EEA Report No 15/2016

Annual European Union greenhouse gas inventory 1990–2014 and inventory report 2016

Submission to the UNFCCC Secretariat

17 June 2016

European Environment Agency

Title of inventory	Annual European Union greenhouse gas inventory 1990–2014 and inventory report 2016
Contact names	Ana Maria Danila (DG CLIMA) Ricardo Fernandez (EEA) Spyridoula Ntemiri (EEA) Nicole Mandl, Elisabeth Rigler (ETC/ACM)
Organisation	European Commission, DG Climate Action European Environment Agency
European Commission address	European Commission DG Climate Action BU 5 2/158 B-1049 Brussels
Fax	(32-2) 296 99 70
Telephone	(32-2) 29 58 219
E-Mail	Ana.danila@ec.europa.eu
European Environment Agency address	Kongens Nytorv 6 DK-1050 Copenhagen
Telephone	(45) 33 36 71 00
Fax	(45) 33 36 71 99
E-Mail	ricardo.fernandez@eea.europa.eu spyridoula.ntemiri@eea.europa.at

Acknowledgements

This report was prepared on behalf of the European Commission (DG CLIMA) by the European Environment Agency's (EEA) European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM) supported by the Joint Research Centre (JRC) and Eurostat.

The coordinating author was Nicole Mandl (ETC). Other authors and contributors were, in alphabetical order, Kristien Aernouts (ETC) , Graham Anderson (ETC),Johannes Burgstaller (ETC), Gema Carmona (JRC), Lukas Emele (ETC), Michael Gager (ETC), Michael Goll (Eurostat), Sabine Gores (ETC), Giacomo Grassi (JRC), Barbara Gschrey (ETC), Bernd Gugele (ETC), Ralph Hartan (ETC), Anke Herold (ETC), Kaat Jespers (ETC), Matina Kastori (ETC), Adrian Leip (JRC), Breffni Lynch (DG CLIMA), Giorgos Mellios (ETC), Lorenz Moosmann (ETC), Ils Moorkens (ETC), Henrik Neier (ETC), Katja Pazdernik (ETC), , Cecile Pierce (DG CLIMA), Marion Pinterits (ETC), Stephan Poupa (ETC), Tibor Priwitzer (JRC), Maria Purzner (ETC), Elisabeth Rigler (ETC), Margarethe Scheffler (ETC), Carmen Schmid (ETC), Günther Schmidt (ETC), Winfried Schwarz (ETC), Janka Szemsova (JRC), Ana Danila (DG Clima), Bernhard Ullrich (ETC), Ronald Velghe (DG CLIMA), Raul Abad Viñas (JRC), Andreas Zechmeister (ETC).

The EEA project managers were Ricardo Fernandez and Spyridoula Ntemiri. They appreaciate the input provided by David Simoens (EEA), Melanie Sporer (EEA), Blaz Kurnik (EEA), and John Van Ardenne (EEA). The EEA also acknowledges the input and comments received from the EU Member States, which have been included in the final version of the report as far as practically feasible.

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 between 1990 and the current calendar year (t) minus two (t-2), for emissions and removals within the area covered by its Member States (i.e. emissions taking place within its territory).

The present report is the official inventory submission of the European Union for 2016 under the UNFCCC, and for 2015 and 2016 under the Kyoto Protocol (KP), in spite of the remaining deficiencies in the CRF Reporter and underlying CRF tables[1,2]. The EU should not be held liable for errors caused by the CRF Reporter in the review of the information submitted. The inventory data reported in the 2015 submission under the UNFCCC have been revised in this submission. Therefore, the 2016 submission should also be considered as a resubmission of the estimates with regard to the 2015 UNFCCC submission. Due to the late availability of the current version of CRF Reporter (version 5.14 released on 3rd May 2016) and the subsequent hot-fixes to resolve important issues with this version, the EU values presented in this report have derived from the direct sum of the national inventories submitted to the EU by its Member States and Iceland by 20th April. To ensure full consistency with the estimates submitted by the EU Member States to the UNFCCC, the EU plans to resubmit its inventory before the UNFCCC review, which will take place in September 2016.

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 EU level relevant to climate change and repealing Decision No 280/2004/EC[3].

This Regulation establishes a mechanism for:

a) ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the EU and its Member States to the UNFCCC Secretariat;
b) reporting and verifying information relating to commitments of the EU 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;

---

[1] According to Decision 13/CP.20 of the Conference of the Parties to the UNFCCC, the CRF Reporter version 5.0.0 software was not functioning, so Annex I Parties were not able to submit their CRF tables. In the same Decision, the Conference of the Parties reiterated that Annex I Parties may submit their CRF tables after April 15 2015, but no later than the end of the corresponding delay in the availability of CRF Reporter. Decisions 20/CP.21 and 10/CMP.11 further noted that CRF reporter was still not functioning. "Functioning" software means that the data on GHG emissions/removals are reported accurately, as both reporting format tables and in XML format. In 2015, the European Union made an inventory submission under the UNFCCC, but not under the Kyoto Protocol because the CRF Reporter could not deliver CRF tables for Kyoto Protocol LULUCF activities without errors.

[2] This submission does not yet include a full set of CRF tables, because of a very recent technical issue with the CRF Reporter software, which does not allow for a proper aggregation of the EU totals. The EU is in close contact with the technical support unit of the UNFCCC secretariat and will submit the CRF tables as soon as the issue has been solved.

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

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. Since in 2014, GHG inventory reporting has taken 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).

In addition, the European Union, its Member States and Iceland have jointly agreed to fulfil their quantified emissions limitation and reduction commitments for the second commitment period to the Kyoto Protocol, as reflected in the Doha Amendment. In this context, the EU and Iceland jointly report their national GHG emissions during the second commitment period of the Kyoto Protocol. This report, therefore, refers to the totals of the EU-28 plus Iceland. For reasons of clarity, please note that in some cases the terms '(EU-28) Member States' and 'EU-28'/'EU' may be used. As a general rule, these terms also refer to Iceland.

The main institutions involved in the compilation of the EU GHG inventory are the 28 Member States plus Iceland, 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 described below:

1. Member States submit their annual GHG inventories by 15 January each year to the European Commission (DG CLIMA), with a copy to the EEA.
2. The EEA and its ETC/ACM, Eurostat, and the JRC then perform initial checks on the data submitted. Specific findings from the initial quality assurance/quality control (QA/QC) checks are communicated to Member States by 28 February. In addition, the draft EU GHG inventory and inventory report are circulated to Member States for review and comments by 28 February.
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.
4. The EEA and its ETC/ACM review final inventory submissions from Member States and their responses to the initial checks, and prepare the final EU GHG inventory and inventory report by 15 April so that they can be submitted to the UNFCCC.

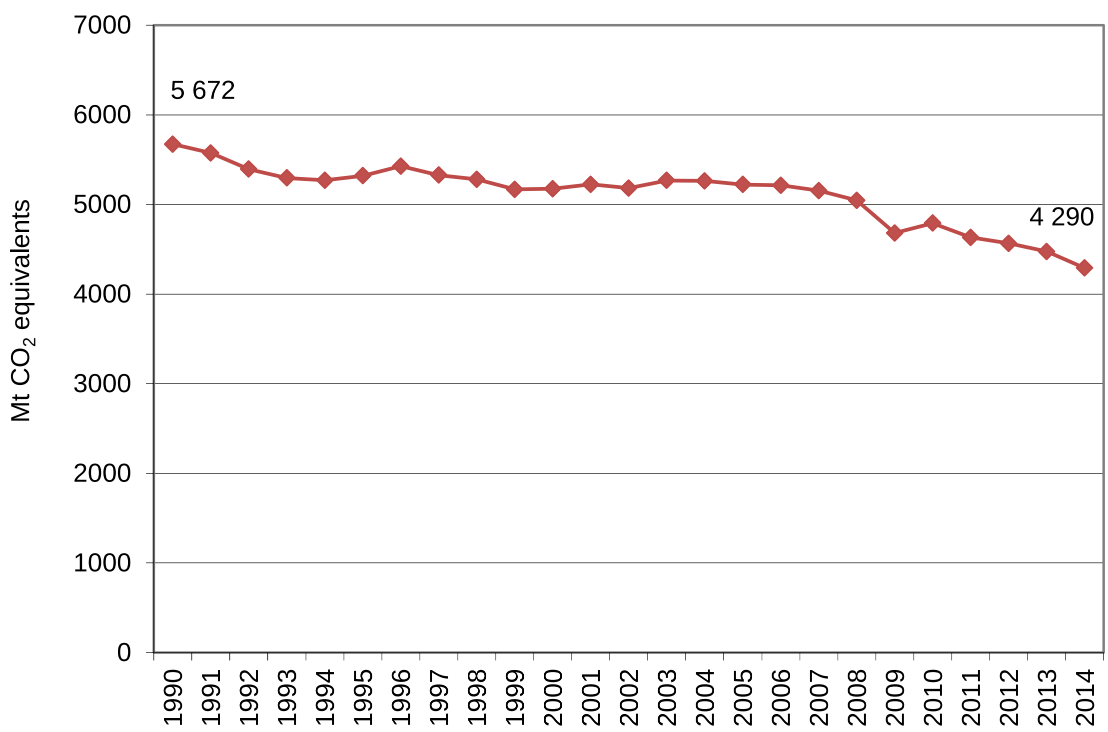
5. A resubmission is prepared by 27 May if needed. In 2016, due to the previously mentioned problems with the UNFCCC's CRF Reporter, the EU's inventory submission has been delayed until mid-June.

ES-2 Summary of greenhouse gas emissions trends in the EU

Total GHG emissions — excluding Land Use, Land Use Change and Forestry (LULUCF) — in the EU-28 plus Iceland amounted to 4 290 million tonnes CO_2 equivalent in 2014 (including indirect CO_2 emissions). All GHG emission totals provided in this report include indirect CO_2 emissions[4].

In 2014, total GHG emissions were 24.4 % (1 382 million tonnes CO_2 equivalents) below 1990 levels. Emissions decreased by 4.1 % (185 million tonnes CO_2 equivalent) between 2013 and 2014 (Figure ES. 1).

Figure ES. 1 EU-28 plus Iceland GHG emissions (excl. LULUCF)



Notes: GHG emissions data for the EU-28 plus Iceland as a whole refer to domestic emissions (i.e. within the territory), include indirect CO_2, 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 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Main trends by source category, 1990-2014

In 2014, total GHG emissions (excluding LULUCF) in the EU-28 plus Iceland reached their lowest level since 1990. There has been a progressive decoupling of gross domestic product (GDP) and GHG emissions compared to 1990, with an increase in GDP of about 47 %

[4] 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 will be presented with and without indirect CO_2. The EU national total includes indirect CO_2 emissions if Member States have reported them. The CRF tables include national totals, including and excluding indirect CO_2 emissions.

alongside a decrease in emissions of more than 24 % over the 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 2014, with the notable exception of transport, including international transport, and refrigeration and air conditioning. At the aggregate level, emissions reductions were largest for manufacturing industries and construction, 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, with a higher share of services and a lower share of more-energy-intensive industry in the total GDP. The economic recession that began in the second half of 2008 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 intensive fuels. Between 1990 and 2014, the use of solid and liquid fuels in thermal stations decreased strongly whereas natural gas consumption almost doubled, resulting in reduced CO_2 emissions per unit of fossil fuel 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 the lower demand for space heating in the EU as a whole over the past 24 years. The year 2014 was also the hottest year on record, leading to substantially lower heat demand. There has also been a very strong increase in CO_2 emissions from biomass combustion, which has contributed to lower GHG emissions in the EU. 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, and lower emissions from managed waste disposal on land and from agricultural soils.

For a more detailed analysis, see the upcoming EEA working paper '*Analysis of key trends and drivers in greenhouse gas emissions in the EU between 1990 and 2014'*, to be published alongside the final GHG inventory submission to the UNFCCC.

Table ES. 1 shows those sources that made the largest contribution to the change in total GHG emissions in the EU plus Iceland between 1990 and 2014.

Table ES. 1 Overview of EU-28 plus Iceland source categories whose emissions increased or decreased by more than 20 million tonnes CO_2 equivalent in the period 1990–2014

Source category	Million tonnes CO_2 equivalent
Road Transportation (CO_2 from 1.A.3.b)	124
Refrigeration and Air conditioning (HFCs from 2.F.1)	99
Aluminium Production (PFCs from 2.C.3)	-20
Fugitive emisisons from Natural Gas (CH_4 from 1.B.2.b)	-20
Enteric Fermentation: Dairy Cattle (CH_4 from 3.A.1)	-21
Agricultural Soils: Direct N_2O Emissions From Managed Soils (N_2O from 3.D.1)	-25
Cement Production (CO_2 from 2.A.1)	-28
Fluorochemical Production (HFCs from 2.B.9)	-29
Nitric Acid Production (N_2O from 2.B.2)	-45
Enteric Fermentation: Cattle (CH_4 from 3.A.1)	-47
Commercial/Institutional (CO_2 from 1.A.4.a)	-56
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)	-62
Coal Mining and Handling (CH_4 from 1.B.1.a)	-75
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-76
Iron and steel production (CO_2 from 1.A.2.a +2.C.1)	-105
Residential: Fuels (CO_2 from 1.A.4.b)	-140
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1.A.2 excl. 1.A.2.a)	-299
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-346
Total	**-1 382**

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 sector grouping does not match the total change listed at the bottom of the table.

Main trends by source category, 2013–2014

Total GHG emissions (excluding LULUCF) decreased by 185 million tonnes CO_2 equivalent (4.1 %) between 2013 and 2014. This significant decrease in emissions in 2014 came with an increase in GDP of 1.4 %. This resulted in a lower GHG-emissions intensity of GDP in the EU in 2014, which can be attributed to the sharp decline in the consumption of heat and electricity. This was in turn triggered by the lower heat demand from households due to the milder winter conditions in Europe. The sustained increase in non-combustible renewables for electricity generation also contributed to lower emissions in 2014. Over 80 % of the total GHG emissions reduction in 2014 was accounted for by lower CO_2 emissions from gas and solid fuels from thermal power stations as well as by lower CO_2 emissions from gas in the residential and commercial sectors. Primary energy consumption declined overall, with emissions decreasing for all fossil fuels, particularly natural gas, but also for hard coal and lignite. The consumption of renewables increased in terms of primary energy. This led to a further improvement in the carbon intensity of the EU energy system in 2014. Germany and the United Kingdom accounted for about 45% of the total GHG emissions reduction at EU level in 2014.

Table ES. 2 shows the source categories making the largest contribution to the change in GHG emissions in the EU-28 between 2013 and 2014.

Table ES. 2 Overview of EU-28 plus Iceland source categories whose emissions increased or decreased by more than 3 million tonnes CO_2 equivalent in the period 2013–2014

Source category	Million tonnes CO_2 equivalent
Road Transportation (CO_2 from 1.A.3.b)	7
Iron and steel production (CO_2 from 1.A.2.a +2.C.1)	6
Cement Production (CO_2 from 2.A.1)	3
Chemicals: Fuels (CO_2 from 1.A.2.c)	-3
Petroleum Refining (CO_2 from 1.A.1.b)	-4
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-5
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1.A.2 excl. 1.A.2.a)	-18
Commercial/Institutional (CO_2 from 1.A.4.a)	-23
Residential (CO_2 from 1.A.4.b)	-66
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-85
Total	**-185**

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.

Table ES.3 gives an overview of total GHG emissions by Member States, illustrating where the main changes occurred.

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

	1990 (million tonnes)	2014 (million tonnes)	2013–2014 (million tonnes)	Change 2013–2014 (%)	Change 1990–2014 (%)
Austria	78.8	76.3	-3.7	-4.6%	-3.2%
Belgium	146.0	113.9	-5.5	-4.6%	-22.0%
Bulgaria	104.0	57.2	2.3	4.1%	-45.0%
Croatia	34.8	24.5	-0.6	-2.3%	-29.7%
Cyprus	5.7	8.4	0.4	5.4%	47.9%
Czech Republic	199.3	125.9	-4.9	-3.7%	-36.8%
Denmark	70.7	51.2	-4.3	-7.7%	-27.6%
Estonia	40.0	21.1	-0.6	-2.8%	-47.3%
Finland	71.3	59.1	-4.2	-6.6%	-17.1%
France	548.1	458.9	-27.6	-5.7%	-16.3%
Germany	1246.1	900.2	-43.3	-4.6%	-27.8%
Greece	104.8	101.4	-3.3	-3.1%	-3.3%
Hungary	94.1	57.2	-0.3	-0.6%	-39.2%
Ireland	56.2	58.3	-0.3	-0.5%	3.7%
Italy	521.9	418.6	-20.3	-4.6%	-19.8%
Latvia	26.2	11.3	0.0	-0.3%	-56.9%
Lithuania	47.1	19.0	-0.1	-0.7%	-59.6%
Luxembourg	12.9	10.8	-0.4	-3.9%	-16.3%
Malta	2.0	3.0	0.0	1.0%	49.1%
Netherlands	222.2	187.1	-8.0	-4.1%	-15.8%
Poland	472.9	380.3	-13.2	-3.3%	-19.6%
Portugal	60.7	64.6	-0.4	-0.5%	6.5%
Romania	251.9	109.8	-0.3	-0.2%	-56.4%
Slovakia	74.7	40.6	-2.3	-5.3%	-45.6%
Slovenia	18.6	16.6	-1.7	-9.5%	-10.9%
Spain	285.9	328.9	1.5	0.5%	15.0%
Sweden	71.9	54.4	-1.6	-2.8%	-24.4%
United Kingdom	796.6	523.7	-42.5	-7.5%	-34.3%
EU-28 (Convention)	**5665.5**	**4282.1**	**-185.0**	-4.1%	**-24.4%**
United Kingdom (KP)	799.8	527.2	-42.6	-7.5%	-34.1%
Iceland	3.6	4.6	0.1	1.4%	26.5%
EU-28 + Iceland (KP)	**5672.3**	**4290.2**	**-185.0**	-4.1%	**-24.4%**

ES-3 Summary of emissions and removals by main greenhouse gas

Table ES. 4 gives an overview of the main trends in the EU-28 plus Iceland GHG emissions and removals for the period 1990–2014. By far the most important GHG is CO_2, which accounted for 81 % of total EU-28 emissions in 2014, excluding LULUCF. In 2014, EU-28 CO_2 emissions excluding LULUCF were 3 474 million tonnes, which was 22 % below 1990 levels. Compared to 2013, CO_2 emissions decreased by 5 %. Emissions of CH_4, PFCs, and SF_6 decreased in 2014, while those of N_2O, HFCs and NF_3 increased.

Table ES. 4 Overview of EU-28 plus Iceland GHG emissions and removals from 1990 to 2014 in million tonnes CO_2 equivalent

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013	2014
Net CO_2 emissions/removals	4 209	3 922	3 851	3 973	3 620	3 474	3 417	3 332	3 163
CO_2 emissions (without LULUCF)	4 474	4 216	4 176	4 301	3 946	3 800	3 739	3 657	3 474
CH_4	748	682	621	553	495	484	480	467	462
N_2O	401	364	323	302	257	253	250	251	253
HFCs	29	44	53	72	103	105	108	110	112
PFCs	26	17	12	7	4	4	4	4	4
Unspecified mix of HFCs and PFCs	5.7	5.8	2.1	0.9	0.4	0.2	0.2	0.2	0.2
SF_6	11	15	11	8	6	6	6	6	6
NF_3	0.02	0.04	0.12	0.16	0.12	0.13	0.09	0.07	0.07
Total (with net CO_2 emissions/removals)	**5 429**	**5 050**	**4 873**	**4 916**	**4 485**	**4 327**	**4 265**	**4 171**	**3 999**
Total (without CO2 from LULUCF)	**5 694**	**5 344**	**5 198**	**5 244**	**4 812**	**4 653**	**4 587**	**4 496**	**4 311**
Total (without LULUCF)	**5 672**	**5 320**	**5 175**	**5 223**	**4 791**	**4 632**	**4 565**	**4 475**	**4 290**

Notes: CO_2 emissions include indirect CO_2

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 plus Iceland GHG emissions in the main source categories for the period 1990–2014. The most important sector by far is energy (i.e. combustion and fugitive emissions), which accounted for 78 % of total EU emissions in 2014. The second largest sector is agriculture (10 %), followed by industrial processes (9 %). More detailed trend descriptions are included in the individual sector chapters (chapters 3-7).

Table ES. 5 Overview of EU-28 GHG emissions (in million tonnes CO_2-equivalent) in the main source and sink categories for the period 1990 to 2014

GHG SOURCE AND SINK	1990	1995	2000	2005	2010	2011	2012	2013	2014
1. Energy	4 358	4 091	4 019	4 117	3 800	3 651	3 604	3 520	3 328
2. Industrial Processes	513	493	448	454	389	384	372	371	375
3. Agriculture	549	479	465	440	428	428	425	429	436
4. Land-Use, Land-Use Change and Forestr	-244	-270	-303	-307	-305	-304	-300	-304	-291
5. Waste	244	250	238	207	170	164	159	151	146
6. Other	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
indirect CO_2 emissions	8.34	7.06	6.30	5.46	4.62	4.50	4.39	4.29	4.10
Total (with net CO_2 emissions/removals)	**5 429**	**5 050**	**4 873**	**4 916**	**4 485**	**4 327**	**4 265**	**4 171**	**3 999**
Total (without LULUCF)	**5 672**	**5 320**	**5 175**	**5 223**	**4 791**	**4 632**	**4 565**	**4 475**	**4 290**

Notes: CO_2 emissions include indirect CO_2

ES-5 Summary of EU Member State emission trends

Table ES. 6 gives an overview of Member State contributions to EU GHG emissions for the period 1990–2014. Member States show large variations in GHG emissions trends.

Table ES. 6 Overview of EU-28 plus Iceland contributions to total GHG emissions, excluding LULUCF, from 1990 to 2014 in million tonnes CO_2-equivalent

Member State	1990	1995	2000	2005	2010	2011	2012	2013	2014
Austria	78.8	79.8	80.4	92.8	84.9	82.6	79.9	80.0	76.3
Belgium	146.0	154.0	149.2	144.8	133.3	122.8	118.8	119.4	113.9
Bulgaria	104.0	73.5	58.3	62.7	59.8	65.1	60.0	54.9	57.2
Croatia	34.8	24.4	27.0	31.1	29.0	28.4	26.1	25.0	24.5
Cyprus	5.7	7.1	8.4	9.3	9.6	9.3	8.7	8.0	8.4
Czech Republic	199.3	158.1	150.9	148.7	140.2	138.8	134.7	130.7	125.9
Denmark	70.7	78.6	71.1	66.7	63.6	58.4	53.5	55.5	51.2
Estonia	40.0	19.9	17.1	18.3	19.9	20.5	19.4	21.7	21.1
Finland	71.3	71.8	70.0	69.5	75.9	68.0	62.4	63.3	59.1
France	548.1	547.0	554.3	554.8	514.5	487.0	488.4	486.5	458.9
Germany	1246.1	1118.5	1041.1	989.9	939.4	920.2	924.7	943.5	900.2
Greece	104.8	110.8	127.7	136.0	118.7	115.7	112.2	104.7	101.4
Hungary	94.1	75.7	73.6	75.9	65.5	63.8	60.1	57.6	57.2
Ireland	56.2	59.9	69.3	70.4	62.3	58.2	58.7	58.5	58.3
Italy	521.9	533.4	554.5	578.9	508.4	494.8	468.7	438.9	418.6
Latvia	26.2	12.8	10.4	11.4	12.3	11.5	11.4	11.3	11.3
Lithuania	47.1	21.6	18.7	22.3	20.1	20.6	20.4	19.1	19.0
Luxembourg	12.9	10.1	9.7	13.0	12.2	12.1	11.8	11.2	10.8
Malta	2.0	2.5	2.6	3.0	3.1	3.2	3.3	3.0	3.0
Netherlands	222.2	232.2	220.3	214.4	213.8	200.0	195.3	195.0	187.1
Poland	472.9	445.2	392.2	396.9	406.2	403.3	396.9	393.4	380.3
Portugal	60.7	71.4	84.0	88.2	70.4	68.9	67.1	65.0	64.6
Romania	251.9	182.8	140.5	146.6	117.0	121.7	120.1	110.0	109.8
Slovakia	74.7	54.7	49.9	51.5	46.5	45.7	43.3	42.9	40.6
Slovenia	18.6	18.8	19.1	20.5	19.6	19.6	19.0	18.3	16.6
Spain	285.9	325.7	385.1	438.5	360.8	360.4	355.4	327.4	328.9
Sweden	71.9	74.0	68.9	67.0	65.0	61.0	57.6	55.9	54.4
United Kingdom	796.6	748.8	713.8	692.1	610.2	562.1	579.2	566.3	523.7
EU-28 (Convention)	**5 665**	**5 313**	**5 168**	**5 215**	**4 782**	**4 623**	**4 557**	**4 467**	**4 282**
United Kingdom (KP)	799.8	752.2	717.3	695.7	613.9	565.7	582.6	569.8	527.2
Iceland	3.6	3.4	4.0	3.9	4.7	4.5	4.6	4.5	4.6
EU-28 + Iceland (KP)	**5 672**	**5 320**	**5 175**	**5 222**	**4 790**	**4 631**	**4 565**	**4 475**	**4 290**

The overall EU GHG emissions trend is dominated by the two largest emitters, Germany (21 %) and the United Kingdom (12 %), which accounted for one third of total EU-28 GHG emissions in 2014. By 2014, these two Member States had achieved total domestic GHG emissions reductions of 619 million tonnes CO_2 equivalent compared to 1990, not counting carbon sinks and the use of Kyoto mechanisms.

About 45 % of the EU's net decrease in GHG emissions was accounted for by Germany and the United Kingdom. The main reasons for the favourable trend in Germany were an increase in the efficiency of power and heating plants and the economic restructuring of the five new Länder after the German reunification, particularly in the iron and steel sector. Other important reasons include a reduction in the carbon intensity of fossil fuels (with the switch from coal to gas), a strong increase in renewable energy use and waste management measures that reduced the landfilling of organic waste. Lower GHG emissions in the United Kingdom were primarily the result of liberalising energy markets and the subsequent fuel switch from oil and coal to gas in electricity production. Other reasons include the shift towards more efficient combined cycle gas turbine stations, decreasing iron and steel production and the implementation of methane recovery systems at landfill sites.

ES-6 Other information

INTERNATIONAL AVIATION AND MARITIME TRANSPORTATION

GHG emissions from international aviation increased by over 95% between 1990 and 2014. GHG emissions from international shipping increased by 24 % during the same 24-year period. In 2014, emissions from international aviation overtook emissions from international shipping (138 million tonnes CO_2 equivalent and 135 million tonnes CO_2 equivalent respectively). Together, the two sectors accounted for about 6 % of the total EU GHG emissions in 2014.

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

INFORMATION ON RECALCULATIONS

According to UNFCCC Reporting Guidelines, the inventory for the whole time series should be estimated using the same methodologies, and the underlying activity data and emissions factors should be used in a consistent manner, ensuring that changes in emissions trends are not introduced as a result of changes in estimation methods. Thus, recalculations of past emissions data occur every year based on GHG inventory improvements by Member States, and should ensure the consistency of the time series and be carried out to improve the accuracy and/or completeness of the inventory.

Based on EU Member States' GHG inventories in 2016, total EU GHG emissions (excluding LULUCF) for 2013 were 0.3 % lower than those reported in the 2015 GHG inventories. Total EU emissions in 1990, reported in 2016 GHG inventories, were 0.4 % lower than the 1990 emissions reported in 2015 inventories.

For detailed information on recalculations see Chapter 10 and the sector-specific recalculations in the sectoral chapters of the main report.

Annexes relevant to the EU submission:

Annex I: Key category analysis

Annex II: Uncertainty assessment (included in NIR section 1.6)

Annex III: Detailed methodological descriptions for individual source or sink categories

Annex IV: Energy balance for 2014, see table 1.16

Annex V: Additional information (summary 2 tables and status & consistency reports by MS)

Annex VI: Accounting Table

PART 1: ANNUAL INVENTORY SUBMISSION (EU-28)

1 INTRODUCTION TO THE EU GREENHOUSE GAS INVENTORY

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 between 1990 and the current calendar year (t) minus two (t-2), for emissions and removals within the area covered by its Member States (i.e. emissions taking place within its territory).

The present report is the official inventory submission of the European Union for 2016 under the UNFCCC, and for 2015 and 2016 under the Kyoto Protocol (KP), in spite of the remaining deficiencies in the CRF Reporter and underlying CRF tables[5,6]. The EU should not be held liable for errors caused by the CRF Reporter in the review of the information submitted. The inventory data reported in the 2015 submission under the UNFCCC have been revised in this submission. Therefore, the 2016 submission should also be considered as a resubmission of the estimates with regard to the 2015 UNFCCC submission. Due to the late availability of the current version of CRF Reporter (version 5.14 released on 3rd May 2016) and the subsequent hot-fixes to resolve important issues with this version, the EU values presented in this report have derived from the direct sum of the national inventories submitted to the EU by its Member States and Iceland by 20th April. To ensure full consistency with the estimates submitted by the EU Member States to the UNFCCC, the EU plans to resubmit its inventory before the UNFCCC review, which will take place in September 2016.

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 are available in the national inventory reports of the Member States, which are submitted to the UNFCCC and published in the UNFCCC website. To facilitate the work of the expert review teams during the annual UNFCCC review process, and as follow up to previous review recommendations, the EU submission in 2016 includes an Annex (Annex III) with a summary description of the methodologies used by each Member State for the EU key categories. The more detailed descriptions can be found in Member State's own submissions. 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

---

[5] According to Decision 13/CP.20 of the Conference of the Parties to the UNFCCC, the CRF Reporter version 5.0.0 software was not functioning, so Annex I Parties were not able to submit their CRF tables. In the same Decision, the Conference of the Parties reiterated that Annex I Parties may submit their CRF tables after April 15 2015, but no later than the end of the corresponding delay in the availability of CRF Reporter. Decisions 20/CP.21 and 10/CMP.11 further noted that CRF reporter was still not functioning. "Functioning" software means that the data on GHG emissions/removals are reported accurately, as both reporting format tables and in XML format. In 2015, the European Union made an inventory submission under the UNFCCC, but not under the Kyoto Protocol because the CRF Reporter could not deliver CRF tables for Kyoto Protocol LULUCF activities without errors.

[6] This submission does not yet include a full set of CRF tables, because of a very recent technical issue with the CRF Reporter software, which does not allow for a proper aggregation of the EU totals. The EU is in close contact with the technical support unit of the UNFCCC secretariat and will submit the CRF tables as soon as the issue has been solved.

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[7]. 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 the respective national inventories, except for the Intergovernmental Panel on Climate Change (IPCC) reference approach for CO_2 emissions from the combustion of 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. Even though not all Member States were part of the European Union in 1990, GHG emissions in the EU are time-series consistent since 1990 and account for all sources and sinks of the current 28 EU MS.

In addition, the European Union, its Member States and Iceland have jointly agreed to fulfil their quantified emissions limitation and reduction commitments for the second commitment period to the Kyoto Protocol, as reflected in the Doha Amendment. In this context, the EU and Iceland jointly report their national GHG emissions during the second commitment period of the Kyoto Protocol. This report, therefore, refers to the totals of the EU-28 plus Iceland. For reasons of clarity, please note that in some cases the terms '(EU-28) Member States' and 'EU-28'/'EU' may be used. As a general rule, these terms also refer to Iceland.

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[8]. 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.

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

[8] Decision No 406/2009/EC

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) [9]. 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 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 moxide (CO), sulphur dioxide (SO2), nitrogen oxides (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[10]) 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 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) [11].

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.

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

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

Figure 1.1 Inventory system of the European Union

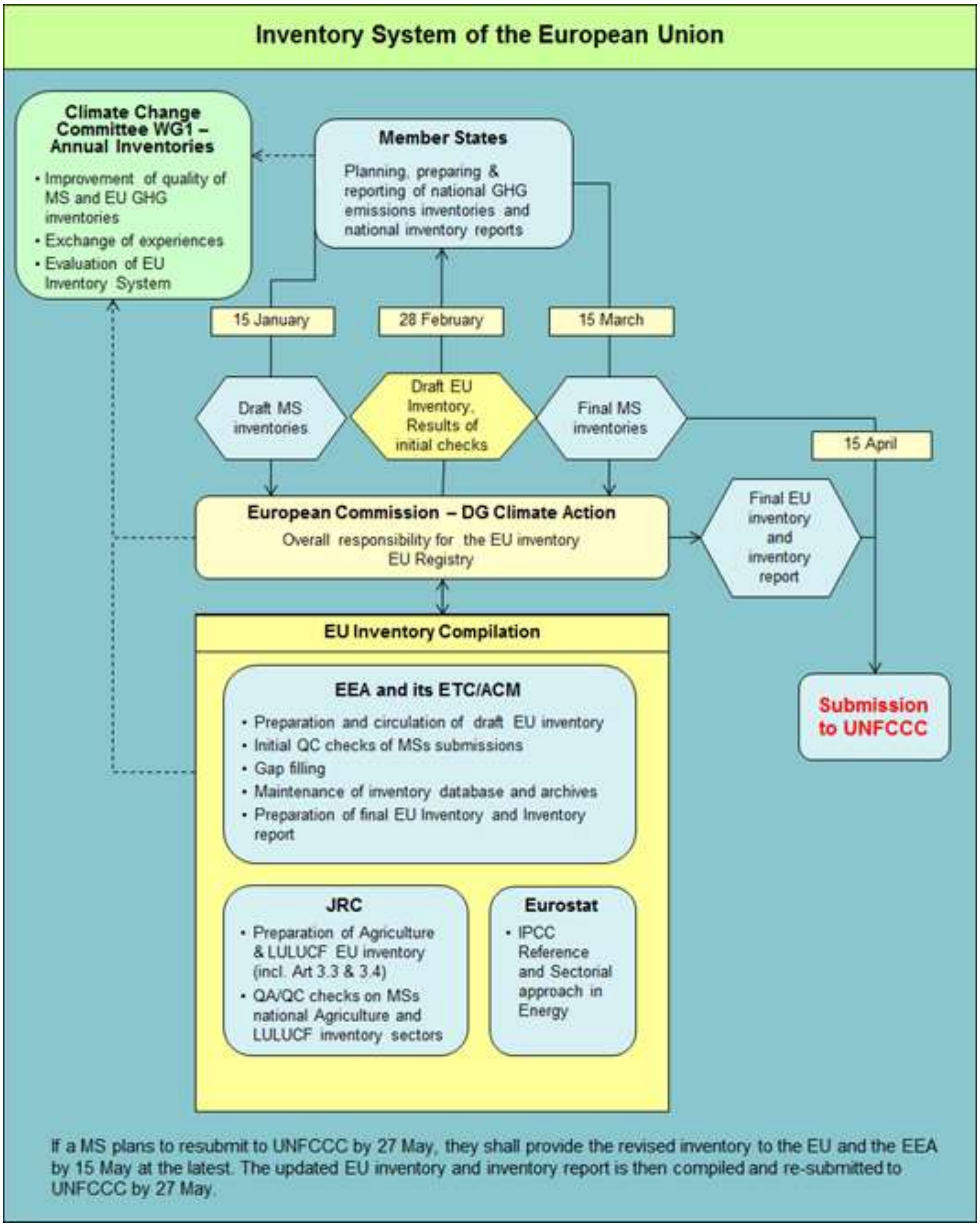


Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EU inventory.

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	Ms Iva Švedek Ekonerg - Energy and Environmental Protection Institute Koranska 5 10000 Zagreb Ms Vlatka Palčić Ministry of Environmental and Nature Protection Radnička cesta 80 10000 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	Katre Kets Adviser, Climate and Radiation Department Tel. +372 626 0754 Fax +372 626 2801 Katre.Kets@envir.ee and Cris-Tiina Türkson Senior officer, Climate and Radiation Department Tel. +372 626 2977 Fax +372 626 2801 Cris-Tiina.Turkson@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	Pascale Vizy Direction Générale de l'Energie et du Climat (DGEC) Ministère de l'Environnement, de l'Energie et de la Mer (MEEM) Tour Sequoia 92055 La Défense CEDEX and Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 42 rue de Paradis, F-75010 Paris Jean-Pierre Chang
Germany	Michael Strogies Federal Environmental Agency Wörlitzer Platz 1, D-06844 Dessau-Roßlau
Greece	Mr. Kyriakos Psychas Ministry of Environment and Energy Amaliados, 17 Athens, Greece

Hungary	Mr. Gábor KIS-KOVÁCS Hungarian Meteorological Service, Kitaibel Pál u. 1, 1024, Budapest, HUNGARY kiskovacs.g@met.hu Tel. +36-1-346-4706
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
Lithuania	Ms. Jolanta Merkeliene, Chief Desk Officer, Climate Change Policy Division of the Ministry of Environment 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	Milos Grajcar 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	Johan Kristensson The Ministry of the Environment and Energy, Rosenbad 4 SE 103 33 Stockholm, Sweden and Ms. Frida Löfström The Swedish Environmental Protection Agency Naturvårdsverket , SE-106 48 Stockholm Sweden

United Kingdom	Julia Sussams UK Greenhouse Gas Inventory GHG Statistics & Inventory Team Department of Energy & Climate Change (0300) 068 2942; julia.sussams@decc.gsi.gov.uk
European Commission	Ana Maria Danila European Commission, DG Climate Action Beaulieu, BU-24 4/32, 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[12]

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 European Commission and to the European Environment Agency (EEA) by 15 January every year.

[12] In addition, the European Union, its Member States and Iceland have jointly agreed to fulfil their quantified emissions limitation and reduction commitments for the second commitment period to the Kyoto Protocol, as reflected in the Doha Amendment. In this context, the EU and Iceland jointly report their national GHG emissions during the second commitment period of the Kyoto Protocol. This report, therefore, refers to the totals of the EU-28 plus Iceland. For reasons of clarity, please note that in some cases the terms '(EU‑28) Member States' and 'EU-28'/'EU' may be used. As a general rule, these terms also refer to Iceland.

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 UNFCCC 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 of MS inventories

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[13] (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 responsible for the implementation of the QA/QC Programme of the EU, by performing inter alia a number of 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 on 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 explained in the next paragraph.

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:

---

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

- 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 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

1.4.2.1 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 ReportNet 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. Any information reported by MS in categories that do not have standardized UIDs or in categories for which several country settings are possible have to be included in the CRF Reporter manually.

Table 1.2 Annual process of submission and review of Member States inventories and compilation of the EU inventory (normal cycle)

Element	Who	When	What
1. Submission of annual greenhouse gas inventories (complete common reporting format (CRF) submission and elements of the national inventory report) by Member States under Council Decision No 280/2004/EC	Member States	15 January	Elements listed in Article 7(1) of 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 Action) assisted by EEA	31 March	The Commission prepares estimates for missing data by 31 March of the reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
11. Comments from Member States regarding the Commission	Member States	7 April	Member States provide comments on the Commission estimates for missing

Element	Who	When	What
estimates for missing data			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. [14]
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.

By 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

[14] In 2016, due to the previously mentioned problems with the UNFCCC's CRF Reporter, the EU's inventory submission has been delayed until mid-June.

completeness of the EU-28and Iceland submissions in 2016 that were taken into account for the compilation EU GHG inventory.

Table 1.3 Date, mode and content of submission of EU-28 Member States and Iceland in 2016 that were taken into account for the compilation of EU GHG inventory

Country	Date	Submission mode	XML	CRF	NIR
AUT	14.04.2016	CDR	simple_1706314771069881684.xml	1990-2014	x
BEL	15.04.2016	CDR	simple_227911604656441714.xml	1990-2014	x
BGR	15.04.2016	CDR	simple_5217872281502387075.xml	1988-2014	x
CYP	18.04.2016	CDR	simple_3078867288811463040.xml	1990-2014	x
CZE	15.04.2016	CDR	simple_6836405472863145748.xml	1990-2014	x
DEU	15.03.2016	CDR	simple_6393176820205736975.xml	1990-2014	x (de)
DNM	15.03.2016	CDR	simple_9077118714662658288.xml	1990-2014	x
ESP	18.04.2016	CDR	simple_456274597973803313.xml	1990-2014	x (es)
EST	15.04.2016	CDR	simple_362962791000084662.xml	1990-2014	x
FIN	15.04.2016	CDR	simple_7647023397855897919.xml	1990-2014	x
FRK	19.04.2016	CDR	simple_8206396921870362474.xml	1990-2014	x (fr)
GBE	15.03.2016	CDR	simple_7527138877501132563.xml	1990-2014	x
GRC	30.03.2016	CDR	simple_7164596053652130423.xml	1990-2014	
HRV	15.04.2016	CDR	simple_1241994617617865103.xml	1990-2014	x
HUN	18.04.2016	CDR	simple_3693273354044794740.xml	1985-2014	x
IRL	15.03.2016	CDR	simple_8612759106446107567.xml	1990-2014	
ISL	18.04.2016	CDR	simple_4287210915098931603.xml	1990-2014	x
ITA	15.04.2016	CDR	simple_6946653036502312885.xml	1990-2014	
LTU	18.04.2016	CDR	simple_5428656574840311435.xml	1990-2014	x

LUX	15.04.2016	CDR	simple_8460726960841497718.xml	1990-2014	x
LVA	16.04.2016	CDR	simple_4301663308748079766.xml	1990-2014	x
MLT	19.04.2016	CDR	simple_7309086141084228531.xml	1990-2014	x
NLD	18.04.2016	CDR	simple_4842032189648112736.xml	1990-2014	x
POL	15.04.2016	CDR	simple_7378865809433380720.xml	1988-2014	x
PRT	18.04.2016	CDR	simple_8288197483950191105.xml	1990-2014	x
ROU	15.04.2016	CDR	simple_2588827613443441067.xml	1989-2014	x
SVK	15.04.2016	CDR	simple_2416119689718095193.xml	1990-2014	x
SVN	15.04.2016	CDR	simple_2026045751354990255.xml	1986-2014	
SWE	18.04.2016	CDR	simple_2413544426629070616.xml	1990-2014	x

Note: Due to the late availability of the current version of CRF Reporter (version 5.14, released on 3 May 2016) and the subsequent hot-fixes to resolve important issues with this version, the EU values presented in this report have derived from the direct sum of the national inventories submitted to the EU by its Member States and Iceland by 20 April. MS have provided updated inventories to the EU and the UNFCCC after the 3 May release. These have not been taken into account in the EU's submission to UNFCCC of June 2016. To ensure full consistency with the estimates submitted by the EU Member States to the UNFCCC, the EU plans to resubmit its inventory before the UNFCCC review, which will take place in September 2016.

Table 1.4 gives an overview on people involved in the compilation of the EU GHG inventory submission in 2016 and their individual responsibilities in this process.

Table 1.4 Responsibility list for the compilation of the EU GHG inventory submission in 2016

		EU GHG inventory/inventory report compilation					**Initial Checks**				
	Name	Overall responsibility	Project manager	Sector experts	Team members	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts	Team members	Quality expert
European Commission	Ana Danila (DG Clima) Ana.DANILA@ec.europa.eu	X		Chapter 13 Changes national system		QA NIR: Executive summary, chapter 1,	X				
	Ronald Velghe (DG Clima) ronald.velghe@ec.europa.eu			Chapter 12 Kyoto units, Chapter 14 Changes to registry, EU-SEF Tables							
	Breffni Lynch (DG CLIMA) breffni.lynch@ec.europa.eu				Chapter 12 Kyoto units, Chapter 14 Changes to registry, EU-SEF Tables						
	Adrian Leip (JRC) adrian.leip@jrc.ec.europa.eu					sector 3					sector 3
	Janka Szemesova (JRC) janka.szemesova@shmu.sk			QA NIR: sector 3					sector 3		
	Gema Carmona (JRC) gema.carmona-garcia@jrc.ec.europa.eu				sector 3					sector 3	
	Giacomo Grassi (JRC) giacomo.grassi@jrc.ec.europa.eu					QA NIR: sector LULUCF and KP LULUCF					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	EU GHG inventory/inventory report compilation					Initial Checks				
		Overall responsibility	Project manager	Sector experts	Team members	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts	Team members	Quality expert
EEA	Ricardo Fernandez (EEA) ricardo.fernandez@eea.europa.eu	X				**QA NIR:** Executive summary, chapter 1 and 2, recalculations & improvements chapter	X				
EEA	Spyridoula Ntemiri (EEA) spyridoula.ntemiri@eea.europa.eu	X				**QA NIR:** Executive summary, chapter 1, recalculations & improvements chapter	X				
EEA	David Simoens (EEA) david.simoens@eea.europa.eu				ReportNet, Data checks, EEA locator	Consistency checks				ReportNet, Data checks, EEA locator	
	Melanie Sporer (EEA) Melanie.sporer@eea.europa.eu									EEA Emission Review Tool (EMRT)	
ETC/ACM	Johannes Burgstaller (ETC-ACM; UBA-V) johannes.burgstaller@umweltbundesamt.at				support UBA work, Uncertainties						
ETC/ACM	Michael Gager (ETC-ACM; UBA-V) michael.gager@umweltbundesamt.at		Data manager								
ETC/ACM	Bernd Gugele (ETC-ACM, UBA-V) bernd.gugele@umweltbundesamt.at			1A Reference approach	1A1, 1A2, 1A4, 1A5				1A Reference approach		QA/QC UBA work , cross cutting issues
ETC/ACM	Nicole Mandl (ETC-ACM, UBA-V) nicole.mandl@umweltbundesamt.at		X			Chapter 2 (trends chapter)		X	cross-cutting issues		
ETC/ACM	Lorenz Moosmann (ETC-ACM, UBA-V lorenz.moosmann@umweltbundesamt.at			2C, 2D, 2G3-2G4, 2H					2C, 2D, 2G3-2G4, 2H		

	Name	**EU GHG inventory/inventory report compilation**					**Initial Checks**				
		Overall responsibility	Project manager	Sector experts	Team members	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts	Team members	Quality expert
	Henrik Neier (ETC-ACM; UBA-V) henrik.neier@umweltbundesamt.at				support UBA work					sector 1A1	
	Katja Pazdernik (ETC-ACM; UBA-V) katja.pazdernik@umweltbundesamt.at										sector 5
	Marion Pinterits (ETC-ACM; UBA-V) marion.pinterits@umweltbundesamt.at			1B, 1C	Chapters 1 & 10, support UBA work				sectors 1B, 1C		
	Stephan Poupa (ETC-ACM; UBA-V) stephan.poupa@umweltbundesamt.at			1A2, 1A4, 1A5					sectors 1A2, 1A4, 1A5		
	Maria Purzner (ETC-ACM; UBA-V) maria.purzner@umweltbundesamt.at				2C, 2D, 2G3-2G4, 2H					2C, 2D, 2G3-2G4, 2H	sector 2 f-gases only
	Carmen Schmid (ETC-ACM; UBA-V) carmen.schmid@umweltbundesamt.at			sector 1A1					sector 1A1		
	Günther Schmidt (ETC-ACM; UBA-V) guether.schmidt@umweltbundesamt.at				Data manager						
	Andreas Zechmeister (ETC-ACM; UBA-V) andreas.zechmeister@umweltbundesamt.at			Chapter 1 Uncertainties							
	Giorgos Mellios (ETC-ACM; Emisia) giorgos.m@emisia.com			1A3 + bunkers					sectors 1A3 + bunkers		
	Matina Kastori (ETC-ACM; Emisia) matina.k@emisia.com				1A3 + bunkers					sectors 1A3 + bunkers	
	Barbara Gschrey (ETC-ACM; Oeko Recherche) b.gschrey@oekorecherche.de			F-gases 2E, 2F, 2G1-2					F-gases 2E, 2F, 2G1-2		
	Winfried Schwarz (ETC_ACM; Oeko Recherche) w.schwarz@oekorecherche.de				F-gases 2E, 2F, 2G1-2					F-gases 2E, 2F, 2G1-2	
	Margarethe Scheffler (ETC-ACM; Oeko) m.scheffler@oeko.de			sector 5					sector 5		
	Anke Herold (ETC-ACM; Oeko) a.herold@oeko.de				Chapter 3.14 Coordinate Oeko work					EU ETS	QA/QC Oeko work,

	Name	**EU GHG inventory/inventory report compilation**					**Initial Checks**				
		Overall responsibility	Project manager	Sector experts	Team members	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts	Team members	Quality expert
	Graham Anderson (ETC-ACM; Oeko) g.anderson@oeko.de			sectors 2A, 2B					sectors 2A, 2B		
	Sabine Gores (ETC-ACM; Oeko) s.gores@oeko.de				1A3a + Aviation bunkers comparison with Eurocontrol				1A3a + Aviation bunkers comparison with Eurocontrol		
	Carina Zell-Ziegler(ETC-ACM; Oeko) C.Zell-Ziegler@oeko.de				1A3a + Aviation bunkers comparison with Eurocontrol					1A3a + Aviation bunkers comparison with Eurocontrol	
	Ralph Harthan (ETC-ACM; Oeko) r.harthan@oeko.de										sector 1
	Lukas Emele (ETC-ACM; Oeko) l.emele@oeko.de			EU ETS					EU ETS		
	Kristien Aernouts (ETC-ACM; VITO) kristien.aernouts@vito.be					**QA NIR:** sector 1					
	Ils Moorkens (ETC-ACM; VITO) ils.moorkens@vito.be					**QA NIR:** sector 2					sector 2 (excl. f-gases)
	Kaat Jespers (ETC-ACM; VITO) kaat.jespers@vito.be					**QA NIR:** sector 5					

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		
ETC 11	Documents	Describes the production, change, proofreading, release and 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, have been implemented by the Member State -

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

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.

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 EMRT during February. The status and consistency reports of the Member States' submissions are included in Annex V 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, including the information on methodologies and EFs used for the EU key categories (Annex III).

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. By that date 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.

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 e.g. 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.

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 and 2017, after analysing the inventory reporting of the Member States and the conclusions from the UNFCCC reviews.

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 led 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 and comprehensive 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.

In April-August 2016, a comprehensive review was carried out. All 28 Member States have been reviewed by a team of 22 reviewers. As it was not possible to carry out the ESD review in 2015 due to the problems with CRF reporter software the ESD comprehensive review 2016 has been an extended review and covered the years 2005, 2008-2010 and 2013-2014. The review considered the six GHGs CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. It did not consider NF_3 because NF_3 is not covered by the ESD. All sectors were considered with the exception of LULUCF; domestic and international aviation was also reviewed but no technical corrections were made because aviation is covered under the EU ETS and excluded under the ESD.

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. The table below lists the most recent workshops.

Table 1.6 Overview of GHG inventory related workshops and expert meetings organised by the EU national system

Workshop/expert meeting	Date and venue
JRC technical LULUCF workshop under the UNFCCC, the Kyoto Protocol (KP) and the EU LULUCF Decision No 529/2013	02-03 May, Baveno, Italy
Capacity building workshop for MS GHG inventory experts	18 February 2016, European Commission, Brussels
Workshop to support EU MS in the calculation of aviation emissions under UNFCCC and LRTAP reporting based on EUROCONTROL data	11 November 2015, Eurocontrol, Brussels
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
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[15].

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. The EU submission in 2016 includes an Annex with a summary description of the methodologies used by each Member State for the EU key categories. The more detailed descriptions can be found in Member State's own submissions, which are considered to be part of the EU inventory.

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.

---

[15] 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.

1.3.2 Documentation and archiving

The documentation consists of quality management documentation in forms, checklists, inventory reports and correspondence. Archiving includes archiving of inventory documents and QM documents; a systematic archiving procedure is a prerequisite for a transparent inventory system.

All the material used for the compilation of the EU GHG inventory including inventory documents and QM documents are posted in the following directory:

\\Umweltbundesamt.at\projekte\1000\1840_ETC_ACC\Intern\0_ETC_ACM_2016\1.3.1.1_EU Data Capture GHG and Inventory Report

There are four sub-directories under this directory:

1. \Inventory
2. \Archive
3. \Quality manual
4. \General

The Member States submissions and all correspondence are stored in the sub-directory\Archive. The central tool for documenting all the material received from MS (including correspondence) is the MS archive database which includes references, short characterisations and links to e-mails for all MS submissions. The MS archive database can be searched for documents (CRF, XML, NIR, etc.) or for mails. Each submission is numbered consecutively.

1.4 Brief general description of methodologies 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 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	6,438	1.235
Refining of mineral oil	21	136	127
Production of coke	22	21	15
Metal ore roasting or sintering	23	9	3
Production of pig iron or steel	24	249	108
Production or processing of ferrous metals	25	224	12
Production of primary aluminium	26	29	7
Production of secondary aluminium	27	32	8
Production or processing of non-ferrous metals	28	86	7
Production of cement clinker	29	245	116
Production of lime, or calcination of dolomite/magnesite	30	296	33
Manufacture of glass	31	358	18
Manufacture of ceramics	32	902	15
Manufacture of mineral wool	33	44	2
Production or processing of gypsum or plasterboard	34	38	1
Production of pulp	35	141	5
Production of paper or cardboard	36	569	22
Production of carbon black	37	11	1

Main activity	**Activity code**	**Number of entities**	**Verified emissions (Mt CO_2-eq.)**
Production of nitric acid	38	34	7
Production of adipic acid	39	2	0
Production of glyoxal and glyoxylic acid	40	1	0
Production of ammonia	41	28	20
Production of bulk chemicals	42	351	36
Production of hydrogen and synthesis gas	43	44	9
Production of soda ash and sodium bicarbonate	44	13	3
Capture of greenhouse gases under Directive 2009/31/EC	45	0	0
Other activity opted-in under Art. 24	99	235	3
All stationary installations		10,536	1,814

Source: EEA, 2016

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	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

EU ETS activity	CRF category	Comment
	2.B.8 Petrochemical and carbon black production	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.
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	• Emissions are included in EU ETS only for those ferroalloy production installations exceeding rated thermal input of 20 MW while in GHG

EU ETS activity	CRF category	Comment

	production
	2.C.2 Ferroalloys production
	1.A.1.c Manufacture of solid fuels and other energy industries
		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

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

EU ETS activity	CRF category	Comment
		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 rotary kilns or in other furnaces	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 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
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

EU ETS activity	CRF category	Comment
		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

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

EU ETS activity	CRF category	Comment
		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
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	1.C.2 Injection and storage	• Consistent with scope of inventory (currently no emissions reported under the EU ETS)

EU ETS activity	CRF category	Comment
a storage site permitted under Directive 2009/31/EC		
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 2016

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 2016 to the European Commission, all 28 Member States indicated that they used EU ETS data at least for QA/QC purposes (see Table 1.9). 19 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	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 2016 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) 2016: EU Emissions Trading System (ETS) data viewer http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer

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 sub-mitted 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 EU-ROCONTROL. The European Environment Agency and its ETC/ACM assist DG CLIMA regarding the technical requirements.

To support the inventory process for the submission in 2016, in October 2015 MS received fuel and emissions data for the years 2005 to 2014 as calculated by EUROCONTROL using a TIER 3b 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. In November 2015 the European Environment Agency provided MS with a comparison between EUROCONTROL data and MS data on fuel consumption of civil and international aviation for the years 2012 and 2013, related CO2 emissions and implied emission factors of CH4 and N2O at a workshop.

The presentations and the minutes have been shared with MS (documentation available upon request). Countries have been encouraged to provide feedback to these

EUROCONTROL results so that suggestions and questions could be taken into account in the next modelling exercise.

In the course of the 'initial checks' of MS inventories in the first months of 2016 the comparison between Tier 3b calculations from EUROCONTROL and time series of MS inventories has been conducted with most actual inventories from Member States. In case of considerable differences between Member State results and those from Eurocontrol, the European Environment Agency and its ETC/ACM asked Member States via the EMRT about possible reasons. For more information on the results of the comparison, see chapter #3.2.

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 recalculate time series for the period 2005 to 2014 in case of considerable changes in the model. There is an ongoing evaluation of an implementation of a web-portal by EUROCONTROL for a user friendly display and download of AEM results for Member States.

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 and a trend assessment was carried out for the years 1990 and 2014 The assessment was carried out for emissions excluding LULUCF and including LULUCF.
  The key category analysis excluding LULUCF resulted in the identification of 92 key categories for the EU-28 and Iceland and cover 94 % of total EU-28 GHG emissions in 2014 (see Annex I). The key category analysis including LULUCF resulted in 99 key categories.

The results of the EU key category analysis including LULUCF are 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 and Iceland (Gg CO_2 equivalents)

Key category (gas)	kt CO_2 equ.		Trend	Level	
	1990	2014		1990	2014
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	86689	165257	T	L	L
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	176545	31458	T	L	L
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	10716	34969	T	L	L
1 A 1 a Public Electricity and Heat Production: Peat (CO_2)	8530	8369	0	0	L
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	1129615	825992	T	L	L
1 A 1 b Petroleum Refining: Gaseous Fuels (CO_2)	5276	24091	T	0	L
1 A 1 b Petroleum Refining: Liquid Fuels (CO_2)	112183	89863	0	L	L
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Gaseous Fuels (CO_2)	17641	18617	T	L	L
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Solid Fuels (CO_2)	92356	31361	T	L	L
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	30936	18179	T	L	L
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	8748	1758	T	0	0
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	135295	84643	T	L	L
1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)	8918	1799	T	0	0
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	56493	38317	T	L	L
1 A 2 c Chemicals: Liquid Fuels (CO_2)	40479	19214	T	L	L
1 A 2 c Chemicals: Solid Fuels (CO_2)	14500	9163	0	L	L
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	13281	17695	T	L	L
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	11656	2051	T	L	0
1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)	7956	2630	T	0	0
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	19424	28339	T	L	L
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	20766	4102	T	L	0
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	12203	4388	T	L	0
1 A 2 f Non-metallic minerals: Gaseous Fuels (CO_2)	27391	27869	T	L	L
1 A 2 f Non-metallic minerals: Liquid Fuels (CO_2)	44942	26468	T	L	L
1 A 2 f Non-metallic minerals: Other Fuels (CO_2)	1065	10000	T	0	L
1 A 2 f Non-metallic minerals: Solid Fuels (CO_2)	58227	18857	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Gaseous Fuels (CO_2)	117060	84275	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Liquid Fuels (CO_2)	112940	49988	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Other Fuels (CO_2)	2452	7988	T	0	L
1 A 2 g Other Manufacturing Industries and Constructions: Solid Fuels (CO_2)	95142	14126	T	L	L
1 A 3 a Domestic Aviation: Jet Kerosene (CO_2)	13984	15183	T	L	L
1 A 3 b Road Transportation: Diesel Oil (CO_2)	298561	584521	T	L	L
1 A 3 b Road Transportation: Diesel Oil (N_2O)	1832	6766	T	0	0
1 A 3 b Road Transportation: Gaseous Fuels (CO_2)	504	3602	T	0	0
1 A 3 b Road Transportation: Gasoline (CH_4)	5744	878	T	0	0
1 A 3 b Road Transportation: Gasoline (CO_2)	406229	233125	T	L	L
1 A 3 b Road Transportation: Liquefied Petroleum Gases (LPG) (CO_2)	7349	15299	T	0	L

Key category (gas)	kt CO_2 equ.		Trend	Level	
	1990	2014		1990	2014
1 A 3 b Road Transportation: Liquid Fuels (CH_4)	6329	1150	T	0	0
1 A 3 b Road Transportation: Liquid Fuels (CO_2)	712458	832962	T	L	L
1 A 3 b Road Transportation: Liquid Fuels (N_2O)	6599	8397	T	0	L
1 A 3 c Railways: Liquid Fuels (CO_2)	12666	6479	T	L	0
1 A 3 d Domestic Navigation: Gas/Diesel Oil (CO_2)	13866	9230	0	L	L
1 A 3 d Domestic Navigation: Liquid Fuels (CO_2)	24352	15418	T	L	L
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	66769	97606	T	L	L
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	84953	38694	T	L	L
1 A 4 a Commercial/Institutional: Other Fuels (CO_2)	1013	4546	T	0	0
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	47642	3909	T	L	0
1 A 4 b Residential: Biomass (CH_4)	9206	9786	0	L	L
1 A 4 b Residential: Gaseous Fuels (CO_2)	184294	224615	T	L	L
1 A 4 b Residential: Liquid Fuels (CO_2)	178606	100895	T	L	L
1 A 4 b Residential: Solid Fuels (CH_4)	7982	2649	T	0	0
1 A 4 b Residential: Solid Fuels (CO_2)	134316	35141	T	L	L
1 A 4 c Agriculture/Forestry/Fishing: Gaseous Fuels (CO_2)	12534	12070	0	L	L
1 A 4 c Agriculture/Forestry/Fishing: Liquid Fuels (CO_2)	68889	57144	T	L	L
1 A 4 c Agriculture/Forestry/Fishing: Solid Fuels (CO_2)	9756	4239	T	L	0
1 A 5 a Other Other Sectors: Solid Fuels (CO_2)	6003	9	T	0	0
1 A 5 b Other Other Sectors: Liquid Fuels (CO_2)	13789	4359	T	L	0
1 B 1 a Coal Mining and Handling: Operation (CH_4)	97900	22834	T	L	L
1 B 2 a Oil: Operation (CH_4)	13821	4320	T	L	0
1 B 2 a Oil: Operation (CO_2)	9545	11878	T	L	L
1 B 2 b Natural Gas: Operation (CH_4)	46097	25799	T	L	L
2 A 1 Cement Production: no classification (CO_2)	102483	74745	T	L	L
2 A 2 Lime Production: no classification (CO_2)	25706	19718	0	L	L
2 A 4 Other Process Uses of Carbonates: no classification (CO_2)	13007	10649	0	L	L
2 B 1 Ammonia Production: no classification (CO_2)	32104	25616	0	L	L
2 B 10 Other chemical industry: no classification (CO_2)	2280	5142	T	0	0
2 B 2 Nitric Acid Production: no classification (N_2O)	49541	4675	T	L	0
2 B 3 Adipic Acid Production: no classification (N_2O)	57555	414	T	L	0
2 B 8 Petrochemical and Carbon Black Production: no classification (CO_2)	13638	14412	T	L	L
2 B 9 Fluorochemical Production: no classification (HFCs)	29034	389	T	L	0
2 B 9 Fluorochemical Production: no classification (Unspecified mix of HFCs and PFCs)	5567	47	T	0	0
2 C 1 Iron and Steel Production: no classification (CO_2)	96114	62454	T	L	L
2 C 3 Aluminium Production: no classification (PFCs)	20789	558	T	L	0
2 D 3 Other non energy products: no classification (CO_2)	10448	7237	0	L	0
2 F 1 Refrigeration and Air conditioning: no classification (HFCs)	3	98692	T	0	L
2 F 4 Aerosols: no classification (HFCs)	2	7279	T	0	L
3 A 1 Enteric Fermentation: Cattle (CH_4)	203497	156627	T	L	L
3 A 1 Enteric Fermentation: Dairy Cattle (CH_4)	79831	59243	T	L	L
3 A 1 Enteric Fermentation: Mature Dairy Cattle (CH_4)	10364	7265	0	L	L
3 A 1 Enteric Fermentation: Non-Dairy Cattle (CH_4)	86734	73679	T	L	L

Key category (gas)	kt CO_2 equ.		Trend	Level	
	1990	2014		1990	2014
3 A 1 Enteric Fermentation: Other Cattle (CH_4)	20879	12985	T	L	L
3 A 2 Enteric Fermentation: Other Sheep (CH_4)	29514	19914	T	L	L
3 B 1 CH_4 Emissions: Farming (CH_4)	55523	44826	0	L	L
3 B 2 N_2O and NMVOC Emissions: Farming (N_2O)	31724	22385	0	L	L
3 D 1 Agricultural Soils: Direct N_2O Emissions From Managed Soils (N_2O)	159411	133952	T	L	L
3 D 2 Agricultural Soils: Farming (N_2O)	38568	31273	0	L	L
4 A 1 Forest Land: Land Use (CO_2)	-363814	-386179	T	L	L
4 A 2 Forest Land: Land Use (CO_2)	-34250	-53485	T	L	L
4 B 1 Cropland: Land Use (CO_2)	22609	25524	T	L	L
4 B 2 Cropland: Land Use (CO_2)	54333	45168	0	L	L
4 C 1 Grassland: Land Use (CO_2)	47392	33224	T	L	L
4 C 2 Grassland: Land Use (CO_2)	-19024	-23970	0	L	L
4 D 1 Wetlands: Land Use (CO_2)	13102	14695	T	L	L
4 E 2 Settlements: Land Use (CO_2)	34839	47068	T	L	L
4 Land Use, Land-Use Change and Forestry: Biomass Burning (CO_2)	11078	3411	T	L	0
5 A 1 Managed Waste Disposal Sites: Waste (CH_4)	168608	92334	T	L	L
5 A 2 Unmanaged Waste Disposal Sites: Waste (CH_4)	24464	14111	T	L	L
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (CH_4)	22283	10702	T	L	L
5 D 2 Wastewater Treatment and Discharge: Industrial Wastewater (CH_4)	12115	9264	0	L	L

1.6 General uncertainty evaluation

The EU-28 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates, which were submitted from the Member States under Article 7(1)(p) of Regulation (EU) 252/2013. Uncertainty calculations have been performed on all MS except Malta and Island. Since the total emissions of Malta and Island are relatively low compared to the total EU emissions, the influence on the results of this uncertainty analysis is negligible. Due to this fact, the sectoral EU and EU total of emissions in the following tables might not always meet exactly the value which is reported as “true” total compare to the values in the individual trend chapters.

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

Trendn,x = En,x(t)-En,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 gives 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 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 given in Table 1.11 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 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.

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, in which waste sector uncertainties are presented both with analytical method and Monte Carlo simulation: If uncertainty increases, also the difference between the two methods increases.

Table 1.12 .Comparison of trend uncertainty estimates 2005 for EU 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 shows the main results of the Tier 1 uncertainty analysis for the EU-28. The lowest level uncertainty estimates are for fuel combustion activities (0.9%), the highest estimates are for agriculture (47.1 %). Overall level uncertainty estimates including LULUCF of all EU-28 GHG emissions is calculated with 6.2 % and excluding LULUCF slightly lower with 5.2 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for fuel combustion activities (+/-0.3 percentage points), the highest estimates are for LULUCF (19.8 percentage points). Overall trend uncertainty (including LULUCF) of all EU-28 GHG emissions is estimated to be 1.2 percentage points.

These results of the Tier 1 uncertainty analysis 2014 are very similar to the results of the previous year. More detailed uncertainty estimates for the source categories are provided in Chapters 3-7.

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

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A Fuel combustion activities	all	4 173 509	3 247 802	-22.2%	0.9%	0.3%
1.B Fugitive emissions	all	202 693	86 346	-57.4%	19.5%	9.7%
2. Industrial processes	all	513 099	356 909	-30.4%	10.2%	4.9%
3. Agriculture	all	544 242	433 684	-20.3%	47.1%	3.0%
5. Waste	all	241 873	143 643	-40.6%	46.5%	12.9%
4. LULUCF	all	-225 331	-280 750	24.6%	41.0%	19.8%
Total (incl LULUCF)	**all**	**5 450 086**	**3 987 633**	**-26.8%**	**6.2%**	**1.2%**
Total (excl LULUCF)	**all**	**5 675 416**	**4 268 384**	**-24.8%**	**5.2%**	**0.9%**

Note: Emissions are in Gg CO_2 equivalents

Table 1.14 gives an overview of information provided by EU-28 Member States on uncertainty estimates in their national inventory reports 2014 and presents summarised results of these estimates. For some Member States, either a national inventory report was available, which did not include quantitative uncertainty analysis, or no national inventory report was available at all.

Table 1.14 Overview of uncertainty estimates available from EU-28 Member States

Member State	Austria		Belgium	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark		
Citation	NIR Apr 2016, pp.55-62		NIR Apr 2016, pp.34-35	NIR Apr 2016, pp.64-66	NIR Apr 2016, pp.80	NIR May 2016, pp.42-43	NIR May 2016, pp.32	NIR Apr. 2016, pp.59-75		
Method used	Tier 1		Tier 1	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1 + Tier 2		
Documentation in NIR (according to IPCC 2006 GL)	Yes		Yes (Annex 2)	Yes (Annex 2)	Yes (Annex 2)	Yes (Annex 2)	Yes (Annex 2)	Yes		
Years and sectors included	emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF	emissions: 2014; trends: 1990-2014; excluding LULUCF	emissions: 2014; trends: 1990-2014; including LULUCF	emissions: 2014; trends: 1990-2014; excluding LULUCF	emissions: 2014; trends: 1990-2014; including LULUCF	emissions: 2014; trends: 1990-2014*; including LULUCF		
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 2 (e. L.)
CO_2								4.7%	2.3%	
CH_4								17.6%		
N_2O								35.9%		
F-gases								39.6%		
Total	24.57%	4.90%	4.15%	12.48%	0.84% +77.95%	9.1%	3.36%	5.6%	4.8%	+6.4% -4.4%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 2 (e. L.)
CO_2								1.6%	1.6%	
CH_4								13.0%		
N_2O								10.8%		
F-gases								105.4%		
Total	2.86%	2.20%	2.15%	1.99%	-18.00% +33.26%	13.2%	2.34%	2.0%	2.1%	+7.2% -6.5%

Member State	Estonia		Finland				France		Germany	Greece	Hungary	Ireland	
Citation	NIR May 2016, pp.44		NIR Apr. 2016, pp.42-44				NIR Apr. 2016, pp.72-74		english NIR May 2016, pp.129-131	NIR Apr. 2016, pp.129-131	NIR May 2016, pp.23	NIR Apr. 2016, pp.25-27;35-42	
Method used	Tier 1		Tier 1 + Tier 2				Tier 1		Tier 1	Tier 1	Tier 1	Tier 1	
Documentation in NIR (according to IPCC 2006 GL)	Yes (Annex 2)		Yes (Annex 6)				Yes (Annex 7)		Yes (Annex 2)	(Annex 4)	Yes (Annex 2)	Yes	
Years and sectors included	emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF				emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF	emissions: 2014; trends: 1990-2014; excluding LULUCF	emissions: 2014; trends: 1990-2014; excluding LULUCF	emissions: 2014; trends: 1990-2014; excluding LULUCF	
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 2 (i .L.)	Tier 2 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2											3%		
CH_4											25%		
N_2O											136%		
F-gases											13%		
Total	7.21%	4.13%	37.00 %	5.00%	-29% +37%	-3% +5%	12.6%	10.6%	5.3%	11.8%	11%	9.70%	10.16%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 2 (i .L.)	Tier 2 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2													
CH_4													
N_2O													
F-gases													
Total	9.00%	1.82%	36.00 %	6.00%	-23% +31%	-5% +5%	4.2%	3.4%	4.9%	11.3%	2%	10.01%	2.72%

Member State	Italy		Latvia		Lithuania		Luxembourg		Malta		Netherlands		Poland	
Citation	NIR Apr. 2016, pp.45-46		NIR May 2016, pp.75-76		NIR May 2016, pp.60-61		NIR Apr. 2016, pp.77-105		NIR Apr. 2016, pp.13		NIR Apr. 2016, pp.50-55		NIR May. 2016, pp.26	
Method used	Tier 1		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1 + Tier 2		Tier 1	
Documentation in NIR (according to IPCC 2006 GL)	Yes (Annex 1)		Yes (Annex 2)		Yes (Annex 2)		Yes		Yes (Annex 2)		Yes (Annex 2)		Yes (Annex 8)	
Years and sectors included	emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF	
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (e. L.)	Tier 2 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2											2.1%	3.5%	3.6%	1.8%
CH_4											17.6%	15.4%	21.2%	21.2%
N_2O											39.4%	34.4%	49.1%	49.2%
F-gases											47.4%	37.9%		
Total	4.9%	2.6%	16%	8%	54.2%	9.3%	2.72%	2.03%	2.22%	2.22%	3.1%	3.8%	4.9%	3.9%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (e. L.)	Tier 2 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2											2%		2.3%	2.0%
CH_4											6%		25.0%	25.0%
N_2O											7%		42.6%	42.7%
F-gases											12%			
Total	3.9%	1.9%	11%	2%	10.5%	2.1%	1.30%	1.24%	2.86%	2.85%	2%		4.5%	4.3%

Member State	Portugal	Romania		Slovakia	Slovenia		Spain		Sweden		United Kingdom
Citation	NIR May 2016, pp.6-58	NIR May 2016, pp.123-125		NIR May 2016, pp.44-45	NIR Mar. 2016, pp.29		NIR May 2016, pp.1.34-1.36		NIR Apr. 2016, pp.66-69		NIR Apr. 2016, pp.94
Method used	Tier 1	Tier 1		Tier 1	Tier 1		Tier 1		Tier 1		Tier 1
Documentation in NIR (according to IPCC 2006 GL)	Yes (Annex L)***	Yes (Annex 2)		Yes (Annex 3)	Yes (Annex)		Yes (Annex 6)		Yes (Annex 7)		Yes (Annex 2)
Years and sectors included	emissions: 2014; trends: 1990-2014; including LULUCF	emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; excluding LULUCF	emissions: 2014; trends: 1986-2014; including LULUCF		emissions: 2014; trends: 1990/95-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF		emissions: 2014; trends: 1990-2014; including LULUCF
Uncertainty (%)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1
CO_2											
CH_4											
N_2O											
F-gases											
Total	7.83%	28.9%	17.3%	10.11%	21.61%	6.22%	19.8%	17.2%	77.5%	4.9%	3.0%
Uncertainty in trend (%)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1
CO_2											
CH_4											
N_2O											
F-gases											
Total	5.48%	12.1%	2.1%	3.25%	16.76%	2.60%	1.1%	1.1%	16.4%	1.9%	2.5%

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 implemented an action plan 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 2006 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 consult and discuss 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. With the implementation of the new 2006 IPCC Guidelines, there is an additional check regarding ‘insignificance’ as described in paragraph 37 of the UNFCCC Reporting Guidelines (see section 1.8.1 on the completeness of MS submissions).

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) gap-filling rules will apply: art. 4 Delegated Act of the MMR.

For the sectors energy, industrial processes and product use, agriculture, LULUCF and waste sector-specific checks are performed by the EU sector experts using outlier tools similar to those of the UNFCCC 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 EEA Emission Review Tool (EMRT). 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 EEA Emission Review Tool (EMRT) 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.

Since 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 example were a Member States does not provide new estimates for the latest reporting 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.

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[16].

1.7.2.2 Gap filling of emissions in GHG inventory submissions 2016

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

---

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

1.7.3 Geographical coverage of the European Union inventory

Table 1.15 shows the geographical coverage of the EU 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.

As the EU-28 inventory 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.

In sum, the EU's submission under the Convention is fully consistent with MS GHG emissions by sources and sinks according to the EU territory. The EU's submission under the Kyoto Protocol is fully consistent with the joint ratification of the second commitment period of KP by the EU.

Table 1.15 Geographical coverage of the Union's GHG 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)	√	√		DNM
Estonia	Estonia	√	√	√	EST
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 and Gibraltar), and the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man).	√		√	GBR
European Union	EU-28		√	√	EUA
Iceland	Iceland	√		√	ISL
European Union and Iceland	EU-28, Iceland and the UK's Oversea Territories and Crown Dependencies that have ratified the Kyoto Protocol	√			EUC

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 1.16 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.16 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	The uncertainty assessment is included in the NIR, section 1.6
Annex III: Detailed methodological descriptions for individual source or sink categories	A summary description of the methodologies used by each Member State for the EU key categories
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. The final national energy balance for the latest inventory year is not publicly available by Eurostat in a format which can be used for inclusion in the NIR. However, the database is publicly available and has been used for the EU's reference approach. http://ec.europa.eu/eurostat/web/energy/data/energy-balances
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. The 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. It should be noted that at EU-level no emissions are calculated directly on the basis of activity data reported by MS. However, all the details for the calculation of MS emissions are documented in the Member States' CRF tables, as part of their national GHG inventories.

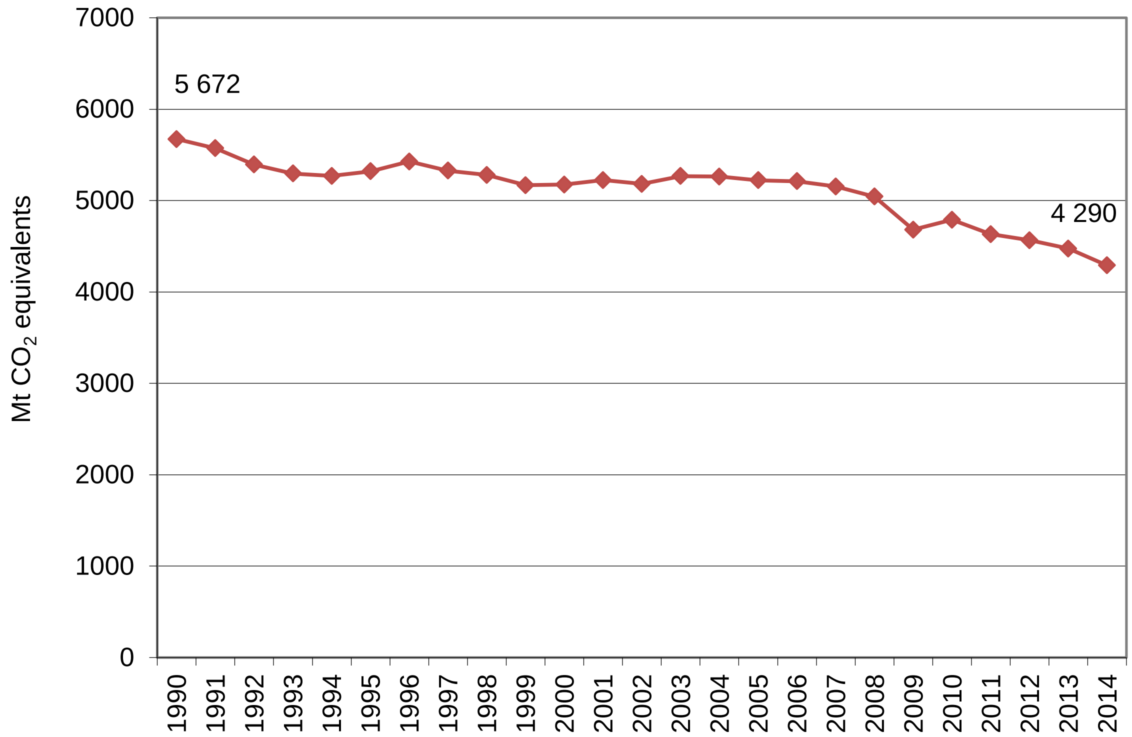
2 EU GREENHOUSE GAS EMISSION TRENDS

This chapter presents the main GHG emission trends in the EU. Aggregated results are described as regards total GHG and emission trends are briefly analysed mainly at gas level. A short overview of Member States' contributions to total EU GHG trends is given. Finally, the trends of indirect GHGs and SO_2 emissions are presented.

2.1 Aggregated greenhouse gas emissions

In 2014 total GHG emissions in the EU-28 and Iceland, without LULUCF, were 24.4 % (-1382 million tonnes CO_2 equivalents) below 1990. Emissions decreased by 4.1 % (185 million tonnes CO_2 equivalents) between 2013 and 2014 (Figure 2.1).

Figure 2.1 EU-28 and Iceland GHG emissions 1990–2014 (excl. LULUCF)



Notes: GHG emission data for the EU-28 as a whole refer to domestic emissions (i.e. within its territory), include indirect CO2 and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO2 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 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

2.1.1 Main trends by source category, 1990-2014

In 2014, total GHG emissions (excluding LULUCF) in the EU-28 plus Iceland reached their lowest level since 1990. There has been a progressive decoupling of gross domestic product (GDP) and GHG emissions compared to 1990, with an increase in GDP of about 47 % alongside a decrease in emissions of more than 24 % over the 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 2014, with the notable exception of transport, including international transport, and refrigeration and air conditioning. At the aggregate level, emissions reductions were largest for manufacturing industries and construction, 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, with a higher share of services and a lower share of more-energy-intensive industry in the total GDP. The economic recession that began in the second half of 2008 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 intensive fuels. Between 1990 and 2014, the use of solid and liquid fuels in thermal stations decreased strongly whereas natural gas consumption almost doubled, resulting in reduced CO_2 emissions per unit of fossil fuel 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 the lower demand for space heating in the EU as a whole over the past 24 years. The year 2014 was also the hottest year on record, leading to substantially lower heat demand. There has also been a very strong increase in CO_2 emissions from biomass combustion, which has contributed to lower GHG emissions in the EU. 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, and lower emissions from managed waste disposal on land and from agricultural soils.

Table 2.1 shows those sources that made the largest contribution to the change in total GHG emissions in the EU plus Iceland between 1990 and 2014.

Table 2.1 Overview of EI-28 plus Iceland source categories whose emissions increased or decreased by more than 20 Million tonnes CO_2 equivalent in the period 1990-2014

Source category	**Million tonnes CO_2 equivalent**
Road Transportation (CO_2 from 1.A.3.b)	124
Refrigeration and Air conditioning (HFCs from 2.F.1)	99
Aluminium Production (PFCs from 2.C.3)	-20
Fugitive emisisons from Natural Gas (CH_4 from 1.B.2.b)	-20
Enteric Fermentation: Dairy Cattle (CH_4 from 3.A.1)	-21
Agricultural Soils: Direct N_2O Emissions From Managed Soils (N_2O from 3.D.1)	-25
Cement Production (CO_2 from 2.A.1)	-28
Fluorochemical Production (HFCs from 2.B.9)	-29
Nitric Acid Production (N_2O from 2.B.2)	-45
Enteric Fermentation: Cattle (CH_4 from 3.A.1)	-47
Commercial/Institutional (CO_2 from 1.A.4.a)	-56
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)	-62
Coal Mining and Handling (CH_4 from 1.B.1.a)	-75
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-76
Iron and steel production (CO_2 from 1.A.2.a +2.C.1)	-105
Residential: Fuels (CO_2 from 1.A.4.b)	-140
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1.A.2 excl. 1.A.2.a)	-299
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-346
Total	**-1 382**

Notes: As the table only presents sectors whose emissions increased or decreased by at least 20 million tonnes CO_2-equivalent, 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, 2013-2014

Total GHG emissions (excluding LULUCF) decreased by 185 million tonnes CO_2 equivalent (4.1 %) between 2013 and 2014. This significant decrease in emissions in 2014 came with an increase in GDP of 1.4 %. This resulted in a lower GHG-emissions intensity of GDP in the EU in 2014, which can be attributed to the sharp decline in the consumption of heat and electricity. This was in turn triggered by the lower heat demand from households due to the milder winter conditions in Europe. The sustained increase in non-combustible renewables for electricity generation also contributed to lower emissions in 2014. Over 80 % of the total GHG emissions reduction in 2014 was accounted for by lower CO_2 emissions from gas and solid fuels from thermal power stations as well as by lower CO_2 emissions from gas in the residential and commercial sectors. Primary energy consumption declined overall, with emissions decreasing for all fossil fuels, particularly natural gas, but also for hard coal and lignite. The consumption of renewables increased in terms of primary energy. This led to a further improvement in the carbon intensity of the EU energy system in 2014. Germany and the United Kingdom accounted for about 45% of the total GHG emissions reduction at EU level in 2014.

Table 2.2 shows the source categories making the largest contribution to the change in GHG emissions in the EU-28 between 2013 and 2014.

Table 2.2 Overview of EU-28 plus Iceland source categories whose emissions increased or decreased by more than 3 million tonnes CO_2 equivalent in the period 2013–2014

Source category	Million tonnes CO_2 equivalent
Road Transportation (CO_2 from 1.A.3.b)	7
Iron and steel production (CO_2 from 1.A.2.a +2.C.1)	6
Cement Production (CO_2 from 2.A.1)	3
Chemicals: Fuels (CO_2 from 1.A.2.c)	-3
Petroleum Refining (CO_2 from 1.A.1.b)	-4
Managed Waste Disposal Sites (CH_4 from 5.A.1)	-5
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1.A.2 excl. 1.A.2.a)	-18
Commercial/Institutional (CO_2 from 1.A.4.a)	-23
Residential (CO_2 from 1.A.4.b)	-66
Public Electricity and Heat Production (CO_2 from 1.A.1.a)	-85
Total	**-185**

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 of the source categories presented does not match the total change listed at the bottom of the table

Table 2.3 gives an overview on total GHG emissions by Member States, illustrating where main changes occurred.

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

	1990 (million tonnes)	2014 (million tonnes)	2013–2014 (million tonnes)	Change 2013–2014 (%)	Change 1990–2014 (%)
Austria	78.8	76.3	-3.7	-4.6%	-3.2%
Belgium	146.0	113.9	-5.5	-4.6%	-22.0%
Bulgaria	104.0	57.2	2.3	4.1%	-45.0%
Croatia	34.8	24.5	-0.6	-2.3%	-29.7%
Cyprus	5.7	8.4	0.4	5.4%	47.9%
Czech Republic	199.3	125.9	-4.9	-3.7%	-36.8%
Denmark	70.7	51.2	-4.3	-7.7%	-27.6%
Estonia	40.0	21.1	-0.6	-2.8%	-47.3%
Finland	71.3	59.1	-4.2	-6.6%	-17.1%
France	548.1	458.9	-27.6	-5.7%	-16.3%
Germany	1246.1	900.2	-43.3	-4.6%	-27.8%
Greece	104.8	101.4	-3.3	-3.1%	-3.3%
Hungary	94.1	57.2	-0.3	-0.6%	-39.2%
Ireland	56.2	58.3	-0.3	-0.5%	3.7%
Italy	521.9	418.6	-20.3	-4.6%	-19.8%
Latvia	26.2	11.3	0.0	-0.3%	-56.9%
Lithuania	47.1	19.0	-0.1	-0.7%	-59.6%
Luxembourg	12.9	10.8	-0.4	-3.9%	-16.3%
Malta	2.0	3.0	0.0	1.0%	49.1%
Netherlands	222.2	187.1	-8.0	-4.1%	-15.8%
Poland	472.9	380.3	-13.2	-3.3%	-19.6%
Portugal	60.7	64.6	-0.4	-0.5%	6.5%
Romania	251.9	109.8	-0.3	-0.2%	-56.4%
Slovakia	74.7	40.6	-2.3	-5.3%	-45.6%
Slovenia	18.6	16.6	-1.7	-9.5%	-10.9%
Spain	285.9	328.9	1.5	0.5%	15.0%
Sweden	71.9	54.4	-1.6	-2.8%	-24.4%
United Kingdom	796.6	523.7	-42.5	-7.5%	-34.3%
EU-28 (Convention)	**5665.5**	**4282.1**	**-185.0**	-4.1%	**-24.4%**
United Kingdom (KP)	799.8	527.2	-42.6	-7.5%	-34.1%
Iceland	3.6	4.6	0.1	1.4%	26.5%
EU-28 + Iceland (KP)	**5672.3**	**4290.2**	**-185.0**	-4.1%	**-24.4%**

2.2 Emission trends by gas

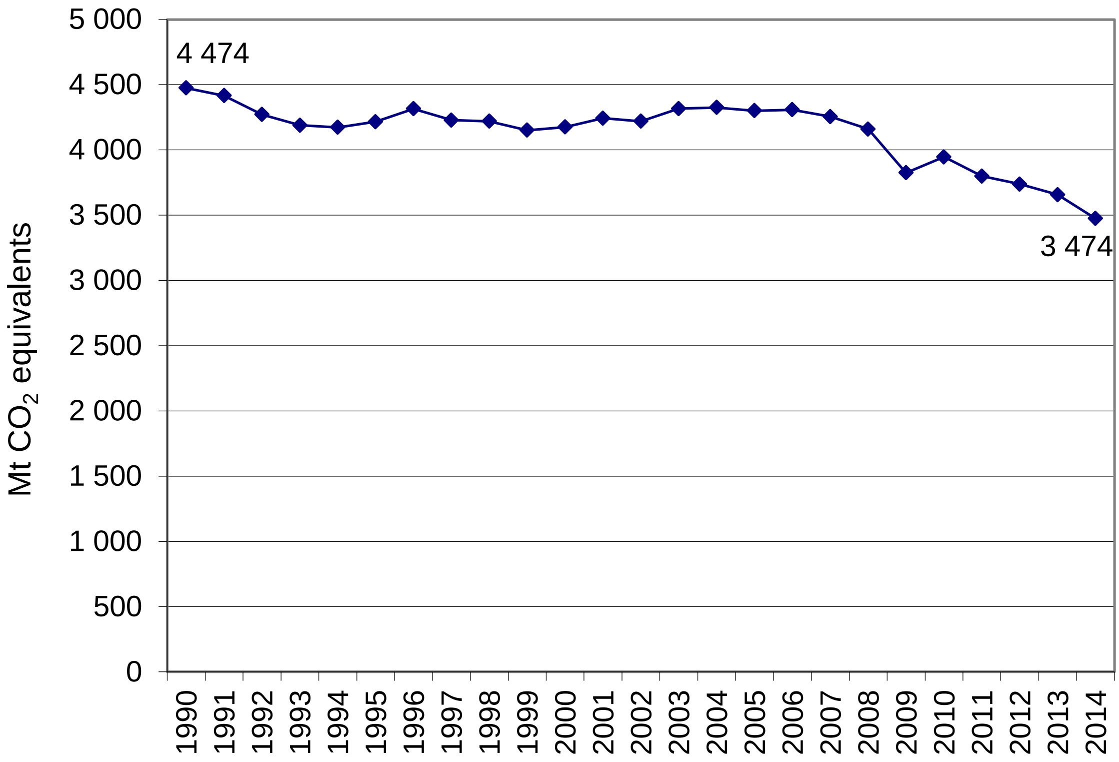
Table 2.4, and Figure 2.3 give an overview of the main trends in EUGHG emissions and removals for 1990–2014. In the EU the most important GHG is CO_2, accounting for 81 % of total EU emissions in 2014 excluding LULUCF. In 2014, EUCO_2 emissions without LULUCF and including indirect CO_2 were 3 474 Mt, which was 22 % below 1990 levels. Compared to 2013, CO_2 emissions decreased by 5.0 %.

Table 2.4 Overview of EU-28 and Iceland GHG emissions and removals from 1990 to 2014 in CO_2 equivalent

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013	2014
Net CO_2 emissions/removals	4 209	3 922	3 851	3 973	3 620	3 474	3 417	3 332	3 163
CO_2 emissions (without LULUCF)	4 474	4 216	4 176	4 301	3 946	3 800	3 739	3 657	3 474
CH_4	748	682	621	553	495	484	480	467	462
N_2O	401	364	323	302	257	253	250	251	253
HFCs	29.1	43.8	52.9	71.5	102.7	105.1	108.2	110.4	112.1
PFCs	25.9	16.9	12.0	7.3	4.0	4.3	3.8	4.0	3.6
Unspecified mix of HFCs and PFCs	5.7	5.8	2.1	0.9	0.4	0.2	0.2	0.2	0.2
SF_6	10.9	15.2	10.5	7.9	6.4	6.2	6.3	6.2	6.1
NF_3	0.02	0.04	0.12	0.16	0.12	0.13	0.09	0.07	0.07
Total (with net CO_2 emissions/removals)	**5 429**	**5 050**	**4 873**	**4 916**	**4 485**	**4 327**	**4 265**	**4 171**	**3 999**
Total (without CO_2 from LULUCF)	**5 694**	**5 344**	**5 198**	**5 244**	**4 812**	**4 653**	**4 587**	**4 496**	**4 311**
Total (without LULUCF)	**5 672**	**5 320**	**5 175**	**5 223**	**4 791**	**4 632**	**4 565**	**4 475**	**4 290**

Notes: CO_2 emissions include indirect CO_2

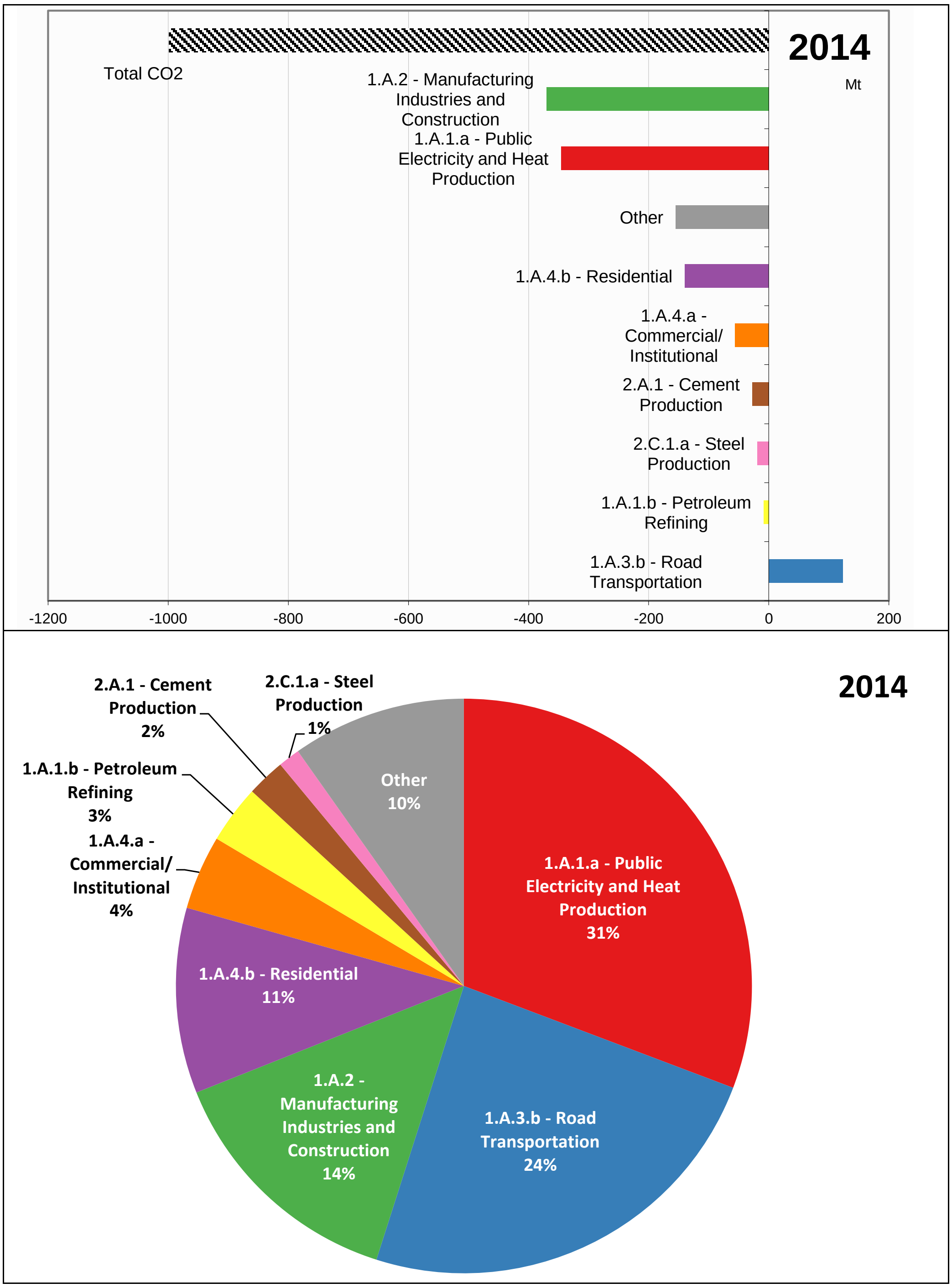
Figure 2.2 CO_2 emissions 1990 to 2014 (Mt)



Notes: CO_2 emissions include indirect CO_2

The largest key source categories for CO_2 emissions (Figure 2.3) have been reduced between 1990 and 2014 with the exception of 1.A.3.b Road transportation which accounts for 24 % of CO_2 emission in 2014.

Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2014 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest key source categories in 2014 for EU-28 and Iceland



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

CH_4 emissions account for 11 % of total EU-28 GHG emissions in 2014 and decreased by 38 % since 1990 to 462 Mt CO_2 equivalents in 2014 (Figure 2.4). The two largest key sources are coal mining and anaerobic waste. They account for 53 % of CH_4 emissions in 2014.

Figure 2.4 CH_4 emissions 1990 to 2014 in CO_2 equivalents (Mt)

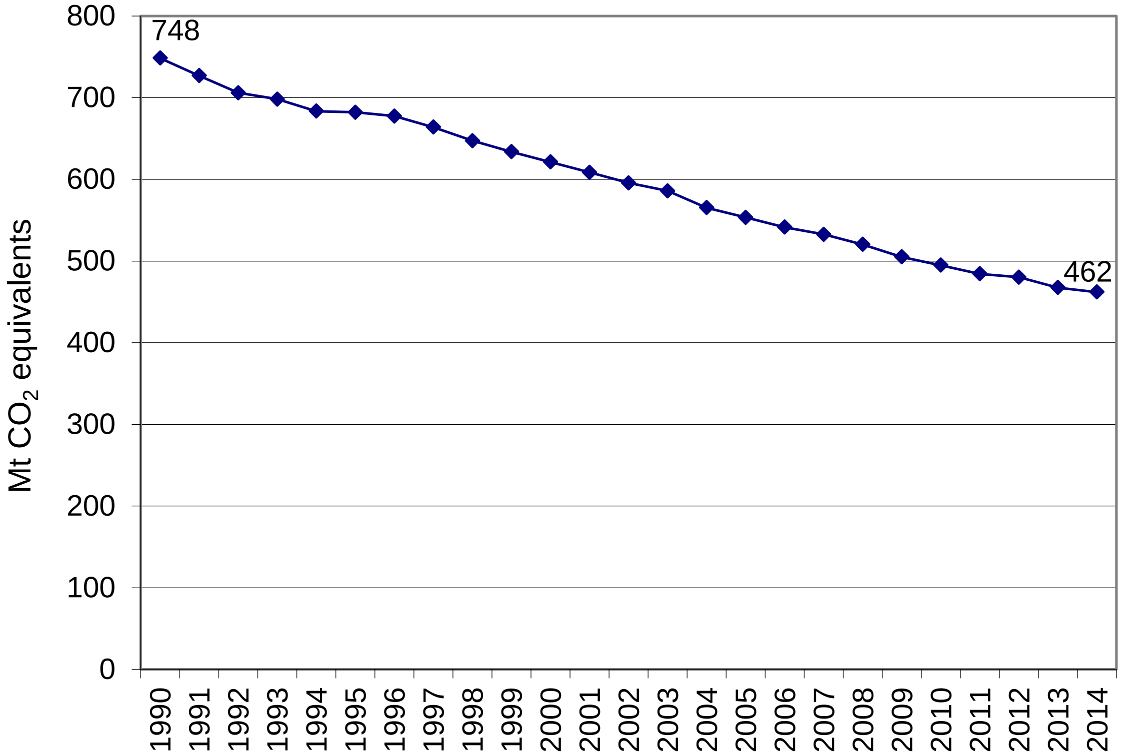
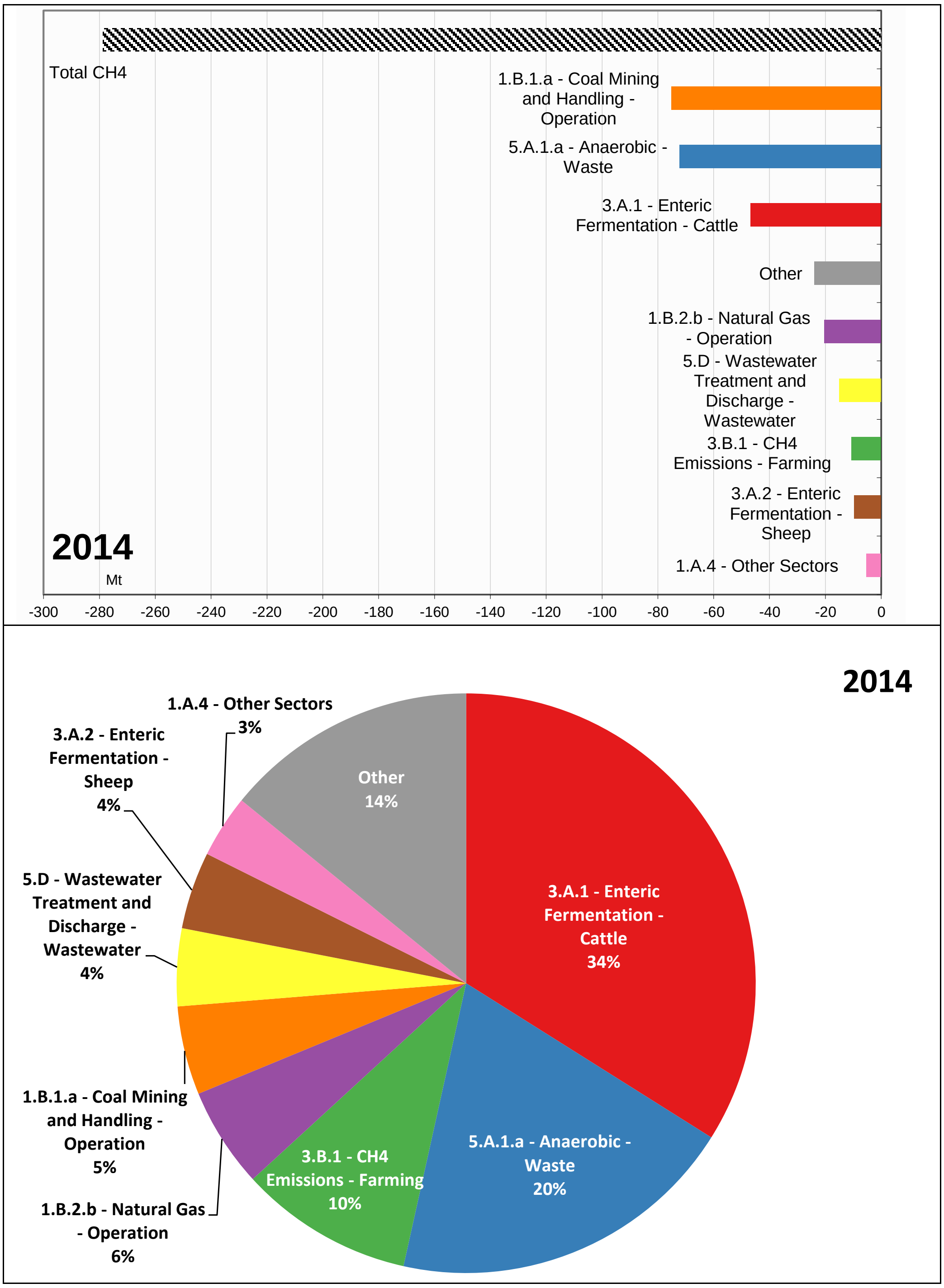


Figure 2.5 shows that the main reasons for declining CH_4 emissions were reductions in coal mining and anaerobic waste.

Figure 2.5 Absolute change of CH_4 emissions by large key source categories 1990 to 2014 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2014 for EU-28 and Iceland



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

N_2O emissions are responsible for 6 % of total EU GHG emissions and decreased by 37 % to 253 Mt CO_2 equivalents in 2014 (Figure 2.6). N_2O emissions derive mainly from agriculture and IPPU sectors (chemical industry). The two largest key sources account for about 65 % of N_2O emissions in 2014. 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 N₂O emissions 1990 to 2014 in CO₂ equivalents (Mt)

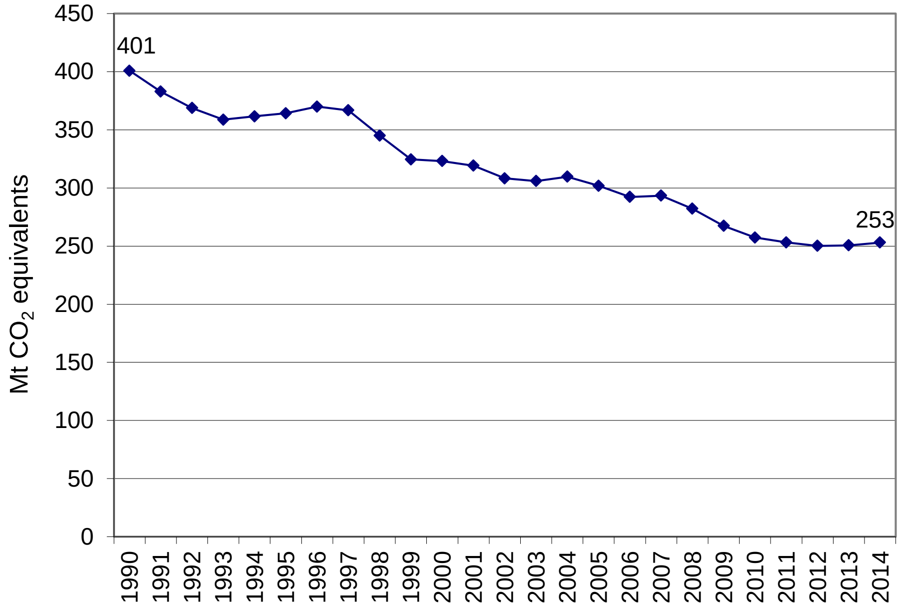
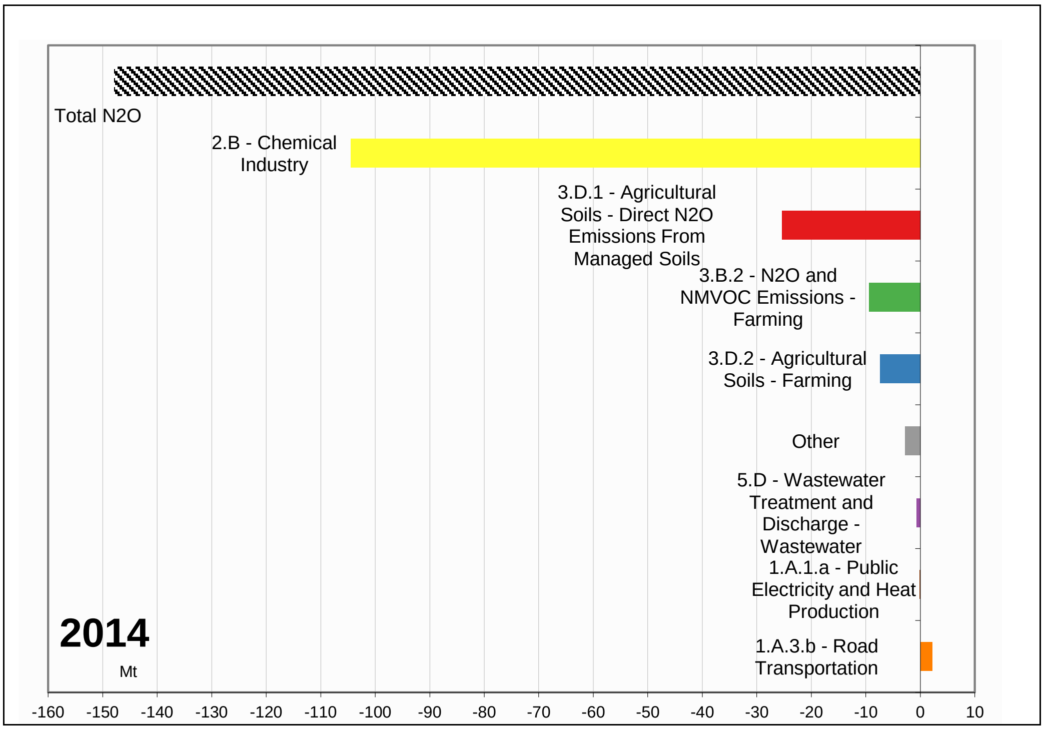
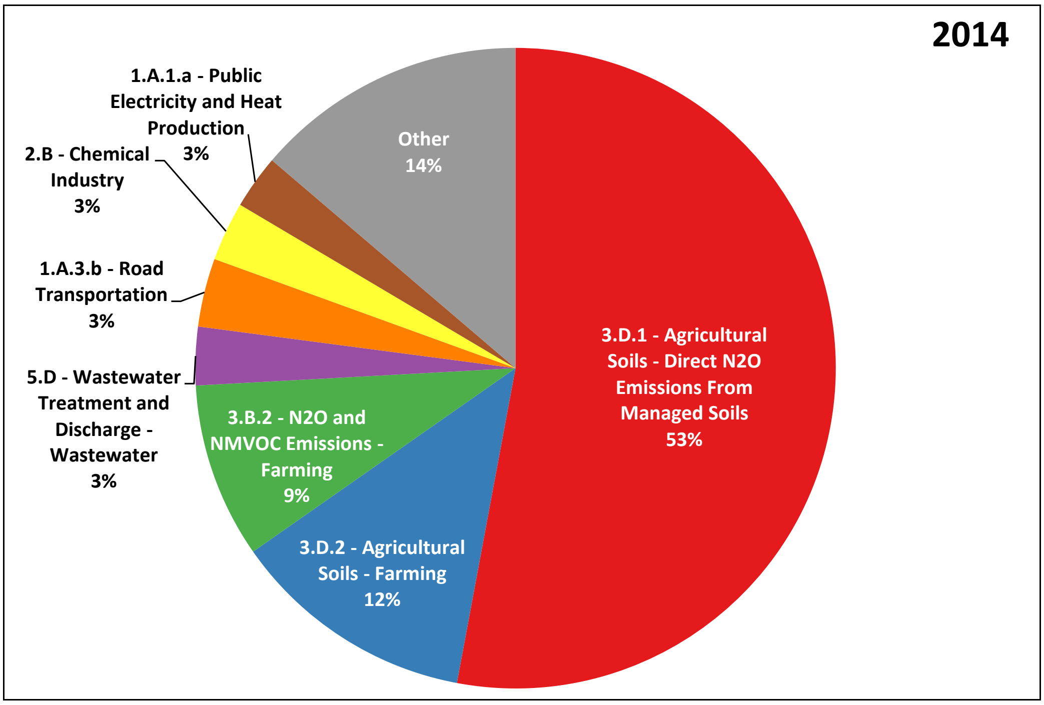


Figure 2.7 Absolute change of N_2O emissions by large key source categories 1990 to 2014 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2014 for EU-28 and Iceland





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

Fluorinated gas emissions account for 2.8 % of total EUGHG emissions. In 2014, emissions were 122 Mt CO_2 equivalents, which was 70 % above 1990 levels (Figure 2.8). Refrigeration and air conditioning, the largest key category, accounts for 82 % of fluorinated gas emissions in 2014. Figure 2.9 shows that HFCs from refrigeration and air conditioning showed large increases between 1990 and 2014. 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, the sum of HFC emissions from categories not presented individually in Figure 2.9 (Other in Figure 2.9) decreased substantially.

Figure 2.8 Fluorinated gas emissions 1990 to 2014 in CO_2 equivalents (Mt)

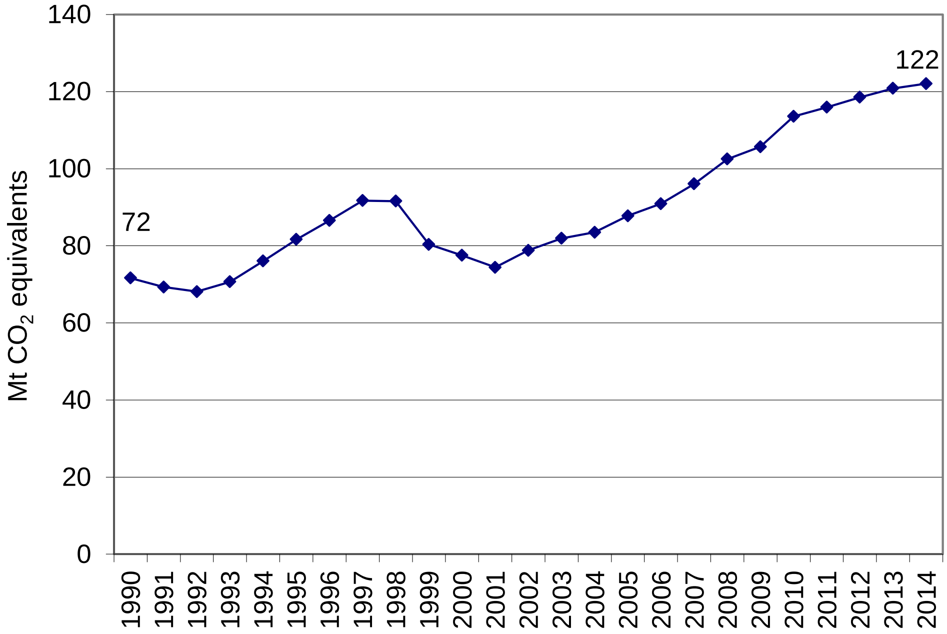
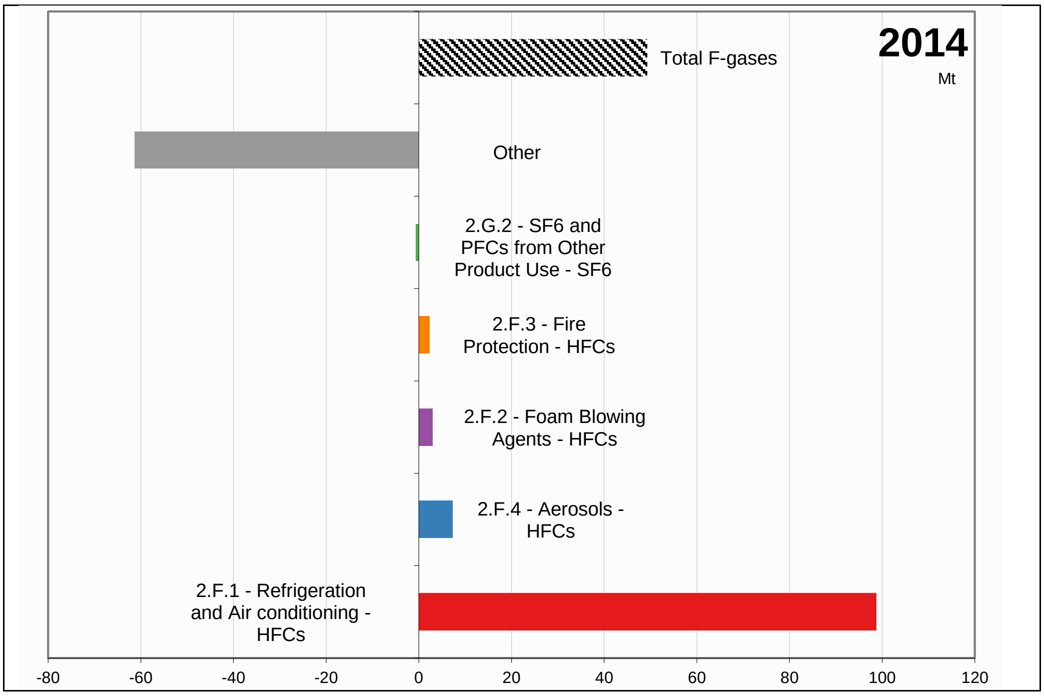
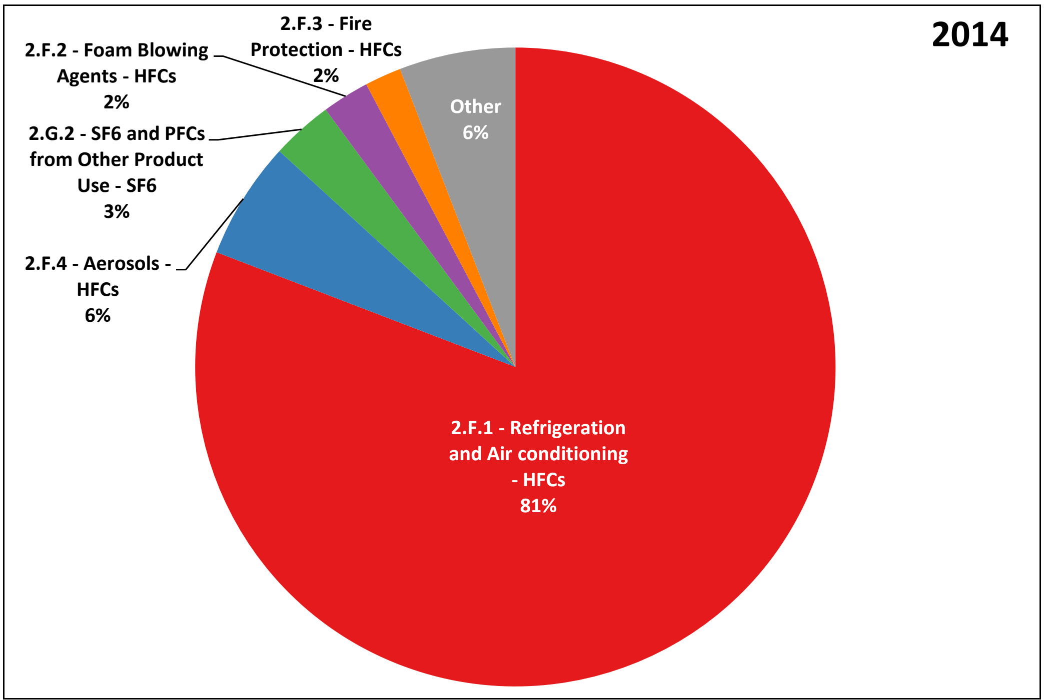


Figure 2.9 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2014 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2014 for EU-28 and Iceland





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

2.3 Emission trends by source

Table 2.5 gives an overview of EU-28 and Iceland GHG emissions in the main source categories for 1990–2014. More detailed trend descriptions are included in Chapters 3 to 9.

Table 2.5 Overview of EU-28 and Iceland GHG emissions (in million tonnes CO_2 equivalent) in the main source and sink categories for the period 1990 to 2014

GHG SOURCE AND SINK	1990	1995	2000	2005	2010	2011	2012	2013	2014
1. Energy	4 358	4 091	4 019	4 117	3 800	3 651	3 604	3 520	3 328
2. Industrial Processes	513	493	448	454	389	384	372	371	375
3. Agriculture	549	479	465	440	428	428	425	429	436
4. Land-Use, Land-Use Change and Forestry	-244	-270	-303	-307	-305	-304	-300	-304	-291
5. Waste	244	250	238	207	170	164	159	151	146
6. Other	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
indirect CO_2 emissions	8.34	7.06	6.30	5.46	4.62	4.50	4.39	4.29	4.10
Total (with net CO_2 emissions/removals)	**5 429**	**5 050**	**4 873**	**4 916**	**4 485**	**4 327**	**4 265**	**4 171**	**3 999**
Total (without LULUCF)	**5 672**	**5 320**	**5 175**	**5 223**	**4 791**	**4 632**	**4 565**	**4 475**	**4 290**

Notes: CO_2 emissions include indirect CO_2

2.4 Emission trends by Member State

Table 2.6 gives an overview of EU countries ‘ contributions to the EU GHG emissions for 1990–2014. Member States show large variations in GHG emission trends.

Table 2.6 Overview of EU-28 plus Iceland contributions to total GHG emissions, excluding LULUCF, from 1990 to 2014 in million tonnes CO_2-equivalent

Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Austria	78.8	79.8	80.4	92.8	84.9	82.6	79.9	80.0	76.3
Belgium	146.0	154.0	149.2	144.8	133.3	122.8	118.8	119.4	113.9
Bulgaria	104.0	73.5	58.3	62.7	59.8	65.1	60.0	54.9	57.2
Croatia	34.8	24.4	27.0	31.1	29.0	28.4	26.1	25.0	24.5
Cyprus	5.7	7.1	8.4	9.3	9.6	9.3	8.7	8.0	8.4
Czech Republic	199.3	158.1	150.9	148.7	140.2	138.8	134.7	130.7	125.9
Denmark	70.7	78.6	71.1	66.7	63.6	58.4	53.5	55.5	51.2
Estonia	40.0	19.9	17.1	18.3	19.9	20.5	19.4	21.7	21.1
Finland	71.3	71.8	70.0	69.5	75.9	68.0	62.4	63.3	59.1
France	548.1	547.0	554.3	554.8	514.5	487.0	488.4	486.5	458.9
Germany	1246.1	1118.5	1041.1	989.9	939.4	920.2	924.7	943.5	900.2
Greece	104.8	110.8	127.7	136.0	118.7	115.7	112.2	104.7	101.4
Hungary	94.1	75.7	73.6	75.9	65.5	63.8	60.1	57.6	57.2
Ireland	56.2	59.9	69.3	70.4	62.3	58.2	58.7	58.5	58.3
Italy	521.9	533.4	554.5	578.9	508.4	494.8	468.7	438.9	418.6
Latvia	26.2	12.8	10.4	11.4	12.3	11.5	11.4	11.3	11.3
Lithuania	47.1	21.6	18.7	22.3	20.1	20.6	20.4	19.1	19.0
Luxembourg	12.9	10.1	9.7	13.0	12.2	12.1	11.8	11.2	10.8
Malta	2.0	2.5	2.6	3.0	3.1	3.2	3.3	3.0	3.0
Netherlands	222.2	232.2	220.3	214.4	213.8	200.0	195.3	195.0	187.1
Poland	472.9	445.2	392.2	396.9	406.2	403.3	396.9	393.4	380.3
Portugal	60.7	71.4	84.0	88.2	70.4	68.9	67.1	65.0	64.6
Romania	251.9	182.8	140.5	146.6	117.0	121.7	120.1	110.0	109.8
Slovakia	74.7	54.7	49.9	51.5	46.5	45.7	43.3	42.9	40.6
Slovenia	18.6	18.8	19.1	20.5	19.6	19.6	19.0	18.3	16.6
Spain	285.9	325.7	385.1	438.5	360.8	360.4	355.4	327.4	328.9
Sweden	71.9	74.0	68.9	67.0	65.0	61.0	57.6	55.9	54.4
United Kingdom	796.6	748.8	713.8	692.1	610.2	562.1	579.2	566.3	523.7
EU-28 (Convention)	**5 665**	**5 313**	**5 168**	**5 215**	**4 782**	**4 623**	**4 557**	**4 467**	**4 282**
United Kingdom (KP)	799.8	752.2	717.3	695.7	613.9	565.7	582.6	569.8	527.2
Iceland	3.6	3.4	4.0	3.9	4.7	4.5	4.6	4.5	4.6
EU-28 + Iceland (KP)	**5 672**	**5 320**	**5 175**	**5 222**	**4 790**	**4 631**	**4 565**	**4 475**	**4 290**

Table ES. 6 gives an overview of Member State contributions to EU GHG emissions for the period 1990–2014. Member States show large variations in GHG emissions trends.

The overall EU GHG emissions trend is dominated by the two largest emitters, Germany (21 %) and the United Kingdom (12 %), which accounted for one third of total EU-28 GHG emissions in 2014. By 2014, these two Member States had achieved total domestic GHG emissions reductions of 619 million tonnes CO_2 equivalent compared to 1990, not counting carbon sinks and the use of Kyoto mechanisms. About 45 % of the EU's net decrease in GHG emissions was accounted for by Germany and the United Kingdom.

The main reasons for the favourable trend in Germany were an increase in the efficiency of power and heating plants and the economic restructuring of the five new Länder after the German reunification, particularly in the iron and steel sector. Other important reasons include a reduction in the carbon intensity of fossil fuels (with the switch from coal to gas), a strong increase in renewable energy use and waste management measures that reduced the landfilling of organic waste. Lower GHG emissions in the United Kingdom were primarily the result of liberalising energy markets and the subsequent fuel switch from oil and coal to gas in electricity production. Other reasons include the shift towards more efficient combined cycle gas turbine stations, decreasing iron and steel production and the implementation of methane recovery systems at landfill sites.

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 between 1990 and 2014. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-90 %), followed by NMVOC (-84 %), CO (-66 %) and NO_x (-55 %).

Table 2.7 Overview of EU-28 and Iceland indirect GHG and SO_2 emissions for 1990–2014 (kt)

	1990	1995	2000	2005	2010	2011	2012	2013	2014
NO_x	17 888	15 189	13 132	12 038	9 513	9 154	8 793	8 430	7 974
CO	66 653	49 894	39 230	30 998	26 839	24 740	24 488	23 897	22 857
NMVOC	44 737	13 668	11 233	9 362	7 897	7 492	7 310	7 227	6 958
SO_2	25 090	15 885	9 558	7 364	4 585	4 451	4 126	3 661	2 589

Table 2.8 shows the NO_x emissions of the EU-28 Member States between 1990 and 2014. The largest emitters, the United Kingdom, Spain, Germany, France and Italy made up 60 % of total EUNO_x emissions in 2014. All EU-28 Member States but one reduced their NO_x emissions between 1990 and 2014.

Table 2.8 Overview of Member States' contributions to EU-28 and Iceland NO_x emissions for 1990–2014 (kt)

Party	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Austria	215	193	209	233	177	167	161	160	149
Belgium	411	382	342	316	248	230	212	204	195
Bulgaria	278	172	146	158	137	147	135	120	127
Croatia	85	68	73	82	65	61	56	55	55
Cyprus	17	20	23	21	18	21	21	15	16
Czech Republic	737	418	338	319	261	247	234	222	211
Denmark	300	290	225	202	146	138	127	122	112
Estonia	93	49	43	40	44	43	40	36	38
Finland	299	252	228	198	177	162	153	149	140
France	2076	1904	1748	1558	1213	1147	1102	1082	990
Germany	2885	2166	1927	1573	1337	1316	1274	1271	1223
Greece	328	332	363	419	324	302	242	249	248
Hungary	237	183	176	166	138	129	120	120	119
Ireland	135	133	140	136	85	76	78	77	76
Italy	2055	1928	1465	1254	984	956	872	820	795
Latvia	91	50	42	43	40	34	34	34	34
Lithuania	130	61	53	58	53	50	52	51	49
Luxembourg	16	13	11	14	12	12	11	9	10
Malta	7	9	10	11	11	11	11	10	10
Netherlands	595	500	421	360	284	268	255	244	208
Poland	1280	1063	844	851	861	843	819	798	721
Portugal	245	276	273	266	187	178	167	167	164
Romania	466	400	382	320	247	252	276	233	225
Slovakia	226	179	91	104	91	87	83	82	84
Slovenia	67	65	54	51	48	47	46	44	39
Spain	1348	1420	1410	1435	971	964	931	825	795
Sweden	278	250	215	184	157	149	141	138	135
United Kingdom	2960	2380	1841	1624	1149	1067	1088	1041	954
EU-28	**17861**	**15156**	**13094**	**11996**	**9465**	**9105**	**8743**	**8380**	**7922**
Iceland	28	33	38	43	48	49	50	51	52
EU-28 + Iceland	**17888**	**15189**	**13132**	**12038**	**9513**	**9154**	**8793**	**8430**	**7974**

Table 2.9 shows the CO emissions of the EU-28 Member States between 1990 and 2014. The largest emitters, France, Germany, Italy and Poland that made up 49 % of the total CO emissions in 2014, reduced their emissions from 1990 levels substantially. But also all other EU-28 Member States, with the exception of Malta reduced emissions.

Table 2.9 Overview of Member States' contributions to EU-28 and Iceland CO emissions for 1990–2014 (kt)

Party	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Austria	1285	986	784	684	578	561	561	580	535
Belgium	1413	1126	938	763	524	420	371	553	351
Bulgaria	818	552	273	215	164	162	155	138	134
Croatia	443	303	336	267	177	167	157	136	203
Cyprus	NE,NA,NO,IE	NE,NA,NO,IE	0	NE,NA,NO,IE	NE,NA,NO,IE	NE,NA,NO,IE	NE,NA,NO,IE	NE,NA,NO,IE	NE,NA,NO,IE
Czech Republic	1028	892	771	727	640	588	587	594	532
Denmark	747	666	491	464	407	370	354	339	311
Estonia	239	179	163	132	128	112	115	111	113
Finland	709	616	548	469	411	375	372	358	349
France	10470	8962	6547	5300	4292	3610	3207	3262	3055
Germany	12579	6438	4792	3718	3528	3447	3090	3115	2959
Greece	1134	956	925	724	529	495	546	459	463
Hungary	1395	893	471	410	319	349	341	315	286
Ireland	349	290	245	216	145	134	128	122	113
Italy	7429	7396	4999	3571	3160	2522	2727	2563	2337
Latvia	374	276	205	196	141	146	151	136	128
Lithuania	448	274	197	189	177	162	164	146	133
Luxembourg	467	225	55	44	32	29	30	30	29
Malta	1	1	1	2	5	5	5	5	5
Netherlands	1257	987	868	778	729	706	686	664	590
Poland	7406	3466	2647	2754	3019	2933	2791	2876	2876
Portugal	823	827	687	480	360	336	306	296	265
Romania	2397	2345	3655	2516	2177	2108	2923	2101	2059
Slovakia	515	423	277	272	220	227	222	218	225
Slovenia	313	276	189	153	135	132	128	127	108
Spain	3662	3165	2706	2144	2003	1991	1756	2000	2010
Sweden	1109	984	724	613	560	544	521	516	498
United Kingdom	7786	6340	4690	3147	2163	1998	1983	2020	2073
EU-28	**66597**	**49845**	**39183**	**30949**	**26725**	**24627**	**24374**	**23781**	**22742**
Iceland	55	50	47	50	115	113	114	116	115
EU-28 + Iceland	**66653**	**49894**	**39230**	**30998**	**26839**	**24740**	**24488**	**23897**	**22857**

Table 2.10 shows the NMVOC emissions of the EU-28 Member States between 1990 and 2014. The largest emitters France, Germany, Italy and the United Kingdom that made up 53 % of the total NMVOC emissions in 2014, reduced their emissions from 1990 levels, together with most other EU-28 Member States.

Table 2.10 Overview of Member States' contributions to EU-28 and Iceland NMVOC emissions for 1990–2014 (kt)

Party	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Austria	280	204	153	136	118	114	113	115	110
Belgium	329	278	217	177	147	134	132	129	122
Bulgaria	508	113	68	58	47	46	47	41	41
Croatia	130	75	77	81	62	59	54	52	59
Cyprus	16	16	13	13	10	8	8	7	7
Czech Republic	301	207	255	223	185	169	164	162	152
Denmark	203	203	173	148	125	118	115	114	106
Estonia	52	34	31	27	24	23	24	23	25
Finland	230	193	166	138	113	102	100	94	91
France	2798	2414	2004	1559	1148	1081	1049	1027	974
Germany	3389	2025	1599	1337	1235	1165	1133	1110	1041
Greece	238	216	209	179	142	131	125	126	125
Hungary	293	203	169	145	125	122	120	120	116
Ireland	136	128	111	105	90	88	88	89	87
Italy	1990	2020	1563	1280	1046	953	941	908	849
Latvia	100	76	65	62	50	51	56	55	54
Lithuania	137	99	71	78	72	69	70	64	65
Luxembourg	21	17	13	13	9	9	9	9	9
Malta	2	2	2	2	3	3	4	4	4
Netherlands	484	344	246	183	167	161	156	150	143
Poland	831	680	575	575	653	638	630	636	606
Portugal	275	271	256	215	185	178	172	174	170
Romania	356	204	266	252	241	229	237	260	254
Slovakia	27432	91	64	130	121	121	114	106	106
Slovenia	72	64	54	46	39	37	35	34	32
Spain	1058	981	998	834	657	624	579	602	604
Sweden	370	288	238	219	210	204	193	187	184
United Kingdom	2698	2212	1571	1140	868	848	839	824	821
EU-28	**44725**	**13658**	**11226**	**9357**	**7892**	**7487**	**7305**	**7222**	**6953**
Iceland	12	11	7	6	5	5	5	5	5
EU-28 + Iceland	**44737**	**13668**	**11233**	**9362**	**7897**	**7492**	**7310**	**7227**	**6958**

Table 2.11 shows the SO_2 emissions of the EU-28 Member States between 1990 and 2014. The largest emitters, Bulgaria, Germany and the United Kingdom and Spain that made up 52% of the total SO_2 emissions in 2014, 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 and Iceland SO_2 emissions for 1990–2014 (Gg)

Party	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Austria	74	47	31	26	18	17	16	16	16
Belgium	365	258	173	142	60	53	47	45	42
Bulgaria	479	378	336	374	412	495	431	371	395
Croatia	134	64	51	58	35	29	25	16	16
Cyprus	31	42	48	38	22	21	16	14	17
Czech Republic	1871	1090	225	208	160	161	155	138	127
Denmark	179	147	32	26	16	14	13	13	11
Estonia	222	103	80	64	73	64	30	26	31
Finland	250	105	81	69	67	61	51	48	44
France	1333	1009	665	493	303	270	257	236	188
Germany	5282	1707	646	474	432	428	413	410	388
Greece	478	541	499	541	248	190	151	141	138
Hungary	825	616	428	41	31	34	31	30	27
Ireland	184	163	142	74	28	27	25	25	19
Italy	1801	1328	755	408	217	195	177	145	131
Latvia	100	49	18	9	4	4	4	4	4
Lithuania	170	69	38	32	21	24	21	20	18
Luxembourg	15	9	3	2	2	1	1	2	2
Malta	0	0	0	0	0	0	0	0	0
Netherlands	199	140	80	72	33	33	33	29	28
Poland	3210	2255	1451	1217	937	885	859	847	800
Portugal	323	331	263	194	70	64	59	53	47
Romania	854	748	526	607	365	354	290	229	201
Slovakia	524	245	98	89	72	69	57	53	45
Slovenia	200	123	93	41	10	12	11	11	9
Spain	2165	1850	1491	1275	417	452	401	252	248
Sweden	106	69	42	36	32	29	28	27	24
United Kingdom	3695	2379	1229	714	425	394	441	388	309
EU-28	**25069**	**15865**	**9523**	**7325**	**4511**	**4378**	**4043**	**3590**	**2524**
Iceland	21	19	35	39	74	73	84	71	65
EU-28 + Iceland	**25090**	**15885**	**9558**	**7364**	**4585**	**4451**	**4126**	**3661**	**2589**

3 ENERGY (CRF SECTOR 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. For each EU-28 + ISL 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 78% to total GHG emissions and is the largest emitting sector in the EU-28 + ISL. Total GHG emissions from this sector decreased by 24% from 4358 Mt in 1990 to 3328 Mt in 2014 (Figure 3.1). In 2014, emissions decreased by 5% compared to 2013.

The most important energy-related gas is CO_2 that makes up 75% of the total EU-28 + ISL Greenhouse gas emissions in 2014. CH_4 of the energy sector is responsible for 2% and N_2O for 1% of the total GHG emissions.

Figure 3.1 CRF Sector 1 Energy: EU-28 + ISL GHG emissions in CO_2 equivalents (Mt) for 1990–2014

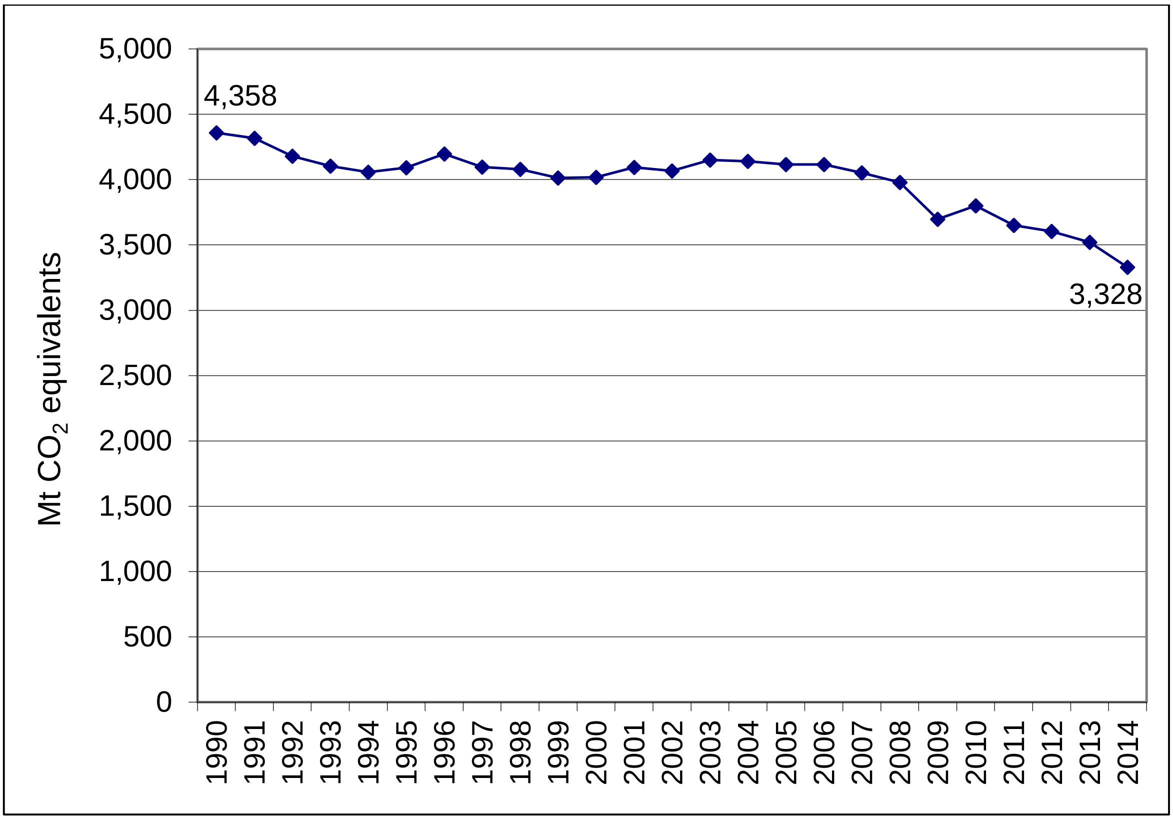
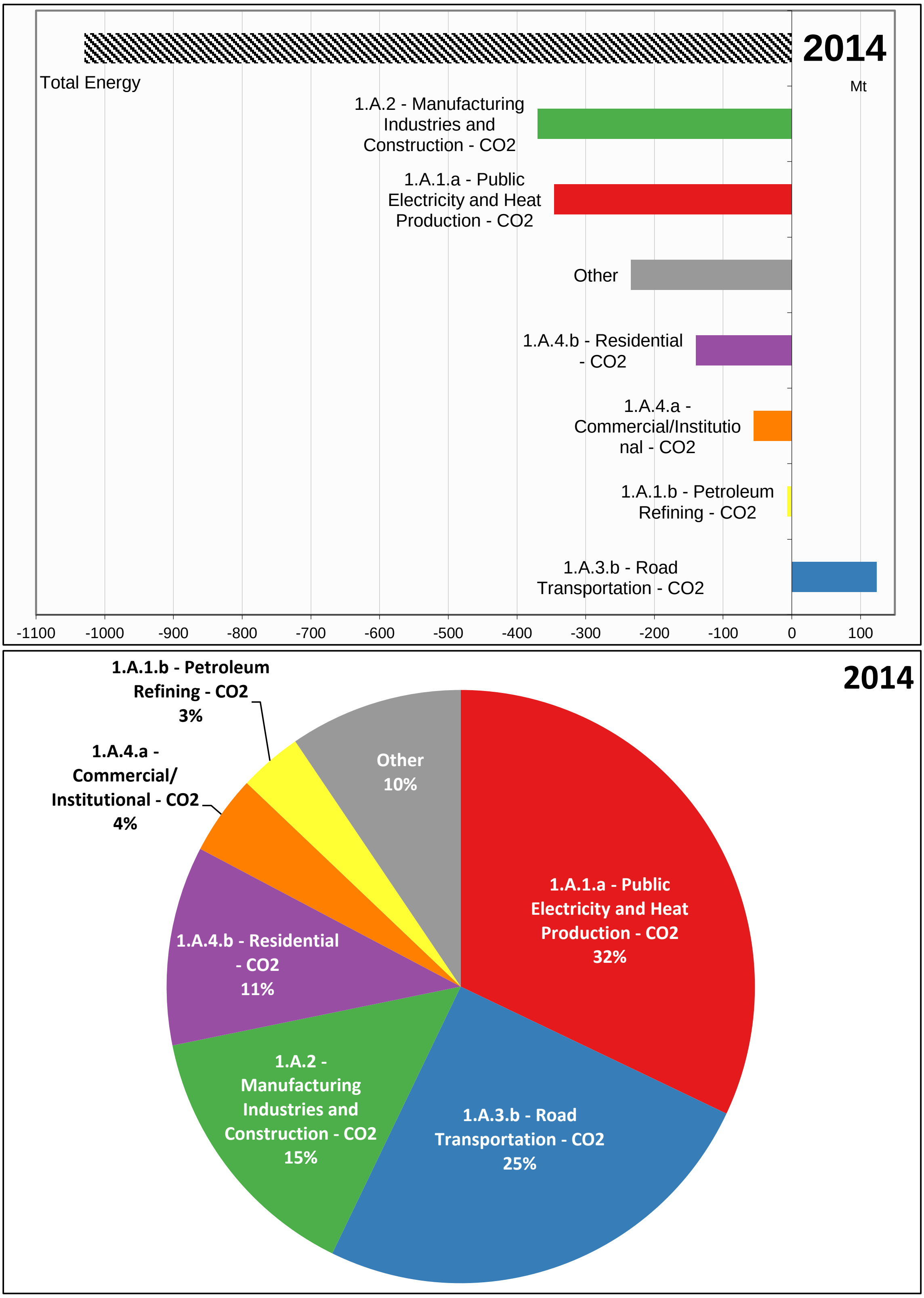


Figure 3.2 shows that CO_2 emissions from Road Transportation had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries as well as Public Electricity and Heat Production decreased substantially between 1990 and 2014. The increases in Road Transportation 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”[17] in Figure 3.2. Furthermore, Figure 3.2 (lower chart) shows that the three largest key sources account for 72% and the largest six for 90% of emissions in Sector 1.

[17] „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 1990-2014 and share of largest key source categories in 2014



The key categories in the energy sector are as follows:[18]

[18] 1 A 1 a Public Electricity and Heat Production: Peat (CO2), 1 A 4 b Residential: Solid Fuels (CH4) and 1B2c Venting and Flaring (CO_2) are new key categories and will be considered in detail in the EU NIR 2017.

- 1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)
- 1 A 1 b Petroleum Refining: Gaseous Fuels (CO_2)
- 1 A 1 b Petroleum Refining: Liquid Fuels (CO_2)
- 1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Gaseous Fuels (CO_2)
- 1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Solid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)
- 1 A 2 a Iron and Steel: Liquid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Solid Fuels (CO_2)
- 1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)
- 1 A 2 b Non-Ferrous Metals: Gaseous Fuels (CO_2)
- 1 A 2 c Chemicals: Gaseous Fuels (CO_2)
- 1 A 2 c Chemicals: Liquid Fuels (CO_2)
- 1 A 2 c Chemicals: Solid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)
- 1 A 2 f Non-metallic minerals: Gaseous Fuels (CO_2)
- 1 A 2 f Non-metallic minerals: Liquid Fuels (CO_2)
- 1 A 2 f Non-metallic minerals: Other Fuels (CO_2)
- 1 A 2 f Non-metallic minerals: Solid Fuels (CO_2)
- 1 A 2 g Other Manufacturing Industries and Constructions: Gaseous Fuels (CO_2)
- 1 A 2 g Other Manufacturing Industries and Constructions: Liquid Fuels (CO_2)
- 1 A 2 g Other Manufacturing Industries and Constructions: Other Fuels (CO_2)
- 1 A 2 g Other Manufacturing Industries and Constructions: Solid Fuels (CO_2)
- 1 A 3 a Domestic Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel Oil (CO_2)
- 1 A 3 b Road Transportation: Diesel Oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Liquefied Petroleum Gases (LPG) (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Domestic Navigation: Gas/Diesel Oil (CO_2)
- 1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Other Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
- 1 A 4 b Residential: Gaseous Fuels (CO_2)
- 1 A 4 b Residential: Liquid Fuels (CO_2)
- 1 A 4 b Residential: Solid Fuels (CO_2)
- 1 A 4 b Residential: Biomass (CH_4)
- 1 A 4 c Agriculture/Forestry/Fishing: Gaseous Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fishing: Liquid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fishing: Solid Fuels (CO_2)

- 1 A 5 a Other Other Sectors: Solid Fuels (CO_2)
- 1 A 5 b Other Other Sectors: Liquid Fuels (CO_2)
- 1 B 1 a Coal Mining and Handling: Operation (CH_4)
- 1 B 2 a Oil: Operation (CH_4)
- 1 B 2 a Oil: Operation (CO_2)
- 1 B 2 b Natural Gas: Operation (CH_4)

3.2 Source categories

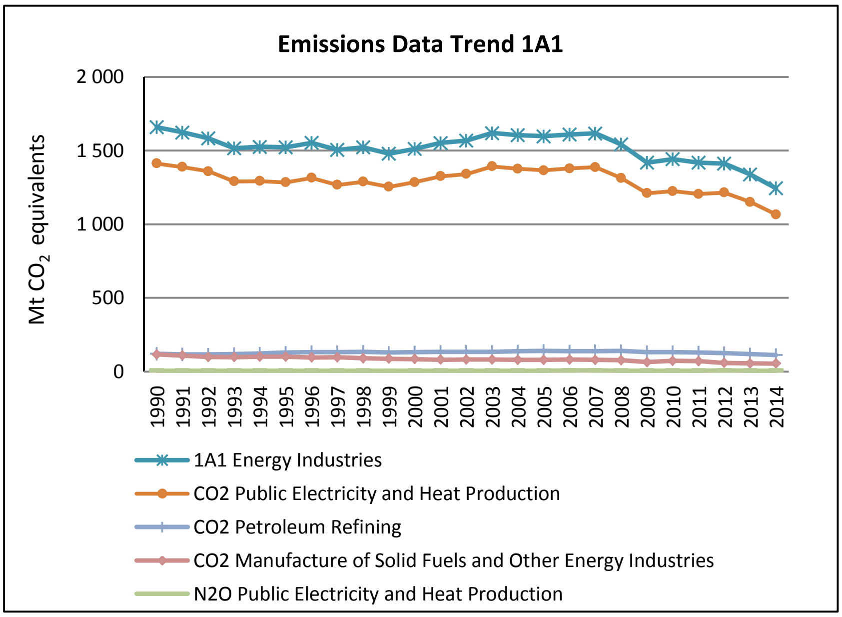
3.2.1 Energy Industries (CRF Source Category 1A1)

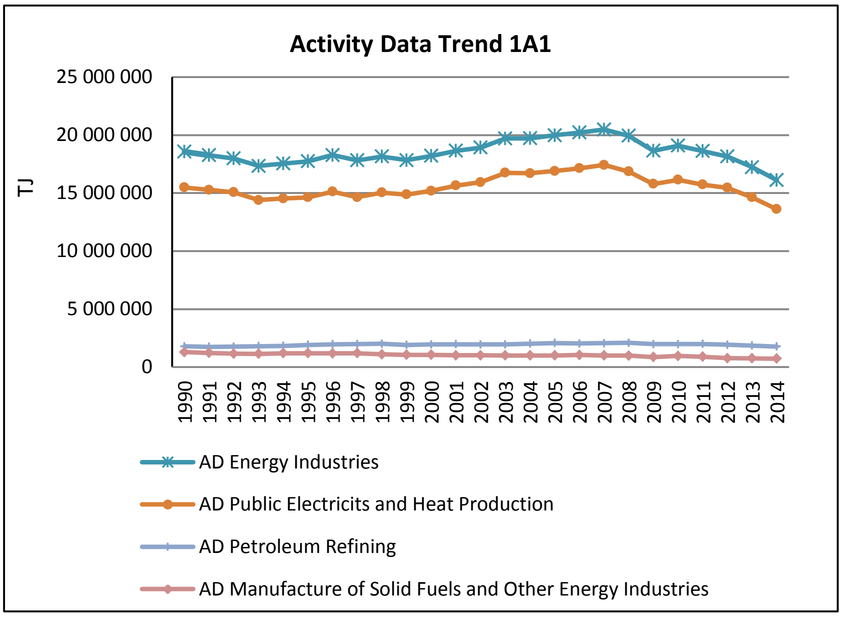
Energy Industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. For the EU-28, this source category includes three key categories: CO_2 from 'Public electricity and heat production' (CRF 1A1a), CO_2 from 'Petroleum-refining' (CRF 1A1b), and 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 + ISL between 1990 and 2014, 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 25%, between 1990 and 2014. This was mainly due to a decrease of CO_2 emission from Public Electricity and Heat Production (-346 Mt CO_2) and the manufacturing of solid fuels (-62 Mt CO_2). CO_2 emissions from petroleum refining decreased by 7 Mt in the period 1990-2014.

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





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

Table 3.1 summarizes the information by Member State. Between 1990 and 2014, greenhouse gas emissions from energy industries increased in six Member States and fell in twenty-three. The highest absolute increase was accounted for by the Netherlands and Greece. The UK, Germany and Poland, account for the largest part of reductions (-241 Mt). The change in the EU-28 + ISL was a net decrease of about 415 Mt. 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)
Austria	13 842	9 661	13 792	9 555	44	93
Belgium	30 059	20 541	29 859	20 328	180	157
Bulgaria	38 813	29 036	38 666	28 914	133	114
Croatia	7 190	4 571	7 167	4 553	17	16
Cyprus	1 767	2 950	1 761	2 940	4	7
Czech Republic	56 912	53 151	56 667	52 892	229	233
Denmark	26 248	15 549	26 146	15 362	86	87
Estonia	28 850	14 945	28 825	14 898	18	31
Finland	18 968	19 396	18 842	19 098	116	273
France	66 439	39 196	66 055	38 932	318	241
Germany	427 353	346 310	423 906	341 182	3 167	2 664
Greece	43 253	45 938	43 094	45 785	145	138
Hungary	20 910	13 188	20 833	13 099	67	65
Ireland	11 223	11 149	11 145	11 018	71	124
Italy	138 860	99 789	138 145	99 225	489	448
Latvia	6 217	1 704	6 201	1 680	11	15
Lithuania	13 556	3 157	13 525	3 114	21	27
Luxembourg	36	721	33	718	1	2
Malta	1 367	1 606	1 361	1 601	5	4
Netherlands	53 389	64 115	53 170	63 742	147	267
Poland	236 199	160 416	235 095	159 531	1 022	768
Portugal	16 344	14 496	16 292	14 391	46	92
Romania	51 412	25 062	51 205	24 952	178	98
Slovakia	19 161	7 162	19 056	7 099	86	44
Slovenia	6 375	4 448	6 348	4 425	25	20
Spain	77 793	75 726	77 324	74 889	300	443
Sweden	9 984	9 302	9 815	8 836	143	371
United Kingdom	237 441	153 534	235 823	152 392	1 417	924
EU-28	**1 659 962**	**1 246 819**	**1 650 152**	**1 235 150**	**8 486**	**7 767**
Iceland	14	3	14	3	0	0
EU-28 + ISL	**1 659 976**	**1 246 821**	**1 650 166**	**1 235 150**	**8 486**	**7 767**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In terms of absolute contributions to EU-28 + ISL greenhouse gas emissions from energy industries, this sector is clearly dominated by Germany, Poland and the United Kingdom. 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 + ISL, 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 + ISL level, 53% 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 23% in 2014 and biomass which has been constantly increasing with a share of 13% in 2014. In total Germany, Poland and the UK contribute to 53% of the total CO_2 emissions in sector 1A1 in the year 2014 (Figure 3.4).

Figure 3.4 1A1 Energy Industries, all fuels: Emission trend and share for CO_2

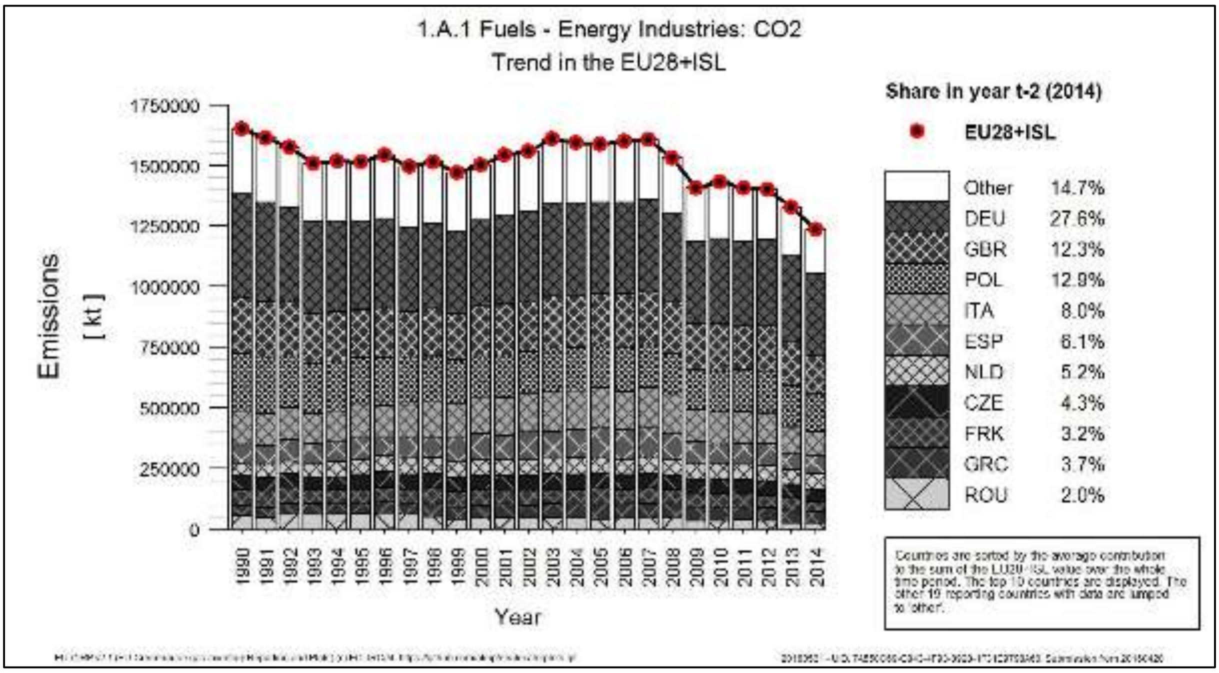


Table 3.2 provides information on the Member States' contribution to EU-28 + ISL recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2013 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.2 1A1 Energy Industries: Contribution of MS to EU-28 + ISL recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
Austria	0.0	0.00	-39.2	-0.35	revised energy balance
Belgium	-747.0	-2.44	38.3	0.18	Updated energy balance, bug in the CRF reporter software (1A1a solid fuels), reallocations, EF corrections
Bulgaria	0.0	0.00	-58.1	-0.21	Information on recalculations not updated in NIR (March 2016)
Croatia	0.0	0.00	0.0	0.00	
Cyprus	0.0	0.00	0.0	0.00	
Czech Republic	12.5	0.02	89.2	0.16	updated activity data
Denmark	0.0	0.00	13.1	0.07	Update of energy statistics
Estonia	0.0	0.00	-5.9	-0.04	An error regarding activity data was fixed.
Finland	0.0	0.00	-76.7	-0.35	Total peat consumption has been corrected, updates of energy statistics.

	1990		2013		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
France	2.7	0.00	156.2	0.30	Update of activity data for public heating
Germany	0.2	0.00	5 320.0	1.49	Revision of energy statistics for 2013
Greece	0.0	0.00	0.0	0.00	
Hungary	0.0	0.00	47.4	0.34	Changes in energy statistics
Ireland	0.0	0.00	0.0	0.00	
Italy	0.0	0.00	1.4	0.00	Update of emission factors and oxidation factors
Latvia	0.0	0.00	0.0	0.00	
Lithuania	6.0	0.04	-23.5	-0.61	– correction of CO_2 plant specific emission factor for not liquefied petroleum gas, orimulsion, emulsified vacuum residue based on EU ETS data in 1.A.1.a.ii Combined Heat and Power Generation; – correction of CO_2 plant specific emission factor for not liquefied petroleum gas, sub-bituminous coal, anthracite based on EU ETS data in 1.A.1.a.iii Heat Plants; – correction of CO_2 plant specific emission factor for residual fuel oil and not liquefied petroleum gas based on EU ETS data in 1.A.1.b is Petroleum Refinery sector;
Luxembourg	0.0	0.00	0.0	0.00	
Malta	-5.8	-0.42	-59.1	-3.48	revised activity data and emission factors
Netherlands	26.2	0.05	-563.2	-0.93	Revision of energy statistics
Poland	0.0	0.00	0.0	0.00	
Portugal	-5.2	-0.03	-3.0	-0.02	Please see explanation provided below for indirect CO_2.
Romania	0.0	0.00	0.0	0.00	
Slovakia	0.0	0.00	0.0	0.00	
Slovenia	0.0	0.00	0.0	0.00	
Spain	-30.7	-0.04	410.6	0.57	Update of emission factors, update of activity data
Sweden	0.0	0.00	0.0	0.00	New emission source in this submission. Reallocations due to classified data material; Minor revision of plant-specific data
United Kingdom	58.0	0.02	281.6	0.16	Revisions to national statistics caused an increase in emissions from 1A1ai. A small increase occurred in 1Acii due to revisions to estimates for LPG and OPG use at oil terminals and revisions to emission factors for natural gas. There was a decrease in emissions from 1A1ciii due to revisions to natural gas activity data reported in national statistics and also changes to emission factors for natural gas as a result of new gas composition data being available from gas companies.
EU-28	-683.2	-0.04	5 529.1	0.42	
Iceland	0.0	0.00	0.4	17.75	In the NIR it is stated that no recalculations were made in the energy sector
EU-28 + ISL	-683.2	-0.04	5 529.5	0.42	

Table 3.3 provides information on the Member States' contribution to EU-28 + ISL recalculations in N_2O from 1A1 Energy Industries for 1990 and 2013 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.3 1A1 Energy Industries: Contribution of MS to EU-28 + ISL recalculations in N_2O for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990	2013	Main explanations

	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
Austria	0.0	0.0	-0.8	-0.8	revised energy balance
Belgium	0.0	0.0	9.1	5.4	See table above
Bulgaria	0.0	0.0	0.0	0.0	
Croatia	0.0	0.0	0.0	0.1	
Cyprus	0.0	0.0	0.0	0.0	
Czech Republic	0.2	0.1	1.1	0.5	updated activity data available,
Denmark	-0.4	-0.4	-0.4	-0.4	Update of energy statistics
Estonia	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	-0.3	-0.1	Total peat consumption has been corrected
France	-83.6	-20.8	-63.8	-17.7	See table above
Germany	0.0	0.0	30.1	1.1	Revision of energy statistics for 2013
Greece	0.0	0.0	0.0	0.0	
Hungary	0.0	0.0	0.1	0.1	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	-1.4	-0.3	
Latvia	0.0	0.0	0.0	0.0	
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Malta	0.0	-0.2	-0.1	-1.5	Revised activity data and emission factors
Netherlands	6.1	4.3	-7.4	-2.8	Revision of energy statistics
Poland	0.0	0.0	0.0	0.0	
Portugal	-0.2	-0.5	0.0	0.0	
Romania	0.0	0.0	0.0	0.0	
Slovakia	0.8	1.0	1.4	3.8	Total amount of Municipal solid waste incineration with energy use is now reported in the subcategory 1.A.1.a
Slovenia	0.0	0.0	0.0	0.0	
Spain	33.4	12.5	-86.1	-16.8	Update of emission factors, update of activity data
Sweden	0.0	0.0	0.0	0.0	
United Kingdom	-498.1	-26.1	-318.2	-23.4	Mostly due to a decrease in emission estimates from public electricity and heat production caused by revisions to national statistics and also revisions to emission factors for coal, petroleum coke, coke, poultry litter.
EU-28	-541.8	-6.0	-436.8	-5.1	
Iceland	0.0	0.0	0.0	8.4	In the NIR it is stated that no recalculations were made in the energy sector
EU-28 + ISL	-541.8	-6.0	-436.8	-5.1	

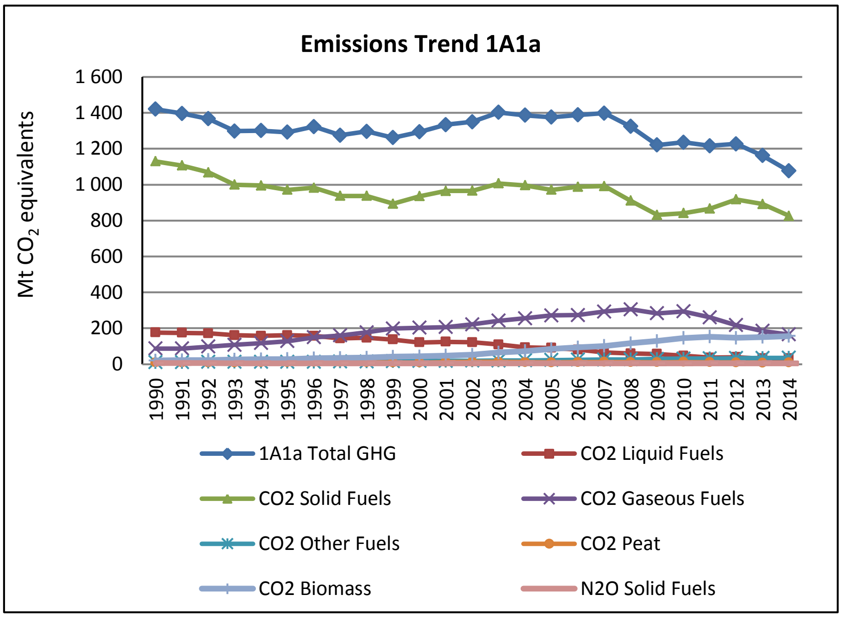
3.2.1.1 Public Electricity and Heat Production (1A1a) (EU-28 + ISL)

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.

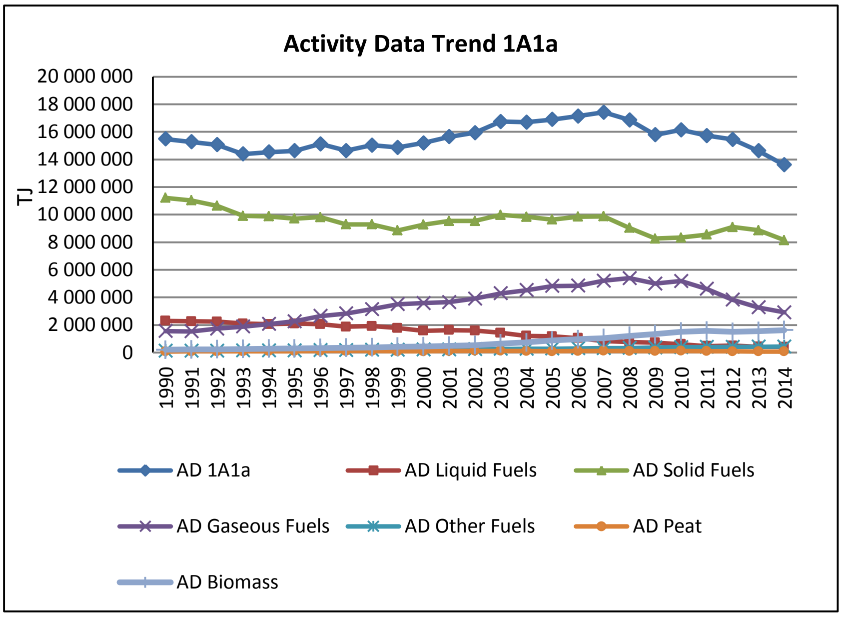
CO_2 emissions from electricity and heat production is the largest key category in the EU-28 + ISL accounting for 25% of total greenhouse gas emissions in 2014 and for 86% of greenhouse gas emissions of the Energy Industries Sector. Between 1990 and 2014, CO_2 emissions from electricity and heat production decreased by 25% in the EU-28 + ISL.

Figure 3.5 shows the trends in emissions originating from the production of public electricity and heat by fuel in the EU-28 + ISL between 1990 and 2014. In the lower chart of Figure 3.5 the underlying activity data[19] is shown.

Figure 3.5 1A1a Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends



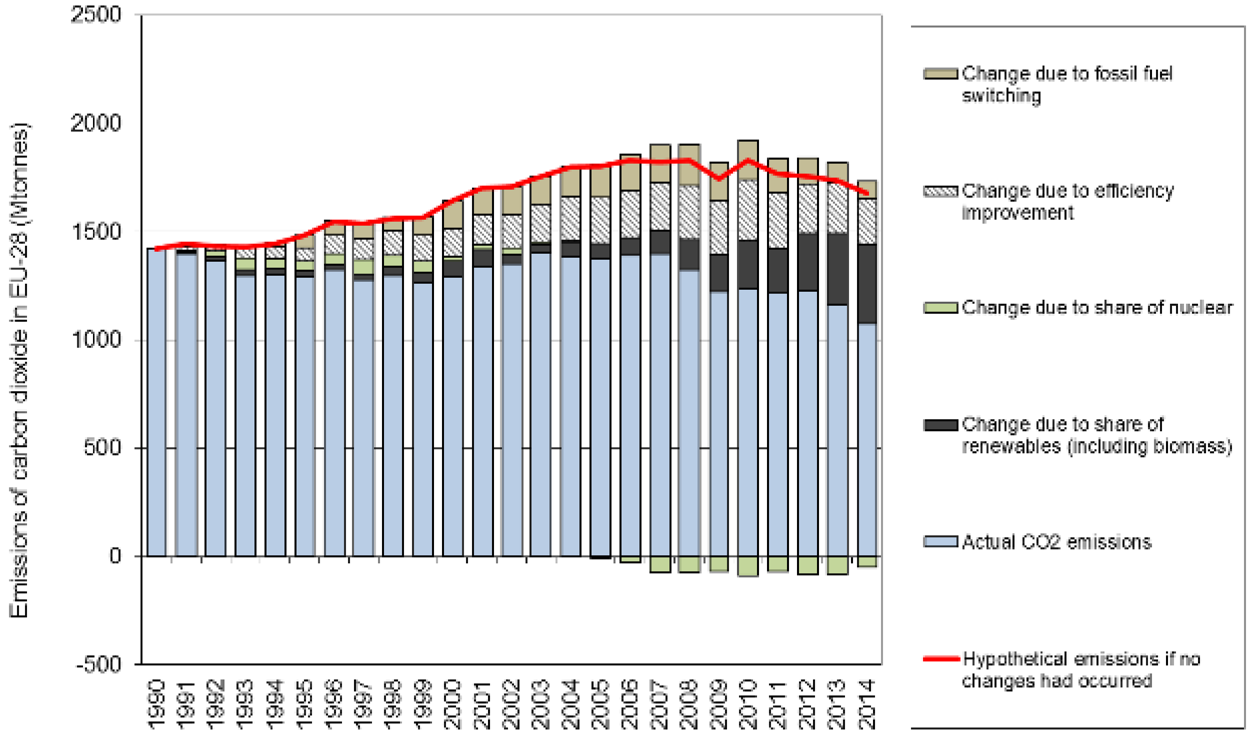
[19] CO_2 emissions from the combustion of biomass fuels are reported as a memo item and are therefore not included in the emissions from public electricity and heat production. The biomass used as a fuel is however included in the national energy consumption (i.e. activity data). The fact that CO_2 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.



Fuel used for public electricity and heat production decreased by 24% in the EU-28 + ISL between 1990 and 2014. Solid fuels still represent 60% of the fuel used in public conventional thermal power plants, although its combustion has been declining in recent years (-27% between 1990 and 2014). Gas has increased very rapidly, by a factor of 3 between 1990 and 2010, but declined in the last years. In 2014 its share amounts to 21% of all 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 12%.

Figure 3.6 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 2014. The main explanatory factors at the EU-28 level during the past 24 years have been the increased share of renewable energy, 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 3.6 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 2014.



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 2014, 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 25% during 1990-2014 (blue bar), but emissions would have risen by over 18%, 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 (18%). The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2014 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2014, 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 1990-2014.
- The higher combined share of renewable energy (increasing share) and the share of nuclear (more or less constant share) for electricity and heat production in 2014 compared to 1990[20]. During 1990-2014, the share of electricity from fossil fuels in total electricity production decreased by 18%.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.18 (increase in electricity and heat production) X 0.84 (efficiency improvement) X 0.93 (fossil fuel switching) X 0.82 (lower nuclear-renewable share) = 0.75. The combined effect was a decrease of 25% in CO_2 emissions in 2014 compared to the 1990 level.

[20] 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 19% in 2014. 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 2014. 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.

Returning to the 2016 inventory, Table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in four Member States and fell in 25 compared to 1990. Of the four countries where emissions were higher in 2014 than in 1990, more than 93% of the increase was accounted for by the Netherlands and Cyprus. Of the countries, where emissions fell, more than 50% of the total reduction was accounted for by the UK (42%), Poland (39%) and Italy (19%). The change in the EU-28 + ISL between 1990 and 2014 was a net decrease of 346 Mt CO_2eq.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	10 888	8 091	6 596	1%	-1 495	-18%	-4 292	-39%
Belgium	23 536	16 537	15 414	1%	-1 122	-7%	-8 122	-35%
Bulgaria	37 443	26 227	27 991	3%	1 764	7%	-9 452	-25%
Croatia	3 752	3 651	3 074	0%	-577	-16%	-678	-18%
Cyprus	1 676	2 830	2 940	0%	111	4%	1 265	75%
Czech Republic	54 658	48 863	46 475	4%	-2 389	-5%	-8 183	-15%
Denmark	24 695	16 441	13 076	1%	-3 365	-20%	-11 619	-47%
Estonia	28 760	14 852	14 316	1%	-536	-4%	-14 444	-50%
Finland	16 452	18 907	16 248	2%	-2 659	-14%	-205	-1%
France	49 370	40 764	27 721	3%	-13 043	-32%	-21 648	-44%
Germany	338 451	333 050	313 296	29%	-19 755	-6%	-25 155	-7%
Greece	40 617	44 100	40 446	4%	-3 654	-8%	-171	0%
Hungary	17 898	12 301	11 347	1%	-954	-8%	-6 551	-37%
Ireland	10 876	10 823	10 642	1%	-181	-2%	-235	-2%
Italy	107 158	78 690	71 379	7%	-7 311	-9%	-35 779	-33%
Latvia	6 058	1 849	1 613	0%	-236	-13%	-4 445	-73%
Lithuania	12 012	2 329	1 791	0%	-539	-23%	-10 222	-85%
Luxembourg	33	682	718	0%	35	5%	684	2056%
Malta	1 361	1 638	1 601	0%	-37	-2%	240	18%
Netherlands	39 999	47 713	51 342	5%	3 629	8%	11 343	28%
Poland	228 055	161 366	152 594	14%	-8 772	-5%	-75 461	-33%
Portugal	14 319	12 559	12 268	1%	-292	-2%	-2 052	-14%
Romania	46 782	21 857	21 685	2%	-173	-1%	-25 098	-54%
Slovakia	14 864	5 613	4 632	0%	-981	-17%	-10 232	-69%
Slovenia	6 096	5 739	4 419	0%	-1 320	-23%	-1 676	-28%
Spain	64 353	58 046	61 653	6%	3 607	6%	-2 700	-4%
Sweden	7 737	7 307	6 311	1%	-996	-14%	-1 426	-18%
United Kingdom	204 183	148 293	124 456	12%	-23 837	-16%	-79 728	-39%
EU-28	**1 412 081**	**1 151 120**	**1 066 043**	**100%**	**-85 077**	**-7%**	**-346 038**	**-25%**
Iceland	14	3	3	0%	0	-3%	-11	-82%
EU-28 + ISL	**1 412 095**	**1 151 123**	**1 066 045**	**100%**	**-85 078**	**-7%**	**-346 050**	**-25%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Finally, N_2O emissions currently represent 0.6% of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2014, emissions decreased by 1% (Table 3.5). The largest decline in emissions from this source category were reported by the UK (-484 kt CO_2eq) and Poland (-245 kt CO_2eq). The biggest increases occurred in Sweden (230 kt CO_2eq).

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

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	40	95	87	1%	-8	-8%	48	120%
Belgium	53	105	80	1%	-25	-24%	27	52%
Bulgaria	132	104	113	2%	9	8%	-19	-14%
Croatia	13	18	15	0%	-3	-16%	2	13%
Cyprus	4	7	7	0%	0	5%	3	77%
Czech Republic	226	225	215	3%	-10	-4%	-11	-5%
Denmark	79	89	78	1%	-11	-12%	0	-1%
Estonia	18	30	31	0%	0	1%	13	73%
Finland	100	272	249	4%	-23	-8%	149	149%
France	290	288	233	3%	-55	-19%	-57	-20%
Germany	2 407	2 555	2 447	35%	-108	-4%	39	2%
Greece	142	141	133	2%	-8	-6%	-8	-6%
Hungary	63	61	63	1%	2	4%	1	1%
Ireland	71	124	124	2%	0	0%	53	74%
Italy	306	295	289	4%	-5	-2%	-16	-5%
Latvia	11	12	14	0%	2	17%	4	33%
Lithuania	19	21	25	0%	4	20%	7	35%
Luxembourg	1	2	2	0%	0	-2%	1	55%
Malta	5	4	4	0%	0	-2%	-1	-20%
Netherlands	133	238	249	4%	11	5%	117	88%
Poland	1 006	795	761	11%	-34	-4%	-245	-24%
Portugal	43	96	91	1%	-5	-5%	48	113%
Romania	174	92	95	1%	3	3%	-79	-45%
Slovakia	80	36	42	1%	6	18%	-38	-47%
Slovenia	25	26	20	0%	-6	-22%	-5	-19%
Spain	285	399	416	6%	17	4%	131	46%
Sweden	137	408	368	5%	-40	-10%	230	168%
United Kingdom	1 127	776	643	9%	-133	-17%	-484	-43%
EU-28	**6 986**	**7 314**	**6 895**	**100%**	**-419**	**-6%**	**-92**	**-1%**
Iceland	0	0	0	0%	0	-8%	0	-75%
EU-28 + ISL	**6 987**	**7 314**	**6 895**	**100%**	**-419**	**-6%**	**-92**	**-1%**

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 + ISL, emissions fell by 82% between 1990 and 2014 (Table 3.6).

Table 3.6 1A1a Public Electricity and Heat Production, Liquid Fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	1 229	188	156	0%	-32	-17%	-1 072	-87%
Belgium	663	19	44	0%	25	134%	-618	-93%
Bulgaria	3 245	668	743	2%	74	11%	-2 503	-77%
Croatia	2 142	173	109	0%	-64	-37%	-2 034	-95%
Cyprus	1 676	2 830	2 940	9%	111	4%	1 265	75%
Czech Republic	1 234	61	58	0%	-3	-5%	-1 176	-95%
Denmark	951	274	210	1%	-63	-23%	-740	-78%
Estonia	4 900	279	245	1%	-34	-12%	-4 655	-95%
Finland	1 230	514	500	2%	-15	-3%	-731	-59%
France	8 257	4 236	3 567	11%	-668	-16%	-4 690	-57%
Germany	8 637	2 516	2 070	7%	-446	-18%	-6 567	-76%
Greece	5 416	3 404	3 512	11%	107	3%	-1 904	-35%
Hungary	1 456	65	61	0%	-4	-6%	-1 394	-96%
Ireland	1 087	124	182	1%	58	47%	-904	-83%
Italy	63 058	2 296	2 022	6%	-275	-12%	-61 037	-97%
Latvia	3 050	16	2	0%	-13	-85%	-3 047	-100%
Lithuania	6 021	247	151	0%	-96	-39%	-5 870	-97%
Luxembourg	NO	2	2	0%	0	-15%	2	100%
Malta	742	1 638	1 601	5%	-37	-2%	859	116%
Netherlands	205	681	1 314	4%	633	93%	1 109	541%
Poland	5 160	498	1 036	3%	539	108%	-4 124	-80%
Portugal	6 407	814	712	2%	-102	-13%	-5 694	-89%
Romania	20 353	713	705	2%	-8	-1%	-19 648	-97%
Slovakia	1 033	20	13	0%	-7	-37%	-1 020	-99%
Slovenia	272	24	44	0%	20	82%	-227	-84%
Spain	6 039	6 950	7 059	22%	109	2%	1 020	17%
Sweden	1 277	497	341	1%	-155	-31%	-936	-73%
United Kingdom	20 791	2 366	2 054	7%	-312	-13%	-18 736	-90%
EU-28	**176 531**	**32 115**	**31 455**	**100%**	**-659**	**-2%**	**-145 076**	**-82%**
Iceland	14	3	3	0%	0	-3%	-11	-82%
EU-28 + ISL	**176 545**	**32 117**	**31 458**	**100%**	**-659**	**-2%**	**-145 087**	**-82%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.7 shows the contribution to the emission trend for liquid fuels by the main Member States. In 2014 Spain, France and Greece are responsible for about 45% of emissions in this category. The strongest decrease in emissions took place in Italy because less oil is used as a fuel in the power sector.

Figure 3.7 1A1a Public Electricity and Heat Production, Liquid Fuels: Emission trend and share for CO_2

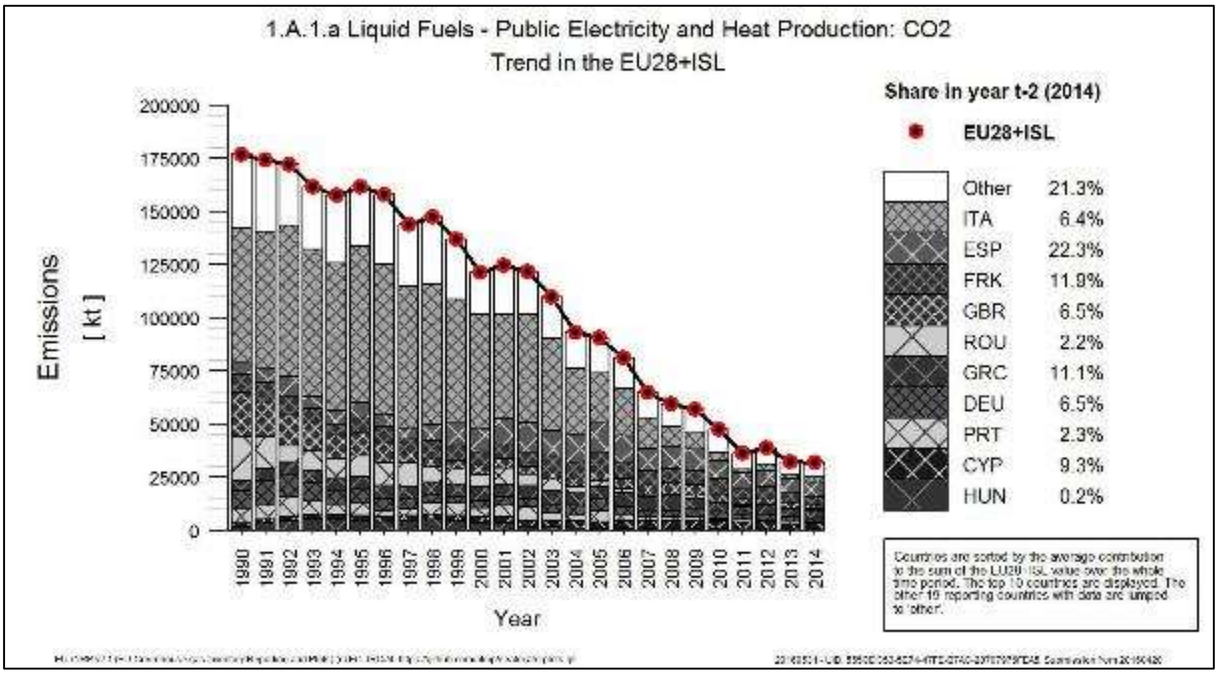
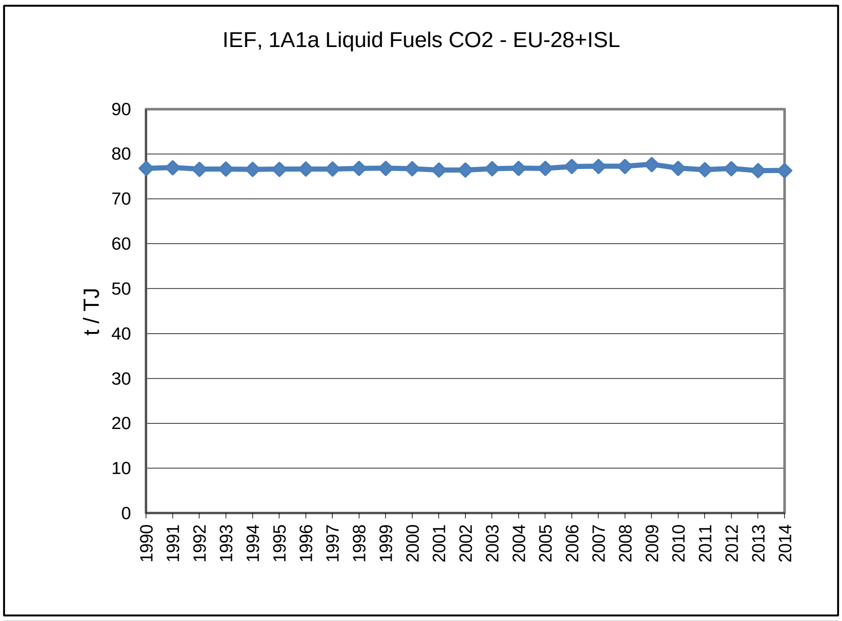
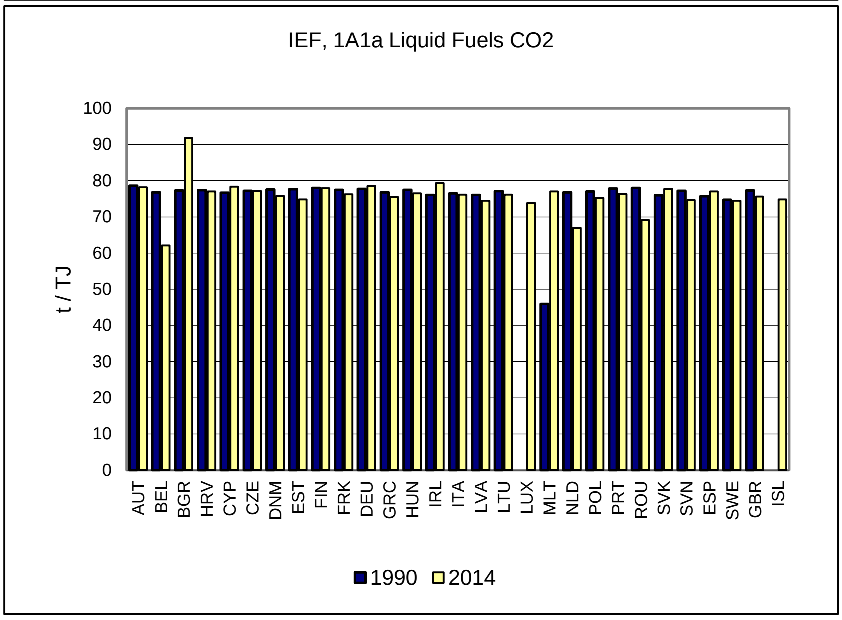


Figure 3.8 shows the implied emission factors for CO_2 emissions from liquid fuels used in public electricity and heat production. The IEFs in most countries ranges between 76 and 79 t/TJ in 1990 as well as in 2014. Bulgaria has the highest IEF in 2014, which is explained by the relatively large share of petroleum coke used in main activity producer CHP plants. The country-specific CO_2 EF for petroleum coke varies in the range of 92-95 t/TJ, which is significantly higher than the average EF of liquid fuels. The IEF of Belgium is the lowest among the Member States in 2014. This is due to a fluctuation caused by the varying mix of liquid fuels including gasoil and heavy fuel (with higher IEF) and on the other hand refinery gas (with lower IEF).

Figure 3.8 1A1a Public Electricity and Heat Production, Liquid Fuels: Implied Emission Factors for CO_2





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

CO_2 emissions from the combustion of solid fuels represented about 76% of all greenhouse gas emissions from public electricity and heat production. Within the EU-28 + ISL, emissions fell by 27% between 1990 and 2014 (Table 3.7).

Table 3.7 1A1a Public Electricity and Heat Production, Solid Fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	6 247	3 295	2 305	0%	-990	-30%	-3 942	-63%
Belgium	19 434	7 160	6 528	1%	-632	-9%	-12 906	-66%
Bulgaria	27 902	23 450	25 233	3%	1 783	8%	-2 669	-10%
Croatia	603	2 202	2 142	0%	-60	-3%	1 538	255%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	52 368	46 546	44 180	5%	-2 366	-5%	-8 188	-16%
Denmark	22 225	12 229	9 628	1%	-2 601	-21%	-12 598	-57%
Estonia	21 704	13 551	13 091	2%	-460	-3%	-8 613	-40%
Finland	9 281	10 416	7 907	1%	-2 510	-24%	-1 374	-15%
France	37 578	24 725	14 822	2%	-9 903	-40%	-22 756	-61%
Germany	307 246	286 836	272 324	33%	-14 512	-5%	-34 922	-11%
Greece	35 201	36 109	33 955	4%	-2 154	-6%	-1 246	-4%
Hungary	12 266	8 032	7 923	1%	-109	-1%	-4 343	-35%
Ireland	4 845	3 798	3 633	0%	-165	-4%	-1 212	-25%
Italy	28 169	39 393	37 726	5%	-1 666	-4%	9 558	34%
Latvia	218	40	17	0%	-24	-59%	-201	-92%
Lithuania	174	10	7	0%	-4	-34%	-167	-96%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	619	NO	NO	-	-	-	-619	-100%
Netherlands	25 862	26 390	30 010	4%	3 620	14%	4 148	16%
Poland	220 928	157 788	148 553	18%	-9 235	-6%	-72 374	-33%
Portugal	7 912	9 875	10 028	1%	152	2%	2 115	27%
Romania	26 429	16 670	16 867	2%	197	1%	-9 562	-36%
Slovakia	11 542	3 673	3 282	0%	-391	-11%	-8 260	-72%
Slovenia	5 712	5 395	4 161	1%	-1 235	-23%	-1 551	-27%
Spain	57 770	39 112	43 096	5%	3 984	10%	-14 674	-25%
Sweden	4 231	3 101	2 785	0%	-316	-10%	-1 446	-34%
United Kingdom	183 150	111 983	85 791	10%	-26 192	-23%	-97 359	-53%
EU-28	**1 129 615**	**891 778**	**825 992**	**100%**	**-65 786**	**-7%**	**-303 623**	**-27%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**1 129 615**	**891 778**	**825 992**	**100%**	**-65 786**	**-7%**	**-303 623**	**-27%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.9 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 + ISL (33%), followed by Poland (18%) and the United Kingdom (11%).

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

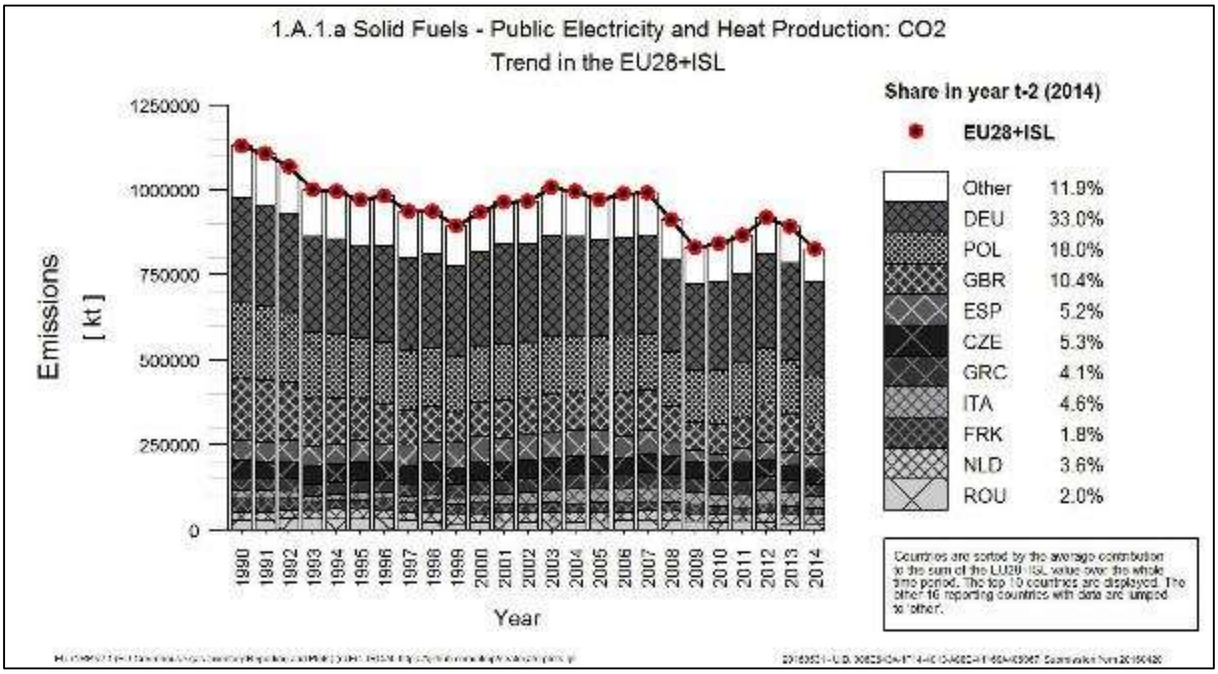
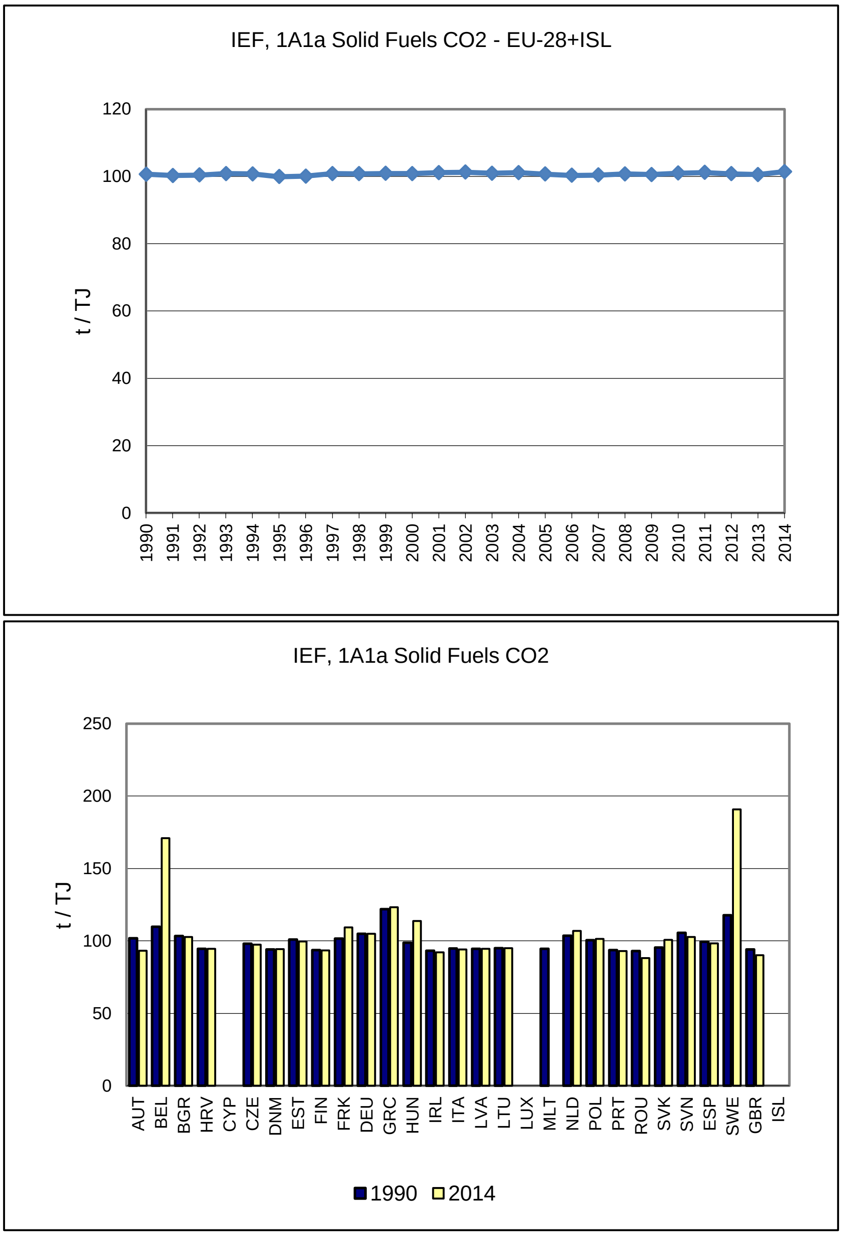


Figure 3.10 shows the relevant implied emission factors for solid fuels. The EU-28 + ISL implied emission factor has remained fairly stable (101 t/TJ in 2014). In Belgium and Sweden, the emission factors increased sharply since the late 1990s due to the use of blast furnace gas which has a higher IEF. The comparatively high IEF of Greece is due to the large importance of domestic lignite use for electricity production.

Figure 3.10 1A1a Public Electricity and Heat Production, Solid Fuels: Implied Emission Factors for CO_2



The related N_2O emissions from the use of solid fuels are responsible for 0.4% of all greenhouse gas emissions in the heat and power sector. For the EU-28 + ISL, emissions decreased by 25% between 1990 and 2014 (Table 3.8).

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

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	22	17	12	0%	-5	-31%	-10	-46%
Belgium	37	4	3	0%	-1	-26%	-34	-92%
Bulgaria	121	102	110	2%	8	8%	-11	-9%
Croatia	3	10	10	0%	0	-3%	7	255%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	222	198	187	4%	-11	-5%	-35	-16%
Denmark	57	31	24	1%	-7	-21%	-33	-58%
Estonia	2	8	7	0%	-1	-11%	5	272%
Finland	41	66	49	1%	-17	-25%	8	19%
France	206	98	44	1%	-54	-55%	-163	-79%
Germany	2 275	2 032	1 948	43%	-84	-4%	-327	-14%
Greece	129	131	123	3%	-8	-6%	-6	-4%
Hungary	56	31	29	1%	-2	-6%	-27	-48%
Ireland	8	6	6	0%	0	-3%	-2	-24%
Italy	133	187	179	4%	-8	-4%	47	35%
Latvia	1	0	0	0%	0	-59%	-1	-92%
Lithuania	1	0	0	0%	0	-34%	-1	-96%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	3	NO	NO	-	-	-	-3	-100%
Netherlands	104	93	107	2%	14	15%	3	3%
Poland	970	687	640	14%	-46	-7%	-330	-34%
Portugal	35	44	44	1%	1	2%	9	27%
Romania	127	85	85	2%	1	1%	-42	-33%
Slovakia	54	16	15	0%	-2	-10%	-39	-73%
Slovenia	24	24	18	0%	-6	-24%	-6	-25%
Spain	257	292	290	6%	-2	-1%	33	13%
Sweden	41	68	54	1%	-15	-22%	13	31%
United Kingdom	1 068	645	495	11%	-150	-23%	-574	-54%
EU-28	**5 997**	**4 874**	**4 479**	**100%**	**-395**	**-8%**	**-1 519**	**-25%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**5 997**	**4 874**	**4 479**	**100%**	**-395**	**-8%**	**-1 519**	**-25%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The trend for N_2O emissions (Figure 3.11) 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 3.11 1A1a Public Electricity and Heat Production, Solid Fuels: Emission trend and share for N_2O

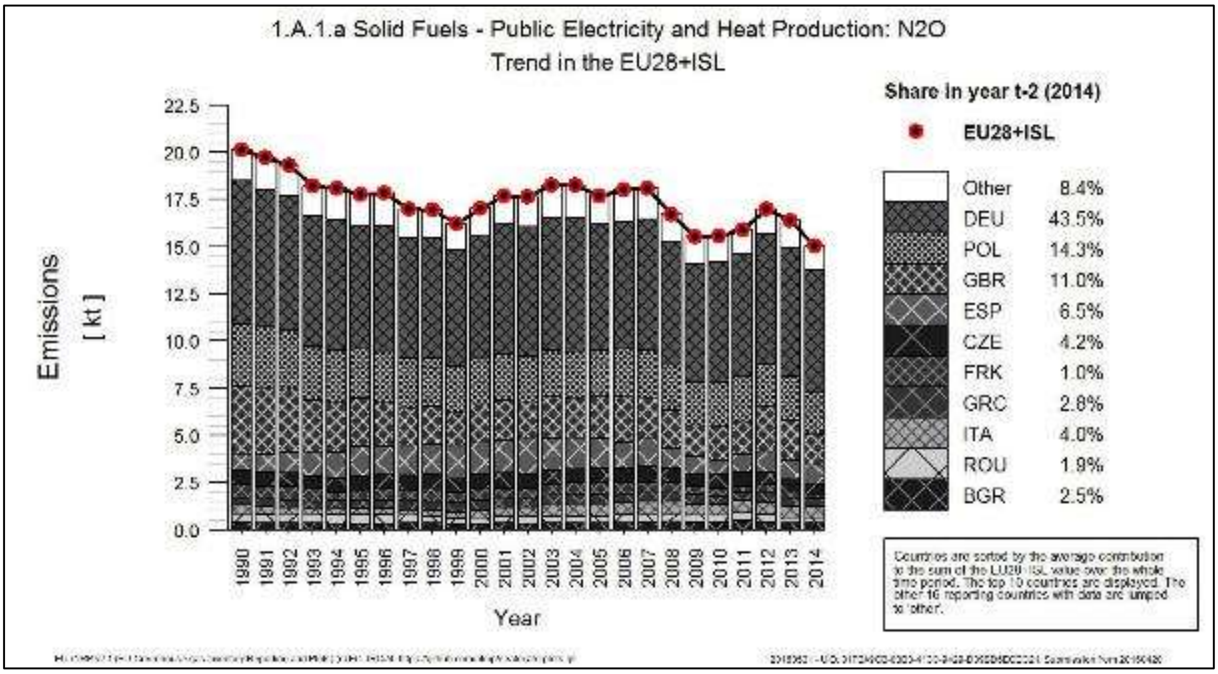
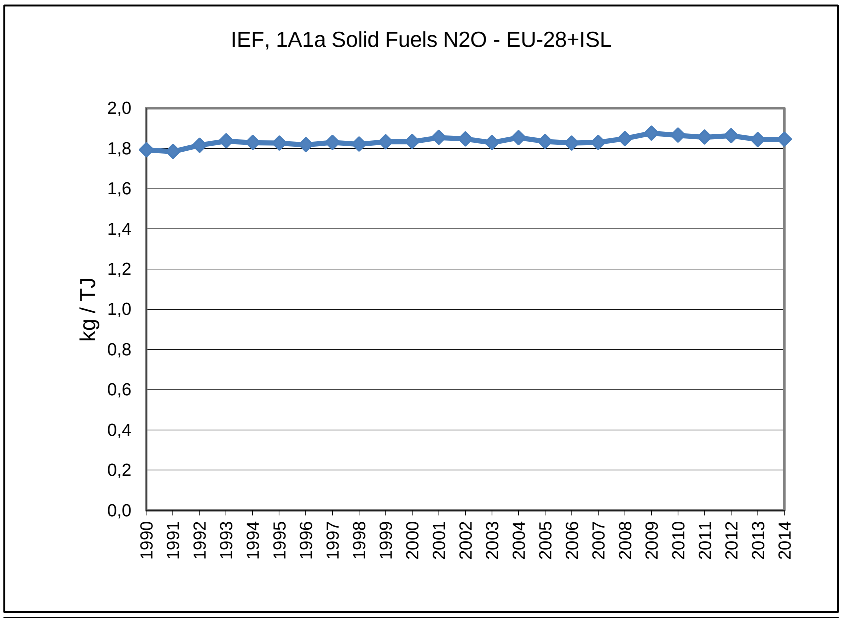
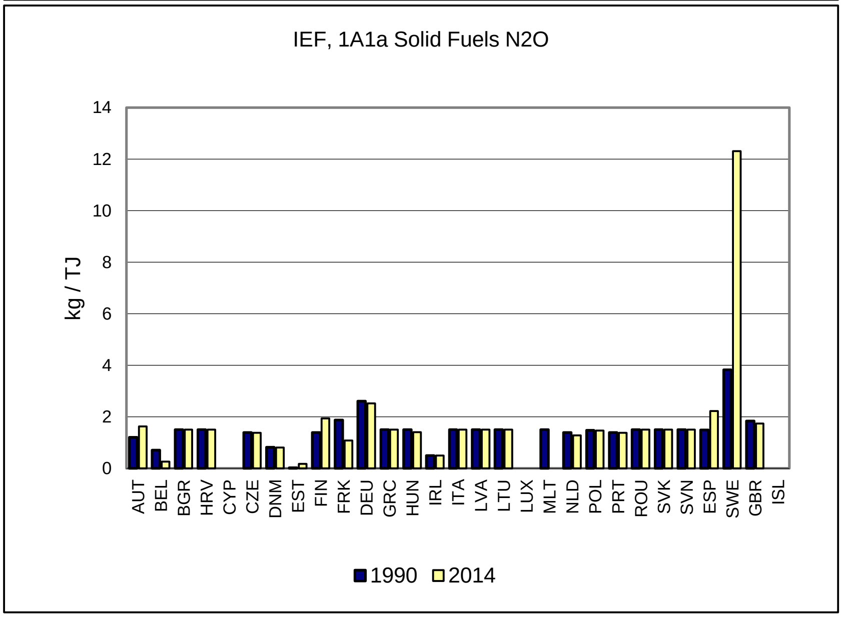


Figure 3.12 shows the implied emission factors for N_2O. The EU-28 + ISL implied emission factor remained stable at around 1.84 kg/TJ between 1990 and 2014. Sweden has the highest IEF (about 12 kg/TJ in 2014); it gradually increased between 1990 and 2014. This is explained by Sweden as mainly caused by the use of coal, with a relatively high EF compared to e.g. steelwork gases. This comparatively high implied emission factor is regularly reviewed and found to be correct for Swedish conditions.

Figure 3.12 1A1a Public Electricity and Heat Production, Solid Fuels: Implied Emission Factors for N_2O





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

CO_2 emissions from the combustion of gaseous fuels accounted for 15% of all greenhouse gas emissions from public electricity and heat generation in 2014. Emissions increased by 91% in the EU-28 + ISL between 1990 and 2014 (Table 3.9).

