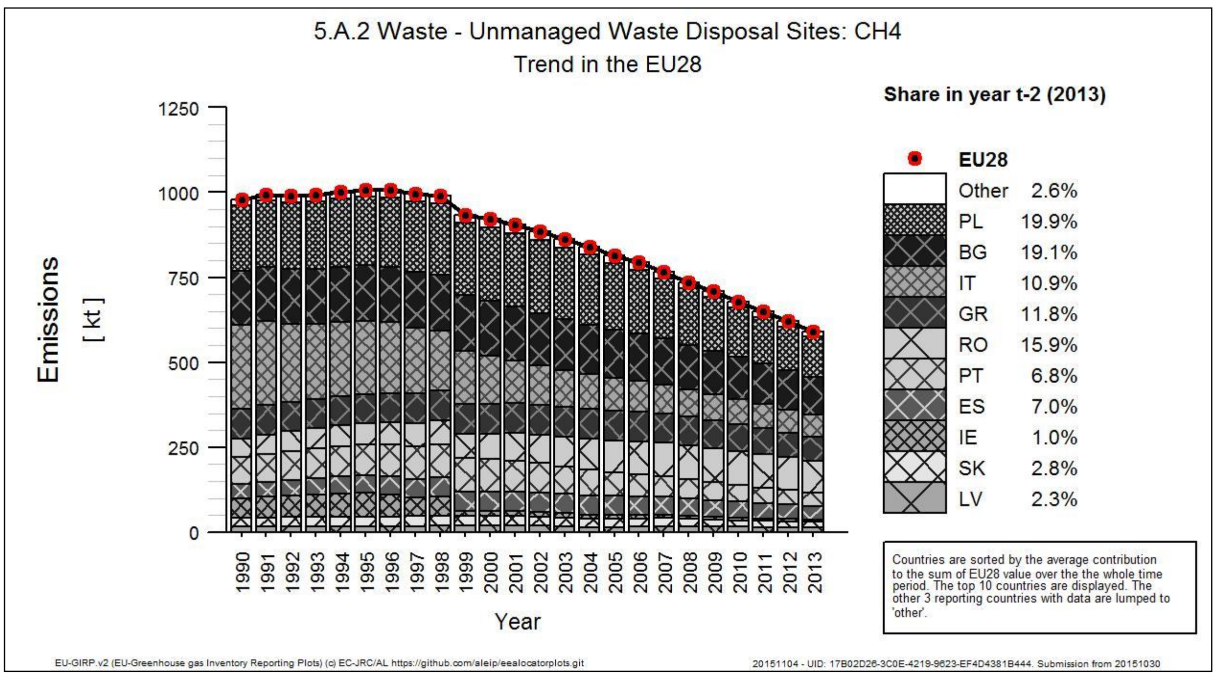


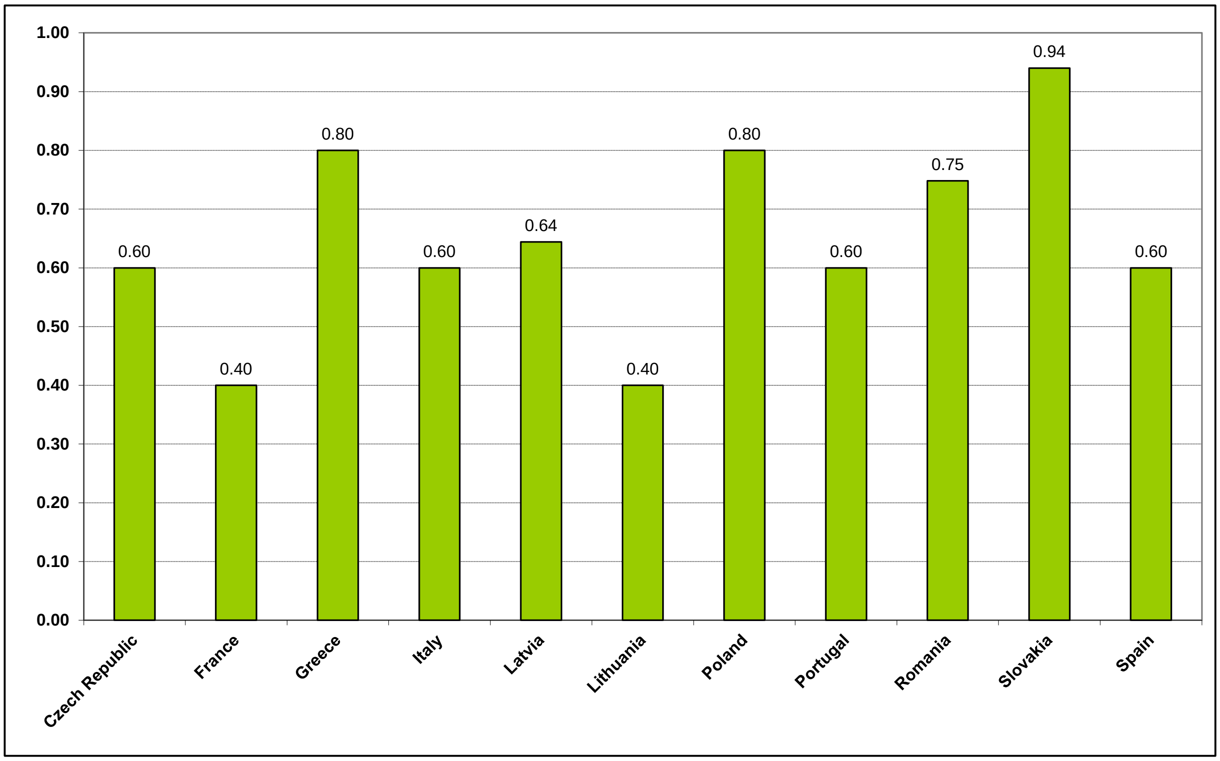
Figure 7.9 5A2 Waste disposal on unmanaged landfills: CH_4 emissions (Trend in relevant MS)



Methodological issues

CH_4 emissions from unmanaged solid waste disposal were reported in thirteen member states in 2013 (Bulgaria, Croatia, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Spain). Only six of these Member States (Bulgaria, Croatia, Greece, Lithuania, Romania and Slovakia) still dispose MSW to unmanaged SWDS, although in small quantities, while in all other countries waste disposals from the past still emits (see Table 7.3). 100% of all EU-28 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 2006 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow or deep. The IPCC default MCF for deep landfills is 0.8, while shallow landfills have an MCF of only 0.4 as in shallow landfills more waste decomposes aerobically. *Figure **7.10*** shows the different MCFs used by countries to estimate CH_4 emissions from waste disposal on unmanaged landfills in 2013.

Figure 7.10 5A2 Waste disposal on unmanaged landfills: MCFs applied by countries in 2013



Source: CRF Table 5.A 2015

7.2.1.3 Recalculations (CRF Source Category 5A)

For information on recalculations please refer to chapter 10.

7.2.2 Biological treatment of solid waste (CRF Source Category 5B)

Source category 5B Biological treatment of solid waste includes the key sources: CH_4 and N_2O from 5B1 Composting. Besides composting the source category 5B includes the subcategory 5B2 anaerobic digestion and also emissions from mechanical-biological treatment according to the IPCC 2006 Guidelines. Decomposition of biomass during biological treatment is much faster than on landfills and the CH_4 and N_2O emissions are estimated on an annual basis without the need for long time series as in the case of landfills. Whereas for composting the decomposition of the organic waste fraction takes place under aerobic conditions, under anaerobic digestion the decomposition takes place without oxygen. Further information on emission trends and methodologies is only provided for source category composting 5B1, as anaerobic digestion 5B2 is no EU key source.

Table 7.4 provides total GHG and CH_4 and N_2O emissions by Member State from 5B Biological treatment of solid waste. Total emissions from this category increased considerably between 1990. Eleven countries (Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Ireland, Latvia, Luxembourg, Malta, Romania and Slovenia) did not practice this kind of waste treatment in 1990. Due to landfill regulations etc. this type of waste treatment increases considerably during the last years and only Malta and Romania do not report emissions from this category.

Table 7.4 5B Biological treatment of solid waste: Member States' contributions to total GHG emissions and CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	36	164	23	102	13	63
Belgium	7	64	4	39	3	26
Bulgaria	0	20	NO	10	NO	11
Croatia	0	8	IE,NE,NA	4	IE,NE	5
Cyprus	0	0	NO	0	NO	0
Czech Republic	0	585	IE,NO	40	IE,NO	545
Denmark	47	249	12	123	35	126
Estonia	1	34	1	16	1	18
Finland	45	129	20	55	26	74
France	87	718	57	470	30	248
Germany	41	1 055	16	318	25	738
Greece	0	38	NO	18	NO	20
Hungary	9	156	4	30	5	126
Ireland	0	25	NO	12	NO	13
Italy	19	507	17	442	2	66
Latvia	0	3	NO,NE	1	NO,NE	1
Lithuania	8	23	4	11	4	12
Luxembourg	0	14	NE,NO	6	NE,NO	8
Malta	0	0	NO	NO,NA	NO	NO
Netherlands	20	159	7	83	14	76
Poland	9	260	4	123	5	137
Portugal	21	38	10	16	11	22
Romania	0	0	NO	NO	NO	NO
Slovakia	123	142	58	67	65	75
Slovenia	0	9	NO	4	NO	5
Spain	146	865	69	399	77	466
Sweden	13	126	6	47	7	79
United Kingdom	10	1 319	5	606	5	713
EU-28	**643**	**6 712**	**316**	**3 041**	**327**	**3 671**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.2.1 Composting (CRF Source Category 5B1)

Emission and Trends

CH_4 emissions from 5B1 Composting account for 0.05 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CH_4 emissions from this source increased considerably from 323 kt CO_2 equivalents to 2327 kt CO_2 equivalents in 2013 (Table 7.5). All Member States that practice composting feature an increasing emission trend from 1990 onwards. Nevertheless between 2012 and 2013 eleven Member States experienced a decrease in CH_4 emissions from composting due to a decreasing amount of waste composted.

Table 7.5 5B1 Composting: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	13	64	63	3%	-2	-2%	50	381%
Belgium	3	29	26	1%	-3	-11%	23	886%
Bulgaria	NO	8	11	0%	3	31%	11	100%
Croatia	IE,NE	IE,NE	4	0%	4	100%	4	100%
Cyprus	NO	0	0	0%	0	-14%	0	100%
Czech Republic	NO	54	45	2%	-9	-16%	45	100%
Denmark	35	89	126	5%	37	41%	91	263%
Estonia	1	15	18	1%	3	21%	17	2555%
Finland	26	69	68	3%	-1	-1%	42	165%
France	28	194	205	8%	11	6%	177	639%
Germany	25	311	311	13%	0	0%	286	1127%
Greece	NO	20	20	1%	0	0%	20	100%
Hungary	5	41	42	2%	1	3%	37	741%
Ireland	NO	13	13	1%	0	1%	13	100%
Italy	0	5	5	0%	0	4%	5	2510%
Latvia	NE,NO	2	1	0%	0	-18%	1	100%
Lithuania	4	10	12	1%	3	27%	8	202%
Luxembourg	NO	8	8	0%	-1	-6%	8	100%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	14	79	76	3%	-2	-3%	63	458%
Poland	5	106	137	6%	31	29%	132	2707%
Portugal	11	16	18	1%	2	11%	7	58%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	65	85	75	3%	-10	-12%	10	16%
Slovenia	NO	5	5	0%	0	-3%	5	100%
Spain	77	447	447	18%	0	0%	370	481%
Sweden	7	56	53	2%	-3	-5%	46	645%
United Kingdom	5	603	635	26%	32	5%	630	11492%
EU-28	**323**	**2 327**	**2 423**	**100%**	**97**	**4%**	**2 100**	**650%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 5B1 Composting account for 0.06 % of total EU-28 GHG emissions in 2013. Between 1990 and 2013, CH_4 emissions from this source increased considerably from 316 kt CO_2 equivalents to 2772 kt CO_2 equivalents in 2013 (Table 7.6).