Table 3.9 1A1a Electricity and heat production, Gaseous Fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	3 294	3 369	2 811	2%	-557	-17%	-483	-15%
Belgium	2 765	7 544	6 856	4%	-688	-9%	4 091	148%
Bulgaria	6 295	2 109	2 015	1%	-94	-4%	-4 281	-68%
Croatia	1 006	1 276	824	0%	-452	-35%	-182	-18%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 019	1 914	1 887	1%	-27	-1%	868	85%
Denmark	980	2 493	1 794	1%	-699	-28%	813	83%
Estonia	1 969	755	719	0%	-36	-5%	-1 249	-63%
Finland	1 989	2 976	2 527	2%	-449	-15%	538	27%
France	977	6 595	4 030	2%	-2 565	-39%	3 053	312%
Germany	18 447	28 898	24 101	15%	-4 797	-17%	5 653	31%
Greece	IE,NO	4 587	2 979	2%	-1 608	-35%	2 979	100%
Hungary	4 148	3 963	3 148	2%	-815	-21%	-1 000	-24%
Ireland	1 881	4 356	4 078	2%	-279	-6%	2 197	117%
Italy	15 788	36 830	31 437	19%	-5 393	-15%	15 649	99%
Latvia	2 644	1 789	1 594	1%	-195	-11%	-1 050	-40%
Lithuania	5 806	1 961	1 533	1%	-428	-22%	-4 273	-74%
Luxembourg	NO	615	654	0%	39	6%	654	100%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	13 330	17 847	17 190	10%	-657	-4%	3 859	29%
Poland	1 214	2 995	2 918	2%	-77	-3%	1 704	140%
Portugal	NO	1 489	1 123	1%	-365	-25%	1 123	100%
Romania	NO	4 474	4 112	2%	-362	-8%	4 112	100%
Slovakia	2 089	1 861	1 275	1%	-586	-31%	-814	-39%
Slovenia	112	306	201	0%	-105	-34%	89	79%
Spain	434	10 827	10 110	6%	-717	-7%	9 677	2232%
Sweden	486	885	469	0%	-416	-47%	-17	-4%
United Kingdom	16	32 240	34 873	21%	2 632	8%	34 857	218629%
EU-28	**86 689**	**184 952**	**165 257**	**100%**	**-19 695**	**-11%**	**78 568**	**91%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**86 689**	**184 952**	**165 257**	**100%**	**-19 695**	**-11%**	**78 568**	**91%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In nine EU-28 Member States the consumption of gas was lower in 2014 than in 1990. In the other countries, gas consumption has increased. Nevertheless there is a decreasing trend since 2008 which is mainly attributed to the increased prices for natural gas. Figure 3.13 shows the trend of emissions from gaseous fuels by the main contributing Member States which are the United Kingdom, Italy and Germany.

Figure 3.13 1A1a Public Electricity and Heat Production, Gaseous Fuels: Emission trend and share for CO_2

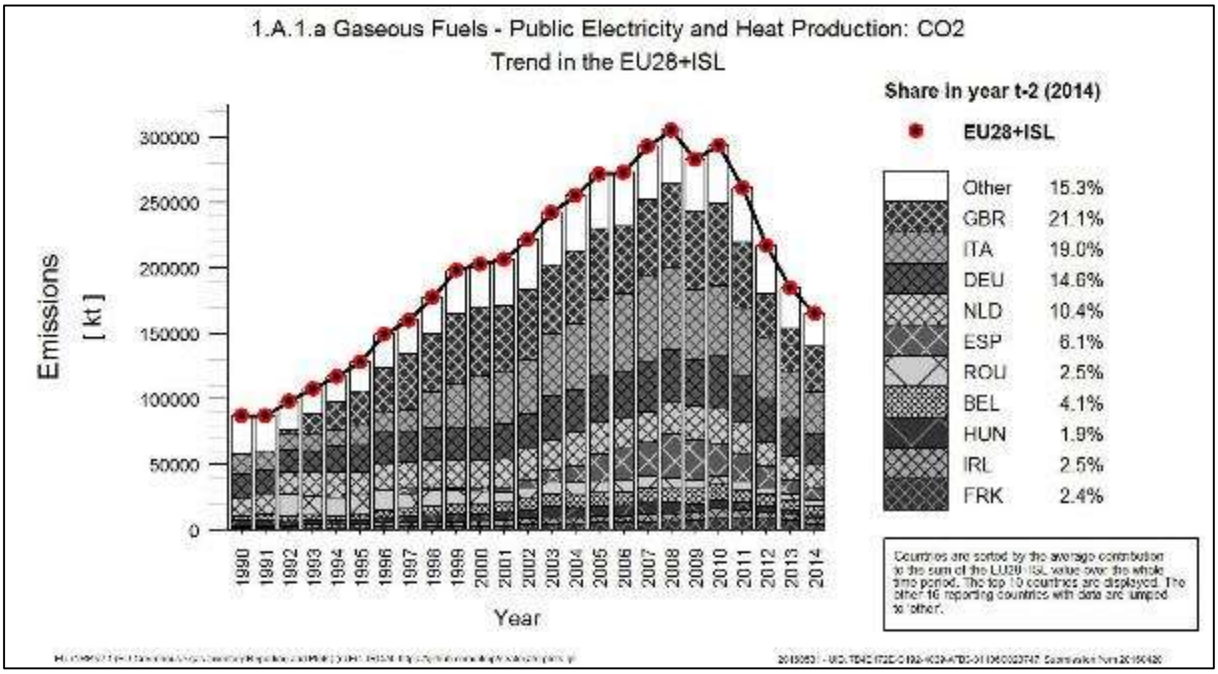
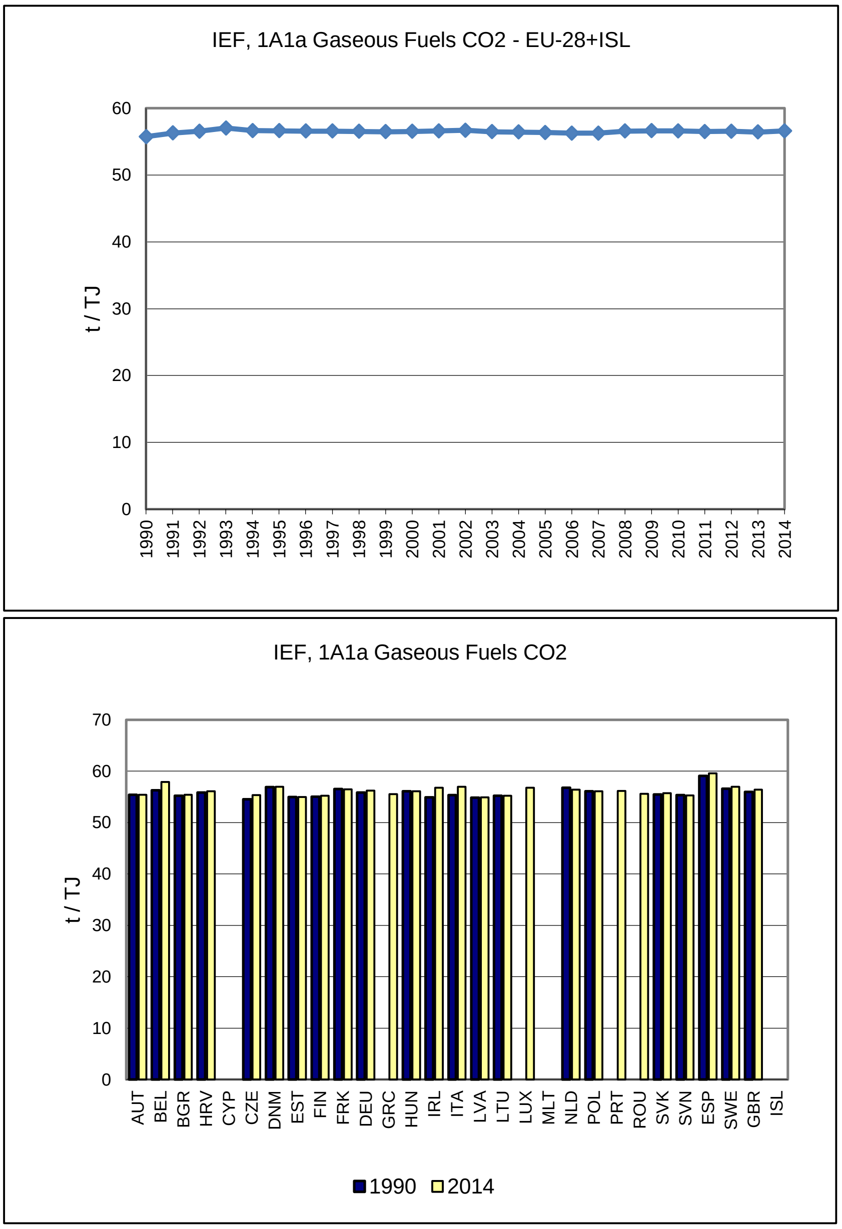


Figure 3.14 shows the implied emission factors from gaseous fuels for CO_2. The EU-28 + ISL implied emission factor has remained fairly stable (56.60 t/TJ in 2014) which is very close to the default value. The increase in the EU-28 + ISL factor observed in the early 1990s can be explained by the higher UK's gas share in the EU-28 + ISL and by an increase in the UK's implied emission factor. The latter is the result of the commissioning of the Peterhead power station in Scotland, which uses sour gas, a fuel with a much higher factor than natural gas.

Figure 3.14 1A1a Public Electricity and Heat Production, Gaseous Fuels: Implied Emission Factors for CO_2



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

In 2014, 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 226% at EU-28 + ISL level between 1990 and 2014 and increased in all countries where 'Other Fuels' except for Latvia, Poland and Slovakia. Other Fuels cover mainly the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.10).

Table 3.10 1A1a Public Electricity and Heat Production, Other Fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	118	1 239	1 324	4%	85	7%	1 206	1022%
Belgium	674	1 814	1 986	6%	172	9%	1 312	195%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	37	342	350	1%	7	2%	313	857%
Denmark	539	1 447	1 445	4%	-2	0%	906	168%
Estonia	NO	109	131	0%	22	20%	131	100%
Finland	1	280	337	1%	57	20%	336	33541%
France	2 558	5 208	5 302	15%	94	2%	2 744	107%
Germany	4 121	14 802	14 802	42%	0	0%	10 681	259%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	28	241	215	1%	-27	-11%	187	671%
Ireland	NO	87	88	0%	1	2%	88	100%
Italy	143	171	194	1%	22	13%	50	35%
Latvia	3	NO	NO	-	-	-	-3	-100%
Lithuania	NO	65	83	0%	17	27%	83	100%
Luxembourg	33	65	62	0%	-3	-5%	29	87%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	601	2 795	2 828	8%	34	1%	2 227	370%
Poland	753	85	86	0%	1	1%	-667	-89%
Portugal	NO	382	404	1%	23	6%	404	100%
Romania	NO	1	1	0%	0	0%	1	100%
Slovakia	200	59	62	0%	3	6%	-137	-69%
Slovenia	NO	13	13	0%	0	0%	13	100%
Spain	110	1 157	1 387	4%	230	20%	1 277	1160%
Sweden	570	2 026	2 132	6%	106	5%	1 562	274%
United Kingdom	227	1 704	1 738	5%	34	2%	1 511	666%
EU-28	**10 716**	**34 092**	**34 969**	**100%**	**878**	**3%**	**24 254**	**226%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**10 716**	**34 092**	**34 969**	**100%**	**878**	**3%**	**24 254**	**226%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.15 shows the largest emitters in 2014 which were Germany and France and the Netherlands which together accounted for 58% of the EU-28 + ISL emissions.

Figure 3.15 1A1a Public Electricity and Heat Production, Other Fuels: Emission trend and share for CO_2

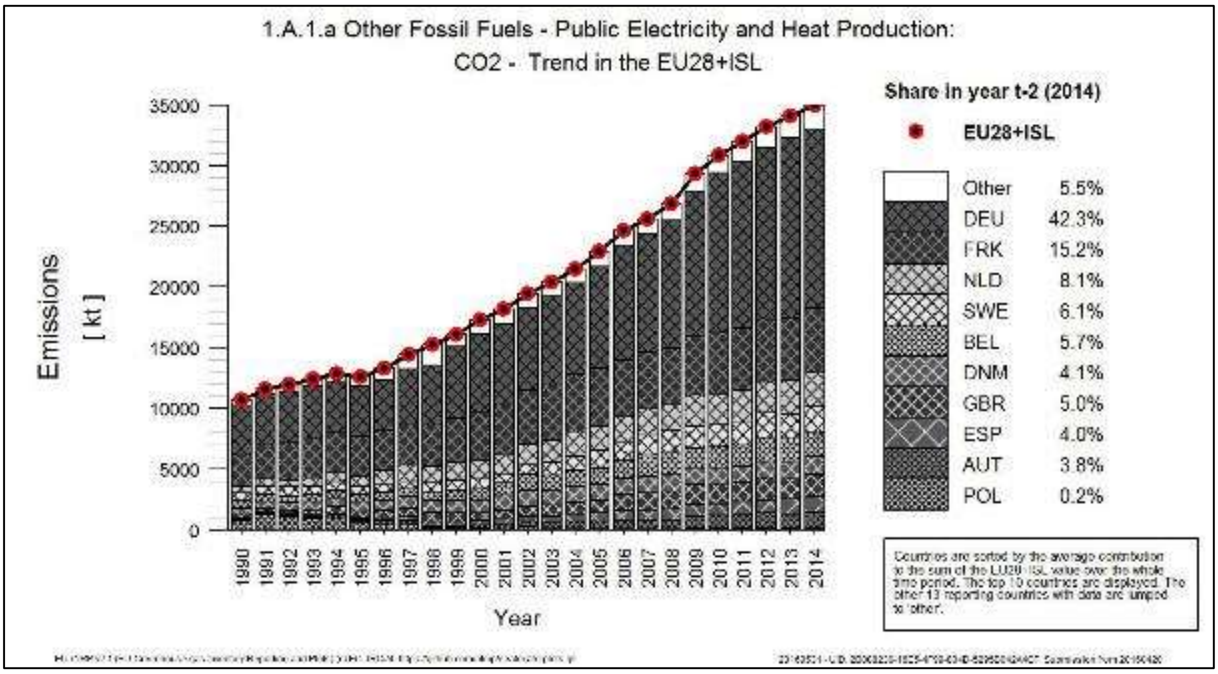
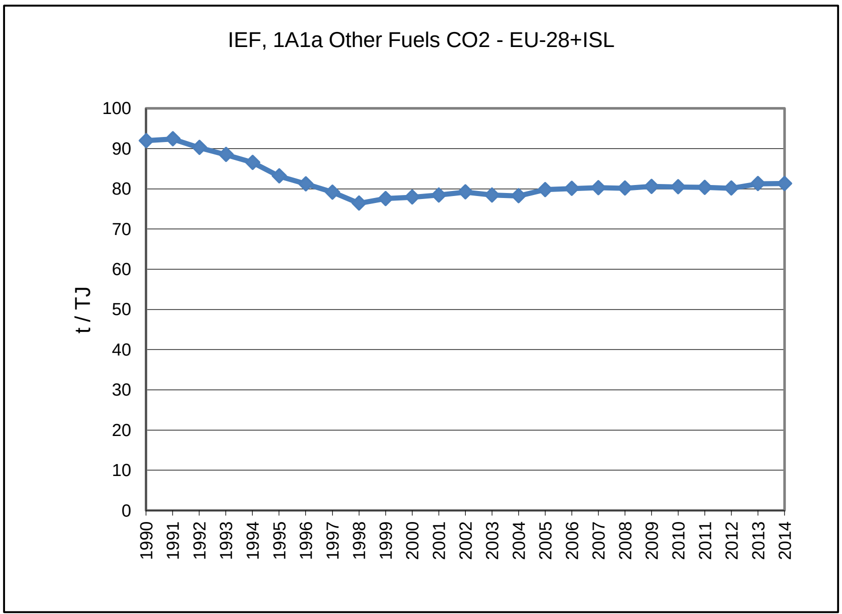


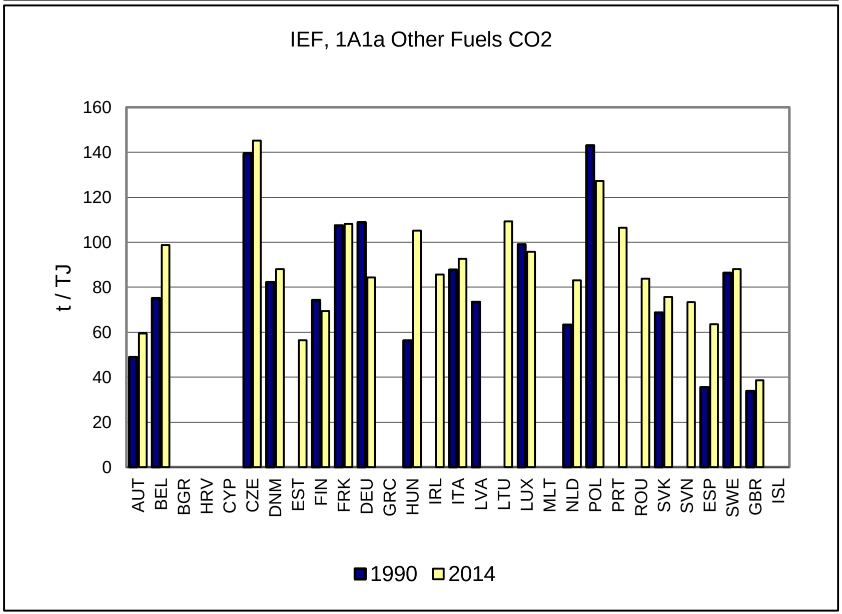
Figure 3.16 shows the implied emission factors of Other Fuels from CO_2. The EU-28 + ISL implied emission factor has gradually fallen until 1998, then levelled out at around 80 t/TJ, and in 2014 it amounts to 81.29 t/TJ.

In Germany, the IEF declined continuously between 1990 and 2014 (from 108.79 to 84.35 t/TJ). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

In the Netherlands, the IEF increased since 1990 and reached 83.06 t/TJ in 2014. This was mainly due to the increase in the share of plastics (with a high carbon fraction) in combustible.

Figure 3.16 1A1a Public Electricity and Heat Production, Other Fuels: Implied Emission Factors for CO_2





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

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 as well as flaring under 1B2c.

CO_2 emissions from Petroleum Refining is accounting for 3% of total greenhouse gas emissions in 2014. Between 1990 and 2014, EU-28 + ISL CO_2 emissions decreased by 6% (Table 3.11). Emissions in 2014 were above 1990 levels in 13 Member States, whereas they were decreasing in 11 countries.

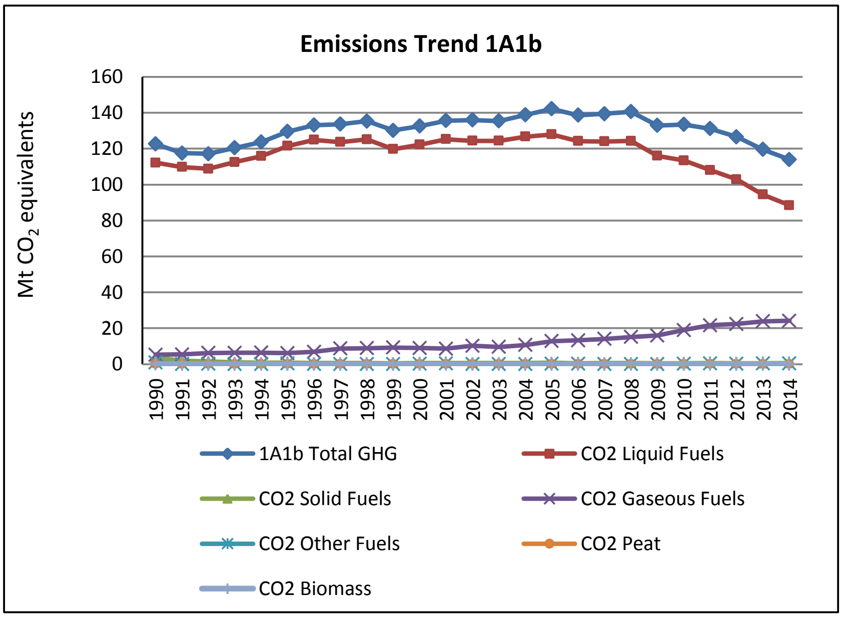
Table 3.11 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

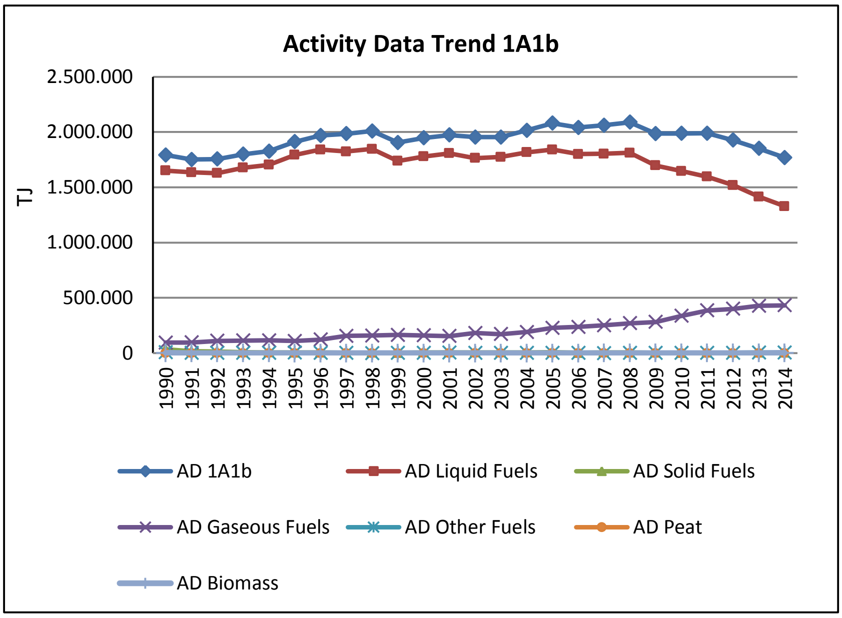
Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	2 394	2 827	2 713	2%	-113	-4%	319	13%
Belgium	4 299	4 373	4 732	4%	359	8%	432	10%
Bulgaria	861	988	919	1%	-69	-7%	58	7%
Croatia	2 422	1 230	1 322	1%	92	7%	-1 100	-45%
Cyprus	86	NO	NO	-	-	-	-86	-100%
Czech Republic	493	702	806	1%	104	15%	313	64%
Denmark	906	911	920	1%	10	1%	14	2%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	2 042	2 513	2 546	2%	33	1%	503	25%
France	11 935	8 061	7 930	7%	-131	-2%	-4 005	-34%
Germany	20 166	18 284	17 636	15%	-648	-4%	-2 529	-13%
Greece	2 375	5 063	5 305	5%	242	5%	2 930	123%
Hungary	2 371	1 312	1 387	1%	75	6%	-983	-41%
Ireland	168	294	279	0%	-15	-5%	111	66%
Italy	17 190	22 162	21 000	18%	-1 162	-5%	3 811	22%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	1 504	1 460	1 306	1%	-154	-11%	-198	-13%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	11 010	9 279	9 692	8%	413	4%	-1 318	-12%
Poland	2 164	4 978	4 042	4%	-936	-19%	1 878	87%
Portugal	1 861	2 547	2 123	2%	-424	-17%	262	14%
Romania	4 277	2 063	1 609	1%	-455	-22%	-2 668	-62%
Slovakia	2 873	1 470	1 216	1%	-253	-17%	-1 657	-58%
Slovenia	170	NO	NO	-	-	-	-170	-100%
Spain	10 854	11 973	11 769	10%	-204	-2%	915	8%
Sweden	1 778	1 904	2 148	2%	245	13%	371	21%
United Kingdom	17 812	14 676	13 484	12%	-1 191	-8%	-4 328	-24%
EU-28	**122 013**	**119 070**	**114 885**	**100%**	**-4 185**	**-4%**	**-7 127**	**-6%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**122 013**	**119 070**	**114 885**	**100%**	**-4 185**	**-4%**	**-7 127**	**-6%**

Figure 3.17 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-28 + ISL between 1990 and 2014 and the activity data.

Fuel used for petroleum refining decreased by 1% in the EU-28 + ISL between 1990 and 2014 and the decreasing trend in the recent years is continuing. Liquid fuels represent 75% of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part (24%) and their use in 2014 is more than three times higher than in 1990. There remains a small amount of solid fuels used accounting for 0.2% in petroleum refining in France (blast furnace gas), Germany (lignite and coke oven gas) and Poland (hard coal).

Figure 3.17 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 78% of all greenhouse gas emissions from petroleum refining in 2014. Emissions decreased by 21% between 1990 and 2014 (Table 3.12). Greece had by far the largest emission increase between 1990 and 2014 whereas the United Kingdom reports the largest decrease in emissions in this period.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	1 958	2 171	2 111	2%	-60	-3%	153	8%	-	-
Belgium	4 285	3 458	3 711	4%	253	7%	-574	-13%	CS,T3	PS
Bulgaria	793	854	791	1%	-62	-7%	-1	0%	T1	D
Croatia	2 408	942	1 073	1%	131	14%	-1 335	-55%	T1	D
Cyprus	86	NO	NO	-	-	-	-86	-100%	NA	NA
Czech Republic	176	491	595	1%	105	21%	420	239%	T1	CS,D
Denmark	906	911	914	1%	4	0%	8	1%	T1,T2,T3	CS,D,PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 383	1 613	1 646	2%	32	2%	263	19%	T3	CS,PS
France	11 413	6 144	5 944	7%	-201	-3%	-5 470	-48%	-	-
Germany	15 417	16 130	15 286	17%	-844	-5%	-131	-1%	CS	CS
Greece	2 375	5 063	5 305	6%	242	5%	2 930	123%	T2	PS
Hungary	1 678	924	1 006	1%	82	9%	-672	-40%	T3	PS
Ireland	168	278	262	0%	-16	-6%	93	55%	T3	CS,PS
Italy	17 030	18 618	17 360	19%	-1 257	-7%	330	2%	T3	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 504	1 459	1 305	1%	-154	-11%	-199	-13%	T2,T3	CS,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	9 968	5 881	6 333	7%	452	8%	-3 636	-36%	T2	CS,D
Poland	1 319	3 009	2 054	2%	-955	-32%	734	56%	T1	D
Portugal	1 861	1 489	1 029	1%	-460	-31%	-833	-45%	T2	CR,D,PS
Romania	4 277	1 506	1 207	1%	-299	-20%	-3 070	-72%	T2	CS
Slovakia	2 786	1 226	967	1%	-259	-21%	-1 818	-65%	T3	PS
Slovenia	43	NO	NO	-	-	-	-43	-100%	NA	NA
Spain	10 808	8 053	8 036	9%	-16	0%	-2 771	-26%	T2	CS,PS
Sweden	1 778	1 849	1 873	2%	25	1%	95	5%	-	-
United Kingdom	17 763	12 382	11 054	12%	-1 328	-11%	-6 709	-38%	T2	CS
EU-28	**112 183**	**94 449**	**89 863**	**100%**	**-4 586**	**-5%**	**-22 319**	**-20%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**112 183**	**94 449**	**89 863**	**100%**	**-4 586**	**-5%**	**-22 319**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.18 shows that Italy, Germany and the United Kingdom are the countries that contributing most in terms of CO_2 emissions in 2014. It also can be seen that the trend for liquid fuels is continuously decreasing since 2009.

Figure 3.18 1A1b Petroleum Refining, Liquid Fuels: Emission trend and share for CO_2

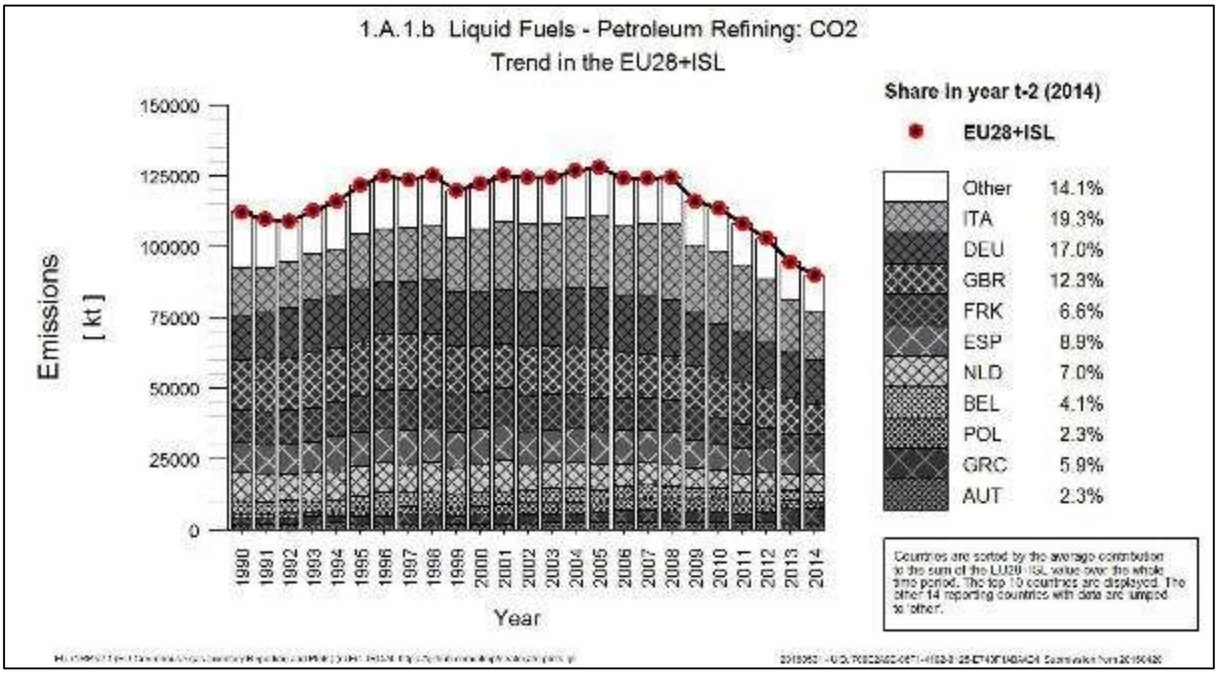
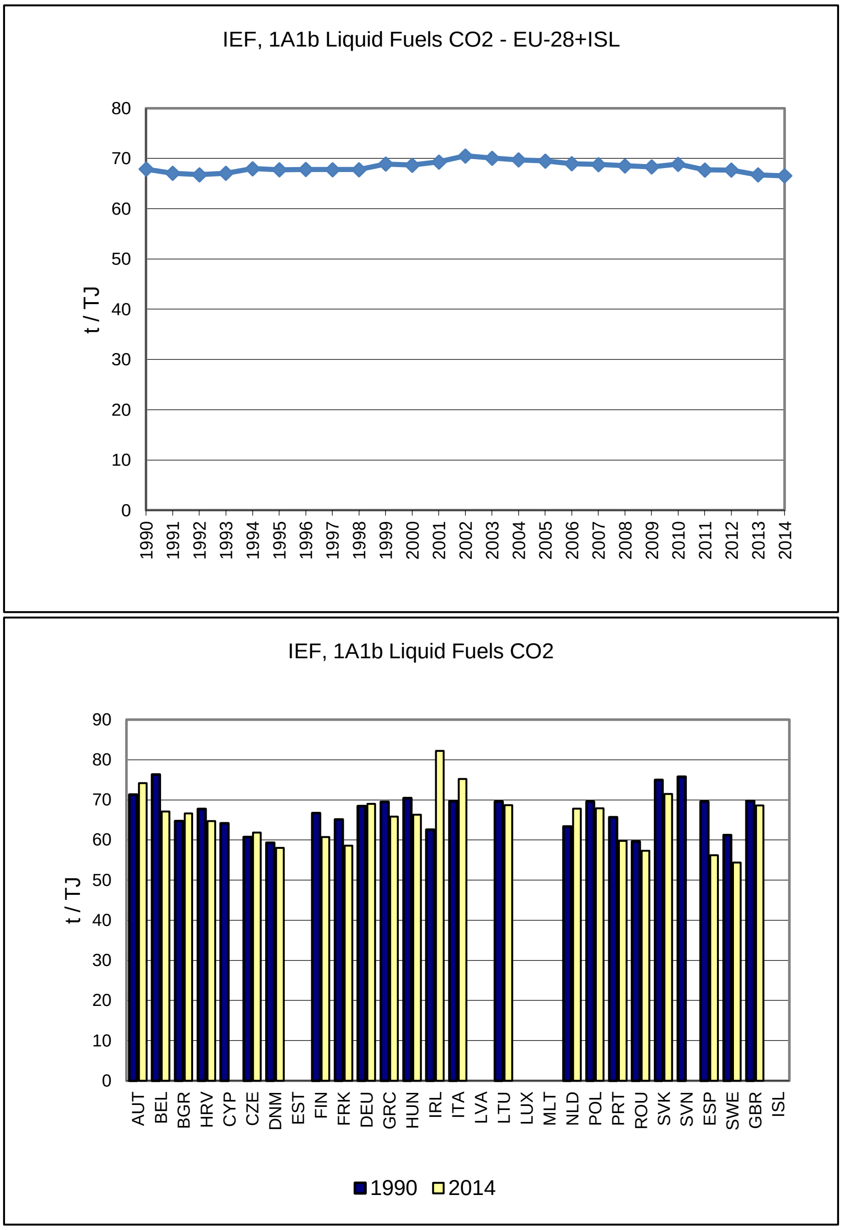


Figure 3.19 shows the emission factors for CO_2 emissions from liquid fuels. The EU-28 + ISL implied emission factor shows small variations between 75.8 t/TJ and 77.01 t/TJ over the time series.

In general the fluctuating IEF is due to the annual variations of fuel consumption with different carbon content. For example in Italy the main fuel used are refinery gases, fuel oil and petroleum coke, which have very different emission factors, and every year their amount used changes resulting in an annual variation of the IEF. Ireland reports the highest IEF in 2014 which is due to differences in the data published in the national energy balance and the reported emissions under the EU ETS, concerning the single oil refinery in Ireland. This will be corrected in future submissions.

Figure 3.19 1A1b Petroleum Refining, Liquid Fuels: Implied Emission Factors for CO_2



1A1b Petroleum Refining - Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels in petroleum refining represented less than 1% of all greenhouse gas emissions from 1A1b in 2014. There are only three countries reporting emissions in the EU-28 + ISL in 2014 (Germany, France and Poland). Poland is the only country that reports increasing emissions. EU-28 + ISL emissions fell by 84% on average between 1990 and 2014 (Table 3.13).

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		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%	NA	NA
France	486	379	490	86%	111	29%	4	1%	-	-
Germany	3 131	62	64	11%	2	3%	-3 067	-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	18	19	3%	1	6%	14	329%	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**	**458**	**572**	**100%**	**114**	**25%**	**-3 061**	**-84%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**3 633**	**458**	**572**	**100%**	**114**	**25%**	**-3 061**	**-84%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.20 shows the trend of 1A1b for solid fuels. The use of solid fuels in petroleum refining has declined markedly since 1990. France contributes more than 85% to the emissions in this sector, whereas Germany is responsible for the declining trend since 1990.

Figure 3.20 1A1b Petroleum Refining, Solid Fuels: Emission trend and share for CO_2

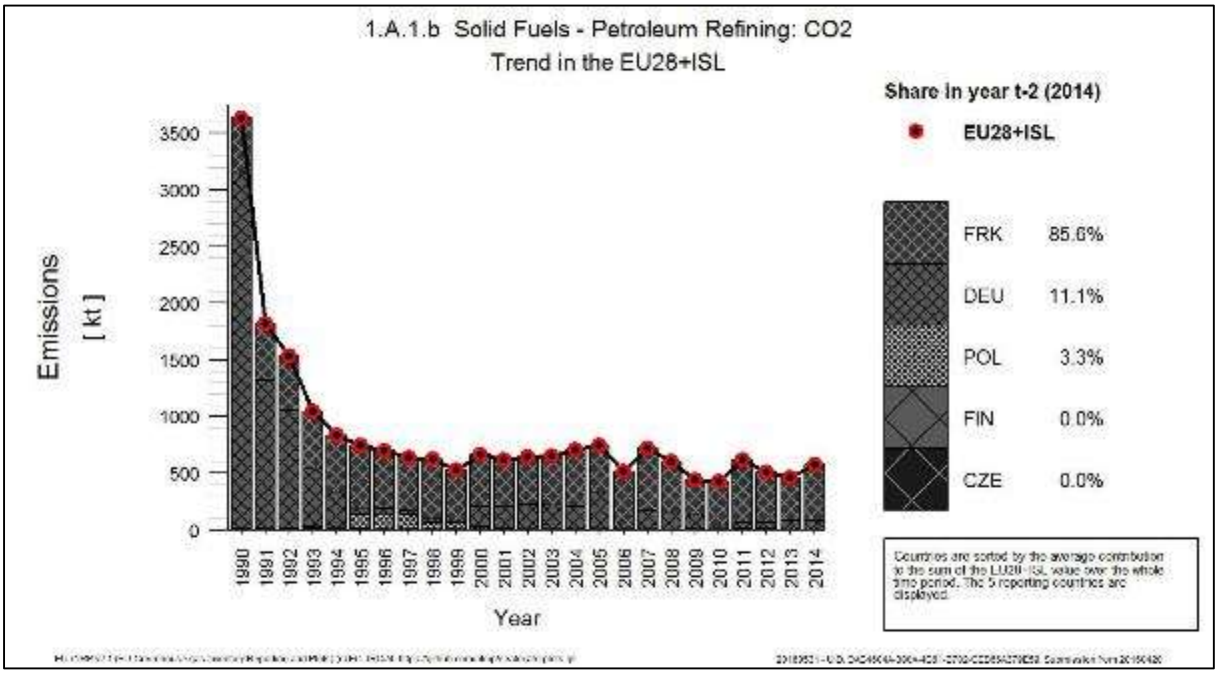
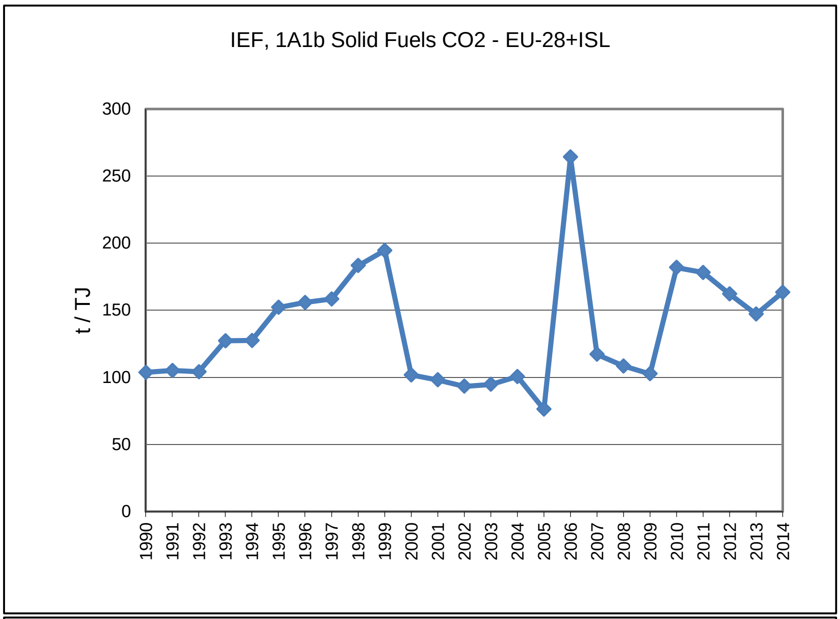
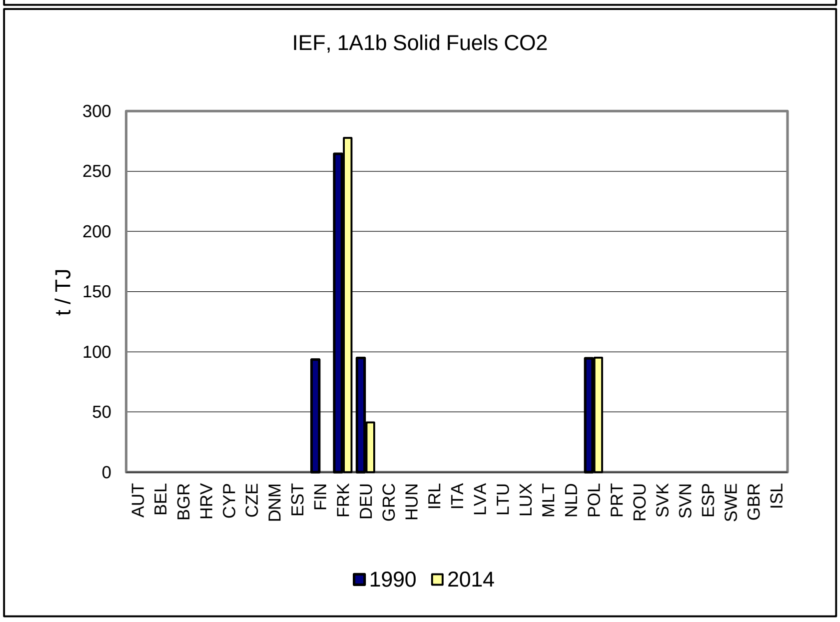


Figure 3.21 shows the relevant activity data and implied emission factors. The EU-28 + ISL implied emission factor showed strong fluctuations, and amounts to 163.40 t/TJ in 2014. The variation in the EU-28 + ISL factor can be partly explained by the declining use of solid fuels in petroleum refining in Germany between 1990 and 1999. This explains the gradual increase of the EU-28 + ISL IEF up to 1999 through the growing weight of the much higher implied emission factor of France. The high emission factor in France is due to the use of blast furnace gas in the Dunkerque refinery. In Germany, there was a decline in the IEF in the early 1990s compared to a rather stable IEF since the mid-1990s. The reason is that the use of - mainly - lignite has constantly been reduced in favour of coke oven gas.

The increased EU-28 + ISL solid fuel combustion in 2000-2005 and 2007-2009 is due to an increase in fuel combustion in Germany in these years. The higher weight of the German IEF also explains the lower IEF at EU-28 + ISL level during these years. For 2006 Germany reports only negligible amounts of solid fuel use in petroleum refining. Therefore, the EU-28 + ISL IEF is almost entirely dominated by the (high) French IEF in this year.

Figure 3.21 1A1b Petroleum Refining, Solid Fuels: Implied Emission Factors for CO_2





1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2014, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 21% of total greenhouse gas emissions from 1A1b. Emissions in the EU-28 + ISL increased by 357% between 1990 and 2014 (Table 3.14). Only three of the EU-28 Member States reduced their emissions: Czech Republic, Hungary and Slovenia.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	437	656	602	2%	-54	-8%	166	38%	-	-
Belgium	14	914	1 020	4%	106	12%	1 007	7246%	CS,T3	PS
Bulgaria	69	135	128	1%	-7	-5%	59	86%	T2	CS
Croatia	14	288	249	1%	-39	-14%	235	1686%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	211	210	1%	-1	0%	-107	-34%	T2	CS
Denmark	NO	NO	6	0%	6	100%	6	100%	-	-
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	648	900	900	4%	0	0%	252	39%	T3	CS
France	36	1 537	1 495	6%	-42	-3%	1 459	4031%	-	-
Germany	1 444	2 093	2 286	9%	193	9%	842	58%	CS	CS
Greece	NO	IE	IE	-	-	-	-	-	NA	NA
Hungary	693	388	382	2%	-7	-2%	-311	-45%	T3	PS
Ireland	NO	17	17	0%	1	5%	17	100%	T3	CS,PS
Italy	159	3 545	3 640	15%	96	3%	3 481	2185%	T3	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	1	1	0%	0	-10%	1	100%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 042	3 398	3 359	14%	-39	-1%	2 317	222%	T2	CS
Poland	94	1 951	1 969	8%	18	1%	1 876	2001%	T1	D
Portugal	NO	1 058	1 094	5%	36	3%	1 094	100%	T2	CR,D,PS
Romania	NO	557	402	2%	-156	-28%	402	100%	T2	CS
Slovakia	88	244	249	1%	5	2%	161	184%	T3	PS
Slovenia	127	NO	NO	-	-	-	-127	-100%	NA	NA
Spain	46	3 609	3 375	14%	-234	-6%	3 329	7239%	T2	CS,PS
Sweden	NO	55	275	1%	220	398%	275	100%	-	-
United Kingdom	49	2 293	2 430	10%	137	6%	2 381	4817%	T2	CS
EU-28	**5 276**	**23 851**	**24 091**	**100%**	**241**	**1%**	**18 815**	**357%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**5 276**	**23 851**	**24 091**	**100%**	**241**	**1%**	**18 815**	**357%**		

Abbreviations explained in the Chapter 'Units and abbreviations'

Figure 3.22 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 2014. The largest absolute increases in 2014 compared to 2013 were reported by Sweden, Germany and the United Kingdom (+550 kt CO_2).

Figure 3.22 1A1b Petroleum Refining, Gaseous Fuels: Emission trend and share for CO_2

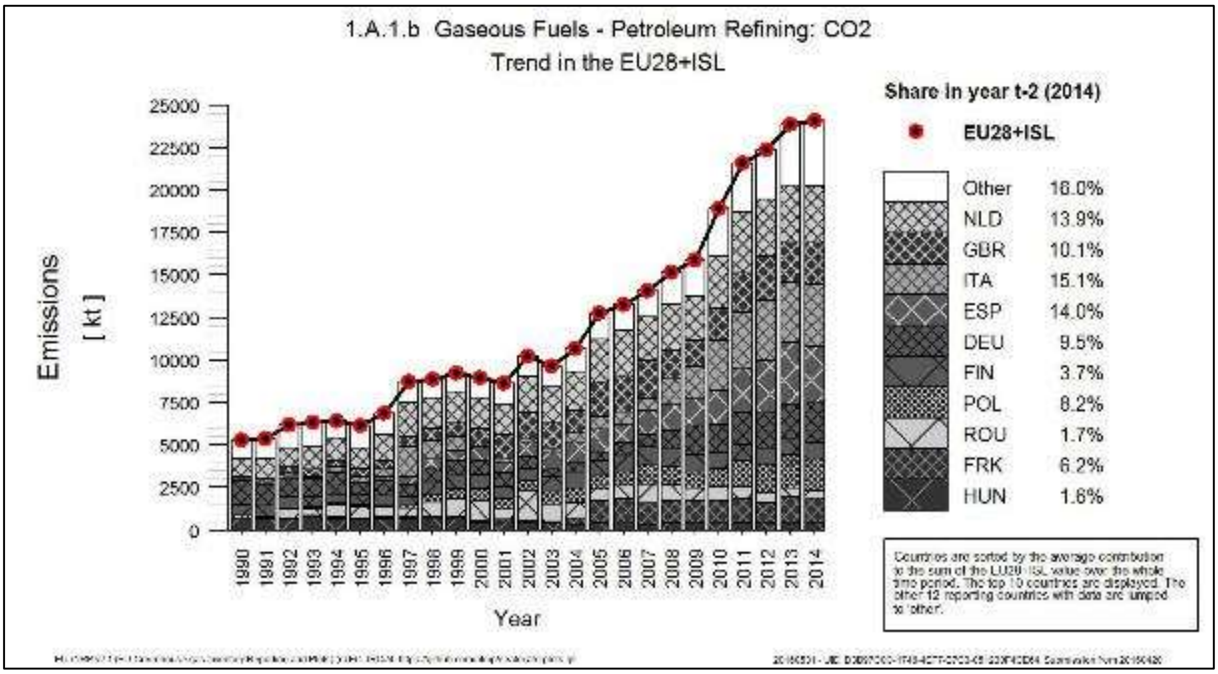
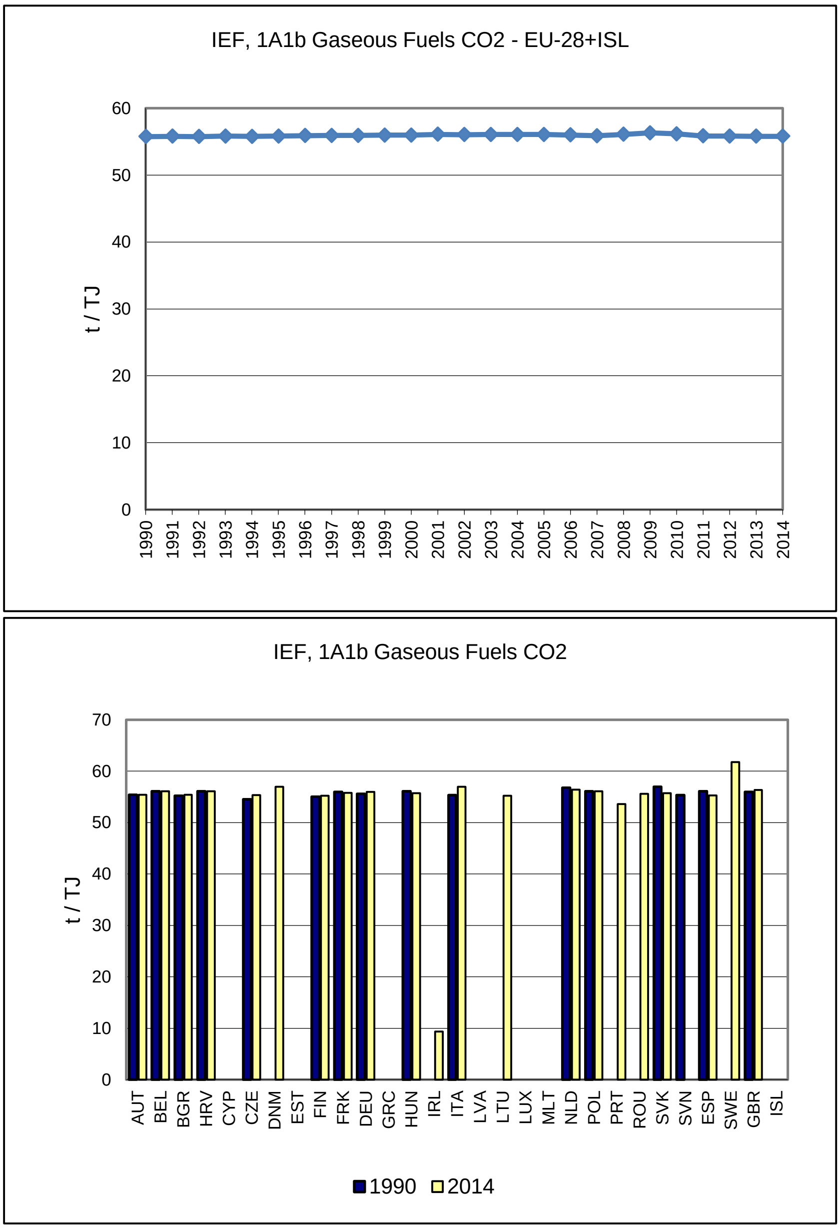


Figure 3.23 shows the implied emission factors for CO_2 emissions from gaseous fuels. The EU-28 + ISL implied emission factor has remained broadly stable and amounts to 55.80 t/TJ in 2014.

Ireland reports a comparably low emission factor in 2014 which is due to differences in the data published in the national energy balance and the reported emissions under the EU ETS by the single refinery plant. The plant reports some natural gas under liquid fuels to the national energy statistics figure, whereby for reporting the ETS emissions it is considered as natural gas only. This misallocation will be corrected by Ireland in future submissions.

The IEF of Sweden is the highest one in the EU-28 + ISL. The reason is because a new LNG-based plant started to be in use in one of the refineries during 2014 and the IEF is a bit higher in 2014 because LNG has a higher EF than natural gas.

Figure 3.23 1A1b Petroleum Refining, Gaseous Fuels: Implied Emission Factors for CO_2



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

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 2014. Between 1990 and 2014, CO_2 emissions fell by 53% in the EU-28 + ISL (Table 3.15) whereas a decrease is reported by 17 MS. 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 in coke production associated with the iron and steel production triggered by the economic downturn.

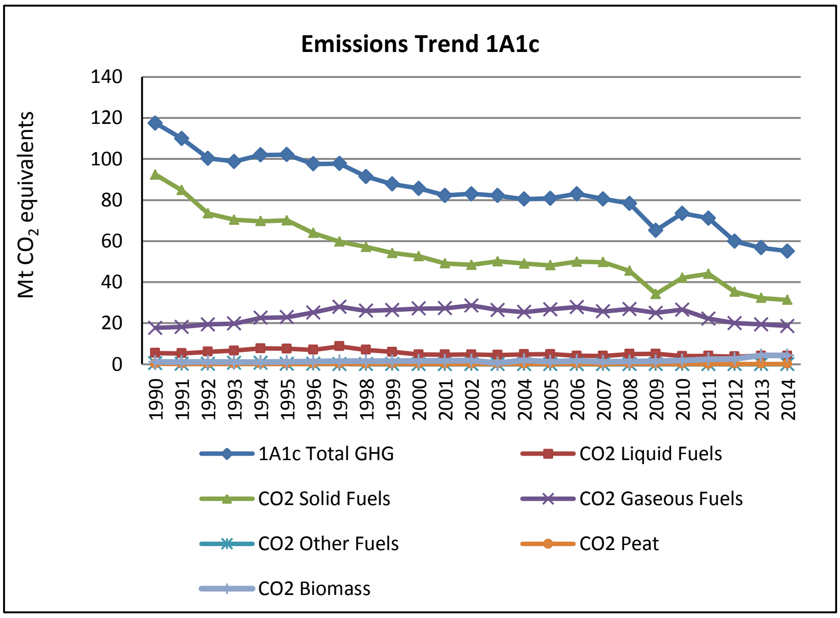
Table 3.15 1A1c Manufacture of Solid Fuels and Other Energy Industries: Member States' contributions to CO_2 emissions

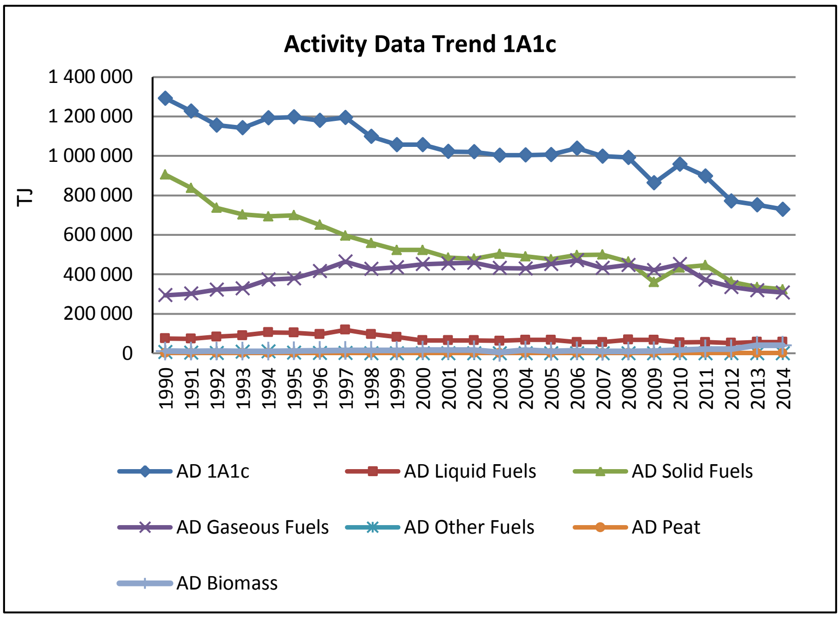
Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	510	249	246	0%	-3	-1%	-264	-52%
Belgium	2 024	282	182	0%	-100	-35%	-1 841	-91%
Bulgaria	362	4	4	0%	0	4%	-358	-99%
Croatia	993	229	157	0%	-72	-31%	-836	-84%
Cyprus	NO	NO	0	0%	0	0%	0	0%
Czech Republic	1 516	6 169	5 612	10%	-557	-9%	4 096	270%
Denmark	545	1 429	1 365	3%	-64	-4%	820	151%
Estonia	65	443	582	1%	139	31%	518	797%
Finland	347	248	304	1%	56	22%	-43	-12%
France	4 749	3 122	3 281	6%	158	5%	-1 469	-31%
Germany	65 289	10 631	10 250	19%	-382	-4%	-55 039	-84%
Greece	102	42	33	0%	-8	-20%	-69	-67%
Hungary	565	443	365	1%	-79	-18%	-201	-35%
Ireland	100	122	97	0%	-25	-20%	-3	-3%
Italy	13 797	7 061	6 846	13%	-215	-3%	-6 952	-50%
Latvia	143	69	67	0%	-3	-4%	-77	-53%
Lithuania	9	17	17	0%	0	0%	8	83%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	2 161	2 722	2 707	5%	-15	-1%	547	25%
Poland	4 876	2 828	2 895	5%	67	2%	-1 981	-41%
Portugal	112	NO	NO	-	-	-	-112	-100%
Romania	146	1 425	1 658	3%	233	16%	1 512	1035%
Slovakia	1 319	1 186	1 251	2%	65	5%	-68	-5%
Slovenia	82	6	6	0%	0	-1%	-76	-93%
Spain	2 117	1 953	1 467	3%	-486	-25%	-650	-31%
Sweden	300	352	377	1%	25	7%	76	25%
United Kingdom	13 827	14 846	14 452	27%	-394	-3%	625	5%
EU-28	**116 058**	**55 881**	**54 222**	**100%**	**-1 659**	**-3%**	**-61 837**	**-53%**
Iceland	NO	NO	0	0%	0	0%	-	-
EU-28 + ISL	**116 058**	**55 881**	**54 222**	**100%**	**-1 659**	**-3%**	**-61 837**	**-53%**

Figure 3.24 shows the trends in emissions from this source category by fuel in the EU-28 + ISL between 1990 and 2014. 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 (34%) fuels.

Fuel used for manufacturing solid fuels fell by 44% in the EU-28 + ISL between 1990 and 2014. The strongest decline was reported for solid fuels (-64%), followed by liquid fuels (-24%). On the other hand gaseous fuels and biomass increased in the period 1990 to 2014. In 2014 solid fuels and gaseous fuels represented 44% and 42% respectively, of all fuel used.

Figure 3.24 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 34% of total greenhouse gas emissions from this category in 2014. Emissions in the EU-28 + ISL increased by 6% (Table 3.16) between 1990 and 2014. However, in the last few years there has been a significant reduction. More than 50% of the gross increase in EU-28 + ISL 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.

Table 3.16 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	506	249	246	1%	-3	-1%	-260	-51%
Belgium	51	NO	NO	-	-	-	-51	-100%
Bulgaria	NO	2	1	0%	0	-26%	1	100%
Croatia	748	229	157	1%	-72	-31%	-590	-79%
Cyprus	NO	NO	0	0%	0	0%	0	0%
Czech Republic	NO	9	10	0%	1	13%	10	100%
Denmark	545	1 429	1 365	7%	-64	-4%	820	151%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	531	8	NO	-	-8	-100%	-531	-100%
Germany	2 622	442	457	2%	16	4%	-2 165	-83%
Greece	102	42	33	0%	-8	-20%	-69	-67%
Hungary	362	215	79	0%	-137	-63%	-283	-78%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	615	1 022	865	5%	-157	-15%	250	41%
Latvia	45	50	46	0%	-5	-10%	1	2%
Lithuania	NO	3	2	0%	-1	-23%	2	100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	1 526	2 128	2 103	11%	-25	-1%	576	38%
Poland	694	674	717	4%	44	6%	23	3%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	731	851	5%	120	16%	851	100%
Slovakia	NO	44	41	0%	-3	-8%	41	100%
Slovenia	42	6	6	0%	0	0%	-36	-86%
Spain	82	1 265	1 153	6%	-112	-9%	1 072	1315%
Sweden	NO	C,NO	C,NO	-	-	-	-	-
United Kingdom	9 172	10 872	10 484	56%	-388	-4%	1 313	14%
EU-28	**17 641**	**19 421**	**18 617**	**100%**	**-804**	**-4%**	**976**	**6%**
Iceland	NO	NO	0	0%	0	0%	-	-
EU-28 + ISL	**17 641**	**19 421**	**18 617**	**100%**	**-804**	**-4%**	**976**	**6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.25 shows the emission trend for gaseous fuels split by Member State. 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. In this sector these are all coke production plants. In particular the consumption of natural gas in one of these plants (the biggest one) has influence on 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.

Figure 3.25 1A1c Manufacture of Solid Fuels and Other Energy Industries, Gaseous Fuels: Emission trend and share for CO_2

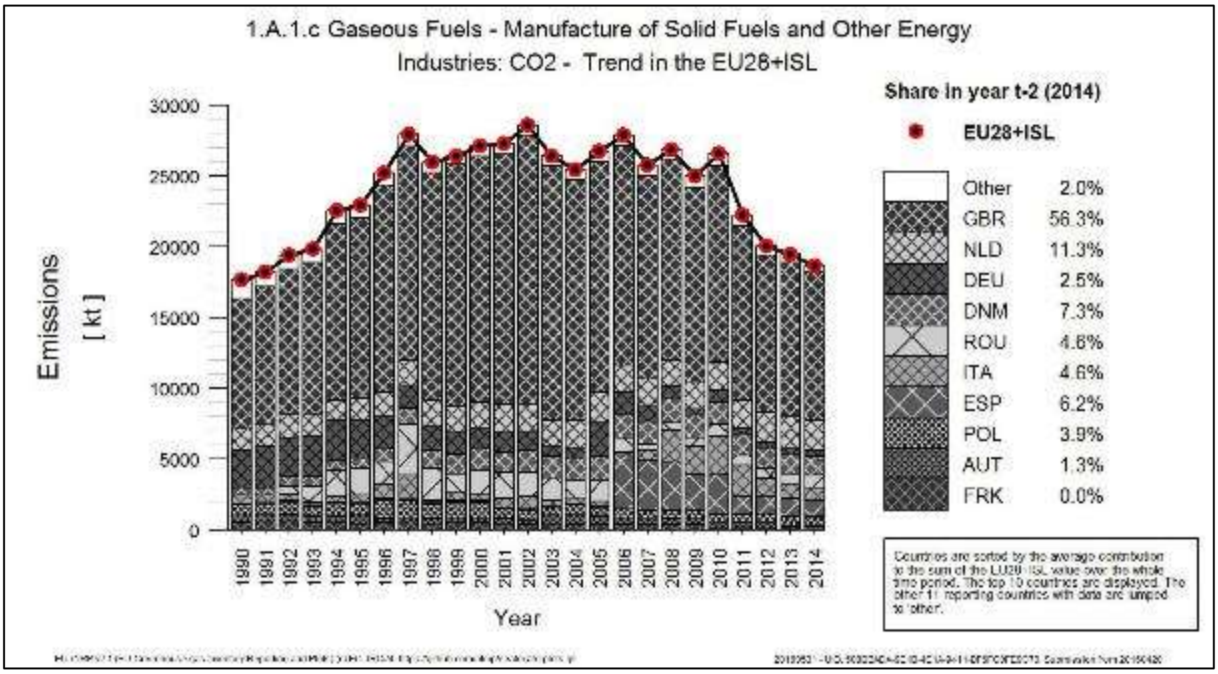
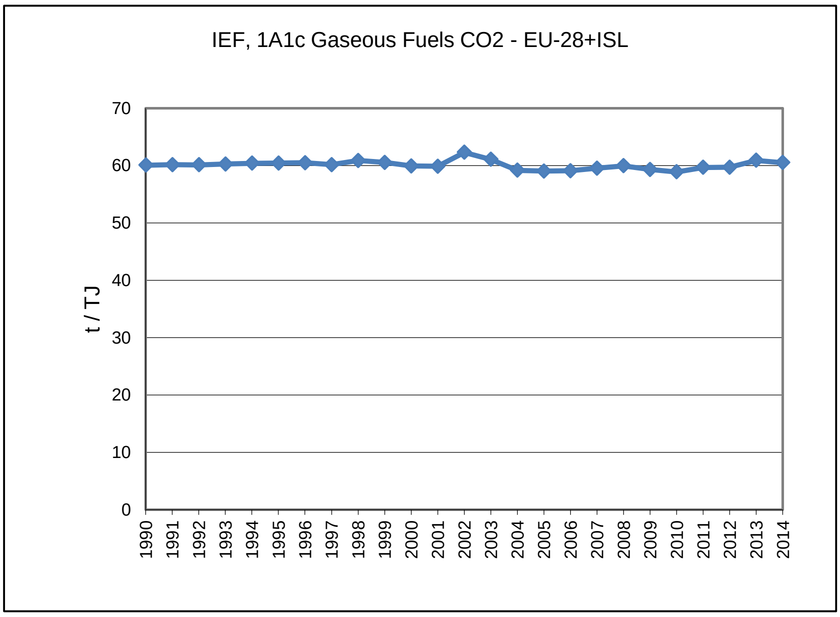
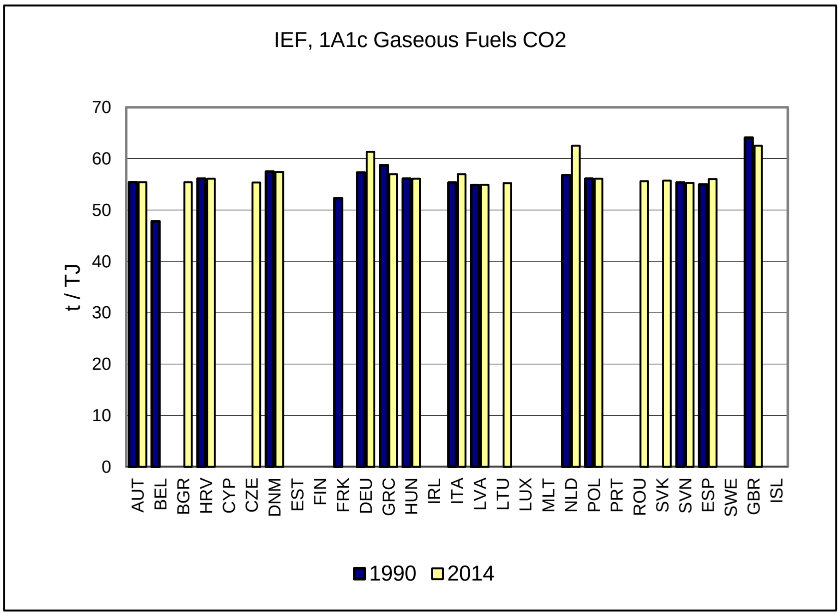


Figure 3.26 shows the implied emission factors for CO_2. The EU-28 + ISL implied emission factor is dominated by the IEF of the United Kingdom and amounts to 60.52 t/TJ in 2014. The reason for the comparatively high IEF in the UK and the explanation for its decrease is as follows: In the UK emissions of gaseous fuels within this sector include colliery methane combustion and natural gas combustion, including offshore own gas use. The carbon emission factor for offshore own gas use is higher than the emission factor for other natural gas combustion, particularly at the start of the time series. This higher emission factor is to be expected, as the unrefined gaseous fuels used in the upstream oil and gas sector will contain heavier hydrocarbons (which are removed in gas treatment prior to injection into natural gas supply infrastructure at onshore terminals). This source is responsible for the majority of the emissions within this sector and is therefore the main driver in the trend in the implied emission factor. The emission factor for this source is based on data supplied by the offshore operators. It decreases across the time series, but remains higher than natural gas consumption in other sectors.

Figure 3.26 1A1c Manufacture of Solid Fuels and Other Energy Industries, Gaseous Fuels: Implied Emission Factors for CO_2





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

CO_2 emissions from the combustion of solid fuels used for the manufacture of solid fuels accounted for 57% of total greenhouse gas emissions from 1A1c in 2014. Emissions in the EU-28 + ISL declined by 66% mainly during the 1990s. This was almost driven entirely by a strong decline in emissions in Germany (-60 995 kt CO_2).

Table 3.17 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	1 969	282	182	1%	-100	-35%	-1 787	-91%
Bulgaria	275	2	3	0%	1	32%	-272	-99%
Croatia	206	NO	NO	-	-	-	-206	-100%
Cyprus	NO	NO	0	0%	0	0%	0	0%
Czech Republic	1 352	6 107	5 552	18%	-555	-9%	4 200	311%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	65	443	582	2%	139	31%	518	797%
Finland	347	248	304	1%	56	22%	-43	-12%
France	4 065	3 114	3 281	10%	167	5%	-784	-19%
Germany	61 101	9 809	9 460	30%	-349	-4%	-51 640	-85%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	164	195	253	1%	58	30%	90	55%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	12 240	6 037	5 981	19%	-56	-1%	-6 259	-51%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	633	593	604	2%	11	2%	-29	-5%
Poland	4 030	2 014	2 065	7%	51	3%	-1 966	-49%
Portugal	62	NO	NO	-	-	-	-62	-100%
Romania	NO	NO	1	0%	1	100%	1	100%
Slovakia	1 319	1 142	1 210	4%	68	6%	-109	-8%
Slovenia	37	NO	NO	-	-	-	-37	-100%
Spain	1 847	629	273	1%	-356	-57%	-1 575	-85%
Sweden	300	352	377	1%	25	7%	76	25%
United Kingdom	2 344	1 264	1 233	4%	-31	-2%	-1 112	-47%
EU-28	**92 356**	**32 231**	**31 361**	**100%**	**-871**	**-3%**	**-60 995**	**-66%**
Iceland	NO	NO	0	0%	0	0%	-	-
EU-28 + ISL	**92 356**	**32 231**	**31 361**	**100%**	**-871**	**-3%**	**-60 995**	**-66%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Solid fuels have fallen steadily to less than half of the 1990-level. The decline in emissions (see Figure 3.27) in Germany is mainly due to a large decline in lignite production in the 1990s. Lignite use decreased strongly in the new German Länder from usage levels of the industry of the former GDR. From raw lignite, a range of refined products used to be produced for industry, households and small commercial operations. A comprehensive transition from lignite to other fuels then took place until the end of the 1990s. The largest emitters in 2014 were Germany, the Czech Republic and Italy, jointly responsible for 67% of all EU-28 + ISL emissions.

Figure 3.27 1A1c Manufacture of Solid Fuels and Other Energy Industries, Solid Fuels: Emission trend and share for CO_2

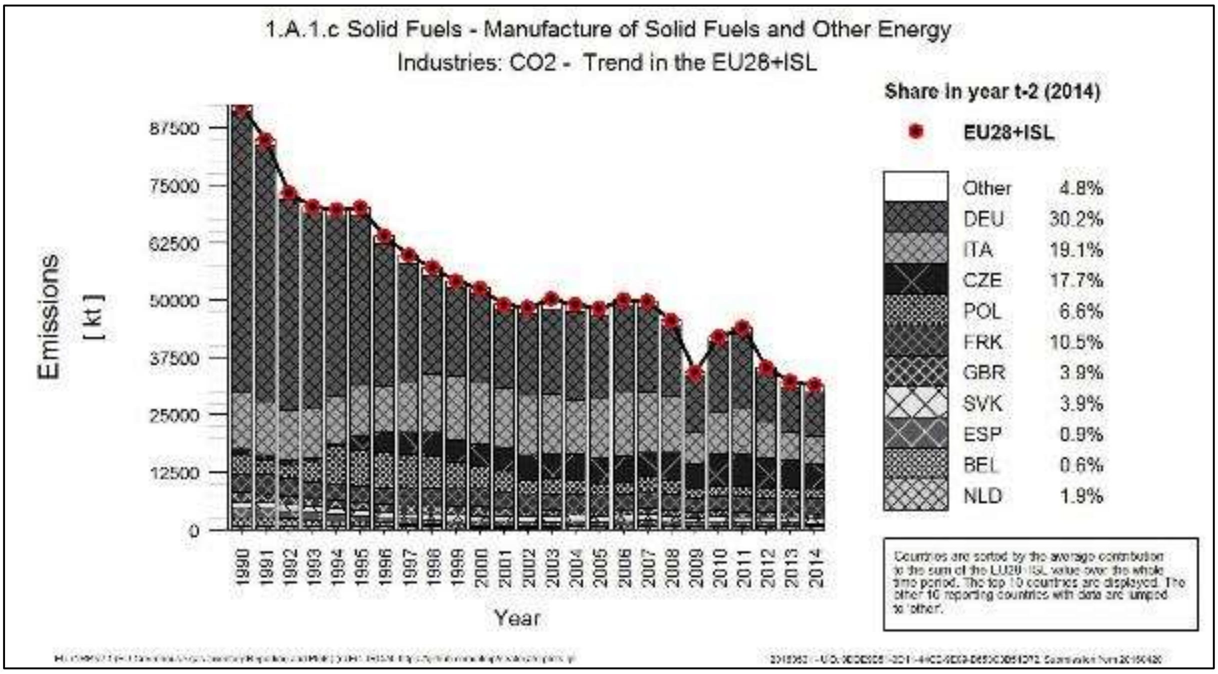
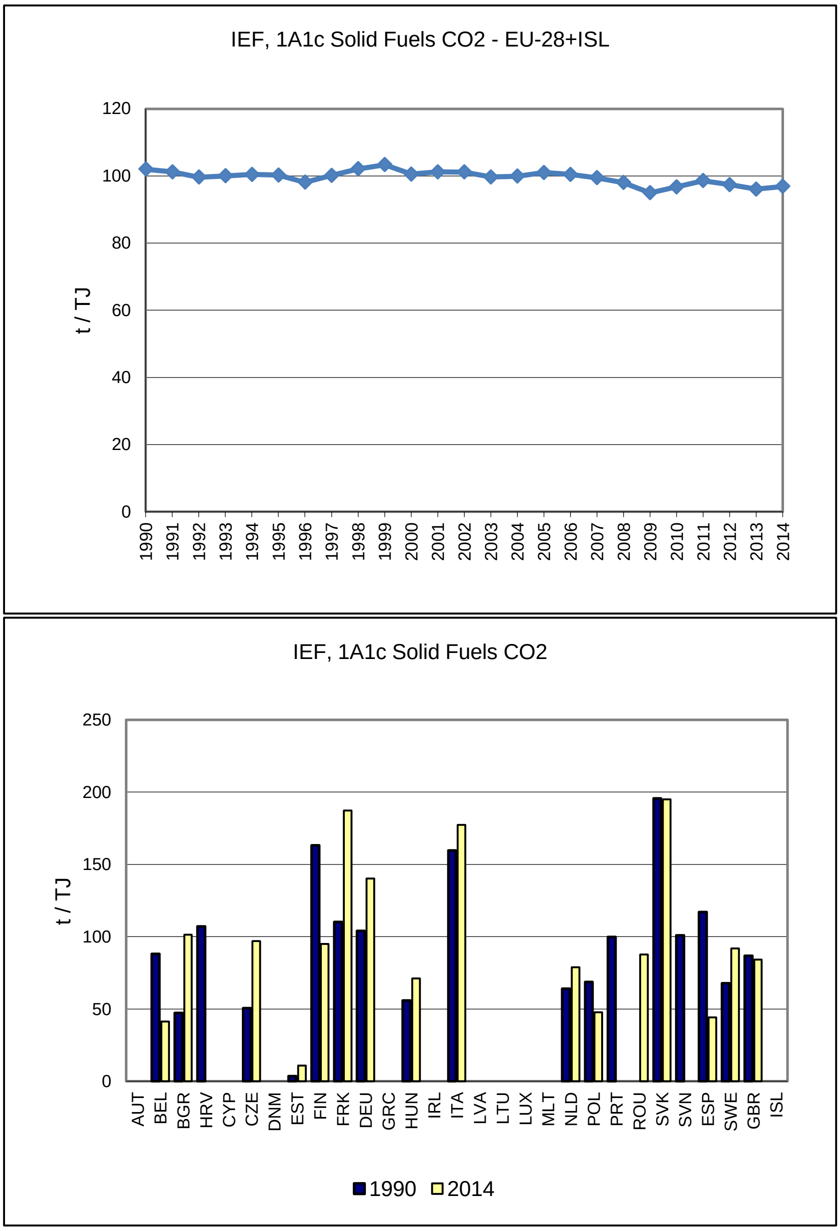


Figure 3.28 shows the relevant implied emission factors for solid fuels. The EU-28 + ISL implied emission factor is relatively stable and amounted to 96.9 t/TJ in 2014.

This increase is mainly due to a decline in the German share in EU-28 + ISL emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The high implied emission factor for solid fuels in Italy is due to the large use of derived steel gases and in particular blast furnace gas to produce electricity in the iron and steel plant plants.

The increased IEF of France is explained by the use of blast furnace gas and the use of a national specific CO_2 (268 t/GJ). The mix of different fuels and the variation of their energy consumptions between years explain the variation of the related CO_2 IEF.

Figure 3.28 1A1c Manufacture of Solid Fuels and Other Energy Industries, Solid Fuels: Implied Emission Factors for CO_2



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

Category 1A2 includes emissions from combustion of fuels in manufacturing industries and construction including fuel use of non-public electricity and heat generation (auto producers). 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. 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 2014 category 1A2 contributed to 492.593 kt CO_2 equivalents of which 98.8% CO_2, 0.9% N_2O and 0.3% CH_4.

Figure 3.29 shows the emission trends within source category 1A2, which is dominated by CO_2 from 1A2g Other contributing by 32% and 1A2a Iron and steel contributing by 21%. Some Member States do not allocate emissions to all sub-categories under 1A2, which is one 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. Germany reports some fuels of subcategories 1A2a-1A2e as confidential (Notation key ‘C’) or included elsewhere (Notation key ‘IE’) and reports the specific emissions and activity data under 1A2g.

Figure 3.29 1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends

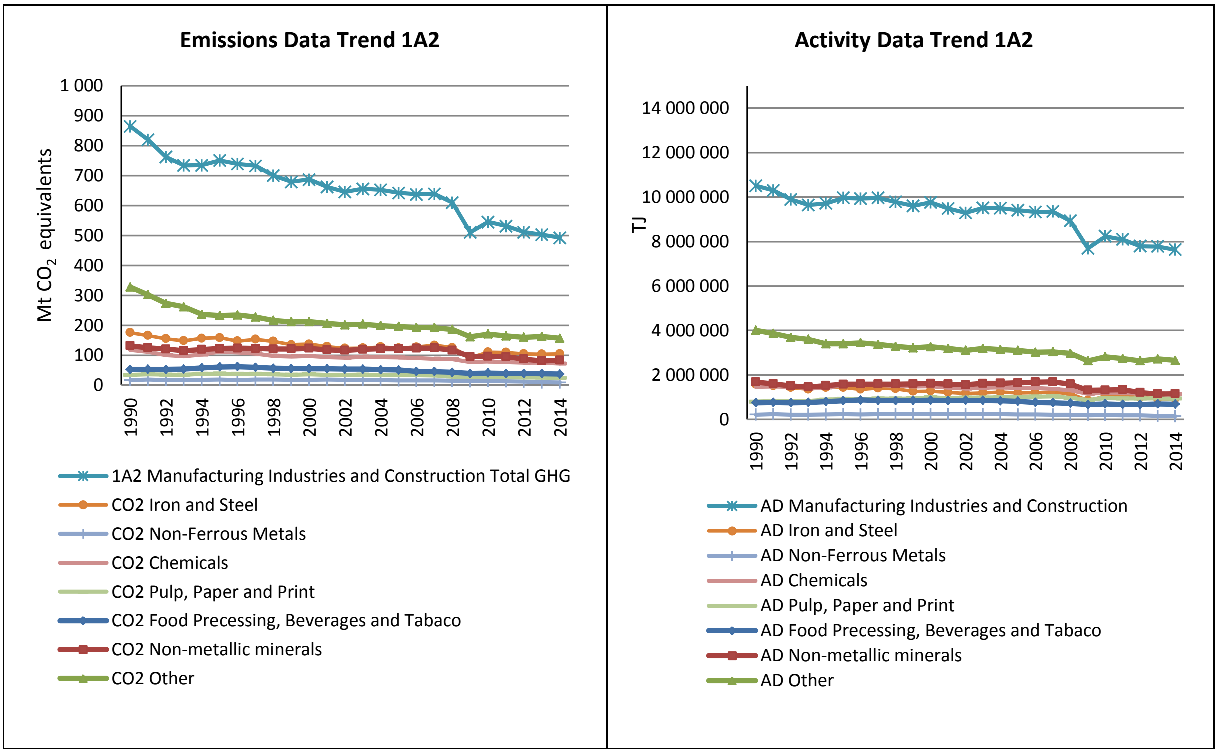


Table 3.1 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.18 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)
Austria	9 892	10 543	9 813	10 401
Belgium	23 236	13 286	23 084	13 147
Bulgaria	17 928	2 778	17 828	2 742
Croatia	5 529	2 554	5 502	2 544
Cyprus	515	703	512	700
Czech Republic	51 224	10 038	50 930	9 953
Denmark	5 517	4 234	5 449	4 177
Estonia	2 489	703	2 480	695
Finland	13 657	8 502	13 472	8 350
France	85 995	59 961	85 255	59 482
Germany	186 681	119 707	185 089	118 683
Greece	9 404	5 475	9 338	5 397
Hungary	13 650	4 244	13 584	4 179
Ireland	3 962	4 328	3 943	4 305
Italy	86 175	52 038	84 535	50 789
Latvia	3 898	725	3 884	689
Lithuania	5 755	1 109	5 739	1 099
Luxembourg	6 307	1 091	6 288	1 080
Malta	23	33	23	33
Netherlands	32 439	24 226	32 329	24 126
Poland	43 135	30 010	42 852	29 725
Portugal	9 772	7 698	9 633	7 557
Romania	74 624	13 771	74 478	13 698
Slovakia	15 890	7 290	15 827	7 235
Slovenia	3 150	1 648	3 119	1 626
Spain	44 502	40 402	44 147	39 693
Sweden	11 404	7 825	11 145	7 615
United Kingdom	97 433	57 670	96 244	56 716
EU-28	**864 184**	**492 593**	**856 520**	**486 436**
Iceland	202	25	202	25
EU-28 + ISL	**864 387**	**492 618**	**856 722**	**486 436**

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+ISL accounting for 11% of total GHG emissions in 2014. Between 1990 and 2014, CO_2 emissions from manufacturing industries declined by 43%. The emissions from this key source are caused by fossil fuel consumption in manufacturing industries and construction, which was 33% below 1990 levels in 2014. 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 2014, 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 Austria, Cyprus, Ireland 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 strong reduction of liquid and solid fuel consumption among all sectors. 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 2013 and 2014 GHG emissions decreased by 2% with category 1A2g Other showing the strongest absolute decrease of – 5 835 kt CO_2 from all sub categories.

Table 3.19 provides information on Member States recalculations in CO_2 from 1A2 Manufacturing Industries for 1990 and 2013 and main explanations for the largest recalculations in absolute terms. The largest recalculations in 2013 were due to Spain, the Netherlands, Italy, France and Germany. The reason for year 2013 revisions are mostly changes in activity data/revised energy balances.

Table 3.19: 1A2 Manufacturing Industries and Construction: Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2013		Main explanations
	Gg	Percent	Gg	Percent	
Austria	10.4	0.1	-110.6	-1.0	revised energy balance
Belgium	13.0	0.1	3.0	0.0	See chapter 3.2.7.5 in NIR. Revision of energy balance. IPCC 2006 guidelines are used since the 2015 submission instead of the IPCC 1996 guidelines in previous submissions. Reallocation of natural gas from 2B1 to 1A2. Revised allocation of some plants (moved to 1A1a). Revised allocation of emissions between 1A2 and IPPU.
Bulgaria	-1 105.2	-5.8	-332.0	-10.7	See chapter 3.3.11.1.1 in NIR. Revision of the energy balance (coke oven coke). Mainly revision of the iron and steel sector. Revised methodology concerning Iron & Steel sector in order to remove the double counting with the IP sector.
Croatia	0.0	0.0	0.0	0.0	
Cyprus	0.0	0.0	-2.1	-0.4	See chapter 3.2.4.5 in NIR. Separate reporting of pulp and paper industries. Revised residual fuel oil consumption.
Czech Republic	0.0	0.0	92.5	0.8	updated activity data (mainly natural gas), .Explanation provided in NIR sub chapters.
Denmark	0.0	0.0	4.4	0.1	See chapters 3.2.8 and 9.1.1 in NIR. Revision of energy statistics.
Estonia	0.6	0.0	0.2	0.0	The emission factors for the category 1A2c were corrected.
Finland	-24.6	-0.2	-168.7	-2.0	Revised fuel consumption data for construction machinery
France	-205.6	-0.2	-1 542.4	-2.4	mise à jour du bilan énergétique national du SOeS (en particulier les produits pétroliers)
Germany	-28.5	0.0	-3 812.8	-3.0	Revision of energy statistics. 1A2f, 1A2g: Changes in the emission factors for other petroleum products and for diesel Fuel. 1A2f: Error correction in the areas of gaseous and waste fuels.1A2g: correction of an error in the waste model.

	1990		2013		Main explanations
	Gg	Percent	Gg	Percent	
					Change of solid fuels NCVs.
Greece	0.0	0.0	0.0	0.0	
Hungary	0.6	0.0	-159.7	-3.7	See chapter 3.2.6.5 in NIR. Revision of energy statistics..
Ireland	0.0	0.0	8.6	0.2	See chapter 3.2.5.5 in NIR. Revision of energy statistics.
Italy	0.0	0.0	1 312.4	2.7	Update of the carbon balance for the iron and steel sector for 2013 as a consequence of an error detected.
Latvia	-5.7	-0.1	-5.6	-0.7	Precised amounts of anthracite and other biogas; excluded amounts of coke in 1A2a sector (allocated to 2C1 sector) recalculated waste amounts and emissions in 2013.
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	0.6	0.0	110.1	10.5	Revision of energy statistics. Updated methodology and EF for off-road vehicles
Malta	-36.6	-61.8	-32.6	-48.0	No specific explanation provided.
Netherlands	1 322.8	4.3	1 972.1	8.6	Revision of energy statistics
Poland	-162.9	-0.4	0.9	0.0	Revision of energy statistics. Coke reallocated from 1.A2.a to 2.C.1
Portugal	-22.5	-0.2	-19.4	-0.3	No specific explanation provided.
Romania	0.0	0.0	0.0	0.0	
Slovakia	0.0	0.0	-10.7	-0.2	Refinements in industrial waste incineration
Slovenia	0.0	0.0	0.1	0.0	Correction of AD (other fuels) in 1A2c Chemicals
Spain	-9.4	0.0	1 746.7	4.3	Actualización de algún dato en 2013 y por la actualización de los factores de emisión
Sweden	-322.9	-2.8	-15.2	-0.2	New emission source in this submission. Reallocations due to classified data material; Minor revision of plant-specific data; The model for estimating the fuel consumption and emissions from Non-road mobile machinery (NRMM) has been adjusted and updated in 2015; The amount of low blended biodiesel used by NRMM was incorrectly allocated in submission 2015.
United Kingdom	43.2	0.0	700.1	1.2	The difference is mostly due to changes in 1A2gviii, 1A2gvii and 1A2d. 1A2gviii - There was an increase in emissions from this category. There were revisions to both activity data and emission factors. Activity data revisions were mostly due to revisions in national statistics. Revisions to emission factors occured for natural gas, coke, petroleum coke and coke oven gas. 1A2gvii - Revision to activity data for industrial class of off-road caused a decrease in emissions from this category. 1A2d - small increase in emissions caused by revisions to both activity data and emission factors.
EU28	-532.7	-0.1	-261.0	-0.1	
Iceland	0.1	0.1	6.1	14.2	
EU28+ISL	-532.6	-0.1	-254.8	-0.1	

3.2.2.1 Iron and Steel (1A2a)

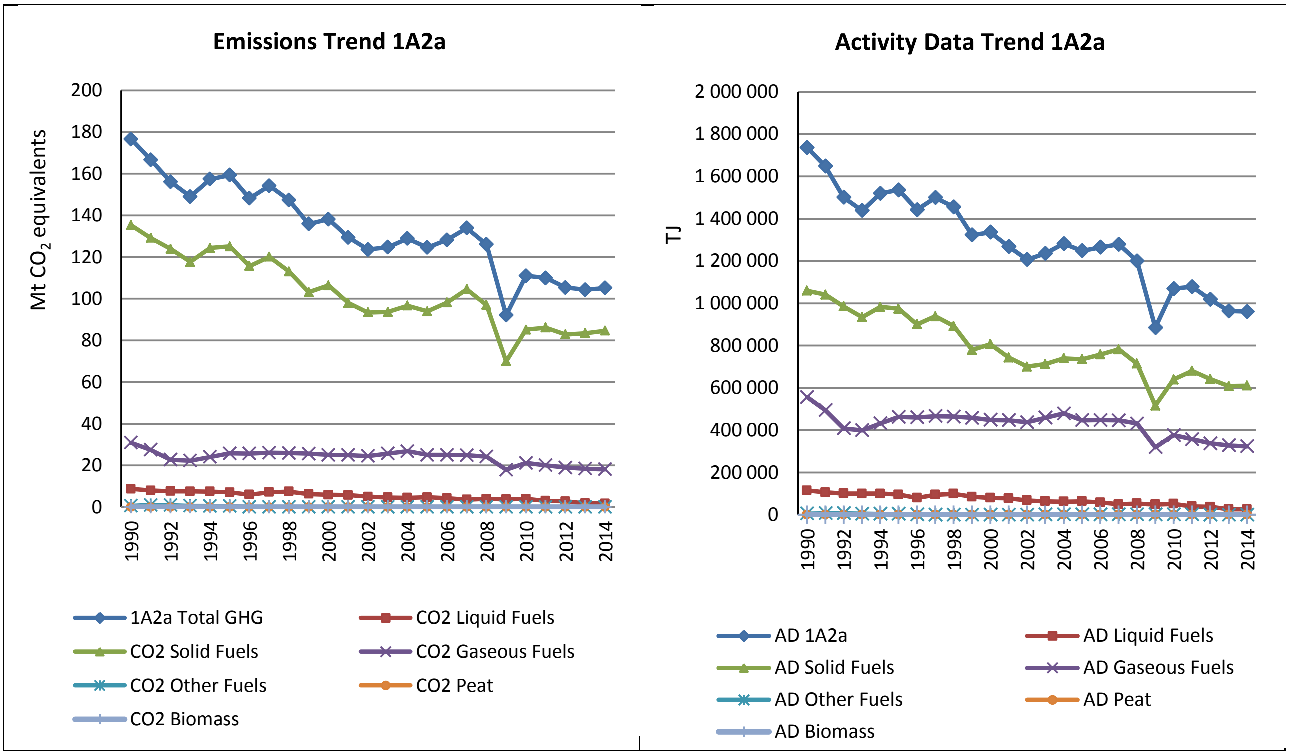
This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. GHG emissions from 1A2a Iron and Steel accounted for 21% of 1A2 source category and 2.5% of total GHG emissions in 2014.

Figure 3.30 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Between 1990 to 2014 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 2013 and 2014 emissions increased by 0.8% and crude steel production increased by 1.8%. Between 1990 and 2014 emissions from solid fuels decreased by 37%, emissions from liquid fuels by 80% and emissions from gaseous fuels decreased by 41%. 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. 23 MS are reporting CO_2 emissions under 2C1 in 2014. However, the share of 1A2a on total 1A2a plus 2C1 CO_2 emissions is mostly over 50% with a range between 14% (Austria) to 89% (Italy). This indicates that not all MS are following the allocation-principle of the new Guidelines yet.

A main driver of category 1A2a CO_2 emissions is crude steel production which decreased from about 192 million tonnes in 1990 to 169 million tonnes in 2014 (www.worldsteel.org statistics) as well as blast furnace production (BFI), which decreased from about 126 million tonnes to 95 million tonnes in 2014 (www.worldsteel.org statistics).

Figure 3.30 1A2a Iron and Steel: CO_2 emissions and activity data trends



Between 1990 and 2014, CO_2 emissions from 1A2a Iron and Steel decreased by 40% (Table 3.20), mainly due to decreases in the Czech Republic, France, Poland, Italy, The United Kingdom and Romania. Between 2013 and 2014 emissions increased by 0.8% with the highest increase reported by France which also correlates to a increase in crude steel production reported in category 2C1..

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	2 062	1 853	1 715	2%	-138	-7%	-347	-17%
Belgium	5 662	1 050	1 088	1%	39	4%	-4 573	-81%
Bulgaria	2 706	99	117	0%	18	19%	-2 588	-96%
Croatia	NO,IE	58	51	0%	-8	-13%	51	100%
Cyprus	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Czech Republic	14 861	2 843	2 131	2%	-712	-25%	-12 729	-86%
Denmark	107	71	83	0%	12	17%	-24	-22%
Estonia	3	NO	NO	-	-	-	-3	-100%
Finland	2 499	2 154	2 331	2%	177	8%	-167	-7%
France	22 395	13 935	15 144	14%	1 209	9%	-7 251	-32%
Germany	35 269	33 112	33 834	32%	722	2%	-1 435	-4%
Greece	447	173	148	0%	-25	-14%	-299	-67%
Hungary	2 365	205	183	0%	-22	-11%	-2 182	-92%
Ireland	16	NO	NO	-	-	-	-16	-100%
Italy	17 225	11 361	11 041	11%	-320	-3%	-6 184	-36%
Latvia	389	33	1	0%	-32	-98%	-388	-100%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	5 407	329	271	0%	-59	-18%	-5 137	-95%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	3 376	3 702	3 597	3%	-105	-3%	221	7%
Poland	16 230	5 819	5 675	5%	-144	-2%	-10 555	-65%
Portugal	1 211	143	142	0%	-1	0%	-1 069	-88%
Romania	8 793	2 703	2 546	2%	-157	-6%	-6 247	-71%
Slovakia	2 682	3 174	3 189	3%	15	0%	507	19%
Slovenia	421	202	196	0%	-5	-3%	-225	-53%
Spain	8 247	4 917	4 933	5%	16	0%	-3 313	-40%
Sweden	1 705	1 261	1 267	1%	6	0%	-438	-26%
United Kingdom	21 562	14 612	14 939	14%	327	2%	-6 623	-31%
EU-28	**175 640**	**103 810**	**104 624**	**100%**	**814**	**1%**	**-71 016**	**-40%**
Iceland	0	1	1	0%	0	17%	1	161%
EU-28 + ISL	**175 640**	**103 811**	**104 625**	**100%**	**814**	**1%**	**-71 015**	**-40%**

Notes: From 1990 to 2000 Croatia includes emissions under 1.A.2.g. Cyprus reports an 'IE' for liquid fuels (included in 1A2b) and a 'NO' for all other fuels. 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 2014 CO_2 from liquid fuels had a share of 2% within this category compared to 5% in 1990. Between 1990 and 2014 emissions decreased by 80% (Table 3.21). Significant absolute decreases have been achieved in Belgium, France, Germany, Poland and Spain.

Table 3.21 1A2a Iron and Steel, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	76	10	6	0%	-3	-35%	-70	-92%	-	-
Belgium	885	36	25	1%	-10	-29%	-859	-97%	T1,T3	D,PS
Bulgaria	37	NO	NO	-	-	-	-37	-100%	NA	NA
Croatia	IE	16	6	0%	-11	-66%	6	100%	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	427	19	NO	-	-19	-100%	-427	-100%	NA	NA
Denmark	7	1	0	0%	-1	-79%	-7	-96%	T1,T2	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	305	253	282	16%	29	12%	-23	-8%	T3	CS
France	1 277	184	156	9%	-29	-15%	-1 121	-88%	-	-
Germany	916	22	18	1%	-4	-16%	-897	-98%	CS	CS
Greece	447	75	85	5%	10	13%	-362	-81%	T2	PS
Hungary	417	3	3	0%	0	0%	-414	-99%	T1	D
Ireland	16	NO	NO	-	-	-	-16	-100%	NA	NA
Italy	156	215	199	11%	-16	-7%	43	28%	T2	CS
Latvia	93	NO	NO	-	-	-	-93	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	48	1	1	0%	0	-16%	-47	-98%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	19	14	13	1%	-1	-10%	-6	-32%	T2	CS,D
Poland	864	6	16	1%	10	160%	-848	-98%	T1	D
Portugal	167	5	4	0%	0	-2%	-163	-97%	T2	CR,D,PS
Romania	NO	13	13	1%	0	-1%	13	100%	T2	CS
Slovakia	164	1	1	0%	0	6%	-163	-99%	T2	CS
Slovenia	54	5	4	0%	-1	-18%	-50	-92%	T1	D
Spain	1 052	77	114	7%	37	48%	-938	-89%	T2	CS,PS
Sweden	856	812	741	42%	-72	-9%	-115	-13%	T2,T3	CS,PS
United Kingdom	462	62	69	4%	6	10%	-393	-85%	T2	CS
EU-28	**8 748**	**1 832**	**1 757**	**100%**	**-75**	**-4%**	**-6 991**	**-80%**		
Iceland	0	1	1	0%	0	17%	1	161%	T1	D
EU-28 + ISL	**8 748**	**1 833**	**1 758**	**100%**	**-75**	**-4%**	**-6 990**	**-80%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.31 and Figure 3.32 shows CO_2 emissions and implied emission factors as well as the share of the Member States with the highest contributions. Liquid fuel consumption decreased by 78% between 1990 and 2014. The CO_2 implied emission factor for liquid fuels was 69.7 t/TJ in 2014.

Figure 3.31 1A2a Iron and Steel, Liquid fuels: Emission trend and share for CO_2

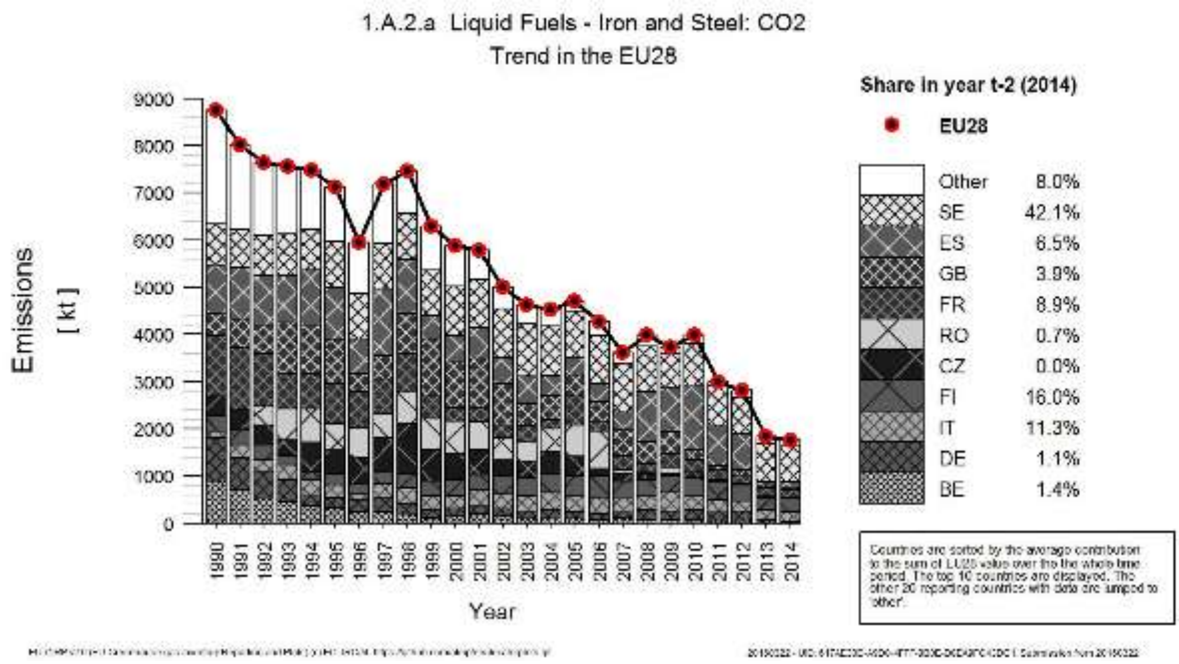
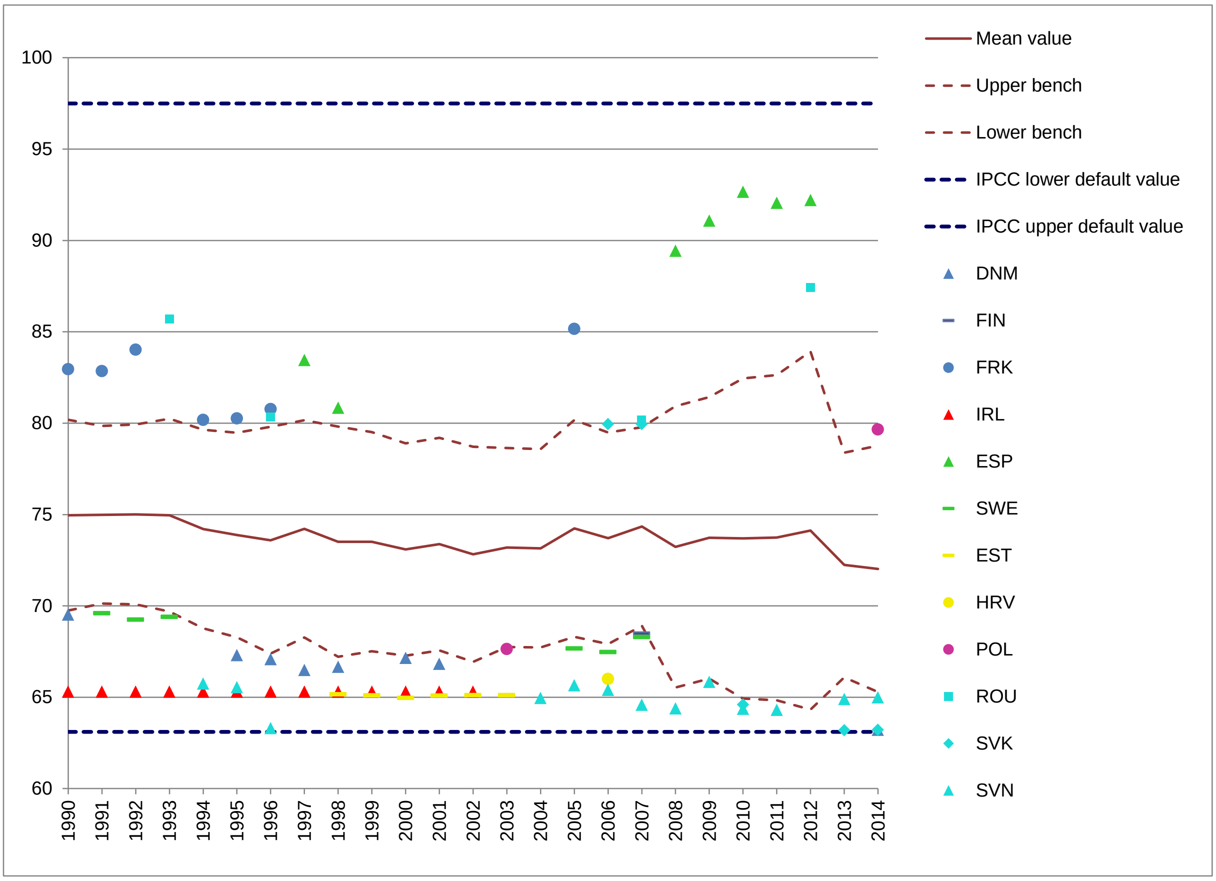


Figure 3.32: 1A2a Iron and Steel, Liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2a Iron and Steel - Solid Fuels (CO_2)

In 2014, CO_2 from solid fuels had a share of 80% within this category and 77% in 1990. Between 1990 and 2014 the emissions decreased by 37% (Table 3.22). Between 1990 and 2014 the Czech Republic, Belgium, Poland, Spain, France, Italy, Luxembourg and the United Kingdom showed major decreases. Between 2013 to 2014 France and Germany show a significant increase while the Czech Republic shows a significant decrease.

Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	1 335	482	353	0%	-129	-27%	-982	-74%	-	-
Belgium	3 284	27	52	0%	25	94%	-3 232	-98%	T3	PS
Bulgaria	1 631	NO	NO	-	-	-	-1 631	-100%	NA	NA
Croatia	IE	12	12	0%	0	-1%	12	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	13 709	2 254	1 642	2%	-612	-27%	-12 066	-88%	T2	CS,D
Denmark	5	0	0	0%	0	14%	-5	-99%	T1	D
Estonia	3	NO	NO	-	-	-	-3	-100%	NA	NA
Finland	2 084	1 789	1 929	2%	140	8%	-155	-7%	T3	CS,PS
France	19 016	12 051	13 366	16%	1 315	11%	-5 650	-30%	-	-
Germany	29 912	29 807	30 561	36%	754	3%	649	2%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	625	74	85	0%	11	15%	-540	-86%	T1,T2	CS,D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	12 793	7 208	6 985	8%	-223	-3%	-5 808	-45%	T2	CS
Latvia	NO	3	NO	-	-3	-100%	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	4 959	NO	NO	-	-	-	-4 959	-100%	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	2 690	3 028	2 945	3%	-83	-3%	255	9%	T2	CS
Poland	11 817	4 901	4 756	6%	-145	-3%	-7 061	-60%	T1,T2	CS,D
Portugal	1 041	23	27	0%	4	17%	-1 014	-97%	T2	CR,D,PS
Romania	2 132	1 487	1 202	1%	-285	-19%	-930	-44%	T1,T2	CS,D
Slovakia	2 296	3 002	3 031	4%	30	1%	735	32%	T2	CS
Slovenia	57	27	29	0%	2	8%	-28	-49%	T1	D
Spain	6 419	3 447	3 408	4%	-40	-1%	-3 011	-47%	T2	CS,PS
Sweden	849	449	526	1%	77	17%	-323	-38%	T2,T3	CS,PS
United Kingdom	18 637	13 427	13 732	16%	305	2%	-4 905	-26%	T2	CS
EU-28	**135 295**	**83 498**	**84 643**	**100%**	**1 144**	**1%**	**-50 653**	**-37%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**135 295**	**83 498**	**84 643**	**100%**	**1 144**	**1%**	**-50 653**	**-37%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 and Figure 3.34 shows CO_2 emissions and implied emission factors for EU-28+ISL and the Member States as well as the share of the Member States with the highest contributions. In 2014 the largest emitters are France, Germany, and the UK; together they cause 68% of the CO_2 emissions from solid fuels in 1A2a. Solid fuel combustion decreased by 42% between 1990 and 2014. The high variation of the IEFs across MS is due to usage of derived coal gases which have significant lower (coke oven gas) or higher carbon content (blast furnace gas) than coal. The CO_2 implied emission factor for solid fuels was 138.6 t/TJ in 2014.

Figure 3.33 1A2a Iron and Steel, solid fuels: Emission trend and share for CO_2

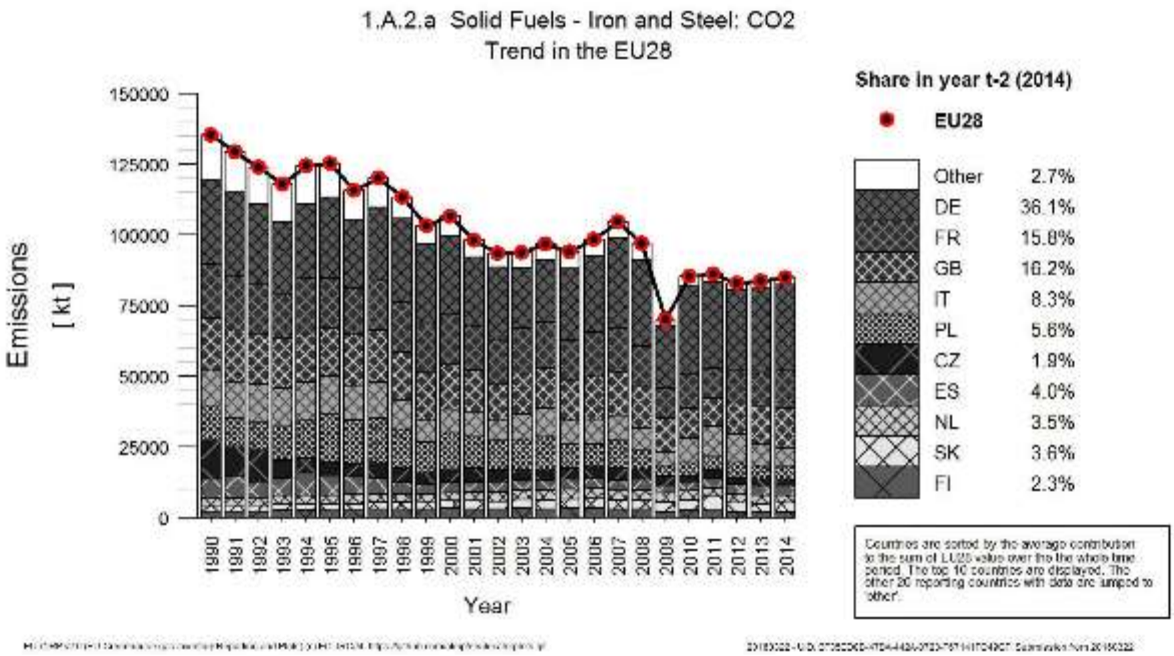
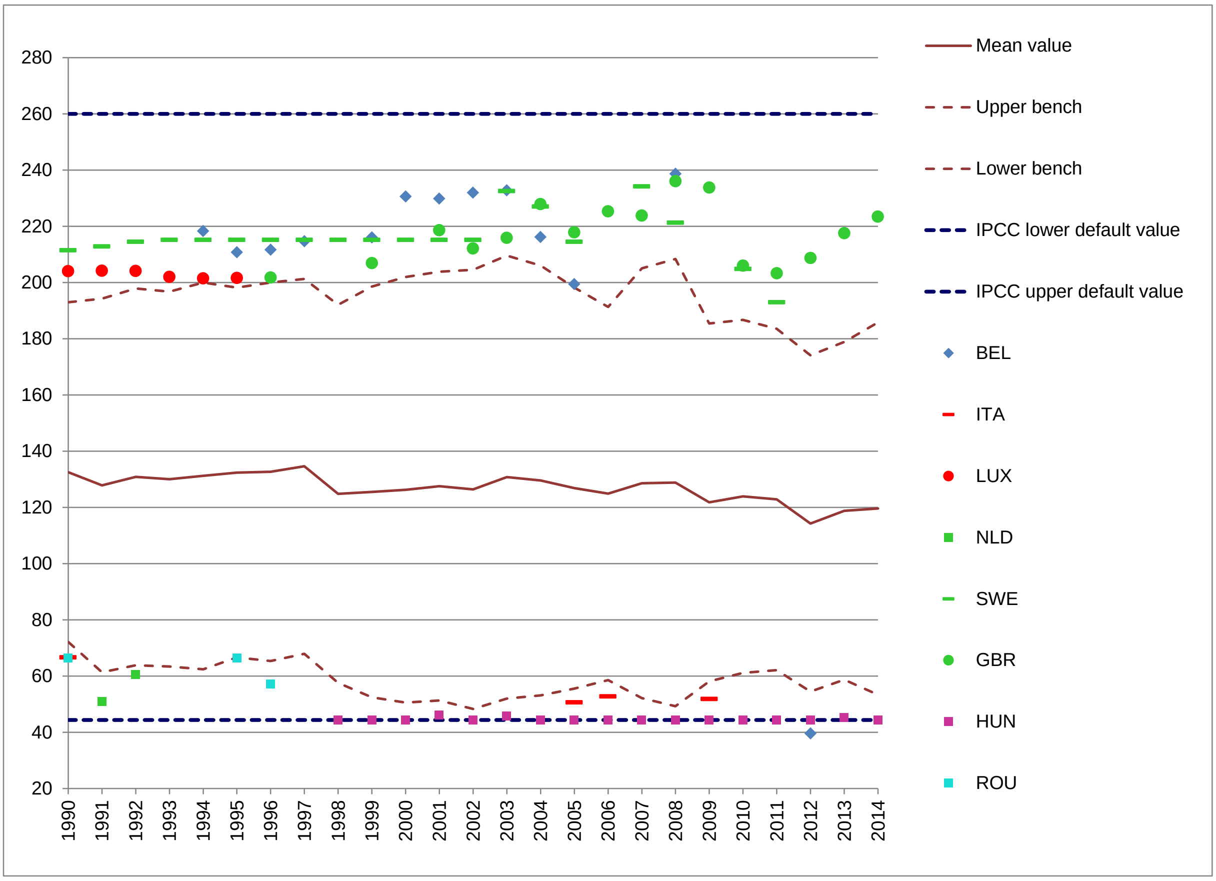


Figure 3.34: 1A2a Iron and Steel, Solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2014 CO_2 from gaseous fuels had a share of 17% within source category 1A2a. Between 1990 and 2014 the emissions decreased by 41% (Table 3.23). Due to confidential reasons Sweden reports emissions from gaseous fuels under liquid fuels.

Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	650	1 361	1 355	7%	-6	0%	706	109%	-	-
Belgium	1 493	987	1 007	6%	20	2%	-486	-33%	T1,T3	D,PS
Bulgaria	1 037	99	117	1%	18	19%	-920	-89%	T2	CS
Croatia	IE	30	33	0%	3	11%	33	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	724	569	489	3%	-81	-14%	-236	-33%	T2	CS
Denmark	96	69	83	0%	13	19%	-13	-14%	T3	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	110	113	121	1%	8	7%	11	10%	T3	CS
France	2 089	1 660	1 585	9%	-75	-5%	-504	-24%	-	-
Germany	4 442	3 283	3 255	18%	-28	-1%	-1 186	-27%	CS	CS
Greece	NO	98	63	0%	-34	-35%	63	100%	T2	CS
Hungary	1 324	128	95	1%	-33	-26%	-1 229	-93%	T1	D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4 276	3 939	3 857	21%	-82	-2%	-419	-10%	T2	CS
Latvia	234	30	1	0%	-29	-98%	-234	-100%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	400	328	270	1%	-59	-18%	-131	-33%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	667	660	639	4%	-21	-3%	-28	-4%	T2	CS
Poland	2 965	911	903	5%	-8	-1%	-2 062	-70%	T1	D
Portugal	NO	115	110	1%	-4	-4%	110	100%	T2	CR,D,PS
Romania	6 661	1 201	1 328	7%	127	11%	-5 333	-80%	T2	CS
Slovakia	221	171	156	1%	-15	-9%	-65	-29%	T2	CS
Slovenia	310	169	163	1%	-6	-4%	-147	-47%	T2	CS
Spain	776	1 393	1 411	8%	19	1%	636	82%	T2	CS
Sweden	IE	C	C	-	-	-	-	-	T2	CS
United Kingdom	2 463	1 123	1 138	6%	15	1%	-1 325	-54%	T2	CS
EU-28	**30 936**	**18 437**	**18 179**	**100%**	**-257**	**-1%**	**-12 757**	**-41%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**30 936**	**18 437**	**18 179**	**100%**	**-257**	**-1%**	**-12 757**	**-41%**		

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

Figure 3.35 and Figure 3.36 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 Spain which contribute 56% to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-28 decreased by 42% between 1990 and 2014. The CO_2-implied emission factor for gaseous fuels was 56.2 t/TJ in 2014.

Figure 3.35 1A2a Iron and Steel, Gaseous fuels: Emission trend and share for CO_2

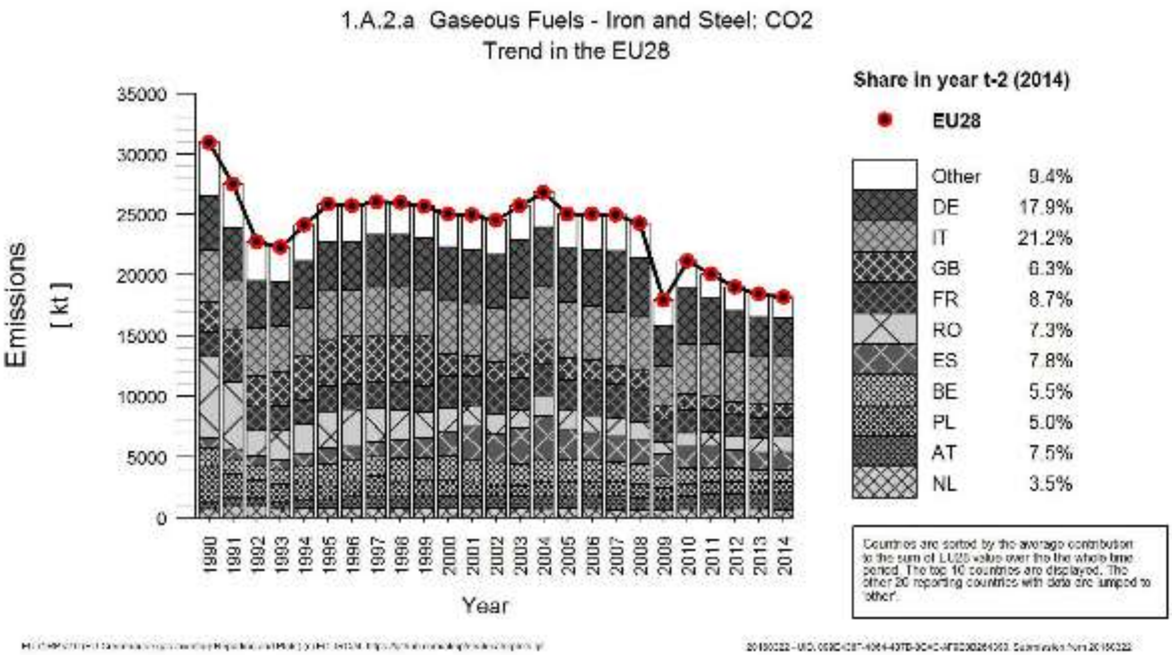
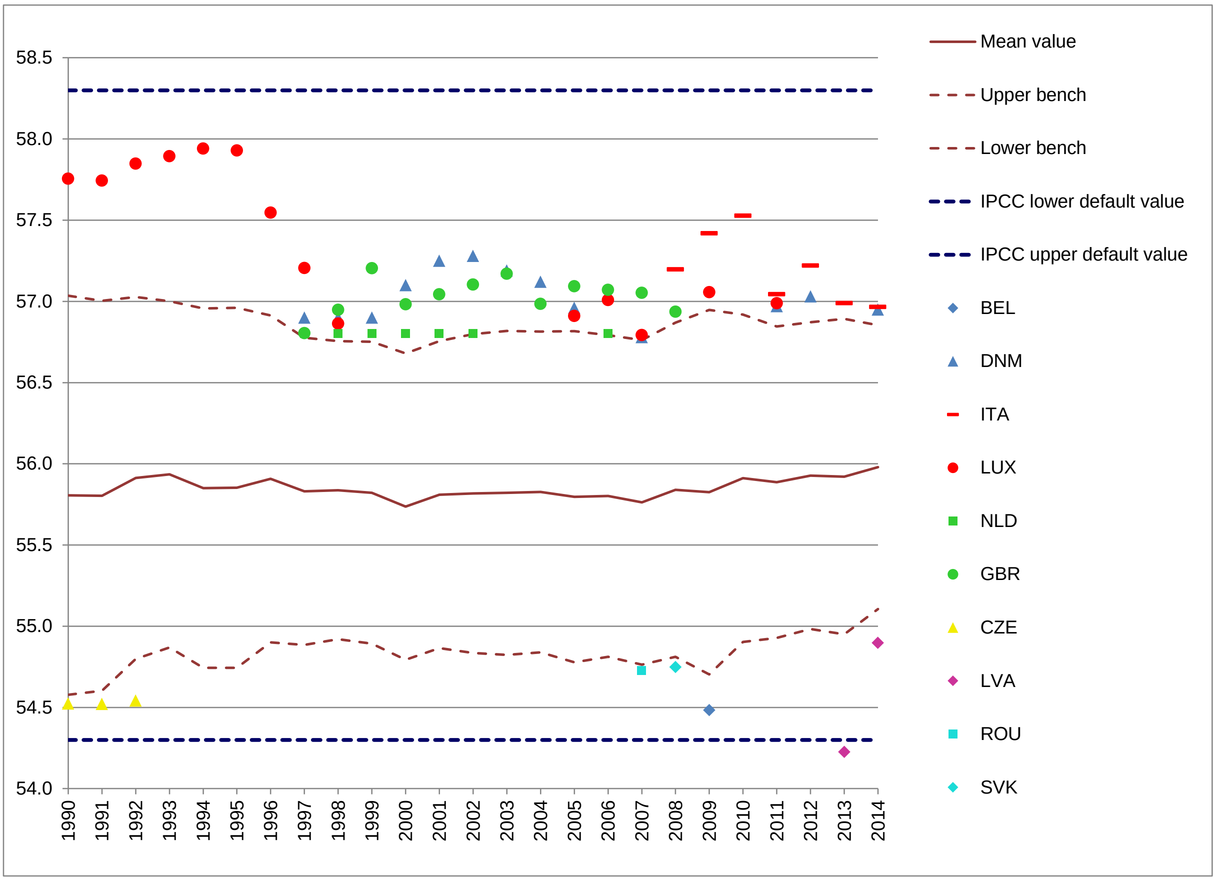


Figure 3.36: 1A2a Iron and Steel, Gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



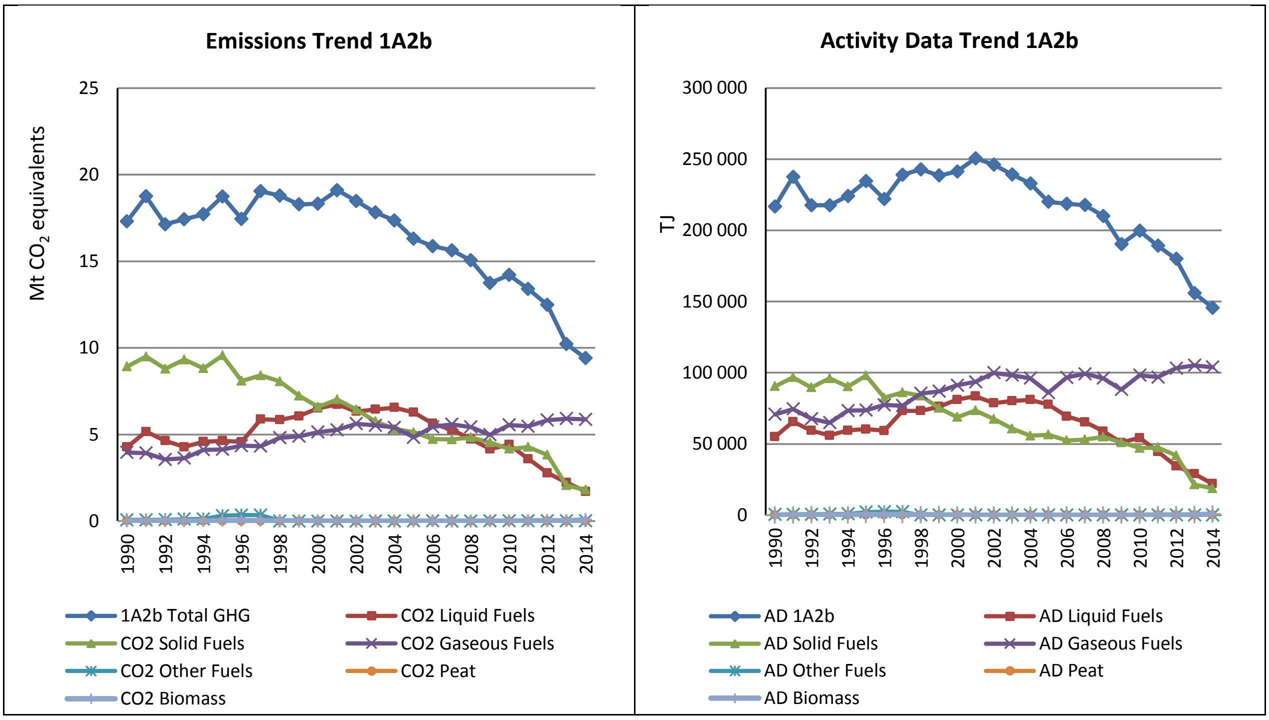
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 1.9% of 1A2 source category and 0.2% of total GHG emissions in 2014.

Figure 3.37 shows the emission trend within the category 1A2b, which is in 2014 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 2014. In 2014 total GHG emissions were 46% below 1990 level. Increasing emissions were reported for CO_2 from gaseous fuels (+48%) while CO_2 emissions from all other fossil fuels decreased.

Figure 3.37 1A2b Non ferrous Metals: CO_2 emissions and activity data trends



CO_2 emissions from 1A2b were 46% below 1990 levels in 2014. In absolute terms, France ,Germany, Slovakia and the United Kingdom reported the highest decreases, while Ireland and Italy reported substantial increases in this period (Table 3.24).

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	132	260	265	3%	5	2%	134	101%
Belgium	629	433	392	4%	-42	-10%	-237	-38%
Bulgaria	438	326	341	4%	15	4%	-97	-22%
Croatia	NO,IE	20	17	0%	-2	-12%	17	100%
Cyprus	5	NO	3	0%	3	100%	-2	-38%
Czech Republic	102	120	96	1%	-24	-20%	-6	-6%
Denmark	11	0	0	0%	0	-28%	-11	-100%
Estonia	NO	2	2	0%	0	-7%	2	100%
Finland	337	98	92	1%	-6	-6%	-245	-73%
France	2 473	1 054	774	8%	-280	-27%	-1 700	-69%
Germany	1 377	117	90	1%	-27	-23%	-1 287	-93%
Greece	582	772	623	7%	-149	-19%	41	7%
Hungary	242	172	170	2%	-2	-1%	-72	-30%
Ireland	809	1 437	1 442	15%	4	0%	633	78%
Italy	748	1 121	1 070	11%	-51	-5%	322	43%
Latvia	NO	7	4	0%	-4	-47%	4	100%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	28	50	49	1%	-1	-2%	21	74%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	216	158	122	1%	-36	-23%	-94	-43%
Poland	1 089	1 129	1 169	12%	40	4%	80	7%
Portugal	IE	IE	IE	-	-	-	-	-
Romania	79	NO,IE	NO,IE	-	-	-	-79	-100%
Slovakia	1 256	186	148	2%	-38	-20%	-1 108	-88%
Slovenia	439	95	96	1%	1	1%	-343	-78%
Spain	1 310	1 598	1 389	15%	-209	-13%	79	6%
Sweden	128	92	94	1%	2	3%	-33	-26%
United Kingdom	4 779	930	911	10%	-19	-2%	-3 868	-81%
EU-28	**17 207**	**10 179**	**9 360**	**100%**	**-818**	**-8%**	**-7 847**	**-46%**
Iceland	14	12	11	0%	-1	-11%	-3	-19%
EU-28 + ISL	**17 221**	**10 191**	**9 371**	**100%**	**-820**	**-8%**	**-7 849**	**-46%**

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 2014 CO_2 from solid fuels had a share of 19% within source category 1A2b (compared to 52% in 1990). Between 1990 and 2014 the emissions decreased by 80% (Table 3.25). Greece, Malta, Portugal and Romania reported emissions as 'Included elsewhere'. Substantial decreases between 1990 and 2014 were reported by France, Germany, Slovakia and the United Kingdom.

Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	22	14	16	1%	2	17%	-6	-28%	-	-
Belgium	147	86	73	4%	-13	-15%	-74	-50%	T1	D
Bulgaria	215	207	226	13%	18	9%	11	5%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	46	15	12	1%	-3	-20%	-34	-73%	T2	CS,D
Denmark	NO	0	0	0%	0	14%	0	100%	T1	D
Estonia	NO	2	2	0%	0	-12%	2	100%	T2	CS
Finland	155	24	24	1%	1	2%	-131	-84%	T3	CS
France	1 167	234	2	0%	-232	-99%	-1 165	-100%	-	-
Germany	1 233	NA	NA	-	-	-	-1 233	-100%	NA	NA
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	9	NO	NO	-	-	-	-9	-100%	NA	NA
Ireland	4	NO	NO	-	-	-	-4	-100%	NA	NA
Italy	172	9	9	0%	0	4%	-163	-95%	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	0	NO	NO	-	-	-	0	-100%	NA	NA
Poland	706	731	759	42%	28	4%	53	8%	T1,T2	CS,D
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	79	IE	IE	-	-	-	-79	-100%	NA	NA
Slovakia	798	108	70	4%	-38	-35%	-729	-91%	T2	CS
Slovenia	154	5	5	0%	0	3%	-149	-97%	T1,T2	CS,D
Spain	185	90	95	5%	5	6%	-89	-48%	T2	CS
Sweden	7	NO	NO	-	-	-	-7	-100%	NA	NA
United Kingdom	3 818	532	506	28%	-26	-5%	-3 312	-87%	T2	CS
EU-28	**8 918**	**2 056**	**1 799**	**100%**	**-257**	**-13%**	**-7 118**	**-80%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**8 918**	**2 056**	**1 799**	**100%**	**-257**	**-13%**	**-7 118**	**-80%**		

Portugal and Malta include emissions under 1A2g. Romania includes emissions under 1A2a.
Greece includes emissions in the Industrial processes sector (as non-energy use of fuels).

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 and Figure **3.39** shows CO_2 emissions and implied emission factors for EU-28+ISL 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 and the United Kingdom; together they cause 83% of the CO_2 emissions from solid fuels in 2014. Consumption of solid fuels decreased by 79% between 1990 and 2014. The strong decline in 2013 is mainly due to a high decrease reported by the United Kingdom. The CO_2-implied emission factor for solid fuels was 96 t/TJ in 2014.

Figure 3.38 1A2b Non ferrous Metals, solid fuels: Emission trend and share for CO_2

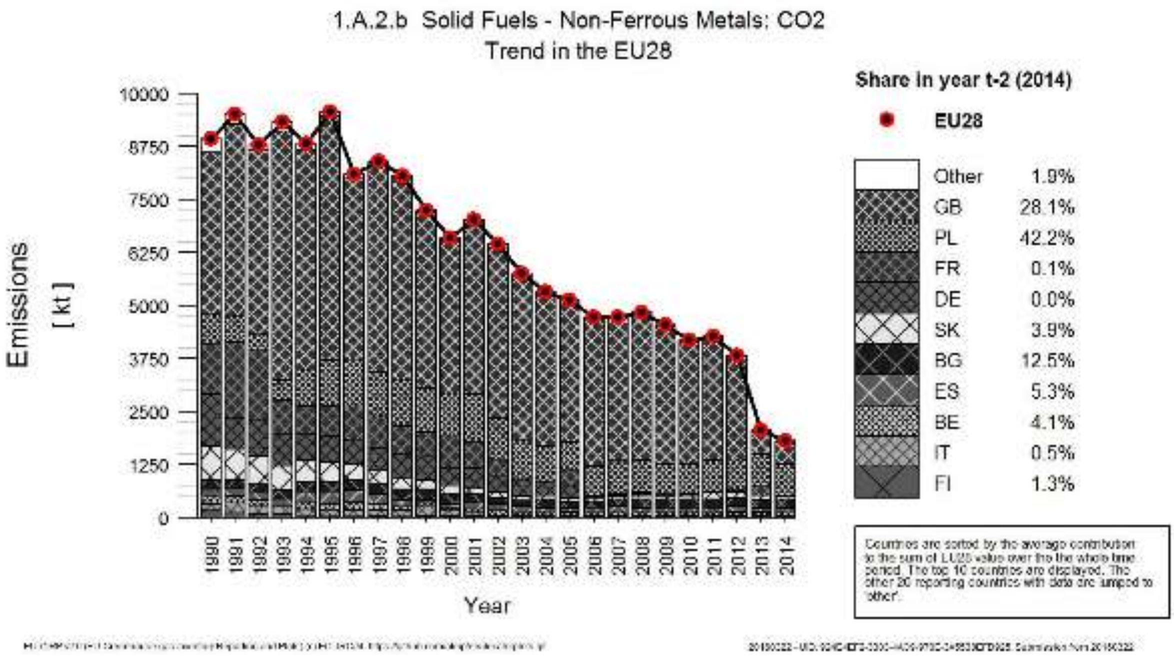
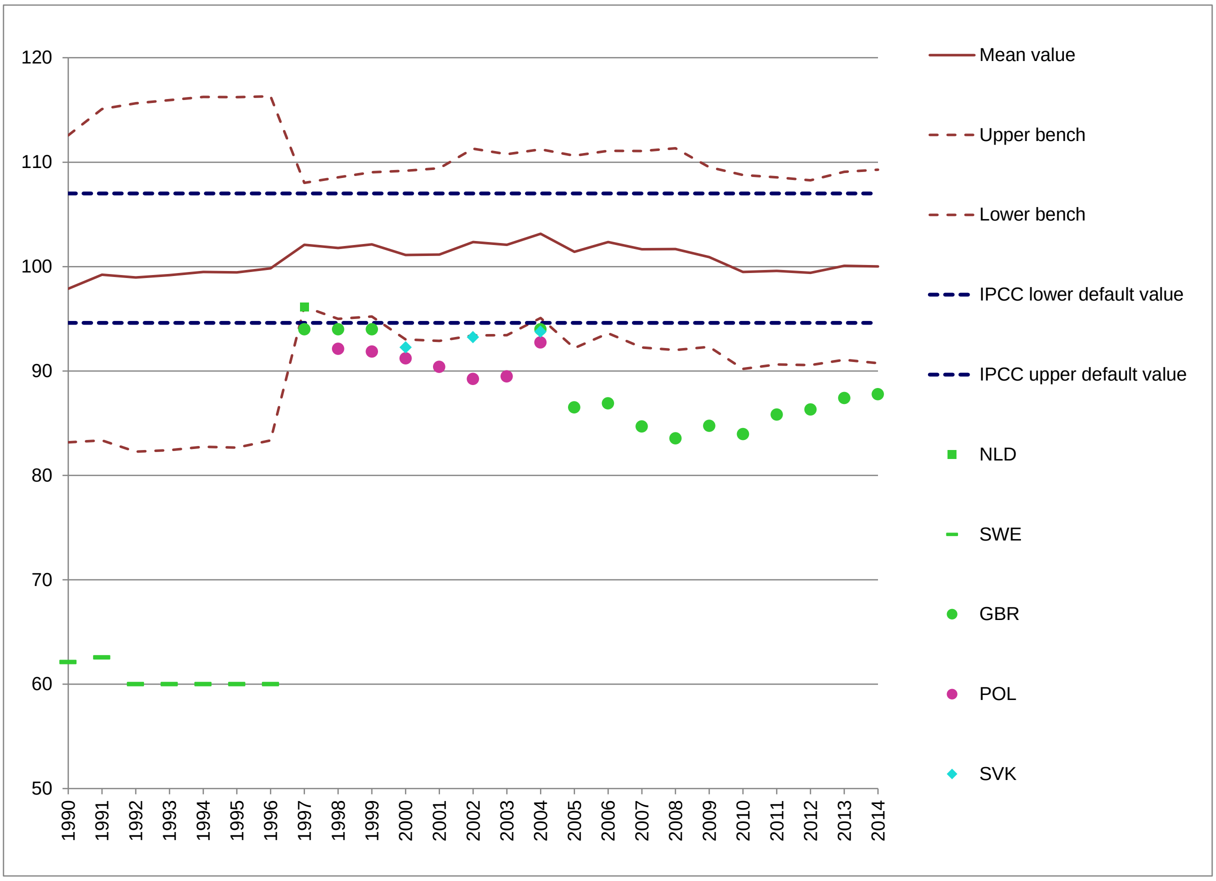


Figure 3.39: 1A2b Non ferrous Metals, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014 CO_2 from gaseous fuels had a share of 62% within source category 1A2b (compared to 23% in 1990). Between 1990 and 2014 the emissions increased by 48% (Table 3.26). Between 1990 and 2014 the highest absolute increases occurred in Ireland, Greece, Italy and Spain. For confidentiality reasons Germany reports emissions in 1A2g.

Table 3.26 1A2b Non ferrous Metals, Gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	75	223	230	4%	7	3%	155	207%	-	-
Belgium	261	297	278	5%	-18	-6%	18	7%	T1	D
Bulgaria	23	55	66	1%	12	21%	43	184%	T2	CS
Croatia	IE	2	2	0%	1	37%	2	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	53	104	84	1%	-20	-19%	31	58%	T2	CS
Denmark	7	NO	NO	-	-	-	-7	-100%	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	3	3	0%	0	-7%	3	100%	T3	CS
France	871	766	735	13%	-30	-4%	-136	-16%	-	-
Germany	C	C	C	-	-	-	-	-	CS	CS
Greece	NO	754	595	10%	-159	-21%	595	100%	T2	CS
Hungary	87	172	167	3%	-5	-3%	80	92%	T1	D
Ireland	39	1 135	1 302	22%	167	15%	1 264	3276%	T2	CS
Italy	558	963	927	16%	-36	-4%	370	66%	T2	CS
Latvia	NO	7	4	0%	-4	-47%	4	100%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	13	50	49	1%	-1	-2%	36	268%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	213	152	122	2%	-30	-20%	-91	-43%	T2	CS
Poland	258	376	390	7%	14	4%	132	51%	T1	D
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	IE	IE	IE	-	-	-	-	-	NA	NA
Slovakia	435	68	65	1%	-3	-4%	-369	-85%	T2	CS
Slovenia	164	64	65	1%	1	2%	-98	-60%	T2	CS
Spain	71	312	364	6%	51	16%	292	409%	T2	CS
Sweden	10	14	14	0%	0	0%	4	36%	T2	CS
United Kingdom	819	395	402	7%	7	2%	-418	-51%	T2	CS
EU-28	**3 958**	**5 912**	**5 866**	**100%**	**-46**	**-1%**	**1 908**	**48%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**3 958**	**5 912**	**5 866**	**100%**	**-46**	**-1%**	**1 908**	**48%**		

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 3.40 and Figure **3.39** shows CO_2 emissions and implied emission factors for EU-28+ISL 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 50% of the CO_2 emissions in 2014 from gaseous fuels in 1A2b. Consumption of gaseous fuels rose by 47% between 1990 and 2014. 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. The CO_2-implied emission factor for gaseous fuels was 56.4 t/TJ in 2014.

Figure 3.40 1A2b Non ferrous Metals, Gaseous fuels: Activity Data and Implied Emission Factors for CO_2

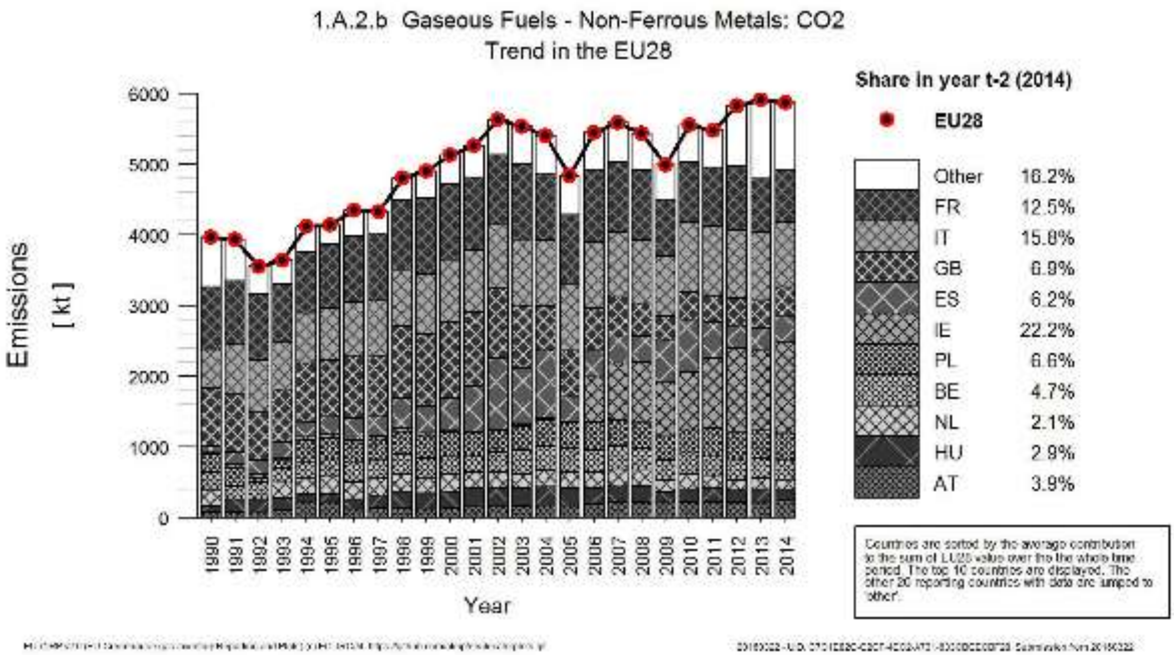
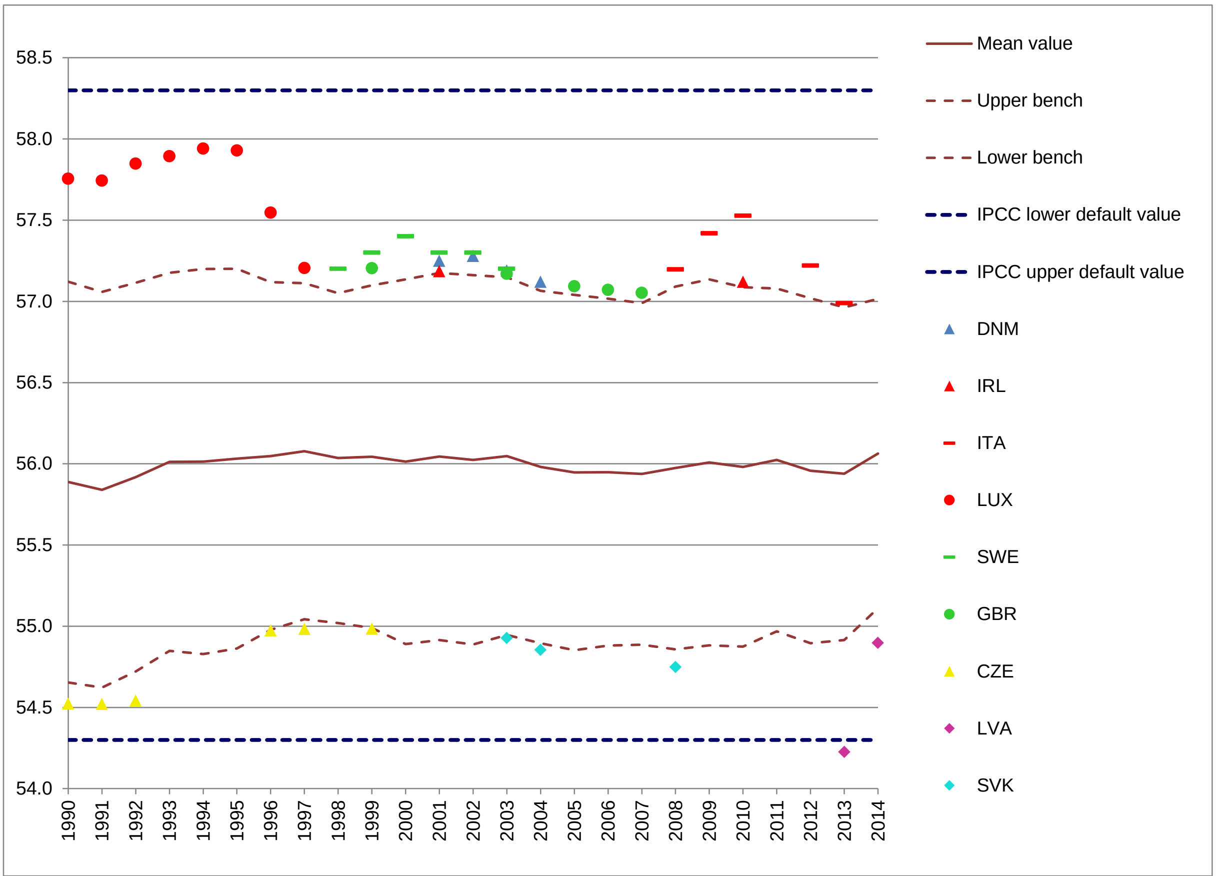


Figure 3.41: 1A2b Non ferrous Metals, Gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



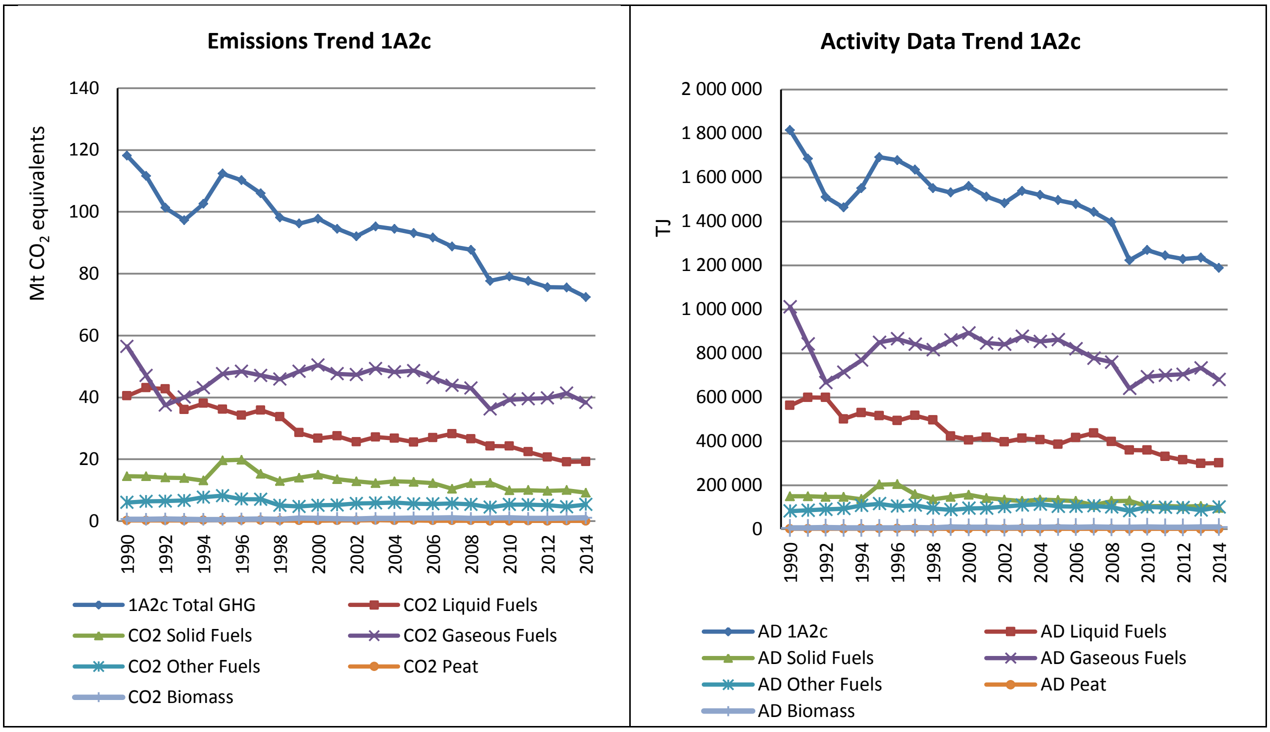
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 14.7% of 1A2 category and 2% of total GHG emissions in 2014.

Figure 3.42 shows the emission trend of category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 39%, mainly due to decreases in emissions from liquid (-53%) and gaseous (-32%) fuels.

Figure 3.42 1A2c Chemicals: Total and CO_2 emission and activity trends



Between 1990 and 2014, CO_2 emissions from 1A2c Chemicals decreased by 39% in the EU-28+ISL (Table 3.27), mainly due to decreases in Italy, Romania, the Netherlands and the United Kingdom; Poland and Spain reported substantial emission increases in this period. Between 2013 and 2014 emissions decreased substantially in Spain, Poland and the Netherlands while emissions from Italy increased substantially.

Table 3.27 1A2c Chemicals: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	892	1 873	1 879	3%	6	0%	988	111%
Belgium	4 786	3 423	3 117	4%	-306	-9%	-1 669	-35%
Bulgaria	966	248	219	0%	-30	-12%	-747	-77%
Croatia	NO,IE	253	312	0%	59	23%	312	100%
Cyprus	2	3	6	0%	3	100%	4	190%
Czech Republic	2 996	1 782	1 586	2%	-196	-11%	-1 410	-47%
Denmark	290	332	335	0%	3	1%	45	16%
Estonia	800	91	15	0%	-75	-83%	-785	-98%
Finland	1 245	737	730	1%	-7	-1%	-516	-41%
France	19 512	17 256	16 985	24%	-271	-2%	-2 526	-13%
Germany	NA,IE	NA,IE	NA,IE	-	-	-	-	-
Greece	808	343	357	0%	14	4%	-451	-56%
Hungary	1 541	494	432	1%	-61	-12%	-1 108	-72%
Ireland	410	261	255	0%	-6	-2%	-155	-38%
Italy	19 263	8 188	8 401	12%	213	3%	-10 862	-56%
Latvia	300	32	29	0%	-3	-9%	-272	-90%
Lithuania	400	152	168	0%	17	11%	-232	-58%
Luxembourg	170	176	141	0%	-35	-20%	-28	-17%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	17 306	12 444	11 959	17%	-484	-4%	-5 346	-31%
Poland	4 020	7 146	6 546	9%	-600	-8%	2 526	63%
Portugal	1 476	1 038	1 160	2%	122	12%	-316	-21%
Romania	19 124	2 976	2 911	4%	-65	-2%	-16 213	-85%
Slovakia	2 624	554	502	1%	-52	-9%	-2 122	-81%
Slovenia	209	78	75	0%	-3	-4%	-135	-64%
Spain	5 252	8 710	7 806	11%	-904	-10%	2 554	49%
Sweden	1 149	1 261	1 174	2%	-87	-7%	25	2%
United Kingdom	12 135	5 252	4 926	7%	-326	-6%	-7 209	-59%
EU-28	**117 675**	**75 103**	**72 027**	**100%**	**-3 076**	**-4%**	**-45 648**	**-39%**
Iceland	7	NO	NO	-	-	-	-	-
EU-28 + ISL	**117 682**	**75 103**	**72 027**	**100%**	**-3 076**	**-4%**	**-45 648**	**-39%**

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

1A2c Chemicals - Liquid Fuels (CO_2)

In 2014, CO_2 from liquid fuels had a share of 27% within source category 1A2c (compared to 34% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 53% (Table 3.28). Several 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 3.28 1A2c Chemicals, Liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	93	122	83	0%	-40	-33%	-10	-11%	-	-
Belgium	1 852	204	146	1%	-58	-28%	-1 705	-92%	T1	D
Bulgaria	857	38	35	0%	-3	-8%	-821	-96%	T1	D
Croatia	IE	6	6	0%	0	5%	6	100%	T1	D
Cyprus	2	3	6	0%	3	100%	4	190%	T1	D
Czech Republic	175	3	3	0%	0	0%	-172	-98%	T1	D
Denmark	188	15	16	0%	1	6%	-172	-92%	T1,T2	CS,D
Estonia	13	7	7	0%	0	5%	-5	-42%	T1,T2	CS,D
Finland	731	694	690	4%	-3	0%	-41	-6%	T3	CS
France	7 560	5 429	4 916	26%	-512	-9%	-2 643	-35%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	639	38	72	0%	34	92%	-567	-89%	T2	CS
Hungary	380	22	6	0%	-16	-72%	-374	-98%	T1	D
Ireland	131	87	74	0%	-14	-15%	-57	-44%	T2	CS
Italy	11 004	2 015	2 340	12%	325	16%	-8 664	-79%	T2	CS
Latvia	277	9	10	0%	2	18%	-267	-96%	T2	CS
Lithuania	69	2	2	0%	0	0%	-67	-98%	T2	CS
Luxembourg	112	17	14	0%	-3	-16%	-98	-87%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	6 522	6 641	6 956	36%	315	5%	434	7%	T2	CS,D
Poland	306	1 376	1 155	6%	-222	-16%	848	277%	T1	D
Portugal	1 373	363	637	3%	273	75%	-737	-54%	T2	CR,D
Romania	NO	621	680	4%	58	9%	680	100%	T1,T2	D
Slovakia	51	9	6	0%	-3	-31%	-45	-88%	T2	CS
Slovenia	32	20	18	0%	-2	-10%	-14	-43%	T1	D
Spain	2 788	195	186	1%	-9	-5%	-2 602	-93%	T2	CS
Sweden	867	1 055	1 000	5%	-56	-5%	133	15%	T2	CS
United Kingdom	4 450	140	148	1%	9	6%	-4 302	-97%	T2	CS
EU-28	**40 471**	**19 132**	**19 214**	**100%**	**82**	**0%**	**-21 257**	**-53%**		
Iceland	7	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**40 479**	**19 132**	**19 214**	**100%**	**82**	**0%**	**-21 257**	**-53%**		

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

Figure 3.43 and Figure **3.43** shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest contributions are reported by France, the Netherlands and Italy; together they cause around 74% of the CO_2 emissions from liquid fuels in 1A2c. Liquid fuel combustion in decreased by 46% between 1990 and 2014. The decline in 1999 is due to the strong decrease reported by Italy. The CO_2-implied emission factor for liquid fuels was 63.8 t/TJ in 2014. Lower implied emissions factors are associated with a high share of refinery gas used within this sector.

Figure 3.43 1A2c Chemicals, Liquid fuels: Emission trend and share for CO_2

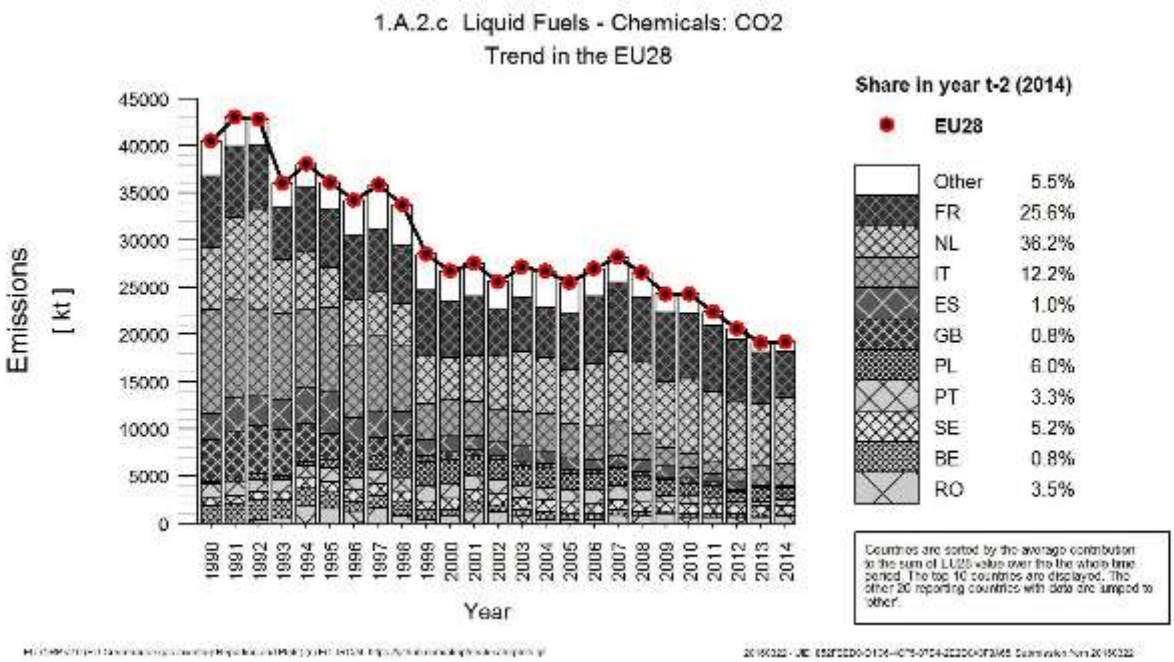
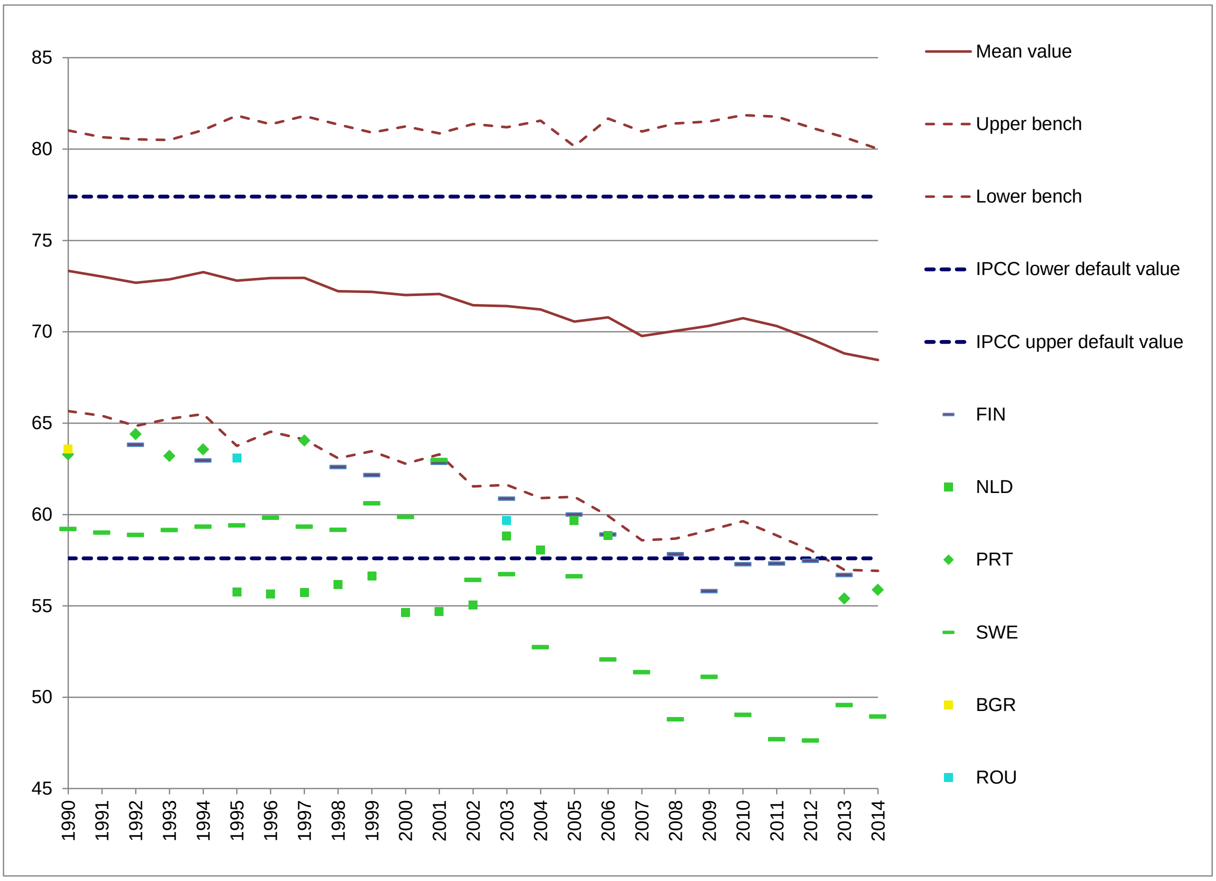


Figure 3.44: 1A2c Chemicals, Liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2c Chemicals - Solid Fuels (CO_2)

In 2014, solid fuels had a share of 13% within source category 1A2c (compared to 12% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 37% (Table 3.29). 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 3.29 1A2c Chemicals, Solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	106	84	123	1%	39	47%	17	16%	-	-
Belgium	402	3	3	0%	0	-8%	-399	-99%	T1	D
Bulgaria	79	NO	NO	-	-	-	-79	-100%	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 487	1 051	841	9%	-210	-20%	-1 647	-66%	T2	CS,D
Denmark	7	3	3	0%	0	14%	-3	-48%	T1	D
Estonia	621	NO	NO	-	-	-	-621	-100%	NA	NA
Finland	214	NO	NO	-	-	-	-214	-100%	NA	NA
France	1 765	1 777	1 741	19%	-36	-2%	-24	-1%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	169	NO	NO	-	-	-	-169	-100%	NA	NA
Hungary	96	3	NO	-	-3	-100%	-96	-100%	NA	NA
Ireland	72	NO	NO	-	-	-	-72	-100%	NA	NA
Italy	489	9	17	0%	8	95%	-472	-97%	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	NO	NO	-	-	-	-1 087	-100%	NA	NA
Poland	1 027	4 789	4 423	48%	-366	-8%	3 396	331%	T1,T2	CS,D
Portugal	40	51	2	0%	-49	-95%	-37	-94%	T2	CR,D
Romania	625	353	323	4%	-30	-8%	-302	-48%	T1,T2	CS,D
Slovakia	1 584	64	59	1%	-5	-8%	-1 525	-96%	T2	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NA	NA
Spain	688	570	639	7%	68	12%	-50	-7%	T2	CS,PS
Sweden	127	31	29	0%	-2	-7%	-98	-77%	T2	CS
United Kingdom	2 815	1 202	960	10%	-243	-20%	-1 855	-66%	T2	CS
EU-28	**14 500**	**9 990**	**9 163**	**100%**	**-827**	**-8%**	**-5 337**	**-37%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**14 500**	**9 990**	**9 163**	**100%**	**-827**	**-8%**	**-5 337**	**-37%**		

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

Figure 3.45 and Figure **3.46** shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland, the Czech Republic, France and the United Kingdom; together they cause 87% of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion decreased by -35% between 1990 and 2014. The CO_2-implied emission factor for solid fuels was 94.8 t/TJ in 2014. The high implied emission factor for Estonia is due to the use of oil shale generator gas which has a high carbon content.

Figure 3.45 1A2c Chemicals, Solid fuels: Emission trend and share for CO_2

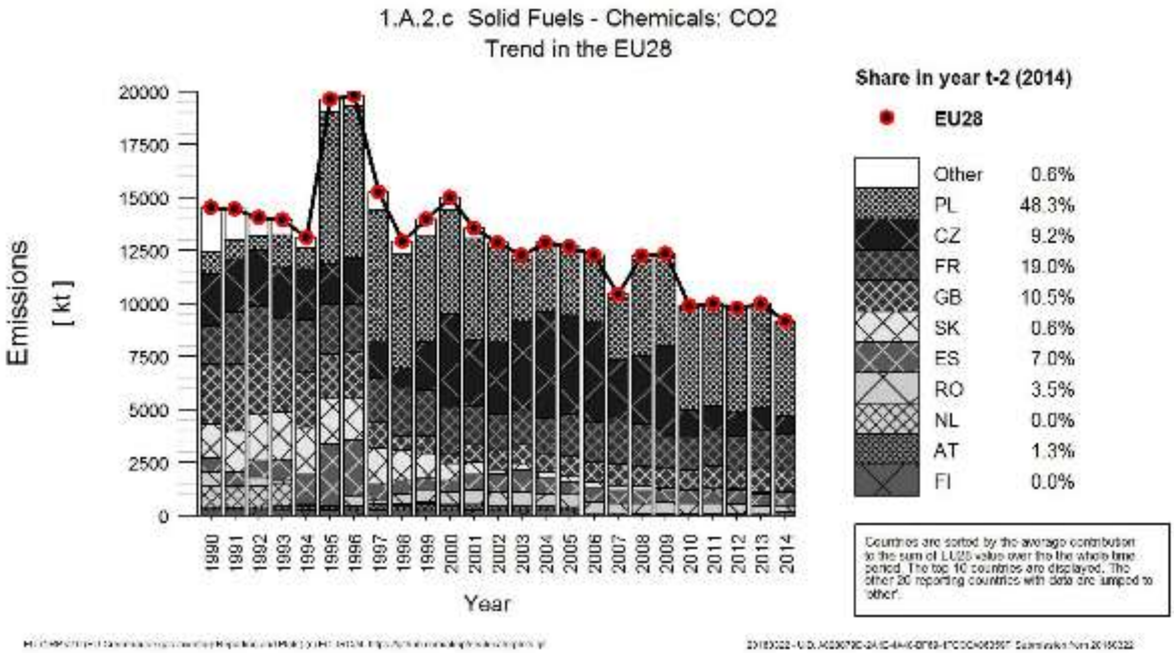
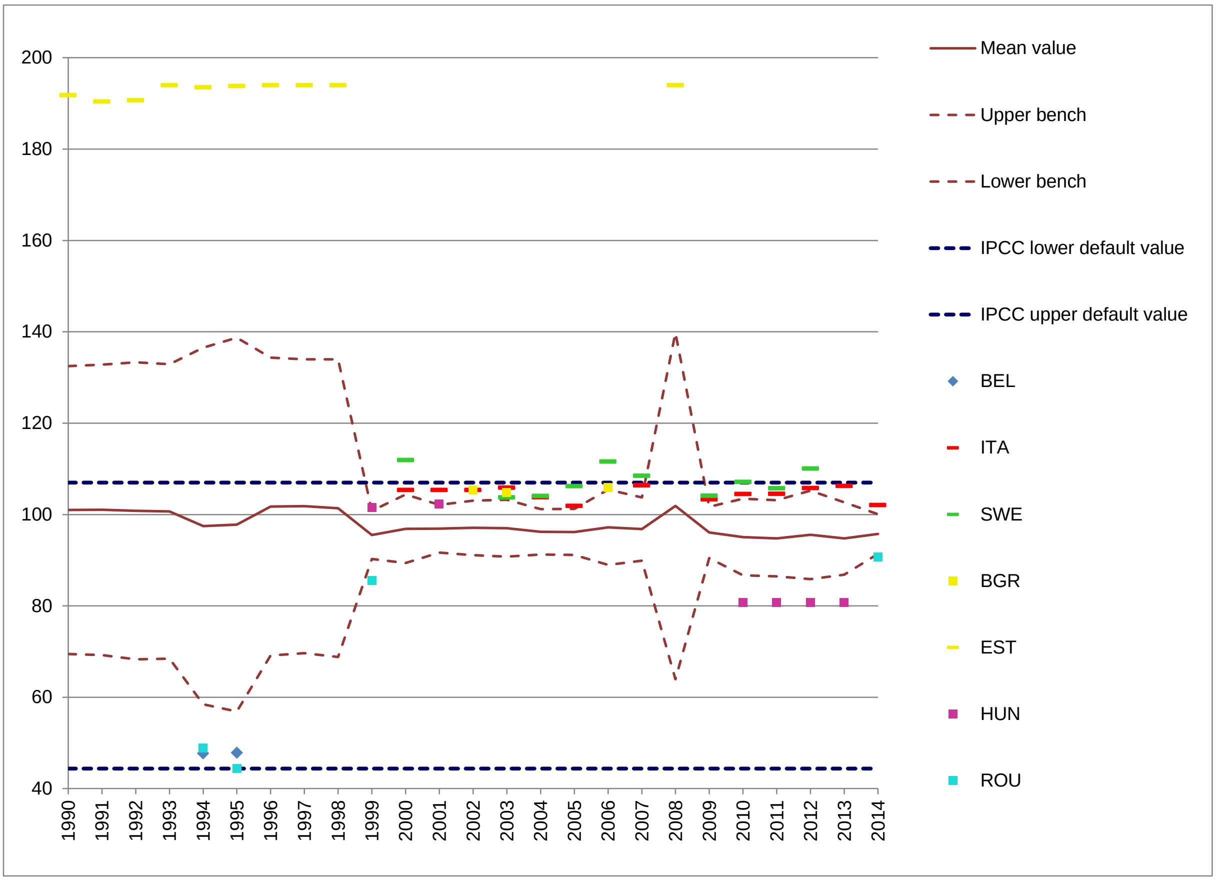


Figure 3.46: 1A2c Chemicals, Solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2c Chemicals – Gaseous Fuels (CO_2)

In 2014, CO_2 from gaseous fuels had a share of 53% within source category 1A2c (compared to 48% in 1990). Between 1990 and 2014, CO_2 emissions decreased by 32% (Table 3.30). Between 1990 and 2014 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 3.30 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	519	1 403	1 448	4%	45	3%	929	179%	-	-
Belgium	2 532	3 207	2 953	8%	-254	-8%	421	17%	T1,T3	D,PS
Bulgaria	30	210	183	0%	-27	-13%	153	507%	T2	CS
Croatia	IE	248	306	1%	59	24%	306	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	334	728	743	2%	15	2%	409	122%	T2	CS
Denmark	96	314	316	1%	1	0%	220	230%	T3	CS
Estonia	167	84	8	0%	-76	-90%	-158	-95%	T2	CS
Finland	99	31	26	0%	-5	-15%	-73	-73%	T3	CS
France	7 014	6 205	5 824	15%	-381	-6%	-1 190	-17%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	305	285	1%	-21	-7%	285	100%	T2	CS
Hungary	1 065	469	426	1%	-43	-9%	-639	-60%	T1	D
Ireland	207	174	181	0%	7	4%	-26	-13%	T2	CS
Italy	7 561	5 994	5 869	15%	-125	-2%	-1 692	-22%	T2	CS
Latvia	23	21	17	0%	-4	-17%	-6	-26%	T2	CS
Lithuania	331	150	167	0%	17	11%	-165	-50%	T2	CS
Luxembourg	57	159	127	0%	-32	-20%	70	121%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	9 696	5 802	5 003	13%	-799	-14%	-4 693	-48%	T2	CS
Poland	297	824	813	2%	-11	-1%	517	174%	T1	D
Portugal	NO	505	343	1%	-162	-32%	343	100%	T2	CR,D
Romania	18 499	1 932	1 841	5%	-91	-5%	-16 658	-90%	T2	CS
Slovakia	989	481	437	1%	-44	-9%	-553	-56%	T2	CS
Slovenia	176	58	57	0%	-1	-2%	-119	-68%	T2	CS
Spain	1 776	7 944	6 981	18%	-964	-12%	5 205	293%	T2	CS
Sweden	155	174	145	0%	-29	-17%	-10	-6%	T2	CS
United Kingdom	4 870	3 909	3 818	10%	-91	-2%	-1 052	-22%	T2	CS
EU-28	**56 493**	**41 334**	**38 317**	**100%**	**-3 017**	**-7%**	**-18 175**	**-32%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**56 493**	**41 334**	**38 317**	**100%**	**-3 017**	**-7%**	**-18 175**	**-32%**		

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

Figure 3.47 and Figure 3.48 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 72% of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-28 decreased by 33% between 1990 and 2014. The CO_2-implied emission factor for gaseous fuels was 56.3 t/TJ in 2014.

Figure 3.47 1A2c Chemicals, Gaseous fuels: Emission trend and share for CO_2

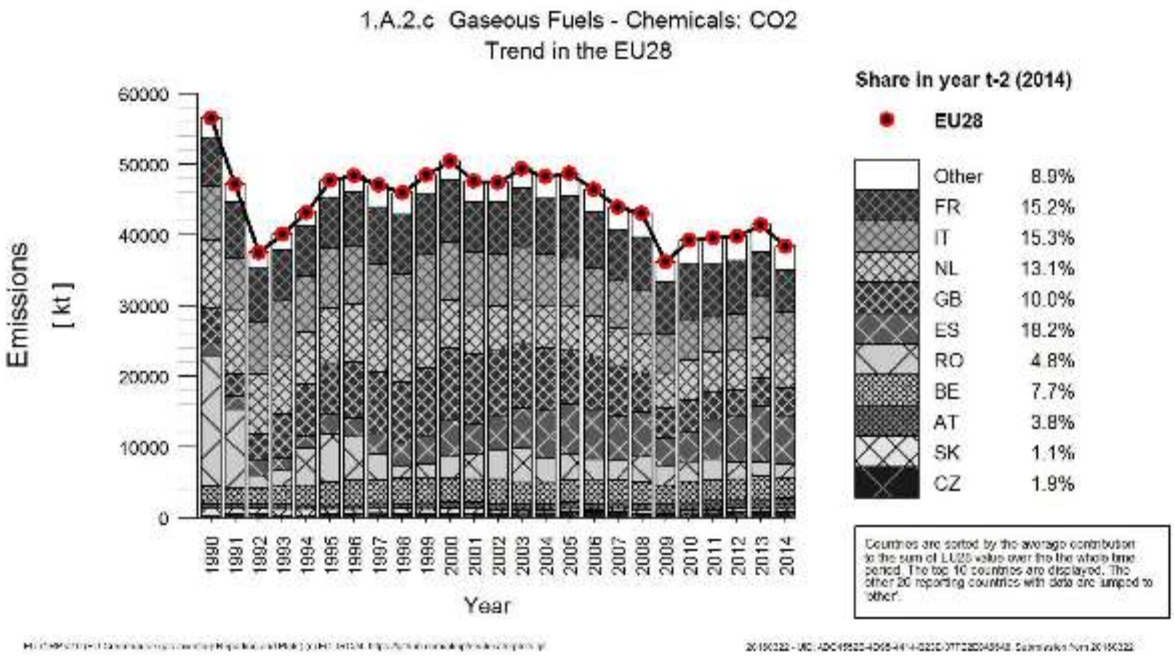
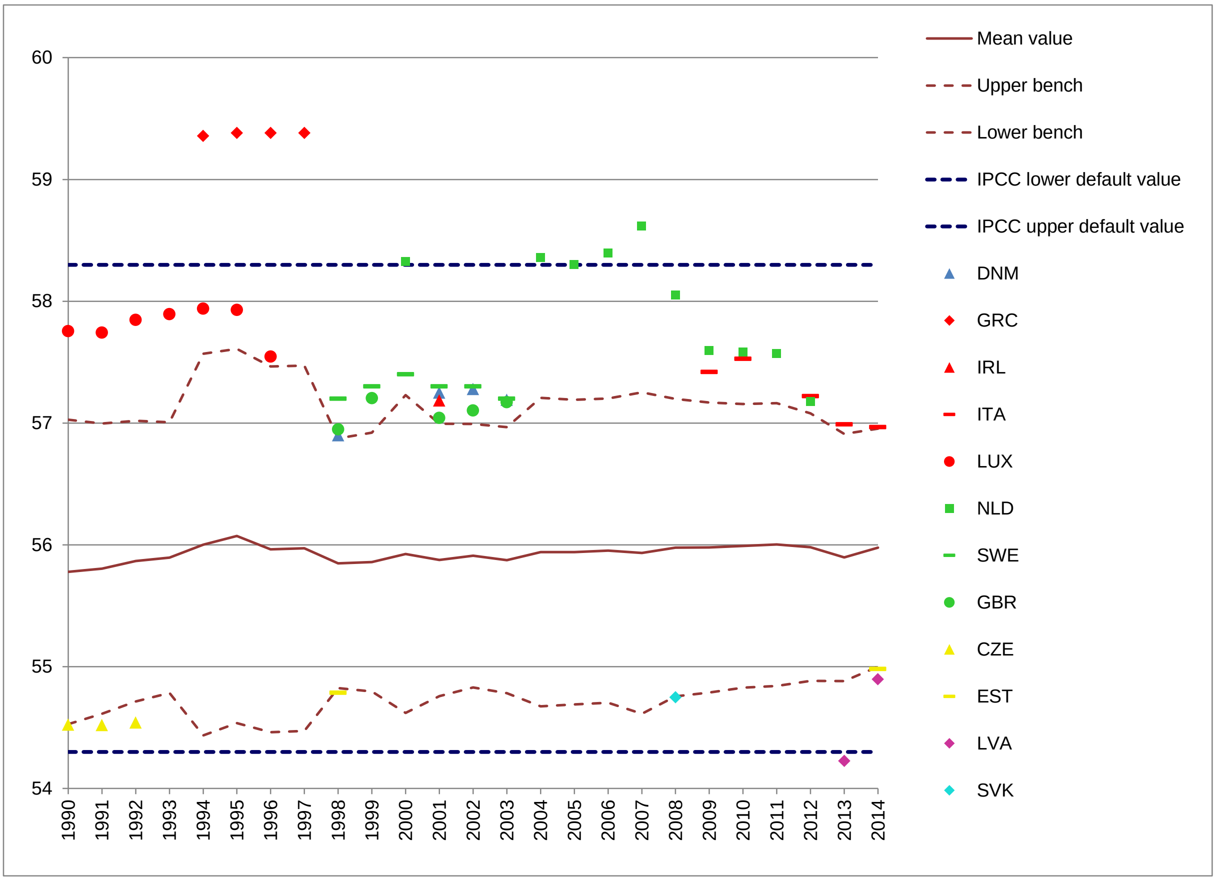


Figure 3.48: 1A2c Chemicals, Gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2c Chemicals - Other Fossil Fuels (CO_2)

In 2014, CO_2 from other fossil fuels had a share of 7% within source category 1A2c (compared to 5% in 1990). Between 1990 and 2014, the emissions decreased by 11% (Table 3.31). Most 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 3.31 1A2c Chemicals, other fossil fuels: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	174	264	226	4%	-38	-14%	52	30%
Belgium	IE	8	14	0%	6	75%	14	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	13	0%	1	8%	2	24%
France	3 174	3 845	4 504	84%	658	17%	1 330	42%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	208	171	175	3%	4	3%	-33	-16%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	2 390	156	155	3%	-1	-1%	-2 235	-94%
Portugal	63	118	178	3%	60	50%	115	183%
Romania	NO	70	67	1%	-3	-4%	67	100%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	1	0	NO	-	0	-100%	-1	-100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	IE	C	C	-	-	-	-	-
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**6 020**	**4 645**	**5 332**	**100%**	**687**	**15%**	**-687**	**-11%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**6 020**	**4 645**	**5 332**	**100%**	**687**	**15%**	**-687**	**-11%**

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

Figure 3.49 and Figure 3.50 shows CO_2 emissions and implied emission factor for EU-28+ISL as well as the share of the Member States with the highest contributions. 84% of CO_2 emissions are reported by France; Other fuel consumption in the EU-28 increased by 21%

between 1990 and 2014. The CO_2-implied emission factor for other fossil fuels was 53.2 t/TJ in 2014.

Figure 3.49 1A2c Chemicals, Other fossil fuels: Emission trend and share for CO_2

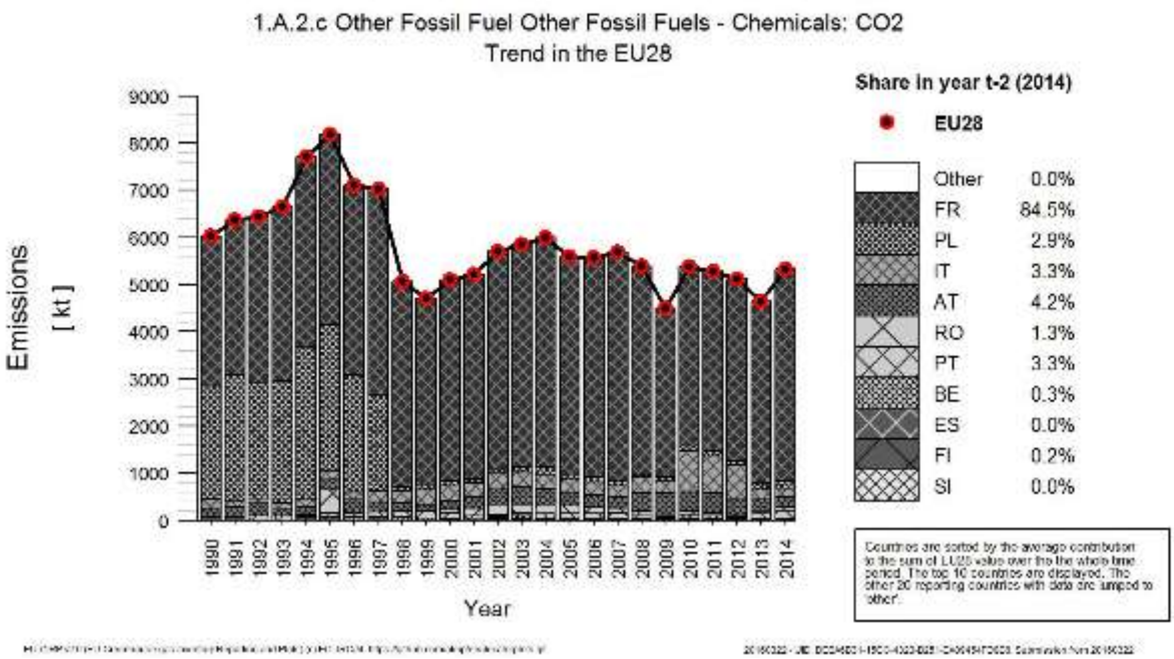
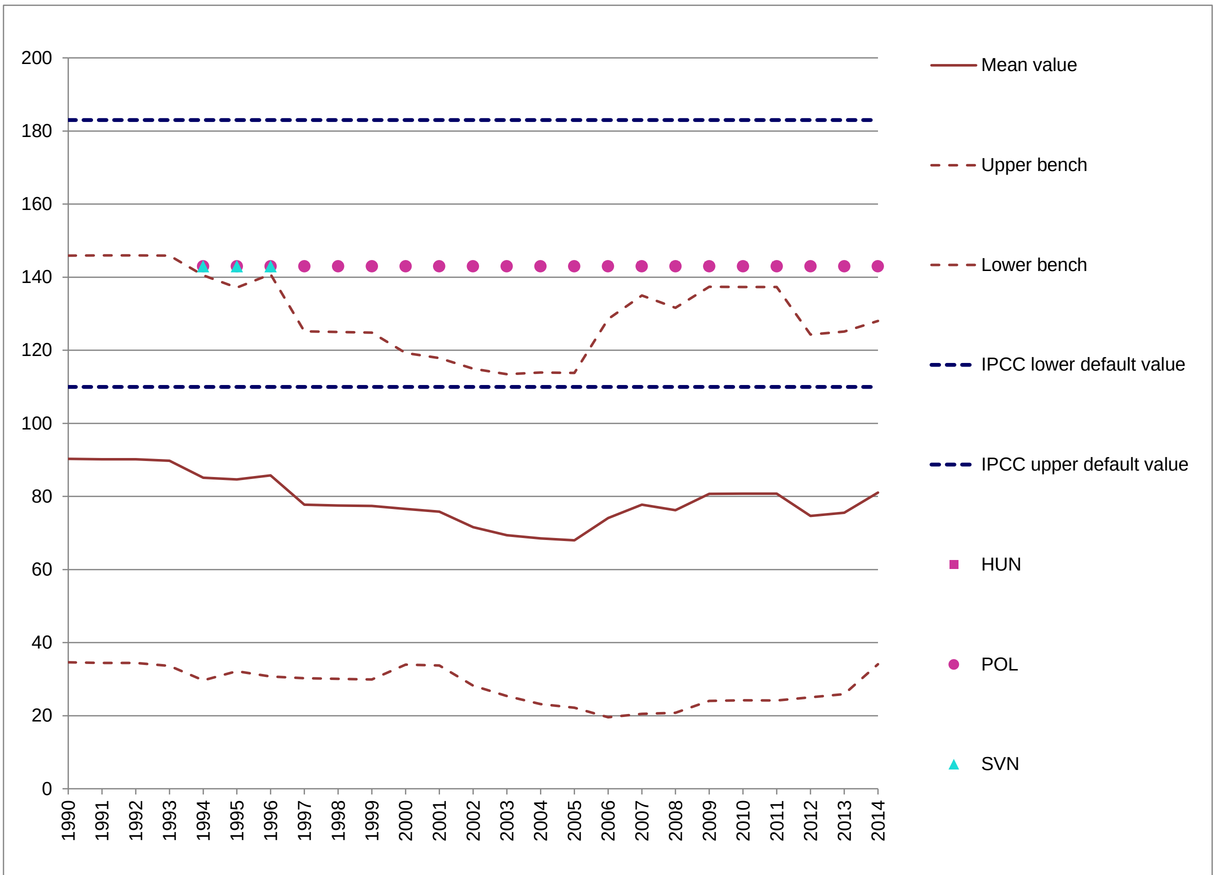


Figure 3.50: 1A2c Chemicals, Other fossil fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



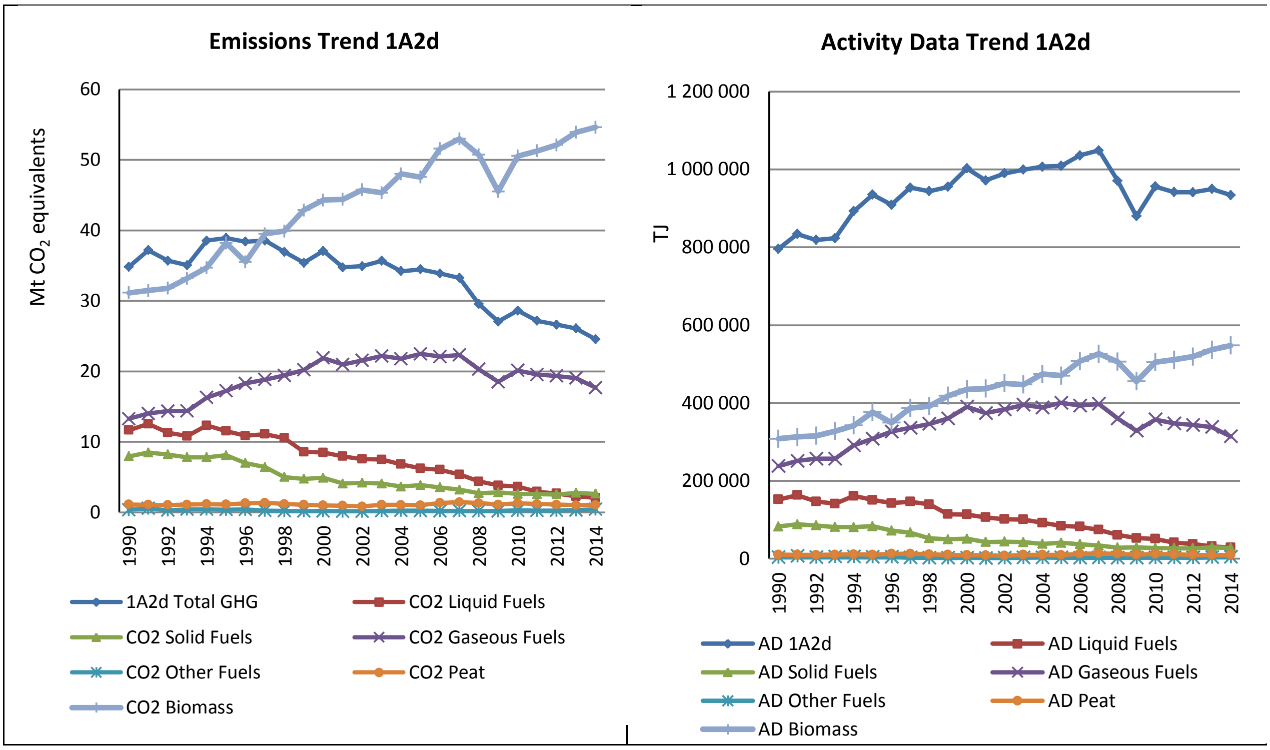
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 2014.

Figure 3.51 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous fuels. Total GHG emissions decreased by 30%. 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 3.51 1A2d Pulp, Paper and Print: Total and CO_2 emission trends



Between 1990 and 2014, CO_2 emissions from 1A2d Pulp, Paper and Print decreased by 31% (Table 3.32), mainly due to decreases in the Czech Republic, Finland, France, Sweden, Slovakia and the UK. Between 2013 and 2014 emissions decreased by 6%. Between 1990 and 1999 Luxembourg reported emissions as included elsewhere and between 1990 to 2000 Croatia and from 1990 onwards Malta reported emissions as ‘Included elsewhere’.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	2 214	1 479	1 362	6%	-117	-8%	-851	-38%
Belgium	644	531	602	3%	70	13%	-42	-7%
Bulgaria	16	123	113	0%	-10	-8%	98	628%
Croatia	NO,IE	113	137	1%	24	21%	137	100%
Cyprus	5	3	3	0%	0	4%	-2	-35%
Czech Republic	2 285	463	413	2%	-50	-11%	-1 872	-82%
Denmark	342	151	143	1%	-8	-5%	-199	-58%
Estonia	NO	4	4	0%	-1	-15%	4	100%
Finland	5 330	2 803	2 721	11%	-82	-3%	-2 609	-49%
France	4 856	2 925	2 669	11%	-256	-9%	-2 187	-45%
Germany	4	8	7	0%	-1	-8%	3	96%
Greece	306	138	133	1%	-5	-4%	-173	-56%
Hungary	84	193	196	1%	3	1%	112	134%
Ireland	28	16	15	0%	-1	-6%	-14	-48%
Italy	3 077	4 263	4 146	17%	-117	-3%	1 069	35%
Latvia	168	6	6	0%	0	2%	-162	-97%
Lithuania	256	43	27	0%	-17	-39%	-229	-90%
Luxembourg	NO,IE	12	10	0%	-2	-15%	10	100%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	1 669	1 009	1 009	4%	0	0%	-659	-40%
Poland	285	1 586	1 595	7%	10	1%	1 310	460%
Portugal	746	983	1 001	4%	18	2%	255	34%
Romania	NO	97	123	1%	26	27%	123	100%
Slovakia	2 329	426	480	2%	53	13%	-1 850	-79%
Slovenia	380	334	324	1%	-10	-3%	-56	-15%
Spain	2 548	4 708	3 853	16%	-855	-18%	1 305	51%
Sweden	2 187	890	710	3%	-180	-20%	-1 477	-68%
United Kingdom	4 612	2 087	2 066	9%	-20	-1%	-2 546	-55%
EU-28	**34 370**	**25 395**	**23 869**	**100%**	**-1 526**	**-6%**	**-10 501**	**-31%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**34 370**	**25 395**	**23 869**	**100%**	**-1 526**	**-6%**	**-10 501**	**-31%**

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

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

In 2014 CO_2 from liquid fuels had a share of 8% within source category 1A2d (compared to 33% in 1990). Between 1990 and 2014 the emissions decreased by 82% (Table 3.33). Between 1990 and 2014 all Member States reported decreasing CO_2 emissions from this source category except Luxembourg (emissions were IE in 1990) and Poland. The CO_2-implied emission factor for liquid fuels was 70.2 t/TJ in 2014.

Table 3.33 1A2d Pulp, Paper and Print, Liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	853	47	43	2%	-4	-9%	-810	-95%	-	-
Belgium	235	99	85	4%	-13	-13%	-149	-64%	T1	D
Bulgaria	16	6	12	1%	6	100%	-3	-20%	T1	D
Croatia	IE	12	12	1%	0	1%	12	100%	T1	D
Cyprus	5	3	3	0%	0	4%	-2	-35%	T1	D
Czech Republic	461	19	3	0%	-16	-83%	-458	-99%	T1	CS,D
Denmark	83	2	0	0%	-2	-96%	-83	-100%	T1,T2	CS,D
Estonia	NO	1	1	0%	0	11%	1	100%	T1,T2	CS,D
Finland	1 138	304	302	15%	-1	0%	-835	-73%	T3	CS
France	1 677	141	112	5%	-29	-21%	-1 565	-93%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	302	82	67	3%	-16	-19%	-236	-78%	T2	CS
Hungary	28	12	12	1%	0	0%	-16	-56%	T1	D
Ireland	28	9	8	0%	-1	-14%	-21	-73%	T2	CS
Italy	1 016	188	172	8%	-16	-8%	-844	-83%	T2	CS
Latvia	16	NO	0	0%	0	100%	-15	-97%	T2	CS
Lithuania	69	0	0	0%	0	20%	-68	-99%	T2	CS
Luxembourg	IE	0	0	0%	0	-16%	0	100%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	2	NO	NO	-	-	-	-2	-100%	NA	NA
Poland	105	143	117	6%	-26	-18%	12	11%	T1	D
Portugal	746	149	178	9%	29	19%	-568	-76%	T2	CR,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	985	1	2	0%	0	32%	-983	-100%	T2	CS
Slovenia	98	4	3	0%	-2	-35%	-95	-97%	T1	D
Spain	1 227	235	322	16%	88	37%	-905	-74%	T2	CS,PS
Sweden	1 786	786	580	28%	-206	-26%	-1 206	-68%	T2	CS
United Kingdom	782	16	16	1%	0	2%	-766	-98%	T2	CS
EU-28	**11 656**	**2 259**	**2 051**	**100%**	**-209**	**-9%**	**-9 605**	**-82%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**11 656**	**2 259**	**2 051**	**100%**	**-209**	**-9%**	**-9 605**	**-82%**		

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

Figure 3.52 and Figure 3.53 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest contributions are reported by Finland, Italy, Portugal, Spain and Sweden; together they cause 76% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-28 decreased by 81% between 1990 and 2014. The implied CO_2 emission factors are mostly within the range of the IPCC lower and upper limits. For the Netherlands the interannual variation in the IEFs for liquid fuels is due to variable shares of derived gases and LPG. The CO_2-implied emission factor for liquid fuels was 70.2 t/TJ in 2014.

Figure 3.52 1A2d Pulp, Paper and Print, Liquid fuels: Emission trend and share for CO_2

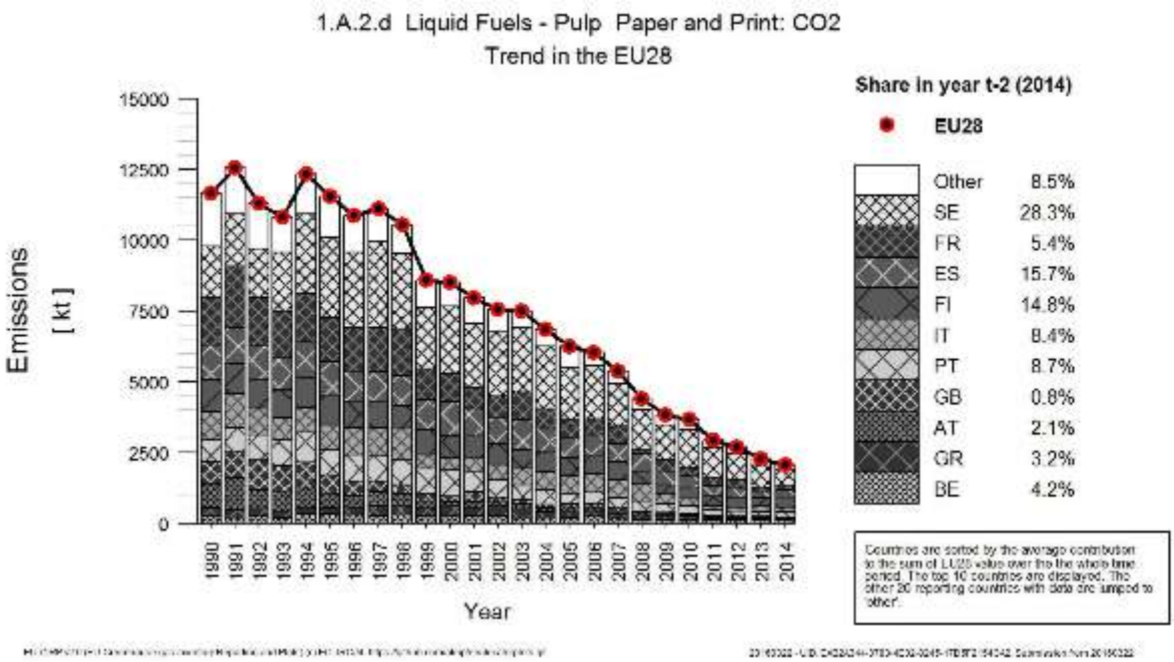
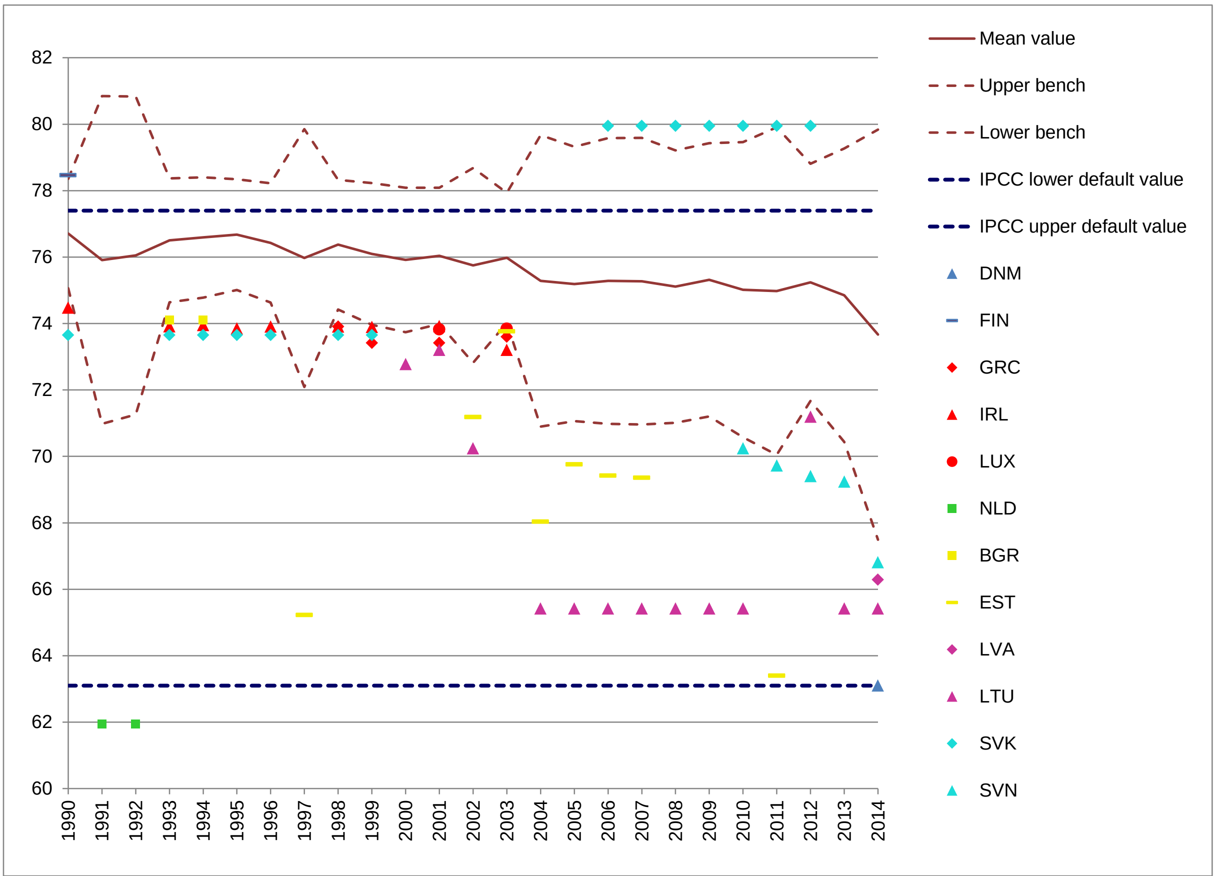


Figure 3.53: 1A2d Pulp, Paper and Print, Liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014 CO_2 from solid fuels had a share of 11% within source category 1A2d (compared to 23% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 67% (Table 3.34). Only eleven of the EU-28+ISL Member States reported CO_2 emissions from this source category in 2014. All Member States reported decreasing emissions except Poland and Bulgaria. For confidentiality reasons Sweden reports emissions from peat and solid fuels together with other solid fuels.

Table 3.34 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	398	369	361	14%	-8	-2%	-37	-9%	-	-
Belgium	128	100	96	4%	-4	-4%	-31	-25%	T1	D
Bulgaria	NO	3	4	0%	1	23%	4	100%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 646	175	146	6%	-30	-17%	-1 500	-91%	T2	CS,D
Denmark	125	NO	NO	-	-	-	-125	-100%	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 318	49	33	1%	-16	-32%	-1 284	-97%	T3	CS
France	848	305	128	5%	-177	-58%	-719	-85%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	4	NO	NO	-	-	-	-4	-100%	NA	NA
Hungary	6	NO	NO	-	-	-	-6	-100%	NA	NA
Ireland	NO	0	0	0%	0	-100%	0	0%	T2	CS
Italy	6	NO	NO	-	-	-	-6	-100%	NA	NA
Latvia	3	NO	NO	-	-	-	-3	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	8	NO	NO	-	-	-	-8	-100%	NA	NA
Poland	174	1 086	1 068	41%	-17	-2%	894	513%	T1,T2	CS,D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	1 142	235	319	12%	84	36%	-823	-72%	T2	CS
Slovenia	172	134	132	5%	-3	-2%	-40	-23%	T3	PS
Spain	272	NO	NO	-	-	-	-272	-100%	NA	NA
Sweden	IE	C	C	-	-	-	-	-	T2	CS
United Kingdom	1 708	308	341	13%	33	11%	-1 366	-80%	T2	CS
EU-28	**7 956**	**2 766**	**2 630**	**100%**	**-136**	**-5%**	**-5 326**	**-67%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**7 956**	**2 766**	**2 630**	**100%**	**-136**	**-5%**	**-5 326**	**-67%**		

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 3.54 and Figure 3.55 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest contributions are reported by Austria, Slovakia, Poland and the United Kingdom; together they cause around 79% of CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption decreased by 66% between 1990 and 2014. The CO_2-implied emission factor for solid fuels was 94.1 t/TJ in 2014.

Figure 3.54 1A2d Pulp, Paper and Print, Solid fuels: Emission trend and share for CO_2

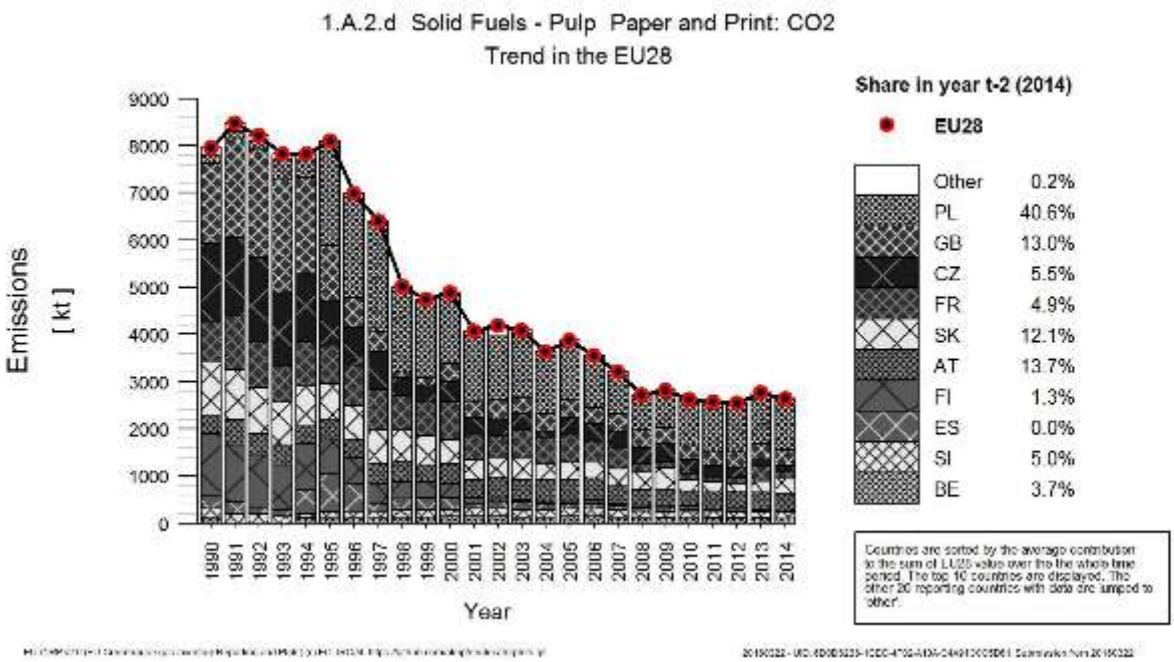
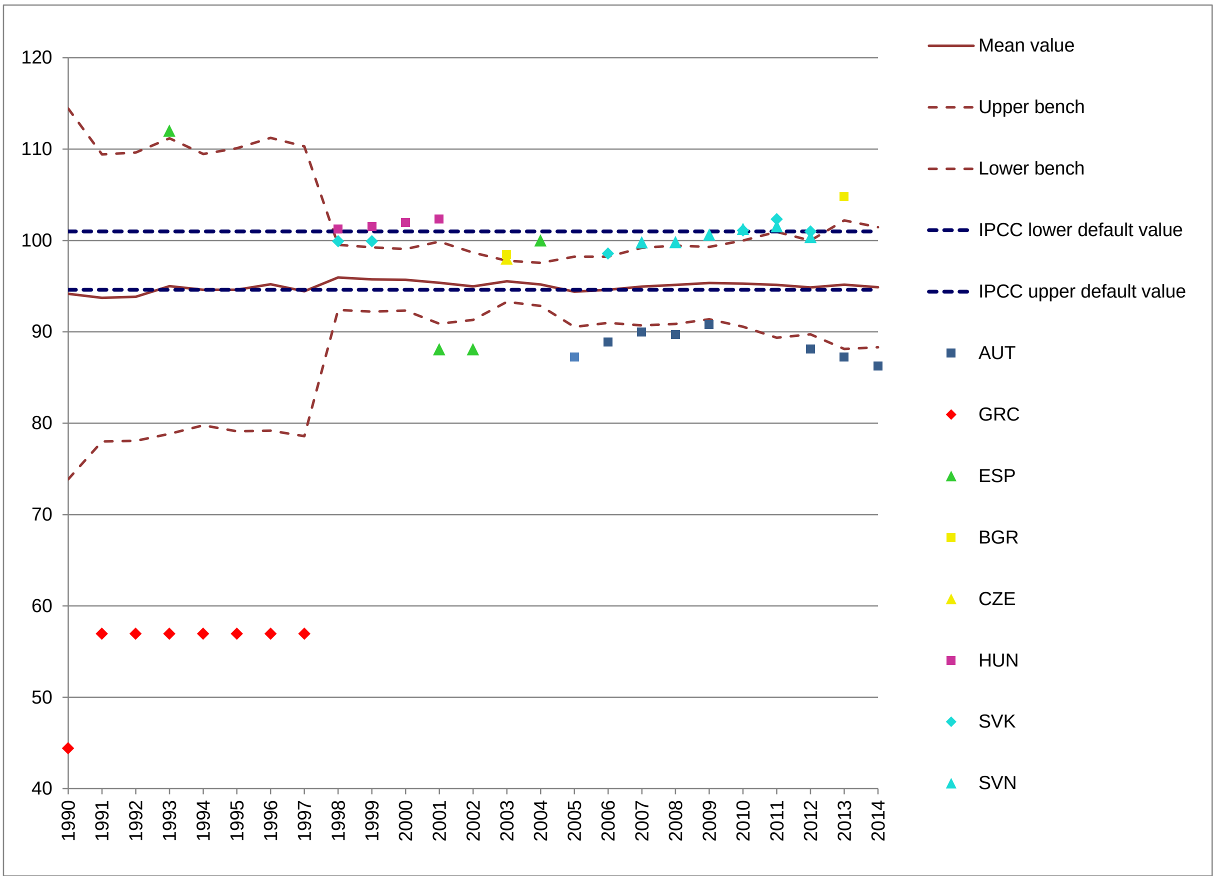


Figure 3.55: 1A2d Pulp, Paper and Print, Solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014, CO_2 from gaseous fuels had a share of 72% within source category 1A2d (compared to 38% in 1990). Between 1990 and 2014, the emissions increased by 33% (Table 3.35). Germany and Malta include emissions in 1A2g.

Table 3.35 1A2d Pulp, Paper and Print, Gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	943	1 041	935	5%	-106	-10%	-7	-1%	-	-
Belgium	282	240	312	2%	72	30%	30	11%	T1	D
Bulgaria	NO	113	97	1%	-17	-15%	97	100%	T2	CS
Croatia	IE	102	126	1%	24	24%	126	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	179	269	264	1%	-5	-2%	86	48%	T2	CS
Denmark	134	149	143	1%	-6	-4%	9	7%	T3	CS
Estonia	NO	4	3	0%	-1	-20%	3	100%	T2	CS
Finland	1 757	1 398	1 235	7%	-163	-12%	-522	-30%	T3	CS
France	2 331	2 461	2 364	13%	-97	-4%	33	1%	-	-
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	56	67	0%	11	19%	67	100%	T2	CS
Hungary	50	181	183	1%	3	2%	133	267%	T1	D
Ireland	NO	7	7	0%	0	5%	7	100%	T2	CS
Italy	2 055	4 076	3 974	22%	-101	-2%	1 919	93%	T2	CS
Latvia	149	6	5	0%	0	-5%	-144	-96%	T2	CS
Lithuania	187	43	26	0%	-17	-39%	-161	-86%	T2	CS
Luxembourg	IE	12	10	0%	-2	-15%	10	100%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 659	1 009	1 009	6%	0	0%	-649	-39%	T2	CS
Poland	6	352	392	2%	41	12%	387	6825%	T1	D
Portugal	NO	834	823	5%	-11	-1%	823	100%	T2	CR,D
Romania	NO	97	123	1%	26	27%	123	100%	T2	CS
Slovakia	203	128	131	1%	4	3%	-71	-35%	T2	CS
Slovenia	110	195	189	1%	-5	-3%	80	73%	T2	CS
Spain	1 050	4 474	3 531	20%	-943	-21%	2 481	236%	T2	CS
Sweden	66	41	35	0%	-7	-16%	-31	-47%	T2	CS
United Kingdom	2 122	1 763	1 709	10%	-54	-3%	-413	-19%	T2	CS
EU-28	**13 281**	**19 048**	**17 695**	**100%**	**-1 353**	**-7%**	**4 414**	**33%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**13 281**	**19 048**	**17 695**	**100%**	**-1 353**	**-7%**	**4 414**	**33%**		

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

Figure 3.56 and Figure 3.57 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 73% of CO_2 emissions from gaseous fuels in 1A2d. Gaseous fuel consumption rose by 32%between 1990 and 2014. The CO_2-implied emission factor for gaseous fuels was 56.3 t/TJ in 2014.

Figure 3.56 1A2d Pulp, Paper and Print, Gaseous fuels: Emission trend and share for CO_2

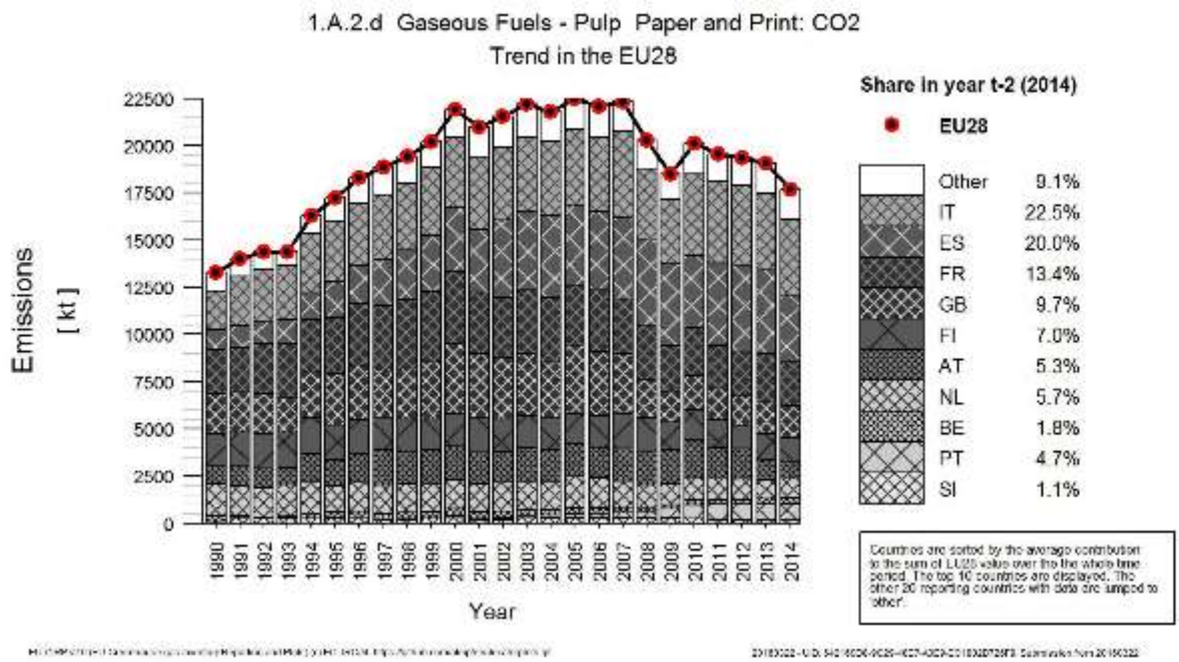
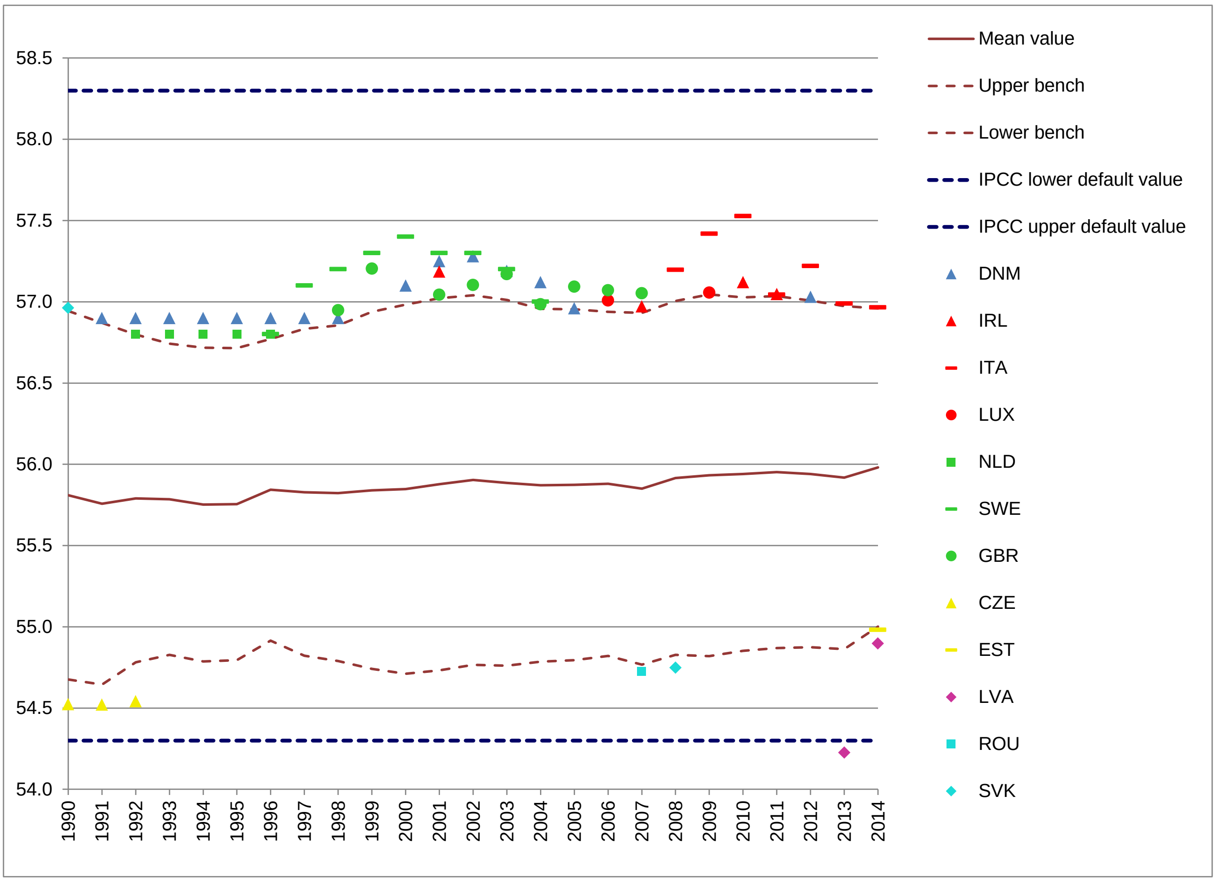


Figure 3.57: 1A2d Pulp, Paper and Print, Gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



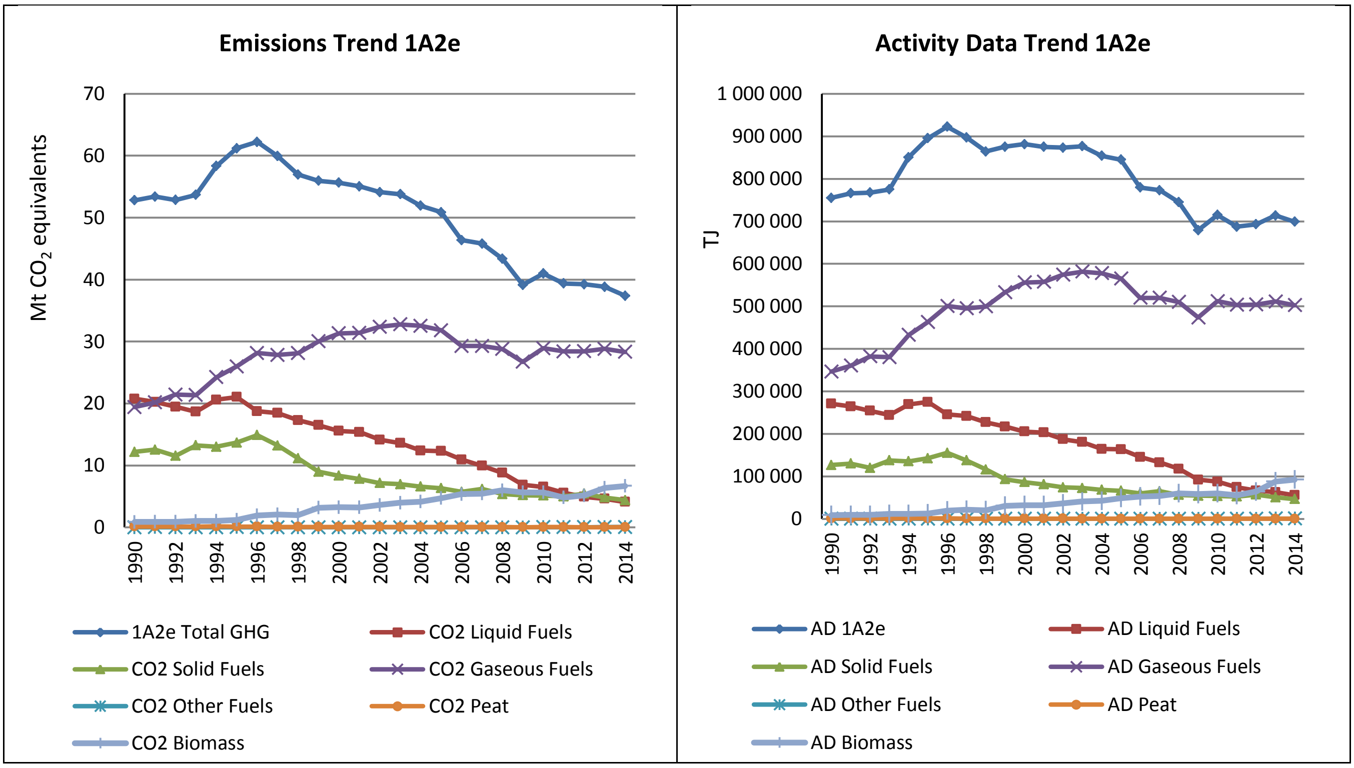
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.2.5 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. GHG emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 7.6% of 1A2 source category and for 0.9% of total GHG emissions in 2014.

Figure 3.58 shows the emission trend within the category 1A2e, which is dominated by CO_2 emissions from gaseous fuels. Total GHG emissions decreased by 29% between 1990 and 2014. Emissions from gaseous fuels increased by 46%, 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 solid fuels together with liquid fuels and also for confidentiality reasons Germany reports emissions from gaseous fuels under 1A2g

Figure 3.58 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2014, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco decreased by 29% in the EU-28+ISL (Table 3.36). Between 2013 and 2014 emissions decreased by 4%. Emissions of Malta are included in 1A2g.

Table 3.36 1A2e Food Processing, Beverages and Tobacco: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	870	933	911	2%	-22	-2%	42	5%
Belgium	3 023	2 256	2 208	6%	-48	-2%	-815	-27%
Bulgaria	454	289	256	1%	-33	-11%	-197	-43%
Croatia	NO,IE	388	411	1%	23	6%	411	100%
Cyprus	73	40	59	0%	19	47%	-14	-19%
Czech Republic	2 988	988	994	3%	6	1%	-1 994	-67%
Denmark	1 466	1 168	1 179	3%	11	1%	-287	-20%
Estonia	457	5	5	0%	0	-3%	-453	-99%
Finland	828	234	238	1%	4	2%	-590	-71%
France	9 014	8 207	7 025	19%	-1 182	-14%	-1 989	-22%
Germany	2 016	165	164	0%	-1	-1%	-1 852	-92%
Greece	917	568	646	2%	77	14%	-271	-30%
Hungary	2 022	671	712	2%	41	6%	-1 310	-65%
Ireland	1 017	865	795	2%	-69	-8%	-222	-22%
Italy	3 857	3 532	3 476	9%	-56	-2%	-381	-10%
Latvia	1 075	136	125	0%	-10	-8%	-950	-88%
Lithuania	677	280	248	1%	-32	-11%	-429	-63%
Luxembourg	8	14	12	0%	-2	-15%	4	45%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	4 076	3 277	3 482	9%	205	6%	-594	-15%
Poland	3 734	4 038	4 123	11%	84	2%	389	10%
Portugal	822	819	781	2%	-38	-5%	-41	-5%
Romania	123	818	849	2%	30	4%	725	587%
Slovakia	1 140	310	326	1%	17	5%	-814	-71%
Slovenia	221	87	105	0%	19	21%	-115	-52%
Spain	2 935	3 280	2 889	8%	-391	-12%	-45	-2%
Sweden	948	455	437	1%	-18	-4%	-511	-54%
United Kingdom	7 651	4 540	4 475	12%	-65	-1%	-3 175	-42%
EU-28	**52 413**	**38 366**	**36 933**	**100%**	**-1 432**	**-4%**	**-15 480**	**-30%**
Iceland	128	36	13	0%	-23	-64%	-115	-90%
EU-28 + ISL	**52 541**	**38 401**	**36 946**	**100%**	**-1 455**	**-4%**	**-15 595**	**-30%**

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

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

In 2014 CO_2 from liquid fuels decreased to a share of 11% within source category 1A2e (compared to 39% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 80% (Table 3.37). Between 1990 and 2014 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 3.37 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	345	186	157	4%	-28	-15%	-188	-54%	-	-
Belgium	1 689	293	259	6%	-34	-12%	-1 430	-85%	T1	D
Bulgaria	409	24	31	1%	6	26%	-379	-92%	T1	D
Croatia	IE	63	31	1%	-33	-52%	31	100%	T1	D
Cyprus	73	40	59	1%	19	47%	-14	-19%	T1	D
Czech Republic	472	12	12	0%	0	-1%	-460	-97%	T1	CS,D
Denmark	601	225	208	5%	-17	-8%	-393	-65%	T1,T2	CS,D
Estonia	438	1	1	0%	1	62%	-436	-100%	T1,T2	CS,D
Finland	365	88	85	2%	-2	-3%	-280	-77%	T3	CS
France	3 580	942	560	14%	-382	-41%	-3 020	-84%	-	-
Germany	908	13	10	0%	-3	-24%	-898	-99%	CS	CS
Greece	863	418	483	12%	66	16%	-379	-44%	T2	CS
Hungary	597	36	45	1%	9	25%	-552	-92%	T1	D
Ireland	433	406	345	8%	-61	-15%	-88	-20%	T1,T2	CS,D
Italy	1 423	120	163	4%	42	35%	-1 260	-89%	T2	CS
Latvia	798	33	26	1%	-7	-21%	-772	-97%	T1,T2	CS,D
Lithuania	174	37	38	1%	1	1%	-137	-78%	T2	CS
Luxembourg	4	2	2	0%	0	-16%	-2	-57%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	232	NO	NO	-	-	-	-232	-100%	NA	NA
Poland	231	283	252	6%	-32	-11%	20	9%	T1	D
Portugal	821	307	263	6%	-44	-14%	-558	-68%	T2	CR,D
Romania	NO	110	109	3%	0	0%	109	100%	T1,T2	CS,D
Slovakia	359	1	0	0%	0	-20%	-358	-100%	T2	CS
Slovenia	146	31	28	1%	-3	-9%	-117	-81%	T1	D
Spain	2 198	349	437	11%	88	25%	-1 761	-80%	T2	CS
Sweden	686	236	218	5%	-19	-8%	-469	-68%	T2	CS
United Kingdom	2 793	340	267	6%	-73	-22%	-2 526	-90%	T2	CS
EU-28	**20 638**	**4 598**	**4 089**	**100%**	**-508**	**-11%**	**-16 549**	**-80%**		
Iceland	128	36	13	0%	-23	-64%	-115	-90%	T1	D
EU-28 + ISL	**20 766**	**4 634**	**4 102**	**100%**	**-531**	**-11%**	**-16 664**	**-80%**		

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

Figure 3.59 and Figure **3.59** shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Spain, Greece and Ireland; together they cause 36% of CO_2 emissions from liquid fuels in 1A2e. Fuel consumption decreased by 79% between 1990 and 2014. The CO_2-implied emission factor for liquid fuels was 73.5 t/TJ in 2014.

Figure 3.59 1A2e Food Processing, Beverages and Tobacco, Liquid fuels: Emission trend and share for CO_2

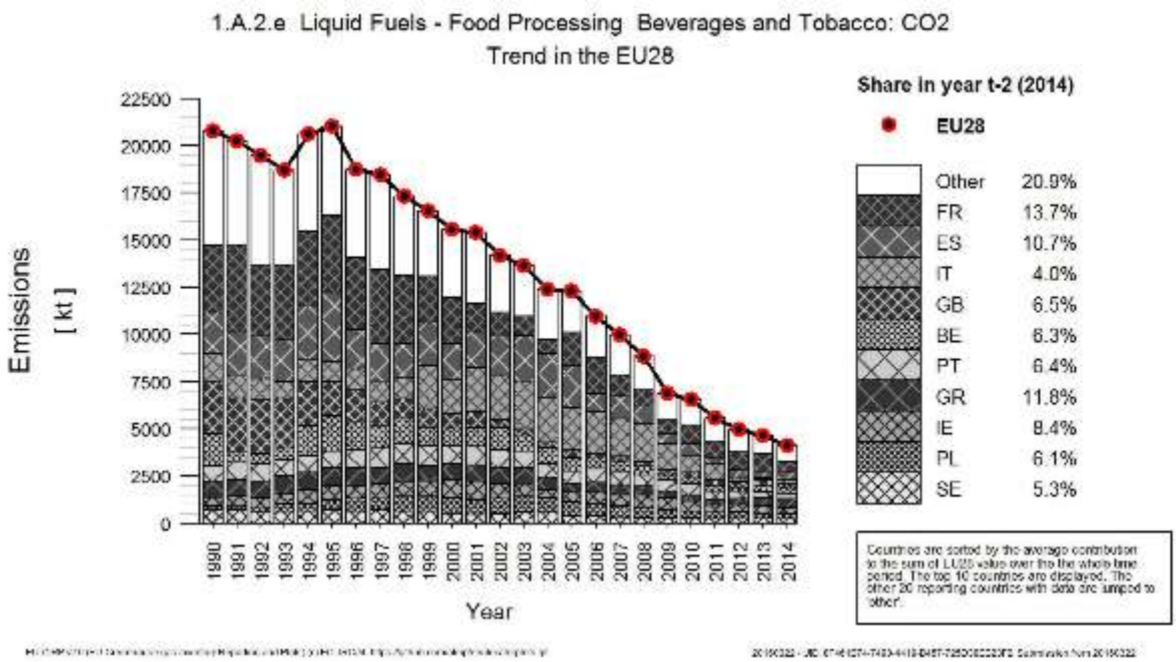
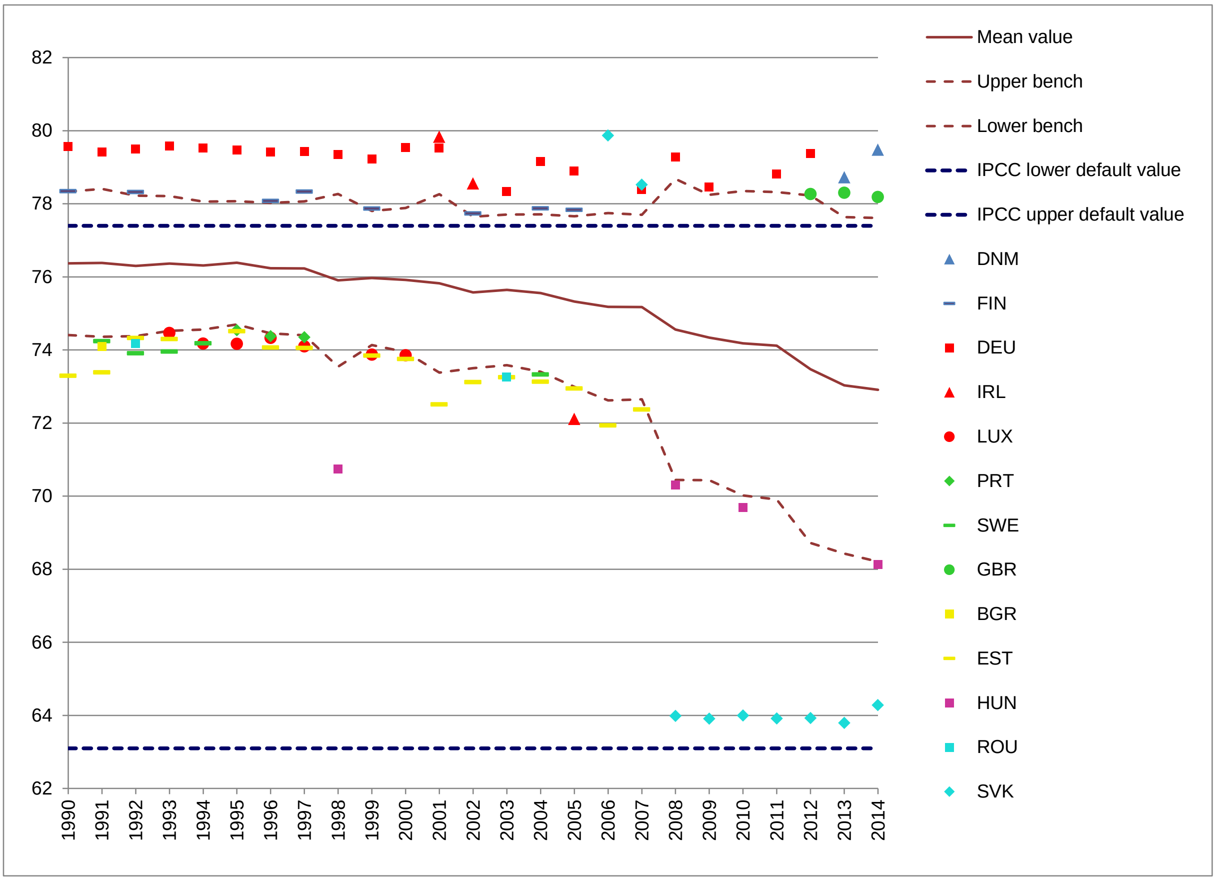


Figure 3.60: 1A2e Food Processing, Beverages and Tobacco, Liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014 solid fuels had a share of 7% within source category 1A2e (compared to 23% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 64% (Table 3.38) 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 3.38 1A2e Food Processing, Beverages and Tobacco, Solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	18	16	19	0%	3	19%	1	4%	-	-
Belgium	651	97	102	2%	5	5%	-549	-84%	T1	D
Bulgaria	33	10	4	0%	-6	-60%	-29	-87%	T1,T2	CS,D
Croatia	IE	70	74	2%	4	6%	74	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 789	201	192	4%	-9	-4%	-1 597	-89%	T2	CS,D
Denmark	402	182	209	5%	27	15%	-192	-48%	T1	D
Estonia	5	0	0	0%	0	-51%	-4	-98%	T1,T2	CS,D
Finland	257	94	94	2%	0	0%	-163	-63%	T3	CS
France	1 776	1 132	550	13%	-582	-51%	-1 226	-69%	-	-
Germany	1 108	152	154	4%	2	1%	-954	-86%	CS	CS
Greece	54	5	6	0%	1	15%	-48	-89%	T2	PS
Hungary	185	10	9	0%	-1	-6%	-175	-95%	T1,T2	CS,D
Ireland	292	82	84	2%	1	2%	-208	-71%	T2	CS
Italy	88	49	22	1%	-27	-55%	-65	-74%	T2	CS
Latvia	103	2	2	0%	0	-4%	-101	-98%	T1	D
Lithuania	33	11	12	0%	1	9%	-21	-63%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	227	75	97	2%	22	29%	-131	-57%	T2	CS
Poland	3 392	2 382	2 464	56%	82	3%	-929	-27%	T1,T2	CS,D
Portugal	1	NO	NO	-	-	-	-1	-100%	NA	NA
Romania	123	34	35	1%	1	4%	-88	-72%	T1	D
Slovakia	312	38	40	1%	1	4%	-272	-87%	T2	CS
Slovenia	9	NO	NO	-	-	-	-9	-100%	NA	NA
Spain	92	32	33	1%	0	1%	-60	-65%	T2	CS
Sweden	IE	C	C	-	-	-	-	-	T2	CS
United Kingdom	1 254	163	187	4%	23	14%	-1 067	-85%	T2	CS
EU-28	**12 203**	**4 839**	**4 388**	**100%**	**-451**	**-9%**	**-7 815**	**-64%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**12 203**	**4 839**	**4 388**	**100%**	**-451**	**-9%**	**-7 815**	**-64%**		

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

Figure 3.61 and Figure 3.62 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland and France which contribute 67% of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption decreased by 53% between 1990 and 2014.The CO_2-implied emission factor for solid fuels was 93.9 t/TJ in 2014.

Figure 3.61   1A2e Food Processing, Beverages and Tobacco, solid fuels: Emission trend and share for CO_2

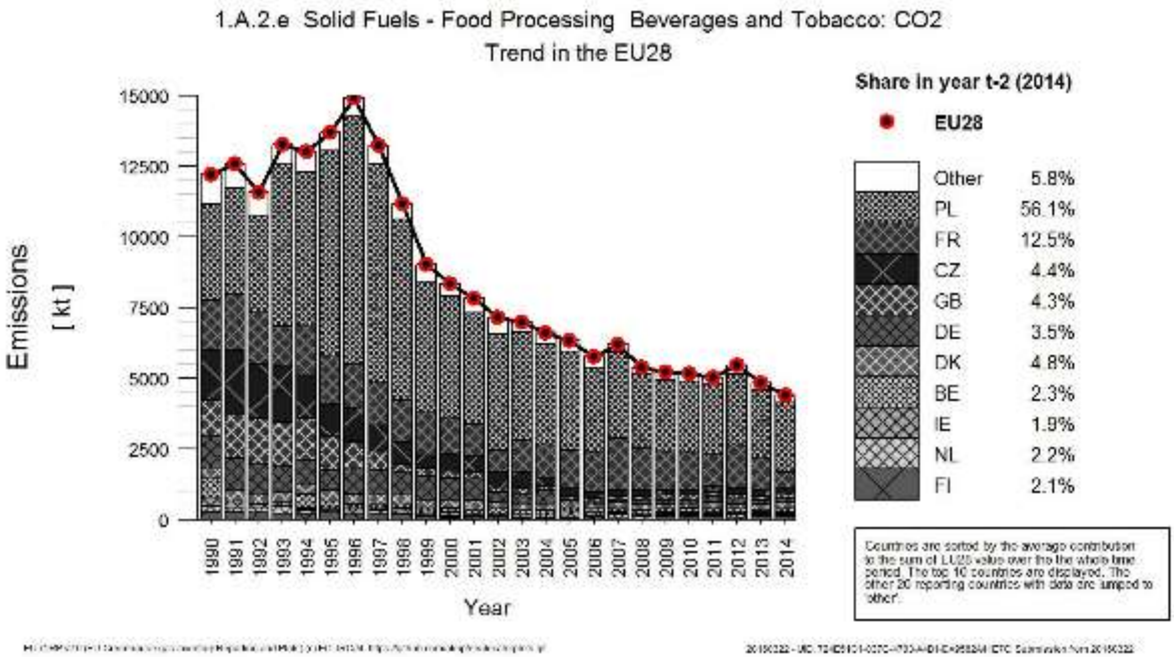
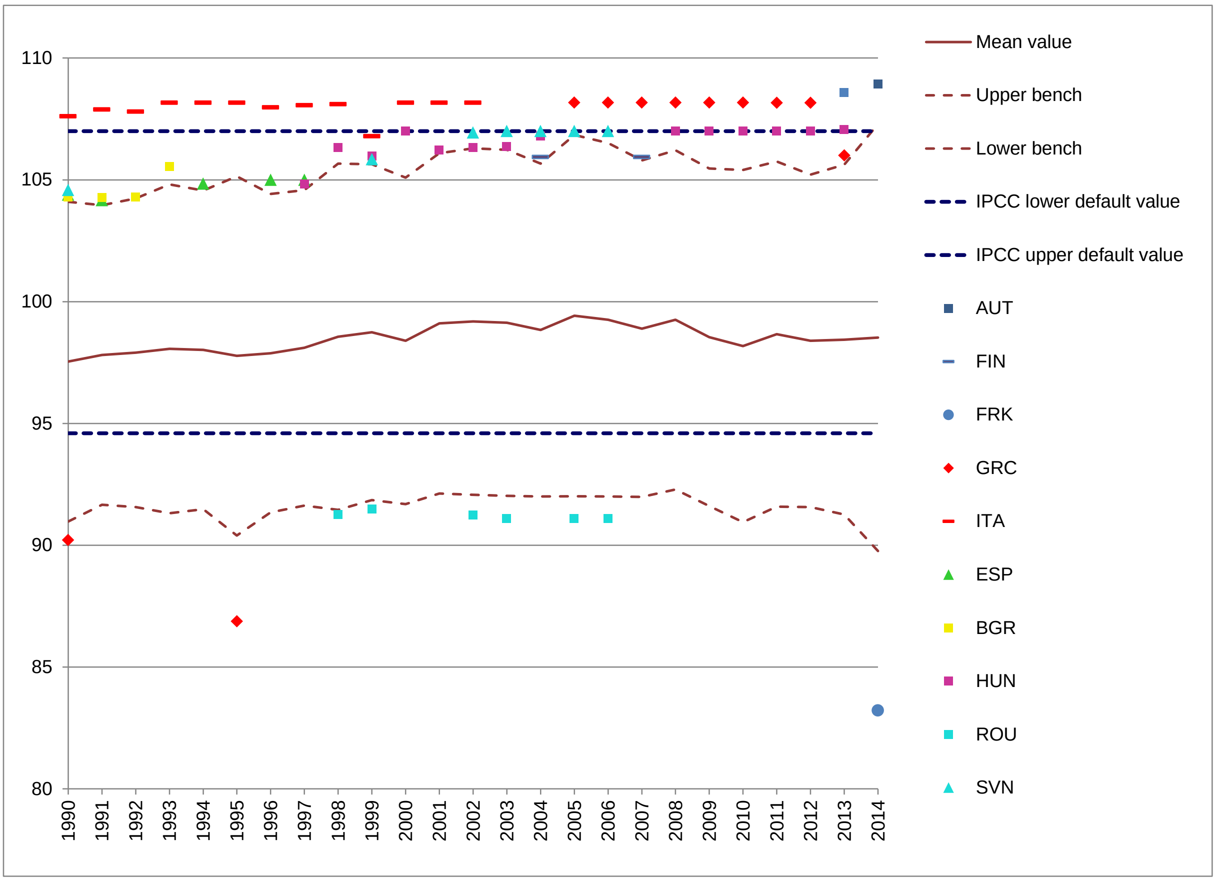


Figure 3.62: 1A2e Food Processing, Beverages and Tobacco, Solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014 CO_2 from gaseous fuels had a share of 76% within source category 1A2e (compared to 37% in 1990). Between 1990 and 2014 CO_2 emissions increased by 46% (Table 3.39). Between 1990 and 2014 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 3.39 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	507	732	735	3%	3	0%	228	45%	-	-
Belgium	684	1 866	1 847	7%	-19	-1%	1 163	170%	T1,T3	D,PS
Bulgaria	11	254	222	1%	-33	-13%	210	1838%	T2	CS
Croatia	IE	255	307	1%	52	20%	307	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	727	775	790	3%	15	2%	63	9%	T2	CS
Denmark	463	760	761	3%	2	0%	298	64%	T3	CS
Estonia	15	4	3	0%	-1	-17%	-12	-80%	T2	CS
Finland	67	15	14	0%	-1	-7%	-53	-79%	T3	CS
France	3 658	6 124	5 883	21%	-241	-4%	2 225	61%	-	-
Germany	C	C	C	-	-	-	-	-	CS	CS
Greece	NO	146	157	1%	11	8%	157	100%	T2	CS
Hungary	1 239	625	658	2%	32	5%	-582	-47%	T1	D
Ireland	293	375	364	1%	-11	-3%	71	24%	T2	CS
Italy	2 347	3 363	3 291	12%	-72	-2%	945	40%	T2	CS
Latvia	174	98	95	0%	-3	-3%	-79	-46%	T2	CS
Lithuania	469	231	197	1%	-34	-15%	-272	-58%	T2	CS
Luxembourg	4	12	10	0%	-2	-15%	6	162%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	3 617	3 202	3 385	12%	183	6%	-232	-6%	T2	CS
Poland	111	1 373	1 408	5%	35	3%	1 297	1174%	T1	D
Portugal	NO	513	518	2%	6	1%	518	100%	T2	CR,D
Romania	NO	626	669	2%	44	7%	669	100%	T2	CS
Slovakia	470	271	286	1%	15	6%	-184	-39%	T2	CS
Slovenia	65	56	77	0%	21	38%	12	18%	T2	CS
Spain	644	2 898	2 419	9%	-479	-17%	1 775	276%	T2	CS
Sweden	254	218	219	1%	1	0%	-35	-14%	T2	CS
United Kingdom	3 605	4 037	4 022	14%	-14	0%	418	12%	T2	CS
EU-28	**19 424**	**28 828**	**28 339**	**100%**	**-489**	**-2%**	**8 914**	**46%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**19 424**	**28 828**	**28 339**	**100%**	**-489**	**-2%**	**8 914**	**46%**		

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

Figure 3.63 and Figure 3.64 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 67% of CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption rose by 48% between 1990 and 2014. The CO_2-implied emission factor for gaseous fuels was 56.4 t/TJ in 2014.

Figure 3.63 1A2e Food Processing, Beverages and Tobacco, Gaseous fuels: Emission trend and share for CO_2

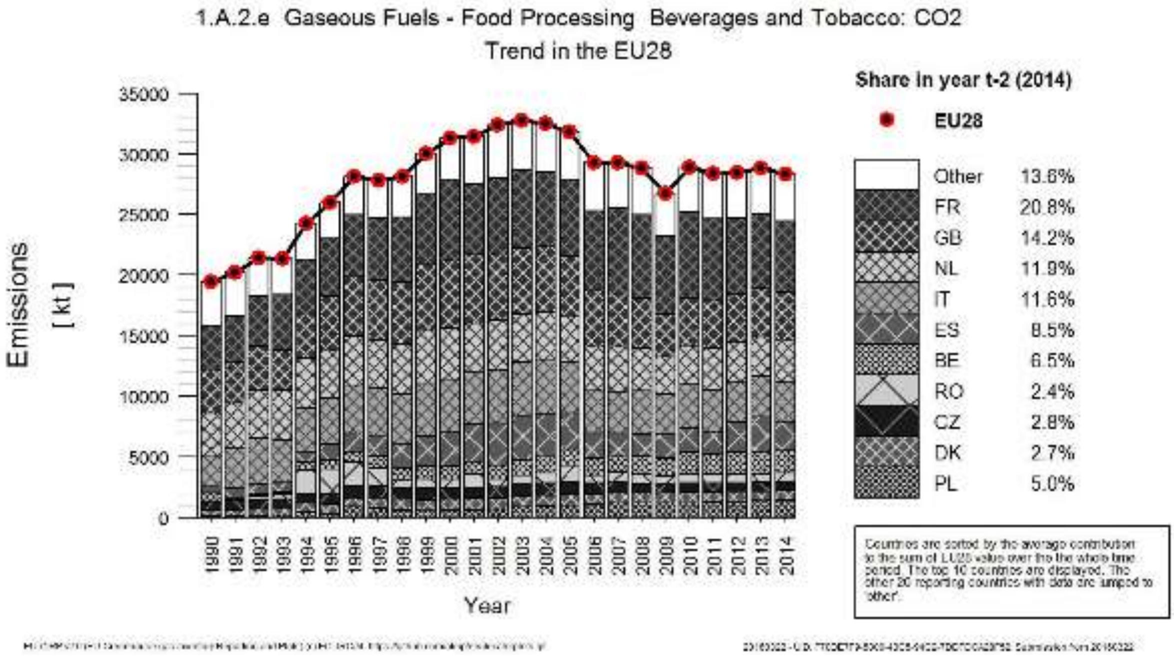
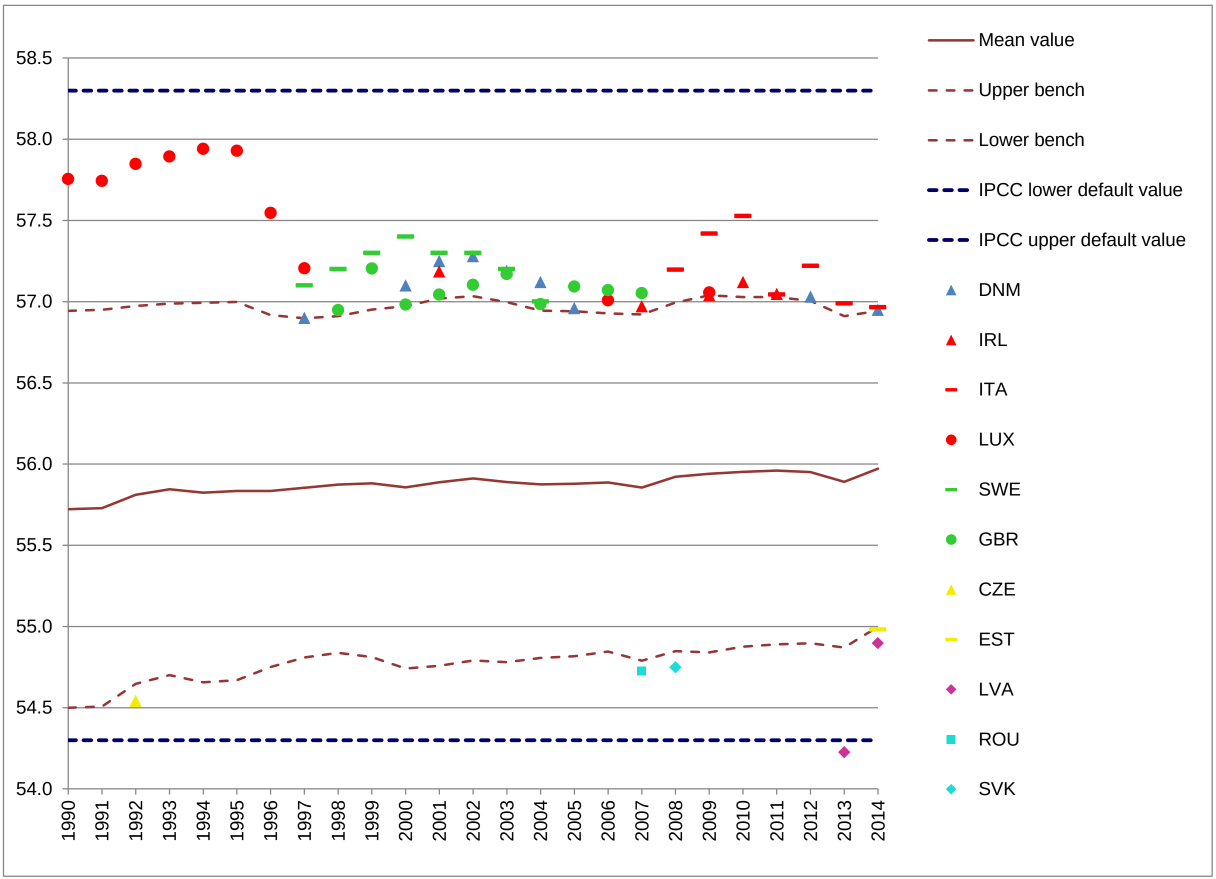


Figure 3.64: 1A2e Food Processing, Beverages and Tobacco, Gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



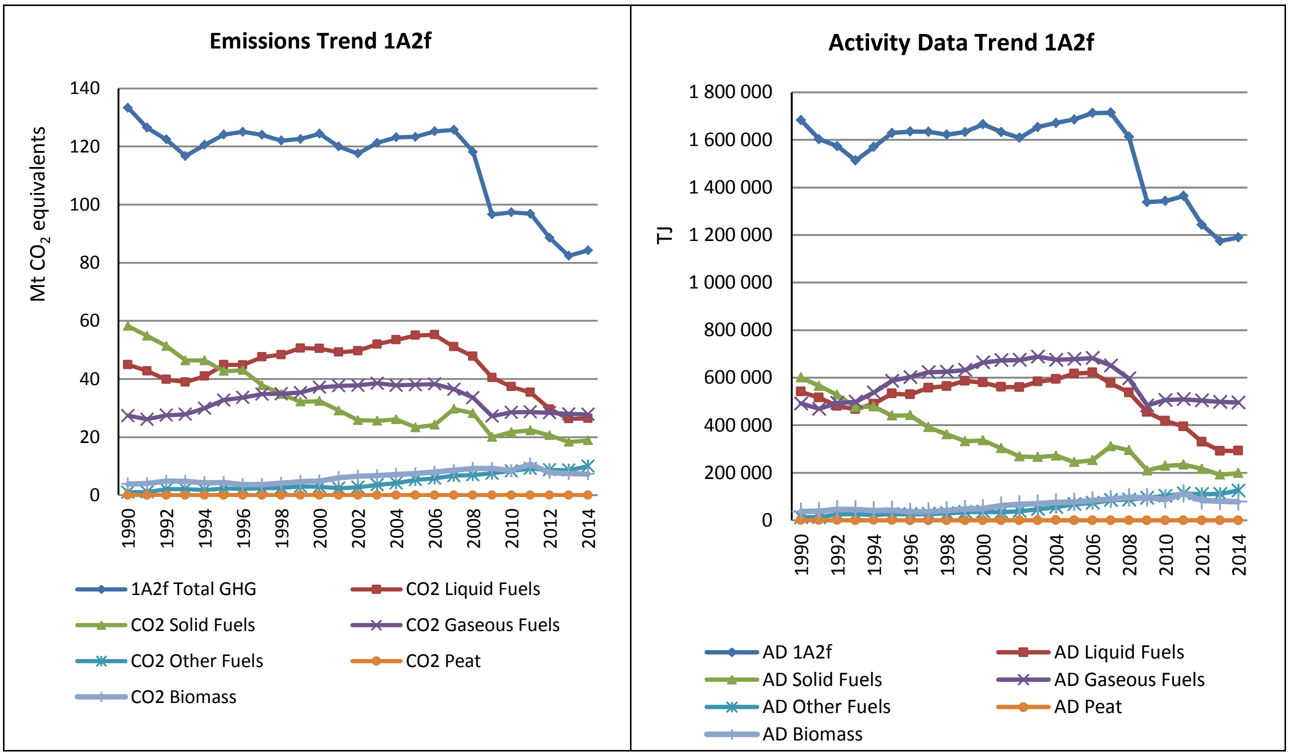
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.2.6 Non-metallic Minerals (1A2f)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2f by fuels. GHG emissions from 1A2f Non-metallic Minerals accounted for 17.1% for 1A2 source category and for 2% of total GHG emissions in 2014.

Figure 3.65 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 2014 total GHG emissions decreased by 37%, mainly due to decreases in CO_2 emissions from solid (-68%) and liquid (-41%) fuels while CO_2 emissions from other fossil fuels (non-renewable waste) increased by 839% and emissions of biomass (renewable waste) increased by 88%.

Figure 3.65 1A2f Non-metallic Minerals : Activity data and CO_2 emission trends



Between 1990 and 2014, CO_2 emissions from 1A2f Non-metallic Minerals decreased by 37% in the EU-28+ISL (Table 3.40), showing significant decreases for almost all Member States. Malta includes emissions in category 1A2g. For reasons of confidentiality Sweden reports emissions from biomass in 1A2g. Greece includes emissions from 1A2g under this category.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	1 669	1 552	1 613	2%	61	4%	-56	-3%
Belgium	5 525	3 686	3 658	4%	-28	-1%	-1 867	-34%
Bulgaria	2 649	1 245	1 254	2%	9	1%	-1 395	-53%
Croatia	NO,IE	97	107	0%	11	11%	107	100%
Cyprus	380	415	584	1%	168	41%	204	54%
Czech Republic	4 527	2 270	2 252	3%	-19	-1%	-2 275	-50%
Denmark	1 293	992	1 049	1%	56	6%	-244	-19%
Estonia	940	449	510	1%	61	14%	-429	-46%
Finland	1 368	631	591	1%	-40	-6%	-777	-57%
France	14 959	9 851	8 828	11%	-1 023	-10%	-6 131	-41%
Germany	18 507	12 672	12 307	15%	-365	-3%	-6 201	-34%
Greece	6 278	3 235	3 490	4%	256	8%	-2 788	-44%
Hungary	2 391	869	944	1%	75	9%	-1 448	-61%
Ireland	934	915	1 104	1%	190	21%	171	18%
Italy	21 225	13 563	14 106	17%	543	4%	-7 119	-34%
Latvia	604	310	321	0%	11	3%	-284	-47%
Lithuania	3 211	602	527	1%	-75	-13%	-2 684	-84%
Luxembourg	537	344	390	0%	46	13%	-147	-27%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	2 334	1 113	1 145	1%	32	3%	-1 189	-51%
Poland	10 433	7 250	7 897	9%	647	9%	-2 535	-24%
Portugal	3 211	2 798	2 974	4%	176	6%	-238	-7%
Romania	278	1 945	2 200	3%	255	13%	1 921	690%
Slovakia	3 236	1 232	1 366	2%	134	11%	-1 869	-58%
Slovenia	296	416	435	1%	18	4%	139	47%
Spain	15 920	9 293	9 800	12%	507	5%	-6 119	-38%
Sweden	1 826	1 178	1 313	2%	134	11%	-513	-28%
United Kingdom	7 069	2 367	2 433	3%	66	3%	-4 636	-66%
EU-28	**131 600**	**81 292**	**83 198**	**100%**	**1 905**	**2%**	**-48 403**	**-37%**
Iceland	52	0	0	0%	0	-13%	-52	-100%
EU-28 + ISL	**131 653**	**81 293**	**83 198**	**100%**	**1 905**	**2%**	**-48 455**	**-37%**

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

1A2f Other - Liquid Fuels (CO_2)

In 2014 CO_2 emissions from liquid fuels had a share of 32% within source category 1A2f (compared to 34% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 41% (Table 3.41). Between 1990 and 2014 the highest absolute decreases were achieved by France, Italy, Lithuania and Spain. Romania is the only member states which reports a significant increase in emissions from this source.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	510	169	157	1%	-13	-8%	-353	-69%	-	-
Belgium	1 509	528	379	1%	-148	-28%	-1 129	-75%	T1,T3	D,PS
Bulgaria	666	470	417	2%	-53	-11%	-249	-37%	T1	D
Croatia	IE	1	4	0%	3	305%	4	100%	T1	D
Cyprus	148	409	519	2%	110	27%	371	250%	CS	CS
Czech Republic	1 029	40	33	0%	-7	-18%	-996	-97%	T1	CS,D
Denmark	478	580	634	2%	54	9%	156	33%	T1,T2	CS,D
Estonia	140	1	3	0%	2	133%	-137	-98%	T1,T2	CS,D
Finland	437	301	251	1%	-49	-16%	-185	-42%	T3	CS
France	6 656	3 762	3 195	12%	-567	-15%	-3 462	-52%	-	-
Germany	2 663	1 167	703	3%	-464	-40%	-1 960	-74%	CS	CS
Greece	2 914	2 885	3 123	12%	238	8%	210	7%	T2	PS
Hungary	488	325	266	1%	-59	-18%	-222	-45%	T1,T2	CS,D
Ireland	312	505	581	2%	76	15%	269	86%	T1,T2	CS,D
Italy	11 367	6 635	7 113	27%	477	7%	-4 254	-37%	T2	CS
Latvia	274	22	20	0%	-2	-7%	-253	-93%	T2	CS
Lithuania	2 750	14	15	0%	1	10%	-2 735	-99%	T2	CS
Luxembourg	23	2	4	0%	2	108%	-19	-81%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	504	29	37	0%	8	27%	-468	-93%	T2	CS
Poland	392	247	175	1%	-73	-29%	-217	-55%	T1	D
Portugal	1 281	1 501	1 663	6%	162	11%	382	30%	T2,T3	CR,D,PS
Romania	NO	799	1 043	4%	244	30%	1 043	100%	T1,T2	CS,D
Slovakia	1 219	202	222	1%	20	10%	-997	-82%	T2	CS
Slovenia	63	150	157	1%	6	4%	93	148%	T1	D
Spain	8 366	4 929	5 273	20%	344	7%	-3 092	-37%	T2	CS,M
Sweden	625	432	365	1%	-67	-15%	-260	-42%	T1,T2	CS
United Kingdom	127	170	115	0%	-55	-32%	-12	-10%	T2	CS
EU-28	**44 942**	**26 276**	**26 468**	**100%**	**192**	**1%**	**-18 474**	**-41%**		
Iceland	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28 + ISL	**44 942**	**26 276**	**26 468**	**100%**	**192**	**1%**	**-18 474**	**-41%**		

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

Figure 3.66 and Figure **3.67** shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Greece, Spain and Italy; together they cause 71% of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption decreased by 46% between 1990 and 2014. The CO_2-implied emission factor for liquid fuels was 90.5 t/TJ in 2014. The high IEF is mainly due to the consumption of petrol coke in cement kilns.

Figure 3.66 1A2f Non-metallic Minerals, liquid fuels: Emission trend and share for CO_2

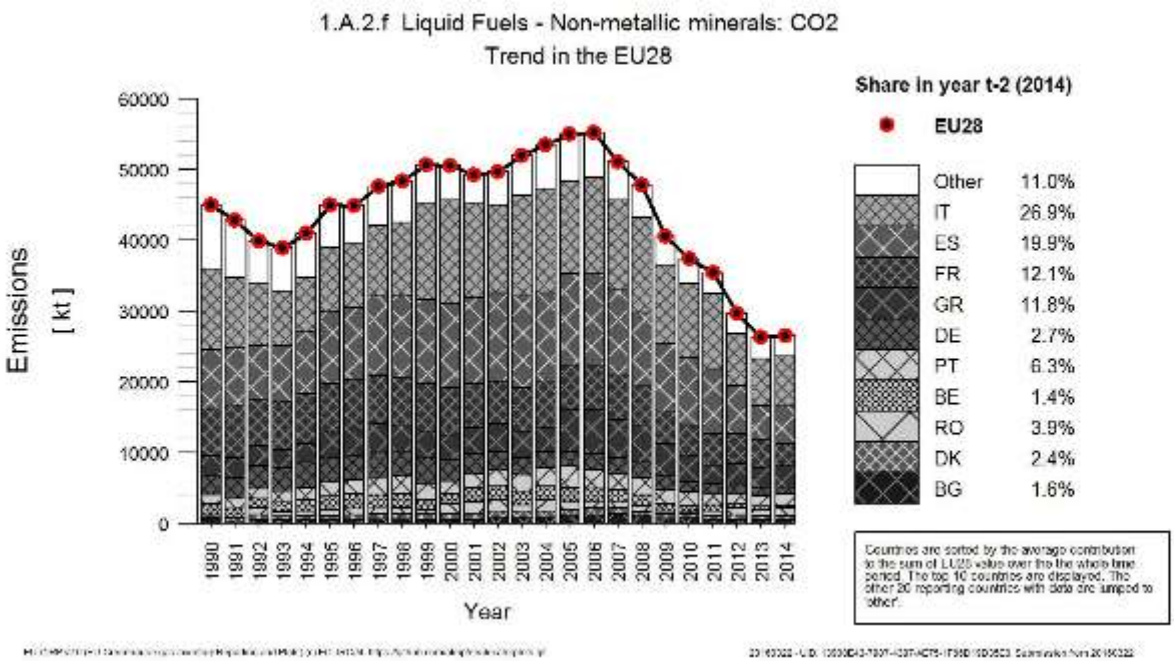
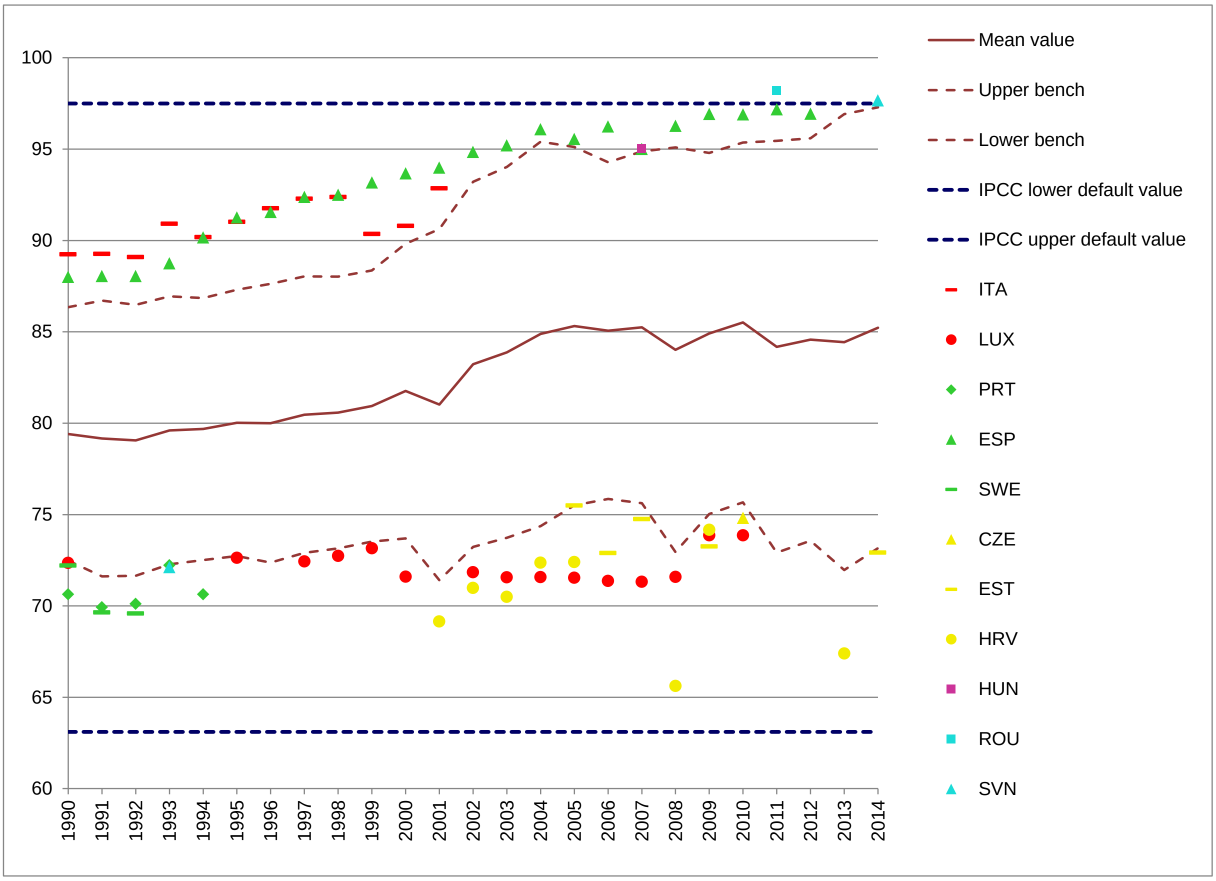


Figure 3.67: 1A2f Non-metallic Minerals, liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2f Non-metallic Minerals - Solid Fuels (CO_2)

In 2014 CO_2 from solid fuels had a share of 22% within source category 1A2f (compared to 44% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 68% (Table 3.42). Between 1990 and 2014 almost all Member States reported decreases of emissions; the highest absolute decreases were reported by Germany, Poland, Spain and the UK. Between 2013 and 2014 emissions increased by 3%.

Table 3.42 1A2f Non-metallic Minerals, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	535	262	278	1%	17	6%	-257	-48%	-	-
Belgium	2 466	1 582	1 720	9%	139	9%	-746	-30%	T1,T3	D,PS
Bulgaria	298	273	279	1%	6	2%	-19	-7%	T1,T2	CS,D
Croatia	IE	NO	NO	-	-	-	-	-	NA	NA
Cyprus	232	NO	9	0%	9	100%	-223	-96%	CS	CS
Czech Republic	2 209	807	678	4%	-129	-16%	-1 531	-69%	T2	CS,D
Denmark	574	141	144	1%	3	2%	-430	-75%	T1,T3	D,PS
Estonia	744	258	310	2%	52	20%	-433	-58%	T1,T2	CS,D
Finland	806	216	225	1%	9	4%	-581	-72%	T3	CS
France	4 164	2 209	1 838	10%	-371	-17%	-2 326	-56%	-	-
Germany	12 053	4 631	4 669	25%	38	1%	-7 384	-61%	CS	CS
Greece	3 364	211	230	1%	20	9%	-3 134	-93%	T2	PS
Hungary	230	75	112	1%	36	48%	-118	-51%	T1,T2	D,PS
Ireland	489	243	340	2%	97	40%	-149	-30%	T2	CS
Italy	3 947	1 041	1 219	6%	178	17%	-2 727	-69%	T2	CS
Latvia	16	123	119	1%	-4	-3%	102	622%	T1	D
Lithuania	60	532	455	2%	-77	-15%	395	663%	T2	CS
Luxembourg	312	157	170	1%	13	8%	-143	-46%	T1	D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	346	126	148	1%	22	17%	-198	-57%	T2	CS
Poland	8 653	2 539	2 888	15%	349	14%	-5 764	-67%	T1,T2	CS,D
Portugal	1 919	1	0	0%	0	-15%	-1 918	-100%	T2,T3	CR,D,PS
Romania	278	379	281	1%	-99	-26%	2	1%	T1,T2	CS,D
Slovakia	1 474	421	482	3%	60	14%	-993	-67%	T2	CS
Slovenia	113	72	70	0%	-2	-3%	-43	-38%	T1,T3	D,PS
Spain	5 126	145	126	1%	-19	-13%	-4 999	-98%	T2	CS
Sweden	1 135	570	599	3%	29	5%	-536	-47%	T2	CS
United Kingdom	6 630	1 349	1 467	8%	118	9%	-5 162	-78%	T2	CS
EU-28	**58 175**	**18 362**	**18 857**	**100%**	**495**	**3%**	**-39 318**	**-68%**		
Iceland	52	0	0	0%	0	-13%	-52	-100%	T1	D
EU-28 + ISL	**58 227**	**18 362**	**18 857**	**100%**	**495**	**3%**	**-39 370**	**-68%**		

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

Figure 3.68 and Figure 3.69 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany, Poland and France; together they cause about 50% of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the decreased by 67% between 1990 and 2014. The CO_2-implied emission factor for solid fuels was 95.0 t/TJ in 2014. The low IEF of Portugal is due to inclusion of non energy use of coal in activity data.

Figure 3.68 1A2f Non-metallic Minerals, solid fuels: Emission trend and share for CO_2

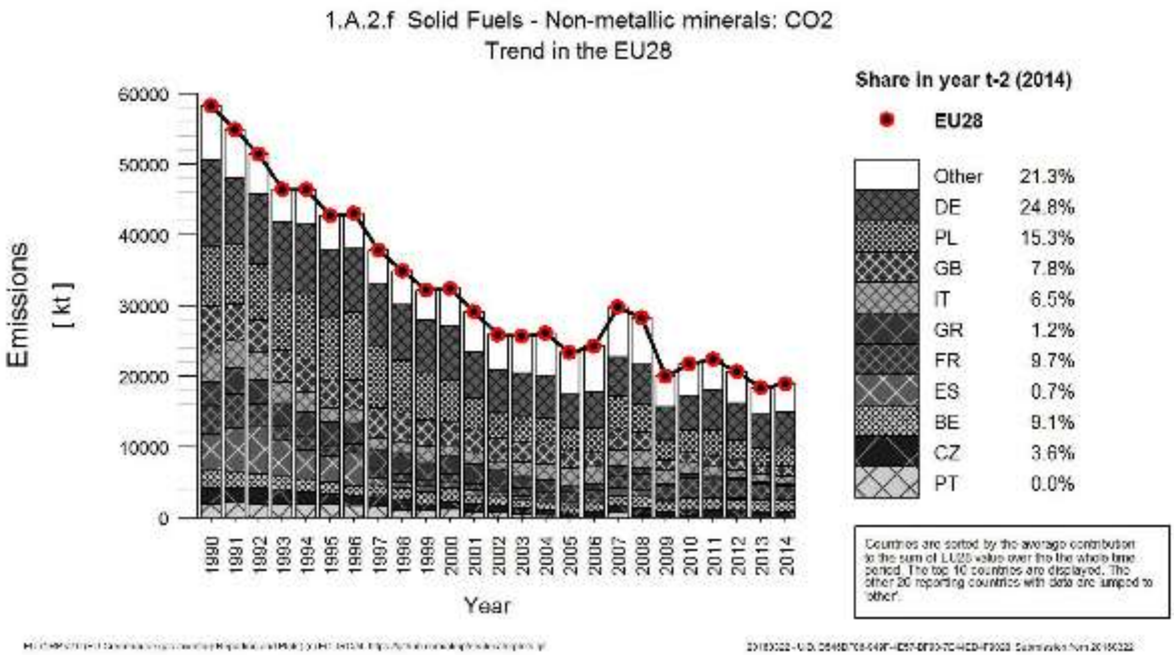
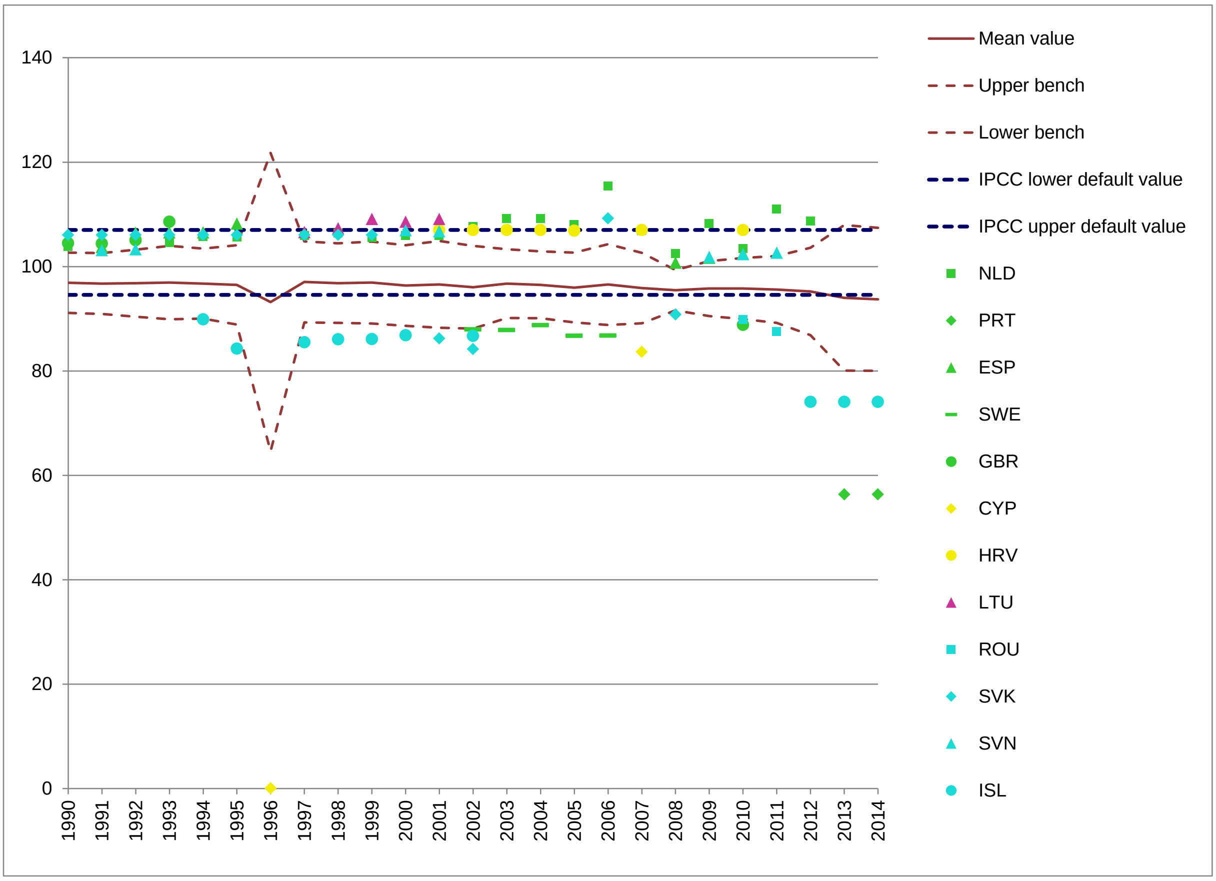


Figure 3.69: 1A2f Non-metallic Minerals, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2f Other - Gaseous Fuels (CO_2)

In 2014 CO_2 from gaseous fuels had a share of 33% within source category 1A2f (compared to 21% in 1990). Between 1990 and 2014, the emissions increased by 2% (Table 3.43). Between 1990 and 2014 Hungary and Bulgaria showed the highest absolute decreases while Germany, Poland and Spain showed the highest absolute increases.

Table 3.43 1A2f Non-metallic Minerals, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	559	629	636	2%	7	1%	77	14%	-	-
Belgium	1 364	1 154	1 175	4%	20	2%	-190	-14%	T1,T3	D,PS
Bulgaria	1 684	502	558	2%	56	11%	-1 126	-67%	T2	CS
Croatia	IE	96	103	0%	8	8%	103	100%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 289	1 225	1 239	4%	14	1%	-50	-4%	T2	CS
Denmark	241	176	179	1%	3	2%	-62	-26%	T3	CS
Estonia	46	40	31	0%	-10	-24%	-16	-34%	T2	CS
Finland	126	61	57	0%	-3	-6%	-68	-54%	T3	CS
France	3 997	3 731	3 594	13%	-137	-4%	-403	-10%	-	-
Germany	3 265	4 538	4 299	15%	-239	-5%	1 033	32%	CS	CS
Greece	NO	118	110	0%	-8	-7%	110	100%	T2	CS
Hungary	1 673	388	449	2%	61	16%	-1 224	-73%	T1	D
Ireland	132	34	36	0%	2	5%	-96	-73%	T2	CS
Italy	5 911	5 517	5 401	19%	-115	-2%	-510	-9%	T2	CS
Latvia	314	73	74	0%	1	2%	-240	-76%	T2	CS
Lithuania	383	52	53	0%	1	1%	-330	-86%	T2	CS
Luxembourg	201	133	164	1%	32	24%	-37	-18%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 484	958	961	3%	2	0%	-523	-35%	T2	CS
Poland	1 379	2 295	2 293	8%	-2	0%	914	66%	T1	D
Portugal	NO	1 060	1 054	4%	-5	-1%	1 054	100%	T2,T3	CR,D,PS
Romania	NO	556	567	2%	11	2%	567	100%	T2	CS
Slovakia	542	376	378	1%	2	0%	-164	-30%	T2	CS
Slovenia	115	146	140	1%	-6	-4%	25	22%	T2	CS
Spain	2 309	3 773	3 817	14%	45	1%	1 509	65%	T2	CS
Sweden	65	106	212	1%	106	101%	147	225%	T1,T2	CS
United Kingdom	311	280	289	1%	9	3%	-22	-7%	T2	CS
EU-28	**27 391**	**28 017**	**27 869**	**100%**	**-147**	**-1%**	**479**	**2%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**27 391**	**28 017**	**27 869**	**100%**	**-147**	**-1%**	**479**	**2%**		

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

Figure 3.70 and Figure 3.71 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 61% of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion increased by 1% between 1990 and 2014. The CO_2-implied emission factor for gaseous fuels was 56.3 t/TJ in 2014.

Figure 3.70 1A2f Non-metallic Minerals, gaseous fuels: Emission trend and share for CO_2

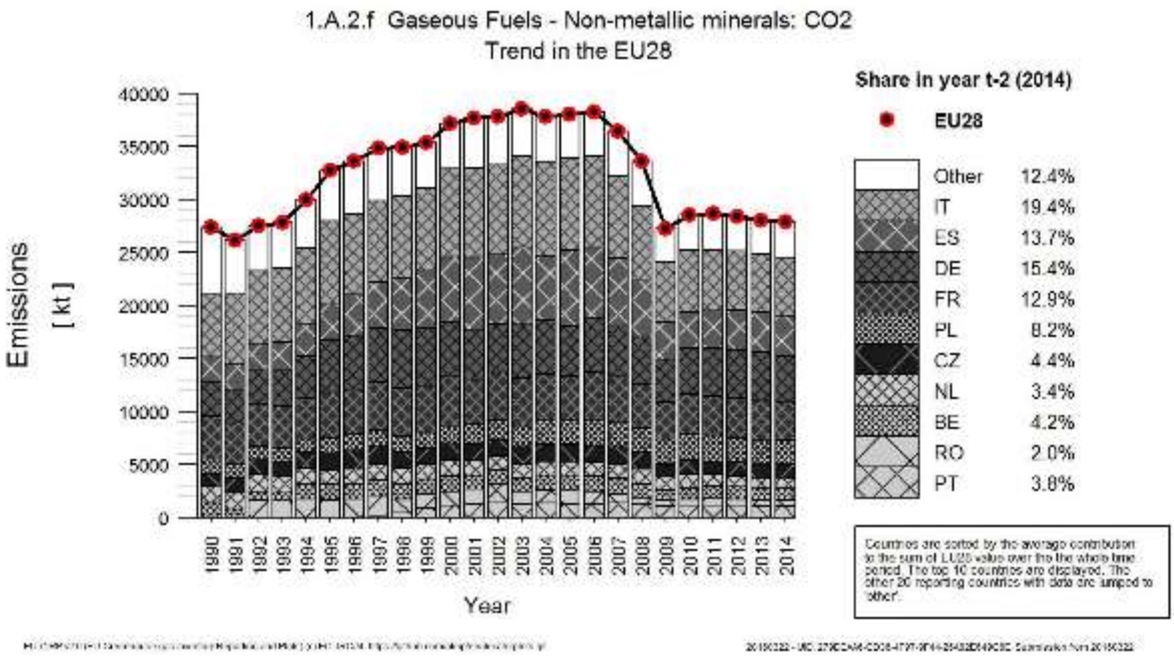
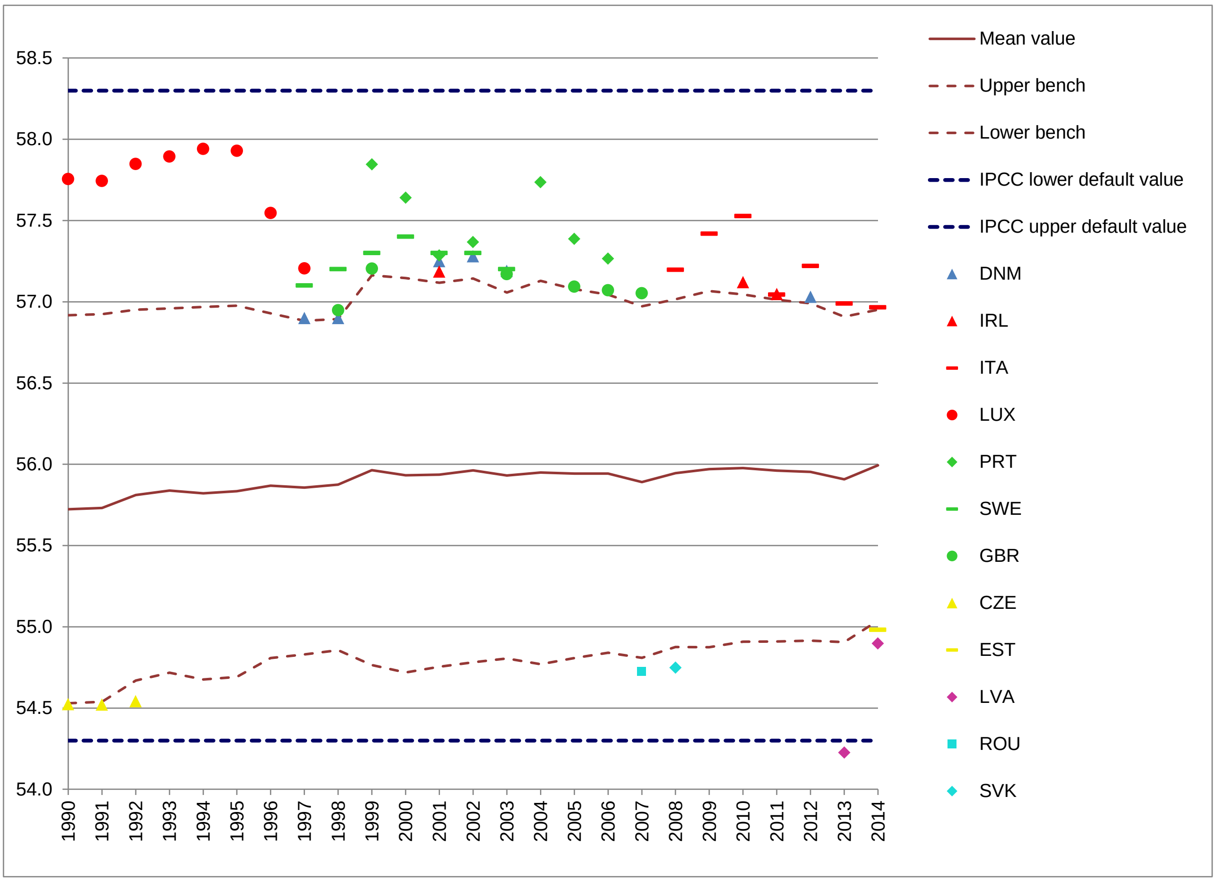


Figure 3.71: 1A2f Non-metallic Minerals, gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2f Other – Other Fossil Fuels (CO_2)

In 2014 CO_2 from other fossil fuels had a share of 12% within source category 1A2f (compared to 1% in 1990). Between 1990 and 2014, the emissions increased by 839% (Table 3.44). Between 1990 and 2014 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 3.44 1A2f Non-metallic Minerals, other fossil fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	66	492	542	5%	50	10%	477	728%
Belgium	186	422	384	4%	-39	-9%	198	106%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	6	56	1%	49	766%	56	100%
Czech Republic	NO	197	302	3%	104	53%	302	100%
Denmark	NO	96	91	1%	-5	-5%	91	100%
Estonia	NO	149	166	2%	17	11%	166	100%
Finland	NO	54	58	1%	4	8%	58	100%
France	141	149	201	2%	52	35%	61	43%
Germany	526	2 337	2 636	26%	299	13%	2 110	402%
Greece	NO	21	26	0%	6	27%	26	100%
Hungary	NO	80	116	1%	37	46%	116	100%
Ireland	NO	133	147	1%	14	11%	147	100%
Italy	NO	370	372	4%	2	1%	372	100%
Latvia	NO	93	108	1%	15	16%	108	100%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	53	52	1%	-1	-2%	52	100%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	10	2 169	2 542	25%	373	17%	2 532	26039%
Portugal	12	237	256	3%	19	8%	244	2018%
Romania	NO	211	309	3%	99	47%	309	100%
Slovakia	NO	232	285	3%	52	23%	285	100%
Slovenia	5	48	68	1%	20	42%	64	1362%
Spain	120	446	583	6%	137	31%	464	388%
Sweden	IE	71	136	1%	65	92%	136	100%
United Kingdom	1	568	562	6%	-6	-1%	561	52180%
EU-28	**1 065**	**8 634**	**10 000**	**100%**	**1 366**	**16%**	**8 935**	**839%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**1 065**	**8 634**	**10 000**	**100%**	**1 366**	**16%**	**8 935**	**839%**

Figure 3.72 and Figure 3.73 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany and Poland; they cause 52% of the CO_2 emissions from other fossil fuels in 1A2f. The CO_2-implied emission factor for other fossil fuels was 79.9 t/TJ in 2014.

Figure 3.72 1A2f Non-metallic Minerals, other fossil fuels: Emission trend and share for CO_2

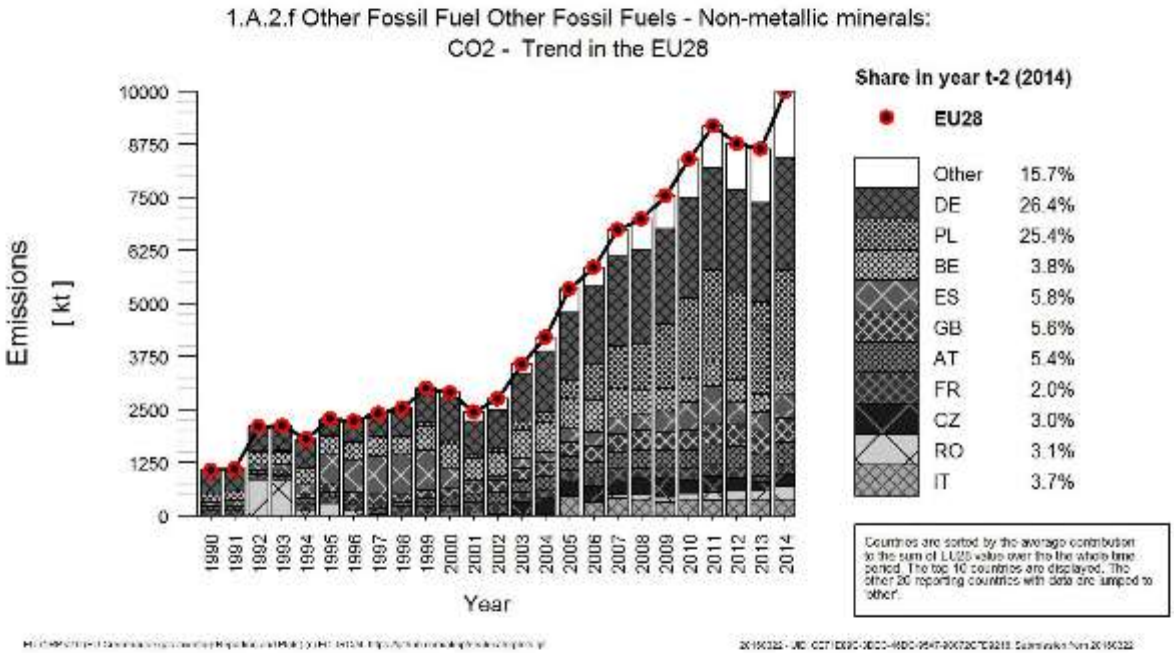


Figure 3.73 1A2f Non-metallic Minerals, other fossil fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)

Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.2.1 Other (1A2g)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2g by fuels. GHG emissions from 1A2g Other accounted for 32.4% for 1A2 source category and for 4% of total GHG emissions in 2014.

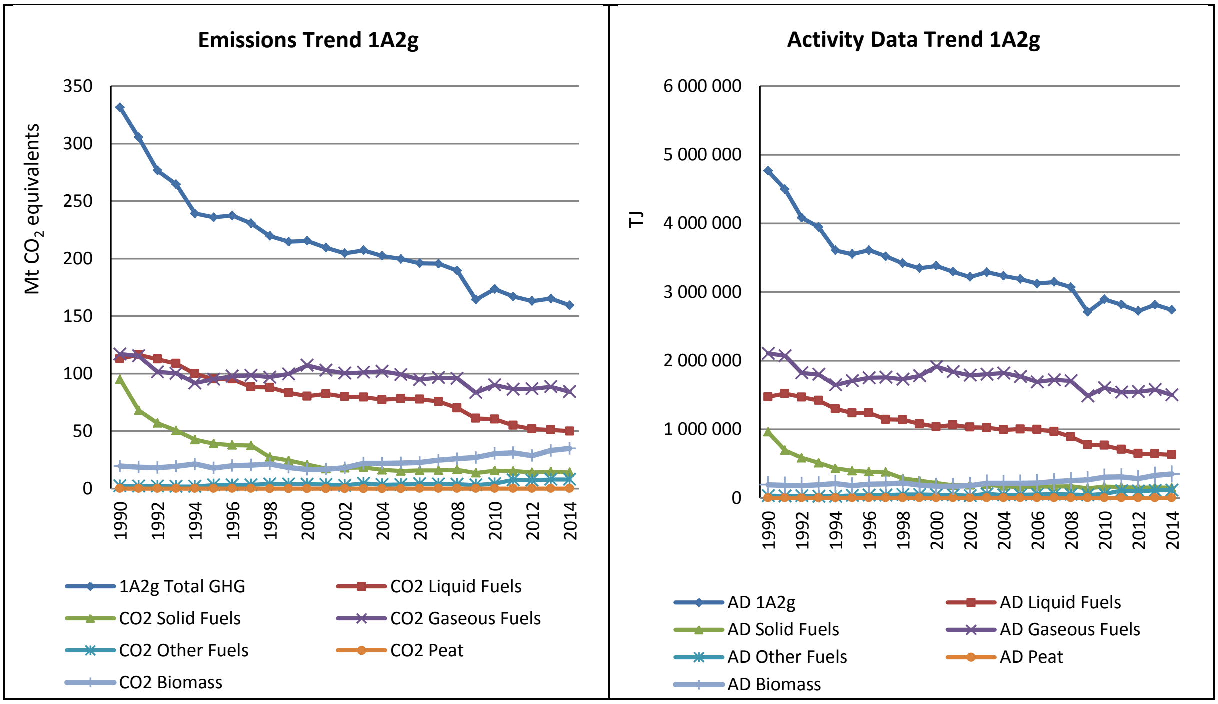
This category includes emissions from stationary combustion but also may include emissions from mobile sources (e.g. construction machinery). Some Member States use this category to report emissions which cannot be allocated to the categories 1A2a to 1A2f due to lack of detailed data, e.g. IEA data provides fuel consumption of Industrial Auto-producers (Electricity, CHP, Heat) for total industry only. Some Member States are reporting/hiding confidential data under this category. The following Table 3.45 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 3.45: 1A2g Other: CO_2, CH_4 and N_2O emissions

Member State		Emissions		
		CO2	CH4	N2O
AUT	g. Other	2 654	0.157	0.296
	1.A.2.g.vii Off-road vehicles and other machinery	1 099	0.024	0.164
BEL	g. Other	2 082	0.176	0.060
	1.A.2.g.vii Off-road vehicles and other machinery	522	0.095	0.049
BGR	g. Other	442	0.117	0.040
	1.A.2.g.vii Off-road vehicles and other machinery	65	0.004	0.025
HRV	g. Other	1 507	0.128	0.019
	1.A.2.g.vii Off-road vehicles and other machinery	367	0.015	0.003
CYP	g. Other	44	0.002	0.000
	1.A.2.g.vii Off-road vehicles and other machinery			
CZE	g. Other	2 480	0.336	0.046
	1.A.2.g.vii Off-road vehicles and other machinery			
DNM	g. Other	1 389	0.111	0.089
	1.A.2.g.vii Off-road vehicles and other machinery	1 021	0.033	0.044
EST	g. Other	159	0.010	0.002
	1.A.2.g.vii Off-road vehicles and other machinery			
FIN	g. Other	1 647	0.511	0.047
	1.A.2.g.vii Off-road vehicles and other machinery	1 212	0.097	0.021
FRK	g. Other	8 058	0.642	0.800
	1.A.2.g.vii Off-road vehicles and other machinery			
DEU	g. Other	72 282	6.666	1.774
	1.A.2.g.vii Off-road vehicles and other machinery	2 825	0.064	0.117
GRC	g. Other	IE	IE	IE
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
HUN	g. Other	1 542	0.103	0.167
	1.A.2.g.vii Off-road vehicles and other machinery	414	0.023	0.157
IRL	g. Other	694	0.152	0.020
	1.A.2.g.vii Off-road vehicles and other machinery			
ITA	g. Other	8 548	0.265	1.239
	1.A.2.g.vii Off-road vehicles and other machinery			
LVA	g. Other	204	0.447	0.060
	1.A.2.g.vii Off-road vehicles and other machinery	3	0.003	0.000
LTU	g. Other	129	0.069	0.009
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
LUX	g. Other	206	0.031	0.021
	1.A.2.g.vii Off-road vehicles and other machinery	119	0.002	0.017
MLT	g. Other	33	0.001	0.000
	1.A.2.g.vii Off-road vehicles and other machinery			
NLD	g. Other	2 810	0.534	0.106
	1.A.2.g.vii Off-road vehicles and other machinery	1 348	0.049	0.060
POL	g. Other	2 719	0.902	0.122
	1.A.2.g.vii Off-road vehicles and other machinery			
PRT	g. Other	1 499	0.096	0.039
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
ROU	g. Other	5 069	0.447	0.062
	1.A.2.g.vii Off-road vehicles and other machinery			
SVK	g. Other	1 224	0.109	0.014
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
SVN	g. Other	395	0.087	0.038
	1.A.2.g.vii Off-road vehicles and other machinery	72	0.004	0.027
ESP	g. Other	9 023	5.569	0.233
	1.A.2.g.vii Off-road vehicles and other machinery	2 329	0.019	0.101
SWE	g. Other	2 620	0.671	0.181
	1.A.2.g.vii Off-road vehicles and other machinery	1 402	0.092	0.058
GBR	g. Other	26 965	2.964	2.727
	1.A.2.g.vii Off-road vehicles and other machinery	6 694	0.860	2.434
ISL	g. Other			
	1.A.2.g.vii Off-road vehicles and other machinery			

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 52%, mainly due to decreases in CO_2 emissions from solid (-85%) and liquid (-56%) fuels.

Figure 3.74 1A2g Other: Total and CO_2 emission trends



Between 1990 and 2014, CO_2 emissions from 1A2g Other decreased by 52% in the EU-28+ISL (Table 3.46). 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. 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 3.46 1A2g Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	1 976	2 941	2 654	2%	-287	-10%	679	34%	NA	NA
Belgium	2 816	2 355	2 082	1%	-273	-12%	-734	-26%	CS,NA,T1,T3	D,NA
Bulgaria	10 600	448	442	0%	-7	-1%	-10 158	-96%	T1,T2	CS,D
Croatia	5 502	1 451	1 507	1%	56	4%	-3 994	-73%	NA,T1	D,NA
Cyprus	48	47	44	0%	-3	-7%	-4	-7%	T1	D
Czech Republic	23 171	2 555	2 480	2%	-75	-3%	-20 691	-89%	T1,T2	CS,D
Denmark	1 941	1 425	1 389	1%	-36	-3%	-552	-28%	CR,M,T1,T2,T3	CS,D
Estonia	280	181	159	0%	-22	-12%	-120	-43%	T1,T2	CS,D
Finland	1 865	1 683	1 647	1%	-37	-2%	-219	-12%	CS,M,T3	CS,D
France	12 046	8 252	8 058	5%	-194	-2%	-3 988	-33%	-	-
Germany	127 916	75 303	72 282	46%	-3 021	-4%	-55 634	-43%	CS	CS,D
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	4 939	1 496	1 542	1%	46	3%	-3 397	-69%	T1,T2	CS,D
Ireland	727	724	694	0%	-30	-4%	-34	-5%	T1,T2	CS,D
Italy	19 141	8 008	8 548	5%	540	7%	-10 593	-55%	T2	CS
Latvia	1 347	232	204	0%	-28	-12%	-1 143	-85%	T1,T2	CS,D
Lithuania	1 196	155	129	0%	-27	-17%	-1 067	-89%	T2	CS
Luxembourg	137	229	206	0%	-22	-10%	69	50%	T1,T2	CS,D
Malta	23	35	33	0%	-3	-8%	10	44%	NA,T1	D,NA
Netherlands	3 352	3 165	2 810	2%	-355	-11%	-542	-16%	NA,T2	CS,NA
Poland	7 061	2 854	2 719	2%	-134	-5%	-4 342	-61%	T1,T2	CS,D
Portugal	2 166	1 521	1 499	1%	-22	-1%	-667	-31%	T2	D,OTH
Romania	46 080	5 404	5 069	3%	-334	-6%	-41 011	-89%	T1,T2	CS,D
Slovakia	2 560	1 231	1 224	1%	-7	-1%	-1 335	-52%	T2	CS
Slovenia	1 153	412	395	0%	-16	-4%	-758	-66%	T1,T2	CS,D
Spain	7 936	10 161	9 023	6%	-1 138	-11%	1 087	14%	T2	CS,M,OTH,PS
Sweden	3 201	2 695	2 620	2%	-75	-3%	-582	-18%	T1,T2	CS
United Kingdom	38 436	27 295	26 965	17%	-330	-1%	-11 470	-30%	T1,T2,T3	CS,D
EU-28	**327 614**	**162 260**	**156 425**	**100%**	**-5 835**	**-4%**	**-171 189**	**-52%**		
Iceland	-	-	-	-	-	-	-	-	-	-
EU-28 + ISL	**327 614**	**162 260**	**156 425**	**100%**	**-5 835**	**-4%**	**-171 189**	**-52%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2g Other – Liquid Fuels (CO_2)

In 2014 CO_2 from liquid fuels decreased to a share of 31% within source category 1A2g (compared to 34% in 1990). Between 1990 and 2014, CO_2 emissions decreased by 56% (Table 3.47). Between 1990 and 2013 all Member States showed a reduction of emissions except for Austria, Malta and Luxembourg. Fuel consumption decreased by 57% between 1990 and 2014.

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

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	866	1 577	1 485	3%	-92	-6%	619	71%
Belgium	1 579	937	970	2%	33	4%	-609	-39%
Bulgaria	8 638	127	140	0%	13	10%	-8 498	-98%
Croatia	2 158	859	882	2%	23	3%	-1 276	-59%
Cyprus	48	47	44	0%	-3	-7%	-4	-7%
Czech Republic	7 041	522	713	1%	191	37%	-6 328	-90%
Denmark	1 317	1 052	1 028	2%	-24	-2%	-289	-22%
Estonia	188	138	122	0%	-16	-12%	-66	-35%
Finland	1 707	1 413	1 380	3%	-33	-2%	-327	-19%
France	6 628	3 734	3 518	7%	-216	-6%	-3 111	-47%
Germany	30 298	16 277	15 471	31%	-806	-5%	-14 826	-49%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	1 659	362	479	1%	116	32%	-1 180	-71%
Ireland	512	399	353	1%	-46	-12%	-159	-31%
Italy	9 462	1 438	1 554	3%	116	8%	-7 908	-84%
Latvia	796	122	105	0%	-17	-14%	-691	-87%
Lithuania	439	18	20	0%	3	15%	-419	-95%
Luxembourg	94	147	133	0%	-14	-9%	40	42%
Malta	23	35	32	0%	-3	-8%	10	44%
Netherlands	1 600	1 475	1 374	3%	-101	-7%	-227	-14%
Poland	1 026	614	699	1%	85	14%	-327	-32%
Portugal	2 115	571	562	1%	-8	-1%	-1 552	-73%
Romania	4 805	1 071	993	2%	-78	-7%	-3 812	-79%
Slovakia	66	12	8	0%	-4	-34%	-59	-89%
Slovenia	647	155	142	0%	-12	-8%	-505	-78%
Spain	5 868	3 393	3 005	6%	-389	-11%	-2 863	-49%
Sweden	2 994	2 185	2 120	4%	-65	-3%	-875	-29%
United Kingdom	20 366	12 369	12 656	25%	287	2%	-7 710	-38%
EU-28	**112 940**	**51 049**	**49 988**	**100%**	**-1 061**	**-2%**	**-62 952**	**-56%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**112 940**	**51 049**	**49 988**	**100%**	**-1 061**	**-2%**	**-62 952**	**-56%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.75 and Figure 3.76 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany and the United Kingdom; together they cause 56% of the CO_2 emissions from liquid fuels in 1A2g. The CO_2-implied emission factor for liquid fuels was 79.5 t/TJ in 2014. The high IEF of Germany is due to inclusion of residual gases of chemical industry.

Figure 3.75 1A2g Other, liquid fuels: Emission trend and share for CO_2

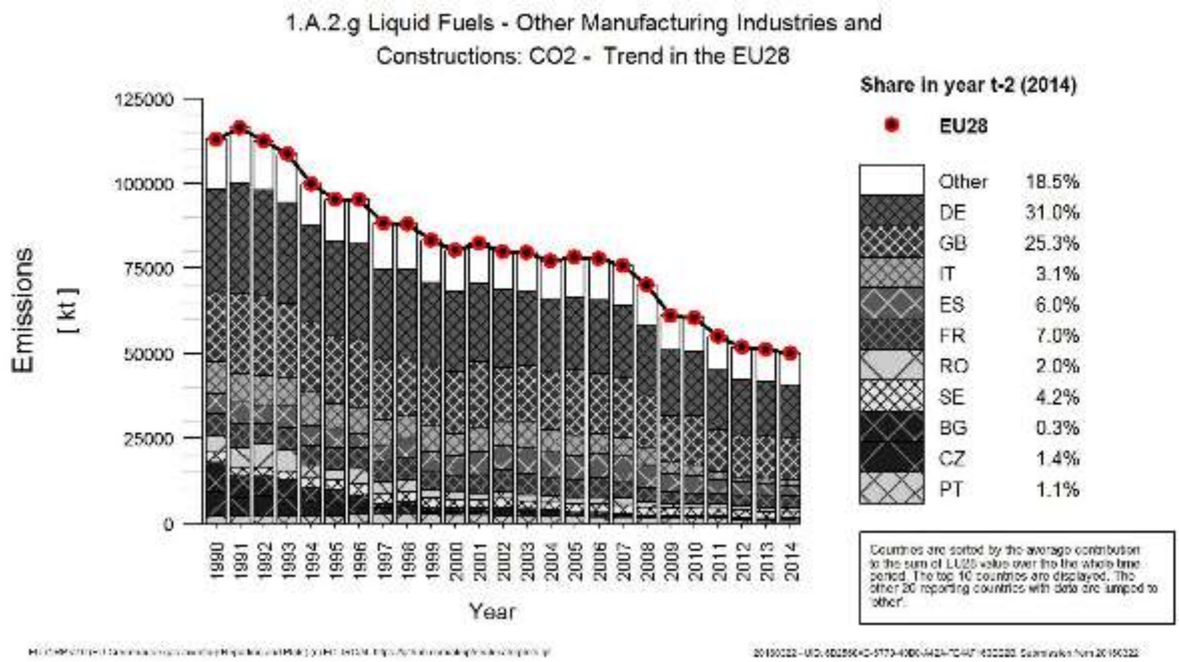
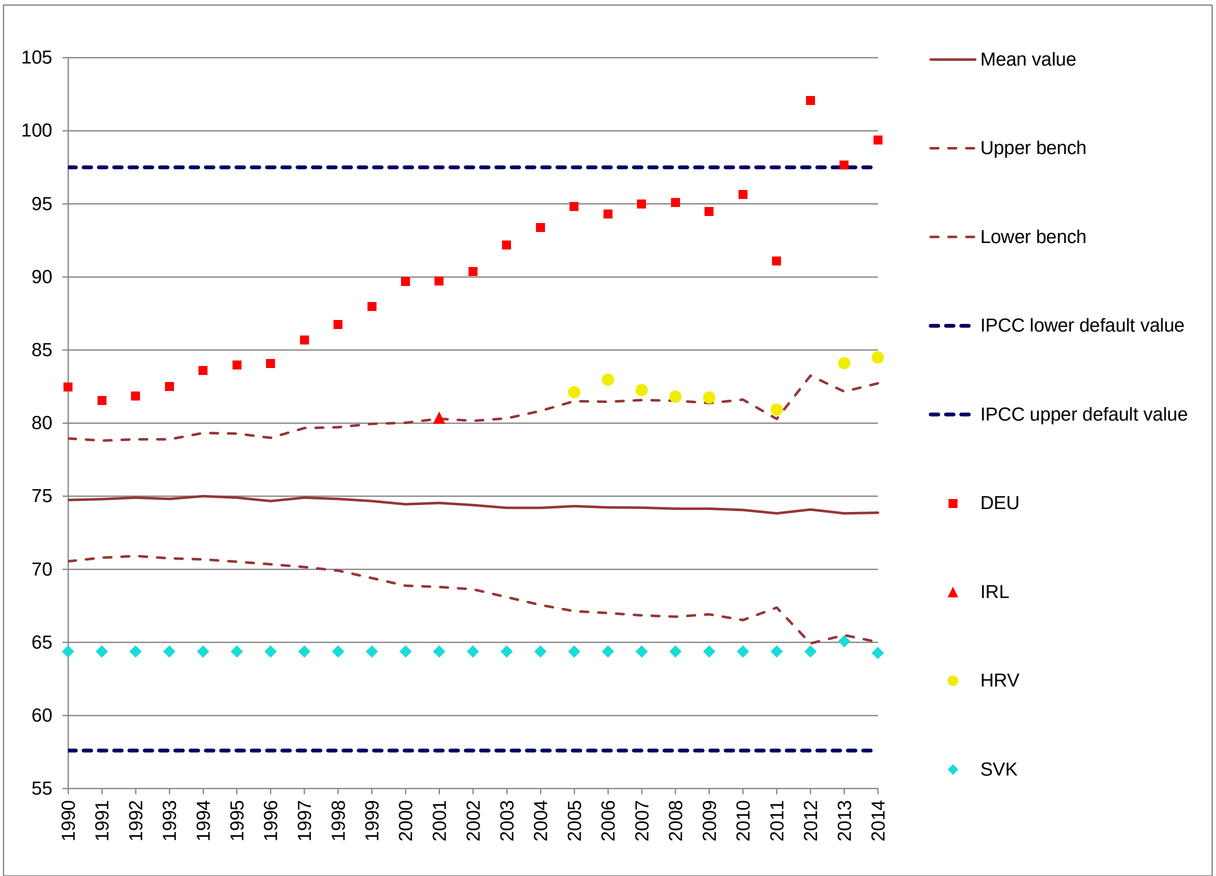


Figure 3.76: 1A2g Other, liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2g Other – Solid Fuels (CO_2)

In 2014 CO_2 from solid fuels decreased to a share of 9% within source category 1A2g (compared to 29% in 1990). Between 1990 and 2014, CO_2 emissions decreased by 85% (Table 3.48). Between 1990 and 2014 all Member States showed a reduction of emissions except for Italy, the Netherlands and Sweden. Fuel consumption decreased by 85% between 1990 and 2014.

Table 3.48 1A2g Other, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	91	1	2	0%	1	89%	-89	-98%
Belgium	33	14	12	0%	-1	-10%	-21	-63%
Bulgaria	1 873	13	10	0%	-3	-24%	-1 863	-99%
Croatia	1 703	382	337	2%	-46	-12%	-1 366	-80%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	13 750	163	140	1%	-22	-14%	-13 610	-99%
Denmark	326	56	62	0%	5	10%	-264	-81%
Estonia	38	0	0	0%	0	23%	-37	-99%
Finland	8	NO	NO	-	-	-	-8	-100%
France	577	NO	NO	-	-	-	-577	-100%
Germany	57 580	6 990	6 906	49%	-84	-1%	-50 674	-88%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	677	34	28	0%	-6	-17%	-649	-96%
Ireland	14	1	0	0%	-1	-100%	-14	-100%
Italy	299	324	319	2%	-5	-1%	20	7%
Latvia	27	5	5	0%	1	16%	-22	-80%
Lithuania	79	6	6	0%	0	6%	-72	-92%
Luxembourg	20	13	14	0%	1	9%	-6	-28%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	42	99	64	0%	-36	-36%	22	52%
Poland	5 154	765	699	5%	-66	-9%	-4 455	-86%
Portugal	51	NO,IE	20	0%	20	100%	-31	-60%
Romania	6 852	1 275	1 236	9%	-39	-3%	-5 615	-82%
Slovakia	1 422	476	470	3%	-6	-1%	-952	-67%
Slovenia	89	1	0	0%	0	-32%	-88	-99%
Spain	253	NO	NO	-	-	-	-253	-100%
Sweden	94	435	430	3%	-4	-1%	336	358%
United Kingdom	4 090	3 578	3 364	24%	-214	-6%	-725	-18%
EU-28	**95 142**	**14 630**	**14 126**	**100%**	**-504**	**-3%**	**-81 016**	**-85%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**95 142**	**14 630**	**14 126**	**100%**	**-504**	**-3%**	**-81 016**	**-85%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.77 and Figure **3.78** shows CO_2 emissions and implied emission factors for EU-28+ISLand the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany and the United Kingdom; together they cause 73% of the CO_2 emissions from liquid fuels in 1A2g.

Figure 3.77 1A2g Other, solid fuels: Emission trend and share for CO_2

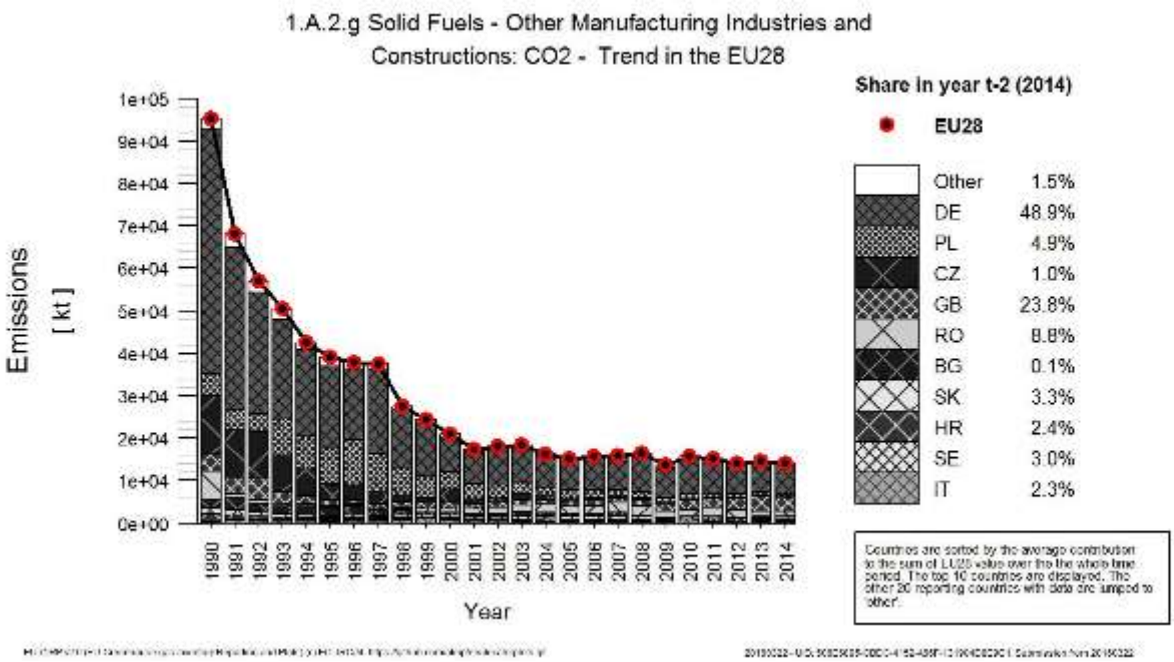
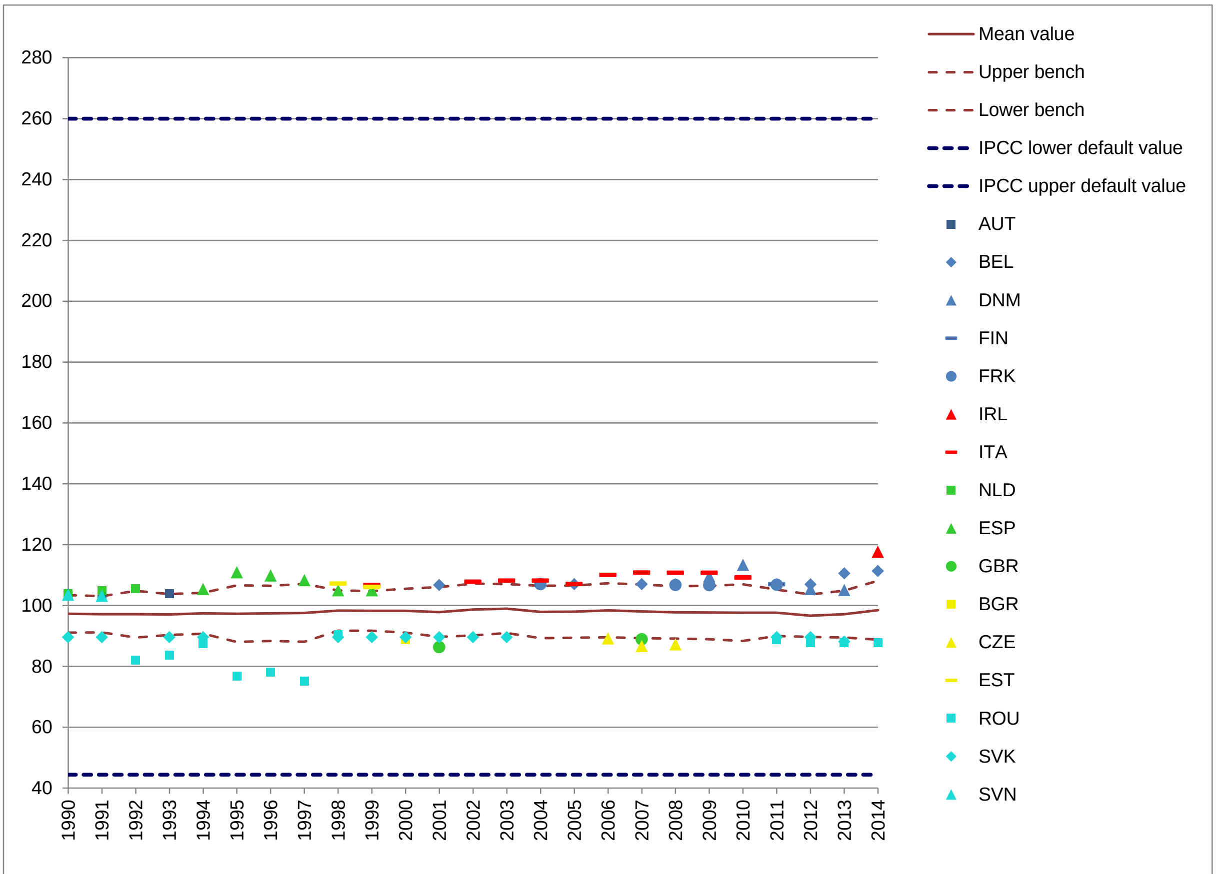


Figure 3.78: 1A2g Other, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2g Other – Gaseous Fuels (CO_2)

In 2014 CO_2 from gaseous fuels increased to a share of 53% within source category 1A2g (compared to 35% in 1990). Between 1990 and 2014, the emissions decreased by 28% (Table 3.49). Between 1990 and 2014 Romania shows the most significant decrease (-92%) while Germany (+13%) and Spain (+232%) show the most significant increase of emissions.

Table 3.49 1A2g Other, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	1 014	1 333	1 147	1%	-186	-14%	133	13%
Belgium	1 204	1 345	1 056	1%	-289	-21%	-148	-12%
Bulgaria	89	257	243	0%	-14	-5%	154	173%
Croatia	1 641	158	228	0%	71	45%	-1 413	-86%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	2 379	1 871	1 627	2%	-244	-13%	-752	-32%
Denmark	297	317	300	0%	-17	-5%	3	1%
Estonia	54	43	37	0%	-6	-14%	-17	-31%
Finland	41	32	33	0%	1	4%	-7	-18%
France	4 830	4 503	4 313	5%	-190	-4%	-517	-11%
Germany	37 693	44 492	42 528	50%	-1 964	-4%	4 834	13%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	2 603	1 100	1 035	1%	-65	-6%	-1 568	-60%
Ireland	202	324	341	0%	17	5%	140	69%
Italy	9 380	6 247	6 675	8%	428	7%	-2 704	-29%
Latvia	524	105	92	0%	-13	-12%	-432	-82%
Lithuania	678	107	100	0%	-7	-7%	-578	-85%
Luxembourg	24	68	59	0%	-9	-14%	35	147%
Malta	0	0	0	0%	0	143%	0	46%
Netherlands	1 710	1 591	1 373	2%	-218	-14%	-337	-20%
Poland	878	1 461	1 312	2%	-148	-10%	435	50%
Portugal	NO,IE	941	909	1%	-32	-3%	909	100%
Romania	34 424	3 057	2 840	3%	-217	-7%	-31 584	-92%
Slovakia	1 071	744	747	1%	3	0%	-324	-30%
Slovenia	417	252	248	0%	-4	-2%	-169	-41%
Spain	1 815	6 768	6 018	7%	-749	-11%	4 203	232%
Sweden	113	75	70	0%	-5	-7%	-43	-38%
United Kingdom	13 981	11 348	10 945	13%	-403	-4%	-3 036	-22%
EU-28	**117 060**	**88 537**	**84 275**	**100%**	**-4 262**	**-5%**	**-32 784**	**-28%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**117 060**	**88 537**	**84 275**	**100%**	**-4 262**	**-5%**	**-32 784**	**-28%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.79 and Figure 3.80 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 79% of the CO_2 emissions from gaseous fuels in 1A2g. Fuel consumption decreased by 29% between 1990 and 2014. The CO_2-implied emission factor for gaseous fuels was 56.2 t/TJ in 2014. The high IEF of Malta is due to the inclusion of LPG.

Figure 3.79 1A2g Other, gaseous fuels: Emission trend and share for CO_2

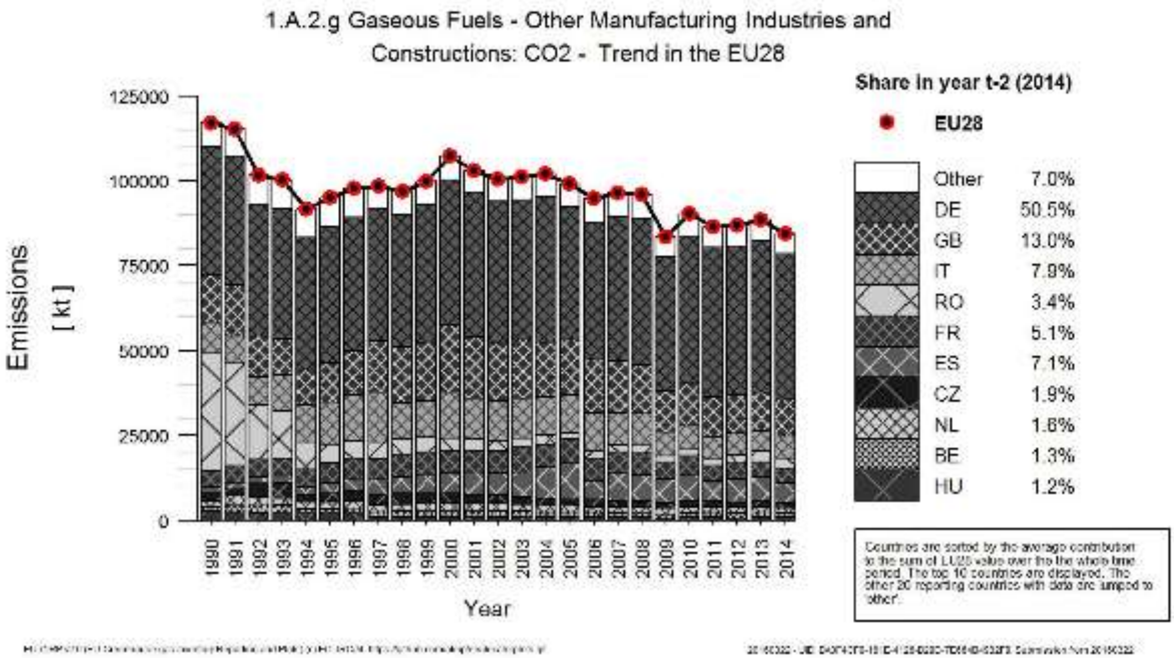
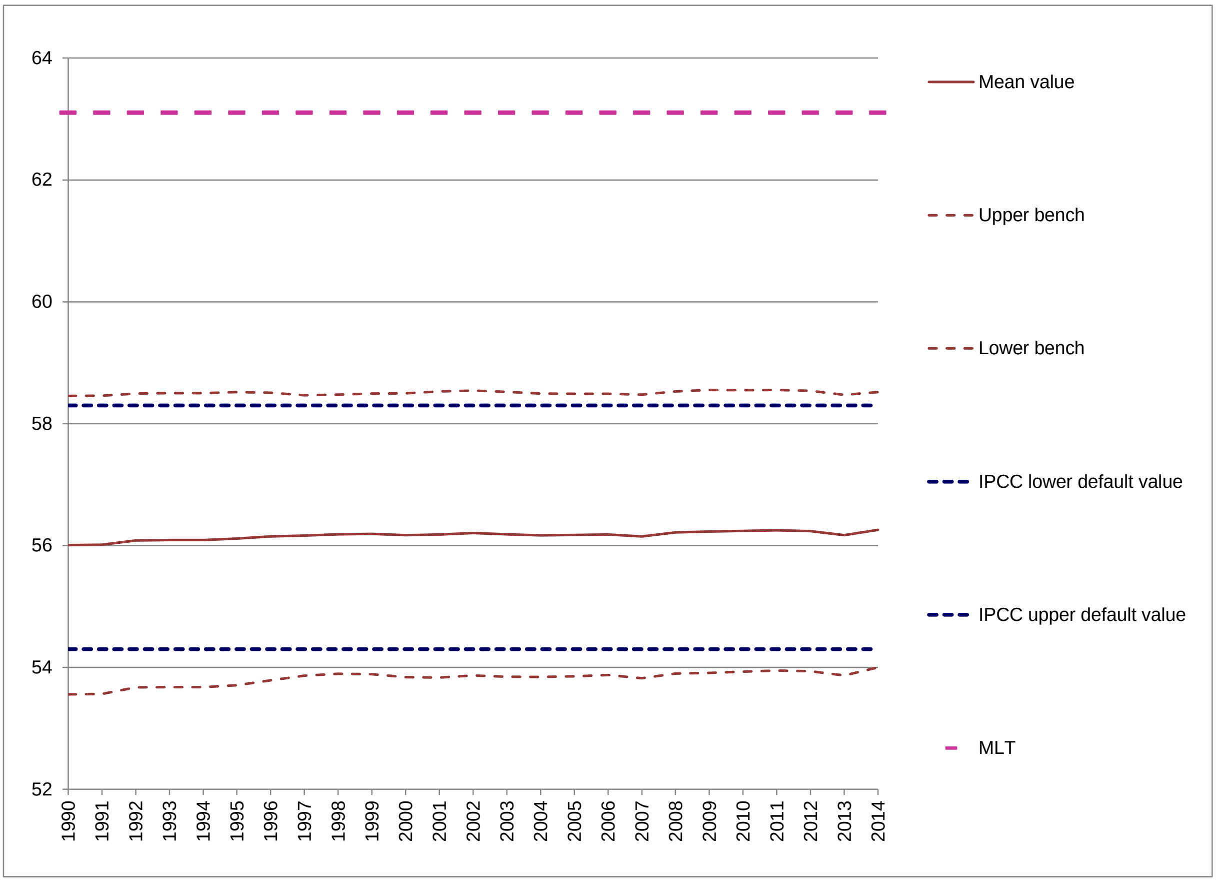


Figure 3.80: 1A2g Other, gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A2g Other – Other fossil fuels (CO_2)

In 2014 CO_2 from other fossil fuels increased to a share of 5% within source category 1A2g (compared to 1% in 1990). Between 1990 and 2013, CO_2 emissions increased by 226% (Table 3.50). 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 3.50 1A2g Other, other fossil fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	5	30	21	0%	-9	-31%	16	330%
Belgium	NO	60	44	1%	-16	-27%	44	100%
Bulgaria	NO	52	49	1%	-2	-4%	49	100%
Croatia	NO	52	61	1%	8	16%	61	100%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	1	NO	NO	-	-	-	-1	-100%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	88	214	189	2%	-26	-12%	101	115%
France	10	15	227	3%	212	1430%	217	2078%
Germany	2 344	7 544	7 376	92%	-167	-2%	5 032	215%
Greece	-	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	22	NO	-	-22	-100%	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	3	14	9	0%	-5	-35%	6	191%
Portugal	NO,IE	9	7	0%	-2	-21%	7	100%
Romania	NO	0	0	0%	0	0%	0	100%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	4	5	0%	1	13%	5	100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO,IE	C,NO	C,NO	-	-	-	-	-
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**2 452**	**8 017**	**7 988**	**100%**	**-29**	**0%**	**5 536**	**226%**
Iceland	-	-	-	-	-	-	-	-
EU-28 + ISL	**2 452**	**8 017**	**7 988**	**100%**	**-29**	**0%**	**5 536**	**226%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.81 and Figure 3.82 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 92% of the CO_2 emissions from other fossil fuels in 1A2g. Fuel consumption in the EU-28 increased by 243% between 1990 and 2014. The CO_2-implied emission factor for other fossil fuels was 70.9 t/TJ in 2014.

Figure 3.81 1A2g Other, other fossil fuels: Emission trend and share for CO_2

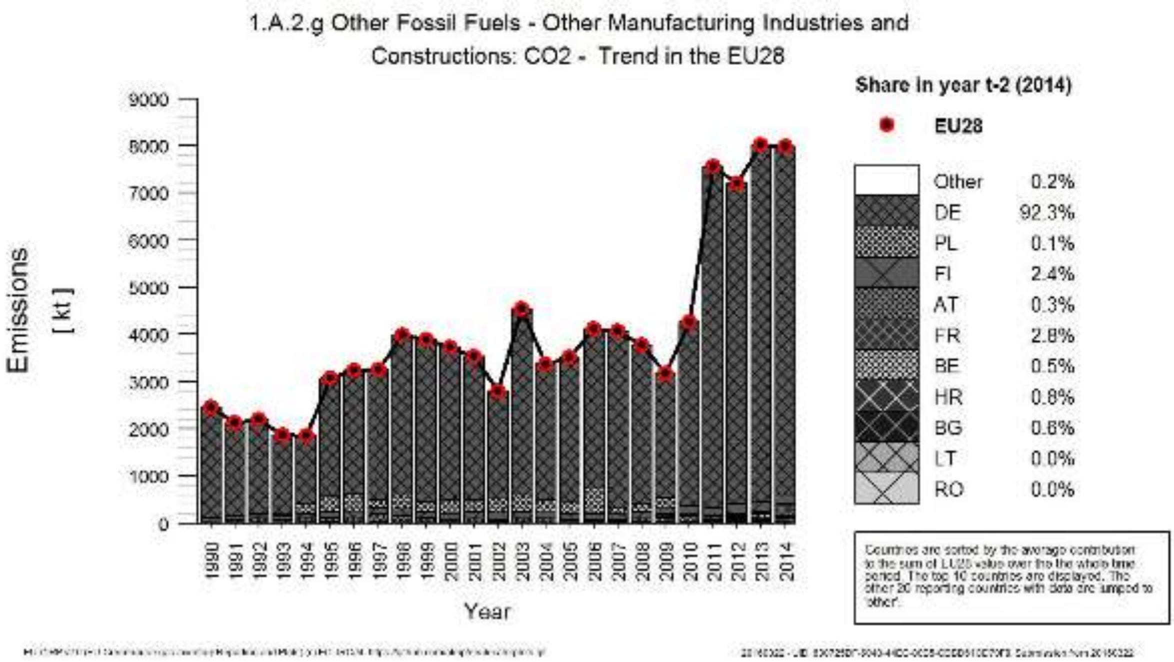
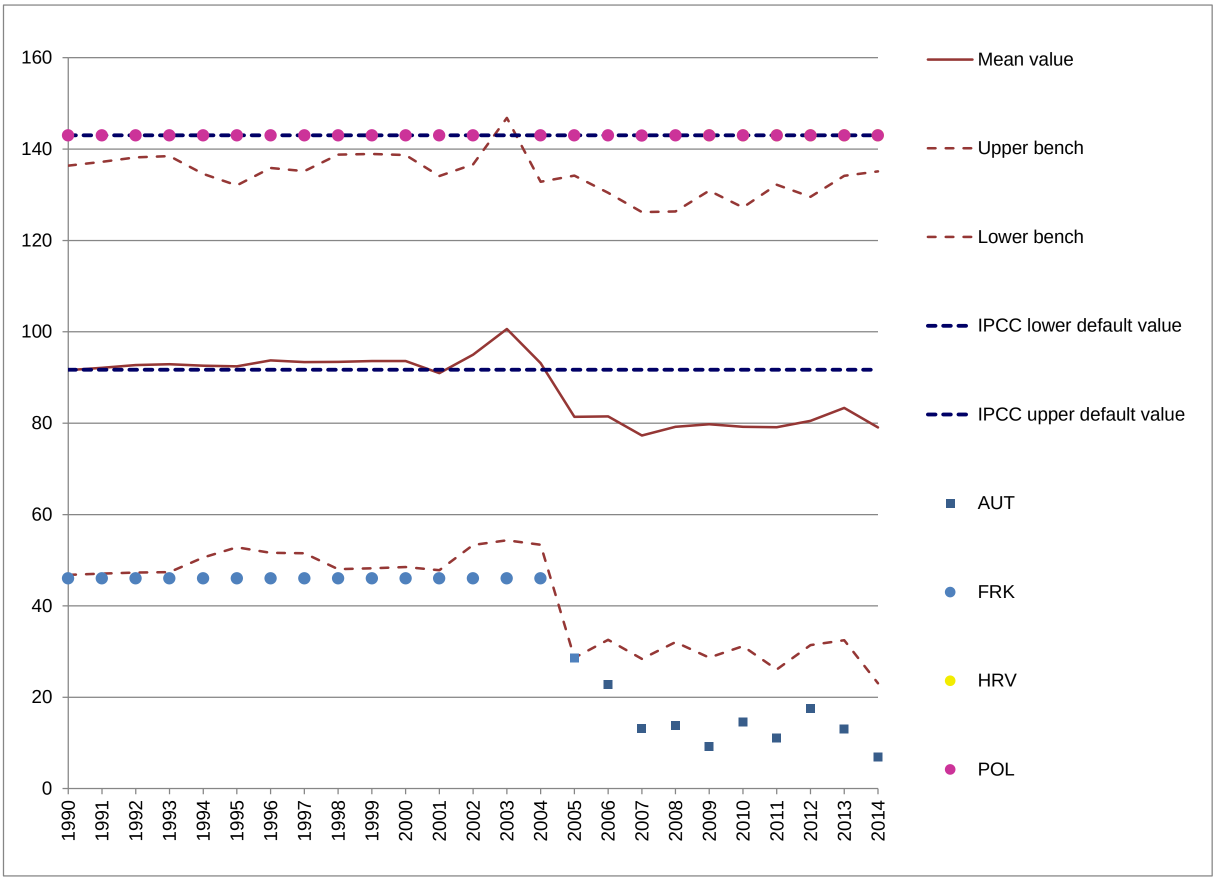


Figure 3.82: 1A2g Other, other fossil fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)

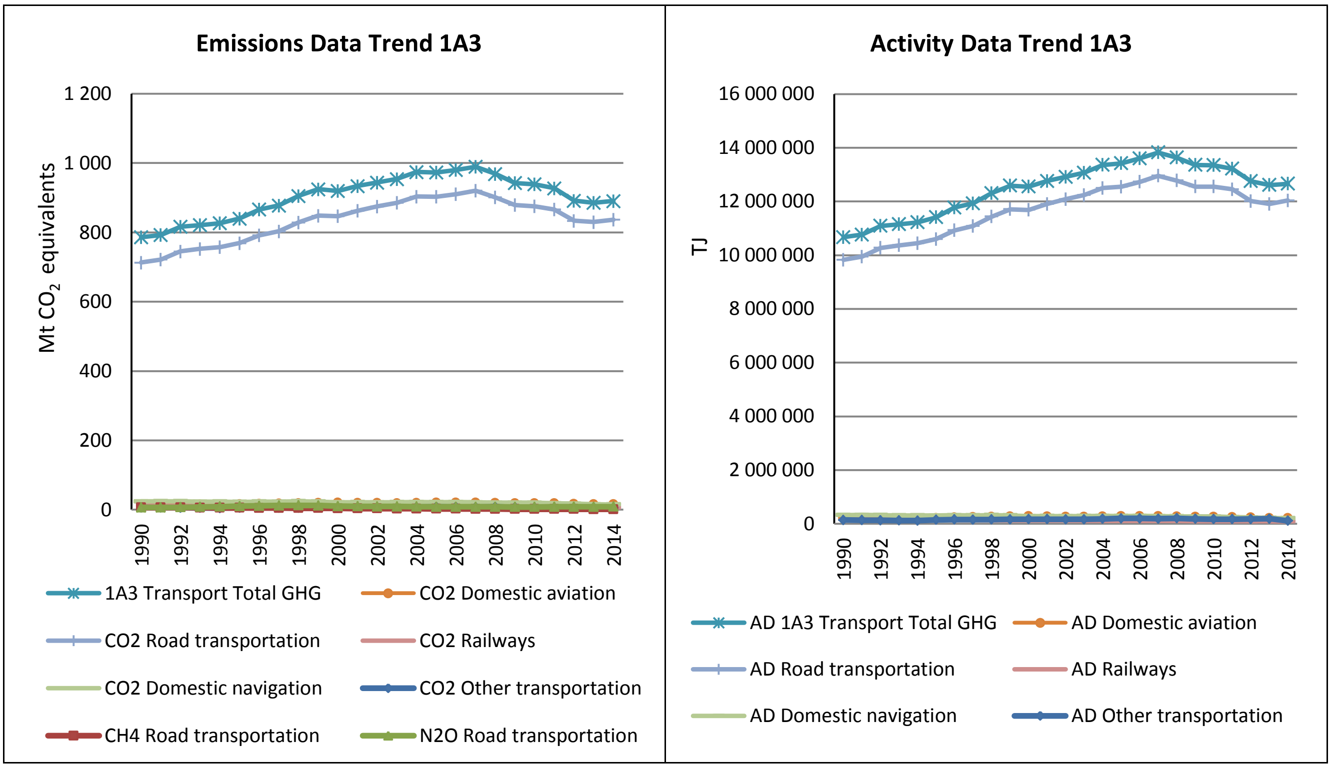


Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.83. CO_2 emissions from this source category account for 21%, CH_4 for 0.03 %, N_2O for 0.2 % of total GHG emissions. Between 1990 and 2014, GHG from transport increased by 13 % in the EU-28+ISL.

Figure 3.83 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Mt) and Activity Data in TJ



This source category includes eight key categories:

- 1 A 3 a Domestic Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel Oil (CO_2)
- 1 A 3 b Road Transportation: Diesel Oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Liquefied Petroleum Gases (LPG) (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Domestic Navigation: Gas/Diesel Oil (CO_2)

Table 3.51 shows total GHG, CO_2, CH_4 and N_2O emissions from 1A3 Transport.

Table 3.51 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	13 976	22 181	13 777	21 976	133	195	65	9
Belgium	20 652	25 226	20 317	24 943	214	265	121	17
Bulgaria	6 783	8 511	6 605	8 409	107	74	70	29
Croatia	4 032	5 720	3 937	5 651	54	56	41	13
Cyprus	1 214	1 819	1 181	1 761	28	48	5	10
Czech Republic	7 284	17 157	7 032	16 491	214	642	39	24
Denmark	10 733	12 126	10 577	11 987	100	128	57	12
Estonia	2 479	2 266	2 418	2 236	38	26	23	4
Finland	12 101	11 052	11 826	10 953	163	77	113	22
France	120 667	130 851	118 720	129 130	956	1 550	992	171
Germany	164 404	161 130	161 882	159 469	1 193	1 508	1 329	153
Greece	14 536	17 596	14 152	17 301	273	214	111	81
Hungary	8 754	11 152	8 554	11 001	131	123	69	28
Ireland	5 135	11 347	5 022	11 212	66	118	48	16
Italy	103 242	104 855	101 307	103 700	955	922	980	233
Latvia	3 031	2 952	2 930	2 894	80	54	20	5
Lithuania	7 705	5 065	7 385	4 974	267	75	53	15
Luxembourg	2 688	6 097	2 658	6 044	19	50	12	2
Malta	342	649	335	637	5	11	2	2
Netherlands	27 669	30 447	27 369	30 141	105	245	196	61
Poland	20 594	44 196	20 283	43 550	193	548	118	98
Portugal	10 020	15 712	9 828	15 536	89	147	104	28
Romania	12 439	15 619	12 059	15 376	285	205	94	38
Slovakia	6 838	6 484	6 702	6 413	106	55	31	17
Slovenia	2 733	5 384	2 666	5 321	38	56	29	7
Spain	59 138	79 879	58 227	79 002	534	788	377	89
Sweden	19 437	17 926	19 101	17 727	180	155	156	44
United Kingdom	116 891	116 377	114 251	115 174	1 386	1 083	1 254	120
EU-28	**785 517**	**889 776**	**771 099**	**879 011**	**7 910**	**9 416**	**6 507**	**1 349**
Iceland	615	859	600	825	16	34	-	-
EU-28 + ISL	**786 132**	**890 635**	**771 699**	**879 011**	**7 926**	**9 450**	**6 507**	**1 349**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.52 provides information on the contribution of Member States to EU-28+ISL recalculations in CO_2 from 1A3 Transport for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 3.52 1A3 Transport: Contribution of MS to EU-28+ISL recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.5	0.0	14.8	0.1	revised energy balance, update traffic performance, changes off-road model
Belgium	-194.8	-0.9	-102.4	-0.4	See chapter 3.1.3 in NIR
Bulgaria	0.0	0.0	24.0	0.3	For the category 1A3a the Activity Data were revised, whereas for the category 1A3b the method was revised. For more information please check table 258 of the NIR.
Croatia	0.0	0.0	23.8	0.4	1A3-NCV for LPG was corrected
Cyprus	-8.5	-0.7	-10.8	-0.6	Consumption of diesel for the whole reporting period has been revised to exclude consumption for domestic water-borne navigation.
Czech Republic	0.0	0.0	0.0	0.0	
Denmark	-9.0	-0.1	11.7	0.1	See NIR
Estonia	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	92.0	0.8	Diesel and gasoline consumption corrected
France	-270.4	-0.2	-457.0	-0.4	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Germany	-71.5	0.0	-47.6	0.0	
Greece	0.0	0.0	-93.0	-0.5	Domestic aviation: Recalculations for year 2013 were performed as a consequence of a change of fuel consumption in EUROCONTROL data.
Hungary	14.0	0.2	-79.1	-0.8	Less gasoil has been reallocated from road transport to off-road machinery and more natural gas has been allocated to pipeline transport.
Ireland	0.0	0.0	-0.5	0.0	Revised fuel consumption and upgrade to COPERT 4 software in 1.A.3.b; revised fuel consumption in 1.A.3.c for 2012 and 2013.
Italy	0.4	0.0	0.1	0.0	The whole time series for road transport emissions has been recalculated because of the application of the new version of the model COPERT 4.
Latvia	0.0	0.0	0.0	0.0	Recalculations have been done due to improvement of activity data and corrected gasoline consumption in road transport.
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	-0.8	0.0	61.6	1.0	Updated AD for the categories 1A3a, 1A3b, 1A3d. For more information please check NIR Table 3-68.
Malta	-7.4	-2.2	57.8	11.2	Recalculations were performed for emissions of direct greenhouse gases in the category Civil Aviation and National Navigation due to the revised methodology (including back-casting) detailed in sub-section 3.2.5.2 of the NIR.
Netherlands	-1 443.0	-5.0	-2 859.3	-8.1	Reallocation of NRMM to 1.A.2 and 1.A.4
Poland	-0.7	0.0	-32.6	-0.1	AD correction (statistical data)
Portugal	0.0	0.0	-0.1	0.0	Emissions were estimated using the new version of COPERT IV (version 11.3 – June 2015).
Romania	0.0	0.0	0.0	0.0	NA
Slovakia	0.0	0.0	-109.4	-1.6	Please check NIR, chapter 3.2.7.5.
Slovenia	0.0	0.0	0.0	0.0	Correction of default CO_2 EF for aviation gasoline (1A3eii)
Spain	-3.5	0.0	1.4	0.0	
Sweden	46.8	0.2	-335.5	-1.8	Development of the HEBEFA model; The model for estimating the fuel consumption and emissions from Non-road mobile machinery (NRMM) has been adjusted and updated in 2015; The amount of low blended biodiesel used by NRMM was incorrectly allocated in submission 2015.
United Kingdom	-1.6	0.0	144.6	0.1	Very small differences to the overall totals. Revisions to the distributions of emissions between road transport vehicle types - update to use COPERT 4v11 emission factors - update to use COPERT 4v11 fuel consumption factors for road transport - Update to use COPERT methodology for lubricant oils small revisions to emissions from railways and navigation due to changes in activity data. Small revision to aviation due to the inclusion of 2014 Heathrow data and the reassignment of some aircraft types.
EU28	-1 949.5	-0.3	-3 695.5	-0.4	
Iceland	-0.2	0.0	19.4	2.4	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
EU28+ISL	-1 949.7	-0.3	-3 676.1	-0.4	

Table 3.53 provides information on the contribution of Member States to EU-28+ISL recalculations in N_2O from 1A3 Transport for 1990 and 2013.

Table 3.53 1A3 Transport: Contribution of MS to EU-28+ISL recalculations in N_2O for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.5	0.3	-2.0	-1.0	Revised energy balance, update traffic performance, changes off-road model
Belgium	-0.2	-0.1	-4.0	-1.6	See chapter 3.1.3 in NIR
Bulgaria	-0.1	-0.1	3.7	5.9	For the category 1A3a the Activity Data were revised, whereas for the category 1A3b the method was revised. For more information please check table 258 of the NIR.
Croatia	0.0	0.0	0.0	0.0	
Cyprus	4.9	21.3	10.4	26.8	Consumption of diesel for the whole reporting period has been revised to exclude consumption for domestic water-borne navigation.
Czech Republic	0.0	0.0	0.0	0.0	
Denmark	-6.4	-6.0	-2.7	-2.2	See NIR
Estonia	0.0	0.0	-0.2	-0.6	Some emission factors were revised.
Finland	0.0	0.0	-0.2	-0.3	Diesel and gasoline consumption corrected
France	-21.5	-2.2	31.5	2.1	
Germany	-0.7	-0.1	-6.1	-0.4	
Greece	0.0	0.0	7.2	3.6	Domestic aviation: Recalculations for year 2013 were performed as a consequence of a change of fuel consumption in EUROCONTROL data.
Hungary	0.0	0.0	-1.0	-0.9	Less gasoil has been reallocated from road transport to off-road machinery and more natural gas has been allocated to pipeline transport.
Ireland	0.2	0.4	0.2	0.2	Revised fuel consumption and upgrade to COPERT 4 software in 1.A.3.b; revised fuel consumption in 1.A.3.c for 2012 and 2013.
Italy	0.0	0.0	-4.7	-0.5	The whole time series for road transport emissions has been recalculated because of the application of the new version of the model COPERT 4.
Latvia	0.0	0.0	3.7	7.5	Recalculations have been done due to improvement of activity data and corrected gasoline consumption in road transport
Lithuania	0.1	0.0	0.0	0.0	
Luxembourg	0.0	0.2	0.4	0.8	Updated AD for the categories 1A3a, 1A3b, 1A3d. For more information please check NIR Table 3-68.
Malta	-0.2	-3.8	4.1	67.3	Recalculations were performed for emissions of direct greenhouse gases in the category Civil Aviation and National Navigation due to the revised methodology (including back-casting) detailed in

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					sub-section 3.2.5.2 of the NIR.
Netherlands	-31.0	-22.9	12.8	5.1	Reallocation of NRMM to 1.A.2 and 1.A.4
Poland	0.0	0.0	-0.3	-0.1	AD correction (statistical data)
Portugal	0.0	0.0	0.4	0.3	Emissions were estimated using the new version of COPERT IV (version 11.3 – June 2015).
Romania	0.0	0.0	0.0	0.0	Recalculation were made for 2013 as a result of data transcription errors.
Slovakia	0.1	0.1	0.0	-0.1	Domestic aviation: For the years 2005-2014 Slovakia decided to use the fuel consumption data from Eurocontrol. Road transport: Recalculations of fuel consumption and N_2O emissions were performed in 1.A.3.b.i-iv for gasoline, diesel oil and biomass. Railways: Recalculations of fuel consumption and N_2O emissions were performed for liquid fuels (diesel oil) and biomass for 2007-2013.
Slovenia	0.0	0.0	0.0	0.0	More precise input in the CRF tables
Spain	-2.5	-0.5	-0.1	0.0	
Sweden	3.2	1.8	5.0	3.5	Development of the HEBEFA model; The model for estimating the fuel consumption and emissions from Non-road mobile machinery (NRMM) has been adjusted and updated in 2015; The amount of low blended biodiesel used by NRMM was incorrectly allocated in submission 2015.
United Kingdom	178.0	14.9	23.2	2.3	Revisions across 1A3. Increases in: 1. 1A3bi - cars for both DERV and Petrol due to a revision to emission factors based on COPERT 4v11 and also a change in the fuel normalisation approach. 2. 1A3bii - light duty trucks, again due to the revision to emission factors based on COPERT 4v11 and the change in the fuel normalisation approach. 3. 1A3c - Railways. Revision to activity data for both coal and gas oil. Also a change to the EF used for gas oil. Also, a decrease in emission from 1A3biii - heavy duty trucks and buses due to a revision to the emission factors based on COPERT 4v11 and a change in the fuel normalisation approach.
EU28	124.4	1.6	81.4	0.9	
Iceland	0.8	5.2	15.3	78.6	
EU28+ISL	125.2	1.6	96.7	1.1	

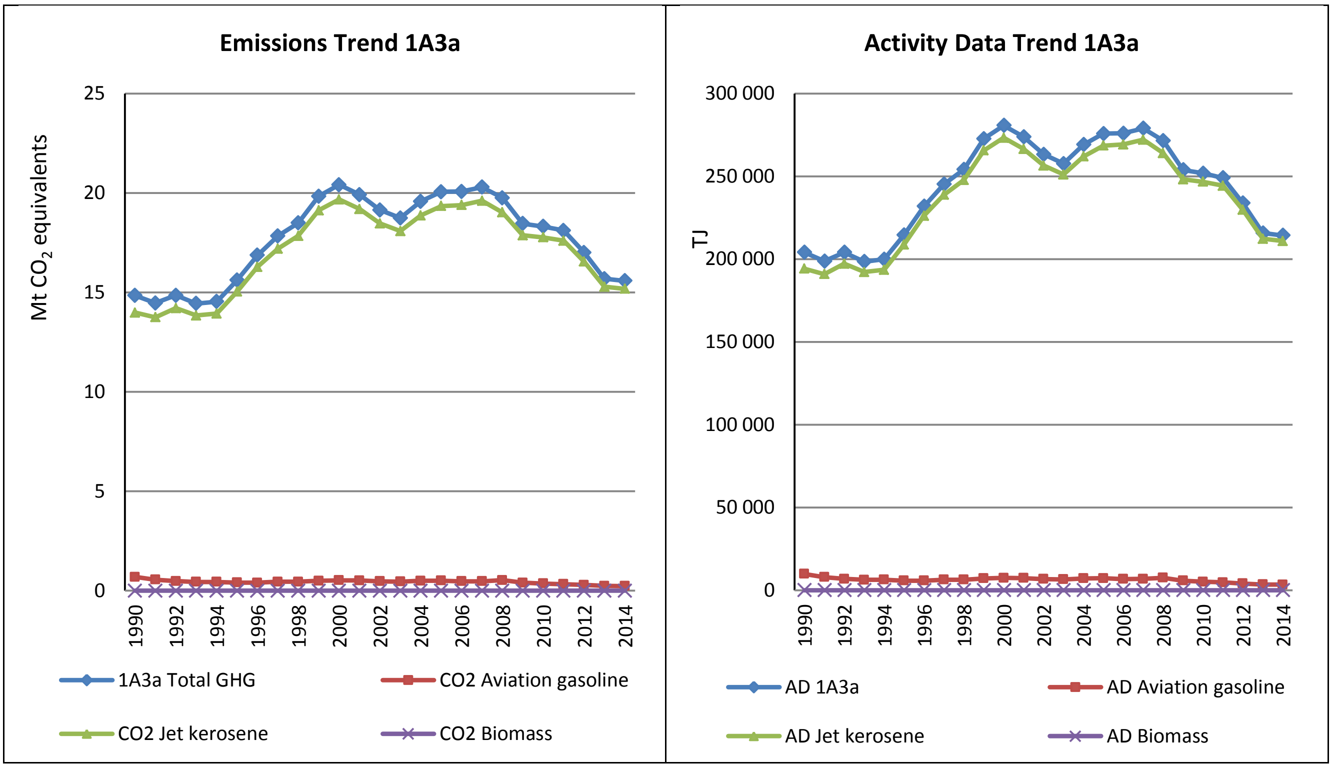
3.2.3.1 Civil Aviation (1A3a) (EU-28+ISL)

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 2014. Between 1990 and 2014, CO_2 emissions from civil aviation increased by 5 % in the EU-28+ISL (Table 3.54, Figure 3.84).

CO_2 emissions from Jet Kerosene account for 98 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2013 and 2014, CO_2 emissions from civil aviation decreased by 1 % in the EU-28+ISL (Table 3.54, Figure 3.84).

Figure 3.84 1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Mt) and Activity data in TJ



The Member States France, Germany, Italy and Spain alone contributed 72 % to the emissions from this source. Most Member States (15 +ISL in total) increased emissions from civil aviation between 1990 and 2014 (Table 3.54).

Table 3.54 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	32	54	50	0%	-4	-7%	18	56%
Belgium	13	29	27	0%	-2	-7%	14	109%
Bulgaria	135	37	28	0%	-9	-25%	-107	-79%
Croatia	156	104	106	1%	2	2%	-50	-32%
Cyprus	11	1	1	0%	0	-37%	-10	-95%
Czech Republic	139	8	7	0%	-1	-7%	-132	-95%
Denmark	248	143	137	1%	-6	-4%	-111	-45%
Estonia	6	1	1	0%	0	3%	-4	-78%
Finland	385	192	193	1%	1	0%	-192	-50%
France	4 238	4 691	4 494	29%	-198	-4%	255	6%
Germany	2 374	2 188	2 209	14%	21	1%	-165	-7%
Greece	319	338	550	4%	212	63%	231	73%
Hungary	1	1	1	0%	0	-21%	0	1%
Ireland	51	10	9	0%	-1	-6%	-42	-82%
Italy	1 613	1 939	1 921	12%	-18	-1%	307	19%
Latvia	0	3	3	0%	0	0%	3	5087%
Lithuania	8	2	2	0%	0	12%	-6	-76%
Luxembourg	0	0	0	0%	0	6%	0	134%
Malta	2	5	4	0%	-1	-18%	2	100%
Netherlands	83	40	41	0%	1	3%	-42	-51%
Poland	66	116	139	1%	22	19%	72	109%
Portugal	229	332	338	2%	5	2%	109	48%
Romania	25	135	73	0%	-63	-46%	48	192%
Slovakia	8	4	4	0%	0	14%	-4	-46%
Slovenia	1	1	1	0%	0	12%	0	37%
Spain	1 992	2 625	2 647	17%	22	1%	655	33%
Sweden	673	517	516	3%	-2	0%	-157	-23%
United Kingdom	1 836	1 989	1 877	12%	-111	-6%	41	2%
EU-28	**14 645**	**15 508**	**15 379**	**100%**	**-129**	**-1%**	**734**	**5%**
Iceland	31	19	40	0%	21	106%	9	27%
EU-28 + ISL	**14 677**	**15 527**	**15 419**	**100%**	**-108**	**-1%**	**742**	**5%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2014 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 98 % of CO_2 emissions in 1A3a. Within the EU-28+ISL the emissions increased between 1990 and 2014 by 9 % (Table 3.55). By far the largest absolute increase occurred in Spain. Between 2013 and 2014, the emissions decreased by 1 %.

Table 3.55 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	24	46	42	0%	-4	-9%	18	75%	-	-
Belgium	5	27	24	0%	-2	-9%	20	400%	T1	D
Bulgaria	114	34	25	0%	-9	-27%	-89	-78%	T2	D
Croatia	156	103	103	1%	0	0%	-53	-34%	T1	D
Cyprus	11	1	1	0%	0	-37%	-10	-95%	T1	D
Czech Republic	1	1	1	0%	-1	-36%	0	-34%	T1	D
Denmark	240	138	134	1%	-4	-3%	-106	-44%	CR,M,T2	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	377	190	190	1%	0	0%	-187	-50%	CS,M,OTH	CS
France	4 133	4 621	4 433	29%	-187	-4%	301	7%	-	-
Germany	2 203	2 154	2 176	14%	22	1%	-27	-1%	CS,T3	CS
Greece	307	332	544	4%	212	64%	237	77%	T2	D
Hungary	1	1	1	0%	0	-21%	0	1%	T1	D
Ireland	48	7	7	0%	0	-3%	-41	-85%	T3	CS
Italy	1 579	1 933	1 914	13%	-19	-1%	335	21%	T1,T2	CS
Latvia	0	3	3	0%	0	0%	3	5617%	T1	D
Lithuania	7	1	1	0%	0	0%	-7	-92%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	2	5	4	0%	-1	-18%	2	152%	T1	D
Netherlands	72	35	36	0%	1	4%	-35	-49%	T2	D
Poland	41	104	124	1%	20	20%	83	202%	T1	D
Portugal	227	331	336	2%	5	2%	110	48%	T3	D
Romania	25	132	70	0%	-63	-47%	45	180%	T2	OTH
Slovakia	7	4	4	0%	1	15%	-3	-42%	T3	D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 957	2 609	2 637	17%	28	1%	680	35%	T2	D
Sweden	658	511	510	3%	0	0%	-148	-22%	T1	CS
United Kingdom	1 762	1 942	1 822	12%	-120	-6%	59	3%	T3	CS
EU-28	**13 958**	**15 265**	**15 144**	**100%**	**-121**	**-1%**	**1 186**	**9%**		
Iceland	26	18	38	0%	20	114%	12	46%	T1	D
EU-28 + ISL	**13 984**	**15 283**	**15 183**	**100%**	**-100**	**-1%**	**1 199**	**9%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 85 % of CO_2 emissions and for 86 % of activity data from jet kerosene in 2014 (Figure 3.86). Table **3.55** shows that the majority of emissions from Civil Aviation jet kerosene were calculated using a higher tier method. In Figure 3.85 the IEF is depicted, showing a mean value of 71.9 t/TJ, with Poland having the higher emission factor (73.26 t/TJ) and Greece the lower (around 70.4 t/TJ).

Figure 3.86 1A3a Civil Aviation, Jet Kerosene: Emission trend and share for CO_2

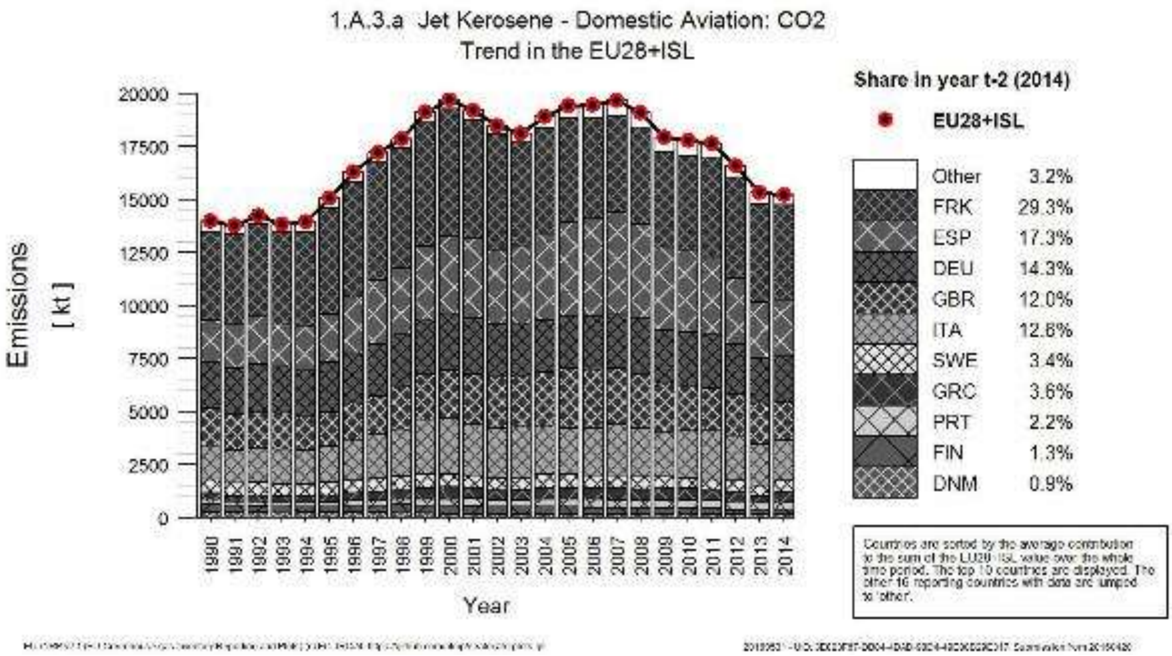
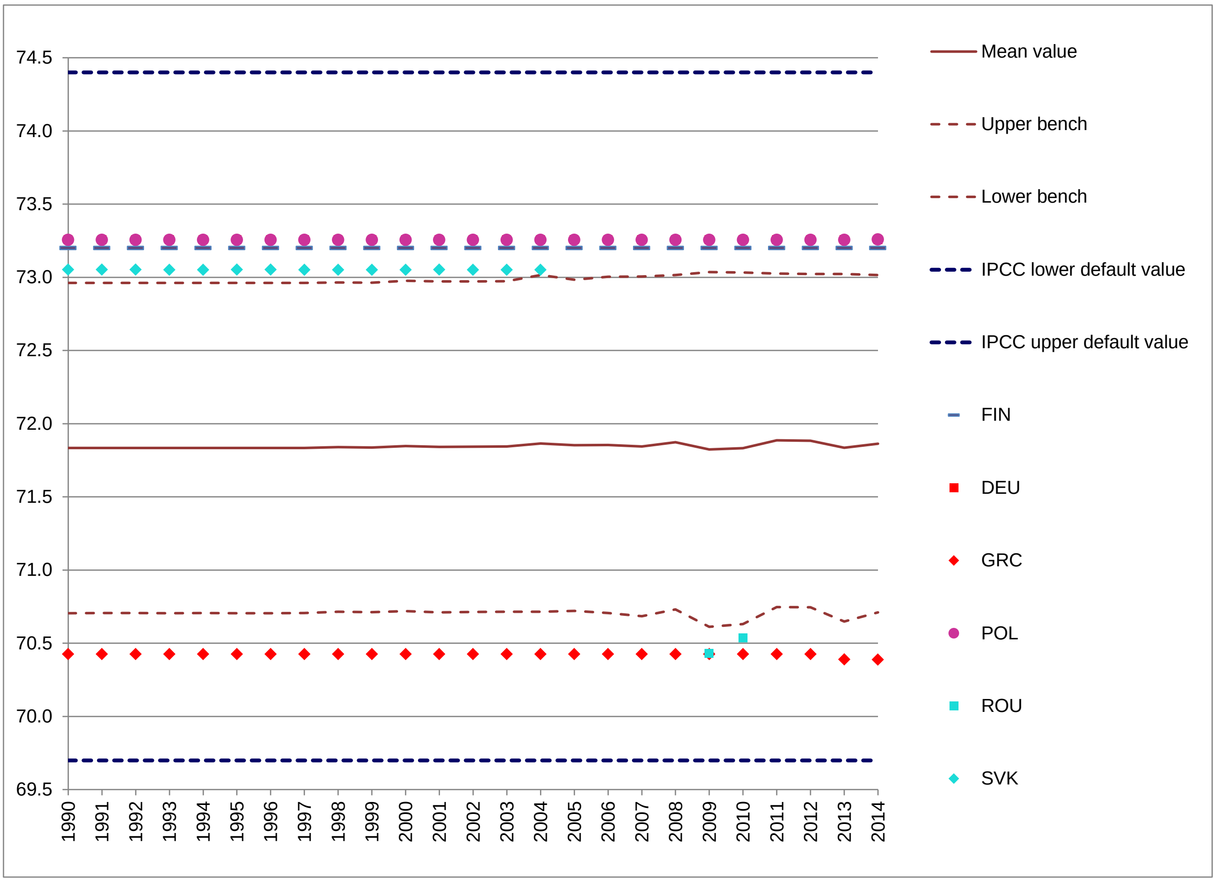


Figure 3.87 1A3a Civil Aviation, Jet Kerosene: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.3.2 **Road Transportation (1A3b) (EU-28+ISL)**

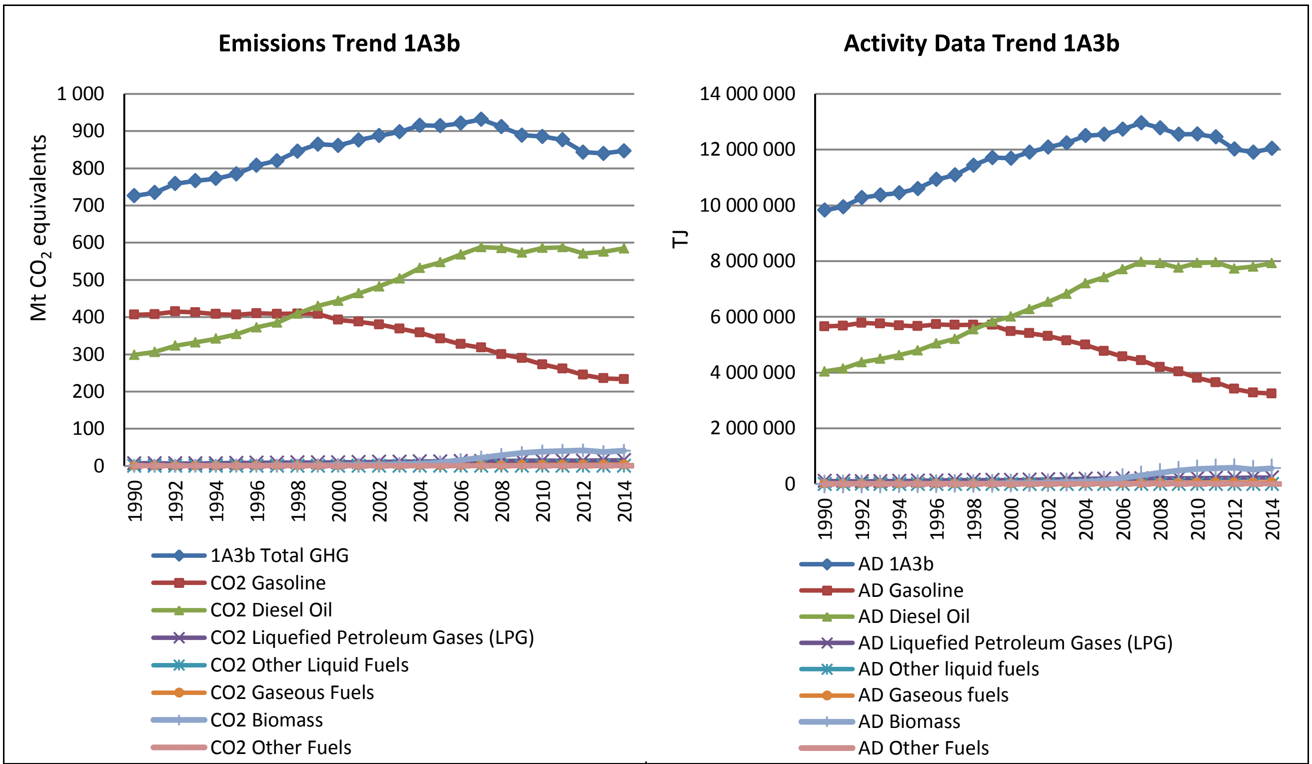
CO_2 emissions from 1A3b Road Transportation

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+ISL accounting for 20 % of total GHG emissions in 2014. Between 1990 and 2014, CO_2 emissions from road transportation increased by 17 % in the EU-28+ISL (Table 3.56). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 23 % between 1990 and 2014.

Figure 3.88 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+ISL Member States.

Figure 3.88 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 (-4%), Finland (-5%), Lithuania (-13%) and Sweden (-6%), show increased emissions from road transportation between 1990 and 2014, whereas the emissions for the United Kingdom remained almost constant in the same period. 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 Germany and Italy (Table 3.56).

Table 3.56 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	13 328	21 831	21 294	3%	-537	-2%	7 966	60%	NA	NA
Belgium	19 493	23 620	24 288	3%	668	3%	4 795	25%	M,NA,T1,T3	NA,OTH
Bulgaria	5 959	6 859	7 945	1%	1 086	16%	1 986	33%	NA,T2	CR,NA
Croatia	3 506	5 404	5 343	1%	-61	-1%	1 837	52%	NA,T1	D,NA,NO
Cyprus	1 167	1 806	1 759	0%	-47	-3%	592	51%	D,T1	D
Czech Republic	6 177	15 619	16 117	2%	498	3%	9 941	161%	NA,T1	CS,D,NA
Denmark	9 284	11 021	11 232	1%	211	2%	1 949	21%	CR,M,T2	CS
Estonia	2 236	2 115	2 142	0%	27	1%	-94	-4%	NA,T1,T2	CS,D,NA
Finland	10 806	11 317	10 249	1%	-1 068	-9%	-557	-5%	M,NA	CS,NA
France	112 226	122 701	122 461	15%	-240	0%	10 235	9%	NA	NA
Germany	151 881	151 124	153 159	18%	2 035	1%	1 278	1%	CS,M,T2,T3	CS,D
Greece	11 826	15 757	15 149	2%	-608	-4%	3 323	28%	T1,T2,T3	CS,D
Hungary	7 718	9 606	10 733	1%	1 127	12%	3 015	39%	NA,T1,T2	CS,D,NA
Ireland	4 690	10 481	10 723	1%	243	2%	6 033	129%	T2,T3	CS,M
Italy	93 379	95 514	97 136	12%	1 622	2%	3 757	4%	NA,T3	CS,NA
Latvia	2 398	2 520	2 663	0%	143	6%	265	11%	NA,T1,T2	CS,D,NA,OTH
Lithuania	5 247	4 078	4 547	1%	469	12%	-700	-13%	NA,T1,T2	CS,D,NA
Luxembourg	2 632	6 310	6 032	1%	-278	-4%	3 401	129%	NA,T1,T2	CS,D,NA
Malta	316	491	534	0%	43	9%	218	69%	NA,NO,T3	CR,NA,NO
Netherlands	26 452	31 136	29 010	3%	-2 126	-7%	2 558	10%	NA,T1,T2	CS,NA
Poland	18 429	42 005	42 229	5%	224	1%	23 800	129%	NO,T1,T2	CS,D,NO
Portugal	9 164	14 681	15 000	2%	318	2%	5 836	64%	NO,T2	D,NO
Romania	10 366	14 043	14 838	2%	795	6%	4 472	43%	NA,T1,T3	D,NA,OTH
Slovakia	4 503	6 078	6 147	1%	69	1%	1 644	37%	M,NA	D,NA
Slovenia	2 599	5 362	5 277	1%	-85	-2%	2 677	103%	M,NA	M,NA
Spain	50 614	73 865	74 814	9%	949	1%	24 200	48%	T3	M,NA
Sweden	17 490	16 697	16 446	2%	-250	-2%	-1 044	-6%	T1	CS
United Kingdom	108 568	107 116	108 533	13%	1 417	1%	-36	0%	NA,T1,T3	CS,NA,OTH
EU-28	**712 454**	**829 155**	**835 799**	**100%**	**6 644**	**1%**	**123 346**	**17%**		
Iceland	509	787	765	0%	-23	-3%	256	50%	NA	NA
EU-28 + ISL	**712 962**	**829 942**	**836 564**	**100%**	**6 622**	**1%**	**123 601**	**17%**		

In Table 3.57 the fuel share is presented per Member State. It is obvious that diesel oil accounts for 66 % for EU-28+ISL and gasoline for 27 %. The highest LPG consumption is observed in Bulgaria (16 %) and Poland (12 %). The share of biomass is around 5 % for EU-28+ISL with Finland having the highest percentage (13 %).

Table 3.57 1A3b Road Transport: Member States' share of different fuel in the total consumption

Member State	Gasoline (%)	Diesel oil (%)	LPG (%)	Gaseous fuels (%)	Biomass (%)
Austria	20.5%	72.6%	0.3%	0.2%	6.4%
Belgium	15.2%	79.5%	0.6%	0.02%	4.7%
Bulgaria	19.1%	57.6%	15.9%	3.7%	3.7%
Croatia	30.8%	63.5%	3.8%	0.2%	1.7%
Cyprus	60.4%	38.4%	NO	NO	1.2%
Czech Republic	27.4%	65.1%	1.5%	0.4%	5.6%
Denmark	32.3%	62.2%	0.001%	NO	5.5%
Estonia	34.4%	64.9%	0.03%	NO	0.7%
Finland	34.6%	52.5%	NA,NO	0.1%	12.9%
France	15.9%	77.2%	0.2%	0.2%	6.5%

Member State	Gasoline (%)	Diesel oil (%)	LPG (%)	Gaseous fuels (%)	Biomass (%)
Germany	34.0%	59.6%	1.0%	0.3%	5.1%
Greece	51.8%	40.9%	4.4%	0.3%	2.6%
Hungary	32.7%	61.2%	0.8%	0.03%	5.2%
Ireland	30.9%	65.8%	0.1%	NO	3.2%
Italy	24.2%	64.9%	5.2%	2.6%	3.1%
Latvia	23.0%	67.7%	7.1%	NO	2.2%
Lithuania	13.1%	73.5%	9.1%	0.3%	4.1%
Luxembourg	15.6%	84.3%	0.1%	NO	NO,IE
Malta	42.4%	54.7%	0.2%	NO,IE	2.7%
Netherlands	39.1%	55.4%	1.7%	0.4%	3.5%
Poland	24.1%	59.6%	11.6%	NO	4.6%
Portugal	21.9%	72.2%	0.7%	0.2%	5.0%
Romania	27.8%	67.6%	1.2%	NO	3.4%
Slovakia	22.7%	69.0%	1.6%	0.4%	6.3%
Slovenia	25.8%	71.0%	0.7%	0.1%	2.4%
Spain	18.0%	77.5%	0.1%	0.4%	4.0%
Sweden	38.6%	48.9%	NO	0.9%	11.6%
United Kingdom	34.3%	62.2%	0.3%	IE	3.3%
EU-28	**27%**	**65.8%**	**2%**	**0.5%**	**4.7%**
Iceland	30.9%	65.8%	0.1%	NO	3.2%
EU-28 + ISL	**27%**	**65.8%**	**2%**	**0.5%**	**4.7%**

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 70 % of CO_2 emissions from 1A3b Road Transport in 2014 (Figure 3.88). All Member States show increased emissions from Diesel oil between 1990 and 2014 (Table 3.58). 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 3.58 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	5 378	16 877	16 471	3%	-406	-2%	11 093	206%
Belgium	10 964	20 043	20 405	3%	362	2%	9 441	86%
Bulgaria	1 550	4 217	4 935	1%	719	17%	3 386	219%
Croatia	1 159	3 489	3 545	1%	56	2%	2 386	206%
Cyprus	667	735	712	0%	-22	-3%	45	7%
Czech Republic	2 690	10 843	11 365	2%	522	5%	8 676	323%
Denmark	4 436	7 180	7 430	1%	250	3%	2 994	67%
Estonia	697	1 391	1 402	0%	11	1%	704	101%
Finland	4 923	7 096	6 189	1%	-907	-13%	1 266	26%
France	54 339	102 162	102 202	17%	39	0%	47 863	88%
Germany	54 478	95 023	96 791	17%	1 768	2%	42 314	78%
Greece	4 297	6 742	6 400	1%	-342	-5%	2 104	49%
Hungary	2 388	6 093	7 004	1%	911	15%	4 615	193%
Ireland	1 914	6 972	7 399	1%	427	6%	5 485	287%
Italy	47 776	64 203	65 904	11%	1 701	3%	18 128	38%
Latvia	616	1 742	1 880	0%	138	8%	1 264	205%
Lithuania	2 134	3 028	3 520	1%	492	16%	1 386	65%
Luxembourg	1 343	5 321	5 083	1%	-238	-4%	3 740	278%
Malta	142	259	300	0%	41	16%	158	111%
Netherlands	13 023	18 542	16 903	3%	-1 639	-9%	3 880	30%
Poland	8 615	26 757	27 121	5%	364	1%	18 506	215%
Portugal	5 009	11 260	11 580	2%	319	3%	6 570	131%
Romania	3 648	10 147	10 643	2%	496	5%	6 995	192%
Slovakia	3 123	4 416	4 599	1%	183	4%	1 476	47%
Slovenia	904	3 889	3 908	1%	20	1%	3 004	332%
Spain	24 504	59 559	60 677	10%	1 118	2%	36 173	148%
Sweden	4 723	9 056	9 125	2%	70	1%	4 402	93%
United Kingdom	33 006	68 387	70 669	12%	2 282	3%	37 664	114%
EU-28	**298 445**	**575 428**	**584 162**	**100%**	**8 735**	**2%**	**285 717**	**96%**
Iceland	117	373	359	0%	-14	-4%	243	208%
EU-28 + ISL	**298 561**	**575 801**	**584 521**	**100%**	**8 721**	**2%**	**285 960**	**96%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 67 % of CO_2 emissions and for 68 % of activity data from diesel oil in 2014 (). **In Figure 3.89 the IEF is depicted and** the mean value is around 73.8 t/TJ. For some Member States the values of the IEF is outside the range of the upper and lower IPCC default value. This is due to the fact that in most cases these IEF are country specific.

Figure 3.90). In Figure 3.89 the IEF is depicted and the mean value is around 73.8 t/TJ. For some Member States the values of the IEF is outside the range of the upper and lower IPCC default value. This is due to the fact that in most cases these IEF are country specific.

Figure 3.90 1A3b Road Transport, Diesel Oil: Emission trend and share for CO_2

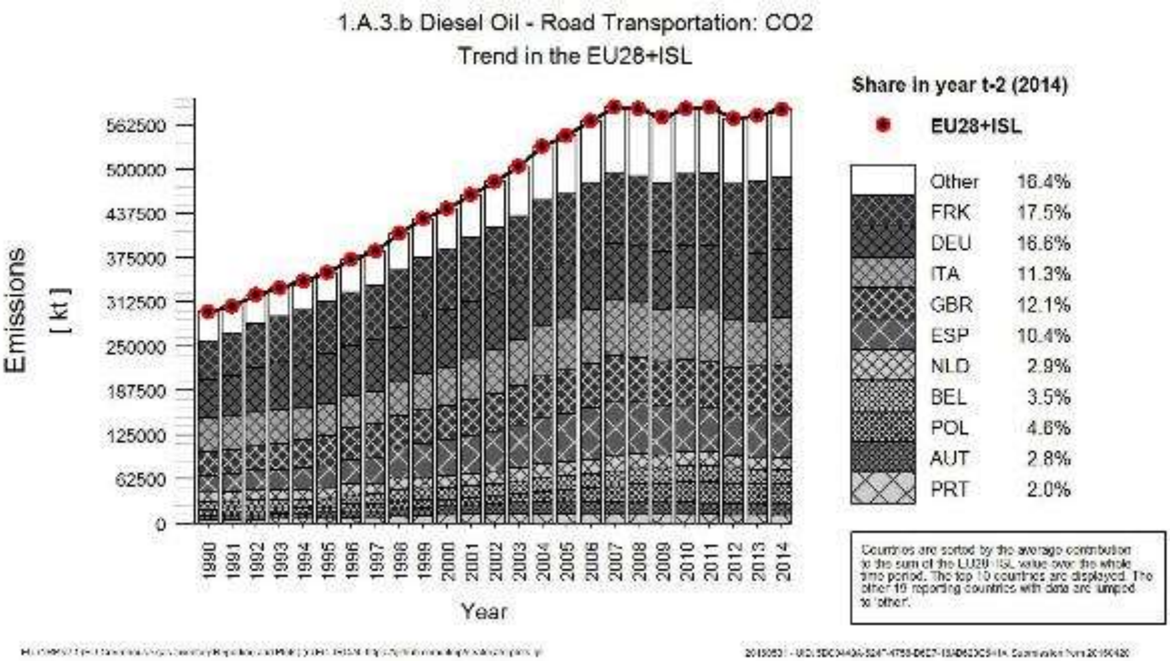
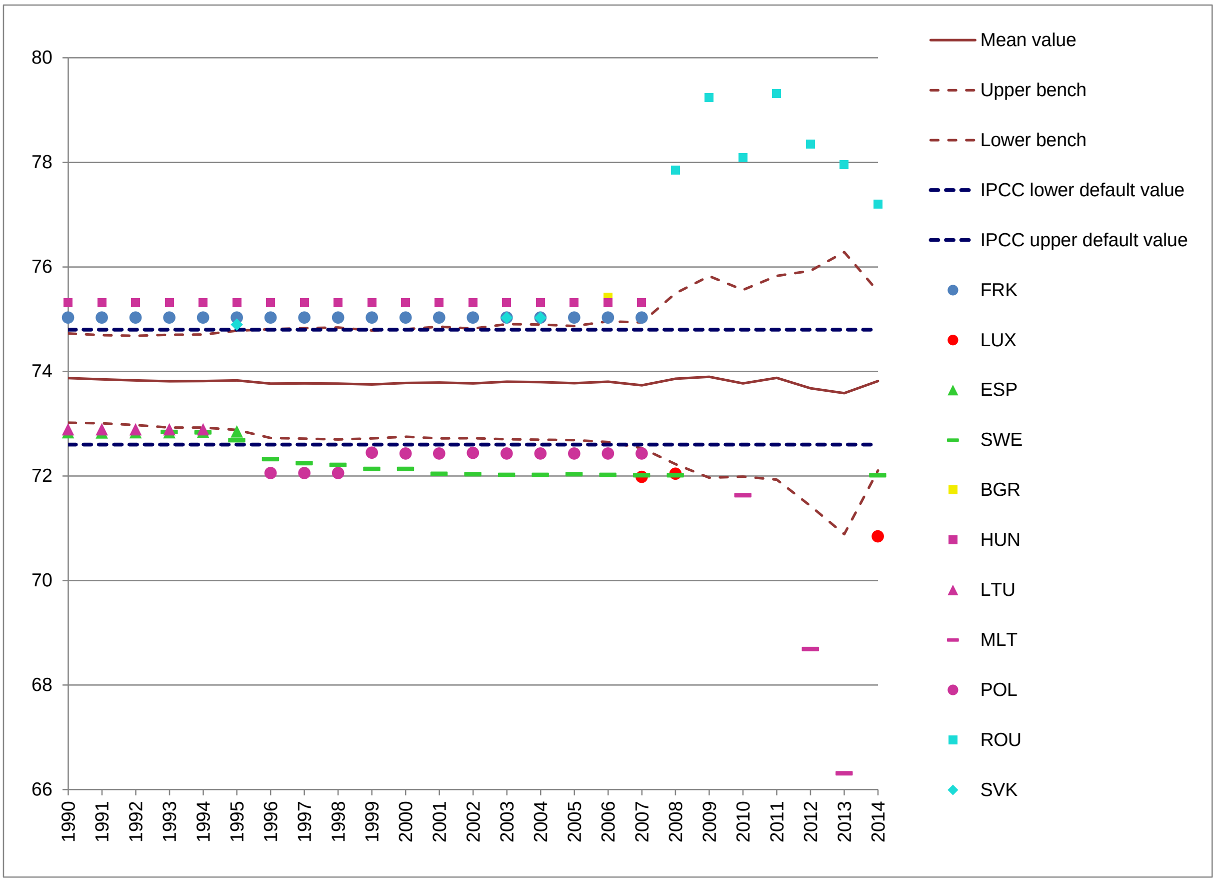


Figure 3.91 1A3b Road Transport, Diesel Oil: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2014, CO_2 emissions from gasoline decreased by 43 % in the EU-28+ISL (Table 3.59).

Table 3.59 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	7 924	4 861	4 734	2%	-127	-3%	-3 190	-40%
Belgium	8 360	3 459	3 751	2%	292	8%	-4 609	-55%
Bulgaria	4 409	1 357	1 575	1%	218	16%	-2 834	-64%
Croatia	2 347	1 745	1 610	1%	-135	-8%	-737	-31%
Cyprus	500	1 071	1 047	0%	-25	-2%	546	109%
Czech Republic	3 487	4 527	4 468	2%	-58	-1%	981	28%
Denmark	4 838	3 841	3 802	2%	-38	-1%	-1 036	-21%
Estonia	1 530	723	740	0%	17	2%	-790	-52%
Finland	5 883	4 215	4 054	2%	-161	-4%	-1 829	-31%
France	57 726	20 005	19 753	8%	-252	-1%	-37 973	-66%
Germany	97 217	54 171	54 455	23%	284	1%	-42 762	-44%
Greece	7 438	8 421	8 113	3%	-308	-4%	675	9%
Hungary	5 329	3 424	3 646	2%	222	6%	-1 683	-32%
Ireland	2 758	3 505	3 318	1%	-187	-5%	561	20%
Italy	41 094	24 721	24 440	10%	-281	-1%	-16 654	-41%
Latvia	1 724	626	613	0%	-13	-2%	-1 110	-64%
Lithuania	3 053	638	626	0%	-13	-2%	-2 427	-80%
Luxembourg	1 277	986	946	0%	-40	-4%	-332	-26%
Malta	174	232	234	0%	1	1%	60	34%
Netherlands	10 776	11 893	11 554	5%	-339	-3%	778	7%
Poland	9 814	10 669	10 545	5%	-124	-1%	731	7%
Portugal	4 154	3 296	3 295	1%	-1	0%	-860	-21%
Romania	6 591	3 756	4 040	2%	284	8%	-2 550	-39%
Slovakia	1 380	1 539	1 426	1%	-113	-7%	45	3%
Slovenia	1 695	1 438	1 331	1%	-108	-7%	-364	-21%
Spain	26 031	14 019	13 808	6%	-211	-2%	-12 223	-47%
Sweden	12 764	7 515	7 191	3%	-324	-4%	-5 573	-44%
United Kingdom	75 562	38 452	37 604	16%	-848	-2%	-37 959	-50%
EU-28	**405 837**	**235 107**	**232 719**	**100%**	**-2 388**	**-1%**	**-173 117**	**-43%**
Iceland	392	414	405	0%	-9	-2%	13	3%
EU-28 + ISL	**406 229**	**235 521**	**233 125**	**100%**	**-2 397**	**-1%**	**-173 104**	**-43%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 63 % for CO_2 emissions and for 64 % of activity data from gasoline in 2014 (Table 3.59).

In Figure 3.92 the mean value is around 71.5 t/TJ. For some Member States the values of the IEF are outside the range of the upper IPCC default value (such as Austria and Malta). This is due to the fact that in most cases these IEF are country specific.

Figure 3.92 1A3b Road Transport, Gasoline: Emission trend and share for CO_2

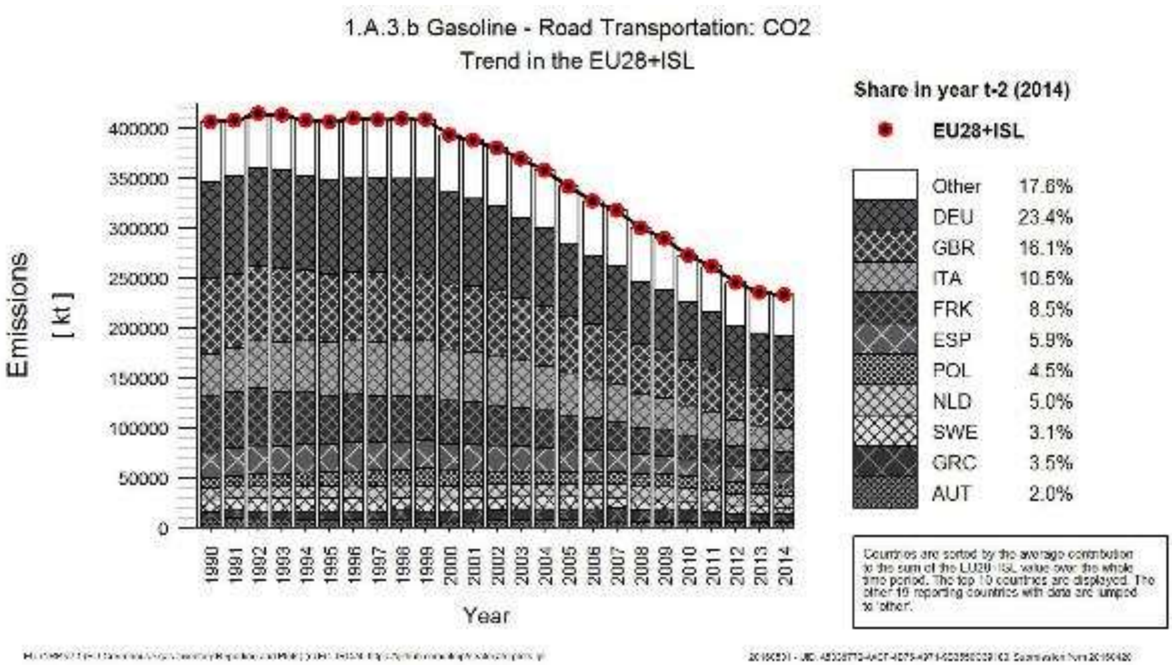
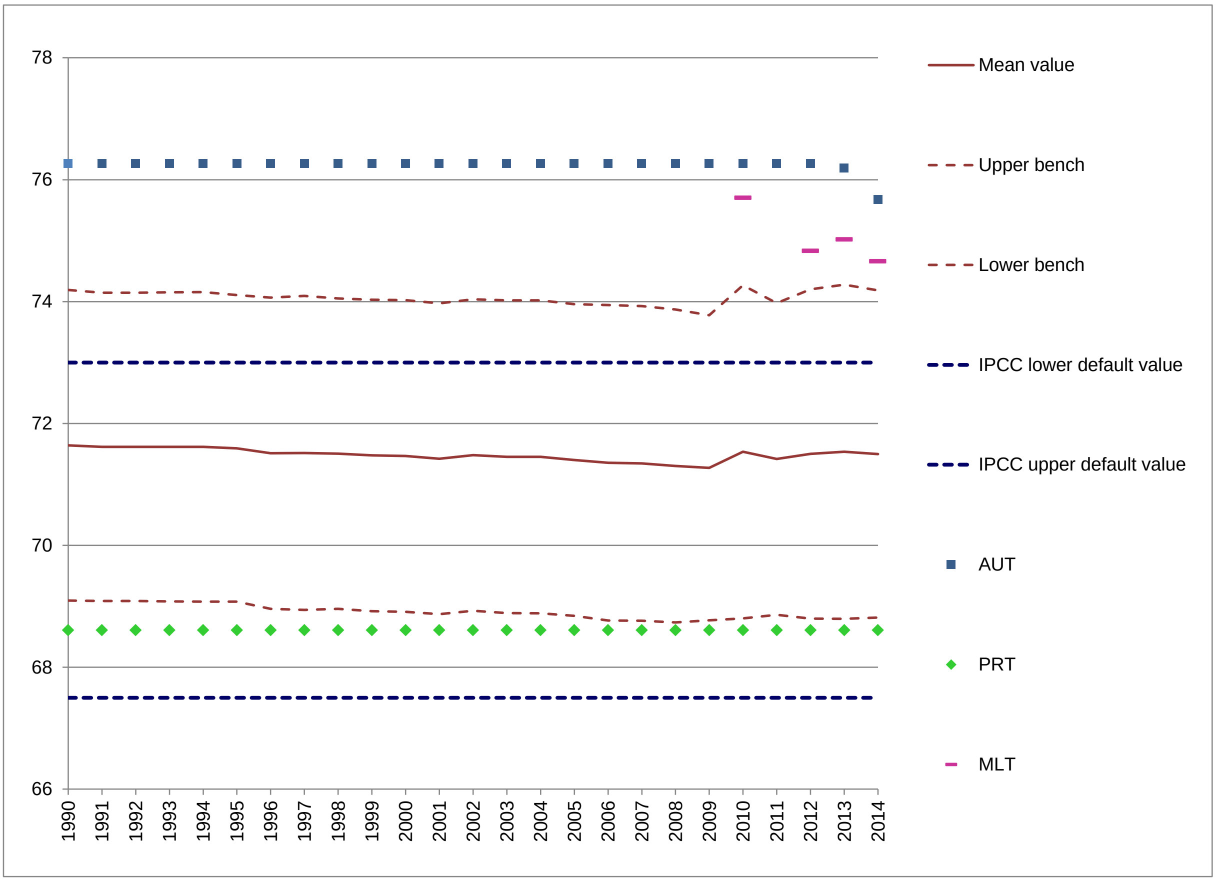


Figure 3.93 1A3b Road Transport, Gasoline: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A3b Road Transportation – LPG (CO_2)

Between 1990 and 2014, CO_2 emissions from LPG increased by 108 % in the EU-28+ISL. Three Member States report emissions as ‘Not occurring’. Between 2013 and 2014 EU-28+ISL emissions remained almost constant (Table 3.60).

Table 3.60 1A3b Road Transport, LPG: Member States’ contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	26	57	50	0%	-7	-12%	24	91%
Belgium	169	116	127	1%	11	9%	-42	-25%
Bulgaria	NO	1 098	1 198	8%	100	9%	1 198	100%
Croatia	NO	167	180	1%	14	8%	180	100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	IE,NO	209	227	1%	18	9%	227	100%
Denmark	9	0	0	0%	0	-5%	-9	-99%
Estonia	9	0	1	0%	0	43%	-8	-93%
Finland	NO,NA	NO,NA	NA,NO	-	-	-	-	-
France	150	307	274	2%	-33	-11%	124	82%
Germany	9	1 510	1 488	10%	-21	-1%	1 479	16351%
Greece	91	562	600	4%	38	7%	509	561%
Hungary	NO	86	80	1%	-6	-7%	80	100%
Ireland	19	3	6	0%	2	62%	-13	-70%
Italy	4 026	4 655	4 736	31%	82	2%	710	18%
Latvia	37	148	165	1%	17	12%	128	347%
Lithuania	60	402	390	3%	-12	-3%	330	548%
Luxembourg	11	3	4	0%	1	15%	-7	-64%
Malta	NO,IE	0	1	0%	1	176%	1	100%
Netherlands	2 654	637	464	3%	-173	-27%	-2 189	-82%
Poland	NO	4 578	4 562	30%	-16	0%	4 562	100%
Portugal	0	96	97	1%	0	0%	97	157956%
Romania	NO	139	154	1%	15	11%	154	100%
Slovakia	NO	101	92	1%	-9	-9%	92	100%
Slovenia	NO	33	35	0%	2	5%	35	100%
Spain	79	94	106	1%	12	13%	27	35%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	NO	277	259	2%	-18	-6%	259	100%
EU-28	**7 349**	**15 281**	**15 299**	**100%**	**18**	**0%**	**7 950**	**108%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**7 349**	**15 281**	**15 299**	**100%**	**18**	**0%**	**7 950**	**108%**

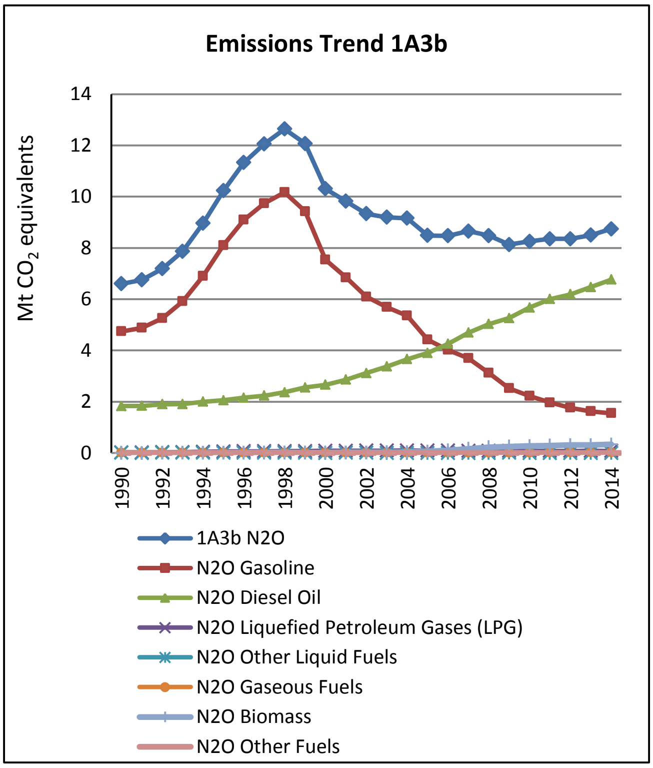
Abbreviations explained in the Chapter ‘Units and abbreviations’.

France, Germany, Italy, Spain and the United Kingdom account for 46 % of CO_2 emissions, whereas Italy accounts for 31 % and Poland for 30 % of CO_2 emissions from LPG in 2014 (Table 3.60).

N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.2 % of total EU-28+ISL GHG emissions in 2014. Figure 3.94 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 3.94 1A3b Road Transport: N_2O Emissions Trend



N_2O emissions increased between 1990 and 2014 by 32 % (Table 3.62). 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+ISL 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.).

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 3.61.

Table 3.61: 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 3.62 1A3b Road Transport: 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	114	182	185	2%	3	2%	71	62%	NA	NA
Belgium	196	244	256	3%	12	5%	61	31%	M,NA,T3	CS,NA,OTH
Bulgaria	53	60	69	1%	9	15%	16	29%	NA,T2	CR,NA
Croatia	39	46	46	1%	0	0%	7	19%	NA,T1,T3	CR,D,NA,NO
Cyprus	28	49	48	1%	-1	-3%	20	72%	T1	D
Czech Republic	137	599	610	7%	11	2%	474	347%	NA,T1,T2	CS,D,NA
Denmark	89	115	121	1%	6	6%	32	36%	CR,M,T3	CR
Estonia	22	18	18	0%	0	1%	-3	-15%	NA,T1,T3	CS,D,NA
Finland	154	70	72	1%	2	2%	-82	-53%	M,NA	D,NA
France	892	1 455	1 487	17%	32	2%	595	67%	NA	NA
Germany	1 113	1 419	1 453	17%	34	2%	340	31%	CS,M,T2,T3	CS,M
Greece	118	113	109	1%	-4	-4%	-8	-7%	M,T1	D,M
Hungary	69	90	104	1%	15	16%	35	51%	NA,T1,T3	D,M,NA
Ireland	48	99	102	1%	3	4%	54	111%	T3	M
Italy	845	850	862	10%	12	1%	17	2%	NA,T3	M,NA
Latvia	19	25	27	0%	3	11%	8	43%	NA,T1,T2	CR,NA,OTH
Lithuania	39	35	35	0%	0	0%	-4	-10%	NA,T1,T3	CR,D,NA
Luxembourg	16	49	49	1%	0	1%	33	207%	NA,T3	M,NA
Malta	5	10	10	0%	0	3%	5	116%	NA,NO,T3	CR,NA,NO
Netherlands	98	255	237	3%	-18	-7%	139	142%	NA,T1,T2	CS,D,NA
Poland	180	532	544	6%	12	2%	364	203%	NO,T1	D,NO
Portugal	64	136	139	2%	3	2%	75	116%	NO,T3	CR,NO
Romania	227	140	165	2%	25	18%	-62	-27%	NA,T1,T3	D,NA,OTH
Slovakia	56	55	52	1%	-2	-4%	-4	-7%	M,NA	D,NA
Slovenia	31	52	51	1%	0	-1%	21	67%	M,NA	M,NA
Spain	474	721	752	9%	30	4%	278	59%	T3	M
Sweden	154	131	137	2%	6	4%	-17	-11%	M,NA	CS,D,M,NA
United Kingdom	1 311	918	970	11%	52	6%	-341	-26%	NA,T3	CR,CS,NA
EU-28	**6 589**	**8 467**	**8 711**	**100%**	**244**	**3%**	**2 123**	**32%**		
Iceland	15	34	34	0%	-1	-2%	19	127%	NA	NA
EU-28 + ISL	**6 603**	**8 501**	**8 745**	**100%**	**244**	**3%**	**2 142**	**32%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 77 % of N_2O emissions from 1A3b "Road Transportation" in 2014. Between 1990 and 2014 N_2O emissions from Diesel oil increased in all Member States, except for Finland (decrease by 33 %) and Slovakia (decrease by 12 %); within the EU-28+ISL the emission increased by 269 %. The smallest increase in absolute terms was reported by Cyprus, Greece, Lithuania and Malta. Between 2013 and 2014, EU-28+ISL emissions rose by 5 % (Table 3.63).

Table 3.63 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	13	166	171	3%	5	3%	158	1189%
Belgium	59	219	229	3%	10	4%	170	287%
Bulgaria	13	28	34	0%	6	21%	21	166%
Croatia	10	29	30	0%	2	6%	20	200%
Cyprus	10	12	11	0%	0	-3%	1	7%
Czech Republic	30	226	238	4%	12	5%	208	694%
Denmark	33	87	96	1%	8	10%	63	193%
Estonia	7	13	14	0%	1	5%	6	90%
Finland	65	46	44	1%	-2	-5%	-22	-33%
France	255	1 184	1 218	18%	34	3%	963	378%
Germany	119	1 173	1 214	18%	41	3%	1 095	917%
Greece	39	48	43	1%	-4	-9%	4	10%
Hungary	21	59	71	1%	13	21%	50	237%
Ireland	13	75	80	1%	5	7%	67	506%
Italy	339	651	679	10%	28	4%	340	100%
Latvia	6	17	19	0%	2	14%	14	248%
Lithuania	19	21	22	0%	1	6%	3	15%
Luxembourg	3	45	46	1%	1	2%	43	1639%
Malta	2	4	4	0%	0	10%	2	92%
Netherlands	23	182	174	3%	-8	-5%	150	643%
Poland	113	394	406	6%	12	3%	294	261%
Portugal	16	102	108	2%	5	5%	92	576%
Romania	31	97	107	2%	10	11%	76	248%
Slovakia	41	36	36	1%	1	2%	-5	-12%
Slovenia	11	41	43	1%	2	5%	33	308%
Spain	201	647	678	10%	31	5%	477	237%
Sweden	14	90	99	1%	9	10%	85	628%
United Kingdom	323	776	844	12%	68	9%	521	161%
EU-28	**1 831**	**6 469**	**6 760**	**100%**	**292**	**5%**	**4 930**	**269%**
Iceland	2	6	6	0%	0	-4%	4	208%
EU-28 + ISL	**1 832**	**6 474**	**6 766**	**100%**	**292**	**5%**	**4 934**	**269%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 68 % of N_2O emissions and for 68 % of activity data from diesel oil in 2014 (Figure 3.96). In Figure 3.95 the IEF is depicted and the mean value is around 2 kg/TJ. In most cases the IEF is country specific, with the exeption of Iceland where the default emission factor was used (3.9 kg/TJ), thus a variation in the values of the IEF through the timeseries is observed.

Figure 3.96 1A3b Road Transport, diesel oil: Emission trend and share for N_2O emission

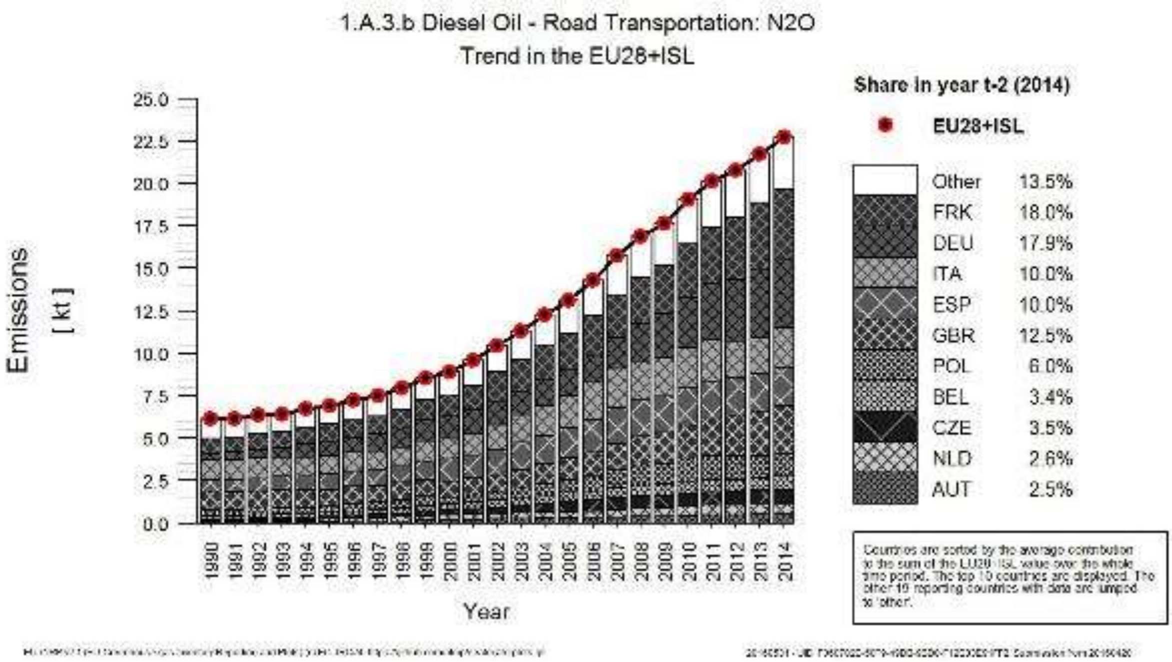
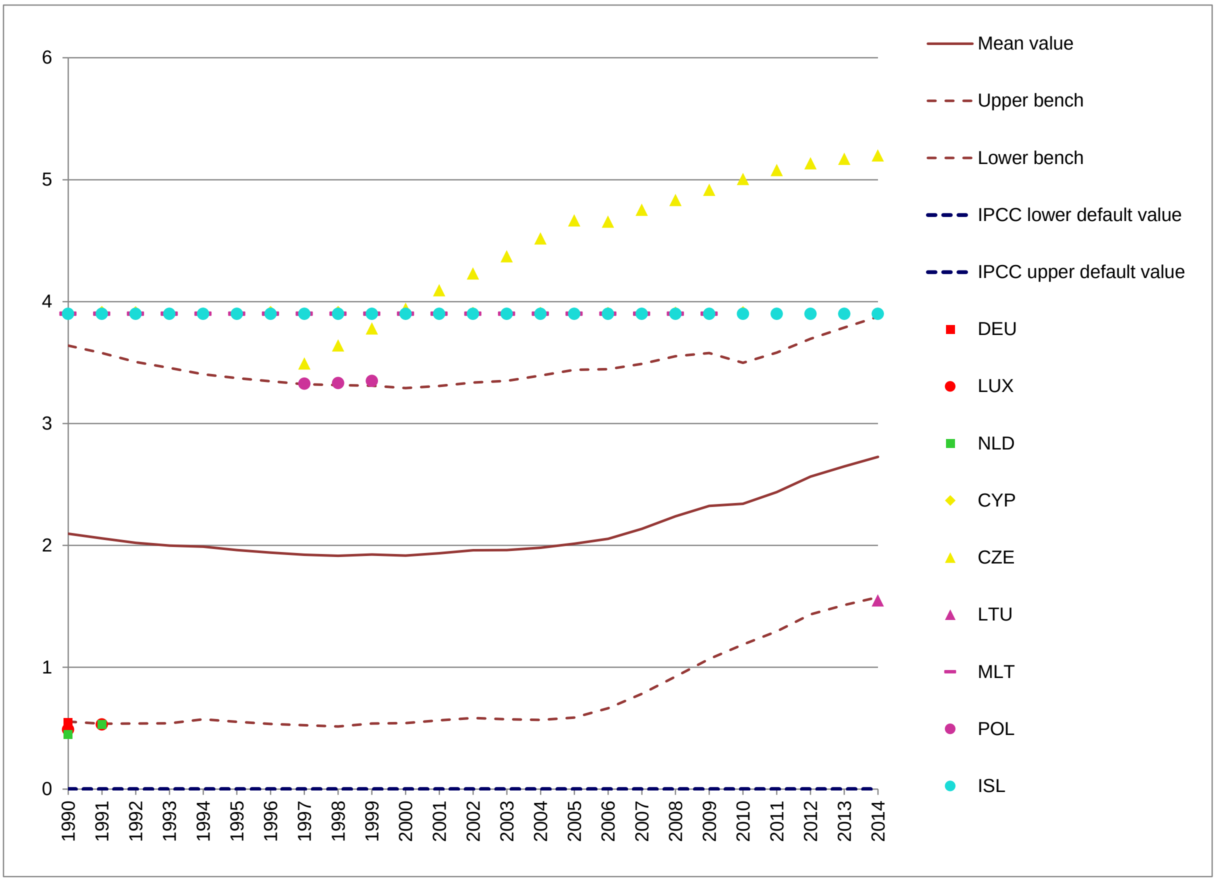


Figure 3.97 1A3b Road Transport, Diesel Oil: Overview of outliers of Implied Emission Factors for N_2O (in kg/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A3b Road Transportation – Gasoline (N_2O)

N_2O emissions from Gasoline account for 18 % of N_2O emissions from 1A3b Road Transportation in 2014. Between 1990 and 2014, N_2O emissions from gasoline decreased by 67 % in the EU-28+ISL 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 2013 and 2014, all Member States, except for Czech Republic and Poland (emissions remained almost constant) and Bulgaria (emissions rose by 14 %), Hungary (emissions rose by 1 %) and Romania (emissions rose by 51 %), showed a decreasing trend. The EU-28+ISL total N_2O emissions dropped by 4 % (Table 3.64).