Table 7.6 5B1 Composting: Member states' contributions to N_2O emissions

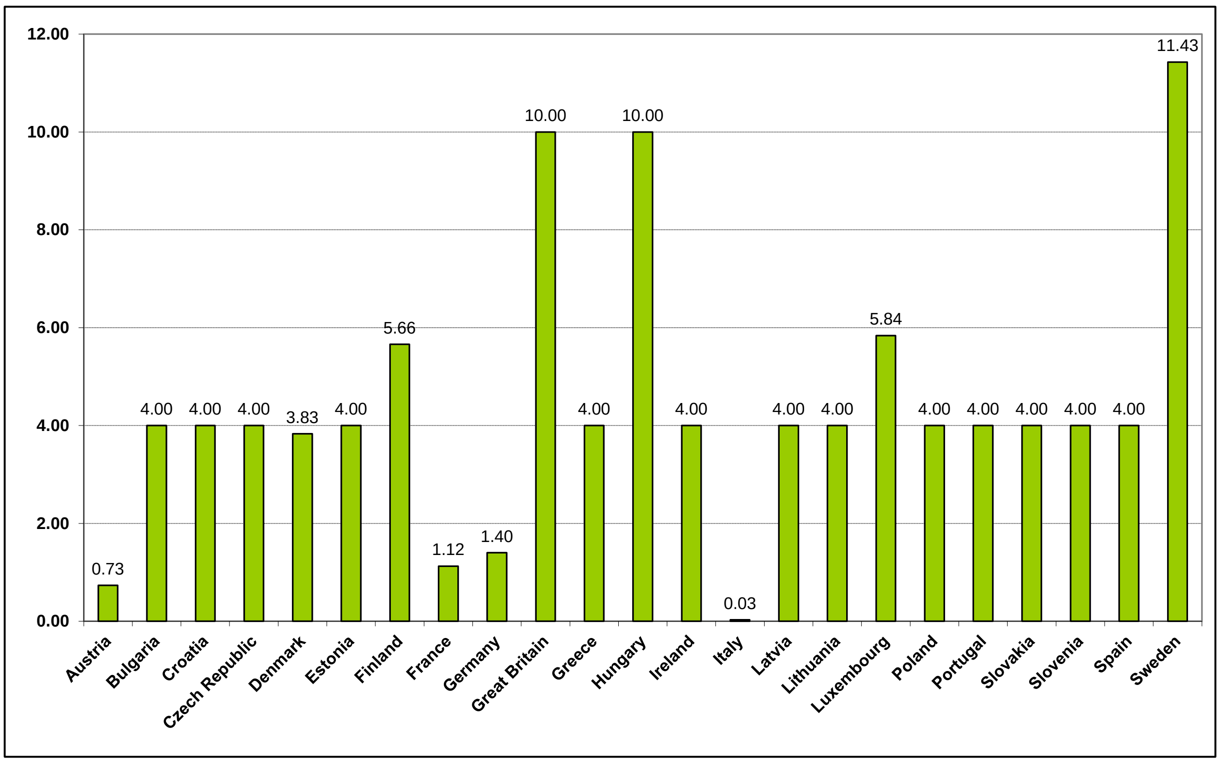
Member State	N2O emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013	
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	23	105	102	4%	-3	-3%	79	347%
Belgium	4	44	39	1%	-5	-11%	35	886%
Bulgaria	NO	7	10	0%	2	31%	10	100%
Croatia	IE,NE	IE,NE	4	0%	4	100%	4	100%
Cyprus	NO	0	0	0%	0	-14%	0	100%
Czech Republic	NO	48	40	1%	-8	-16%	40	100%
Denmark	12	87	123	4%	36	41%	111	898%
Estonia	1	13	16	1%	3	21%	15	2555%
Finland	20	55	55	2%	-1	-1%	35	179%
France	57	450	470	16%	20	4%	412	719%
Germany	16	196	196	7%	0	0%	180	1127%
Greece	NO	18	18	1%	0	0%	18	100%
Hungary	4	29	30	1%	1	3%	26	741%
Ireland	NO	12	12	0%	0	1%	12	100%
Italy	17	426	442	15%	15	4%	425	2510%
Latvia	NE,NO	2	1	0%	0	-18%	1	100%
Lithuania	4	9	11	0%	2	27%	7	202%
Luxembourg	NO	7	6	0%	0	-6%	6	100%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	7	87	83	3%	-3	-4%	77	1175%
Poland	4	95	123	4%	28	29%	118	2707%
Portugal	10	14	16	1%	2	11%	6	58%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	58	76	67	2%	-9	-12%	9	16%
Slovenia	NO	4	4	0%	0	-3%	4	100%
Spain	69	399	399	14%	0	0%	331	481%
Sweden	6	50	47	2%	-3	-5%	41	645%
United Kingdom	5	539	568	20%	29	5%	563	11492%
EU-28	**316**	**2 772**	**2 882**	**100%**	**110**	**4%**	**2 566**	**813%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Methodological information

According to the IPCC 2006 Guidelines CH_4 and N_2O emissions from composting are estimated by using the quantity of organic waste processed by composting and the respective emission factor. The application of a Tier 2 method requires the use of a country specific emission factor based on representative measurements. The IPCC default emission factor for CH_4 emissions from composting is 10 g CH_4/kg waste treated on a dry weight basis and 4 g CH_4/kg based on a wet weight basis. The range of this emission factor is very high and varies between 0.08 and 20 g CH_4/kg waste treated. Reported EFs by Member States show also large variation ranging from 0.03 for Italy to 11.4 in Sweden. Most countries applied the default EF for CH_4 emissions based on a wet weight basis. Italy uses a country specific EF for CH_4 emissions from composting that is based on literature data and refers to national experimental measurements and assumes that CH_4 emissions are almost zero if the facility is well operating.

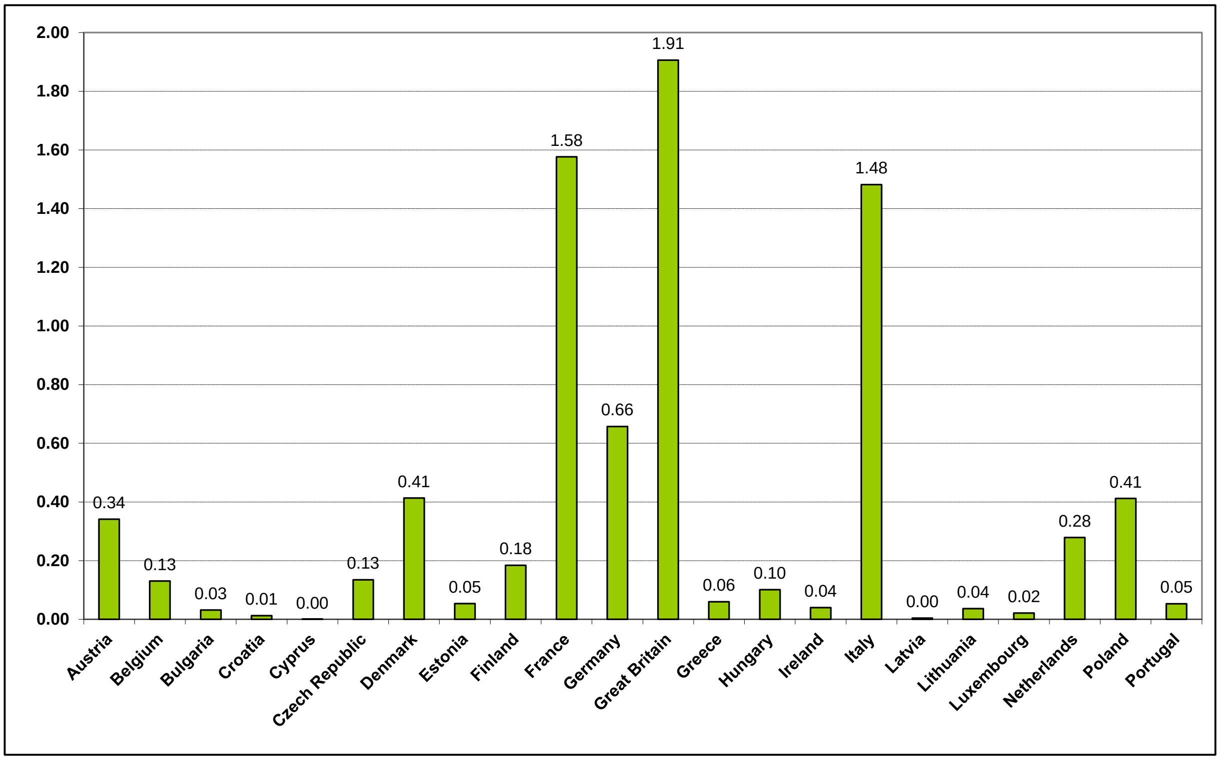
Figure 7.11 5B1 Composting: EFs applied by Member States in 2013 in g CH_4/kg waste treated



Source: CRF Table 5.B 2015

The IPCC default emission factor for N_2O emissions from composting is 0.6 g N_2O/kg waste treated on a dry weight basis and 0.3 g N_2O/kg based on a wet weight basis. The range of this emission factor is very high and is between 0.2 and 1.6 g N_2O/kg for dry waste treated and 0.06 and 0.6 g N_2O/kg for wet waste. Reported EFs by Member States show also large variation ranging from 0.000015 for Cyprus to 1.91 in UK.

Figure 7.12 5B1 Composting: EFs applied by Member States in 2013 in g N_2O/kg waste treated



Source: CRF Table 5.B 2015

7.2.2.2 Recalculations (CRF Source Category 5B)

For information on recalculations please refer to chapter 10.

7.2.3 Incineration and open burning of waste (CRF Source Category 5.C)

This category includes incineration of waste and open burning. Emissions from waste incinerated for energy use are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 3 Agriculture.

Table 7.7 gives an overview of greenhouse gas emissions from waste incineration and open burning by member state. Total emissions from (non-biogenic) waste incineration and open burning, including CO_2, N_2O and CH_4 emissions account for 0.08 % of total EU-28 GHG emissions. Total emissions decreased by 36 % between 1990 and 2013. Most member states decreased their emissions from waste incineration and open burning between 1990 and 2013, except for Belgium, Bulgaria, Czech Republic, Greece, Hungary, Malta, Poland, Portugal, Romania, Slovenia and Sweden. The United Kingdom, France, Italy and Spain feature the largest decreases in absolute terms; these Member States account for 59 % of emissions from this source in 2013.

Table 7.7 5C Incineration and open burning of waste: Member States' contributions to total GHG emissions and CO_2, CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	27	2	27	2	0	0	0	0
Belgium	290	311	287	310	3	1	NO,NA	NO,NA
Bulgaria	21	42	20	39	2	3	0	0
Croatia	1	0	1	0	0	NA,NO	NA,NO	NA,NO
Cyprus	0	0	NO	NO	NO	NO	NO	NO
Czech Republic	24	179	23	176	0	3	0	0
Denmark	0	0	NO	NO	0	0	0	0
Estonia	3	1	1	0	0	0	1	0
Finland	0	0	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE
France	2 243	1 599	2 129	1 521	91	49	22	29
Germany	0	0	NO	NO	NA,NO	NA,NO	NA,NO	NA,NO
Greece	0	4	0	3	0	1	0	0
Hungary	122	200	121	197	1	2	0	0
Ireland	92	44	91	43	1	0	1	0
Italy	594	272	507	194	37	23	50	55
Latvia	6	5	1	0	5	4	NO,NA,NE	NO,NA,NE
Lithuania	3	1	3	1	0	0	0	0
Luxembourg	0	0	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
Malta	0	1	0	0	0	0	0	0
Netherlands	0	0	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
Poland	358	598	350	553	7	44	NO,NA	0
Portugal	8	20	7	14	1	5	0	1
Romania	0	9	NO	9	NO,NE	1	NE,NO	NE,NO
Slovakia	66	9	60	7	6	2	0	0
Slovenia	1	12	1	12	NO	0	NO	NO
Spain	346	4	305	3	25	0	16	0
Sweden	45	63	44	58	1	5	0	0
United Kingdom	1 459	306	1 292	252	30	44	137	10
EU-28	**5 708**	**3 680**	**5 270**	**3 394**	**210**	**190**	**228**	**96**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.3.1 Recalculations (CRF Source Category 5C)

For information on recalculations please refer to chapter 10.