Table 3.64 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	100	15	13	1%	-2	-12%	-87	-87%
Belgium	135	12	12	1%	0	-2%	-124	-91%
Bulgaria	41	15	17	1%	2	14%	-24	-58%
Croatia	29	15	13	1%	-1	-10%	-15	-54%
Cyprus	17	37	36	2%	-1	-2%	19	109%
Czech Republic	107	371	369	24%	-2	0%	262	246%
Denmark	56	20	18	1%	-3	-12%	-38	-68%
Estonia	14	5	5	0%	-1	-10%	-10	-67%
Finland	88	20	17	1%	-2	-11%	-71	-80%
France	637	171	154	10%	-17	-10%	-483	-76%
Germany	994	159	148	10%	-11	-7%	-846	-85%
Greece	78	59	58	4%	-1	-1%	-20	-25%
Hungary	48	26	26	2%	0	1%	-22	-45%
Ireland	35	21	18	1%	-2	-12%	-17	-48%
Italy	502	132	124	8%	-9	-7%	-378	-75%
Latvia	13	5	5	0%	0	-2%	-8	-65%
Lithuania	19	9	8	0%	-1	-12%	-11	-60%
Luxembourg	13	3	3	0%	0	-9%	-10	-77%
Malta	2	6	6	0%	0	-3%	3	136%
Netherlands	58	61	51	3%	-10	-17%	-7	-12%
Poland	67	128	128	8%	0	0%	61	91%
Portugal	48	25	23	1%	-3	-10%	-26	-53%
Romania	196	32	48	3%	16	51%	-148	-76%
Slovakia	15	15	11	1%	-4	-25%	-4	-26%
Slovenia	20	5	4	0%	-1	-27%	-16	-80%
Spain	273	69	68	4%	-2	-2%	-205	-75%
Sweden	140	20	18	1%	-2	-12%	-122	-87%
United Kingdom	988	140	124	8%	-16	-11%	-863	-87%
EU-28	**4 734**	**1 596**	**1 524**	**98%**	**-71**	**-4%**	**-3 209**	**-68%**
Iceland	13	29	28	2%	-1	-2%	15	116%
EU-28 + ISL	**4 747**	**1 624**	**1 552**	**100%**	**-72**	**-4%**	**-3 194**	**-67%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom accounted for 40 % of N_2O emissions, whereas Czech Republic accounts for 24 % of N_2O emissions from gasoline in

2014 (Figure **3.99**). In Figure 3.98 the IEF is depicted and it is obvious that high variability exists for all Member States through the whole time series.

Figure 3.99 1A3b Road Transport, Gasoline: Emission trend and share for N_2O emissions

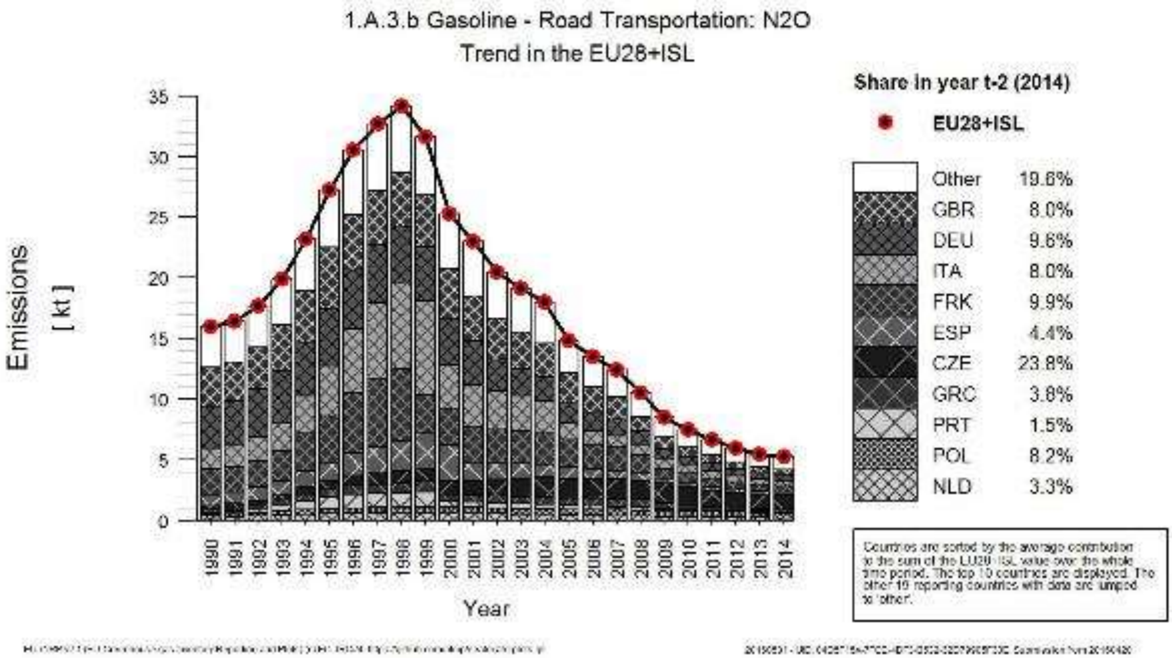
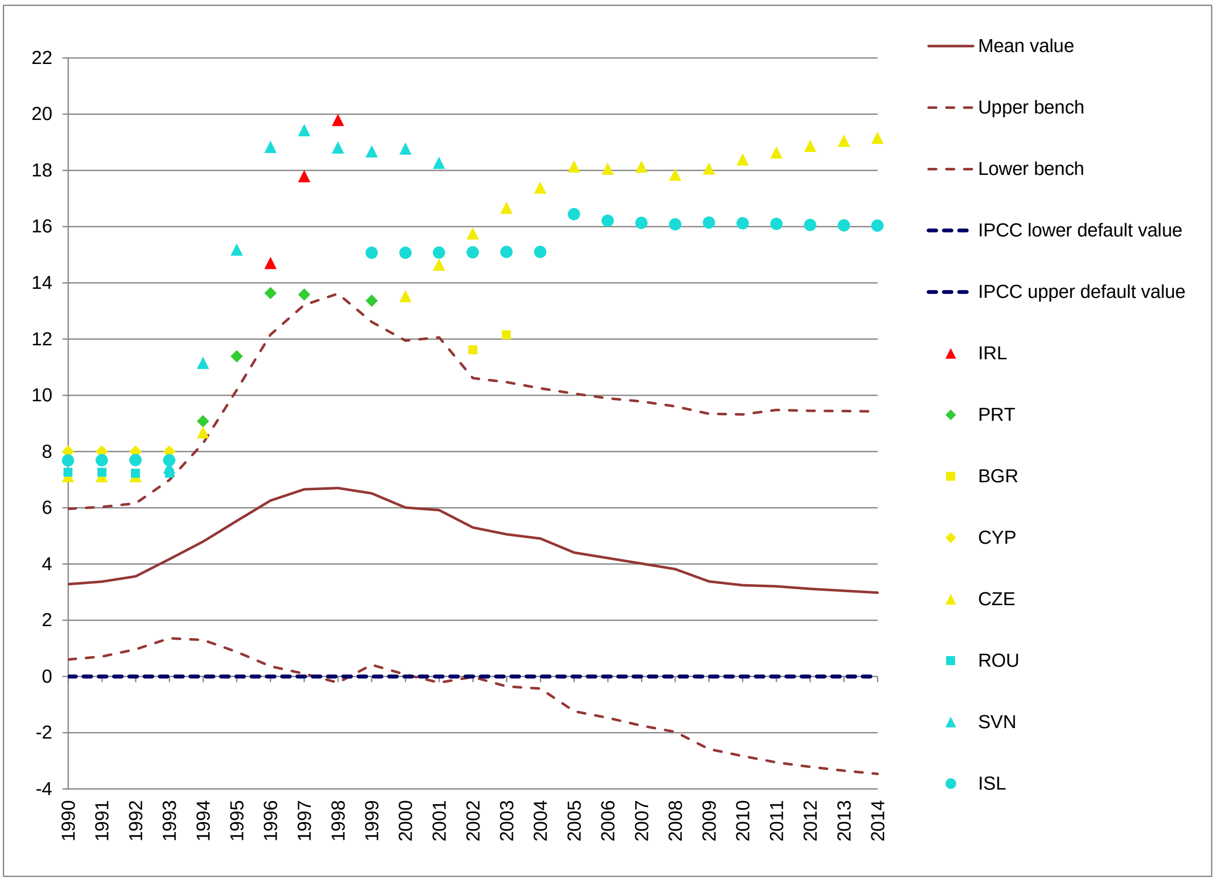


Figure 3.100 1A3b Road Transport, Gasoline: Overview of outliers of Implied Emission Factors for N_2O (in kg/TJ)



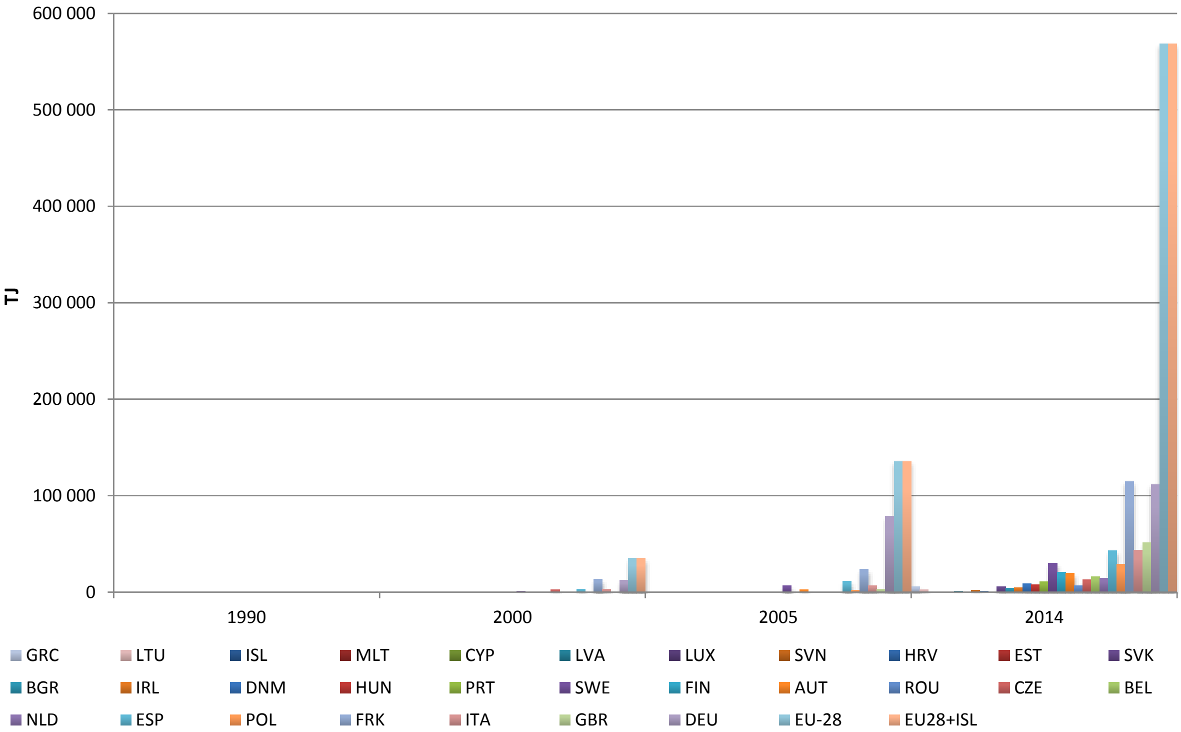
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 2014, activity data of biofuels increased from 41.12 TJ to 568 778 TJ in the EU-28+ISL (Figure 3.101). France reports most of total amount of biofuels (20.1 % of total EU-28+ISL activity in 2014), followed by Germany (19.6 %). All Member States but Luxembourg report biofuels activity data under 1A3b for 2014.

Figure 3.101   1A3b Road Transport, Biofuels: Trend of Activity data of Biofuels

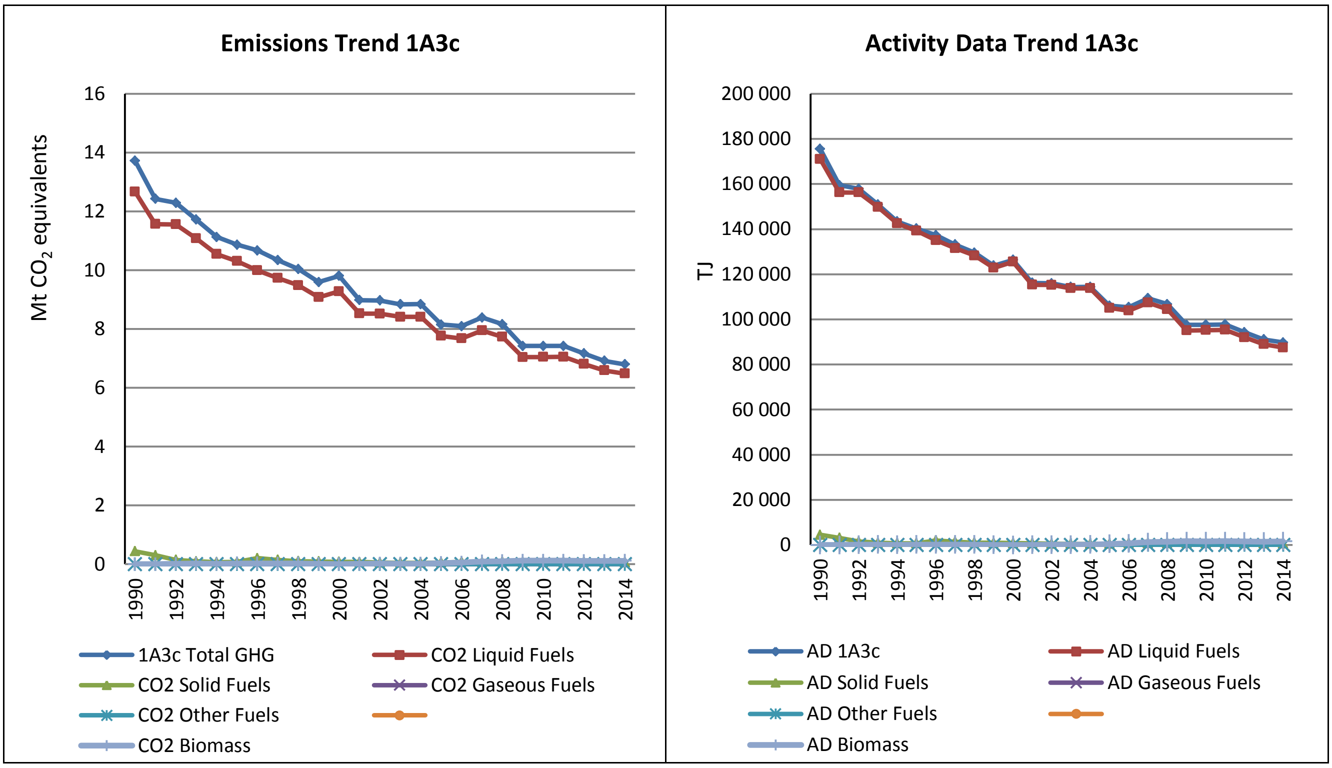


3.2.3.3 Railways (1A3c) (EU-28+ISL)

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 0.2 % of total EU-28+ISL GHG emissions in 2014. Between 1990 and 2014, CO_2 emissions from rail transportation decreased by 50 % in the EU-28+ISL. The total trend is dominated by CO_2 emissions from liquid fuels (Figure 3.102). The emissions from this key category are due to fossil fuel consumption in rail transport, which decreased by 49 % between 1990 and 2014.

Figure 3.102 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 (54 %). Between 1990 and 2014, Germany had by far the highest decreases in absolute terms (Table 3.65).

Table 3.65 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	178	114	118	2%	4	4%	-60	-34%
Belgium	222	88	88	1%	0	0%	-134	-60%
Bulgaria	323	47	37	1%	-9	-20%	-285	-88%
Croatia	140	74	66	1%	-8	-10%	-74	-53%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	654	271	274	4%	3	1%	-380	-58%
Denmark	297	248	252	4%	4	2%	-45	-15%
Estonia	154	81	61	1%	-20	-25%	-93	-60%
Finland	191	93	85	1%	-8	-9%	-106	-56%
France	1 070	461	459	7%	-3	-1%	-612	-57%
Germany	2 901	1 050	1 042	16%	-8	-1%	-1 859	-64%
Greece	199	56	135	2%	78	139%	-64	-32%
Hungary	524	149	159	2%	9	6%	-366	-70%
Ireland	133	118	108	2%	-10	-8%	-25	-19%
Italy	441	60	57	1%	-3	-5%	-384	-87%
Latvia	531	223	214	3%	-9	-4%	-318	-60%
Lithuania	350	166	174	3%	8	5%	-176	-50%
Luxembourg	25	9	10	0%	1	15%	-15	-59%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	91	83	85	1%	2	3%	-6	-6%
Poland	1 638	322	318	5%	-4	-1%	-1 321	-81%
Portugal	175	30	31	0%	2	5%	-144	-82%
Romania	452	509	339	5%	-170	-33%	-113	-25%
Slovakia	377	83	78	1%	-5	-6%	-299	-79%
Slovenia	65	32	41	1%	9	30%	-24	-37%
Spain	414	239	243	4%	4	2%	-171	-41%
Sweden	101	51	47	1%	-4	-8%	-55	-54%
United Kingdom	1 455	1 994	2 021	31%	27	1%	566	39%
EU-28	**13 102**	**6 650**	**6 541**	**100%**	**-109**	**-2%**	**-6 561**	**-50%**
Iceland	NO,NA	NO,NA	NO	-	-	-	-	-
EU-28 + ISL	**13 102**	**6 650**	**6 541**	**100%**	**-109**	**-2%**	**-6 561**	**-50%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2014, CO_2 emissions from liquid fuels decreased by 49 % in the EU-28+ISL. Between 2013 and 2014, EU-28+ISL emissions decreased by 2 % (Table 3.66).

Table 3.66 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	171	113	118	2%	4	4%	-54	-31%	-	-
Belgium	222	88	88	1%	0	0%	-134	-60%	T1	CS,D
Bulgaria	323	47	37	1%	-9	-20%	-285	-88%	T1	D
Croatia	119	74	66	1%	-8	-10%	-53	-44%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	654	271	274	4%	3	1%	-380	-58%	T1	D
Denmark	297	248	252	4%	4	2%	-45	-15%	CR,T2	CS
Estonia	143	81	61	1%	-20	-25%	-81	-57%	T2	CS
Finland	191	93	85	1%	-8	-9%	-106	-56%	M	CS
France	1 070	461	459	7%	-3	-1%	-612	-57%	-	-
Germany	2 847	1 019	1 011	16%	-8	-1%	-1 836	-64%	CS,M	CS,M
Greece	199	56	135	2%	78	139%	-64	-32%	T2	CS
Hungary	520	149	159	2%	9	6%	-361	-69%	T1	D
Ireland	133	118	108	2%	-10	-8%	-25	-19%	T2	CS
Italy	441	60	57	1%	-3	-5%	-384	-87%	T2	CS
Latvia	531	223	214	3%	-9	-4%	-318	-60%	T2	CS
Lithuania	350	166	174	3%	8	5%	-176	-50%	T2	CS
Luxembourg	25	9	10	0%	1	15%	-15	-59%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	91	83	85	1%	2	3%	-6	-6%	T2	CS
Poland	1 332	322	318	5%	-4	-1%	-1 015	-76%	T1	D
Portugal	175	30	31	0%	2	5%	-144	-82%	T1	D
Romania	420	509	339	5%	-170	-33%	-81	-19%	T1,T2	CS,D
Slovakia	377	83	78	1%	-5	-6%	-299	-79%	T1	D
Slovenia	65	32	41	1%	9	30%	-24	-37%	T1	D
Spain	414	239	243	4%	4	2%	-171	-41%	T1	M
Sweden	101	51	47	1%	-4	-8%	-55	-54%	T1	CS
United Kingdom	1 455	1 962	1 990	31%	29	1%	535	37%	T2	CS
EU-28	**12 666**	**6 587**	**6 479**	**100%**	**-108**	**-2%**	**-6 187**	**-49%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**12 666**	**6 587**	**6 479**	**100%**	**-108**	**-2%**	**-6 187**	**-49%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Poland, Romania and the United Kingdom account for 64 % of CO_2 emissions and for 64 % of activity data from liquid fuels in 2014 (Figure 3.104).

Table 3.66 shows that the majority of CO_2 emissions from the combustion of liquid fuels in railways were calculated using a higher tier method. In Figure 3.103 the IEF is depicted where the mean value is around 73.8 t/TJ.

Figure 3.104 1A3c Railways, Liquid Fuels: Emission trend and share for CO_2

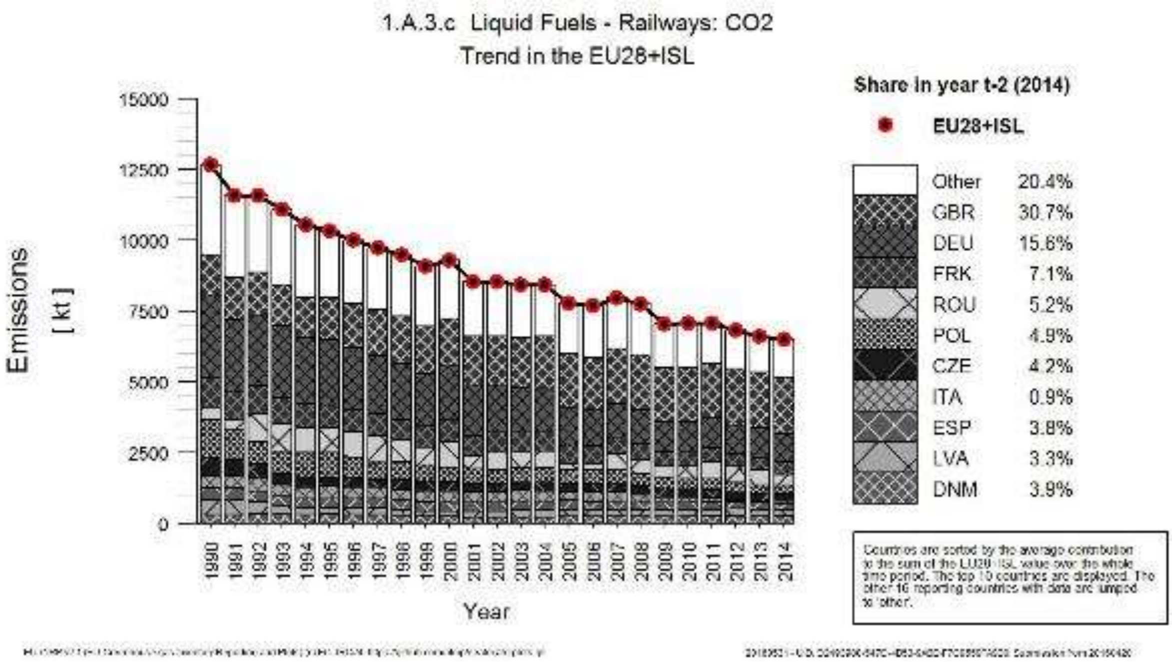
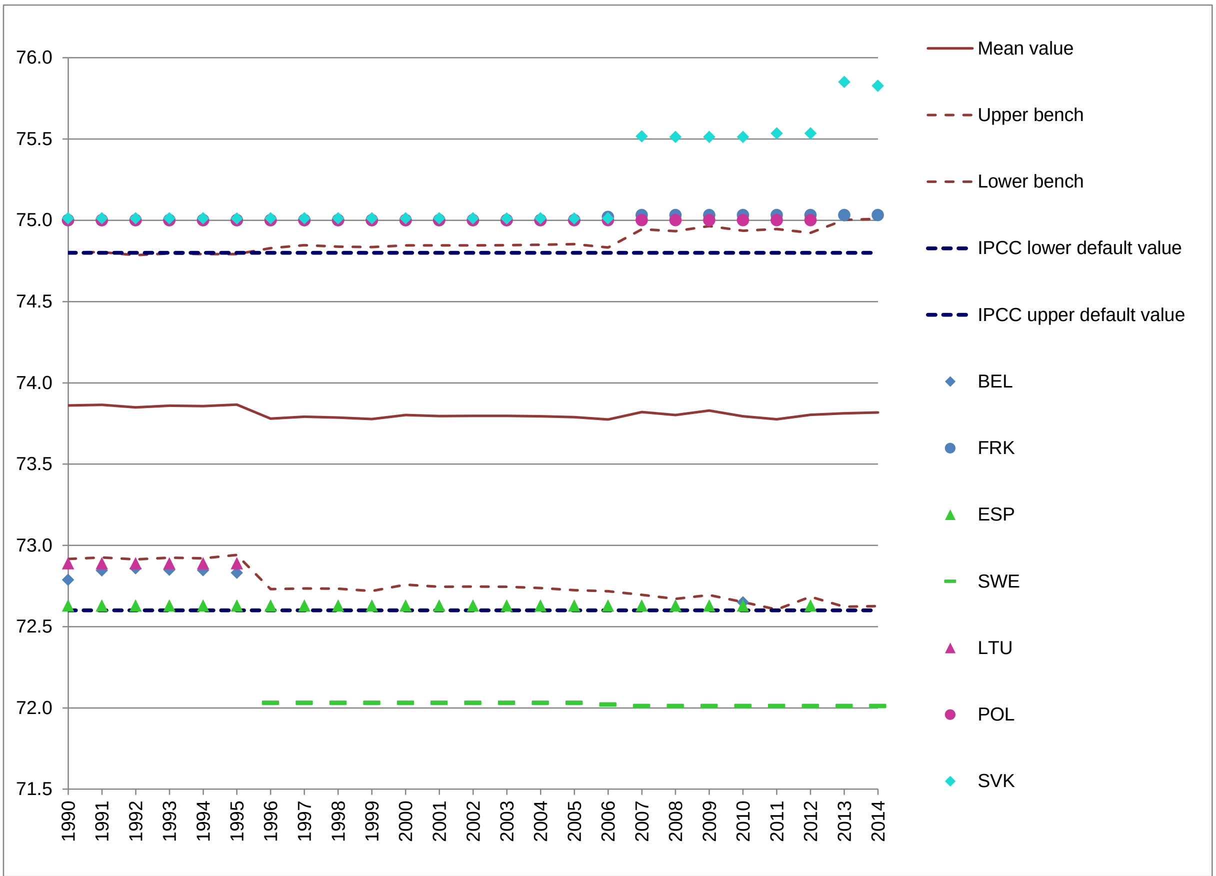


Figure 3.105 1A3c Railways, Liquid Fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



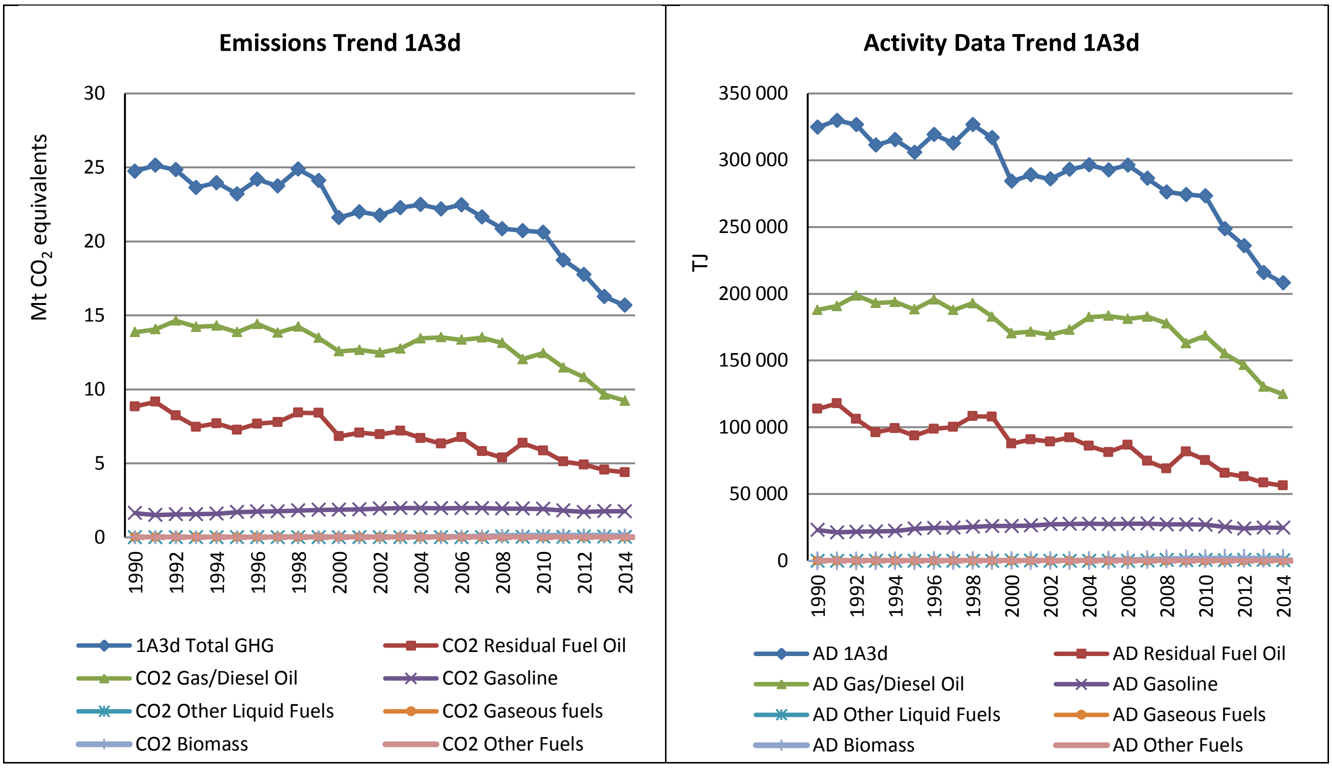
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.3.4 Navigation (1A3d) (EU-28+ISL)

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+ISL GHG emissions in 2014. Between 1990 and 2014, CO_2 emissions from navigation decreased by 37 % in the EU-28+ISL (Table 3.67). 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 3.106).

Figure 3.106 1A3d Navigation: CO_2 Emission Trend and Activity Data



Five Member States (France, Germany, Greece, Italy, and the United Kingdom) contributed the most to the emissions from this source (70 %). Most Member States (18 in total) had decreasing emissions from navigation between 1990 and 2014. The Member States with the highest decreases in absolute terms were Germany, Italy and Spain (Table 3.67).

Table 3.67 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	15	12	11	0%	-1	-7%	-3	-23%
Belgium	362	430	414	3%	-16	-4%	52	14%
Bulgaria	56	7	9	0%	1	20%	-48	-85%
Croatia	134	122	136	1%	14	12%	2	1%
Cyprus	2	2	1	0%	0	-3%	-1	-34%
Czech Republic	57	6	10	0%	3	50%	-47	-83%
Denmark	748	402	365	2%	-36	-9%	-383	-51%
Estonia	22	13	32	0%	19	149%	10	46%
Finland	441	476	414	3%	-62	-13%	-27	-6%
France	973	1 260	1 256	8%	-4	0%	282	29%
Germany	3 645	1 756	1 865	12%	110	6%	-1 779	-49%
Greece	1 809	1 394	1 457	9%	63	4%	-352	-19%
Hungary	209	16	19	0%	3	20%	-190	-91%
Ireland	85	178	222	1%	45	25%	138	162%
Italy	5 466	4 104	4 082	26%	-22	-1%	-1 384	-25%
Latvia	1	25	13	0%	-13	-49%	12	1185%
Lithuania	15	14	15	0%	0	2%	-1	-6%
Luxembourg	1	1	1	0%	0	7%	0	-5%
Malta	17	77	98	1%	21	28%	81	474%
Netherlands	743	1 165	1 005	7%	-159	-14%	262	35%
Poland	150	12	16	0%	3	26%	-134	-90%
Portugal	260	247	168	1%	-79	-32%	-92	-35%
Romania	1 151	154	116	1%	-38	-24%	-1 035	-90%
Slovakia	0	3	4	0%	1	28%	4	19564%
Slovenia	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Spain	5 187	1 565	1 003	7%	-563	-36%	-4 185	-81%
Sweden	575	371	400	3%	29	8%	-175	-30%
United Kingdom	2 167	2 171	2 264	15%	93	4%	97	4%
EU-28	**24 293**	**15 984**	**15 397**	**100%**	**-586**	**-4%**	**-8 895**	**-37%**
Iceland	59	16	20	0%	5	29%	-39	-66%
EU-28 + ISL	**24 352**	**15 999**	**15 418**	**100%**	**-581**	**-4%**	**-8 934**	**-37%**

1A3d Navigation – Residual Fuel Oil (CO_2)

CO_2 emissions from residual oil account for 29 % of CO_2 emissions from 1A3d Navigation in 2014. Between 1990 and 2014, CO_2 emissions from residual fuel oil decreased by 50 % in the EU-28+ISL. The countries with the highest decrease in absolute terms were Romania, Spain and United Kingdom. 15 Member States reported emissions as 'Not Occurring' (Table 3.68) for 2014, whereas Belgium reported emissions as 'Included Elsewhere' and specifically, the aforementioned emissions are included in gas/diesel oil, since the amounts of residual fuel oil are very small.

Table 3.68 1A3d Navigation, residual fuel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	IE	IE	IE	-	-	-	-	-	NA	NA
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	7	NO	NO	-	-	-	-7	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	357	176	166	4%	-10	-6%	-190	-53%	CR,T2	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	123	96	88	2%	-9	-9%	-36	-29%	M	CS
France	156	74	67	2%	-7	-10%	-89	-57%	-	-
Germany	935	510	502	11%	-8	-2%	-433	-46%	CS	CS,M
Greece	746	828	862	20%	34	4%	116	16%	T1	CS
Hungary	3	NO	NO	-	-	-	-3	-100%	NA	NA
Ireland	63	NO	NO	-	-	-	-63	-100%	NA	NA
Italy	2 574	1 832	1 824	41%	-8	0%	-750	-29%	T1,T2	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	6	23	28	1%	5	19%	22	400%	D,T1	D
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	70	2	2	0%	0	-17%	-68	-98%	T1	D
Portugal	188	178	121	3%	-57	-32%	-66	-35%	T2	D
Romania	1 025	NO	NO	-	-	-	-1 025	-100%	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 234	395	268	6%	-126	-32%	-966	-78%	T1	CS,M
Sweden	194	151	157	4%	7	4%	-37	-19%	T1	CS
United Kingdom	1 142	285	307	7%	23	8%	-835	-73%	T2	CS
EU-28	**8 822**	**4 551**	**4 393**	**100%**	**-158**	**-3%**	**-4 429**	**-50%**		
Iceland	22	4	7	0%	3	73%	-16	-70%	T1	D
EU-28 + ISL	**8 844**	**4 554**	**4 399**	**100%**	**-155**	**-3%**	**-4 444**	**-50%**		

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 fuel oil in 2014 (Figure 3.108).

Table **3.68** shows that the majority of CO_2 emissions from the combustion of residual fuel oil in navigation were calculated using a higher tier method. In Figure 3.107 the IEF is depicted where the mean value is around 77.7 t/TJ.

Figure 3.108 1A3d Navigation, Residual Fuel Oil: Emission trend and share for CO_2

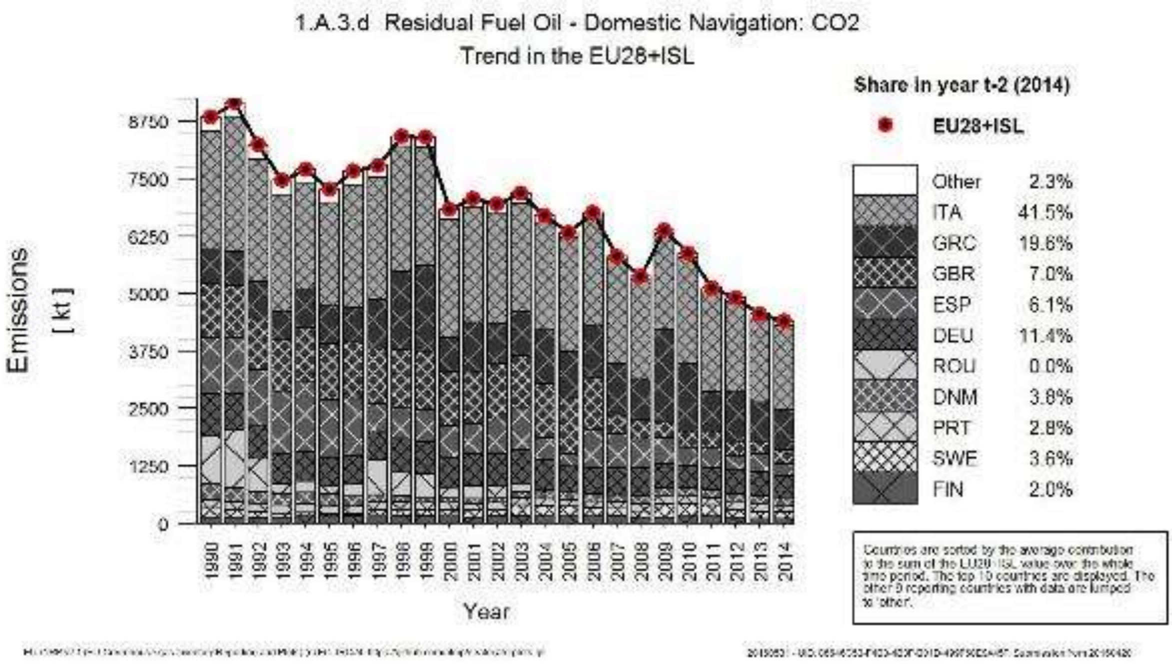
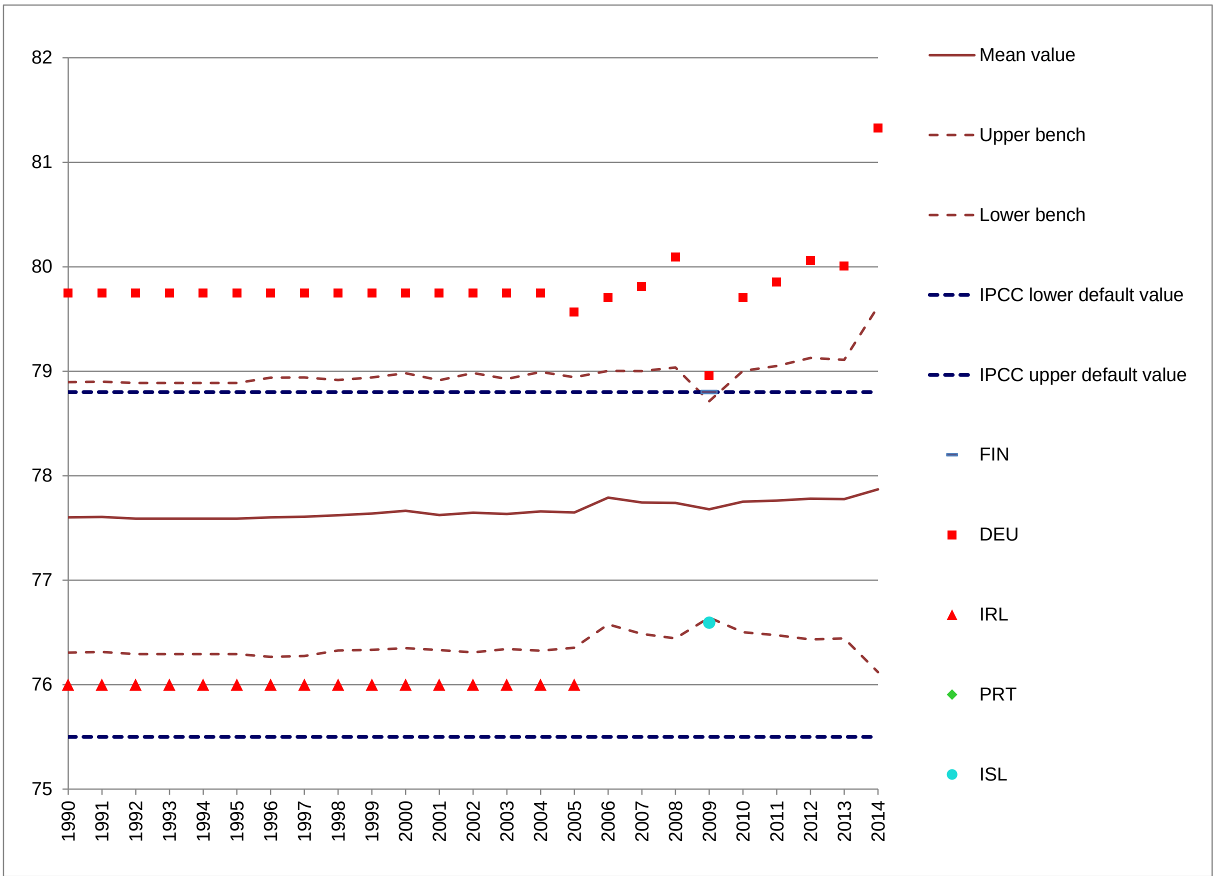


Figure 3.109 1A3d Navigation, Residual Fuel Oil: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 2014 (Table 3.69). The CO_2 emissions from Gas/Diesel oil decreased by 33 % between 1990 and 2014.

Table 3.69 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	5	5	4	0%	-1	-16%	-1	-20%	-	-
Belgium	362	430	414	4%	-16	-4%	52	14%	T1,T3	CS,D
Bulgaria	56	7	9	0%	1	20%	-48	-85%	T1	D
Croatia	128	122	136	1%	14	12%	9	7%	T1	D
Cyprus	2	2	1	0%	0	-3%	-1	-34%	T1	D
Czech Republic	57	6	10	0%	3	50%	-47	-83%	T1	D
Denmark	392	225	199	2%	-26	-12%	-193	-49%	CR,M,T2	CS
Estonia	22	13	32	0%	19	149%	10	46%	T2	CS
Finland	186	241	201	2%	-40	-17%	14	8%	M,T3	CS
France	290	334	334	4%	-1	0%	44	15%	-	-
Germany	2 710	1 245	1 363	15%	118	9%	-1 346	-50%	CS	CS,M
Greece	1 063	566	595	6%	28	5%	-468	-44%	T1	CS
Hungary	28	16	19	0%	3	20%	-9	-33%	T1	D
Ireland	22	178	222	2%	45	25%	200	901%	T2	CS
Italy	2 324	1 953	1 939	21%	-14	-1%	-386	-17%	T1,T2	CS
Latvia	1	25	13	0%	-13	-50%	12	1410%	T2	CS
Lithuania	15	14	15	0%	0	2%	-1	-6%	T2	CS
Luxembourg	1	1	1	0%	0	7%	0	10%	T2	CS
Malta	12	53	70	1%	18	33%	59	506%	D,T1	D
Netherlands	697	1 096	937	10%	-159	-14%	240	34%	T2	CS
Poland	80	10	14	0%	4	34%	-66	-82%	T1	D
Portugal	72	69	47	1%	-22	-32%	-26	-35%	T2	D
Romania	125	129	116	1%	-13	-10%	-9	-7%	T2	CS
Slovakia	0	3	4	0%	1	28%	4	19564%	T1	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
Spain	3 953	1 170	734	8%	-436	-37%	-3 219	-81%	T1	CS,M
Sweden	304	132	154	2%	22	17%	-150	-49%	T1	CS
United Kingdom	921	1 581	1 633	18%	52	3%	713	77%	T2	CS
EU-28	**13 829**	**9 627**	**9 217**	**100%**	**-410**	**-4%**	**-4 612**	**-33%**		
Iceland	37	12	14	0%	2	15%	-24	-64%	T1	D
EU-28 + ISL	**13 866**	**9 639**	**9 230**	**100%**	**-409**	**-4%**	**-4 636**	**-33%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Italy, Netherlands, Spain and the United Kingdom account for 72 % of the CO_2 emissions and for 72 % of activity data from gas/diesel oil in 2014 (Figure 3.111).

Table 3.69 shows that the majority of CO_2 emissions from the combustion of gas/diesel oil in navigation were calculated using a higher tier method. In Figure 3.110 the IEF is depicted where the mean value is around 73.9 t/TJ.

Figure 3.111   1A3d Navigation, Gas/Diesel Oil: Emission trend and share for CO_2

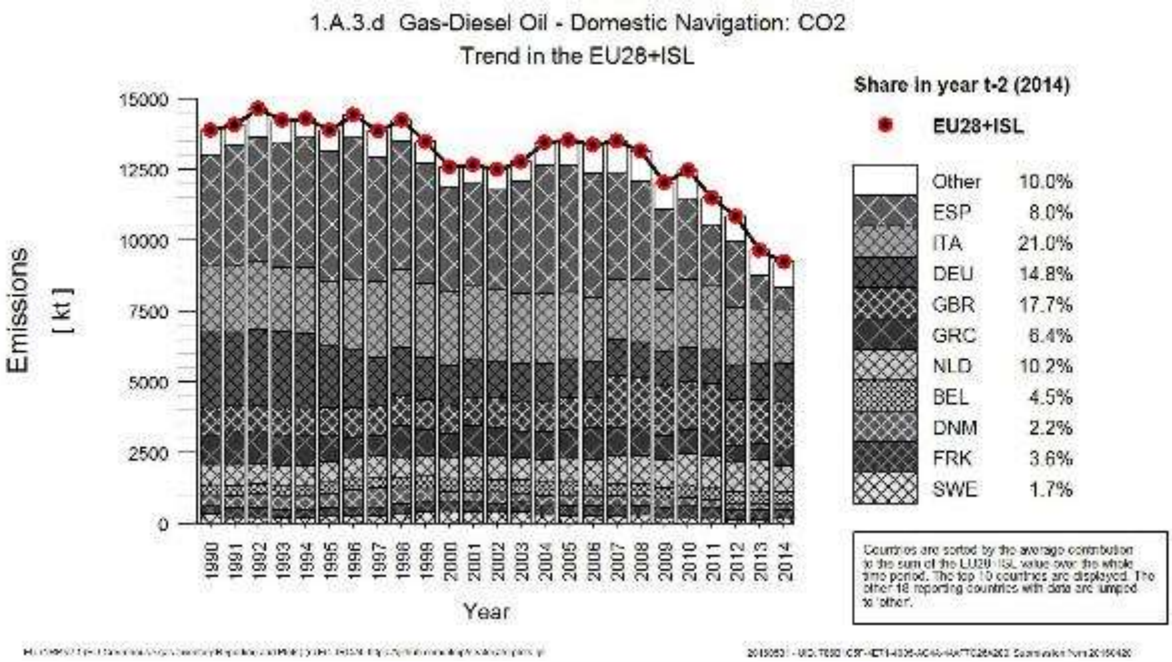
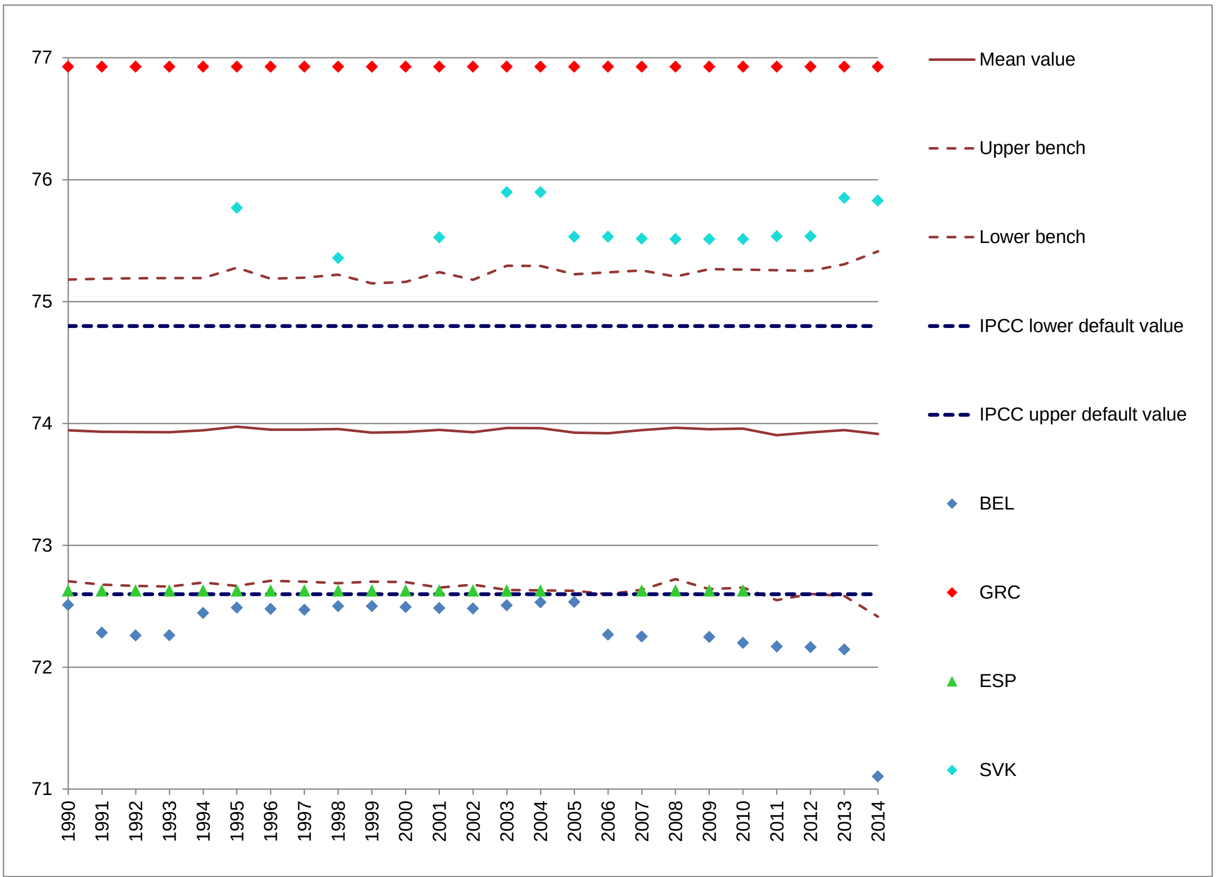


Figure 3.112   1A3d Navigation, Gas/Diesel Oil: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.3.5 Other (1A3e) (EU-28+ISL)

CO_2 emissions from 1A3e Other account for 0.1 % of total EU-28+ISL GHG emissions in 2014. 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 22 % between 1990 and 2014. A fuel shift occurred from oil to gas.

Germany contributed 20 % and Poland 14 % to the EU-28+ISL emissions from this source in 2014 (Table 3.70). Between 1990 and 2014 the EU-28+ISL emissions decreased by 11 %. Eight 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 3.70 1A3e Other: Member States’ contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	224	607	503	9%	-104	-17%	279	124%	NA	NA
Belgium	226	191	125	2%	-65	-34%	-101	-44%	CS,T3	D
Bulgaria	132	421	390	7%	-31	-7%	258	196%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	5	92	84	1%	-9	-9%	78	1444%	D,T1	CS,D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	2	13	13	0%	-1	-5%	11	481%	NA,T1	CS,NA
France	212	490	461	8%	-29	-6%	250	118%	NA	NA
Germany	1 083	1 469	1 195	20%	-274	-19%	111	10%	CS	CS
Greece	NO	13	10	0%	-3	-23%	10	100%	T1	CS
Hungary	102	76	90	2%	14	19%	-12	-12%	NA,T1	D,NA
Ireland	62	149	149	3%	1	0%	87	141%	T2	CS
Italy	407	660	505	9%	-156	-24%	97	24%	NA,T2	CS,NA
Latvia	IE,NO	IE,NO	NO,IE	-	-	-	-	-	NA	NA
Lithuania	1 764	234	236	4%	2	1%	-1 528	-87%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	NO	864	849	14%	-15	-2%	849	100%	NO,T1	D,NO
Portugal	NO	NO	NO	-	-	-	-	-	NO	NO
Romania	66	9	10	0%	1	10%	-55	-84%	T1,T2	CS,D
Slovakia	1 814	482	179	3%	-302	-63%	-1 635	-90%	M,T2	CS,M
Slovenia	NO	0	2	0%	1	287%	2	100%	NA,T2	CS,NA
Spain	20	305	296	5%	-9	-3%	276	1362%	T2	CS
Sweden	262	327	319	5%	-8	-2%	57	22%	T1,T2	CS
United Kingdom	225	459	479	8%	20	4%	254	113%	T3	CS
EU-28	**6 606**	**6 861**	**5 895**	**100%**	**-966**	**-14%**	**-711**	**-11%**		
Iceland	-	-	-	-	-	-	-	-	-	-
EU-28 + ISL	**6 606**	**6 861**	**5 895**	**100%**	**-966**	**-14%**	**-711**	**-11%**		

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 2014 category 1A4 contributed to 603.310 kt CO_2 equivalents of which 96% CO_2, 2.7% CH_4 and 1.3% N_2O.

It is remarkable that almost all countries report similar decreases in 2014. The main reason might be the comparatively high temperatures in the heating period within whole Europe. The following Table 3.71 presents the (15°/18°) heating degree days in 2013 and 2014 for EU-28 Member States and the population-weighted calculated values for EU-28 as well as the trend in 1A4 total fuel consumption.

Table 3.71: EU-28 heating degree days 2013 and 2014 and 1A4 trend in total fuel consumption

	2013	2014	Trend 2013 - 2014	Trend fuel consumption 1A4
Austria	4 046	3 554	-12%	-13%
Belgium	3 049	2 333	-23%	-18%
Bulgaria	2 414	2 413	0%	-8%
Croatia	2 616	2 119	-19%	36%
Cyprus	695	723	4%	-10%
Czech Republic	3 698	3 159	-15%	-14%
Denmark	3 255	2 664	-18%	-14%
Estonia	4 089	4 061	-1%	2%
Finland	5 309	5 315	0%	-2%
France	2 624	2 102	-20%	-14%
Germany	3 417	2 812	-18%	-14%
Greece	1 763	1 833	4%	-2%
Hungary	2 688	2 242	-17%	-10%
Ireland	2 975	2 787	-6%	-9%
Italy	2 211	2 017	-9%	-14%
Latvia	4 012	3 911	-3%	-2%
Lithuania	3 871	3 729	-4%	-6%
Luxembourg	3 361	2 686	-20%	-9%

	2013	2014	Trend 2013 - 2014	Trend fuel consumption 1A4
Malta	898	820	-9%	-6%
Netherlands	3 060	2 344	-23%	-20%
Poland	3 454	3 068	-11%	-8%
Portugal	1 578	1 314	-17%	-1%
Romania	2 987	2 851	-5%	-4%
Slovakia	3 572	2 952	-17%	-14%
Slovenia	3 257	2 768	-15%	-17%
Spain	2 049	1 695	-17%	-4%
Sweden	5 284	4 986	-6%	-5%
United Kingdom	3 218	2 777	-14%	-16%
EU-28 (weighted)	2 944	2 532	-14%	-13%

Source: EEA 2016

Figure **3.113** shows the trend of total GHG emissions within source category 1A4 and the dominating sources which are 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 2014. Between 1990 and 2014 emissions from 1A4 decreased by 27%. From 2013 to 2014 emissions decreased by 13.3% (93 Mt CO_2 equivalents) which is mainly due to a decrease of category 1A4b CO_2 emissions which decreased by 15.1% (-67 Mt CO_2) and category 1A4a CO_2 emissions which decreased by 13.4% (-23 Mt CO_2). The significant decrease of 1A4b CO_2 emissions in the year 2014 is mostly influenced by Germany (-15 Mt CO_2), France (-10 Mt CO_2), Italy (-9 Mt CO_2), The Netherlands (-5 Mt CO_2) and the United Kingdom (-13 Mt CO_2). The trend of 1A4a CO_2 emissions in the year 2014 is mostly influenced by Germany (-5 Mt CO_2), France (-3 Mt CO_2), the United Kingdom (-3 Mt CO_2) and Italy (-3 Mt CO_2).

It is remarkable that almost all countries report similar decreases in 2014. The main reason might be the comparatively high temperatures in the heating period within whole Europe. The following Table **3.72** presents the (15°/18°) heating degree days in 2013 and 2014 for EU-28 Member States and the population-weighted calculated values for EU-28 as well as the trend in 1A4 total fuel consumption.

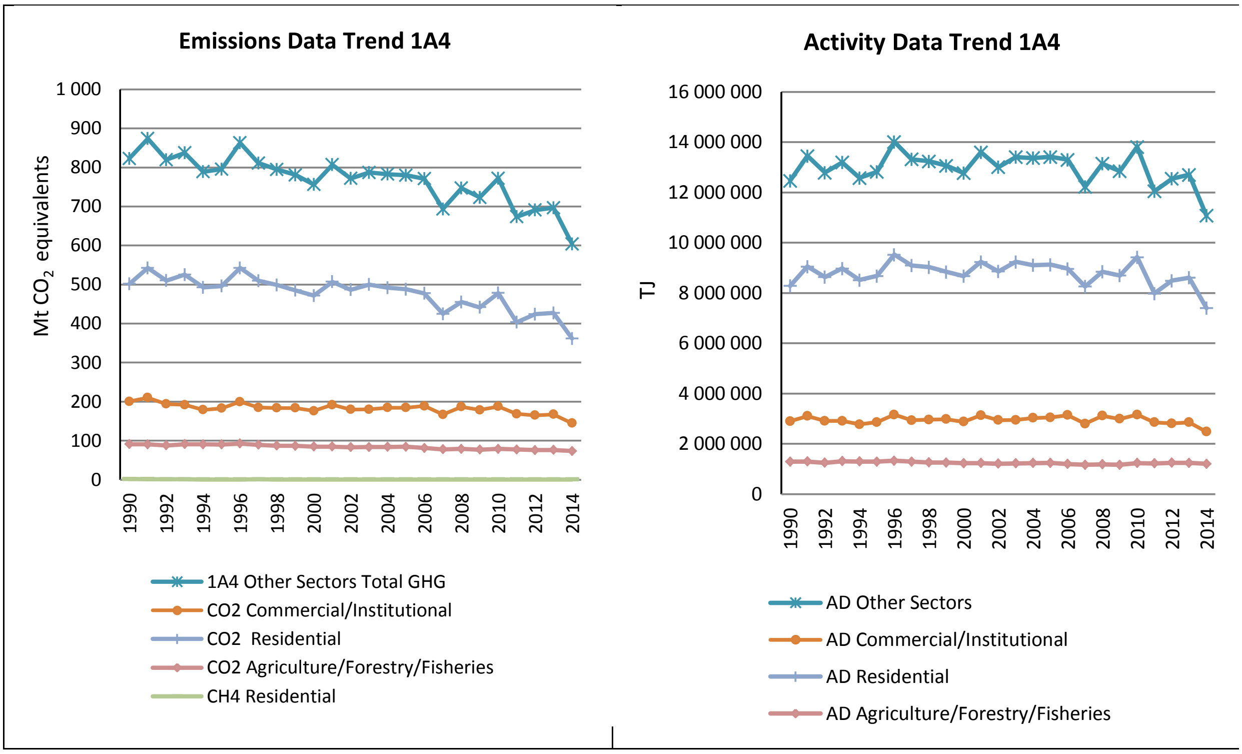
Table 3.72: EU-28 heating degree days 2013 and 2014 and 1A4 trend in total fuel consumption.

	2013	2014	Trend 2013 - 2014	Trend fuel consumption 1A4
Austria	4 046	3 554	-12%	-13%
Belgium	3 049	2 333	-23%	-18%
Bulgaria	2 414	2 413	0%	-8%
Croatia	2 616	2 119	-19%	36%
Cyprus	695	723	4%	-10%
Czech Republic	3 698	3 159	-15%	-14%
Denmark	3 255	2 664	-18%	-14%
Estonia	4 089	4 061	-1%	2%
Finland	5 309	5 315	0%	-2%

	2013	2014	Trend 2013 - 2014	Trend fuel consumption 1A4
France	2 624	2 102	-20%	-14%
Germany	3 417	2 812	-18%	-14%
Greece	1 763	1 833	4%	-2%
Hungary	2 688	2 242	-17%	-10%
Ireland	2 975	2 787	-6%	-9%
Italy	2 211	2 017	-9%	-14%
Latvia	4 012	3 911	-3%	-2%
Lithuania	3 871	3 729	-4%	-6%
Luxembourg	3 361	2 686	-20%	-9%
Malta	898	820	-9%	-6%
Netherlands	3 060	2 344	-23%	-20%
Poland	3 454	3 068	-11%	-8%
Portugal	1 578	1 314	-17%	-1%
Romania	2 987	2 851	-5%	-4%
Slovakia	3 572	2 952	-17%	-14%
Slovenia	3 257	2 768	-15%	-17%
Spain	2 049	1 695	-17%	-4%
Sweden	5 284	4 986	-6%	-5%
United Kingdom	3 218	2 777	-14%	-16%
EU-28 (weighted)	2 944	2 532	-14%	-13%

Source: EEA 2016

Figure 3.113 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



In 2014 GHG emissions from source category 1A4 accounted for 14% of total GHG emissions. This source category includes eleven key sources which contributed to 97% of total 1A4 GHG emissions in 2014.[21] The following list shows the key sources and their contribution to total 1A4 GHG emissions for the year 2014:

- 1 A 4 a Commercial/Institutional: Liquid Fuels - CO_2 (6.4%)
- 1 A 4 a Commercial/Institutional: Solid Fuels - CO_2 (0.6%)
- 1 A 4 a Commercial/Institutional: Gaseous Fuels - CO_2 (16.2%)
- 1 A 4 a Commercial/Institutional: Other Fuels – CO_2 (0.8%)
- 1 A 4 b Residential: Liquid Fuels - CO_2 (16.7%)
- 1 A 4 b Residential: Solid Fuels - CO_2 (5.8%)
- 1 A 4 b Residential: Gaseous Fuels - CO_2 (37.2%)
- 1 A 4 b Residential: Biomass - CH_4 (1.6%)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels - CO_2 (9.4%)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels - CO_2 (0.7%)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels - CO_2 (2.0%)

Table 3.73 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2014 CO_2 emissions from 1A4 Other Sectors decreased by 27%, CH_4 decreased by 24% and N_2O emissions decreased by 7%.

Table 3.73 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	14 470	8 494	13 784	8 121	461	205
Belgium	27 972	22 579	27 555	22 117	317	372
Bulgaria	8 108	1 771	7 629	1 410	286	279
Croatia	3 860	2 917	3 643	2 536	186	327
Cyprus	434	452	430	447	3	4
Czech Republic	31 187	10 375	29 651	9 714	1 387	565
Denmark	9 190	4 245	8 969	4 030	159	140
Estonia	2 038	734	1 881	557	103	123
Finland	7 574	4 170	7 266	3 809	223	297
France	100 395	85 325	94 236	82 429	4 704	1 366
Germany	207 137	123 657	203 031	122 211	3 131	1 022
Greece	8 512	4 999	8 066	4 811	102	107
Hungary	22 129	10 829	21 046	10 396	857	282
Ireland	10 586	8 128	10 031	7 891	451	166
Italy	79 833	74 109	76 933	69 729	1 148	2 129
Latvia	5 791	1 423	5 536	1 256	221	148
Lithuania	5 836	1 259	5 599	1 058	207	171
Luxembourg	1 332	1 456	1 317	1 438	11	11
Malta	137	211	136	210	0	1
Netherlands	39 415	32 400	38 811	30 943	542	1 394
Poland	57 215	55 843	53 729	51 594	2 811	3 342
Portugal	4 719	4 431	4 062	4 012	414	247
Romania	11 427	10 077	10 954	8 885	426	1 027
Slovakia	11 855	4 524	11 356	4 308	462	186
Slovenia	1 851	1 413	1 646	1 223	147	142
Spain	26 119	37 119	25 093	35 868	819	974
Sweden	11 072	3 287	10 617	2 899	296	289
United Kingdom	111 756	87 087	109 328	85 570	1 535	876
EU-28	**821 951**	**603 310**	**792 333**	**579 473**	**21 409**	**16 192**
Iceland	839	603	818	584	-	-
EU-28 + ISL	**822 789**	**603 913**	**793 151**	**579 473**	**21 409**	**16 192**

[21] 1 A 4 b Residential: Solid Fuels (CH4) is a new key category and will be considered in detail in the EU NIR 2017.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.74 provides information on the contribution of Member States to EU-28+ISL recalculations in CO_2 from 1A4 Other sectors for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 3.74 1A4 Other Sectors: Contribution of MS to EU-28 recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	-1	0.0	286	3.2	revised energy balance, revised household census data
Belgium	4	0.0	158	0.6	See chapter 3.2.9.5 in NIR. Use of IPCC default emission factors from 2006 guidelines since the 2015 submission instead of 1996 guidelines before. Use of country specific NCVs. Correction of activity data in Flemish region.
Bulgaria	0	0.0	-3	-0.2	No specific explanations provided.
Croatia	0	0.0	0	0.0	
Cyprus	-8	-1.8	0	0.0	See chapter 3.2.6.5 in NIR. RFO consumption by commerce has been revised due to the addition of Pulp, Paper and Print industries. Diesel consumption by agriculture has been revised to exclude the consumption for fishing, which is now reported separately.
Czech Republic	0	0.0	-293	-2.4	Updated activity data (mainly natural gas), Explanation provided in NIR sub chapters.
Denmark	-1	0.0	-27	-0.5	See chapters 3.2.8 and 9.1.1 in NIR. Revision of energy statistics.
Estonia	0	0.0	0	0.0	
Finland	0	0.0	-41	-1.0	Revised fuel data in residential and commercial sectors
France	22	0.0	280	0.3	See chapter 3.2.7.5 in NIR. Mise à jour des données d'activité (données de consommations d'énergie pour les secteurs commercial/tertiaire et résidentiel).
Germany	-68	0.0	-5 981	-4.0	Revision of energy statistics. Change of solid fuels NCVs. The emission factor for carbon dioxide from combustion of fossil diesel fuel, which to date has been used for all relevant sources, was replaced with a country-specific value.
Greece	0	0.0	0	0.0	
Hungary	0	0.0	153	1.3	See chapter 3.2.8.5 in NIR. Revision of energy statistics. Removed double counting of industrial waste with category 5.C.
Ireland	0	0.0	-18	-0.2	See chapter 3.2.7.5 in NIR. Revised energy statistics. Revised CO_2 emission factor for natural gas.
Italy	0	0.0	10	0.0	Most probably revised activity data.
Latvia	0	0.0	0	0.0	
Lithuania	0	0.0	0	0.0	
Luxembourg	1	0.1	-83	-4.9	Revision of energy statistics. Updated methodology and EF for off-road vehicles.
Malta	40	41.6	91	68.1	No specific explanation provided.
Netherlands	1 986	5.4	462	1.2	Revision of energy statistics

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Poland	-4	0.0	-2	0.0	Revision of energy statistics
Portugal	0	0.0	-17	-0.4	Correction of a compilation error in residual fueloil consumption between 2004 and 2013
Romania	0	0.0	0	0.0	
Slovakia	93	0.8	-299	-5.4	NIR chapter 3.2.8.5: Revision of energy statistics. Inclusion of LPG.
Slovenia	0	0.0	1	0.1	Improved AD for fuel used in 1A4a and b Commercial and Residential sector
Spain	0	0.0	-2 323	-5.8	Revisión de los consumos de biomasa de 2012 y 2013 para el sector residencial y de 2013 también para el sector comercial e institucional; y además en 2013, de los consumos de residuos municipales, gasóleo, gas natural, y biogás para el sector comercial e institucional, y de biogás y keroseno para instalaciones estacionarias en el sector agrícola. Al haberse modificado la información original publicada por los cuestionarios internacionales remitidos por MINETUR a los organismos internacionales, AIE y EUROSTAT, y sobre los cuales se construyen los balances energéticos nacionales. Revisión de la serie de superficie de regadío, indicador de actividad empleado para los motores de riego (encuadrados dentro de la categoría 1A4c). Esta modificación tiene por objeto actualizar las superficies para el año 2013 con la nueva información disponible en el Anuario Estadístico de MAGRAMA. Modificación de la cantidad de combustible asignada a maquinaria móvil agroforestal (dentro de la categoría 1A4c) para el año 2012 y 2013. Se ha revisado el consume de combustibles estimado para los equipos destinados a labores de reforestación, tala y arrastre de madera al estar disponible en el Anuario Estadístico del MAGRAMA la información de base correspondiente al año 2012 y 2013 para estas actividades (volumen de madera cortada y superficie repoblada). Modificación del factor de emisión de CH_4 y N_2O de las fuentes estacionarias. Se habían utilizado factores seleccionados de las diferentes guías metodológicas (EMEP/CORINAIR, EMEP/EEA, IPCC) y de fuentes sectoriales e institucionales (API, CITEPA) sobre la variable de actividad energía (GJ) en términos de PCI. Se han actualizado estos factores de emisión según la Guía IPCC 2006.
Sweden	276	2.7	345	12.7	Activity data of fuels amounts in sector 1A4 was revised from 2005 for all categories; The model for estimating the fuel consumption and emissions from Non-road mobile machinery (NRMM) has been adjusted and updated in 2015; The amount of low blended biodiesel used by NRMM was incorrectly allocated in submission 2015.
United Kingdom	177	0.2	-902	-0.9	Overall change mostly due to revisions in 1A4ai, 1A4bi and 1A4cii. 1A4ai - large decrease in emissions from this sector due to revisions in activity data and also updates to the natural gas emission factor following new data from gas companies. 1A4bi - decrease to emission from this sector due to revisions to national statistics and also revisions to emission factors for coal, natural gas, coke, anthracite. 1A4cii - increase in emissions from this sector due to a revision in national statistics

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
EU28	2 517	0.3	-8 203	-1.2	
Iceland	0	0.0	-2	-0.3	No specific explanation provided.
EU28+ISL	2 517	0.3	-8 204	-1.2	

Table 3.75 provides information on the contribution of Member States to EU-28+ISL recalculations in CH_4 from 1A4 Other sectors for 1990 and 2013.

Table 3.75 1A4 Other Sectors: Contribution of MS to EU-28 recalculations in CH_4 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	7	3.0	revised energy balance, revised household census data
Belgium	1	0.2	12	2.8	See chapter 3.1.3 in NIR
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	0.0	
Cyprus	0	-0.1	0	0.5	Revised biomass consumption (biogas)
Czech Republic	0	0.0	-1	-0.1	Updated activity data (mainly natural gas), Explanation provided in NIR sub chapters.
Denmark	1	0.6	1	0.5	See NIR
Estonia	0	0.0	0	0.0	
Finland	0	0.0	1	0.3	Revised fuel data in residential and commercial sectors
France	0	0.0	57	3.6	See chapter 3.2.7.5 in NIR. Mise à jour des données d'activité (données de consommations d'énergie pour les secteurs commercial/tertiaire et résidentiel).
Germany	0	0.0	-220	-16.1	Revision of energy statistics
Greece	0	0.0	0	0.0	
Hungary	0	0.0	-17	-5.1	See chapter 3.2.8.5 in NIR. Revision of energy statistics. Removed double counting of industrial waste and Open Burning of Waste with category 5.C.
Ireland	0	0.0	0	0.0	
Italy	565	96.7	-2	-0.1	See chapter 3.6.6 in NIR. Revision of biomass consumption.
Latvia	-54	-19.5	-79	-34.0	Methodology change for biomass use in 1A4b sector (Tier 1 to Tier 2, using CS methane EFs), precised data for wood in 1A4a.
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	0	-1.9	Revision of energy statistics. Updated methodology and EF for off-road vehicles.
Malta	0	45.7	0	78.7	No specific explanation provided.
Netherlands	-3	-0.5	42	2.6	Revision of energy statistics
Poland	0	0.0	0	0.0	

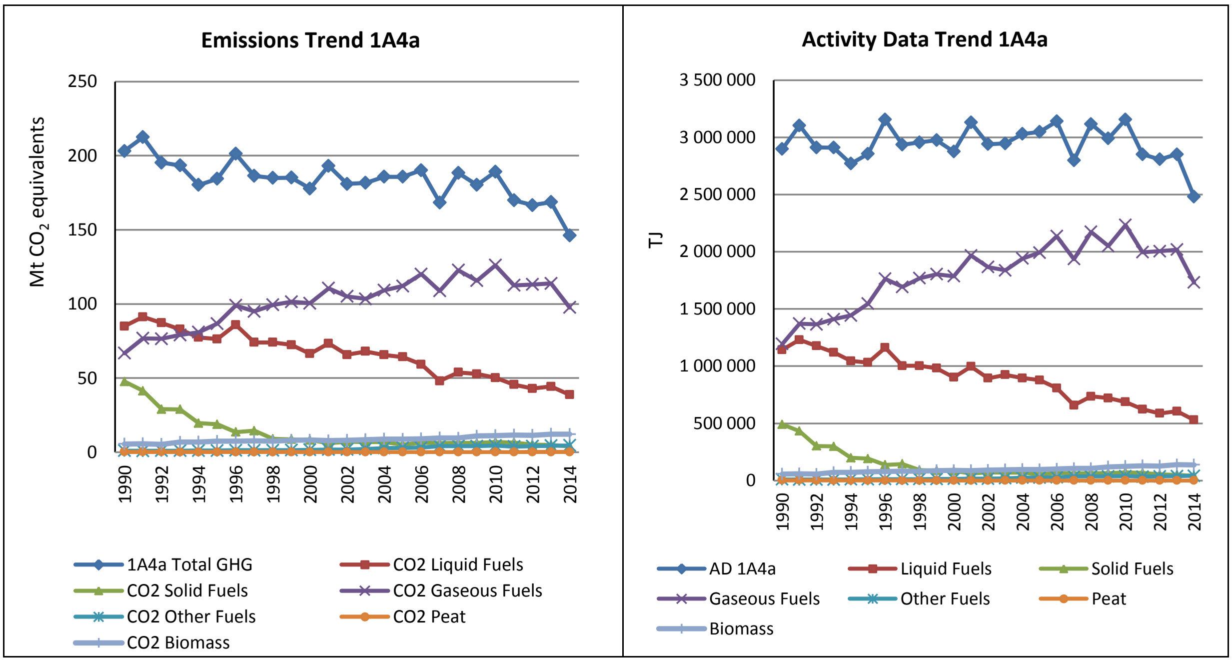
	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Portugal	0	0.0	0	0.0	
Romania	0	0.0	0	0.0	
Slovakia	0	0.0	-2	-0.9	NIR chapter 3.2.8.5: Revision of energy statistics. Inclusion of LPG. Minor corrections in biomass consumption.
Slovenia	133	953.6	154	934.8	Correction of default CH_4 EF for solid fuels, natural gas and biomass. Improved AD for fuel used in 1A4a and b Commercial and Residential sector
Spain	-87	-9.6	-119	-10.7	Revision of energy statistics (biomass). Revision of CH_4 emission factors (switch to IPCC 2006 GL).
Sweden	3	1.0	29	10.5	Activity data of fuels amounts in sector 1A4 was revised from 2005 for all categories; The model for estimating the fuel consumtion and emissions from Non-road mobile machinery (NRMM) has been adjusted and updated in 2015; The amount of low blended biodiesel used by NRMM was incorrectly allocated in submission 2015.
United Kingdom	-254	-14.2	282	41.9	Due to a change to emission factors in 1A4bi - residential stationary. IPCC T1 default emission factors now used for coal, coke, ssf, anthracite and this has lead to an increase in estimated emissions.
EU28	304	1.4	145	0.8	
Iceland	0	-0.5	0	-0.5	No specific explanation provided.
EU28+ISL	304	1.4	145	0.8	

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 3.4% of total GHG emissions in 2014.

Figure 3.114 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Between 1990 and 2014 GHG emissions decreased by 28%, mainly due to decreases in CO_2 emissions from solid (-92%) and liquid (-54%) fuels while CO_2 emissions from gaseous fuels increased by 46% and showed an continuous uptrend for the whole time series until 2013. Between 2013 and 2014 the CO_2 emissions decreased by 13.4%, mainly driven by a decrease in gaseous and liquid fuel consumption.

Figure 3.114 1A4a Commercial/Institutional: Total and CO_2 emission and activity trends



Between 1990 and 2014, CO_2 emissions from 1A4a decreased by 28% 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 decreased by 17% between 1990 and 2014 and biomass consumption increased by 137%

France, Germany, Italy and the United Kingdom contributed the most to the CO_2 emissions from this source (68%). The Member States with the highest increases in absolute terms were Spain, Italy and Romania. The Member States with the highest reduction in absolute terms were Germany, the Czech Republic, France and the United Kingdom (Table 3.76).

Table 3.76 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	1995	2013	2014		kt CO2	%	kt CO2	%		
Austria	2 569	3 262	1 946	2 007	1%	62	3%	-561	-22%	NA	NA
Belgium	4 288	5 559	6 166	4 884	3%	-1 282	-21%	596	14%	NA,T1	D,NA
Bulgaria	3 085	321	273	249	0%	-25	-9%	-2 836	-92%	T1,T2	CS,D
Croatia	779	662	509	470	0%	-39	-8%	-309	-40%	T1	D
Cyprus	75	104	90	77	0%	-12	-14%	2	3%	T1	D
Czech Republic	10 024	5 905	3 145	2 538	2%	-607	-19%	-7 486	-75%	T1,T2	CS,D
Denmark	1 486	1 221	905	741	1%	-165	-18%	-746	-50%	CR,M,T1,T2,T3	CS,D
Estonia	47	7	64	58	0%	-6	-9%	11	23%	T1,T2	CS,D
Finland	2 257	1 390	1 037	1 023	1%	-13	-1%	-1 233	-55%	CS,M,T1,T3	CS,D
France	28 445	30 000	27 261	23 981	17%	-3 280	-12%	-4 464	-16%	-	-
Germany	64 148	53 226	37 819	32 602	23%	-5 217	-14%	-31 545	-49%	CS,T2,T3	CS
Greece	519	666	829	561	0%	-268	-32%	42	8%	T1,T2	CS,D
Hungary	2 691	3 706	3 382	2 827	2%	-555	-16%	137	5%	T1,T2	CS,D
Ireland	2 232	2 091	1 920	1 755	1%	-165	-9%	-477	-21%	T2	CS
Italy	16 079	17 190	23 388	20 488	14%	-2 901	-12%	4 408	27%	T2	CS
Latvia	2 759	630	434	437	0%	3	1%	-2 322	-84%	T1,T2	CS,D
Lithuania	2 827	924	351	317	0%	-34	-10%	-2 510	-89%	T2	CS
Luxembourg	637	679	491	394	0%	-97	-20%	-243	-38%	T1,T2	CS,D
Malta	63	107	129	119	0%	-10	-8%	56	88%	T1	D
Netherlands	8 230	8 883	8 844	7 061	5%	-1 783	-20%	-1 169	-14%	T2	CS,D
Poland	9 838	7 040	8 659	7 762	5%	-897	-10%	-2 076	-21%	T1,T2	CS,D
Portugal	745	1 109	1 059	1 138	1%	78	7%	393	53%	T1	D
Romania	NO	797	2 061	2 054	1%	-7	0%	2 054	FALSCH	T1,T2	CS
Slovakia	4 148	2 424	2 084	1 561	1%	-524	-25%	-2 587	-62%	T2	CS
Slovenia	503	698	453	347	0%	-106	-23%	-156	-31%	T1,T2	CS,D
Spain	3 804	5 425	10 044	8 644	6%	-1 400	-14%	4 840	127%	NA,T2	CS,M,NA,OTH
Sweden	2 810	1 956	697	679	0%	-18	-3%	-2 131	-76%	NA,T1,T2	CS,NA
United Kingdom	25 508	26 959	23 267	20 034	14%	-3 232	-14%	-5 474	-21%	T2	CS
EU-28	**200 594**	**182 939**	**167 307**	**144 808**	**100%**	**-22 500**	**-13%**	**-55 787**	**-28%**		
Iceland	16	6	2	2	0%	-1	-21%	-14	-88%	T1,T2	D
EU-28 + ISL	**200 610**	**182 945**	**167 310**	**144 810**	**100%**	**-22 500**	**-13%**	**-55 801**	**-28%**		

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

In 2014 CO_2 emissions from liquid fuels had a share of 26% within source category 1A4a (compared to 42% in 1990). Between 1990 and 2014, CO_2 decreased by 54% (Table 3.77). Five 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. 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). Between 2013 and 2014 EU-28+ISL CO_2 emissions decreased by 13%. It is remarkable that almost all countries report similar decreases in 2014. The main reason might be the comparatively high temperatures in the heating period within whole Europe.

Table 3.77 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	1 422	574	764	2%	190	33%	-658	-46%
Belgium	2 315	1 522	1 196	3%	-326	-21%	-1 119	-48%
Bulgaria	2 986	73	46	0%	-27	-37%	-2 940	-98%
Croatia	531	190	159	0%	-31	-16%	-372	-70%
Cyprus	75	90	77	0%	-12	-14%	2	3%
Czech Republic	2 116	40	40	0%	0	-1%	-2 076	-98%
Denmark	1 081	369	336	1%	-33	-9%	-746	-69%
Estonia	19	5	3	0%	-2	-32%	-16	-82%
Finland	2 196	939	938	2%	-1	0%	-1 258	-57%
France	18 886	13 611	12 736	33%	-874	-6%	-6 150	-33%
Germany	28 175	15 860	12 662	33%	-3 198	-20%	-15 513	-55%
Greece	499	539	268	1%	-270	-50%	-230	-46%
Hungary	1 106	124	154	0%	31	25%	-952	-86%
Ireland	1 870	931	771	2%	-160	-17%	-1 099	-59%
Italy	5 199	1 280	1 069	3%	-211	-17%	-4 130	-79%
Latvia	1 007	142	156	0%	13	9%	-852	-85%
Lithuania	933	9	11	0%	2	19%	-923	-99%
Luxembourg	467	185	154	0%	-31	-17%	-314	-67%
Malta	63	129	119	0%	-10	-8%	56	88%
Netherlands	370	263	274	1%	11	4%	-96	-26%
Poland	IE,NO	1 303	1 324	3%	21	2%	1 324	100%
Portugal	745	368	450	1%	82	22%	-295	-40%
Romania	NO	233	226	1%	-7	-3%	226	100%
Slovakia	384	40	28	0%	-12	-31%	-356	-93%
Slovenia	270	380	264	1%	-116	-30%	-6	-2%
Spain	3 254	4 371	3 521	9%	-850	-19%	267	8%
Sweden	2 724	492	474	1%	-18	-4%	-2 251	-83%
United Kingdom	6 244	247	474	1%	227	92%	-5 770	-92%
EU-28	**84 937**	**44 307**	**38 692**	**100%**	**-5 616**	**-13%**	**-46 245**	**-54%**
Iceland	16	2	2	0%	-1	-21%	-14	-88%
EU-28 + ISL	**84 953**	**44 310**	**38 694**	**100%**	**-5 616**	**-13%**	**-46 259**	**-54%**

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 3.115and Figure 3.116 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 75% of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption decreased by 54% between 1990 and 2014. The dip in activity data 2007 is mainly due to Germany due to reasons explained earlier in this chapter. The CO_2 implied emission factor for liquid fuels was 73.1 t/TJ in 2014.

Figure 3.115 1A4a Commercial/Institutional, liquid fuels: Emission trend and share for CO_2

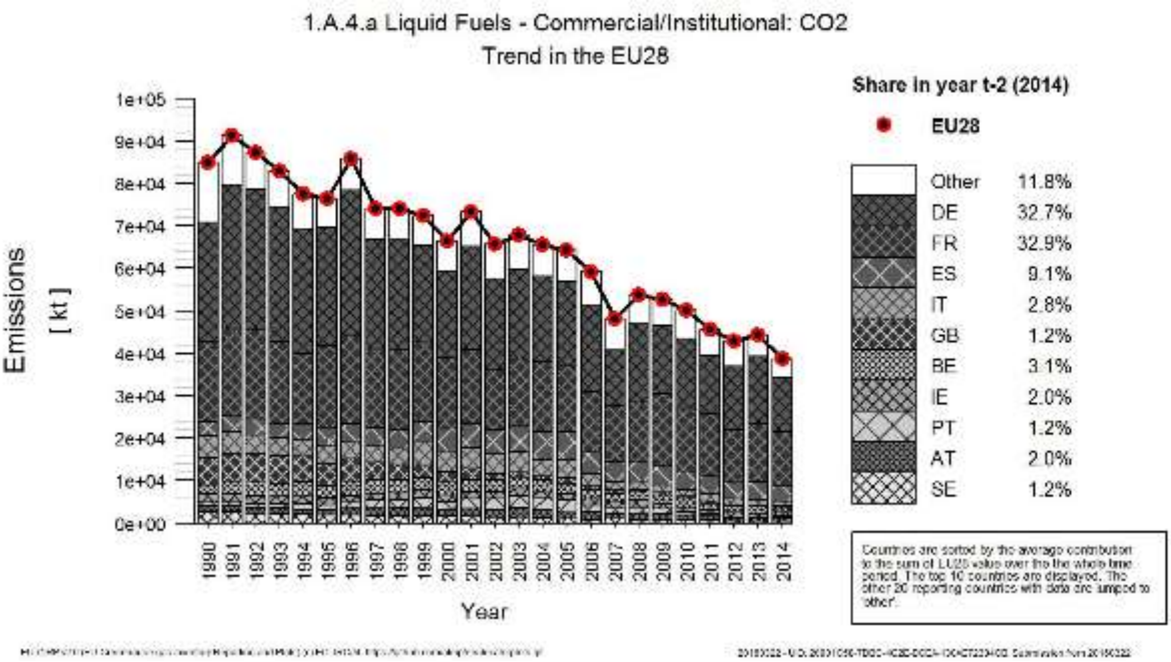
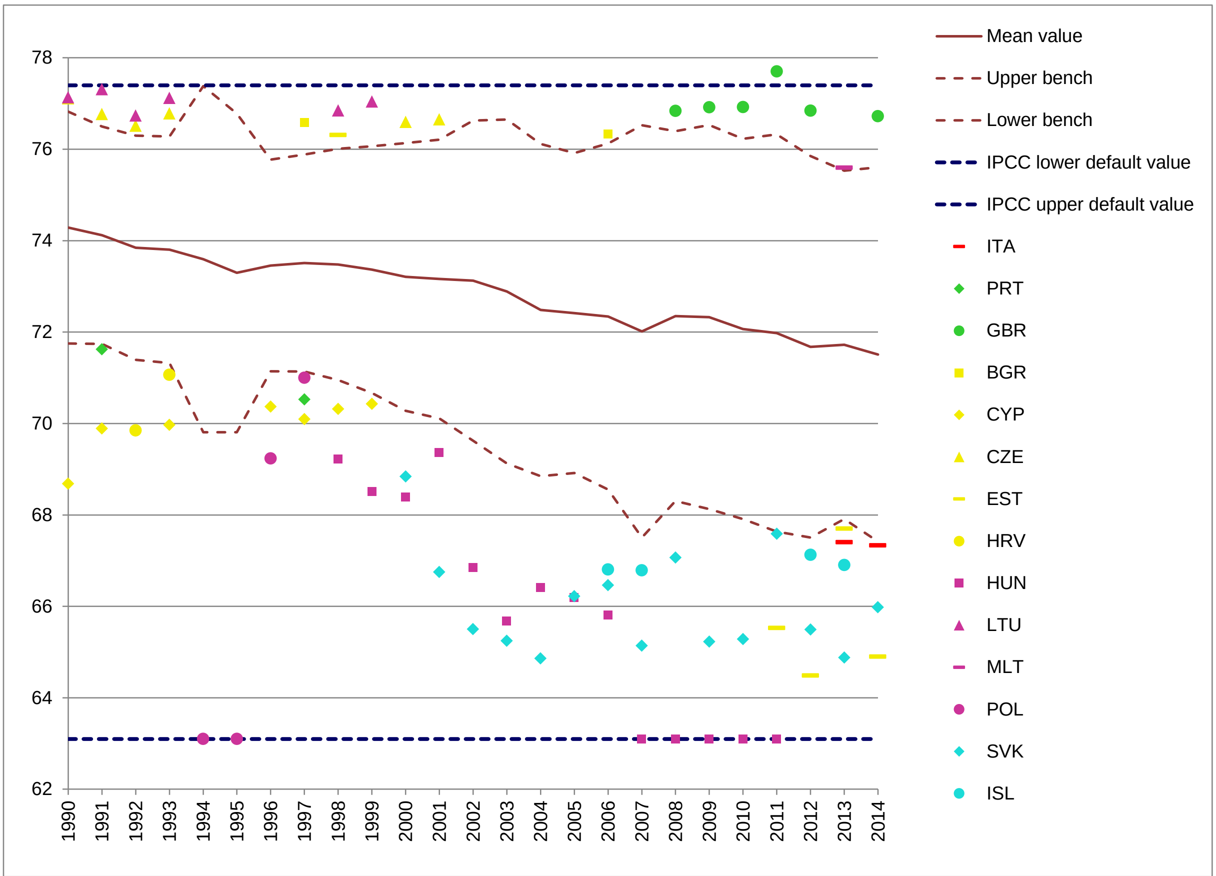


Figure 3.116 1A4a Commercial/Institutional, liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2014, CO_2 from solid fuels had a share of 3% within source category 1A4a (compared to 23% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 92% (Table 3.78). Twelve Member States and Island report emissions as 'Not occurring' in 2014; all other Member States reduced emissions between 1990 and 2014 except Romania and Spain. Between 2013 and 2014 CO_2 emissions decreased by 19%.

Table 3.78 1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	91	13	11	0%	-2	-15%	-80	-88%
Belgium	9	NO	NO	-	-	-	-9	-100%
Bulgaria	60	19	10	0%	-10	-50%	-51	-84%
Croatia	88	1	NO,IE	-	-1	-100%	-88	-100%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	6 237	155	73	2%	-82	-53%	-6 164	-99%
Denmark	8	NO	NO	-	-	-	-8	-100%
Estonia	5	8	0	0%	-8	-99%	-4	-98%
Finland	NO	NO	NO	-	-	-	-	-
France	693	212	93	2%	-119	-56%	-601	-87%
Germany	22 426	60	50	1%	-11	-17%	-22 376	-100%
Greece	20	IE,NO	NO,IE	-	-	-	-20	-100%
Hungary	475	10	9	0%	-1	-7%	-466	-98%
Ireland	3	NO	NO	-	-	-	-3	-100%
Italy	219	NO	NO	-	-	-	-219	-100%
Latvia	1 411	49	39	1%	-11	-22%	-1 372	-97%
Lithuania	1 173	151	129	3%	-22	-15%	-1 044	-89%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	101	9	5	0%	-4	-45%	-96	-95%
Poland	8 992	3 006	2 630	67%	-376	-13%	-6 363	-71%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	2	1	0%	-1	-28%	1	100%
Slovakia	1 729	513	298	8%	-215	-42%	-1 431	-83%
Slovenia	203	NO	NO	-	-	-	-203	-100%
Spain	154	199	168	4%	-31	-16%	14	9%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	3 544	393	393	10%	0	0%	-3 151	-89%
EU-28	**47 642**	**4 802**	**3 909**	**100%**	**-893**	**-19%**	**-43 734**	**-92%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**47 642**	**4 802**	**3 909**	**100%**	**-893**	**-19%**	**-43 734**	**-92%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.117 and Figure 3.118 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland, Slovakia and the United Kingdom in 2014; together they cause 85% of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-28 decreased by 92% between 1990 and 2014. The CO_2 implied emission factor for solid fuels was 95.3 t/TJ in 2014. The comparatively low IEFs of Spain, Greece and Italy in 1990 are due to a high share of gas works gas consumption in the 1990s.

Figure 3.117 1A4a Commercial/Institutional, solid fuels: Emission trend and share for CO_2

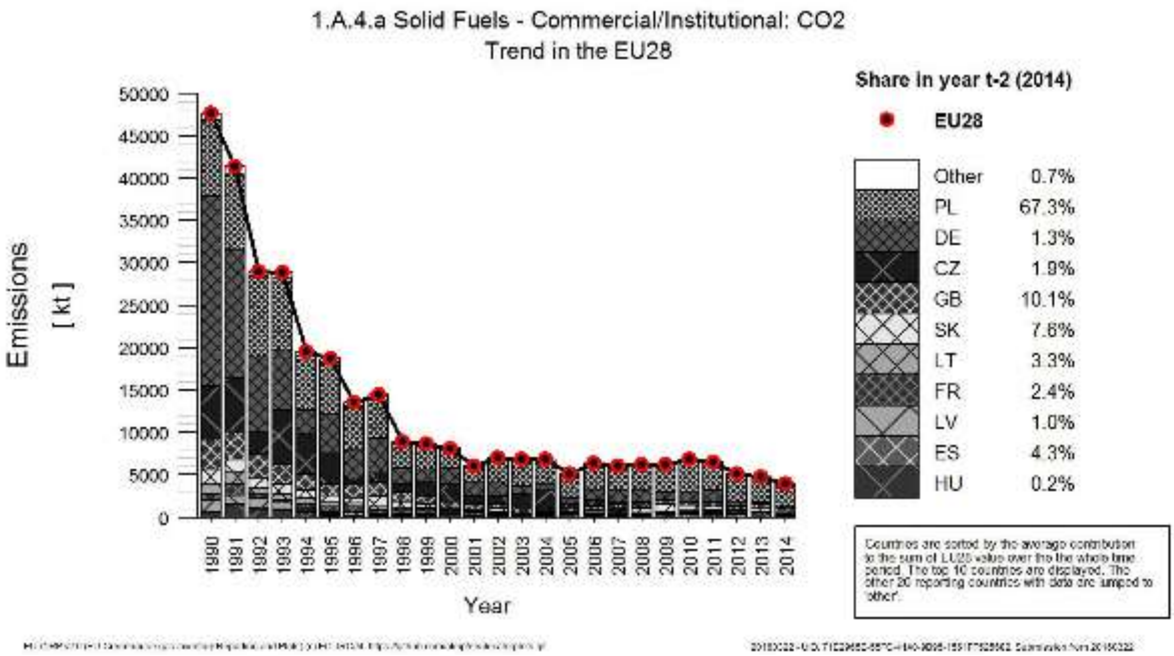
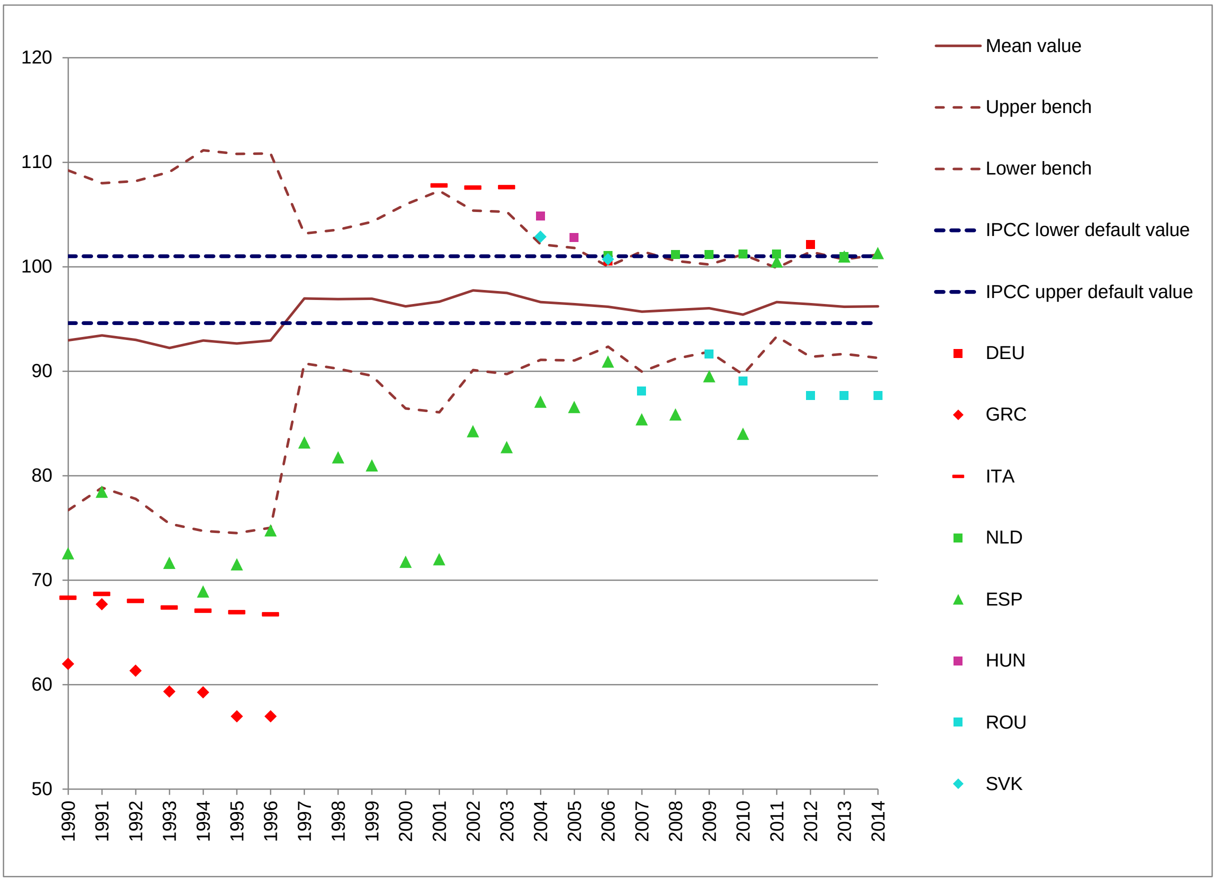


Figure 3.118 1A4a Commercial/Institutional, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2014 CO_2 from gaseous fuels had a share of 67% within source category 1A4a (compared to 33% in 1990). Between 1990 and 2014, the emissions increased by 46% (Table 3.79). All Member States except Latvia, Lithuania, the Netherlands and Slovakia reported increasing emissions. The highest absolute increases occurred in Germany, France, Italy, Poland, Spain and the United Kingdom. Between 2013 and 2014 CO_2 emissions decreased by 14%.

Table 3.79 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	707	1 354	1 227	1%	-127	-9%	520	74%
Belgium	1 934	4 542	3 586	4%	-956	-21%	1 652	85%
Bulgaria	39	181	193	0%	12	7%	154	396%
Croatia	160	318	311	0%	-7	-2%	151	95%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	1 670	2 950	2 425	2%	-525	-18%	754	45%
Denmark	363	529	391	0%	-138	-26%	28	8%
Estonia	20	50	54	0%	4	8%	34	168%
Finland	45	86	74	0%	-12	-14%	28	63%
France	8 866	13 438	11 152	11%	-2 286	-17%	2 287	26%
Germany	13 547	21 898	19 890	20%	-2 008	-9%	6 344	47%
Greece	IE,NO	290	293	0%	2	1%	293	100%
Hungary	1 110	3 249	2 664	3%	-585	-18%	1 554	140%
Ireland	223	989	984	1%	-6	-1%	760	340%
Italy	10 135	17 977	15 045	15%	-2 932	-16%	4 910	48%
Latvia	274	243	242	0%	-1	0%	-33	-12%
Lithuania	709	147	135	0%	-11	-8%	-573	-81%
Luxembourg	170	306	240	0%	-66	-22%	71	42%
Malta	0	0	0	0%	0	19%	0	108%
Netherlands	7 758	8 571	6 782	7%	-1 789	-21%	-976	-13%
Poland	773	4 292	3 783	4%	-509	-12%	3 009	389%
Portugal	NO	691	687	1%	-4	-1%	687	100%
Romania	NO	1 826	1 805	2%	-21	-1%	1 805	100%
Slovakia	2 035	1 531	1 235	1%	-296	-19%	-800	-39%
Slovenia	29	73	83	0%	10	14%	54	186%
Spain	395	5 474	4 955	5%	-519	-9%	4 560	1154%
Sweden	86	202	202	0%	0	0%	116	135%
United Kingdom	15 721	22 626	19 168	20%	-3 459	-15%	3 447	22%
EU-28	**66 769**	**113 833**	**97 606**	**100%**	**-16 227**	**-14%**	**30 837**	**46%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**66 769**	**113 833**	**97 606**	**100%**	**-16 227**	**-14%**	**30 837**	**46%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.119 and Figure 3.120 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 67% of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion rose by 45% between 1990 and 2014. The CO_2 implied emission factor for gaseous fuels was 56.4 t/TJ in 2014. The comparatively high IEF of Malta is because LPG is included under gaseous fuels.

Figure 3.119 1A4a Commercial/Institutional, gaseous fuels: Emission trend and share for CO_2

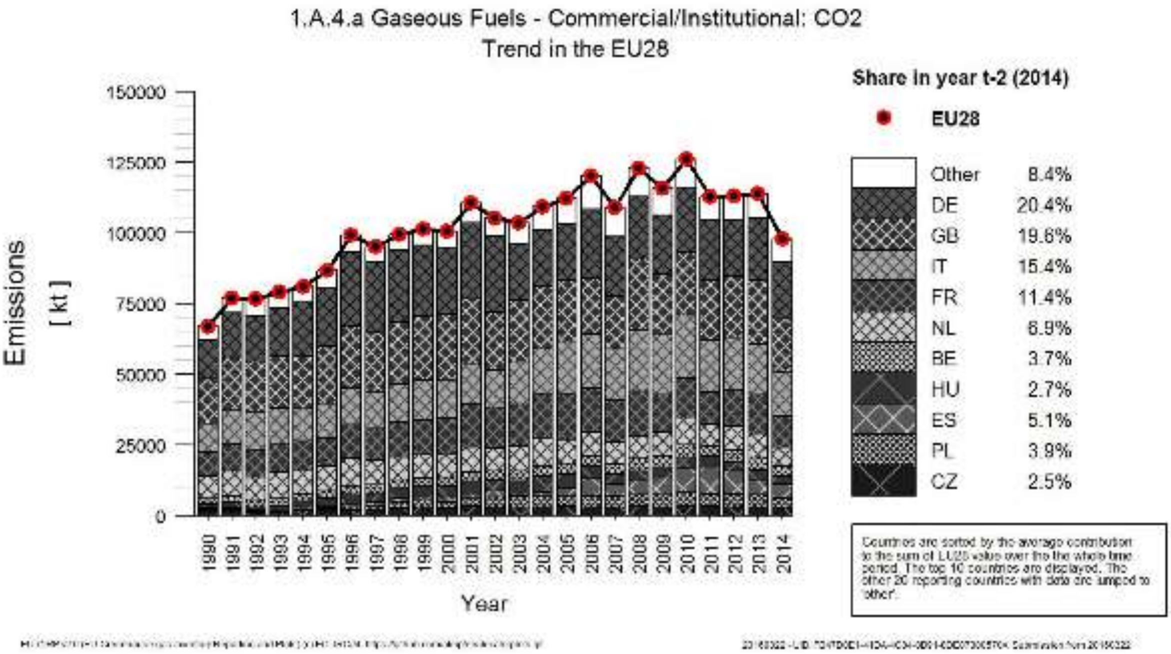
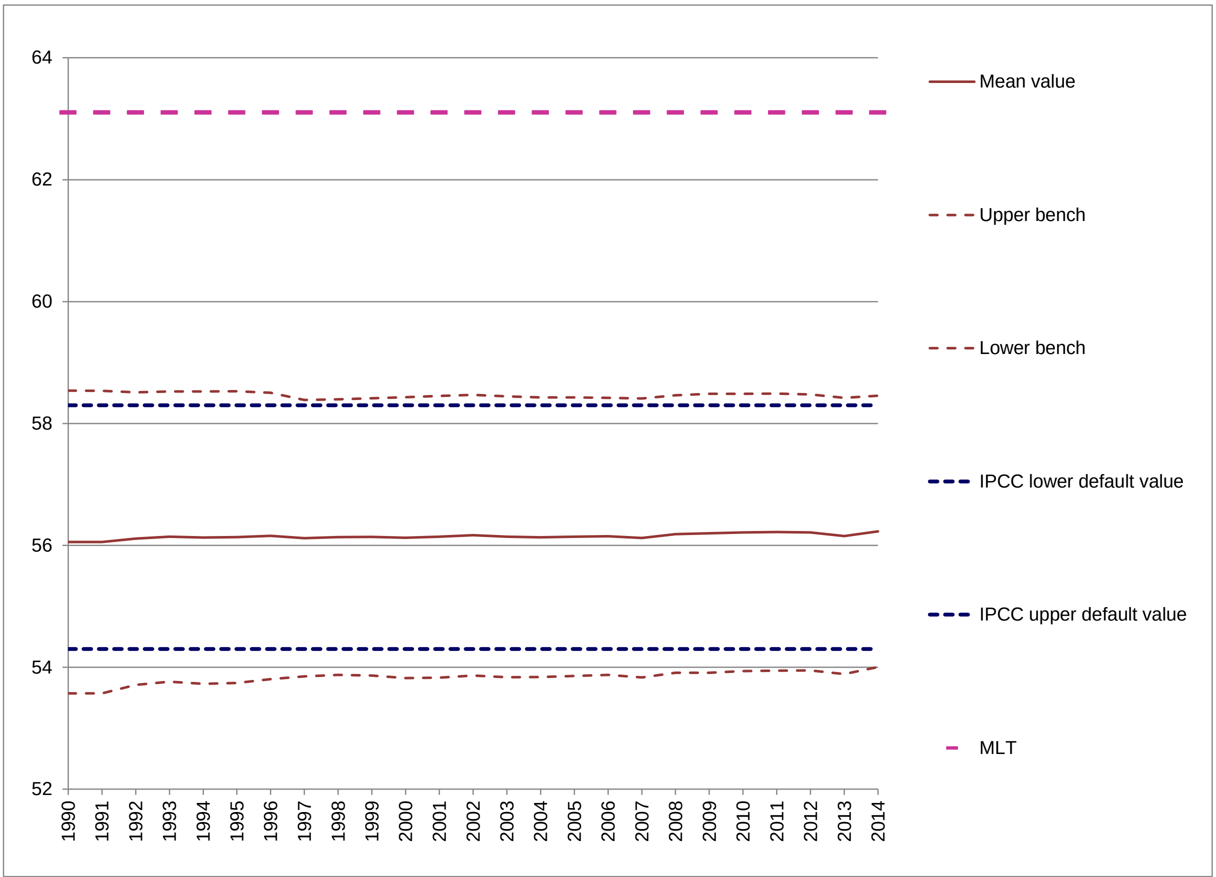


Figure 3.120 1A4a Commercial/Institutional, gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 2014, CO_2 from other fossil fuels had a share of 3%. Between 1990 and 2014 CO_2 increased by 349% (Table 3.80). 21 Member States and Island report emissions as 'Not occurring' in 2014; Between 2013 and 2014 CO_2 increased by 6%. Emissions trend and emissions level are strongly dominated by Italy.

Table 3.80: 1A4a Commercial/Institutional, other fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	350	5	6	0%	1	17%	-344	-98%
Belgium	31	102	102	2%	0	0%	72	233%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	34	7	14	0%	7	89%	-20	-58%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	0	NO	NO	-	-	-	0	-100%
France	NO	NO	NO	-	-	-	-	-
Germany	NA	NA	NA	-	-	-	-	-
Greece	IE,NO	IE,NO	NO,IE	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	526	4 132	4 374	96%	242	6%	3 848	731%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	72	59	25	1%	-33	-57%	-47	-65%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	0	21	0%	21	11494%	21	100%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	3	3	0%	0	0%	3	100%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**1 013**	**4 308**	**4 546**	**100%**	**238**	**6%**	**3 533**	**349%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**1 013**	**4 308**	**4 546**	**100%**	**238**	**6%**	**3 533**	**349%**

Figure 3.121 and Figure 3.122 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Italy; it causes 96% of the CO_2 emissions from other fuels in 1A4a. The CO_2 implied emission factor for other fossil fuels was 112.0 t/TJ in 2014.

Figure 3.121 1A4a Commercial/Institutional, other fuels: Emission trend and share for CO_2

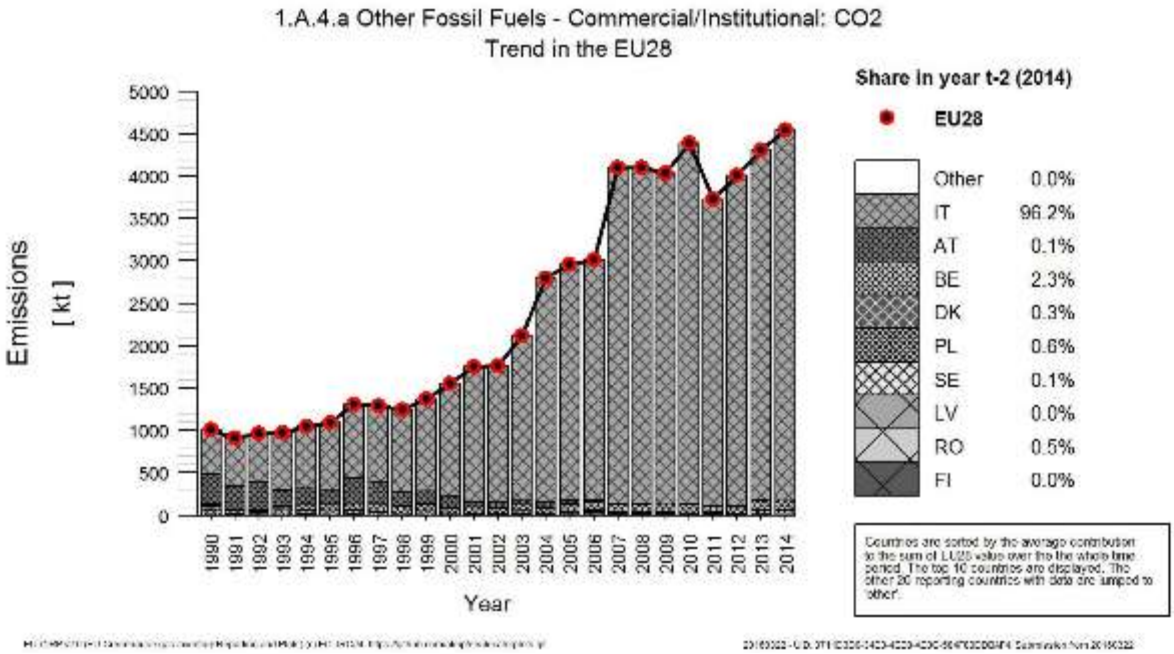
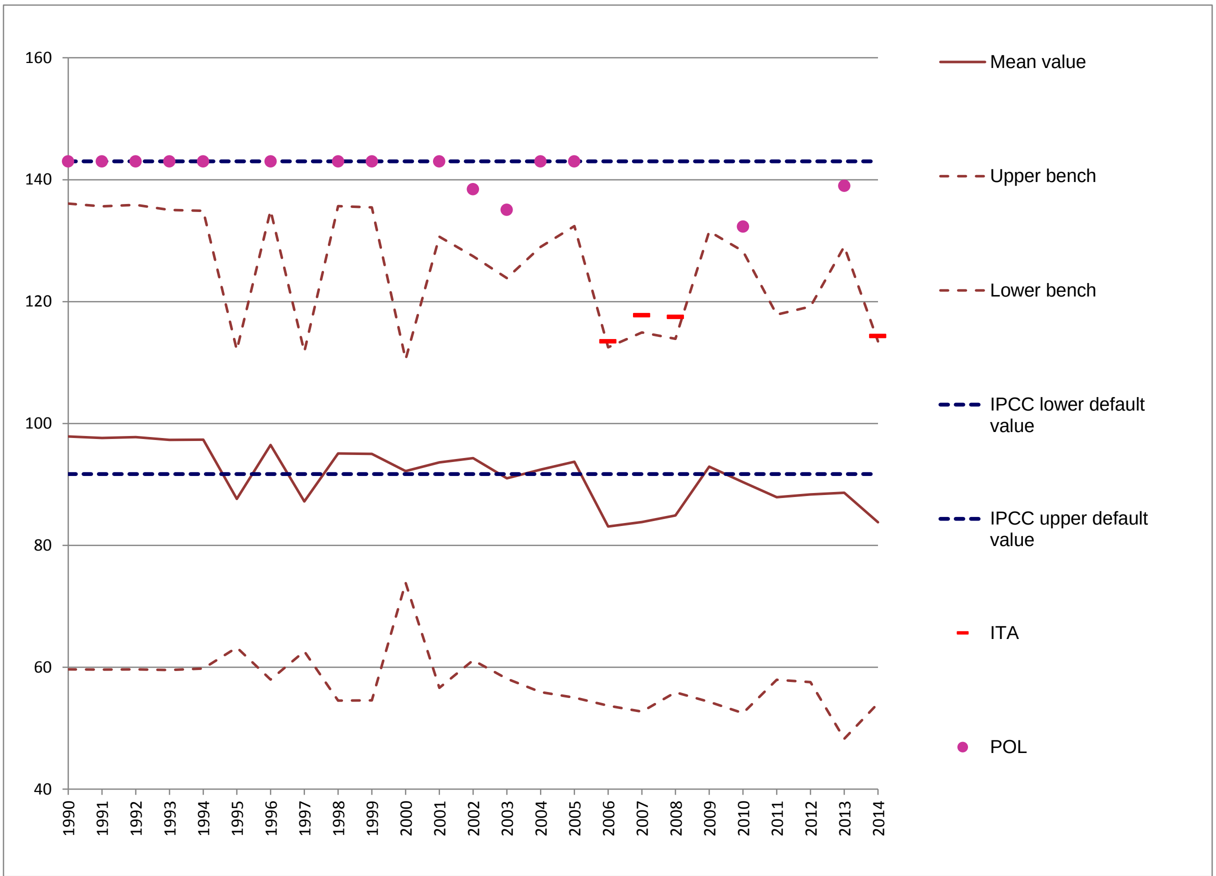


Figure 3.122 1A4a Commercial/Institutional, other fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



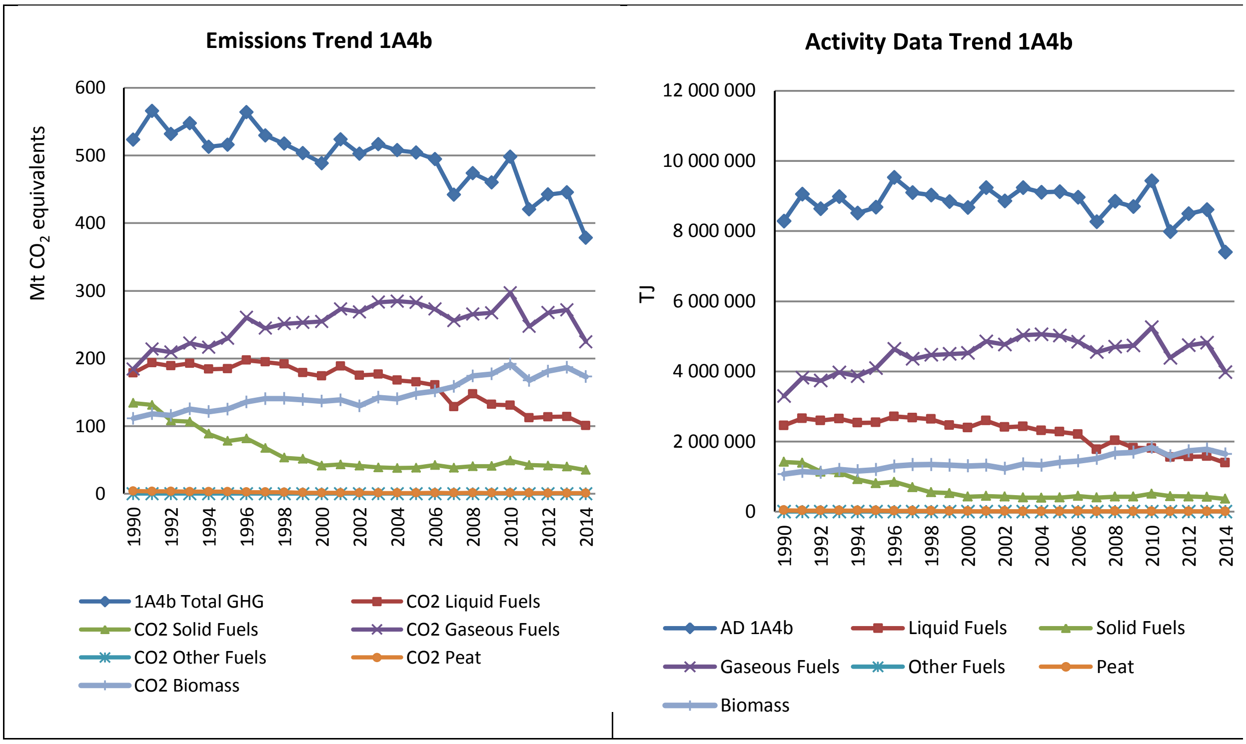
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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+ISL and account for 9.5% of total GHG emissions in 2014.

Figure 3.123 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 28% since 1990, although CO_2 emissions from gaseous fuels increased strongly (+22%) which was counterbalanced by decreasing emissions from other fossil fuels. From 2013 to 2014 CO_2 emissions decreased by 15.1% and energy consumption decreased by 14.1% which is correlating with the trend in EU-28 heating degree days (-14%). Biomass consumption reached a share of 22% in the year 2014 while the share of solid fuels consumption dropped to 5%.

Figure 3.123 1A4b Residential: Total, CO_2 and CH_4 emission and activity trends



CO_2 emissions from 1A4b Residential

Between 1990 and 2014, CO_2 emissions from households decreased by 28% in the EU-28+ISL (Figure 3.123). 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 20% between 1990 and 2014, with a fuel shift from coal and oil to natural gas and biomass.

Between 1990 and 2014, the largest CO_2 reduction in absolute terms was reported by Germany reducing emissions by 44.3 million tonnes. Only five 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 2013 and 2014 all Member States except Latvia and Greece show decreasing emissions with the largest decrease reported by France, Italy, Germany and the United Kingdom.

Table 3.81 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	9 963	6 336	5 298	1%	-1 039	-16%	-4 665	-47%	NA	NA
Belgium	20 471	18 473	15 502	4%	-2 972	-16%	-4 969	-24%	CS,NA,T1,T3	D,NA
Bulgaria	2 891	934	699	0%	-235	-25%	-2 192	-76%	NA,T1,T2	CS,D,NA
Croatia	2 029	1 636	1 427	0%	-209	-13%	-602	-30%	NA,T1	D,NA
Cyprus	300	337	302	0%	-35	-10%	3	1%	T1	D
Czech Republic	15 837	7 572	5 954	2%	-1 618	-21%	-9 883	-62%	T1,T2	CS,D
Denmark	5 004	2 142	1 473	0%	-670	-31%	-3 531	-71%	CR,M,T1,T2,T3	CS,D
Estonia	1 338	193	192	0%	-1	-1%	-1 146	-86%	T1,T2	CS,D
Finland	3 147	1 456	1 411	0%	-45	-3%	-1 736	-55%	CS,M,NA,T1,T3	CS,D,NA
France	54 976	57 327	46 887	13%	-10 440	-18%	-8 089	-15%	-	-
Germany	128 636	99 733	84 307	23%	-15 425	-15%	-44 328	-34%	CS,T2	CS
Greece	4 654	3 588	3 781	1%	193	5%	-873	-19%	T1,T2	CS,D
Hungary	15 717	6 847	6 183	2%	-663	-10%	-9 534	-61%	NA,T1,T2	CS,D,NA
Ireland	7 052	6 202	5 579	2%	-623	-10%	-1 473	-21%	T2	CS
Italy	52 479	51 322	42 423	12%	-8 899	-17%	-10 056	-19%	NA,T2	CS,NA
Latvia	1 198	436	441	0%	5	1%	-757	-63%	T1,T2	CS,D
Lithuania	2 362	698	644	0%	-54	-8%	-1 719	-73%	T2	CS
Luxembourg	663	1 057	990	0%	-67	-6%	326	49%	NA,T1,T2	CS,D,NA
Malta	70	79	74	0%	-5	-6%	4	6%	T1	D
Netherlands	20 732	20 490	15 283	4%	-5 207	-25%	-5 449	-26%	NA,T2	CS,D,NA
Poland	35 383	37 049	34 105	9%	-2 945	-8%	-1 279	-4%	NO,T1,T2	CS,D,NO
Portugal	1 656	1 949	1 860	1%	-89	-5%	205	12%	-	-
Romania	8 956	6 314	5 880	2%	-435	-7%	-3 077	-34%	T1,T2	CS,D
Slovakia	7 163	3 088	2 651	1%	-437	-14%	-4 511	-63%	T2	CS
Slovenia	809	819	656	0%	-163	-20%	-153	-19%	T1,T2	CS,D
Spain	12 979	15 852	15 420	4%	-432	-3%	2 441	19%	NA,T2	CS,M,NA,OTH
Sweden	6 236	791	745	0%	-45	-6%	-5 491	-88%	T1,T2	CS
United Kingdom	78 587	74 482	61 427	17%	-13 055	-18%	-17 160	-22%	NA,T1,T2,T3	CS,D,NA
EU-28	**501 289**	**427 202**	**361 595**	**100%**	**-65 607**	**-15%**	**-139 694**	**-28%**		
Iceland	31	8	16	0%	9	113%	-14	-47%	T1,T2	D
EU-28 + ISL	**501 319**	**427 209**	**361 611**	**100%**	**-65 598**	**-15%**	**-139 708**	**-28%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2014 CO_2 from liquid fuels had a share of 27% within source category 1A4b (compared to 34% in 1990). Between 1990 and 2014 emissions decreased by 44% (Table 3.82). France, Germany and Italy show the highest absolute decreases.Only four Member States reported increasing emissions since 1990. Between 2013 and 2014 EU-28+ISL CO_2 emissions decreased by 12%. 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 3.82 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	5 605	3 437	2 885	3%	-551	-16%	-2 720	-49%
Belgium	12 801	9 331	8 369	8%	-962	-10%	-4 432	-35%
Bulgaria	158	64	64	0%	0	0%	-94	-59%
Croatia	1 137	472	394	0%	-78	-16%	-742	-65%
Cyprus	300	337	302	0%	-35	-10%	3	1%
Czech Republic	239	12	12	0%	0	0%	-227	-95%
Denmark	3 944	557	97	0%	-460	-83%	-3 847	-98%
Estonia	545	37	40	0%	3	9%	-505	-93%
Finland	3 022	1 370	1 329	1%	-42	-3%	-1 694	-56%
France	30 989	19 097	15 294	15%	-3 803	-20%	-15 695	-51%
Germany	56 382	42 886	38 295	38%	-4 591	-11%	-18 087	-32%
Greece	4 565	3 044	3 229	3%	185	6%	-1 336	-29%
Hungary	3 459	226	163	0%	-62	-28%	-3 296	-95%
Ireland	1 175	2 752	2 570	3%	-182	-7%	1 395	119%
Italy	25 540	8 020	6 694	7%	-1 327	-17%	-18 846	-74%
Latvia	330	154	157	0%	3	2%	-173	-52%
Lithuania	397	138	132	0%	-6	-4%	-265	-67%
Luxembourg	467	556	457	0%	-99	-18%	-10	-2%
Malta	70	78	74	0%	-5	-6%	4	6%
Netherlands	775	205	183	0%	-22	-11%	-593	-76%
Poland	107	1 621	1 647	2%	26	2%	1 540	1434%
Portugal	1 656	1 375	1 255	1%	-120	-9%	-401	-24%
Romania	922	541	559	1%	18	3%	-363	-39%
Slovakia	93	23	12	0%	-12	-50%	-81	-88%
Slovenia	439	553	450	0%	-103	-19%	11	2%
Spain	9 971	7 893	7 710	8%	-184	-2%	-2 261	-23%
Sweden	6 150	692	646	1%	-46	-7%	-5 504	-89%
United Kingdom	7 338	8 629	7 859	8%	-770	-9%	522	7%
EU-28	**178 575**	**114 099**	**100 879**	**100%**	**-13 220**	**-12%**	**-77 696**	**-44%**
Iceland	31	8	16	0%	9	113%	-14	-47%
EU-28 + ISL	**178 606**	**114 107**	**100 895**	**100%**	**-13 212**	**-12%**	**-77 711**	**-44%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.124 and Figure 3.125 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 84% of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-28+ISL decreased by 43% between 1990 and 2014. The CO_2 implied emission factor for liquid fuels was 72.3 t/TJ in 2014.

Figure 3.124 1A4b Residential, liquid fuels: Emission trend and share for CO_2

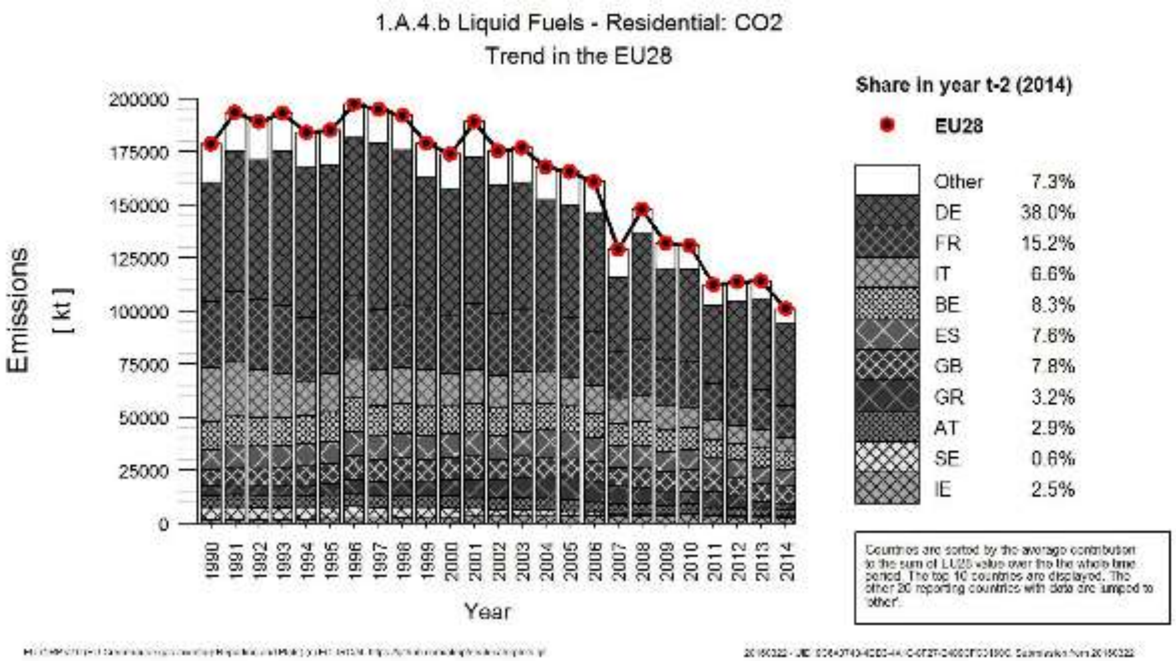
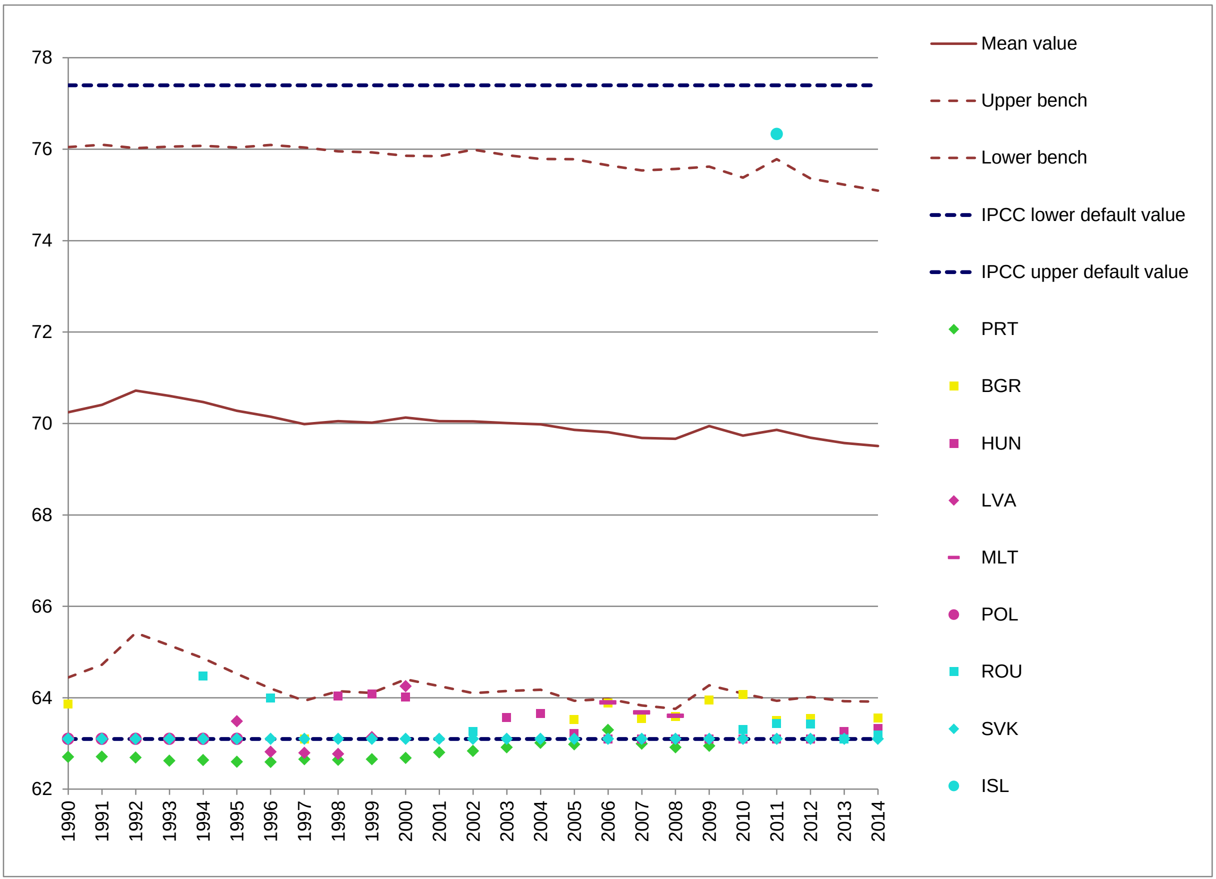


Figure 3.125 1A4b Residential, liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A4b Residential –Solid Fuels (CO_2)

In 2014 CO_2 from solid fuels had a share of 9% within source category 1A4b (compared to 26% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 74% (Table 3.83). 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 2013 and 2014 CO_2 emissions decreased by 13%. Iceland, Cyprus, Malta, Sweden and Portugal report emissions as 'Not occurring'.

Table 3.83 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	2 511	112	91	0%	-21	-19%	-2 420	-96%
Belgium	1 796	360	284	1%	-76	-21%	-1 512	-84%
Bulgaria	2 734	766	530	2%	-236	-31%	-2 203	-81%
Croatia	436	17	14	0%	-2	-13%	-422	-97%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	13 500	2 850	2 121	6%	-729	-26%	-11 379	-84%
Denmark	72	2	0	0%	-2	-98%	-72	-100%
Estonia	338	23	19	0%	-4	-18%	-319	-94%
Finland	33	1	1	0%	0	-2%	-32	-97%
France	3 327	381	168	0%	-213	-56%	-3 159	-95%
Germany	40 661	2 805	2 031	6%	-774	-28%	-38 630	-95%
Greece	89	4	12	0%	8	231%	-77	-86%
Hungary	8 107	576	446	1%	-131	-23%	-7 661	-95%
Ireland	2 483	1 099	882	3%	-217	-20%	-1 601	-64%
Italy	707	12	12	0%	0	0%	-695	-98%
Latvia	606	50	50	0%	0	0%	-556	-92%
Lithuania	1 440	198	168	0%	-29	-15%	-1 271	-88%
Luxembourg	26	3	2	0%	-1	-24%	-24	-92%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	61	5	3	0%	-2	-41%	-58	-95%
Poland	28 420	27 396	25 075	71%	-2 321	-8%	-3 346	-12%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	2 810	85	264	1%	179	210%	-2 546	-91%
Slovakia	5 441	248	222	1%	-26	-11%	-5 220	-96%
Slovenia	345	2	1	0%	-1	-47%	-344	-100%
Spain	2 091	460	444	1%	-15	-3%	-1 646	-79%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	16 283	2 725	2 300	7%	-425	-16%	-13 983	-86%
EU-28	**134 316**	**40 177**	**35 141**	**100%**	**-5 036**	**-13%**	**-99 175**	**-74%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**134 316**	**40 177**	**35 141**	**100%**	**-5 036**	**-13%**	**-99 175**	**-74%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.126 and Figure 3.127 shows CO_2 emissions and implied emission factors for EU-28+ISL 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 90% of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-28 decreased by 74% between 1990 and 2014. The CO_2 implied emission factor for solid fuels was 95.4 t/TJ in 2014. The comparatively low IEFs of Italy and Spain in 1990 are due to a high share of gas works gas consumption in the 1990s.

Figure 3.126 1A4b Residential, solid fuels: Emission trend and share for CO_2

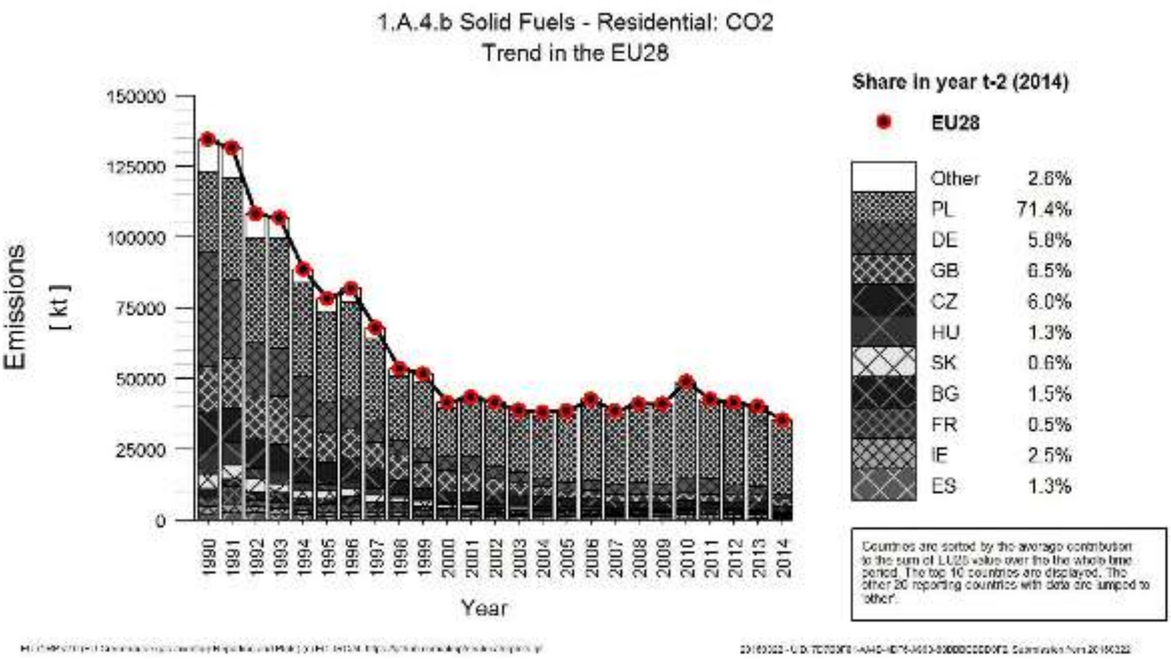
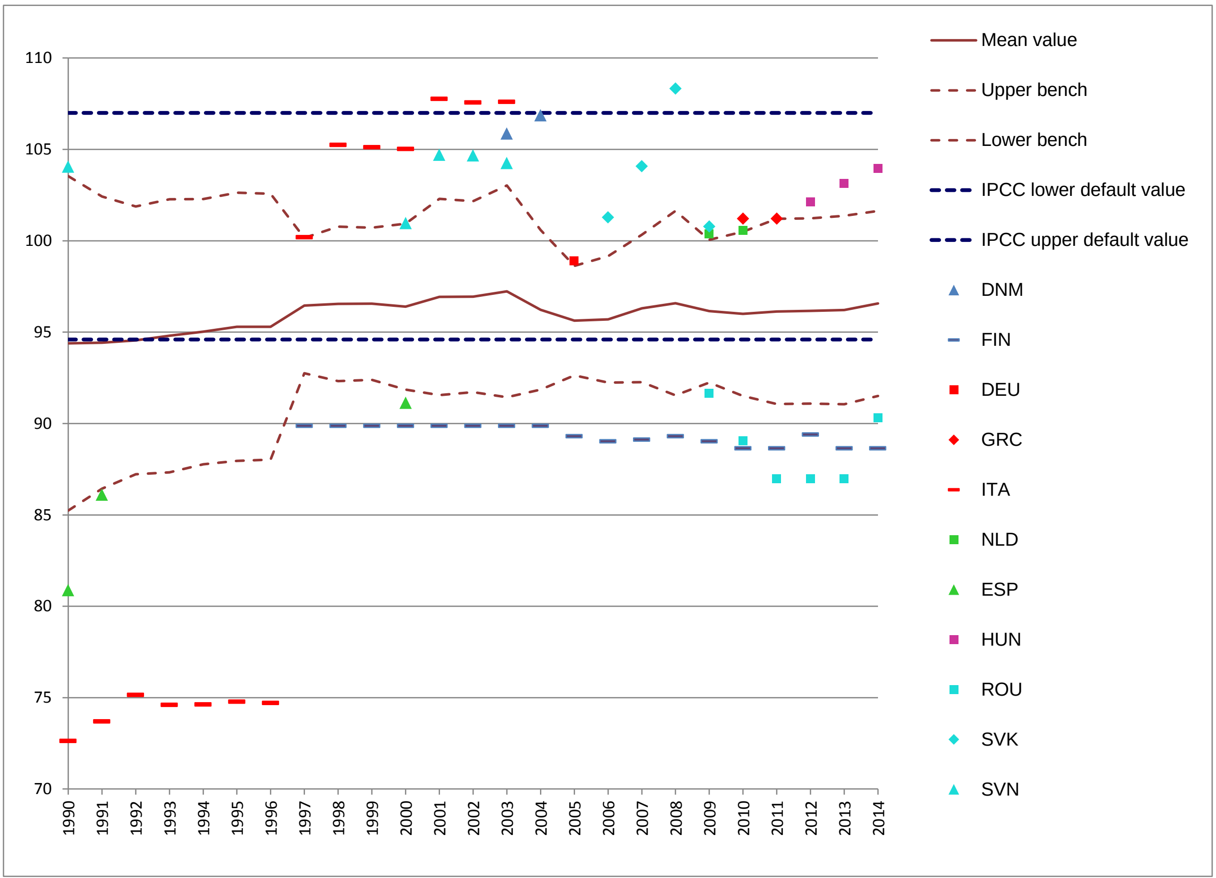


Figure 3.127 1A4b Residential, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

1A4b Residential – Gaseous Fuels (CO_2)

In 2014, CO_2 from gaseous fuels had a share of 59% within source category 1A4b (compared to 35% in 1990). Between 1990 and 2014, the emissions increased by 22% (Table 3.84). All Member States except Lithuania, the Netherlands, Romania and the United Kingdom reported increasing emissions. The highest absolute increase occurred in Germany, France, Spain and Italy. Between 2013 and 2014, EU-28+ISL emissions decreased by 17%.

Table 3.84 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	1 847	2 787	2 321	1%	-466	-17%	474	26%
Belgium	5 874	8 783	6 849	3%	-1 934	-22%	975	17%
Bulgaria	NO	104	105	0%	1	1%	105	100%
Croatia	456	1 147	1 018	0%	-129	-11%	562	123%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	2 098	4 710	3 821	2%	-889	-19%	1 722	82%
Denmark	988	1 584	1 376	1%	-208	-13%	388	39%
Estonia	116	117	117	0%	0	0%	1	1%
Finland	25	66	64	0%	-2	-3%	39	153%
France	20 660	37 848	31 425	14%	-6 423	-17%	10 764	52%
Germany	31 564	54 042	43 981	20%	-10 061	-19%	12 417	39%
Greece	IE,NO	541	540	0%	-1	0%	540	100%
Hungary	4 152	6 045	5 574	2%	-470	-8%	1 423	34%
Ireland	270	1 422	1 272	1%	-150	-11%	1 002	372%
Italy	26 232	43 290	35 718	16%	-7 572	-17%	9 486	36%
Latvia	220	231	233	0%	2	1%	14	6%
Lithuania	510	285	278	0%	-7	-2%	-232	-46%
Luxembourg	170	499	531	0%	32	6%	361	213%
Malta	0.2	0.4	0.4	0%	0.0	-9%	0.2	95%
Netherlands	19 896	20 280	15 097	7%	-5 183	-26%	-4 799	-24%
Poland	6 856	8 033	7 383	3%	-650	-8%	527	8%
Portugal	NO	574	606	0%	31	5%	606	100%
Romania	5 225	5 689	5 057	2%	-632	-11%	-168	-3%
Slovakia	1 628	2 817	2 418	1%	-399	-14%	790	48%
Slovenia	25	265	205	0%	-60	-23%	180	717%
Spain	918	7 499	7 266	3%	-233	-3%	6 349	692%
Sweden	86	99	99	0%	0	0%	13	15%
United Kingdom	54 478	63 121	51 261	23%	-11 860	-19%	-3 217	-6%
EU-28	**184 294**	**271 877**	**224 615**	**100%**	**-47 262**	**-17%**	**40 321**	**22%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**184 294**	**271 877**	**224 615**	**100%**	**-47 262**	**-17%**	**40 321**	**22%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.128 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 72% of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-28+ISL rose 21% between 1990 and 2014. The CO_2 implied emission factor for gaseous fuels was 56.4 t/TJ in 2014. The comparatively high IEF of Malta is because LPG is included under gaseous fuels.

Figure 3.128 1A4b Residential, gaseous fuels: Emission trend and share for CO_2

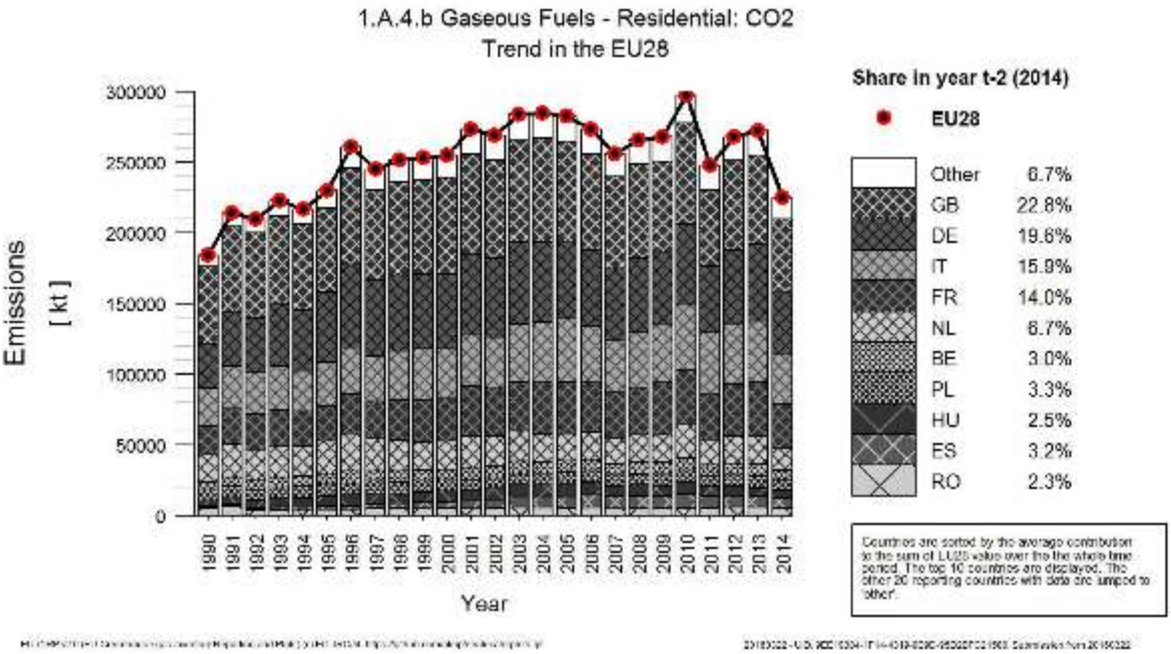
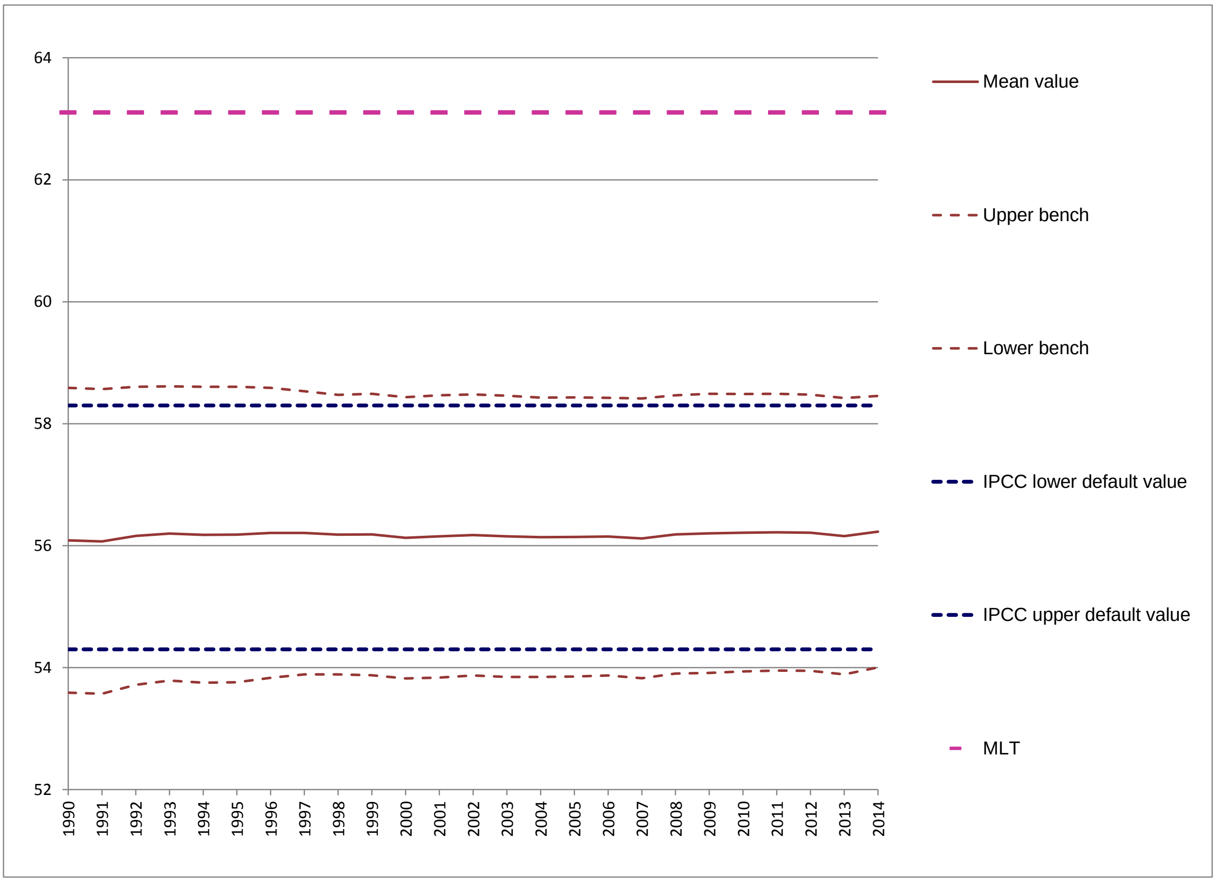


Figure 3.129 1A4b Residential, gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

CH_4 emissions from 1A4b Residential

CH_4 emissions mainly occur from incomplete biomass and coal combustion. CH_4 emissions from 1A4b Residential accounted for 0.3% of total GHG emissions in 2014. Between 1990 and 2014, CH_4 emissions from households decreased by 28% in the EU-28 (Table 3.85). France, the Check Republic and the United Kingdom reported the highest decrease in emissions while Italy and Poland reported the highest increase in emissions. Between 2013 and 2014 CH_4 emissions decreased by 9%.

Table 3.85 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	450	227	186	1%	-41	-18%	-264	-59%	NA	NA
Belgium	270	277	208	2%	-70	-25%	-62	-23%	CS,NA,T1,T3	CR,D,NA
Bulgaria	262	295	272	2%	-23	-8%	10	4%	NA,T1	D,NA
Croatia	181	127	322	2%	195	153%	142	78%	NA,T1	D,NA
Cyprus	2	3	2	0%	0	-10%	1	29%	T1	D
Czech Republic	1 226	615	547	4%	-68	-11%	-679	-55%	T1	D
Denmark	119	117	97	1%	-21	-18%	-22	-19%	CR,M,T1,T2,T3	CS,D,OTH
Estonia	95	122	120	1%	-2	-1%	25	27%	T1	D
Finland	198	272	275	2%	3	1%	76	38%	CS,M,NA,T1,T3	CS,D,NA
France	4 596	1 536	1 278	10%	-258	-17%	-3 319	-72%	-	-
Germany	1 445	772	633	5%	-138	-18%	-812	-56%	T2,T3	CS,M
Greece	92	97	97	1%	0	0%	5	5%	T1	D
Hungary	827	271	238	2%	-32	-12%	-589	-71%	NA,T1	D,NA
Ireland	443	176	151	1%	-24	-14%	-291	-66%	T1	D
Italy	1 091	2 284	1 981	15%	-303	-13%	890	82%	NA,T2	CR,NA
Latvia	149	109	107	1%	-1	-1%	-42	-28%	T1,T2	CS,D
Lithuania	175	169	157	1%	-12	-7%	-18	-10%	T1,T2	CS,D
Luxembourg	9	10	10	0%	0	-3%	1	10%	NA,T1	D,NA
Malta	0.2	0.2	0.2	0%	0.0	-7%	0.0	-5%	T1	D
Netherlands	456	500	423	3%	-76	-15%	-33	-7%	NA,T1,T2	CS,D,NA
Poland	2 445	3 071	2 801	21%	-270	-9%	356	15%	NO,T1	D,NO
Portugal	410	244	243	2%	-1	0%	-167	-41%	-	-
Romania	416	997	1 014	8%	16	2%	598	144%	T1	D
Slovakia	452	173	173	1%	0	0%	-279	-62%	T1	D
Slovenia	128	169	140	1%	-28	-17%	12	9%	T1	D
Spain	794	862	865	6%	3	0%	71	9%	NA,T2	D,NA
Sweden	284	259	245	2%	-14	-5%	-39	-14%	M,T1	CS
United Kingdom	1 440	843	762	6%	-81	-10%	-678	-47%	NA,T1,T2,T3	CS,D,NA
EU-28	**18 456**	**14 598**	**13 350**	**100%**	**-1 248**	**-9%**	**-5 106**	**-28%**		
Iceland	0	0	0	0%	0	129%	0	-51%	T1,T2	D
EU-28 + ISL	**18 456**	**14 598**	**13 350**	**100%**	**-1 248**	**-9%**	**-5 106**	**-28%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 4 CH_4 from biomass had a share of 2.6% within source category 1A4b (compared to 1.8% in 1990). Between 1990 and 2014 CH_4 increased by 6% (Table 3.86). France reported the highest absolute decrease, while CH_4 emissions of Italy, Romania and Poland increased significantly. Between 2013 and 2014, CH_4 emissions decreased by 7%.

Table 3.86 1A4b Residential, biomass: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	374	222	182	2%	-41	-18%	-192	-51%
Belgium	71	197	141	1%	-56	-28%	70	98%
Bulgaria	54	235	230	2%	-5	-2%	176	325%
Croatia	143	122	318	3%	196	160%	175	122%
Cyprus	1	2	2	0%	0	-9%	1	53%
Czech Republic	254	382	376	4%	-6	-2%	122	48%
Denmark	109	110	92	1%	-18	-17%	-18	-16%
Estonia	40	118	117	1%	-1	-1%	77	191%
Finland	181	262	265	3%	3	1%	84	46%
France	4 179	1 352	1 137	12%	-215	-16%	-3 042	-73%
Germany	280	628	524	5%	-104	-17%	244	87%
Greece	91	96	96	1%	0	0%	5	6%
Hungary	186	215	193	2%	-22	-10%	7	4%
Ireland	14	9	8	0%	-1	-10%	-6	-42%
Italy	1 000	2 224	1 931	20%	-293	-13%	931	93%
Latvia	96	103	102	1%	-1	-1%	5	5%
Lithuania	58	147	138	1%	-9	-6%	80	136%
Luxembourg	5	7	7	0%	0	0%	2	40%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	98	133	136	1%	3	2%	38	38%
Poland	258	876	791	8%	-86	-10%	533	207%
Portugal	409	243	242	2%	-1	0%	-166	-41%
Romania	181	976	979	10%	3	0%	799	442%
Slovakia	36	151	153	2%	2	2%	117	326%
Slovenia	102	166	138	1%	-28	-17%	36	36%
Spain	651	789	794	8%	5	1%	143	22%
Sweden	277	254	240	2%	-14	-5%	-36	-13%
United Kingdom	57	473	453	5%	-20	-4%	396	698%
EU-28	**9 206**	**10 493**	**9 786**	**100%**	**-708**	**-7%**	**579**	**6%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**9 206**	**10 493**	**9 786**	**100%**	**-708**	**-7%**	**579**	**6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.130 and Figure 3.131 shows CH_4 emissions and implied emission factors for EU-28+ISL 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 58% of the CH_4 emissions from biomass fuels in 1A4b. Biomass fuel consumption in the EU-28 rose by 54% between 1990 and 2014. The CH_4 implied emission factor for biomass fuels was 237.8 kg/TJ in 2014. The high IEF of the Netherlands is due to wrong activity data reported in the CRF.

Figure 3.130 1A4b Residential, biomass: Emission trend and share for CH_4

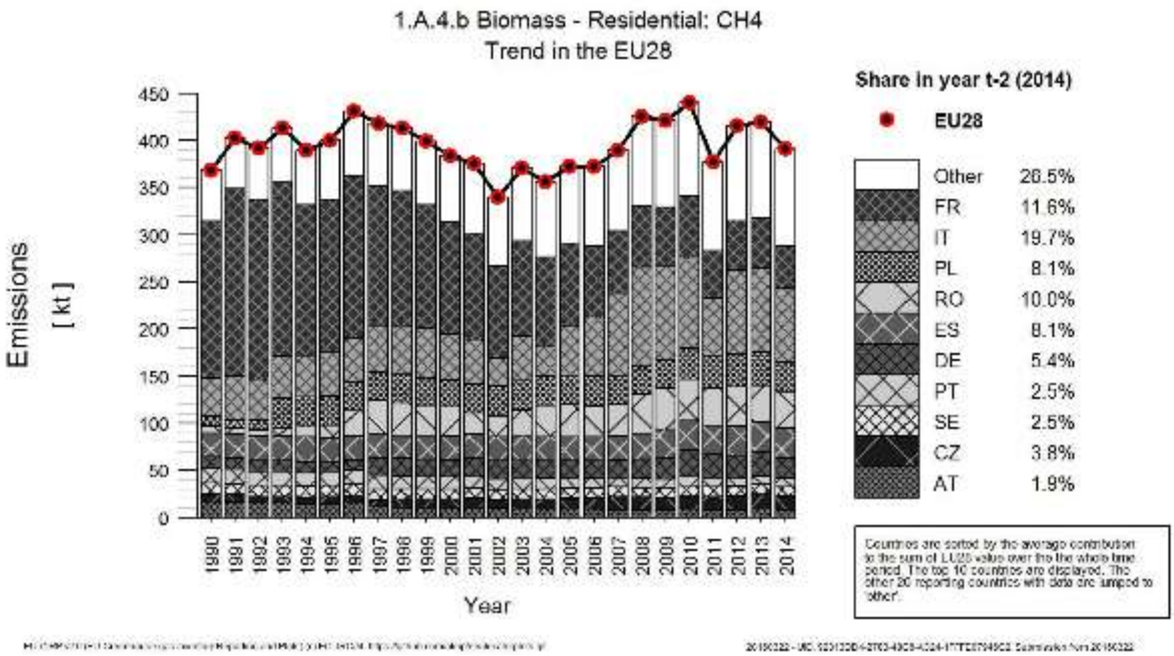
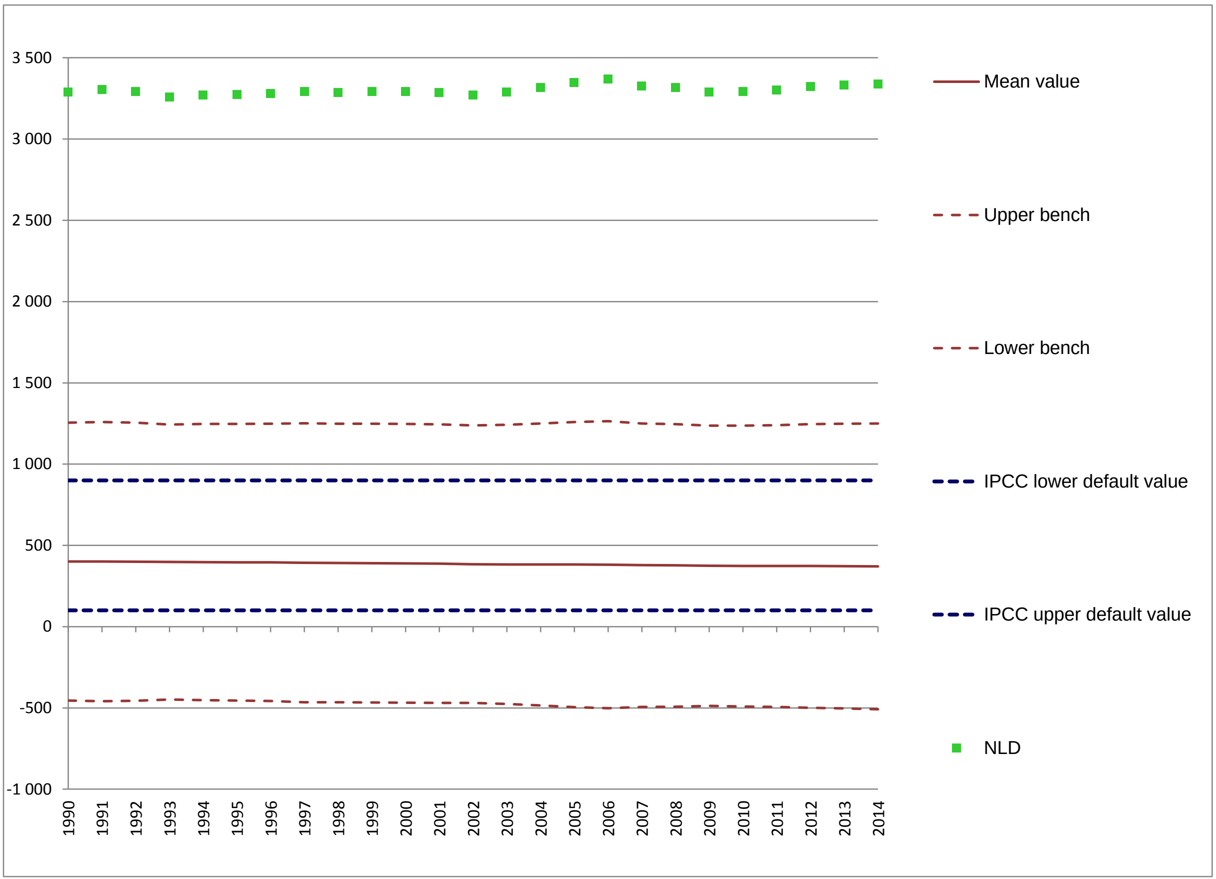


Figure 3.131 1A4b Residential, biomass: Overview of outliers of Implied Emission Factors for CH_4 (in kg/TJ)



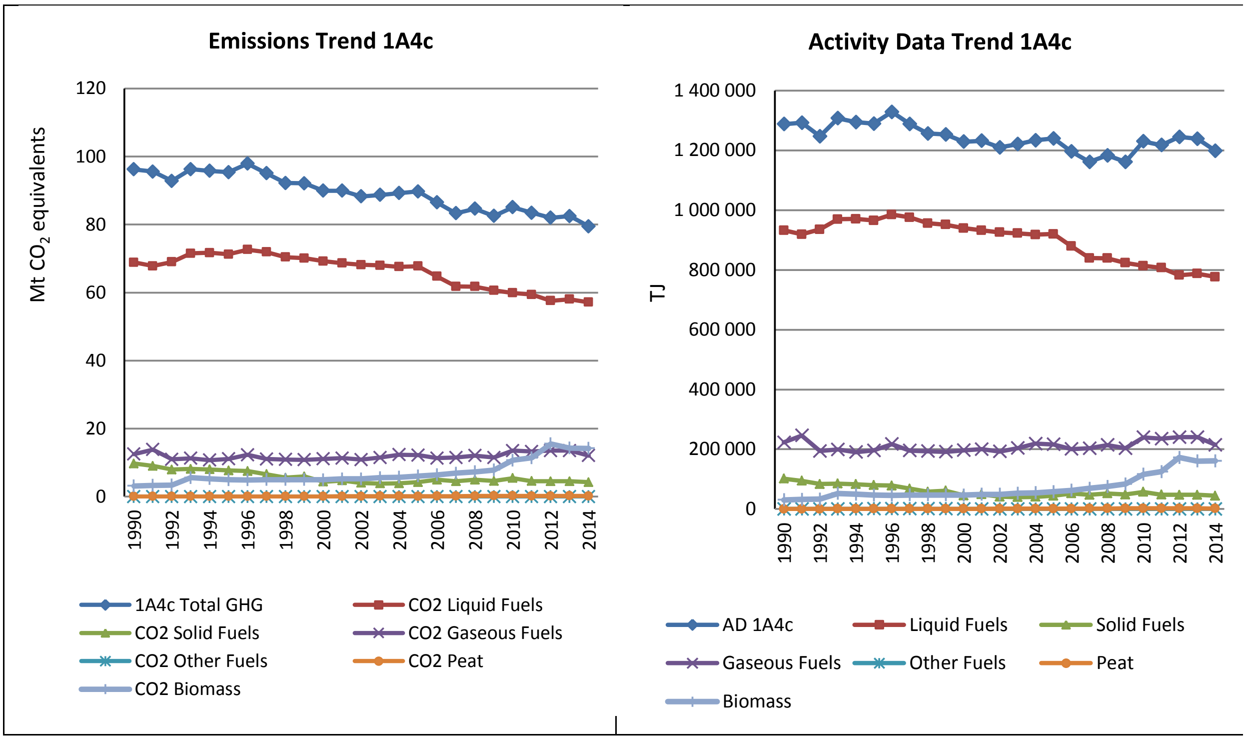
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.2.4.3 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+ISL GHG emissions in 2014. Between 1990 and 2014, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 19% in the EU-28+ISL (Table 3.87).

Figure 3.132 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 17%, mainly due to decreases in CO_2 emissions from liquid fuels (-17%).

Figure 3.132 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



The five Member States, France, Poland, Italy, the Netherlands and Spain together contributed 66% to the emissions from this source in 2014. Spain and Poland were the Member State with the highest increase in absolute terms between 1990 and 2014, while the highest decreases were achieved in the Czech Republic, Germany and Greece.

Table 3.87 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	1 252	811	816	1%	5	1%	-436	-35%	NA	NA
Belgium	2 796	2 015	1 731	2%	-284	-14%	-1 065	-38%	CS,NA,T1,T3	D,NA
Bulgaria	1 653	476	462	1%	-13	-3%	-1 191	-72%	T1,T2	CS,D
Croatia	835	635	639	1%	5	1%	-196	-23%	NA,T1	D,NA
Cyprus	55	76	67	0%	-9	-12%	11	21%	T1	D
Czech Republic	3 790	1 244	1 223	2%	-22	-2%	-2 568	-68%	NA,T1,T2	CS,D,NA
Denmark	2 478	1 916	1 817	2%	-98	-5%	-661	-27%	CR,M,T1,T2,T3	CS,D
Estonia	496	246	307	0%	61	25%	-189	-38%	NA,T1,T2	CS,D,NA
Finland	1 863	1 483	1 375	2%	-108	-7%	-488	-26%	CS,M,NA,T1,T3	CS,D,NA
France	10 815	11 794	11 561	16%	-233	-2%	746	7%	NA	NA
Germany	10 247	5 569	5 301	7%	-267	-5%	-4 946	-48%	CS,T1,T2,T3	CS,M
Greece	2 893	486	469	1%	-17	-4%	-2 424	-84%	T1,T2	CS,D,NO
Hungary	2 638	1 254	1 385	2%	130	10%	-1 253	-47%	NA,T1,T2	CS,D,NA
Ireland	747	616	557	1%	-59	-10%	-190	-25%	NA,T1,T2	CS,D,NA
Italy	8 375	6 787	6 818	9%	30	0%	-1 557	-19%	T2	CS
Latvia	1 579	378	379	1%	1	0%	-1 200	-76%	NA,T1,T2	CS,D,NA
Lithuania	410	94	97	0%	3	3%	-313	-76%	NA,T2	CS,NA
Luxembourg	17	56	55	0%	-1	-2%	38	232%	NA,T1,T2	CS,D,NA
Malta	3.0	17.4	16.5	0%	-1.0	-6%	13.4	445%	T1	D
Netherlands	9 848	9 810	8 599	12%	-1 211	-12%	-1 249	-13%	NA,T2	CS,D,NA
Poland	8 508	10 154	9 727	13%	-427	-4%	1 219	14%	NO,T1,T2	CS,D,NO
Portugal	1 661	1 052	1 014	1%	-38	-4%	-647	-39%	NO,T1,T2	CR,D,NO
Romania	1 998	987	951	1%	-35	-4%	-1 046	-52%	D,T1,T2	CS,D
Slovakia	45	103	96	0%	-8	-8%	50	111%	NA,T1,T2	CS,D,NA
Slovenia	334	208	220	0%	12	6%	-114	-34%	NA,T1	D,NA
Spain	8 310	11 770	11 804	16%	33	0%	3 493	42%	NA,T2,T3	CS,M,NA,OTH
Sweden	1 571	1 565	1 475	2%	-91	-6%	-96	-6%	M,T1	CS
United Kingdom	5 232	4 193	4 109	6%	-84	-2%	-1 123	-21%	NA,T1,T2,T3	CS,D,NA
EU-28	**90 450**	**75 797**	**73 070**	**99%**	**-2 726**	**-4%**	**-17 380**	**-19%**		
Iceland	772	561	566	1%	5	1%	-206	-27%	T1,T2	D
EU-28 + ISL	**91 222**	**76 357**	**73 636**	**100%**	**-2 721**	**-4%**	**-17 586**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2014 CO_2 from liquid fuels had a share of 72% within source category 1A4c (compared to 71% in 1990). Between 1990 and 2014 CO_2 decreased by 17% (Table 3.88). Nine Member States reported increasing emissions with the highest increases in absolute terms in Spain and Poland. Between 2013 and 2014 EU-28+ISL emissions decreased by 2%.

Table 3.88 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	1 181	775	783	1%	8	1%	-398	-34%
Belgium	2 516	1 111	931	2%	-180	-16%	-1 585	-63%
Bulgaria	1 498	401	389	1%	-12	-3%	-1 109	-74%
Croatia	788	595	597	1%	2	0%	-190	-24%
Cyprus	55	76	67	0%	-9	-12%	11	21%
Czech Republic	1 655	1 052	1 059	2%	7	1%	-595	-36%
Denmark	2 114	1 656	1 615	3%	-41	-2%	-498	-24%
Estonia	476	245	304	1%	59	24%	-172	-36%
Finland	1 777	1 259	1 214	2%	-45	-4%	-563	-32%
France	10 435	11 000	10 811	19%	-190	-2%	376	4%
Germany	6 904	4 879	4 675	8%	-203	-4%	-2 228	-32%
Greece	2 882	482	457	1%	-25	-5%	-2 424	-84%
Hungary	2 067	1 002	1 041	2%	39	4%	-1 026	-50%
Ireland	747	616	557	1%	-59	-10%	-190	-25%
Italy	8 323	6 479	6 529	11%	50	1%	-1 795	-22%
Latvia	695	317	321	1%	3	1%	-375	-54%
Lithuania	99	30	39	0%	9	29%	-60	-60%
Luxembourg	17	56	55	0%	-1	-2%	38	232%
Malta	3	17	16	0%	-1	-6%	13	446%
Netherlands	2 519	1 771	1 745	3%	-26	-1%	-774	-31%
Poland	4 709	5 837	5 641	10%	-196	-3%	932	20%
Portugal	1 661	1 019	996	2%	-24	-2%	-666	-40%
Romania	9	805	780	1%	-25	-3%	771	8238%
Slovakia	3	3	4	0%	1	27%	1	28%
Slovenia	334	208	220	0%	12	6%	-114	-34%
Spain	8 267	10 250	10 330	18%	81	1%	2 063	25%
Sweden	1 381	1 545	1 455	3%	-91	-6%	74	5%
United Kingdom	5 001	3 991	3 946	7%	-45	-1%	-1 055	-21%
EU-28	**68 117**	**57 479**	**56 579**	**99%**	**-901**	**-2%**	**-11 538**	**-17%**
Iceland	772	561	566	1%	5	1%	-206	-27%
EU-28 + ISL	**68 889**	**58 040**	**57 144**	**100%**	**-896**	**-2%**	**-11 744**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.133 and Figure 3.134 show CO_2 emissions and implied emission factors for EU-28+ISL 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+ISL decreased by 17% between 1990 and 2014. The CO_2 implied emission factor for liquid fuels was 73.6 t/TJ in 2014.

Figure 3.133 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Emission trend and share for CO_2

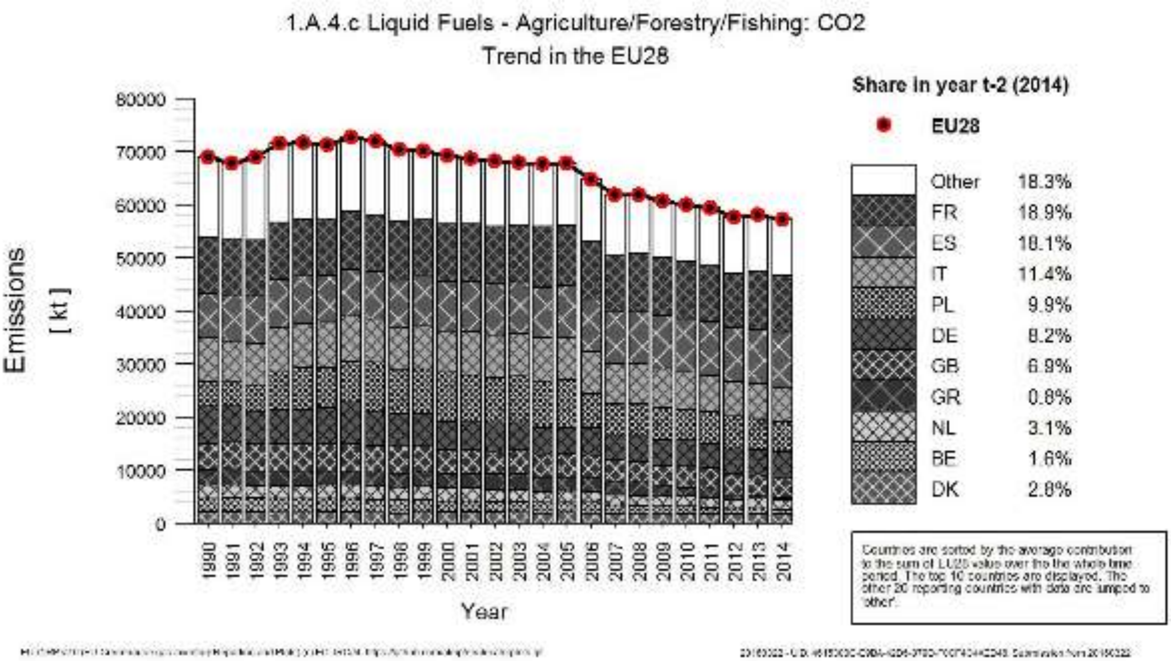
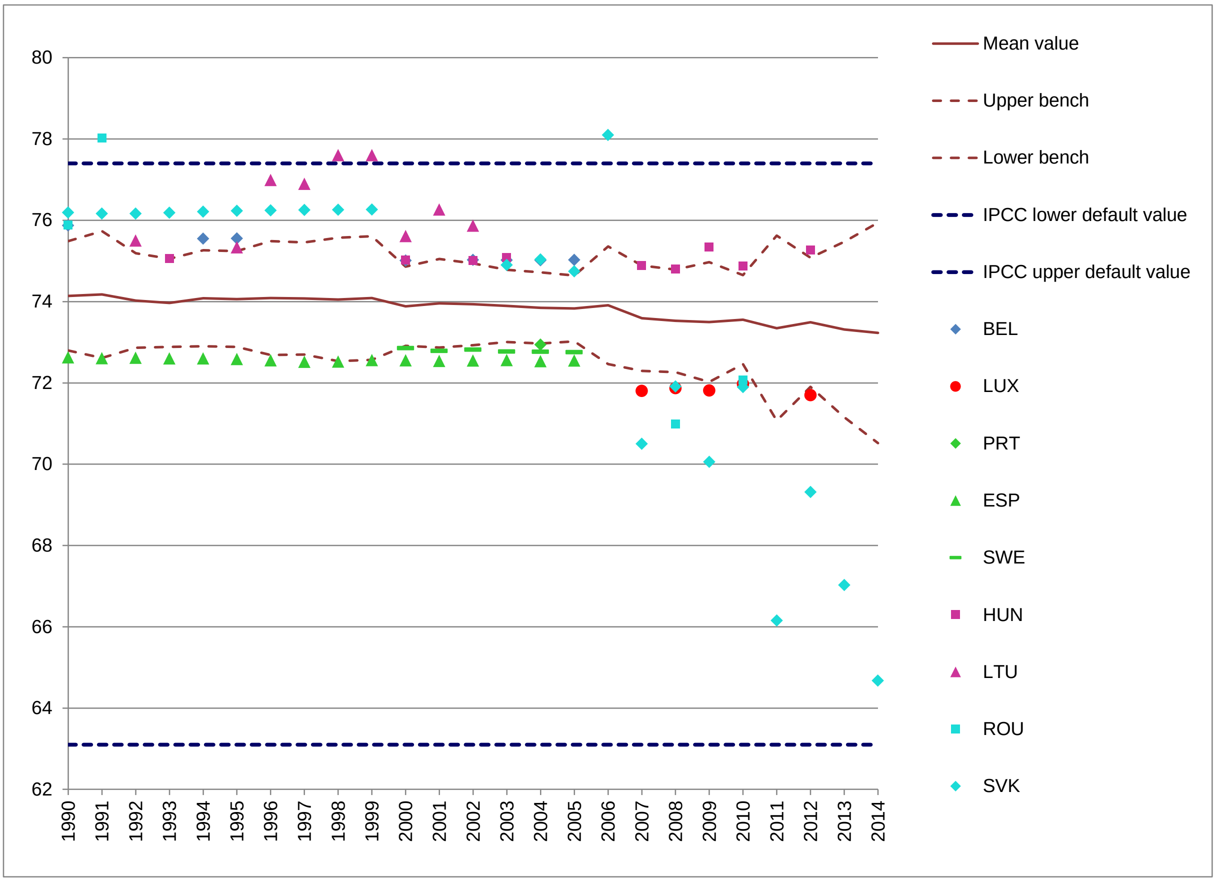


Figure 3.134 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014 CO_2 from solid fuels had a share of 5% within source category 1A4c (compared to 10% in 1990). Between 1990 and 2014 CO_2 decreased by 57% (Table 3.89). Sixteen member states and Iceland reported CO_2 emissions from this source category as 'Not occurring' in 2014. All Member States except for Poland, Greece and Slovakia reported decreasing emissions between 1990 and 2014. Between 2013 and 2014 EU-28+ISL emissions decreased by 6%, mainly due to decreases reported by Poland. The strong decrease in 1990 to 1992 emissions is due to the reporting of Germany.

Table 3.89 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	51	3	3	0%	0	-9%	-48	-94%
Belgium	212	37	37	1%	0	0%	-175	-83%
Bulgaria	152	27	24	1%	-3	-12%	-128	-84%
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 730	44	32	1%	-11	-26%	-1 698	-98%
Denmark	238	144	98	2%	-45	-32%	-140	-59%
Estonia	16	NO	NO	-	-	-	-16	-100%
Finland	13	8	8	0%	0	-2%	-5	-40%
France	NO	NO	NO	-	-	-	-	-
Germany	2 861	8	7	0%	-1	-18%	-2 854	-100%
Greece	11	4	11	0%	7	177%	0	4%
Hungary	134	4	NO	-	-4	-100%	-134	-100%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	102	2	2	0%	0	-8%	-100	-98%
Lithuania	148	3	8	0%	4	135%	-140	-95%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	3 773	4 232	4 006	94%	-227	-5%	232	6%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	69	NO	NO	-	-	-	-69	-100%
Slovakia	1	4	3	0%	-1	-19%	2	148%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	37	NO	NO	-	-	-	-37	-100%
Sweden	157	NO	NO	-	-	-	-157	-100%
United Kingdom	50	NO	NO	-	-	-	-50	-100%
EU-28	**9 756**	**4 521**	**4 239**	**100%**	**-282**	**-6%**	**-5 517**	**-57%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**9 756**	**4 521**	**4 239**	**100%**	**-282**	**-6%**	**-5 517**	**-57%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.135 and Figure 3.136 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. Poland contributes to 95% of emissions in 2014. Fuel consumption in the EU-28+ISL decreased by 56% between 1990 and 2014. The CO_2 implied emission factor for solid fuels was 94.9 t/TJ in 2014.

Figure 3.135 1A4c Agriculture/Forestry/Fisheries, solid fuels: Emission trend and share for CO_2

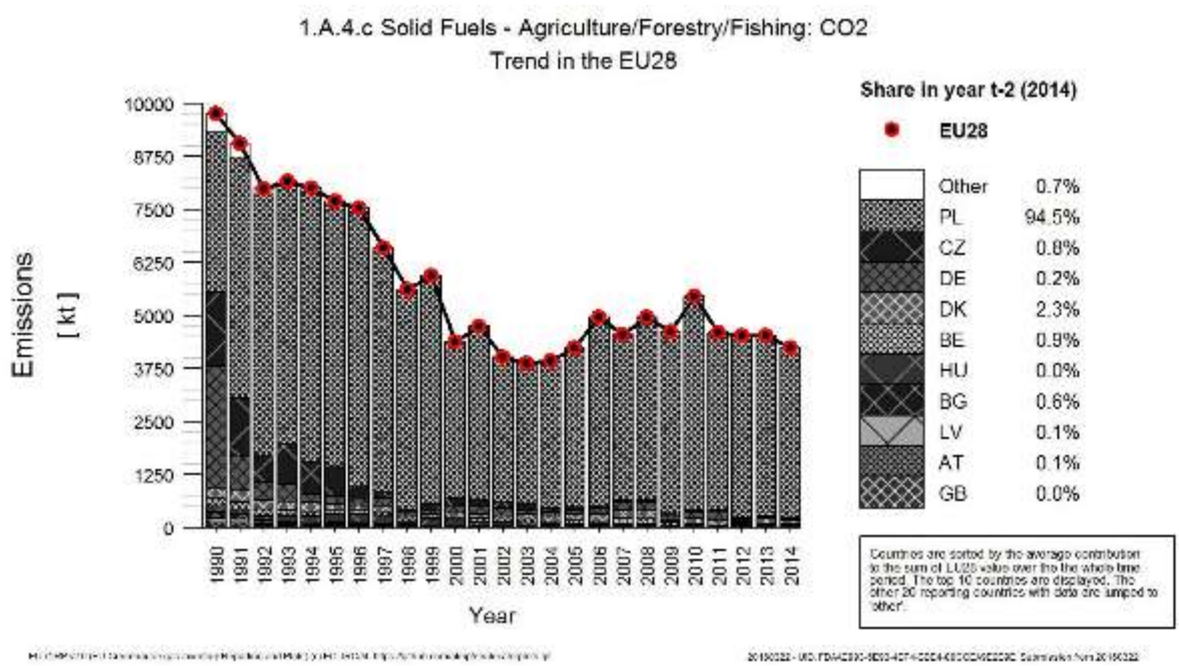
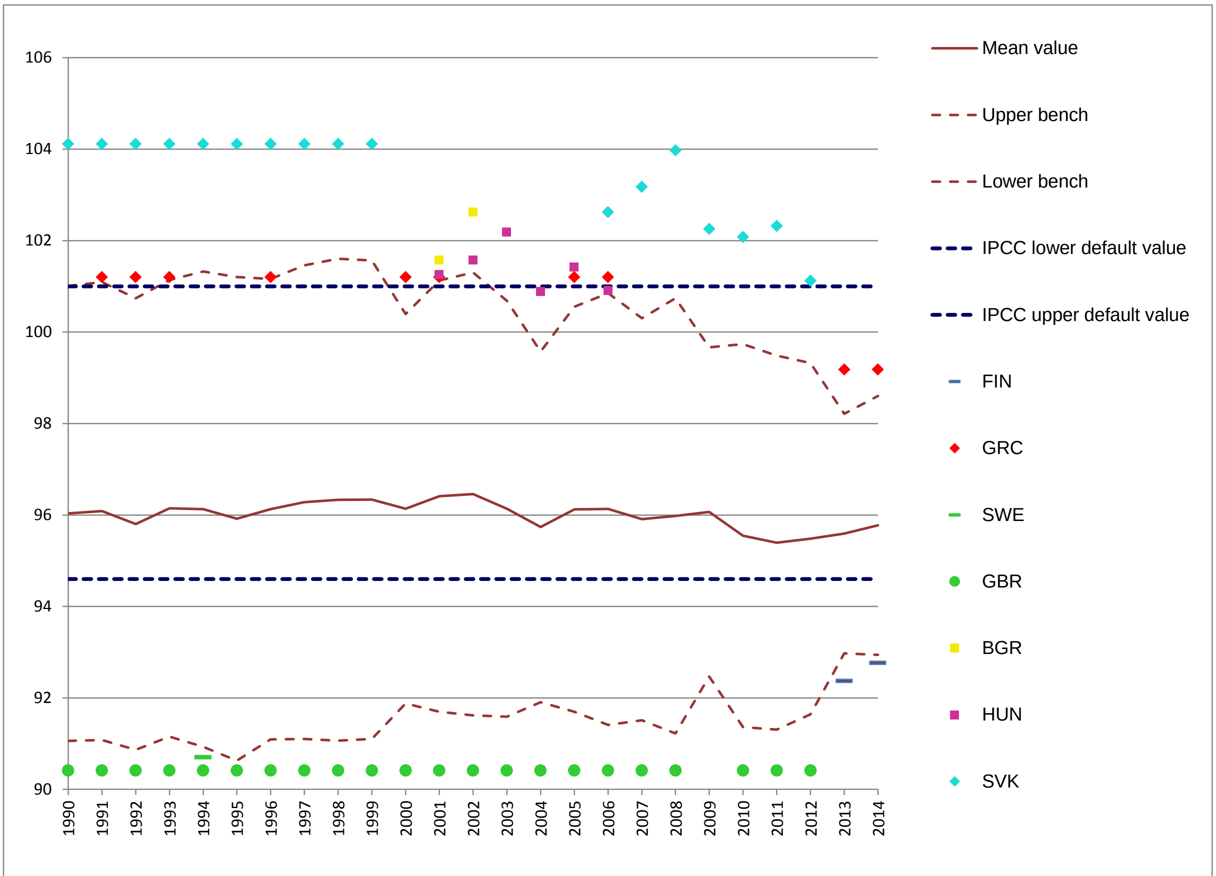


Figure 3.136 1A4c Agriculture/Forestry/Fisheries, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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

In 2014, CO_2 from gaseous fuels had a share of 15% within source category 1A4c (compared to 13% in 1990). Between 1990 and 2014 CO_2 emissions decreased by 4% (Table 3.90). The highest increase occurred in Spain (+23 835%). Between 2013 and 2014 EU-28+ISL emissions decreased by 11%.

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

Table 3.90 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	20	33	30	0%	-3	-9%	10	48%
Belgium	67	867	763	6%	-104	-12%	696	1033%
Bulgaria	3	47	49	0%	2	4%	46	1405%
Croatia	48	40	42	0%	2	5%	-6	-12%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	405	149	131	1%	-17	-12%	-274	-68%
Denmark	126	116	103	1%	-12	-11%	-23	-18%
Estonia	4	1	3	0%	2	225%	-1	-22%
Finland	32	4	3	0%	-1	-31%	-29	-91%
France	380	794	751	6%	-43	-5%	371	98%
Germany	483	682	619	5%	-63	-9%	137	28%
Greece	IE,NO	IE,NO	NO,IE	-	-	-	-	-
Hungary	437	249	344	3%	95	38%	-93	-21%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	52	309	289	2%	-20	-6%	237	460%
Latvia	779	58	56	0%	-2	-3%	-723	-93%
Lithuania	163	58	48	0%	-10	-18%	-115	-71%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	0	0	0	0%	0	11%	0	75%
Netherlands	7 329	8 039	6 855	57%	-1 184	-15%	-475	-6%
Poland	25	84	81	1%	-4	-4%	56	221%
Portugal	NO	33	18	0%	-15	-44%	18	100%
Romania	1 919	146	140	1%	-6	-4%	-1 779	-93%
Slovakia	41	96	88	1%	-8	-8%	47	116%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	6	1 521	1 473	12%	-47	-3%	1 467	23835%
Sweden	33	20	20	0%	0	0%	-13	-40%
United Kingdom	182	202	163	1%	-39	-19%	-19	-10%
EU-28	**12 534**	**13 547**	**12 070**	**100%**	**-1 477**	**-11%**	**-464**	**-4%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**12 534**	**13 547**	**12 070**	**100%**	**-1 477**	**-11%**	**-464**	**-4%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.137 and Figure 3.138 shows CO_2 emissions and implied emission factors for EU-28+ISL 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+ISL decreased by 4% between 1990 and 2014. The CO_2 implied emission factor for gaseous fuels was 56.3 t/TJ in 2014.

Figure 3.137 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Emission trend and share for CO_2

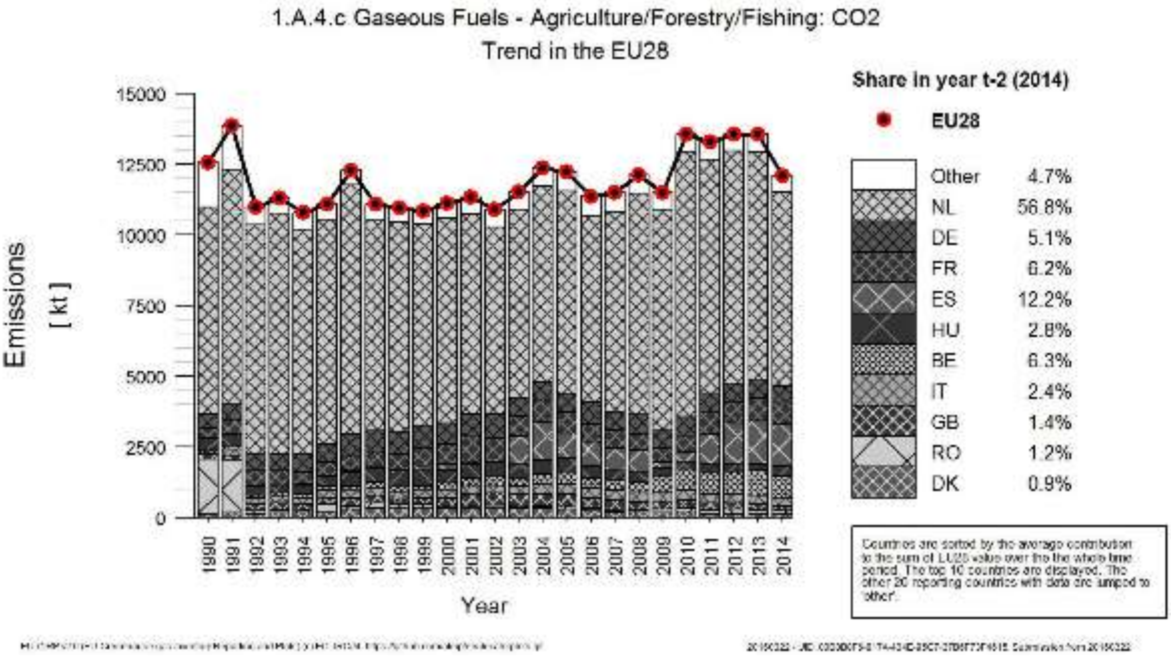
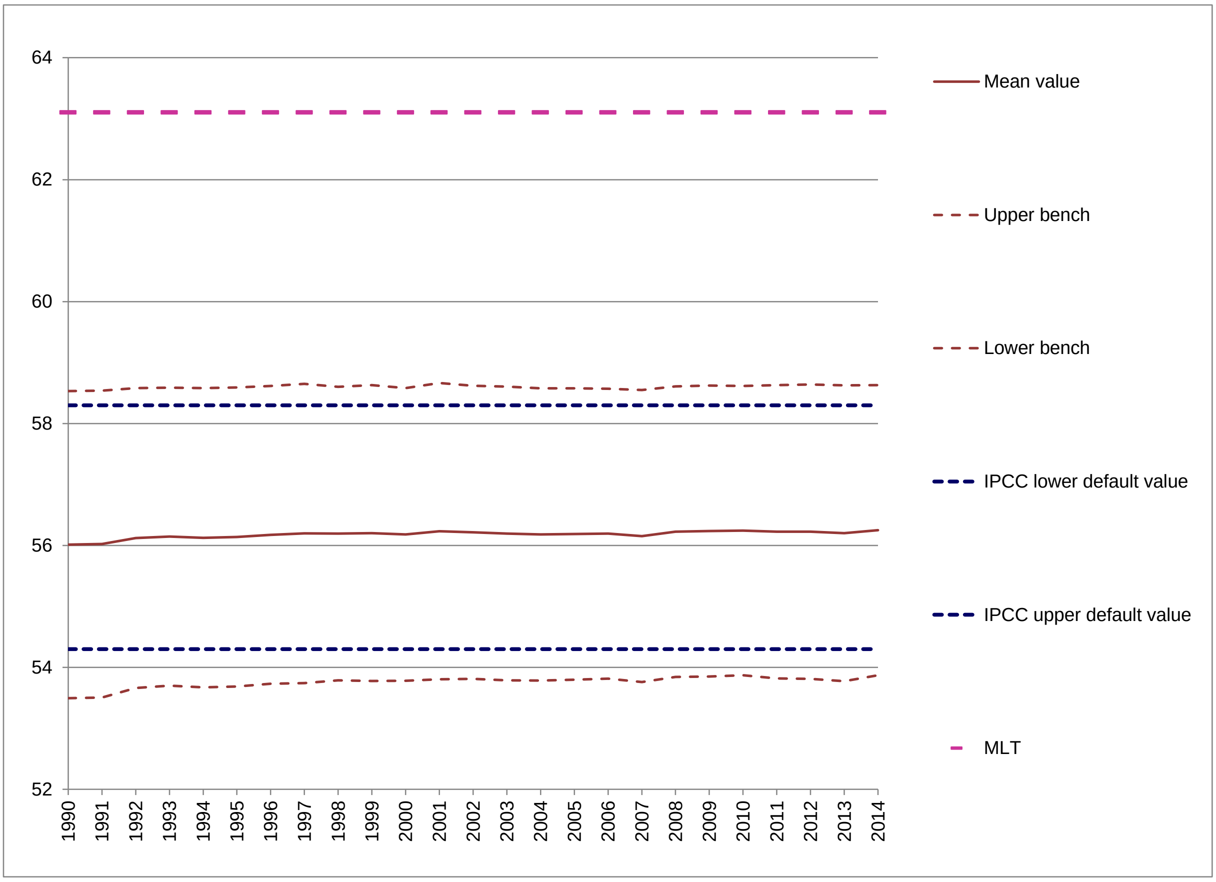


Figure 3.138 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 2015 category 1A5 contributed to 6 537 kt CO_2 equivalents of which 98.4% CO_2, 0.4% CH_4 and 1.2% N_2O.

Table 3.91 provides an overview of Member States' source allocation to Source Category 1A5 Other as reported in CRF Table1.A(a)s4.

Table 3.91 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'
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 3.139 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 72% between 1990 and 2014. Germany has the most

influence to the overall trend, it reports minus 92% 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 31% to CO_2 emissions in 2014. The United Kingdom reports military aircraft and naval vessels within this category.

Figure 3.139 1A5 Other: Total and CO_2 emission and activity trends

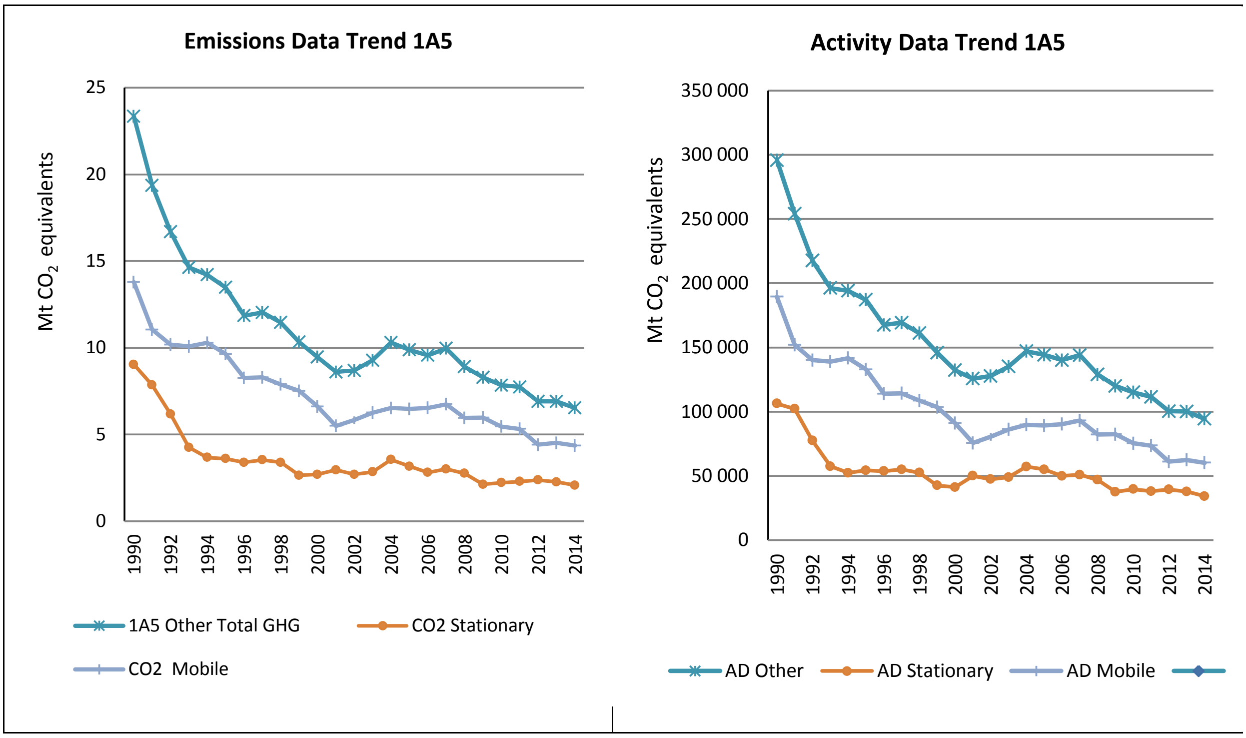


Table 3.92 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.15% of total EU-28+ISL GHG emissions in 2014. Between 1990 and 2014, CO_2 emissions from this source decreased by 72% in the EU-28+ISL. Between 1990 and 2014 the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.92 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)
Austria	36	50	35	49
Belgium	169	34	167	34
Bulgaria	30	3	30	3
Croatia	0	0	NO	NO
Cyprus	11	35	11	35
Czech Republic	0	342	NO	332
Denmark	170	233	167	230
Estonia	44	33	43	33
Finland	1 139	1 148	1 127	1 136
France	0	0	NO	NO
Germany	12 138	1 022	11 797	1 016
Greece	0	0	NO,IE	NO,IE
Hungary	0	0	NO	NO
Ireland	0	0	IE	IE
Italy	1 142	599	1 070	573
Latvia	0	10	NO,NE	9
Lithuania	0	35	0	35
Luxembourg	29	0	27	NO
Malta	0	0	NO	NO
Netherlands	455	242	447	238
Poland	0	0	NO,IE	0
Portugal	105	69	104	68
Romania	1 241	420	1 232	402
Slovakia	415	53	413	52
Slovenia	32	4	32	4
Spain	0	0	IE	IE
Sweden	863	166	846	164
United Kingdom	5 336	2 039	5 285	2 019
EU-28	**23 354**	**6 537**	**22 833**	**6 432**
Iceland	0	0	NO,NA	0
EU-28 + ISL	**23 354**	**6 537**	**22 833**	**6 432**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.93 provides information on the contribution of Member States to EU-28 recalculations in CO_2 from 1A5 Other for 1990 and 2014 and main explanations for the largest recalculations in absolute terms.

Table 3.93 1A5 Other: Contribution of MS to EU-28 recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

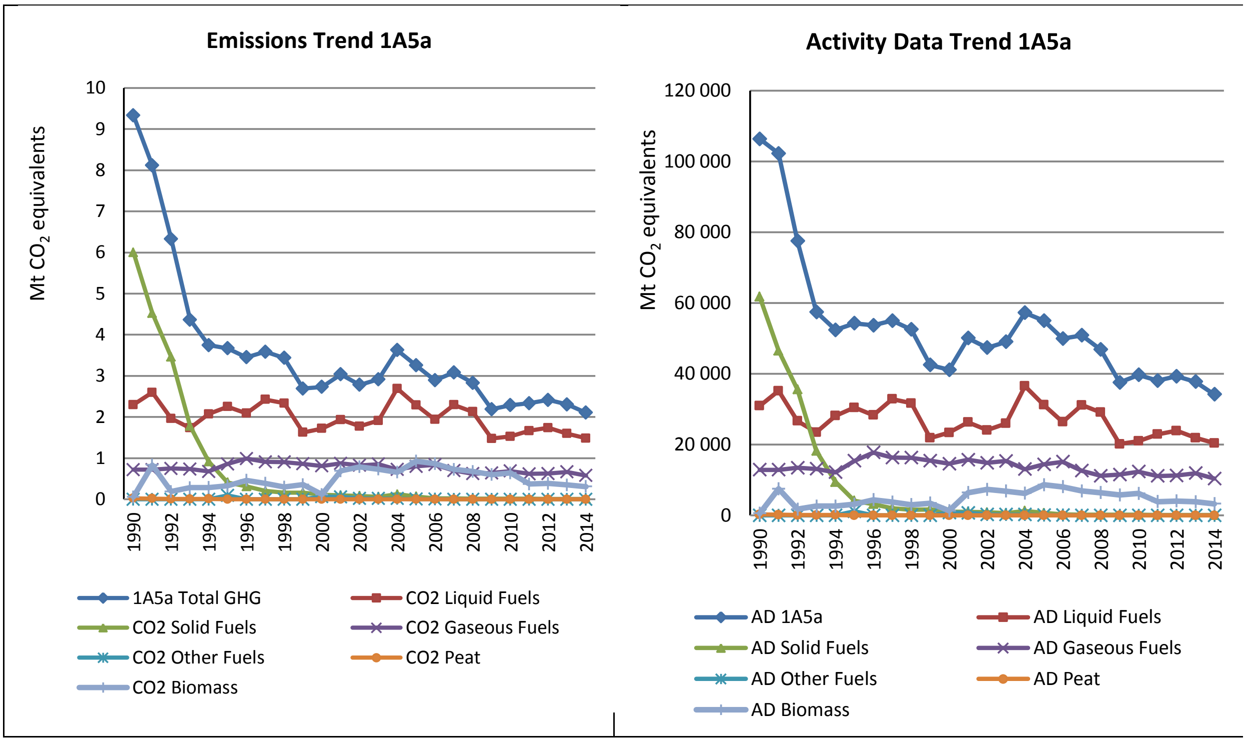
	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.1	-47	-57.9	See chapter 3.2.10.5 in NIR. Use of IPCC default emission factors from 2006 guidelines since the 2015 submission instead of 1996 guidelines before. Use of country specific NCVs.
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	0.0	
Cyprus	-4	-28.3	3	13.2	See chapter 3.2.8.5 in NIR. Revision of lignite consumption due to the correction of a mistake identified in the transfer of the data.
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Estonia	0	0.0	0	0.0	-
Finland	0	0.0	193	18.9	Corrections in activity data
France	0	0.0	0	0.0	
Germany	6	0.0	38	3.7	Revision of energy statistics. Change of hard coal and lignite NCVs. The emission factor for carbon dioxide from combustion of fossil diesel fuel, which to date has been used for all relevant sources, was replaced with a country-specific value based on current findings.
Greece					
Hungary	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Malta					
Netherlands	0	0.0	0	0.0	
Poland	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Romania	0	0.0	0	0.0	
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	Development of the HEBEFA model
United Kingdom	0	0.0	0	0.0	Tiny change due to the incorporation of 2014 Heathrow data for aviation turbine fuel in 1A5b_other: mobile
EU28	1	0.0	187	2.8	
Iceland	0	0.0	0	0.0	
EU28+ISL	1	0.0	187	2.8	

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+ISL GHG emissions in 2014. Figure 3.140 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 77%, mainly due to decreases in emissions from solid fuels (-99.8%) and liquid fuels (-35.4%).

Figure 3.140 1A5a Stationary: Total and CO_2 emission and activity trends



Only six Member States (Bulgaria, Cyprus, Germany, Finland, Romania and Slovakia) reported emissions from this key source in 2014 (Table 3.94). Between 1990 and 2014, Germany reported the highest absolute decrease. Portugal reports emissions from 1990 to 1994 only. Luxembourg reports emissions 1990 to 2003 only. This led to an EU-28+ISL decrease of 77% in GHG emissions. Between 2013 and 2014 CO_2 emissions decreased by 9%.

Table 3.94 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	30	NO	3	0%	3	100%	-26	-90%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	11	23	35	2%	12	49%	24	218%	T1	D
Czech Republic	NO	NO	NO	-	-	-	-	-	D	D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 127	1 214	1 136	55%	-78	-6%	10	1%	T1	CS
France	NO	NO	NO	-	-	-	-	-	-	-
Germany	6 227	555	446	22%	-109	-20%	-5 781	-93%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	IE	IE	IE	-	-	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	-	-	-	-	-	-	-	-	NA	NA
Luxembourg	3	NO	NO	-	-	-	-3	-100%	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	IE	IE	IE	-	-	-	-	-	-	-
Portugal	9	NO	NO	-	-	-	-9	-100%	-	-
Romania	1 232	423	402	19%	-22	-5%	-831	-67%	T1,T2	CS,D
Slovakia	406	53	51	2%	-2	-4%	-355	-88%	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	**9 044**	**2 269**	**2 073**	**100%**	**-196**	**-9%**	**-6 971**	**-77%**		
Iceland	NO	NO	0	0%	0	0%	-	-	-	-
EU-28 + ISL	**9 044**	**2 269**	**2 073**	**100%**	**-196**	**-9%**	**-6 971**	**-77%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2015 CO_2 from solid fuels had a share of 0.4% within source category 1A5a (compared to 64% in 1990). Between 1990 and 2014, CO_2 decreased by nearly 100% (Table 3.95). In 2014 only Germany and Slovakia reported emissions for this key source.

Table 3.95 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	30	NO	NO	-	-	-	-30	-100%
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	1	NO	-	-1	-100%	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	-	-	-	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	1	NO	NO	-	-	-	-1	-100%
France	NO	NO	NO	-	-	-	-	-
Germany	4 553	7	7	76%	0	-6%	-4 546	-100%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	-	-	-	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	IE	IE	0	0%	0	-	0	-
Portugal	9	NO	NO	-	-	-	-9	-100%
Romania	1 195	NO	NO	-	-	-	-1 195	-100%
Slovakia	216	3	2	24%	0	-15%	-214	-99%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-28	**6 003**	**11**	**9**	**100%**	**-2**	**-18%**	**-5 994**	**-100%**
Iceland	NO	NO	0	0%	-	-	-	-
EU-28 + ISL	**6 003**	**11**	**9**	**100%**	**-2**	**-18%**	**-5 994**	**-100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.141 shows CO_2 emissions for EU-28 and the Member States. Germany accounts for 76% of EU-28 CO_2 emissions from this source category. Fuel combustion in the EU-28+ISL decreased by 99.9% between 1990 and 2014. The CO_2 implied emission factor for solid fuels was 99.4 t/TJ in 2014.

Figure 3.141 1A5a Stationary, solid fuels: Emission trend and share for CO_2

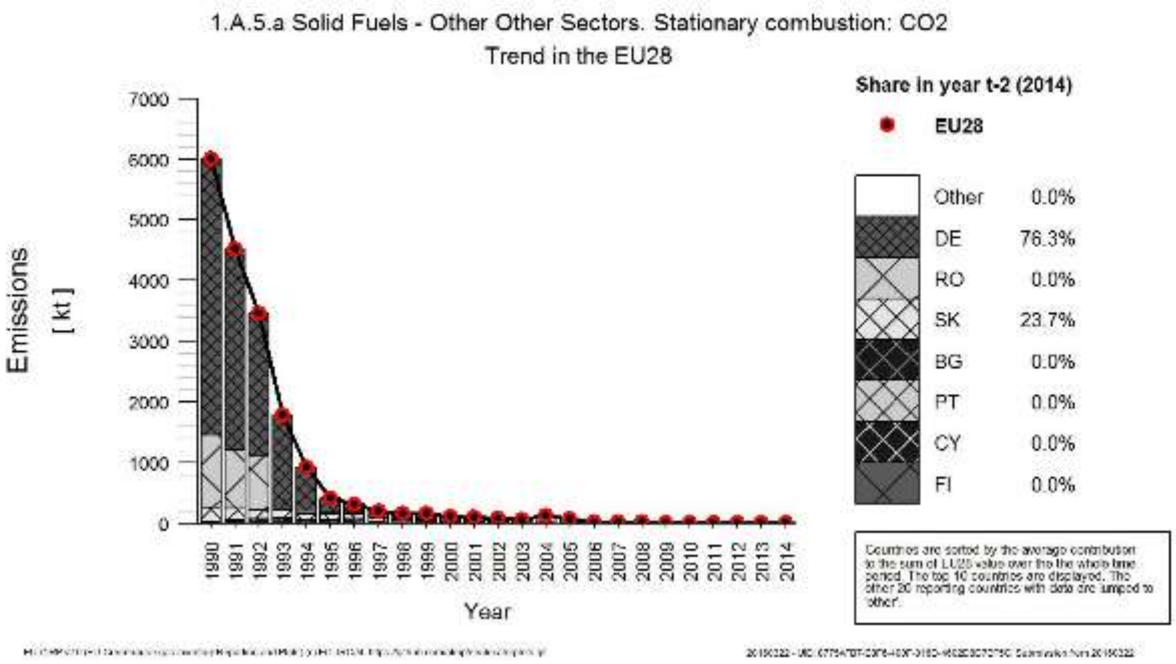
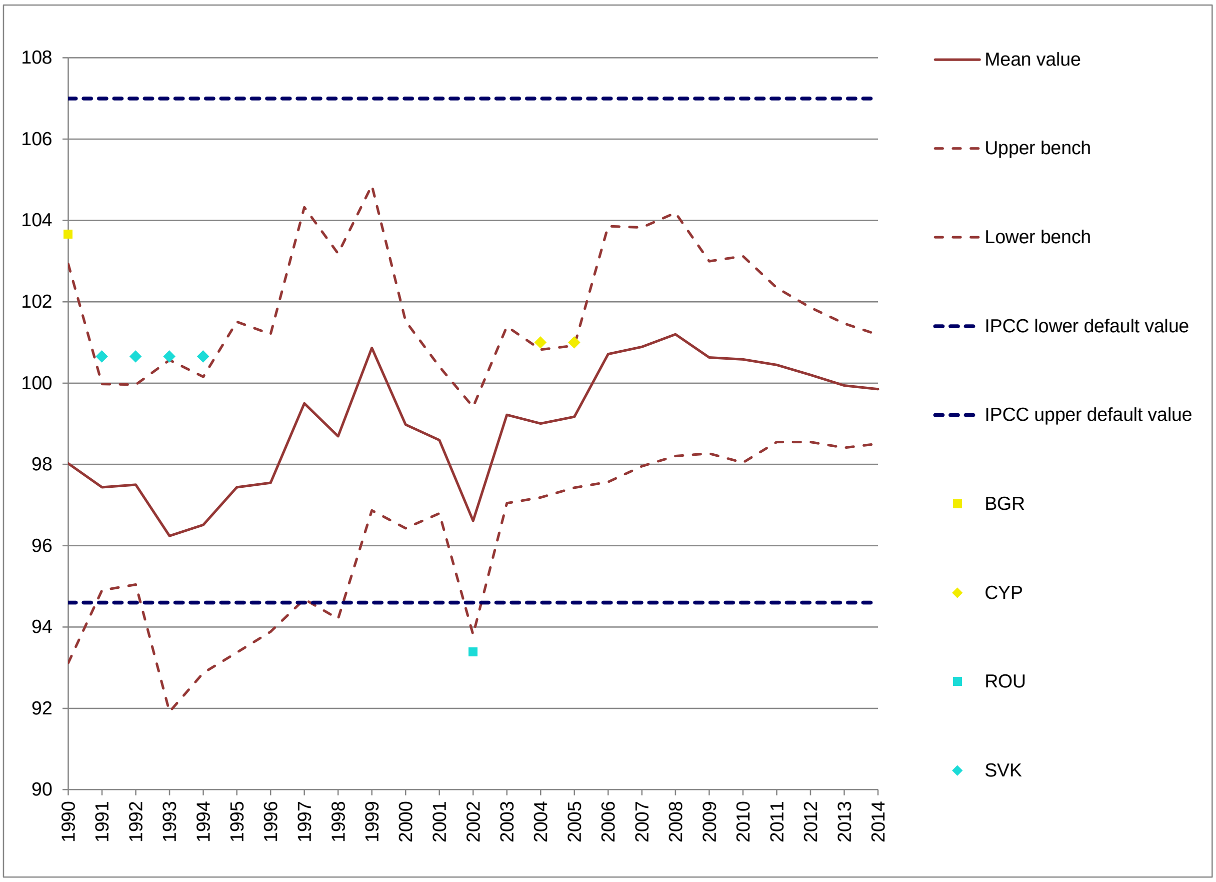


Figure 3.142 1A5a Stationary, solid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)

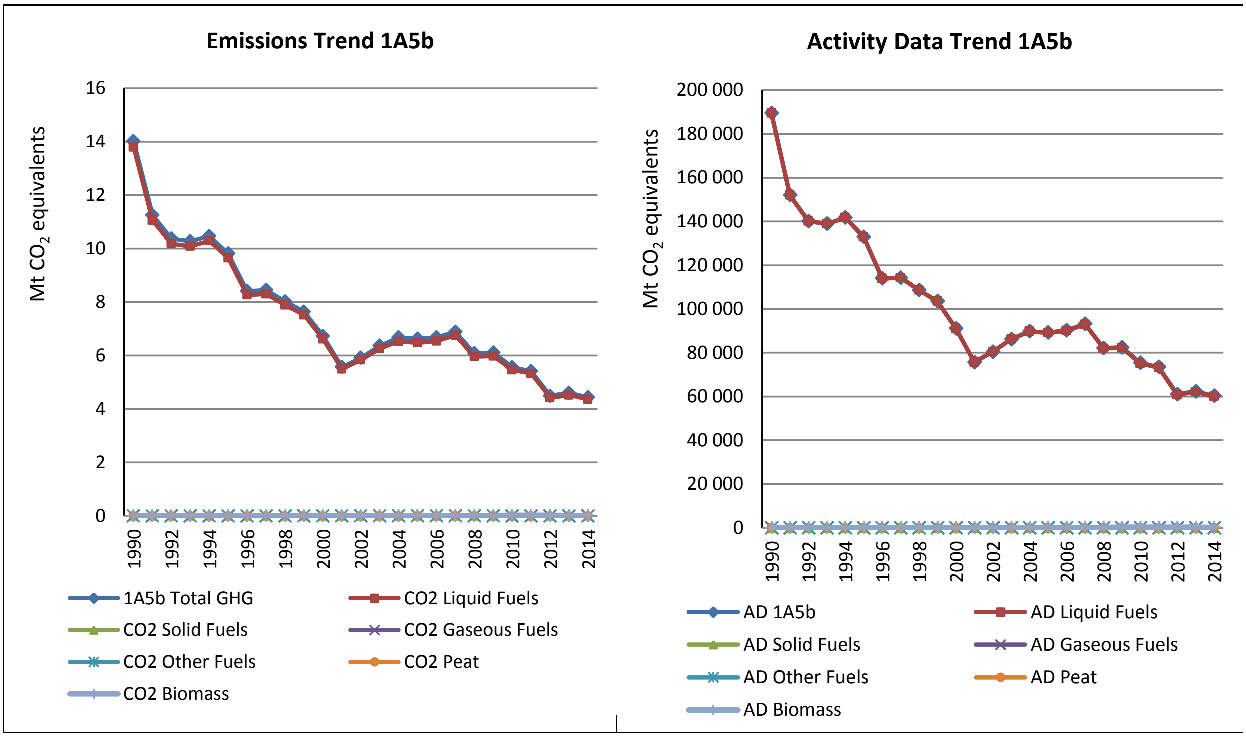


Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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+ISL GHG emissions in 2014. Figure 3.143 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 68%.

Figure 3.143 1A5b Mobile: Total and CO_2 emission trends



Eleven Member States and Iceland reported emissions as 'Not occurring' or "Included elsewhere". The United Kingdom had the highest emissions in 2014 and – together with Germany - decreased the most in absolute terms between 1990 and 2014. Between 2013 and 2014 the United Kingdom had the highest absolute decrease. The EU-28+ISL emissions decreased by 3% between 2013 and 2014 (Table 3.96).

Table 3.96 1A5b Mobile: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	35	48	49	1%	1	1%	14	39%	-	-
Belgium	167	34	34	1%	0	0%	-133	-80%	T1	D
Bulgaria	NO	NO	NO	-	-	-	-	-	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NO	NO
Cyprus	-	-	-	-	-	-	-	-	-	-
Czech Republic	NO	300	332	8%	31	10%	332	100%	T1	D
Denmark	167	239	230	5%	-9	-4%	63	38%	CR,T2	CS
Estonia	43	32	33	1%	0	1%	-11	-25%	T2	CS
Finland	C,NO	C,NO	C,NO	-	-	-	-	-	T1	CS
France	NO	NO	NO	-	-	-	-	-	-	-
Germany	5 570	522	570	13%	48	9%	-5 000	-90%	-	CS,M
Greece	IE	IE	IE	-	-	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	IE	IE	IE	-	-	-	-	-	-	-
Italy	1 070	584	573	13%	-12	-2%	-498	-46%	T2	CS
Latvia	NO,NE	6	9	0%	3	46%	9	100%	T1	D
Lithuania	0	17	35	1%	18	102%	35	9560%	T2	CS
Luxembourg	24	NO	NO	-	-	-	-24	-100%	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	447	234	238	5%	4	2%	-209	-47%	T2	D
Poland	NO	NO	NO	-	-	-	-	-	-	-
Portugal	95	58	68	2%	10	17%	-27	-28%	-	-
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	7	1	1	0%	0	-3%	-6	-81%	T2	D
Slovenia	32	3	4	0%	1	24%	-28	-88%	T1	D
Spain	IE	IE	IE	-	-	-	-	-	NA	NA
Sweden	846	149	164	4%	15	10%	-682	-81%	NA,T1	CS,NA
United Kingdom	5 285	2 285	2 019	46%	-266	-12%	-3 266	-62%	T1	CS
EU-28	**13 789**	**4 515**	**4 359**	**100%**	**-156**	**-3%**	**-9 430**	**-68%**		
Iceland	NA	NA	0	0%	0	0%	-	-	-	-
EU-28 + ISL	**13 789**	**4 515**	**4 359**	**100%**	**-156**	**-3%**	**-9 430**	**-68%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2014, CO_2 from liquid fuels had a share of 98% within source category 1A5b (compared to 98% in 1990). Between 1990 and 2014 CO_2 decreased by 68% (Table 3.97). Only fifteen Member States reported emissions in 2014 while other Member States report emissions as 'Not occurring', 'Included Elsewhere' or 'Confidential'. The highest decrease in absolute terms was achieved in Germany (-90%) and the United Kingdom (-62%), while the Czech Republic had the largest increases.

Table 3.97 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	35	48	49	1%	1	1%	14	39%
Belgium	167	34	34	1%	0	0%	-133	-80%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	300	332	8%	31	10%	332	100%
Denmark	167	239	230	5%	-9	-4%	63	38%
Estonia	43	32	33	1%	0	1%	-11	-25%
Finland	C	C	C	-	-	-	-	-
France	NO	NO	NO	-	-	-	-	-
Germany	5 570	522	570	13%	48	9%	-5 000	-90%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	1 070	584	573	13%	-12	-2%	-498	-46%
Latvia	NE	6	9	0%	3	46%	9	100%
Lithuania	0	17	35	1%	18	102%	35	9560%
Luxembourg	24	NO	NO	-	-	-	-24	-100%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	447	234	238	5%	4	2%	-209	-47%
Poland	NO	NO	0	0%	0	-	0	-
Portugal	95	58	68	2%	10	17%	-27	-28%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	7	1	1	0%	0	-3%	-6	-81%
Slovenia	32	3	4	0%	1	24%	-28	-88%
Spain	IE	IE	IE	-	-	-	-	-
Sweden	846	149	164	4%	15	10%	-682	-81%
United Kingdom	5 285	2 285	2 019	46%	-266	-12%	-3 266	-62%
EU-28	**13 789**	**4 515**	**4 359**	**100%**	**-156**	**-3%**	**-9 430**	**-68%**
Iceland	NA	NA	0	0%	-	-	-	-
EU-28 + ISL	**13 789**	**4 515**	**4 359**	**100%**	**-156**	**-3%**	**-9 430**	**-68%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.144 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 73% of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-28+ISL decreased by 68% between 1990 and 2014. The CO_2 implied emission factor for liquid fuels was 72.6 t/TJ in 2014.

Figure 3.144 1A5b Mobile, liquid fuels: Emission trend and share for CO_2

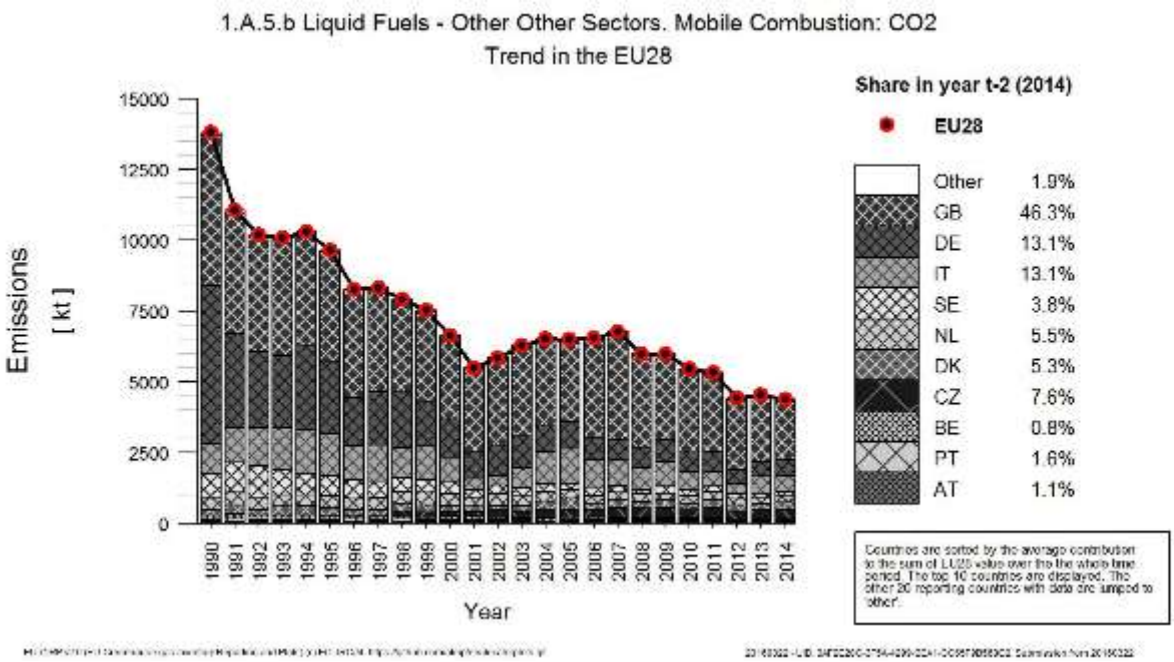


Figure 3.145 1A5b Mobile, liquid fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)

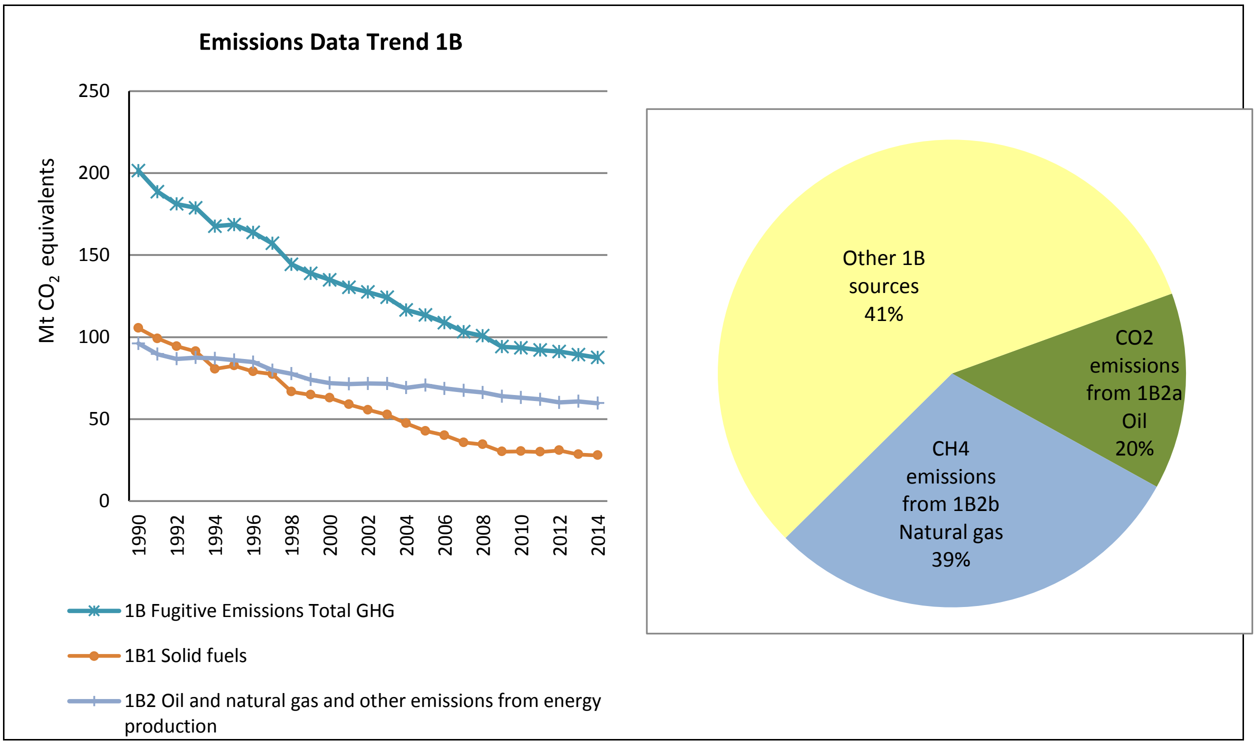
Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

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 2014, in terms of CO_2 equivalents, about 68% of emissions from source category 1B were fugitive CH_4 emissions while about 32% were fugitive CO_2 emissions. Together, they represent 2 % of total GHG emissions in the EU-28+ISL. Fugitive GHG emissions have been steadily declining (Figure 3.146). Between 1990 and 2014, the total fugitive GHG emissions decreased by 57 %. This was mainly due to the decrease in underground mining activities: underground mining activity decreased by 80 % since 1990 (Figure 3.149) 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 2014, GHG emissions from 1B1 Solid Fuels decreased by 74 % Figure 3.147), while emissions from 1B2 Oil and Natural Gas decreased only by 38 % (Figure 3.147). 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 32 % of total fugitive emissions in 2014 (Figure 3.146).

Figure 3.146 1B Fugitive Emission from Fuel: GHG Emissions trend and proportion of fugitive emissions within source category



Fugitive emissions includes four key sources:[22]

- 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 3.146).

3.2.6.1 Fugitive emissions from Solid Fuels (1B1)

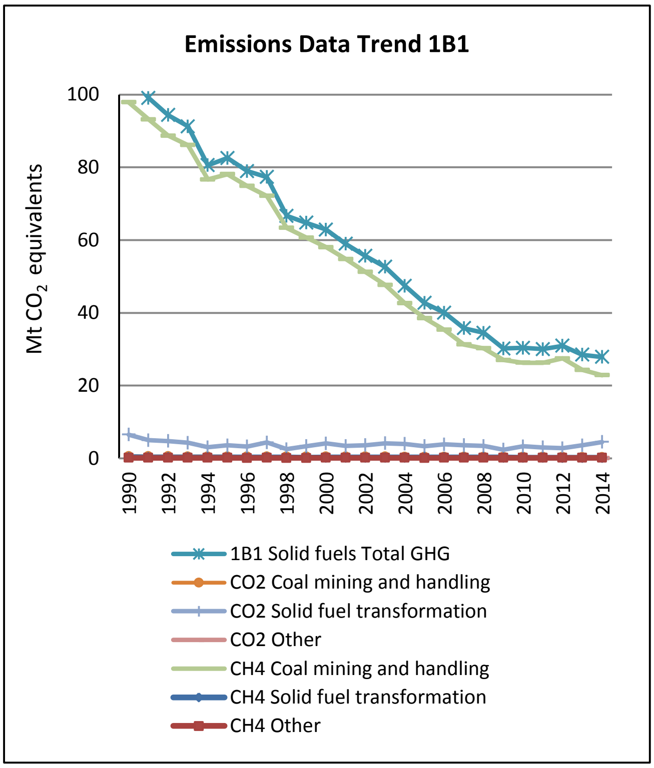
In the 2006 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions from solid fuels are defined as the intentional or unintentional release of greenhouse gases that may occur during the extraction, processing and delivery of fossil fuels to the point of final use. Combustion emissions 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 2014 fugitive emissions from solid fuels accounted for 0.7 % of the total GHG emissions in the EU-28+ISL and 32 % of total fugitive emissions:

- 82 % of fugitive emissions from solid fuels 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.
- 17 % of fugitive emissions from solid fuels 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

[22] 1B2c Venting and Flaring (CO_2) is a new key category and will be considered in detail in the EU NIR 2017.

Figure 3.147 1B1 Fugitive Emissions from Solid Fuels: Trend



In 2014 three countries, Poland, Germany and Czech Republic represented 77 % of total fugitive GHG emissions from solid fuels (Table 3.98).

Table 3.98 1B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	333	0	NO,NA	NA,NO	333	NA,NO
Belgium	392	1	NA,NO	NA,NO	392	1
Bulgaria	1 943	837	NO	NO	1 943	837
Croatia	60	0	NO	NO	60	NO
Cyprus	0	0	NO	NO	NO	NO
Czech Republic	9 576	3 331	456	197	9 120	3 134
Denmark	0	0	NO	NO	NO	NO
Estonia	0	0	NO	NO	NO	NO
Finland	0	0	NO	NO	NO	NO
France	4 810	14	NA,NO	NA,NO	4 810	14
Germany	27 386	3 509	1 833	707	25 553	2 802
Greece	1 130	1 107	NO	NO	1 130	1 107
Hungary	896	65	7	NA,NO,IE	889	65
Ireland	56	20	NO	NO	56	20
Italy	151	51	0	0	151	51
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	NA,NO	NO,NA	NA,NO
Netherlands	406	654	403	654	4	NO
Poland	27 982	14 567	2 561	2 660	25 421	11 907
Portugal	89	9	NO	NO	89	9
Romania	3 899	598	NA,NO	NA	3 899	598
Slovakia	699	410	19	26	680	384
Slovenia	459	324	98	109	361	215
Spain	1 666	268	18	29	1 648	238
Sweden	5	7	5	7	0	0
United Kingdom	23 487	2 101	1 699	436	21 788	1 665
EU-28	**105 424**	**27 874**	**7 098**	**4 827**	**98 326**	**23 048**
Iceland	0	0	NO,NA	NA,NO	NO,NA	NA,NO
EU-28 + ISL	**105 424**	**27 874**	**7 098**	**4 827**	**98 326**	**23 048**

Abbreviations explained in the Chapter 'Units and abbreviations'

Between 1990 and 2014 fugitive CH_4 emissions from solid fuels decreased by 74 % (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 (+61%) and Sweden (+34%) (Table 3.98).

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

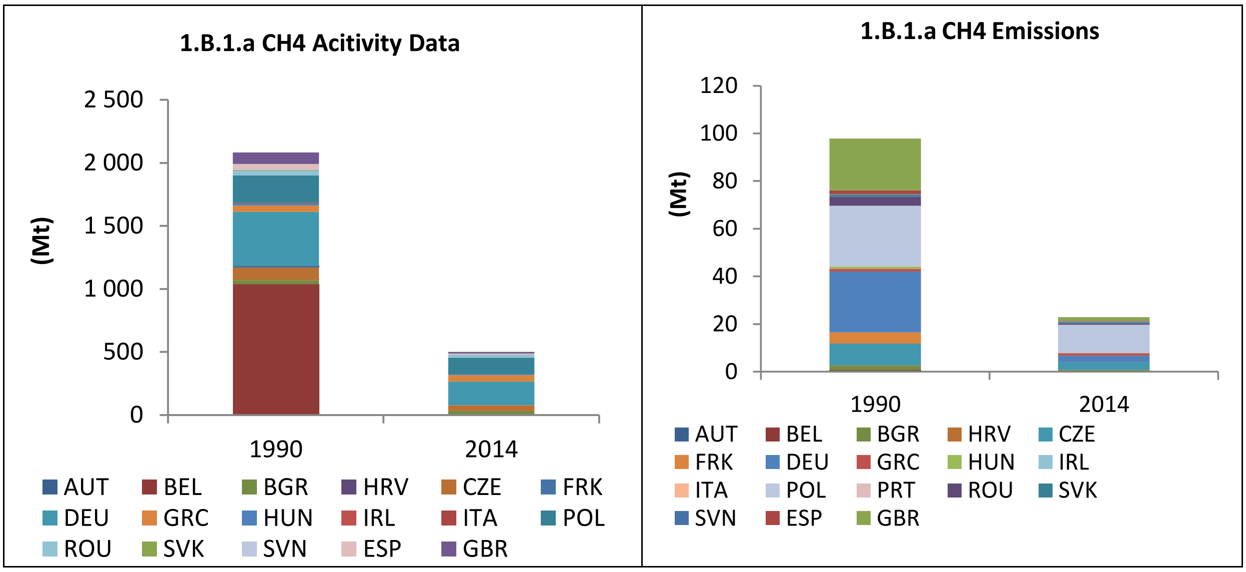
CH_4 emissions from 1B1a coal-mining accounted for 0.5 % of total GHG emissions in 2014 and for 26 % of all fugitive emissions in the EU-28+ISL. CH_4 emissions from this source decreased by 77 % in the EU-28+ISL between 1990 and 2014 and also decreased by 6 % between 2013 and 2014 due to decreases in Germany, Poland and Romania (Table 3.99). In 2014 Poland, Germany Czech Republic accounted together for 77 % of CH_4 emissions from 1B1a. They had substantially reduced their emissions between 1990 and 2014 due to the decline of coal mining (Figure 3.90).

Table 3.99 1B1a Coal Mining: Member States contribution to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	333	NO,NA	NA,NO	-	-	-	-333	-100%
Belgium	356	NO	NO	-	-	-	-356	-100%
Bulgaria	1 927	800	833	4%	33	4%	-1 095	-57%
Croatia	60	NO	NO	-	-	-	-60	-100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	9 119	3 155	3 130	14%	-25	-1%	-5 989	-66%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	4 780	13	11	0%	-3	-21%	-4 770	-100%
Germany	25 494	3 521	2 742	12%	-779	-22%	-22 752	-89%
Greece	1 130	1 174	1 107	5%	-67	-6%	-23	-2%
Hungary	889	67	65	0%	-1	-2%	-824	-93%
Ireland	56	20	20	0%	0	-2%	-36	-64%
Italy	71	20	24	0%	4	18%	-48	-67%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	25 307	12 254	11 823	52%	-431	-4%	-13 485	-53%
Portugal	89	9	9	0%	0	-2%	-80	-90%
Romania	3 857	699	598	3%	-101	-14%	-3 259	-84%
Slovakia	680	405	381	2%	-24	-6%	-299	-44%
Slovenia	361	267	215	1%	-52	-19%	-146	-40%
Spain	1 620	214	225	1%	11	5%	-1 395	-86%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	21 770	1 674	1 653	7%	-21	-1%	-20 117	-92%
EU-28	**97 900**	**24 293**	**22 834**	**100%**	**-1 458**	**-6%**	**-75 066**	**-77%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**97 900**	**24 293**	**22 834**	**100%**	**-1 458**	**-6%**	**-75 066**	**-77%**

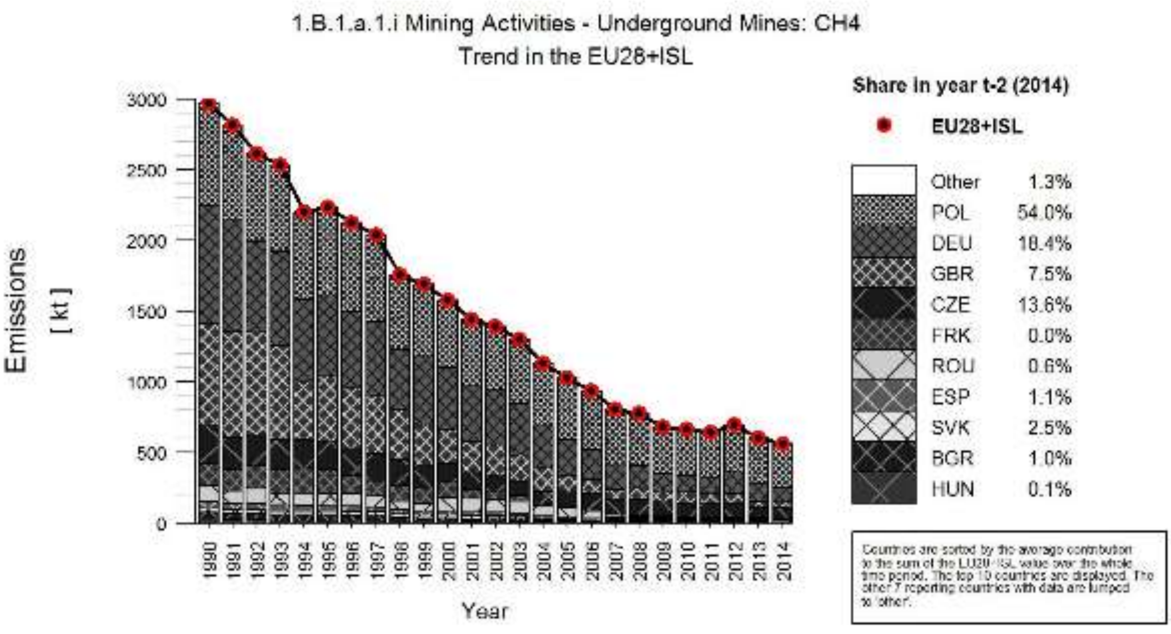
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.148 1B1a Coal Mining and Handling: Contribution of MS to CH_4 Emission and Activity Data



In 2014 most fugitive emissions from coal mines were due to underground mines. Within the EU-28 coal mining in underground mines decreased substantially (80 %) (Figure 3.149). Poland, Germany and Czech Republic are the biggest contributors to this sector.

Figure 3.149 1B1a1i Mining activities - 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 22 % between 1990 and 2014 (Figure 3.150). CH_4 emissions from coal mining in surface mines decreased in all Member States except in Bulgaria and Spain. (Figure 3.150).

Figure 3.150 1B1ai Mining activities - Surface Mines: Emission trend and share for the emitting countries of CH_4

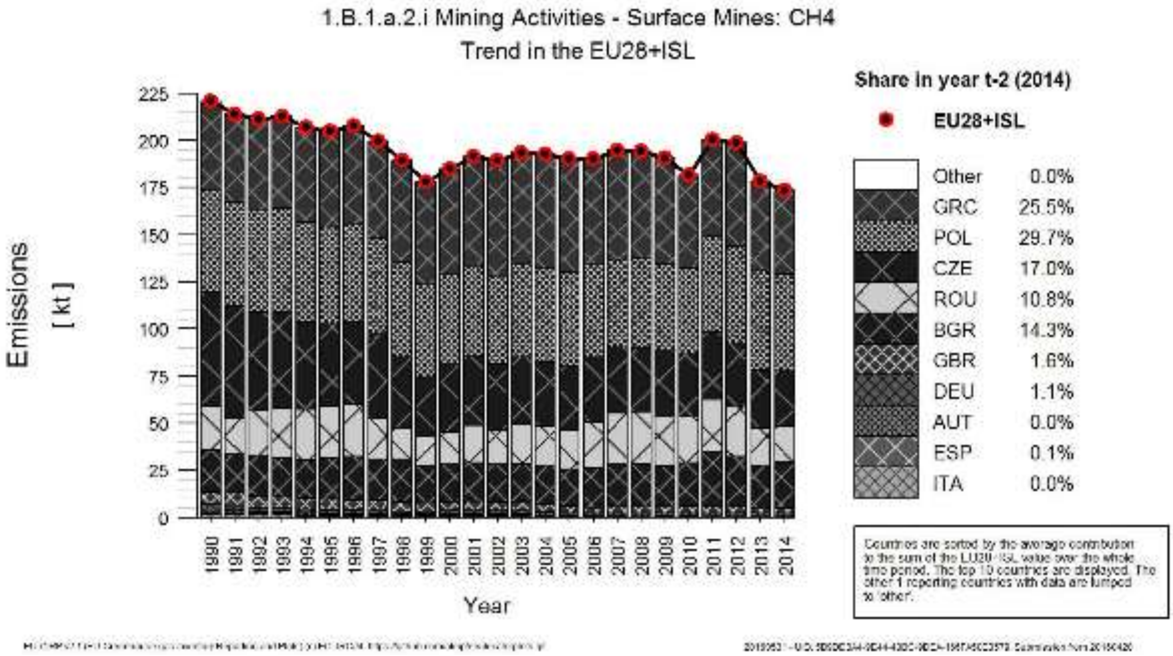
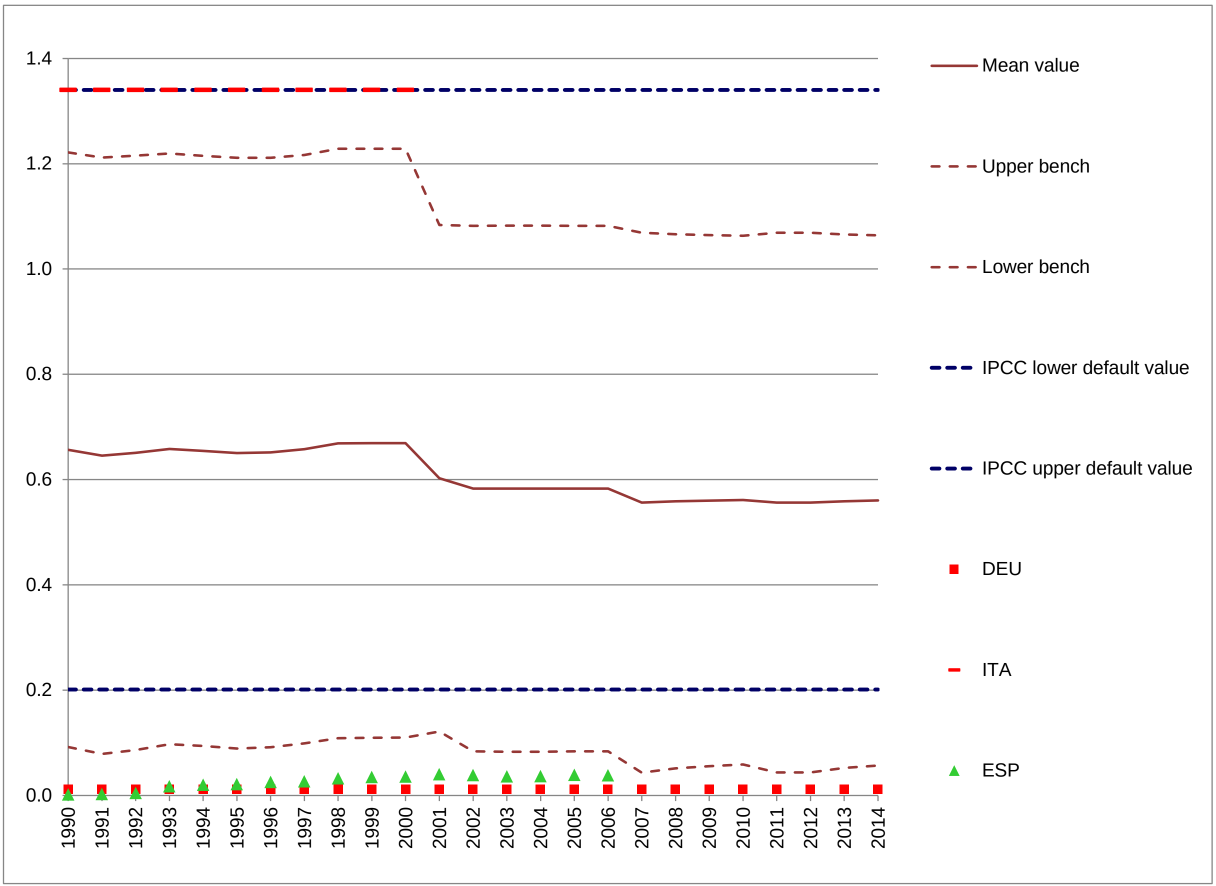


Table 3.100: 1B1a2i Mining activities – Surface mines - Overview of outliers of Implied Emission Factors for CH_4 (in kg/t)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated.
If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

Table 3.100 shows that only 2 countries are reporting an implied emission factor which is below the default emission factor of the IPCC 2006 Guidelines. Germany applies a country specific emission factor for this category as it states that the IPCC emission factors cannot be applied to german lignite as these default emission factors have been derived from figures for American bituminous coal. Also Spain is applying a country specific emission factor for this category.

Table 3.101 provides information on the contribution of Member States to EU-28+ISL recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2013.

Table 3.1011B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-28+ISL recalculations in CH_4 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	0.0	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Estonia	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.7	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Hungary	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Poland	-169	-0.7	-111	-0.9	CH_4 EF update according to 2006 IPCC GLs
Portugal	0	0.0	0	0.0	
Romania	0	0.0	0	0.0	
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	-516	-23.8	-222	-49.3	Reestimation of mining activities
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	0	0.0	
EU28	-684	-0.7	-333	-1.3	
Iceland	0	0.0	0	0.0	
EU28+ISL	-684	-0.7	-333	-1.3	

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 3.102.

Table 3.102 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	Emissions from Coke Oven Gas Subsystem
Slovenia	CO_2	SO2 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 2014 and for 68 % (Figure 3.151) of all fugitive emissions in the EU-28+ISL.

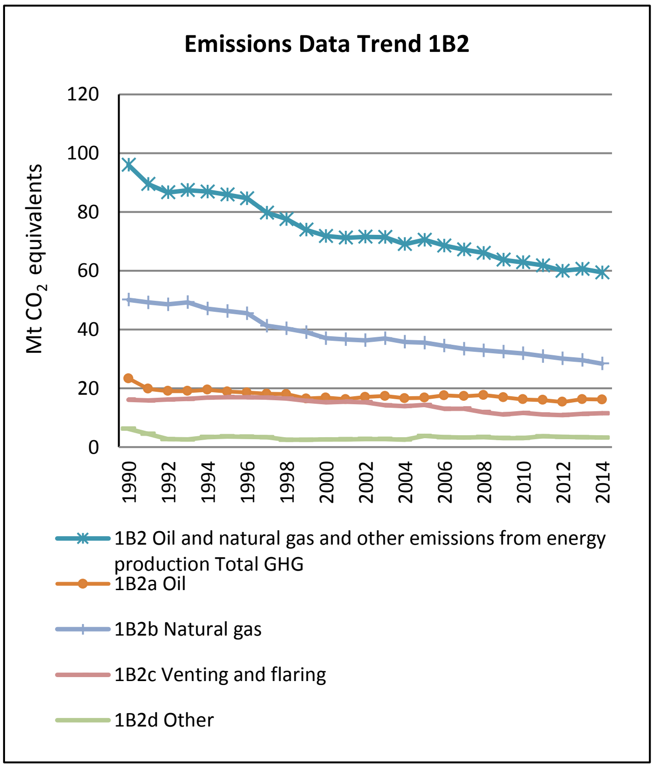
Of all fugitive emissions from oil and natural gas, in 2014:

- 43 % were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution)
- 20 % were CO_2 emissions from oil (exploration, production, transport, refining and storage and distribution)
- 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 3.151 1B2-Fugitive Emissions Oil and Natural Gas: Trend



Fugitive emissions from oil and natural gas arose in all Member States but Malta (Table 3.103). Total greenhouse gas emissions from 1B2 decreased by 38 % between 1990 and 2014 (Figure 3.150). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 44 % over that period.

In 2014, 59% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: Germany, Italy, Romania and the United Kingdom (Table 3.103). The largest reductions (in absolute terms) were observed in the Romania and in the United Kingdom (both mainly CH_4 emissions), while emissions increased most in Poland (mainly CH_4 emissions) (Table 3.103).

Table 3.103 1B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	369	491	102	221	266	269
Belgium	714	622	85	98	629	525
Bulgaria	274	212	4	10	270	202
Croatia	4 481	1 995	1 131	752	3 350	1 243
Cyprus	0	0	NO,NE	NE,NO	0	NE,NO
Czech Republic	1 082	632	2	6	1 080	625
Denmark	516	398	341	250	123	107
Estonia	50	17	0	0	50	17
Finland	123	117	111	84	11	33
France	5 821	3 955	4 329	3 042	1 465	898
Germany	10 583	7 003	2 232	1 922	8 351	5 081
Greece	79	92	43	4	36	88
Hungary	1 750	802	478	129	1 271	672
Ireland	156	28	NO	NO	156	28
Italy	12 745	8 357	4 013	2 500	8 720	5 848
Latvia	248	135	0	0	248	135
Lithuania	272	291	1	4	272	287
Luxembourg	19	38	0	0	19	38
Malta	0	0	NO,NA,NE	NE,NA,NO	NO,NA,NE	NE,NA,NO
Netherlands	2 707	1 705	775	1 014	1 932	692
Poland	1 075	4 349	83	1 873	992	2 476
Portugal	271	1 565	208	1 360	60	202
Romania	29 962	10 756	1 213	988	28 746	9 766
Slovakia	1 714	1 058	5	1	1 708	1 057
Slovenia	50	33	0	0	50	33
Spain	2 387	4 697	1 656	3 957	730	739
Sweden	383	772	292	708	91	63
United Kingdom	18 164	9 332	5 778	3 912	12 345	5 388
EU-28	**95 995**	**59 454**	**22 881**	**22 837**	**72 972**	**36 514**
Iceland	62	187	61	182	1	5
EU-28 + ISL	**96 057**	**59 641**	**22 943**	**22 837**	**72 973**	**36 519**

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+ISL GHG emissions in 2014 and for 14 % of all fugitive emissions. Between 1990 and 2014, CO_2 emissions from this source increased by 24 % in the EU-28+ISL (Table 3.104). By contrast, during the same period 1990-2014, CH_4 emissions of this source category were reduced by 69 %.

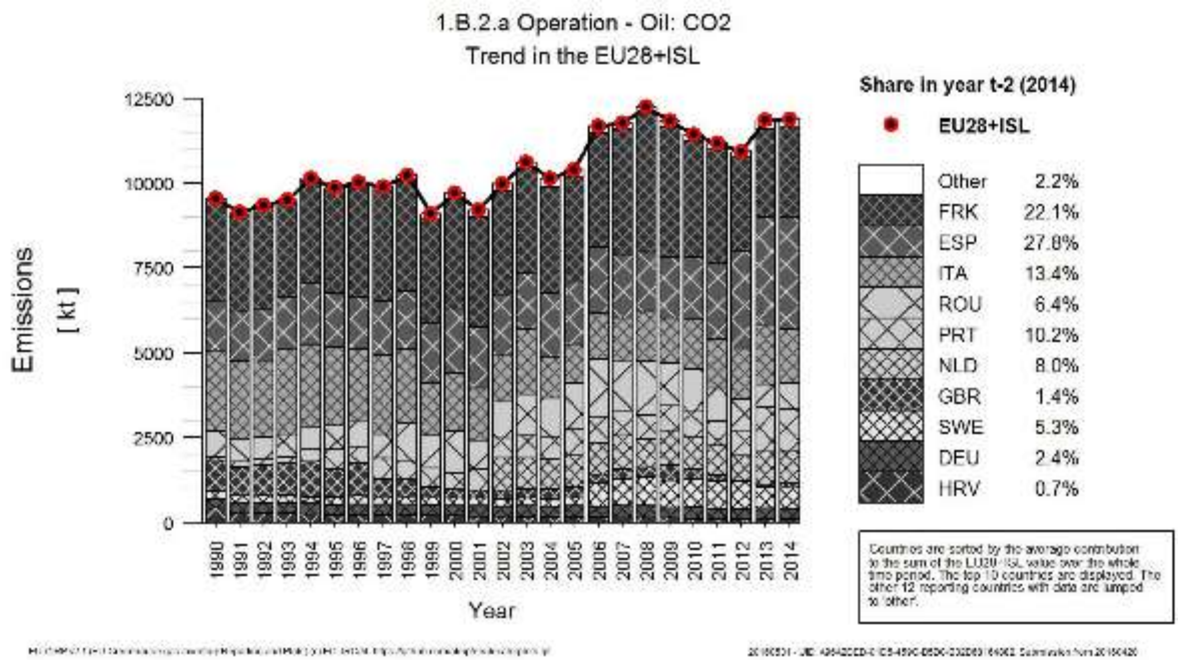
Together France, Italy, Portugal and Spain accounted for 73 % of the EU-28+ISL total CO_2 emissions of 1B2a 'Fugitive CO_2 emissions from oil' (Table 3.104, Figure 3.152). During the period 1990-2014, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Portugal and in Spain (Table 3.104).

Table 3.104 1B2a Fugitive CO_2 emissions from oil: Member States' contributions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	0	0	0	0%	0	0%	0	16%
Belgium	0	0	0	0%	0	17%	0	28%
Bulgaria	1	0	0	0%	0	-7%	0	-57%
Croatia	411	92	83	1%	-9	-10%	-329	-80%
Cyprus	NO,NE	NO,NE	NE,NO	-	-	-	-	-
Czech Republic	0	0	0	0%	0	-2%	0	165%
Denmark	5	3	0	0%	-3	-100%	-5	-100%
Estonia	NO,NA	NO,NA	NA,NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	2 951	2 585	2 625	22%	40	2%	-326	-11%
Germany	283	321	290	2%	-31	-10%	7	2%
Greece	0	0	0	0%	0	-9%	0	-92%
Hungary	5	0	1	0%	0	10%	-5	-90%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	2 368	1 761	1 587	13%	-173	-10%	-781	-33%
Latvia	NO,NA	NO,NA	NA,NO	-	-	-	-	-
Lithuania	0	0	0	0%	0	-2%	0	-11%
Luxembourg	NO,NA	NO,NA	NA,NO	-	-	-	-	-
Malta	NO,NE	NO,NE	NE,NO	-	-	-	-	-
Netherlands	0	996	953	8%	-43	-4%	953	5294057%
Poland	42	253	256	2%	3	1%	215	516%
Portugal	155	1 311	1 210	10%	-101	-8%	1 055	681%
Romania	769	674	764	6%	90	13%	-5	-1%
Slovakia	0	0	0	0%	0	1%	0	-71%
Slovenia	0	0	0	0%	0	-4%	0	119%
Spain	1 477	3 180	3 308	28%	128	4%	1 831	124%
Sweden	219	630	633	5%	3	1%	414	189%
United Kingdom	859	41	168	1%	127	308%	-691	-80%
EU-28	**9 545**	**11 848**	**11 878**	**100%**	**30**	**0%**	**2 333**	**24%**
Iceland	0	0	0	0%	0	3%	0	9%
EU-28 + ISL	**9 545**	**11 848**	**11 878**	**100%**	**30**	**0%**	**2 333**	**24%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.152 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+ISL GHG emissions in 2014 and for 5 % of all fugitive emissions. Between 1990 and 2014, CH_4 emissions from this source decreased by 69 % in the EU-28+ISL (Table 3.104).

Together Romania and Croatia accounted for 72 % of the EU-28+ISL total CH_4 emissions of 1B2a 'Fugitive CH_4 emissions from oil' (Table 3.105). During the period 1990-2014, the largest decreases in CH_4 emissions (in absolute terms) were observed in Croatia and Romania, while emissions increased most in Poland (Table 3.105).

Table 3.105 1B2a Fugitive CH_4 emissions from oil: Member States' contributions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	7	8	8	0%	0	-2%	1	7%
Belgium	11	6	7	0%	1	12%	-4	-38%
Bulgaria	9	6	5	0%	0	-8%	-4	-46%
Croatia	2 560	572	516	12%	-56	-10%	-2 044	-80%
Cyprus	0	NO,NE	NE,NO	-	-	-	0	-100%
Czech Republic	23	6	7	0%	1	10%	-16	-71%
Denmark	31	35	34	1%	-1	-4%	2	7%
Estonia	NO,NA	NO	NO	-	-	-	-	-
Finland	6	9	9	0%	0	-3%	2	39%
France	189	51	49	1%	-2	-4%	-140	-74%
Germany	402	224	229	5%	5	2%	-173	-43%
Greece	10	13	13	0%	1	4%	4	36%
Hungary	179	37	37	1%	0	-1%	-142	-79%
Ireland	0	0	0	0%	0	-3%	0	53%
Italy	295	293	303	7%	10	3%	8	3%
Latvia	NO,NA	NO,NA	NA,NO	-	-	-	-	-
Lithuania	11	10	8	0%	-1	-15%	-3	-25%
Luxembourg	NO,NA	NO,NA	NA,NO	-	-	-	-	-
Malta	NO,NE	NO,NE	NE,NO	-	-	-	-	-
Netherlands	20	11	11	0%	0	2%	-9	-45%
Poland	27	94	95	2%	1	1%	68	252%
Portugal	60	72	66	2%	-7	-9%	6	9%
Romania	9 370	2 676	2 615	61%	-61	-2%	-6 756	-72%
Slovakia	15	8	8	0%	-1	-7%	-7	-48%
Slovenia	0	NA,NO	NA,NO	-	-	-	0	-100%
Spain	69	55	54	1%	-2	-3%	-15	-22%
Sweden	25	23	25	1%	2	7%	0	-1%
United Kingdom	500	230	223	5%	-7	-3%	-277	-55%
EU-28	**13 820**	**4 439**	**4 320**	**100%**	**-119**	**-3%**	**-9 501**	**-69%**
Iceland	0	1	1	0%	0	3%	0	9%
EU-28 + ISL	**13 821**	**4 439**	**4 320**	**100%**	**-119**	**-3%**	**-9 501**	**-69%**

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 0.6 % of total EU-28+ISL GHG emissions in 2014 and for 29 % of all fugitive emissions in the EU-28+ISL. Between 1990 and 2014, CH_4 emissions from this source decreased by 44 % (Table 3.106).

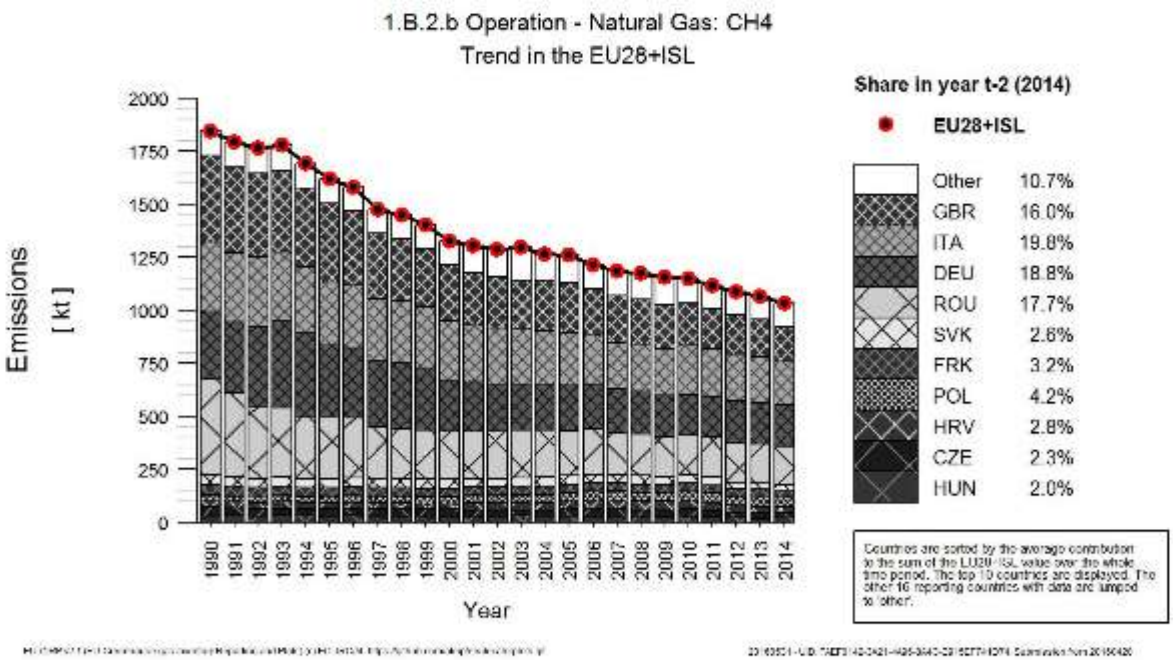
In 2014, 72% of the EU-28+ISL CH_4 emissions from 1B2b were emitted by four Member States: Germany, Italy, Romania and the United Kingdom (Table 3.106, Figure 3.153). The emission decreases between 1990 and 2014 observed in Romania (-60 %), the United Kingdom (-59 %), Germany (-39 %) and in Italy (-38 %) contributed most significantly to the overall reduction in the EU-28+ISL between 1990 and 2014.

Table 3.106 1B2b Fugitive CH_4 emissions from natural gas: Member States' contributions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	259	272	262	1%	-11	-4%	3	1%
Belgium	618	441	518	2%	77	18%	-100	-16%
Bulgaria	245	201	189	1%	-12	-6%	-56	-23%
Croatia	790	767	727	3%	-39	-5%	-62	-8%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 045	583	581	2%	-2	0%	-464	-44%
Denmark	61	48	50	0%	2	3%	-11	-18%
Estonia	50	22	17	0%	-5	-22%	-33	-65%
Finland	4	31	24	0%	-7	-22%	20	465%
France	1 201	968	828	3%	-140	-14%	-373	-31%
Germany	7 947	4 875	4 849	19%	-26	-1%	-3 098	-39%
Greece	9	69	60	0%	-9	-13%	51	555%
Hungary	735	458	503	2%	45	10%	-231	-31%
Ireland	156	23	28	0%	5	20%	-128	-82%
Italy	8 235	5 370	5 100	20%	-270	-5%	-3 135	-38%
Latvia	177	82	109	0%	27	33%	-68	-38%
Lithuania	261	236	277	1%	41	17%	16	6%
Luxembourg	19	41	38	0%	-2	-6%	19	98%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	421	384	350	1%	-34	-9%	-71	-17%
Poland	678	1 058	1 092	4%	34	3%	415	61%
Portugal	NO	139	135	1%	-4	-3%	135	100%
Romania	11 306	4 591	4 566	18%	-25	-1%	-6 740	-60%
Slovakia	1 103	804	677	3%	-127	-16%	-427	-39%
Slovenia	42	32	29	0%	-3	-10%	-14	-33%
Spain	500	618	628	2%	11	2%	129	26%
Sweden	66	45	39	0%	-7	-15%	-28	-42%
United Kingdom	10 168	4 402	4 122	16%	-281	-6%	-6 047	-59%
EU-28	**46 097**	**26 562**	**25 799**	**100%**	**-763**	**-3%**	**-20 297**	**-44%**
Iceland	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**46 097**	**26 562**	**25 799**	**100%**	**-763**	**-3%**	**-20 297**	**-44%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.153 1B2b Natural Gas: Emission trend and share for the emitting countries of CH_4



Emissions from Other (1B2d)

Six countries report CO_2 emissions in this sector, five are reporting CH_4 emissions, three are also reporting N_2O emission. The description of the subcategories is presented in Table 3.107.

Table 3.107 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
Iceland	CH_4, CO_2	Geothermal Energy
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 3.108 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					2014				
Member State		GHG source category	Activity data: Description	Activity data: Unit	Activity data: Value	Implied emission factor (kg/unit)	CH4 emissions (kt)	Activity data: Description	Activity data: Unit	Activity data: Value	Implied emission factor (kg/unit)	CH4 emissions (kt)
AUT	Austria	**Natural Gas**					**10.36**					**10.46**
		1. Exploration	Mm3 natural gas	Mm3	248.09	IE	IE	Mm3 natural gas	Mm3	307.48	IE	IE
		2. Production	Mm3 natural gas	Mm3	1288.00	4478.94	5.77	Mm3 natural gas	Mm3	1247.00	4023.32	5.02
		3. Processing	Mm3 natural gas	Mm3	1288.00	NA	NA	Mm3 natural gas	Mm3	1247.00	NA	NA
		4. Transmission and storage	km pipeline length	km	3628.00	718.43	2.61	km pipeline length	km	7227.33	538.72	3.89
		5. Distribution	km distribution network length	km	11672.00	170.22	1.99	km distribution network length	km	30226.39	51.37	1.55
		6. Other	Mm3 natural gas stored	Mm3	1500.00	NO	NO	Mm3 natural gas stored	Mm3	5334.00	NO	NO
BEL	Belgium	**Natural Gas**					**24.71**					**20.71**
		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	0	PJ	341.02	5979.07	2.04	0	PJ	523.18	11370.83	5.95
		5. Distribution	0	PJ	341.02	66474.21	22.67	0	PJ	523.18	28210.44	14.76
		6. Other	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
BGR	Bulgaria	**Natural Gas**					**9.82**					**7.57**
		2. Exploration	0	NA	IE	IE	IE	0	NA	IE	IE	IE
		3. Production	0	106m3	14.00	1340.00	0.02	0	106m3	197.00	1340.00	0.26
		4. Processing	0	106m3	14.00	590.00	0.01	0	106m3	197.00	590.00	0.12
		5. Transmission and storage	0	106m3	8789.55	273.00	2.40	0	106m3	14816.15	273.00	4.04
		6. Distribution	0	106m3	6717.00	1100.00	7.39	0	106m3	2860.00	1100.00	3.15
		7. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
CYP	Cypress	**Natural Gas**					**NO**					**NO**
		2. Exploration	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		3. Production	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		4. Processing	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		5. Transmission and storage	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		6. Distribution	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		7. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
CZE	Czech Republic	**Natural Gas**					**41.80**					**23.26**
		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	8.82	38649.05	0.34
		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	1398.35	4769.01	6.67
		6. Distribution	(e.g. PJ gas consumed)	PJ	55.77	517563.35	28.86	(e.g. PJ gas consumed)	PJ	114.95	141338.53	16.25
		7. Other	(e.g. PJ gas consumed)	PJ	29.68	IE	IE	(e.g. PJ gas consumed)	PJ	145.64	IE	IE

DEU	Germany	**Natural Gas**					**317.87**					**193.96**
		3. Exploration	number of wells drilled	number	IE	IE	IE	number of wells drilled	number	IE	IE	IE
		4. Production	gas produced	1000 m³	15262000.00	0.38	5.80	gas produced	1000 m³	9193043.32	0.17	1.58
		5. Processing	gas produced	1000 m³	15262000.00	0.37	5.61	gas produced	1000 m³	9193043.32	0.11	1.01
		6. Transmission and storage	length of transmission pipelines	km	22673.00	1959.41	44.43	length of transmission pipelines	km	35575.00	2145.78	76.34
		7. Distribution	length of distribution pipelines	km	282612.00	824.05	232.89	length of distribution pipelines	km	505500.00	175.00	88.46
		8. Other	gas consumed	TJ	893519.00	32.62	29.15	gas consumed	TJ	1377067.00	19.29	26.57
DNM	Denmark	**Natural Gas**					**2.43**					**2.00**
		3. Exploration	0	m3	2892051.56	0.01	0.03	0	m3	NO	NO	NO
		4. Production	Gas produced	10^6 m3	5137.00	380.00	1.95	Gas produced	10^6 m3	4502.00	380.00	1.71
		5. Processing	Gas produced	10^6 m3	5137.00	NA	NA	Gas produced	10^6 m3	4502.00	NA	NA
		6. Transmission and storage	Gas transmission	10^6 m3	2739.00	69.45	0.19	Gas transmission	10^6 m3	4474.00	29.32	0.13
		7. Distribution	Gas distributed	10^6 m3	1749.06	145.93	0.26	Gas distributed	10^6 m3	2319.79	66.25	0.15
		8. Other	Incl. In transmission	m3	NO	NO	NO	Incl. In transmission	m3	NO	NO	NO
ESP	Spain	**Natural Gas**					**19.99**					**25.14**
		3. Exploration	0	PJ	IE	IE	IE	0	PJ	NO	NO	NO
		4. Production	PJ gas produced (NCV)	PJ	51.17	70657.76	3.62	PJ gas produced (NCV)	PJ	1.01	70657.76	0.07
		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	994.15	1334.61	1.33
		7. Distribution	PJ gas consumed (NCV)	PJ	205.50	78857.88	16.21	PJ gas consumed (NCV)	PJ	1001.53	23703.19	23.74
		8. Other	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)	0	NE	NE	NE
EST	Estonia	**Natural Gas**					**2.01**					**0.70**
		4. Exploration	Exploration	NA	NO	NO	NO	Exploration	NA	NO	NO	NO
		5. Production	Production	NA	NO	NO	NO	Production	NA	NO	NO	NO
		6. Processing	Processing	NA	NO	NO	NO	Processing	NA	NO	NO	NO
		7. Transmission and storage	Amount of the transmission of Natural G	PJ	51.23	2217.60	0.11	Amount of the transmission of Natural Ga	PJ	17.81	2217.60	0.04
		8. Distribution	Amount of natural gas distributed	PJ	51.23	36960.00	1.89	Amount of natural gas distributed	PJ	17.81	36960.00	0.66
		9. Other	Other	NA	NO	NO	NO	Other	NA	NO	NO	NO
FIN	Finland	**Natural Gas**					**0.17**					**0.96**
		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	105.23	1508.15	0.16
		8. Distribution	PJ gas distributed	NO	NO	NO	NO	PJ gas distributed	NO	8.00	100220.97	0.80
		9. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
FRK	France	**Natural Gas**					**48.04**					**33.12**
		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	2376.20	0.73	Gas processed	PJ	2.15	303.96	0.00
		7. Transmission and storage	Gas consumed	PJ	1055.46	13469.65	14.22	Gas consumed	PJ	1362.27	9417.62	12.83
		8. Distribution	Gas consumed	PJ	1055.46	31352.55	33.09	Gas consumed	PJ	1362.27	14890.64	20.29
		9. Other	NO	PJ	NO	NO	NO	NO	PJ	NO	NO	NO

GBR	**United Kingdom**	**Natural Gas**					**406.73**					**164.87**
		5. Exploration	Exploration drilling: fuel use	t	225517.62	15.66	3.53	Exploration drilling: fuel use	t	46912.26	45.00	2.11
		6. Production	Gas produced	PJ	1709.37	IE	IE	Gas produced	PJ	1376.67	IE	IE
		7. Processing	Gas produced	PJ	1709.37	12756.73	21.81	Gas produced	PJ	1376.67	2189.58	3.01
		8. Transmission and storage	Natural gas supply	GWh	387730.56	23.58	9.14	Natural gas supply	GWh	472387.78	11.50	5.43
		9. Distribution	Natural gas supply	GWh	387730.56	960.08	372.25	Natural gas supply	GWh	472387.78	326.66	154.31
		10. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO
GRC	**Greece**	**Natural Gas**					**0.37**					**2.42**
		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	5.00	1930.00	0.01
		7. Processing	0	mil_m3	123.00	IE	IE	0	mil_m3	5.00	IE	IE
		8. Transmission and storage	0	mil m3	123.00	298.00	0.04	0	mil m3	2924.00	298.00	0.87
		9. Distribution	0	mil m3	86.24	1100.00	0.09	0	mil m3	1395.73	1100.00	1.54
		10. Other	0	0	IE	IE	IE	0	0	IE	IE	IE
HRV	**Croatia**	**Natural Gas**					**31.59**					**29.09**
		5. Exploration	0	1000000 m3	1982.30	1702.00	3.37	0	1000000 m3	1777.85	1702.00	3.03
		6. Production	gas produced	1000000 m3	1982.30	12190.88	24.17	gas produced	1000000 m3	1777.85	12190.88	21.67
		7. Processing	gas produced	1000000 m3	1982.30	252.40	0.50	gas produced	1000000 m3	1777.85	252.40	0.45
		8. Transmission and storage	marketable gas	1000000 m3	2686.60	1066.50	2.87	marketable gas	1000000 m3	2486.74	1066.50	2.65
		9. Distribution	utility sales	1000000 m3	379.30	1800.00	0.68	utility sales	1000000 m3	718.03	1800.00	1.29
		10. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
HUN	**Hungary**	**Natural Gas**					**29.39**					**20.14**
		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	1858.00	1340.00	2.49
		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	577.00	953.88	0.55
		9. Transmission and storage	Marketable gas (million m3)	million m3	11278.00	674.50	7.61	Marketable gas (million m3)	million m3	10800.00	298.00	3.22
		10. Distribution	Utility sales (million m3)	million m3	12507.10	1100.00	13.76	Utility sales (million m3)	million m3	12619.13	1100.00	13.88
		11. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
IRL	**Ireland**	**Natural Gas**					**6.24**					**1.12**
		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	5.14	70642.93	0.36
		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	68.31	11085.29	0.76
		11. Other	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
ISL	**Iceland**	**Natural Gas**					**NO**					**NO**
		6. Exploration	Natural gas exploration	PJ	NO	NO	NO	Natural gas exploration	PJ	NO	NO	NO
		7. Production	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		8. Processing	0	PJ	0.00	0.00	NO	0	PJ	0.00	0.00	NO
		9. Transmission and storage	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		10. Distribution	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO
		11. Other	0	PJ	NO	NO	NO	0	PJ	NO	NO	NO

		Natural Gas					**329.41**					**204.01**
		6. Exploration	Wells explored	Number	36.00	158.15	0.01	Wells explored	Number	NO	NO	NO
		7. Production	Gas produced	Mm3	17296.39	1726.36	29.86	Gas produced	Mm3	7285.71	906.05	6.60
ITA	**Italy**	8. Processing	Gas produced	Mm3	17296.39	773.26	13.37	Gas produced	Mm3	7285.71	405.75	2.96
		9. Transmission and storage	Gas transported	Mm3	45683.58	822.12	37.56	Gas transported	Mm3	62280.00	508.18	31.65
		10. Distribution	Gas distributed	Mm3	20632.00	12049.80	248.61	Gas distributed	Mm3	29451.00	5528.04	162.81
		11. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO
		Natural Gas					**10.42**					**11.06**
		7. Exploration	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		8. Production	0	NO	NO	NO	NO	0	NO	NO	NO	NO
LTU	**Lithuania**	9. Processing	0	NO	NO	NO	NO	0	NO	NO	NO	NO
		10. Transmission and storage	Natural gas leakages	thous.t	2.01	977699.00	1.97	Natural gas leakages	thous.t	3.11	970900.00	3.02
		11. Distribution	Natural gas leakages	thous.t	8.65	977699.00	8.46	Natural gas leakages	thous.t	8.28	970900.00	8.04
		12. Other	Natural gas leakages	thous.t	IE	IE	IE	Natural gas leakages	thous.t	IE	IE	IE
		Natural Gas					**0.77**					**1.54**
		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
LUX	**Luxembourg**	9. Processing	NO	NA	NO	NO	NO	NO	NA	NO	NO	NO
		10. Transmission and storage	gas consumed	TJ	17933.32	13.12	0.24	gas consumed	TJ	35310.03	13.22	0.47
		11. Distribution	gas consumed	TJ	17933.32	30.07	0.54	gas consumed	TJ	35310.03	30.30	1.07
		12. Other	NO	NA	NO	NO	NO	NO	NA	NO	NO	NO
		Natural Gas					**7.09**					**4.37**
		7. Exploration	Exploration	m3	NO	NO	NO	Exploration	m3	NO	NO	NO
		8. Production	Production	m3	NO	NO	NO	Production	m3	NO	NO	NO
LVA	**Latvia**	9. Processing	Processing	m3	NO	NO	NO	Processing	m3	NO	NO	NO
		10. Transmission and storage	Transmission and storage	m3	125172.00	0.69	0.09	Transmission and storage	m3	44226.00	0.68	0.03
		11. Distribution	Distribution	m3	694188.00	0.69	0.48	Distribution	m3	662135.00	0.68	0.45
		12. Other	Other	m3	12435406.00	0.52	6.53	Other	m3	5688837.00	0.68	3.89
		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
MLT	**Malta**	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
		Natural Gas					**16.84**					**14.02**
		8. Exploration	0	number	NA	IE	IE	0	number	NA	IE	IE
		9. Production	0	PJ	2300.00	IE	IE	0	PJ	0.00	0.00	IE
NLD	**Netherlands**	10. Processing	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE
		11. Transmission and storage	0	PJ	2648.08	4121.34	10.91	0	PJ	0.00	0.00	8.22
		12. Distribution	0	10^3 km	99.98	59294.88	5.93	0	10^3 km	0.00	0.00	5.79
		13. Other	0	PJ	IE	IE	IE	0	PJ	IE	IE	IE

POL	Poland	**Natural Gas**					**27.10**					**43.69**
		8. Exploration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		9. Production	Production	PJ	99.56	66879.91	6.66	Production	PJ	156.01	66879.91	10.43
		10. Processing	0	PJ	99.56	29950.57	2.98	0	PJ	156.01	29950.57	4.67
		11. Transmission and storage	gas consumed	PJ	374.21	13957.55	5.22	gas consumed	PJ	612.49	13957.55	8.55
		12. Distribution	gas consumed	PJ	374.21	31986.04	11.97	gas consumed	PJ	612.49	31986.04	19.59
		13. Other	NA	PJ	374.21	726.96	0.27	NA	PJ	612.49	726.96	0.45
PRT	Portugal	**Natural Gas**					**NO**					**5.40**
		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	h NG Imported	3169.05	1704.11	5.40
		13. Distribution	0	ton NG Distrib	NO	NO	NO	0	G Distributued	1699.30	NO	NO
		14. Other	0	NO	NO	NO	NO	0	NO	NO	NO	NO
ROU	Romania	**Natural Gas**					**452.23**					**182.62**
		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	11056.00	12190.00	134.77
		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	11640.00	633.00	7.37
		13. Distribution	gas supplied	0	35667.00	1800.00	64.20	gas supplied	0	11640.00	1800.00	20.95
		14. Other	gas consumed	0	143.63	139500.00	20.04	gas consumed	0	139.99	139509.96	19.53
SVK	Slovakia	**Natural Gas**					**44.14**					**27.08**
		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	100.00	2300.00	0.23
		11. Processing	0	mil m3	444.00	1030.00	0.46	0	mil m3	100.00	1030.00	0.10
		12. Transmission and storage	Transfer	mil m3	73600.00	480.00	35.33	Transfer	mil m3	46500.00	480.00	22.32
		13. Distribution	Distribution	mil m3	6666.00	1100.00	7.33	Distribution	mil m3	4014.00	1100.00	4.42
		14. Other	Storage	mil m3	1.00	25.00	0.00	Storage	mil m3	319.00	25.00	0.01
SVN	Slovenia	**Natural Gas**					**1.70**					**1.14**
		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	2696.17	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	769012.00	0.38	0.29
		14. Distribution	Utility sale	1000 m3	892000.60	1.10	0.98	Utility sale	1000 m3	769012.00	1.10	0.85
		15. Other	0	1000 m3	NO	NO	NO	0	1000 m3	NO	NO	NO
SWE	Sweden	**Natural Gas**					**2.65**					**1.54**
		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	6.76	0.00
		14. Distribution	0	NA	NA	NA	2.65	0	NA	NA	NA	1.54
		15. Other	0	NA	NO	NO	NO	0	NA	NO	NO	NO

Table 3.109 and Table 3.110 provide information on the contribution of countries to EU-28+ISL recalculations in CO_2 and CH_4 from 1B2 'Oil and natural gas' for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 3.1091B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EU recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.1	0	0.0	Emissions were re-allocated from category 1.B.2.b.1 to 1.B.2.b.3 CO_2-emissions in category 1.B.2.b.5 (Distribution of Natural Gas) were calculated for the first time slightly increasing CO_2 emissions for the whole time series
Belgium	0	0.0	11	10.3	
Bulgaria	0	0.0	1	4.2	
Croatia	159	16.4	129	19.7	1B2a.iii Oil – Refining and storage and 1B2b.i. Natural gas - Exploration emissions calculated in NIR 2016
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	5	2.3	Activity data have been updated for one natural gas distribution company for 2012-2013. Further, the admixing rate of atmospheric air in town gas distribution has been changed from 49 % to 50 % as detailed rates are not available for all companies and a calculation error has been corrected for one town gas company for the years 1990-2005. The recalculation has less influence on the CH_4 and CO_2 emis-sions, corresponding -0.1 (2013) % to 0.2 % (2012) and -0.1 (2013) % to 0.1 (2012) %, respectively, of the total fugitive emission.
Estonia	0	1.7	0	1.7	Starting from the 2016 submission, fugitive emissions from the transmission of natural gas are also included.
Finland	0	0.0	0	-0.2	Corrections in activity data
France	1	0.0	2	0.1	
Germany	1	0.0	10	0.5	Change of statistics regarding line lengths and -composition (1.B.2.b)
Greece	0	0.0	0	0.0	
Hungary	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	0	-4.2	0	-1.0	Application of Tier 2 method for fugitive emissions from natural gas based on data provided by national natural gas supply companies instead of Tier 1 in 1.B.2 Oil and natural gas and other emissions from energy production sector.
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Poland	0	0.0	0	0.0	
Portugal	-46	-18.1	-54	-3.4	In 2015 submission, due to a misunderstanding on the way how to report indirect CO_2 emissions, all CO_2 indirect emissions were reported twice, both in the sectors and in Table 6. In this submission, following the guidance from WG1/MMR, only CO_2 indirect emissions from "solvents" and "road paving with asphalt" are included in CRF table/categories: CRF table 2(I) under "2D Non-energy products from fuels and solvent use". All other CO_2 indirect emissions are reported in Table 6 and are separated from the national total.
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	0	0.0	68	1.9	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	56	1.5	New data available from the Environment Agency on the time series of CO_2 at a terminal has lead to an increase in estimates of direct process emissions at the site, and revised process emissions from one of the terminals.
EU28	115	0.5	229	1.0	
Iceland	0	0.0	0	0.0	
EU28+ISL	115	0.5	229	1.0	

Table 3.1101B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-28+ISL recalculations in CH_4 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	-1	-0.1	In Brussels, recalculation of CH_4 emissions from natural gas transmission from 1993 onward (correction of a mistake in previous calculations).
Bulgaria	0	0.0	1	0.5	For category 1.B.2.b.4 Fugitive emissions from gas transmission, the previous emission factor of 1340 kgCH_4/km was changed to 2500 kgCH_4/km (IPCC GPG 2000, Table 2.16, p.2.86), following a recommendation of the ERT during the Centralized review in 2012.
Croatia	89	2.7	81	6.4	1B2a.iii Oil – Refining and storage and 1B2b.i. Natural gas - Exploration emissions calculated in NIR 2016
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	0	0.1	Activity data have been updated for one natural gas distribution company for 2012-2013. Further, the admixing rate of atmospheric air in town gas distribution has been changed from 49 % to 50 % as detailed rates are not available for all companies and a calculation error has been corrected for one town gas company for the years 1990-2005. The recalculation has less influence on the CH_4 and CO_2 emis-sions, corresponding -0.1 (2013) % to 0.2 % (2012) and -0.1 (2013) % to 0.1 (2012) %, respectively, of the total fugitive emission.
Estonia	3	6.0	1	6.0	Starting from the 2016 submission, fugitive emissions from the transmission of natural gas are also included.
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.0	
Germany	-1 319	-13.6	-2 564	-33.4	Change of statistics regarding line lengths and -composition (1.B.2.b) Correction of unit error of EF(CH_4) for natural gas compressor (1.B.2.b)
Greece	0	0.0	0	0.0	
Hungary	0	0.0	4	0.6	Some activity data were revised by IEA last year in case of oil, so fugitive emissions were recalculated in the following sectors and years: • 1.B.2.a.3 Transport; 2010-2013 • 1.B.2.a.4 Refining / Storage; 2012-2013 CO_2 emissions from oil refineries of Hungary are taken from EU ETS annual emission reports and oil refinery flaring data is extrapolated for the years before 2005 using the amount of “Refinery intake” as

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					surrogate data.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	95	53.5	-66	-21.1	Application of Tier 2 method for fugitive emissions from natural gas 1.B.2 Oil and natural gas
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	-24	-1.2	-90	-11.1	For the gas distribution sector, new sets of leakage measurement have become available, which have been used to derive an improved set of emission factors. For gas transmission, new CH_4 leakage data have become available through the Leak Detection and Repair (LDAR) programme of Gasunie. The leakages at 13 large compressor stations were all fully measured. This data was also used to estimate the emissions at other facilities.
Poland	0	0.0	0	0.0	
Portugal	15	32.0	20	10.4	Revision of total amounts of loaded and unloaded crude and fuels in marine terminals.
Romania	0	0.0	0	0.0	
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	0	0.0	1	0.1	
Sweden	0	0.0	0	0.4	Emissions of CH_4 were revised for 2013 due to new corrected information from one facility
United Kingdom	12	0.1	6	0.1	Changes in the gas distribution category - revision to activity data from national statistics and also revision to 2013 total gas use from LDZs (in previous submission these data were rolled as they were not available).
EU28	-1 130	-1.5	-2 607	-6.6	
Iceland	0	0.0	0	0.0	
EU28+ISL	-1 130	-1.5	-2 607	-6.6	

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). No country is reporting emissions under this category.

3.3 Methodological issues and uncertainties (EU-28)

The previous section presented for each EU-28 key source in CRF Sector 1 an overview of the Member States' contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.111 shows the total EU-28 uncertainty estimates for the sector 'Energy' excluding 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. For those emissions for which no split by source category was available, uncertainty estimates were made for stationary combustion as a whole. The highest level uncertainty was estimated for N_2O from 1A2e and the lowest for CO_2 from 1A1a and 1A2f. With regard to trend CH_4 from 1A1a shows the highest uncertainty estimates, CO_2 from 1A1a the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-28 see Chapter **Error! Reference source not found.**.

Table 3.111 Sector 1 Energy (excl. 1A3b and 1B): Uncertainty estimates for EU-28

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	CO_2	563 066	497 897	-11.6%	3.01%	0.003%
1.A.1.a Public electricity and heat production	CH_4	330	2 471	648%	72%	4.8%
1.A.1.a Public electricity and heat production	N_2O	2 600	3 125	20%	22%	0.1%
1.A.1.b Petroleum refining	CO_2	54 231	50 235	-7%	4%	0.02%
1.A.1.b Petroleum refining	CH_4	20	15	-21%	29%	0.11%
1.A.1.b Petroleum refining	N_2O	199	136	-32%	33%	0.1%
1.A.1.c Manufacture of solid fuels and other energy industries	CO_2	47 511	18 335	-61%	4%	0.03%
1.A.1.c Manufacture of solid fuels and other energy industries	CH_4	146	180	24%	125%	0.3%
1.A.1.c Manufacture of solid fuels and other energy industries	N_2O	369	166	-55%	22%	0.1%
1.A.2.a Iron and Steel	CO_2	53 574	37 551	-30%	5%	0.01%
1.A.2.a Iron and Steel	CH_4	80	73	-8%	27%	0.1%
1.A.2.a Iron and Steel	N_2O	212	158	-25%	103%	0.6%
1.A.2.b Non-ferrous Metals	CO_2	3 019	1 870	-38%	9%	0.026%
1.A.2.b Non-ferrous Metals	CH_4	3	2	-35%	65%	0.1%
1.A.2.b Non-ferrous Metals	N_2O	17	8	-55%	90%	0.3%
1.A.2.c Chemicals	CO_2	33 205	8 406	-75%	4%	0.0%
1.A.2.c Chemicals	CH_4	22	13	-43%	70%	0.3%
1.A.2.c Chemicals	N_2O	41	28	-32%	230%	0.8%
1.A.2.d Pulp, Paper and Print	CO_2	3 752	2 452	-35%	4%	0.04%
1.A.2.d Pulp, Paper and Print	CH_4	49	66	35%	46%	0.1%
1.A.2.d Pulp, Paper and Print	N_2O	134	154	15%	103%	0.4%
1.A.2.e Food Processing, Beverages and Tobacco	CO_2	8 599	4 618	-46%	2%	0.02%
1.A.2.e Food Processing, Beverages and Tobacco	CH_4	11	7	-37%	62%	0.2%
1.A.2.e Food Processing, Beverages and Tobacco	N_2O	53	20	-62%	160%	0.5%
1.A.2.f Non-metallic minerals	CO2	29 299	23 282	-21%	3%	0.01%
1.A.2.f Non-metallic minerals	CH4	43	55	26%	47%	0.50%
1.A.2.f Non-metallic minerals	N2O	252	195	-23%	55%	0.30%
1.A.2.g Other	CO_2	133 042	83 564	-37%	3%	0.01%
1.A.2.g Other	CH_4	214	212	-1%	27%	0.08%
1.A.2.g Other	N_2O	835	655	-22%	31%	0.1%
1.A.4.a Commercial/Institutional	CO_2	71 708	48 806	-32%	6%	0.02%
1.A.4.a Commercial/Institutional	CH_4	366	233	-36%	40%	1.1%
1.A.4.a Commercial/Institutional	N_2O	189	106	-44%	84%	0.3%
1.A.4.b Residential	CO_2	188 289	124 087	-34%	6%	0.02%
1.A.4.b Residential	CH_4	2 809	3 065	9%	68%	0.2%
1.A.4.b Residential	N_2O	795	683	-14%	95%	0.3%
1.A.4.c Agriculture/forestry/fishing	CO_2	30 747	21 367	-31%	5%	0.02%
1.A.4.c Agriculture/forestry/fishing	CH_4	268	1 438	437%	39%	1.8%
1.A.4.c Agriculture/forestry/fishing	N_2O	344	293	-15%	103%	0.2%
1.A.5 Other	CO_2	16 045	4 376	-73%	17%	0.11%
1.A.5 Other	CH_4	36	24	-32%	127%	2.6%
1.A.5 Other	N_2O	151	61	-60%	285%	1.7%
1.A (where no subsector data were submitted)	*all*	754 918	*514 675*	*-32%*	*1%*	*0.7%*
1.A.1 (where no subsector data were submitted)	*all*	*610 299*	*395 294*	*-35%*	*2%*	*0.7%*
1.A.2 (where no subsector data were submitted)	*all*	*387 339*	*238 722*	*-38%*	*3%*	*0.7%*
1.A.3 (where no subsector data were submitted)	*all*	*251 501*	*285 759*	*14%*	*3%*	*0.5%*
1.A.4 (where no subsector data were submitted)	*all*	*389 627*	*287 747*	*-26%*	*3%*	*1.4%*
Total - 1.A (where no subsector data were submitted)	**all**	**754 918**	**514 675**	**-32%**	**1.3%**	**0.7%**
Total - 1.A.1	**all**	**1 278 771**	**967 855**	**-24%**	**1.7%**	**0.4%**
Total - 1.A.2	**all**	**653 796**	**402 109**	**-38%**	**1.9%**	**0.5%**
Total - 1.A.3	**all**	**784 651**	**870 877**	**11%**	**2.1%**	**0.6%**
Total - 1.A.4	**all**	**685 142**	**487 824**	**-29%**	**2.6%**	**1.0%**
Total - 1.A.5	**all**	**16 232**	**4 461**	**-73%**	**4.5%**	**2.9%**
Total - 1.A	**all**	**4 173 509**	**3 247 802**	**-22%**	**0.9%**	**0.3%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.112 shows the total EU-28 uncertainty estimates for the sector 1.B 'Fugitive emissions' and the uncertainty estimates for the relevant gases for each source category. The highest level uncertainties were estimated for N_2O from 1B2 and the lowest for CO_2 from 1B1; the highest trend uncertainties were estimated for N_2O from 1B2, the lowest for CH_4 from 1B2.

Table 3.112 1B Fugitive Emissions: Uncertainty estimates for EU-28

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid Fuels	CO_2	6 754	3 842	-43%	8%	0.02%
1.B.1 Solid Fuels	CH_4	94 129	21 994	-77%	41%	0.2%
1.B.1 Solid Fuels	N_2O	0.1	0.1	-25%	111%	0.3%
1.B.2. Oil and Natural Gas and other emissions from energy pr	CO_2	19 395	20 314	5%	28%	0.14%
1.B.2. Oil and Natural Gas and other emissions from energy pr	CH_4	68 285	30 602	-55%	39%	0.12%
1.B.2. Oil and Natural Gas and other emissions from energy pr	N_2O	103	78	-24%	548%	1.10%
1.B (werhe no subsector data were submitted)	*all*	*14 026*	*9 515*	*-32%*	*56%*	*11.5%*
Total - 1.B	**all**	**202 693**	**86 346**	**-57%**	**19.5%**	**9.7%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.113 shows the total EU-28 uncertainty estimates for the sector 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1A3d and the lowest for CO_2 from 1A3b. With regard to trend N_2O from 1A3c and 1A3e show the highest uncertainty estimates, CO_2 from 1A3b the lowest.

Table 3.113 1A3 Transport: Uncertainty estimates for EU-28

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Domestic aviation	CO_2	8 441	8 230	-3%	12%	0.02%
1.A.3.a Domestic aviation	CH_4	9	4	-52%	66%	0.2%
1.A.3.a Domestic aviation	N_2O	74	66	-11%	173%	0.3%
1.A.3.b Road transport	CO_2	487 678	556 205	14%	3%	0.01%
1.A.3.b Road transport	CH_4	3 159	648	-79%	19%	0.3%
1.A.3.b Road transport	N_2O	5 062	5 518	9%	29%	0.2%
1.A.3.c Railways	CO_2	7 062	3 255	-54%	4%	0.02%
1.A.3.c Railways	CH_4	9	5	-43%	46%	0.3%
1.A.3.c Railways	N_2O	492	211	-57%	83%	0.4%
1.A.3.d Domestic navigation	CO_2	14 849	7 482	-50%	13%	0.2%
1.A.3.d Domestic navigation	CH_4	22	17	-23%	70%	0.2%
1.A.3.d Domestic navigation	N_2O	211	134	-36%	215%	0.8%
1.A.3.e Other transportation	CO_2	5 856	3 292	-44%	3%	0.03%
1.A.3.e Other transportation	CH_4	13	8	-40%	57%	0.1%
1.A.3.e Other transportation	N_2O	214	43	-80%	84%	0.4%
Total - 1.A.3	**all**	**784 651**	**870 877**	**11%**	**2.1%**	**0.6%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

3.4 Sector-specific quality assurance and quality control

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 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. In 2016, again a comprehensive review was carried out for all sectors and all EU Member States with a focus on the years 1005, 2008-2010, 2013 and 2014 in order to track progress of the EU Member States under the EU Effort Sharing Decision. (ESD review 2016)

Since the inventory 2005 plant-specific data is available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2). During the ESD reviews 2012, 2015 and 2016 and during the initial checks 2015 and 2016 consistency checks have been 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 reviews 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[23]. 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 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,

[23] 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.

- 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 ETC/ACM 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 # 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 $_X$. 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 not included in the dataset of EUROCONTROL.

The comparison of EUROCONTROL results and MS inventory data for the timeseries 2005 to 2014 has been prepared by the European Environment Agency and its ETC/ACM in February 2016. Results have been shared with Member States during the 'initial checks' for aviation gasoline and kerosene consumption, domestic splits for kerosene and implied emission factors for CO_2, N_2O and CH_4. In addition Member States have been contacted in case of considerable differences between inventory and EUROCONTROL results.

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 1 % lower for domestic aviation and 3 % 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 below 0.1 Mt CO_2 in 2014. 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 2014 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. 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.

During the last years it can be seen that EUROCONTROL information has increasingly been used by Member States, either for checking purposes but also by using the numbers directly in inventory calculations. In the course of the 'initial checks' 2016 an intensive discussion with Member States took place to understand the reasons for differences on MS level. Some of the outcomes could on the one hand lead to eventual further improvement of inventories in next submissions or on the other hand for additional use of national information in EUROCONTOL calculations. In most cases the differences occur due to the need to align inventory numbers with the energy balance which might always lead to differences compared to a bottom-up calculation. Further improvements, partly resulting from the discussions with Member States, are planned for the calculation from EUROCONTROL in 2016.

3.5 Sector-specific recalculations

Table 3.114 shows that in the energy sector the largest recalculations in absolute terms in 1990 were made for N_2O and in 2013 for CO_2. In relative terms, the largest recalculations in 1990 were made for N_2O (-2.6 %) and in 2013 for CH_4 (-2.6 %).

Table 3.114 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2013 by gas in kt (CO_2-eq.) and percentage

1990	**CO_2**		**CH_4**		**N_2O**		**HFCs**		**PFCs**		**SF_6**		**Unspecified mix of HFCs and PFCs**		**NF3**	
	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%
Total emissions and removals	2 768	0.1%	-6 755	-0.9%	-14 971	-3.6%	-202	-0.7%	145	0.6%	-17	-0.2%	2	0.0%	0	0.0%
Energy	-542	0.0%	-921	-0.5%	-847	-2.6%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2013																
Total emissions and removals	-6 347	-0.2%	-3 838	-0.8%	-9 399	-3.6%	6 661	6.4%	110	2.8%	-68	-1.1%	19	11.0%	0	-1.0%
Energy	-6 030	-0.2%	-2 343	-2.6%	-709	-2.3%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.115 provides an overview of Member States' contributions to EU-28 and Iceland recalculations. In absolute terms, Germany had the most influence on CO_2 recalculations in the EU-28 + ISL in 2013. Explanations for recalculations by Member State are provided in # 3.2 and 10.1.

Table 3.115 Sector 1 Energy: Contribution of Member States to EU-28 and Iceland recalculations for 1990 and 2013 by gas (difference between latest submission and previous submission kt of CO_2 equivalents)

	1990								2013							
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF3	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF3
Austria	10	1	1	NO	NO	NO	NO	NO	151	6	-3	NO	NO	NO	NO	NO
Belgium	-925	1	-2	NO	NO	NO	NO	NO	61	-26	5	NO	NO	NO	NO	NO
Bulgaria	-1 105	-2	-127	NO	NO	NO	NO	NO	-369	2	-35	NO	NO	NO	NO	NO
Croatia	159	89	0	NO	NO	NO	NO	NO	153	81	0	NO	NO	NO	NO	NO
Cyprus	-21	3	5	NO	NO	NO	NO	NO	-10	8	10	NO	NO	NO	NO	NO
Czech Republic	12	-0.5	0.2	NO	NO	NO	NO	NO	-111	-6	1	NO	NO	NO	NO	NO
Denmark	-10	1	-13	NO	NO	NO	NO	NO	8	1	-11	NO	NO	NO	NO	NO
Estonia	0.6	3	0	NO	NO	NO	NO	NO	-6	1	-1	NO	NO	NO	NO	NO
Finland	-25	0	0	NO	NO	NO	NO	NO	-2	1	-0.1	NO	NO	NO	NO	NO
France	-450	-31	-162	NO	NO	NO	NO	NO	-1 562	19	-120	NO	NO	NO	NO	NO
Germany	-161	-1 320	-0.5	NO	NO	NO	NO	NO	-4 473	-2 532	-26	NO	NO	NO	NO	NO
Greece	0	0	0	NO	NO	NO	NO	NO	-93	0	7	NO	NO	NO	NO	NO
Hungary	15	0	4	NO	NO	NO	NO	NO	-39	-13	-12	NO	NO	NO	NO	NO
Ireland	0	-0.04	1	NO	NO	NO	NO	NO	-10	0	-1	NO	NO	NO	NO	NO
Italy	0.4	565	294	NO	NO	NO	NO	NO	1 324	1	-6	NO	NO	NO	NO	NO
Latvia	-6	-54	-15	NO	NO	NO	NO	NO	-6	-79	-14	NO	NO	NO	NO	NO
Lithuania	6	95	0.1	NO	NO	NO	NO	NO	-23	-66	0	NO	NO	NO	NO	NO
Luxembourg	1	0.03	-0.2	NO	NO	NO	NO	NO	89	0	-6	NO	NO	NO	NO	NO
Malta	-10	-0.01	-0.2	NO	NO	NO	NO	NO	57	0	4	NO	NO	NO	NO	NO
Netherlands	1 891	-19	6	NO	NO	NO	NO	NO	-930	-52	42	NO	NO	NO	NO	NO
Poland	-168	-169	-0.2	NO	NO	NO	NO	NO	-34	-111	-0.3	NO	NO	NO	NO	NO
Portugal	-84	15	-1	NO	NO	NO	NO	NO	-94	21	0.4	NO	NO	NO	NO	NO
Romania	0	0	-0.0001	NO	NO	NO	NO	NO	0	0.01	0.01	NO	NO	NO	NO	NO
Slovakia	93	12	1	NO	NO	NO	NO	NO	-419	2	4	NO	NO	NO	NO	NO
Slovenia	0.01	135	0	NO	NO	NO	NO	NO	1	155	3	NO	NO	NO	NO	NO
Spain	-44	-455	-248	NO	NO	NO	NO	NO	-96	-131	-384	NO	NO	NO	NO	NO
Sweden	-0.3	-66	-0.4	NO	NO	NO	NO	NO	-6	13	10	NO	NO	NO	NO	NO
United Kingdom	277	275	-591	NO	NO	NO	NO	NO	384	364	-195	NO	NO	NO	NO	NO
EU28	-542	-921	-849	NO	NO	NO	NO	NO	-6 054	-2 341	-725	NO	NO	NO	NO	NO
Iceland	-0.1	0.1	2	NO	NO	NO	NO	NO	24	-2	16	NO	NO	NO	NO	NO
EU28+ISL	-542	-921	-847	NO	NO	NO	NO	NO	-6 030	-2 343	-709	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach (EU-28 + ISL)

The IPCC reference approach for CO_2 from fossil fuels for the EU-28 + ISL is based on Eurostat energy data (Eurostat database, February 2016). This submission includes the reference approach tables for 1990–2014.

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 + ISL as a whole.

The Eurostat data for the EU-28 + ISL 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 + ISL 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 and Iceland, 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 + ISL 2016 inventory submission, and reported in table 1.A(b), corresponds to the sum of its 28 MS and Iceland.
- 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 February 2016.
- 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 data included in table 1.A(d). the Eurostat database.
- Eurostat data is also used for table 1A(d) (columns D-H). However, for column I we used the sum of the MS because this reporting in column I is closely linked to the inventories in IPPU.sectors.
- 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.

CRF table 1A(c) compares EU-28 + ISL CO_2 emissions calculated with the IPCC reference approach based on Eurostat data and the sectoral approach available from Member States and Iceland for 1990 and 2014. The percentage differences for both energy consumption and CO_2 emissions are very low.

Table 3.116 provides an overview for EU-28 Member States and Iceland on differences between the Eurostat and national reference approach for 2014. For EU-28 + ISL 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.

France did not include liquid fuels and solid fuels in the reference approach in the April submission

Iceland did not include solid fuels in the reference approach in the April submission

Table 3.116 Comparison between Eurostat and national reference approach for apparent consumption for EU-28 for 2014 (CRF 1.A) [24]

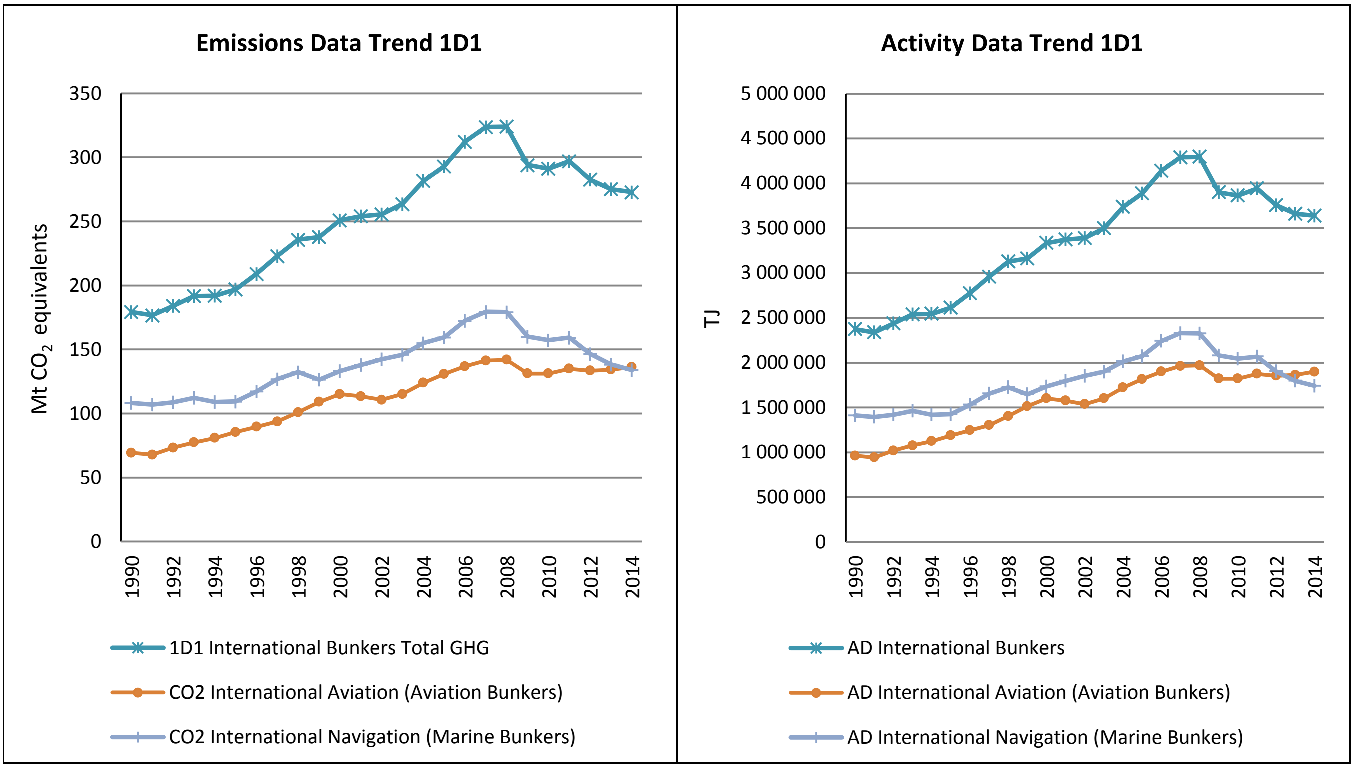
	Total liquid			Total solid			Total gaseous		
MS	**Eurostat TJ**	**Crf TJ**	**Difference %**	**Eurostat TJ**	**Crf TJ**	**Difference %**	**Eurostat TJ**	**Crf TJ**	**Difference %**
AT	941,732	967,388	3%	255,138	258,504	1%	539,664	539,665	0%
BE	1,835,174	1,870,551	2%	275,214	274,493	0%	1,055,012	1,049,737	0%
BG	306,192	325,592	6%	534,452	534,241	0%	197,834	197,834	0%
CY	153,970	155,724	1%	186	193	4%	- -	- -	0%
CZ	733,966	717,360	-2%	1,322,100	1,321,086	0%	517,668	518,778	0%
DE	8,299,094	8,394,890	1%	6,666,830	6,595,714	-1%	5,363,898	5,376,088	0%
DK	476,256	487,103	2%	199,834	212,282	6%	235,580	235,579	0%
EE	29,804	34,009	14%	374,114	374,116	0%	36,472	35,616	-2%
ES	3,802,762	3,758,382	-1%	961,830	946,265	-2%	1,981,720	1,983,923	0%
FI	726,510	693,723	-5%	255,194	273,012	7%	210,444	210,486	0%
FR	5,988,168	- -	-100%	762,272	- -	-100%	2,729,340	2,710,922	-1%
GR	939,230	924,109	-2%	559,950	567,922	1%	208,026	208,026	0%
HR	249,488	251,439	1%	54,104	54,104	0%	169,098	169,098	0%
HU	482,004	533,192	11%	185,266	184,397	0%	584,612	584,613	0%
IE	488,144	477,681	-2%	104,412	105,320	1%	311,710	311,573	0%
IS	46,822	40,186	-14%	7,378	0	-100%	- -	- -	0%
IT	4,417,018	4,547,110	3%	1,094,166	1,120,779	2%	4,245,924	4,243,568	0%
LT	197,758	203,880	3%	16,382	16,434	0%	172,874	172,900	0%
LU	189,750	189,341	0%	4,416	4,466	1%	70,604	70,603	0%
LV	110,766	104,160	-6%	4,930	4,946	0%	90,572	90,772	0%
MT	63,402	77,391	22%	- -	- -	0%	- -	24	0%
NL	2,345,078	2,283,418	-3%	754,548	758,129	0%	2,414,588	2,414,361	0%
PL	1,772,988	1,879,717	6%	4,089,948	4,112,691	1%	1,122,434	1,122,433	0%
PT	761,920	761,045	0%	224,284	224,338	0%	290,844	292,738	1%
RO	694,112	662,002	-5%	480,530	477,547	-1%	784,132	784,130	0%
SE	944,594	978,911	4%	161,978	155,478	-4%	66,490	66,791	0%
SI	193,222	193,439	0%	87,690	87,794	0%	52,420	52,420	0%
SK	240,480	249,197	4%	286,740	282,559	-1%	315,880	315,636	0%
UK	4,829,450	4,869,444	1%	2,506,936	2,554,687	2%	5,006,090	5,000,709	0%

[24] Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

3.7 International bunker fuels (EU-28+ISL)

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[25]. Between 1990 and 2014, greenhouse gas emissions from international bunker fuels increased by 52 % in the EU-28+ISL. CO_2 emissions from "Marine bunkers" account for 50 % of total greenhouse gas emissions from international bunkers in 2014, CO_2 from "Aviation bunkers" accounts for 50 % (Figure 3.154).

Figure 3.154 1D1 International bunker fuels: GHG emission trend and activity data



3.8.1 Aviation bunkers (EU-28+ISL)

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 2014 but are not included in the national total of GHG emissions (Table 3.117).

The Member States France, Germany, Spain and the United Kingdom contributed more than 60 % to the EU-28+ISL emissions from this source. Most Member States (25 in total) increased emissions from Aviation bunkers between 1990 and 2014.

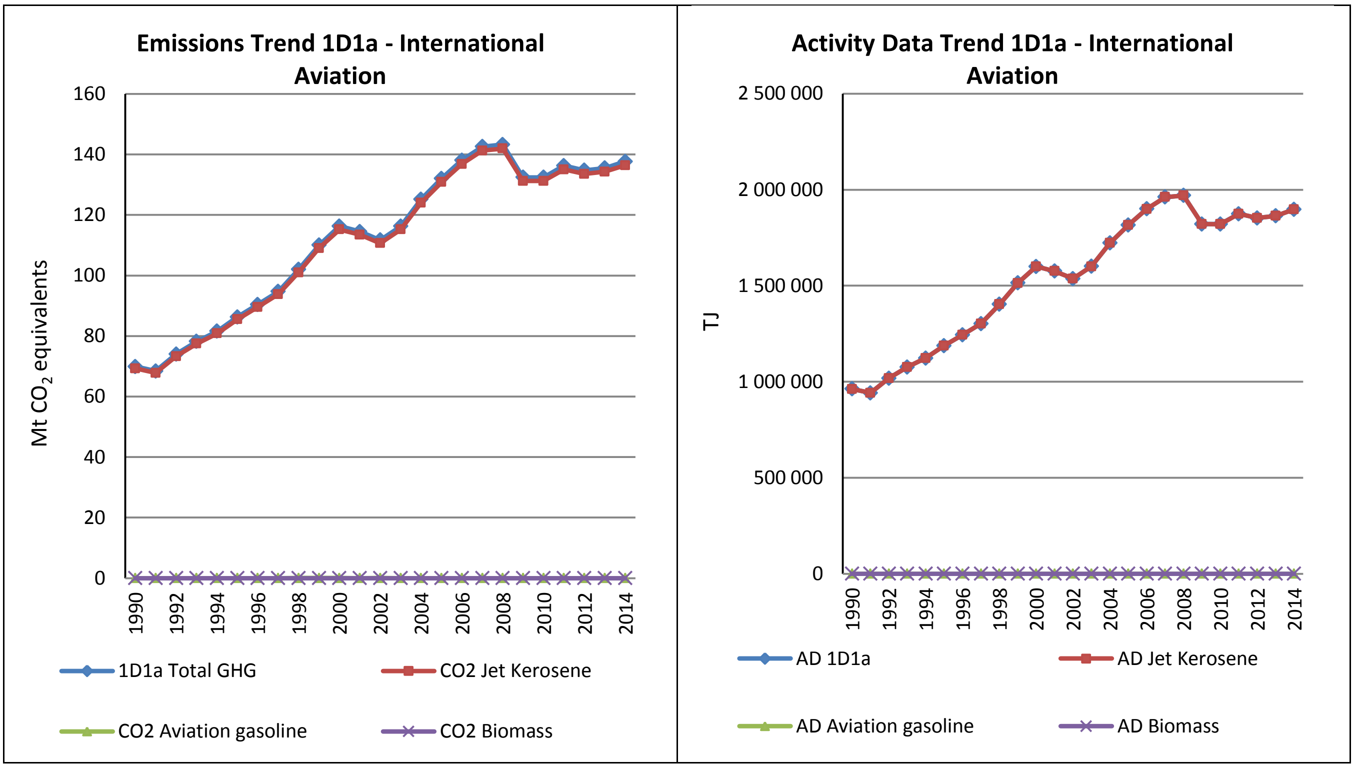
[25] The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within 'one country". This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers 'national fuel statistics' for domestic 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 3.117 Aviation bunkers: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	886	1 975	1 977	1%	1	0%	1 091	123%
Belgium	3 127	3 873	4 053	3%	179	5%	926	30%
Bulgaria	713	481	512	0%	31	6%	-202	-28%
Croatia	347	291	291	0%	0	0%	-56	-16%
Cyprus	733	776	776	1%	1	0%	43	6%
Czech Republic	524	853	875	1%	22	3%	352	67%
Denmark	1 731	2 470	2 680	2%	210	8%	949	55%
Estonia	108	88	125	0%	37	42%	17	16%
Finland	1 008	1 949	1 921	1%	-28	-1%	913	91%
France	8 657	16 216	16 333	12%	117	1%	7 676	89%
Germany	11 960	25 293	24 333	18%	-960	-4%	12 374	103%
Greece	2 439	2 472	2 830	2%	358	14%	391	16%
Hungary	480	487	511	0%	25	5%	31	6%
Ireland	1 070	2 011	2 229	2%	218	11%	1 159	108%
Italy	4 161	9 221	9 392	7%	171	2%	5 231	126%
Latvia	221	374	333	0%	-41	-11%	111	50%
Lithuania	399	211	234	0%	23	11%	-165	-41%
Luxembourg	403	1 144	1 242	1%	98	9%	839	208%
Malta	197	313	332	0%	19	6%	135	69%
Netherlands	4 540	10 433	10 827	8%	394	4%	6 286	138%
Poland	636	1 547	1 735	1%	188	12%	1 099	173%
Portugal	1 465	2 798	2 972	2%	174	6%	1 507	103%
Romania	790	491	619	0%	129	26%	-171	-22%
Slovakia	63	115	121	0%	6	5%	58	92%
Slovenia	48	73	73	0%	0	0%	25	51%
Spain	5 575	13 185	13 642	10%	457	3%	8 067	145%
Sweden	1 335	2 237	2 266	2%	29	1%	931	70%
United Kingdom	15 435	32 387	32 611	24%	224	1%	17 175	111%
EU-28	**69 050**	**133 764**	**135 844**	**100%**	**2 080**	**2%**	**66 794**	**97%**
Iceland	217	494	554	0%	60	12%	337	155%
EU-28 + ISL	**69 267**	**134 257**	**136 398**	**100%**	**2 140**	**2%**	**67 130**	**97%**

CO_2 emissions from jet kerosene account for 100 % of total emissions from "Aviation bunkers" in 2014 (Figure 3.155). All Member States but Bulgaria, Croatia, Lithuania and Romania increased emissions from jet kerosene between 1990 and 2014. Member States with the highest increase between 1990 and 2014 in percent were Iceland, Luxembourg, Poland and Spain.

Figure 3.155 1D1a Aviation bunkers: Trend of CO_2 Emissions and Activity Data



3.8.1.1 Aviation Bunkers – Jet Kerosene (CO_2)

Figure 3. provides an overview of emissions for EU-28+ISL and those Member States contributing most to EU-28+ISL emissions. France, Germany, Spain and the United Kingdom are the Member States that contributed more to the EU-28+ISL emissions. Fuel combustion of EU-28+ISL increased by 97 % between 1990 and 2014.

In Figure 3. the IEF is depicted, showing a mean value of around 72 t/TJ, with Romania having a small value of 48.9 t/TJ for 2014.

Figure 3.3 Aviation bunkers, Jet kerosene: Emission trend and share for CO_2

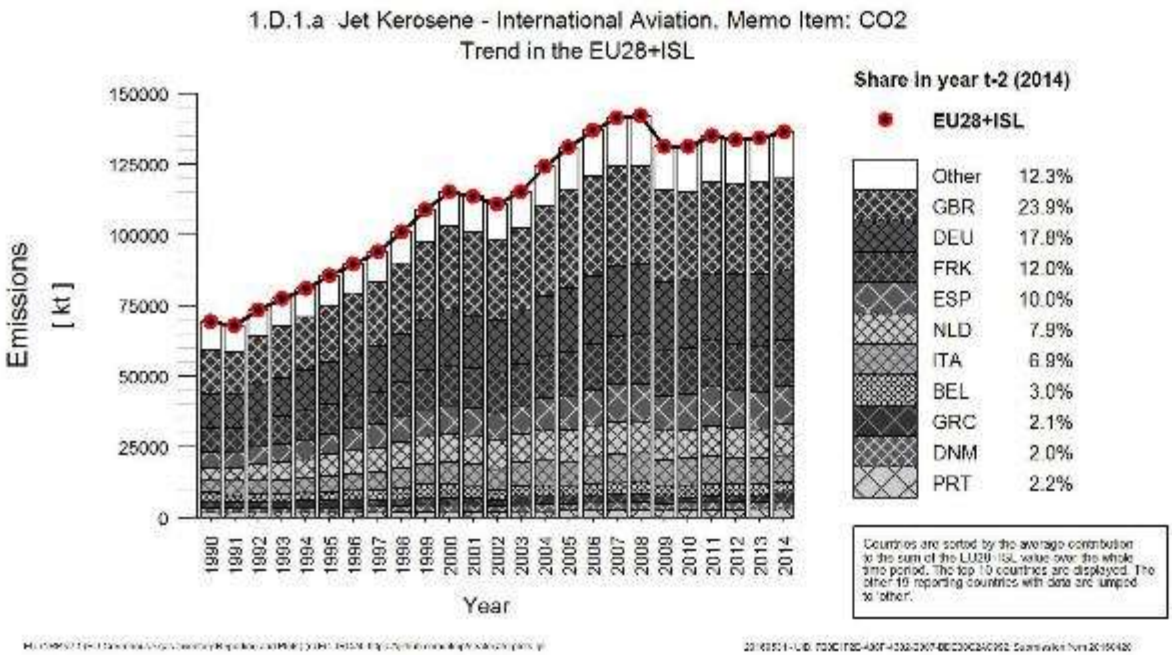
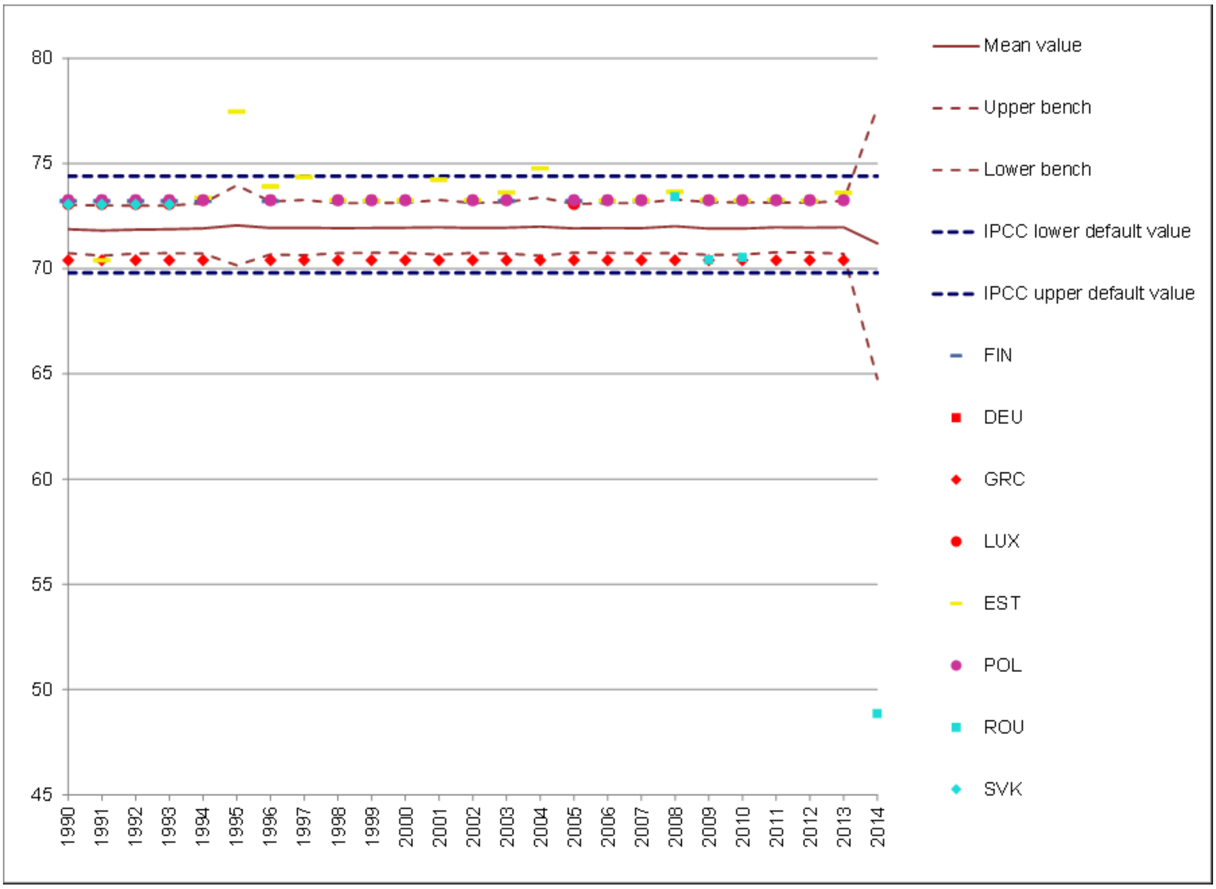


Figure 3.4: 1D1a Aviation bunkers – Jet kerosene: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated. If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.8.2 Marine bunkers (EU-28+ISL)

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 2014 and are also not included in the national total of GHG emissions. Between 1990 and 2014, CO_2 emissions from Marine bunkers increased by 24 % in the EU-28+ISL (Table 3.118).

The Member States Belgium, the Netherlands and Spain contributed most to the emissions from this source (62 %) in 2014. Between 1990 and 2014, most Member States (16 in total) increased emissions from Marine bunkers. The Member States with the highest increase in absolute terms were Belgium, the Netherlands and Spain.

Table 3.118 Marine bunkers: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	49	69	64	0%	-5	-7%	14	29%
Belgium	13 313	20 159	17 719	13%	-2 440	-12%	4 406	33%
Bulgaria	183	283	255	0%	-28	-10%	72	40%
Croatia	147	NO	NO	-	-	-	-147	-100%
Cyprus	183	755	733	1%	-22	-3%	551	301%
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	3 012	1 886	2 247	2%	361	19%	-766	-25%
Estonia	553	1 278	980	1%	-299	-23%	427	77%
Finland	1 832	371	261	0%	-110	-30%	-1 571	-86%
France	7 984	7 331	6 255	5%	-1 076	-15%	-1 729	-22%
Germany	6 405	6 629	6 626	5%	-3	0%	220	3%
Greece	8 041	7 096	6 048	5%	-1 048	-15%	-1 992	-25%
Hungary	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Ireland	57	451	414	0%	-37	-8%	357	629%
Italy	4 426	4 991	4 505	3%	-486	-10%	80	2%
Latvia	1 500	743	736	1%	-7	-1%	-764	-51%
Lithuania	302	279	35	0%	-243	-87%	-267	-88%
Luxembourg	0	0	0	0%	0	12%	0	47%
Malta	721	3 751	3 968	3%	216	6%	3 247	451%
Netherlands	34 235	42 252	41 692	31%	-560	-1%	7 456	22%
Poland	1 258	446	463	0%	17	4%	-796	-63%
Portugal	1 386	2 188	2 034	2%	-154	-7%	648	47%
Romania	NO	129	248	0%	119	93%	248	100%
Slovakia	65	13	15	0%	2	13%	-51	-78%
Slovenia	NO,NA	200	184	0%	-16	-8%	184	100%
Spain	11 527	22 890	24 766	18%	1 875	8%	13 238	115%
Sweden	2 228	5 453	5 850	4%	397	7%	3 622	163%
United Kingdom	8 763	8 551	7 756	6%	-795	-9%	-1 008	-11%
EU-28	**108 171**	**138 193**	**133 853**	**100%**	**-4 340**	**-3%**	**25 683**	**24%**
Iceland	99	209	229	0%	20	9%	130	131%
EU-28 + ISL	**108 270**	**138 402**	**134 082**	**100%**	**-4 320**	**-3%**	**25 812**	**24%**

CO_2 emissions from residual fuel oil account for 84 % of total emissions from "Marine bunkers" in 2014 (Figure 3.). Between 1990 and 2014, CO_2 emissions from residual fuel oil increased by 34 % in the EU-28+ISL. Bulgaria, Croatia, Denmark, Finland, France, Greece, Italy, Latvia, Lithuania, Poland and United Kingdom decreased their emissions, all other Member states increased emissions from residual oil between 1990 and 2014. Member States with the highest increase in percent were Cyprus, Malta, Sweden and Spain.

CO_2 emissions from gas/diesel oil account for 16 % of total emissions from "Marine bunkers" in 2014. Between 1990 and 2014, CO_2 emissions from gas/diesel oil decreased by 7 % in the EU-28+ISL.

Figure 3.5 1D1b Marine bunkers: Trend of CO_2 Emissions and Activity Data

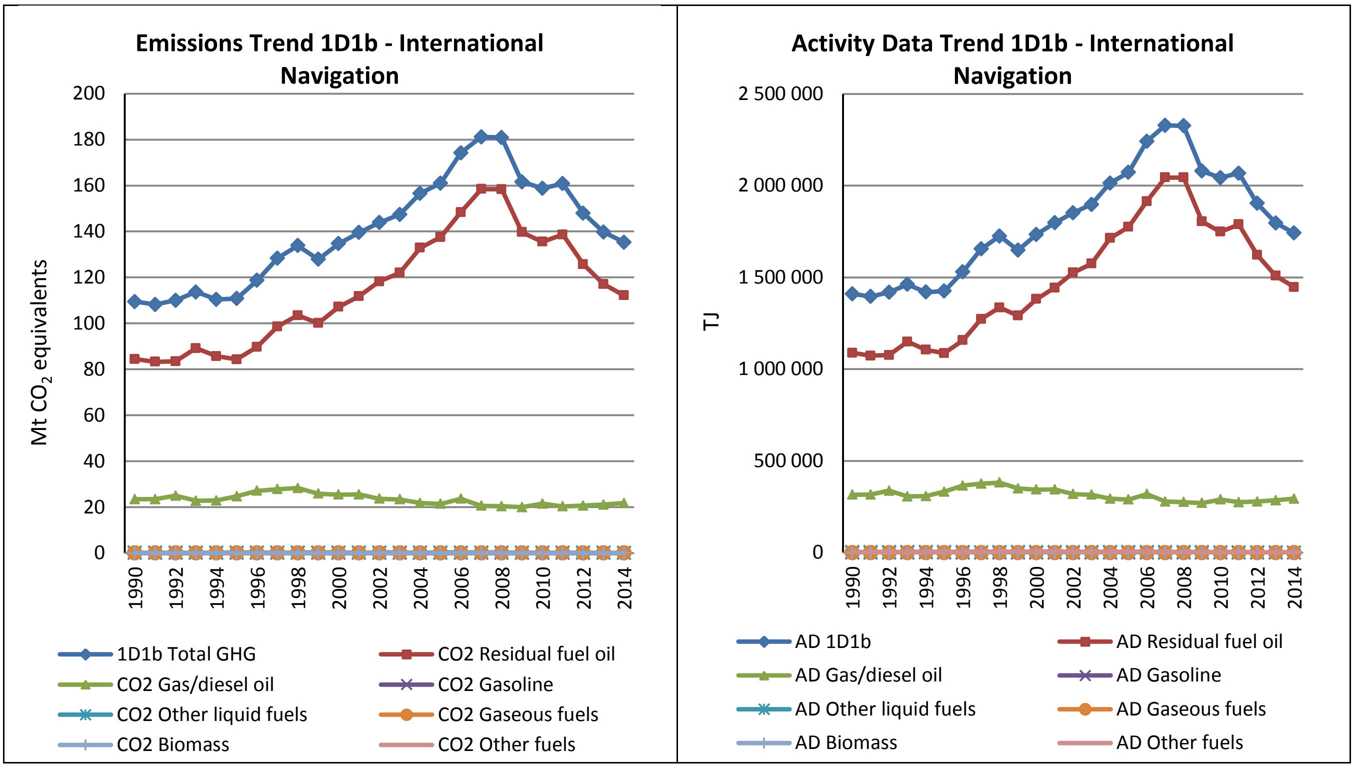


Figure 3. and **Error! Reference source not found.** provide an overview of emissions for residual oil and gas/diesel oil for EU-28 and those Member States contributing most to EU-28 emissions.

3.8.2.1 Marine Bunkers – Residual Oil (CO_2)

Combustion of residual oil in the EU-28+ISL increased by 33 % between 1990 and 2014. In Figure 3. the IEF is depicted, with Germany having a high value of 81.3 t/TJ for 2014.

Figure 3.6 Marine bunkers' – Residual Oil: Emission trend and share for CO_2

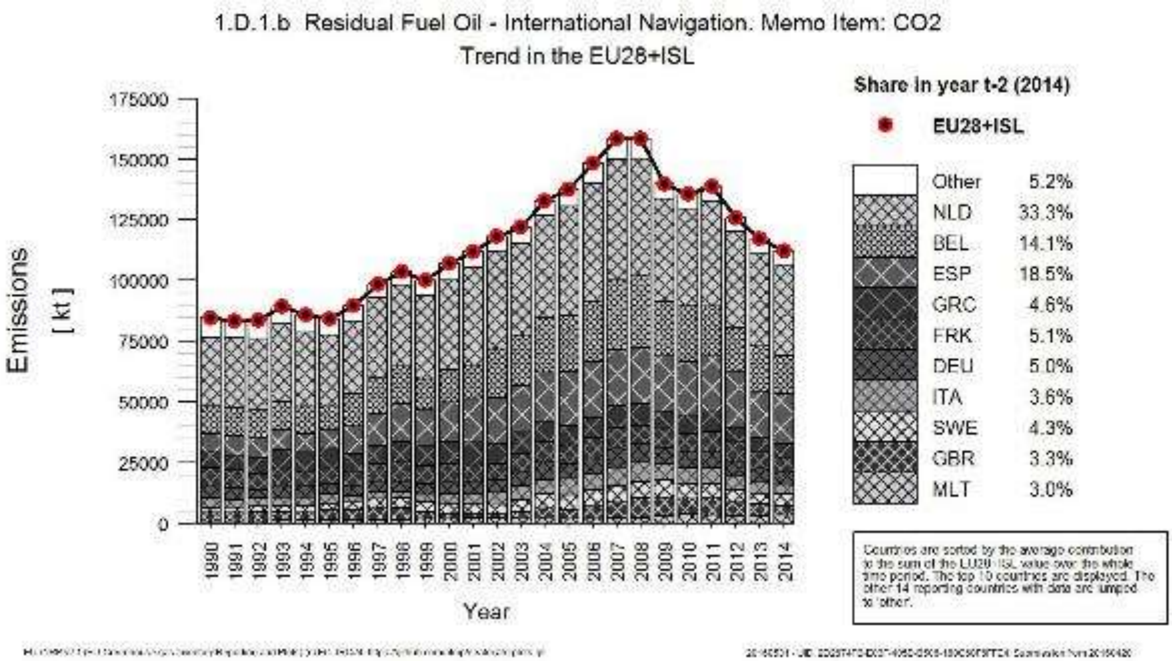
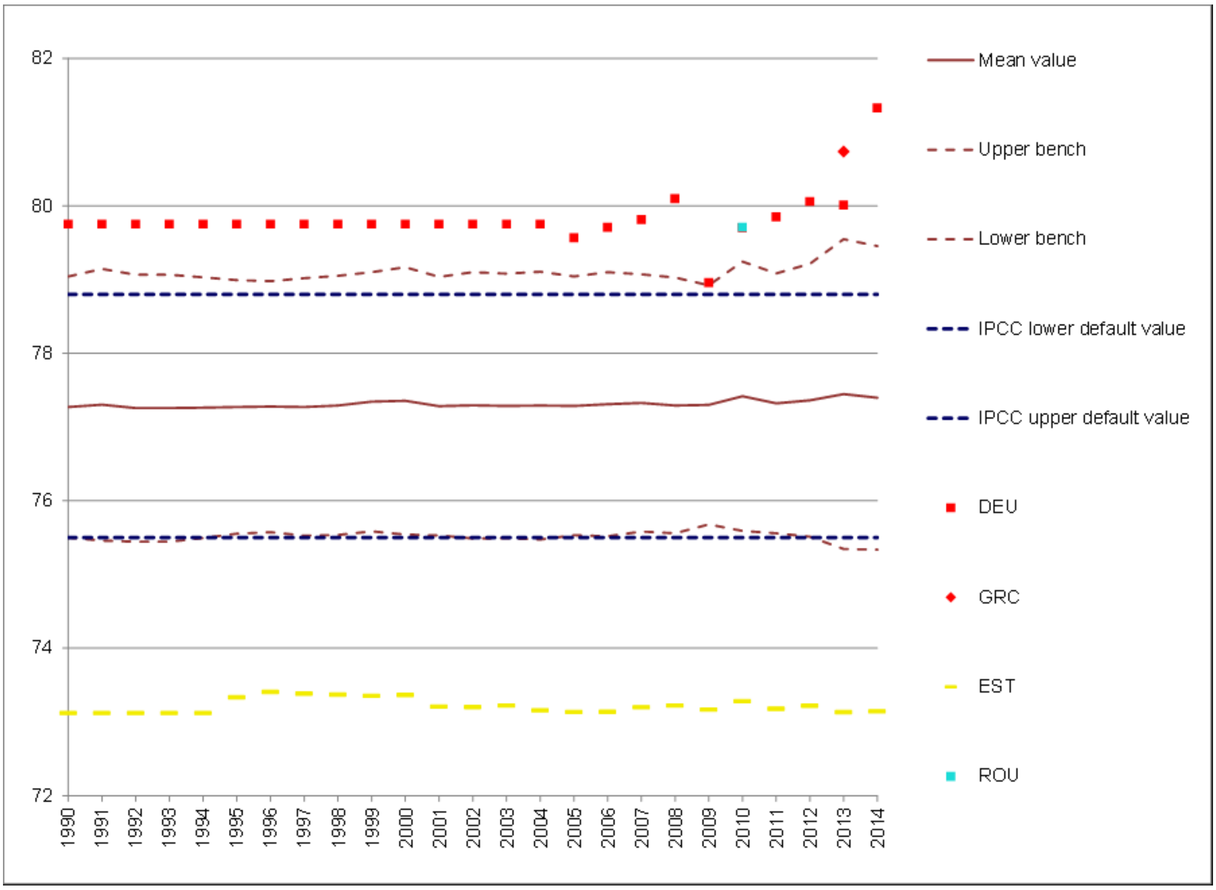


Figure 3.7: 1D1b Marine bunkers – Residual Oil: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated. If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.8.2.2 Marine Bunkers – Gas/Diesel Oil (CO_2)

Combustion of gas/diesel oil in the EU-28 decreased by 7 % between 1990 and 2014. In Figure 3.156 the IEF is depicted, with Greece having a high value of 77 t/TJ for 2014.

Figure 3.156 Marine bunkers, Gas/Diesel Oil: Emission trend and share for CO_2

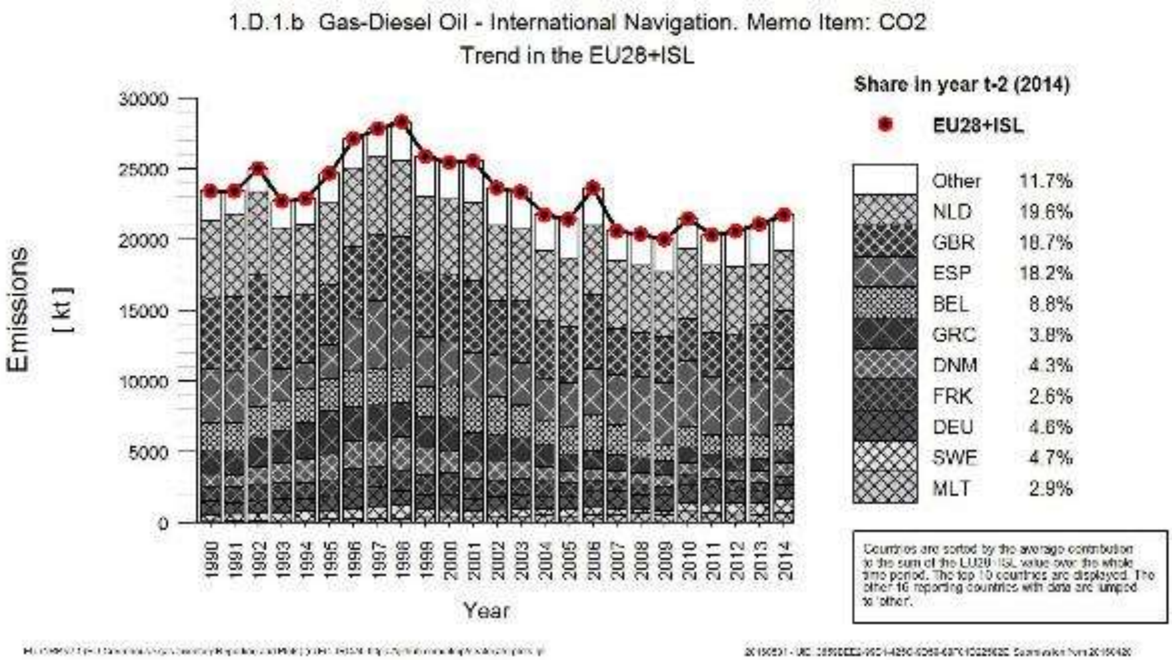
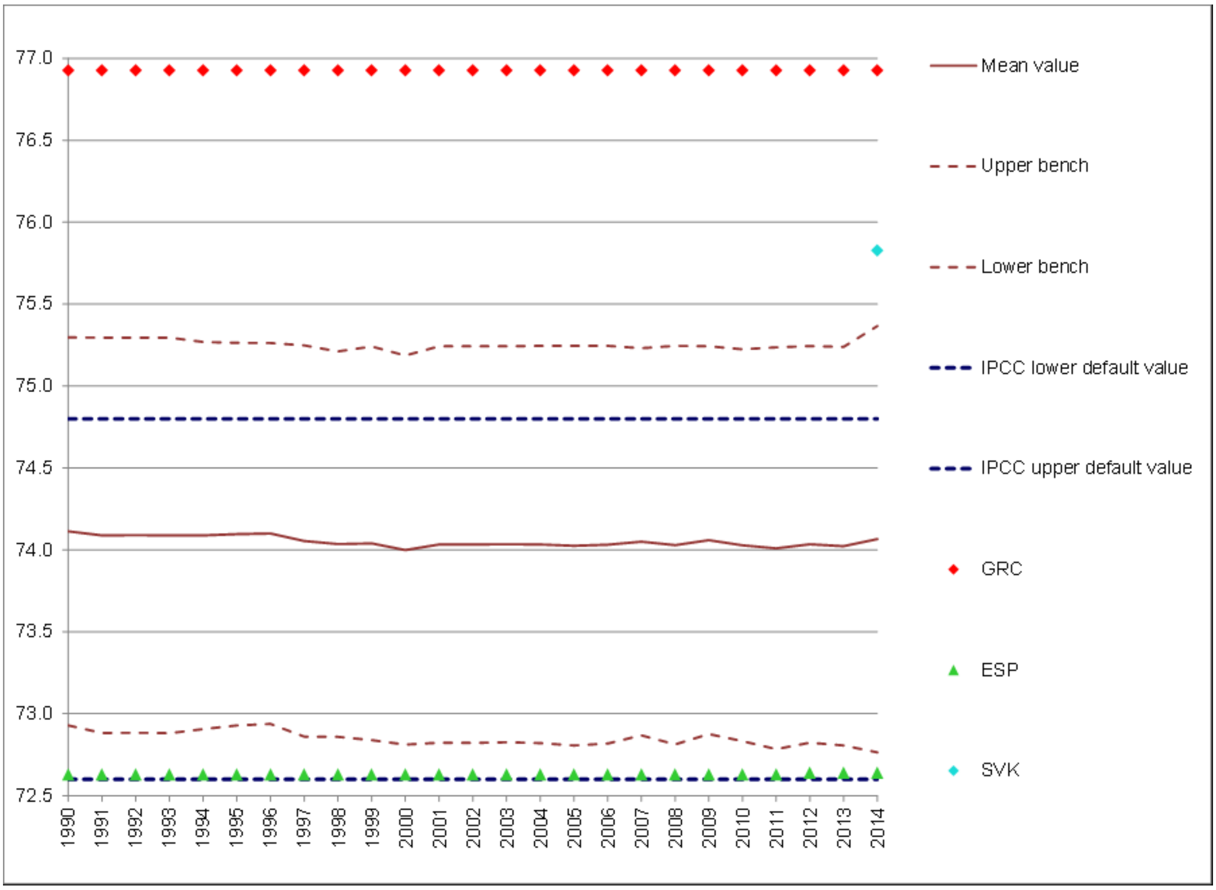


Figure 3.157 1D1b Marine bunkers – Gas/Diesel Oil: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



Note: Individual data points where MS IEFs are outside of the range of the mean IEF +/- 1.5 standard deviations (upper and lower bench) are illustrated. If only one IPCC default value exists, lower and upper IPCC default values are identical and appear as one line.

3.8.3 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 1990-2014.

Table 3.119 provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.119 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 2016 April 2016 p. 73f

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 1990-2014 April 2016 p. 65f

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. The most significant fuels used as feedstock are bitumen, anthracite and natural gas. The use of naphtha has been discontinued since 2010. 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 2016 April 2016 p. 83ff
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). Non-energy use of fuels in Cyprus refers to the consumption of lubricants in transport and bitumen in construction. Data on the non-energy consumption of fuels was obtained from the national energy balance (Gross inland deliveries (Calculated)). The calculation of carbon dioxide emissions from non-energy use of fuels is according to the methodology proposed by the IPCC2006 guidelines. NCVs, carbon emission factor and fraction of C stored are according to the guidelines (Table 3.34).Non-energy fuel use, carbon dioxide emissions and the amount of carbon stored in the final products are presented in Table 3.35. The emissions are reported under 2D.The large difference that occurs for bitumen between the C stored estimated in Reference and 1AD between 1990-2004 is due to the production of bitumen by the refinery.	Cyprus National Greenhou se Gases Inventory Report 1990-2014 April 2016 p. 97
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 2016 April 2016 p. 109

Denmark	The consumption for non-energy purposes is subtracted in the reference ap-proach, because non-energy use of fuels is included in other sectors (Indus-trial processes and Solvent use) in the Danish national approach. Three fuels are used for non-energy purposes: lubricants, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 10.5 PJ in 2014. 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 2016 April 2016 p. 255ff
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 1990-2014 April 2016 p. 65
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 otherfeedstocks only carbon from paraffin waxes is estimated to oxidise and these emissions are reported in sector 2.D.2 (section 4.5.3). 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 (2-stroke oil and part of motor oil in 4-stroke engines) or illegal combustion of waste oil in small boilers. These non-specified emissions from burning of lubricants (excluding above mentioned emissions reported in 1.A.2) are included in category 2.D.1 (section 4.5.2).	Greenhouse Gas emissions in Finland 1990-2014, 15 March 2016 p. 70

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

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. It uses fossil fuels in steam crackers, in reforming, in synthetic-gas production and in the produciton of graphite electrodes. 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). Without suitable adjustments, the consumption figures listed in Energy Balance line 43 cannot be compared with the CO_2 and NMVOC emissions from use of fossil fuels, in non-energy-related uses, that are reported in the inventory under industrial processes. The reason is that for the industrial processes, only emissions from production or use of products are taken into account, while line 43 takes account of entire feedstocks, thereby including both product-specific emissions and the carbon quantities stored in products. The latter account for far and away the largest share of the feedstocks. Yet a more important difference is that import and export quantities are taken into account in calculation of emissions from use of products. In the interest of obtaining a complete balance, Table 466 (see below) also takes account of the fossil-fuel carbon quantities stored in products. 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 products listed in the table 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 were obtained from the Official Mineral Oil Statistics, and they are based on gross refinery production. The production quantities 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 97 % 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 1990-2014 March 2016 p. 816f

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 IPPU, 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 since 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 itdid 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. CO_2 emissions from the use of fuels as reduction agents in the iron and steel industry, 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. Since this submission, following 2006 IPCC GLs, all fuels with non-energy use were reallocated to the IPPU sector (e.g. other petroleum products, lubricants, etc). On the basis of the abovementioned clarifications, the possibility to double-count or underestimate CO_2 emissions from thenon-energy use of fuels is minor.	Annual Inventory submission to the EC April 2016 p.103f
Hungary	The 2006 IPCC Guidelines 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 1985-2014 April 2016 p. 45f

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.	Ireland National Inventory Report 2015 April 2016 p. 70
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 1990-2014 April 2016 p.109ff

Latvia	3.2.3.1 Source category description Under this category consumption of different types of fuels used as feedstock is reported. Emissions from these fuels are reported as “CO_2 not emitted” because it is assumed that in CO_2 emissions is captured and not emitted to the air. Consumption of Bitumen, Lubricants, Coke, White spirits and Paraffin wax is reported in 1.D tables for all years in time series 1990–2014. 3.2.3.2 Methodological issues Carbon emission factors used in 2006 IPCC Guidelines were taken for all fuel types – Bitumen (22 t/TJ), Lubricants (20 t/TJ), Coke (29.2 t/TJ), White spirits (20 t/TJ) and Paraffin waxes (20 t/TJ). Activity data prepared by CSB and available on CSB on-line database were used (Table 3.14). Constant increase of bitumen use since 2004 until 2008 is explained with development of construction sector and availability of financial resources from European Union (Latvia is a member of European Union since 2004) for building and improvement of transportation infrastructure. However, during the economic crisis the funding reduced and the amounts of bitumen used decreased in 2008-2010. After the financial crisis increase in bitumen use can be observed. Lubricants are mainly used in transport sector. Coke is used as ingredient in metallurgy to produce higher quality steel. Evident decrease in coke use can be explained with changes in metallurgy. Financial crisis in 2010 and bankruptcy of “Liepājas metalurgs” is the reason of reduced metal production and use of coke. Paraffin waxes and white spirits mainly are used as feedstocks in chemical industry and wood processing.	Latvia´s National Inventory Report 1990-2014 15 March 2016 p. 112
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 2014, natural gas amounted about 87,4% 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 2016 April 2016 p. 89ff

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 the fraction of carbon stored, the IPCC default values are applied. 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). Emissions from lubricants use are reported under category 2D1 – Lubricant Use. Please refer to section 4.5.1 for more details on the estimation of emissions from lubricant use. 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. Use: by default the carbon contained in bitumen is considered to be entirely stored in the product, i.e. asphalt for road paving. Disposal: CO_2 emissions from the disposal of bitumen are assumed to be negligible. Recycling is not considered. 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. Disposal: not applicable. 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 category 2.D.3. - Nonenergy products from fuels and solvent use – Other – Solvent use. 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 1990-2014 15 March 2016 p. 192f
Malta	Activity data on feedstocks and non-energy use of fuels has, to-date, not been collected. Efforts are being made to improve on this specific area in order to include it in the methodological approach described in section 3.2.5.2 and to thus be able to estimate emissions (if any) in this particular category.	National Greenhouse Gas Emissions and Removals Inventory for Malta 2016 April 2016 p. 35
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 1990-2014 15 March 2016 p. 70
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 2016 February 2016 p. 55

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 1990-2014 March 2016 p. 3-176
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, Paraffin waxes, White spirit. According to the IPCC 2006GL provisions, Volume 3, Chapter 5: Non-Energy Products from Fuels and Solvent Use, the following methodology to report in the CRF Table 1.A(d), Feedstocks, reductants and other non-energy use of fuels, was used: - Bitumen: the carbon is reported as being full stored in the final product; - Lubricants, Naphta, Refinery gas, Other kerosene, Gas Diesel-Oil, Petroleum Coke, Residual Fuel Oil, Other products, White spirit: the carbon was presumed that is fully emitted and not stored, having the full oxidation during use; - Paraffin Waxes: the fraction of carbon stored is 0.8., the rest of 0.2 being emitted 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 11% of the total apparent energy consumption during the period 1999-2008, and arround 8% for the rest of the years. This could be in tight relation with the developing of the industry after 2000 until the economic crisis to have effects on the industry branches. 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.	Romania´s Greenhouse Gas Inventory 1989-2014 March 2016 p.157ff

Slovakia	Using the IPCC 2006 Guidelines, the quantity of carbon excluded from reference approach (carbon used for ammonia production, petrochemicals production, carbide production, hydrogen production, iron and steel production, ferroalloys production, aluminium production as well as non-energy using of lubricants) was estimated. Total carbon excluded from reference approach was 1 922.03 Gg in 2014, which represents 7 047.43.29 Gg of CO_2. The emissions from the carbon excluded are reported in respective categories in the IPPU sector. The major share of carbon excluded represents the carbon from coking coal, both in fuel consumption and in amount of carbon (57.4% and 57.4%, respectively) The other significant source of carbon excluded is using of natural gas (19.5% in fuel consumption and 16.1% in quantity of carbon). Details on the share in fuel units and carbon units are presented on Figures 3.9 and 3.10. The CO_2 emissions excluded from the RA are presented in Figure 3.11 for the whole time series 1990 – 2014. Liquid fuels (natural gas liquids, naphtha, and refinery feedstocks), solid fuels (coking coal, other bituminous coal) and gaseous fuels (natural gas) are used as feedstock in Slovakia. Lubricants and bitumen (liquid fuels) are used for non-energy purposes. The respective amounts of mentioned fuels are allocated in the IPPU sector and emissions are included there. The allocation of the fuels excluded from the reference approach and included in the IPPU sector is presented in the Table 3.18. The plant-specific (where available) and country-specific NCVs and EFs are used for estimation the volume of carbon excluded and respective CO_2 emissions excluded from the reference approach balance. The following fuels were balanced as feedstocks and non-energy use: natural gas, natural gas liquids, naphtha, lubricants, refinery feedstocks, coking coal, other bituminous coal. The quantities of the fuels and carbon used for non-energy purposes were provided directly by the plant operators or by the Statistical Office of the Slovak Republic. The results are presented in the Table 3.19. In this submission, carbon excluded from bitumen use is reported for the whole time series for first time. In previous submissions, amount of bitumen in TJ was reported without of content of carbon in it. In this submission, NCVs and carbon contents in bitumen were unified with RA on the basis of data of Statistical Office of the Slovak Republic. The non-energy use of bitumen was recalculated for the whole time series.	Slovak republic national Inventory report 2016 April 2016 Chapter 3 p. 23

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. Natural gas was entirely used as the row material for transformation into methanol. In every cycle only a fifth of it is transformed to the product, while the remaining natural gas is returned into the process. The schematic diagram of the process is shown in the Figure 3.1.3. **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. Slovenia has been adhering to the basic system of collection, recovery and disposal of waste oil since 1998. The main foci and provisions regarding the programme of waste oil management are stipulated in our legislation, in particular in the Decree on the disposal of waste oils, which is harmonized with the EU directive on the disposal of waste oils. Producers of waste oil are obliged to deliver the oil to collection services. Each collector must have a collection centre and must ensure either recovery or disposal of waste oils. Recovery is the preferred choice, if technically feasible and if its cost is not unreasonably higher than the cost of disposal. One of the forms of recovery is the utilisation of waste oils for energy – co-incineration in accordance with recovery procedure R1. Records by the SEA show that most waste oils have been used for this purpose. The only evidence of such a use is in the cement production. Emissions are already included in the inventory and are reported in the CRF tables in “1A2 Manufacturing industry and construction/other industries/Other fuel”. 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. The data on import and export as well as data from waste oil combusted in the industry have been obtained from SORS while the data on incineration of waste oils are from EARS. Stored CO_2 has been calculated on the basis of the formula 6.4 from 2006, IPCC guidelines, Vol. 2, Ch.6 Reference Approach. **Other fuels** Coke and petroleum coke, used in industry as reduction agent or feedstock, have been subtracted from energy sector and emissions from these fuels are presented in industrial processes sector. 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. To avoid double counting we have subtracted all coke used in iron and steel, ferroalloys and carbide production from energy sector except coke in iron production in the base year 1986. In that time, pig iron was still produced and disaggregated into the consumption of fuel as an additive. Thus the consumption of fuel as an energy product was impossible. For consumption of coke, the decision was taken to attribute all coke, which is consumed in the production of iron and steel in this year, to the energy sector as fuel consumption and no emissions from coke used in iron and steel production are presented in industrial processes. 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 2016 April 2016 p. 45ff
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

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 2016 Sweden April 2016 p.133
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, 2015) 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 were introduced in the Digest of UK Energy Statistics 2014 (DECC, 2014), improving consistency between the inventory and the UK energy statistics. The activity data used for the national inventory and any deviations from the UK energy balance are presented and explained 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 2014 March 2016 pp. 115f

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 category, overview tables are presented including the Member States' contributions to the key categories 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 2014. The most important GHGs from this sector are CO_2 (6 % 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 decreased by 27 % from 513 Mt in 1990 to 375 Mt in 2014 (Figure 4.1). In 2014, the emissions increased by 1.3 % compared to 2013. Factors for declining emissions in the early 1990s were lower 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 categories in this sector are:

- 2 A 1 Cement Production: (CO_2)
- 2 A 2 Lime Production: (CO_2)
- 2 A 4 Other Process Uses of Carbonates: (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 9 Fluorochemical Production: (Unspecified mix of HFCs and PFCs)
- 2 C 1 Iron and Steel Production: (CO_2)
- 2 C 3 Aluminium production: (PFCs)
- 2 D 3 Other non energy products: (CO_2)
- 2 F 1 Refrigeration and Air Conditioning Equipment : (HFCs)
- 2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)

Figure 4.1: CRF Sector 2 Industrial Processes and Product Use: EU-28 and Iceland GHG emissions for 1990–2014 in CO_2 equivalents (Mt)

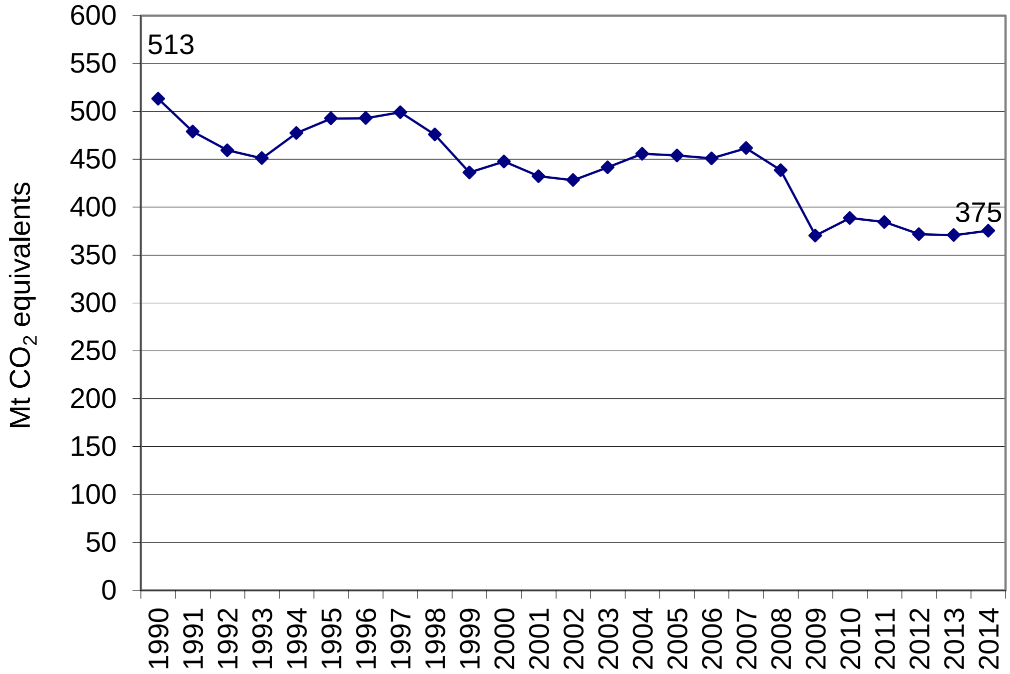
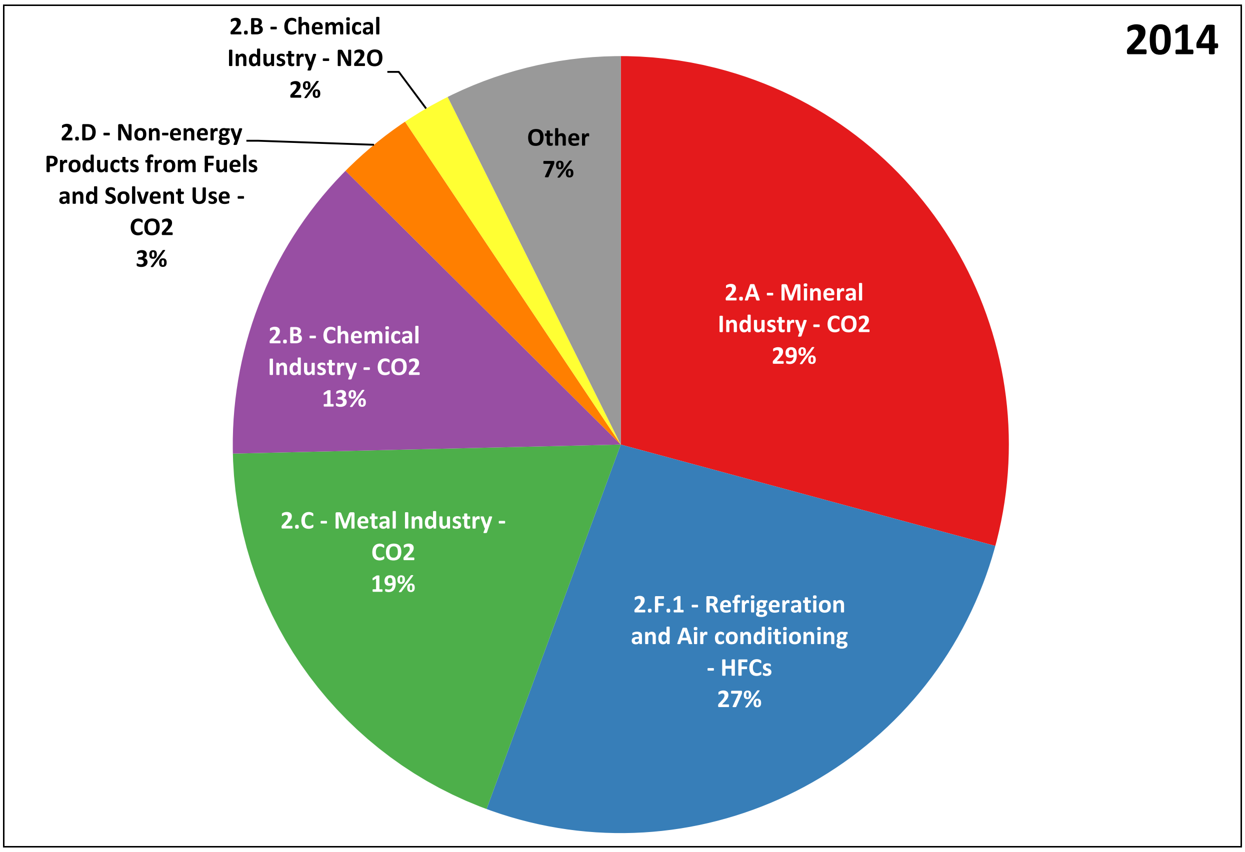
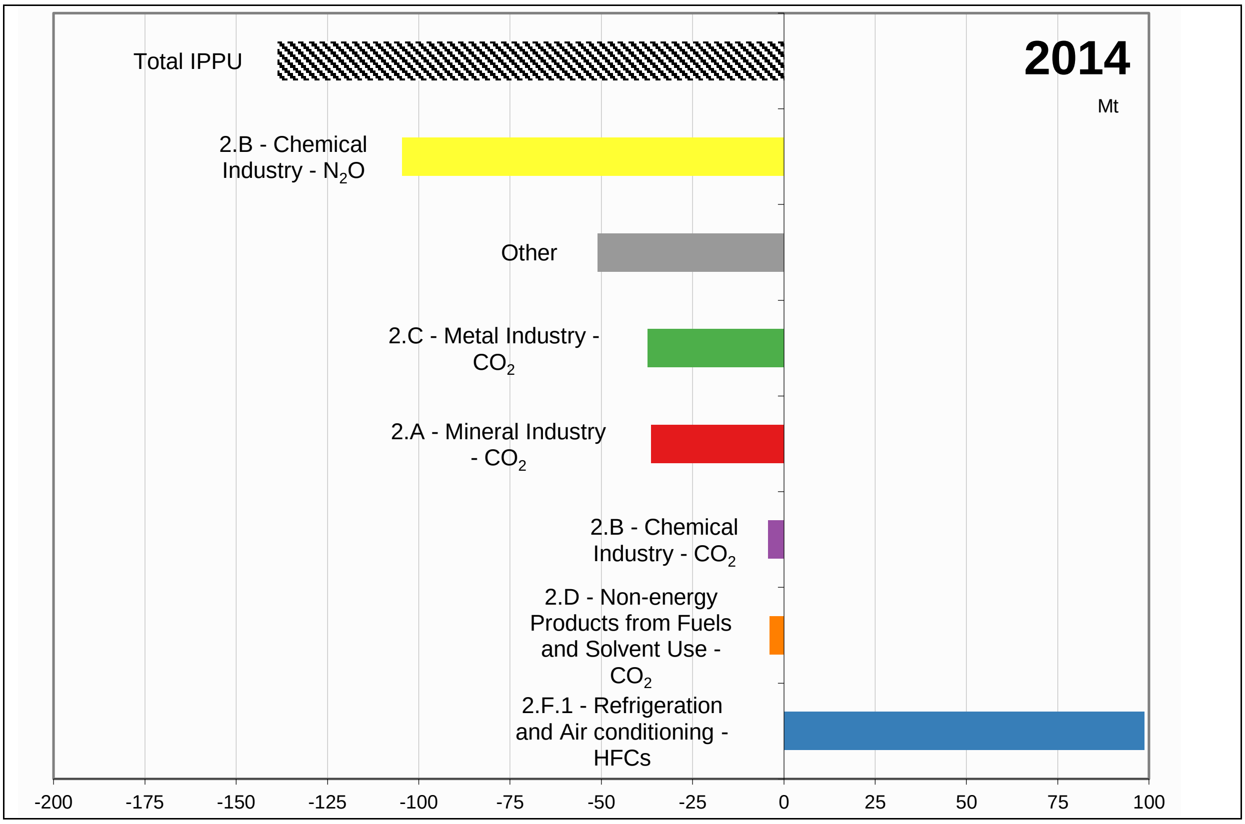


Figure 4.2: CRF Sector 2 Industrial processes and Product Use: Share of largest key categories in 2014 and absolute change of GHG emissions by large key categories 1990–2014 in CO_2 equivalents (Mt)





It is important to explain the reasons why the EU is not always able to provide EU-level AD or IEFs but has instead opted to transparently document what the MS have reported.

Because of the differences in methodological approaches used by countries the EU NIR provides overview tables for the activity data used by Member States and the corresponding IEFs. Several of these tables do include a calculation of EU-level implied emission factors based on a number of Member States. In those cases where (a) more than 80% of the emissions are calculated on basis of consistent activity data, and (b) the IEF has a reasonable degree of consistency (i.e. standard deviation divided by mean < 50%) we gap-filled activity data in the CRF. In these cases we are confident that the IEF included in the CRF provides reliable information to reviewers and adds to the transparency of the EU inventory. In all other cases we believe that an IEF in the CRF would be misleading because it would be based on a limited number of Member States or based on very different methodological approaches which cannot be meaningfully aggregated.

4.2 Source categories and methodological issues

4.2.1 Mineral industry (CRF Source Category 2A)

The source category 2A Mineral industry includes three key categories: CO_2 from 2A1 Cement production, CO_2 from 2A2 Lime production and CO_2 from 2A4 Other Process Uses of Carbonates. Cement production emissions occur during the production of clinker, an intermediate component in the cement manufacturing process. The source category 2A2 Lime production accounts for CO_2 emitted through the calcination of the calcium in limestone or dolomite for lime production. The source category 2A4 Other process uses of carbonates, is composed of several sources with independent estimation methods.

While CO_2 emissions from Mineral industry have decreased by 25 % since 1990 they increased by 3% between 2013 and 2014. The fall seen since 2007, due to the decrease in cement production during the economic crisis may have ended (Figure **4.3**). Twenty countries have higher CO_2 emissions in 2014 compared to the previous year, six decreased and three did not change (Table 4.1).

Figure 4.3 2A Mineral industry CO_2 emissions

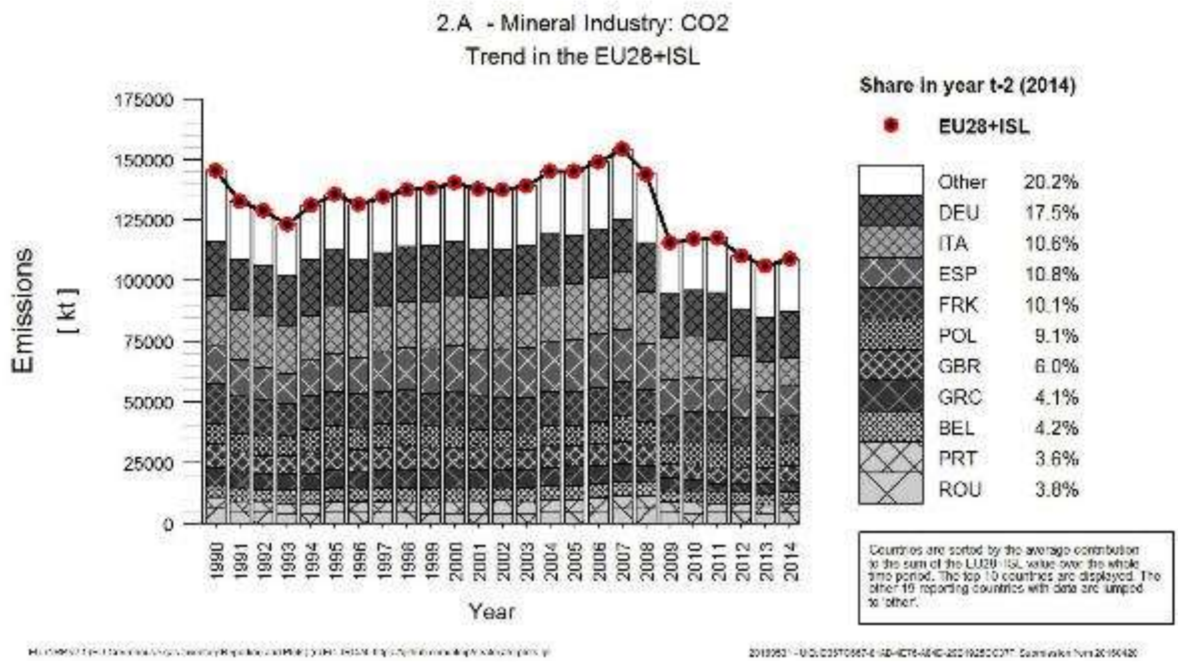


Table 4.1 2A Mineral industry: Member States total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)
Austria	3 092	2 722	3 092	2 722
Belgium	5 323	4 616	5 323	4 616
Bulgaria	3 276	1 986	3 276	1 986
Croatia	1 281	1 359	1 281	1 359
Cyprus	759	986	759	986
Czech Republic	4 059	2 543	4 059	2 543
Denmark	1 080	1 021	1 080	1 021
Estonia	614	464	614	464
Finland	1 200	1 026	1 200	1 026
France	16 467	10 988	16 467	10 988
Germany	22 780	19 054	22 780	19 054
Greece	6 775	4 495	6 775	4 495
Hungary	2 780	1 013	2 780	1 013
Ireland	1 117	1 650	1 117	1 650
Italy	20 714	11 595	20 714	11 595
Latvia	589	568	589	568
Lithuania	2 142	467	2 142	467
Luxembourg	623	415	623	415
Malta	1	0	1	0
Netherlands	1 248	1 139	1 248	1 139
Poland	8 792	9 937	8 792	9 937
Portugal	4 010	3 946	4 010	3 946
Romania	6 530	4 165	6 530	4 165
Slovakia	2 714	2 277	2 714	2 277
Slovenia	706	501	706	501
Spain	15 157	11 728	15 157	11 728
Sweden	1 684	1 848	1 684	1 848
United Kingdom	9 806	6 563	9 806	6 563
EU-28	**145 321**	**109 073**	**145 321**	**109 073**
Iceland	52	1	52	1
EU-28 + ISL	**145 373**	**109 074**	**145 373**	**109 073**

Abbreviations explained in the Chapter 'Units and abbreviations'.
As there are no N_2O and CH_4 emissions for this category, the table has two sets of columns with the same numbers.

Table 4.2 provides information on the Member States' contribution to EU-28+ISL recalculations in CO_2 from 2A Mineral industry for 1990 and 2013 as well as some explanations for the largest recalculations in absolute terms provided by Member States.

Table 4.2 2A Mineral industry: Contribution of MS to EU-28+ISL recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent (*)	kt CO_2 equiv.	Percent (*)	
Austria	0.1	0.0	0.1	0.0	
Belgium	0.0	0.0	1.5	0.0	Correction in the 2016 submission in the Walloon region (the process emissions of a sugar plant were missing (gas desulfuration). Optimization of the process emissions in the sectors of glass and ceramic took place in the Flemish region for the 2013.
Bulgaria	33.6	1.0	9.3	0.5	2A1- CO_2 emissions from usage of feedstocks, used for supplemental purification of waste gases, are added. 2A2 - Data for the CaO and MgO content in quicklime are changed as average scopes from the 2006 IPCC are taken.
Croatia	0.0	0.0	-16.0	-1.2	For 2012 and 2013 emissions from the production of sugar are no longer included in this sub-sector but in the Energy sector, in line with requirements of the EU ETS in the verified reports for the combustion. New data for limestone and dolomite use for 2013.
Cyprus	0.0	0.0	-14.4	-1.8	
Czech Republic	-44.2	-1.1	238.4	11.1	Updated activity data available, explanation provided in the Czech Republic NIR
Denmark	1.2	0.1	0.1	0.0	See Denmark NIR
Estonia	0.0	0.0	0.0	0.0	-
Finland	22.7	1.9	32.2	3.1	The default correction factor from 2006 IPCC Guidelines was adopted. New plants included. Reallocation from energy sector
France	4.3	0.0	3.1	0.0	Recalculations were made in the use of carbonates sector Use of carbonates (2A4-d) where a new site hasbeen taken into account
Germany	0.0	0.0	-11.9	-0.1	
Greece	-12.2	-0.2	-2.8	-0.1	
Hungary	7.5	0.3	4.1	0.4	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Latvia	0.0	0.0	0.3	0.1	Recalculations have been done for years 2012-2014 in sector 2.A.3 due to data of soda ash used in direct glass production are available and indirect CO_2 emissions from glass fibre production are reported under this sector.
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Malta	0.0	0.0	0.0	-25.8	The reduction of -25.8% is from 0.079 to 0.059 Gg CO_2e: a change of twenty tonnes: small in absolute terms large in relative terms
Netherlands	0.0	0.0	0.1	0.0	
Poland	0.0	0.0	2.0	0.0	
Portugal	424.1	11.8	217.5	6.1	- Lime Production in Paper Pulp Lime Kilns (2.A.2): This sector has been revised based on updated time series on CaCO3 consumption in Paper Pulp lime kilns and on Na2CO3 consumption in Paper Pulp causticisers, provided by each plant. - Uses of Carbonates in Ceramics (2.A.4.a): This sector has been completely revised. PT started using both ETS and Energy Balance data in order to estimate CO_2 emissions for the entire period. - Other Processes Uses of Carbonates (2.A.4.d): This sector has been revised and solved double counting issues with other sectors (soda ash consumption, uses of carbonates in ceramics, iron and steel and paper pulp.
Romania	0.0	0.0	-116.8	-2.9	Recalculations were made as a result of due to revised activity data for 2013. (CRF Category 2.A.4 d)
Slovakia	0.0	0.0	0.0	0.0	
Slovenia	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	82.3	0.8	
Sweden	-3.1	-0.2	-24.6	-1.3	Activity data for the entire time series for 2A2 lime production have been updated, resulting in recalculation of emissions. Minor corrections in 2A4b other uses of soda ash
United Kingdom	-5.8	-0.1	1.1	0.0	1990 change in emissions due to revisions in the Fletton/Non-Fletton split which affect the UK-specific CEF derived from 2008-2013 ETS

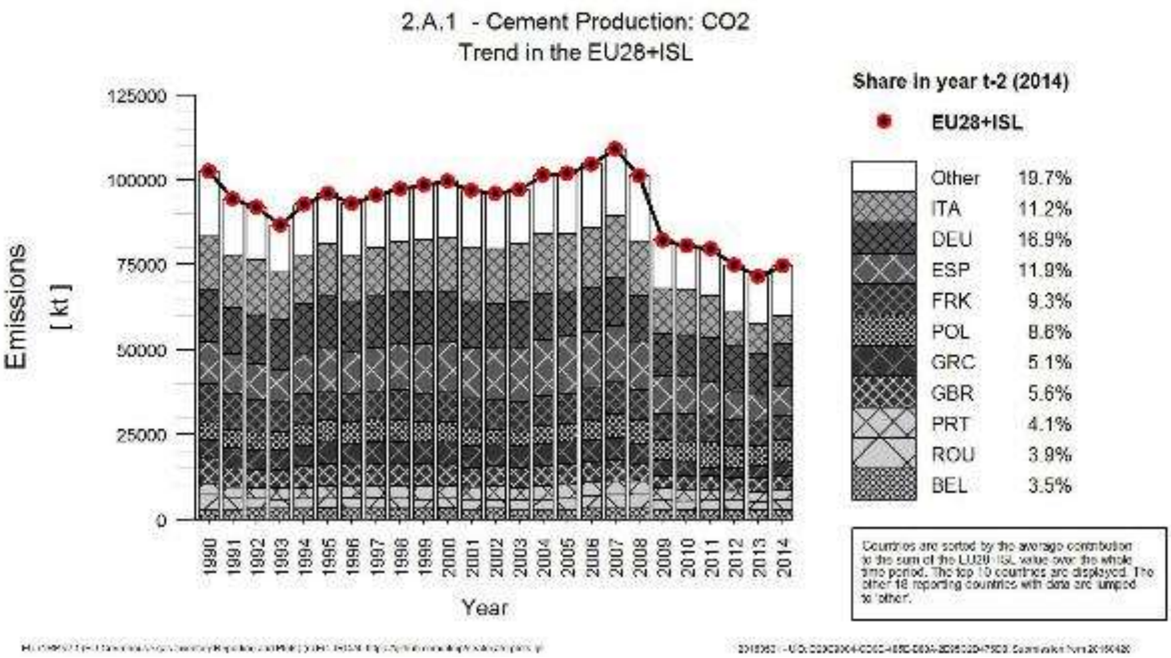
	1990		2013		Main explanations
	kt CO_2 equiv.	Percent (*)	kt CO_2 equiv.	Percent (*)	
					data for non-fletton bricks. 2013 small overall increase in emissions due to the addition of EU ETS based emissions for gypsum production at a heat and power plant. Also due to a recalculation for glass production, due to a very small site which closed in 2011.
EU28	428.0	0.3	405.6	0.4	
Iceland	0.7	1.4	0.6	100.0	
EU28+ISL	428.7	0.3	406.2	0.4	

(*) contribution of the recalculation as percentage of the total emissions of category 2A for the respective year and MS

4.2.1.1 2A1 Cement production

CO_2 emissions from Cement production account for 1.6 % of total EU 28+ISL (without LULUCF) emissions in 2014. In 2014, CO_2 emissions from Cement production were 37 % below 1990 levels. This source is a key category of CO_2 emissions in terms of emissions level and trend.

Figure 4.4 2A1 Cement production: EU-28+ISL CO_2 emissions



Germany, Spain and Italy were the largest emitters accounting for 17%, 12% and 11% respectively of cement related emissions. (Figure 4.4). While emissions from Cement production have fallen significantly since 2007, 2014 saw a 5% increase in emissions. Cement related emissions increased in most member states, with eight member states increasing by more than 10%. Compared to 2013, only Italy and France had significant decreases in emissions. Site closures in France in the early 1990s led to a 21% decrease in production between 1990 and 1993 and although there was some recovery in 2010, the year 2014 has the lowest level of emissions over the entire period (36% below 1990 levels).

Table 4.3 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	2 033	1 659	1 641	2%	-18	-1%	-392	-19%	-	-
Belgium	2 824	2 541	2 643	4%	102	4%	-181	-6%	T3	PS
Bulgaria	2 100	896	917	1%	21	2%	-1 183	-56%	T2	PS
Croatia	1 086	1 141	1 225	2%	84	7%	139	13%	T2	CS
Cyprus	697	752	974	1%	221	29%	277	40%	CS	CS
Czech Republic	2 489	1 332	1 482	2%	150	11%	-1 007	-40%	T3	PS
Denmark	882	867	887	1%	20	2%	5	1%	T3	PS
Estonia	483	399	422	1%	23	6%	-61	-13%	T2	PS
Finland	734	486	470	1%	-16	-3%	-264	-36%	T2	CS
France	10 937	7 300	6 975	9%	-325	-4%	-3 963	-36%	-	-
Germany	15 146	12 258	12 652	17%	394	3%	-2 494	-16%	T2	CS
Greece	5 762	3 639	3 822	5%	183	5%	-1 940	-34%	CS	PS
Hungary	1 636	516	566	1%	50	10%	-1 070	-65%	CS	CS
Ireland	884	1 112	1 461	2%	349	31%	577	65%	T3	PS
Italy	15 846	8 877	8 339	11%	-539	-6%	-7 507	-47%	T2	CS,PS
Latvia	371	538	556	1%	18	3%	185	50%	T2	PS
Lithuania	1 668	461	401	1%	-60	-13%	-1 267	-76%	T2	PS
Luxembourg	570	365	354	0%	-12	-3%	-216	-38%	T2	CS,PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	416	274	282	0%	8	3%	-133	-32%	CS	PS
Poland	5 453	5 874	6 456	9%	582	10%	1 003	18%	T1	D
Portugal	3 176	2 814	3 096	4%	282	10%	-80	-3%	T3	OTH
Romania	4 445	2 695	2 944	4%	249	9%	-1 501	-34%	CS,T2	PS
Slovakia	1 464	1 135	1 267	2%	131	12%	-198	-14%	T2	PS
Slovenia	482	391	418	1%	27	7%	-64	-13%	T2	CS
Spain	12 279	7 642	8 886	12%	1 243	16%	-3 393	-28%	T2	CS
Sweden	1 272	1 392	1 396	2%	4	0%	124	10%	D	CS,D
United Kingdom	7 295	4 029	4 215	6%	186	5%	-3 080	-42%	T3	CS
EU-28	**102 432**	**71 385**	**74 745**	**100%**	**3 360**	**5%**	**-27 686**	**-27%**		
Iceland	52	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**102 483**	**71 385**	**74 745**	**100%**	**3 360**	**5%**	**-27 686**	**-27%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.4 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement production for 1990 and 2014. Almost all 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 in 2014 range from 0.48 t CO_2/t of clinker produced for Luxembourg to 0.59 t CO_2/t of clinker produced for the United Kingdom and Estonia. All MS use country-specific and plant-specific emission factors and report comparable types of activity data (clinker production). In 2014 the EU-28+ISL 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 2014 only Austria, Denmark, Netherlands, Latvia and Luxembourg have decreases of more than 5% of 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 for the recent years. The IEF for UK increased by more than 7% over the same period.

The EF in Denmark decreased primarily during the period 1990-1996 (-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 4.4 2A1 Cement production: Information on methods applied and emission factors for CO_2 emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO2 emission (kt)	2014 Activity data Description	2014 Activity data (kt)	2014 Implied emission factor (t/t)	2014 CO2 emissions (kt)
Austria	T2	CS	Clinker production	3694	0.55	2033	Cement Clinker	3143	0.52	1641
Belgium	T3	PS	Clinker production	5292	0.53	2824	Clinker production	4831	0.55	2643
Bulgaria	T2	CS	Clinker production	3987	0.53	2100	Clinker production	1717	0.53	917
Croatia	T2	CS	Clinker production	2062	0.53	1086	Clinker production	2278	0.54	1225
Cyprus	CS	CS	Clinker production	1249	0.56	697	Clinker production	1823	0.53	974
Czech Republic	T3	PS	Clinker production	4726	0.53	2489	Clinker production	2792	0.53	1482
Denmark	T2	PS	Clinker production	1406	0.63	882	Clinker production	1644	0.54	887
Estonia	T2	PS	Clinker production	790	0.61	483	Clinker production	720	0.59	422
Finland	T2	CS	Clinker production	1470	0.50	734	Clinker production	941	0.50	470
France	T2 and T3	PS	Clinker production	20854	0.52	10937	Clinker production	13146	0.53	6975
Germany	T2	CS	Clinker production	28577	0.53	15146	Clinker production	23871	0.53	12652
Greece	CS	OTH	Clinker production	10645	0.54	5762	Clinker production	7234	0.53	3822
Hungary	CS	CS	Clinker production	3210	0.51	1636	Clinker production	1095	0.52	566
Ireland	T3	PS	Clinker production	1610	0.55	884	Clinker production	2682	0.54	1461
Italy	T2	CS,PS	Clinker production	29786	0.53	15846	Clinker production	15833	0.53	8339
Latvia	T2	PS	Clinker production	669	0.55	371	Clinker production	1093	0.51	556
Lithuania	T2	PS	Clinker production	3058	0.55	1668	Clinker production	754	0.53	401
Luxembourg	T2	CS,PS	Clinker production	1048	0.54	570	Clinker production	731	0.48	354
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	CS	PS	-	770	0.54	416	-	559	0.51	282
Poland	T1	D	Clinker production	10309	0.53	5453	Clinker production	11866	0.54	6456
Portugal	T3	OTH	-	6128	0.52	3176	-	5968	0.52	3096
Romania	CS,T2	PS	Clinker production	8379	0.53	4445	Clinker production	5467	0.54	2944
Slovakia	T2	CS	Clinker production	2836	0.52	1464	Clinker production	2415	0.52	1267
Slovenia	T2	CS	Clinker production	891	0.54	482	Clinker production	807	0.52	418
Spain	T2	CS	Clinker production	23212	0.53	12279	Clinker production	16917	0.53	8886
Sweden	-	-	Clinker production	2348	0.54	1272	Clinker production	2602	0.54	1396
United Kingdom	T2	CS	Clinker production	13199	0.55	7295	Clinker production	7197	0.59	4215
EU-28				**192203**	**0.53**	**102432**		**140126**	**0.53**	**74745**
Iceland	T2	D,PS	Clinker production	97	0.53	52	Clinker production	NO	NO	NO
EU-28+ISL				**192300**	**0.53**	**102483**		**140126**	**0.53**	**74745**

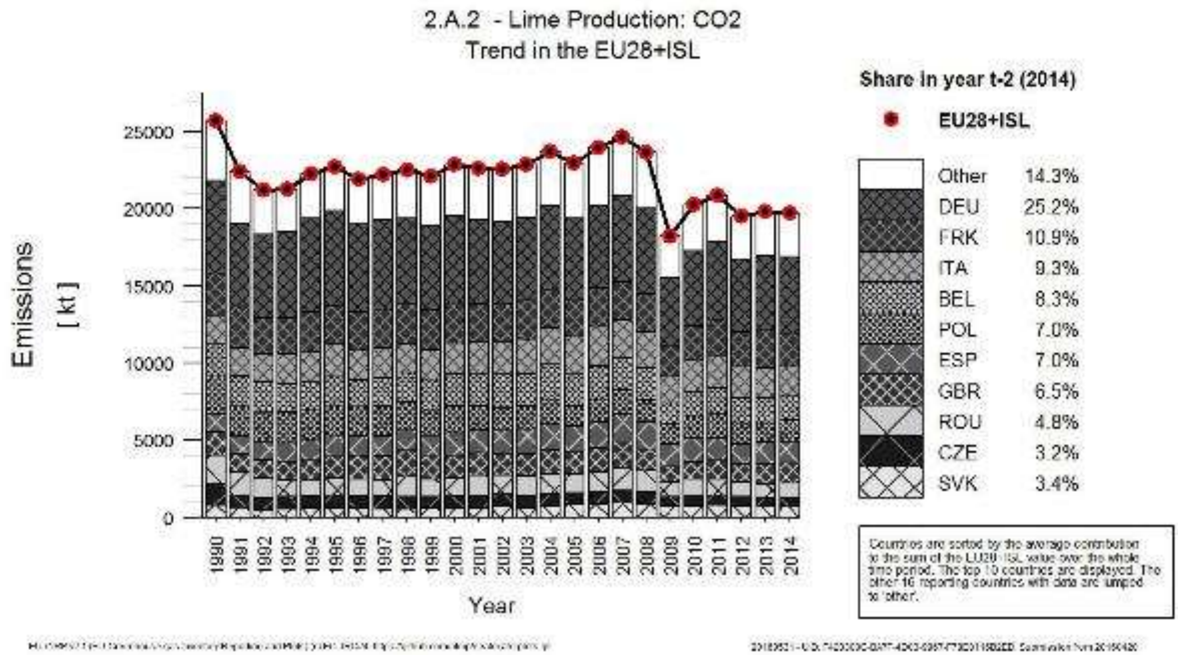
Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.2 2A2 Lime production

CO_2 emissions from 2A2 Lime production account for 0.4% of total EU 28+ISL (without LULUCF) emissions in 2014. Between 1990 and 2014, CO_2 emissions from this source decreased by 23 %. Germany, France and Italy are the largest emitters contributing 25 %, 11 % and 9 % respectively of the sector.

Lime production emissions remain at a similar level to the preceding two years having decreased sharply with the economic crisis (Figure 4.5).

Figure 4.5 2A2 Lime production: EU-28+ISL 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. Romania also contributed considerably to the drop in the early nineties. In 2014, ten countries have decreased their emissions since 1990, twelve increased emissions and seven remain unchanged (Table 4.5).

Table 4.5 2A2 Lime production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	396	588	589	3%	2	0%	193	49%	-	-
Belgium	2 097	1 629	1 642	8%	12	1%	-456	-22%	T3	PS
Bulgaria	390	213	204	1%	-10	-5%	-187	-48%	T2	D
Croatia	153	74	71	0%	-3	-4%	-82	-53%	T2	CS
Cyprus	5	3	3	0%	0	-10%	-3	-54%	T1	D
Czech Republic	1 337	613	629	3%	16	3%	-708	-53%	T3	PS
Denmark	105	54	58	0%	4	8%	-47	-45%	T1	D
Estonia	130	47	34	0%	-13	-28%	-96	-74%	T2	PS
Finland	383	401	386	2%	-15	-4%	4	1%	T2	CS
France	2 743	2 470	2 150	11%	-320	-13%	-593	-22%	-	-
Germany	5 987	4 811	4 973	25%	161	3%	-1 014	-17%	T2	D
Greece	404	294	293	1%	-1	0%	-111	-28%	CS	PS
Hungary	614	131	141	1%	10	8%	-473	-77%	CS	CS
Ireland	214	190	189	1%	-1	0%	-25	-12%	T3	PS
Italy	1 877	1 892	1 841	9%	-51	-3%	-36	-2%	T2	CS,PS
Latvia	149	0	0	0%	0	67%	-148	-100%	T1,T2,T3	D,PS
Lithuania	223	29	41	0%	12	41%	-181	-81%	T2	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	1	NO	NO	-	-	-	-1	-100%	NA	NA
Netherlands	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2 461	1 274	1 372	7%	98	8%	-1 089	-44%	T1	D
Portugal	203	328	346	2%	18	6%	143	70%	T3	OTH
Romania	1 898	901	952	5%	52	6%	-945	-50%	T2	CS,D
Slovakia	795	662	667	3%	5	1%	-128	-16%	T2	PS
Slovenia	201	59	56	0%	-2	-4%	-144	-72%	T3	CS
Spain	1 146	1 432	1 381	7%	-51	-4%	235	21%	D	D,PS
Sweden	331	479	415	2%	-64	-13%	84	25%	CS	D
United Kingdom	1 462	1 239	1 284	7%	45	4%	-178	-12%	T3	CS
EU-28	**25 706**	**19 815**	**19 718**	**100%**	**-96**	**0%**	**-5 988**	**-23%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**25 706**	**19 815**	**19 718**	**100%**	**-96**	**0%**	**-5 988**	**-23%**		

Emissions of the Netherlands are included in 2D2 Food industries.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.6 shows information on methods applied and emission factors for CO_2 emissions from 2A2 Lime production for 1990 to 2014. All countries that report emissions from lime production use lime production as activity data for calculating CO_2 emissions. The average IEF in 2014 is 0.71 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced range from 0.45 for UK to 0.87 for Greece. Nineteen MS estimate emissions using higher tier methodologies (country-specific emission factors and/or Tier 2 and Tier 3) which accounts for more than 76 % of emissions from this category.

Table 4.6 2A2 Lime production: Information on methods applied, activity data, emission factors for CO_2 emissions

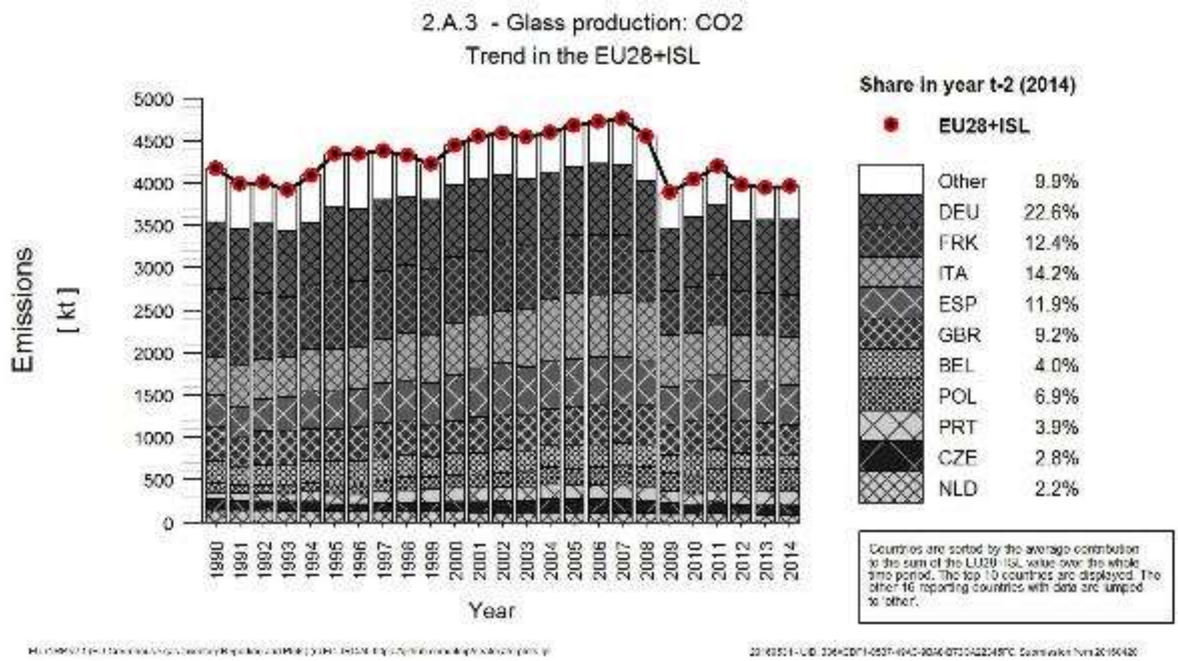
Member State	Method applied	Emission factor	1990				2014			
			Activity data		Implied emission factor (t/t)	CO_2 emission (kt)	Activity data		Implied emission factor (t/t)	CO_2 emissions (kt)
			Description	(kt)			Description	(kt)		
Austria	-	-	Lime Production	513	0.77	396	Lime Production	787	0.75	589
Belgium	T3	PS	Lime Production	2660	0.79	2097	Lime Production	2110	0.78	1642
Bulgaria	T2	D	-	490	0.80	390	-	261	0.78	204
Croatia	T2	CS	Lime Production	232	0.66	153	Lime Production	123	0.58	71
Cyprus	T1	D	Lime Production	7	0.75	5	Lime Production	3	0.75	3
Czech Republic	T3	PS	Lime Production	1823	0.73	1337	Lime Production	814	0.77	629
Denmark	T1	D	Lime Production	134	0.79	105	Lime Production	74	0.79	58
Estonia	T2	PS	Lime Production	185	0.70	130	Lime Production	49	0.70	34
Finland	T2	CS	Lime Production	488	0.78	383	Lime Production	492	0.79	386
France	-	-	Lime Production	3589	0.76	2743	Lime Production	3268	0.66	2150
Germany	T2	D	Lime Production	7927	0.76	5987	Lime Production	6629	0.75	4973
Greece	CS	PS	Lime Production	491	0.82	404	Lime Production	336	0.87	293
Hungary	CS	CS	Lime Production	831	0.74	614	Lime Production	190	0.74	141
Ireland	T3	PS	Lime Production	255	0.84	214	Lime Production	258	0.73	189
Italy	T2	CS,PS	Lime Production	2583	0.73	1877	Lime Production	2562	0.72	1841
Latvia	T1,T2,T3	D,PS	Lime Production	225	0.66	149	Lime Production	1	0.55	0
Lithuania	T2	D	Lime Production	288	0.77	223	Lime Production	53	0.77	41
Luxembourg	NA	NA	Lime Production	NO	NO	NO	Lime Production	NO	NO	NO
Malta	NA	NA	Lime Production	2	0.75	1	Lime Production	NO	NO	NO
Netherlands	NA	NA	-	NE	NO,IE	IE	-	NE	NO,IE	IE
Poland	T1	D	Lime Production	3464	0.71	2461	Lime Production	1886	0.73	1372
Portugal	T3	OTH	-	298	0.68	203	-	521	0.66	346
Romania	T2	CS,D	Lime Production	2414	0.79	1898	Lime Production	1233	0.77	952
Slovakia	T2	PS	Lime Production	1076	0.74	795	Lime Production	853	0.78	667
Slovenia	T3	CS	Lime Production	275	0.73	201	Lime Production	76	0.74	56
Spain	D	D,PS	Lime Production	1601	0.72	1146	Lime Production	1902	0.73	1381
Sweden	CS	D	Lime Production	439	0.75	331	Lime Production	556	0.75	415
United Kingdom	T3	CS	Lime Production	3282	0.45	1462	Lime Production	2881	0.45	1284
EU-28				**35573**	**0.72**	**25706**		**27919**	**0.71**	**19718**
Iceland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
EU-28+ISL				**35573.2**	**0.72**	**25706**		**27919**	**0.71**	**19718**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.3 2A3 Glass production

CO_2 emissions from 2A3 Glass production contributed less than 0.1% of total EU 28+ISL (without LULUCF) emissions in 2014. Emissions from glass production in 2014 were 5 % lower than 1990 levels. Between 1990 and 2007, CO_2 emissions from this source increased by 14 %. In 2014 emissions were 17 % lower than the 2007 peak (Figure 4.6).

Figure 4.6 2A3 Glass production: EU-28+ISL CO_2 emissions



In 2014, Germany was responsible for 23 %, Italy for 14 % and France for 12 % of the emissions from this source. The largest absolute reduction in annual emissions compared to 1990 has been seen in France (-305 kt or -38%),

Table 4.7 2A3 Glass production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	39	39	37	1%	-2	-5%	-1	-4%	-	-
Belgium	266	165	157	4%	-8	-5%	-109	-41%	T3	CS,PS
Bulgaria	138	63	69	2%	6	10%	-70	-50%	T1	CS
Croatia	36	29	30	1%	1	3%	-5	-15%	T3	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	124	116	112	3%	-4	-3%	-12	-9%	T1	D
Denmark	20	7	8	0%	1	14%	-12	-60%	T3	D
Estonia	1	11	8	0%	-4	-32%	7	530%	T3	PS
Finland	21	2	3	0%	1	27%	-18	-88%	T3	CS
France	797	510	491	12%	-19	-4%	-305	-38%	-	-
Germany	780	860	894	23%	34	4%	113	15%	T2	CS
Greece	20	17	17	0%	0	1%	-3	-17%	CS	CS
Hungary	82	58	59	1%	1	2%	-23	-28%	CS	CS
Ireland	13	NO	NO	-	-	-	-13	-100%	NA	NA
Italy	453	546	562	14%	16	3%	108	24%	T2	CS,PS
Latvia	0	3	1	0%	-2	-71%	1	165%	T1,T2	D,PS
Lithuania	12	8	7	0%	-1	-9%	-4	-37%	T2	D
Luxembourg	54	43	61	2%	18	41%	8	14%	CS	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	142	84	86	2%	2	3%	-56	-39%	CS	CS
Poland	106	266	273	7%	8	3%	167	158%	T1	D
Portugal	84	157	156	4%	-1	0%	73	87%	T3	OTH
Romania	150	62	56	1%	-6	-10%	-94	-63%	T2	CS,D
Slovakia	8	13	12	0%	-1	-7%	4	56%	T3	PS
Slovenia	3	9	9	0%	0	-3%	5	167%	T3	D
Spain	374	474	471	12%	-3	-1%	97	26%	D	CS,D,PS
Sweden	45	17	16	0%	0	-2%	-28	-64%	CS	CS,D
United Kingdom	408	390	366	9%	-24	-6%	-43	-10%	T3	CS
EU-28	**4 177**	**3 949**	**3 961**	**100%**	**12**	**0%**	**-216**	**-5%**		
Iceland	NO	NO	0	0%	0	0%	-	-	-	-
EU-28 + ISL	**4 177**	**3 949**	**3 961**	**100%**	**12**	**0%**	**-216**	**-5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.8 provides information on the methods applied, activity data, and the emissions factors for CO_2 emissions from 2A3 Glass production for 1990 to 2014. The table shows that almost all MS 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 largely 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 country's estimates are mostly composed by several sources with independent estimation methods, using partly higher tiers, partly default methods.

Table 4.8 2A3 Glass 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 emission (kt)	2014 Activity data Description	2014 Activity data (kt)	2014 Implied emission factor (t/t)	2014 CO_2 emissions (kt)
Austria	-	-	Glass Production	399	0.10	39	Glass Production	497	0.07	37
Belgium	T3	CS,PS	Glass Production	1971	0.14	266	Glass Production	1534	0.10	157
Bulgaria	T1	CS	-	818	0.17	138	-	508	0.14	69
Croatia	T3	CS	Glass Production	275	0.13	36	Glass Production	277	0.11	30
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	T1	D	Glass Production	1237	0.10	124	Glass Production	1119	0.10	112
Denmark	T3	D	Glass Production	200	0.10	20	Glass Production	192	0.04	8
Estonia	T3	PS	Glass Production	12	0.10	1	Glass Production	64	0.12	8
Finland	T3	CS	Used Carbonates	48	0.44	21	Used Carbonates	6	0.40	3
France	-	-	Glass Production	4307	0.19	797	Glass Production	2561	0.19	491
Germany	T2	CS	Glass Production	6562	0.12	780	Glass Production	7480	0.12	894
Greece	CS	CS	Glass Production	135	0.15	20	Glass Production	109	0.15	17
Hungary	CS	CS	Glass Production	418	0.20	82	Glass Production	457	0.13	59
Ireland	NA	NA	Carbonate Use	64	0.21	13	Carbonate Use	NO	NO	NO
Italy	T2	CS,PS	Glass Production	3779	0.12	453	Glass Production	4872	0.12	562
Latvia	T1,T2	D,PS	Glass Production	44	0.01	0	Glass Production	16	0.06	1
Lithuania	T2	D	Glass Production	66	0.18	12	Glass Production	52	0.14	7
Luxembourg	CS	PS	Glass Production	377	0.14	54	Glass Production	430	0.14	61
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	CS	CS	-	1095	0.13	142	-	1300	0.07	86
Poland	T1	D	Glass Production	1058	0.10	106	Glass Production	2732	0.10	273
Portugal	T3	OTH	-	614	0.14	84	-	1726	0.09	156
Romania	T2	CS,D	Glass Production	926	0.16	150	Glass Production	364	0.15	56
Slovakia	T3	PS	Used Carbonates	18	0.44	8	Used Carbonates	29	0.42	12
Slovenia	T3	D	Glass Production	25	0.13	3	Glass Production	67	0.13	9
Spain	D	CS,D,PS	Glass Production	3	130.67	374	Glass Production	4	107.08	471
Sweden	CS	CS,D	-	NE	NE	45	-	NE	NE	16
United Kingdom	T3	CS	Glass Production	1942	0.21	408	Glass Production	1846	0.20	366
EU-28				**26392**	**0.16**	**4177**		**28242**	**0.14**	**3961**
Iceland	-	-	-	NO	NO	NO	-	0	0.00	0
EU-28+ISL				**26391.775**	**0.16**	**4177**		**28242**	**0.14**	**3961**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.4 2A4 Other process uses of carbonates

CO_2 emissions from 2A4 Other process uses of carbonates contributed only 0.2% of total EU 28+ISL (without LULUCF) emissions in 2014. Emissions from this sector in 2014 were 18% lower than 1990 levels. It is not easy to compare specific shares of emissions due to the fact that country's estimates are mostly composed by several sources with independent estimation methods, using partly higher tiers, partly default methods.

Table 4.9 2A4 Other process uses of carbonates: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	624	434	454	4%	20	5%	-170	-27%
Belgium	136	170	174	2%	4	2%	38	28%
Bulgaria	647	751	797	7%	46	6%	150	23%
Croatia	6	31	32	0%	2	5%	26	457%
Cyprus	57	10	9	0%	-1	-6%	-47	-83%
Czech Republic	109	334	321	3%	-13	-4%	211	194%
Denmark	71	67	67	1%	0	0%	-4	-6%
Estonia	0	237	1	0%	-236	-100%	0	145%
Finland	63	170	167	2%	-2	-1%	104	165%
France	1 990	1 332	1 372	13%	41	3%	-618	-31%
Germany	867	572	537	5%	-35	-6%	-331	-38%
Greece	590	333	363	3%	30	9%	-226	-38%
Hungary	448	265	248	2%	-18	-7%	-200	-45%
Ireland	5	0	0	0%	0	12%	-5	-93%
Italy	2 537	975	854	8%	-121	-12%	-1 683	-66%
Latvia	69	9	11	0%	2	20%	-58	-84%
Lithuania	240	18	17	0%	-1	-5%	-222	-93%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	0	0	0	0%	0	-36%	0	-79%
Netherlands	690	719	770	7%	51	7%	81	12%
Poland	771	1 843	1 835	17%	-8	0%	1 064	138%
Portugal	546	468	347	3%	-121	-26%	-199	-36%
Romania	37	192	212	2%	20	11%	175	472%
Slovakia	447	322	331	3%	10	3%	-115	-26%
Slovenia	20	18	18	0%	0	0%	-2	-11%
Spain	1 358	906	990	9%	85	9%	-368	-27%
Sweden	36	23	20	0%	-2	-10%	-16	-44%
United Kingdom	641	773	698	7%	-74	-10%	58	9%
EU-28	**13 006**	**10 971**	**10 648**	**100%**	**-322**	**-3%**	**-2 358**	**-18%**
Iceland	1	1	1	0%	0	-1%	0	-20%
EU-28 + ISL	**13 007**	**10 971**	**10 649**	**100%**	**-322**	**-3%**	**-2 358**	**-18%**

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:

2 B 1 Ammonia Production: no classification (CO_2)

2 B 2 Nitric Acid Production: no classification (N_2O)

2 B 3 Adipic Acid Production: no classification (N_2O)

2 B 8 Petrochemical and Carbon Black Production: no classification (CO_2)

2 B 9 Fluorochemical Production: no classification (HFCs)

2 B 9 Fluorochemical Production: no classification (Unspecified mix of HFCs and PFCs)

The key category 2B1 Ammonia production accounts for the CO_2 emissions that occur during the production of ammonia, a chemical used as a feedstock for the production of several chemicals. The key category 2B2 Nitric acid production accounts for N_2O that emitted as a by-product of the high temperature catalytic oxidation of ammonia (NH_3) in the production of nitric acid. The key category 2B3 Adipic acid production emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid. The key category Petrochemical and Carbon Black Production (2B8) includes the CO_2 emissions associated with a wide range of petrochemicals including methanol and ethylene and carbon black manufacture.