7.2.4 Wastewater treatment and discharge (CRF Source Category 5D)

Source category 5D includes the CH_4 and N_2O emissions from domestic and industrial and other wastewater treatment and discharge. 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 environments63. According to the key category analysis only CH_4 emissions from 5D1 Domestic wastewater are an EU key source and analysed in more detail in the following chapter. Domestic 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 7.8 shows total GHG, CH_4 and N_2O emissions by member state from 5D Wastewater Handling. Between 1990 and 2013, total emissions from wastewater handling decreased by 36% in EU-28. All Member States except for France, Ireland and Portugal decreased their emissions from wastewater

[63] 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.

treatment and discharge between 1990 and 2013. Due to the implementation of new wastewater treatment technologies CH_4 emission decreased considerably by 43 % between 1990 and 2013, while N_2O emissions decreased moderatly by 6 %.

Table 7.8 5D Wastewater handling: Member states' contributions to total GHG, CH_4 and N_2O *emissions from 5D*

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	217	185	96	160	121	25
Belgium	1 082	484	247	269	835	215
Bulgaria	4 176	908	0	0	4 176	908
Croatia	305	284	67	84	238	200
Cyprus	26	26	14	20	12	6
Czech Republic	1 217	793	234	204	983	589
Denmark	200	187	101	74	99	113
Estonia	151	93	39	30	113	63
Finland	300	251	79	77	221	174
France	2 254	2 609	729	449	1 525	2 160
Germany	2 843	581	1 068	516	1 775	65
Greece	4 255	1 861	279	323	3 976	1 538
Hungary	1 332	618	260	228	1 072	389
Ireland	157	170	96	119	61	51
Italy	4 488	3 846	1 266	1 330	3 222	2 516
Latvia	366	209	6	7	360	202
Lithuania	609	266	67	46	542	220
Luxembourg	16	11	9	7	7	4
Malta	25	12	8	12	17	NA,IE
Netherlands	454	273	149	69	306	205
Poland	3 658	1 625	723	739	2 936	886
Portugal	3 460	3 541	500	610	2 960	2 931
Romania	3 652	2 532	505	553	3 146	1 979
Slovakia	604	366	138	50	466	317
Slovenia	210	138	50	49	159	89
Spain	2 399	1 800	733	961	1 666	839
Sweden	261	235	226	208	35	27
United Kingdom	5 239	4 371	1 092	1 039	4 148	3 331
EU-28	**43 960**	**28 273**	**8 782**	**8 230**	**35 178**	**20 043**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.4.1 Domestic wastewater (CRF Source Category 5D1)

Emission and Trends

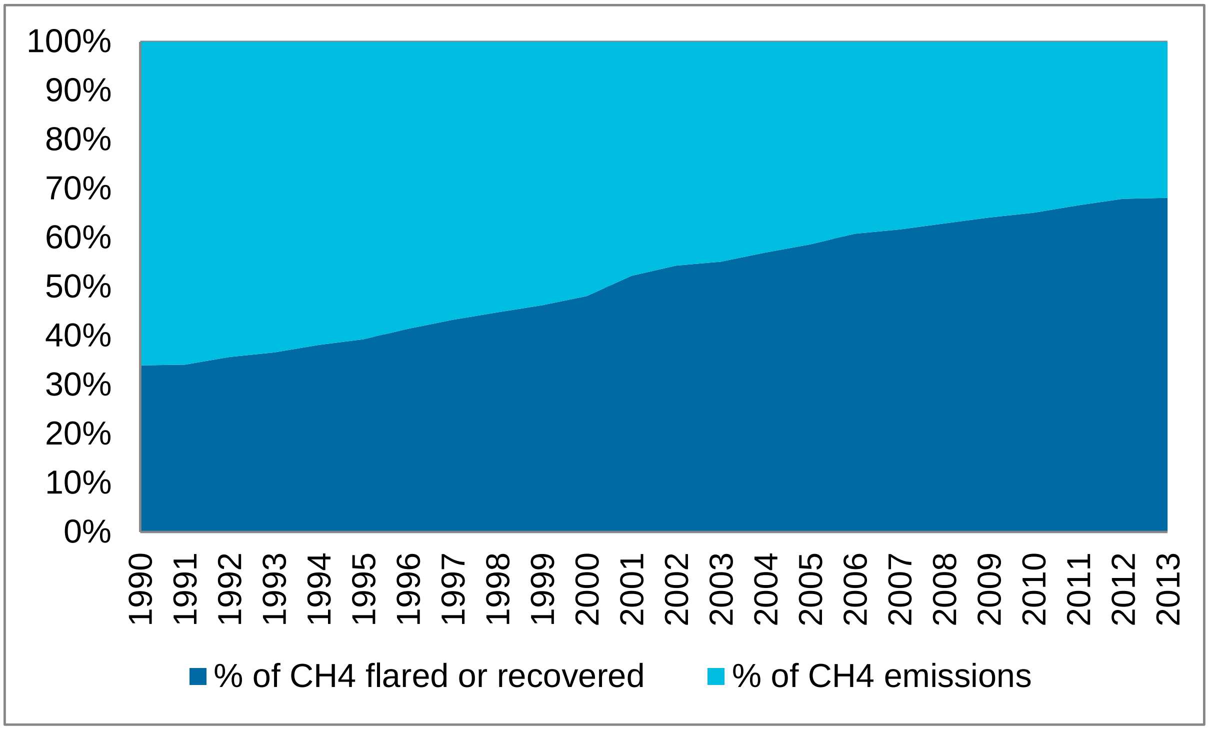
CH_4 emissions from 5D1 Domestic Wastewater account for 0.2 % of total EU-28 GHG emissions. Between 1990 and 2013, CH_4 emissions decreased by 51 %. Key drivers for the large emission reduction are the introduction of wastewater treatment technologies and an increase of CH_4 recovery and flaring (see *Figure **7.13***). Large decreases in absolute terms are reported by Germany, Greece and Poland, contributing together to only 11 % of EU-28 emissions from source 5D1 in 2013, whereas France shows significant emission increases (Table 7.9). France is responsible for 19 %, Italy for 10 % and Romania for 16 % of EU-28 emissions from this source in 2013. Although one of these Member States (France) increased its emissions between 1990 and 2013, the trend of EU-28 emissions is dominated by the large emission reductions in Germany, Greece and Poland.

Table 7.9 5D1 Domestic and commercial wastewater: Member states' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU28 emissions in 2013	Change 2012-2013		Change 1990-2013		Method applied	Emission factor
	1990	2012	2013		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	121	25	25	0%	0	1%	-96	-79%	-	-
Belgium	835	255	215	2%	-40	-16%	-620	-74%	CR,T1	CR,D
Bulgaria	890	570	681	6%	111	19%	-209	-23%	T2	CS
Croatia	141	113	112	1%	-1	-1%	-29	-21%	T1	D
Cyprus	11	4	3	0%	-1	-27%	-8	-74%	T1	D
Czech Republic	371	308	308	3%	0	0%	-63	-17%	T1,T2	CS,D
Denmark	99	112	113	1%	1	1%	13	13%	CS	CS
Estonia	113	52	49	0%	-2	-5%	-63	-56%	T1	D
Finland	194	152	150	1%	-2	-1%	-45	-23%	CS,T2	CS,D
France	1 435	2 053	2 060	19%	8	0%	625	44%	-	-
Germany	1 766	27	24	0%	-3	-11%	-1 742	-99%	CS	CS,D
Greece	2 959	521	522	5%	1	0%	-2 437	-82%	D	D
Hungary	919	360	356	3%	-5	-1%	-563	-61%	T1	D
Ireland	61	51	51	0%	0	0%	-10	-17%	T1,T2	CS,D
Italy	1 702	1 148	1 113	10%	-35	-3%	-589	-35%	D	D
Latvia	223	58	65	1%	7	13%	-158	-71%	D	CS
Lithuania	542	238	220	2%	-18	-8%	-322	-59%	T1	D
Luxembourg	7	4	4	0%	0	-3%	-3	-46%	T1	CS
Malta	17	NA	NA	-	-	-	-17	-100%	D	CS
Netherlands	298	192	195	2%	3	2%	-103	-35%	T2	CS
Poland	2 309	568	631	6%	63	11%	-1 678	-73%	T1	D
Portugal	1 258	885	879	8%	-5	-1%	-378	-30%	T2	CS,D
Romania	2 768	1 790	1 789	16%	-2	0%	-979	-35%	D	D
Slovakia	437	315	311	3%	-5	-2%	-126	-29%	CS,T2	D
Slovenia	152	82	87	1%	6	7%	-64	-42%	T1	CS,D
Spain	1 167	261	261	2%	0	0%	-906	-78%	T1,T2	D
Sweden	31	23	23	0%	0	1%	-9	-27%	-	-
United Kingdom	1 427	750	726	7%	-24	-3%	-701	-49%	CS	CS
EU-28	**22 255**	**10 916**	**10 973**	**100%**	**57**	**1%**	**-11 282**	**-51%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 7.13 5D1 Domestic wastewater: Share of CH_4 recovered or flared and CH_4 emissions on total CH_4 produced from domestic wastewater handling



An important driver for CH_4 emissions from 5D Wastewater Handling are CH_4 emissions from 5D1 Domestic Wastewater in Germany, Greece, Poland and Romania in 1990. 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. *Figure **7.14*** show the relevant trends of the most important Member States for the time series 1990-2013.

French CH_4 emissions from domestic wastewater (5D1) 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 2013. Wastewater treatment in collective systems increased slightly from 79 % in 1990 to 81 % in 2013.

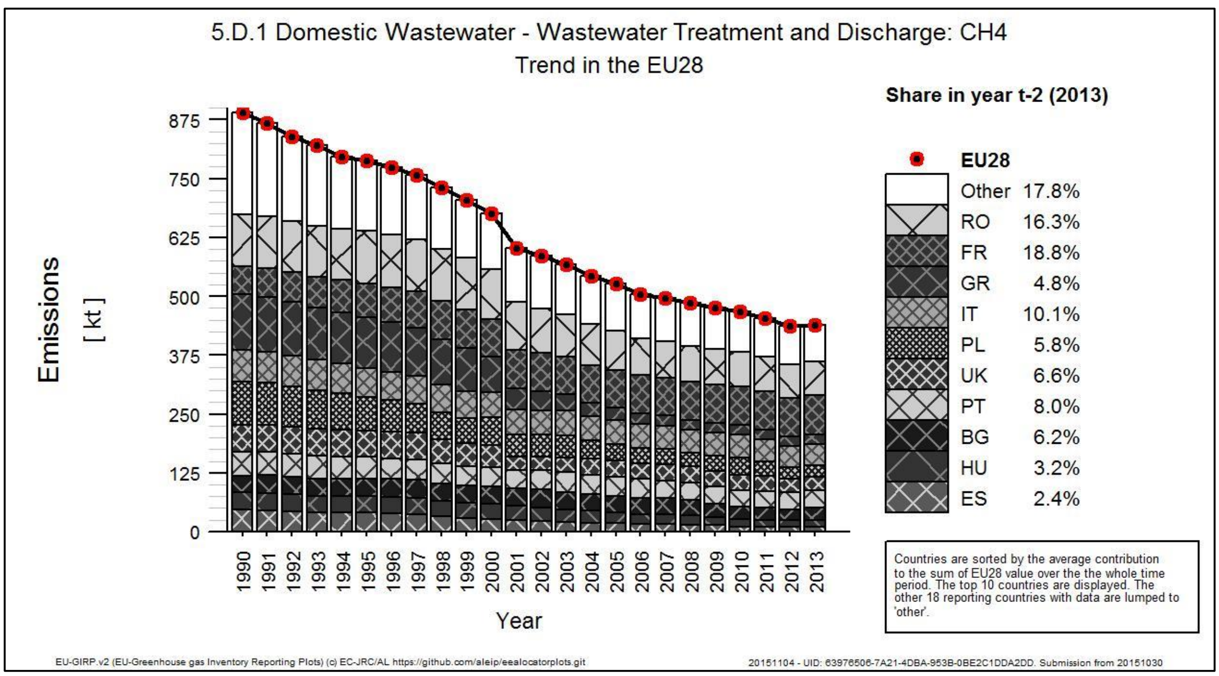
CH_4 emissions from domestic wastewater are continuously decreasing from 1999 onwards in Romania. The amount of wastewater that underlies sufficient treatment increases over the years. About 60 % of the total wastewater has been treated appropriate in 2013. Between 2000 and 2013 public sewage systems have been expanded and modernized.