Figure 4.7 shows chemical industry CO_2 emissions while Table 4.10 presents summary information as CO_2, N_2O, CH_4 and total emissions as CO_2 equivalents. Ammonia production accounts for more than half of the chemical industry's CO_2 emissions.

Figure 4.7 2B Chemical industry CO_2 emissions

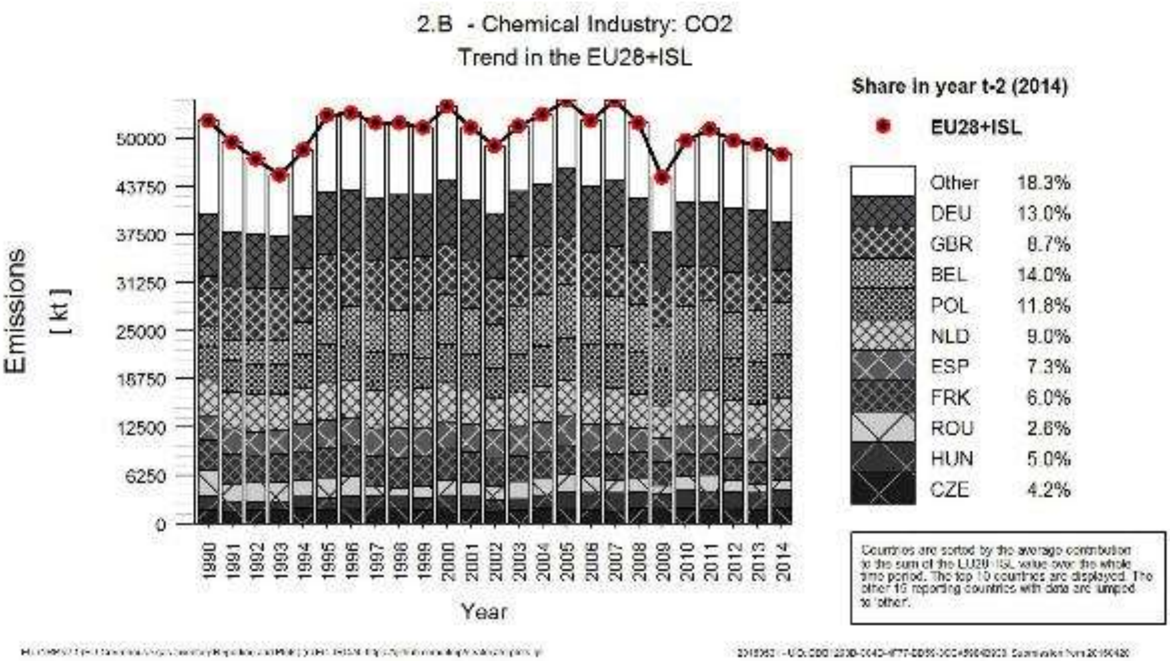


Table 4.10 summarises information on emissions from the chemical industry in 1990 and 2014 for CO_2, CH_4, N_2O and total CO_2e. Between 1990 and 2014 CO_2e emissions from the chemical industry sector decreased markedly largely due to the significant reduction in N_2O emissions which fell by 93%. The greatest absolute decreases in N_2O emissions were in UK, France and Germany.

Table 4.10 2B Chemical industry: EU-28+ISL CO_2, N_2O, CH_4 and total emissions as CO_2 equivalents

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	1 555	810	643	715	877	48	35	47
Belgium	10 057	8 168	2 590	6 692	3 788	1 168	0	9
Bulgaria	4 541	1 592	2 889	1 468	1 647	125	5	0
Croatia	1 532	801	772	534	754	266	6	0
Cyprus	0	0	NO	NO	NO	NO	NO	NO
Czech Republic	2 944	2 373	1 783	1 989	1 125	330	36	53
Denmark	1 003	1	1	1	1 003	NA,NO	NA,NO	NA,NO
Estonia	304	0	304	NO	NO	NO	NO	NO
Finland	1 862	982	270	777	1 592	205	NO,NA	NA,NO
France	33 408	4 136	3 985	2 894	23 648	1 039	79	51
Germany	35 681	7 622	8 109	6 249	21 557	747	334	484
Greece	2 931	596	681	569	1 066	27	1	NA,NO
Hungary	4 867	2 494	1 759	2 388	3 090	64	18	42
Ireland	1 986	0	990	NO	995	NO	NO	NO
Italy	10 546	2 939	2 577	1 416	6 418	112	61	6
Latvia	0	0	NO	NO	NO	NO	NO	NO
Lithuania	2 178	2 207	1 280	1 875	893	332	5	NO
Luxembourg	0	0	NO	NO	NO	NO	NO	NO
Malta	0	0	NO	NO	NO	NO	NO	NO
Netherlands	17 531	6 043	4 713	4 322	6 825	1 230	387	419
Poland	7 944	6 440	4 368	5 663	3 536	728	40	48
Portugal	1 152	86	640	21	498	54	14	10
Romania	7 494	1 681	3 309	1 266	4 135	405	50	10
Slovakia	2 020	1 365	878	1 219	1 142	145	0	0
Slovenia	70	47	66	47	NO	NO	4	NA,NO
Spain	9 104	4 206	3 145	3 473	2 788	425	131	150
Sweden	906	188	102	125	803	62	1	1
United Kingdom	44 792	4 430	6 377	4 181	23 797	42	214	102
EU-28	**206 406**	**59 206**	**52 230**	**47 885**	**111 976**	**7 556**	**1 422**	**1 432**
Iceland	47	0	0	NE,NA,NO,IE	46	NO	NO,NE	NE,NO,IE
EU-28 + ISL	**206 453**	**59 206**	**52 230**	**47 885**	**112 022**	**7 556**	**1 422**	**1 432**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.11 and Table 4.12 lists information on recalculations in CO_2 from 2B Chemical industry for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 4.11 2B Chemical Industry: Contribution of MS to EU recalculations of N_2O emissions for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Belgium	-2.5	-0.1	0.0	0.0	Small corrections of process emissions of CH_4 from 2004 on (category 2B10a). Re-allocation of emissions of 1 company of the chemical sector from category 2H3 (other) to 2B10a (chemical industry) before.
Croatia	0.0	0.0	0.0	0.0	Small corrections for 2B2 Nitric acid production - new data for verified emissions has been included.
France	0.0	0.0	2.4	0.3	
Germany	0.0	0.0	2.4	0.3	
Netherlands	3.1	0.0	-51.9	-4.2	The N_2O emissions from caprolactam production have been recalculated for the entire time series based on a consultation with the production company.
Portugal	0.0	0.0	-8.4	-14.6	Revision of Nitric Acid (2B2) N_2O emissions based on ETS data.
EU28+ISL	0.7	0.0	-55.4	-0.7	

Table 4.12: 2B Chemical Industry: Contribution of MS to EU recalculations of CO_2 emissions for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Belgium	0	0.0	181	2.8	- Small corrections of procesemissions of CH_4 from 2004 on (category 2B10a). - Completeness of emissions and activity data of the timeseries for the years 1992 and 1993 in the category 2B1 (production of NH_3). - Re-allocation of emissions of 1 company of the chemical sector from category 2H3 (other) to 2B10a (chemical industry) before.
Bulgaria	9	0.3	14	1.0	2.B.7: A mistake in the calculation file is found, wrong EFs - CO_2/CaCO3 and CO_2/MgCO3 are used. For 2016 submission they are corrected - CO_2/CaO and CO_2/MgO.
Croatia	0	0.0	0	0.0	2C1a Steel production - New data for verified emission has been included.
Czech Republic	0	0.0	215	13.9	updated activity data available, explanation provided in NIR
Denmark	0	0.0	0	1.9	Corrections were made for the activity data for catalyst production for 1996, 2010 and 2013. These changes resulted in recalculations in the CO_2 emission for the three years of -8.8 %, +5.5 % and +1.9 %, respectively.
Estonia	-115	-27.5	-85	-55.4	CO_2 captured in urea that was exported, was subtracted.
Finland	1	0.4	2	0.2	The default correction factor from 2006 IPCC Guidelines was adopted
France	233	6.2	194	7.3	2.B.1, 2.B.7, 2.B.8,2.B.10 :Improved accuracy of inventory. 2.B.4: Changing the 2013 activity data following a site reporting error.
Germany	88	1.1	-1 030	-11.2	Adjustment of emission factor: The EF has increased from 14.89 kg/t product to 28.00 kg/t product, and thus the CO_2 emissions have increased by a factor of 1.88. The emission factor had to be adjusted because flare-emissions data became available for additional installations and because an error in calculation of flare emissions was corrected.
Lithuania	0	0.0	-1	-0.1	Correction of typing error
Netherlands	160	3.5	112	2.5	Minor errors in Handling activities (2B9a2) were detected and corrected for several years.
Portugal	-19	-2.9	-13	-14.9	Please see explanation provided below for indirect CO_2.
Spain	-12	-0.4	-65	-2.1	Para la presente edición, se ha podido disponer de nueva información relativa al reparto de las producciones entre los diferentes procesos de fabricación empleados en las actividades 2B8d y 2B8f (producción de óxido de etileno y producción de negro de humo), así como estimaciones de emisiones de la propia planta productora de negro de humo desde 2007 en adelante. Esto ha permitido desglosar con mayor exactitud la variable de actividad (producción) entre los diferentes procesos contemplados por las Guías IPCC 2006, y aplicar los factores de emisión en unas proporciones que reflejen de una manera más fidedigna la realidad concreta del país.
United Kingdom	0	0.0	18	0.4	Revision to activity data used to derive EF from reported emissions for petroleum coke in the Chemical industry - titanium dioxide. Also due to a revision to petrochemical data for OPG in 2B8g.
EU28	346	0.7	-461	-0.9	
Iceland	0	0.0	0	0.0	
EU28+ISL	346	0.7	-461	-0.9	

4.2.2.1 2B1 Ammonia production

In most instances, anhydrous ammonia is produced by catalytic steam reforming of natural gas (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.

CO_2 emissions from ammonia production contributed 0.5 % of total EU-28+ISL emissions in 2014. Between 1990 and 2014, CO_2 emissions from this source decreased by 20%

Figure 4.8 2B1 Ammonia production: CO_2 emissions

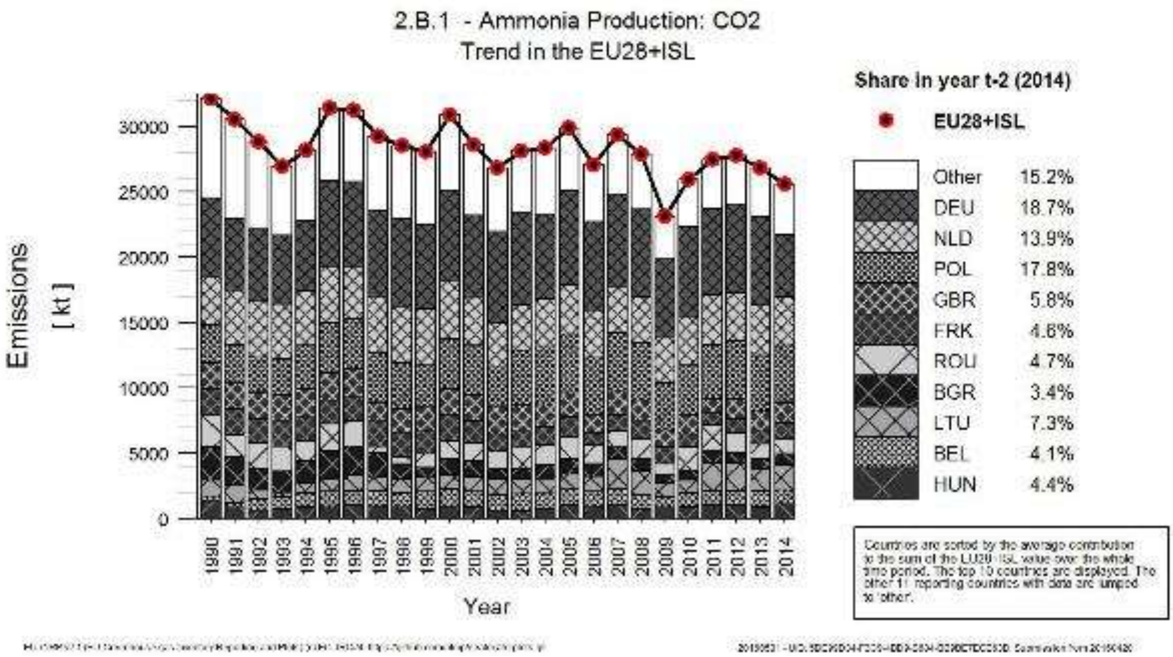


Figure 4.8 and Table 4.14 show that in 2014 Germany was responsible for 19% of this category’s emissions. The next largest contributors, Poland and Netherlands contribute 18% and 14% respectively. Bulgaria, Germany, Romania, Italy and Ireland all had large reductions in absolute terms between 1990 and 2014. 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 2014 were in Lithuania, Poland, Slovakia and Belgium.

Table 4.13 2B1 Ammonia production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	467	423	526	2%	103	24%	58	12%	-	-
Belgium	423	1 247	1 052	4%	-194	-16%	630	149%	T3	D,PS
Bulgaria	2 508	802	873	3%	70	9%	-1 635	-65%	T2	PS
Croatia	552	486	534	2%	48	10%	-18	-3%	T3	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	991	601	689	3%	88	15%	-302	-30%	T1	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	304	69	NO	-	-69	-100%	-304	-100%	NA	NA
Finland	93	NO	NO	-	-	-	-93	-100%	NA	NA
France	2 019	1 090	1 179	5%	89	8%	-840	-42%	-	-
Germany	6 025	6 739	4 797	19%	-1 942	-29%	-1 228	-20%	T3	PS
Greece	652	212	241	1%	29	14%	-411	-63%	T1a	CS
Hungary	1 255	875	1 121	4%	246	28%	-134	-11%	T3	D
Ireland	990	NO	NO	-	-	-	-990	-100%	NA	NA
Italy	1 892	643	711	3%	69	11%	-1 180	-62%	T2	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 256	1 672	1 875	7%	203	12%	619	49%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 730	3 760	3 564	14%	-196	-5%	-166	-4%	T1b	CS
Poland	2 910	4 403	4 565	18%	161	4%	1 655	57%	T2	CS
Portugal	569	NO	NO	-	-	-	-569	-100%	NA	NA
Romania	2 423	1 081	1 203	5%	122	11%	-1 220	-50%	T2	PS
Slovakia	332	674	530	2%	-145	-21%	198	60%	T3	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	709	652	673	3%	21	3%	-35	-5%	D	PS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	2 004	1 383	1 482	6%	99	7%	-522	-26%	T3	CS
EU-28	**32 104**	**26 812**	**25 616**	**100%**	**-1 196**	**-4%**	**-6 488**	**-20%**		
Iceland	NO	NO	0	0%	0	0%	-	-	-	-
EU-28 + ISL	**32 104**	**26 812**	**25 616**	**100%**	**-1 196**	**-4%**	**-6 488**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.14 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia production for 1990 to 2014. Not all countries show ammonia production as activity data for this emissions category. To derive the EU IEF gap filling was used to approximate the missing ammonia production activity. The table also shows that in 2014 about 70 % of ammonia production emissions are estimated with higher Tier methods.

Table 4.14 2B1 Ammonia production: Information on methods applied, activity data, emission factors for CO_2 emissions

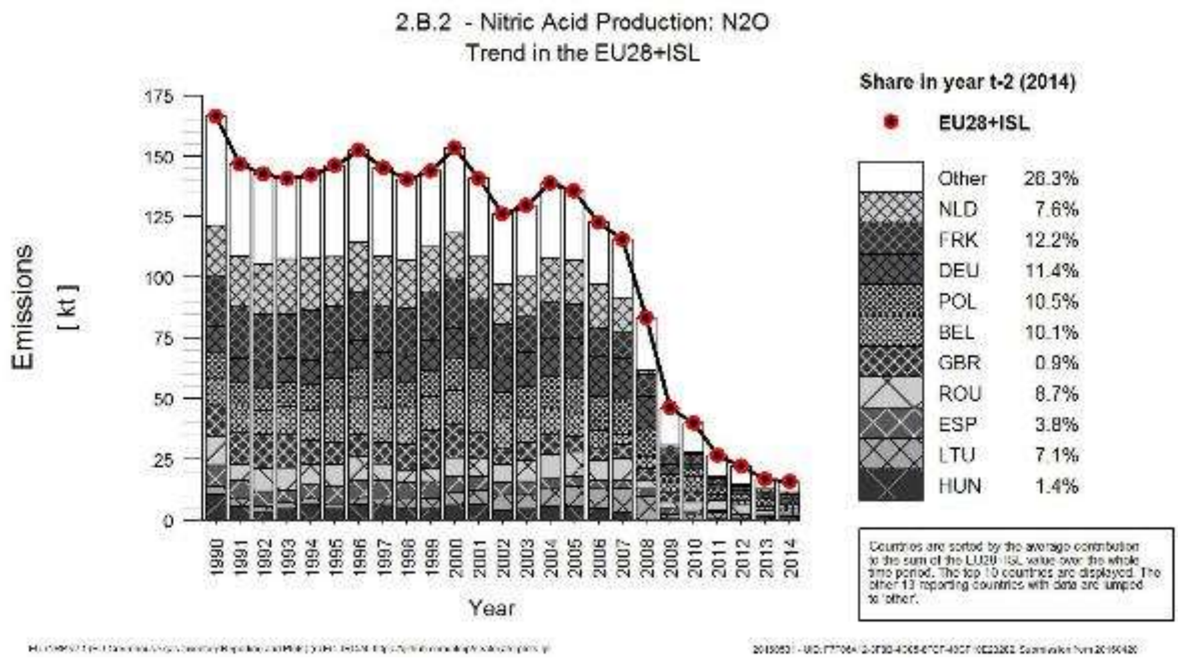
Member State	Method applied	Emission factor	1990				2014			
			Activity data		Implied emission factor (t/t)	CO_2 emission (kt)	Activity data		Implied emission factor (t/t)	CO_2 emissions (kt)
			Description	(kt)			Description	(kt)		
Austria	-	-	Ammonia Production	461	1.01	467	Ammonia Production	537	0.98	526
Belgium	T3	D,PS	Ammonia Production	360	1.17	423	Ammonia Production	922	1.14	1052
Bulgaria	T2	PS	-	C	C	2508	-	C	C	873
Croatia	T3	PS	Ammonia Production	345	2.24	552	Ammonia Production	458	1.99	534
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	T1	CS	Ammonia Production	336	3.27	991	Ammonia Production	211	3.27	689
Denmark	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Estonia	NA	NA	Ammonia Production	294	1.43	304	Ammonia Production	NO	NO	NO
Finland	NA	NA	Ammonia Production	28	3.27	93	Ammonia Production	NO	NO	NO
France	-	-	Ammonia Production	1928	1.05	2019	Ammonia Production	929	1.27	1179
Germany	T3	PS	Ammonia Production	2705	2.41	6025	Ammonia Production	2899	2.02	4797
Greece	T1a	CS	Ammonia Production	313	2.08	652	Ammonia Production	145	1.67	241
Hungary	T3	D	-	25334	0.06	1255	-	20636	0.06	1121
Ireland	NA	NA	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	NO	NO	NO
Italy	T2	PS	Ammonia Production	1455	1.30	1892	Ammonia Production	606	1.17	711
Latvia	NA	NA	Ammonia Production	NO	NO	NO	Ammonia Production	NO	NO	NO
Lithuania	T3	CS	Ammonia Production	568	2.27	1256	Ammonia Production	991	2.06	1875
Luxembourg	NA	NA	Ammonia Production	NO	NO	NO	Ammonia Production	NO	NO	NO
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	T1b	CS	-	C	C	3730	-	C	C	3564
Poland	T2	CS	Ammonia Production	1532	1.90	2910	Ammonia Production	2635	1.73	4565
Portugal	NA	NA	-	C	C	569	-	C	NA,NO	NO
Romania	T2	PS	Natural Gas Consumption	1511	1.60	2423	Natural Gas Consumption	729	1.65	1203
Slovakia	T3	PS	Ammonia Production	360	1.71	332	Ammonia Production	346	1.91	530
Slovenia	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Spain	D	PS	Ammonia Production	573	1.24	709	Ammonia Production	540	1.25	673
Sweden	NA	NA	-	NO	NO	NO	-	NO	NO	NO
United Kingdom	T3	CS	Ammonia Production	1328	1.51	2004	Ammonia Production	987	1.50	1482
EU-28				**39861**	**0.81**	**32104**		**33569**	**0.76**	**25616**
Iceland	-	-	-	NO	NO	NO	-	0	0.00	0
EU-28+ISL				**39861.2**	**0.81**	**32104**		**33569**	**0.76**	**25616**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.2 2B2 Nitric acid production

N_2O is emitted in the production of nitric acid as a by-product of the high temperature catalytic oxidation of ammonia (NH_3). Emissions have decreased by 91% since 1990 and all countries have had marked reductions from this source notably post 2007. N_2O emissions from nitric acid production contributed 0.1% of total EU 28+ISL (without LULUCF) emissions in 2014. (Figure **4.9** and Table 4.15). 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 4.9 2B2 Nitric acid production N_2O emissions



The substantial decrease in N_2O emissions since 2007 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 slowed between 2013 and 2014 with emissions decreasing by -5%. Eleven countries reported small emission increases in this period.

Table 4.15 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	877	48	48	1%	0	-1%	-829	-95%	-	-
Belgium	3 422	555	473	10%	-82	-15%	-2 948	-86%	T3	PS
Bulgaria	1 647	123	125	3%	1	1%	-1 523	-92%	T3	PS
Croatia	754	240	266	6%	26	11%	-488	-65%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 050	212	256	5%	44	21%	-795	-76%	T1	PS
Denmark	1 003	NO	NO	-	-	-	-1 003	-100%	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 592	211	205	4%	-6	-3%	-1 387	-87%	T3	PS
France	6 316	444	571	12%	127	29%	-5 745	-91%	-	-
Germany	3 258	483	535	11%	52	11%	-2 724	-84%	T3	PS
Greece	1 066	21	27	1%	6	30%	-1 039	-97%	CS	CS
Hungary	3 090	38	64	1%	26	67%	-3 025	-98%	CS	PS
Ireland	995	NO	NO	-	-	-	-995	-100%	NA	NA
Italy	2 005	112	53	1%	-59	-53%	-1 953	-97%	T2	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	893	336	332	7%	-4	-1%	-561	-63%	T3	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	6 085	274	356	8%	82	30%	-5 729	-94%	T2	PS
Poland	3 041	884	492	11%	-392	-44%	-2 549	-84%	T1	CS
Portugal	498	49	54	1%	5	11%	-443	-89%	D	PS
Romania	3 473	508	405	9%	-103	-20%	-3 068	-88%	T2,T3	D,PS
Slovakia	1 142	129	145	3%	15	12%	-997	-87%	T3	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	2 692	186	177	4%	-9	-5%	-2 515	-93%	T3	PS
Sweden	782	48	52	1%	4	8%	-730	-93%	NA	NA
United Kingdom	3 860	43	40	1%	-3	-6%	-3 820	-99%	T3	CS
EU-28	**49 541**	**4 944**	**4 675**	**100%**	**-269**	**-5%**	**-44 866**	**-91%**		
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**49 541**	**4 944**	**4 675**	**100%**	**-269**	**-5%**	**-44 866**	**-91%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.16 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric acid production for 1990 to 2014. The table shows that while most countries report nitric acid production as activity data; for some MS this information is confidential. The decrease of the IEF between 1990 and 2014 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 4.16 2B2 Nitric acid production: Information on methods applied, activity data, emission factors for N_2O emissions

			1990				2014			
Member State	**Method applied**	**Emission factor**	**Activity data**		**Implied emission factor (t/t)**	**N2O emissions (kt CO2 equiv.)**	**Activity data**		**Implied emission factor (t/t)**	**N2O emissions (kt CO2 equiv.)**
			Description	**(kt)**			**Description**	**(kt)**		
Austria	-	-	Nitric Acid Production	530	0.01	877	Nitric Acid Production	552	0.00	48
Belgium	T3	PS	Nitric Acid Production	1436	0.01	3422	Nitric Acid Production	2031	0.00	473
Bulgaria	T3	PS	-	C	C	1647	-	C	C	125
Croatia	T2	PS	Nitric Acid Production	332	0.01	754	Nitric Acid Production	307	0.00	266
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	T1	PS	Nitric Acid Production	530	0.01	1050	Nitric Acid Production	550	0.00	256
Denmark	NA	NA	-	450	0.01	1003	-	NO	NO	NO
Estonia	NA	NA	Nitric Acid Production	NO	NO	NO	Nitric Acid Production	NO	NO	NO
Finland	T3	PS	Nitric Acid Production	549	0.01	1592	Nitric Acid Production	632	0.00	205
France	-	-	Nitric Acid Production	3200	0.01	6316	Nitric Acid Production	1974	0.00	571
Germany	T3	PS	Nitric Acid Production	1698	0.01	3258	Nitric Acid Production	2601	0.00	535
Greece	CS	CS	Nitric Acid Production	511	0.01	1066	Nitric Acid Production	182	0.00	27
Hungary	CS	PS	-	732	0.01	3090	-	740	0.00	64
Ireland	NA	NA	Nitric Acid Production	339	0.01	995	Nitric Acid Production	NO	NO	NO
Italy	T2	D,PS	Nitric Acid Production	1037	0.01	2005	Nitric Acid Production	443	0.00	53
Latvia	NA	NA	Nitric Acid Production	NO	NO	NO	Nitric Acid Production	NO	NO	NO
Lithuania	T3	PS	Nitric Acid Production	355437	0.00	893	Nitric Acid Production	1140746	0.00	332
Luxembourg	NA	NA	Nitric Acid Production	NO	NO	NO	Nitric Acid Production	NO	NO	NO
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	T2	PS	-	C	C	6085	-	C	C	356
Poland	T1	CS	Nitric Acid Production	1577	0.01	3041	Nitric Acid Production	2366	0.00	492
Portugal	D	PS	-	C	C	498	-	C	C	54
Romania	T2,T3	D,PS	Nitric Acid Production	1261	0.01	3473	Nitric Acid Production	1001	0.00	405
Slovakia	T3	PS	Nitric Acid Production	401	0.01	1142	Nitric Acid Production	580	0.00	145
Slovenia	NA	NA	Nitric Acid Production	NO	NO	NO	Nitric Acid Production	NO	NO	NO
Spain	T3	PS	Nitric Acid Production	1329	0.01	2692	Nitric Acid Production	662	0.00	177
Sweden	NA	NA	Nitric Acid Production	374	0.01	782	Nitric Acid Production	262	0.00	52
United Kingdom	T3	CS	Nitric Acid Production	2408	0.01	3860	Nitric Acid Production	1097	0.00	40
EU-28				**374131**	**0.13**	**49541**		**1156727**	**0.00**	**4675**
Iceland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
EU-28+ISL				**374131**	**0.13**	**49541**		**1156727**	**0.00**	**4675**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.3 2B3 Adipic acid production

Adipic acid production emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid. N_2O emissions from adipic acid production now account for only 0.01% of total EU 28+ISL (without LULUCF) emissions. Between 1990 and 2014, N_2O emissions from this source decreased by 99% (Figure 4.10 and Table **4.17**). Only France, Germany and Italy continue to 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 4.10 2B3 Adipic acid production N_2O emissions

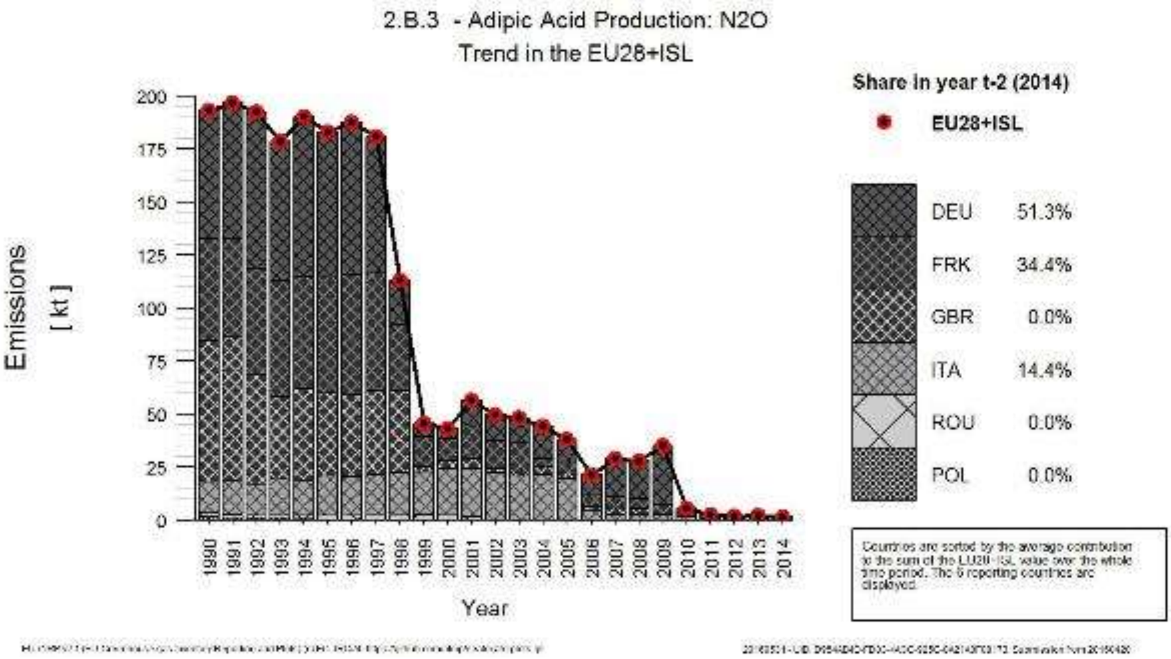


Table 4.17 2B3 Adipic acid production: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NA	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	157	142	34%	-15	-9%	-14 090	-99%	-	-
Germany	18 077	338	213	51%	-126	-37%	-17 864	-99%	T3	PS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4 402	110	59	14%	-51	-46%	-4 342	-99%	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%	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	552	NO	NO	-	-	-	-552	-100%	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	19 935	NO	NO	-	-	-	-19 935	-100%	NA	NA
EU-28	**57 555**	**605**	**414**	**100%**	**-191**	**-32%**	**-57 140**	**-99%**		
Iceland	NO	NO	0	0%	0	0%	-	-	-	-
EU-28 + ISL	**57 555**	**605**	**414**	**100%**	**-191**	**-32%**	**-57 140**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.18 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic acid production for 1990 to 2014. In 2014 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 0.03 t/t for 1990 and 0.02 t/t for 2014. In 2014 most emissions are estimated with higher Tier methods.

Table 4.18 2B3 Adipic acid production: methods, activity data, emission factors for N_2O emissions

			1990				2014			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	N2O emissions (kt CO2 equiv.)	Activity data		Implied emission factor (t/t)	N2O emissions (kt CO2 equiv.)
			Description	(kt)			Description	(kt)		
Austria	NA	NA	Adipic Acid Production	NO	NO	NO	Adipic Acid Production	NO	NO	NO
Belgium	NA	NA	-	NO	NA,NO	NA	-	NO	NO	NO
Bulgaria	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Croatia	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	NA	NA	Adipic Acid Production	NO	NO	NO	Adipic Acid Production	NO	NO	NO
Denmark	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Estonia	NA	NA	Adipic Acid Production	NO	NO	NO	Adipic Acid Production	NO	NO	NO
Finland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
France	-	-	Adipic Acid Production	C	C	14232	Adipic Acid Production	C	C	142
Germany	T3	PS	Adipic Acid Production	C	C	18077	Adipic Acid Production	C	C	213
Greece	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Hungary	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Ireland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Italy	T2	D,PS	Adipic Acid Production	49	0.30	4402	Adipic Acid Production	80	0.00	59
Latvia	NA	NA	Adipic Acid Production	NO	NO	NO	Adipic Acid Production	NO	NO	NO
Lithuania	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Luxembourg	NA	NA	Adipic Acid Production	NO	NO	NO	Adipic Acid Production	NO	NO	NO
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Poland	NA	NA	Adipic Acid Production	4	0.30	358	Adipic Acid Production	NO	NO	NO
Portugal	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Romania	NA	NA	Adipic Acid Production	6	0.30	552	Adipic Acid Production	NO	NO	NO
Slovakia	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Slovenia	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Spain	NA	NA	Adipic Acid Production	NO	NO	NO	Adipic Acid Production	NO	NO	NO
Sweden	NA	NA	-	NO	NO	NO	-	NO	NO	NO
United Kingdom	NA	NA	Adipic Acid Production	C	C	19935	Adipic Acid Production	NO	NO	NO
EU-28				**59**	**968.82**	**57555**		**80**	**5.18**	**414**
Iceland	-	-	-	NO	NO	NO	-	0	0.00	0
EU-28+ISL				**59**	**968.82**	**57555**		**80**	**5.18**	**414**

Note: Most 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'.

4.2.2.1 2B8 Petrochemical and carbon black production

Europe has a significant petrochemical industry, with production of all chemicals listed in the 2006 IPCC Guidelines. Seventeen countries report CO_2 emissions for at least part of the period 1990-2014 with this source being a key category of CO_2 emissions in terms of emissions level and trend for EU 28+ISL.

CO_2 emissions from 2B8 Petrochemical and carbon black production contributed 0.3% of total EU 28+ISL (without LULUCF) emissions in 2014. Between 1990 and 2014, CO_2 emissions from this source increased by 6%. United Kingdom, Belgium and Spain contribute the largest share of emissions. In the United Kingdom a series of site closures in recent years has reduced emissions by 41% since 1990. In Belgium emissions have more than doubled over the same period.

Figure 4.11 2B8 Petrochemical and carbon black production: EU-28+ISL CO_2 emissions

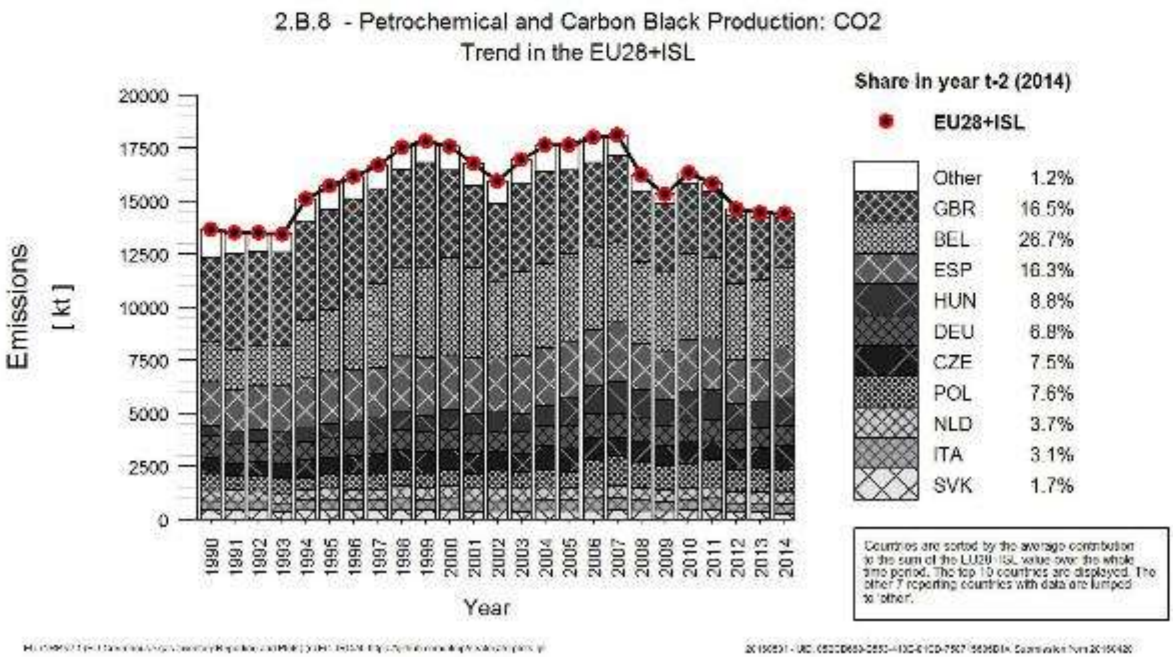


Table 4.19 2B8 Petrochemical and carbon black production CO_2

Member State	Emissions CO_2 kt			Share in EU-28+ISL in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO_2	%	kt CO_2	%
Austria	0	0	0	0%	0		0	
Belgium	1882	3738	3845	27%	107	3%	1962	104%
Bulgaria	0	0	0	0%	0		0	
Croatia	220	0	0	0%	0		-220	-100%
Cyprus	0	0	0	0%	0		0	
Czech Republic	792	945	1081	8%	136	14%	288	36%
Denmark	0	0	0	0%	0		0	
Estonia	0	0	0	0%	0		0	
Finland	0	0	0	0%	0		0	
France	370	190	170	1%	-21	-11%	-200	-54%
Germany	974	950	974	7%	24	3%	0	0%
Greece	29	0	0	0%	0		-29	-100%
Hungary	504	1271	1267	9%	-4	0%	762	151%
Ireland	0	0	0	0%	0		0	
Italy	422	425	453	3%	28	7%	31	7%
Latvia	0	0	0	0%	0		0	
Lithuania	24	0	0	0%	0		-24	-100%
Luxembourg	0	0	0	0%	0		0	
Malta	0	0	0	0%	0		0	
Netherlands	490	546	538	4%	-7	-1%	48	10%
Poland	806	1114	1098	8%	-16	-1%	292	36%
Portugal	51	55	0	0%	-55	-100%	-51	-100%
Romania	574	1	4	0%	3	200%	-570	-99%
Slovakia	429	331	251	2%	-80	-24%	-178	-42%
Slovenia	16	0	0	0%	0		-16	-100%
Spain	2018	1933	2356	16%	423	22%	338	17%
Sweden	0	0	0	0%	0		0	
United Kingdom	4036	2952	2375	16%	-577	-20%	-1661	-41%
EU-28	**13638**	**14450**	**14412**	**100%**	**-38**	**0%**	**774**	**6%**
Iceland	0	0	0	0%	0		0	
EU-28 + ISL	**13638**	**14450**	**14412**	**100%**	**-38**	**0%**	**774**	**6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.2 2B10 Other chemical industry

Thirteen countries report CO_2, CH_4 or N_2O emissions in this category which contributed 5.4 Mt of CO_2e in 2014 or 0.1% of total EU 28+ISL (without LULUCF) emissions in 2014. Between 1990 and 2014, CO_2 emissions from this source have more than doubled (Table 4.20 and Table 4.21) while CH_4 and N_2O emissions both more than halved. This category contains a wide range of emissions and sources as shown in Table 4.20.

Table 4.20 2B10 Other: CO_2, CH_4 and N_2O emissions for 1990 and 2014

Member State	2.B.10 Other	CO_2 emissions [kt]	CO_2 emissions [kt]	CH_4 emissions [kt]	CH_4 emissions [kt]	N_2O emissions [kt]	N_2O emissions [kt]
		1990	2014	1990	2014	1990	2014
AUT	10. Other (please specify)	138.56	143.04	0.29	0.29	NA	NA
	Other chemical bulk production	138.15	142.63	0.29	0.29	NA	NA
	CO2 from Nitric Acid Production	0.41	0.40	NA	NA	NA	NA
BEL	10. Other (please specify)	285.15	1794.65	NA	0.35	0.03	0.06
	Other non-specified	285.15	1794.65	NA	0.35	0.03	0.06
BGR	10. Other (please specify)	0	0	0	0	0	0
CYP	10. Other (please specify)	0	0	0	0	0	0
CZE	10. Other (please specify)	IE	219.52	NO	NO	NO	NO
	Non selective catalytic reduction	IE	14.77	NO	NO	NO	NO
	Other non energy use in chemical industry	IE	204.75	NO	NO	NO	NO
DEU	10. Other (please specify)	NA	NA	NA	NA	0	0
	Other	NA	NA	NA	NA	0	0
DNM	10. Other (please specify)	0.85	148	NA	NA	NA	NA
	Production of catalysts	0.85	148	NA	NA	NA	NA
ESP	10. Other (please specify)	NA	NA	NA	NA	NA	NA
	Other No-Specify	NA	NA	NA	NA	NA	NA
EST	10. Other (please specify)	NO	NO	NO	NO	NO	NO
FIN	10. Other (please specify)	177.28	777.13	NO	NO	NO	NO
	Chemicals Production	NO	NO	NO	NO	NO	NO
	Limestone and Dolomite Use	36.52	82.30	NO	NO	NO	NO
	Hydrogen Production	116.22	654.27	NO	NO	NO	NO
	Phosphoric Acid Production	24.54	40.55	NO	NO	NO	NO
FRK	10. Other (please specify)	1021.98	1170.85	0.04	0.06	1.76	0.62
GBR	10. Other (please specify)	NO	NO	7.43	2.71	0.01	0.00
	Chemical industry - other	NO	NO	7.43	2.71	0.01	0.00
GRC	10. Other (please specify)	NA,NO	328.08	NA	NA	NA	NA
	Hydrogen production	NO	328.08	NA	NA	NA	NA
	Sulfuric acid	NA	NA	NA	NA	NA	NA
HRV	10. Other (please specify)	NO	NO	NO	NO	NO	NO
HUN	10. Other (please specify)	NO	NO	NO	NO	NO	NO
IRL	10. Other (please specify)	0	0	0	0	0	0
ITA	10. Other (please specify)	IE	IE	IE,NA	NA,IE	IE,NA	NA,IE
	Soda Ash (CO emissions only)	IE	IE	NA	NA	NA	NA
	other (indirect emissions)	IE	IE	IE	IE	IE	IE
LTU	10. Other (please specify)	NO	NO	NO	NO	NO	NO
	Sulfuric acid production	NO	NO	NO	NO	NO	NO
LUX	10. Other (please specify)	NO	NO	NO	NO	NO	NO
LVA	10. Other (please specify)	NO	NO	NO	NO	NO	NO
MLT	10. Other (please specify)	NO	NO	NO	NO	NO	NO
NLD	10. Other (please specify)	429.00	219.54	NO	NO	NO	NO
	Other process emissions	429.00	219.54	NO	NO	NO	NO
POL	10. Other (please specify)	NO	NO	NO	NO	NO	NO
PRT	10. Other (please specify)	19.73	21.21	NA,NO	NA,NO	NA,NO	NA,NO
	2.B.10.a Sulphuric Acid	NA	NA	NA	NA	NA	NA
	2.B.10.c Explosives	NA	NA	NA	NA	NA	NA
	2.B.10.b Ammonium Sulphate	NO	NO	NA	NA	NA	NA
	2.B.10.d Solvent use in plastic products manufact	19.73	21.21	NO	NO	NO	NO
ROU	10. Other (please specify)	NO	NO	NO	NO	NO	NO
	Other - non-specified	NO	NO	NO	NO	NO	NO
SVK	10. Other (please specify)	116.99	353.04	0.00	0.01	0.00	0.00
	Hydrogen Production	116.99	353.04	0.00	0.01	0.00	0.00
SVN	10. Other (please specify)	NO	NO	NO	NO	NO	NO
SWE	10. Other (please specify)	90.08	113.91	0.03	0.03	0.07	0.04
	Sulphuric acid production	NA	NA	NA	NA	NA	NA
	Other inorganic chemical products	52.40	67.40	0.00	0.00	0.01	0.00
	Base chemicals for plastic industry	NA	NA	NE	NE	0.01	NE
	Other organic chemical products	37.68	46.51	0.03	0.03	NA	NA
	Other non-specified	NA	NA	NE	NE	NE	NE
	Pharmaceutical industry	NA	NA	NE	NE	0.05	0.03
ISL	10. Other (please specify)	0.36	NE,NO	NE	NE	0.16	0.00
	Fertilizer production	NE	NE	NE	NE	0.16	0.00
	Silicium production	0.36	NO	0.00	0.00	0.00	0.00
EU-28	**10. Other (please specify)**	**2279.62**	**5142.45**	**7.79**	**3.45**	**1.87**	**0.72**
EU-28 + ISL	**10. Other (please specify)**	**2279.98**	**5142.45**	**7.79**	**3.45**	**2.03**	**0.72**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.20 provides an overview of change between 1990 and 2014 at an aggregated level. Due to the heterogeneity of emission sources in this category, it is not possible to interpret trends in a meaningful way Table **4.23** provides an overview of sources reported under this source category for 2014.

Table 4.21 2B10 Other: CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	139	128	143	3%	15	12%	4	3%
Belgium	285	1 739	1 795	35%	56	3%	1 509	529%
Bulgaria	-	-	-	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	IE	215	220	4%	5	2%	220	100%
Denmark	1	1	1	0%	0	7%	1	73%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	177	912	777	15%	-134	-15%	600	338%
France	1 022	1 234	1 171	23%	-63	-5%	149	15%
Germany	NA	NA	NA	-	-	-	-	-
Greece	NA,NO	305	328	6%	23	8%	328	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	429	217	220	4%	3	1%	-209	-49%
Poland	NO	NO	NO	-	-	-	-	-
Portugal	20	21	21	0%	0	0%	1	8%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	117	369	353	7%	-16	-4%	236	202%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	90	119	114	2%	-5	-4%	24	26%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**2 280**	**5 260**	**5 142**	**100%**	**-117**	**-2%**	**2 863**	**126%**
Iceland	0	NE,NO	NE,NO	-	-	-	-	-
EU-28 + ISL	**2 280**	**5 260**	**5 142**	**100%**	**-117**	**-2%**	**2 863**	**126%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.22 2B10 Other: N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NA	NA	NA	-	-	-	-	-
Belgium	9	17	18	9%	2	10%	9	105%
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	106	185	86%	79	75%	-341	-65%
Germany	-	-	-	-	-	-	-	-
Greece	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-
Italy	IE,NA	IE,NA	NA,IE	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Portugal	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	0	0	0	0%	0	-5%	0	209%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	21	7	10	5%	4	58%	-10	-50%
United Kingdom	2	2	1	1%	0	-20%	-1	-32%
EU-28	**557**	**131**	**215**	**100%**	**84**	**64%**	**-342**	**-61%**
Iceland	46	0	0	0%	0	-	-46	-100%
EU-28 + ISL	**604**	**131**	**215**	**100%**	**84**	**64%**	**-389**	**-64%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.23 provides an overview of all sources reported under 2B10 Other Chemical Industry for the year 2014 and for all gases. The largest contributors to the total emissions are France and Finland.

Table 4.23 2B10 Other: Overview of sources reported under this source category for 2014

Member State	2.B.10 Other Chemical Industry	CO2 emissions [kt]	CH4 emissions [kt]	N2O emissions [kt]	Total emissions [kt CO2 equivalents]	Share in EU-28 Total
Austria	10. Other (please specify), Other chemical bulk production, CO2 from Nitric Acid Production	143	0	NA	150	3%
Belgium	10. Other (please specify), Other non-specified	1795	0	0	1822	33%
Bulgaria	10. Other (please specify)				-	-
Croatia	10. Other (please specify)	NO	NO	NO	-	-
Cyprus	10. Other (please specify)				-	-
Czech Republic	10. Other (please specify), Non selective catalytic reduction, Other non energy use in chemical industry	220	NO	NO	220	4%
Denmark	10. Other (please specify), Production of catalysts	1	NA	NA	1	0.03%
Estonia	10. Other (please specify)	NO	NO	NO	-	-
Finland	10. Other (please specify), Chemicals Production, Limestone and Dolomite Use, Hydrogen Production, Phosphoric Acid Production	777	NO	NO	777	14%
France	10. Other (please specify)	1171	0	1	1357	25%
Germany	10. Other (please specify), Other	NA	NA		-	-
Greece	10. Other (please specify), Hydrogen production, Sulfuric acid	328	NA	NA	328	6%
Hungary	10. Other (please specify)	NO	NO	NO	-	-
Ireland	10. Other (please specify)				-	-
Italy	10. Other (please specify), Soda Ash (CO emissions only), other (indirect emissions)	IE	NA,IE	NA,IE	-	-
Latvia	10. Other (please specify)	NO	NO	NO	-	-
Lithuania	10. Other (please specify), Sulfuric acid production	NO	NO	NO	-	-
Luxembourg	10. Other (please specify)	NO	NO	NO	-	-
Malta	10. Other (please specify)	NO	NO	NO	-	-
Netherlands	10. Other (please specify), Other process emissions	220	NO	NO	220	4%
Poland	10. Other (please specify)	NO	NO	NO	-	-
Portugal	10. Other (please specify), 2.B.10.a Sulphuric Acid, 2.B.10.c Explosives, 2.B.10.b Ammonium Sulphate, 2.B.10.d Solvent use in plastic products manufacturing	21	NA,NO	NA,NO	21	0.4%
Romania	10. Other (please specify), Other - non-specified	NO	NO	NO	-	-
Slovakia	10. Other (please specify), Hydrogen Production	353	0	0	353	6%
Slovenia	10. Other (please specify)	NO	NO	NO	-	-
Spain	10. Other (please specify), Other No-Specify	NA	NA	NA	-	-
Sweden	10. Other (please specify), Sulphuric acid production, Other inorganic chemical products, Base chemicals for plastic industry, Other organic chemical products, Other non-specified, Pharmaceutical industry	114	0	0	125	2%
Great Britain	10. Other (please specify), Chemical industry - other	NO	3	0	-	-
EU 28 - Total		**5142**	**3**	**1**	**5444**	**100%**
Island	10. Other (please specify), Fertilizer production, Silicium production	NE,NO	NE		-	-
EU 28+ISL - Total		**5142**	**3**	**1**	**5444**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.3 Non-key sources

Emissions from the non key categories: 2B4 Caprolactam, glyoxal and glyoxylic acid production; 2B5 Carbide production; 2B6 Titanium dioxide production and 2B7 Soda ash production are grouped to for comparison. Table **4.24** allows identification of these emissions and the countries that contribute to these sources. Fourteen countries reported emissions from these categories which contributed 4.9 Mt of CO_2 equivalent or 0.1% of total EU 28+ISL (without LULUCF) emissions in 2014.

Table 4.24 Emissions from the non-key categories: 2B4, 2B5, 2B6 and 2B7.

Member State	Category	Emissions in kt CO2 (or CO2 equiv.)			Share total emissions in 2014	Change 2013-2014		Change 1990-2014	
		1990	2013	2014		kt CO2e	%	kt CO2e	%
Austria	2B5 Carbide production CO2	38	48	47	1%	-1	-3%	9	24%
Belgium	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	358	680	677	14%	-4	-1%	319	89%
Bulgaria	2B5 Carbide production CO2	72	9	8	0%	-1	-8%	-64	-89%
	2B7 Soda ash production CO2	309	518	587	12%	69	13%	278	90%
Czech Republic	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	75	75	75	2%	0	0%	0	0%
France	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	2573	149	141	3%	-8	-5%	-2433	-95%
	2B5 Carbide production CO2	159	21	20	0%	-1	-6%	-139	-87%
	2B7 Soda ash production CO2	400	283	341	7%	58	21%	-59	-15%
Germany	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	222	0	0	0%	0		-222	-100%
	2B5 Carbide production CO2	443	11	4	0%	-7	-60%	-439	-99%
	2B7 Soda ash production CO2	667	471	474	10%	3	1%	-193	-29%
Italy	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	11	0	0	0%	0		-11	-100%
	2B5 Carbide production CO2	26	5	5	0%	0	0%	-21	-81%
	2B6 Titanium dioxide production CO2	53	31	38	1%	7	24%	-15	-28%
	2B7 Soda ash production CO2	183	231	206	4%	-24	-10%	23	13%
Netherlands	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	740	898	874	18%	-24	-3%	134	18%
	2B7 Soda ash production CO2	64	0	0	0%	0		-64	-100%
Poland	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	137	226	237	5%	11	5%	99	72%
	2B5 Carbide production CO2	651	0	0	0%	0		-651	-100%
Romania	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	110	0	0	0%	0		-110	-100%
	2B5 Carbide production CO2	224	7	1	0%	-6	-90%	-224	-100%
	2B7 Soda ash production CO2	87	59	58	1%	-1	-1%	-29	-34%
Slovakia	2B5 Carbide production CO2	0	95	86	2%	-10	-10%	86	
	2B5 Carbide production CO2	34	0	0	0%	0		-34	-100%
	2B6 Titanium dioxide production CO2	16	45	47	1%	1	3%	31	193%
Spain	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	97	254	248	5%	-5	-2%	152	157%
	2B5 Carbide production CO2	76	61	58	1%	-3	-5%	-18	-23%
	2B6 Titanium dioxide production CO2	71	81	78	2%	-3	-4%	7	9%
	2B7 Soda ash production CO2	270	270	307	6%	37	14%	37	14%
Sweden	2B5 Carbide production CO2	12	11	11	0%	-1	-5%	-1	-9%
United Kingdom	2B6 Titanium dioxide production CO2	105	137	165	3%	28	20%	61	58%
	2B7 Soda ash production CO2	232	285	158	3%	-128	-45%	-74	-32%
Total		8513	4960	4949	100%	-11	0%	-3564	-42%

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 4.25 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2014, CO_2 emissions from 2C Metal Production decreased by approx. 45 %. The absolute decrease of CO_2 emissions was largest in Germany, Romania and Belgium.

Table 4.25 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	PFC emissions in 1990 (kt CO2 equivalents)	PFC emissions in 2014 (kt CO2 equivalents)	SF6 emissions in 1990 (kt CO2 equivalents)	SF6 emissions in 2014 (kt CO2 equivalents)
Austria	8 177	10 198	6 787	10 182	1 149	NO	242	16
Belgium	10 342	3 903	10 328	3 882	-	-	-	-
Bulgaria	1 439	40	1 413	40	-	-	-	-
Croatia	1 583	28	339	28	1 240	NO	NO	NO
Cyprus	0	0	NO	NO	-	-	-	-
Czech Republic	9 668	7 093	9 653	6 580	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	2 054	1 976	2 054	NO	0	NO	NA,NO
France	8 463	3 527	4 113	3 395	3 567	80	781	52
Germany	28 147	17 195	25 073	17 018	2 889	83	180	37
Greece	1 203	1 205	1 012	1 125	190	80	NO	0
Hungary	3 699	908	3 316	904	376	NO	NO	NO
Ireland	26	0	26	NO	NO	NO	NO	NO
Italy	5 921	1 457	3 878	1 405	1 975	NO	NO	NO
Latvia	53	0	53	0	NO	NO	NO	NO
Lithuania	17	3	17	3	NO	NO	NO	NO
Luxembourg	985	102	985	102	NO	NO	NO	NO
Malta	0	0	NO	NO	NO	NO	NO	NO
Netherlands	5 312	959	2 675	959	2 638	0	NO	NO
Poland	5 943	2 605	5 779	2 586	142	NA,NO	NA,NO	4
Portugal	114	78	109	62	-	-	-	-
Romania	13 848	3 367	11 372	3 357	2 455	6	NO	NO
Slovakia	4 901	4 553	4 586	4 540	315	11	NO	NO
Slovenia	551	207	343	191	208	15	-	-
Spain	4 587	3 390	3 397	3 310	1 164	62	NA,NO	NA,NO
Sweden	3 760	2 863	3 284	2 767	434	80	23	16
United Kingdom	9 399	5 039	7 404	4 861	1 553	43	387	102
EU-28	**130 171**	**70 772**	**107 945**	**69 351**	**20 294**	**459**	**1 642**	**227**
Iceland	841	1 744	347	1 645	495	99	NO,NA	NA
EU-28 + ISL	**131 013**	**72 517**	**108 292**	**69 351**	**20 789**	**558**	**1 642**	**227**

Figure 4.12: 2C Metal Industry CO_2 – Trend in EU-28

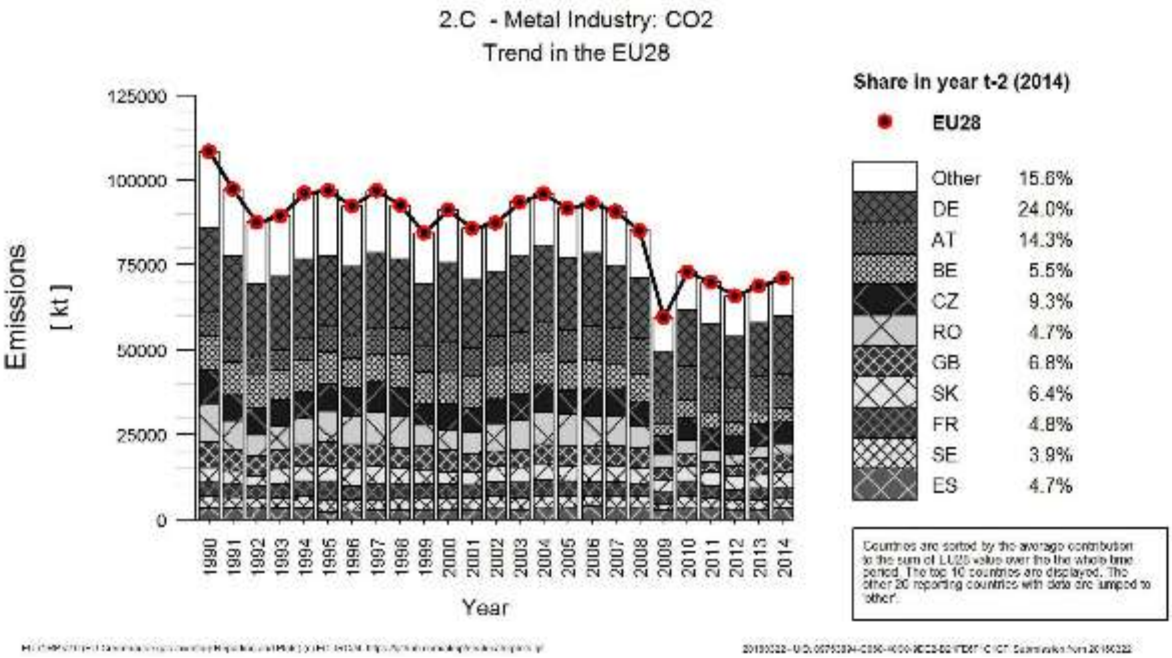


Table 4.25 provides information on the contribution of Member States to EU recalculations of CO_2 emissions from 2C Metal Production for 1990 and 2014, including main explanations.

Table 4.26: 2C Metal Production: Contribution of MS to EU recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.0	0.0	32.7	0.3	Revised energy balance
Belgium	-72.4	-0.7	-76.3	-1.9	Re-allocation between the energetic and the process emissions in the iron and steel sector
Bulgaria	0.0	0.0	0.0	0.0	
Croatia	0.0	0.0	0.0	0.2	2C1a Steel production - New data for verified emissions have been included.
Cyprus	0.0	0.0	0.0	0.0	
Czech Republic	0.0	0.0	-13.0	-0.2	Updated activity data available
Denmark	0.0	0.0	0.0	0.0	
Estonia	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.3	0.0	Correction of emission data
France	0.0	0.0	0.0	0.0	
Germany	0.0	0.0	709.5	4.7	Updated activity data available
Greece	12.2	1.2	2.8	0.3	Reallocation of CO_2 emitted from limestone use in the Iron and steel Industry from the "2.A.4 Other Process Uses of Carbonates" subsector to the "2.C.1 Iron and Steel Production"
Hungary	0.0	0.0	0.0	0.0	
Ireland	26.1	100.0	0.0	0.0	Activity and emission data in category 2.C.1 were updated.
Italy	0.0	0.0	284.0	23.8	Update of EAF emission factor

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Latvia	39.8	310.4	12.9	1 354.9	Recalculations have been done in all time series in sector 2.C.1 because data of used carburizators (coke, coke fine etc.) were allocated from Energy sector to IPPU.
Lithuania	2.4	16.6	0.1	3.3	In order to be in line with Tier 2 as described in the 2006 IPCC Guidelines and due to updated data CO_2 emissions were recalculated for the period 1990-2013.
Luxembourg	0.0	0.0	0.0	0.0	
Malta	0.0	0.0	0.0	0.0	
Netherlands	-39.0	-1.4	-16.0	-1.3	Activity data in category 2.C.1 were updated.
Poland	-258.0	-4.3	-164.8	-6.8	Introduction of country specific value for C content in blast furnace gas.
Portugal	-13.6	-11.1	-3.9	-5.9	In the previous submissions, indirect emissions had been allocated to this category. This has now been corrected.
Romania	0.0	0.0	-54.4	-1.6	An error in the data used in the calculation of CO_2 emissions from Aluminium Production was corrected (CRF Category 2.C.3).
Slovakia	0.0	0.0	0.0	0.0	
Slovenia	0.0	0.0	-18.3	-8.8	Improved data on Zinc and Lead production (2.C.5 and 6).
Spain	0.0	0.0	-29.7	-1.0	Emission data in category 2.C.2 were updated.
Sweden	38.0	1.2	102.1	3.7	Entire time series updated for 2.C.7 Other metal production due to previously missing emission sources. Minor corrections in 2C1a.
Great Britain	12.0	0.2	-18.5	-0.4	Decrease mostly due to a revision to blast furnace gas emission factor in 2C1b Pig iron. Also a small revision to coke activity data in sinter production.
EU28	-252.6	-0.2	749.4	1.1	
Iceland	0.0	0.0	6.9	0.4	Activity and emission data in categories 2.C.2, 2.C.3 and 2.C.5 were updated.
EU28+ISL	-252.6	-0.2	756.4	1.1	

Table **4.27** provides information on the contribution of Member States to EU recalculations of PFC emissions from 2C Metal Production for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 4.27: 2C Metal Production: Contribution of MS to EU recalculations in PFC for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Bulgaria	0.0	0.0	0.0	0.0	
Croatia	0.0	0.0	0.0	0.0	
Cyprus	0.0	0.0	0.0	0.0	
Czech Republic	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Estonia	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
France	0.0	0.0	0.0	0.0	
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Hungary	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Latvia	0.0	0.0	0.0	0.0	
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Malta	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Poland	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Romania	0.0	0.0	0.0	0.0	
Slovakia	0.0	0.0	0.0	0.0	
Slovenia	0.0	0.0	0.0	0.0	
Spain	143.8	14.1	22.5	51.0	Revised estimates of PFC emissions, based on the 2006 IPCC guidelines.
Sweden	0.0	0.0	0.0	0.0	
United Kingdom	0.0	0.0	0.0	0.0	
EU28	143.8	0.7	22.5	5.2	
Iceland	0.0	0.0	0.5	0.5	Emission data in category 2.C.3 were updated.
EU28+ISL	143.8	0.7	23.0	4.4	

Table **4.28** provides information on the contribution of Member States to EU recalculations of SF_6 emissions from 2C Metal Production for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 4.28: 2C Metal Production: Contribution of MS to EU recalculations in SF_6 for 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Bulgaria	0.0	0.0	0.0	0.0	
Croatia	0.0	0.0	0.0	0.0	
Cyprus	0.0	0.0	0.0	0.0	
Czech Republic	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Estonia	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	-5.0	-5.4	SF_6 emissions were updated due to the update of activity data reported from one site.
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Hungary	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Latvia	0.0	0.0	0.0	0.0	
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Malta	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Poland	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Romania	0.0	0.0	0.0	0.0	
Slovakia	0.0	0.0	0.0	0.0	
Slovenia	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
United Kingdom	0.0	0.0	-42.7	-29.2	Revision to emission factor - uses reported values rather than an estimate.
EU28	0.0	0.0	-47.7	-16.1	
Iceland	0.0	0.0	0.0	0.0	
EU28+ISL	0.0	0.0	-47.7	-16.1	

Relating to SF_6 emissions, the expert review team in the 2014 review of the inventory asked to provide, in the NIR, information on the emission trend from aluminium and magnesium foundries in Denmark. The trend of SF_6 emissions from magnesium foundries (reported under 2.C.4) follows the trend in magnesium production, which peaked in 1994 and went to zero in 2001. Magnesium production has not been occurring in Denmark since 2001. SF_6 emissions from aluminium production (2.C.3) are NO for the whole time series.

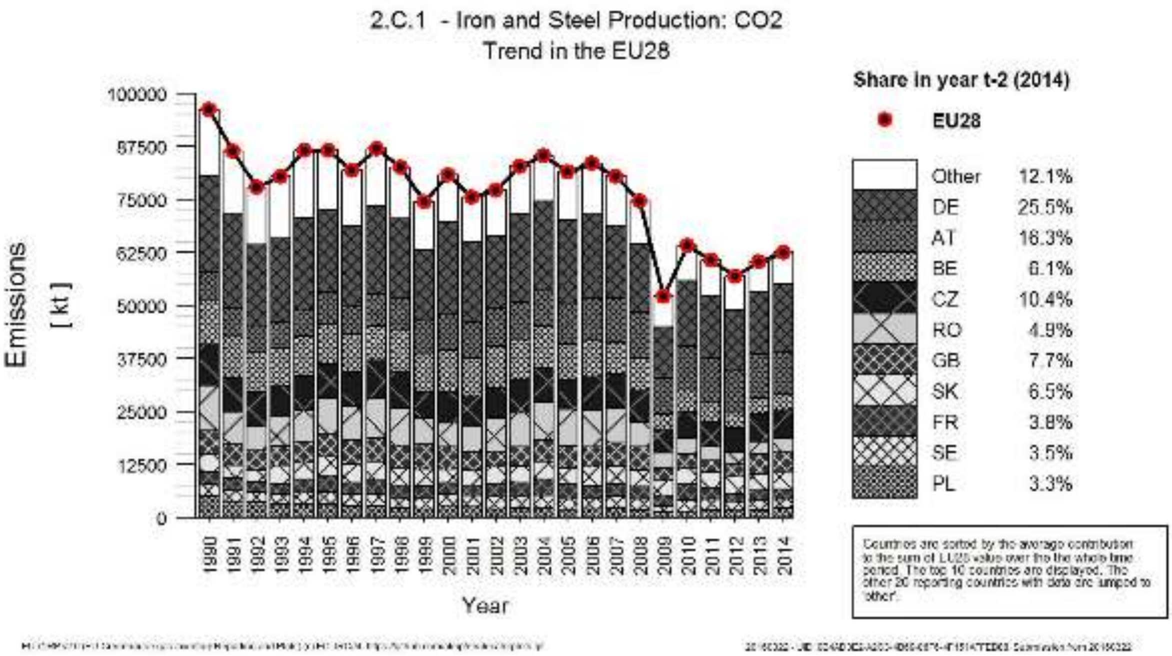
4.2.3.1 2C1 Iron and steel production

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 **4.30**.

CO_2 emissions from 2C1 Iron and Steel Production amounted to approx. 1.5 % of total GHG emissions (without LULUCF) in 2014. Germany accounts for 25 % of these emissions in the EU-28. Germany had the largest decrease in absolute terms between 1990 and 2014 while increases were encountered in Austria, Finland and (on a small scale) Slovenia.

The overall emission trend between 1990 and 2014 roughly follows the trend of emissions from Germany that fluctuates due to varying production figures. Between 1990 and 2014, overall CO_2 emissions from iron and steel production decreased by 35 % (Table 4.29). Between 2013 and 2014 emissions increased by 3.5 %.

Figure 4.13 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, as well as Iceland. All follow higher-tier methods and most use country or plant specific methods (see Table **4.29**).

Table 4.29 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2	%	kt CO2	%		
Austria	6 610	10 224	10 151	16%	-73	-1%	3 540	54%	NA	NA
Belgium	10 278	3 799	3 794	6%	-5	0%	-6 484	-63%	CS,T3	PS
Bulgaria	1 283	33	40	0%	8	23%	-1 243	-97%	T2	CS
Croatia	46	17	28	0%	11	68%	-18	-39%	NA,T2	CS,NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	9 643	6 543	6 499	10%	-44	-1%	-3 144	-33%	CS,T2	D,PS
Denmark	30	NO	NO	-	-	-	-30	-100%	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 967	2 074	2 032	3%	-41	-2%	65	3%	CS,T2,T3	CS
France	2 877	2 337	2 396	4%	59	3%	-481	-17%	NA	NA
Germany	22 810	14 687	15 914	25%	1 227	8%	-6 896	-30%	T2	CS
Greece	105	69	70	0%	1	2%	-35	-33%	CS,NA	NA,PS
Hungary	3 153	725	904	1%	179	25%	-2 249	-71%	NA,T3	NA,PS
Ireland	26	NO	NO	-	-	-	-26	-100%	NA	NA
Italy	3 124	1 441	1 381	2%	-60	-4%	-1 743	-56%	T2	CR,CS,PS
Latvia	53	14	0	0%	-14	-100%	-53	-100%	NA,T2	D,NA,PS
Lithuania	17	2	3	0%	0	5%	-14	-85%	T2	D
Luxembourg	985	102	102	0%	1	1%	-882	-90%	CS,NA,T2	CS,NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2 266	1 110	956	2%	-154	-14%	-1 311	-58%	T2	CS
Poland	5 085	1 697	2 078	3%	381	22%	-3 007	-59%	T2,T3	CS
Portugal	109	62	62	0%	0	0%	-47	-43%	T2	PS
Romania	10 781	2 933	3 038	5%	105	4%	-7 743	-72%	NA,T3	CS,NA
Slovakia	4 168	3 763	4 051	6%	288	8%	-117	-3%	T2,T3	PS
Slovenia	44	49	53	0%	3	7%	9	21%	NA,T2	NA,PS
Spain	2 428	1 482	1 895	3%	413	28%	-533	-22%	T2	CS,PS
Sweden	2 632	2 245	2 210	4%	-35	-2%	-422	-16%	CS,T2	PS
United Kingdom	5 595	4 927	4 797	8%	-130	-3%	-798	-14%	NA,T2	CS,NA
EU-28	**96 114**	**60 336**	**62 454**	**100%**	**2 118**	**4%**	**-33 660**	**-35%**		
Iceland	NO,NA	NO,NA	NA,NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**96 114**	**60 336**	**62 454**	**100%**	**2 118**	**4%**	**-33 660**	**-35%**		

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 emission factors and CO_2 emissions for the various Member States and sub-categories are provided in Table **4.30**.

Figure 4.14 2C1 Iron and Steel Production: Implied emission factors

1990					2014				
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**			10151
	Steel	3921	1.68	6591		Steel	7185	1.41	10111
	Pig Iron	3444	NO,IE	IE		Pig Iron	6015	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			20		Other			39
	Electric Furnace Steel			20		Electric Furnace Steel			39
Belgium	**Iron and steel production**			10278	Belgium	**Iron and steel production**			3794
	Steel	11570	0.75	8689		Steel	7420	0.50	3713
	Pig Iron	9415	NA,IE	IE		Pig Iron	4388	NA,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	13075	0.12	1589		Sinter	5041	0.02	76
	Pellet	660	NO,IE	IE		Pellet	NO	NO	NO
	Other			IE		Other			5
	Use of electrodes			IE		Use of electrodes			5
Bulgaria	**Iron and steel production**			1283	Bulgaria	**Iron and steel production**			40
	Steel	2180	0.59	1283		Steel	634	0.06	40
	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**			28
	Steel	171	0.27	46		Steel	175	0.16	28
	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**			6499
	Steel	8190	IE,NA	IE		Steel	5404	NA,IE	IE
	Pig Iron	6106	IE,NA	IE		Pig Iron	4170	NA,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	8469	IE,NA	IE		Sinter	5764	NA,IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			9643		Other			6499
	Metallurgical coke			9180		Metallurgical coke			5615
	Use of limestone and dolomite			462		Use of limestone and dolomite			884
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					2014			
Member State	Activity data		Implied emission factor	CO2 emissions	Member State	Activity data		Implied emission factor	CO2 emissions
	Description	(kt)	(t/t)	(kt)		Description	(kt)	(t/t)	(kt)
Finland	**Iron and steel production**			1967	**Finland**	**Iron and steel production**			2032
	Steel	2861	0.69	1967		Steel	3808	0.53	2032
	Pig Iron	NO	NO,IE	IE		Pig Iron	NO	IE,NO	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NA	IE,NO	IE		Sinter	NA	IE,NO	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
	Other non-specified			NO		Other non-specified			NO
France	**Iron and steel production**			2877	**France**	**Iron and steel production**			2396
	Steel	19073	0.09	1643		Steel	16368	0.07	1225
	Pig Iron	14088	0.09	1234		Pig Iron	10441	0.11	1171
	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**			15914
	Steel	43939	0.52	22810		Steel	42943	0.37	15914
	Pig Iron	32263	NO,IE	IE		Pig Iron	27945	NO,IE	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**			105	**Greece**	**Iron and steel production**			70
	Steel	999	0.10	105		Steel	1022	0.07	70
	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**			904
	Steel	2963	0.12	346		Steel	1152	0.12	134
	Pig Iron	1697	1.65	2427		Pig Iron	801	1.73	508
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	72	5.28	380		Sinter	49	5.35	262
	Pellet	IE	IE	IE		Pellet	IE	IE	IE
	Other			NO		Other			NO
Iceland	**Iron and steel production**			NO,NA	**Iceland**	**Iron and steel production**			NA,NO
	Steel	NO	NO,NA	NO		Steel	NO	NA,NO	NO
	Pig Iron	NO	NO,NA	NO		Pig Iron	NO	NA,NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO,NA	NO		Sinter	NO	NA,NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NA		Other			NA
Ireland	**Iron and steel production**			26	**Ireland**	**Iron and steel production**			NO
	Steel	326	0.08	26		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**			1381
	Steel	25467	0.05	1346		Steel	23715	0.04	833
	Pig Iron	11852	0.15	1778		Pig Iron	6371	0.09	548
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	13577	NA	NA		Sinter	8358	NA	NA
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

1990					2014				
Member State	Activity data		Implied emission factor	CO2 emissions	Member State	Activity data		Implied emission factor	CO2 emissions
	Description	(kt)	(t/t)	(kt)		Description	(kt)	(t/t)	(kt)
Latvia	**Iron and steel production**			53	Latvia	**Iron and steel production**			0
	Steel	550	0.10	53		Steel	0	0.11	0
	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
Lithuania	**Iron and steel production**			17	Lithuania	**Iron and steel production**			3
	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			17		Other			3
	Cast Iron			17		Cast Iron			3
Luxembourg	**Iron and steel production**			985	Luxembourg	**Iron and steel production**			102
	Steel	3506	0.12	404		Steel	2193	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	Malta	**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
Netherlands	**Iron and steel production**			2266	Netherlands	**Iron and steel production**			956
	Steel	5162	0.01	43		Steel	7013	0.00	25
	Pig Iron	NA	NO,IE	IE		Pig Iron	NA	NO,IE	IE
	Direct reduced iron	NA	NA	1		Direct reduced iron	NA	NA	0
	Sinter	NA	NO,IE	IE		Sinter	NA	NO,IE	IE
	Pellet	NA	NO,IE	IE		Pellet	NA	NO,IE	IE
	Other			2223		Other			931
	Other non specified			2223		Other non specified			931
Poland	**Iron and steel production**			5085	Poland	**Iron and steel production**			2078
	Steel	IE	IE	IE		Steel	IE	IE	IE
	Pig Iron	8657	0.14	1169		Pig Iron	4637	0.16	743
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	11779	0.07	841		Sinter	7389	0.05	363
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			3075		Other			972
	Open-hearth Steel			929		Basic Oxygen Furnace Steel			761
	Basic Oxygen Furnace Steel			2060		Open-hearth Steel			NO
	Electric Furnace Steel			85		Electric Furnace Steel			211
Portugal	**Iron and steel production**			109	Portugal	**Iron and steel production**			62
	Steel	621	0.07	41		Steel	2053	0.03	62
	Pig Iron	308	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	338	0.20	68		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

Member State	Activity data		Implied emission factor	CO2 emissions	Member State	Activity data		Implied emission factor	CO2 emissions
1990					**2014**				
	Description	(kt)	(t/t)	(kt)		Description	(kt)	(t/t)	(kt)
Romania	**Iron and steel production**			10781	**Romania**	**Iron and steel production**			3038
	Steel	9959	1.08	10781		Steel	3275	0.93	3038
	Pig Iron	5916	NO,IE	IE		Pig Iron	1631	NO,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	11357	NO,IE	IE		Sinter	2166	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**			4051
	Steel	3562	1.17	4150		Steel	4439	0.91	4025
	Pig Iron	17	NO,IE	IE		Pig Iron	24	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			26
	EAF production of steel			18		EAF production of steel			26
Slovenia	**Iron and steel production**			44	**Slovenia**	**Iron and steel production**			53
	Steel	632	0.07	44		Steel	649	0.08	53
	Pig Iron	NO	NO,NA	NO		Pig Iron	NO	NA,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
Spain	**Iron and steel production**			2428	**Spain**	**Iron and steel production**			1895
	Steel	13163	0.07	979		Steel	14341	0.05	677
	Pig Iron	C	C	246		Pig Iron	C	C	291
	Direct reduced iron	IE	IE,NA	IE		Direct reduced iron	IE	IE,NA	IE
	Sinter	C	C	538		Sinter	C	C	218
	Pellet	IE	IE,NA	IE		Pellet	IE	IE,NA	IE
	Other			666		Other			708
	Flaring in iron and steel production			666		Flaring in iron and steel production			708
Sweden	**Iron and steel production**			2632	**Sweden**	**Iron and steel production**			2210
	Steel	1755	0.09	156		Steel	1665	0.10	175
	Pig Iron	2736	0.77	2094		Pig Iron	3006	0.59	1763
	Direct reduced iron	109	1.19	129		Direct reduced iron	105	1.54	162
	Sinter	1058	0.20	212		Sinter	NO	NO	NO
	Pellet	9919	0.00	41		Pellet	23222	0.00	110
	Other					Other			
United Kingdom	**Iron and steel production**			5595	**United Kingdom**	**Iron and steel production**			4797
	Steel	17485	0.01	224		Steel	12032	0.01	156
	Pig Iron	12463	0.15	1837		Pig Iron	9705	0.19	1852
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	C	C	3534		Sinter	C	C	2788
	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 categories. 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 4.30.

Table 4.30 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 kt			Share in EU28+ISL emissions in 2014	Share 2C1
	1A2a	2C1	Combined		
Austria	1 715	10 151	11 865	7%	86%
Belgium	1 088	3 794	4 882	3%	78%
Bulgaria	117	40	158	0%	26%
Croatia	51	28	79	0%	36%
Cyprus	NO,IE	NO	-	-	-
Czech Republic	2 131	6 499	8 630	5%	75%
Denmark	83	NO	83	0%	-
Estonia	NO	NO	-	-	-
Finland	2 331	2 032	4 364	3%	47%
France	15 144	2 396	17 540	10%	14%
Germany	33 834	15 914	49 749	30%	32%
Greece	148	70	218	0%	32%
Hungary	183	904	1 087	1%	83%
Ireland	NO	NO	-	-	-
Italy	11 041	1 381	12 422	7%	11%
Latvia	1	0	1	0%	1%
Lithuania	NO	3	3	0%	100%
Luxembourg	271	102	373	0%	27%
Malta	IE	NO	-	-	-
Netherlands	3 597	956	4 553	3%	21%
Poland	5 675	2 078	7 753	5%	27%
Portugal	142	62	204	0%	30%
Romania	2 546	3 038	5 584	3%	54%
Slovakia	3 189	4 051	7 240	4%	56%
Slovenia	196	53	249	0%	21%
Spain	4 933	1 895	6 828	4%	28%
Sweden	1 267	2 210	3 477	2%	64%
United Kingdom	14 939	4 797	19 735	12%	24%
EU-28	**104624**	**62454**	**167078**	**100%**	**37%**
Iceland	1	NA,NO	-	-	-
EU-28 + ISL	**104625**	**62454**	**167078**	**100%**	**37%**

It can be seen that the ratio of emissions under 2C1 and combined emissions (see column "Share 2C1" in Table **4.30**) 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. 32 % 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 (76 %) 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 %), including combustion emissions during sinter production, is reported under 1A2a. Austria: 86 % 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 (89 %) 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: 75 % of emissions are reported under category 2C1. It also includes emissions from limestone and dolomite use.
- Slovakia: 56 % of emissions are reported under category 2C1. Combustion emissions during pig iron and steel production are reported in the energy sector.
- Poland: 73 % 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.

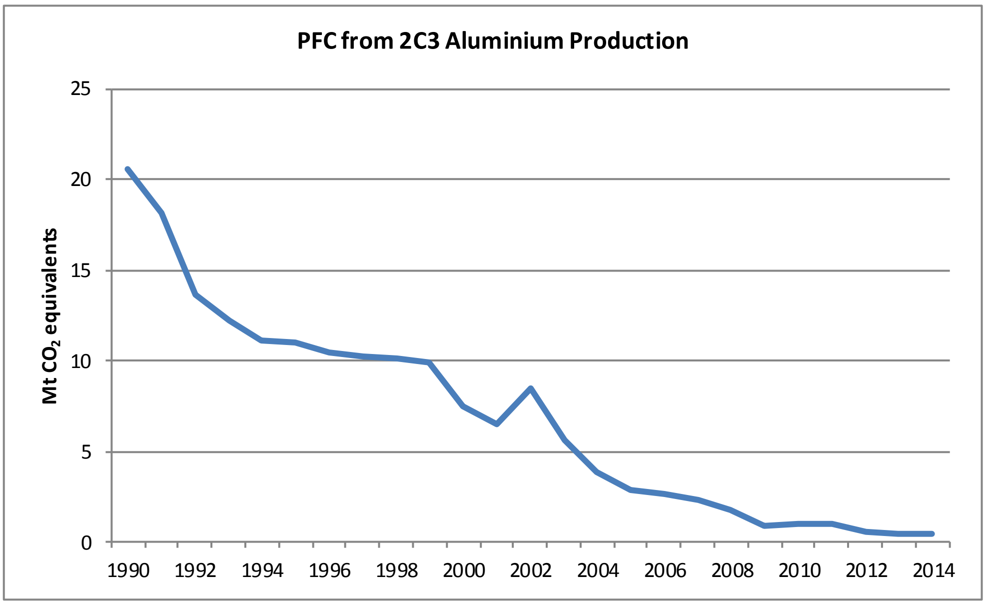
Table 4.31 summarises information by Member States on emission trends for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.01 % of total EU-28+ISL GHG emissions (without LULUCF) in 2014. Between 1990 and 2014, PFC emissions from this source decreased by 97 %. In 2014, Germany contributed the highest share among the EU-28+ISL, amounting to 15 % of overall emissions. Of the ten Member States reporting PFC emissions under this category in 2014, seven use plant or country-specifc emission factors.

Table 4.31 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		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	NA
Cyprus	-	-	-	-	-	-	-	-	-	-
Czech Republic	-	-	-	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	0	0%	0	0%	0	0%	NA	NA
Finland	NO	NO	0	0%	0	0%	0	0%	-	-
France	3 567	98	80	14%	-18	-18%	-3 487	-98%	NA	NA
Germany	2 889	108	83	15%	-25	-23%	-2 806	-97%	T3	CS
Greece	190	83	80	14%	-3	-4%	-111	-58%	NA,T3	NA,PS
Hungary	376	NO	NO	-	-	-	-376	-100%	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1 975	NO	NO	-	-	-	-1 975	-100%	NA	NA
Latvia	-	-	-	-	-	-	-	-	NA	NA
Lithuania	NO	NO	0	0%	0	0%	0	0%	-	-
Luxembourg	-	-	-	-	-	-	-	-	NA	NA
Malta	-	-	-	-	-	-	-	-	NA	NA
Netherlands	2 638	11	0	0%	-11	-100%	-2 638	-100%	T2	CS
Poland	142	NO	NO	-	-	-	-142	-100%	NA	NA
Portugal	-	-	-	-	-	-	-	-	-	-
Romania	2 455	6	6	1%	0	3%	-2 449	-100%	NA	NA
Slovakia	315	10	11	2%	1	14%	-304	-96%	T3	PS
Slovenia	208	15	15	3%	0	-1%	-192	-93%	NA,T3	CS,D,NA
Spain	1 164	67	62	11%	-5	-7%	-1 102	-95%	NA,T2	D,NA
Sweden	434	49	80	14%	31	62%	-354	-82%	-	-
United Kingdom	1 553	7	43	8%	36	513%	-1 511	-97%	T2	PS
EU-28	**20 294**	**453**	**459**	**82%**	**6**	**1%**	**-19 835**	**-98%**		
Iceland	495	88	99	18%	11	12%	-396	-80%	T2	D
EU-28 + ISL	**20 789**	**541**	**558**	**100%**	**17**	**3%**	**-20 231**	**-97%**		

All Member States reduced their emissions from this source between 1990 and 2014. France, Germany, Italy, the Netherlands, Romania, Spain and the United Kingdom had the largest decreases in absolute terms. The decreasing trend of PFC emissions from this key source between 1990 and 2014 is due to production stop or decline and due to process improvements. The emission peak in 2002 (see Figure 4.15) can be explained by technological changes and sub-optimal conditions of operation (in France and in the Netherlands).

Figure 4.15   2C3 Aluminium Production: PFC emissions



4.2.4 Electronics Industry (CRF Source Category 2.E)

2.E Electronics Industry comprises mainly emissions which were formerly reported under 2.F.7 Semiconductor Manufacture (2.F.7). The category includes the following subcategories: 2.E.1 Integrated Circuit or Semiconductor, 2.E.2 TFT Flat Panel Display, 2.E.3 Photovoltaics, 2.E.4 Heat Transfer Fluid and 2.E.5 Other. Out of these, the most important emission source in Europe is the production of integrated circuits and semiconductors (2.E.1). Emissions from photovoltaics industry and heat transfer fluids are reported by very few Member States only. Manufacture of TFT Flat Panel Displays does not take place in the EU.

4.2.5 Product uses as substitutes for ODS (CRF Source Category 2F) (EU-28+ISL)

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) 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. PFCs are used to minor extent in this subcategory but mainly in semiconductor manufacture (2.E.1).

For 2.F Product uses as substitutes for ODS, Table 4.32 summarizes information by Member States on emission trends of total GHG emissions as well as on HFCs and PFCs. Emissions of SF_6 and NF_3 do not occur in this subcategory.

Table 4.32 2F Product uses as substitutes for ODS: Member States' and EU-28+ISL total GHG, HFC and PFC emissions. ,

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	HFC emissions in 1990 (kt CO2 equivalents)	HFC emissions in 2014 (kt CO2 equivalents)	PFC emissions in 1990 (kt CO2 equivalents)	PFC emissions in 2014 (kt CO2 equivalents)
Austria	0	1 641	NO	1 641	NO	NO
Belgium	0	2 811	NO	2 810	NO	2
Bulgaria	0	1 017	NO	1 017	NO	0
Croatia	0	583	NO	583	NO	0
Cyprus	0	320	0	320	-	-
Czech Republic	0	2 835	NO	2 830	NO	5
Denmark	0	706	NO	700	NO	6
Estonia	0	217	NO	217	NO	0
Finland	0	1 749	0	1 741	NO	7
France	0	19 163	NO,IE	19 163	-	-
Germany	0	10 683	C,NO,NA	10 673	C,NA	9
Greece	0	5 813	NO	5 758	NO	55
Hungary	0	1 430	NO	1 428	NO	2
Ireland	1	1 152	1	1 152	NO	NO
Italy	0	11 960	NO	11 960	-	-
Latvia	0	128	NO,NE	128	NO	NO
Lithuania	0	312	NO,NA	312	NO,NA	NO
Luxembourg	0	64	0	64	-	-
Malta	0	233	NO,NE,IE	233	NO	NO
Netherlands	0	2 172	NA,NO,IE	2 172	NO	NO
Poland	0	8 459	NO	8 445	NO	14
Portugal	0	1 750	NE,NA	1 750	NE	0
Romania	0	1 373	0	1 373	NO	NO
Slovakia	0	546	NO	546	NO	NO
Slovenia	0	324	NO	324	NO	NO
Spain	0	16 900	NO	16 896	NO	4
Sweden	5	809	5	807	NO	2
United Kingdom	0	16 393	NO,NA,IE	16 393	NO	NO
EU-28	**6**	**111 543**	**6**	**111 437**	**0**	**106**
Iceland	0	163	NO	163	NO	0
EU-28 + ISL	**6**	**111 706**	**6**	**111 600**	**0**	**106**

Abbreviations explained in the Chapter 'Units and abbreviations'.

F-gas emissions from 2.F Product uses as substitutes for ODS account for 2.6% of total EU-28+ISL GHG emissions (w/o LULUCF) in 2014. HFC emissions in 2014 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 4.33 shows the sub-categories of F-gas 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 F-gas emissions in this source category. While ODS were formerly widely used as aerosols and foam blowing agents, the subcategories 2.F.4 Aerosols/Metered Dose Inhalers contribute today only about 7% and 2.F.2 Foam blowing agents ca. 2.6%, respectively.

Table 4.33 2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2014 (kt 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	**1 600**	1 546	17	13	24	NO	-
Belgium	**2 702**	2 546	61	12	83	-	-
Bulgaria	**899**	863	20	5	11	-	-
Croatia	**578**	564	NO	4	9	-	-
Cyprus	**324**	317	1	3	2	-	-
Czech Republic	**2 621**	2 584	3	19	12	4	-
Denmark	**781**	703	61	-	18	-	-
Estonia	**206**	198	2	3	3	NO	NO
Finland	**1 611**	1 533	12	C,NA,NO	66	NO	NO
France	**18 957**	16 408	194	142	1 906	307	NO,IE
Germany	**10 515**	9 303	597	48	567	C	-
Greece	**5 650**	5 373	191	41	45	-	-
Hungary	**1 280**	1 072	146	8	55	NO	NO
Ireland	**1 067**	904	NO	32	130	NO	NO
Italy	**11 487**	10 156	594	225	512	-	-
Latvia	**130**	125	2	0	4	NO	NO
Lithuania	**296**	274	13	2	7	NO	NO
Luxembourg	**59**	55	1	-	2	-	-
Malta	**217**	210	2	2	3	NO	NO
Netherlands	**1 957**	1 802	NA,IE	-	NO	-	155
Poland	**7 955**	7 432	336	61	125	0	-
Portugal	**1 735**	1 680	41	7	7	-	-
Romania	**1 299**	1 265	0	4	29	NO	NO
Slovakia	**535**	505	2	19	9	NO	-
Slovenia	**302**	294	2	1	5	-	-
Spain	**17 679**	14 783	82	1 327	1 488	NO	NO
Sweden	**838**	771	35	1	31	-	-
United Kingdom	**16 115**	13 178	408	281	2 159	42	46
EU-28	**109 395**	**96 446**	**2 824**	**2 262**	**7 310**	**353**	**201**
Iceland	**170**	169	-	-	1	-	-
EU-28 + ISL	**109 565**	**96 614**	**2 824**	**2 262**	**7 311**	**353**	**201**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.34 to Table 4.37 show the contribution of each MS to EU-28+ISL HFC emissions from the most important sub-sources 2F1, 2F2, 2F3 and 2F4.

Table 4.34 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Change 1995-2014		Method applied	Emission factor
	1990	1995	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	38	1 546	1 586	2%	39	3%	1 586	100%	1 548	4116%	-	-
Belgium	NO	103	2 546	2 654	3%	108	4%	2 654	100%	2 551	2473%	NA	NA
Bulgaria	NO	3	863	982	1%	119	14%	982	100%	979	32799%	T2	D
Croatia	NO	57	564	569	1%	4	1%	569	100%	512	895%	T1a,T2	D
Cyprus	0.14561	9	317	313	0%	-4	-1%	313	214999%	304	3409%	NA	NA
Czech Republic	NO	0	2 584	2 797	3%	213	8%	2 797	100%	2 797	1305161%	T1	CS
Denmark	NO	42	703	642	1%	-61	-9%	642	100%	600	1431%	T1	D
Estonia	NO	10	198	208	0%	10	5%	208	100%	198	1993%	T2	CS
Finland	0.01363	24	1 533	1 668	2%	135	9%	1 668	12232075%	1 643	6751%	T2	NA
France	NO	544	16 408	16 700	17%	292	2%	16 700	100%	16 156	2967%	-	-
Germany	NA,NO	581	9 303	9 459	10%	155	2%	9 459	100%	8 878	1528%	T2	CS,D
Greece	NO	42	5 373	5 480	6%	106	2%	5 480	100%	5 437	12838%	IE,T2	D,IE
Hungary	NO	26	1 072	1 208	1%	136	13%	1 208	100%	1 181	4497%	T2	D
Ireland	NO	76	904	989	1%	85	9%	989	100%	914	1209%	NA	NA
Italy	NO	265	10 156	10 633	11%	477	5%	10 633	100%	10 369	3917%	T2	CS,D
Latvia	NE	11	125	122	0%	-3	-2%	122	100%	111	1001%	NA,T2	CS,D,NA,OTH
Lithuania	NO	2	274	290	0%	16	6%	290	100%	288	13128%	T2	CS,D,PS
Luxembourg	0.00007	3	55	61	0%	6	11%	61	85067993%	58	2013%	T2	CS,M,PS
Malta	NO,IE	0	210	227	0%	17	8%	227	100%	227	12059382%	T2	CS
Netherlands	NO	72	1 802	2 026	2%	224	12%	2 026	100%	1 954	2720%	T2	CS
Poland	NO	80	7 432	7 904	8%	472	6%	7 904	100%	7 825	9802%	IE,T2	D,IE
Portugal	NE,NA	13	1 680	1 696	2%	15	1%	1 696	100%	1 683	12949%	NA	NA
Romania	NO	2	1 265	1 337	1%	72	6%	1 337	100%	1 335	73958%	T2	D
Slovakia	NO	8	505	516	1%	10	2%	516	100%	507	6041%	T2	CS
Slovenia	NO	6	294	316	0%	22	7%	316	100%	310	5252%	T1,T2	CS,D
Spain	NO	NO	14 783	14 022	14%	-761	-5%	14 022	100%	14 022	100%	T2	D
Sweden	3	141	771	741	1%	-30	-4%	738	23267%	600	424%	CS,T2	CS,D
United Kingdom	NO	531	13 178	13 386	14%	207	2%	13 386	100%	12 855	2420%	T3	CS
EU-28	**3**	**2 690**	**96 446**	**98 529**	**100%**	**2 084**	**2%**	**98 526**	**2957264%**	**95 839**	**3563%**		
Iceland	NO	10	169	162	0%	-7	-4%	-	-	152	1484%	-	-
EU-28 + ISL	**3**	**2 700**	**96 614**	**98 692**	**100%**	**2 077**	**2%**	**98 526**	**2957264%**	**95 991**	**3555%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2014, HFC emissions from 2F1 were about 37 times higher than in 1995 (Figure 4.16).

France, Germany, Italy, Spain and the UK are responsible for 65 % of total EU-28+ISL emissions from this source. Between 2013 and 2014 EU-28+ISL emissions increased by 2%. The largest increase of HFC emissions from 2F1 between these years was in Bulgaria (14%) and Hungary (13%). Decreasing emissions compared to the previous year were reported by Cyprus (-1%), Denmark (-9%), Latvia (-2%), Spain (-5%), Sweden (-4%) and Iceland (-4%).

Figure 4.16 2F1 Refrigeration and Air conditioning: EU-28+ISL HFC emissions

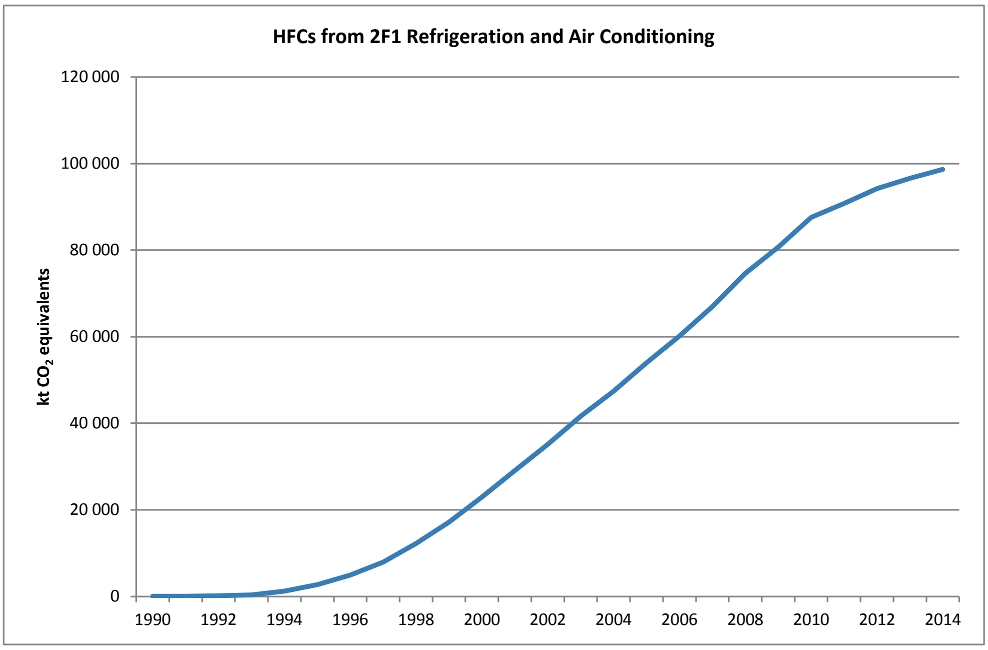


Table 4.35 2F2 Foam Blowing: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFCs emissions in kt CO2 equiv.				Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Change 1995-2014		Method applied	Emission factor
	1990	1995	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	301	17	17	1%	0	-1%	17	100%	-284	-94%	NA	NA
Belgium	NO	357	61	65	2%	4	6%	65	100%	-292	-82%	NA	NA
Bulgaria	NO	NO	20	20	1%	0	3%	20	100%	20	100%	NO,T2	D,NO
Croatia	NO	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Cyprus	NE,NO	0	1	1	0%	0	-1%	1	100%	1	20269%	NA	NA
Czech Republic	NO	0	3	3	0%	0	-5%	3	100%	3	18352%	T1	D
Denmark	NO	200	61	40	1%	-21	-34%	40	100%	-160	-80%	T1	D
Estonia	NO	18	2	2	0%	0	10%	2	100%	-16	-87%	T2	CS
Finland	NO	1	12	9	0%	-3	-27%	9	100%	8	1596%	T2	D
France	NO	NO	194	224	8%	30	15%	224	100%	224	100%	-	-
Germany	C,NO	1 666	597	620	21%	23	4%	620	100%	-1 046	-63%	T2	CS
Greece	NO	NO	191	190	7%	-2	-1%	190	100%	190	100%	NA,T2	D,NA
Hungary	NO	NO	146	157	5%	11	8%	157	100%	157	100%	CS	CS
Ireland	NO	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Italy	NO	NO	594	606	21%	12	2%	606	100%	606	100%	T2	D
Latvia	NO	0	2	1	0%	-1	-48%	1	100%	1	140%	T1a,T2	D,OTH
Lithuania	NO	NO	13	14	0%	1	9%	14	100%	14	100%	NA,T2	D,NA
Luxembourg	NO	13	1	1	0%	0	5%	1	100%	-12	-90%	T1	CS
Malta	NO,NE	NO,NE	2	2	0%	0	-18%	2	100%	2	100%	T1	D
Netherlands	NA,IE	NA,IE	NA,IE	NA,IE	-	-	-	-	-	-	-	T2	CS
Poland	NO	NO	336	344	12%	8	2%	344	100%	344	100%	T2	D
Portugal	NE	1	41	41	1%	0	1%	41	100%	41	5379%	NA	NA
Romania	NO	NO	0	0	0%	0	192%	0	100%	0	100%	T2	D
Slovakia	NO	NO	2	2	0%	0	-7%	2	100%	2	100%	T2	D
Slovenia	NO	30	2	2	0%	0	-5%	2	100%	-28	-94%	T2	CS,D
Spain	NO	NO	82	83	3%	1	2%	83	100%	83	100%	NA,T2	D,NA
Sweden	NO	NO	35	33	1%	-2	-5%	33	100%	33	100%	T2	PS
United Kingdom	NO	184	408	432	15%	24	6%	432	100%	247	134%	T2	CS
EU-28	**0**	**2 771**	**2 824**	**2 909**	**100%**	**85**	**3%**	**2 909**	**100%**	**138**	**5%**		
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	-
EU-28 + ISL	**0**	**2 771**	**2 824**	**2 909**	**100%**	**85**	**3%**	**2 909**	**100%**	**138**	**5%**		

In 2014, HFC emissions from 2F2 (Table 4.35) increased by 3 % compared to 2013 – and increased by 5% compared to 1995. This shows that the phase-out of ODS in the foam sector from the 1990s onwards resulted mainly in the introduction of alternative technologies not relying on fluorinated gases. The biggest contributors to this sector are Germany (21%), Italy (21%), Poland (12%) and UK (15%), those four countries account for 69% of the share in EU-28+ISL emissions in this sector.

Table 4.36 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Change 1995-2014		Method applied	Emission factor
	1990	1995	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	13	13	1%	0	0%	13	100%	13	100%	-	-
Belgium	NO	1	12	12	1%	1	4%	12	100%	12	2040%	-	-
Bulgaria	NO	NO	5	6	0%	0	4%	6	100%	6	100%	T2	D
Croatia	NO	0	4	4	0%	0	5%	4	100%	4	3367%	T2	D
Cyprus	NE,NO	0	3	3	0%	0	-1%	3	100%	3	44288%	NA	NA
Czech Republic	NO	NO	19	21	1%	2	10%	21	100%	21	100%	D	D
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-
Estonia	NO	NO	3	3	0%	0	5%	3	100%	3	100%	T2	CS
Finland	NO	NO	C,NA,NO	C,NA,NO	-	-	-	-	-	-	-	NA	NA
France	NO	5	142	122	5%	-20	-14%	122	100%	118	2569%	-	-
Germany	NO	NO	48	43	2%	-5	-11%	43	100%	43	100%	CS	CS,D
Greece	NO	NO	41	43	2%	2	5%	43	100%	43	100%	CS	D
Hungary	NO	NO	8	8	0%	0	-3%	8	100%	8	100%	T1	D
Ireland	NO	NO	32	32	1%	0	0%	32	100%	32	100%	-	-
Italy	NO	NO	225	238	11%	13	6%	238	100%	238	100%	T2	CS
Latvia	NE	NE	0	0	0%	0	-55%	0	100%	0	100%	T2	D
Lithuania	NO	NO	2	2	0%	0	4%	2	100%	2	100%	T1b	D
Luxembourg	-	-	-	-	-	-	-	-	-	-	-	-	-
Malta	NE	NE	2	3	0%	1	37%	3	100%	3	100%	CS	CS
Netherlands	-	-	-	-	-	-	-	-	-	-	-	T2	CS
Poland	NO	NO	61	71	3%	10	16%	71	100%	71	100%	T2	D
Portugal	NE	NO	7	7	0%	0	1%	7	100%	7	100%	-	-
Romania	NO	NO	4	4	0%	0	1%	4	100%	4	100%	T2	D
Slovakia	NO	2	19	19	1%	0	1%	19	100%	17	807%	T1a	CS
Slovenia	NO	NO	1	1	0%	0	1%	1	100%	1	100%	T2	CS,D
Spain	NO	3	1 327	1 301	58%	-26	-2%	1 301	100%	1 298	39124%	T1a	CS,D
Sweden	NO	NO	1	1	0%	0	-15%	1	100%	1	100%	CS,T2	CS
United Kingdom	NO	1	281	293	13%	12	4%	293	100%	292	30106%	T2	CS
EU-28	**0**	**12**	**2 262**	**2 252**	**100%**	**-10**	**0%**	**2 252**	**100%**	**2 240**	**19160%**		
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	-
EU-28 + ISL	**0**	**12**	**2 262**	**2 252**	**100%**	**-10**	**0%**	**2 252**	**100%**	**2 240**	**19160%**		

In 2014, HFC emissions from 2F3 (Table 4.36) did hardly change compared to 2013 – but increased dramatically since 1995. This development was caused by the phase-out of halons and HCFCs as fire extinguishing agents under the Montreal Protocol and the subsequent introduction of HFCs and other ODS alternatives. In Denmark and Luxembourg HFCs are not used as fire extinguishing agents. Instead, other chemicals or not-in-kind alternatives, e.g. water mist, fluorinated ketones etc., are applied.

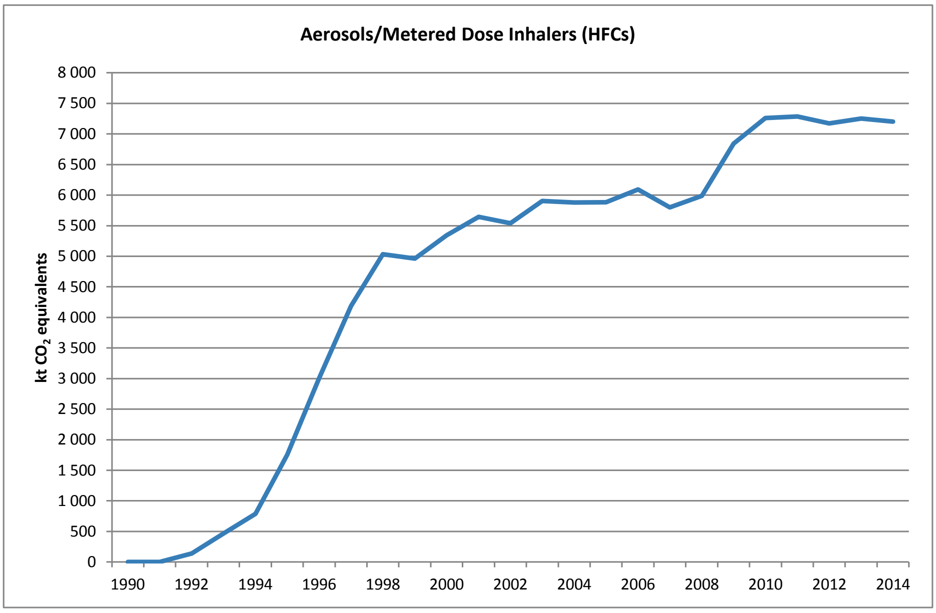
The biggest contributors to this sector are Spain (58%), UK (13%), and Italy (11%), those three countries account for 81% of the share in EU-28+ISL emissions in this sector. A decrease of emissions from this subcategory compared to 2013 was reported by Cyprus (-1%), France (-14%), Germany (-11%), Hungary (-3%), Latvia (-55%), Spain (-2%) and Sweden (-15%).

Table 4.37 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Change 1995-2014		Method applied	Emission factor
	1990	1995	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	9	24	25	0%	1	4%	25	100%	16	183%	NA	NA
Belgium	NO	41	83	79	1%	-4	-4%	79	100%	37	90%	-	-
Bulgaria	NO	NO	11	10	0%	-1	-10%	10	100%	10	100%	NO,T2	D,NO
Croatia	NO	NO	9	10	0%	0	5%	10	100%	10	100%	NA,T2	D,NA
Cyprus	NO	0	2	2	0%	0	-1%	2	100%	2	17320%	NA	NA
Czech Republic	NO	NO	12	8	0%	-4	-33%	8	100%	8	100%	D	D
Denmark	NO	NO	18	18	0%	0	1%	18	100%	18	100%	T1	D
Estonia	NO	0	3	3	0%	0	-3%	3	100%	3	6526%	T2	CS
Finland	NO	2	66	65	1%	-1	-2%	65	100%	63	3117%	T2	D
France	NO	610	1 906	1 887	26%	-19	-1%	1 887	100%	1 277	209%	-	-
Germany	C,NO	342	567	552	8%	-15	-3%	552	100%	210	61%	CS,T2	CS
Greece	NO	0	45	46	1%	1	2%	46	100%	45	142020%	T2	D
Hungary	NO	15	55	55	1%	1	1%	55	100%	40	260%	T1	D
Ireland	1	25	130	130	2%	0	0%	130	20221%	105	415%	-	-
Italy	NO	NO	512	483	7%	-29	-6%	483	100%	483	100%	T2	CS
Latvia	NO,NE	NO,NE	4	5	0%	1	33%	5	100%	5	100%	NO,T1a	D,NO
Lithuania	NO	1	7	6	0%	-1	-15%	6	100%	5	630%	NA,T1a	D,NA
Luxembourg	NO	2	2	2	0%	0	-4%	2	100%	1	37%	T1,T3	CS
Malta	NE,NO	NE,NO	3	2	0%	-1	-32%	2	100%	2	100%	T1	CS
Netherlands	NO	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Poland	NO	18	125	125	2%	0	0%	125	100%	108	616%	T1a,T1b,T2	D
Portugal	NE	17	7	7	0%	0	1%	7	100%	-10	-60%	-	-
Romania	0	1	29	31	0%	2	8%	31	17182%	31	4246%	NA,T2	D,NA
Slovakia	NO	NO	9	9	0%	0	4%	9	100%	9	100%	T1a	D
Slovenia	NO	NO	5	5	0%	0	0%	5	100%	5	100%	NA,T1	D,NA
Spain	NO	2	1 488	1 490	20%	2	0%	1 490	100%	1 487	62311%	T2	D
Sweden	1	7	31	31	0%	1	2%	30	2101%	24	332%	CS,T2	D
United Kingdom	IE,NO	663	2 159	2 191	30%	33	2%	2 191	100%	1 528	230%	T2	CS
EU-28	**2**	**1 756**	**7 310**	**7 278**	**100%**	**-32**	**0%**	**7 276**	**322902%**	**5 522**	**315%**		
Iceland	0	0	1	1	0%	0	-1%	1	100%	1	100%	-	-
EU-28 + ISL	**2**	**1 756**	**7 311**	**7 279**	**100%**	**-32**	**0%**	**7 277**	**322941%**	**5 523**	**315%**		

In 2014, HFC emissions from 2F4 reached more than 4 times the level of emissions from this subcategory in 1995 (Figure 4.17). France, Spain and UK are responsible for 76% of total EU-28+ISL emissions from this source. Between 2013 and 2014 EU-28+ISL emissions hardly changed. A significant relative decrease between these years was reported by Czech Republic (-33%) and Malta (-32%); the biggest increase was reported by Latvia (33%) (Table 4.37).

Figure 4.17 2F4 Aerosols/Metered Dose Inhalers: EU-28+ISL HFC emissions



The subcategories 2F5 Solvents and 2F6 Other applications are not described in detail in this submission. Emission estimates for these subcategories are confidential in several Member States because the relevant industrial processes are only performed by very few companies. Emissions are thus reported together with other subcategories.

Table **4.38** provides information on the contribution of Member States to EU-28+ISL recalculations in HFC from 2F Product uses as substitutes for ODS for 1990 and 2014 and main explanations for the largest recalculations in absolute terms.

Table 4.38 2F Product uses as substitutes for ODS: Contribution of MS to EU recalculations in HFC for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.0	0.0	-70,98	-3%	For 2.F.1 Refrigeration and air conditioning the calculation was further improved by adjusting the overall amounts of cooling agents to the amounts actually considered in the calculations for the years 2011 onwards, where previously estimated amounts from importers were used. Additionally some parameters for the model concerning the share of refrigerants filled into new equipment of sub category commercial refrigeration were improved to remove minor inconsistencies of the resulting IEF. For 2.F.4 Aerosols, the data report concerning MDIs containing HFCs was checked by the data provider and completed. The data was corrected which results in recalculations for the years 2009 onwards.
Belgium	0.0	0.0	174.8 0,206 0 -0.63	7.37 0.34 0.0 -0.34	The main changes made to the inventory data for the period 1995-2013 are the following: The emissions of refrigeration and air conditioning installations have been revised for the whole time series, in order to improve the calculation of disposal emissions. The modification has essentially consisted in recalculating the 'Amounts charged into new systems'. For rail transport, the time series has been adjusted. New information from the NMBS/SNCB made it possible to estimate the stock of HFCs in trains based on specific quantities of HFC per model of train. For room air conditioning emissions in 2012 and 2013 were adjusted to account for new statistics on the number of appliances. For refrigerated transport emissions in kt CO_2-eq have been adjusted, because an incorrect GWP value was used. Emissions in tonnes remain the same. 2013 HFC emissions for technical aerosols have been adjusted to take into account more recent information on consumption.
Bulgaria	0.0	0.0	0	0.0	
Croatia	0.0	0.0	0.0	0.0	
Cyprus	0.1	100.0	-219.25 -2.57 -0.43 2,39	-41 -73 -11	The emissions for the whole time series have been recalculated due to change of methodology which is based on average per capita emission estimates of other Southern European countries.
Czech Republic	0.0	0.0	-23.2 0 -22,25 0	-1 0 -54 0	Updated activity data became available which led to several recalculations. Historical data has been revaluated on the basis of consultations with external experts. The following recalculations were made: relocation of HFC-23,

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
			-0.11	-3	HFC-32, HFC-143a and HFC-125 from 2.F.1.e Mobile Air conditioning to 2.F.1.a Subcategory 2.F.3 Fire Protection was recalculated by changing the life factor and lifetime according to IPCC 2006 GL. The subcategory 2.F.5 Solvents was recalculated on the basis of new, more reliable data.
Denmark	0.0	0.0	-1,22	-0.17	
Estonia	0.0	0.0	2,86	1	Disposal emissions were corrected for Stationary and room AC (see NIR chapter 4.5.1.6.2.)
Finland	0.0	0.0	55.5	3.6	In subcategory 2.F.1.e information of one new company added to the calculation.
France	0.0	0.0	-612.1	-3.1	Recalculations were made because updated activity data became available for certain refrigeration and air conditioning subsectors. This relates in particular to the types of refrigerants used for retrofit, the use of R404A in new installations in recent years and the recovery efficiency. Updated information and/or new activity data was also included for 2.F.2 Foam blowing, 2.F.3 Fire extinguishing, 2.F.4 Aerosols and 2.F.5 Solvents.
Germany	0.0	0.0	1.0	0.0	
Greece	0.0	0.0	5.6	0.1	
Hungary	0.0	0.0	0.9	0.1	
Ireland	0.6	100.0	-206.7	-16.2	Recalculations in this source category are due to the revisions in activity data and correction of transcription errors, the effect of which is an annual average reduction in the emissions from 2.F.1 (NIR, p. 130).
Italy	0.0	0.0	-16.2	-0.1	
Latvia	0.0	0.0	23.6	22.2	For 2.F.1., the results of new research on the split of reported data into subcategories were included (NIR, p.255). Emission factors on the basis of country-specific expert estimates were established. For 2.F.1.e Mobile Air conditioning more detailed information on the vehicle stock and age was obtained and the methodology for emission estimates was revised (NIR, pp. 255). Emissions from 2.F.2 foam blowing increased because foaming of polyether for shoe soles was allocated to this subcategory.
Lithuania	0.0	0.0	-18.3	-5.8	New data and assumptions for domestic refrigeration, mobile air conditioning and heat pumps were included (NIR, pp. 293-294): For 2.F.1.b Domestic Refrigeration, this concerns the share of new equipment containing HFCs (decrease since 2010 assumed) and the recovery efficiency and disposal (NIR, table 4-38). For 2.F.1.e Mobile Air Conditioning, assumptions were revised on the share of vehicles containing air conditioning systems and the amount of gas remaining in the system at disposal (NIR, table 4-39). For heat pumps, new information was included (NIR, table 4-40).
Luxembourg	0.0	0.0	0.2	0.3	
Malta	0.0	0.0	3.4	1.6	The recalculation affected only the domestic refrigeration sector.
Netherlands	0.0	0.0	-58.5	-2.9	Small errors in the previous submission were corrected. More detailed information on foam-blowing has become available.
Poland	0.0	0.0	-1 651.3	-17.2	Assumptions for estimating HFCs emission from 2.F.1.d Transport refrigeration were revised to reflect new data obtained from the market. Especially assumptions applied to the share of equipment containing HFC-134a and R404A were revised to provide more realistic values and reflect national circumstances. In current submission a gradual increase of the number of equipment used in transport refrigeration was implemented (increasing

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					gradually form 25% in 2000 to 94% in 2014) instead of applying constant values for whole time series (see NIR, p. 154).
Portugal	0.0	0.0	6.8	0.4	Emissions in 2013 have been revised assuming the same trend verified between 2011 and 2012 emissions.
Romania	0.0	0.0	0.0	0.0	Recalculations were made as a result of changes in activity data for this year. (CRF Category 2.F.1.c)
Slovakia	0.0	0.0	0.1	0.0	Correction of distinguishing between import of filled products and filling of empty imported products.
Slovenia	0.0	0.0	24.4	8.8	Emissions from transport refrigeration have been included for the first time.
Spain	-41.8		9 205.5	108.6	Emission estimates in the stationary refrigeration and air conditioning subcategories of 2.F.1 for the entire time series have been based on sales data for 1996-1997 and the trend of HFC-134a consumption in 2.F.1.e was used as a proxy for the extrapolation until 2014.
Sweden	0.0	0.0	-13.5	-1.6	Changes in reported HFC emissions in other CRF codes lead, due to the models construction, to changes in emissions in 2.F.1.a. Emissions of HFC-134a from disposal have been corrected in 2.F.1.b. In earlier submissions emissions have been wrongly reported from 2008. Now the first reporting year is 2011. Updated activity data 2005 – 2013 for refrigerator trucks have led to updated emissions from manufacturing and stock. Emissions of HFC-134a from stock have been corrected 2010 – 2013. A calculation error in the model has been corrected. The correction leads to decreased emissions from disposal compared to submission 2015. Emissions of HFC-227ea from stock have been added for 2013.
United Kingdom	-161.1		-97.0	-0.6	Recalculations were due to corrections to the model, changed assumptions post 2011 (actual data, revised assumptions re new regulations) and updated assumptions to bring data into line with British Refrigeration Association (BRA) data. The foams model has been revised to account for the impacts of recent F-gas regulations and the economic down turn and earlier assumptions were verified or updated. Updated Eurostat GDP data used as a proxy caused a small change to the emission factor. Updated Eurostat GDP data used as a proxy, previously in the absence of data for the amount of HFC placed on the market for the most recent year a value of 0 was used, this has been replaced with an assumed no change from 2012. The refrigerant containers model has been revised to account for the impacts of recent F-gas regulations and the economic down turn.
EU28	-202.1	-97.3	6 492.6	6.3	
Iceland					
EU28+ISL	-202.1	-97.3	6 662.2	6.5	

4.2.6 Other product manufacture and use (CRF Source Category 2G) (EU-28+ISL)

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. Primary uses of SF_6 include gas insulated switch gear for transportation and distribution of electric power (2.G.1). PFCs and SF_6 have been used for certain applications under this category for many decades.

Table 4.39 shows that all Member States report GHG emissions in 2G Other product manufacture and use for the year 2014. The major use of SF_6 is electrical switch gear and SF_6 emissions from the predominant subcategory electrical equipment (2.G.1) are reported by Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, 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 4.39 2G Other: Overview of sources reported under this source category for 2014

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 + ISL Total
AUT	Electrical equipment (SF6); Soundproof windows (SF6); Other (SF6)	NO	NO	266			266	4%
BEL	Electrical equipment (SF6); Soundproof windows (SF6); Other (C6F14)	0.00	NO	92	0	0	92	1%
DNM	Electrical equipment (SF6); Soundproof windows (SF6); Other (SF6)			132			132	2%
FIN	Electrical equipment (SF6)	NO	NO	11	NO	NO	11	0.2%
FRK	Electrical equipment (SF6); Accelerators (SF6); Other (SF6, Unspecified mix of PFCs)	0.11	430.69	414	NA	NA	845	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)	8.81	C,NA,NO	3227			3236	52%
GRC	Electrical equipment (SF6)		NO	5			5	0.1%
IRL	Electrical equipment (SF6); Soundproof windows (SF6); Adiabatic properties: shoes and tyres (SF6); Other (SF6)	NO	NO	22	NO	NO	22	0.4%
ITA	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	316	NO	NO	316	5%
LUX	Electrical equipment (SF6); Soundproof windows (SF6), Other (HFC-43-10mee)	2		8			10	0.2%
NLD	Other (SF6)	NO	NA	135			135	2%
PRT	Electrical equipment (SF6)		NO	56	NO		56	1%
ESP	Electrical equipment (SF6)	NA,NO	NA,NO	207	NA,NO	NA,NO	207	3%
SWE	Electrical equipment (SF6); Soundproof windows (SF6); Adiabatic properties: shoes and tyres (C3F8; SF6)		NO	31			31	0.5%
GBR	Electrical equipment (SF6); Military applications (SF6); Accelerators (SF6); Other (CF4, C2F6, C3F8, c-C4F8, SF6)		142	366			508	8%
BGR	Electrical equipment (SF6)		NO	16			16	0.3%
CYP	Electrical equipment (SF6)			0			0	0.0%
CZE	Electrical equipment (SF6); Soundproof windows (SF6)			79			79	1%
EST	Electrical equipment (SF6); Soundproof windows (SF6)	NO	NO	2	NO	NO	2	0.0%
HRV	Electrical equipment (SF6)	NO	NO	7	NO	NO	7	0.1%
HUN	Electrical equipment (SF6)	NO	NO	104	NO	NO	104	2%
LVA	Electrical equipment (SF6), Other (HFC-134a)	NA,NO	NO	9	NO	NA,NO	9	0.1%
LTU	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	1	NO	NO	1	0.02%
MLT	Electrical equipment (SF6), Other (SF6, C3F8)		0	1			1	0.01%
POL	Electrical equipment (SF6)	NA	NA	49	NA	NA	49	1%
ROU	Electrical equipment (SF6)	NO	NO	52	NO	NO	52	1%
SVK	Electrical equipment (SF6)	NO	NO	14	NO	NO	14	0.2%
SVN	Electrical equipment (SF6)	NO	NO	16	NO	NO	16	0.2%
EU-28	**TOTAL**	**11**	**573**	**5 636**	**0**	**0**	**6219**	
ISL				2			2	0
EU-28+ISL	**TOTAL**	**11**	**573**	**5 638**	**0**	**0**	**6 221**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 4.18 and Table 4.40 summarizes information by Member State on emissions for the key source SF_6 from 2G Other sources of SF_6. Emissions have been relatively stable since 2002. The development of emissions from this category is largely driven by the emission trend in Germany (57% of SF_6 emissions from EU-28+ISL in 2014). Major manufacturers of SF_6 containing switchgear are located in Germany.

Figure 4.18 2G Other: EU-28+ISL SF_6 emissions

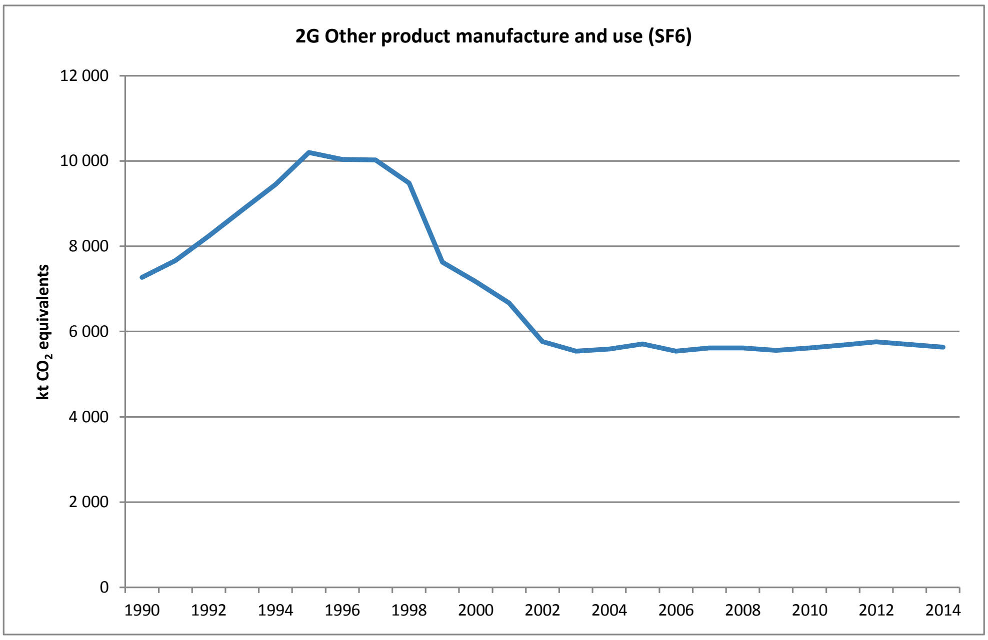


Table 4.40 2G Other: Member States' contributions to SF_6 emissions

Member State	SF6 emissions in kt CO2 equiv.				Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Change 1995-2014	
	1990	1995	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	132	268	267	266	5%	-1	0%	134	102%	-2	-1%
Belgium	88	134	113	92	2%	-22	-19%	4	5%	-43	-32%
Bulgaria	4	5	20	16	0%	-4	-21%	12	323%	11	219%
Croatia	10	11	6	7	0%	1	11%	-4	-35%	-4	-38%
Cyprus	0	0	0	0	0%	0	-1%	0	476%	0	155%
Czech Republic	85	90	81	79	1%	-2	-2%	-6	-8%	-11	-12%
Denmark	13	68	131	132	2%	2	1%	120	937%	64	94%
Estonia	NO	3	2	2	0%	0	4%	2	100%	-1	-32%
Finland	45	27	10	11	0%	1	8%	-34	-76%	-16	-59%
France	1 252	1 482	482	414	7%	-68	-14%	-838	-67%	-1 068	-72%
Germany	4 050	6 072	3 108	3 227	57%	120	4%	-822	-20%	-2 845	-47%
Greece	3	3	5	5	0%	0	-4%	2	68%	2	44%
Hungary	11	52	123	104	2%	-19	-15%	93	856%	52	100%
Ireland	33	38	22	22	0%	1	3%	-11	-33%	-16	-42%
Italy	294	550	373	316	6%	-57	-15%	22	7%	-234	-43%
Latvia	NO	0	9	9	0%	0	1%	9	100%	8	4848%
Lithuania	NO	0	0	1	0%	1	210%	1	100%	1	2580%
Luxembourg	1	1	8	8	0%	0	5%	8	863%	7	507%
Malta	0	1	3	1	0%	-2	-78%	1	5403%	-1	-59%
Netherlands	207	261	120	135	2%	15	12%	-72	-35%	-126	-48%
Poland	NA,NO	13	43	49	1%	5	12%	49	100%	36	288%
Portugal	NE,NO	15	55	56	1%	1	1%	56	100%	41	281%
Romania	0	1	57	52	1%	-5	-9%	51	10802%	51	5204%
Slovakia	0	10	22	14	0%	-8	-36%	14	24174%	4	40%
Slovenia	10	12	16	16	0%	0	-3%	6	58%	3	28%
Spain	64	101	214	207	4%	-6	-3%	144	226%	107	106%
Sweden	79	108	30	31	1%	1	3%	-48	-61%	-77	-71%
United Kingdom	892	877	378	366	6%	-12	-3%	-526	-59%	-511	-58%
EU-28	**7 270**	**10 204**	**5 697**	**5 636**	**100%**	**-61**	**-1%**	**-1 635**	**-22%**	**-4 568**	**-45%**
Iceland	1	1	3	2	0%	-1	-31%	1	102%	1	78%
EU-28 + ISL	**7 272**	**10 205**	**5 700**	**5 638**	**100%**	**-62**	**-1%**	**-1 633**	**-22%**	**-4 567**	**-45%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.3 Methodological issues and uncertainties

The previous section presented for each EU-28 key source in CRF Sector 2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.41 shows the total EU-28 uncertainty estimates for the sector 'Industrial processes' and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for SF_6 from 2F (206 %) and the lowest for CO_2 from 2A (5 %) and 2C (5 %). With regard to trend NF_3 from 2F shows the highest uncertainty estimates, CO_2 from 2C the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-28 see Chapter **Error! Reference source not found.**.

Table 4.41 Sector 2 Industrial processes: Uncertainty estimates for the EU-28

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A Mineral Industry	CO_2	149 069	107 612	-28%	5%	0.008%
2.A Mineral Industry	CH_4	31	5	-84%	100%	0.8%
2.A Mineral Industry	N_2O	0	0		0%	
2.B Chemical Industry	CO_2	52 592	46 413	-12%	9%	0.014%
2.B Chemical Industry	CH_4	2 032	2 252	11%	34%	0.1%
2.B Chemical Industry	N_2O	116 192	7 136	-94%	13%	0.2%
2.B Chemical Industry	HFC	26 605	82	-100%	17%	0.1%
2.B Chemical Industry	PFC	3 237	1 797	-44%	44%	0.1%
2.B Chemical Industry	Unspecifie	0	0		0%	0.0%
2.B Chemical Industry	SF_6	1 761	95	-95%	10%	0.2%
2.B Chemical Industry	NF3	0	0		0%	0.0%
2.C Metal Industry	CO_2	103 286	62 567	-39%	5%	0.012%
2.C Metal Industry	CH_4	9 906	6 710	-32%	12%	0.04%
2.C Metal Industry	N_2O	34	25	-26%	90%	0.22%
2.C Metal Industry	HFC	3 887	69	-98%	30%	0.5%
2.C Metal Industry	PFC	10 272	311	-97%	12%	0.1%
2.C Metal Industry	Unspecifie	0	0		0%	0.0%
2.C Metal Industry	SF_6	874	171	-80%	13%	0.1%
2.C Metal Industry	NF3	0	0		0%	0.0%
2.D Non-energy products from fuels and solvent use	CO_2	16 400	11 744	-28%	31%	0.1%
2.D Non-energy products from fuels and solvent use	CH_4	2	2	-16%	93%	0.2%
2.D Non-energy products from fuels and solvent use	N_2O	4	3	-24%	69%	0.3%
2.E Electronics industry	CO_2	0	17		21%	
2.E Electronics industry	CH_4	0	0		0%	
2.E Electronics industry	N_2O	0	0		0%	
2.E Electronics industry	HFC	28	47	65%	31%	0.2%
2.E Electronics industry	PFC	349	457	31%	19%	0.1%
2.E Electronics industry	Unspecifie	0	0		0%	0.0%
2.E Electronics industry	SF_6	145	117	-19%	13%	0.1%
2.E Electronics industry	NF3	6	60	886%	13%	1.0%
2.F Product uses as substitutes for ODS	CO_2	0	1 017		51%	
2.F Product uses as substitutes for ODS	CH_4	0	0		0%	
2.F Product uses as substitutes for ODS	N_2O	0	0		0%	
2.F Product uses as substitutes for ODS	HFC	4 544	97 230	2040%	36%	2.9%
2.F Product uses as substitutes for ODS	PFC	21	115	447%	107%	4.8%
2.F Product uses as substitutes for ODS	Unspecifie	0	0		0%	0.0%
2.F Product uses as substitutes for ODS	SF_6	0	0	-100%	206%	2.1%
2.F Product uses as substitutes for ODS	NF3	0	2 797	1305161%	44%	5686.1%
2.G Other product manufacture and use	CO_2	132	147	11%	18%	0.1%
2.G Other product manufacture and use	CH_4	64	80	26%	30%	0.1%
2.G Other product manufacture and use	N_2O	2 806	2 341	-17%	53%	0.1%
2.G Other product manufacture and use	HFC	52	204	293%	71%	1.9%
2.G Other product manufacture and use	PFC	245	252	3%	39%	0.1%
2.G Other product manufacture and use	Unspecifie	0	0		0%	0.00%
2.G Other product manufacture and use	SF6	8 123	4 800	-41%	13%	0.03%
2.G Other product manufacture and use	NF3	0	0		0%	0.00%
2.H Other	CO2	98	55	-43%	20%	0.07%
2.H Other	CH4	6	8	29%	21%	0.1%
2.H Other	N2O	64	82	29%	21%	0.1%
2.H Other	HFC	0	2	17167%	36%	62.1%
2.H Other	PFC	0	3	1308%	38%	5.0%
2.H Other	Unspecifie	0	0		0%	0.0%
2.H Other	SF6	7	23	213%	64%	1.4%
2.H Other	NF3	0	0		0%	0.0%
2 (werhe no subsector data were submitted)	*all*	225	61	-73%	0%	0.0%
Total - 2	**all**	**513 099**	**356 909**	-30%	**10.2%**	**4.9%**

N*ote: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories*

4.4 Sector-specific quality assurance and quality control

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.

After the implementation of the new IPCC guidelines in 2015 and the subsequent changes to the sector (it now comprises 2D, Non-Energy Products from Fuels and Solvent Use,, 2E, Electronics Industry, 2F Product Uses as Substitutes for Ozone Depleting Substances, and 2G Other Product Manufacture and Use), chapters had to be re-written, and certain methodological changes had to be applied. NF_3 as a new gas had to be included, and new GWPs for most fluorinated gases had to be applied. These changes are undergoing a comprehensive ESD review in 2016.

4.5 Sector Specific Recalculations

Table 4.42 shows that in the industrial processes sector the largest recalculations in absolute terms were made for N_2O and HFCs in 1990 and 2013.

Table 4.42 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2013 by gas (kt CO_2 equivalents) and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6		Unspecified mix of HFCs and PFCs		NF3	
	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%
Total emissions and removals	2 768	0.1%	-6 755	-1%	-14 971	-4%	-202	-0.7%	145	0.6%	-17	-0.2%	2	0.03%	0	0%
Industrial Processes and Product Use	1 130	0.4%	-14	-1%	536	0.5%	-202	-0.7%	145	0.6%	-17	-0.2%	2	0.03%	0	0%
2013																
Total emissions and removals	-6 347	-0.2%	-3 838	-0.8%	-9 399	-3.6%	6 661	6%	110	2.8%	-68	-1%	19	11%	0	-1%
Industrial Processes and Product Use	1 279	0.5%	-23	-1.1%	636	5.6%	6 661	6%	110	2.8%	-68	-1%	19	11%	0	-1%

Table 4.43 provides an overview of Member States' contributions to EU-28+ISL recalculations.

Table 4.43 Sector 2 Industrial processes: Contribution of Member States to EU-28+ISL recalculations for 1990 and 2013 by gas (difference between latest submission and previous submission kt of CO_2 equivalents)

	1990								2013							
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF3	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF3
Austria	70	0	0	0	0	0	NA	NO,NA	39	0	0	-72	0	1	NA	0
Belgium	-31	14	-2	NA,NO	0	0	NA,NO	NA,NO	14	0	0	174	3	0	NA,NO	0
Bulgaria	80	0	0	NO	NO	0	NO	NO	56	0	0	0	0	0	NO	NO
Croatia	2	0	0	NO	0	0	NO	NO	-2	0	0	0	0	0	NO	NO
Cyprus	7	NE,NO	0	0		0			-4	NE,NO,IE	0	-220		0		
Czech Republic	-44	0	0	NO	NO	70	NO,NE,IE	NO	456	0	0	-46	1	64	NO,NE,IE	0
Denmark	2	0	0	NA,NO	NA,NO	-1	NA,NO	NA,NO	1	0	0	-1	0	0	NA,NO	NA,NO
Estonia	-94	NO	0	NO	NO	NO	NO	NO	-69	NO	0	3	NO	0	NO	NO
Finland	24	0	0	0	0	0	NO	NO	34	0	0	56	0	0	NO	NO
France	429	-10	3	0	0	0	NA,NO	0	424	-7	5	-612	0	-6	NA,NO	0
Germany	87	0	0	0	0	-84	2	0	-387	0	2	2	1	0	19	-1
Greece	102	0	0	0	0	0	NA,NO	NA,NO	86	0	0	6	0	0	NA,NO	NA,NO
Hungary	116	0	0	NO	0	0	NO	NO	86	0	0	1	0	0	NO	NO
Ireland	26	NO	0	1	0	0	NO	NO	2	NO	0	-207	0	0	NO	0
Italy	0	0	0	0	0	0	NA,NO	NA,NO	292	0	0	-16	0	0	NA,NO	0
Latvia	101	0	1	NO,NA,NE	NO,NA	NA,NO	NO,NA	NO,NA	68	0	2	22	NO,NA	0	NO,NA	NO,NA
Lithuania	-19	0	0	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	-21	NO	0	-18	NO	0	NO	0
Luxembourg	0	NO	0	0	NO	0	NO	NO	3	NO	0	0	NO	0	NO	NO
Malta	0	NO,NA	0	NO,NA,NE,IE	NA,NO	0	NA,NO		0	NO,NA	0	3	0	0	NA,NO	
Netherlands	150	0	3	0	2	-2	NO	NO,IE	177	0	-84	-58	17	-12	NO	NO,IE
Poland	-258	0	0	NA,NO	0	NA,NO	NA,NO	NA,NO	-166	0	0	-1 651	0	8	NA,NO	NA,NO
Portugal	363	0	0	NE,NA,NO	NE,NO	NE,NO	NO	NA,NO	170	0	-47	7	0	0	NO	NA,NO
Romania	0	0	0	0	0	0	NO	NO	-58	0	0	0	0	0	NO	NO
Slovakia	0	0	0	NO	0	0	NO	NO	0	0	0	0	0	0	NO	NO
Slovenia	-1	0	0	NO	0	0	NO	NO	-19	NO,NA	0	24	0	3	NO	NO
Spain	-12	-17	0	-42	144	0	NA,NO	NA,NO	22	-14	0	9 205	24	1	NA,NO	NA,NO
Sweden	38	0	0	0	0	-1	NA	NA	38	0	-15	-13	-2	-10	NA	NA
United Kingdom	-8	0	525	-161	0	0	NO,NE	0	31	-2	770	-97	65	-120	NO,NE	0
EU28	1 129	-14	530	-202	145	-18	2	0	1 271	-23	633	6 492	109	-72	19	-1
Iceland	1	0	6	NO	0	1			8	0	3	170	0	3		
EU28+ISL	1 130	-14	536	-202	145	-17	2	0	1 279	-23	636	6 661	110	-68	19	-1

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[26].

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:

- "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.

[26] http://ec.europa.eu/agriculture/envir/index_en.htm

In 2013, the Council of the EU Agriculture Ministers adopted four Basic Regulations for a reformed CAP following a CAP Health Check[27] in 2008 and a Commission Communication on the CAP towards 2020[28] in 2011. The four legislative texts that regulate the post-2013 CAP are:

- Rural Development: Regulation 1305/2013[29]
- "Horizontal" issues such as funding and controls: Regulation 1306/2013[30]
- Direct payments for farmers: Regulation 1307/2013[31]
- Market measures: Regulation 1308/2013[32]

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 NO_3^- 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 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.

---

27 http://ec.europa.eu/agriculture/healthcheck/index_en.htm

28 http://ec.europa.eu/agriculture/cap-post-2013/communication/index_en.htm

29 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:en:PDF

30 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0549:0607:en:PDF

31 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0608:0670:en:PDF

32 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0671:0854:en:PDF

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[33]) 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[34]), 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[35]), which was established in 1996, and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2000 fattening pigs; more than750 sows or more than 40,000 head of poultry). These are required under the directive to apply control techniques for preventing NH_3 emissions according to Best Available Technology (BAT).

Structural changes are caused also by the general development of countries. For example, in Finland, the membership in the EU resulted in changes in the economic structure followed by an increase in the average farm size and a decrease in the number of small farms (Pipatti, 2001), causing also a decrease in the livestock numbers for most animal types. Swedish agriculture has undergone radical structural changes and 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 small holdings and those remaining are growing larger. In 1999, some 31,000 agricultural holdings were livestock farms, 14,000 were purely crop husbandry farms, and only 5,000 were a combination of the two. Livestock farmers predominately engage in milk production and the main crops grown in Sweden are grain and fodder crops. The decrease of agricultural land area has continued since Sweden joined the European Union in 1995 and the acreages of land for hay and silage has increased. Organic farming increased from 3% of the arable land area in 1995 to 17% in 2007.

---

33 *http://www.unece.org/env/lrtap/multi_h1.html*

34 *http://ec.europa.eu/environment/air/pollutants/ceilings.htm*

35 *http://ec.europa.eu/environment/air/pollutants/stationary/ippc/summary.htm*

5.1 Overview of sector

In the year 2014, CH_4, N_2O and CO_2 emissions from CRF sector 3 Agriculture were 23.3%, 34.7%, and 0.13% of total EU28+ISL CH_4, N_2O, and CO_2 emissions, respectively. Total emissions from agriculture were 436 Mt CO_2-eq with contributions from CH_4, N_2O, and CO_2 of 237 Mt CO_2-eq, 188 Mt CO_2-eq and 10.2 Mt CO_2-eq, respectively.

Thus, CH_4, N_2O, and CO_2 contributed with 23%, 35% and 0.13% total EU28+ISL GHG emissions. They make 54.5%, 43.2% and 2.3% of total agricultural emissions.

Figure 5.1 shows the development of total GHG emissions from agriculture from 1990 to 2014 and the considerably decrease in EU28+ISL. The decrease was most pronounced for CO_2 with a decrease of 26.6%, followed by CH_4 with a decrease of 22.1% and N_2O with a decrease of 18.2%.

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 1990-2014 from CRF Sector 3: 'Agriculture' in CO_2 equivalents (Mt)

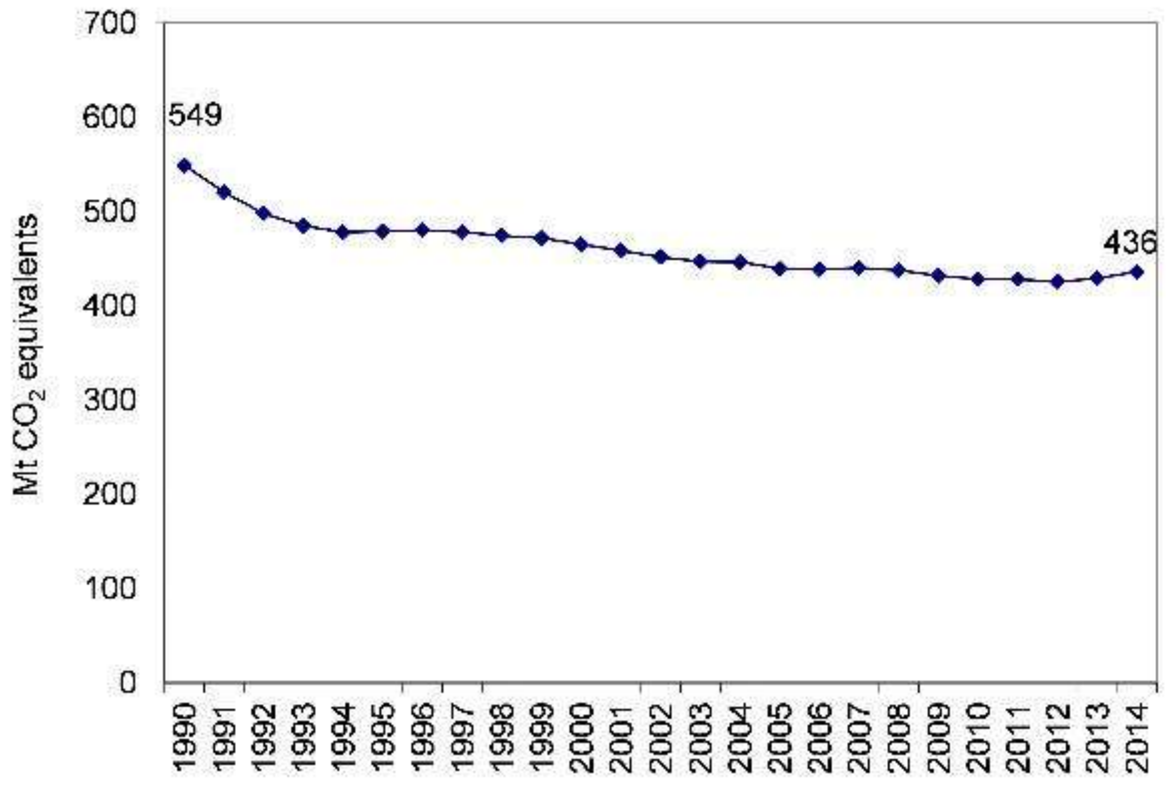


Figure 5.2 Absolute change of GHG emissions by large key source categories 1990-2014 in CO_2 equivalents (Mt) in CRF Sector 3: 'Agriculture'

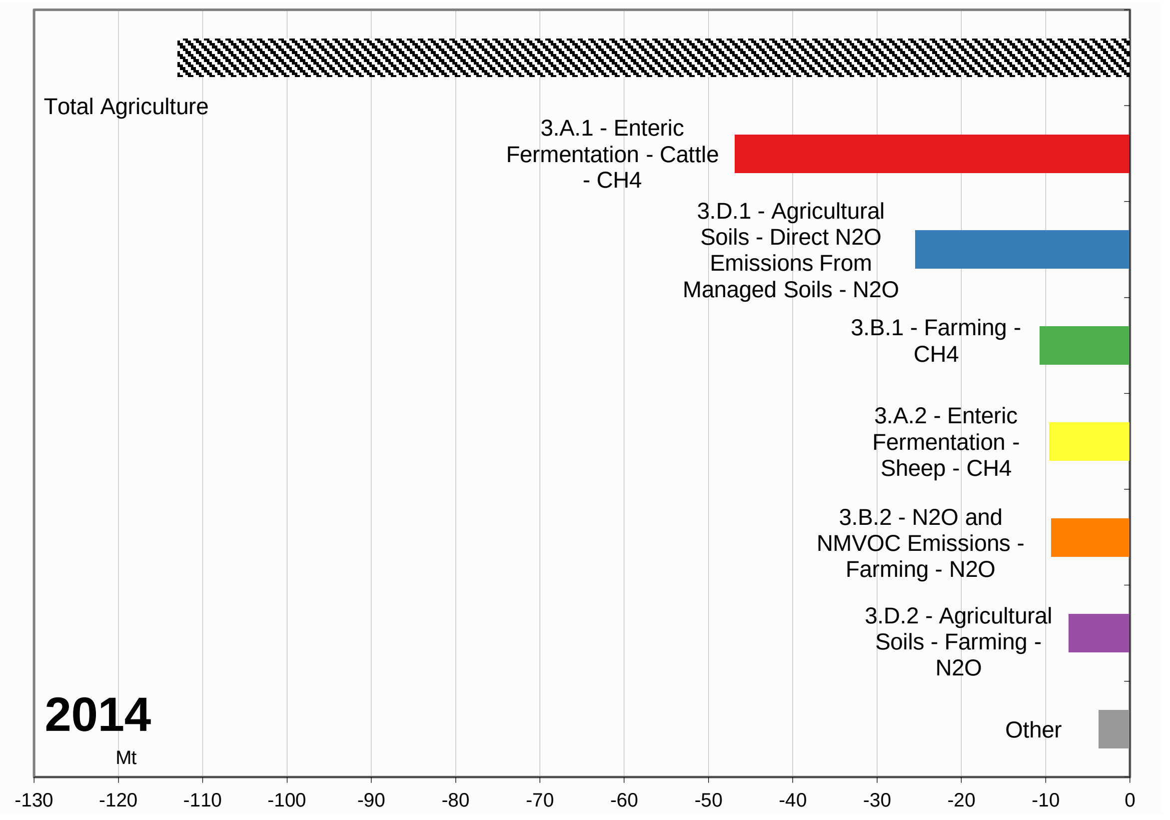
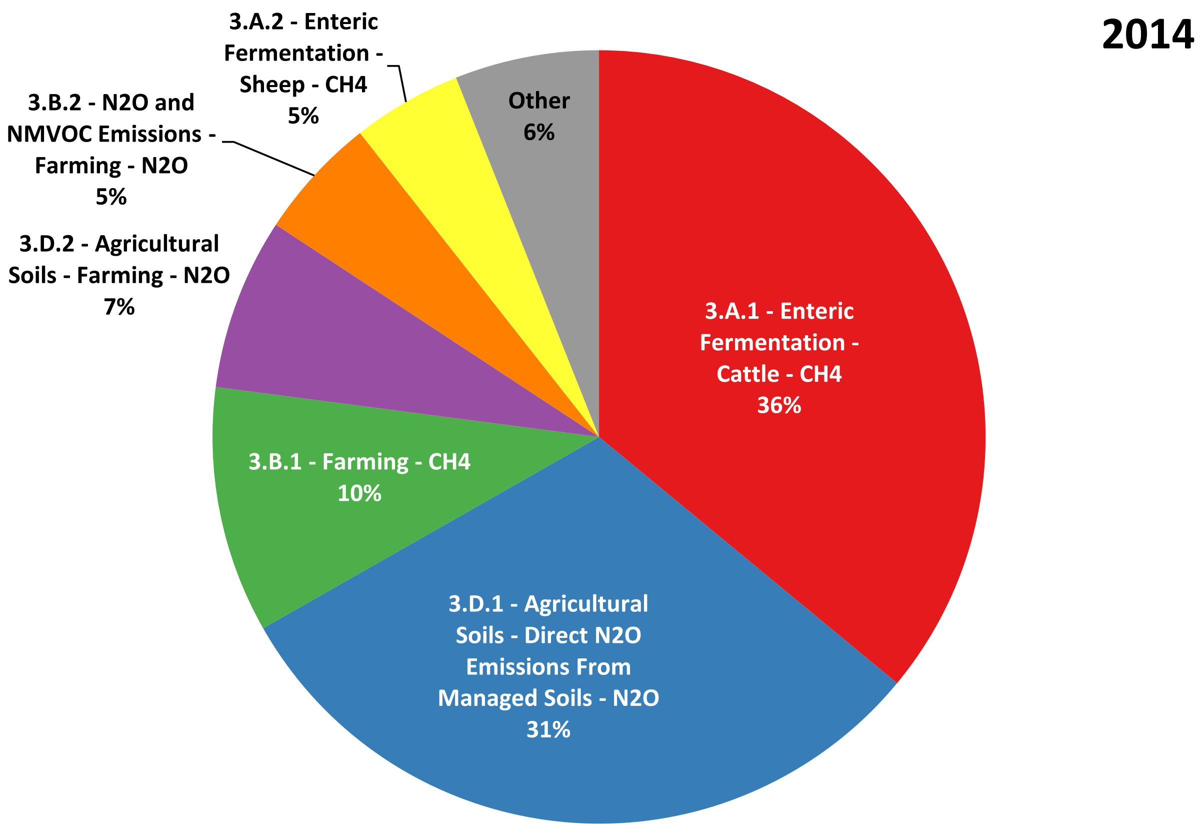


Figure 5.3 Distribution of agricultural GHG emissions among the different source categories for the year 2014



5.2 Source categories and methodological issues

In this section we present the information relevant for EU28+ISL key source categories in the sector 3 Agriculture.[36]

Sources categories considered are:

- CH_4 emissions from source category 3.A.1 - Cattle
- CH_4 emissions from source category 3.A.2 - Sheep
- CH_4 emissions from source category 3.B.1.1 - Cattle
- CH_4 emissions from source category 3.B.1.3 - Swine
- N_2O emissions from source category 3.B.1.1 - Cattle
- N_2O emissions from source category 3.B.1.5 - Indirect emissions
- N_2O emissions from source category 3.B.1.4 - Other Livestock (mainly Poultry)
- N_2O emissions from source category 3.D.1.1 - Direct N_2O emissions from managed soils from inorganic N fertilizers
- N_2O emissions from source category 3.D.1.2 - Direct N_2O emissions from managed soils from organic N fertilizers

[36] 3 A 4 Enteric Fermentation: Other livestock (CH_4) is a new key category and will be considered in detail in the EU NIR 2017.

- N_2O emissions from source category 3.D.2.1 - Indirect Emissions from Managed Soils, Atmospheric Deposition
- N_2O emissions from source category 3.D.2.2 - Indirect Emissions from Managed Soils, Nitrogen leaching and run-off

Other source categories are not contributing to a key source analysis at EU28+ISL level and are therefore not further discussed here.

For each of the above-mentioned source categories, data on the countries contributing most to EU28+ISL emissions and to EU28+ISL 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 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 3.A)

CH_4 emissions from source category *3.A Enteric Fermentation* are 2% of total EU28+ISL GHG emissions and 18% of total EU28+ISL CH_4 emissions. They make 42.9% 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.1.2 (Non-Dairy Cattle) and 3.A.1.1 (Dairy Cattle) as shown in Figure 5.4. Regarding the origin of emissions in the different Member States, Figure 5.5 shows the distribution of CH_4 emissions from enteric fermentation by livestock category in all Member States and in the EU28+ISL. Each bar represents the total emissions of a country in the current emission category, where different shades of grey correspond to the emitting animal types.

Figure 5.4 Share of source category 3.A on total EU28+ISL agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emissions in the year 2014.

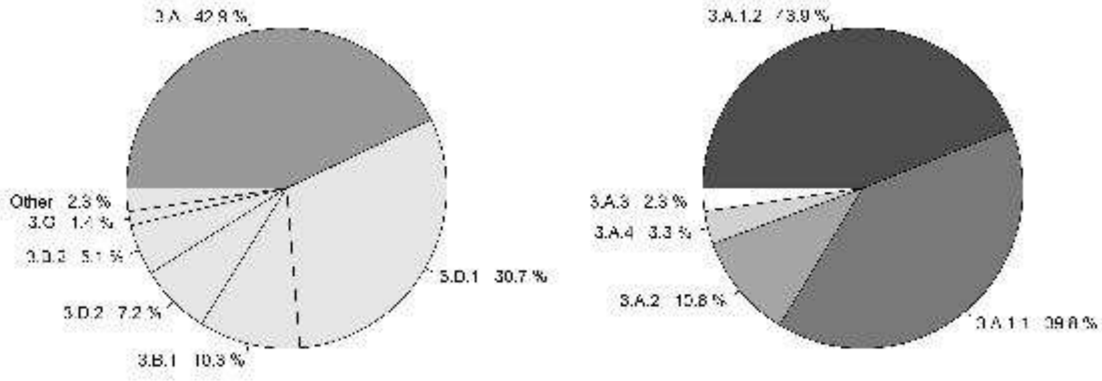
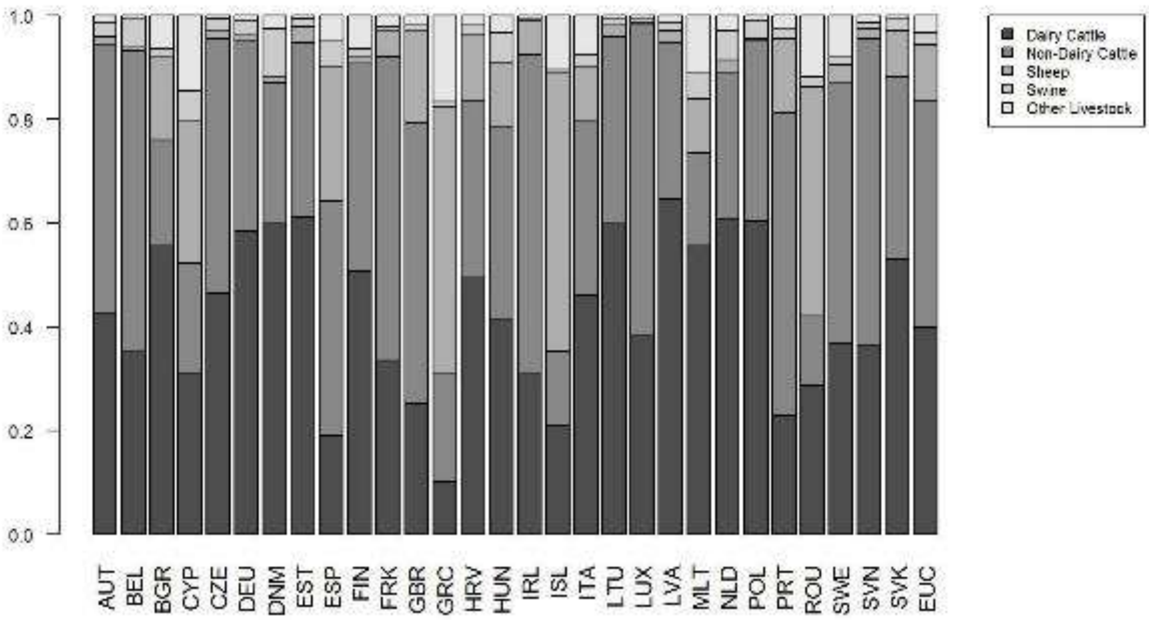


Figure 5.5 Decomposition of emissions in source category 3.A - Enteric Fermentation into its sub-categories by Member State in the year 2014.



Total GHG and CH_4 emissions by Member State from 3.A *Enteric Fermentation* are shown in Table 5.1 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq.In this category GHG and CH_4 columns have the same values, as no other greenhouse gases are produced in the enteric fermentation process. Between 1990 and 2014, CH_4 emission in this source category decreased by 24% or 57.5 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (67%) and in Germany in absolute terms (9.8 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 1.1%.

Table 5.1 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 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	4 821	4 120	4 821	4 120
Belgium	5 327	4 466	5 327	4 466
Bulgaria	4 474	1 489	4 474	1 489
Croatia	1 978	954	1 978	954
Cyprus	211	233	211	233
Czech Republic	5 755	2 817	5 755	2 817
Denmark	3 955	3 636	3 955	3 636
Estonia	1 251	561	1 251	561
Finland	2 423	2 089	2 423	2 089
France	36 553	33 705	36 553	33 705
Germany	34 652	24 875	34 652	24 875
Greece	4 017	4 041	4 017	4 041
Hungary	3 754	1 995	3 754	1 995
Ireland	11 357	10 615	11 357	10 615
Italy	15 743	13 762	15 743	13 762
Latvia	2 222	873	2 222	873
Lithuania	4 220	1 637	4 220	1 637
Luxembourg	434	416	434	416
Malta	26	36	26	36
Netherlands	9 227	8 223	9 227	8 223
Poland	21 554	12 295	21 554	12 295
Portugal	3 343	3 426	3 343	3 426
Romania	19 299	9 903	19 299	9 903
Slovakia	2 379	1 044	2 379	1 044
Slovenia	936	906	936	906
Spain	12 818	11 704	12 818	11 704
Sweden	3 629	3 138	3 629	3 138
United Kingdom	27 932	23 846	27 932	23 846
EU-28	**244 286**	**186 803**	**244 286**	**186 803**
Iceland	314	294	314	294
EU-28 + ISL	**244 600**	**187 097**	**244 600**	**187 097**

Total GHG and CH_4 emissions by Member State from *3.A.1 - Cattle Enteric Fermentation* are shown in Table 5.2 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, CH_4 emission in this source category decreased by 23% or 46.9 Mt CO_2-eq. The decrease was largest in Romania in relative terms (62%) and in Germany in absolute terms (9.5 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 1.2%.

Table 5.2 3.A.1 - Cattle: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	4 579	3 861	3 882	2%	21	1%	-698	-15%	-	-
Belgium	5 026	4 120	4 166	3%	46	1%	-860	-17%	T2	CS
Bulgaria	2 632	1 111	1 132	1%	21	2%	-1 500	-57%	T2	CS
Croatia	1 821	839	798	1%	-41	-5%	-1 023	-56%	T2	CS
Cyprus	112	119	121	0%	2	2%	9	8%	T1,T2	CS,D
Czech Republic	5 472	2 636	2 694	2%	57	2%	-2 778	-51%	T2	CS
Denmark	3 577	3 133	3 166	2%	33	1%	-411	-11%	T2	CS,D
Estonia	1 194	526	531	0%	5	1%	-663	-56%	T2	CS,D
Finland	2 226	1 864	1 897	1%	32	2%	-330	-15%	T2	CS
France	33 079	30 511	31 034	20%	523	2%	-2 045	-6%	-	-
Germany	33 252	23 562	23 707	15%	155	1%	-9 546	-29%	T2,T3	CS,D
Greece	1 178	1 273	1 250	1%	-24	-2%	72	6%	T2	CS,D
Hungary	2 962	1 517	1 568	1%	52	3%	-1 394	-47%	T2	CS
Ireland	10 101	9 749	9 821	6%	72	1%	-280	-3%	CS,T2	CS
Italy	13 167	10 982	10 953	7%	-30	0%	-2 215	-17%	T2	CS
Latvia	2 118	800	828	1%	28	4%	-1 290	-61%	T2	CS
Lithuania	4 101	1 492	1 571	1%	78	5%	-2 531	-62%	T2	CS
Luxembourg	428	398	408	0%	9	2%	-21	-5%	T2	CS
Malta	16	27	26	0%	0	-1%	10	64%	T2	D
Netherlands	8 191	7 229	7 327	5%	98	1%	-864	-11%	T2,T3	CS
Poland	19 547	11 584	11 711	7%	127	1%	-7 835	-40%	T3	CS
Portugal	2 335	2 730	2 784	2%	54	2%	450	19%	T2	CS
Romania	11 019	4 155	4 161	3%	6	0%	-6 858	-62%	T2	CS
Slovakia	2 145	919	920	1%	1	0%	-1 225	-57%	T2	CS
Slovenia	904	848	866	1%	18	2%	-37	-4%	T2	CS
Spain	7 173	7 296	7 527	5%	231	3%	353	5%	CS,T2	CS,D
Sweden	3 236	2 713	2 725	2%	13	0%	-511	-16%	CS	CS
United Kingdom	21 806	18 693	18 950	12%	258	1%	-2 856	-13%	T1,T2	CS,D
EU-28	**203 400**	**154 678**	**156 523**	**100%**	**1 845**	**1%**	**-46 876**	**-23%**		
Iceland	98	95	104	0%	9	9%	6	6%	-	-
EU-28 + ISL	**203 497**	**154 774**	**156 627**	**100%**	**1 854**	**1%**	**-46 870**	**-23%**		

Total GHG and CH_4 emissions by Member State from *3.A.2 - Sheep Enteric Fermentation* are shown in Table 5.3 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, CH_4 emission in this source category decreased by 33% or 9.6 Mt CO_2-eq. The decrease was largest in Poland in relative terms (95%) and in Romania in absolute terms (2.2 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 0.7%.

Table 5.3 3.A.2 - Sheep: Member States' contributions to total GHG and CH_4 emissions

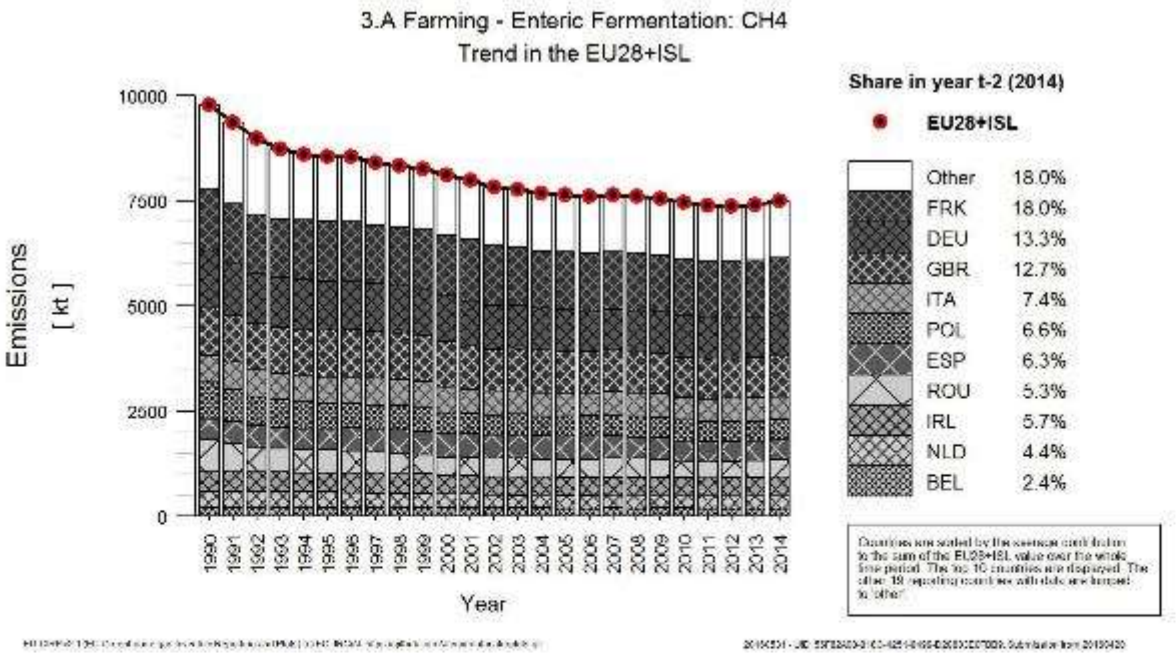
Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	62	71	70	0%	-2	-2%	8	13%	-	-
Belgium	38	22	22	0%	1	3%	-16	-42%	T1	D
Bulgaria	1 455	239	240	1%	1	0%	-1 215	-83%	T2	CS
Croatia	94	120	119	1%	-1	-1%	25	27%	T2	CS
Cyprus	58	63	65	0%	2	3%	7	11%	T1	D
Czech Republic	86	44	45	0%	1	2%	-41	-48%	T1	D
Denmark	39	37	37	0%	0	-1%	-2	-4%	T2	D
Estonia	32	17	17	0%	1	4%	-15	-46%	D,T1	D
Finland	18	28	29	0%	0	2%	11	65%	CS	CS
France	2 580	1 719	1 710	9%	-9	-1%	-870	-34%	-	-
Germany	506	292	294	1%	2	1%	-212	-42%	T1	D
Greece	2 054	2 086	2 085	10%	-1	0%	31	2%	T2	CS,D
Hungary	392	242	247	1%	5	2%	-144	-37%	T1	D
Ireland	1 176	696	695	3%	-1	0%	-481	-41%	T1	D
Italy	1 748	1 436	1 433	7%	-3	0%	-315	-18%	T1	D
Latvia	33	17	19	0%	2	9%	-14	-44%	T1	D
Lithuania	17	29	36	0%	6	22%	19	115%	T2	CS
Luxembourg	2	2	2	0%	0	2%	0	20%	T2	CS
Malta	2	4	4	0%	0	-4%	1	55%	T2	D
Netherlands	340	207	192	1%	-15	-7%	-149	-44%	T1	D
Poland	832	45	40	0%	-4	-10%	-792	-95%	T2	D
Portugal	737	456	492	2%	37	8%	-245	-33%	T2	CS
Romania	6 587	4 212	4 389	22%	177	4%	-2 198	-33%	T2	CS
Slovakia	148	96	92	0%	-4	-4%	-56	-38%	T2	CS
Slovenia	4	16	17	0%	1	6%	13	311%	T1	D
Spain	4 662	3 184	3 006	15%	-178	-6%	-1 657	-36%	CS,T2	CS,D
Sweden	81	115	118	1%	2	2%	37	45%	T1	D
United Kingdom	5 550	4 134	4 242	21%	108	3%	-1 308	-24%	T1	CS,D
EU-28	**29 333**	**19 629**	**19 756**	**99%**	**127**	**1%**	**-9 577**	**-33%**		
Iceland	181	154	158	1%	5	3%	-23	-13%	-	-
EU-28 + ISL	**29 514**	**19 782**	**19 914**	**100%**	**132**	**1%**	**-9 600**	**-33%**		

5.2.1.1 Trends in Emissions and Activity Data

3.A - Enteric Fermentation - Emissions

Emissions in source category *3.A - Enteric Fermentation* decreased considerably in EU28+ISL by 24% or 57.5 Mt CO_2-eq in the period 1990 to 2014. Figure 5.6 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 emissions from enteric fermentation for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 82% of the total. Emissions decreased in 25 countries and increased in four countries. The three countries with the largest decreases were Germany, Romania and Poland with a total absolute decrease of 28.4 Mt CO_2-eq. The three countries with the largest increases were Cyprus, Greece and Portugal, with a total absolute increase of 129 kt CO_2-eq.

Figure 5.6 3.A: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.A.1 - Cattle - Emissions

Emissions in source category *3.A.1 - Cattle* decreased considerably in EU28+ISL by 23% or 46.9 Mt CO_2-eq in the period 1990 to 2014. The ten countries with the highest emissions accounted together for 82.6% of the total. Emissions decreased in 23 countries and increased in six countries. The three countries with the largest decreases were Germany, Poland and Romania with a total absolute decrease of 24.2 Mt CO_2-eq. Largest increases occurred in Spain and Portugal, with a total absolute increase of 803 kt CO_2-eq.

Emissions in source category *3.A.1 - Dairy Cattle* decreased strongly in EU28+ISL by 29% or 29.8 Mt CO_2-eq in the period 1990 to 2014. Figure 5.7 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 emissions from enteric fermentation for the different Member States along the inventory period. Each bar shows the emissions accumulated by the different Member States in a specific year, in kt, where every Member State is represented by a different pattern. Only the first ten Member States with the highest emission shares are shown separately, while the emissions corresponding to the remaining countries are represented under ‘other’ label. In red points, we see the total emissions of the category for the EU28+ISL. The legend on the right shows the Member States corresponding to each pattern and the share of their emissions over the EU-28 total. The ten countries with the highest emissions accounted together for 82.2% of the total. Emissions decreased in 27 countries and increased in two countries. The three countries with the largest decreases were Poland, Germany and Romania with a total absolute decrease of 14.8 Mt CO_2-eq. Emissions increased in Cyprus and Malta, with a total absolute increase of 15 kt CO_2-eq.

Emissions in source category *3.A.1 - Non-Dairy Cattle* decreased considerably in EU28+ISL by 17% or 17.1 Mt CO_2-eq in the period 1990 to 2014. Figure 5.8 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 emissions from enteric fermentation for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 84.7% of the total. Emissions decreased in 21 countries and increased in eight countries. The three countries with the largest decreases were Germany, Romania and Poland with a total absolute decrease of 9.4 Mt CO_2-eq. Largest increases occurred in Portugal and Spain, with a total absolute increase of 1.9 Mt CO_2-eq.

3.A.1 - Cattle - Population

The main driver for the decrease of CH_4 emissions from enteric fermentation was the decrease in animal numbers shown in Figure 5.9 and Figure 5.10.

Cattle population decreased strongly in EU28+ISL by 26% or 31.9 mio heads in the period 1990 to 2014. The ten countries with the highest population accounted together for 84.2% of the total. Population decreased in 24 countries and increased in five countries. The three countries with the largest decreases were Germany, Poland and Romania with a total absolute decrease of 14.2 mio heads. Largest increases occurred in Portugal and Spain, with a total absolute increase of 1.1 mio heads.

Figure 5.7 3.A.1 Dairy Cattle: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

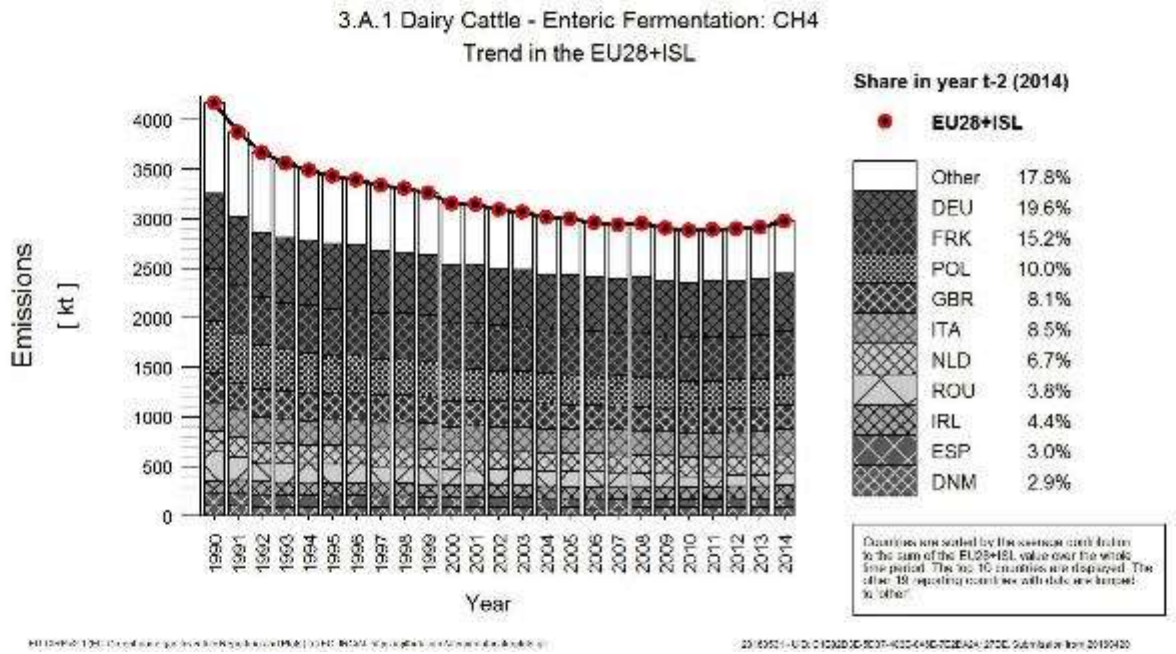


Figure 5.8 3.A.1 Non-Dairy Cattle: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

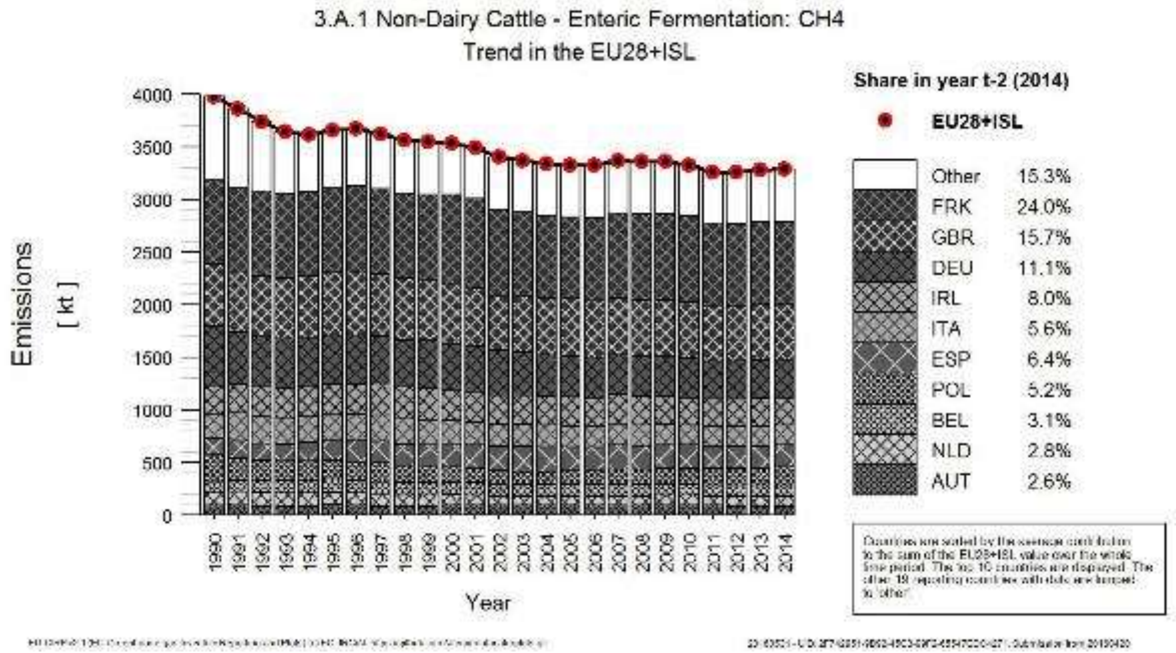


Figure 5.9 3.A.1 Dairy Cattle: Trend in cattle population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

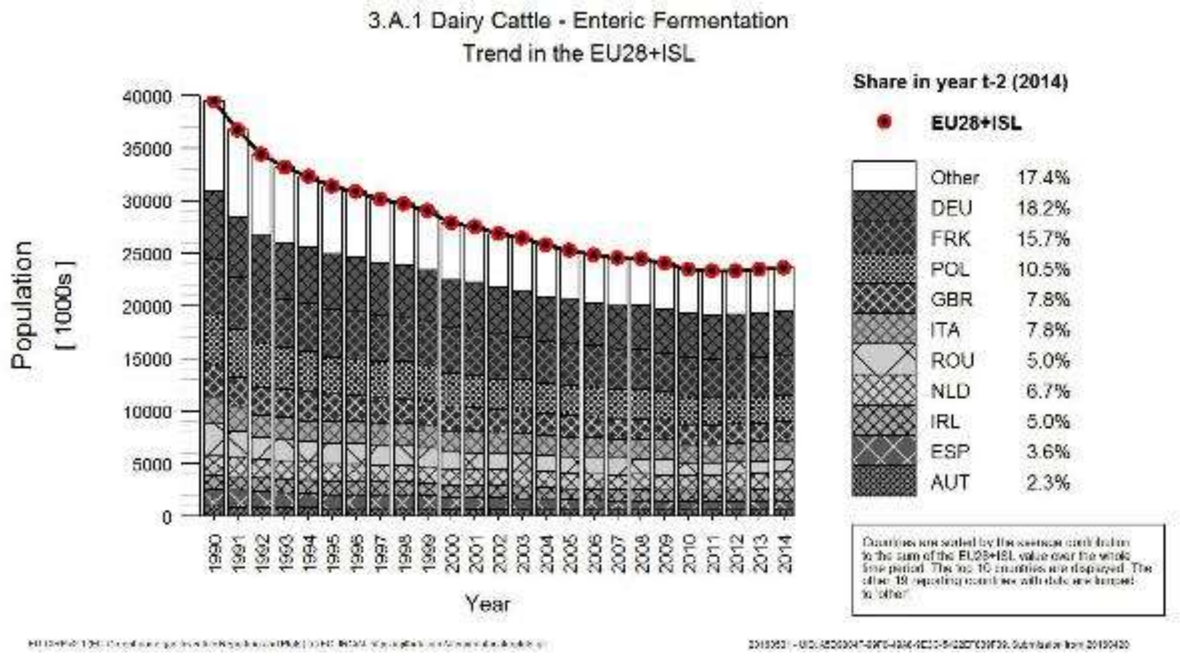
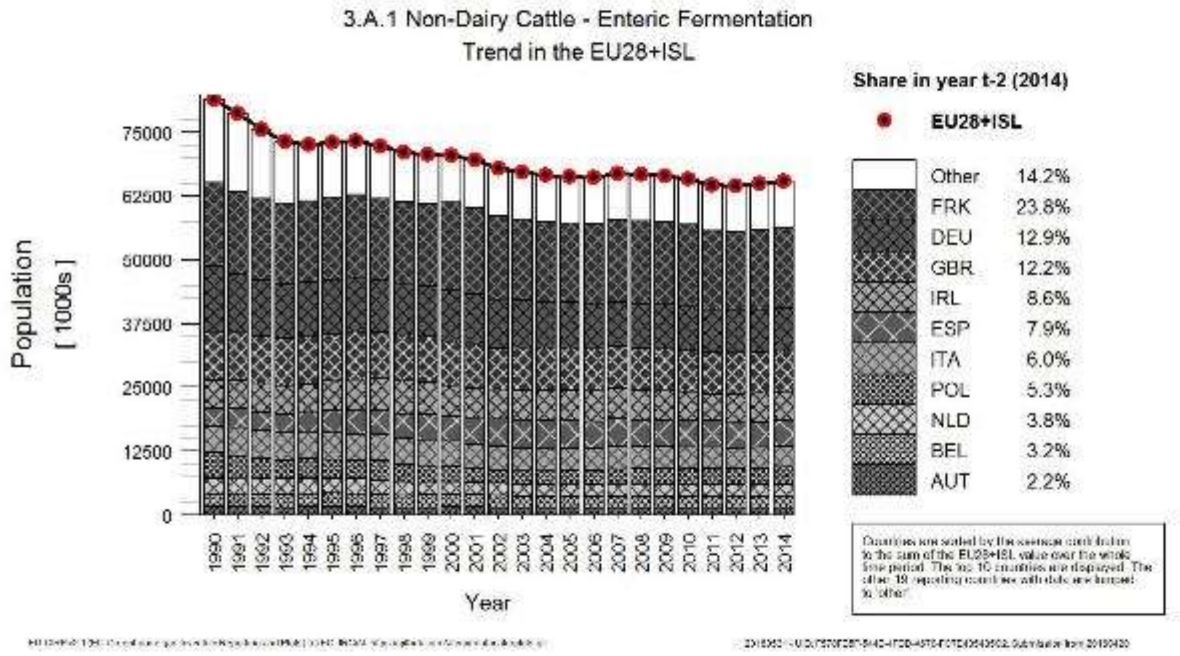


Figure 5.10 3.A.1 Non-Dairy Cattle: Trend in cattle population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.A.2 - Sheep - Emissions

Emissions in source category *3.A.2 - Sheep* decreased strongly in EU28+ISL by 33% or 9.6 Mt CO_2-eq in the period 1990 to 2014. Figure 5.11 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 emissions from enteric fermentation for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 93.4% of the total. Emissions decreased in nineteen countries and increased in ten countries. The four countries with the largest decreases were Romania, Spain, the United Kingdom and Bulgaria with a total absolute decrease of 6.4 Mt CO_2-eq. The four countries with the largest increases were Lithuania, Croatia, Greece and Sweden, with a total absolute increase of 112 kt CO_2-eq.

3.A.2 - Sheep - Population

The main driver for the decrease of CH_4 emissions from enteric fermentation for sheep was the decrease in animal numbers shown in Figure 5.12.

Sheep population decreased strongly in EU28+ISL by 33% or 48 mio heads in the period 1990 to 2014. Figure 5.12 shows the trend of sheep population indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 population for the different Member States along the inventory period. The ten countries with the highest population accounted together for 93.4% of the total. Population decreased in twenty countries and increased in nine countries. The three countries with the largest decreases were the United Kingdom, Spain and Bulgaria with a total absolute decrease of 26.3 mio heads. The four countries with the largest increases were Slovenia, Lithuania, Greece and Sweden, with a total absolute increase of 455 thousand heads.

Figure 5.11 3.A.2: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

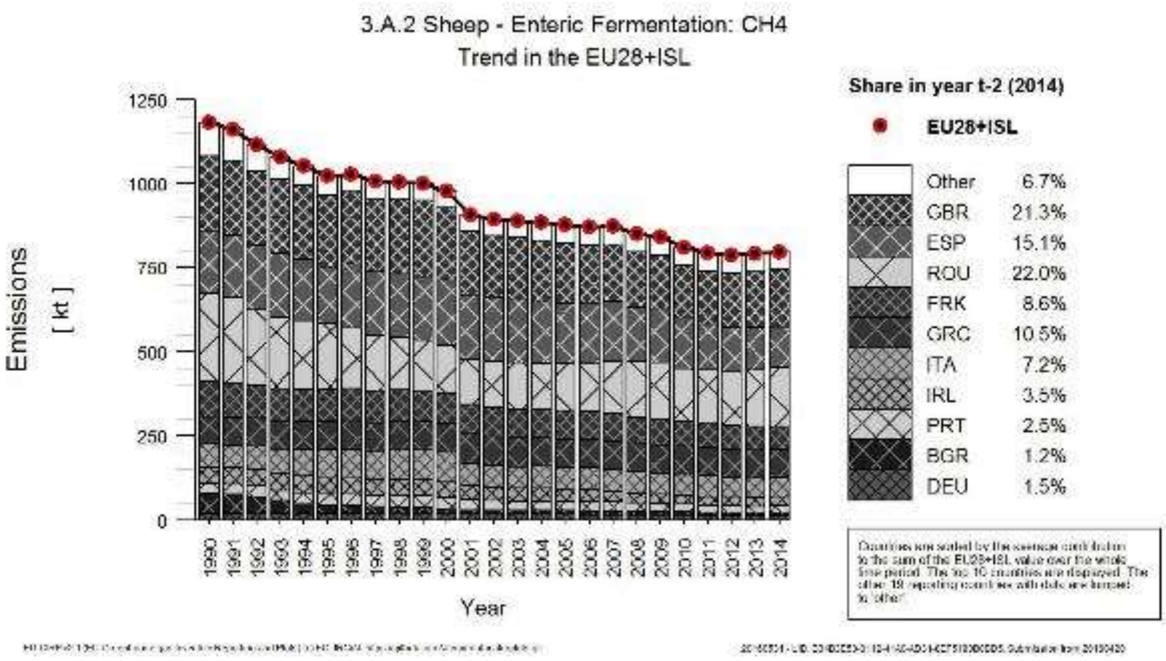
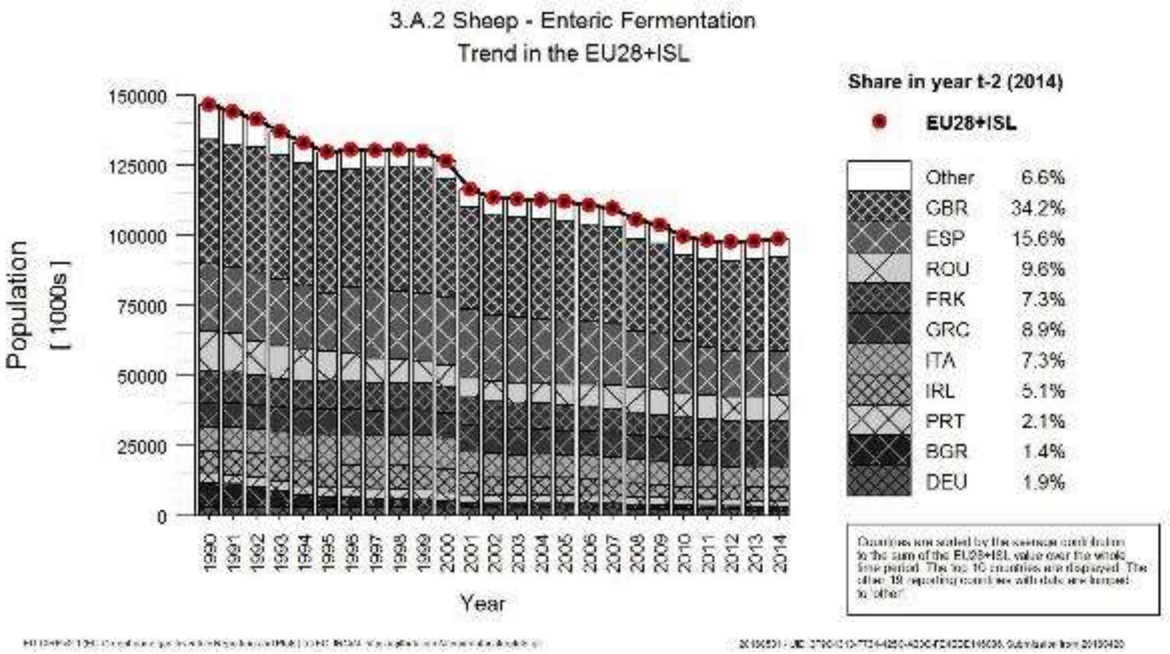


Figure 5.12 3.A.2: Trend in sheep population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



5.2.1.2 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 distinguishes '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+ISL 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 categories 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.

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+ISL slightly between 1990 and 2014 by 4.6% or 3.09 kg/head/year. Table 5.4 shows the implied emission factor for CH_4 emissions in source category *3.A.1 - Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in five countries and increased in 24 countries. The three countries with the largest decreases were Croatia, Spain and Sweden with a mean absolute value of 8 kg/head/year. The four countries with the largest increases were, Slovakia, Latvia, Estonia and Finland with a mean absolute value of 20 kg/head/year.

Table 5.4 3.A.1 - Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	71	79	|	Ireland	59	58
Belgium	62	66	|	Iceland	52	56
Bulgaria	66	80	|	Italy	68	76
Cyprus	82	81	|	Lithuania	71	85
Czech Republic	62	78	|	Luxembourg	78	82
Germany	68	74	|	Latvia	59	78
Denmark	64	78	|	Malta	62	71
Estonia	63	80	|	Netherlands	67	72
Spain	56	50	|	Poland	78	79
Finland	65	83	|	Portugal	68	74
France	61	64	|	Romania	83	83
United Kingdom	72	77	|	Sweden	75	73
Greece	68	72	|	Slovenia	68	74
Croatia	86	72	|	Slovakia	55	79
Hungary	73	79	|	**EU28+ISL**	**67**	**70**

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+ISL considerably between 1990 and 2014 by 19.7% or 20.8 kg/head/year. Figure 5.13 shows the trend of the implied emission factor in EU28+ISL 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 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in two countries and increased in 26 countries. It was in 2014 at the level of 1990 in one country. Decreases occurred in Croatia and Cyprus with a mean absolute value of 4 kg/head/year. The four countries with the largest increases were, Slovakia, Czech Republic, Estonia and Portugal with a mean absolute value of 40 kg/head/year.

Figure 5.13 3.A.1 - Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

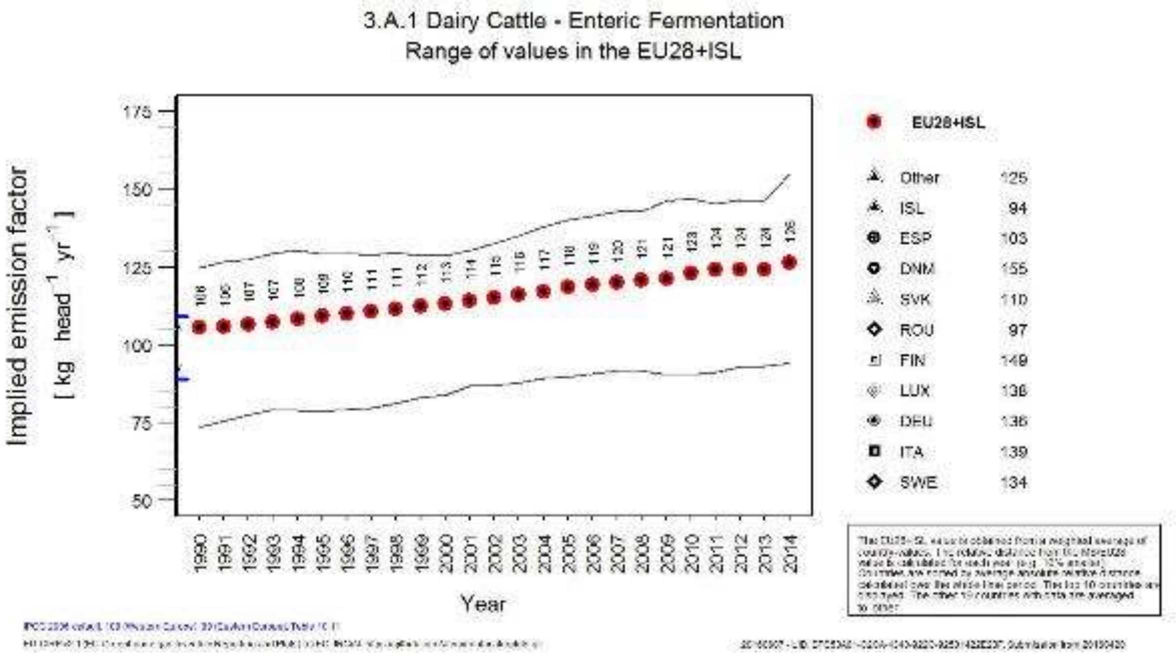


Table 5.5 3.A.1 - Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	105	130	|	Ireland	101	111
Belgium	110	140	|	Iceland	79	94
Bulgaria	110	110	|	Italy	111	139
Cyprus	118	115	|	Lithuania	101	125
Czech Republic	97	141	|	Luxembourg	120	138
Germany	120	136	|	Latvia	103	136
Denmark	125	155	|	Malta	104	122
Estonia	102	143	|	Netherlands	110	127
Spain	77	103	|	Poland	108	120
Finland	112	149	|	Portugal	97	135
France	99	122	|	Romania	97	97
United Kingdom	101	131	|	Sweden	120	134
Greece	93	119	|	Slovenia	92	122
Croatia	109	105	|	Slovakia	74	110
Hungary	111	131	|	**EU28+ISL**	**106**	**126**

3.A.1 - Dairy Cattle - Gross energy

The gross energy, a parameter used for calculating CH_4 emissions in source category *3.A.1 - Dairy Cattle*, increased in EU28+ISL considerably between 1990 and 2014 by 22.5% or 55.9 MJ/day. Figure 5.14 shows the trend of the gross energy in EU28+ISL indicating also the range of values used by the countries. Table 5.6 shows the gross energy in source category *3.A.1 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Gross energy decreased in one country and increased in 23 countries. It was in 2014 at the level of 1990 in one country. No data were available for four countries (Bulgaria, Czech Republic, France and the Netherlands). A decrease occurred in Cyprus with an absolute value of 9 MJ/day. The four countries with the largest increases were, Estonia, Spain, Malta and Slovakia with a mean absolute value of 81 MJ/day. Data from Luxembourg are reported in a different unit and are therefore not included in this comparison.

Figure 5.14 3.A.1 - Dairy Cattle: Trend in gross energy in the EU28+ISL and range of values reported by countries

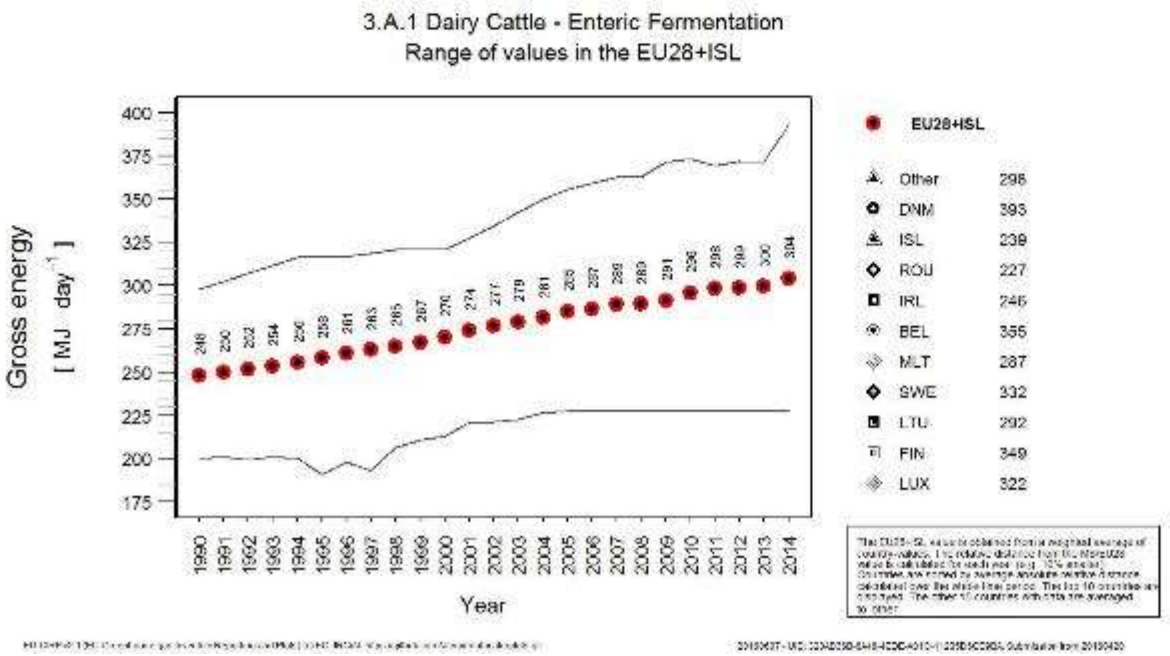


Table 5.6 3.A.1 - Dairy Cattle: Member States' and EU28+ISL gross energy (MJ/day)

Member State	1990	2014		Member State	1990	2014
Austria	247	305	|	Iceland	200	239
Belgium	279	355	|	Italy	261	325
Cyprus	278	269	|	Lithuania	234	292
Germany	260	326	|	Luxembourg	280	322
Denmark	298	393	|	Latvia	242	319
Estonia	241	337	|	Malta	212	287
Spain	225	306	|	Poland	254	281
Finland	264	349	|	Portugal	227	285
United Kingdom	237	307	|	Romania	227	227
Greece	217	280	|	Sweden	276	332
Croatia	256	268	|	Slovenia	215	286
Hungary	255	302	|	Slovakia	211	281
Ireland	222	246	|	**EU28+ISL**	**248**	**304**

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+ISL very strongly between 1990 and 2014 by 58.8% or 6.87

kg/head/day. Figure 5.15 shows the trend of the milk yield in EU28+ISL indicating also the range of values used by the countries. Table 5.7 shows the milk yield in source category *3.A.1 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Milk yield decreased in one country and increased in 25 countries. It was in 2014 at the level of 1990 in one country. No data were available for the Netherlands. A decrease occurred in Bulgaria with an absolute value of 0.035 kg/head/day. The four countries with the largest increases were, Slovakia, Spain, Croatia and Slovenia with a mean absolute value of 9 kg/head/day.

Figure 5.15 3.A.1 - Dairy Cattle: Trend in milk yield in the EU28+ISL and range of values reported by countries

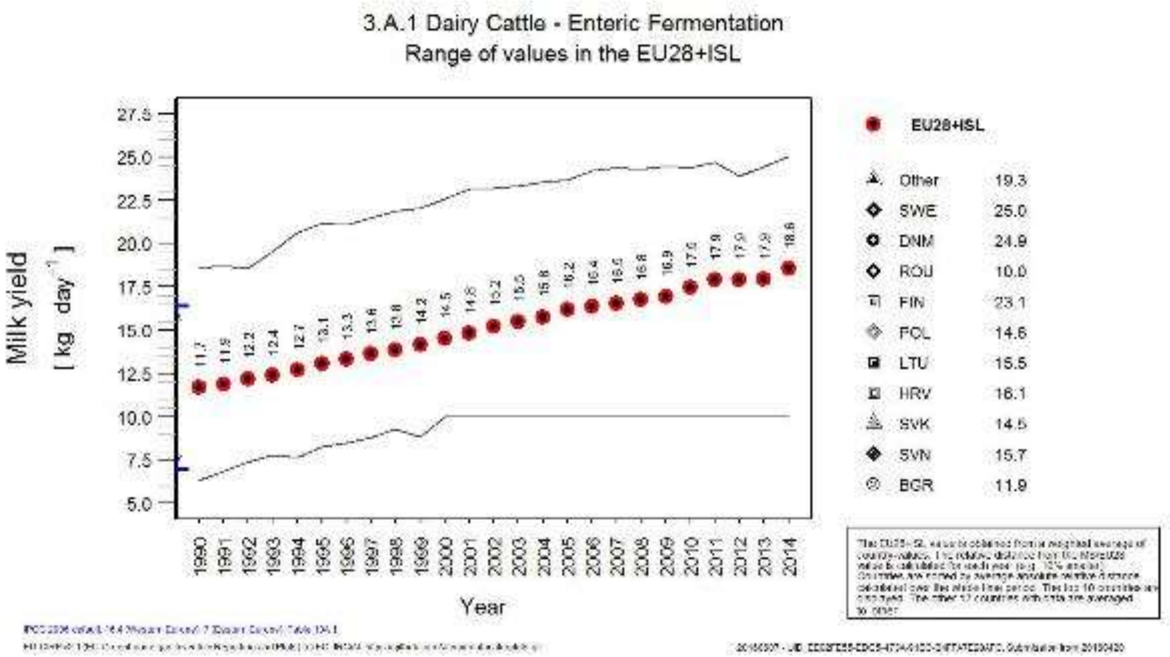


Table 5.7 3.A.1 - Dairy Cattle: Member States' and EU28+ISL milk yield (kg/head/day)

Member State	1990	2014		Member State	1990	2014
Austria	10.4	18	|	Ireland	11.5	14
Belgium	11.2	21	|	Iceland	11.3	16
Bulgaria	11.9	12	|	Italy	11.5	19
Cyprus	12.2	17	|	Lithuania	10.2	16
Czech Republic	10.7	21	|	Luxembourg		
Germany	12.9	21	|	Latvia	11.3	19
Denmark	16.5	25	|	Malta	15.1	19
Estonia	11.4	23	|	Poland	8.9	15
Spain	9.9	21	|	Portugal	12.2	23
Finland	15.7	23	|	Romania	10.0	10
France	13.1	19	|	Sweden	18.6	25
United Kingdom	14.1	22	|	Slovenia	7.7	16
Greece	7.6	15	|	Slovakia	6.3	14
Croatia	7.8	16	|	**EU28+ISL**	**11.7**	**19**
Hungary	13.8	20	|			

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+ISL slightly between 1990 and 2014 by 3% or 1.48 kg/head/year. Figure 5.16 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.8 shows the implied emission factor for CH_4 emissions in source category *3.A.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in six countries and increased in 23 countries. The three countries with the largest decreases were Spain, Croatia and the Netherlands with a mean absolute value of 4 kg/head/year. The largest increases occurred in Finland and Latvia with a mean absolute value of 11 kg/head/year.

Figure 5.16 3.A.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

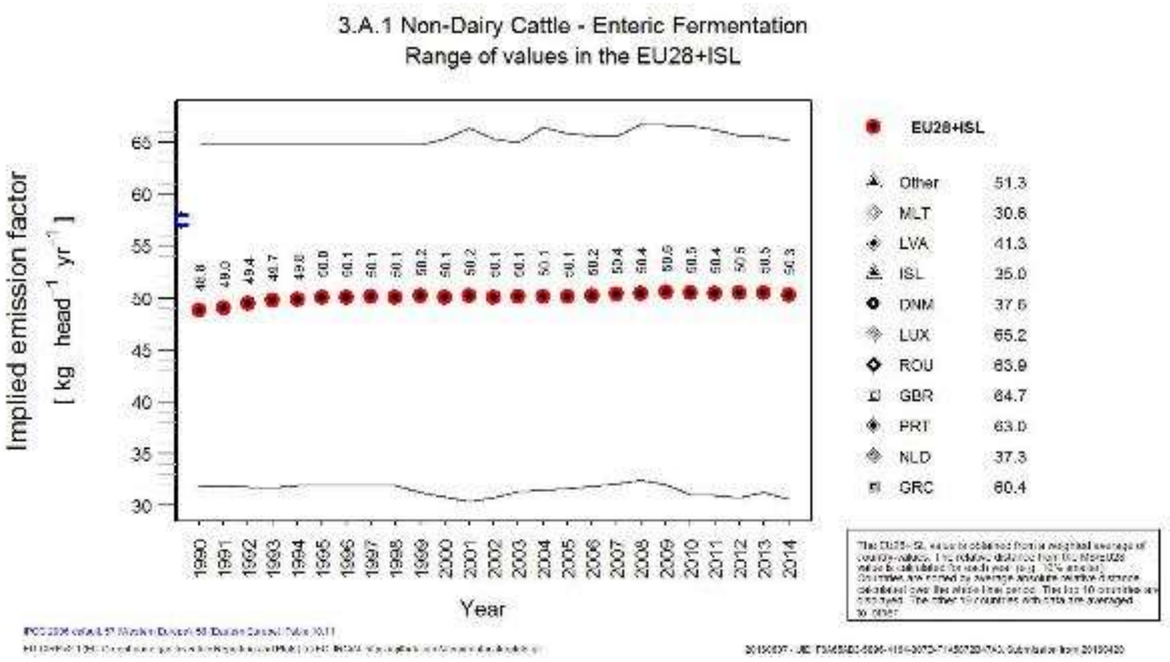


Table 5.8 3.A.1 - Non-Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014	Member State	1990	2014
Austria	52	60	Ireland	49	47
Belgium	45	50	Iceland	32	35
Bulgaria	38	46	Italy	46	47
Cyprus	57	57	Lithuania	54	56
Czech Republic	44	55	Luxembourg	63	65
Germany	43	43	Latvia	33	41
Denmark	33	38	Malta	32	31
Estonia	40	44	Netherlands	40	37
Spain	47	41	Poland	49	50
Finland	39	53	Portugal	56	63
France	49	51	Romania	65	64
United Kingdom	63	65	Sweden	53	55

Greece	57	60	|	Slovenia	50	60
Croatia	54	50	|	Slovakia	45	55
Hungary	53	55	|	**EU28+ISL**	**49**	**50**

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*, decreased in EU28+ISL barely between 1990 and 2014 by 0.061% or 0.0725 MJ/head/day. Figure 5.17 shows the trend of the average gross energy intake in EU28+ISL indicating also the range of values used by the countries. Table 5.9 shows the average gross energy intake in source category *3.A.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Average gross energy intake decreased in five countries and increased in nineteen countries. It was in 2014 at the level of 1990 in two countries. No data were available for three countries (Cyprus, the United Kingdom and Malta). The largest decrease occurred in the Netherlands with an absolute value of 5 MJ/head/day. The largest increase occurred in Finland with an absolute value of 33 MJ/head/day.

Figure 5.17 3.A.1 - Non-Dairy Cattle: Trend in average gross energy intake in the EU28+ISL and range of values reported by countries

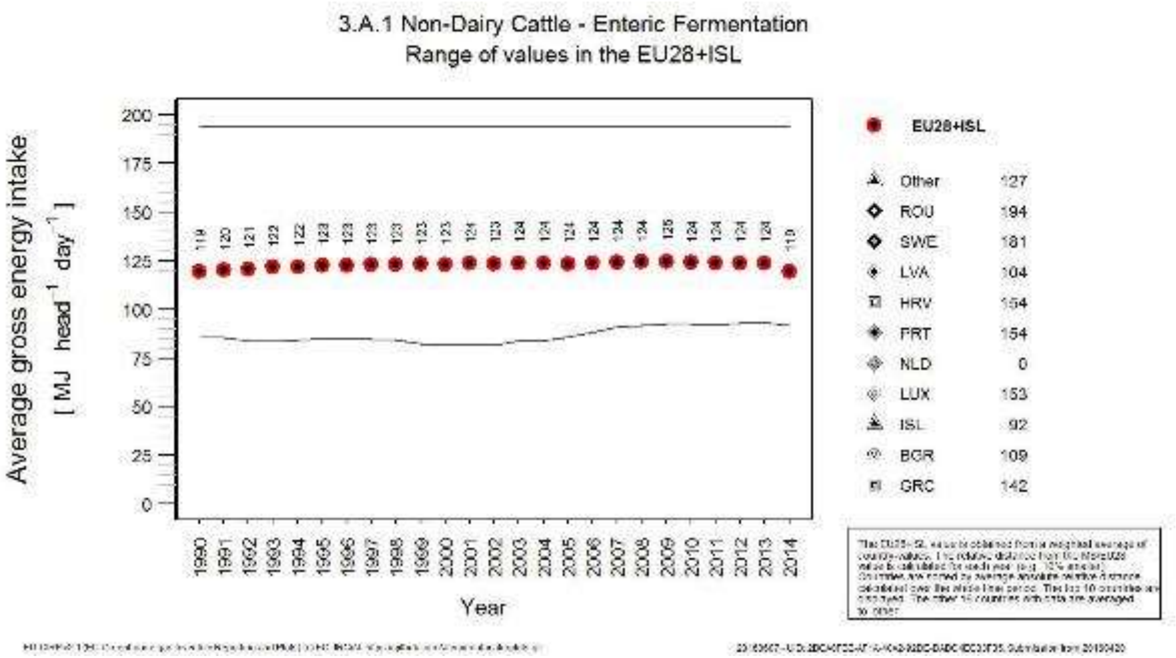


Table 5.9 3.A.1 - Non-Dairy Cattle: Member States' and EU28+ISL average gross energy intake (MJ/head/day)

Member State	1990	2014		Member State	1990	2014
Austria	123	141	|	Iceland	85	92
Belgium	119	132	|	Italy	141	140
Bulgaria	90	109	|	Lithuania	127	130
Czech Republic	104	130	|	Luxembourg	146	153
Germany	103	104	|	Latvia	86	104

Denmark	107	130	Netherlands	98	
Estonia	105	108	Poland	114	117
Spain	124	121	Portugal	139	154
Finland	92	125	Romania	194	194
France	116	119	Sweden	181	181
Greece	134	142	Slovenia	111	133
Croatia	155	154	Slovakia	122	140
Hungary	134	138	**EU28+ISL**	**119**	**119**
Ireland	132	127			

3.A.2 - Sheep - Implied emission factor

The implied emission factor for CH_4 emissions in source category *3.A.2 - Sheep* increased in EU28+ISL barely between 1990 and 2014 by 0.25% or 0.0199 kg/head/year. Figure 5.18 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.10 shows the implied emission factor for CH_4 emissions in source category *3.A.2 - Sheep* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in nine countries and increased in twelve countries. It was in 2014 at the level of 1990 in eight countries. The three countries with the largest decreases were Ireland, Slovakia and Lithuania with a mean absolute value of 0.4 kg/head/year. The largest increase occurred in Croatia with an absolute value of 3 kg/head/year.

Figure 5.18 3.A.2 - Sheep: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

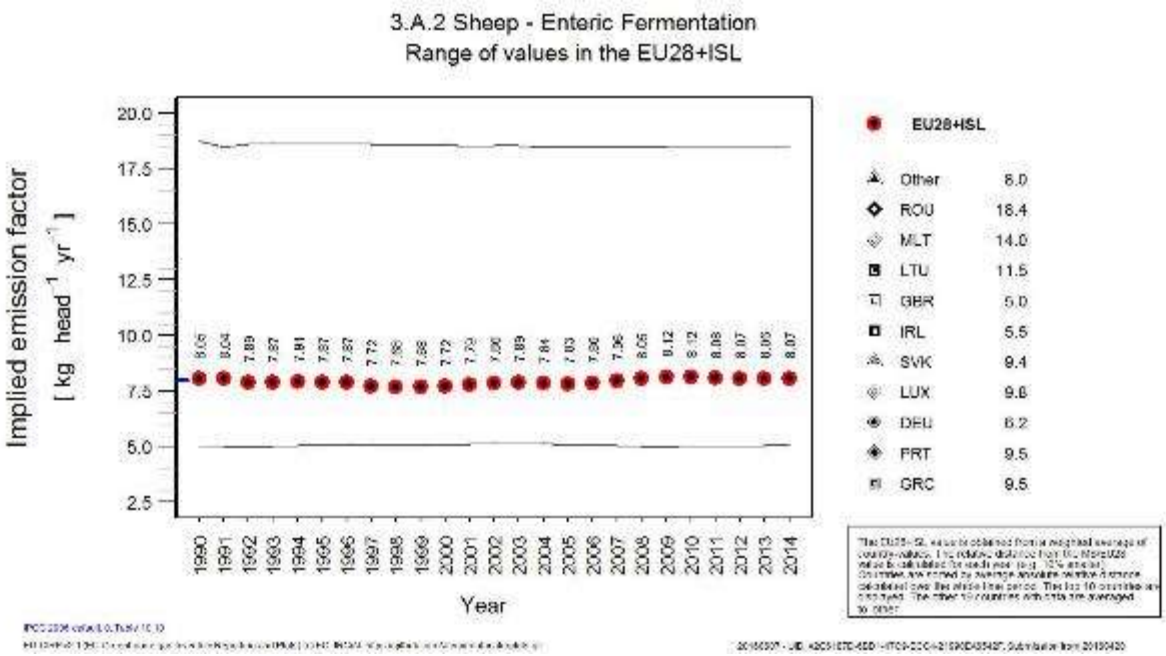


Table 5.10 3.A.2 - Sheep: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014	Member State	1990	2014

Austria	8.0	8.0	|	Ireland	5.9	5.5
Belgium	8.0	8.0	|	Iceland	8.4	8.3
Bulgaria	7.0	7.1	|	Italy	8.0	8.0
Cyprus	8.0	8.0	|	Lithuania	11.8	11.5
Czech Republic	8.0	8.0	|	Luxembourg	9.8	9.8
Germany	6.2	6.2	|	Latvia	8.0	8.0
Denmark	6.7	6.7	|	Malta	12.8	14.0
Estonia	8.0	8.0	|	Netherlands	8.0	8.0
Spain	7.8	7.8	|	Poland	8.0	8.0
Finland	6.8	8.4	|	Portugal	9.0	9.5
France	9.1	9.5	|	Romania	18.7	18.4
United Kingdom	5.0	5.0	|	Sweden	8.0	8.0
Greece	9.5	9.5	|	Slovenia	8.0	8.0
Croatia	5.0	7.9	|	Slovakia	9.9	9.4
Hungary	8.0	8.0	|	**EU28+ISL**	**8.0**	**8.1**

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+ISL slightly between 1990 and 2014 by 3.7% or 0.917 MJ/head/day. Figure 5.19 shows the trend of the average gross energy intake in EU28+ISL indicating also the range of values used by the countries. Table 5.11 shows the average gross energy intake in source category *3.A.2 - Sheep* for the years 1990 and 2014 for all Member States and EU28+ISL. Average gross energy intake decreased in five countries and increased in five countries. It was in 2014 at the level of 1990 in four countries. No data were available for fifteen countries (Austria, Belgium, Cyprus, Czech Republic, Estonia, Finland, France, the United Kingdom, Croatia, Hungary, Italy, Latvia, the Netherlands, Poland and Slovenia). The three countries with the largest decreases were Denmark, Lithuania and Greece with a mean absolute value of 1 MJ/head/day. The three countries with the largest increases were, Slovakia, Malta and Portugal with a mean absolute value of 2 MJ/head/day.

Figure 5.19 3.A.2 - Sheep: Trend in average gross energy intake in the EU28+ISL and range of values reported by countries

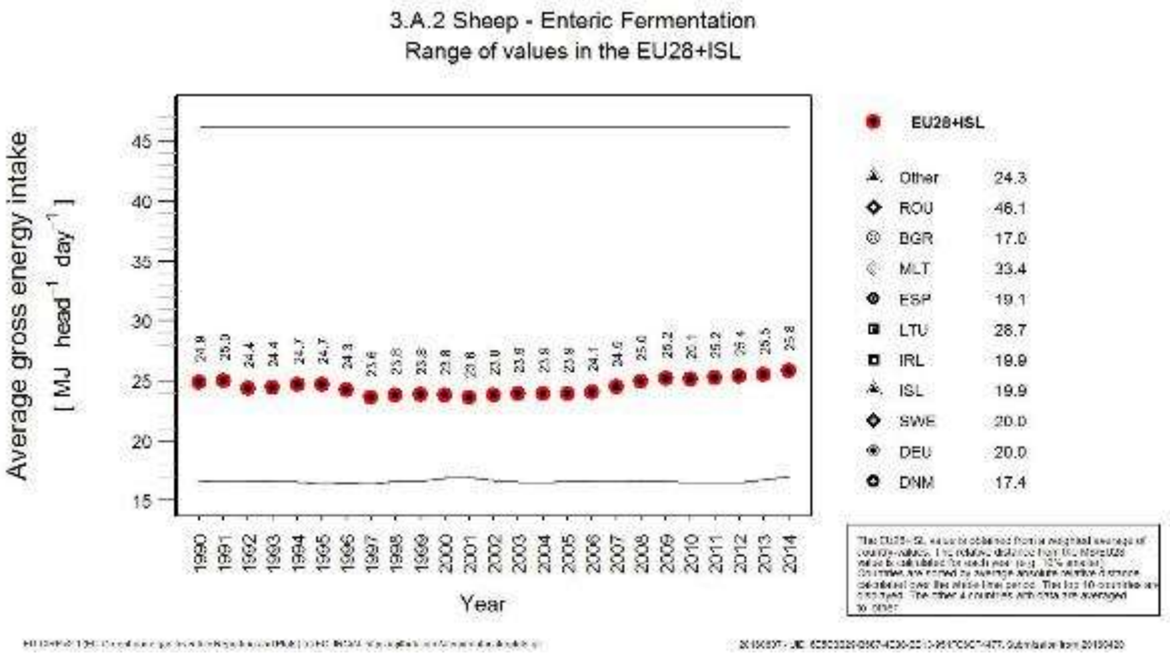


Table 5.11 3.A.2 - Sheep: Member States' and EU28+ISL average gross energy intake (MJ/head/day)

Member State	1990	2014		Member State	1990	2014
Bulgaria	17	17	|	Luxembourg	27	27
Germany	20	20	|	Malta	31	33
Denmark	20	17	|	Portugal	22	23
Spain	19	19	|	Romania	46	46
Greece	23	23	|	Sweden	20	20
Ireland	20	20	|	Slovakia	22	24
Iceland	20	20	|	**EU28+ISL**	**25**	**26**
Lithuania	29	29	|			

5.2.2 Manure Management - CH_4 (CRF Source Category 3B1)

CH_4 emissions from source category 3.B.1 manure management are 0.47% of total EU28+ISL GHG emissions and 4.4% of total EU28+ISL CH_4 emissions. They make 10.3% of total agricultural emissions. The main sub-categories are 3.B.1.3 (Swine) and 3.B.1.1.1 (Dairy Cattle) as shown in Figure 5.20. Regarding the origin of emissions in the different Member States, Figure 5.21 shows the distribution of CH_4 emissions from manure management by livestock category in all Member States and in the EU28+ISL. Each bar represents the total emissions of a country in the current emission category, where different shades of grey correspond to the emitting animal types.

Figure 5.20 Share of source category 3.B.1 on total EU28+ISL agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emissions in the year 2014.

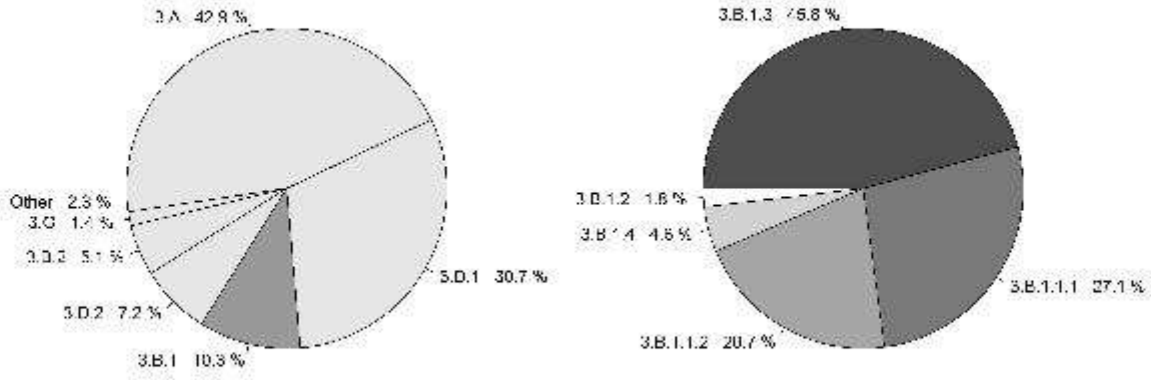
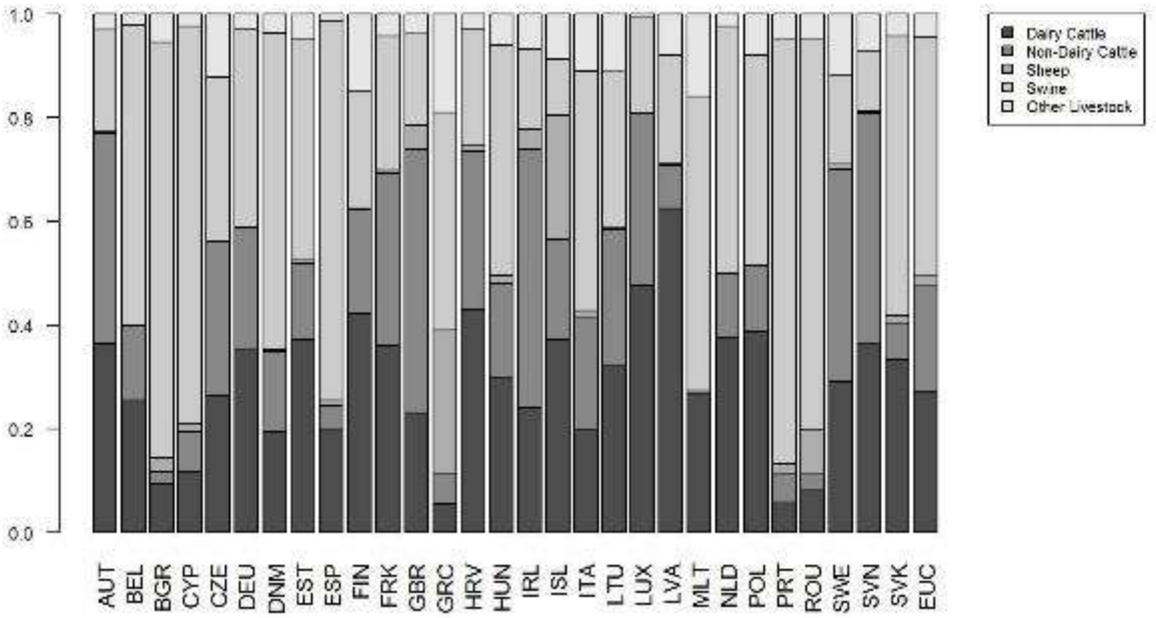


Figure 5.21 Decomposition of emissions in source category 3.B.1 - Manure Management into its sub-categories by Member State in the year 2014.



Total GHG and CH_4 emissions by Member State from 3.B.1 *Manure Management* are shown in Table 5.12 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, CH_4 emission in this source category decreased by 19% or 10.7 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (87%) and in Romania in absolute terms (2.9 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 2.8%.

Table 5.12 3.B.1 - Manure Management: Member States' contributions to total GHG and CH_4 emissions

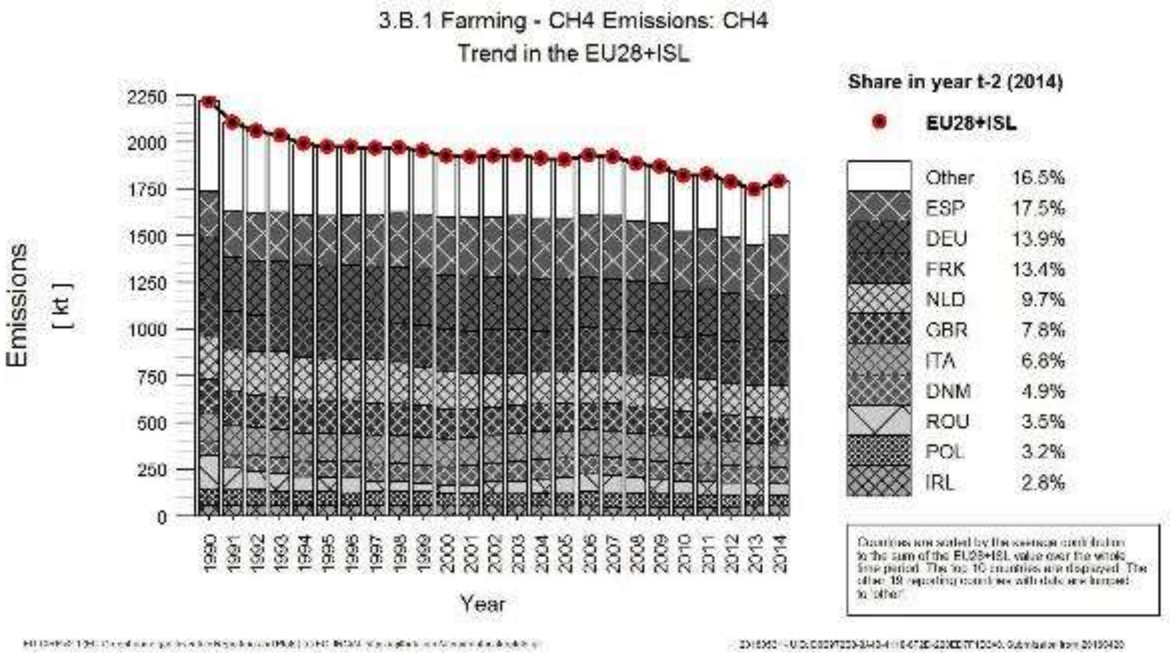
Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	587	438	587	438
Belgium	1 296	1 257	1 296	1 257
Bulgaria	2 049	261	2 049	261
Croatia	353	175	353	175
Cyprus	129	153	129	153
Czech Republic	1 772	768	1 772	768
Denmark	1 811	2 200	1 811	2 200
Estonia	145	84	145	84
Finland	368	453	368	453
France	5 032	5 976	5 032	5 976
Germany	8 073	6 246	8 073	6 246
Greece	884	822	884	822
Hungary	1 161	653	1 161	653
Ireland	1 342	1 248	1 342	1 248
Italy	3 934	3 071	3 934	3 071
Latvia	190	100	190	100
Lithuania	559	236	559	236
Luxembourg	52	61	52	61
Malta	15	13	15	13
Netherlands	5 811	4 352	5 811	4 352
Poland	2 274	1 442	2 274	1 442
Portugal	1 387	1 161	1 387	1 161
Romania	4 454	1 582	4 454	1 582
Slovakia	617	193	617	193
Slovenia	342	242	342	242
Spain	6 157	7 842	6 157	7 842
Sweden	246	261	246	261
United Kingdom	4 433	3 487	4 433	3 487
EU-28	**55 472**	**44 776**	**55 472**	**44 776**
Iceland	51	50	51	50
EU-28 + ISL	**55 523**	**44 826**	**55 523**	**44 826**

5.2.2.1 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+ISL by 19% or 10.7 Mt CO_2-eq in the period 1990 to 2014. Figure 5.22 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 emissions from manure management for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 83.6% of the total. Emissions decreased in 22 countries and increased in seven countries. The four countries with the largest decreases were Romania, Germany, Bulgaria and the Netherlands with a total absolute decrease of 7.9 Mt CO_2-eq. The three countries with the largest increases were Denmark, France and Spain, with a total absolute increase of 3 Mt CO_2-eq.

Figure 5.22 3.B.1: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.B.1.1 - Cattle - Emissions

CH_4 emissions in source category *3.B.1.1 - Cattle* are 0.22% of total EU28+ISL GHG emissions and 2.1% of total EU28+ISL CH_4 emissions. They make 4.9% of total agricultural emissions. Figure 5.23 and Figure 5.24 show the trend of emissions for Dairy and Non-Dairy Cattle indicating the countries contributing most to EU28+ISL.

Total GHG and CH_4 emissions by Member State from 3.B.1.1 *Manure Management* are shown in Table 5.13 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, CH_4 emission in this source category decreased by 15% or 3.7 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (72%) and in Germany in absolute terms (1.6 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 4.4%. The ten countries with the highest emissions accounted together for 87.2% of the total. Emissions decreased in sixteen countries and increased in thirteen countries. The largest decreases occurred in Germany and Italy with a total absolute decrease of 2.2 Mt CO_2-eq. Largest increases occurred in the Netherlands and France, with a total absolute increase of 1.1 Mt CO_2-eq.

Table 5.13 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	424	336	338	2%	1	0%	-87	-20%	-	-
Belgium	485	492	500	2%	8	2%	15	3%	T2	CS
Bulgaria	74	30	31	0%	0	1%	-43	-58%	T2	CS
Croatia	279	132	129	1%	-3	-3%	-150	-54%	T2	CS
Cyprus	27	29	30	0%	1	4%	3	10%	T1	D
Czech Republic	912	422	430	2%	8	2%	-482	-53%	T1,T2	CS
Denmark	659	778	765	4%	-13	-2%	106	16%	CS,T2	D
Estonia	42	44	44	0%	0	1%	1	3%	T2	CS,D
Finland	234	275	283	1%	8	3%	49	21%	T2	CS
France	3 354	3 163	4 132	19%	969	31%	777	23%	-	-
Germany	5 250	3 694	3 675	17%	-19	-1%	-1 575	-30%	T2	CS
Greece	95	96	95	0%	-1	-1%	0	0%	T2	CS,D
Hungary	566	305	314	1%	9	3%	-252	-45%	T2	CS
Ireland	1 039	918	921	4%	3	0%	-118	-11%	T2	CS
Italy	1 947	1 322	1 278	6%	-44	-3%	-669	-34%	T2	CS
Latvia	111	65	71	0%	6	9%	-40	-36%	T2	CS
Lithuania	247	127	138	1%	10	8%	-110	-44%	T2	CS
Luxembourg	41	48	49	0%	1	3%	8	20%	T2	CS
Malta	2	4	3	0%	0	-2%	1	44%	T2	D
Netherlands	1 823	2 136	2 170	10%	33	2%	347	19%	T2	CS
Poland	1 149	900	742	3%	-158	-18%	-407	-35%	T2	CS
Portugal	97	131	134	1%	3	2%	37	38%	T2	CS
Romania	553	177	178	1%	1	0%	-376	-68%	T2	CS
Slovakia	273	92	78	0%	-14	-15%	-196	-72%	T2	CS
Slovenia	176	193	196	1%	3	1%	20	12%	T2	CS
Spain	2 041	1 854	1 912	9%	58	3%	-129	-6%	CS,T2	CS,D
Sweden	156	183	183	1%	-1	0%	26	17%	NA,T2	CS,NA
United Kingdom	3 041	2 533	2 571	12%	38	2%	-469	-15%	T2	CS,D
EU-28	**25 100**	**20 479**	**21 388**	**100%**	**909**	**4%**	**-3 712**	**-15%**		
Iceland	28	26	28	0%	2	8%	0	-1%	-	-
EU-28 + ISL	**25 128**	**20 505**	**21 416**	**100%**	**911**	**4%**	**-3 712**	**-15%**		

Figure 5.23 3.B.1.1: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

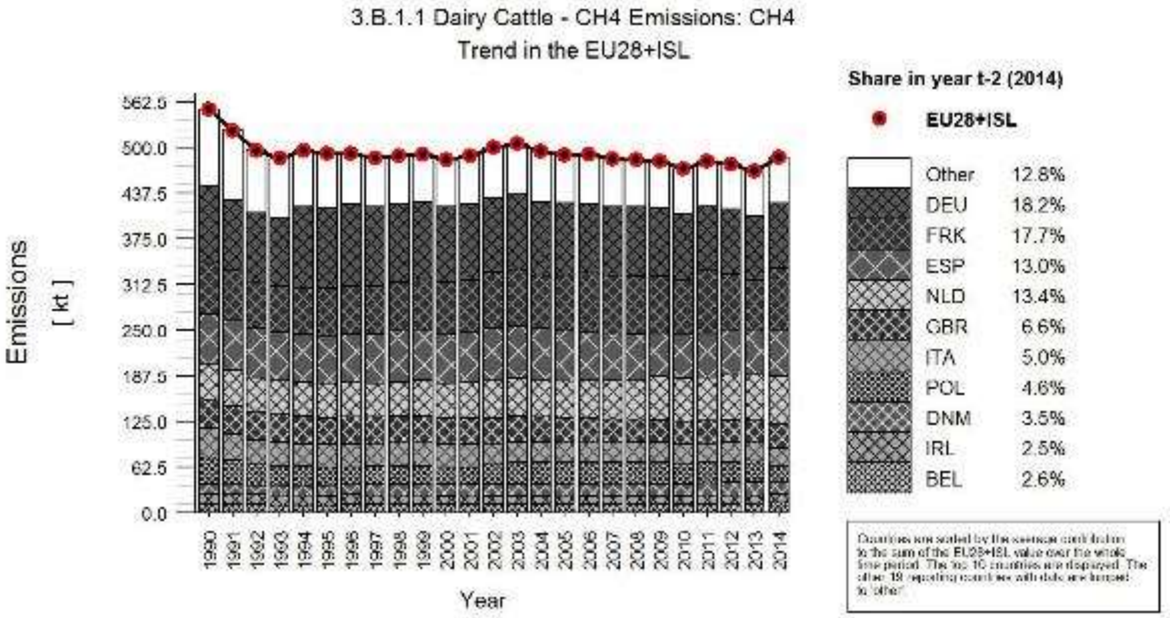
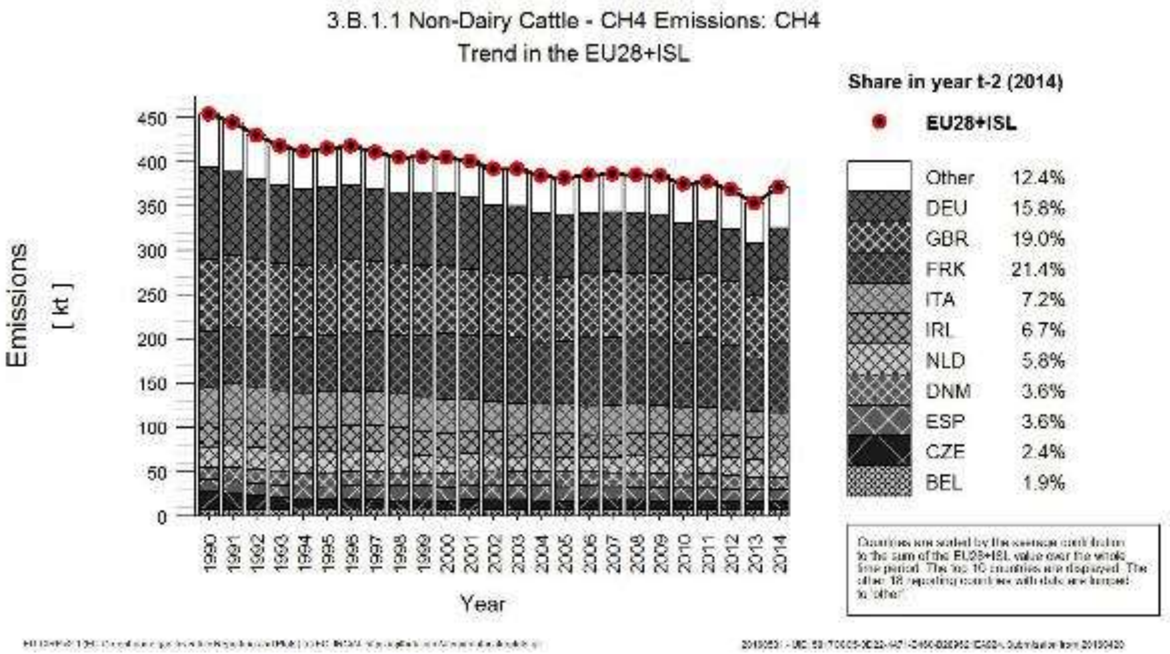


Figure 5.24 3.B.1.1: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



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 the allocation by climate region and the allocation by manure management system (MMS).

3.B.1.3 - Swine - Emissions

The CH_4 emissions in source category *3.B.1.3 - Swine* are 0.22% of total EU28+ISL GHG emissions and 2% of total EU28+ISL CH_4 emissions. They make 4.7% of total agricultural emissions.

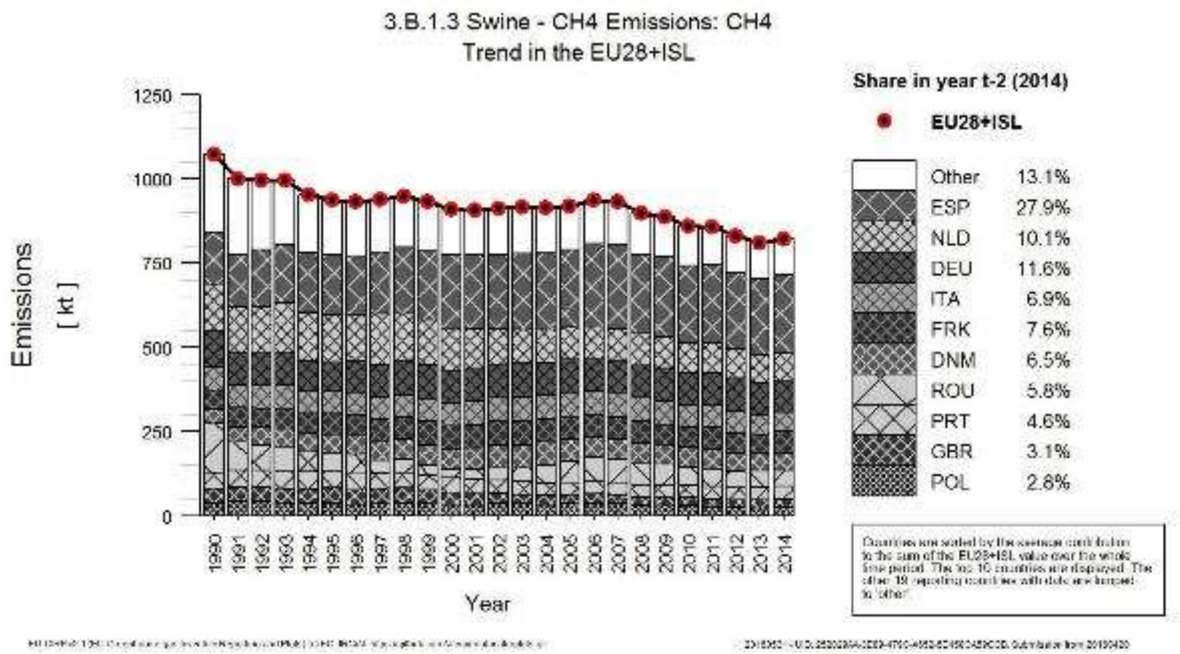
Total GHG and CH_4 emissions by Member State from 3.B.1.3 *Manure Management* are shown in Table 5.14 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, CH_4 emission in this source category decreased by 23% or 6.3 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (89%) and in Romania in absolute terms (2.5 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 1.3%. Figure 5.25 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 emissions for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 87.6% of the total. Emissions decreased in 21 countries and increased in eight countries. The three countries with the largest decreases were Romania, Bulgaria and the Netherlands with a total absolute decrease of 5.6 Mt CO_2-eq.

Largest increases occurred in Denmark and Spain, with a total absolute increase of 2.1 Mt CO_2-eq.

Table 5.14 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	87	85	0%	-2	-2%	-64	-43%	-	-
Belgium	793	756	730	4%	-26	-3%	-62	-8%	T2	CS
Bulgaria	1 890	206	209	1%	3	2%	-1 681	-89%	T2	CS
Croatia	59	39	40	0%	1	2%	-20	-33%	T2	CS
Cyprus	96	122	117	1%	-5	-4%	21	22%	T1	D
Czech Republic	718	238	243	1%	5	2%	-476	-66%	T1	D
Denmark	1 083	1 310	1 343	7%	33	3%	261	24%	CS,T2	D
Estonia	94	36	36	0%	0	1%	-57	-61%	T2	CS,D
Finland	66	108	102	0%	-6	-6%	36	54%	T2	CS
France	1 372	1 379	1 551	8%	172	12%	178	13%	-	-
Germany	2 685	2 376	2 384	12%	8	0%	-300	-11%	T2	CS,D
Greece	398	346	346	2%	0	0%	-53	-13%	T1	D
Hungary	500	278	290	1%	12	4%	-210	-42%	T2	CS
Ireland	160	190	193	1%	3	1%	33	21%	T2	CS,D
Italy	1 705	1 444	1 419	7%	-25	-2%	-286	-17%	T2	CS
Latvia	65	22	21	0%	-1	-6%	-45	-68%	T2	CS
Lithuania	237	80	71	0%	-9	-11%	-166	-70%	T2	CS
Luxembourg	11	11	11	0%	0	-1%	1	5%	T2	CS
Malta	10	8	7	0%	0	-4%	-2	-23%	T2	D
Netherlands	3 489	2 086	2 072	10%	-15	-1%	-1 418	-41%	T2	CS
Poland	913	558	585	3%	27	5%	-328	-36%	T2	CS
Portugal	1 184	931	949	5%	18	2%	-234	-20%	T2	CS
Romania	3 661	1 235	1 190	6%	-45	-4%	-2 471	-67%	T2	CS
Slovakia	329	103	104	1%	1	1%	-225	-68%	T1	D
Slovenia	132	29	29	0%	-1	-3%	-104	-78%	T1	D
Spain	3 886	5 612	5 730	28%	118	2%	1 845	47%	CS,T2	CS,D
Sweden	59	44	44	0%	0	0%	-15	-25%	T2	CS
United Kingdom	1 090	633	627	3%	-7	-1%	-463	-43%	T2	CS,D
EU-28	**26 834**	**20 268**	**20 528**	**100%**	**260**	**1%**	**-6 306**	**-24%**		
Iceland	4	5	5	0%	1	18%	1	22%	-	-
EU-28 + ISL	**26 838**	**20 273**	**20 533**	**100%**	**261**	**1%**	**-6 305**	**-23%**		

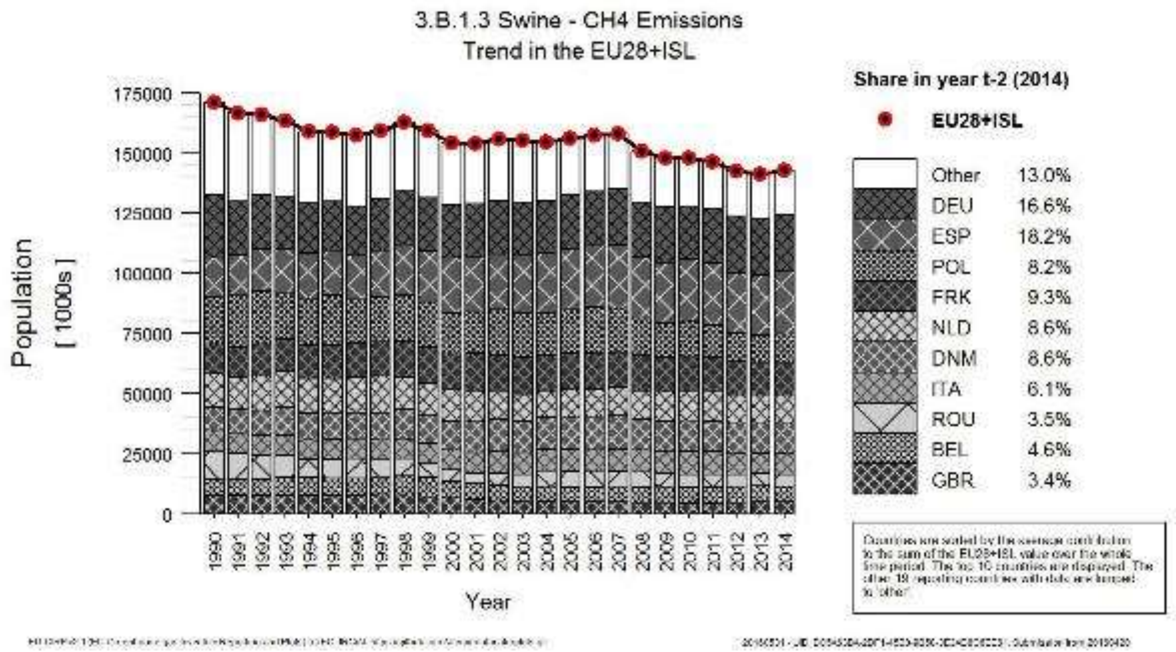
Figure 5.25 3.B.1.3: Trend in swine emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.B.1.3 - Swine - Population

The 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 its population data is discussed here. Swine population decreased considerably in EU28+ISL by 17% or 28.3 mio heads in the period 1990 to 2014. Figure 5.26 shows the trend of swine population indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 population for the different Member States along the inventory period. The ten countries with the highest population accounted together for 87% of the total. Population decreased in 21 countries and increased in eight countries. The three countries with the largest decreases were Poland, Romania and Hungary with a total absolute decrease of 20.3 mio heads. Largest increases occurred in Denmark and Spain, with a total absolute increase of 12.5 mio heads.

Figure 5.26 3.B.1.3: Trend in swine population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



5.2.2.2 Implied EFs and methodological issues

In this section we discuss the implied emission factor for the category 3.B.1 for the main animal types. Furthermore, we present data on the typical animal mass as reported in CRF Tables 3B(a)s1 and average volatile solid (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+ISL considerably between 1990 and 2014 by 15.9% or 1.32 kg/head/year. Table 5.15 shows the implied emission factor for CH_4 emissions in source category *3.B.1.1 - Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in nine countries and increased in twenty countries. The three countries with the largest decreases were Spain, Romania and Italy with a mean absolute value of 2 kg/head/year. The four countries with the largest increases were, Estonia, Latvia, Finland and Lithuania with a mean absolute value of 4 kg/head/year.

Table 5.15 3.B.1.1 - Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	6.6	6.9	|	Ireland	6.1	5.4
Belgium	6.0	8.0	|	Iceland	15.2	15.1
Bulgaria	1.8	2.2	|	Italy	10.0	8.9
Cyprus	19.7	20.0	|	Lithuania	4.3	7.5
Czech Republic	10.4	12.5	|	Luxembourg	7.4	9.9
Germany	10.8	11.5	|	Latvia	3.1	6.7
Denmark	11.8	18.9	|	Malta	22.4	21.4
Estonia	2.2	6.6	|	Netherlands	14.8	21.3
Spain	16.1	12.7	|	Poland	4.6	5.0
Finland	6.9	12.4	|	Portugal	2.8	3.6
France	6.2	8.6	|	Romania	4.2	3.6
United Kingdom	10.0	10.5	|	Sweden	3.6	4.9
Greece	5.5	5.5	|	Slovenia	13.2	16.7
Croatia	13.1	11.6	|	Slovakia	7.0	6.7
Hungary	14.0	15.9	|	**EU28+ISL**	**8.3**	**9.6**

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+ISL strongly between 1990 and 2014 by 47.5% or 6.64 kg/head/year. Figure 5.27 shows the trend of the implied emission factor in EU28+ISL 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 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in five countries and increased in 23 countries. It was in 2014 at the level of 1990 in one country. The three countries with the largest decreases were Romania, Italy and Bulgaria with a mean absolute value of 1 kg/head/year. The four countries with the largest increases were, Estonia, Portugal, Latvia and Finland with a mean absolute value of 10 kg/head/year.

Figure 5.27 3.B.1.1 - Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

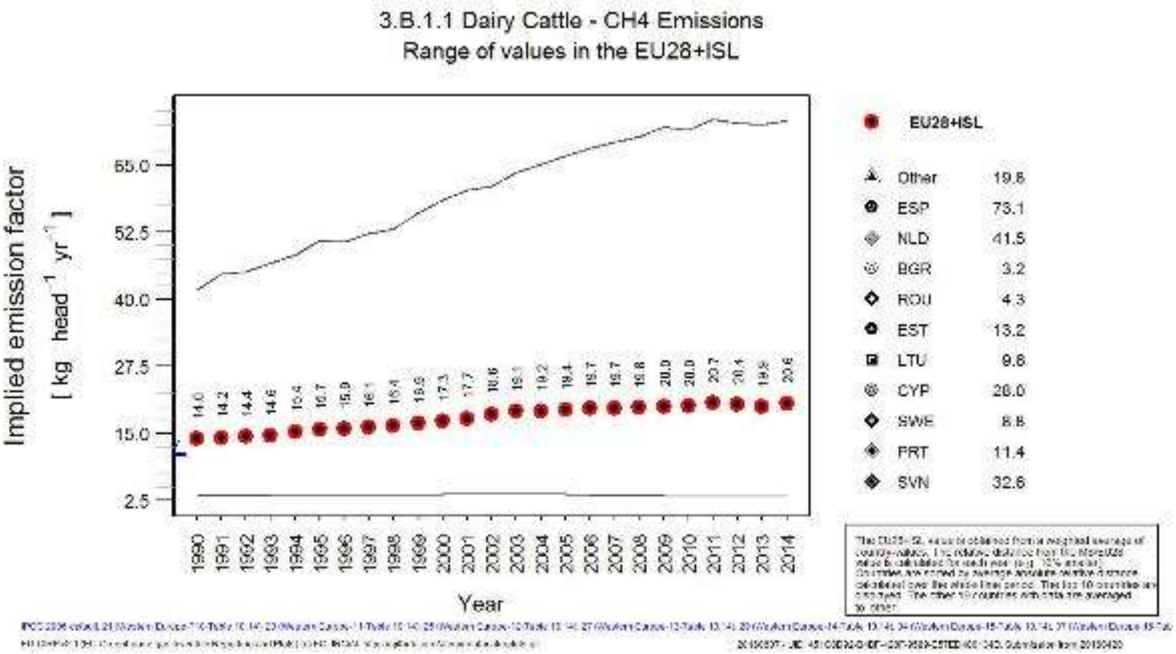


Table 5.16 3.B.1.1 - Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	11.1	11.9	|	Ireland	10.6	10.2
Belgium	14.1	28.3	|	Iceland	24.6	28.4
Bulgaria	3.4	3.2	|	Italy	15.0	13.3
Cyprus	28.0	28.0	|	Lithuania	6.0	9.6
Czech Republic	14.3	21.8	|	Luxembourg	14.5	25.1
Germany	16.7	20.6	|	Latvia	6.4	15.0
Denmark	17.5	30.4	|	Malta	22.4	21.4
Estonia	4.0	13.2	|	Netherlands	26.2	41.5
Spain	41.7	73.1	|	Poland	7.3	9.0
Finland	12.5	26.8	|	Portugal	4.8	11.4
France	13.2	23.3	|	Romania	5.2	4.3
United Kingdom	14.1	17.5	|	Sweden	6.6	8.8
Greece	10.4	13.4	|	Slovenia	21.0	32.6
Croatia	16.9	16.9	|	Slovakia	12.5	12.7
Hungary	24.6	30.9	|	**EU28+ISL**	**14.0**	**20.6**

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+ISL slightly between 1990 and 2014 by 4.5% or 25.9 kg. Figure 5.28 shows the trend of the typical animal mass in EU28+ISL indicating also the range of values used by the countries. Table 5.17 shows the typical animal mass in source category *3.B.1.1 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Typical animal mass decreased in one country and increased in twelve countries. It was in 2014 at the level of 1990 in fourteen countries. No data were available for France and the Netherlands. A decrease occurred in Iceland with an absolute value of 5.7e-14 kg. The three countries with the largest increases were, Finland, Slovenia and Czech Republic with a mean absolute value of 99 kg.

Figure 5.28 3.B.1.1 - Dairy Cattle: Trend in typical animal mass in the EU28+ISL and range of values reported by countries

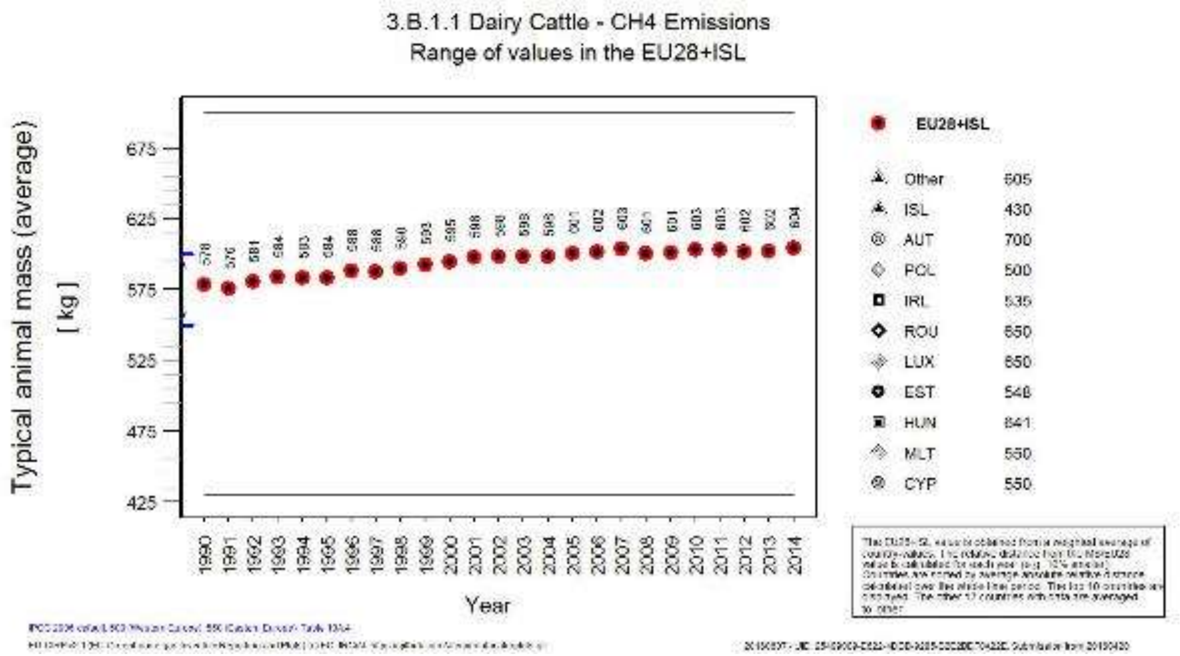


Table 5.17 3.B.1.1 - Dairy Cattle: Member States' and EU28+ISL typical animal mass (kg)

Member State	1990	2014	Member State	1990	2014
Austria	700	700	Ireland	535	535
Belgium	600	600	Iceland	430	430
Bulgaria	588	588	Italy	603	603
Cyprus	550	550	Lithuania	575	620
Czech Republic	520	590	Luxembourg	650	650
Germany	608	645	Latvia	550	565
Denmark	550	580	Malta	550	550
Estonia	545	548	Poland	500	500
Spain	598	647	Portugal	600	600
Finland	520	650	Romania	650	650
United Kingdom	556	630	Sweden	600	600
Greece	600	600	Slovenia	510	608
Croatia	563	563	Slovakia	550	596
Hungary	633	641	**EU28+ISL**	**578**	**604**

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+ISL clearly between 1990 and 2014 by 11.8% or 0.497 kg dm/head/day. Figure 5.29 shows the trend of the VS daily excretion in EU28+ISL indicating also the range of values used by the countries. Table 5.18 shows the VS daily excretion in source category *3.B.1.1 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. VS daily excretion decreased in two countries and increased in 23 countries. It was in 2014 at the level of 1990 in three countries. No data were available for Cyprus. The largest decrease occurred in Slovakia with an absolute value of 2 kg dm/head/day. The four countries with the largest increases were, Czech Republic, Estonia, Finland and Spain with a mean absolute value of 2 kg dm/head/day.

Figure 5.29 3.B.1.1 - Dairy Cattle: Trend in VS daily excretion in the EU28+ISL and range of values reported by countries

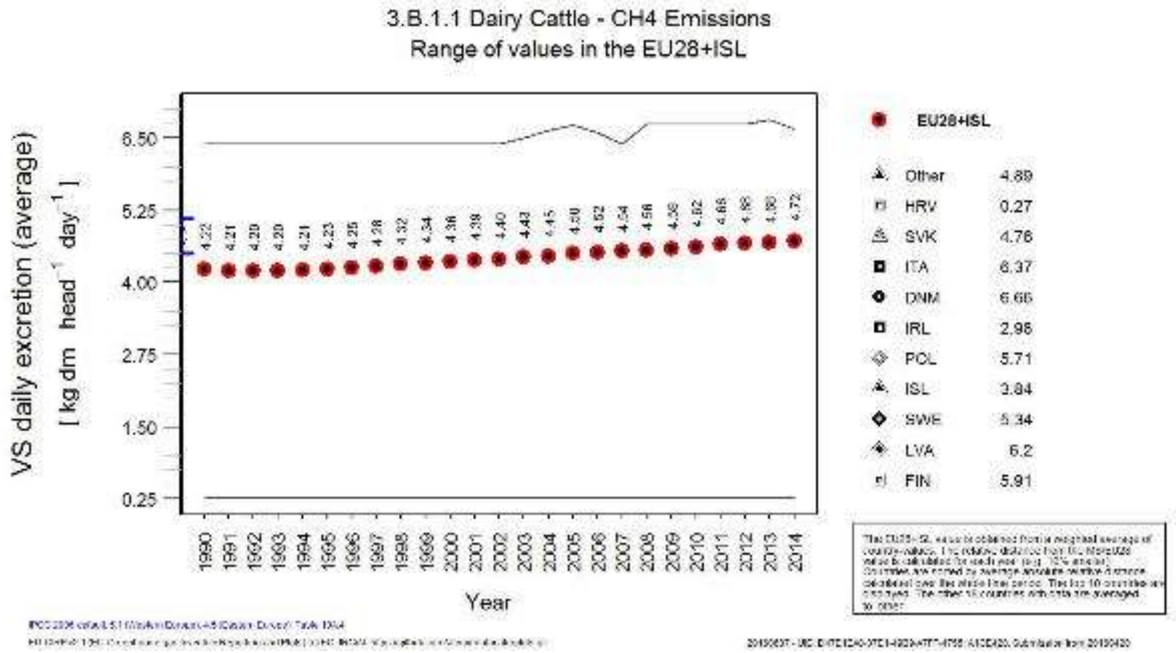


Table 5.18 3.B.1.1 - Dairy Cattle: Member States' and EU28+ISL VS daily excretion (kg dm/head/day)

Member State	1990	2014		Member State	1990	2014
Austria	4.50	4.91	|	Iceland	3.21	3.84
Belgium	4.01	5.09	|	Italy	6.37	6.37
Bulgaria	4.37	4.37	|	Lithuania	4.55	5.68
Czech Republic	4.29	6.19	|	Luxembourg	4.75	5.47
Germany	3.47	4.04	|	Latvia	4.70	6.20
Denmark	5.66	6.66	|	Malta	3.98	3.98
Estonia	4.44	6.22	|	Netherlands	3.84	4.70
Spain	3.90	5.16	|	Poland	5.69	5.71
Finland	4.47	5.91	|	Portugal	3.47	4.43
France	3.46	4.15	|	Romania	4.09	4.09
United Kingdom	3.48	4.51	|	Sweden	5.11	5.34

Member State	1990	2014	Member State	1990	2014
Greece	3.68	4.75	Slovenia	4.51	5.22
Croatia	0.27	0.27	Slovakia	6.40	4.76
Hungary	4.41	5.12	**EU28+ISL**	**4.22**	**4.72**
Ireland	2.76	2.98			

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* increased in EU28+ISL slightly between 1990 and 2014 by 1.9% or 0.105 kg/head/year. Figure 5.30 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.19 shows the implied emission factor for CH_4 emissions in source category *3.B.1.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in seven countries and increased in twenty countries. It was in 2014 at the level of 1990 in one country. No data were available for Malta. The largest decreases occurred in Slovakia and Spain with a mean absolute value of 2 kg/head/year. The four countries with the largest increases were, Estonia, Lithuania, Sweden and Slovenia with a mean absolute value of 3 kg/head/year.

Figure 5.30 3.B.1.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

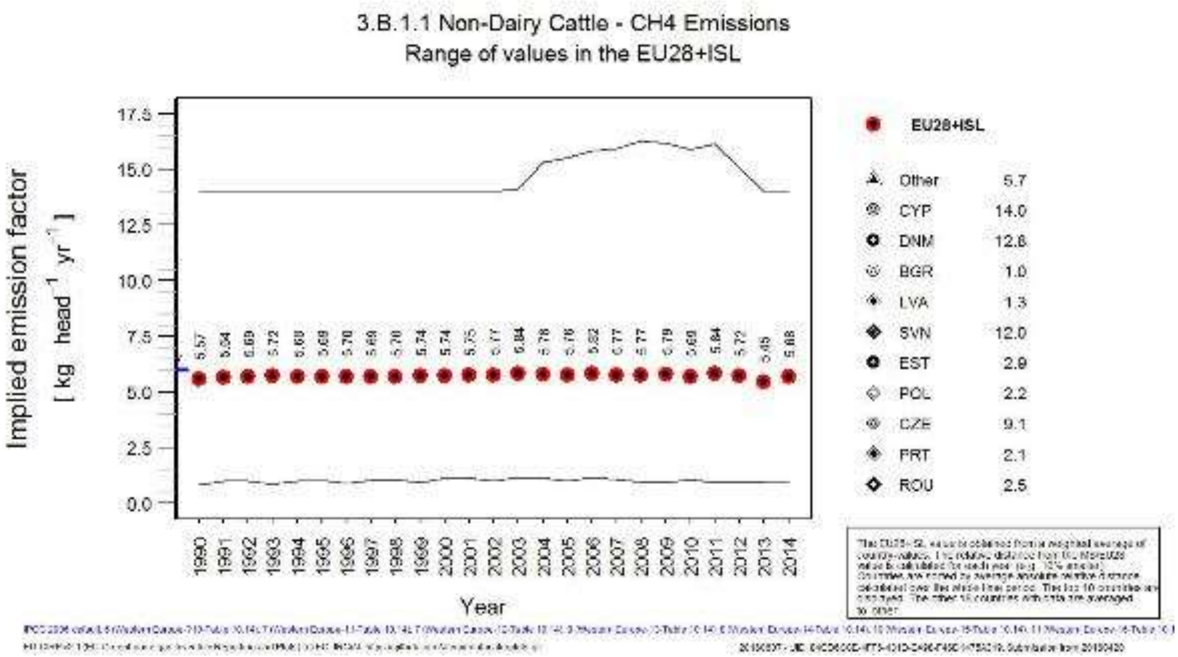


Table 5.19 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014	Member State	1990	2014
Austria	4.15	5.01	Ireland	5.00	4.42
Belgium	3.13	3.49	Iceland	8.14	7.95
Bulgaria	0.84	0.96	Italy	7.46	6.84
Cyprus	14.00	14.00	Lithuania	3.29	5.85

Member State	1990	2014	Member State	1990	2014
Czech Republic	8.39	9.09	Luxembourg	4.85	5.29
Germany	7.93	6.93	Latvia	1.13	1.32
Denmark	8.90	12.83	Netherlands	7.78	8.60
Estonia	1.19	2.94	Poland	1.95	2.16
Spain	4.19	2.61	Portugal	2.04	2.13
Finland	3.71	5.82	Romania	2.87	2.47
France	3.96	5.11	Sweden	2.14	3.71
United Kingdom	8.73	8.83	Slovenia	7.44	11.99
Greece	3.34	3.52	Slovakia	4.03	2.05
Croatia	8.09	8.09	**EU28+ISL**	**5.57**	**5.68**
Hungary	8.32	8.83			

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+ISL moderately between 1990 and 2014 by 7.2% or 26.5 kg. Figure 5.31 shows the trend of the typical animal mass in EU28+ISL indicating also the range of values used by the countries. Table 5.20 shows the typical animal mass in source category *3.B.1.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Typical animal mass decreased in three countries and increased in twenty countries. It was in 2014 at the level of 1990 in three countries. No data were available for three countries (the United Kingdom, Malta and the Netherlands). Decreases occurred in Slovakia, Ireland and Iceland with a mean absolute value of 5 kg. The largest increases occurred in Finland and Bulgaria with a mean absolute value of 103 kg.

Figure 5.31 3.B.1.1 - Non-Dairy Cattle: Trend in typical animal mass in the EU28+ISL and range of values reported by countries

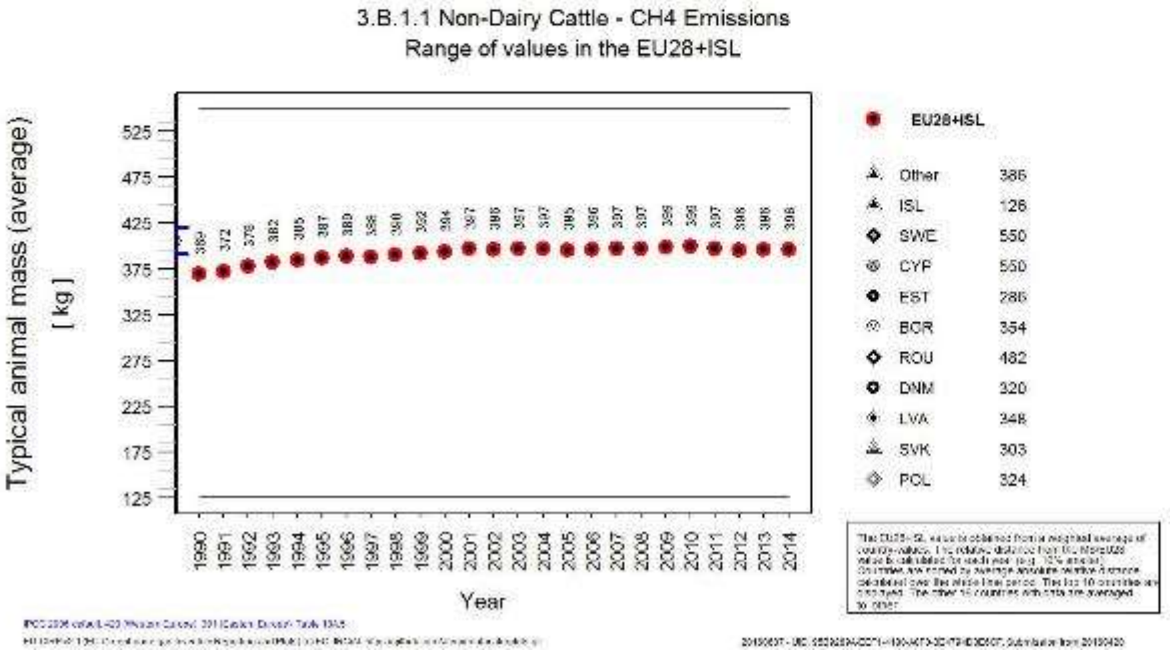


Table 5.20 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28+ISL typical animal mass (kg)

Member State	1990	2014		Member State	1990	2014
Austria	364	418	|	Ireland	349	343
Belgium	381	408	|	Iceland	126	126
Bulgaria	263	354	|	Italy	376	381
Cyprus	550	550	|	Lithuania	326	338
Czech Republic	326	386	|	Luxembourg	405	417
Germany	339	367	|	Latvia	298	348
Denmark	290	320	|	Poland	311	324
Estonia	247	286	|	Portugal	355	410
Spain	395	428	|	Romania	482	482
Finland	278	393	|	Sweden	550	550
France	428	434	|	Slovenia	289	348
Greece	374	408	|	Slovakia	313	303
Croatia	331	341	|	**EU28+ISL**	**369**	**396**
Hungary	327	356	|			

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+ISL slightly between 1990 and 2014 by 1.2% or 0.0247 kg dm/head/day. Figure 5.32 shows the trend of the VS daily excretion in EU28+ISL indicating also the range of values used by the countries. Table 5.21 shows the VS daily excretion in source category *3.B.1.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. VS daily excretion decreased in six countries and increased in nineteen countries. It was in 2014 at the level of 1990 in three countries. No data were available for Cyprus. The three countries with the largest decreases were Slovakia, the Netherlands and Spain with a mean absolute value of 0.3 kg dm/head/day. The largest increases occurred in Finland and Denmark with a mean absolute value of 1 kg dm/head/day.

Figure 5.32 3.B.1.1 - Non-Dairy Cattle: Trend in VS daily excretion in the EU28+ISL and range of values reported by countries

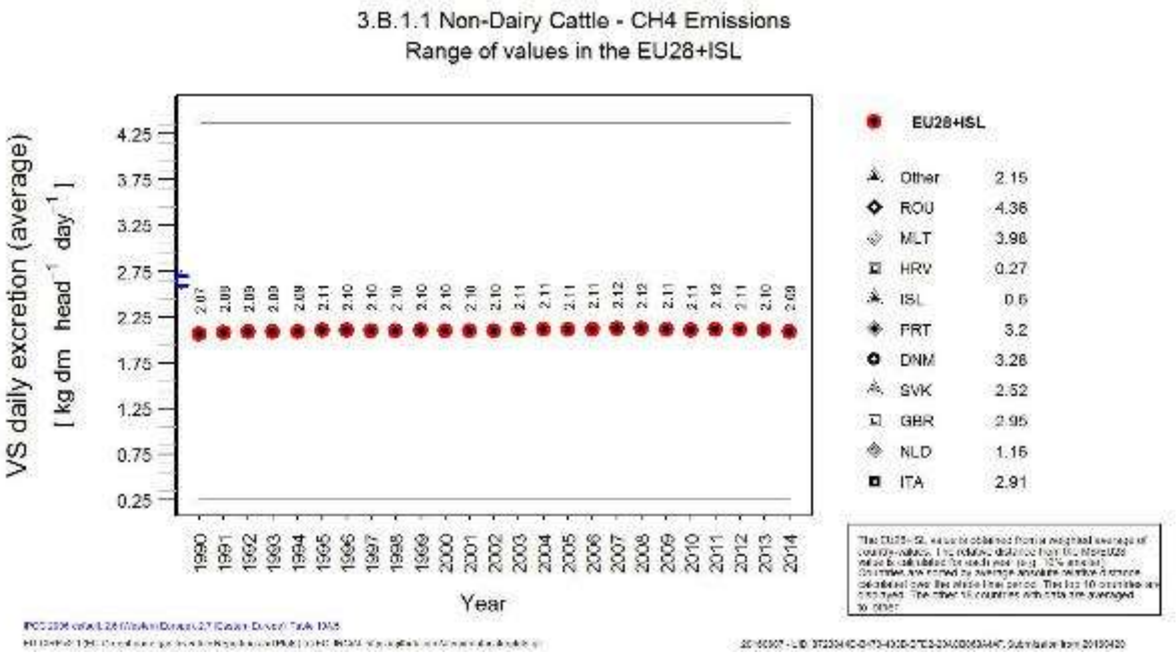


Table 5.21 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28+ISL VS daily excretion (kg dm/head/day)

Member State	1990	2014		Member State	1990	2014
Austria	1.78	2.17	|	Iceland	0.60	0.60
Belgium	1.51	1.69	|	Italy	2.80	2.91
Bulgaria	1.52	1.84	|	Lithuania	2.47	2.52
Czech Republic	2.40	2.82	|	Luxembourg	2.48	2.59
Germany	1.37	1.37	|	Latvia	1.68	2.03
Denmark	2.37	3.28	|	Malta	3.98	3.98
Estonia	1.94	2.22	|	Netherlands	1.37	1.16
Spain	2.53	2.25	|	Poland	2.04	2.09
Finland	1.55	2.17	|	Portugal	2.89	3.20
France	1.87	1.91	|	Romania	4.36	4.36
United Kingdom	2.85	2.95	|	Sweden	1.60	1.72
Greece	2.61	2.75	|	Slovenia	2.14	2.56
Croatia	0.27	0.27	|	Slovakia	3.05	2.52
Hungary	2.54	2.64	|	**EU28+ISL**	**2.07**	**2.09**
Ireland	1.43	1.31	|			

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+ISL moderately between 1990 and 2014 by 8.4% or 0.524 kg/head/year. Figure 5.33 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.22 shows the implied emission factor for CH_4 emissions in source category *3.B.1.3 - Swine* for the years 1990 and 2014 for all Member

States and EU28+ISL. The implied emission factor decreased in nineteen countries and increased in eight countries. It was in 2014 at the level of 1990 in two countries. The three countries with the largest decreases were Slovenia, the Netherlands and Austria with a mean absolute value of 3 kg/head/year. The three countries with the largest increases were, Finland, Hungary and Latvia with a mean absolute value of 1 kg/head/year.

Figure 5.33 3.B.1.3 - Swine: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

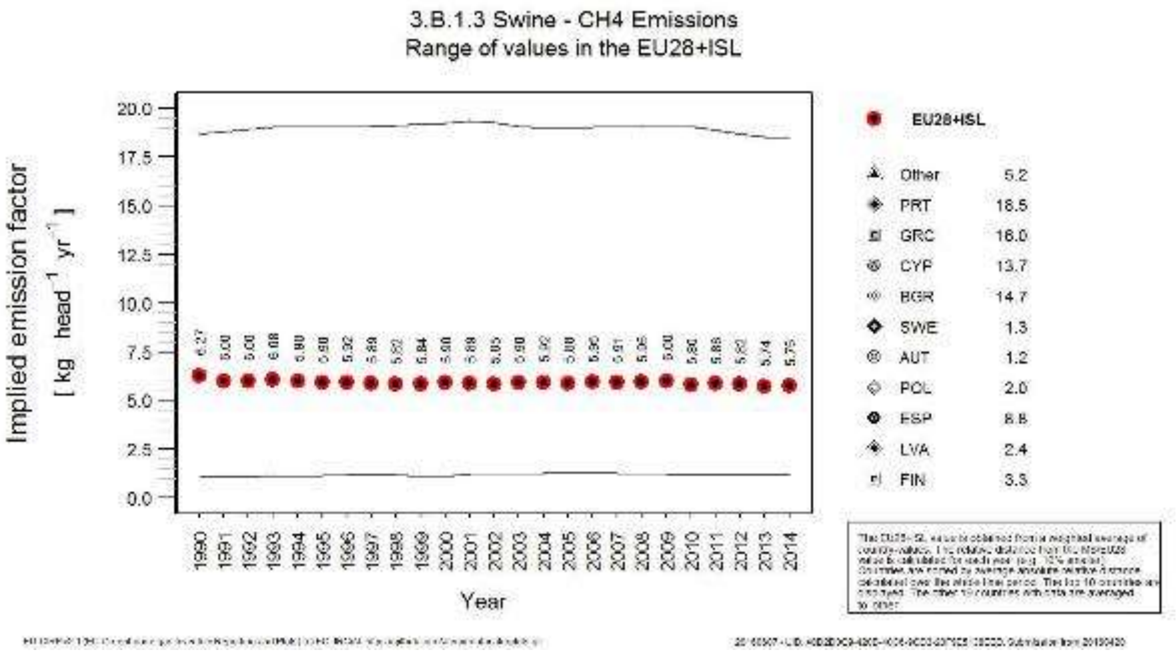


Table 5.22 3.B.1.3 - Swine: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	1.6	1.2	|	Ireland	5.2	5.1
Belgium	4.7	4.5	|	Iceland	6.0	6.0
Bulgaria	17.9	14.7	|	Italy	8.1	6.5
Cyprus	13.9	13.7	|	Lithuania	3.9	4.0
Czech Republic	6.0	6.0	|	Luxembourg	5.8	5.2
Germany	4.1	4.0	|	Latvia	1.9	2.4
Denmark	4.6	4.4	|	Malta	6.2	6.2
Estonia	4.4	4.1	|	Netherlands	10.0	6.8
Spain	9.5	8.8	|	Poland	1.9	2.0
Finland	1.9	3.3	|	Portugal	18.7	18.5
France	4.4	4.7	|	Romania	12.2	9.4
United Kingdom	5.8	5.2	|	Sweden	1.0	1.3
Greece	16.0	16.0	|	Slovenia	9.0	4.1
Croatia	3.0	2.9	|	Slovakia	6.5	6.5
Hungary	2.3	3.8	|	**EU28+ISL**	**6.3**	**5.7**

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+ISL slightly between 1990 and 2014 by 3% or 2.28 kg. Figure 5.34 shows the trend of the typical animal mass in EU28+ISL indicating also the range of values used by the countries. Table 5.23 shows the typical animal mass in source category *3.B.1.3 - Swine* for the years 1990 and 2014 for all Member States and EU28+ISL. Typical animal mass decreased in eleven countries and increased in six countries. It was in 2014 at the level of 1990 in three countries. No data were available for nine countries (Austria, Cyprus, Finland, France, the United Kingdom, Malta, the Netherlands, Poland and Slovakia). The three countries with the largest decreases were Latvia, Croatia and Ireland with a mean absolute value of 8 kg. The three countries with the largest increases were, Denmark, Slovenia and Estonia with a mean absolute value of 7 kg.

Figure 5.34 3.B.1.3 - Swine: Trend in typical animal mass in the EU28+ISL and range of values reported by countries

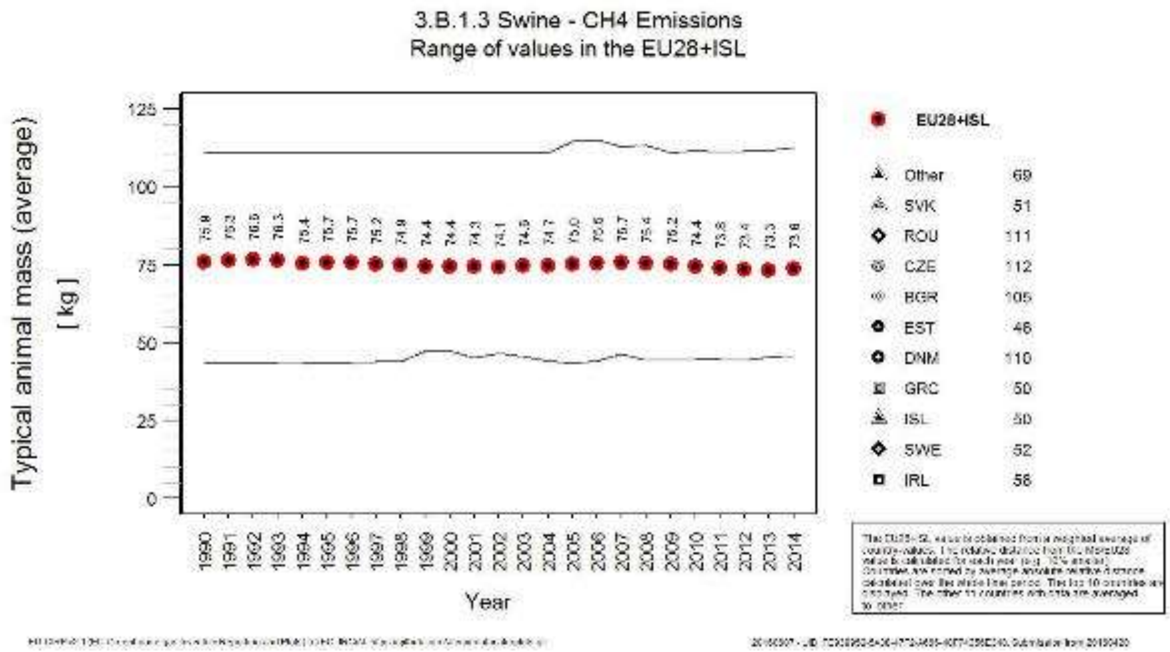


Table 5.23 3.B.1.3 - Swine: Member States' and EU28+ISL typical animal mass (kg)

Member State	1990	2014		Member State	1990	2014
Belgium	69	65	|	Iceland	52	50
Bulgaria	109	105	|	Italy	79	81
Czech Republic	110	112	|	Lithuania	63	60
Germany	67	64	|	Luxembourg	92	86
Denmark	98	110	|	Latvia	75	64
Estonia	43	46	|	Portugal	62	58
Spain	62	61	|	Romania	111	111
Greece	50	50	|	Sweden	52	52
Croatia	88	78	|	Slovenia	66	74
Hungary	63	64	|	Slovakia		51

Ireland	63	58	**EU28+ISL**	**76**	**74**

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*, increased in EU28+ISL very strongly between 1990 and 2014 by 89.3% or 0.304 kg dm/head/day. Figure 5.35 shows the trend of the VS daily excretion in EU28+ISL indicating also the range of values used by the countries. Table 5.24 shows the VS daily excretion in source category *3.B.1.3 - Swine* for the years 1990 and 2014 for all Member States and EU28+ISL. VS daily excretion decreased in thirteen countries and increased in five countries. It was in 2014 at the level of 1990 in four countries. No data were available for seven countries (Cyprus, Czech Republic, France, the United Kingdom, Greece, Iceland and Slovakia). The three countries with the largest decreases were Denmark, Latvia and Bulgaria with a mean absolute value of 0.042 kg dm/head/day. The largest increase occurred in the Netherlands with an absolute value of 3 kg dm/head/day.

Figure 5.35 3.B.1.3 - Swine: Trend in VS daily excretion in the EU28+ISL and range of values reported by countries

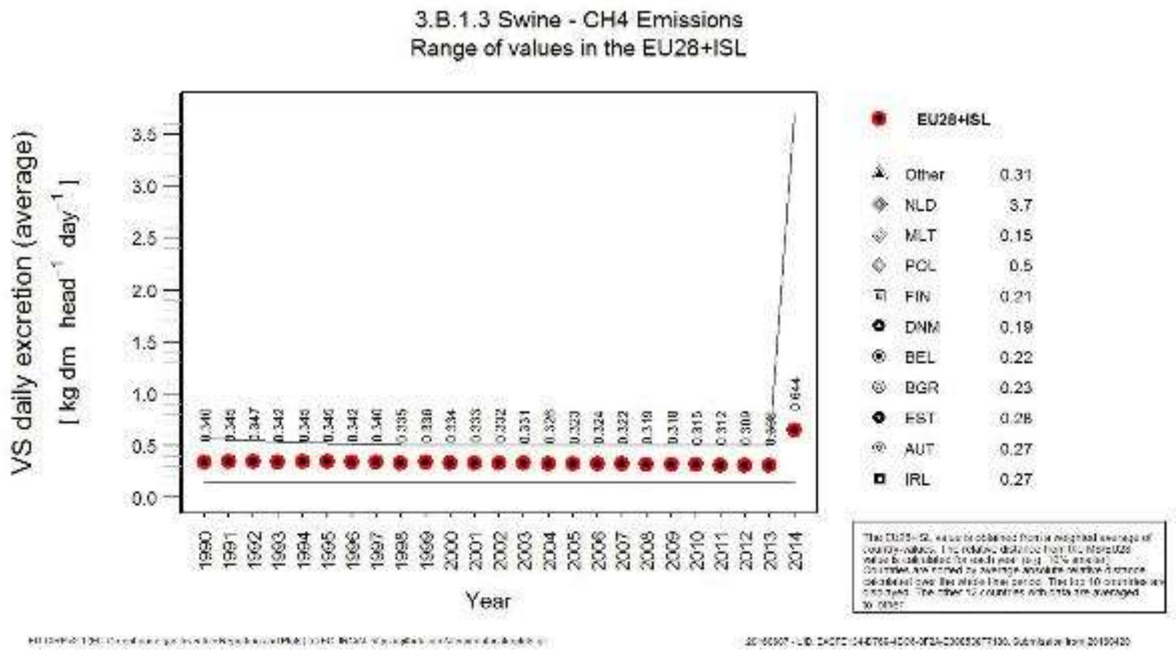


Table 5.24 3.B.1.3 - Swine: Member States' and EU28+ISL VS daily excretion (kg dm/head/day)

Member State	1990	2014	Member State	1990	2014
Austria	0.27	0.27	Lithuania	0.38	0.38
Belgium	0.23	0.22	Luxembourg	0.32	0.31
Bulgaria	0.25	0.23	Latvia	0.40	0.35
Germany	0.26	0.30	Malta	0.15	0.15
Denmark	0.24	0.19	Netherlands	0.57	3.70
Estonia	0.26	0.28	Poland	0.50	0.50
Spain	0.30	0.29	Portugal	0.28	0.26
Finland	0.21	0.21	Romania	0.28	0.28
Croatia	0.36	0.34	Sweden	0.29	0.31

Member State	1990	2014		Member State	1990	2014
Hungary	0.30	0.30	|	Slovenia	0.32	0.31
Ireland	0.28	0.27	|	**EU28+ISL**	**0.34**	**0.64**
Italy	0.37	0.34	|			

5.2.3 Manure Management - N_2O (CRF Source Category 3B2)

N_2O emissions from source category *3.B.2 - Manure Management* are 0.23% of total EU28+ISL GHG emissions and 4.1% of total EU28+ISL N_2O emissions. They make 5.1% of total agricultural emissions. The main sub-categories are 3.B.2.5 (Indirect Emissions), 3.B.2.1.2 (Non-Dairy Cattle) and 3.B.2.1.1 (Dairy Cattle) as shown in Figure 5.36.

Regarding the origin of emissions in the different Member States, Figure 5.37 shows the distribution of N_2O emissions from manure management by livestock category in all Member States and in the EU28+ISL. Each bar represents the total emissions of a country in the current emission category, where different shades of grey correspond to the emitting animal types.

Regarding the handling of manure in the different Member States, Figure 5.38 shows the distribution of total manure nitrogen by manure system in all Member States and in the EU28. Each bar represents the total manure nitrogen handled in the current system for the country, where different shades of grey correspond to the emitting manure systems.

Figure 5.36 Share of source category 3.B.2 on total EU28+ISL agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emissions in the year 2014.3.B.2.1-3.B.3.4: emissions by animal types (cattle, sheep, swine, other livestock); 3.B.2.5:Indirect emissions from manure management.

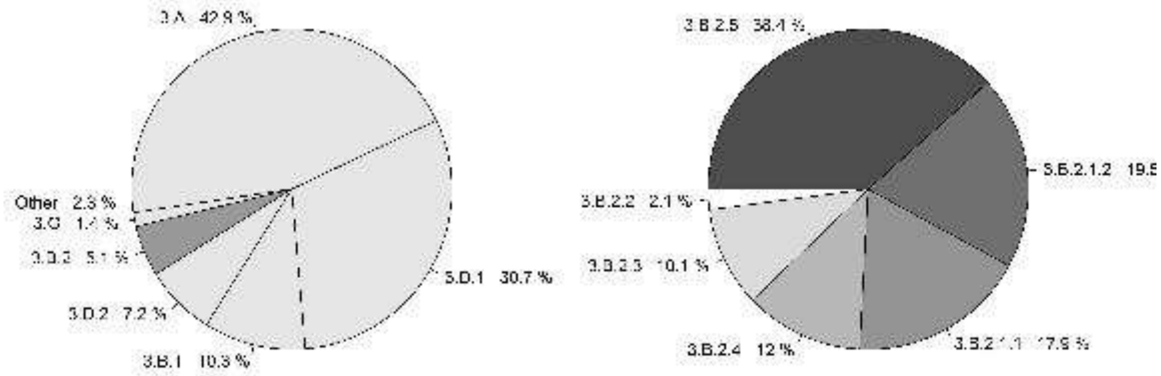


Figure 5.37 Decomposition of emissions in source category 3.B.2 - Manure Management into its sub-categories by Member State in the year 2014.

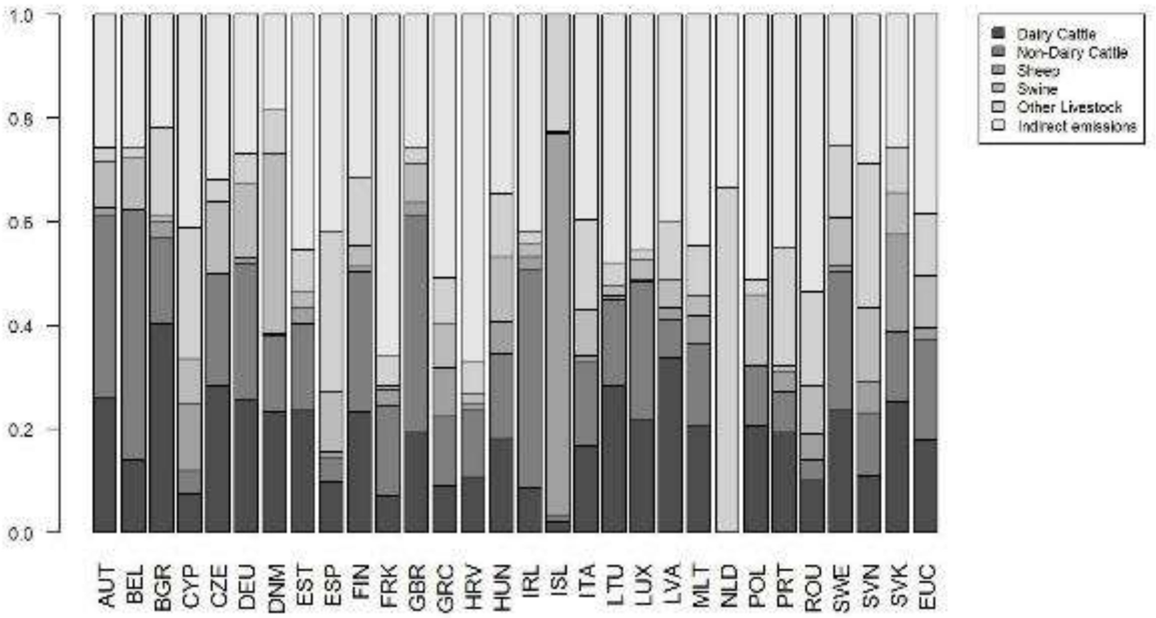
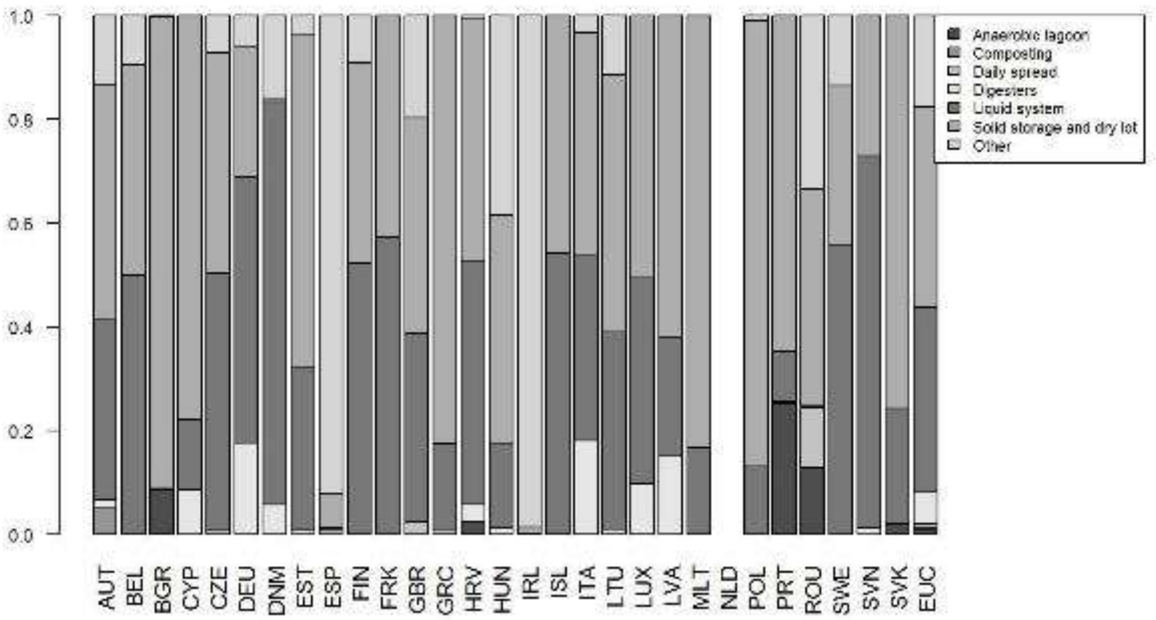


Figure 5.38 Decomposition of manure nitrogen handled in source category 3.B.2 - Manure Management into the different manure management systems by Member State in the year 2014.



Total GHG and N_2O emissions by Member State from 3.B.2 *Manure Management* are shown in Table 5.25 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 29% or 9.3 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (69%) and in Czech Republic in absolute terms (2 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 0.8%.

Table 5.25 3.B.2 - Manure Management: Member States' contributions to total GHG and N_2O emissions

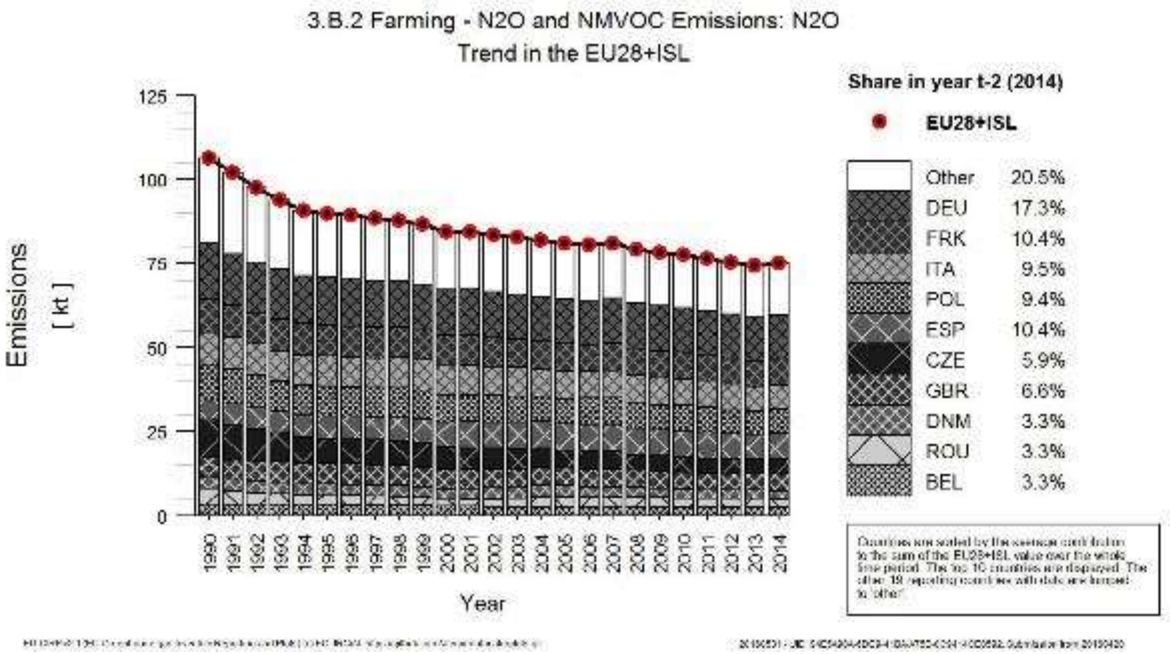
Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)
Austria	438	433	438	433
Belgium	972	733	972	733
Bulgaria	1 179	440	1 179	440
Croatia	324	137	324	137
Cyprus	73	73	73	73
Czech Republic	3 310	1 312	3 310	1 312
Denmark	979	747	979	747
Estonia	142	67	142	67
Finland	284	283	284	283
France	2 861	2 329	2 861	2 329
Germany	5 085	3 883	5 085	3 883
Greece	305	325	305	325
Hungary	879	459	879	459
Ireland	478	496	478	496
Italy	2 864	2 136	2 864	2 136
Latvia	324	104	324	104
Lithuania	539	169	539	169
Luxembourg	39	35	39	35
Malta	11	13	11	13
Netherlands	926	658	926	658
Poland	3 163	2 103	3 163	2 103
Portugal	253	193	253	193
Romania	1 400	740	1 400	740
Slovakia	754	231	754	231
Slovenia	164	98	164	98
Spain	1 783	2 339	1 783	2 339
Sweden	361	335	361	335
United Kingdom	1 785	1 472	1 785	1 472
EU-28	**31 674**	**22 343**	**31 674**	**22 343**
Iceland	50	42	50	42
EU-28 + ISL	**31 724**	**22 385**	**31 724**	**22 385**

5.2.3.1 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+ISL by 29% or 9.3 Mt CO_2-eq in the period 1990 to 2014. Figure 5.39 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from manure management for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 79.5% of the total. Emissions decreased in 24 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 4.3 Mt CO_2-eq. Largest increases occurred in Spain, with a total absolute increase of 556 kt CO_2-eq.

Figure 5.39 3.B.2 Manure Management: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.B.2.1 - Cattle - Emissions

N_2O emissions in source category *3.B.2.1 - Cattle* are 0.088% of total EU28+ISL GHG emissions and 1.5% of total EU28+ISL N_2O emissions. They make 1.9% of total agricultural emissions. Figure 5.40 and Figure 5.41 show the trend of emissions indicating the countries contributing most to the EU28+ISL total. The figures represent the trend in N_2O emissions from manure management for the different Member States along the inventory period.

Total GHG and N_2O emissions by Member State from 3.B.2.1 *Manure Management* are shown in Table 5.26 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 35% or 4.5 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (73%) and in Germany in absolute terms (1 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 0.1%. The ten countries with the highest emissions accounted together for 81.8% of the total. Emissions decreased in twenty countries and increased in eight countries. The three countries with the largest decreases were Germany, Czech Republic and Italy with a total absolute decrease of 2.6 Mt CO_2-eq. The four countries with the largest increases were Ireland, Finland, Greece and Spain, with a total absolute increase of 102 kt CO_2-eq.

Table 5.26 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	258	264	266	3%	1	1%	8	3%
Belgium	651	457	456	5%	-2	0%	-195	-30%
Bulgaria	535	244	250	3%	6	2%	-286	-53%
Croatia	92	34	32	0%	-2	-5%	-60	-65%
Cyprus	8	9	9	0%	0	1%	0	5%
Czech Republic	1 648	647	654	8%	7	1%	-994	-60%
Denmark	326	289	284	3%	-4	-1%	-41	-13%
Estonia	55	27	27	0%	0	1%	-28	-51%
Finland	128	140	142	2%	2	1%	14	11%
France	875	563	570	7%	7	1%	-305	-35%
Germany	3 022	1 998	2 012	24%	14	1%	-1 010	-33%
Greece	57	74	73	1%	-2	-2%	16	28%
Hungary	281	150	158	2%	8	5%	-122	-44%
Ireland	241	257	252	3%	-5	-2%	11	5%
Italy	1 267	738	700	8%	-38	-5%	-567	-45%
Latvia	121	41	43	1%	1	4%	-78	-64%
Lithuania	202	74	76	1%	1	2%	-126	-62%
Luxembourg	19	16	17	0%	0	2%	-2	-13%
Malta	3	5	5	0%	0	-3%	1	38%
Netherlands	IE	IE	IE	-	-	-	-	-
Poland	918	677	678	8%	1	0%	-240	-26%
Portugal	62	53	52	1%	0	0%	-9	-15%
Romania	214	102	103	1%	1	1%	-111	-52%
Slovakia	337	104	90	1%	-14	-14%	-247	-73%
Slovenia	48	22	23	0%	1	3%	-25	-53%
Spain	271	320	332	4%	12	4%	61	23%
Sweden	179	168	169	2%	1	1%	-10	-6%
United Kingdom	1 101	890	903	11%	13	1%	-198	-18%
EU-28	**12 918**	**8 364**	**8 374**	**100%**	**10**	**0%**	**-4 544**	**-35%**
Iceland	1	1	1	0%	0	8%	0	5%
EU-28 + ISL	**12 920**	**8 365**	**8 375**	**100%**	**10**	**0%**	**-4 544**	**-35%**

Figure 5.40 3.B.2.1 - Cattle: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

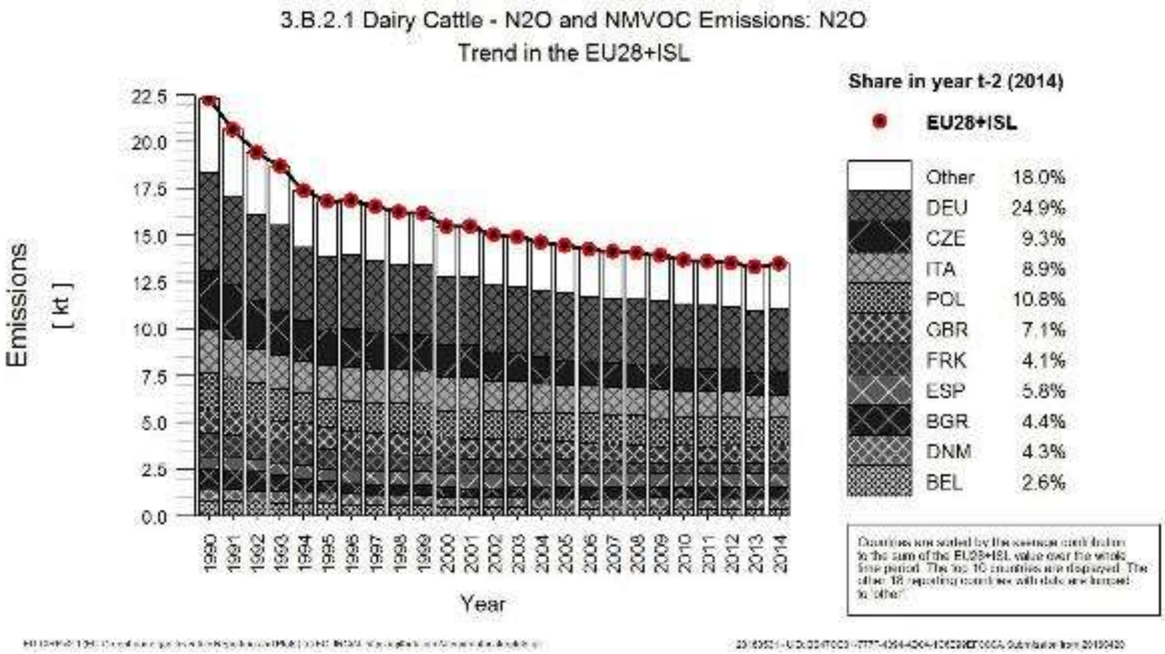
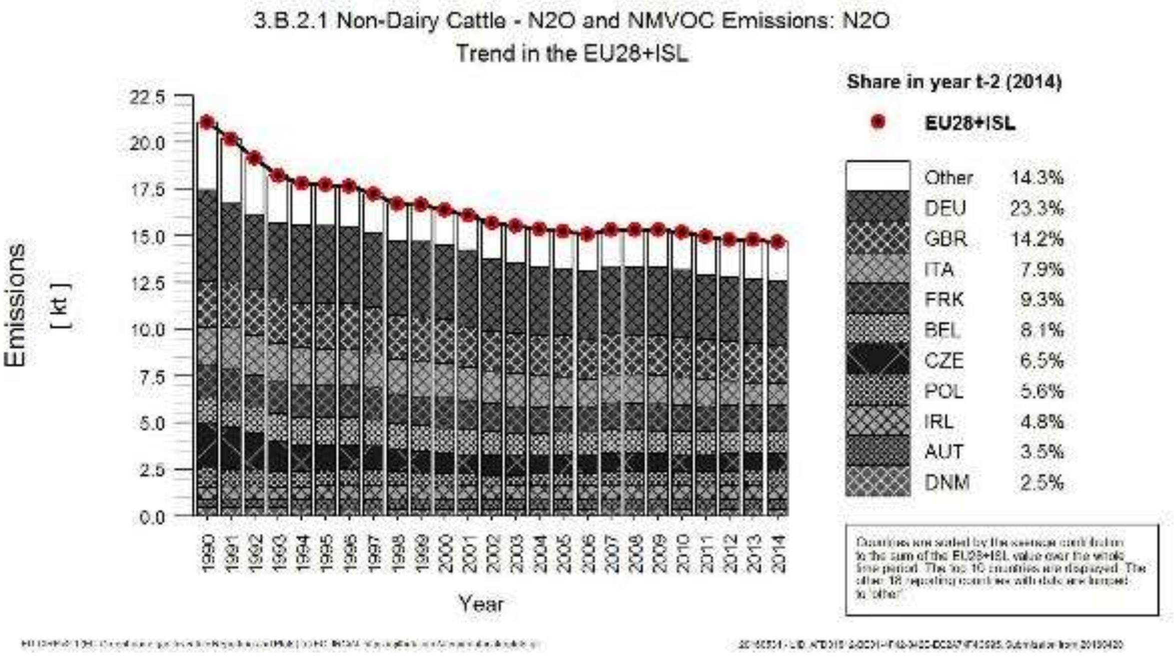


Figure 5.41 *3.B.2.1 - Cattle: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014*



3.B.2.1 - Cattle - population

One of the main activity data for N_2O emissions from manure management - cattle is 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.

3.B.2.5 - Indirect N_2O emissions from manure management - Emissions

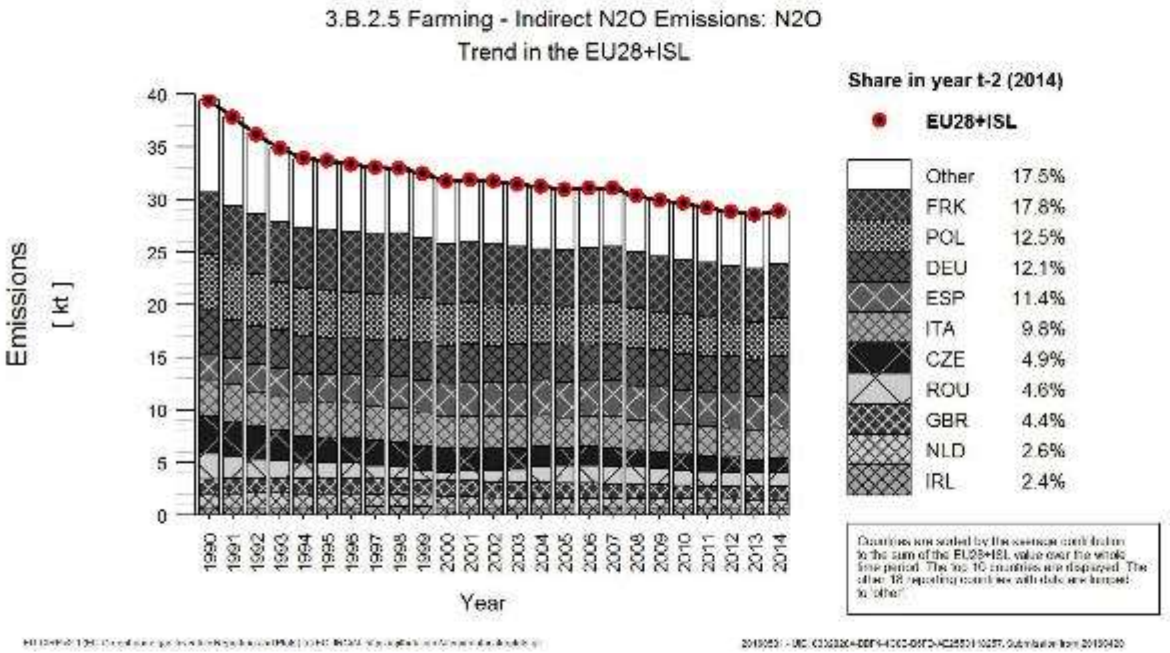
N_2O emissions in source category *3.B.2.5 - Indirect N_2O emissions from manure management* - *Indirect N_2O emissions* are 0.09% of total EU28+ISL GHG emissions and 1.6% of total EU28+ISL N_2O emissions. They make 2% of total agricultural emissions.

Total GHG and N_2O emissions by Member State from 3.B.2.5 *Manure Management - Indirect Emissions* are shown in Table 5.27 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 27% or 3.1 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (77%) and in Czech Republic in absolute terms (639 kt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 1.3%. Figure 5.42 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from manure management - indirect emissions for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 82.5% of the total. Emissions decreased in 23 countries and increased in five 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. Largest increases occurred in Spain, with a total absolute increase of 246 kt CO_2-eq.

Table 5.27 3.B.2.5 - Indirect N_2O emissions from manure management: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	107	112	112	1%	0	0%	5	4%
Belgium	218	187	188	2%	0	0%	-31	-14%
Bulgaria	335	100	96	1%	-4	-4%	-239	-71%
Croatia	192	94	92	1%	-2	-2%	-100	-52%
Cyprus	30	28	30	0%	2	7%	0	-1%
Czech Republic	1 058	359	419	5%	60	17%	-639	-60%
Denmark	197	138	138	2%	0	0%	-59	-30%
Estonia	68	30	31	0%	1	2%	-38	-55%
Finland	99	90	90	1%	0	0%	-9	-9%
France	1 719	1 517	1 533	18%	16	1%	-186	-11%
Germany	1 243	1 037	1 043	12%	6	1%	-200	-16%
Greece	157	167	166	2%	-2	-1%	8	5%
Hungary	321	152	159	2%	6	4%	-162	-51%
Ireland	198	209	209	2%	0	0%	11	6%
Italy	1 035	856	844	10%	-12	-1%	-191	-18%
Latvia	138	41	42	0%	1	2%	-96	-70%
Lithuania	227	82	81	1%	-1	-1%	-147	-64%
Luxembourg	18	16	16	0%	0	2%	-2	-11%
Malta	5	6	6	0%	0	-1%	0	6%
Netherlands	394	212	221	3%	8	4%	-173	-44%
Poland	1 579	1 048	1 076	13%	29	3%	-502	-32%
Portugal	114	88	87	1%	-1	-1%	-27	-24%
Romania	745	405	396	5%	-9	-2%	-349	-47%
Slovakia	257	80	59	1%	-21	-26%	-198	-77%
Slovenia	43	28	28	0%	0	2%	-15	-34%
Spain	737	958	983	11%	25	3%	246	33%
Sweden	99	85	85	1%	0	0%	-14	-14%
United Kingdom	411	370	376	4%	6	2%	-35	-9%
EU-28	**11 745**	**8 494**	**8 604**	**100%**	**109**	**1%**	**-3 141**	**-27%**
Iceland	NE	NE	NE	-	-	-	-	-
EU-28 + ISL	**11 745**	**8 494**	**8 604**	**100%**	**109**	**1%**	**-3 141**	**-27%**

Figure 5.42 3.B.2.5 - Indirect N_2O emissions from manure management: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.B.2.4 - Other Livestock - Emissions

N_2O emissions in source category *3.B.2.4 - Other Livestock* are 0.028% of total EU28+ISL GHG emissions and 0.49% of total EU28+ISL N_2O emissions. They make 0.62% of total agricultural emissions.

Total GHG and N_2O emissions by Member State from 3.B.2.4 *Manure Management* are shown in Table 5.28 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 9% or 254 kt CO_2-eq. The decrease was largest in Bulgaria in relative terms (63%) and in Romania in absolute terms (128 kt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 1.2%. Figure 5.43 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from manure management for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 84.8% of the total. Emissions decreased in fourteen countries and increased in fifteen countries. The four countries with the largest decreases were Romania, Bulgaria, the Netherlands and Poland with a total absolute decrease of 446 kt CO_2-eq. Largest increases occurred in Italy and Spain, with a total absolute increase of 233 kt CO_2-eq.

Table 5.28 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	9	12	12	0%	0	0%	3	36%
Belgium	10	16	17	1%	0	1%	6	63%
Bulgaria	202	77	74	3%	-3	-3%	-128	-63%
Croatia	21	8	8	0%	0	6%	-13	-62%
Cyprus	18	17	18	1%	1	5%	1	4%
Czech Republic	83	61	56	2%	-5	-8%	-27	-33%
Denmark	46	62	62	2%	0	0%	17	36%
Estonia	12	6	6	0%	0	-4%	-6	-53%
Finland	29	37	37	1%	0	0%	8	27%
France	124	137	137	5%	0	0%	13	10%
Germany	198	218	219	8%	1	1%	21	11%
Greece	30	29	29	1%	0	0%	-1	-3%
Hungary	83	54	56	2%	2	4%	-27	-33%
Ireland	10	12	11	0%	0	-1%	1	11%
Italy	292	379	372	14%	-7	-2%	80	27%
Latvia	23	11	12	0%	0	4%	-11	-50%
Lithuania	8	7	8	0%	1	11%	0	3%
Luxembourg	0	1	1	0%	0	1%	0	77%
Malta	1	1	1	0%	0	0%	0	8%
Netherlands	533	419	437	16%	18	4%	-96	-18%
Poland	157	60	62	2%	2	3%	-95	-60%
Portugal	60	46	44	2%	-2	-5%	-16	-27%
Romania	264	149	135	5%	-13	-9%	-128	-49%
Slovakia	27	19	20	1%	2	10%	-6	-23%
Slovenia	34	26	27	1%	1	5%	-6	-19%
Spain	568	689	721	27%	32	5%	153	27%
Sweden	40	46	46	2%	0	0%	7	16%
United Kingdom	45	44	46	2%	1	3%	1	2%
EU-28	**2 924**	**2 641**	**2 674**	**100%**	**33**	**1%**	**-250**	**-9%**
Iceland	13	10	10	0%	0	0%	-3	-25%
EU-28 + ISL	**2 937**	**2 651**	**2 684**	**100%**	**33**	**1%**	**-253**	**-9%**

3.B.2.4.7 - Poultry - Emissions

Largest contribution to other livestock emissions comes from sub-category poultry with 55% of total N_2O emissions. Other animal types with high emissions are 'other' animals in this sub-category with a share of 28% 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 moderately in EU28+ISL by 8.8% or 141 kt CO_2-eq in the period 1990 to 2014. Figure 5.44 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from manure management for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 92.2% of the total. Emissions decreased in eighteen countries and increased in nine countries. The largest decreases occurred in Bulgaria and Romania with a total absolute decrease of 236 kt CO_2-eq. Largest increases occurred in Germany and Spain, with a total absolute increase of 173 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+ISL by 1.4% or 18.4 mio heads in the period 1990 to 2014. Figure 5.45 shows the trend of poultry population indicating the countries contributing most to EU28+ISL total. The figure represents the trend in CH_4 population for the different Member States along the inventory period. The ten countries with the highest population accounted together for 85.6% of the total. Population decreased in fourteen 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 173 mio heads. The three countries with the largest increases were Spain, the United Kingdom and Germany, with a total absolute increase of 144 mio heads.

Other activity data related to this emission category are:

- Nitrogen managed on each manure management system

Figure 5.43 3.B.2.4 - Other Livestock: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

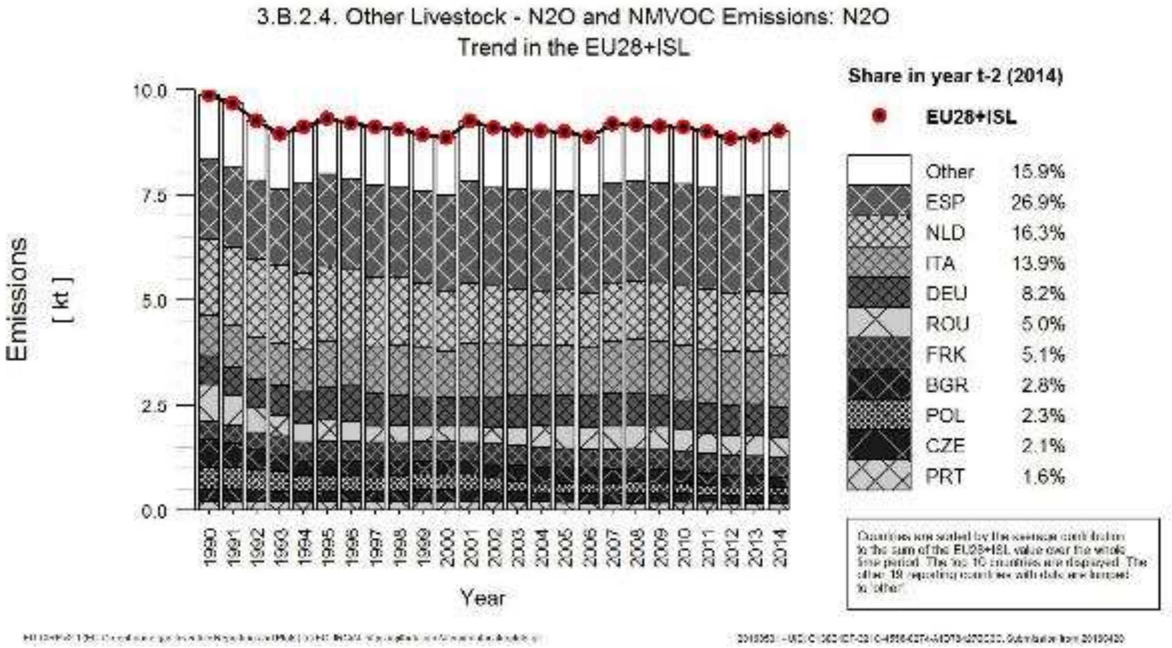


Figure 5.44 3.B.2.4.7 - Poultry: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

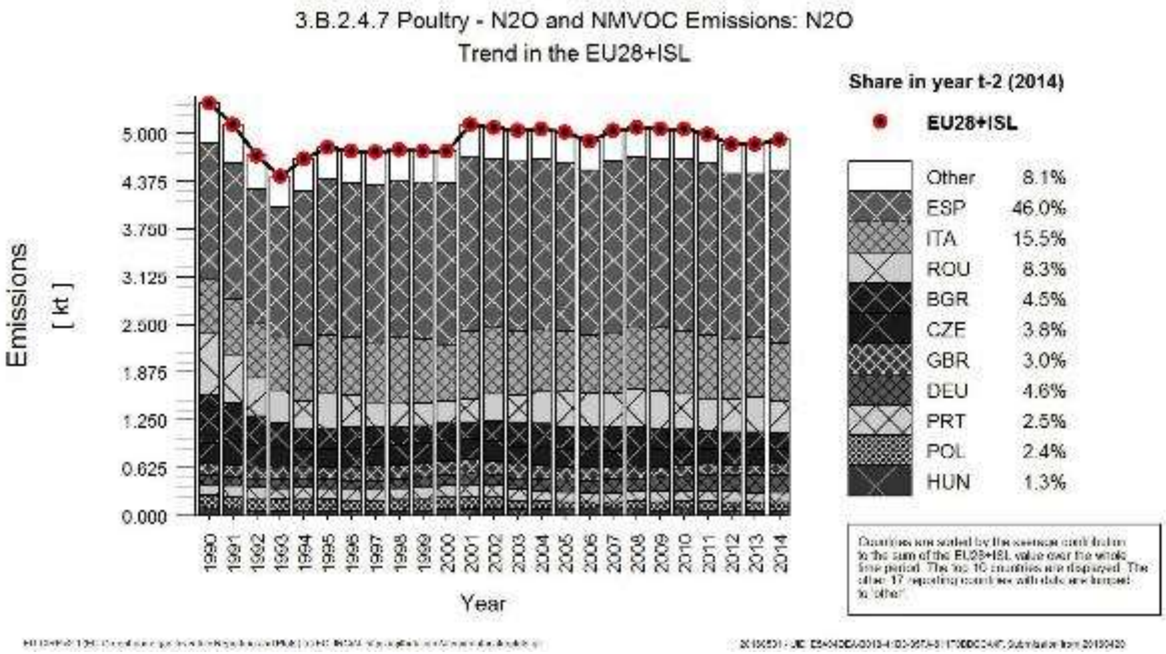
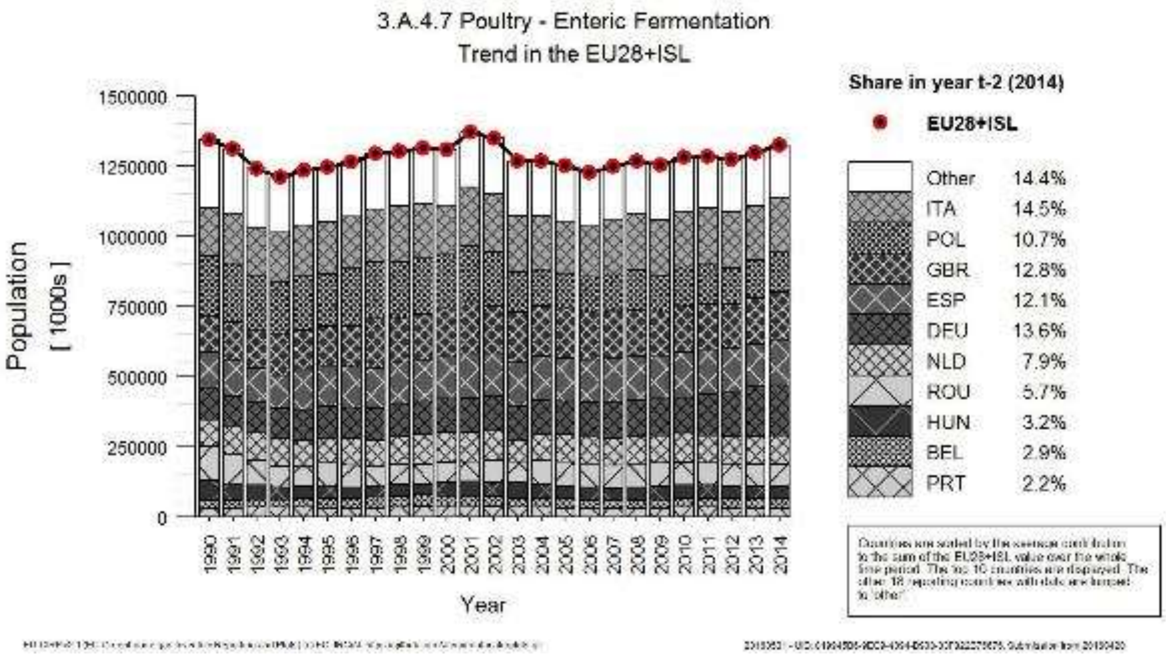


Figure 5.45 3.A.4.7 - Poultry: Trend in poultry population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



5.2.3.2 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 for the different animal types.

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+ISL clearly between 1990 and 2014 by 11.5% or 0.0428 kg/head/year. Table 5.29 shows the implied emission factor for N_2O emissions in source category *3.B.2.1 - Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in ten countries and increased in eighteen countries. No data were available for the Netherlands. The four countries with the largest decreases were Slovenia, Croatia, France and Italy with a mean absolute value of 0.1 kg/head/year. The four countries with the largest increases were, Finland, Estonia, Austria and Bulgaria with a mean absolute value of 0.2 kg/head/year.

Table 5.29 3.B.2.1 - Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	0.34	0.455	|	Ireland	0.12	0.124
Belgium	0.67	0.608	|	Iceland	0.06	0.063
Bulgaria	1.13	1.485	|	Italy	0.55	0.408
Cyprus	0.51	0.487	|	Lithuania	0.29	0.345
Czech Republic	1.58	1.598	|	Luxembourg	0.29	0.284
Germany	0.52	0.530	|	Latvia	0.28	0.341
Denmark	0.49	0.591	|	Malta	1.10	1.054
Estonia	0.25	0.343	|	Poland	0.31	0.384
Spain	0.18	0.184	|	Portugal	0.15	0.117
Finland	0.32	0.522	|	Romania	0.14	0.173
France	0.14	0.099	|	Sweden	0.35	0.379
United Kingdom	0.30	0.308	|	Slovenia	0.30	0.162
Greece	0.28	0.351	|	Slovakia	0.72	0.647
Croatia	0.36	0.243	|	**EU28+ISL**	**0.37**	**0.331**
Hungary	0.58	0.672	|			

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+ISL slightly between 1990 and 2014 by 3.3% or 0.0196 kg/head/year. Figure 5.46 shows the trend of the implied emission factor in EU28+ISL 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 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in seven countries and increased in 21 countries. No data were available for the Netherlands. The largest decreases occurred in France and Croatia with a mean absolute value of 0.1 kg/head/year. The four countries with the largest increases were, Spain, Greece, Portugal and Finland with a mean absolute value of 0.3 kg/head/year.

Figure 5.46 3.B.2.1 - Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

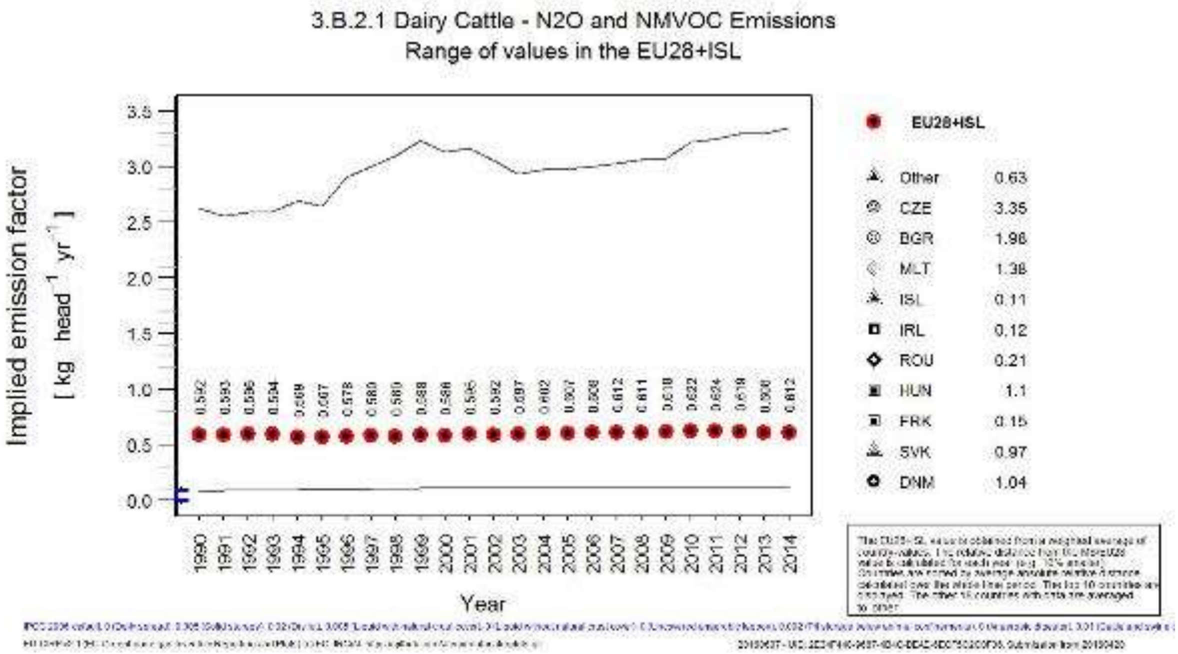


Table 5.30 3.B.2.1 - Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	0.444	0.70	|	Ireland	0.128	0.12
Belgium	0.935	0.76	|	Iceland	0.085	0.11
Bulgaria	1.737	1.98	|	Italy	0.866	0.65
Cyprus	0.759	0.72	|	Lithuania	0.377	0.51
Czech Republic	2.624	3.35	|	Luxembourg	0.503	0.55
Germany	0.827	0.78	|	Latvia	0.596	0.71
Denmark	0.876	1.04	|	Malta	1.380	1.38
Estonia	0.377	0.56	|	Poland	0.402	0.58
Spain	0.411	0.90	|	Portugal	0.330	0.53
Finland	0.484	0.78	|	Romania	0.169	0.21
France	0.231	0.15	|	Sweden	0.626	0.77
United Kingdom	0.435	0.52	|	Slovenia	0.319	0.33
Greece	0.357	0.71	|	Slovakia	0.928	0.97
Croatia	0.392	0.27	|	**EU28+ISL**	**0.592**	**0.61**
Hungary	0.883	1.10	|			

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+ISL clearly between 1990 and 2014 by 10.4% or 9.64 kg/head/year. Figure 5.47 shows the trend of the nitrogen excretion rate in EU28+ISL indicating also the range of values used by the countries. Table 5.31 shows the nitrogen excretion rate in source category *3.B.2.1 - Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in one country and increased in 23 countries. It was in 2014 at the level of 1990 in five countries. A decrease occurred in the Netherlands with an absolute value of 25 kg/head/year. The four countries with the largest increases were, Greece, Spain, Finland and Portugal with a mean absolute value of 41 kg/head/year.

Figure 5.47 3.B.2.1 - Dairy Cattle: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

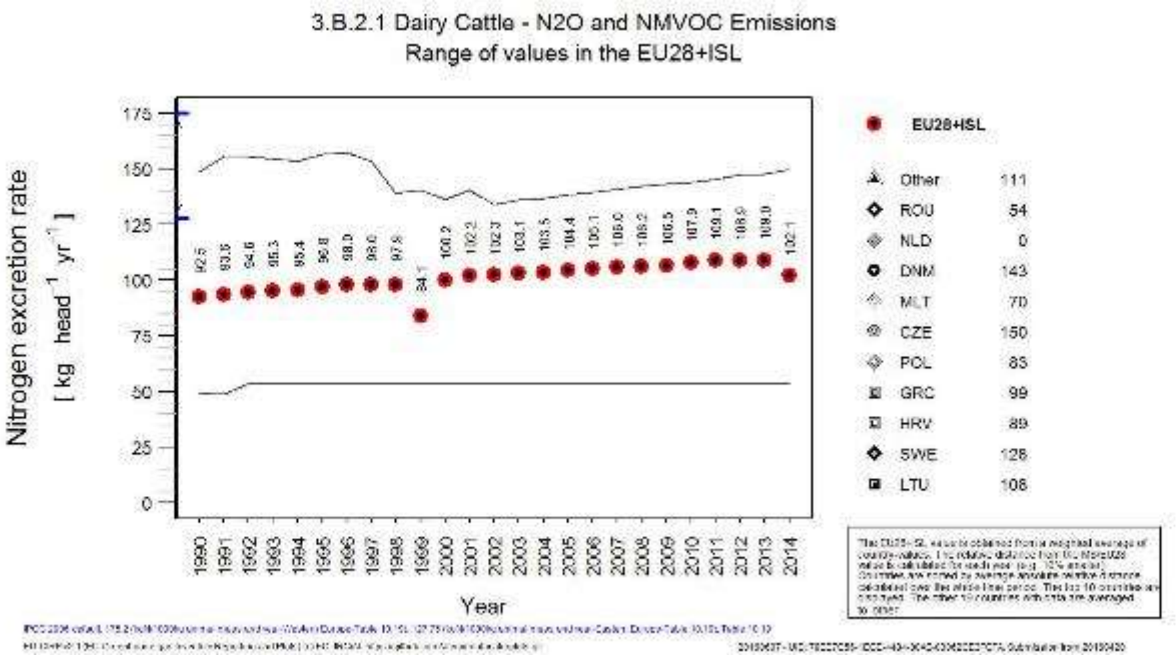


Table 5.31 3.B.2.1 - Dairy Cattle: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	77	101	|	Ireland	96	101
Belgium	114	118	|	Iceland	72	95
Bulgaria	100	100	|	Italy	116	116
Cyprus	96	96	|	Lithuania	80	108
Czech Republic	112	150	|	Luxembourg	85	102
Germany	98	119	|	Latvia	86	114
Denmark	129	143	|	Malta	70	70
Estonia	85	118	|	Netherlands	149	
Spain	69	111	|	Poland	65	83
Finland	91	131	|	Portugal	86	119
France	102	113	|	Romania	54	54
United Kingdom	97	128	|	Sweden	105	128
Greece	49	99	|	Slovenia	82	113
Croatia	70	89	|	Slovakia	100	104
Hungary	83	106	|	**EU28+ISL**	**92**	**102**

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+ISL clearly between 1990 and 2014 by 13.5% or 0.0362 kg/head/year. Figure 5.48 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.32 shows the implied emission factor for N_2O emissions in source category *3.B.2.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in fifteen countries and increased in thirteen countries. No data were available for the Netherlands. The four countries with the largest decreases were Slovenia, Portugal, Slovakia and Croatia with a mean absolute value of 0.1 kg/head/year. The four countries with the largest increases were, Finland, Estonia, Austria and Romania with a mean absolute value of 0.1 kg/head/year.

Figure 5.48 3.B.2.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

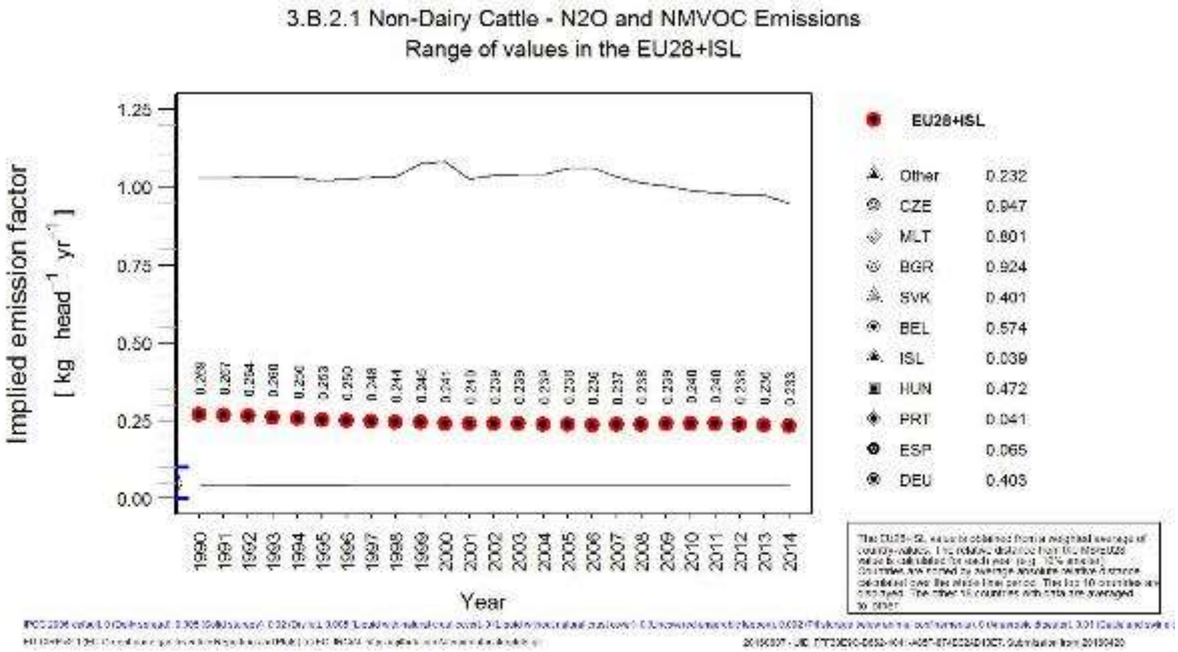


Table 5.32 3.B.2.1 - Non-Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	0.277	0.362	|	Ireland	0.116	0.125
Belgium	0.581	0.574	|	Iceland	0.040	0.039
Bulgaria	0.739	0.924	|	Italy	0.384	0.294
Cyprus	0.332	0.316	|	Lithuania	0.243	0.222
Czech Republic	1.029	0.947	|	Luxembourg	0.218	0.205
Germany	0.372	0.403	|	Latvia	0.095	0.100
Denmark	0.292	0.353	|	Malta	0.897	0.801
Estonia	0.169	0.223	|	Poland	0.215	0.240
Spain	0.071	0.065	|	Portugal	0.078	0.041
Finland	0.223	0.406	|	Romania	0.092	0.119
France	0.105	0.087	|	Sweden	0.209	0.263

Member State	1990	2014		Member State	1990	2014
United Kingdom	0.263	0.260	|	Slovenia	0.291	0.112
Greece	0.240	0.262	|	Slovakia	0.613	0.401
Croatia	0.323	0.222	|	**EU28+ISL**	**0.269**	**0.233**
Hungary	0.422	0.472	|			

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+ISL barely between 1990 and 2014 by 0.47% or 0.226 kg/head/year. Figure 5.49 shows the trend of the nitrogen excretion rate in EU28+ISL indicating also the range of values used by the countries. Table 5.33 shows the nitrogen excretion rate in source category *3.B.2.1 - Non-Dairy Cattle* for the years 1990 and 2014 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in five countries and increased in 21 countries. It was in 2014 at the level of 1990 in three countries. The largest decreases occurred in the Netherlands and Slovakia with a mean absolute value of 19 kg/head/year. The largest increases occurred in Finland and Latvia with a mean absolute value of 12 kg/head/year.

Figure 5.49 3.B.2.1 - Non-Dairy Cattle: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

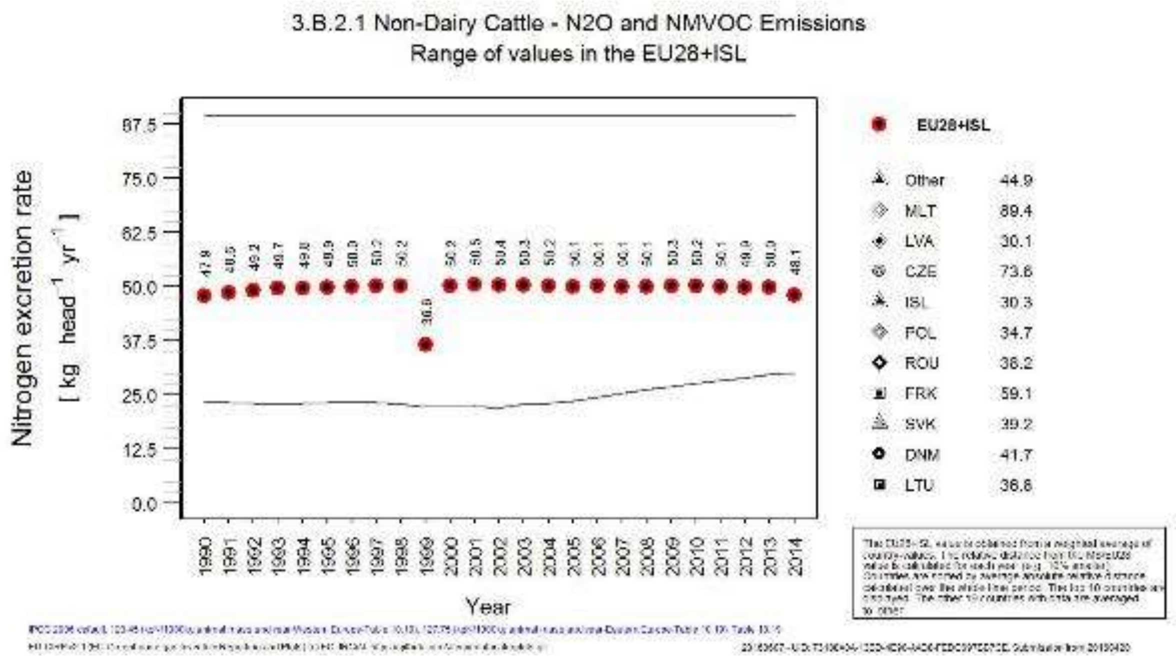


Table 5.33 3.B.2.1 - Non-Dairy Cattle: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2014		Member State	1990	2014
Austria	40	46	|	Ireland	49	51
Belgium	54	54	|	Iceland	29	30
Bulgaria	43	47	|	Italy	50	51
Cyprus	42	42	|	Lithuania	41	37

Member State	1990	2014	Member State	1990	2014
Czech Republic	62	74	Luxembourg	45	46
Germany	41	42	Latvia	23	30
Denmark	36	42	Malta	89	89
Estonia	38	41	Netherlands	57	
Spain	43	42	Poland	33	35
Finland	34	51	Portugal	44	50
France	58	59	Romania	38	38
United Kingdom	53	54	Sweden	39	42
Greece	48	52	Slovenia	35	42
Croatia	55	50	Slovakia	60	39
Hungary	44	51	**EU28+ISL**	**48**	**48**

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+ISL moderately between 1990 and 2014 by 6.7% or 0.000288 kg/head/year. Figure 5.50 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.34 shows the implied emission factor for N_2O emissions in source category *3.B.2.4.7 - Poultry* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in sixteen countries and increased in nine countries. It was in 2014 at the level of 1990 in two countries. No data were available for France and the Netherlands. The four countries with the largest decreases were Iceland, Finland, Latvia and Denmark with a mean absolute value of 0.0054 kg/head/year. The largest increase occurred in Luxembourg with an absolute value of 0.00089 kg/head/year.

Figure 5.50 3.B.2.4.7 - Poultry: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

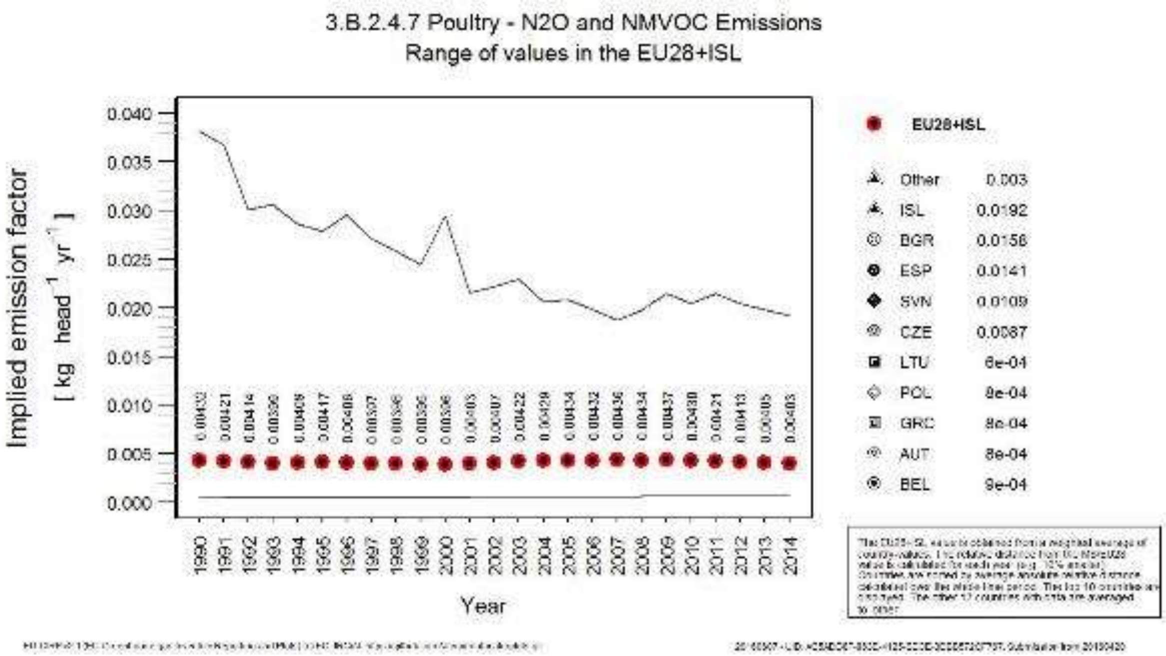


Table 5.34 3.B.2.4.7 - Poultry: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2014	Member State	1990	2014
Austria	0.00092	0.00080	Ireland	0.00109	0.00102
Belgium	0.00094	0.00094	Iceland	0.03810	0.01920
Bulgaria	0.01585	0.01583	Italy	0.00409	0.00396
Cyprus	0.00715	0.00642	Lithuania	0.00053	0.00061
Czech Republic	0.00872	0.00872	Luxembourg	0.00344	0.00433
Germany	0.00110	0.00126	Latvia	0.00364	0.00254
Denmark	0.00112	0.00081	Malta	0.00106	0.00106
Estonia	0.00337	0.00326	Poland	0.00078	0.00083
Spain	0.01423	0.01410	Portugal	0.00435	0.00421
Finland	0.00288	0.00168	Romania	0.00662	0.00544
United Kingdom	0.00113	0.00088	Sweden	0.00435	0.00390
Greece	0.00085	0.00085	Slovenia	0.00999	0.01094
Croatia	0.00507	0.00455	Slovakia	0.00395	0.00404
Hungary	0.00135	0.00144	**EU28+ISL**	**0.00432**	**0.00403**

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+ISL moderately between 1990 and 2014 by 6.3% or 0.0396 kg/head/year. Figure 5.51 shows the trend of the nitrogen excretion rate in EU28+ISL indicating also the range of values used by the countries. Table 5.35 shows the nitrogen excretion rate in source category *3.B.2.4.7 - Poultry* for the years 1990 and 2014 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in thirteen countries and increased in eight countries. It was in 2014 at the level of 1990 in six countries. No data were available for France and the Netherlands. The largest decrease occurred in Iceland with an absolute value of 1 kg/head/year. The largest increase occurred in Luxembourg with an absolute value of 0.1 kg/head/year.

Figure 5.51 3.B.2.4.7 - Poultry: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

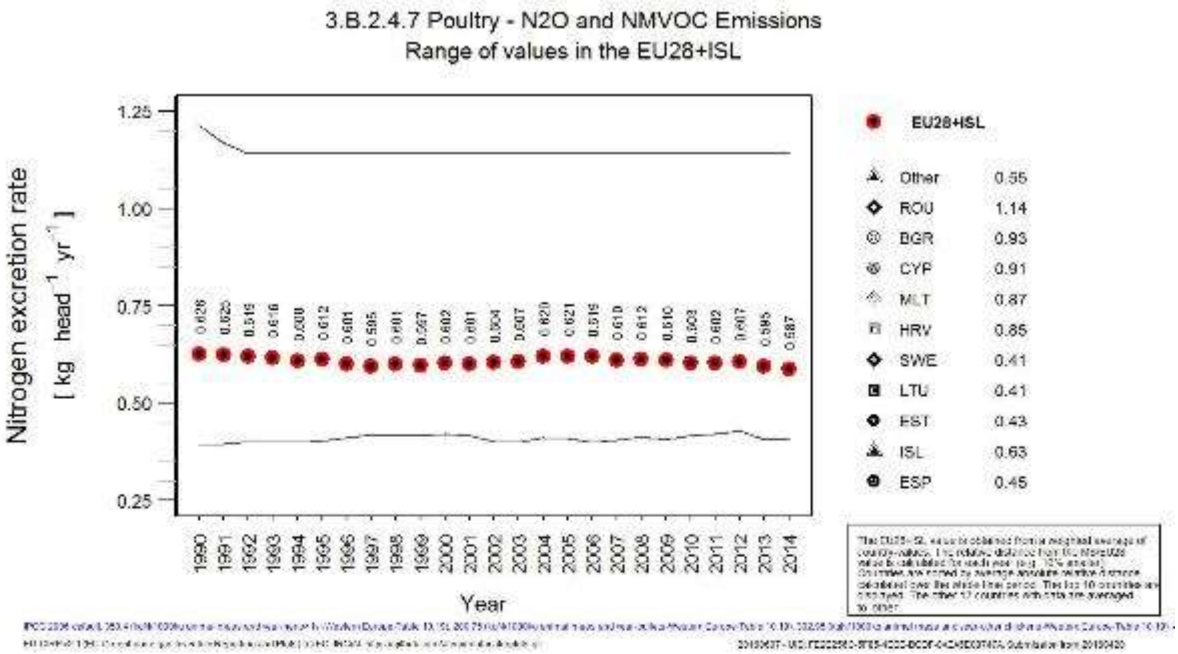


Table 5.35 3.B.2.4.7 - Poultry: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2014	Member State	1990	2014
Austria	0.59	0.54	Ireland	0.60	0.54
Belgium	0.60	0.60	Iceland	1.21	0.63
Bulgaria	0.94	0.93	Italy	0.52	0.50
Cyprus	0.91	0.91	Lithuania	0.39	0.41
Czech Republic	0.61	0.61	Luxembourg	0.44	0.55
Germany	0.70	0.70	Latvia	0.48	0.49
Denmark	0.63	0.51	Malta	0.87	0.87
Estonia	0.44	0.43	Poland	0.50	0.49
Spain	0.45	0.45	Portugal	0.55	0.55
Finland	0.50	0.55	Romania	1.14	1.14
United Kingdom	0.73	0.57	Sweden	0.46	0.41
Greece	0.50	0.50	Slovenia	0.47	0.51
Croatia	0.85	0.85	Slovakia	0.50	0.51
Hungary	0.48	0.56	**EU28+ISL**	**0.63**	**0.59**

3.B.2.5 - Indirect N_2O emissions from manure management - Implied emission factor

The implied emission factor for N_2O emissions in source category *3.B.2.5 - Indirect N_2O emissions from manure management - Indirect N_2O emissions* decreased in EU28+ISL barely between 1990 and 2014 by 0.15% or 2.36e-05 kg N_2O/kg N. Figure 5.52 shows the trend of the implied emission factor in EU28+ISL 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.2.5 - Indirect N_2O emissions from manure management - Indirect N_2O*

emissions for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in one country and increased in six countries. It was in 2014 at the level of 1990 in twenty countries. No data were available for Iceland and the Netherlands. A decrease occurred in Estonia with an absolute value of 2.8e-05 kg N_2O/kg N. The three countries with the largest increases were, Croatia, Poland and Spain with a mean absolute value of 4.4e-05 kg N_2O/kg N.

Figure 5.52 3.B.2.5 - Indirect N_2O emissions from manure management: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

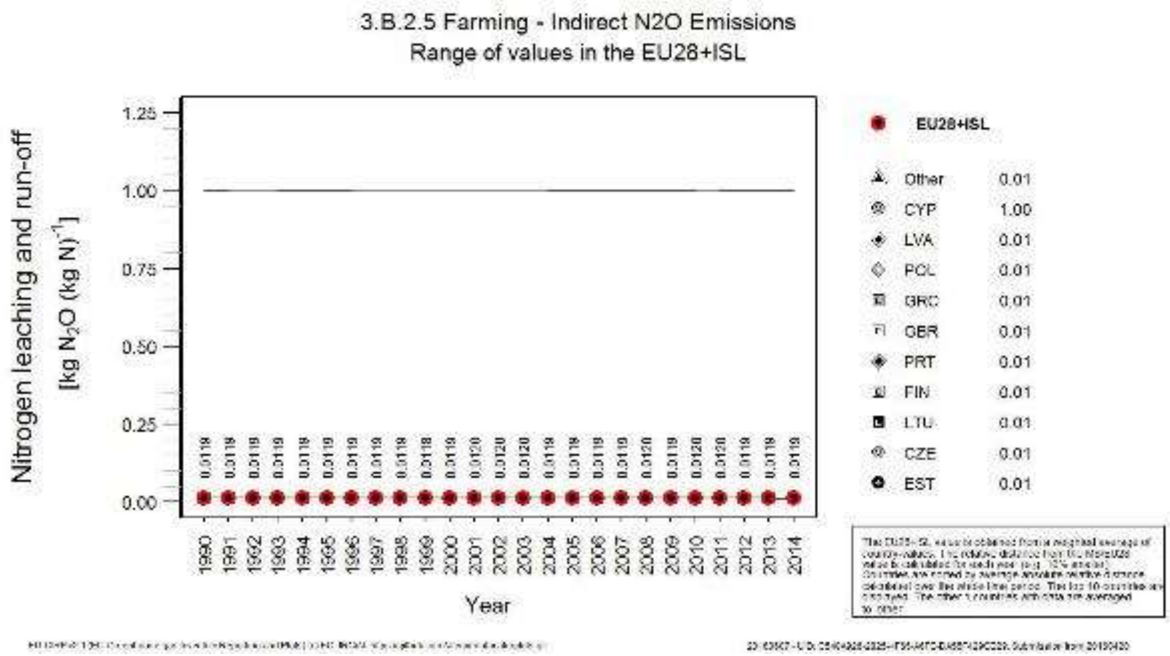


Table 5.36 3.B.2.5 - Indirect N_2O emissions from manure management: Member States' and EU28+ISL implied emission factor (kg N_2O/kg N)

Member State	1990	2014		Member State	1990	2014
Austria	0.016	0.016	|	Hungary	0.016	0.016
Belgium	0.016	0.016	|	Ireland	0.016	0.016
Bulgaria	0.016	0.016	|	Italy	0.016	0.016
Cyprus	1.000	1.000	|	Lithuania	0.016	0.016
Czech Republic	0.016	0.016	|	Luxembourg	0.016	0.016
Germany	0.016	0.016	|	Latvia	0.016	0.016
Denmark	0.016	0.016	|	Malta	0.016	0.016
Estonia	0.016	0.016	|	Poland	0.016	0.016
Spain	0.016	0.016	|	Portugal	0.016	0.016
Finland	0.016	0.016	|	Romania	0.016	0.016
France	0.016	0.016	|	Sweden	0.016	0.016
United Kingdom	0.016	0.016	|	Slovenia	0.016	0.016
Greece	0.016	0.016	|	Slovakia	0.016	0.016
Croatia	0.025	0.025	|	**EU28+ISL**	**0.016**	**0.016**

5.2.4 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 1.4% of total EU28+ISL GHG emissions and 25% of total EU28+ISL N_2O emissions. They make 30.7% 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.1.4 (Crop Residues) as shown in Figure 5.53. Regarding the origin of emissions in the different Member States, Figure 5.54 shows the distribution of direct N_2O emissions from managed soils by emission source in all Member States and in the EU28+ISL. Each bar represents the total emissions of a country in the current emission category, where different shades of grey correspond to the emitting sub-categories.

Figure 5.53 Share of source category 3.D.1 on total EU28+ISL agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emissions in the year 2014. Categories 3.D.1.1-3.D.1.5: direct N_2O emissions by N source (inorganic fertilizers, organic fertilizers, urine and dung deposited by grazing animals, crop residues and mineralization of soil organic matter); category 3.D.1.6: cultivation of histosols.

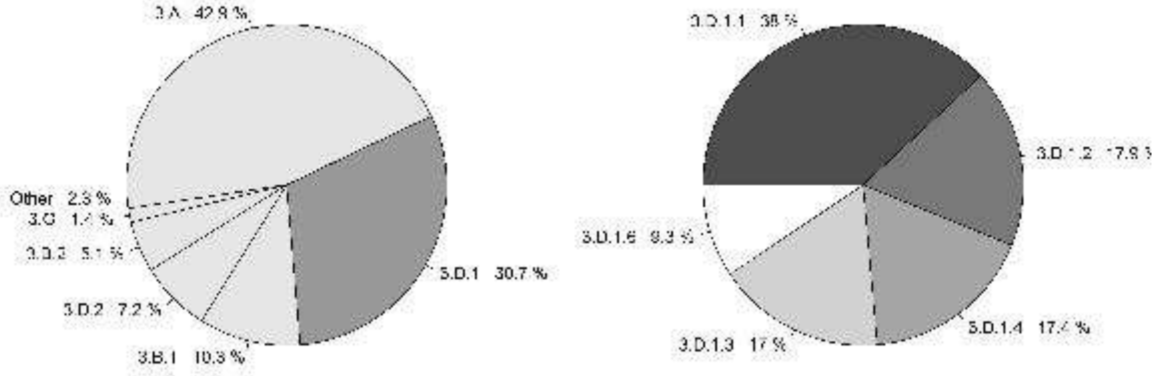
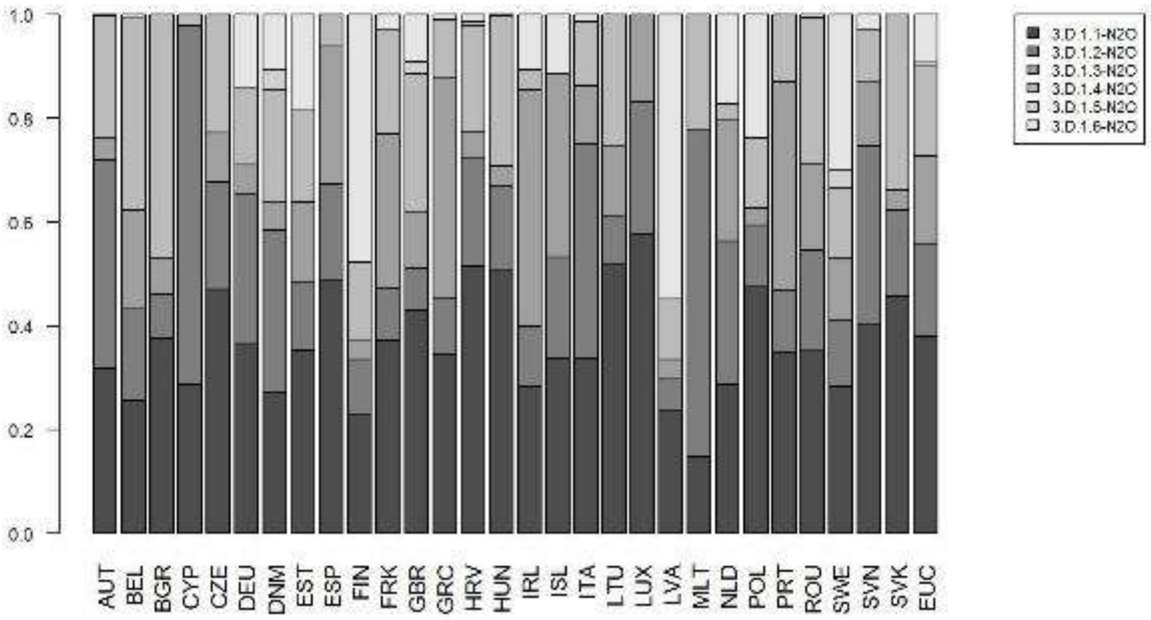


Figure 5.54 Decomposition of emissions in source category 3.D.1 - Direct N_2O Emissions From Managed Soils into its sub-categories by Member State in the year 2014. 3.D.1.1 inorganic N fertilisers, 3.D.1.2 organic N fertilisers, 3.D.1.3 urine and dung deposited by grazing animals, 3.D.1.4 crop residues incorporated in the soil, 3.D.1.5 mineralisation/immobilisation associated with loss/gain of soil organic matter, and 3.D.1.6 cultivation of organic soils (histosols).



Total GHG and N_2O emissions by Member State from 3.D.1 *Direct N_2O Emissions From Managed Soils* are shown in Table 5.37 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 16% or 25.5 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (47%) and in Romania in absolute terms (3.1 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 2%.

Table 5.37 3.D.1 - Direct N_2O Emissions From Managed Soils: Member States' contributions to total GHG and N_2O emissions

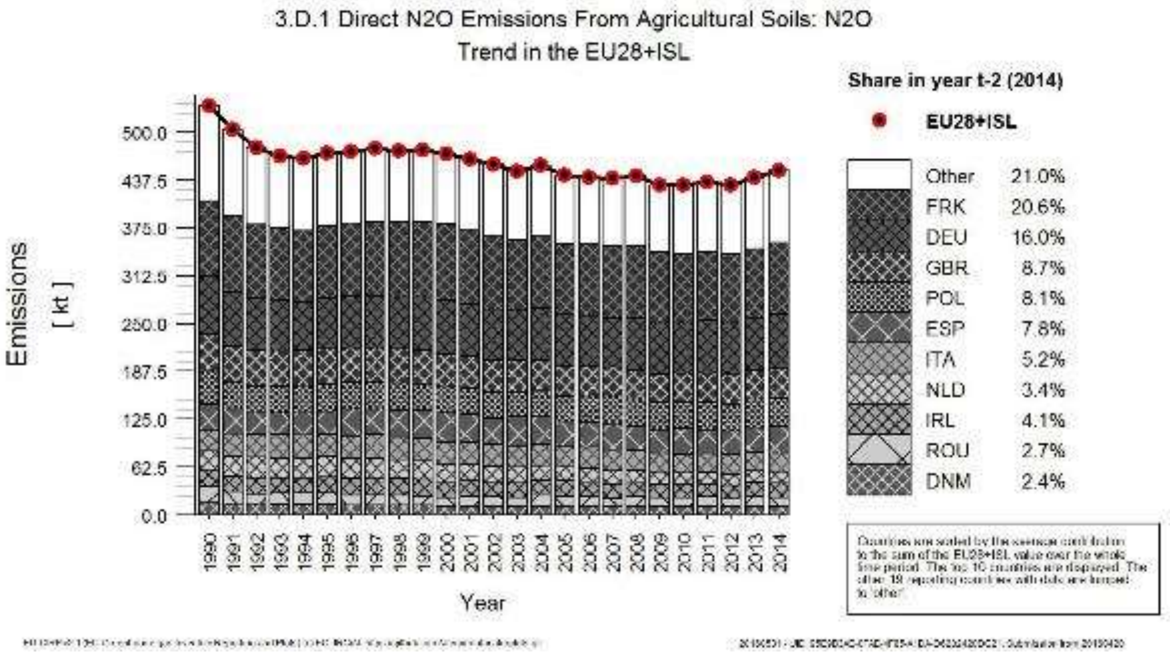
Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	1 817	1 563	1 645	1%	82	5%	-172	-9%	NA	NA
Belgium	3 356	2 556	2 630	2%	74	3%	-726	-22%	T1	D
Bulgaria	3 951	2 512	2 167	2%	-345	-14%	-1 784	-45%	T1	D
Croatia	1 106	795	734	1%	-61	-8%	-373	-34%	T1	D
Cyprus	130	109	109	0%	0	0%	-21	-16%	T1	D
Czech Republic	3 992	2 234	2 397	2%	163	7%	-1 594	-40%	T1,T2	CS,D
Denmark	4 500	3 274	3 230	2%	-43	-1%	-1 270	-28%	CS,D,T1,T2	D
Estonia	856	437	476	0%	39	9%	-380	-44%	CS,T1,T2	D
Finland	3 269	2 977	3 034	2%	57	2%	-236	-7%	T1,T2	CS,D
France	29 103	26 584	27 583	21%	999	4%	-1 520	-5%	NA	NA
Germany	22 616	20 726	21 425	16%	699	3%	-1 191	-5%	T1,T2	CS,D
Greece	3 554	2 468	2 460	2%	-9	0%	-1 094	-31%	T1	D
Hungary	3 414	2 934	3 008	2%	75	3%	-405	-12%	T1	D
Ireland	6 028	5 601	5 516	4%	-85	-2%	-512	-8%	T1	D
Italy	8 485	7 090	6 996	5%	-94	-1%	-1 489	-18%	CS,T1	CS,D
Latvia	1 963	1 395	1 429	1%	35	2%	-533	-27%	T1	D
Lithuania	1 865	1 356	1 393	1%	37	3%	-472	-25%	T1	D
Luxembourg	139	112	113	0%	1	1%	-26	-19%	T1	D
Malta	22	20	20	0%	0	0%	-2	-9%	T1	D
Netherlands	7 476	4 479	4 528	3%	49	1%	-2 948	-39%	T1,T1b,T2	CS,D
Poland	13 796	11 014	10 836	8%	-178	-2%	-2 959	-21%	T1	CS,D
Portugal	1 809	1 688	1 735	1%	47	3%	-74	-4%	T1	D
Romania	6 696	3 741	3 635	3%	-105	-3%	-3 060	-46%	T1	D
Slovakia	2 301	1 225	1 218	1%	-7	-1%	-1 083	-47%	T1,T2	CS
Slovenia	324	312	332	0%	19	6%	8	2%	T1	D
Spain	9 631	9 722	10 435	8%	713	7%	804	8%	CS,T1a,T1b	D
Sweden	3 203	2 898	2 994	2%	96	3%	-208	-7%	T1,T2	CS,D
United Kingdom	13 782	11 285	11 648	9%	363	3%	-2 134	-15%	T1,T1a,T2	CS,D
EU-28	**159 182**	**131 107**	**133 727**	**100%**	**2 620**	**2%**	**-25 454**	**-16%**		
Iceland	229	203	224	0%	22	11%	-5	-2%	T1b,T2	CS,D
EU-28 + ISL	**159 411**	**131 310**	**133 952**	**100%**	**2 642**	**2%**	**-25 459**	**-16%**		

5.2.4.1 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+ISL by 16% or 25.5 Mt CO_2-eq in the period 1990 to 2014. Figure 5.55 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from direct N_2O emissions from managed soils for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 79% of the total. Emissions decreased in 27 countries and increased in two countries. The three countries with the largest decreases were Romania, Poland and the Netherlands with a total absolute decrease of 9 Mt CO_2-eq. Largest increases occurred in Spain, with a total absolute increase of 804 kt CO_2-eq.

Figure 5.55 3.D.1 Direct N_2O Emissions From Managed Soils: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



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 14% below 1990 levels in 2014, 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 inorganic N fertilizers - Emissions

Emissions in source category *3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers* decreased strongly in EU28+ISL by 26% or 18.1 Mt CO_2-eq in the period 1990 to 2014. Figure 5.56 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from inorganic N fertilizers for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 81.4% of the total. Emissions decreased in 25 countries and increased in four countries. The three countries with the largest decreases were the United Kingdom, Germany and France with a total absolute decrease of 6.8 Mt CO_2-eq. Largest increases occurred in Spain, with a total absolute increase of 92 kt CO_2-eq.

3.D.1.1 - Direct N_2O emissions from inorganic N fertilizers - Application of inorganic fertilizers

Application of inorganic fertilizers decreased strongly in EU28+ISL by 25% or 3.7 kt N/year in the period 1990 to 2014. Figure 5.57 shows the trend of application of inorganic fertilizers indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O application of inorganic fertilizers from inorganic N fertilizers for the different Member States along the inventory period. The ten countries with the highest application of inorganic fertilizers accounted together for 81.7% of the total. Application of inorganic fertilizers decreased in 25 countries and increased in four countries. The three countries with the largest decreases were Germany, the United Kingdom and France with a total absolute decrease of 1.3 kt N/year. Largest increases occurred in Spain, with a total absolute increase of 28 kt N/year.

Figure 5.56 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

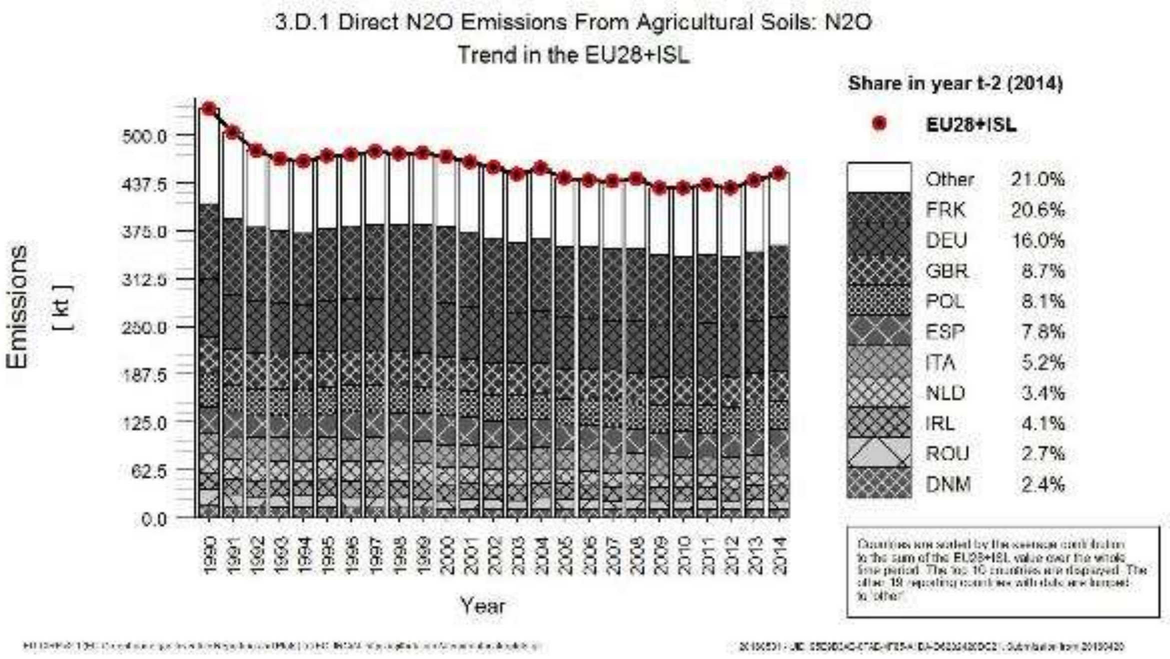
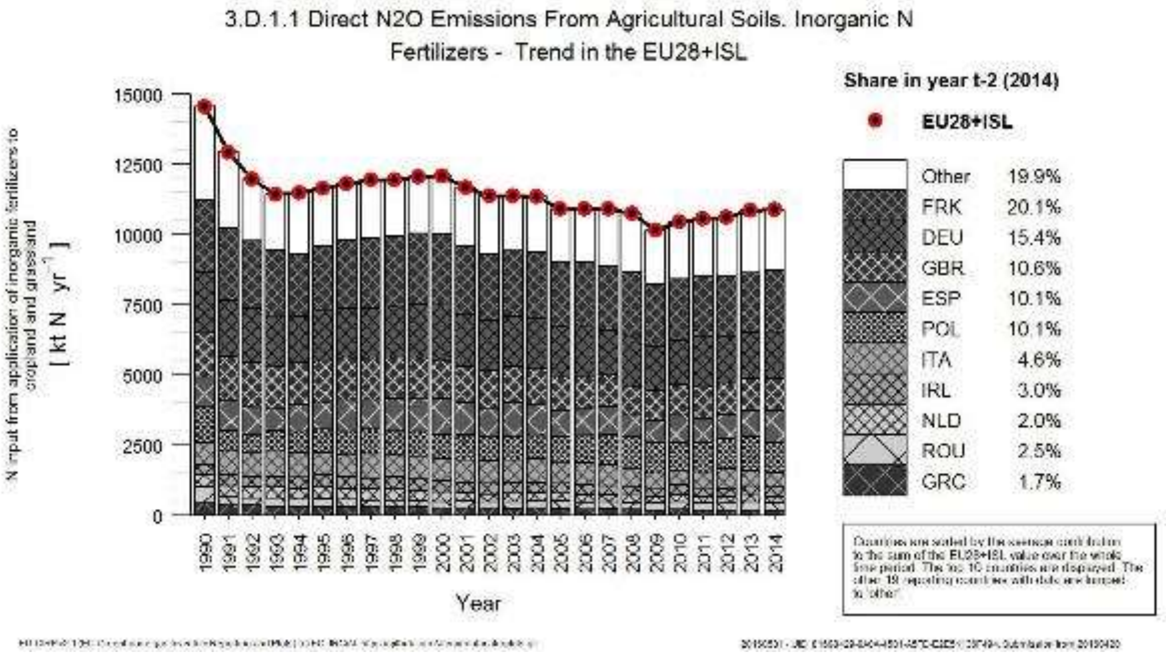


Figure 5.57 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers: Trend in application of inorganic fertilizers in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.D.1.2 - Direct N_2O emissions from organic N fertilizers - Emissions

Emissions in source category *3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers* decreased clearly in EU28+ISL by 12% or 3.1 Mt CO_2-eq in the period 1990 to 2014. Figure 5.58 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from organic N fertilizers for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 81.8% of the total. Emissions decreased in 21 countries and increased in eight countries. The four countries with the largest decreases were Romania, Poland, Czech Republic and Slovakia with a total absolute decrease of 2.7 Mt CO_2-eq. The three countries with the largest increases were the Netherlands, Spain and Germany, with a total absolute increase of 1.6 Mt CO_2-eq.

3.D.1.2 - Direct N_2O emissions from organic N fertilizers - N from applied organic N fertilizers

N from applied organic N fertilizers decreased clearly in EU28+ISL by 14% or 880 kt N/year in the period 1990 to 2014. Figure 5.59 shows the trend of N from applied organic N fertilizers indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O N from applied organic N fertilizers from organic N fertilizers for the different Member States along the inventory period. The ten countries with the highest N from applied organic N fertilizers accounted together for 82.1% of the total. N from applied organic n fertilizers decreased in 22 countries and increased in seven countries. The largest decreases occurred in Romania and Poland with a total absolute decrease of 333 kt N/year. Largest increases occurred in Spain and Germany, with a total absolute increase of 250 kt N/year.

Figure 5.58 *3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014*

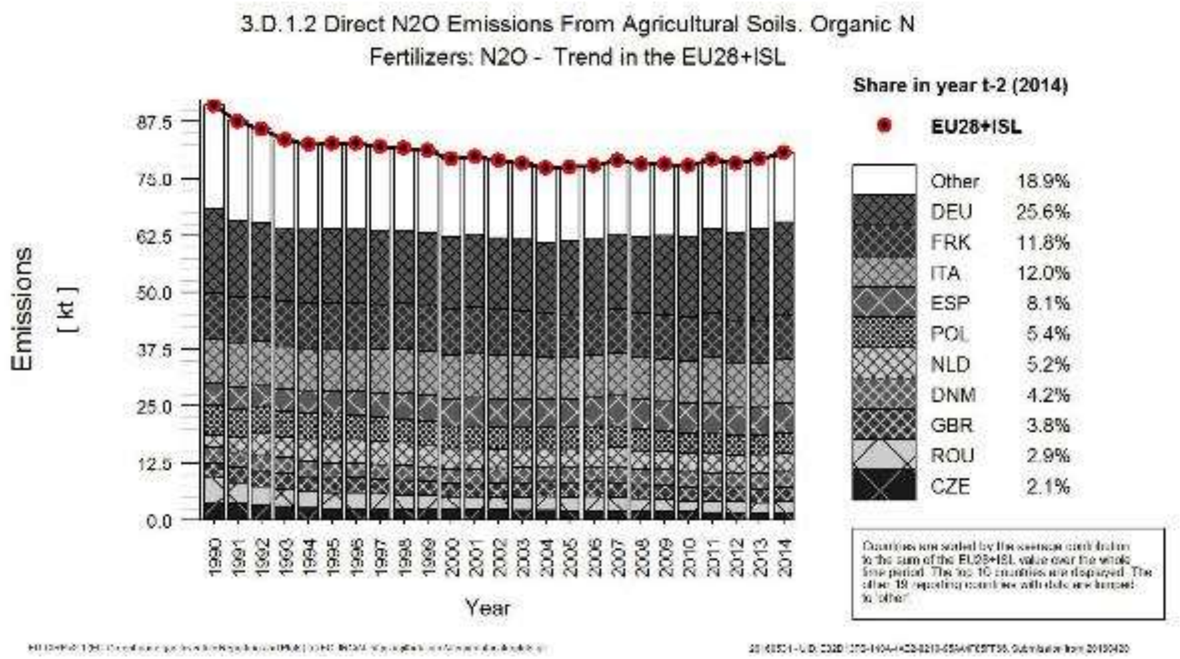
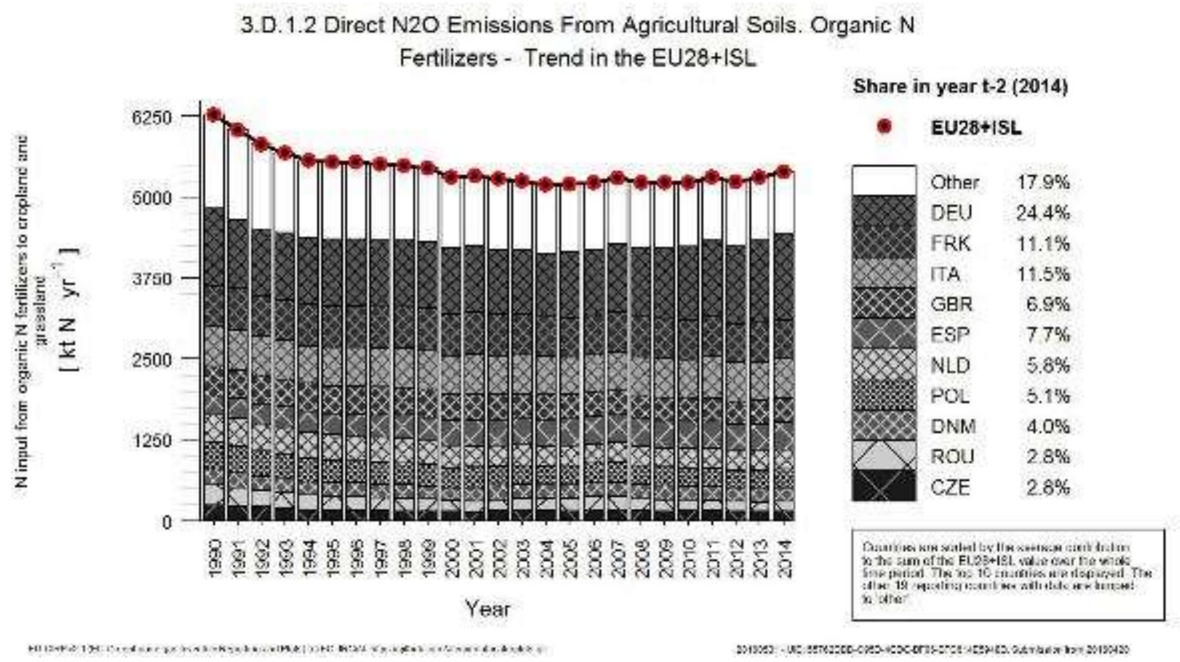


Figure 5.59 *3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014*



3.D.1.3 - Urine and Dung Deposited by Grazing Animals - Emissions

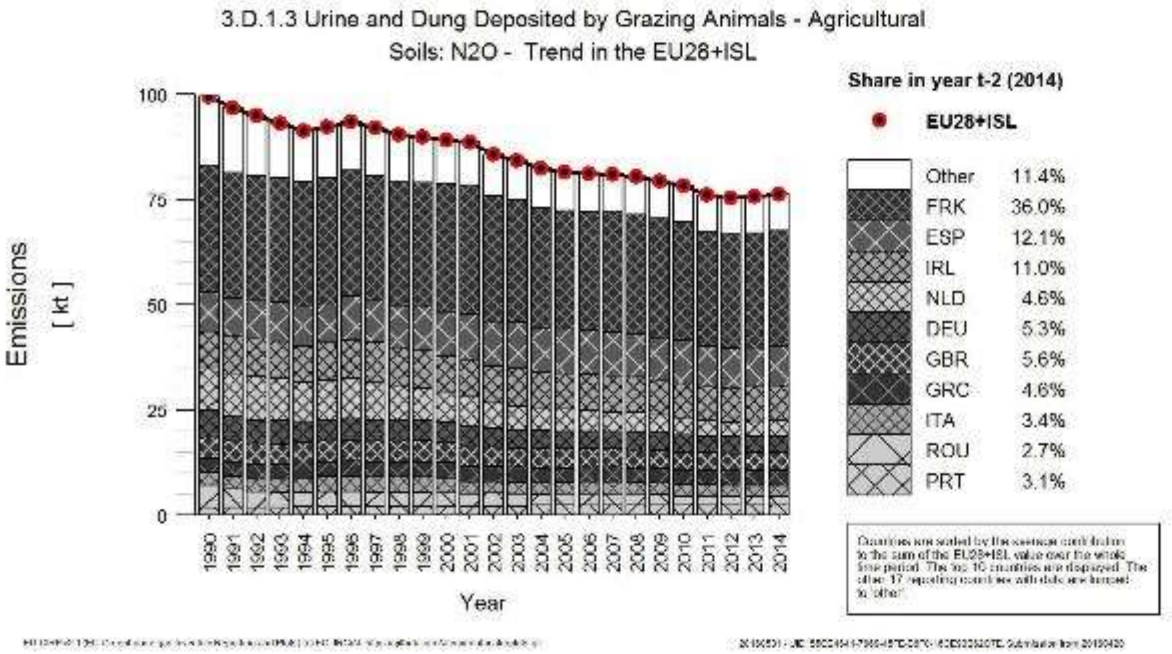
N_2O emissions in source category *3.D.1.3 - Urine and Dung Deposited by Grazing Animals* are 0.24% of total EU28+ISL GHG emissions and 4.2% of total EU28+ISL N_2O emissions. They make 5.2% of total agricultural emissions.

Total GHG and N_2O emissions by Member State from 3.D.1.3 *Grazing Animals* are shown in Table 5.38 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 23% or 6.9 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (75%) and in the Netherlands in absolute terms (2 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 0.7%. Figure 5.60 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from grazing animals for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 88.6% of the total. Emissions decreased in 24 countries and increased in three countries. The three countries with the largest decreases were the 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 183 kt CO_2-eq.

Table 5.38 3.D.1.3 - Urine and Dung Deposited by Grazing Animals: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	71	71	0%	-1	-1%	-78	-52%	-	-
Belgium	711	499	503	2%	3	1%	-208	-29%	T1	D
Bulgaria	577	145	147	1%	2	1%	-430	-75%	T1	D
Croatia	106	38	37	0%	-2	-4%	-69	-65%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	270	241	230	1%	-11	-5%	-40	-15%	T1	D
Denmark	299	185	183	1%	-1	-1%	-116	-39%	T1	D
Estonia	183	72	73	0%	1	1%	-110	-60%	CS,T2	D
Finland	151	109	109	0%	0	0%	-42	-28%	T1	D
France	8 944	8 097	8 175	36%	78	1%	-770	-9%	-	-
Germany	1 909	1 192	1 206	5%	15	1%	-703	-37%	T1	D
Greece	1 049	1 051	1 046	5%	-4	0%	-3	0%	T1	D
Hungary	193	108	112	0%	4	4%	-81	-42%	T1	D
Ireland	2 540	2 498	2 509	11%	11	0%	-31	-1%	T1	D
Italy	934	786	779	3%	-7	-1%	-155	-17%	T1	CS,D
Latvia	149	51	55	0%	4	7%	-94	-63%	T1	D
Lithuania	415	176	190	1%	14	8%	-224	-54%	T1	D
Luxembourg	19	19	19	0%	0	1%	0	0%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 028	1 052	1 055	5%	3	0%	-1 973	-65%	T1	D
Poland	1 048	348	350	2%	1	0%	-698	-67%	T1	CS,D
Portugal	538	696	700	3%	4	1%	161	30%	T1	D
Romania	1 522	608	613	3%	5	1%	-909	-60%	T1	D
Slovakia	127	49	45	0%	-3	-7%	-82	-64%	T1	CS
Slovenia	19	39	40	0%	1	3%	22	117%	T1	D
Spain	2 815	2 731	2 759	12%	28	1%	-56	-2%	CS,T1a,T1b	D
Sweden	366	350	351	2%	1	0%	-15	-4%	T1	D
United Kingdom	1 455	1 256	1 273	6%	17	1%	-182	-13%	T2	CS
EU-28	**29 515**	**22 466**	**22 629**	**100%**	**163**	**1%**	**-6 886**	**-23%**		
Iceland	86	74	80	0%	5	7%	-7	-8%	-	-
EU-28 + ISL	**29 601**	**22 540**	**22 708**	**100%**	**168**	**1%**	**-6 893**	**-23%**		

Figure 5.60 3.D.1.3 - Urine and Dung Deposited by Grazing Animals: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



5.2.4.2 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 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 Inorganic N Fertilizers* decreased in EU28+ISL slightly between 1990 and 2014 by 1.3% or 0.000135 kg N_2O-N/kg N. Figure 5.61 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.39 shows the implied emission factor for N_2O emissions in source category *3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in six countries and increased in two countries. It was in 2014 at the level of 1990 in 21 countries. The three countries with the largest decreases were the United Kingdom, Belgium and Spain with a mean absolute value of 0.00036 kg N_2O-N/kg N. Increases occurred in Cyprus and Germany with a mean absolute value of 3.4e-07 kg N_2O-N/kg N.

Figure 5.61 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

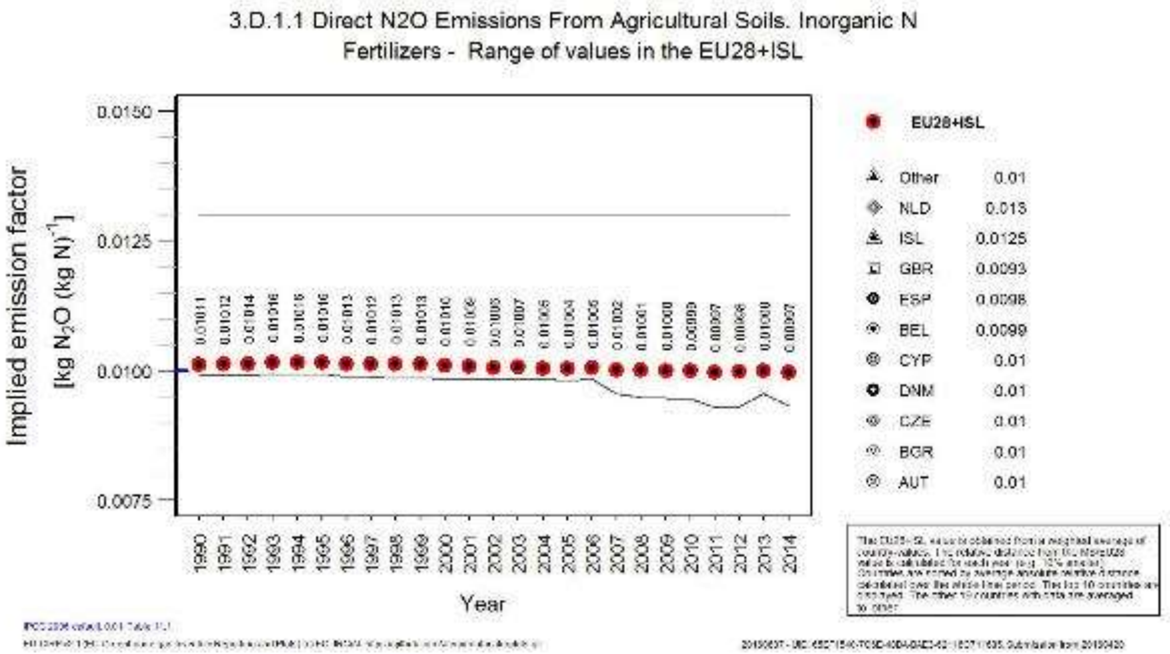


Table 5.39 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)

Member State	1990	2014		Member State	1990	2014
Austria	0.0100	0.0100	|	Ireland	0.0100	0.0100
Belgium	0.0100	0.0099	|	Iceland	0.0125	0.0125
Bulgaria	0.0100	0.0100	|	Italy	0.0100	0.0100
Cyprus	0.0100	0.0100	|	Lithuania	0.0100	0.0100
Czech Republic	0.0100	0.0100	|	Luxembourg	0.0100	0.0100
Germany	0.0100	0.0100	|	Latvia	0.0100	0.0100
Denmark	0.0100	0.0100	|	Malta	0.0100	0.0100
Estonia	0.0100	0.0100	|	Netherlands	0.0130	0.0130
Spain	0.0099	0.0098	|	Poland	0.0100	0.0100
Finland	0.0100	0.0100	|	Portugal	0.0100	0.0100
France	0.0100	0.0100	|	Romania	0.0100	0.0100
United Kingdom	0.0103	0.0093	|	Sweden	0.0100	0.0100
Greece	0.0100	0.0100	|	Slovenia	0.0100	0.0100
Croatia	0.0100	0.0100	|	Slovakia	0.0100	0.0100
Hungary	0.0100	0.0100	|	**EU28+ISL**	**0.0101**	**0.0100**

3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers 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 Organic N Fertilizers* increased in EU28+ISL slightly between 1990 and 2014 by 2.9% or 0.000268 kg N_2O-N/kg N. Figure 5.62 shows the trend of the implied emission factor in EU28+ISL 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.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers* for the years 1990 and 2014 for all Member States and EU28+ISL. The implied emission factor decreased in seven countries and increased in four countries. It was in 2014 at the level of 1990 in eighteen countries. The largest decrease occurred in Czech Republic with an absolute value of 0.003 kg N_2O-N/kg N. The largest increase occurred in the Netherlands with an absolute value of 0.0045 kg N_2O-N/kg N.

Figure 5.62 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

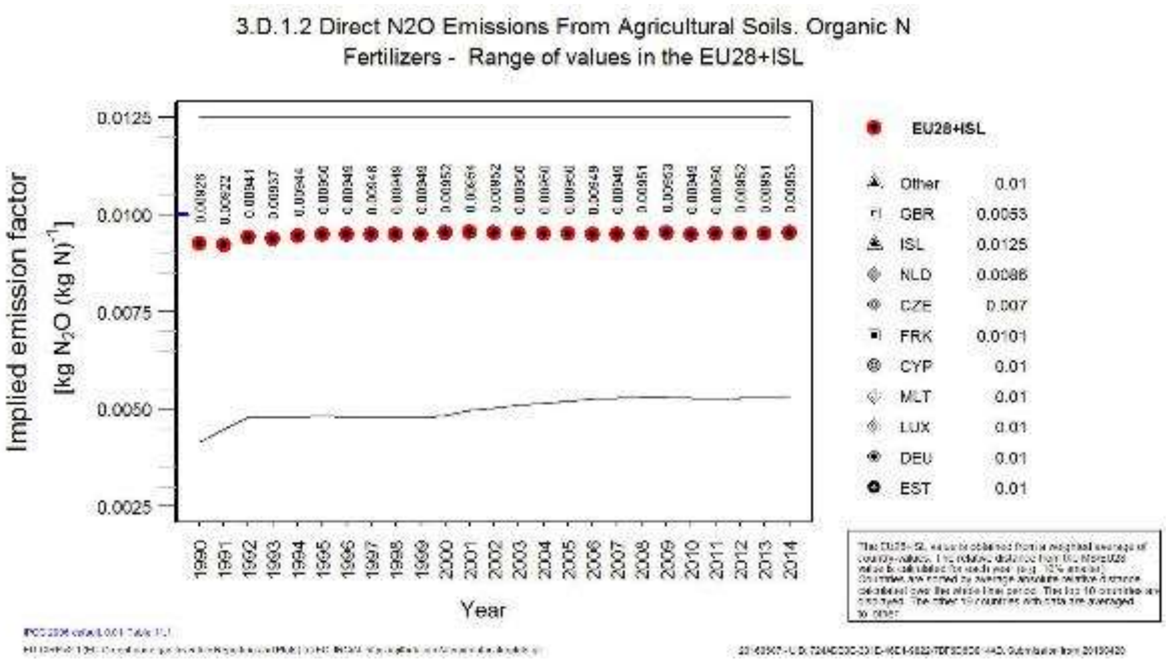


Table 5.40 *3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)*

Member State	1990	2014	Member State	1990	2014
Austria	0.0100	0.0100	Ireland	0.0100	0.0100
Belgium	0.0100	0.0100	Iceland	0.0125	0.0125
Bulgaria	0.0100	0.0100	Italy	0.0100	0.0100
Cyprus	0.0100	0.0100	Lithuania	0.0100	0.0100
Czech Republic	0.0100	0.0070	Luxembourg	0.0100	0.0100
Germany	0.0100	0.0100	Latvia	0.0100	0.0100
Denmark	0.0100	0.0100	Malta	0.0100	0.0100
Estonia	0.0100	0.0100	Netherlands	0.0042	0.0086
Spain	0.0100	0.0100	Poland	0.0100	0.0100
Finland	0.0100	0.0100	Portugal	0.0100	0.0100
France	0.0100	0.0101	Romania	0.0100	0.0100
United Kingdom	0.0048	0.0053	Sweden	0.0100	0.0100
Greece	0.0100	0.0100	Slovenia	0.0100	0.0100
Croatia	0.0100	0.0100	Slovakia	0.0100	0.0100
Hungary	0.0100	0.0100	**EU28+ISL**	**0.0093**	**0.0095**

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+ISL level. Table 5.41 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 2014 for all Member States and EU28+ISL. The implied emission factor decreased in fourteen countries and increased in eleven countries. It was in 2014 at the level of 1990 in two countries. No data were available for Cyprus and Malta. The three countries with the largest decreases were Croatia, Slovakia and Romania with a mean absolute value of 0.0024 kg N_2O-N/kg N. The three countries with the largest increases were, Portugal, Bulgaria and Poland with a mean absolute value of 0.0014 kg N_2O-N/kg N.

Table 5.41 *3.D.1.3 - Urine and Dung Deposited by Grazing Animals: Member States' implied emission factor (kg N_2O-N/kg N)*

Member State	1990	2014	Member State	1990	2014
Austria	0.0182	0.0159	Ireland	0.0184	0.0189
Belgium	0.0197	0.0196	Iceland	0.0200	0.0200
Bulgaria	0.0115	0.0125	Italy	0.0112	0.0112
Czech Republic	0.0176	0.0183	Lithuania	0.0211	0.0221
Germany	0.0191	0.0190	Luxembourg	0.0100	0.0100
Denmark	0.0187	0.0180	Latvia	0.0198	0.0193
Estonia	0.0191	0.0187	Netherlands	0.0330	0.0330
Spain	0.0200	0.0201	Poland	0.0178	0.0191
Finland	0.0179	0.0170	Portugal	0.0163	0.0181
France	0.0186	0.0189	Romania	0.0174	0.0150
United Kingdom	0.0044	0.0044	Sweden	0.0174	0.0169

Member State	1990	2014		Member State	1990	2014
Greece	0.0104	0.0105	|	Slovenia	0.0183	0.0170
Croatia	0.0140	0.0116	|	Slovakia	0.0167	0.0142
Hungary	0.0138	0.0145	|			

5.2.5 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 0.33% of total EU28+ISL GHG emissions and 5.8% of total EU28+ISL N_2O emissions. They make 7.2% 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 5.63. Regarding the origin of emissions in the different Member States, Figure 5.64 shows the distribution of indirect N_2O emissions from managed soils by emission source in all Member States and in the EU28+ISL. Each bar represents the total emissions of a country in the current emission category, where different shades of grey correspond to the emitting sub-categories.

Figure 5.63 Share of source category 3.D.2 on total EU28+ISL agricultural emissions (left panel) and decomposition into its sub-categories (right panel). The percentages refer to the emissions in the year 2014.

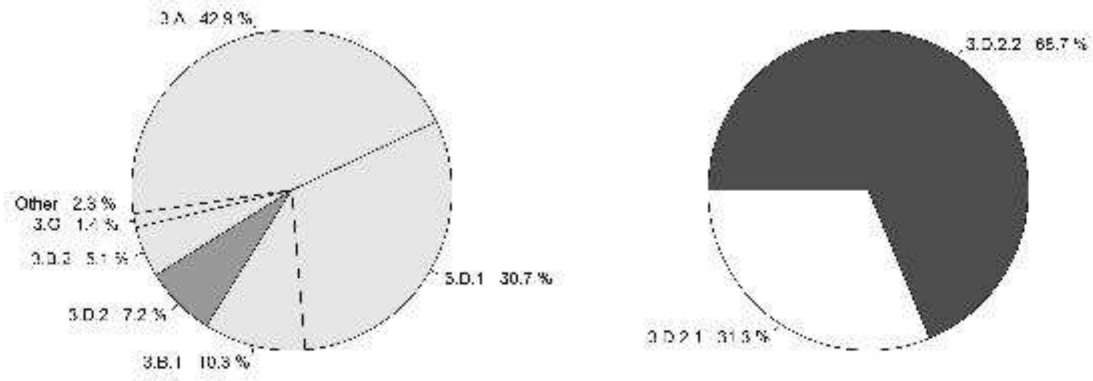
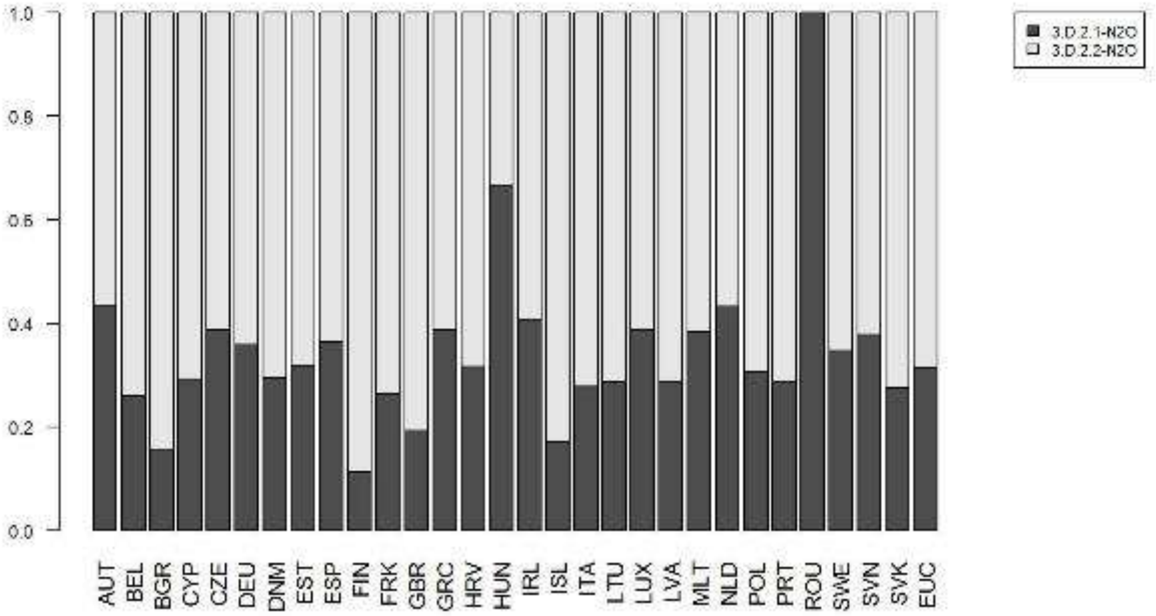


Figure 5.64 Decomposition of emissions in source category 3.D.2 - Indirect Emissions from Managed Soils into its sub-categories by Member State in the year 2014. 3.D.2.1 Atmospheric Deposition and 3.D.2.2 Nitrogen Leaching and Run-off.



Total GHG and N_2O emissions by Member State from 3.D.2 *Indirect Emissions from Managed Soils* are shown in Table 5.42 by Member State plus Iceland and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2014). Values are given in kt CO_2-eq. Between 1990 and 2014, N_2O emission in this source category decreased by 19% or 7.3 Mt CO_2-eq. The decrease was largest in the Netherlands in relative terms (66%) and also in absolute terms (1.1 Mt CO_2-eq). From 2013 to 2014 emissions in the current category increased by 2.4%.

Table 5.42 3.D.2 - Indirect Emissions from Managed Soils: Member States' contributions to total GHG and N_2O emissions

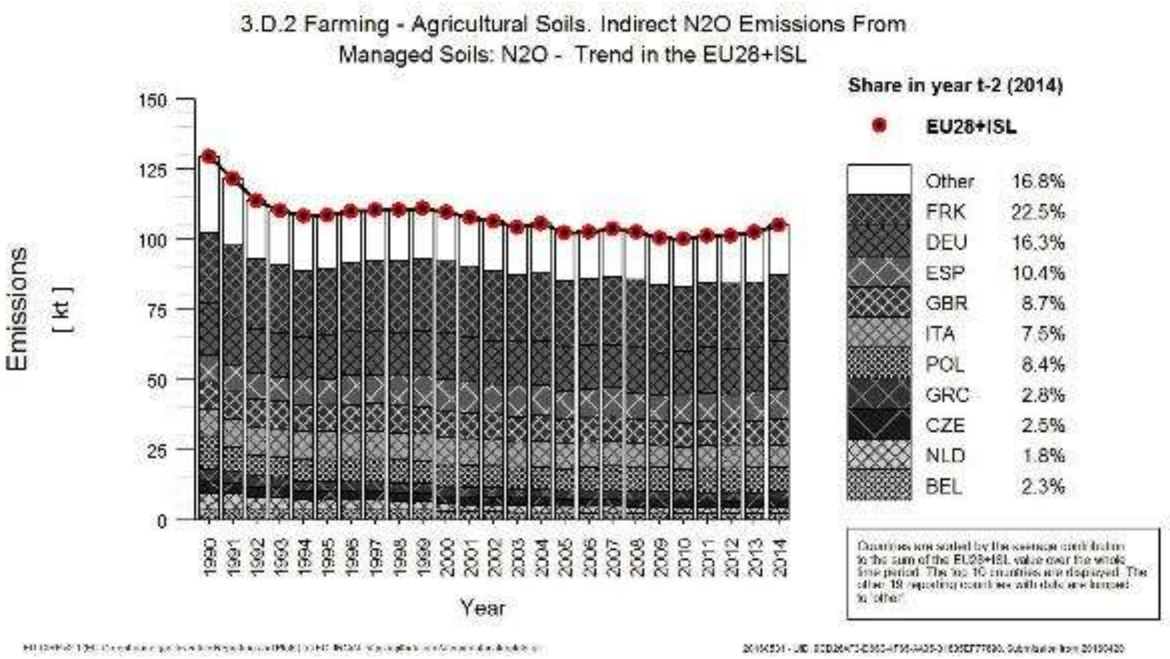
Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	346	314	326	1%	12	4%	-20	-6%	-	-
Belgium	1 052	706	724	2%	18	3%	-327	-31%	T1	D
Bulgaria	1 152	662	570	2%	-91	-14%	-582	-51%	T1	D
Croatia	365	255	237	1%	-18	-7%	-128	-35%	T1	D
Cyprus	20	11	11	0%	-1	-6%	-9	-46%	T1	D
Czech Republic	1 501	777	785	3%	8	1%	-716	-48%	T1	D
Denmark	862	484	512	2%	28	6%	-350	-41%	T2	D
Estonia	228	111	117	0%	6	5%	-111	-49%	D,T1	D
Finland	477	379	390	1%	11	3%	-86	-18%	T1	D
France	7 581	6 786	7 043	23%	257	4%	-539	-7%	-	-
Germany	5 367	4 934	5 106	16%	172	3%	-261	-5%	T1	D
Greece	1 238	878	875	3%	-3	0%	-363	-29%	T1	D
Hungary	385	258	255	1%	-3	-1%	-130	-34%	NA,T1	D,NA
Ireland	520	479	473	2%	-5	-1%	-46	-9%	T1	CS,D
Italy	2 813	2 363	2 332	7%	-31	-1%	-481	-17%	T1	CS,D
Latvia	377	188	196	1%	8	4%	-181	-48%	T1	D
Lithuania	582	402	412	1%	11	3%	-169	-29%	T1	D
Luxembourg	50	41	41	0%	0	1%	-9	-17%	T1	D
Malta	8	7	7	0%	0	-1%	-1	-11%	T1	D
Netherlands	1 641	563	564	2%	11	2%	-1 077	-66%	T1	D
Poland	3 438	2 695	2 625	8%	-70	-3%	-813	-24%	T1	D
Portugal	510	440	449	1%	9	2%	-61	-12%	T1,T2	CS,D
Romania	767	367	351	1%	-16	-4%	-416	-54%	T1	D
Slovakia	766	380	374	1%	-6	-2%	-392	-51%	T1	D
Slovenia	113	106	111	0%	5	4%	-2	-2%	T1	D
Spain	2 930	3 008	3 243	10%	236	8%	313	11%	CS,T1a,T1b	D
Sweden	388	291	292	1%	1	0%	-96	-25%	CS	D
United Kingdom	2 957	2 556	2 714	9%	158	6%	-243	-8%	CS,T1	D
EU-28	**38 432**	**30 431**	**31 137**	**100%**	**705**	**2%**	**-7 295**	**-19%**		
Iceland	136	121	136	0%	15	13%	0	0%	T1b	D
EU-28 + ISL	**38 568**	**30 552**	**31 273**	**100%**	**721**	**2%**	**-7 295**	**-19%**		

5.2.5.1 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+ISL by 19% or 7.3 Mt CO_2-eq in the period 1990 to 2014. Figure 5.65 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from indirect emissions from managed soils for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 83.2% of the total. Emissions decreased in 27 countries and increased in two countries. The largest decreases occurred in the Netherlands and Poland with a total absolute decrease of 1.9 Mt CO_2-eq. Largest increases occurred in Spain, with a total absolute increase of 313 kt CO_2-eq.

Figure 5.65 3.D.2 Indirect Emissions from Managed Soils: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition - Emissions

Emissions in source category *3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition* decreased strongly in EU28+ISL by 26% or 3.4 Mt CO_2-eq in the period 1990 to 2014. Figure 5.66 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from atmospheric deposition for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 82.8% of the total. Emissions decreased in 28 countries and increased in one country. The largest decreases occurred in the Netherlands and Romania with a total absolute decrease of 1.2 Mt CO_2-eq. Emissions increased in Spain, with a total absolute increase of 115 kt CO_2-eq.

3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition - Volatilized N from agricultural N inputs

Volatilized N from agricultural N inputs decreased strongly in EU28+ISL by 26% or 731 kt N/year in the period 1990 to 2014. Figure 5.67 shows the trend of volatilized N from agricultural N inputs indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O volatilized N from agricultural N inputs from atmospheric deposition for the different Member States along the inventory period. The ten countries with the highest volatilized N from agricultural N inputs accounted together for 82.8% of the total. Volatilized n from agricultural n inputs decreased in 28 countries and increased in one country. The largest decreases occurred in the Netherlands and Romania with a total absolute decrease of 255 kt N/year. Volatilized n from agricultural n inputs increased in Spain, with a total absolute increase of 25 kt N/year.