Germany's reduction in CH_4 emissions from domestic and commercial wastewater (5D1) occurred mainly between 1990 and 1998. The decrease of 95 % in that period was due to the legal requirement to connect households to decentralised wastewater treatment plants. The basis for legal requirements for the collection and treatment of domestic and commercial wastewater is the Council directive 91/271/EWG concerning urban wastewater treatment from 1991. Many wastewater plants had to be built in the former GDR after the German reunification, as most households were not connected to a sewage system, but used septic tanks.

The Greek CH_4 emissions from 5D1 decreased mainly between 1999 and 2007 (-82 %) 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.

Italian CH_4 emissions from domestic wastewater handling have decreased slightly throughout the time series. In 1990 57 % of population was served by sewer systems and only 52 % of the population was served by wastewater treatment plants. In 2013 about 80 % of population is served by wastewater treatment plants.

Figure 7.14 5D1 Domestic wastewater: CH_4 emissions (Trend in relevant MS)



Methodological information

All wastewater generated by households as well as any wastewater not disposed of on site in industrial installations is reported as domestic wastewater. CH_4 emissions from wastewater occur under anaerobic conditions, they can originate during all stages from wastewater generation to final disposal. CH_4 emissions from domestic wastewater handling (5D1) are a significant emission source in category 5D and key source in the EU. The IPCC 2006 Guidelines introduce three different Tier methods to calculate

CH_4 emissions from waste water handling. Input data needed to estimate CH_4 emissions from domestic wastewater handling is the total degradable organic carbon (TOW) produced in a country. The TOW needs to be calculated based on the total population and the quantity of carbon discharged per person and day expressed in Biochemical Oxygen Demand (BOD). Many Member States apply the default value for BOD (0.6 kg CH_4/kg BOD) to estimate the total degradable organic carbon. Furthermore the country specific share of the different treatment pathways and systems of wastewater need to be identified. This is mainly done by analysing wastewater statistics and determining the share of population that is connected to the central sewage system and remaining wastewater that is treated in septic tanks or other wastewater treatment plants. The IPCC 2006 Guidelines provide default MCFs (methane correction factor) for each pathway, but also country specific MCFs can be applied. In the next submission a table on Member States specific methodology will be provided in the Annex.

If methane is recovered and burned (see *Figure **7**.**13***), the emissions from wastewater need to be adjusted accordingly. If sludge is removed from the wastewater, a corresponding quantity needs to be deducted from the Total Organically Degradable Content (TOW). Emissions from sludge decomposition are reported under solid waste disposal, biological treatment, burning or in the AFOLU sector depending on the disposal method.

7.2.4.2 Recalculations CH_4 emissions (CRF Source Category 5D)

For information on recalculations please refer to chapter 10.

7.2.5 Waste – Other (CRF Category 5E)

With the inclusion of the new IPCC category 5B on biological treatment of solid waste, the reporting of emissions from composting formerly reported under the category Other shifted. Only Denmark, Germany and Spain still report emissions under this category.

Germany reports N_2O and CH_4 emissions from the mechanical-biological treatment under the category 5E. Mechanical-biological treatment started in 1995 and continuously increases until 2013 in Germany. Denmark reports CO_2 and CH_4 emissions from accidental fires under 5E Other. Spain reports under the category 5E CH_4 emissions from the collected extended sludge from sewage treatment plants for drying, which can considered as an integral process of wastewater treatment.

Table 7.10 5E Other: Member states' contributions to CO_2, CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2013 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2013 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2013 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2013 (kt CO2 equivalents)
Austria	0	0	NO	NO	NO	NO	NO	NO
Belgium	0	0	NO	NO	NO	NO	NO	NO
Bulgaria	0	0	NO	NO	NO	NO	NO	NO
Croatia	0	0	NO	NO	NO	NO	NO	NO
Cyprus	0	0	NO	NO	NO	NO	NO	NO
Czech Republic	0	0	NO	NO	NO	NO	NO	NO
Denmark	19	18	18	16	NA	NA	2	2
Estonia	0	0	NO	NO	NO	NO	NO	NO
Finland	0	0	NO	NO	NO	NO	NO	NO
France	0	0	NO	NO	NO	NO	NO	NO
Germany	0	133	NA	NA	NO	127	NO	6
Greece	0	0	NO	NO	NO	NO	NO	NO
Hungary	0	0	NO	NO	NO	NO	NO	NO
Ireland	0	0	NO	NO	NO	NO	NO	NO
Italy	0	0	NO	NO	NO	NO	NO	NO
Latvia	0	0	NO	NO	NO	NO	NO	NO
Lithuania	0	0	NO	NO	NO	NO	NO	NO
Luxembourg	0	0	NO	NO	NO	NO	NO	NO
Malta	0	0	NO	NO	NO	NO	NO	NO
Netherlands	0	0	NA	NA	NO	NO	NO	NO
Poland	0	0	NO	NO	NO	NO	NO	NO
Portugal	0	0	NA	NA	NO	NO	NO	NO
Romania	0	0	-	-	-	-	-	-
Slovakia	0	0	NO	NO	NO	NO	NO	NO
Slovenia	0	0	NO	NO	NO	NO	NO	NO
Spain	44	1	NA	NA	NA	NA	44	1
Sweden	0	0	-	-	-	-	-	-
United Kingdom	0	0	NO	NO	NO	NO	NO	NO
EU-28	**63**	**152**	**18**	**16**	**0**	**127**	**46**	**8**

7.3 EU-28 uncertainty estimates

For information on uncertainties please refer to chapter 1.6.

7.4 Sector-specific quality assurance and quality control

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-28 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).

Every year 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 2015, additional quality checks of the EU NIR chapter waste were carried out in order to improve the consistency between the CRF tables and the EU NIR and consistency of tables and figures with text in the EU NIR.

7.5 Sector-specific recalculations

For information on recalculations please refer to chapter 10.

8 OTHER

This sector does not include any emissions in 2015.

9 INDIRECT CO_2 AND NITROUS OXIDE EMISSIONS

9.1 Description of sources of indirect emissions in the GHG inventory

Figure 9.1 summarizes indirect CO_2 and nitrous oxide emissions reported in the CRF. For the 2013 reporting round nine countries provided values for indirect CO_2 emissions[64]. The highest shares of the EU-28 total of indirect CO_2 emissions are held by the Czech Republic (49%), France (22%) and Denmark (10%). Eight countries reported indirect N_2O emissions, whereof the United Kingdom holds a share of 99% of the total EU-28 indirect N_2O emissions in 2013.

Figure 9.1 Indirect CO_2 and nitrous oxide emission for EU-28

Member States	indirect CO_2 kt CO_2 equiv.	Share in EU-28 %	indirect N_2O kt CO_2 equiv.	Share in EU-28 %
Austria	NO,NA	-	NO,NA	-
Belgium	NE,NO	-	NE,NO	-
Bulgaria	NO	-	2	0.06%
Croatia	NA,NO	-	NA,NO	-
Cyprus	NO	-	NO	-
Czech Republic	2249	49%	8	0.2%
Denmark	465	10%	0.8	0.02%
Estonia	14	0.3%	NO	-
Finland	80	2%	0.6	0.015%
France	1001	22%	NO	-
Germany	NE,NA,NO	-	IE,NE,NA,NO	-
Greece	NE,NO	-	NE,NO	-
Hungary	NE,NO	-	NE,NO	-
Ireland	66	1.5%	NO,NE	-
Italy	NO	-	4	0.1%
Latvia	112	2.5%	IE,NA,NO	-
Lithuania	NE,NO	-	NE,NO	-
Luxembourg	NE,NO	-	NE,NO	-
Malta	NO,NE	-	NO,NE	-
Netherlands	329	7%	NE,NO	-
Poland	NA	-	NA	-
Portugal	236	5%	NE,NO	-
Romania	NE,NO	-	5	0.1%
Slovakia	NE,NO	-	NE,NO	-
Slovenia	NE,NO	-	NE,NO	-
Spain	NE	-	NE	-
Sweden	NE,NO	-	0.009	0.0002%
United Kingdom	NE,NO	-	4221	99%
EU-28	**4 553**	**100%**	**4 243**	**100%**

[64] According to the UNFCCC reporting guidelines, Annex I Parties may report indirect CO_2 from the atmospheric oxidation of CH_4, CO and NMVOCs. For Parties that decide to report indirect CO_2 the national totals shall be presented with and without indirect CO_2. For technical reasons in the 2015 inventory submission, the EU-28 totals shown in this report are based on national totals excluding LULUCF and excluding indirect CO_2. This does not pre-empt the inclusion of these emissions in future inventory submissions.

10 RECALCULATIONS AND IMPROVEMENTS

10.1 Explanations and justifications for recalculations, including responses to the review process

This chapter includes an overview of the recalculations made since the the submission 2014. As new global warming potentials have been used in 2015 for CH_4, N_2O and fluorinated gases the recalculations are not only the result of methodological changes and revised activity data but also reflect the new global warming potentials.

10.2 Implications for emission levels

Table 10.1 provides the differences in total EU-28 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-28 1990 GHG emissions excluding LULUCF have increased in the latest submission compared to the previous submission by 1.0 %. EU-28 GHG emissions for 2012 increased by 0.4 % due to recalculations.

Table 10.1 Overview of recalculations of EU-28 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2005	2010	2011	2012
Total CO_2 equivalent emissions including LULUCF (absolute)	52 629	77 573	46 820	29 218	32 563	22 762	9 703
Total CO_2 equivalent emissions including LULUCF (percent)	1.0%	1.6%	1.0%	0.6%	0.7%	0.5%	0.2%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	53 890	69 093	55 602	45 614	34 900	26 900	18 480

Table 10.2 and Table 10.3 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2012. Large recalculations in relative terms (more than 2 %) for 2012 were made in Belgium, Croatia, Finland, Hungary, Netherlands, Portugal, Slovakia, and Spain.

Table 10.2 Contribution of Member States to EU-28 recalculations of total GHG emissions without LULUCF for 1990–2012 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2010	2011	2012
Austria	597	-287	-153	-85	-20	-178	-266
Belgium	4,166	3,943	3,492	2,954	2,727	2,803	2,700
Bulgaria	240	-222	300	454	296	196	91
Croatia	3,178	1,089	413	42	-567	-823	-914
Cyprus	-528	-400	-435	-290	-65	16	-124
Czech Republic	-2,790	1,634	-246	-1,545	-1,374	-654	-868
Denmark	607	1,067	1,231	1,394	1,038	880	962
Estonia	-585	-104	-78	-29	-2	-19	220
Finland	737	856	802	706	1,310	1,184	1,400
France	-7,988	-5,325	-6,086	-3,916	0	-912	-623
Germany	-181	2,573	3,990	-1,767	-3,731	-5,981	-10,991
Greece	82	1,460	1,358	1,027	1,238	1,339	1,594
Hungary	-3,380	-2,740	-2,855	-2,427	-2,145	-2,128	-1,994
Ireland	1,426	741	799	1,693	975	1,012	1,005
Italy	2,003	2,339	2,505	3,996	7,131	7,691	8,830
Latvia	-29	115	154	-17	-90	-9	-12
Lithuania	-909	279	-61	-151	-212	-262	-381
Luxembourg	-13	-9	-44	87	18	-22	-95
Malta	8	-4	22	-22	31	51	31
Netherlands	7,627	7,429	5,943	3,781	4,505	4,985	4,599
Poland	7,537	4,237	-3,305	-559	635	-590	-456
Portugal	-341	-277	-499	212	-295	-372	-1,796
Romania	5,654	8,433	7,068	6,060	1,907	1,052	2,213
Slovakia	2,306	1,801	1,296	1,337	1,566	1,472	996
Slovenia	118	146	121	142	83	37	-13
Spain	6,991	8,446	9,824	9,434	9,639	9,344	7,913
Sweden	-877	-243	124	-89	-90	40	-279
United Kingdom	28,233	32,115	29,921	23,192	10,394	6,749	4,736
EU-28	**53,890**	**69,093**	**55,602**	**45,614**	**34,900**	**26,900**	**18,480**

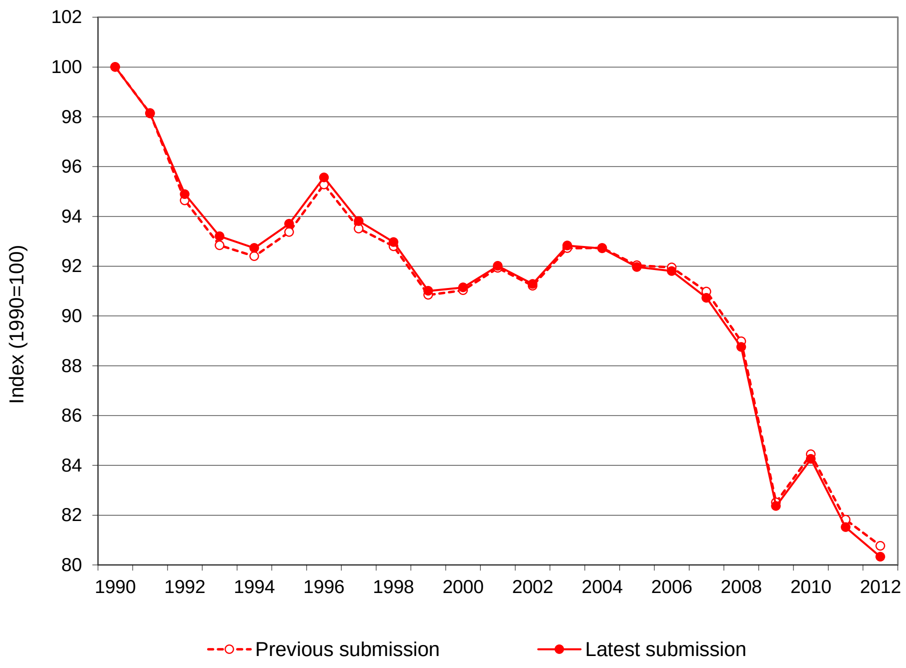
Table 10.3 Contribution of Member States to EU-28 recalculations of total GHG emissions without LULUCF for 1990–2012 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2010	2011	2012
Austria	0.8%	-0.4%	-0.2%	-0.1%	0.0%	-0.2%	-0.3%
Belgium	2.9%	2.6%	2.4%	2.1%	2.1%	2.3%	2.3%
Bulgaria	0.2%	-0.3%	0.5%	0.7%	0.5%	0.3%	0.1%
Croatia	10.0%	4.6%	16%	0.1%	-2.0%	-2.9%	-3.5%
Cyprus	-8.7%	-5.3%	-4.9%	-2.9%	-0.6%	0.2%	-13%
Czech Republic	-14%	11%	-0.2%	-11%	-10%	-0.5%	-0.7%
Denmark	0.9%	14%	18%	2.2%	17%	16%	19%
Estonia	-14%	-0.5%	-0.5%	-0.2%	0.0%	-0.1%	11%
Finland	10%	12%	12%	10%	18%	18%	2.3%
France	-14%	-10%	-11%	-0.7%	0.0%	-0.2%	-0.1%
Germany	0.0%	0.2%	0.4%	-0.2%	-0.4%	-0.6%	-12%
Greece	0.1%	13%	11%	0.8%	11%	12%	14%
Hungary	-3.5%	-3.5%	-3.7%	-3.1%	-3.2%	-3.2%	-3.2%
Ireland	2.6%	13%	12%	2.4%	16%	18%	17%
Italy	0.4%	0.4%	0.5%	0.7%	14%	16%	19%
Latvia	-0.1%	0.9%	15%	-0.1%	-0.8%	-0.1%	-0.1%
Lithuania	-19%	13%	-0.3%	-0.6%	-10%	-12%	-18%
Luxembourg	-0.1%	-0.1%	-0.4%	0.7%	0.1%	-0.2%	-0.8%
Malta	0.4%	-0.2%	0.9%	-0.8%	10%	17%	10%
Netherlands	3.6%	3.3%	2.8%	18%	2.2%	2.6%	2.4%
Poland	16%	10%	-0.8%	-0.1%	0.2%	-0.1%	-0.1%
Portugal	-0.6%	-0.4%	-0.6%	0.2%	-0.4%	-0.5%	-2.6%
Romania	2.3%	4.8%	5.3%	4.3%	16%	0.9%	19%
Slovakia	3.1%	3.4%	2.6%	2.7%	3.5%	3.3%	2.3%
Slovenia	0.6%	0.8%	0.6%	0.7%	0.4%	0.2%	-0.1%
Spain	2.5%	2.6%	2.6%	2.2%	2.8%	2.7%	2.3%
Sweden	-12%	-0.3%	0.2%	-0.1%	-0.1%	0.1%	-0.5%
United Kingdom	3.6%	4.4%	4.3%	3.4%	17%	12%	0.8%
EU-28	**10%**	**13%**	**11%**	**0.9%**	**0.7%**	**0.6%**	**0.4%**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that recalculations in 1990 were higher than in 2012 the emission trend in the EU-28 change. In the previous submission the trend of GHG excluding LULUCF between 1990 and 2012 was – 19.2 %. In the latest submission the trend is -19.7 %.

Figure 10.1: Comparison of EU-28 GHG emission trends 1990–2012 (excl. LULUCF) of the latest and the previous submission



10.4 Planned improvements in response to the review process

10.4.1 EU response to UNFCCC review

In Table 10.4 a list of recommendations and improvements is presented in. The table focuses on UNFCCC recommendations from the review reports 2013 and 2014

Table 10.4 Improvements in the in 2015 in response to UNFCCC review findings

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Energy	Feedstocks and non-energy use of fuels	Previous review reports recommended that the European Union use weighted averages of carbon stored for all fuels in a consistent manner.11 The ERT commends the Party for implementing this recommendation. However, the ERT noted that some of the weighted averages of carbon stored reported in CRF table 1.A(d) were significantly higher than IPCC default values in the Revised IPCC Guidelines. For example, for lubricants, the weighted average is 0.77 compared with the IPCC default value of 0.5. In response to questions raised by the ERT during the review, the European Union indicated that some Parties used 1.0 as the fraction of carbon stored in order to remove fuel emissions that are reported under other sectors (industrial processes) and avoid double counting. The ERT recommends that the European Union clearly explain this in its annual submission and make efforts to enhance the consistency and accuracy of reporting among member States. (para 46)	Draft ARR 2014	Planned for 2015
Chapter 3 / Energy	1A3 / Transport	The ERT noted that the European Union has provided many tables in the NIR giving details on tiers and sources of EFs used in the member States' estimates for each subcategory (e.g. table 3.6). The ERT believes such tables are very useful. However, the information is often reported in an inconsistent way. For example table 3.51 (road transport, gasoline) does not describe all methods as tier 1, 2 or 3 (e.g. Belgium reports "other (OTH)", Austria reports "country specific, model"). Further, these labels are not always consistent with the accompanying text in the NIR. The ERT also noted that not all abbreviations are explained (e.g. OTH, CR) and the version of the core inventory of air emissions (CORINAIR) used is not specified. The ERT recommends that the European Union check these tables and ensure that: all member States' methods are correctly and consistently classified where tiers are provided in the Revised 1996 IPCC Guidelines or the IPCC good practice guidance; all codes used in the table are explained in the section Units and abbreviations; and references to sources such as CORINAIR are included.	ARR 2013	Ongoing This issue has been corrected in almost all cases in the EU NIR 2014, with the collaboration of MSs. But we will continue to improve the quality of these tables since they are useful.
Chapter 3 / Energy	1A3 / Transport	The ERT noted that the 2013 NIR states that "[a]t the moment two versions of the COPERT model are being used in EU–15 countries to estimate emissions, namely COPERT III and COPERT 4" (page 220), while table 3.56 indicates that only COPERT 4 is used." In response to an earlier draft of this report, the European Union revealed that, in fact, COPERT III was used by only one region of Belgium. The ERT reiterates the recommendation made in the previous review report that the European Union strengthen the QA/QC procedures to ensure that the member States' information is updated and correctly represented in the NIR.	ARR 2013	Ongoing This issue has been corrected in the EU NIR 2014, since Belgium in now using COPERT 4. But we will continue the effort to ensure that the MSs information is updated and correctly represented in future inventory submissions.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 3 / Energy	1A3b / Transport - Road Transport diesel N_2O IEF	The ERT noted that the peak for the IEF for road transportation (diesel oil - N_2O) for 1998 is not explained in the NIR. The ERT recomments that the Party improve the transparency of its reporting by ensuring that explanatory information regarding the emission and IEF trends is included in the NIR in a comprehensive manner	Draft ARR 2014	Some explanatory information has been incluede in the NIR 2015
Chapter 3 / Energy	1A3b / Transport - Recalculations	The ERT noted that some improvements that resulted in recalculations were not reported as such in the NIR: for example, during the review the European Union informed the ERT that Belgium had recalculated the emissions from transport for the entire time series using COPERT 4v10 but this is not reflected in the European Union NIR under recalculations. Therefore, the ERT recommends that the Party ensure transparency, completeness and consistency in its reporting of the recalculations, by working with its member States to achieve the enhancement of the European Union QA/QC system	Draft ARR 2014	ongoing
Chapter 3 / Energy	International bunker fuels	The ERT recommends to use most recent results of the collaboration with Eurocontrol to improve the accuracy of emission estimates for the European Union and for the member States, ensuring the consistency in the time series in accordance with the IPCC good practice guidance	Draft ARR 2014	The results of the collaboration with Eurocontrol are provided in the EU NIR 2015
Chapter 3 / Energy	1A3a / Transport - Civil Aviation	The ERT recommends to promote the use of the results of the collaboration between the European Union and Eurocontrol to improve the accuracy of the inventory in the annual submission	Draft ARR 2014	In the 2015 NIR we reporedt the results of the collaboration with Eurocontrol, in order to improve the accuracy of the emissions estimates
IPPU	Sector overview	Para 44, ERT recommends that the European Union explore ways to replace the use of notation keys with actual values in background data . . . in order to improve the transparency of the reporting of the background data.	ARR 2013	implemented
IPPU	Sector overview	Para 56, The ERT . . .recommends that the Party provide justifications in the NIR as to why the use of international data sources to report AD at European Union's level would lead to strongly inaccurate reporting	ARR 2014	ongoing
IPPU	Sector overview	Para 57, … the ERT noted significant disparities among the description of methods for individual member States in the summary tables presented in the Party's NIR, whereby there are no sufficient subcategory descriptions of methods for some member States, for example there is a lack of methodology descriptions in NIR table 4.4 and 4.22 …The ERT recommends that the European Union improves the summary descriptions of methodologies in the NIR for all member States.	ARR 2014	ongoing

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
IPPU	Cement production – CO_2	Para 59. The ERT was provided with further information on Germany using the same clinker EF for the whole time series and recommends that the European Union include this information in the NIR.	ARR 2014	implemented
IPPU	Cement production – CO_2	Para 60. The ERT found insufficient methodological information for the methodology used by the United Kingdom	ARR 2014	implemented
IPPU	Cement production – CO_2	61. On the basis of table 4.5 of the NIR (on the implementation of previous recommendations), the ERT reiterates the recommendation made in previous review reports that the EU continue to work with Spain to implement a qualitative assessment of the range of IEFs based on of the composition of raw material used.	ARR 2014	ongoing
IPPU	Cement production – CO_2	62. The ERT noted in the NIR that Latvia reports the use of a tier 1 approach and recommends that the EU work with Latvia to ensure that it uses a tier 2 rather than a tier 1 approach when estimating cement production emissions, given that it is possible to obtain clinker data from the plants.	ARR 2014	ongoing
IPPU	Cement production – CO_2	63. The ERT considers that referring to the NIRs of member States does not ensure sufficient transparency within the NIR of the EU.	ARR 2014	implemented
IPPU	Lime production – CO_2	64. ERT reiterates previous recommendations that the EU provide more information for Italy about the methods used to estimate emissions from lime production for the entire time series	ARR 2014	implemented
IPPU	Limestone and dolomite use – CO_2	65. Croatia reports on approaches for the collection of AD (mainly surveys), for an overall period of 1990–1996, without explaining what data collection methods have been used from 1997 to 2012. In response to a question raised by the ERT during the review, the European Union stated that Croatia explained that more detailed AD have been collected from individual plants for the period 2008–2012, and that all data regarding this category are currently being further investigated in order to ensure accurate CO_2 emission calculations for the whole time series in a consistent manner. The ERT recommends that the European Union include this information for Croatia in the NIR in order to enhance the transparency of the description of methods and also recommends that the European Union work with Croatia to ensure the consistency of the full time series.	ARR 2014	ongoing
IPPU	Ammonia production – CO_2	52. In the United Kingdom, CO_2 emissions from ammonia production are assumed to be stored in chemical feedstocks in one plant. The ERT ecommended that the EU provide more detailed explanations.	ARR 2013	implemented

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
IPPU	Ammonia production – CO_2	66. The ERT noted in the NIR that the European Union did not provide adequate methodology overviews for emissions from ammonia production for France and Germany. The methodology summary for France essentially mentions four ammonia production plants in France, without giving details on AD, EFs and other methodological information. The methodology summary for Germany essentially mentions a tier 3 approach being used without giving any further details. The ERT recommends that the European Union provide in its NIR adequate and transparent methodology overviews for France and Germany to enable the ERT to make a thorough review of the AD and EFs used in the ammonia production emission estimations of these countries.	ARR 2014	implemented
IPPU	Ammonia production – CO_2	67. On the basis of the status report provided by the European Union in table 4.23 of the NIR (on the implementation of previous recommendations), the ERT reiterates the recommendation made in previous review reports that the European Union make efforts to ensure that Greece complete the on-going work to obtain more accurate data on the amount of liquid fuel used as feedstock and the updated AD in the emission estimates.	ARR 2014	implemented
IPPU	Nitric acid production – N_2O	68. The ERT noted that the European Union did not provide adequate methodology overviews in its NIR for emissions from nitric acid production for France, Germany and Greece. The methodology summary for Germany essentially mentions a tier 3 approach being used without giving any further details. The methodology summary for Greece essentially mentions the source of data and use of average IPCC default factors for the single production unit in the country, without giving details on AD, rationale for the EFs used and other methodological information. The ERT recommends that the European Union provide in its NIR adequate methodology overviews for France, Germany and Greece to enable the ERT make a thorough review of the AD and EFs used in the nitric acid production emission estimations of those member States.	ARR 2014	implemented
IPPU	Nitric acid production – N_2O	69. On the basis of the status report provided by the European Union in table 4.27 of the NIR (on the implementation of previous recommendations), the ERT reiterates the recommendation made in the previous review report that the European Union improve the transparency of information provided in the NIR for Spain by finding alternative ways of reporting the necessary information without violating the existing rules on confidentiality.	ARR 2014	implemented
IPPU	Other (chemical industry) – CO_2	70. On the basis of the status report provided by the European Union in table 4.37 of the NIR (on the implementation of previous recommendations), the ERT reiterates the recommendation made in previous review reports that the European Union work with Finland in order to develop a way of reporting indirect CO_2 emissions which will allow CO_2 emissions from biomass to be distinguished from the fossil fuel component and use this in the CRF tables of its annual inventory submission, and provide an appropriate methodology description in the NIR.	ARR 2014	implemented

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
IPPU	Other (chemical industry) – CO_2	71. From table 4.37 of the NIR, the ERT reiterates recommendations to include the methodological description of France for this subcategory.	ARR 2014	implemented
IPPU	Other (chemical industry) – CO_2, refinery catalyst coke burn off emissions	para 72, … The ERT welcomes the clarification provided by the European Union regarding Germany's effort to better understand the nature of emissions and recommends that the European Union work with Germany to report follow-up information on the appropriate allocation of catalyst coke burn off emissions.	ARR 2014	ongoing
IPPU - Product uses as substitutes to ODS (2F)	Methodologies for emission estimates from 2.F onlyfor EU-15 in EU NIR	74. Noting that the Party's reference to the NIRs from member States, which are included as annexes and, in total, cover thousands of pages, does not ensure the transparency of reporting, the ERT recommends that the European Union endeavour to provide in the NIR summary overviews of methodology descriptions for key categories based on the relevant methodological descriptions reported in the NIRs of its member States.	AAR 2014	Done
IPPU - Product uses as substitutes to ODS (2F)	Notation keys partly lacking or recommendations unresolved	75. The unresolved issues on notation keys include the following: "NE" reported by Denmark for amount of gas remaining in products at decommissioning; "NO" (not occurring) reported by Finland for SF_6 emissions from aluminium and magnesium foundries; "IE" and "NA" (not applicable) by Ireland regarding AD and emission estimates for HFC emissions from refrigeration and air-conditioning equipment (except mobile air conditioning); "NO" by Luxembourg for reporting potential emissions of PFCs from refrigeration and air-conditioning equipment; "NA" and "NA and NO" by the Netherlands for AD and IEFs of emissions from stocks in industrial refrigeration and mobile equipment, whereas the emissions are actually estimated; and empty cells in the CRF tables for Spain as a replacement of "NA" and "NE" notation keys in reporting emissions from semiconductor manufacturing.	AAR 2014	Partly resolved, partly software issues
IPPU - Product uses as substitutes to ODS (2F)	Transparency of emission reporting done by the Netherlands	77. The ERT noted in the NIR of the European Union that the Netherlands explains that many processes related to the use of HFCs and SF_6 take place in only one or two companies, and that because of the sensitivities of the data from these companies only certain emissions are reported. In response to a question raised by the ERT during the review, the European Union stated that the Netherlands explained that there was a misunderstanding in the way the information was portrayed in the NIR of the European Union, and that the information was clearer in the NIR of the Netherlands. The Netherlands had further informed the Party that the correct version was: "The consumption data of aerosols, fire extinguishers, foams and solvents originate from only one or two companies and because of the sensitivity of data from these companies, the HFC emissions from categories 2F2-2F5 are reported together in 2F9. In addition, processes related to the use of PFCs and SF_6 in semiconductor manufacture and electrical equipment take place in only one or two companies. Because of the sensitivity of data from these companies, only the sum of the PFC and SF_6 emissions of 2F7	AAR 2014	Resolved.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		and 2F8 is reported (included in 2F9)". The ERT accepted this clarification and recommends that the European Union include this explanation in the annual submission when reporting emissions for the Netherlands and enhance the QC procedures to ensure that the information in the Party's NIR accurately reflects the information in the NIR of member States.		
IPPU - Product uses as substitutes to ODS (2F)	Activity data for emission reporting from fire protection equipment (2F3)	78. The ERT observed that the NIR of the European Union reports that Greece uses AD from neighbouring countries (Italy, Spain and Portugal) to estimate emissions from consumption of halocarbons and SF_6. In response to a question raised by the ERT during the review, the European Union informed the ERT that Greece stated that it had explained in its NIR 2014 for Greece (p. 207) that this approach has been used for estimating HFC-227ea emissions from "fire protection equipment" only, which accounted for about 0.9 per cent of total F-gas emissions from the use of ozone-depleting substances (ODS) substitutes in 2012. Greece explained that this was due to a lack of information to implement the methodology suggested in the IPCC good practice guidance, but a country-specific estimation of the emissions has been used, based on the assumption that the use of HFCs in fire equipment in Greece is similar to the use in other Mediterranean countries (Italy, Portugal, Spain) and taking into consideration each country's population. Greece also stated that, in the framework of the 2011 improvement plan, the Greek Fire Service-Fire Safety Division has been contacted in order to determine the availability of information for the use of HFCs and/or PFCs in fire equipment. The ERT recommends that the European Union work with Greece in order to implement appropriate country-specific methodologies to estimate these emissions in accordance with the IPCC good practice guidance.	AAR 2014	Ongoing.

Table 10.5 Improvements in the sector Agriculture in 2015 in response to UNFCCC review findings

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Agriculture		ERT encouragement: use the NIR structure as it is included in the Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol.	ICR 2013	New structure has been implementd

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Agriculture		para 67. The ERT commends the Party for the increased use of higher-tier approaches in comparison to the 2012 annual submission (e.g. for manure management, the percentage of emissions estimated based on a country-specific methodology increased from approximately 63 per cent in the 2012 annual submission to 86 per cent in 2013). The ERT recommends that the European Union further support and encourage member States to develop country-specific AD and EFs in order to allow for increased use of higher-tier approaches.	ARR 2013	no further action required
Agriculture	Consist.	• Several inconsistencies within the NIR, for example:	ICR 2013	
		o in Tables 6.14 and 6.86 a Tier 1 method is specified as used by Greece for Non -Dairy Cattle, while in Table 6.15 a Tier 2 method is presented;		
		o in Table 6.23 only the value of uncertainty associated with the Cattle livestock number in Austria in presented, in Table 6.24 only the value for Cattle related EF is included, while in Table 6.25 containing background information from the MSs NIRs, values are included for all livestock.		Sector-specific method for the quantification of the Tier level and the aggregation of the uncertainty has been dropped in 2015. No further action required
		• ERT recommendations:		
		o improve the implementation of QC activities;		A completely new QA/QC system has been implemented in 2015.
		o update the algorithm of inclusion of MSs data and information into the EU inventory .		
Agriculture	Transp.	In addition, the ERT identified some transparency issues linked to the reporting of the tier method used to estimate CH_4 emissions from enteric fermentation in tables 6.2, 6.14 and 6.15 of the NIR for sheep and cattle for some member States. During the review, the Party explained that the aforementioned three tables have different sources: table 6.2 was obtained from the officially submitted CRF tables of the European Union member States; table 6.15 comprises quotations from the member States' NIRs, with the level of detail and nature of the information depending on each NIR; and table 6.14 provides a quantification of the tier level according to the approach from Leip (2010).9 The ERT recommends that, in the next annual submission, the Party improve the transparency of the reported information. The ERT welcomes the information provided by the Party on the thorough update of the tables on the basis of the data in the NIRs for the next annual submission. (para 74)	ARR 2012	Sector-specific method for the quantification of the Tier level and the aggregation of the uncertainty has been dropped in 2015. No further action required
Agriculture	Consist.	The ERT noted some inconsistencies within the NIR, within the CRF tables and between the CRF tables and the NIR concerning the reporting of some data and methods. For example: a tier 1 method for estimating emissions from enteric fermentation is reported for France in table 6.15 for sheep, whereas a tier 2 method is reported in table 6.14 and a tier 3 method in table 6.3;	ARR 2012	see above

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Agriculture	Consist.	the summation of the allocation per animal waste management system for swine is lower than 100 per cent in table 6.29 (74 per cent) and table 6.30 (80 per cent) of the NIR; and reference is made to a non-existent CRF table 7s2 in section 6.3 of the NIR. The ERT also noted that data on the weight reported for different livestock differ from CRF table 4.A to CRF table 4.B(a); and that the numbers of dairy cattle and non-dairy cattle are reported as 17,525,000 and 58,515,000, respectively, in table 6.13 of the NIR and CRF table 4.A, and these values are different from those reported in table 6.16 of the NIR for dairy cattle (19,045,000) and non-dairy cattle (61,169,000). In response to questions raised by the ERT during the review, the Party attributed the inconsistencies related to the population size of dairy cattle and non-dairy cattle within the NIR and between the NIR and the CRF tables to unintentional double counting of the number of cattle that were reported using option B. The ERT recommends that, in the next annual submission, the European Union improve its QC activities to ensure the consistency of the reporting within the NIR, within the CRF tables and between the CRF tables and the NIR. (para 75)	ARR 2012	no further action required
Agriculture	Transp.	68. Recalculations were performed for the entire time series (see table 9 below) and are documented in the NIR at the sectoral level. However, only the reasons for recalculations by categories for some member States are included, and it is not clear whether all the reasons for recalculations are reported. In addition, no numerical information by member State on the impact of recalculations per category is included (CRF table 8(b) only refers to member States which performed recalculations). Furthermore, there are inconsistencies in how recalculations are presented in the NIR. For example, a section on the recalculations of CH_4 emissions from field burning of agricultural residues is not included in the NIR, but a section on the recalculations of CH_4 emissions from agricultural soils is (although it includes primarily a discussion on rice cultivation). The ERT reiterates the recommendation made in the previous review report that the Party include in the NIR information on recalculations for all member States that conducted recalculations, including numerical information per member State, and include the rationale and impact of the recalculations on the category. The ERT encourages the European Union to include a specific section in the NIR on the recalculations performed for CH_4 emissions from field burning of agricultural residues and recommends that the Party resolve the error described above in the section on agricultural soils.	ARR2013	No further action required. The approach of reporting re-calculation in the 2015 submission is different due to the specifities of this year.
Agriculture	Transp.	However, the ERT noted some issues relating to a lack of transparency, as background information related to data and methods is not provided for all member States (e.g. tables of background information on AD and EFs related to CH_4 from manure management covered 11 and 14 member States, respectively; background information on methods and EFs related to N_2O from manure management was provided for nine and six members States, respectively; and the background information on agricultural soils, including methods, data and parameters, such as $Frac_{GRAZ}$, $Frac_{GASF}$, $Frac_{GASM}$ and FracLEACH, also did not cover all member States). The ERT reiterates the recommendation made in the previous review report that the European Union provide complete background tables with information for all member States in its next annual submission. (para 73)	ARR 2012	Methodological tables are now provided as Annex

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Agriculture	4A	para 69. The ERT noted that sheep and swine population numbers reported in the CRF tables are below the values included by the Food and Agriculture Organization of the United Nations (FAO) (0.6 per cent and 3.5 per cent difference, respectively). In response to a question raised by the ERT during the review, the European Union identified which member States are mainly responsible for the differences (for sheep, Ireland and Portugal are responsible for approximately 80 per cent of the difference and in the case of swine, Germany and Portugal are responsible for over 90 per cent) and provided the rationale for them. The ERT encourages the European Union, in the context of implementing its verification activities, to include in the NIR the results of the comparison of livestock population data used in the inventory with similar data reported to FAO and Eurostat, together with the description of the potential reasons for differences.	ARR2013	NO further action required. The exercise of comparing FAO data and CAPRI data with national inventories might be repeated in a following year
Agriculture	4A - Trans	para 70. The ERT noted that in table 6.20 of the NIR some additional background information on milk production (kg milk/head/day) associated with the CH_4 emissions for dairy cattle are reported as "NA" for the Netherlands, while data which allow their derivation (milk production expressed as kg milk/head/year) are available in the respective member States' NIRs. The ERT recommends that the Party continues its efforts to achieve the completeness and comparability of reported data.	ARR2013	Several issues of missing background information (or wrong units used) have been raised during the QA/QC checks
Agriculture	4B	para 72. The ERT commends the Party for the inclusion in the NIR of a distinct section on the distribution of livestock by IPCC climate regions, including the comparison of data reported by member States with an independent estimate elaborated by JRC. During the review, the Party presented the need to further assess, perhaps in a workshop setting, the conclusions of the previously presented analysis considering also the uncertainty associated with the model used. The ERT welcomes the Party's initiative to consider further these conclusions, including through workshop(s) and through Working Group 1 under the Climate Change Committee. The ERT recommends that the Party continue the analysis through the collaboration between the JRC, member States, DG CLIMA and EEA, focusing on the differences revealed. In addition, the ERT recommends that the Party, as appropriate, update the member States' livestock allocation to climate regions and associated parameters and report in the NIR on the status and results of any further analysis.	ARR2013	No further action required
Agriculture	4B - Cons.	71. During the review, the Party described a pilot project implemented by Eurostat and member States (in cooperation with JRC) related to animal waste management systems (AWMS). The ERT commends the Party for the extensive discussions held at the European Union level with the goal of developing country-specific parameters for AWMS and housing, as well as the implementation of the pilot project and use by member States of the results. The ERT welcomes the European Union efforts and recommends that the Party continue efforts to develop and implement country-specific data. The ERT encourages the European Union to consider further opportunities to coordinate EU-wide data collection and inventory improvements, including through Working Group 1 under the Climate Change Committee. In addition, the ERT recommends that the European Union report in the NIR on the status and results of further progress in collecting farm-level data.	ARR2013	Sectio had been added in 2014. No further action required

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
	4C - trans	para 66. The ERT found several areas where there was lack of transparency in the NIR. For example, table 6.61 on relative uncertainty estimates for AD and EFs for rice cultivation includes data only for Greece, Italy and Portugal, although the activity occurs also in France and Spain. In addition, the NIR does not include a section on category-specific planned improvements. The ERT encourages the European Union to use the NIR structure as it is included in the annotated outline of the NIR. The ERT recommends that the Party include in the NIR uncertainty data for all member States and for the European Union at the category level, as well as category-specific planned improvements.	ARR2013	Rice is no EU key source category and is not discussed in detail in the EU GHG inventory report.
	4D	para 73. According to table 6.75 in the NIR, N_2O emissions from the cultivation of histosols for Portugal and Ireland were regarded as negligible although in CRF table 4.D the AD and emissions were reported as “NO”. In response to a question raised by the ERT during the review, the Party responded that in relation to Portugal the NIR already describes that histosols are at most negligible, which is supported by data available at European Soil Data Centre. Regarding Ireland, the Party responded that based on discussions with experts on agricultural practices and geographic information system analysis, cultivated organic soils are designated as not occurring, that non-permanent grassland is accounted for under cropland, consistent with the definition of arable land temporarily used for forage crops or grazing (page 3.69 of the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (hereinafter referred to as the IPCC good practice guidance for LULUCF)). The Party also indicated that, in its understanding, the term “cultivated” refers to soil disturbance by ploughing, and that discussions on the term were included within the KP-LULUCF workshop organized by JRC in November 2013. Additionally, the Party responded that data from FAO on the existence of cultivated organic soils for agricultural purposes might reflect that sometimes countries report data on the drained areas. The ERT recommends that the Party resolve the inconsistencies between the NIR and CRF tables, clarifying whether emissions arise from cultivation of histosols. The ERT commends the Party for the inclusion of a discussion on the meaning of “cultivated” in the JRC KP-LULUCF workshop in November 2013, believing that the term includes more than ploughing, and recommends that the European Union include in the NIR the clarifications provided to the ERT during the review, together with the results of the workshop discussion.	ARR2013	No further action required.
	4A, 4B, and 4D - Cons.	Several inconsistencies between the NIR and CRF tables, for example: o in page 499 of the NIR reindeer, deer, fur farming, rabbits and other poultry livestock are presented as characterized by several MSs while in the CRF tables 4.A, 4.B(a)s1 and 4.B(b) NE has been assigned to the population data. ERT recommendations: strengthen the QC activities; update the algorithm of extracting MSs CRF data and filling of the EU CRF. (partly re-iteration of para 82 from ARR 2012)	ICR2013	No further action required. Better data on 'other animal' types are now available.
Agriculture	4D	para 74. The ERT noted a large inter-annual change in the fraction of livestock nitrogen excreted and deposited onto soil during grazing (FracPRP) between 2010 (0.3512) and 2011 (0.3315), the 2011 value being 5.6 per cent lower than 2010. In response to a question raised by the ERT during the review, the European Union indicated that this is due to a mistake resulting from the use of a zero in the FracPRP to reflect the non-reporting by the United Kingdom. The Party added that the correct value for 2011 is 0.3475, resulting in a 1 per cent decrease. The ERT notes that this error does not lead to an underestimate of emissions, but recommends that the Party include the correct value and improve the implementation of QC procedures in order to prevent such errors.	ARR2013	No further action required

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Agriculture	4E	para 64. Prescribed burning of savannas is reported as “NA, NO” in CRF table 4.E but no information is included in the NIR. The ERT recommends that the European Union provide information in the NIR on the occurrence of this category within the Party	ARR2013	Savannah burnig is no EU key source category and is not discussed in detail in the EU GHG inventory report.
Agriculture	4F	• The Agriculture Sector is complete, but several elements were not included in the NIR, for example:	ICR2013	Field burnig of agricultural residues is no EU key source category and is not discussed in detail in the EU GHG inventory report.
		o in Table 6.84 on CH_4 and N_2O emissions from IPCC 4F category, the activity has not been characterized for Belgium, Germany, Ireland, Luxemburg, Netherlands, Sweden and United Kingdom of Great Britain and North Ireland;		
		o in Table 6.85 on methodologies used to estimate CH_4 and N_2O emissions associated to the IPCC 4F category, no methodological element but a general description was included while for Greece, except the fraction of residues burned on field, no AD, EFs		
		and estimation method were presented.		
		• ERT recommendations:		
		o strengthen the QC activities;		
		o update the algorithm of filling the EU NIR from the data and information provided by MSs;		
		o strengthen the collaboration between EU and MSs in order that complete data and information be included in the MSs NIRs, for example, in the context of the Working Group 1 under the Climate Change Committee and/or dedicated workshop(s)		

10.4.2 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 2014/2015

At the beginning of each year the EU inventrory team drafts the EU improvement plan. This improvement plan takes into account the recommendations and encouragements of the most recent UNFCCC review reports as well as planned improvements that have not yet been fully implemented and are therefore still ongoing. After the submission the coordinator evaluates the implementation status of the improvements.

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

As explained in the Chapter 1, the present report is not an official submission under Kyoto Protocol. For this reason the information to be provided in accordance with Decision 15/CMP.1 Annex I, Paragraph D is not included in the present report. In particular, information in relation to KP LULUCF tables cannot be provided due to the issues with the CRF Reporter.

12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

As stated in chapter 1 the present report is not the first inventory submission for the first year of the second commitment period of KP, and consequently it does not include information as per Decision 15/CMP.1 Annex I section E Decision 15/CMP.1.

13 CHANGES TO THE NATIONAL SYSTEM

As explained in the chapter 1, the present report is not an official submission under Kyoto Protocol. For this reason the information to be provided in accordance with Decision 15/CMP.1 Annex I, section F is not included in the present report. Information on any changes to the national system under the Convention are reported in paragraph 1.2.4 of the Introduction.

14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

The report is not an official submission under Kyoto Protocol as, explained in chapter 1. and, consequently does not present information as per Decision 15/CMP.1 Annex I, section G.

15 INFORMATION ON MINIMIZING ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

As stated in chapter 1 the present report is not an official submission under the Kyoto Protocol. For this reason the information to be provided in accordance with Decision 15/CMP.1 Annex I, section H is not updated in the present report. This chapter will be updated in the first inventory submission for the first year of the second commitment period of KP.

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, text from the last year's inventory report was included and additional and new information is 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 6th national communication provides a detailed overview of the European policies and measures to mitigate GHG emissions in all sectors.. 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/smart-regulation/impact/ia_carried_out/cia_2014_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, in particular its relation to biomass and biofuels, 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 strategy 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 liquid 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. To address the risk of potentially negative 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 2012a). 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 additional market incentives to the eixsing ones 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 stronger 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 a Directive is analysing social, economic and environmental impacts on third countries in detail. The legislative proposal is now with the colegislators in the European Parliament and the Council.

The Directive also ensures that the Commission reports 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 analyses *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.

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 recent Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01)[65] sets up a system for certifying sustainable biofuels, including those imported into the EU. It lays down rules that such schemes must 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 2014) recognised **15** 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), Biograce GHG calculation tool and HVO Renewable Diesel Scheme for Verification of Compliance with the RED sustainability criteria for biofuels[66].

In line with Article 19(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources[67] 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

65 OJ C160, 19.6.2010, p.1

66 http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm

67 OJ L 140, 5.6.2009, p. 16

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).

As part of the Communication on a policy framework for climate and energy in the period from 2020 to 2030 (European Commission 2014a) it is proposed not to establish new targets for renewable energy specifically for the transport sector, or the greenhouse gas intensity of fuels used in the transport sector or any other sub-sector after 2020. The priority expressed in the communication is a focus of policy development on improving the efficiency of the transport system, further development and deployment of electric vehicles, second and third generation biofuels and other alternative, sustainable fuels as part of a more holistic and integrated approach. A greenhouse gas reduction target of 40% to be shared between the ETS and non-ETS sector is accompanied by a coherent headline target at EU level for renewable energy of at least of at least 27% with flexibility for Member States to set national objectives.

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.

In April 2013 the EU temporarily suspended enforcement of the EU ETS requirements for flights operated from or to non-European countries, while continuing to apply the legislation to flights within and between countries in Europe. The EU took this initiative to allow time for the International Civil Aviation Organization (ICAO) Assembly in autumn 2013 to reach a global agreement to tackle aviation emissions – something Europe has been seeking for more than 15 years. In October 2013 the EU's hard work paid off when the ICAO Assembly agreed to develop by 2016 a global market-based mechanism (MBM) addressing international aviation emissions and apply it by 2020. Until then countries or groups of countries, such as the EU, can implement interim measures.

In response to the ICAO outcome and to give further momentum to the global discussions, the European Commission has proposed amending the EU ETS[68] so that only the part of a flight that takes place in European regional airspace is covered by the EU ETS. The change would have applied from the beginning of 2014 until the planned global MBM enters into force. In March 2014 the Council of the EU and European Parliament reached an informal agreement on the changes to aviation in the EU ETS.

The regulation in preparation will limit the aviation coverage of EU ETS to emissions from flights within the European Economic Area (EEA) for the period from 2013 to 2016. This applies to all (also third country) aircraft operators. All options are left open for the EU to react to the developments of the ICAO Assembly in 2016 and to re-adjust the scope of the EU ETS from 2017 onwards. The regulation also includes exemptions for small emitters. The legislative process is expected to be concluded in the spring of 2014.

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, with cost effective reduction milestones of 40% by 2030 and 60% in 2040..

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

[68] See Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emissions, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013PC0722

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.

Communication on a policy framework for climate and energy in the period from 2020 to 2030

In January 2014, the European Commission published a Communication on a policy framework for climate and energy in the period from 2020 to 2030 (COM(2014)15 final) (European Commission 2014a). This Communication develops a framework for the future EU climate and energy policy and proposes to set a greenhouse gas emission reduction target for domestic EU emissions of 40% in 2030 relative to emissions in 1990. The EU level target will be shared between the EU Emissions Trading System (EU ETS) and what the Member States must achieve collectively in the sectors outside of the ETS. The ETS sector would have to deliver a reduction of 43% in GHG in 2030 and the non-ETS sector a reduction of 30% both compared to 2005.

In addition the Commission proposes an EU-level target for the share of renewable energy in the EU of at least 27% in 2030. While binding at the EU level, there would not be binding renewable targets for Member States individually but the objective would be fulfilled through clear commitments decided by the Member States themselves which should be guided by the need to deliver collectively the EU-level target and build upon what each Member State should deliver in relation to their current targets for 2020. While not foreseeing national-level targets, the 2030 framework proposes a new governance framework based on national plans for competitive, secure and sustainable energy. The plans will be prepared by Member States under a common approach to ensure coherence at the EU level.

The EU Emissions Trading System (ETS) will remain an important instrument to bring about the transition to a low carbon economy. A market stability reserve is proposed for the period after 2020 which provides an automatic adjustment of the supply of auctioned allowances based on a pre-defined set of rules with the aim to avoid a large supply/demand imbalances in the ETS.[69]

A stakeholder consultation was carried out in preparation for the 2030 framework. The Communication on the 2030 policy framework follows the Commission's March 2013 “Green Paper on a 2030 framework for climate and energy policies” which was explained in this section of the NIR in the previous inventory submission. The Green paper launched a broadpublic stakeholder

[69] See COM/2014/20 Proposal for a Decision oft he European Parliament and of the Council concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, http://ec.europa.eu/clima/policies/ets/reform/docs/com_2014_20_en.pdf

consultation on the most appropriate range and structure of climate and energy targets for 2030. The public consultation was conducted between March and July 2013 and also addressed relevant stakeholders from outside the EU.

An impact assessment (IA) was conducted for this communication (European Commission 2014b), which gives significant detail on costs and savings achieved on the basis of the proposed policy under different scenarios. All scenarios demonstrate reduced GHG emissions compared to the Reference scenario. All scenarios show reduced energy consumption (both primary and final) compared to the Reference scenario, with more pronounced energy savings and improved energy intensity in scenarios with strong energy efficiency policies, with highest improvements in those scenarios that next to ambitious energy efficiency policies also include a renewables target. Future fuel consumption in the EU will have economic impacts on fuel prices as well as trade effects for fuel exporting countries, therefore the impacts on future fuel use are summarized: With regard to fuel use, the IA analysed that solid fuel consumption declines substantially under all scenarios until 2030. Also oil consumption decreases in all scenarios, but much faster in those with policies that promote transport electrification. Natural gas absolute consumption also declines in all scenarios (in general less harply than oil) but slightly more under the scenarios that include renewable targets. By 2050 in all scenarios natural gas becomes the main fossil fuel. Net energy imports decrease significantly for all scenarios already in 2030 between 4% to 22% below 2010 levels in 2030 and by about 50% in most scenarios in 2050.[70]

The Communication was discussed by the European Council (EU Member States' heads of state and goverments) on 21-24 March 2014, which requested the Council and the Commission to rapidly develop further policy elements, including mechanisms for fair effort sharing. EU leaders agreed to take a final decision on the framework as soon as possible and in October 2014 at the latest.

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.

[70] For a more detailed analysis and explanation on the scenarios, see the Impact Assessment Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A policy framework for climate and energy in the period from 2020 up to 2030, available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014SC0015

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”[71] have been established. The Guidelines foresee in particular the possibility to authorise State aid for particular environmental purposes, such as for renewable energy sources or energy saving. The European Commission published on 9 April 2014 the “Guidelines on on State aid for environmental protection and energy 2014-2020” that intend to replace the 2008 Guidelines from 1 July 2014. A public consultation process on these draft guidelines has been conducted between December 2013 and February 2014 (European Commission 2014c). The Guidelines set out the conditions under which state aid measures for environmental protection or energy objectives may be declared compatible with the internal market. This proposal includes a list of environmental and energy measures for which state aid under certain conditions may be compatible with the EU Treaty, covering the following areas:

- Aid to energy from renewable sources
- Energy efficiency measures, including cogeneration and district heating and district cooling
- Aid for resource efficiency and in particular aid to waste management
- Aid to Carbon Capture and Storage (CCS)
- Aid in the form of reductions in or exemptions from environmental taxes and in the form of reductions in funding support for electricity from renewable sources
- Aid to energy infrastructure
- Aid for generation adequacy

[71] Official Journal No C 82, 1.4.2008, p.1

- o Aid in the form of tradable permit schemes
- o Aid for the relocation of undertakings

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, 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. It is foreseen that the final carbon leakage list for 2015-19 will be adopted by the Commission before the end of 2014 and applied to free allocation for the first time in 2015.

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)".[72]

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

[72] See http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0264en01.pdf

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.

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.

In 2009 the European Commission published a Communication on CCS in emerging developing countries (European Commission 2009). The Communication sets out the Commission's plans for establishing an investment scheme to co-finance the design and construction of a power plant to demonstrate carbon capture and storage (CCS) technology in China. The Commission has programmed funding of up to €50 million for the construction and operation phase of the project, out of a total of €60 million that has been earmarked for cooperation with emerging economies on cleaner coal technologies and carbon capture and storage. nt progress in identifying options and constraints for CCS in China. At the 2009 Summit, China and EU jointly agreed to finalise the feasibility (phase II) of a demonstration plant, and a Memorandum of Understanding was signed between the European Commission and the Ministry of Science and Technology (MOST). Implementation is on-going. In 2010 Norway joined the initiative. A call for proposals has been launched in 2013 to select the project and conduct pre-feasibility studies to be finalised in 2014.

The EU is cooperating with other Annex I and Non-Annex I Parties (Australia, Brazil, Canada, China, 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 2013 and 2014, such as the 2013 and 2014 CSLF Technical Group Meeting and the 5th CSLF Ministerial Meeting. The CSLF Task Force on Reviewing Best Practices and Standards for Geological Storage and Monitoring of CO_2 published an annual report in 2013 that compiles best practice manuals developed acorss the world, guidelines published related to CCS, and summaries of regulations in place as well as monitoring tools and techniques used in ongoing projects (CSLF 2013). The Task force on Technical Challenges in the Conversion of CO_2-EOR Projects to CO_2 Storage Projects also provided a report in 2013 that concluded that the main impediment in the adoption and deployment of this technology is the unavailability of CO_2 at economic prices at the CO_2-EOR operation sites and the absence of infrastructure to both capture the CO_2 and transport it from CO_2 sources to oil fields suitable for CO_2 –EOR.

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)[73], 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 Commission has recently started a project with the specific objective to create and facilitate the operation of an EU-GCC Clean Energy Network. 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. In 2013 also a Workshop and training seminar on integration of renewables in the grid and on energy efficiency and demand side management was held in Oman and an event related to CCS took place in London. In December 2013, the EU-GCC Energy Experts Group meeting was reconvened and is planned to continue in a fruitful dialogue beyond, with the next meeting planned in 2014. The dialogue focused on energy efficiency and natural gas, and in incuded EU market regulators and the private sector, as well as representatives of the EU-GCC clean energy network.

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:

[73] The Gulf Cooperation Council covers Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

- 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 the EU's 6th national communication and 1st Biennial Report several support programmes exist in this respect. These include:

- ***Cooperation with the EU neighboring countries on renewable electricity production***

In order to support the implementation of the Renewable Energy Directive, the Commission will in September 2013 issue guidance to Member States and potential third country partners on the implementation of cooperation and trade in the renewable energy sector. Cooperation, for example, in deploying solar energy installations in North Africa for domestic consumption as well as export is supported as part of an overall agenda for sustainable growth in a viable regional renewable energy sector. The EU has already supported this development through the "Paving the Way towards a Mediterranean Solar Plan" project as well as member States substantial input into tech Mediterranean solar Plans Technical Working Groups looking at the details of the implementation of closer cooperation. The Mediterranean Solar Plan Project Preparation Initiative (MSP-PPI), an initiative of the European Investment Bank (EIB), together with the European Commission, AFD, KfW, AECID, EBRD and the Union for the Mediterranean, is financed by the EU-funded Neighbourhood Investment Facility, with the aim to accelerate the implementation of renewable energy and energy efficiency projects in 7 Mediterranean partner countries: Algeria, Egypt, Gaza/West Bank, Jordan, Lebanon, Morocco and Tunisia.[74]

Currently an additional study "Bringing Europe and Third countries closer together through renewable Energies" (BETTER) financed by the Commission is further preparing the ground for pilot projects to be put into place.

The European Union, alongside 22 of its Member States, is a member of the International Renewable Energy Agency and as such actively supporting its work, inter alia giving substantial input to the implementation of the UN Secretary's General "Sustainable Energy For All" initiative or conducting renewable energy readiness assessment in Africa, Latin America and the Pacific region. Additionally development cooperation in many areas contributes to technology transfer. The Global Energy Efficiency and Renewable Energy Fund (GEEREF), which is managed by the European Investment Fund (EIF), for example facilitates participation in small-scale private ventures that introduce new technology in the area of renewable energy.

- *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 € 220 million. 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. A second Energy Facility (EFII), with a total budget of €200 million, has been established for the period 2009-2013. A €100 million call for proposals, launched in November 2009, resulted in the selection of 65 projects for funding.

[74] http://www.eib.org/infocentre/publications/all/mediterranean-solar-plan-project-preparation-initiative.htm

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 was 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 established the Latin America Investment Facility (LAIF). The European Commission has foreseen an amount of € 125 million for the period 2009-2013.

The primary objective of LAIF is to finance key infrastructure projects in transport, energy, social and environmental sectors as well as to support private sector development in the Latin American region, in particular small- and medium-sized enterprises (SMEs). The main purpose of the LAIF is to mobilise additional financing to support investment in Latin America, encouraging beneficiary governments and public institutions to carry out essential investment in projects and programmes that could not be otherwise financed either by the market or by development Finance Institutions alone.

As part of its efforts to achieve this objective, LAIF pursues three strategic objectives:

- Improving interconnectivity between and within Latin American countries, in particular establishing better energy and transport infrastructure, including energy efficiency, renewable energy systems and the sustainability of transport and communication networks.
- Increasing the protection of the environment and supporting climate change adaptation and mitigation actions.
- Promoting equitable and sustainable socio-economic development through the improvement of social services infrastructure and support for small- and medium-sized enterprises (SMEs).

The 2012 operational annual report of LAIF reported that the grant contributions approved by the LAIF Board amounted to over € 160 million, leveraging total new investments of about € 4.2 billion. Since 2012, the amount allocated to LAIF increased to € 192.15 million.

- *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, aims to accelerate the transfer, development, use and enforcement of environmentally sound technologies for the world's poorer regions, helping to bring secure, clean and affordable energy to local people. 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.
- Emerging Energy Latin America Fund II receives € 12.5 million from GEEREF which is managed by Emerging Energy & Environment Group which is a regional fund dedicated to small and medium size renewable energy infrastructure in Latin America (more information available under http://www.emergingenergy.com).

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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17 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**
CR — Corinair	CR — 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	
OTH - other				
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				