Figure 5.66 3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

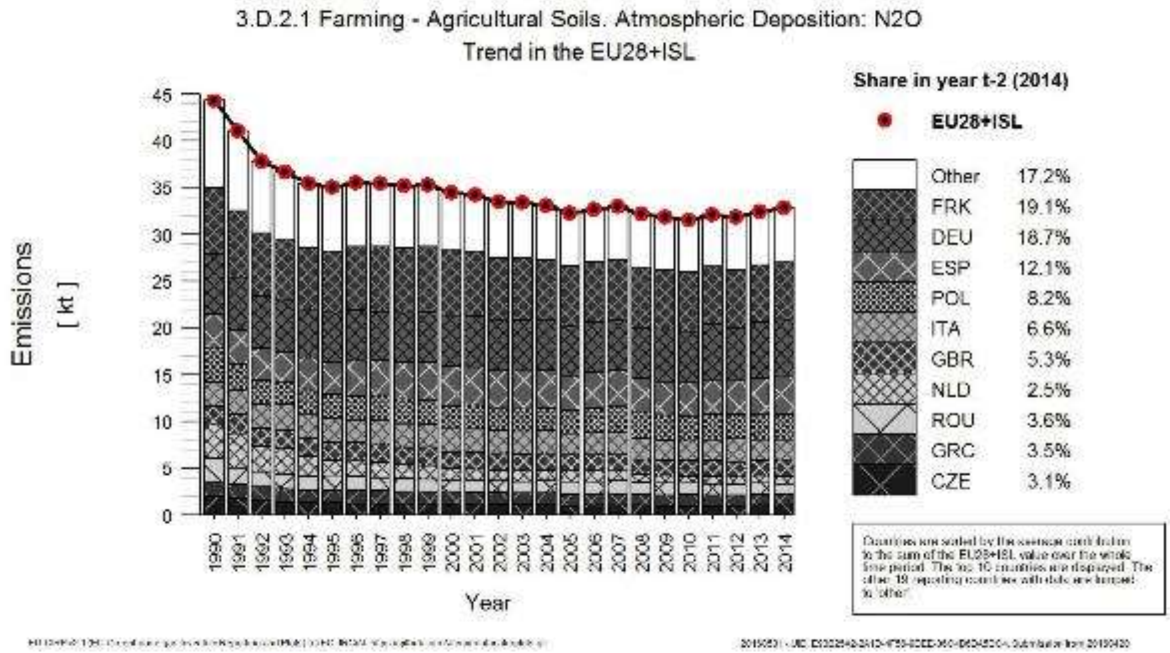
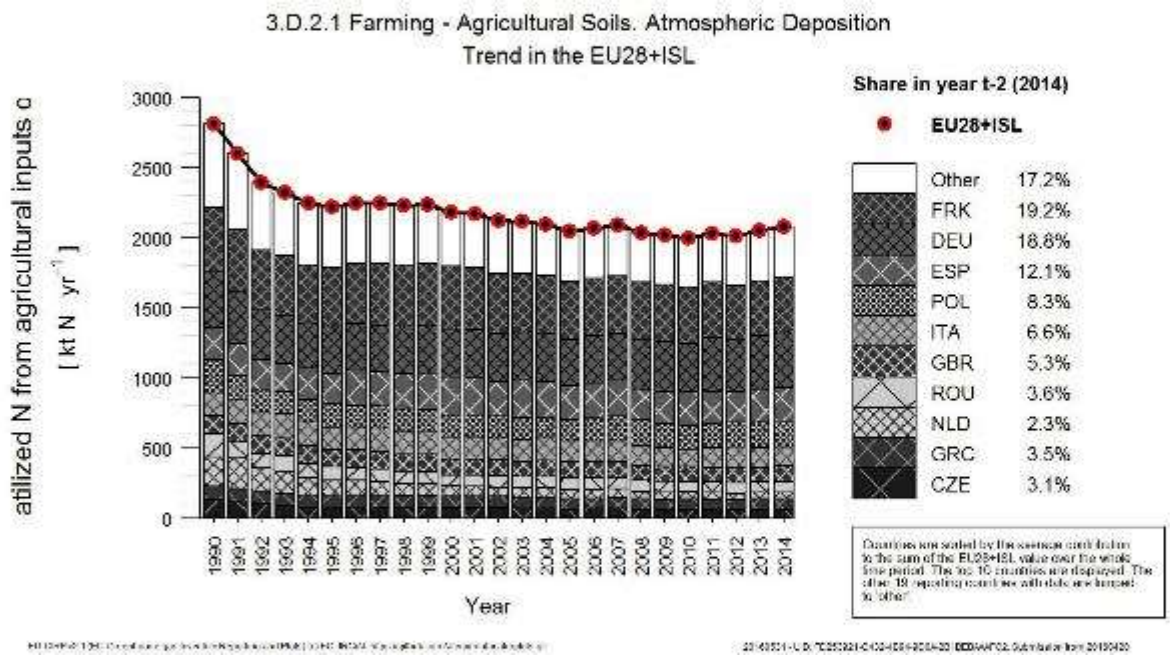


Figure 5.67 3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off - Emissions

Emissions in source category *3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off* decreased considerably in EU28+ISL by 15% or 3.9 Mt CO_2-eq in the period 1990 to 2014. Figure 5.68 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions from nitrogen leaching and run-off for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 84.9% of the total. Emissions decreased in 26 countries and increased in two countries. The largest decreases occurred in Poland and Czech Republic with a total absolute decrease of 925 kt CO_2-eq. Largest increases occurred in Spain, with a total absolute increase of 198 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+ISL by 15% or 1.2 kt N/year in the period 1990 to 2014. Figure 5.69 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+ISL total. The figure represents the trend in N_2O N from fertilizers and other agricultural inputs that is lost through leaching and run-off from nitrogen leaching and run-off for the different Member States along the inventory period. The ten countries with the highest N from fertilizers and other agricultural inputs that is lost through leaching and run-off accounted together for 85.2% of the total. N from fertilizers and other agricultural inputs that is lost through leaching and run-off decreased in 26 countries and increased in two countries. The largest decreases occurred in Poland with a total absolute decrease of 145 kt N/year. Largest increases occurred in Spain, with a total absolute increase of 55 kt N/year.

Figure 5.68 3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014

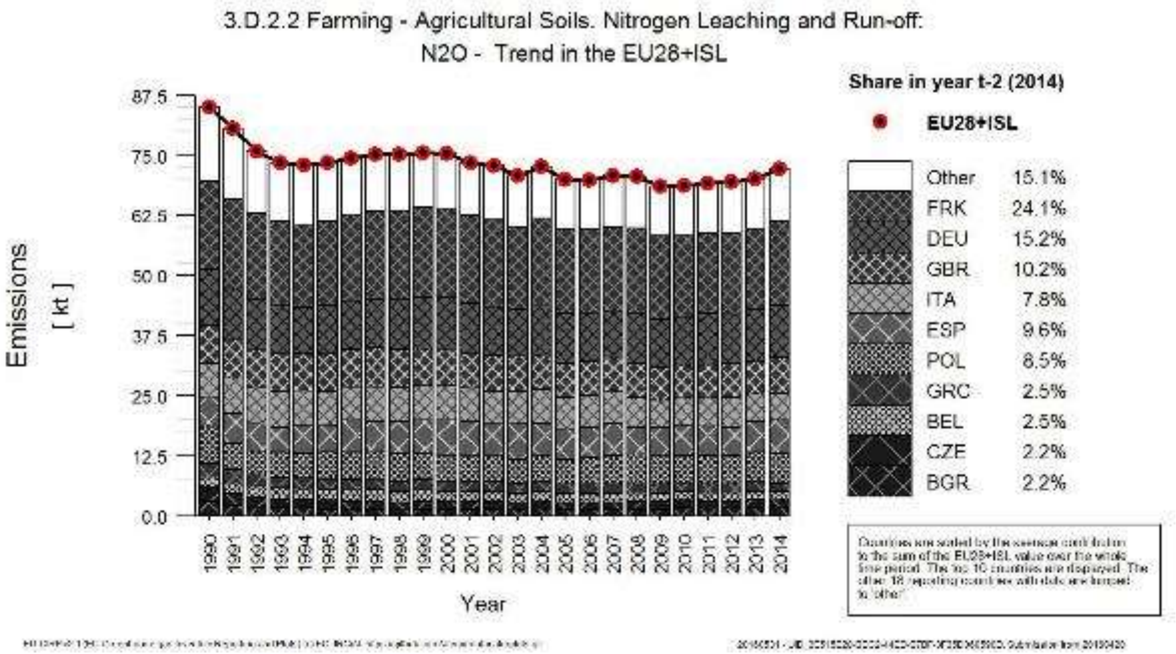
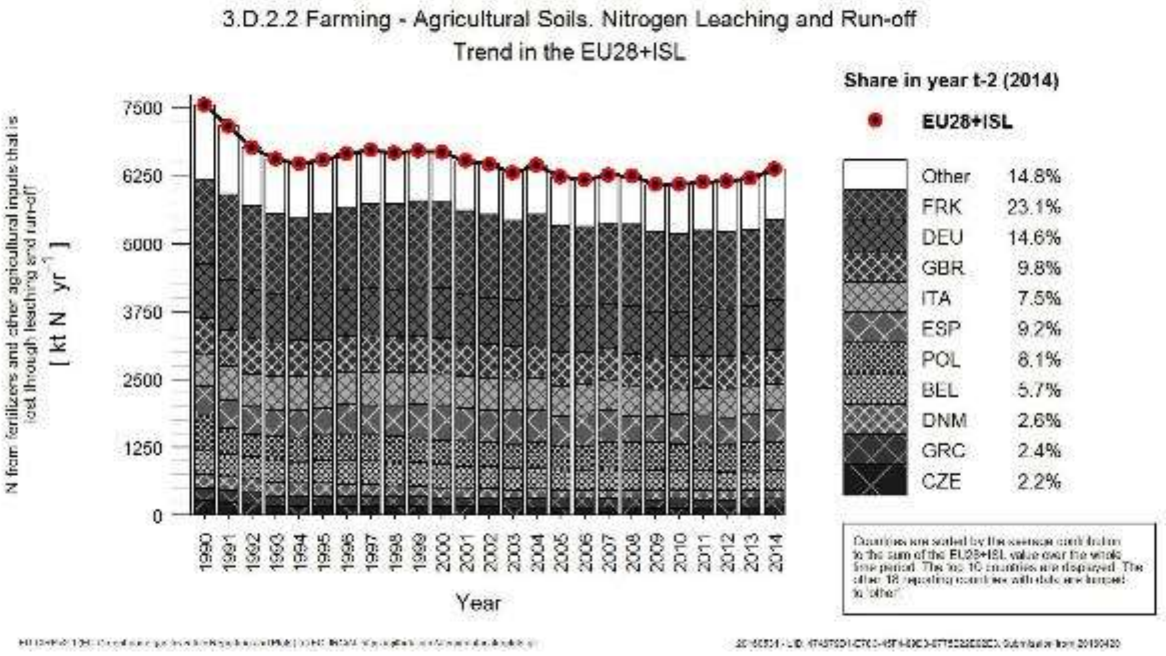


Figure 5.69 3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2014



5.2.5.2 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 the most relevant parameters related with indirect N_2O emissions:

- $Frac_{GASF}$: 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* increased in EU28+ISL barely between 1990 and 2014 by 0.0031% or 3.1e-07 kg N_2O-N/kg N. Figure 5.70 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.43 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 2014 for all Member States and EU28+ISL. The implied emission factor decreased in three countries and increased in five countries. It was in 2014 at the level of 1990 in 21 countries. Decreases occurred in Cyprus, Iceland and Malta with a mean absolute value of 1.7e-06 kg N_2O-N/kg N. The three countries with the largest increases were, the Netherlands, Portugal and Luxembourg with a mean absolute value of 0.00027 kg N_2O-N/kg N.

Figure 5.70 3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

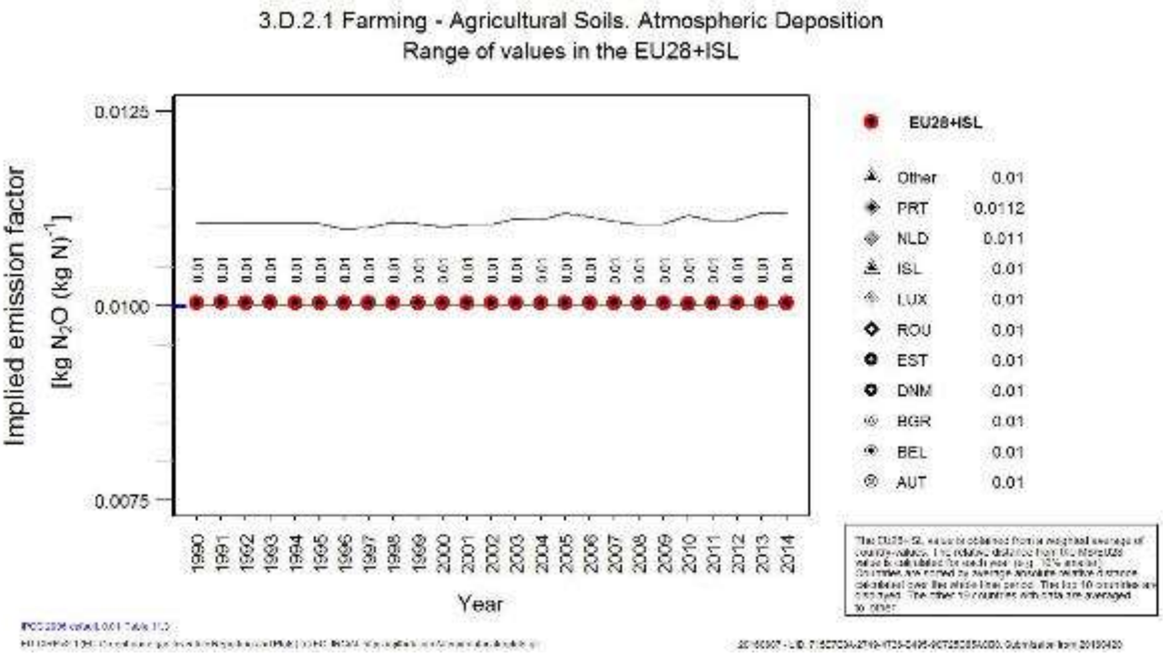


Table 5.43 3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)

Member State	1990	2014		Member State	1990	2014
Austria	0.010	0.010	|	Ireland	0.010	0.010
Belgium	0.010	0.010	|	Iceland	0.010	0.010
Bulgaria	0.010	0.010	|	Italy	0.010	0.010
Cyprus	0.010	0.010	|	Lithuania	0.010	0.010
Czech Republic	0.010	0.010	|	Luxembourg	0.010	0.010
Germany	0.010	0.010	|	Latvia	0.010	0.010
Denmark	0.010	0.010	|	Malta	0.010	0.010
Estonia	0.010	0.010	|	Netherlands	0.010	0.011
Spain	0.010	0.010	|	Poland	0.010	0.010
Finland	0.010	0.010	|	Portugal	0.011	0.011
France	0.010	0.010	|	Romania	0.010	0.010
United Kingdom	0.010	0.010	|	Sweden	0.010	0.010
Greece	0.010	0.010	|	Slovenia	0.010	0.010
Croatia	0.010	0.010	|	Slovakia	0.010	0.010
Hungary	0.010	0.010	|	**EU28+ISL**	**0.010**	**0.010**

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+ISL level. Table 5.44 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 2014 for all Member States and EU28+ISL. The 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 2014 at the level of 1990 in sixteen countries. No data were available for Iceland and the Netherlands. The largest decrease occurred in Hungary with an absolute value of 0.026. The largest increases occurred in Austria and Germany with a mean absolute value of 0.02.

Table 5.44 3.D.2.1 - Indirect emissions from Atmospheric Deposition: Member States' fraction of synthetic fertilizer N applied to soils that volatilises as NH_3 and NO_x (-)

Member State	1990	2014		Member State	1990	2014
Austria	0.026	0.042	|	Hungary	0.093	0.067
Belgium	0.064	0.078	|	Ireland	0.028	0.021
Bulgaria	0.035	0.035	|	Italy	0.087	0.103
Cyprus	0.100	0.100	|	Lithuania	0.100	0.100
Czech Republic	0.100	0.100	|	Luxembourg	0.100	0.100
Germany	0.061	0.085	|	Latvia	0.100	0.100
Denmark	0.047	0.044	|	Malta	0.100	0.100
Estonia	0.100	0.100	|	Poland	0.100	0.100
Spain	0.100	0.100	|	Portugal	0.071	0.081
Finland	0.015	0.015	|	Romania	0.100	0.100
France	0.100	0.100	|	Sweden	0.029	0.024
United Kingdom	0.026	0.030	|	Slovenia	0.072	0.073
Greece	0.100	0.100	|	Slovakia	0.100	0.100
Croatia	0.100	0.100	|			

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+ISL level. Table 5.45 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 2014 for all Member States and EU28+ISL. The fraction of livestock N excretion that volatilises as NH_3 and NO_x decreased in eight countries and increased in four countries. It was in 2014 at the level of 1990 in thirteen countries. No data were available for three countries (Cyprus, Iceland and the Netherlands). The largest decreases occurred in Denmark and Belgium with a mean absolute value of 0.1. The three countries with the largest increases were, Finland, Sweden and Ireland with a mean absolute value of 0.0078.

Table 5.45 3.D.2.2 - Indirect emissions from Atmospheric Deposition: Member States' fraction of livestock N excretion that volatilises as NH_3 and NO_x (-)

Member State	1990	2014		Member State	1990	2014
Austria	0.169	0.170	|	Hungary	0.121	0.119
Belgium	0.266	0.188	|	Ireland	0.078	0.080

Member State	1990	2014		Member State	1990	2014
Bulgaria	0.200		|	Italy	0.230	0.219
Czech Republic	0.200	0.200	|	Lithuania	0.200	0.200
Germany	0.195	0.172	|	Luxembourg	0.200	0.200
Denmark	0.137	0.083	|	Latvia	0.200	0.200
Estonia	0.200	0.200	|	Malta	0.200	0.200
Spain	0.200	0.200	|	Poland	0.200	0.200
Finland	0.075	0.088	|	Portugal	0.164	0.136
France	0.200	0.200	|	Romania	0.200	0.200
United Kingdom	0.075	0.072	|	Sweden	0.160	0.169
Greece	0.200	0.200	|	Slovenia	0.393	0.354
Croatia	0.200	0.200	|	Slovakia	0.200	0.200

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+ISL barely between 1990 and 2014 by 0.34% or 2.41e-05 kg N_2O-N/kg N. Figure 5.71 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.46 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 2014 for all Member States and EU28+ISL. The implied emission factor decreased in five countries and increased in five countries. It was in 2014 at the level of 1990 in eighteen countries. No data were available for Romania. The three countries with the largest decreases were Belgium, France and Iceland with a mean absolute value of 8.6e-05 kg N_2O-N/kg N. The three countries with the largest increases were, Denmark, Spain and Cyprus with a mean absolute value of 9.4e-05 kg N_2O-N/kg N.

Figure 5.71 3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

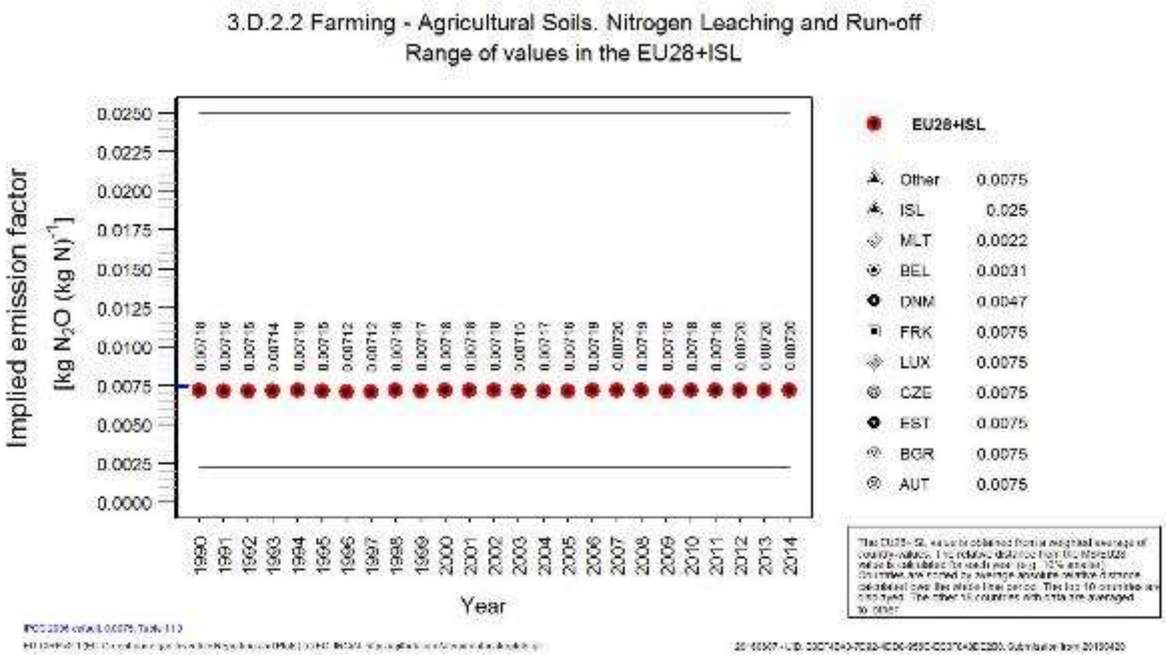


Table 5.46 *3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)*

Member State	1990	2014		Member State	1990	2014
Austria	0.0075	0.0075	|	Ireland	0.0075	0.0075
Belgium	0.0034	0.0031	|	Iceland	0.0250	0.0250
Bulgaria	0.0075	0.0075	|	Italy	0.0075	0.0075
Cyprus	0.0075	0.0075	|	Lithuania	0.0075	0.0075
Czech Republic	0.0075	0.0075	|	Luxembourg	0.0075	0.0075
Germany	0.0075	0.0075	|	Latvia	0.0075	0.0075
Denmark	0.0044	0.0047	|	Malta	0.0022	0.0022
Estonia	0.0075	0.0075	|	Netherlands	0.0075	0.0075
Spain	0.0075	0.0075	|	Poland	0.0075	0.0075
Finland	0.0075	0.0075	|	Portugal	0.0075	0.0075
France	0.0075	0.0075	|	Sweden	0.0075	0.0075
United Kingdom	0.0075	0.0075	|	Slovenia	0.0075	0.0075
Greece	0.0075	0.0075	|	Slovakia	0.0075	0.0075
Croatia	0.0075	0.0075	|	**EU28+ISL**	**0.0072**	**0.0072**
Hungary	0.0075	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+ISL level. Table 5.47 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 2014 for all Member States and EU28+ISL. Fraction of n input to managed soils that is lost through leaching and run-off decreased in two countries and increased in one country. It was in 2014 at the level of 1990 in 22 countries. No data were available for three countries (Iceland, the Netherlands and Romania). Decreases occurred in Sweden and Denmark with a mean absolute value of 0.045. There was an increase in the United Kingdom with an absolute value of 0.018.

Table 5.47 *3.D.2.2 - Indirect emissions from Nitrogen Leaching and Run-off: Member States' fraction of N input to managed soils that is lost through leaching and run-off (-)*

Member State	1990	2014		Member State	1990	2014
Austria	0.15	0.15	|	Croatia	0.30	0.30
Belgium	0.30	0.30	|	Hungary	0.30	0.30
Bulgaria	0.30		|	Ireland	0.10	0.10
Cyprus	0.30	0.30	|	Italy	0.30	0.30
Czech Republic	0.30	0.30	|	Lithuania	0.30	0.30
Germany	0.30	0.30	|	Luxembourg	0.30	0.30
Denmark	0.33	0.28	|	Latvia	0.30	0.30
Estonia	0.30	0.30	|	Malta	0.30	0.30
Spain	0.30	0.30	|	Poland	0.30	0.30

Member State	1990	2014		Member State	1990	2014
Finland	0.30	0.30	|	Portugal	0.30	0.30
France	0.30	0.30	|	Sweden	0.17	0.13
United Kingdom	0.21	0.22	|	Slovenia	0.30	0.30
Greece	0.30	0.30	|	Slovakia	0.30	0.30

5.3 Uncertainties

Table 5.48 shows the total EU-28 uncertainty estimates for the sector Agriculture and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for N_2O from 3D and the lowest for CH_4 from sector 3A. With regard to the uncertainty on trend N_2O from sector 3J shows the highest uncertainty estimates, CH_4 from sector 3A the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-28 see Chapter 1.6.

Table 5.48 Sector Agriculture: EU-28 uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
3.A Enteric Fermentation	CO2	0	0		0%	
3.A Enteric Fermentation	CH4	238.193	184.575	-23%	16%	0,0%
3.A Enteric Fermentation	N2O	5.755	2.817	-51%	21%	0,1%
3.B Manure Mangement	CO2	0	0		0%	
3.B Manure Mangement	CH4	58.404	46.364	-21%	25%	0,0%
3.B Manure Mangement	N2O	26.706	20.245	-24%	93%	0,1%
3.C Rice Cultivation	CO2	0	0		0%	
3.C Rice Cultivation	CH4	2.301	1.991	-13%	16%	0,0%
3.C Rice Cultivation	N2O	0	0		0%	
3.D Agricultural Soils	CO2	0	0		0%	
3.D Agricultural Soils	CH4	0	0		0%	
3.D Agricultural Soils	N2O	198.387	165.914	-16%	121%	0,1%
3.E Prescribed burning of savannas	CO2	0	0		0%	
3.E Prescribed burning of savannas	CH4	0	0		0%	
3.E Prescribed burning of savannas	N2O	0	0		0%	
3.F Field Burning of Agricultural Residues	CO2	0	0		0%	
3.F Field Burning of Agricultural Residues	CH4	1.453	1.205	-17%	47%	0,1%
3.F Field Burning of Agricultural Residues	N2O	341	209	-39%	49%	0,1%
3.G Liming	CO2	8.192	5.096	-38%	25%	0,1%
3.G Liming	CH4	0	0		0%	
3.G Liming	N2O	1.178	156	-87%	57%	0,5%
3.H Urea application	CO2	3.240	3.398	5%	19%	0,0%
3.H Urea application	CH4	0	0		0%	
3.H Urea application	N2O	0	0		0%	
3.I Other carbon-containing fertilizers	CO2	87	75	-13%	23%	0,4%
3.I Other carbon-containing fertilizers	CH4	0	0		0%	
3.I Other carbon-containing fertilizers	N2O	0	0		0%	
3.J Other	CO2	0	0		0%	0,0%
3.J Other	CH4	3	1.351	39190%	41%	161,6%
3.J Other	N2O	1	288	19121%	98%	186,6%
Total - 3	**all**	**544.242**	**433.684**	**-20%**	**47%**	**3%**

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions of the EU-NIR because uncertainty estimates are not available for all source categories in each of this 28 EU Member States;*

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

5.4.2.1 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

5.4.2.2 Major changes for the 2015 submissions`

The submission in the year 2015 the QA/QC system 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 software products (e.g. EEA review tool, EU-GIRP). For this purpose, the EU GHG inventory was thoroughly revised. While this was true for the whole EU GHG inventory, this was particularly true for the agriculture sector. The following specific issues with regard to the 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[37]. 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[38], *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

[37] 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*.

[38] EU-GIRP: EU-Greenhouse gas Inventory Reporting and Plots, see *https://github.com/aleip/eealocatorplots.git*

- 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[39] 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

5.4.2.3 Main improvements in 2016

For the 2016 submission, the system implemented in 2015 was further developed, providing now some additional 'checks' that identify issues requiring clarification or justification. Particular attention was paid this year to 'country outlier' and 'time series' checks.

Furthermore, chapters comparing GHG emissions and activity data reported by countries with data from the FAO-STAT data base and the CAPRI model are included again.

5.4.2.4 Further improvements

The following further improvements are foreseen for the next submission:

- Further addition of sector-specific checks that could not be performed for the current submission
- Further development of the comparison with FAO and CAPRI data

5.4.3 QA/QC system in the agriculture sector

5.4.3.1 Quality checks

Several quality checks are performed in the EU-GIRP[40] 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**[41] 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+ISL values were determined. A share above 95% was further assessed and in case this was not linked 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 instead of percent values or vice versa; values per day

[39] 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/*

[40] EU-GIRP: EU-Greenhouse gas Inventory Reporting and Plots, see *https://github.com/aleip/eealocatorplots.git*

[41] *https://github.com/aleip/eealocatorplots/blob/master/eugirp_checknes.r*

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+ISL level) is important to ensure correct comparison of countries' values and a correct calculation of EU28+ISL background data. An automated check[42] 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[43]. 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 criterion, 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 criterion 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 or parameter as reported by all countries[44]. 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 assessment. The following types of 'issues' were identified, which might be linked either to an inconsistent time series or be the consequence of 'real' trends:

– *Period outphased*: Relative constant trend with few years above/below the trend that 'looks plausible'.

– *Trend break*: Time series in steps, in a stair shape: a few similar values, then a jump, and the same again.

– *One break group trend*: Regular time series with a different trend for a group of years, and a step when jumping from/coming back to the general trend.

– *Inflection point*: Trend suddenly changes from a specific year from which the growth of the values changes sign.

– *Single outlier*: One or few isolated year(s) where the value is out of the general trend

– *Smooth group trend change*: A series of years where the trend changes compared to the rest of the time series, but without any jumps

---

[42] https://github.com/aleip/eealocatorplots/blob/master/eugirp_checkunits.r

[43] https://github.com/aleip/eealocatorplots/blob/master/eugirp_checkoutliers.r

[44] See function `ispotentialissue()` in the file https://github.com/aleip/eealocatorplots/blob/master/eugirp_functions.r

- *Trend jump*: There is a jump at some point in the time trend but it continues running parallel to the first section, after the jump.
- *Jump and shape*: There is a jump at some point in the time trend and, after the jump, the trend changes shape

- **Sector-specific checks**: Several checks were performed tailored to the reporting in the sector agriculture[45,46]. First, the data are checked on consistency in reporting of activity data throughout the tables. Further, 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**: 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.

5.4.3.2 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[47].

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+ISL weighted averages
- Data which *obviously* wrong (very large outliers) but for which no clear correction could be identified were *eliminated* from the calculation of the EU28+ISL weighted averages to avoid biases in the results. Therefore, the EU28+ISL weighted averages - in some cases - could not represent 100% of EU28+ISL activity data.

5.4.3.3 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 possibility of mistakes completely. Therefore, all values are cross-checked.

---

45 *https://github.com/aleip/eealocatorplots/blob/master/agrichecks1ADs.r*

46 *https://github.com/aleip/eealocatorplots/blob/master/agrichecks2Nex.r*

47 *https://github.com/aleip/eealocatorplots/blob/master/eugirp_euweightedaverages.r*

5.4.4 Workshops and activities to improve the quality of the inventory in agriculture

5.4.4.1 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*[48]

5.4.4.2 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[49] 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 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[50].

A list of characteristics of potential relevance for the quantification of GHG emissions is given in Table 5.49.

---

[48] Leip, A., 2005. N2O 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*.

[49] *http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32008R1166*

[50] *http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1448050507039&uri=CELEX:32009R1200*

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 animals are outdoors on pasture	Month per year
	Common land grazing	Total number of animals grazing on common land	Head
		Amount of time when animals 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])
Manure storage and treatment facilities	Storage facilities for:	Solid dung	Yes/No

Characteristic			Units/categories
		Liquid 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).

5.4.4.3 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"[51]. The Eurostat/OECD Methodology and Handbook on Nutrient Budgets has been updated and amended in 2013[52]. 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 as 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)[53].

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:

---

[51] http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/introduction

[52] http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/documents/Nutrient_Budgets_Handbook_%28CPSA_AE_109%29_corrected3.pdf

[53] 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.

5.4.4.4 Regionalisation of the Gross Nutrient Budget with the CAPRI model

The JRC was cooperating with EUROSTAT on a methodology to use the CAPRI model[54] for the regionalisation of the Gross Nutrient Budget (GNB) indicators (nitrogen and phosphorus) that needs to be reported regularly by countries to EUROSTAT and OECD. The GNBs are identified as one of the key agro-environmental indicators. Current reporting occurs at the national level. For policy making, a higher resolution, matching with legislative and environmental boundaries (NVZ, watershed) rather than administrative boundaries (country) is required. The CAPRI model is an economic model for agriculture, which has an environmental accounting model integrated. It has a spatial resolution of NUTS2 and reports,

---

[54] http://www.capri-model.org/

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 formulated in the final RegNiBal report[55] 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)[56] would likely help (grassland out of production but

[55] 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*.

[56] 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.

maintained, unimproved grassland (including 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[57]). 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.

5.4.4.5 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[58]. 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),

---

57 Leip, A., Britz, W., Weiss, F., de Vries, W., 2011. Farm, land, and soil nitrogen budgets for agriculture in Europe calculated with CAPRI. Environ. Pollut. 159, 3243?53. doi: http://dx.doi.org/10.1016/j.envpol.2011.01.040.

58 http://www.ncgg.info/

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 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.

5.4.5 Verification

5.4.5.1 Comparison of national inventories with EU-wide calculations with the CAPRI model

Authors: Sandra Marquardt[1], Alexander Gocht[1], Adrian Leip[2]

1 Thünen Institute of Farm Economics, Braunschweig, Germany

2 European Commission, Joint Research Centre, Ispra (VA), Italy

An in-depth comparison between GHG emission estimates as calculated with the CAPRI model and national GHG emission inventories had been done in the context of the GGELS project[59].

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[60].

---

59 ftp://mars.jrc.ec.europa.eu/Afoludata/Public/DOCU236/

In contrast, the objective of the following comparison is to examine the development of GHG emissions over the timespan 1990 to 2014. This comparison is done using the values of the March submission of the national inventory reports (NIRs) and the results of GHG emissions calculations from the CAPRI modeling system. For CAPRI the GHG emission values from 1990 to 2012 are calculated based on activity data contained in the CAPRI database. The values for 2013 and 2014 are, however, simulated activity values. As simulations are done based on the observed relationships and values in the database, the values for 2013 and 2014 allow for a consistent continuation of the time series.

Table 5.50 provides an overview of the emissions in the agricultural sector in 2014 in the EU28 for relevant UNFCCC emission categories.

Table 5.50 Total emissions for the EU28 in kt CO_2-eq for the year 2014 for relevant emission categories; UNFCCC data submitted in March 2016 and data from the GHG emissions module of CAPRI (extracted March 2016).

Emission category		**CAPRI**	**NIR**	**Difference CAPRI vs NIR**	
		in kt CO_2-eq		absolute	relative
Enteric fermentation	(CH_4)	197,757	187,097	10,660	6%
Manure management	(CH_4)	33,361	44,826	-11,465	-26%
	(N_2O)	23,539	22,355	1,184	5%
Rice cultivation	(CH_4)	2,230	2,650	-420	-16%
Agricultural soils - direct	Synthetic fertilizer (N_2O)	54,132	50,844	3,289	6%
	Organic fertilizer (N_2O)	34,377	24,004	10,373	43%
	Manure during grazing (N_2O)	27,268	22,708	4,560	20%
	Crop residues (N_2O)	23,256	23,325	-69	0%
	Organic soils (N_2O)	10,961	12,517	-1,556	-12%
Agricultural soils - indirect	Atmospheric deposition (N_2O)	12,565	9,785	2,780	28%
	Leaching and run-off (N_2O)	4,460	21,508	-17,049	-79%
Burning of Residues	(CH_4)	-	1,253	-1,253	-100%
Liming and urea	Liming (CO_2)	5,286	6,176	-890	-14%
	Urea (CO_2)	2,598	3,955	-1,357	-34%
Total		431,791	433,005	-1,214	0%

Although the overall emissions of the agricultural sector are relatively equal, there are considerable differences for individual sub-categories of emissions. For example, while the overall deviation in livestock emissions is close to zero, CAPRI reports higher CH_4 emissions for enteric fermentation and lower CH_4 emissions for manure management. This difference in allocation is connected to underlying assumptions on digestibility and animal numbers.

60 ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/leip_weiss2014.ggels_summary.pdf

Concerning the emissions for agricultural soils, it is also necessary to look at the individual sub-categories. Even though overall emissions only deviate by 1%, CAPRI reports 12% higher emissions for direct emissions of agricultural soils and 46% lower emissions for indirect emissions for this category. The difference in direct emissions is mainly due to higher emissions for manure on agricultural soils as well as manure deposited during grazing. Whereas the lower value for indirect emissions is associated with lower emission values for leaching and run-off.

Reasons for differences in results are primarily related to the underlying values for activity data, such as animal numbers or N input to soils, and the employed calculation methodology. For the estimation of activity data, the values of the different data sources are determined by the definitions used for the quantification of e.g. animal numbers as well as the consistency in the data collection process. Furthermore, nitrogen accounting in CAPRI is based on a mass-preserving N balance approach (for more details see Velthof et al., 2007). This approach consistently accounts for all nitrogen flows (e.g. also NH_3, NO_x) and quantifies available N at each step in the N accounting system (for more details see Leip et al., 2010). Furthermore, within the scope of the IPCC guidelines, countries can follow a highly standardized approach (Tier 1) or appropriate nationalized approaches (Tier 2 and Tier 3) for the calculation of results reported in the NIRs. On the other hand, for the generation of the CAPRI results, one calculation method is applied to all reporting parties. The definition of this methodology was defined in such a way as to be in compliance with the IPCC guidelines of 2006 as much as possible.

Livestock emissions – CH_4

Livestock emissions correspond to roughly 60% of total agricultural emissions, with over 90% being due to CH_4 emissions from enteric fermentation and manure management. With emissions from cattle accounting for over three-quarters of CH_4 emissions from livestock, deviations in these values will have the greatest impact on overall CH_4 emissions from enteric fermentation and manure management.

Cattle

While underlying population values for cattle are similar between NIR and CAPRI, there are noticeable differences in resulting EU28 mean emission values for the time horizon 1990 to 2014 (see Figure 5.72 to Figure 5.74). CAPRI EU28 values for CH_4 emissions from enteric fermentation for cattle are on average by 14% higher than those reported in the NIR, while those for manure management are by 27% lower. This difference in allocation is related to the underlying calculation of digestibility. In CAPRI, feed composition and the resulting digestibility ratios are calculated endogenously taking the dry-matter contents of feed into account. For the two main cattle producers, France and Germany, these differences range from plus 17% for enteric fermentation and minus 49% for manure management in France to plus 12% for enteric fermentation and plus 8% for manure management in Germany.

Figure 5.72 Average cattle population in the NIR and in CAPRI for the EU28

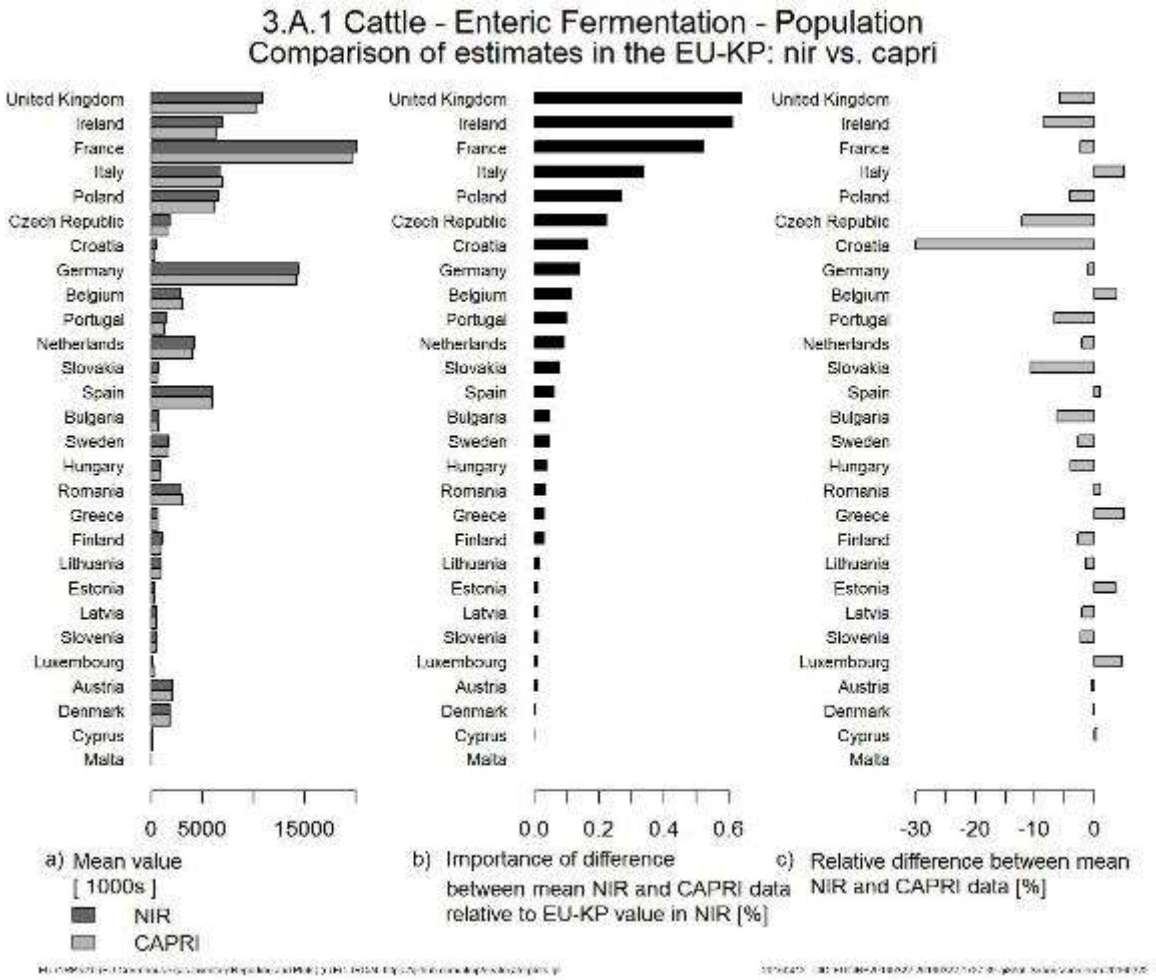


Figure 5.73 Average CH_4 emissions from enteric fermentation for cattle in the NIRs and in CAPRI for the EU28

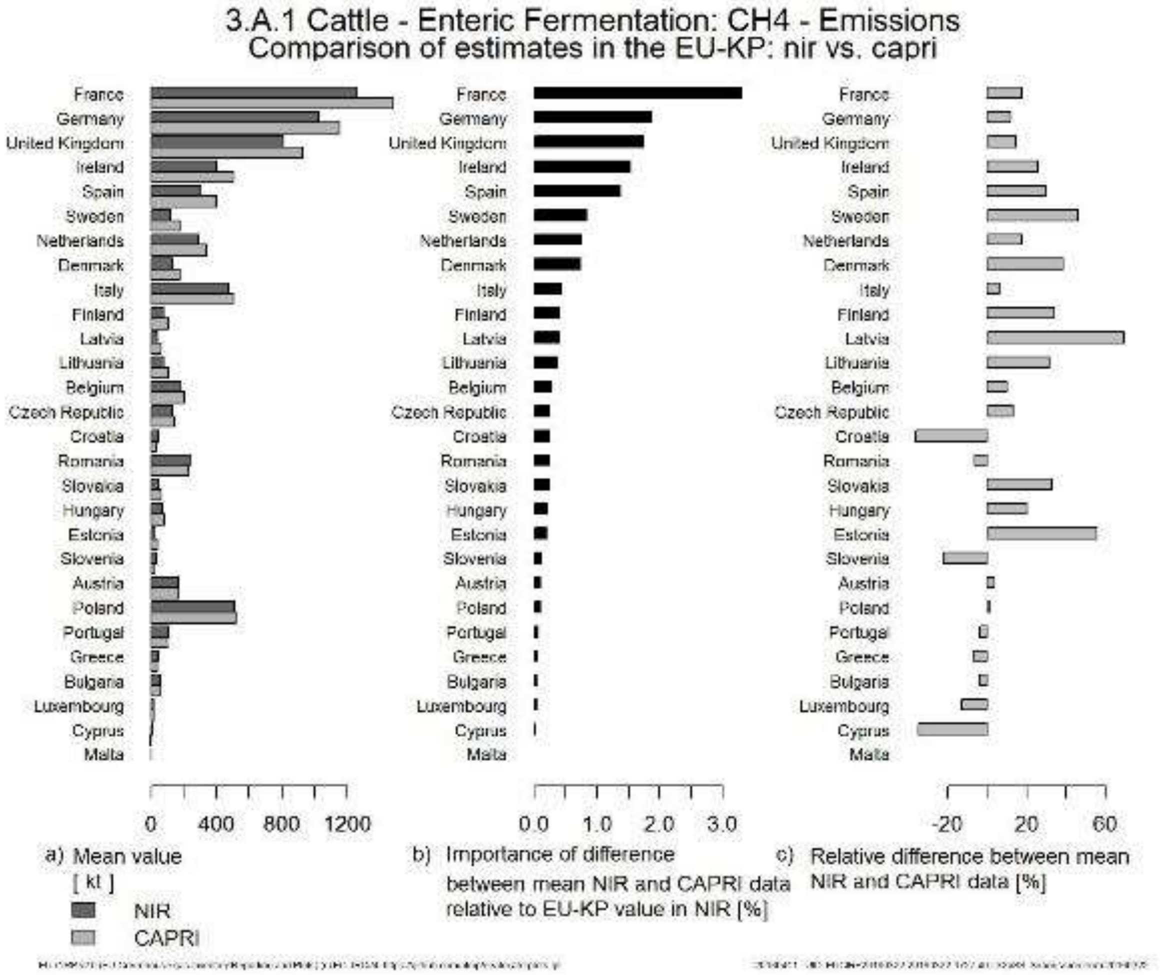
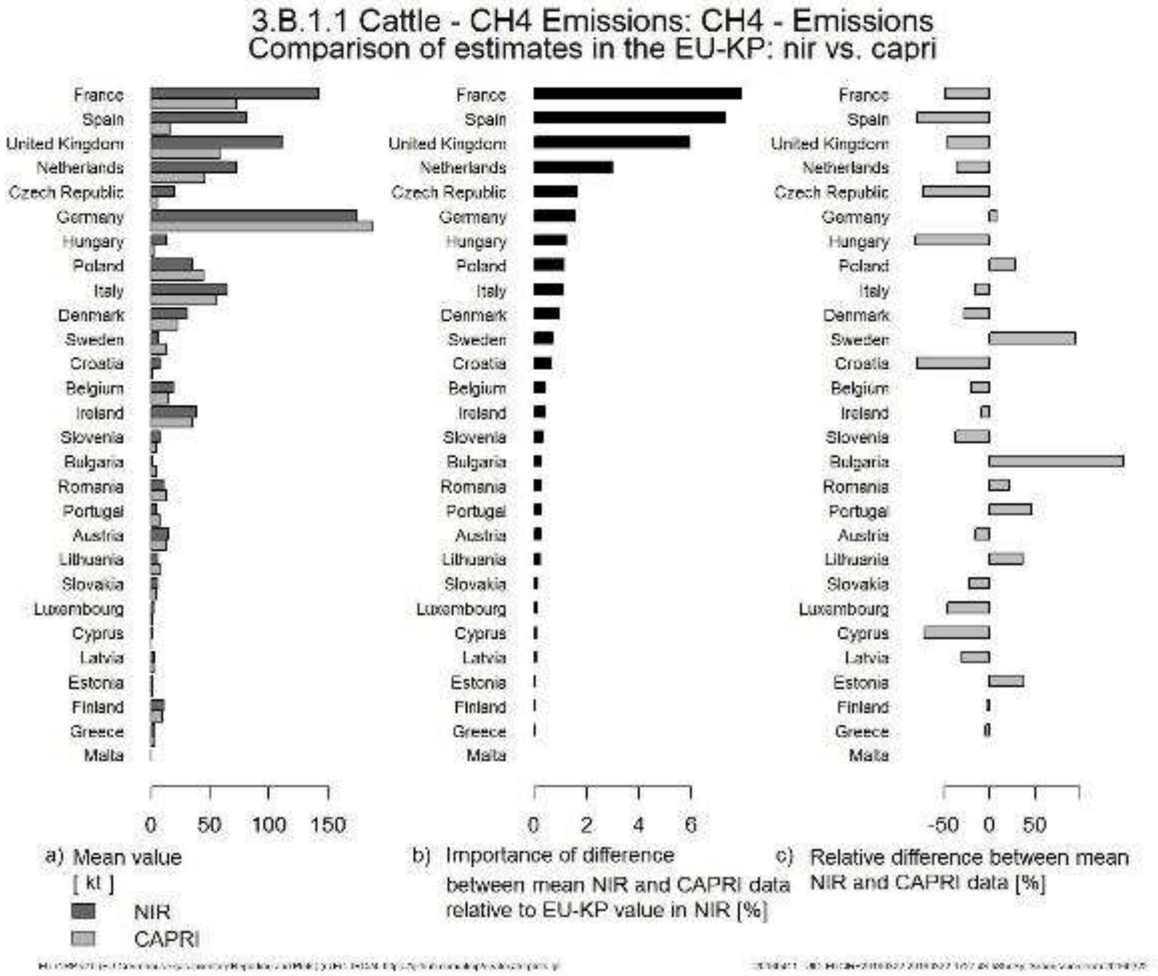


Figure 5.74 Average CH_4 emissions from manure management for cattle in the NIRs and in CAPRI for the EU28



Sheep and swine

In CAPRI, CH_4 emissions for sheep and swine are calculated following a Tier 1 approach. This approach does not take differences in digestibility into account and relies on standardized IPCC parameters. As the IPCC guidelines advise the utilization of Tier 2 and higher methodologies if an animal category plays a significant part in a country's agriculture, differences in results may thus not only be a consequence of differing animal numbers but also due to the underlying calculation methodology. For sheep, overall mean emission values for methane of the EU28 for the time horizon 1990 to 2014 are by 8% lower in CAPRI than those reported in the NIR and for swine they are by 27% lower.

Manure – emissions from manure management and manure on agricultural soils

Differences in N_2O emissions from manure management as well as the application of manure on agricultural soils and deposition during grazing also need to be viewed relative to each other (see Figure 5.75 and Figure 5.76). While CAPRI reports 7% lower average emission values for N_2O in terms of manure management in the EU28, it reports 25% higher average emission values for N_2O for the category agricultural soils. This deviation is also reflected in the respective amounts of N accruing for the individual GHG accounting positions. As Table 5.51 highlights, on average, CAPRI allocates less N for N_2O emissions from manure management but higher values for the calculation of N_2O emissions from agricultural soils. This is especially linked to N in manure from swine. For the biggest swine producers, Germany and Spain, CAPRI reports 30% higher average N excretion for Germany and 40% for Spain. This is also reflected in higher values for N input to soils, with CAPRI reporting a 61% higher average value for Germany and 23% for Spain.

Table 5.51 Average nitrogen accruing to manure management and as an input on agricultural soils for the EU28 (1990-2014).

		CAPRI	NIR	Difference CAPRI vs NIR
		kt N per year		%
Manure management[1]		8,643	8,934	-3%
	Cattle	5,740	6,691	-14%
	Sheep	778	827	-6%
	Swine	2,125	1,417	50%
N input to soils		7,244	5,426	33%

Note: [1]Emission for manure management are calculated without consideration of emissions for the animal category "Other livestock".

The difference in N excretion for manure management is determined by the underlying values for animal population as well as nitrogen excretion rates. As Table 5.52 highlights, for cattle both average population and nitrogen excretion rates for the EU28 are lower in CAPRI than in the NIRs with the relative difference being of the same order of magnitude. Thus, both, differences in population and difference in nitrogen excretion rates cause the lower overall nitrogen excretion for cattle.

For swine the values for population in CAPRI are lower, while the nitrogen excretion rate is higher. Based on the overall higher value for total nitrogen excretion (Table 5.52), it can be concluded that the positive difference in nitrogen excretion rate has a greater influence on total nitrogen excretion.

Table 5.52 Average animal population for cattle and for swine as well as average nitrogen excretion rates for the EU28 (1990-2014).

			CAPRI	NIR	Difference CAPRI vs NIR
Cattle					
	Population	1000s	95,240	97,722	-3%
	N excretion rate	kg N/head/year	61	65	-5%
Swine					
	Population	1000s	106,311	155,583	-32%
	N excretion rate	kg N/head/year	20	11	75%

Figure 5.75 Average amount of N excreted for swine in the NIRs and in CAPRI for the EU28

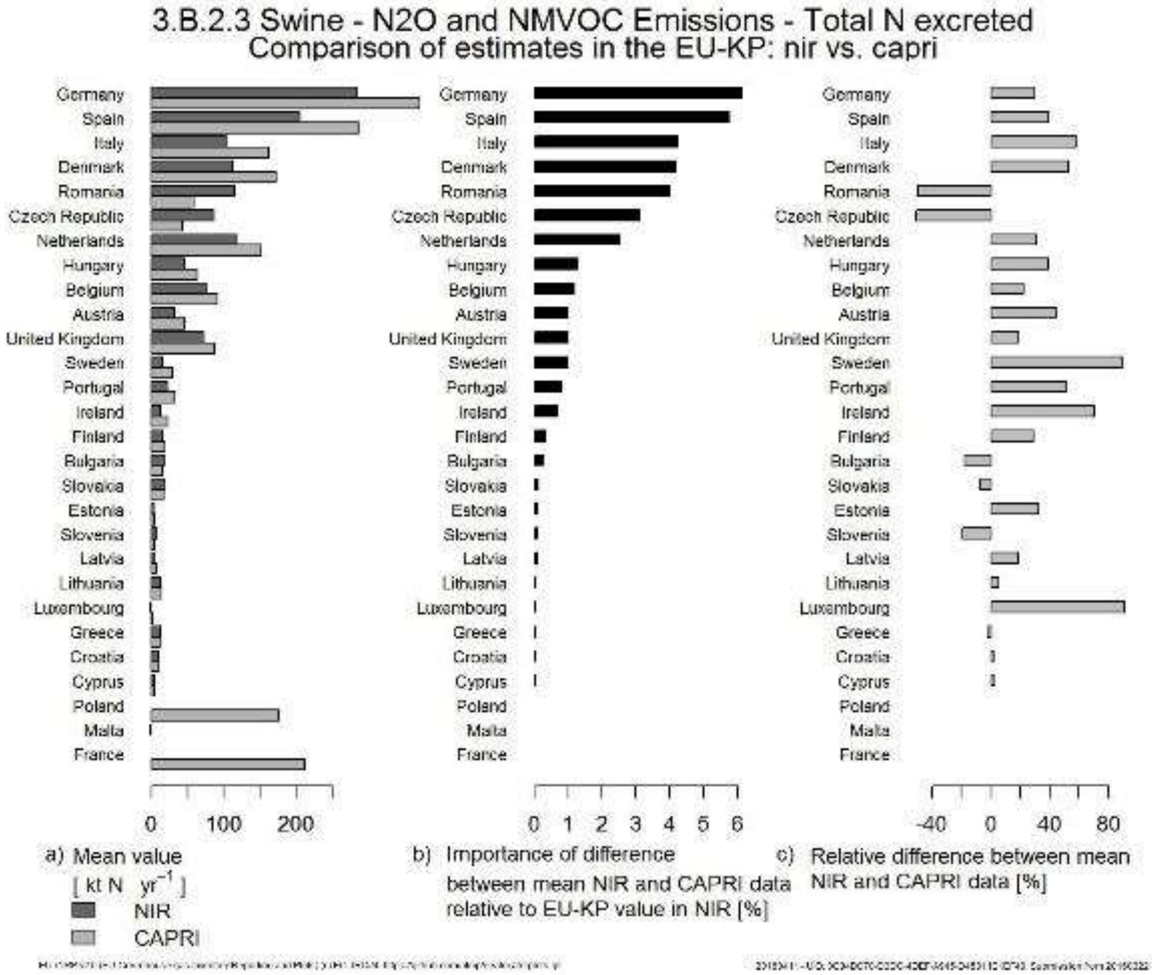
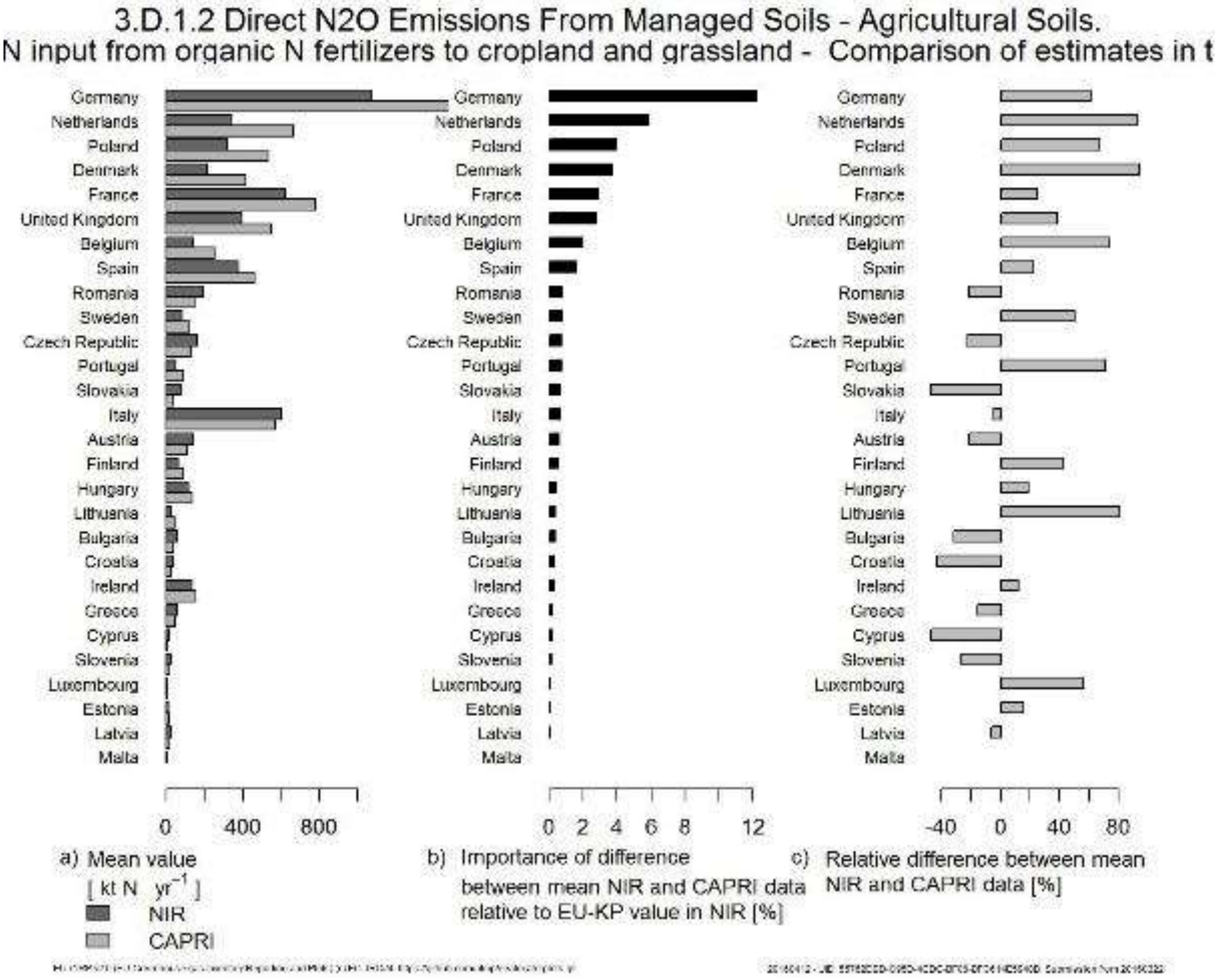


Figure 5.76 Average N input from organic fertilizer from the NIRs and from CAPRI for the EU28



Emission from agricultural soils

While overall emissions for agricultural soils only deviate by 1%, there are noticeable differences for direct and indirect emissions (see Figure 5.77 and Figure 5.78). For the year 2014 CAPRI reports 12% (16,597 kt CO_2 eq.) higher direct emissions from agricultural soils and 46% (-14,268 kt CO_2 eq.) lower indirect emissions. As discussed in the section on emissions from manure, differences in direct emissions of agricultural soils are closely linked to assumptions on N input from organic fertilizer, especially manure. For the other components of this category, namely emissions from synthetic fertilizer application, from crop residues and the cultivation of organic soils, differences range from almost 0% for crop residue emissions to minus 12% for emissions from the cultivation of organic soils.

The difference in indirect emissions of agricultural soils is associated with assumptions on leaching and run-off. While most countries use default values for the calculation of these emissions in the NIRs, CAPRI incorporates this calculation in the mass-balance accounting framework for nitrogen flows. For France and Germany (the highest emitters for this category based on NIR values), this results in 84% and 76% lower emissions, respectively.

Figure 5.77 Average direct emissions N_2O of agricultural soils from the NIRs and from CAPRI for the EU28

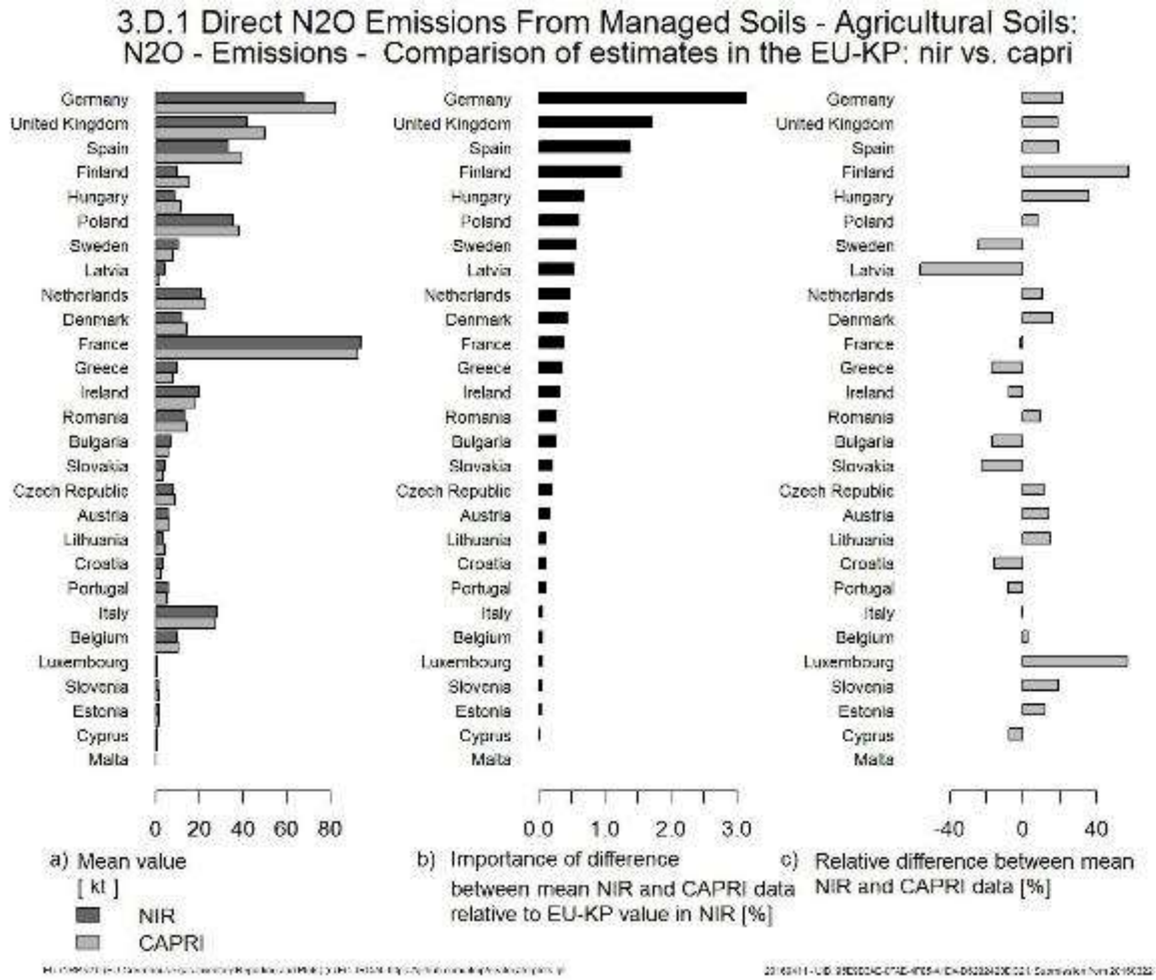
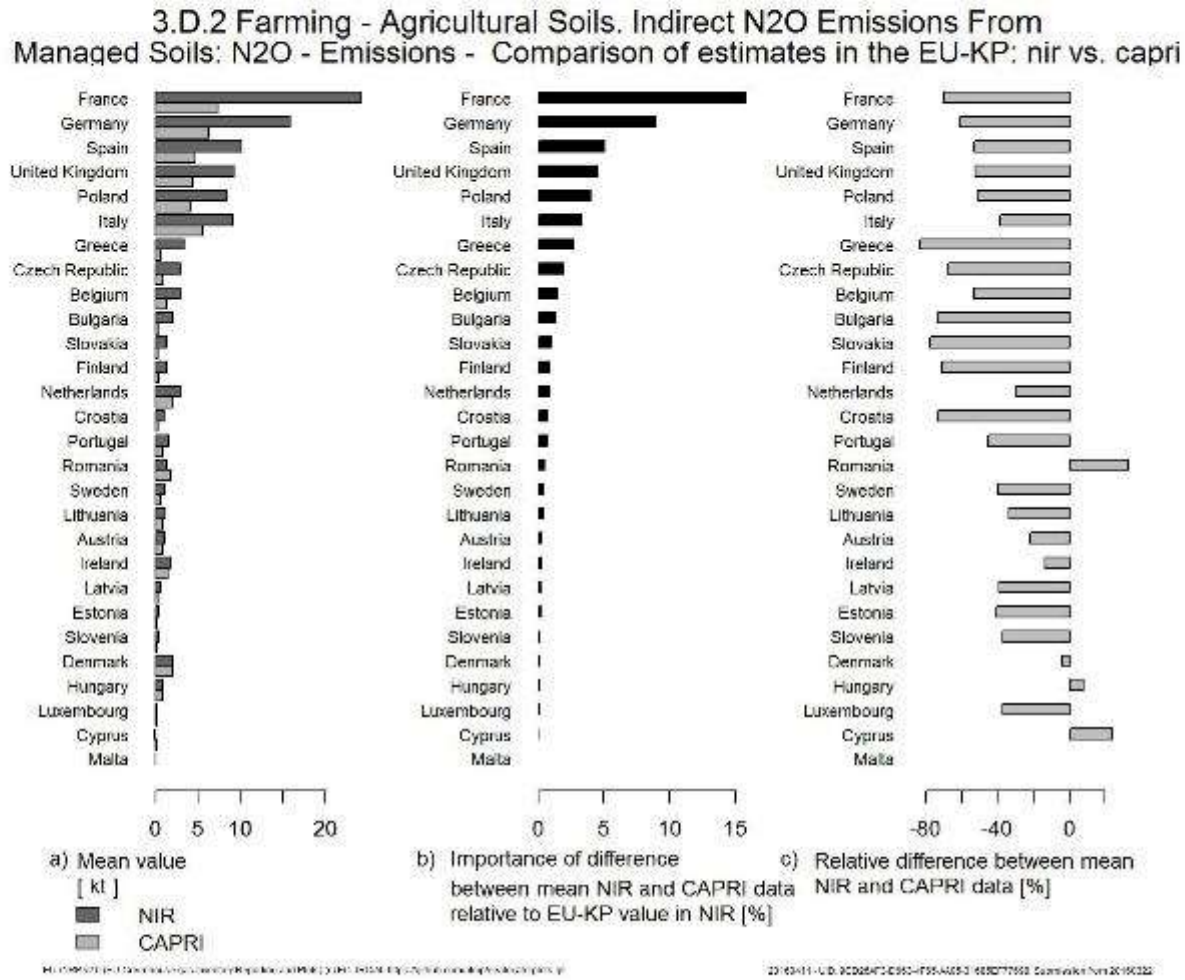


Figure 5.78 Average indirect emissions N_2O of agricultural soils from the NIRs and from CAPRI for the EU28



References used in this section:

IPCC, 2006. 2006 Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Program – Volume 4 Agriculture, Forestry and Other Land Use. Eggleston, H. et al. (Eds.). IGES, Japan.

Leip, A. et al., 2010. Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS) – final report. European Commission, Joint Research Centre.

Velthof, G., L., Oudendag,D., A., Oenema, O., 2007: Development and Application of the Integrated

Nitrogen Model MITERRA-EUROPE, Alterra report 1663.1, Wageningen.

5.4.5.2 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[61]

5.4.5.3 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 5.79. 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 an organic carbon content of >30%, thus de facto only criterion (1) was applied.

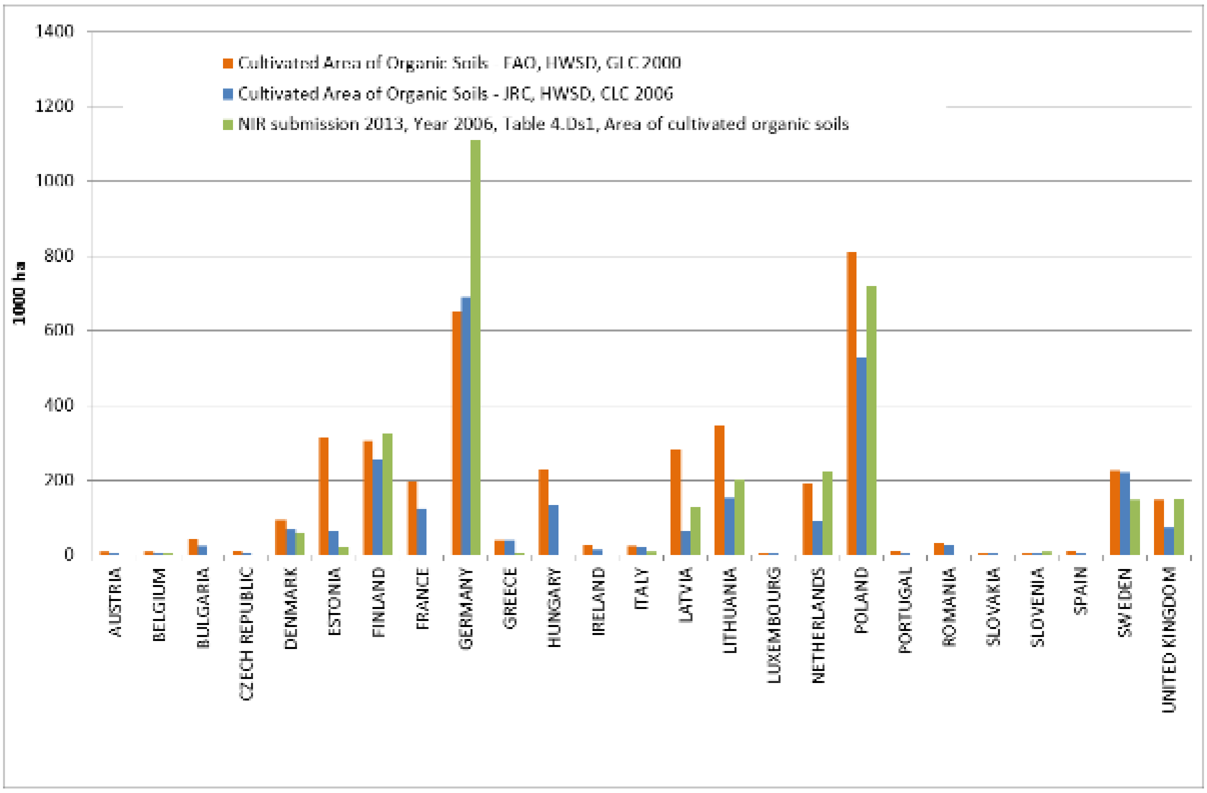
---

[61] *ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/koeble_leip2014.livestockallocation.pdf*

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 soil but 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 5.79 Area of cultivated organic soils based on two studies and the values given in the National Inventory Reports (2013) for the year 2006



5.4.5.4 Comparison of activity data in the FAO GHG database on the national inventory reports

The Food and Agriculture Organization of the United Nations (FAO) has developed a database of greenhouse gas emissions, contained in FAOSTAT, which provides estimations of the emissions of main gases in the agricultural sector (CH_4 and N_2O) and statistics on the activity data related to these emissions for the period 1990-2010. The data base can be consulted at the following link:

http://faostat3.fao.org/faostat-gateway/go/to/download/G1//E*

Emissions are specified for the different agricultural sub-domains, estimated by FAO following Tier 1 approach from the 2006 IPCC Guidelines for National GHG Inventories (IPCC, 2006), using activity data provided by countries and default emission factors by IPCC. The data provided by FAO does not necessarily match the numbers reported by countries to the UNFCCC in their national inventory reports.

The FAOSTAT database is intended primarily as a service to help member countries assess and report their emissions, as well as a useful international benchmark. The FAOSTAT Emissions data are disseminated publicly to facilitate continuous feedback from member countries.

Table 5.53 presents total GHG emissions of the agricultural sector by emission source category for the whole EU-28+Iceland and year 2012 (last year available in FAOSTAT). It compares emission values and the share of emissions by category in FAOSTAT database vs. UNFCCC values reported by countries in their National Inventory Reports (NIR).

Table 5.53 GHG emissions from the agricultural sector by emission source category, in kt CO_2-eq/year and % of total emissions, for the whole EU-28 +Iceland and year 2012, according to FAOSTAT database and to the UNFCCC data reported by countries (NIR).

Source category	Gas	NIR [kt CO_2-eq yr^{-1}]	NIR [%]	FAO [kt CO_2-eq yr^{-1}]	FAO [%]
3.A - Enteric Fermentation	**CH_4**	203,364.7	43.9	209,122	44.4
3.B.1 - CH_4 Emissions	**CH_4**	48,732.0	11.0	63,288	13.0
3.B.2 - N_2O and NMVOC Emissions	**N_2O**	25,589.6	5.5	14,650	3.1
3.C - Rice Cultivation	**CH_4**	2,788.0	1.0	5,202	1.0
3.D.1.1 - Direct N_2O Emissions From Managed SoilsInorganic N Fertilizers	**N_2O**	54,360.0	12.0	52,338	11.0
3.D.1.2 - Direct N_2O Emissions From Managed SoilsOrganic N Fertilizers	**N_2O**	24,075.0	5.0	24,489	5.0
3.D.1.3 - Urine and Dung Deposited by Grazing Animals	**N_2O**	25,844.6	5.6	24,496	5.2
3.D.1.4 - Crop Residues	**N_2O**	20,218.0	4.0	14,806	3.0
3.D.1.5 - Mineralization of Soil Organic Matter	**N_2O**	568.8	0.1	-	-
3.D.1.6 - Cultivation of Organic Soils	**N_2O**	12,603.0	3.0	22,855	5.0
3.D.2 - Indirect N_2O Emissions From Managed Soils	**N_2O**	32,167.0	7.0	37,865	8.0
3.F - Field Burning of Agricultural Residues	**CH_4**	1,357.0	0.0	1,332	0.0
3.F - Field Burning of Agricultural	**N_2O**	409.7	0.1	412	0.1

Source category	Gas	NIR [kt CO_2-eq yr^{-1}]	NIR [%]	FAO [kt CO_2-eq yr^{-1}]	FAO [%]
Residues					
3.G - Liming	**CO_2**	6,753.0	1.0	-	-
3.H - Urea Application	**CO_2**	3,383.7	0.7	-	-
3.I - Other agriculture emissions	**CH_4**	509.0	0.0	-	-
3.I - Other agriculture emissions	**N_2O**	185.0	0.0	-	-
3.I - Other agriculture emissions	**CO_2**	3.0	0.0	-	-
3.i - Other Carbon-containing Fertilizers	**CO_2**	33.6	0.0	-	-
Total	**GHGs**	462,945.0	100.0	470,853	100.0

Comparing both databases, we can see that UNFCCC reports higher total emissions than FAOSTAT, but that difference is lower if we remove from the UNFCCC total emissions the amount corresponding to 3.D.1.5, 3.G, 3.H and 3.I categories, which are not reported in FAOSTAT. Looking at the individual emission categories, we can also identify differences between the two databases, which can be due to different reasons: (1) Differences in the methodology used for the estimation of emissions. While countries apply tier 1 to tier 3 approaches, depending on the emission category, FAOSTAT estimations are based on a tier 1 approach, using always default emission factors. (2) The use of different activity data, coming from different sources or suffering different processing after data collection.

Comparing the estimations of FAOSTAT with the UNFCCC inventory data, we find that the biggest differences correspond to CH_4 emissions from rice cultivation, followed by N_2O emissions from the cultivation of organic soils and N_2O emissions from manure management. These three emission categories, however, do not represent a high share of the total agricultural emissions, accounting for 1%, 3-5% and 3.1-5.5%, respectively.

In the next sections, we will focus on the comparison of activity data, trying to find out if the differences found in both databases can explain the differences in emissions, analysing the trends of livestock population, fertilizer use and cultivated area along the inventory years (1990-2012).

Animal population

First of all, we show in Figure 5.80 the trend in Dairy Cattle population. We can see that it decreased strongly in EU-KP by 40% or 15.9 mio heads in the period 1990 to 2014. Figure 5.80 shows the trend of Dairy Cattle population indicating the countries contributing most to EU-KP total. The figure represents the trend in CH_4 population from enteric fermentation for the different member states along the inventory period, as reported in UNFCCC and in FAOSTAT. The ten countries with the highest population accounted together for 82.7% of the total. Population decreased in 27 countries and increased in two countries. The four countries with the largest decreases were Poland, Germany, Romania and France with a total absolute decrease of 7.9 mio heads. Population increased in Malta and Cyprus, with a total absolute increase of 5 thousand heads. Population changes along the time series given by FAOSTAT are smoother, starting with less than 35 thousand heads in 1990, which evolve to more similar figures to NIRs data in the last years. In this case, the ten countries with the highest number of heads account for 81.9% of the total EU values. The share of emissions per country is very similar to the results obtained from NIRs population numbers.

Figure 5.81 shows the differences between both databases, comparing the average population of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR.

According to the results of the comparison, Italy and France show the biggest differences between databases in absolute terms. From 3.A.1(b) we see that, in relative terms, Greece presents the highest differences between databases compared to average national population, followed by Croatia. According to 3.A.1(c), Romania is the country contributing the most to the total EU difference in dairy cattle numbers, followed by the Czech Republic and Italy.

Figure 5.80 3.A.1: Comparison of Dairy Cattle population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

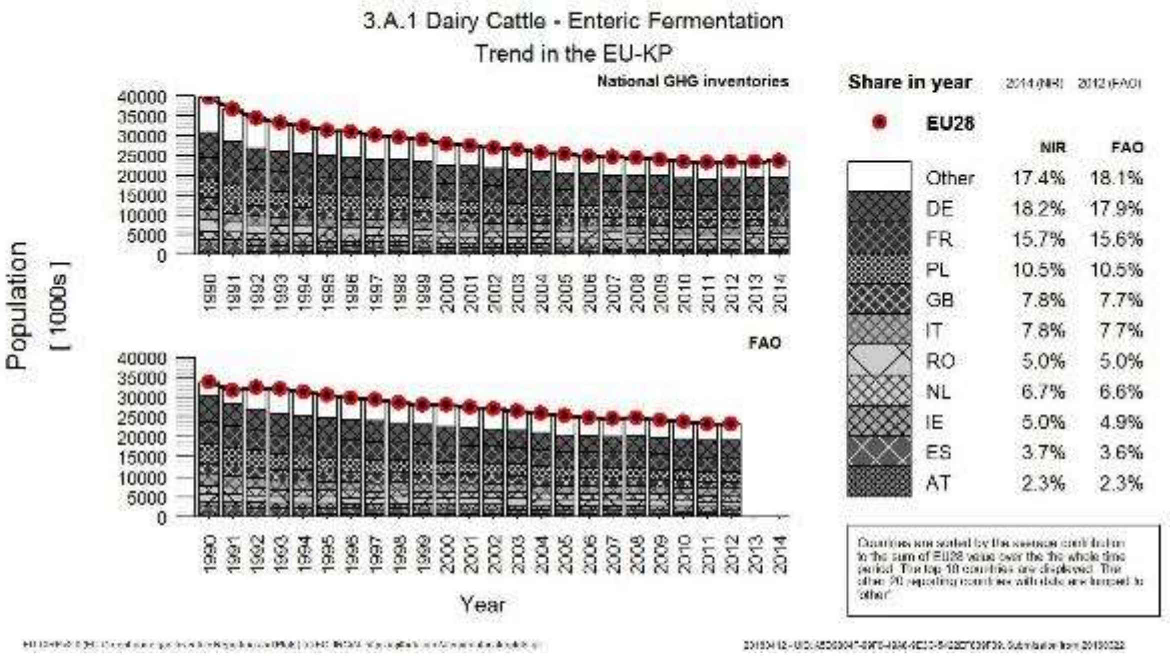


Figure 5.81 3.A.1: (a) Average Dairy Cattle population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

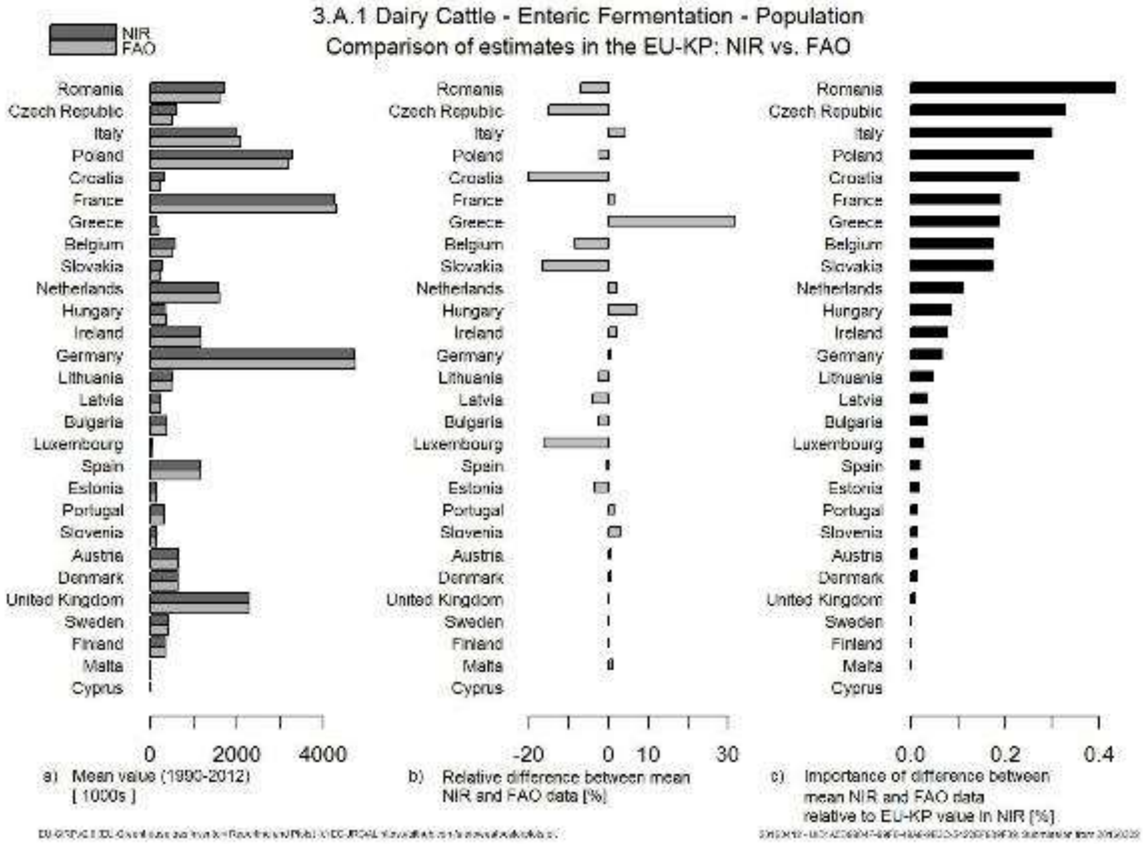


Figure 5.82 and Figure 5.83 show the same type of comparison for non-dairy cattle population, first comparing the trends in population for the EU total, from 1990 to 2012/2014 and then analysing the differences between UNFCCC and FAOSTAT figures. Non-dairy cattle population differences between the two databases for the entire EU28 are also small as for dairy cattle, and also the share of emissions by country is very similar in both data sources. The population trend along the time series is a decreasing line. Between 1990 and 2014, the number of heads in the EU28 has decreased in 16 million units, of which approximately 1/3 in Germany. In the last reporting year, the ten countries with the highest shares accounted for 85.8% (NIR) and 85.4% (FAO) of total EU population.

Comparing the average population of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR, we see that the biggest differences between databases, in absolute terms, correspond to Germany and Romania. In relative terms, also Romania presents the highest differences between databases compared to average national population, followed by Malta. According to 3.A.1(c), Romania is also the country contributing the most to the total EU difference in non-dairy cattle numbers, followed by Ireland, France and Germany.

Figure 5.82 3.A.1: Comparison of Non-Dairy Cattle population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

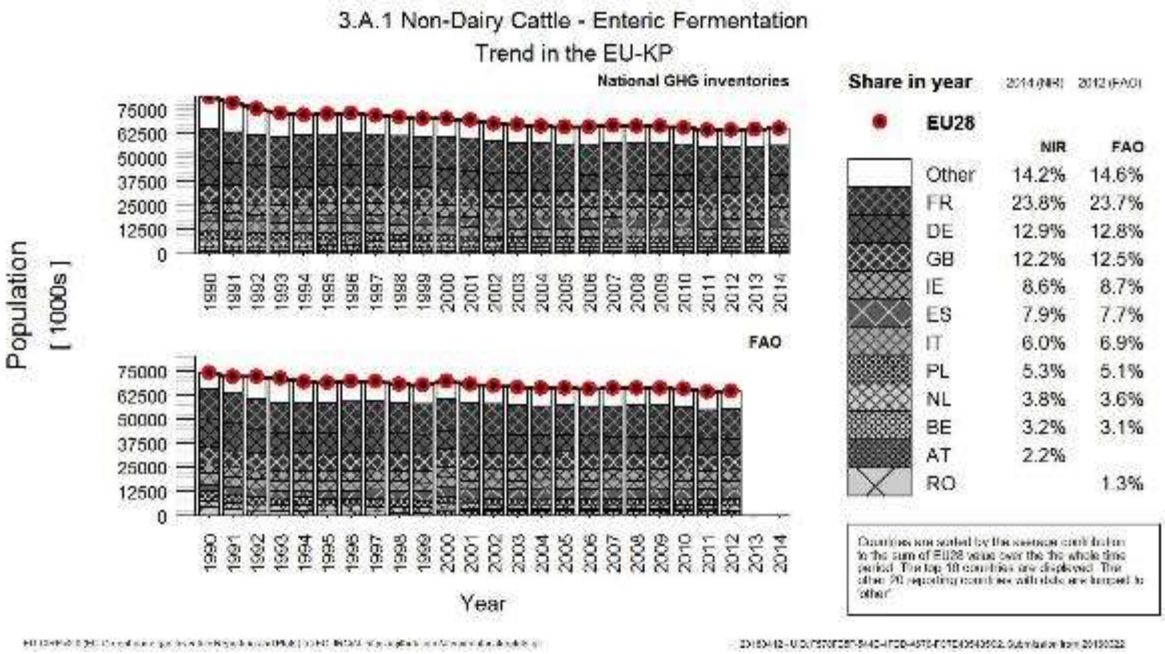


Figure 5.83 3.A.1: (a) Average Non-Dairy Cattle population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

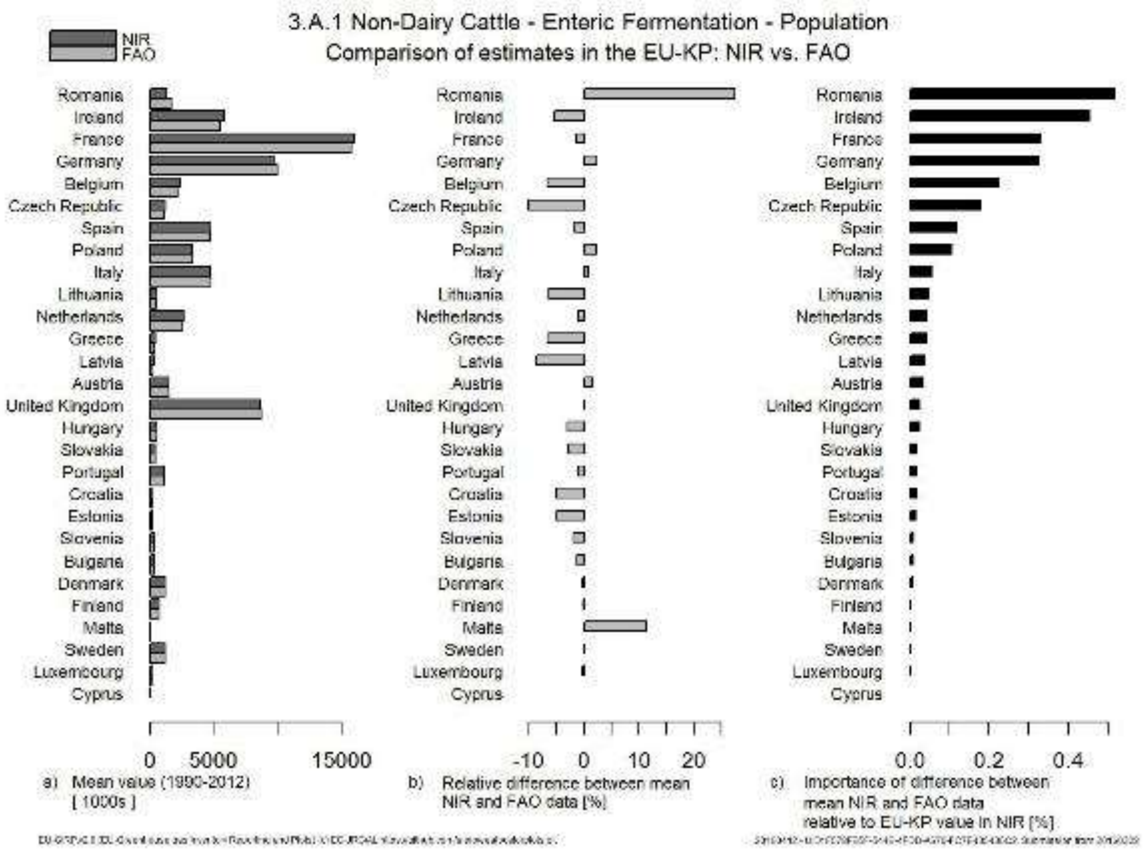


Figure 5.84 and Figure 5.85 present sheep population figures, first the evolution along the inventory years and then the comparison between databases. Like in the previous case, the trend and values provided by both databases are very close, also showing a decreasing number along the time series (48 million heads for EU28). 40% of the population decrease corresponds to two countries, UK and Spain, which currently account for half of the European sheep population. In the last reporting year, the ten countries with the highest sheep population accounted for 93.4% (NIR) and 94.4% (FAO) of EU totals. Comparisons also show that, in relative terms, Denmark presents the highest differences between databases compared to average national population, followed by Slovenia and Malta. Ireland is by far the country contributing the most to the total EU difference in sheep numbers.

Figure 5.84 3.A.1: Comparison of Sheep population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

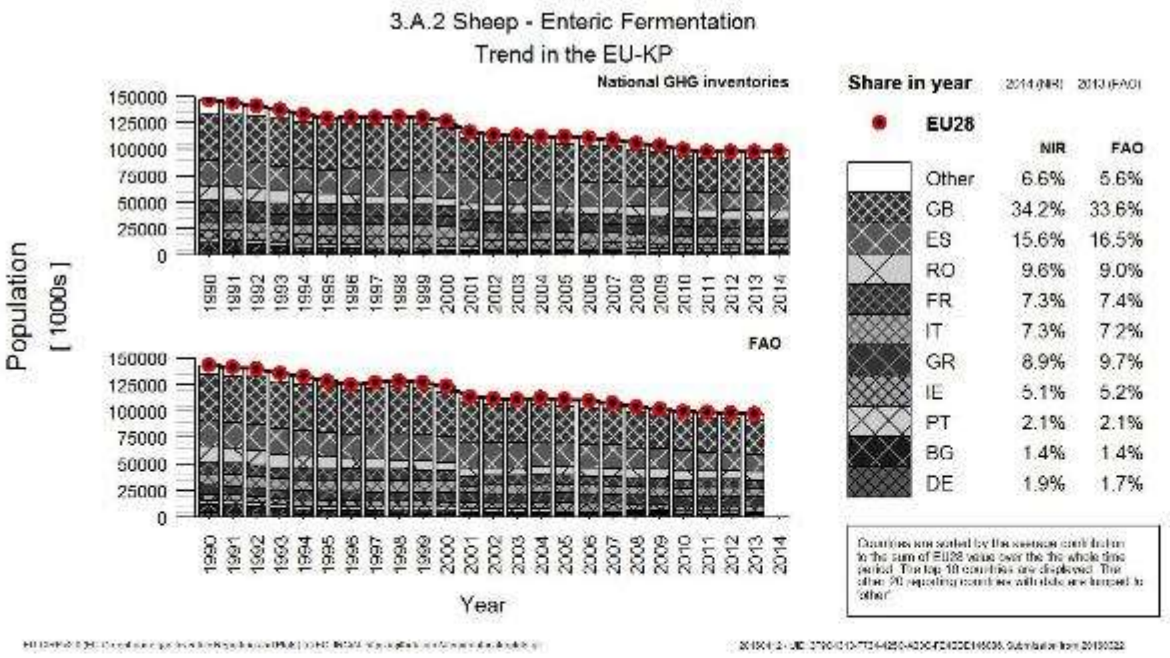


Figure 5.85 3.A.1: (a) Average Sheep population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

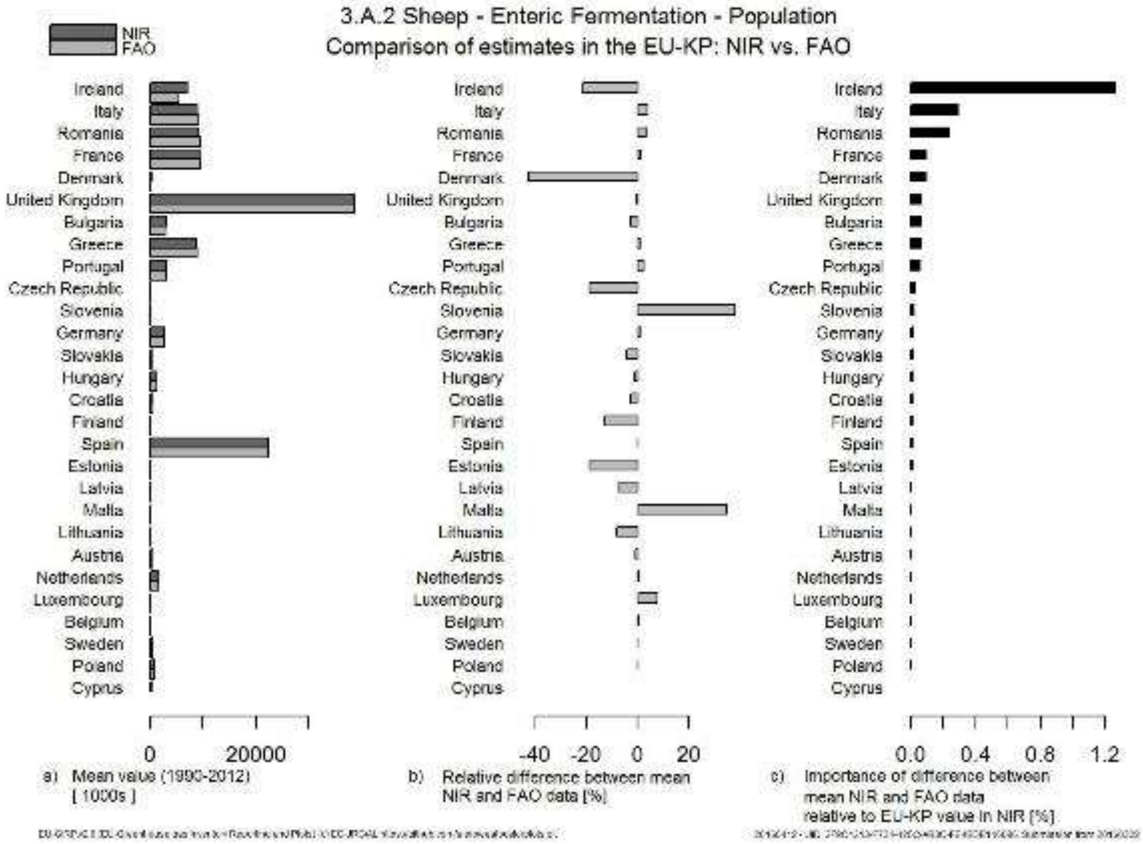


Figure 5.86 and Figure 5.87 analyse swine population in UNFCCC vs. FAOSTAT databases, first the evolution of swine numbers in the EU-28 countries along time (1990-2012/2014) and then the comparison between the two databases by country. Data shows a decrease of swine population of 28 million heads between 1990 and 2014 in the EU28, with the highest decreases, in absolute terms, in Poland and Romania (14.7 million heads together), but also an important increase in Spain (9.6 million heads). As for the previous livestock categories, values and trends are not very different between the NIRs and FAO data. Approximately 1/3 of total swine heads are currently located in Germany and Spain. In relative terms, Croatia presents the highest differences between databases compared to average national population; the average swine numbers in the country are, however, very low compared to the total in Europe. Germany is by far the country contributing the most to the total EU difference in swine numbers.

Figure 5.86 *3.A.1: Comparison of Swine population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.*

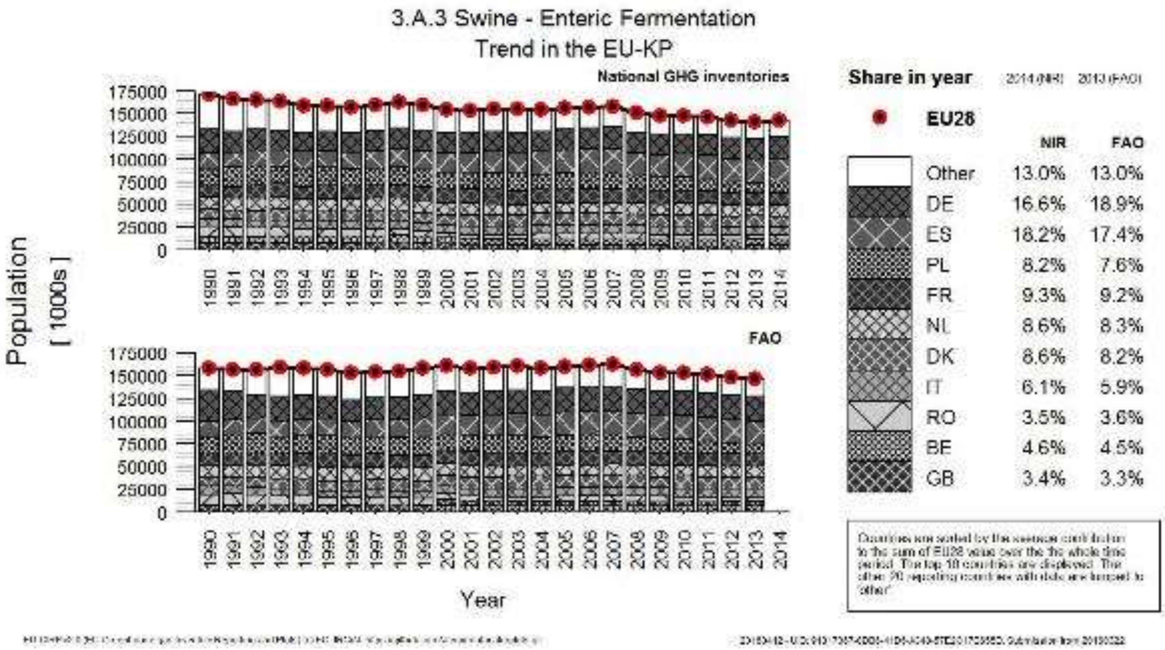
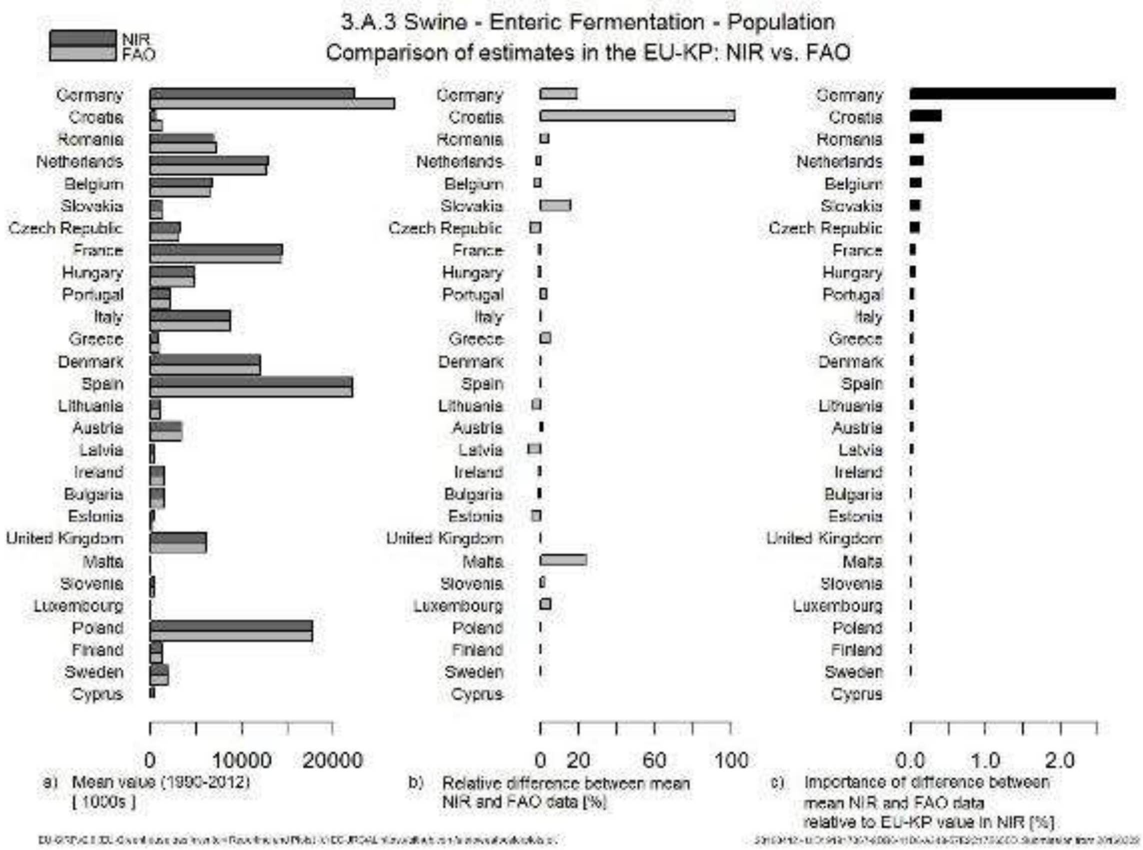


Figure 5.87 *3.A.1: (a) Average Swine population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.*



Nitrogen excretion

In addition to population data, nitrogen excretion data is another parameter with a high influence on emissions, notably on N_2O emissions from manure in various emission categories. FAOSTAT calculates N excretion based on default typical animal mass and nitrogen excretion per animal mass unit, while UNFCCC provides national data, calculated with different methodologies. Figure 5.88 to Figure 5.96 compare UNFCCC vs. FAOSTAT data related to N excretion rate for some livestock categories: non-dairy cattle, sheep, swine and poultry. Note that due to an erroneous value for the Czech Republic, the plot for Dairy Cattle is not shown. We can see that, for most livestock categories, FAOSTAT presents lower values, being these differences highest for sheep. Only for Swine, approximately half of the countries are reporting higher values in their NIR than FAOSTAT.

Figure 5.88 3.B.2: (a) Average Dairy Cattle total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

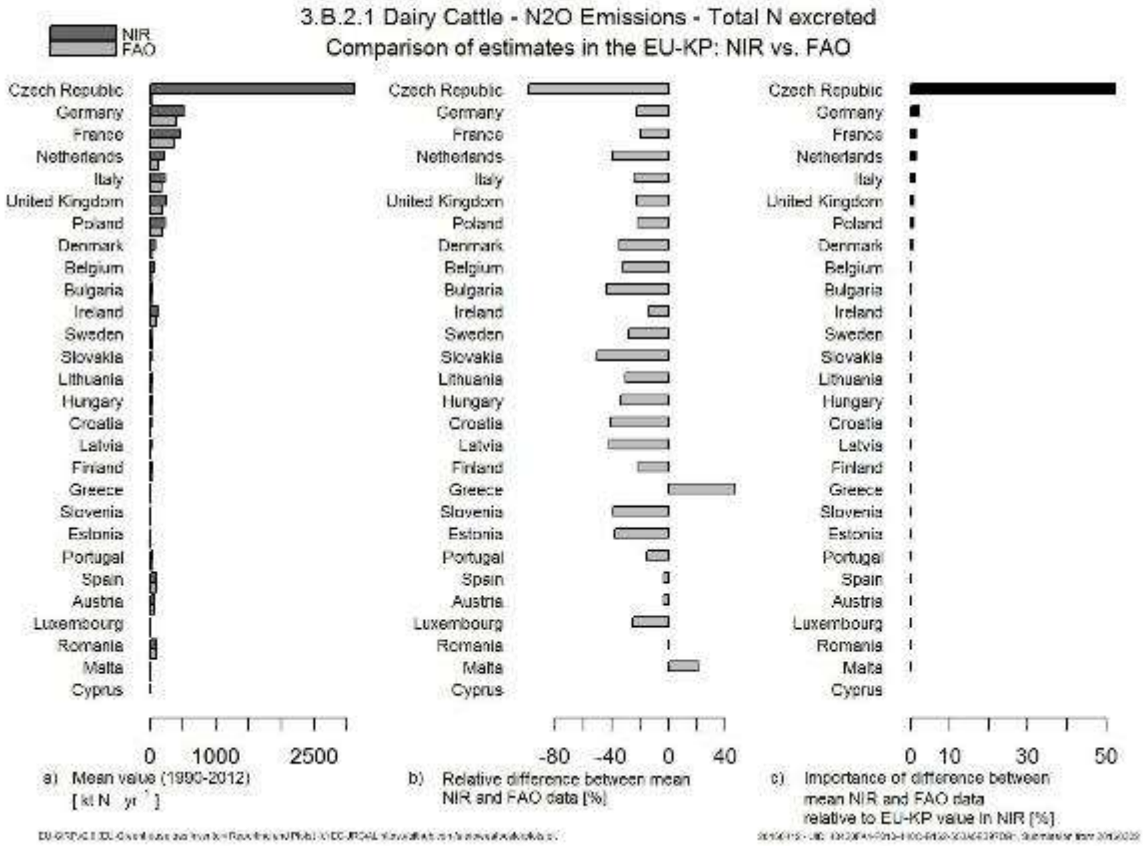


Figure 5.89 compares non-dairy cattle nitrogen excretion data from the NIRs and from FAO for the entire time series (1990-2012/2014). As in the previous case, the values given by FAOSTAT are much lower than those reported in the NIRs, for all years and all countries, but presenting a similar trend. In the last reporting year, France represented around ¼ (26% according to the NIR, 23% according to FAO) of the total nitrogen excretion from swine in the entire EU. Together with the UK and Germany, they account for nearly half of the EU total.

Figure 5.90 shows the differences between both databases, comparing the average nitrogen excretion rate for non-dairy cattle of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.B.2.1(b) we see that, in relative terms, the Netherlands and Romania present the highest differences (with opposed signs) between databases compared to average national nitrogen excretion. According to 3.B.2.1(c), the Netherlands and France are the countries contributing the most to the total EU difference in nitrogen excretion from non-dairy cattle.

Figure 5.89 3.B.2: Comparison of Non-Dairy Cattle total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

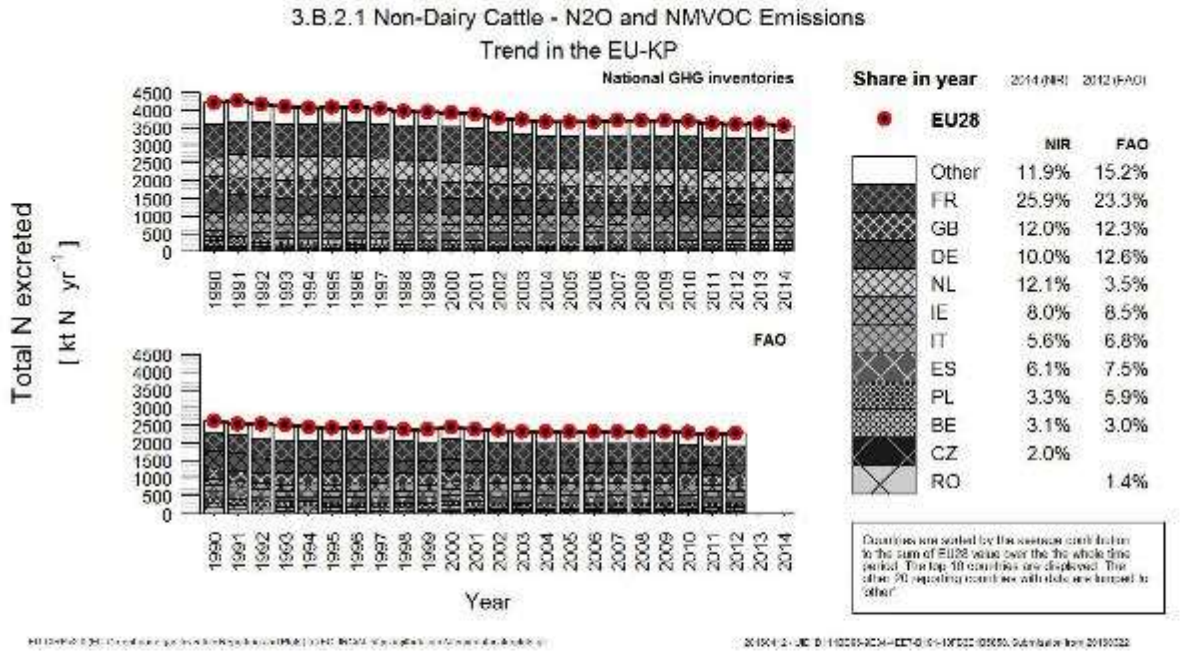


Figure 5.90 3.B.2: (a) Average Non-Dairy Cattle total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

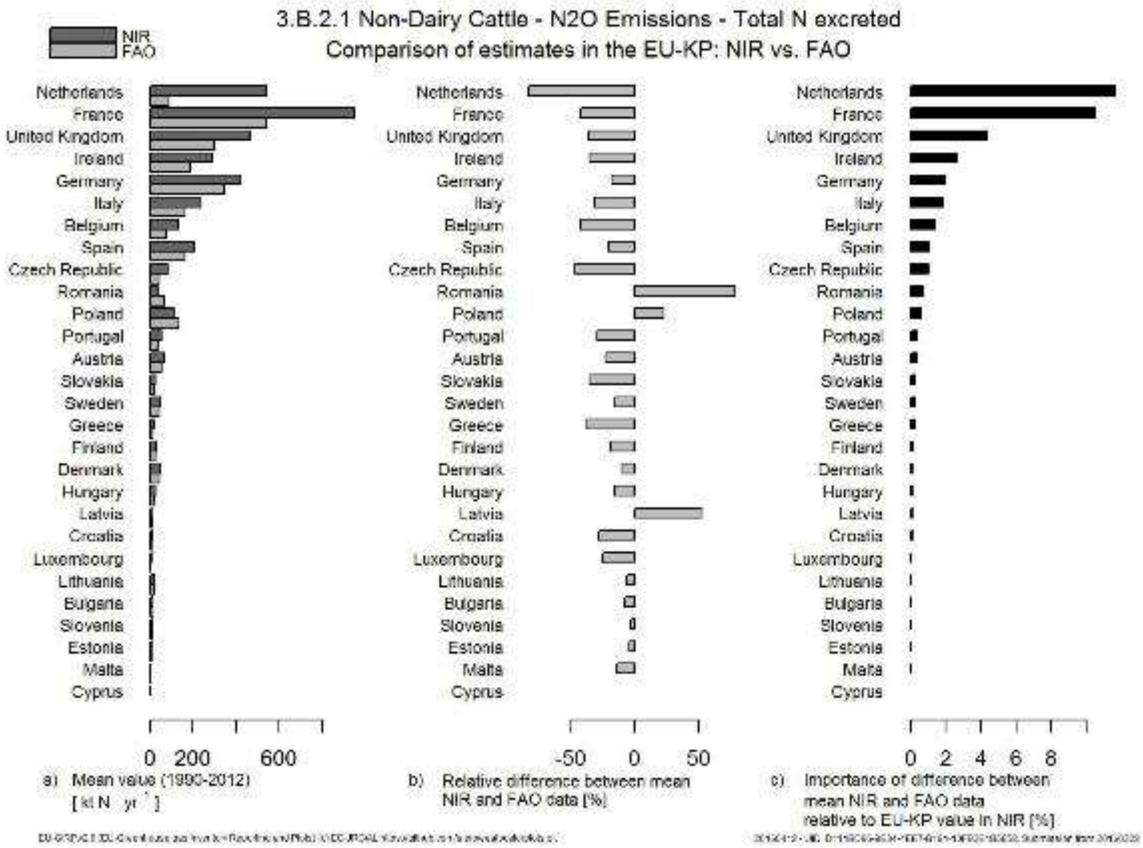


Figure 5.91 and Figure 5.92 are focused on nitrogen excretion from sheep. Figure 5.91 compares sheep nitrogen excretion data from the NIRs and from FAO for the entire time series (1990-2012/2014). The values given by FAOSTAT are much lower (around 1/3) than those reported in the NIRs, for all years and all countries, but presenting a similar decreasing trend. In the last reporting year, the UK represented around 26% (NIR) – 29% (FAO) of the total nitrogen excretion from sheep in the entire EU. The three countries with the highest share account together for 60% of total EU nitrogen excretion from sheep; these countries differ according to the database used: UK, Italy and Greece when using the NIR data and UK, Romania and Spain when using the FAO data. Figure 5.92 shows the differences between both databases, comparing the average nitrogen excretion rate for sheep of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.B.2.2(b) we see that all countries except Romania present high differences (50 and 80%) between databases, compared to the average national values. According to 3.B.2.2(c), UK, Italy and Greece are the countries contributing the most to the total EU difference in nitrogen excretion from sheep, coinciding with the countries with the highest amounts of total nitrogen excretion from sheep.

Figure 5.91 3.B.2: Comparison of Sheep total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

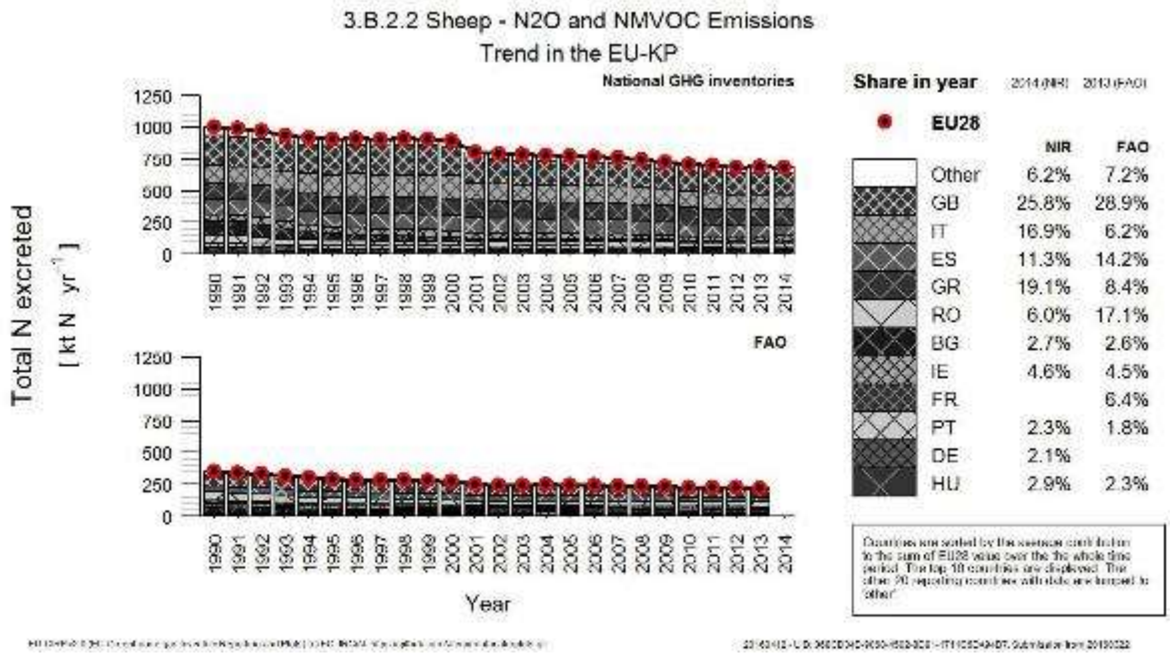
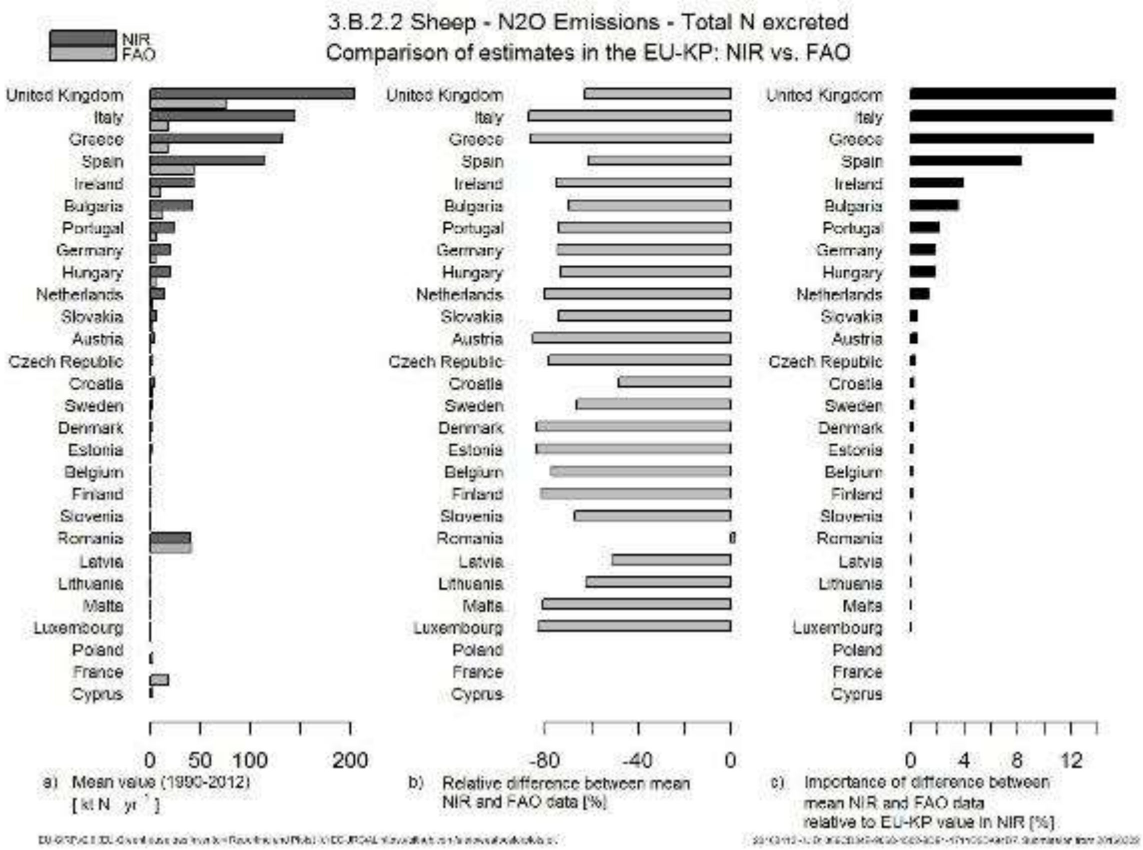


Figure 5.92 3.B.2: (a) Average Sheep total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



Next, we analyse the data on nitrogen excretion from swine. Figure 5.93 compares swine nitrogen excretion data from the NIRs and from FAO for the entire time series (1990-2012/2014). In this case, differences between databases are not as high as for the previous livestock categories, being the numbers very similar for the first years of the time series, with increasing differences in the later years, as FAO data remains approximately constant while nitrogen excretion data reported in the NIRs has a decreasing trend. In the last reporting year, Germany and Spain account for the highest shares of swine nitrogen excretion (together 46% according to NIR, 36% according to FAO).

Figure 5.94 shows the differences between both databases, comparing the average nitrogen excretion rate for swine of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.B.2.3(b) we see that the Czech Republic presents the highest differences between databases, compared to the average national values. According to 3.B.2.3(c), the Czech Republic, Spain and Romania are the countries contributing the most to the total EU difference in nitrogen excretion from swine.

Figure 5.93 3.B.2: Comparison of Swine total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

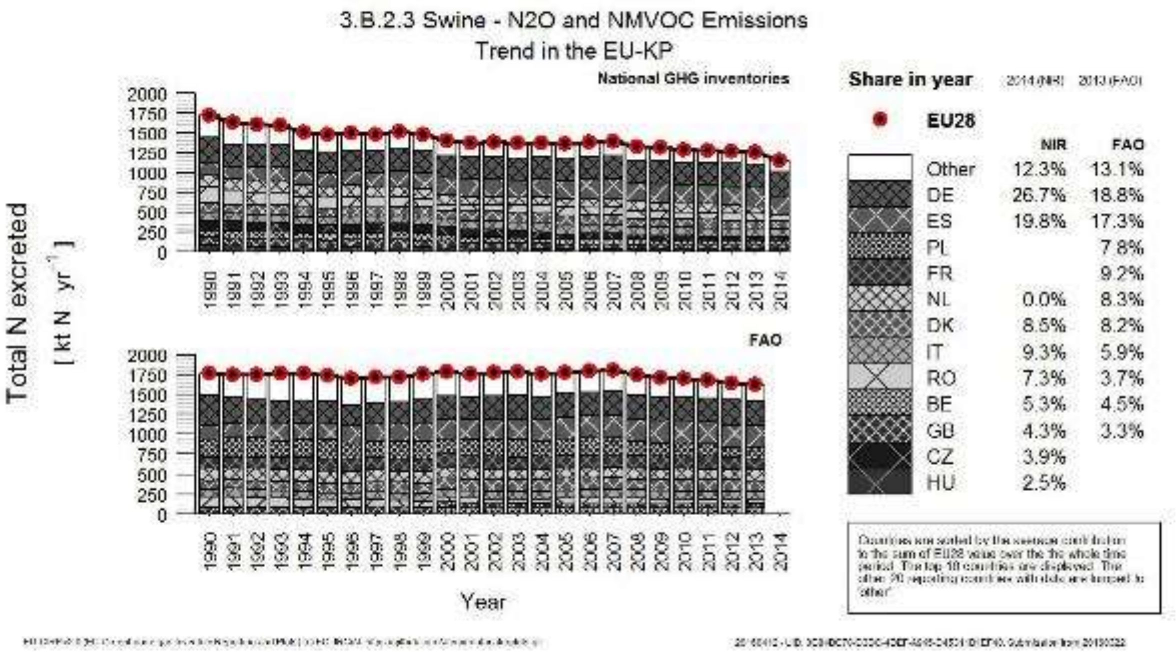
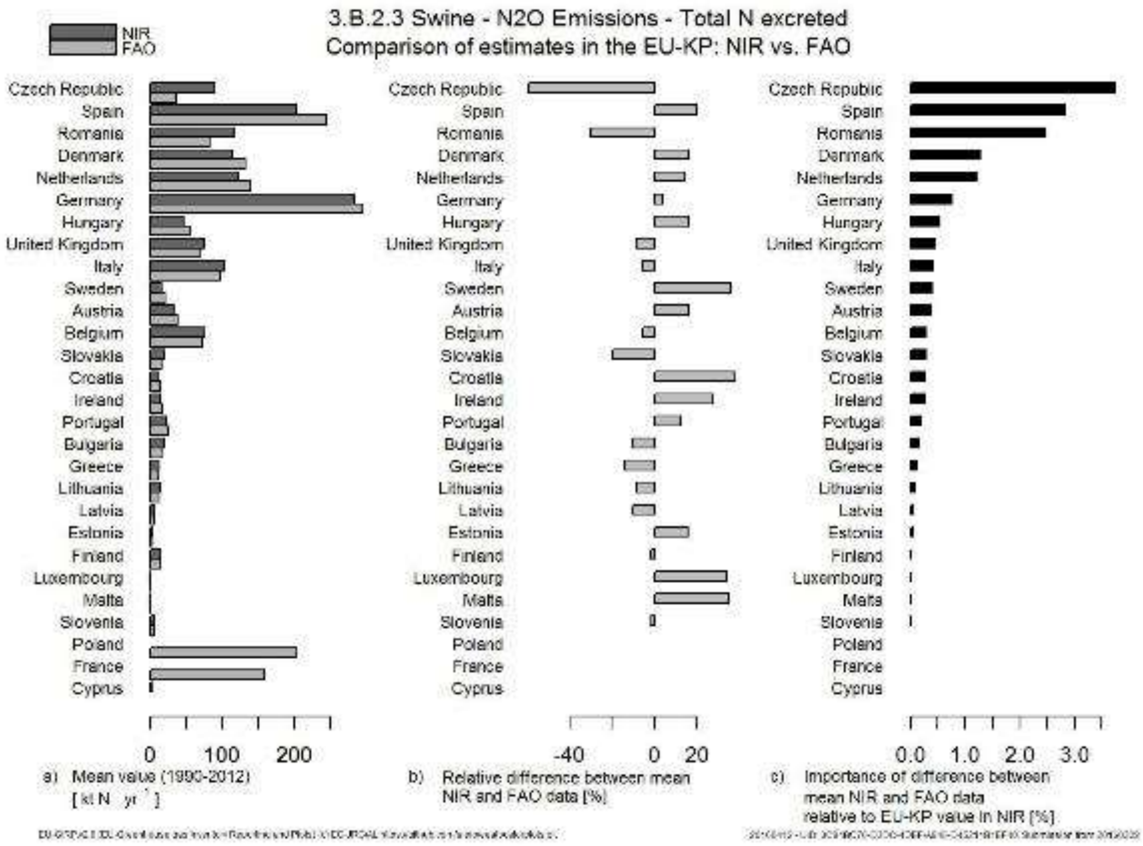


Figure 5.94   3.B.2: (a) Average Swine total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



The last livestock category whose nitrogen excretion data we analyse is poultry. Figure 5.95Figure 5.1 compares poultry nitrogen excretion data from the NIRs and from FAO for the entire time series (1990-2012/2014). As in the case of swine, differences between databases are not as big as for the previous livestock categories, although usually bigger in the NIR data in this case. In the last reporting year, France and Italy account for half of the total nitrogen excretion from poultry in the EU, according to FAO.

Figure 5.96 shows the differences between both databases, comparing the average nitrogen excretion rate for poultry of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.B.2.4.7(b) we see that Luxemburg presents the highest differences between databases, compared to the average national values, followed by Romania. According to 3.B.2.4.7(c), Romania is, by far, the country contributing the most to the total EU difference in nitrogen excretion from poultry.

Figure 5.95 3.B.2: Comparison of Poultry total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

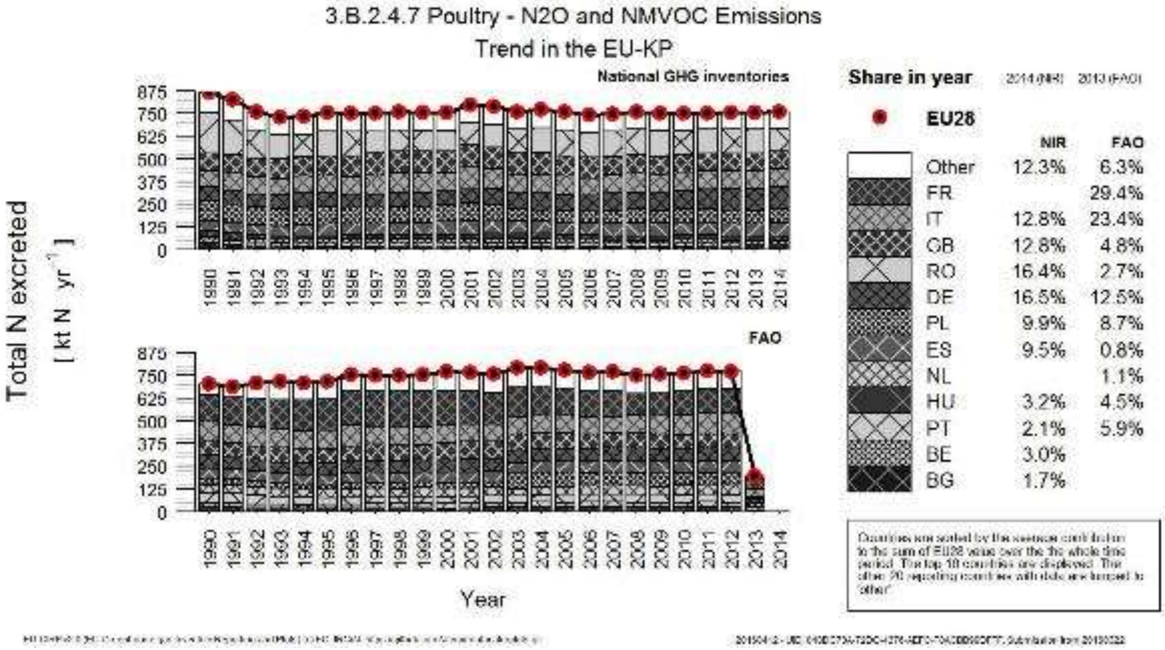
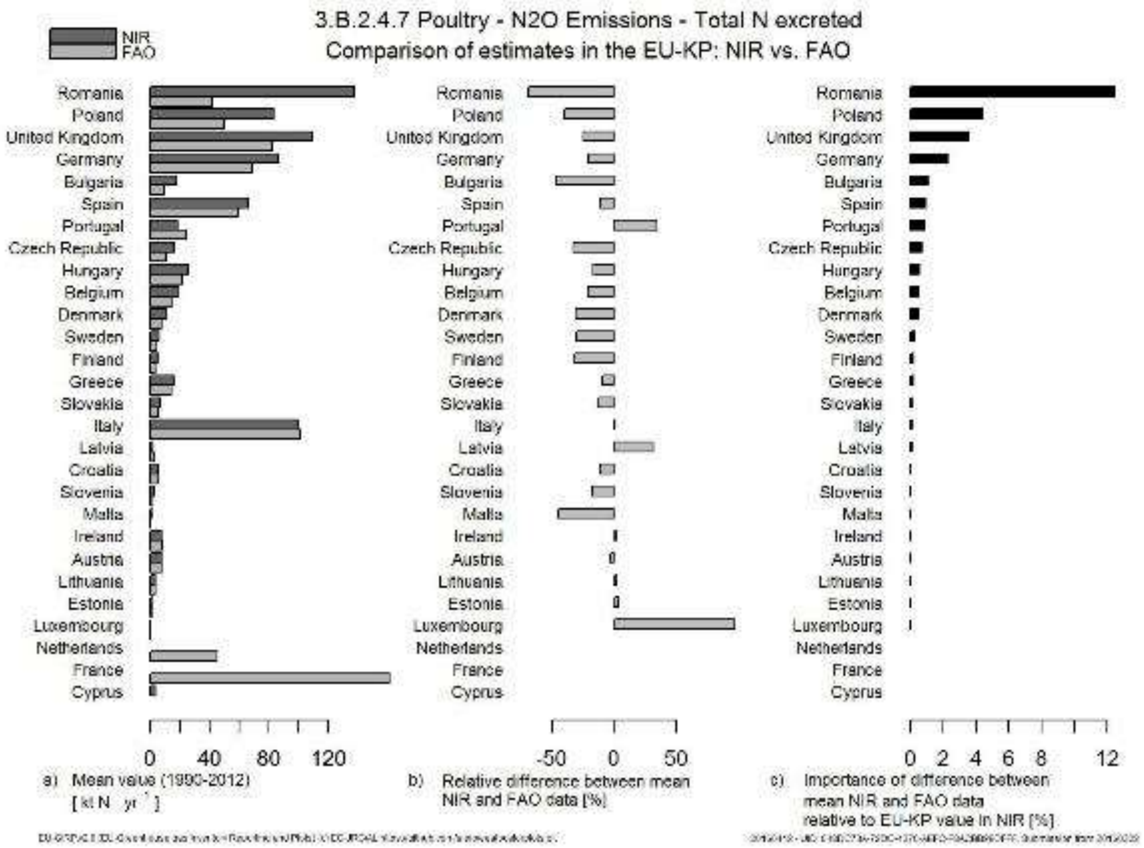


Figure 5.96 3.B.2: (a) Average Poultry total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



Cultivation of histosols

Focusing on the area of cultivated organic soils, we can see in Figure 5.97 and Figure 5.98 that total EU-28 area provided by FAOSTAT is higher than the area reported by countries to UNFCCC, constant in both databases for nearly the whole time series.

Figure 5.98 shows the differences between both databases, comparing the average area of organic soils of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.D.1.6(b) we see that Estonia presents, by far, the highest differences between databases. According to 3.D.1.6(c), Poland is the country contributing the most to the total EU difference in the area of histosols, followed by Estonia, Lithuania and the UK, which are also some of the main contributors to the total area of organic soils

Figure 5.97 3.C: Comparison of Histosols area in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

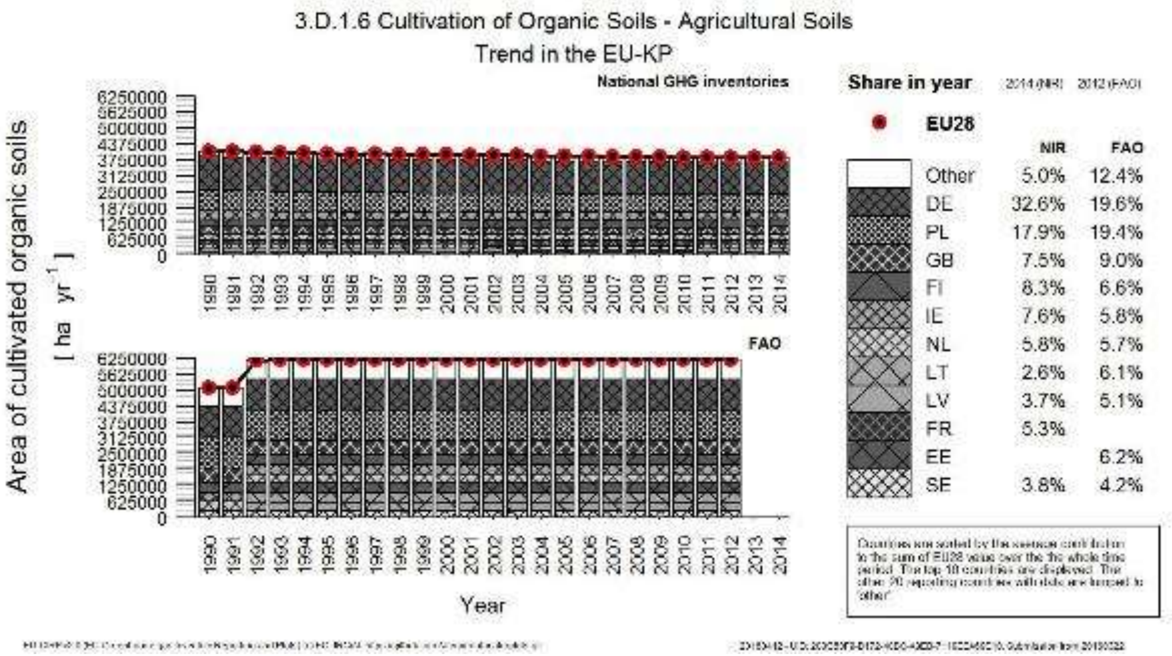
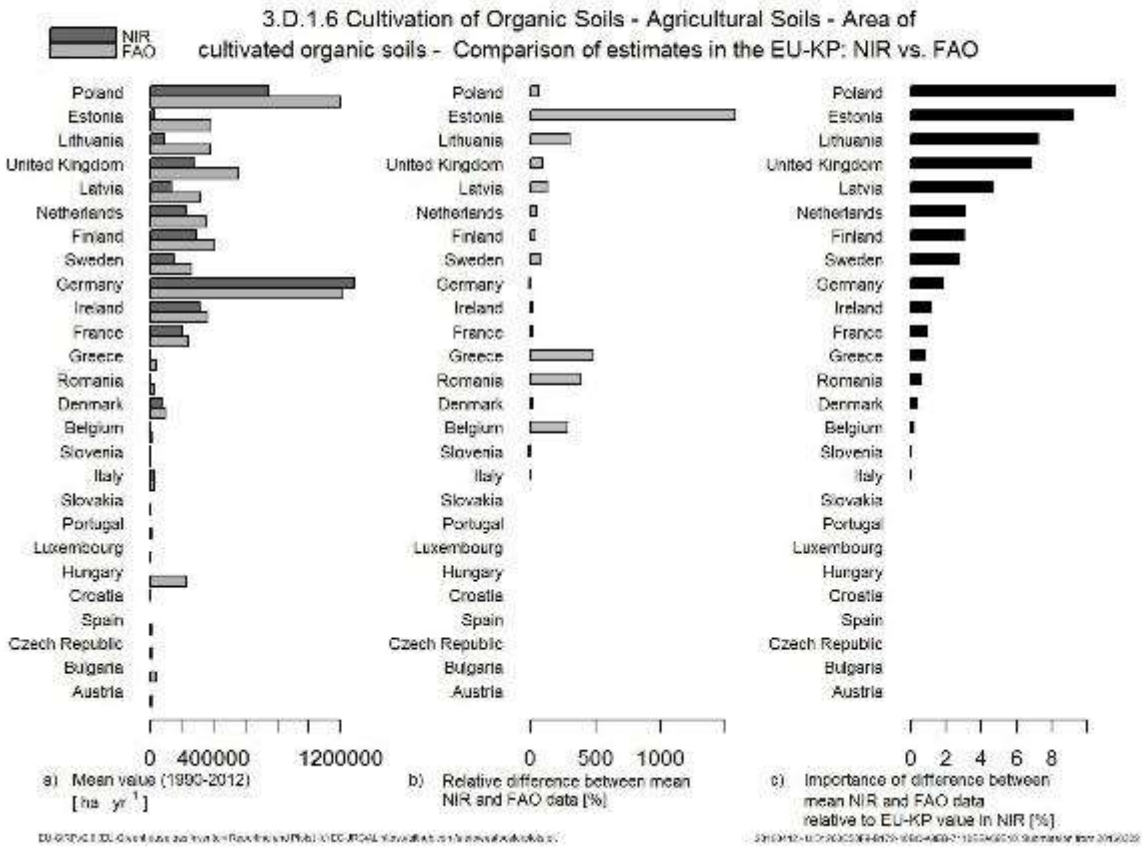


Figure 5.98 3.C: (a) Average Histosols area in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



Nitrogen input to agricultural soils

In this section we analyse the different between databases for three sources of nitrogen input to soils: synthetic fertilisers, organic fertilisers and crop residues applied to soils.

Figure 5.99 and Figure 5.100 compare the activity data related to the application of synthetic fertilisers to agricultural soils.

Figure 5.101 and Figure 5.102 show the comparison of the N from organic fertilisers applied to soils.

Finally, we compare UNFCC and FAOSTAT data on N from crop residues applied to soils in Figure 5.103 and Figure 5.104.

We can see that differences between databases are higher in the first years, where the NIRs report higher quantities of synthetic fertilisers applied, which decrease until around 2003, where numbers become similar to FAO dataset and from when quantities remain approximately constant. In the last reporting year, France accounts for 20.1% (NIR) - 21.2% (FAO) of total nitrogen from synthetic fertilisers applied in the EU, followed by Germany, UK and Spain.

Figure 5.100 shows the differences between both databases, comparing the average quantity of nitrogen applied from synthetic fertilisers of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.D.1.1(b) we see that Malta presents the highest differences between databases, followed by Lithuania and Latvia; however, all three represent only a small share of the total quantity applied in the EU. According to 3.D.1.1(c), Italy and Poland are the countries contributing the most to the total EU difference in the quantity of synthetic fertilisers applied, followed by Greece, France and Romania.

Figure 5.99 3.D: Comparison of Inorganic N fertilizers N input in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

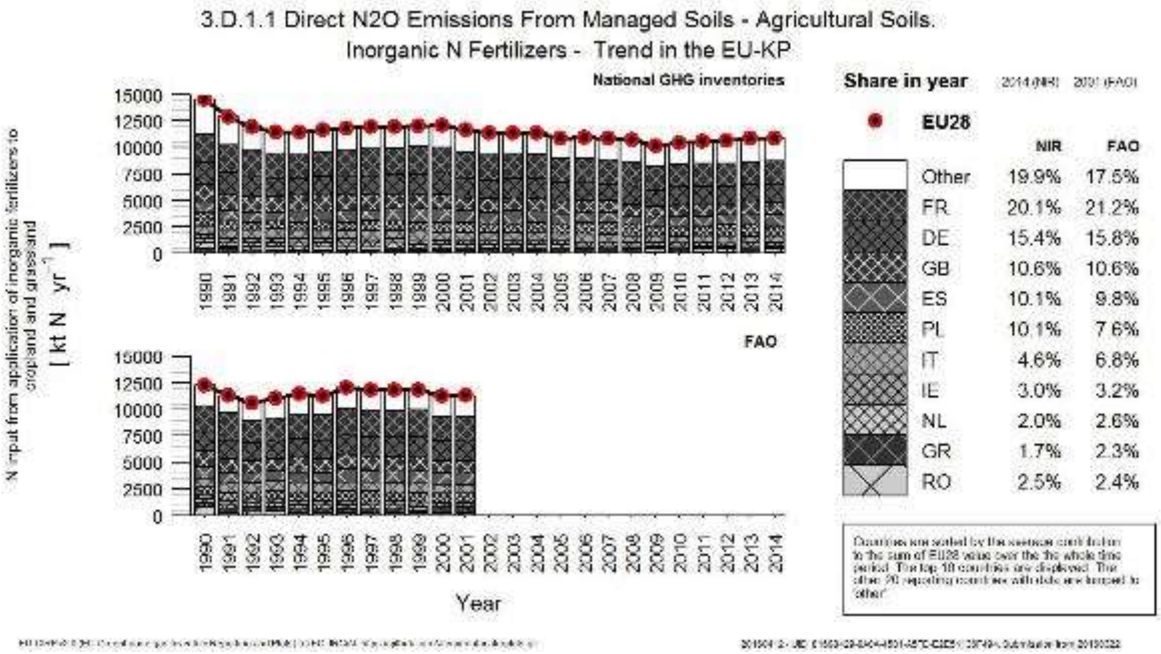


Figure 5.100 3.D: (a) Average Inorganic N fertilizers N input in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

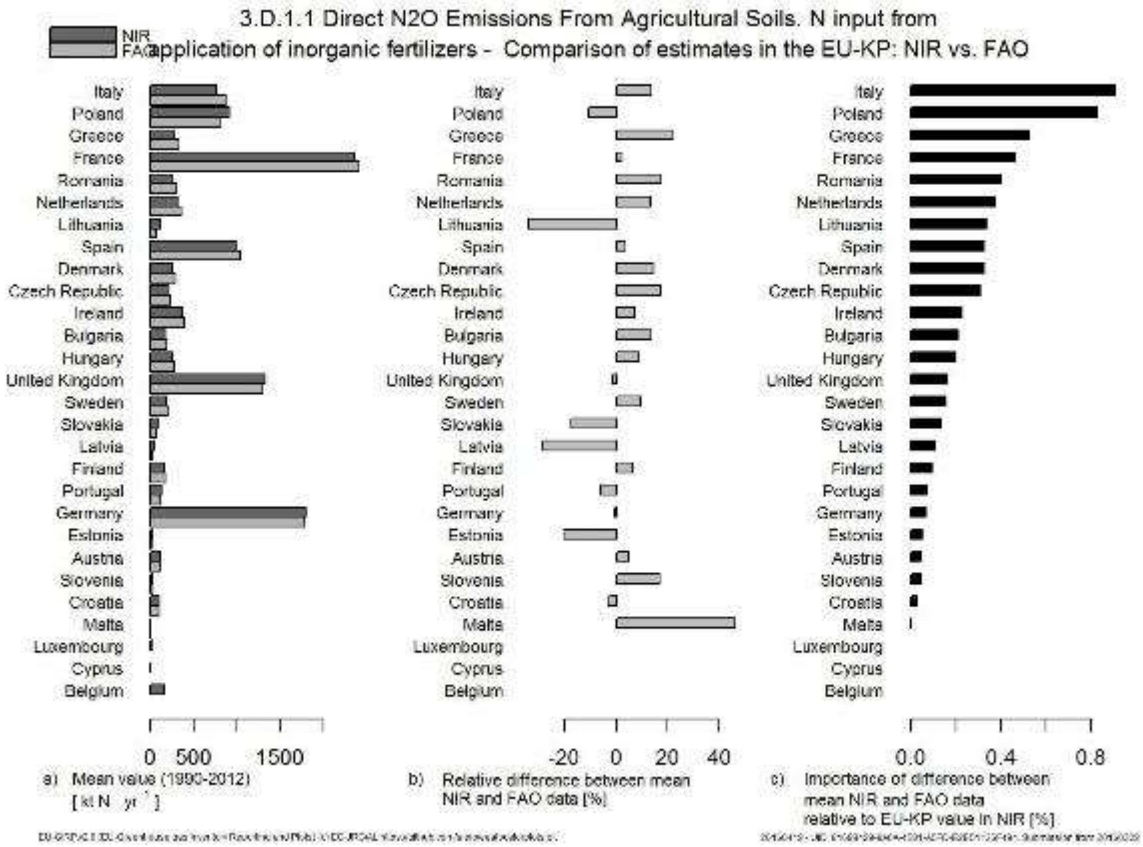


Figure 5.101 compares data on the nitrogen applied from organic fertilisers from the NIRs and from FAO for the entire time series (1990-2012/2014). We can see that, as for the synthetic fertilisers, differences between databases are higher in the first years, where the NIRs report higher quantities. For the biggest part of the time series, numbers are quite similar in both datasets and follow a quite constant trend. In the last reporting year, Germany appears as the first contributor to organic fertilisation, with 24.4% (NIR) – 16.6% (FAO) of total quantities applied in the EU, followed by France, Italy and UK.

From Figure 5.102 we see that Lithuania presents the highest differences between databases, followed by Portugal and Ireland; none of them represents an important share of the total quantity applied in the EU. Germany, France and Italy are the countries contributing the most to the total EU difference in the quantity of organic fertilisers applied, being also the main contributors to the total amounts applied in the EU.

Figure 5.101 3.D: Comparison of Organic N fertilizers N input in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

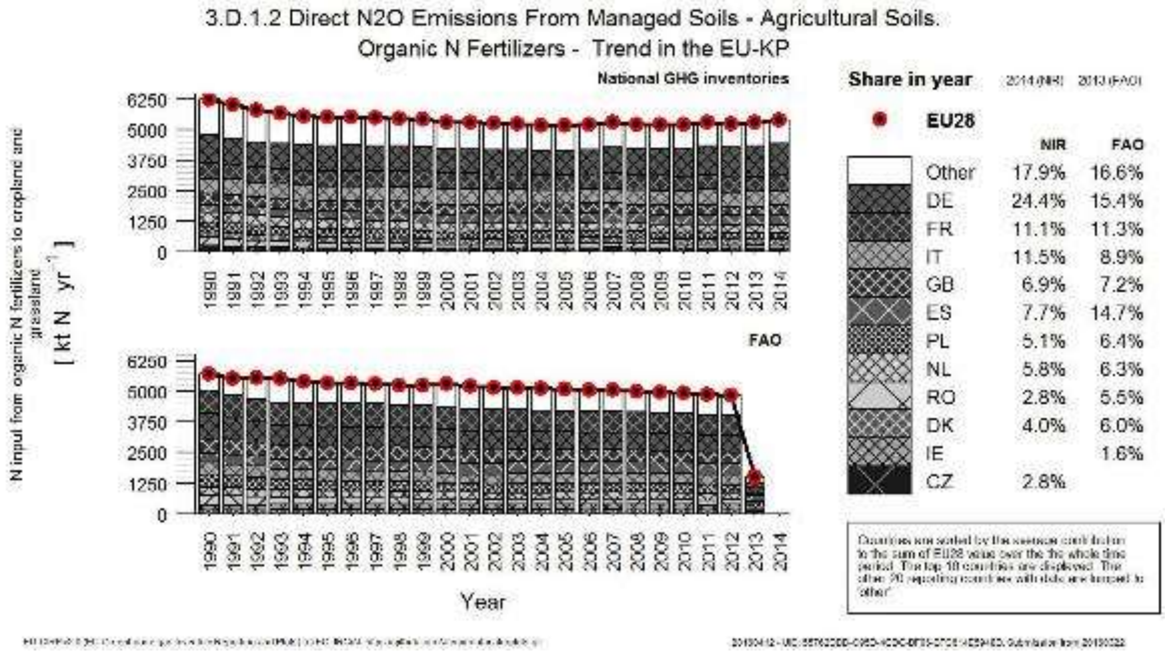
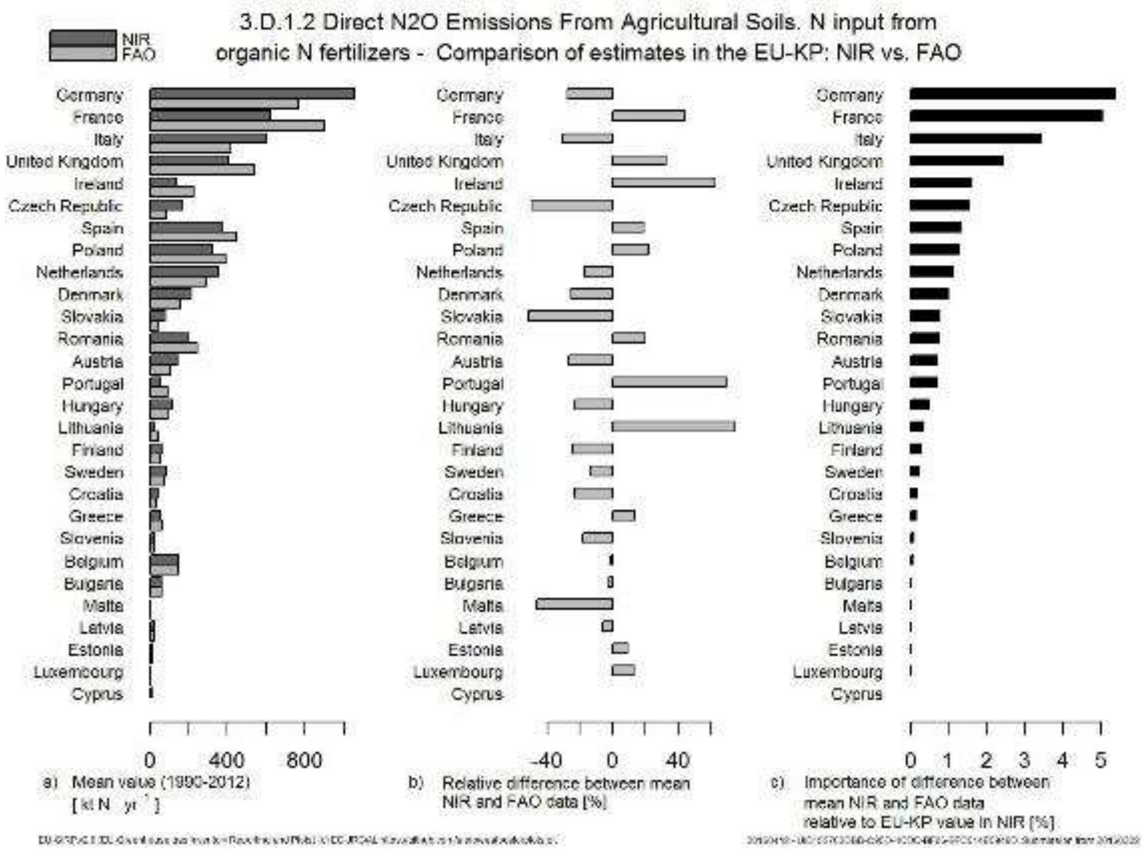


Figure 5.102 3.D: (a) Average Organic N fertilizers N input in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



Finally, we compare UNFCC and FAOSTAT data on N from crop residues applied to soils in Figure 5.103 and Figure 5.104. Figure 5.103 compares data on the application of nitrogen through crop residues from the NIRs and from FAO for the entire time series (1990-2012/2014). In this case, both databases follow a similar trend along the time series but the NIRs report higher quantities of crop residue application. In the last reporting year, France is identified as the first contributor to the incorporation of crop residues, with 24% (NIR) – 24.3% (FAO) of total quantities applied in the EU, followed by UK and Germany.

Figure 5.104 shows the differences between both databases, comparing the average quantity of nitrogen applied from the incorporation of crop residues of all years by country, the weight of the national differences compared to the EU total differences and the relative differences between databases compared with the mean values given in the NIR. From 3.D.1.4(b) we see that Luxemburg presents the highest differences between databases, some orders of magnitude bigger than the rest of the countries; however, its contribution to total crop residues applied in the EU is not relevant. According to 3.D.1.4(c), France and the UK, which have the highest shares of crop residue application, are also the countries contributing the most to the total EU difference in the quantity of organic fertilisers applied, followed by Belgium and Spain.

Figure 5.103 3.D: Comparison of Crop residues N input in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

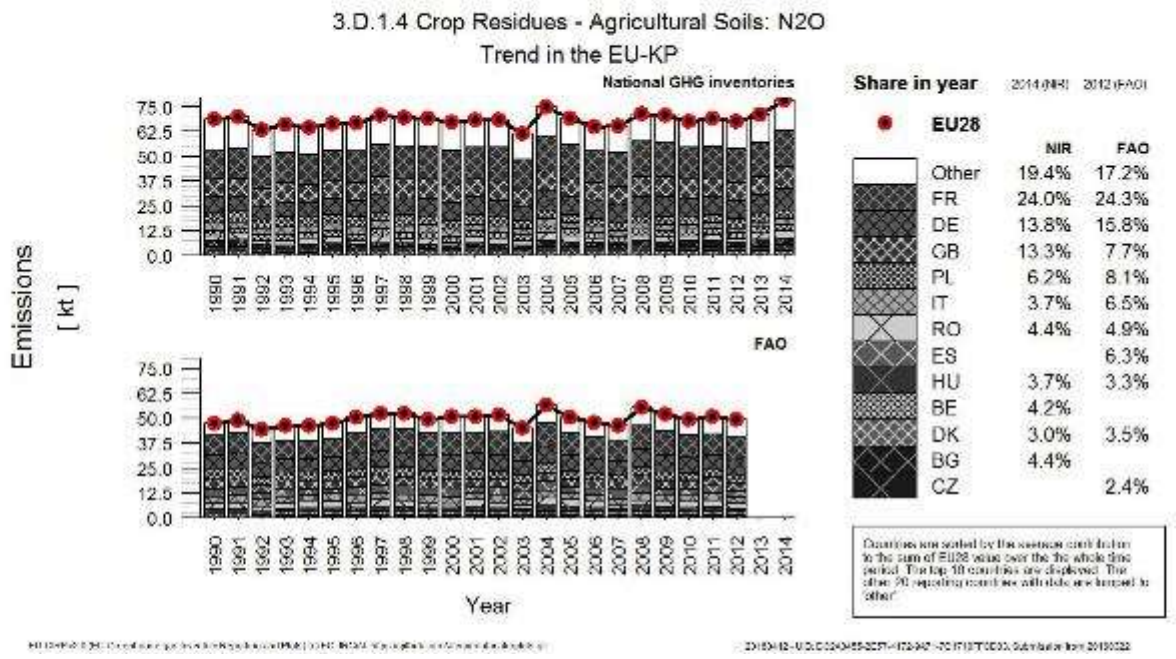
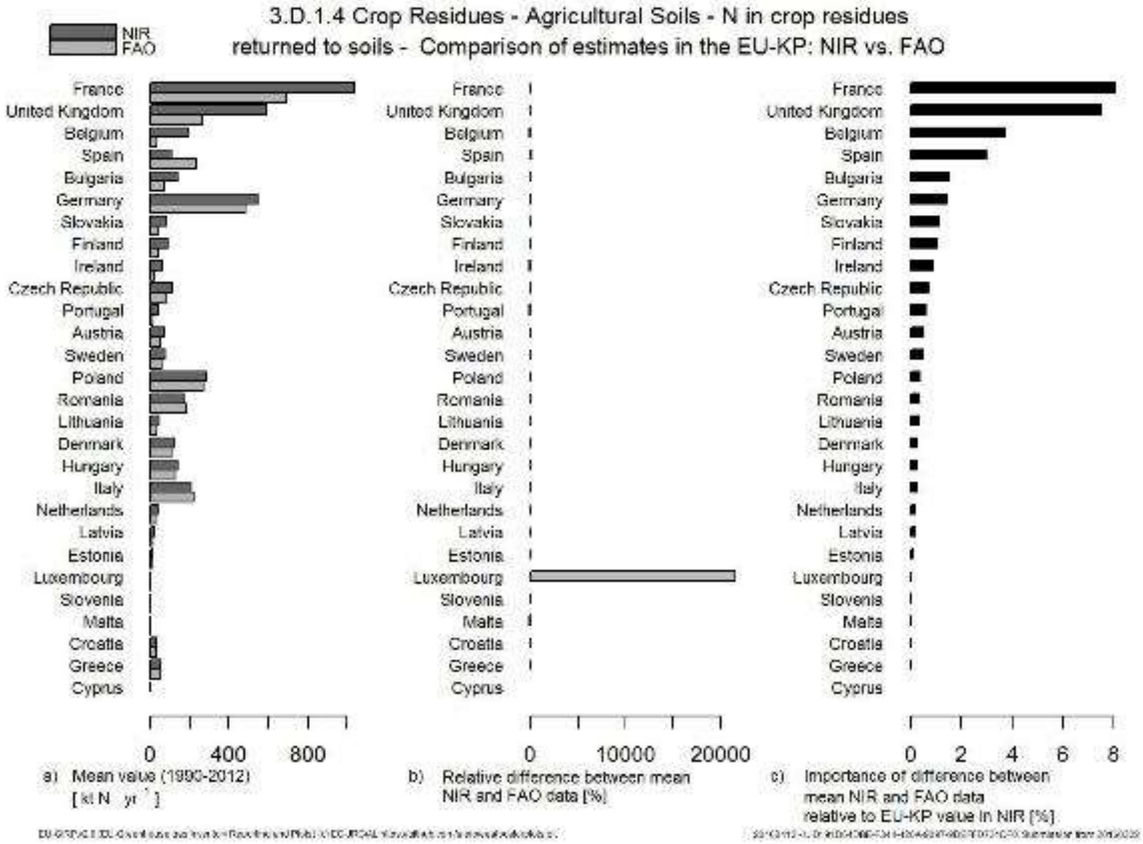


Figure 5.104 3.D: (a) Average Crop residues N input in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



5.5 Sector-specific recalculations, including changes in response of to the review process and impact on emission trend

Table 5.54 to Table 5.57 provide information on the contribution of Member States to EU-28+ISL recalculations in sectors 3A (CH_4), 3B (CH_4 and N_2O) and 3D (N_2O) for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 5.54 3A Enteric fermentation: Contribution of MS to EU-28+ISL Recalculations in CH_4 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	-1	0.0	Updated livestock data
Belgium	-208	-3.8	-161	-3.5	Flemish region: Revision of livestock and milk production (per cow) from 2007 on. Walloon region: Revision of livestock from 2013 and revision of the methane conversion factor (Ym) over the time series Brussels region: Revision of the methane conversion factor (Ym) over the time series
Bulgaria	-1 001	-18.3	-397	-21.3	Emissions recalculated for cattle due to implemntation of new values of digestibility of feed and CH_4 conversion factor.

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Croatia	-524	-20.9	156	18.6	Emissions were recalculated for the entire due to further improvents in Tier 2 methodology for emission calculation of all cattle categories (improvements in digestibility, methane conversion factors and milk yield parameters.)
Cyprus	-31	-12.9	-34	-13.0	Recalculations that took place have been caused by (a) the change of the daily weight gain, the % fat in milk and (b) the change of fat percentage in milk. The recalculations have affected the whole reporting period
Czech Republic	732	14.6	346	14.3	The emission factors for estimates of methane emissions from Enteric Fermentation of cattle (dairy and non-dairy) were recalculated following the revision of coefficient for calculating net energy for maintenance (Cfi) and cattle methane conversion factor (Ym). These changes generated new GE intake values and updated emission factors for estimation of methane emissions from enteric fermentation.
Denmark	156	4.1	131	3.8	Updated values for gross energy for dairy cattle
Estonia	1	0.1	0	0.0	An incorrect equation was corrected in the working tables.
Finland	-2	-0.1	-3	-0.1	Updated animal numbers (fur animals, swine) for 2013 and new EF for fur animals (time series recalculated).
France	-8	0.0	10	0.0	
Germany	0	0.0	-2	0.0	Slight update of animal numbers and of poultry animal mass
Greece	0	0.0	0	0.0	
Hungary	175	4.9	86	4.7	Country-specific methane conversion factor Ym for dairy and non-dairy cattle were recalculated based on a related publication (Soliva, 2006) for the whole time series.
Ireland	0	0.0	-8	-0.1	Updated activity data for replacement heifers.
Italy	0	0.0	-1	0.0	Update of number of rabbits.
Latvia	-60	-2.6	40	4.9	The number of non-dairy cattle is split down in new 7 sub-groups by characterizing specifics of dairy and beef production. Reporting in CRF is performed for 3 cattle groups below Option: B. New sub-groups are defined by implementing research results under 2009 - 2014 EEA Grants Programme National Climate Policy Pre-Defined Project "Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections". Distribution of MMS is recalculated for all livestock groups due to application of new methodology developed under research results mentioned above. As share of pasture for cattle is changed, also feeding situation is described differently, comparing to the previous submission. Cattle weight data are updated by national expert judgment based on Animal Breeders Association of Latvia Breeding Program results. Amount of milk production per day is adjusted to 305 lactation days. Deer is included in the inventory as a new animal category.
Lithuania	-17	-0.4	12	0.8	In order to increase consistency of used methodologies for calculation of emission from enteric fermentation, the gross energy intake of dairy cattle in the period 1990-2013 has been recalculated considering productivity of dairy cattle sub-categories (NIR Chapter 5.2.5, Table 5-28).The average weight of dairy cattle was changed due to updated

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					information.
Luxembourg	1	0.2	1	0.3	
Malta	4	18.6	3	9.5	Livestock characterisation carried out for sheep population, as well as amendments in cattle characterisation.
Netherlands	0	0.0	0	0.0	
Poland	0	0.0	438	3.7	Correction of swine population
Portugal	0	0.0	0	0.0	
Romania	0	0.0	22	0.2	Have been made changes since the latest submission due to of the errors of the livestock to non dairy cattle (Cattle between 1 and 2 years-for slaugther)
Slovakia	-18	-0.8	0	0.0	Implementation of national parameters and emission factors for animals.
Slovenia	0	0.0	-2	-0.2	Correction of data for daily weight gain in fattening cattle
Spain	-420	-3.2	-285	-2.4	Update of Ym values for sheep.
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	70	0.3	Due to a revision in the beef cow live weight data and also an update to the dairy cow milk yield data. Both these revisions lead to an increase in emissions. Also, some minor revisions to livestock numbers for minor categories.
EU28	-1 223	-0.5	421	0.2	
Iceland	14	4.7	14	5.2	
EU28+ISL	-1 209	-0.5	435	0.2	

Table 5.55 3B Manure Management: Contribution of MS to EU-28+ISL Recalculations in CH_4 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	50	9.2	42	10.5	Updated livestock data
Belgium	-553	-29.9	-594	-31.8	Flemish region: Revision of livestock and milk production (per cow) from 2007 on. Correction of the feed digestibility for swine. Walloon region: Revision of livestock from 2013
Bulgaria	-1 819	-47.0	-253	-49.6	Emissions recalculated for the entire time series due to revised estimates of VS excreted for swine.
Croatia	0	0.0	0	0.0	Error corrected
Cyprus	0	0.0	0	0.0	
Czech Republic	493	38.5	199	35.3	Updated CH_4 emission factor for cattle was recalculated following the adoption of Cfi and Ym parameters in accordance with 2006 IPCC GL.Emissions from pig manure were also updated, better fitting actual manure handling conditions in the country, and also for goats, horses and poultry

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Denmark	82	4.7	261	13.6	Updated MCF for cattle and swine. Following measurements and new data, CH_4 emissions from biogas treated slurry have been estimated, and in line with this work, updated MCF values for both untreated and biogas treated slurry have been calculated for cattle and swine slurry. Also B0 has been updated for all animal categories to be in line with IPCC 2006 GL. Updated statistics on animal numbers.
Estonia	38	35.4	15	21.2	An incorrect equation was corrected in the working tables in the cattle subcategory; new value of MCF was applied in the working tables for swine category in order to harmonize reporting with the IPCC 2006 GL.
Finland	0	0.1	-5	-1.0	Updated animal numbers (fur animals, swine) for 2013. Poultry VS updated and poultry AWMS (slurry) corrected.
France	-280	-5.3	-719	-13.0	Some corrections were done regarding: regional temperatures for the calculation of the MCF; sheep excretion factor modified according to IPCC 2006; emission factor for stocking poultry corrected
Germany	-1	0.0	-89	-1.4	Slight update of animal numbers and of poultry animal mass (with effect on VS excretion and B0 values); update of activity data for anaerobic digestion
Greece	0	0.0	0	0.0	
Hungary	-655	-36.1	-326	-34.0	Revised values of the B0 for non-dairy cattle, which were incorrect. Additionally, VS for swine was revised (formerly applied value for breeding swine was replaced by mvalue for market swine). MCF for dairy cattle liquid manure was recalculated, because fractions of natural crust cover were inconsistent between N_2O and CH_4 emission calculations. MCF for cattle, swine and poultry manure treated in anaerobic digesters was revised, and the formerly applied value was replaced with the values for liquid slurry.
Ireland	0	0.0	-1	-0.1	Updated activity data for replacement heifers.
Italy	0	0.0	-1	0.0	Update of number of rabbits.
Latvia	-219	-53.6	-43	-31.1	For emissions calculation from manure management, also the number of swine is split down in 3 sub-groups and Tier 2 methodology is implemented to calculate methane emissions from cattle. Distribution of MMS is recalculated for all livestock groups due to application of new methodology developed under research results mentioned above. Also a new animal category as deer is included in the inventory. MCF value 2 for anaerobic digester is implemented in the inventory, according to TERT recommendations after the EU ESD voluntary review in 2015.
Lithuania	-126	-18.4	-40	-14.6	For dairy cattle category due to division of dairy cattle category into two sub-categories methane emission factors were recalculated. For non-dairy cattle category, the animal population in sub-categories were updated because the grouping has been revised and errors have been corrected. For swine category new methane producing capacity (B0) factor was used. Therefore, methane emission factor and methane emission were changed. Recalculated CH_4 emissions for all animals category from manure management.
Luxembourg	0	0.0	0	0.0	
Malta	-13	-45.8	-13	-49.9	Changes in the characterisation of sheep and cattle population. In addition, Tier 2 methodology was

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					apllied to methane emissions from cattle, swine and poultry.
Netherlands	-10	-0.2	-1	0.0	Recalculations are performed on manure management of partial grazing systems of dairy cattle. A new calculation method is used from Ogink et al. (2014) from 2002 onwards. Furthermore the amount of time spent grazing per day is adjusted from 10 to 8 hours per day from 2006 onwards.
Poland	-523	-18.7	-283	-15.3	Correction VS for market swine according to IPCC 2006, correction of population of fur animals and poultry
Portugal	-27	-1.9	-31	-2.6	Update of the allocation of livestock population at each climate region with the last climate normals and the last agriculture census and update of poultry and rabbit population with the data of the last Farm Survey (2013)
Romania	0	0.0	1	0.0	Have been made changes since the latest submission due to of the errors of the livestock to non dairy cattle (Cattle between 1 and 2 years-for slaugther)
Slovakia	55	9.9	25	13.9	Implementation of national parameters and emission factors for animals.Time series for poultry implied emission factor was recalculated for 1990 - 2014 with the consistent methodology and weighted average of EF based on poultry subcategories using the IPCC 2006 GL.
Slovenia	-82	-19.3	-23	-8.7	Factor for density of methane (0.67 kg/m3) has been included in the calculation for all animal types except cattle. Mistake in the proportion of cattle manure treated in anaerobic fermenters was eliminated, data for daily weight in fattening cattle were corrected, the number of poultry number was corrected according to latest version of SORS report, data on the number of other chickens were not used in previous submission (by mistake)
Spain	0	0.0	3	0.0	Update of MCF values for Tier 1 livestock categories to new IPCC 2006. Update of poultry population for 2012.
Sweden	0	0.0	0	0.0	
United Kingdom	-7	-0.1	0	0.0	Minor revisions to AWMS timeseries, dairy cow milk yield, livestock numbers, cattle live weights.
EU28	-3 598	-6.1	-1 877	-4.1	
Iceland	34	199.8	42	940.2	

Table 5.56 3B Manure Management: Contribution of MS to EU-28+ISL Recalculations in N_2O for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	-15	-3.4	-12	-2.8	New emission factor (2006 IPCC) and new data on agricultural practice used in the mass-flow model from EMEP/CORINAIR
Belgium	-6	-0.6	10	1.4	Flemish region: Revision of livestock and milk production (per cow) from 2007 on. Correction of the feed digestibility for swine. Update of NH_3-emissions from indoor stable from 2007 on. Walloon region: Revision of livestock from 2013

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Bulgaria	296	33.5	83	23.1	Direct N_2O emissions recalculated for the entire time series due to revised estimates of Nex rate for mature non-dairy cattle. Indirect N_2O emissions recalcuated due to corrections of technical mistakes.
Croatia	0	0.0	0	-0.2	Error corrected
Cyprus	-252	-77.7	-184	-72.7	Revised calculations have been made for N_2O emissions from sheep, swine and goats for the whole time series due to the fact that the sum of manure excretion over the different MMS did not match the total N excreted by animals. In addition, N_2O emissions per technology and per animal has been revised due to a mistake in tthe conversion of N_2O-N to N_2O.
Czech Republic	329	11.0	52	4.3	Updated Nex values for cattle were used. Due to application of the national TAM for other than cattle categories, the country-specific Nex values were developed.
Denmark	1	0.1	-4	-0.5	Updated statistics on animal numbers.
Estonia	-15	-9.7	-6	-8.3	N_2O EF was revised for pig slurry, in the 2016 submission Estonia applied the value of 0 kg N_2O-N (kg N ex)-1 in order to estimate N_2O emissions from pig slurry management.
Finland	0	0.0	-3	-1.1	Updated animal numbers (fur animals, swine) for 2013. Poultry VS updated and poultry AWMS (slurry) corrected.
France	-316	-10.0	-296	-11.4	Some corrections were done regarding: regional temperatures for the calculation of the MCF; sheep excretion factor modified according to IPCC 2006; the quantity of straw used in the livestock buildings has been corrected, having an impact on the calculation of NH_3 and N_2O emissions; emission factor for stocking poultry corrected
Germany	-29	-0.6	-55	-1.4	Slight update of animal numbers
Greece	0	0.0	0	0.0	
Hungary	60	7.4	36	9.0	Nex for rabbits was revised due to an error, . Indirect N_2O emissions from N losses due to volatilisation were revised due to the revision of NH_3 and $_X$ emissions from 3.B in the CLRTAP inventory.
Ireland	-18	-3.7	-17	-3.2	Revision in the emission factor associated with NH_3 emissions from dairy collecting yards.
Italy	0	0.0	-1	0.0	Update of number of rabbits and correction of the nitrogen excretion rate of sows.
Latvia	18	6.0	-9	-8.4	Nitrogen excretion values are changed for cattle, poultry and swine according to ERT review results. The amount of manure nitrogen that is lost due to volatilization of NH_3 and $_X$ is assigned to Tier 2 approach, according to TERT suggestion after EU ESD voluntary review in 2015. A new animal category as deer is included in the inventory.
Lithuania	-5	-1.0	1	0.4	Nitrogen excretion rates were recalculated due to updated protein consumption for dairy-cattle and for non-dairy cattle category due to updated the animal numbers in sub-categories and due to recalculated Net energy for growth. As a result of recalculated N excretion and N_2O emissions have changed. After recalculating N excretion and revising percent of manure nitrogen losses due to run-off and leaching during solid storage of manure, the indirect N_2O emission has also changed.
Luxembourg	-6	-13.9	-5	-12.1	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Malta	5	79.8	6	93.5	N_2O emissions from swine manure management were revised to apply a Tier 2 methodology. Defaut Efs for direct emissions were applied to all livestock categories and reflect the manure management system.
Netherlands	396	74.7	213	50.8	Recalculations are performed on manure management of partial grazing systems of dairy cattle. A new calculation method is used from Ogink et al. (2014) from 2002 onwards. Furthermore the amount of time spent grazing per day is adjusted from 10 to 8 hours per day from 2006 onwards.
Poland	0	0.0	63	3.2	Correction of population of fur animals and poultry
Portugal	4	1.7	-11	-5.5	Update of the livestock allocation by climate region (with the last climate normals and the last agriculture census). Update of poultry and rabbits populations with the data of the last Farm Structure Survey (2013); revision of N amounts from animal bedding straws for the livestock categories where a percentage of animals is managed in pasture as a result of a QA/QC procedure.
Romania	0	0.0	1	0.1	Have been made changes since the latest submission due to of the errors of the livestock to non dairy cattle (Cattle between 1 and 2 years-for slaugther)
Slovakia	-492	-39.5	-182	-40.8	Implementation of national parameters and emission factors for animals. Nex for horses, poutry and indirect emissions were recalculated in 1990 -2013 using national value reported in 2014.
Slovenia	0	0.0	0	0.0	The number of poultry number was corrected according to latest version of SORS report
Spain	490	37.9	744	49.2	Update of Nex of horses and emission factors according to IPCC 2006. Indirect emissions are included.
Sweden	99	37.9	85	34.3	Reallocation of indirect EM from 3.D to 3.B
United Kingdom	-532	-23.0	-371	-20.4	Default FracGasMS values replaced by country-specific values. Also minor revisions to AWMS timeseries, milk yield, livestock numbers.
EU28	9	0.0	136	0.6	
Iceland	-89	-63.9	-75	-64.5	
EU28+ISL	-80	-0.3	61	0.3	

Table 5.57 3D Agricultural Soils: Contribution of MS to EU-28+ISL Recalculations in N_2O for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	111	5.4	124	7.1	New emission factor (2006 IPCC); new source (compost applied); revised calculation (crop residues)
Belgium	605	15.9	458	16.4	Flemish region: Revision of livestock and milk production (per cow) from 2007 on. Update of NH_3-emissions from manure application on land, fertilizer use and emissions from grazing animals from 2007 on. Change of region specific FracLEACH to FracLEACH=0.30, default 2006 IPCC Guidelines. Walloon region: Revision of livestock from 2013; Change of FracLEACH = 0 to FracLEACH=0.30, default 2006 IPCC Guidelines.

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					Brussels region: Change of FracLEACH = 0 to FracLEACH=0.30, default 2006 IPCC Guidelines.
Bulgaria	-534	-9.5	93	3.0	Direct N_2O emissions recalculated for the entire time series due to implementation of new estimates for nitrogen from crop residues returned to soils and nitrogen input of manure applied to soils according to IPCC 2006 GL. Indirect emissions have been recalculated for the entire time series due to implementation of new estimates for FracGASF.
Croatia	-68	-4.4	-40	-3.7	Emissions were recalculateddue to replacing FAO activity data on harvested area of crops with national sources (CBS) and updating the AD on crop yield with new CBS values. In addition, FSOM emissions are now reported under this category.
Cyprus	68	81.9	96	392.7	Changes in emissions are due to changes in crop production data by crop and in cultivated area data by crop (from Eurostat) and to changes in data source regarding the annual amount of synthetic fertiliser N applied to soil.
Czech Republic	243	4.6	56	1.9	Updated N_2O emissions from manure applied to soils and pastures due to the revision of input parameters of livestock. Changes in direct emissions resulted in changes of indirect emissions, too.
Denmark	1	0.0	0	0.0	Updated statistics on crop areas and yields.
Estonia	2	0.2	0	0.0	Cultivation of organic soils data on areas of organic soils cultivated were updated in the framework of the NFI. The emission estimates under the subcategory Mineralization/immobilization associated with loss/gain of soil organic matter were revised and corrected to NO for the whole timseries.
Finland	-10	-0.3	19	0.6	Animal numbers (fur animals, swine) updated for year 2013, crop residue correction (amount of bedding), poultry bedding updated; area of organic soils updated, C stock change of mineralisation updated. Error correction.
France	-2 678	-6.8	-2 454	-6.8	Two calculation errors have been corrected, affecting pastures and indirect emissions linked to run-off. Emissions related to the mineralisation of soils for land becoming cropland have been moved to the land use sector. Indirect emissions linked to redeposition have also been modified following adjustments on the ammonia emissions.
Germany	-310	-1.1	382	1.5	Changes in emissions from cultivated histosols due to updated activity data, and the application of anaerobic digestate due to updates of the quantity of energy crops.
Greece	0	0.0	0	0.0	
Hungary	274	7.8	255	8.7	Recalculations of: 3.D.1.2.1 Animal manure applied to soils, mainly due to changes in Nex rate from rabbits; 3.D.1.4 Crop residues due to changes in N added to soild for some crops; 3.D.2.2 Nitrogen leaching and run-off, because of the revision of irrigated areas.

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Ireland	-593	-8.3	-34	-0.5	Revision of the emission factor associated with NH_3 emissions from dairy collecting yards leads to an increased quantity of N available for losses downstream in the manure management chain, therefore increased losses from manure applied to soils and indirect losses from atmospheric deposition and leaching. Revised approach to the estimation of lands used for cropland and grassland resulting in recalculation of emissions associated with the mineralisation of organic soils, also leading to changes in indirect emissions from leaching.
Italy	3	0.0	1	0.0	Update of the area of organic soils for the entire time series. In 2013, updated number of rabbits and corrections of Nex rate of sows, and also update of cultivated surface and production of some cereals, legumes, industrial crops, horticultural and forage crops.
Latvia	156	7.2	342	27.6	Recalculations are done due to the implementation of new emission factor for emission estimation from organic soils defined by 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) methodological issues. This is done to reach consistent reporting of emissions with LULUCF sector. Updated organic soil areas are including in the inventory, based on information from LULUCF sector. Values of organic soils area are updated for 2009-2013. Dry matter fraction values and grassland area was updated for emission calculations from crop residue, based on the revision of current estimation and suggested technical corrections. Recalculations also are affected by implementation of new methodology to determine MMS and the share of grazing animals.
Lithuania	-654	-21.1	-655	-27.1	3.D.1.2.a Animal manure applied to soils sub-category N amounts that arise from bedding materials was excluded from estimation in relation to double accounting. In 3.D.1.5 Mineralized N resulting from loss of soil organic C stocks in mineral soils sub-category emissions from LUC and cropland remaining cropland were reported, as was clarified that only cropland remaining cropland N_2O emissions should be reported in Agriculture sector the mistake was corrected. Forest land area was included in 3.D.1.6 Cultivation of Organic soils sub-category estimates, also Cropland organic area and Grassland organic area data from LULUCF sector was taken for the estimation of emissions. As it was clarified that Cropland remaining Cropland and Grassland remaining Grassland organic soil areas should be taken for the emission estimates, the mistake was corrected.
Luxembourg	-12	-6.0	-11	-6.8	Revised fraction of livestock N excreted and deposited onto soil during grazing (FracPRP) following revised AWMS shares for cattle. Revised Nex rate due to revised activity data for horses.
Malta	13	80.4	11	62.2	Nitrous oxide emissions from swine manure management were revised to apply a Tier 2 methodology. Default emission factors for direct emissions from manure management were applied to all livestock categories and reflect the manure management system. Changes have been applied in the estimation of inorganic nitrogen applied through

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					synthetic fertilisers. Nitrogen inputs through crop residues have been evaluated through areas of production and yield.
Netherlands	-401	-4.2	-286	-5.4	An error correction is performed on the N_2O emission from animal manure applied to agricultural soils. The N_2O emissions from crop residues are recalculated based on new information on N-content of crops. The 2013 emissions from sewage sludge were recalculated as new data were available.
Poland	1	0.0	85	0.6	Correction of population of fur animals and poultry, F-SOM emissions corrected
Portugal	-22	-0.9	-46	-2.1	Revision of 2013 values for apparent consumption of N synthetic fertilizers, updated by INE; update of poultry and rabbits populations with the data of the last Farm Structure Survey (2013); revision of N amounts available for application to the soil as a result of the revision of N amounts from animal bedding straw; revision of the estimates of N available from manure applied to soil exclusively from poultry category due to an error on the calculation formula (QA/QC procedure).
Romania	-1 403	-15.8	-812	-16.5	Have been made changes since the latest submission due to of the errors of the livestock (Cattle between 1 and 2 years-for slaugther); Have been made recalculation at the level N_2O Indirect emissions from N leaching/Runoff from Managed Soils; because there is not the data for the calculation of the N_2O emissions from N leaching from all AWMS not in Managed soils are not calculated.
Slovakia	-458	-13.0	-218	-12.0	Due to recalculations in the categories 3.B.2.4, recalculations in nitrogen applied to soils also in the category 2.D.1.3 were necessary. Values of volatilized nitrogen in agricultural input included in the CRF Reporter were corrected.
Slovenia	2	0.5	2	0.6	Emissions due to deposition of $_X$-N which results from application of animal manures and grazing activities were added
Spain	-4 760	-27.5	-4 445	-25.9	Adaptation to IPCC 2006 GL (all emission factors and volatilisation fractions).
Sweden	11	0.3	10	0.3	(i) FRACrenew changed from 1 to 5 year for temporary grass, (ii) updated EF for N_2O from histosols and new areas from the national forest inventory, (iii) reallocation of indirect EM from 3.D to 3.B
United Kingdom	-6 362	-27.5	-5 636	-28.9	Default EF1 (0.01), EF3 (cattle and sheep), FracGasF, FracGasM and FracLossMS, FracLeach (0.30) have been replaced by country specific values. Revised activity data for urea and UAN use as part of ensuring consistency with the ammonia inventory. Also minor revisions to AWMS, milk yield, livestock numbers, crop production, mineralisation data.
EU28	-16 776	-7.8	-12 704	-7.3	
Iceland	-183	-33.3	-179	-35.7	
EU28+ISL	-16 959	-7.9	-12 884	-7.4	

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) greenhouse gas (GHG) inventory is a compilation of the inventories submitted by individual Member States (MS). Submissions by MS in 2016 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 and it includes the information from Iceland. It provides information on the methods used by different MS, and describes the efforts carried out to harmonize and improve the quality of the EU GHG inventory. More detailed information can be found in individual national inventory reports (NIR) and common reporting format tables (CRF) submitted by MS.

In particular, this chapter includes: an overview of LULUCF sector including overall trends, the contribution of land use changes, the completeness reporting of the sector by individual MS, the key categories analysis of the EU GHG inventory, general methodological information used to derive GHG emissions by sources and removals by sinks, the trends of net emissions and activity data for each land use category, 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

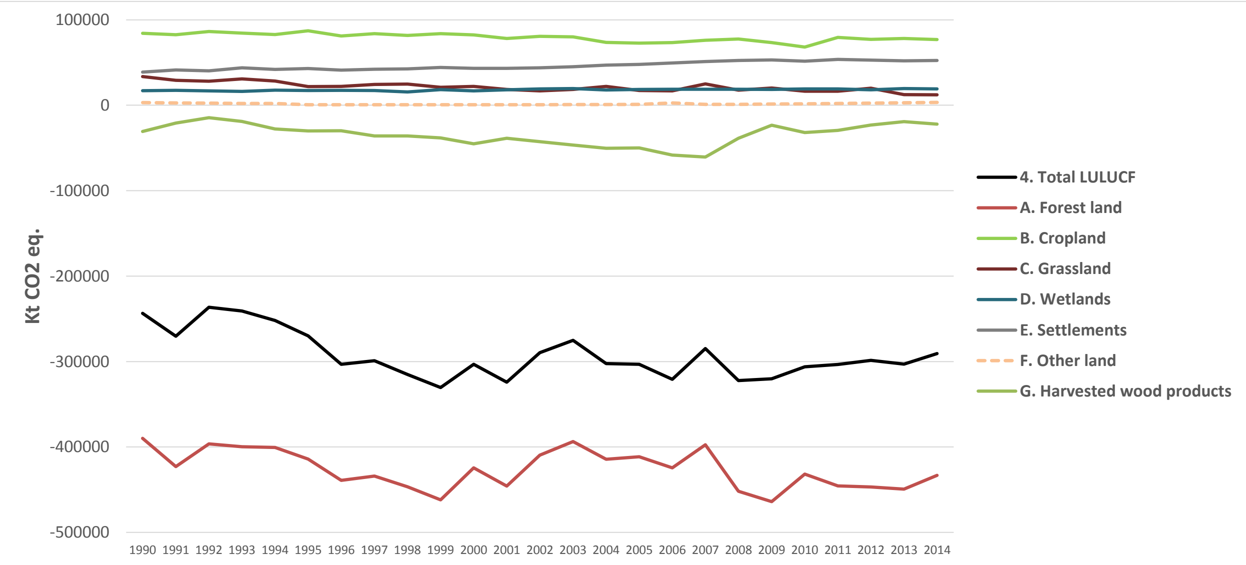
With almost all lands under more or less intensive management, Europe is a fine-grained mosaic of different land uses, resulting in a highly fragmented landscape. The EU agricultural and environmental policies have been the major driver of land use and land use changes in Europe especially since 1990. 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 about 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 within the EU GHG inventory is a net carbon sink resulting from higher removals by sinks than emissions by sources. In terms of land use categories the only carbon sink is represented by Forest land. Cropland is the larger source of emissions, and Grasslands, along with the other land use categories, represents a small source of emissions. In 2014, LULUCF sector of the EU MS + ISL results in a total net sink of -290.618 kt CO_2eq which corresponds to an increase of about 20% as compared to the net carbon sink reported for the year 1990 (Figure 6.1). Harvested Wood Product carbon pool in 2014 is reported as a net carbon sink of - 22.078 kt CO_2eq. Emissions of CH_4 and N_2O offset about 4% of total annual removals.

Within the EU, few MS also reported in the CFR table 4, under the category "Other", additional emissions of GHG. For instance, France reports CO_2 and CH_4 emissions from Reservoir of Petit-Saut in French Guiana, and biogenic NMVOC emissions from managed forest.

Figure 6.1 Sector 4 LULUCF: EU + ISL GHG net emissions (+) / removals (-) for 1990–2014, in CO_2 eq. (kt).



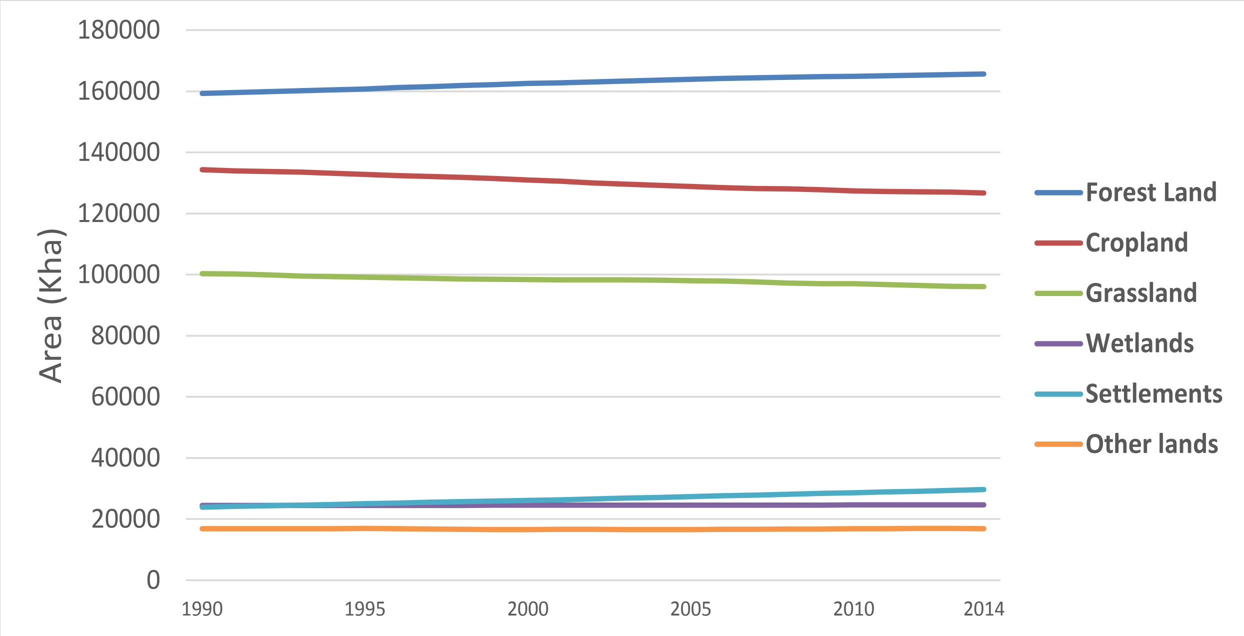
Source: MS submissions 2016, CRF Table10s1

The overall trend of the LULUCF sector since 1990 is mainly affected by the Forest Land category.

An increase of the forest carbon sink took place during the 90s mainly due to forest area expansion, which has been followed by a decline, largely attributable to a general increase in harvest rates. In the late 2000s harvest rate decreased and the sink increased again. Inter-annual variations are mainly related with natural disturbance events. For instance, major wind storms in central-western Europe (e.g. 2000, 2005 and 2007) and wildfires (e.g. forest fires in 1990, 2003 and 2007) in Mediterranean countries. However, in some specific years the methods implemented by MS had also an impact in the EU trend. For instance, the decrease of the forest carbon sink in 2002 is due to a drop in the carbon sink reported by Germany in the subcategory 4A1, which takes place in a single year due to the stock-difference method used. It resulted in a reduction by half of its carbon sink.

The total reported land area of the different land use categories in 2014 by EU MS and Iceland is 459.521 kha. The trend on these reported areas (Figure 6.2) confirms the trends known from other EU statistics (e.g. Eurostat). Nevertheless, absolute numbers may slightly differ due to different definitions used that are linked to each of the different reporting requirements. The main changes in areas reported under each land use categories for 2014 as compared to 1990 are in Settlements (+24%), Croplands (-6%), Forest land (+4%), Grassland (-4%), Wetlands (+1%). Other lands (c.a. 0%).

Figure 6.2 Total area for each of the land use categories (kha), as reported in EU MS and ISL GHGI 2014.



Despite the LULUCF sector is a sink in 2014 at the level of EU + plus Iceland, the LULUCF estimates reported by individual MS inventories range from sources (e.g. Netherlands, Latvia, Ireland, Iceland) to small sinks (e.g. Malta, Cyprus, Luxembourg, Estonia) or large sinks (e.g. France, Finland, Sweden) (Table 6.1). Compared to 1990, some MS reports large increase in their sink (e.g. UK, Lithuania) whiles other reported a substantial reduction (i.e. Austria, Germany).

Table 6.1 Sector 4 LULUCF: MS' contributions to net CO_2 removals in 2014 (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	-12 868	-5 220	-5 577	2%	-357	-7%	7 291	57%
Belgium	-2 348	-3 865	-3 854	1%	10	0%	-1 506	-64%
Bulgaria	-14 970	-10 193	-11 339	4%	-1 146	-11%	3 631	24%
Croatia	-6 617	-6 327	-5 874	2%	453	7%	743	11%
Cyprus	-614	-652	-652	0%	1	0%	-38	-6%
Czech Republic	-6 606	-7 994	-7 878	3%	116	1%	-1 272	-19%
Denmark	6 205	2 237	1 308	0%	-929	-42%	-4 897	-79%
Estonia	-8 128	-656	-584	0%	71	11%	7 544	93%
Finland	-18 833	-22 511	-22 956	7%	-445	-2%	-4 123	-22%
France	-34 264	-56 974	-54 122	17%	2 851	5%	-19 858	-58%
Germany	-32 985	-16 025	-16 689	5%	-664	-4%	16 297	49%
Greece	-2 346	-3 166	-3 247	1%	-81	-3%	-901	-38%
Hungary	-3 371	-3 501	-4 858	2%	-1 357	-39%	-1 488	-44%
Ireland	5 837	4 143	4 451	-1%	308	7%	-1 386	-24%
Italy	-8 552	-31 739	-27 693	9%	4 046	13%	-19 141	-224%
Latvia	-9 305	152	3 133	-1%	2 982	1968%	12 439	134%
Lithuania	-4 014	-9 971	-8 498	3%	1 473	15%	-4 485	-112%
Luxembourg	48	-542	-463	0%	78	14%	-511	-1075%
Malta	-3	-3	-3	0%	0	1%	0	-10%
Netherlands	6 075	6 193	6 245	-2%	51	1%	170	3%
Poland	-27 517	-36 421	-28 175	9%	8 247	23%	-658	-2%
Portugal	1 003	-8 889	-10 392	3%	-1 502	-17%	-11 395	-1136%
Romania	-20 715	-20 077	-20 102	6%	-26	0%	612	3%
Slovakia	-9 078	-8 102	-6 166	2%	1 935	24%	2 912	32%
Slovenia	-4 231	-6 899	-6 911	2%	-11	0%	-2 680	-63%
Spain	-25 804	-32 472	-31 965	10%	507	2%	-6 162	-24%
Sweden	-38 540	-44 001	-46 856	15%	-2 855	-6%	-8 316	-22%
United Kingdom	-853	-9 383	-9 725	3%	-341	-4%	-8 872	-1040%
EU-28	**-273 395**	**-332 857**	**-319 443**	**103%**	**13 414**	**4%**	**-46 048**	**-17%**
Iceland	7 694	7 987	7 980	-3%	-7	0%	286	4%
EU-28 + ISL	**-265 701**	**-324 870**	**-311 463**	**100%**	**13 407**	**4%**	**-45 762**	**-17%**

Overall, at EU level, in the year 2014 the LULUCF sector offsets 7% of the total emissions from other sectors ("Total without LULUCF"), with significant differences among MS (Table 6.2, column a). Forest Land category is the most important driver within the LULUCF sector, offsetting about 10% of total emissions from other sectors. In 2014 this category resulted, in terms of CO_2 equivalent, a net sink for all the MS with the exception of Latvia (Table 6.2, column b). The most significant contributors to the total net sink reported under the category 4A at EU level are France, Germany and Sweden (Table 6.2, column c).

Table 6.2 Sector 4 LULUCF: Contribution of Sector 4 (column a) and category 4A (column b) to total MS emissions (without LULUCF); and MS contribution to total EU category 4A (column c)

Member States	LULUCF over total inventory excluding LULUCF	Category 4A over total inventory excluding LULUCF	MS contribution to total EU category 4A
	(a)	(b)	(c)
Austria	-7.3%	-5.7%	1.0%
Belgium	-3.3%	-3.5%	0.9%
Bulgaria	-19.5%	-18.3%	2.4%
Croatia	-24.0%	-26.8%	1.5%
Cyprus	-7.8%	-7.8%	0.2%
Czech Republic	-6.3%	-5.9%	1.7%
Denmark	3.1%	-7.4%	0.9%
Estonia	-2.7%	-6.0%	0.3%
Finland	-35.2%	-47.0%	6.4%
France	-10.9%	-15.0%	16.1%
Germany	-1.7%	-6.4%	13.4%
Greece	-3.2%	-2.3%	0.5%
Hungary	-8.4%	-7.8%	1.0%
Ireland	9.0%	-5.4%	0.7%
Italy	-6.4%	-8.1%	7.8%
Latvia	37.4%	6.6%	-0.2%
Lithuania	-42.5%	-51.4%	2.3%
Luxembourg	-4.3%	-5.0%	0.1%
Malta	-0.1%	-0.1%	0.0%
Netherlands	3.4%	-1.4%	0.6%
Poland	-7.4%	-9.1%	8.0%
Portugal	-15.6%	-20.7%	3.1%
Romania	-16.6%	-23.2%	5.9%
Slovakia	-15.1%	-11.3%	1.1%
Slovenia	-41.6%	-44.7%	1.7%
Spain	-9.6%	-10.4%	7.9%
Sweden	-72.4%	-74.7%	10.7%
United Kingdom	-1.7%	-3.3%	4.0%
EU 28	**-7.0%**	**-10.1%**	**100%**
Iceland	258.2%	-6.3%	0.1%

Source: MS submissions 2016, CRF Table10s1 and Table10s6.

6.1.2 Contribution of land use changes

The conversion of lands at the level of EU + ISL in the year 2014 results in a net source of CO_2 emissions of 15.584 kt CO_2 (Table 6.3). Entire land use change area represents 9% of the total reported land area in EU + ISL. The carbon sink resulting from conversions to Forest Land and Grasslands is balanced by emissions from conversions to Cropland and Settlements.

Table 6.3 Contribution of land use changes in 2014 for EU +ISL, 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]
4A2. Land converted to Forest Land	8,336	5%	-53,535	12%
4B2. Land converted to Cropland	10,572	8%	44,755	63%
4C2. Land converted to Grassland	13,489	14%	-25,800	409%
4D2. Land converted to Wetlands	1,442	6%	1,049	7%
4E2. Land converted to Settlements	6,551	22%	47,014	94%
4F2. Land converted to Other Land	1,169	7%	2,100	100%
Total land use changes	**41,559**	**9%**	**174,253**	**27%**

[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.
Source: submissions 2016, CRF 4A-4F.

On average, in 2014, from total area under conversion, 32% is conversion to Grassland, 25% is conversions to Cropland, 20% is conversions to Forest land, 16 % is conversions to Settlements, and 3% conversions to Wetlands and 3% conversions Other lands respectively.

6.1.3 Completeness of the sector

Table 6.4 illustrates the current coverage of reporting for each of the land use sub-categories in the year 2014. The three main land uses categories, Forest Land, Cropland and Grassland, including their land use changes sub-categories, are in most of the submissions fully covered. However, under certain subcategories, there are still some gaps that are mainly associated with the lack of IPCC methods for estimating GHG emissions (e.g. Flooded land remaining flooded land, under Wetlands), the assumption of equilibrium under Tier 1 methods (e.g. Living biomass under Grassland remaining grassland) or the absence of land conversions to certain subcategories.

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 2014, as derived from individual 2016 GHGI submissions

MS	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	4.A.1. F-F	4.A.2. L-F	4.B.1. C-C	4.B.2. L-C	4.C.1. G-G	4.C.2. L-G	4.D.1. W-W	4.D.2. L-W	4.E.1. S-S	4.E.2. L-S	4.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		R
Croatia	R	R	R	E	E	R		E		E		
Cyprus	R											
Czech Republic	R	R	R	E	R	R		E		E		E
Denmark	R	E	E	R	E	E	E	R		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	R	E	E	E	E		
Greece	R	R	R	E	E	R		E		E		E
Hungary	R	R	R	E	R	R	R	E		E		E
Ireland	R	R	R		E	E	E	E		E		E
Italy	R	R	E	E	R	R				E		
Latvia	E	R	E	E	E	R	E		R	E		
Lithuania	R	R	E	E	E	R	E	E		E		E
Luxembourg	R	R	E	E		R		E		E		E
Malta	R		R									
Netherlands	R	R	E	E	E	E	R	E	E	E		E
Poland	R	R	E	R	E	R	E		R	E		
Portugal	R	R	R	E	R	E		E		E		R
Romania	R	R	R	E	R	E		E		E		E
Slovakia	R	R	R	E		R				E		E
Slovenia	R	R	R	E		E		E	R	E		E
Spain	R	R	R	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		E
Iceland	R	R	E	E	E	E	R	E		E		

R = Carbon stock changes in the pool result in net Removals;
E = Carbon stocks change in the pool results in a net Emissions
Empty cells = the pool was not reported, included elsewhere or reported with no net carbon stock changes.

Overall, the reporting of Wetlands, Settlements and Other lands categories involves lower tiers methods in comparison to the major land use categories. Carbon stock changes in “land remaining in the same category” are often assumed in equilibrium for these land use categories while, if land use changes take place in these categories, there is a quite complete reporting on emissions and removals on such conversions.

Table 6.5 shows with more detail the completeness reporting on carbon stock changes by carbon pools for the three most important land use categories for the year 2014. Compared to the previous years, several MS have increased the number of carbon pools estimated and reported. As for Table 6.4, empty cells in Table 6.5 represent carbon pools which are not reported with quantitative estimates (i.e. in some cases based on Tier 1 assumptions and in some cases providing also demonstration that they are not a net source of emissions). Further, whenever empty cells are associated with issues affecting the completeness, MS reported in their individual submissions information on the ongoing efforts aiming to prepare estimates for these pools in future submissions.

Table 6.5 Sector 4 LULUCF: Reporting on carbon pools for the most important land use sub-categories for the year 2014

MS	Reporting category																							
	Forest land								Cropland								Grassland							
	4.A.1. F-F				4.A.2. L-F				4.B.1. C-C				4.B.2. L-C				4.C.1. G-G				4.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		E		E		E						R		R	
Croatia	R				R		R		R		R	E	R		E					E	E		R	
Cyprus	R																							
Czech Rep	R				R	R	R		E		R		E	E	E				R		E	E	R	
Denmark	R	R		E	E	R	R	E	E		E	E	R		R		E			E	E	E	E	E
Estonia	E	E	R	E	R	R	E	E	E		R	E	E	E	E	E	R	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		E								R	E	E	E		E
Italy	R	R			R	R	R		E			E			E		R	R		E	E		R	
Latvia	R	R		E	R	R		E	R	R		E	E	E	E	E	R	R		E			R	E
Lithuania	R	R			R	R			R		R	E	E		E	E				E	R		R	E
Luxembou	R				R	R	R		E		R		E	E	E						E	E	R	
Malta	R								R															
Netherland	R	R			R		E	E				E	E	E	E	E			R	E	E	E	R	E
Poland	R		R	E	R		R	E	R		E	E			R				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	E	E	E		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	R	
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	R		E	E	E	E	E	E	E		R		E	E	R	E
Iceland	R			E	R	R	R	E				E	E		R	E	R	R	R	E	R	R	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 quantitatively reported because it is: assumed "in balance" (i.e. following IPCC tier 1), demonstrated to be not a net source of emissions, or the pool is not present (i.e. absence of organic sols under certain land use categories)

Source: MS submissions 2016, CRF table 4A-4C

6.1.4 Data and methods

This section provides an overview of the information on methods and data used by individual MS for reporting on emissions by sources and removals by sinks from the three main land use categories. More 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 not common 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. The underlying assumption of the EU GHG inventory is that the implementation of country-specific definitions and methods that reflect specific national circumstances (as long as that they are in accordance with IPCC) is likely to result in more accurate GHG estimates than the implementation of a EU wide single approach.

Table 6.6 is a summary of relevant information on methodologies applied for each individual carbon pool in the GHG inventory 2016, for the three main land use categories of the LULUCF sector. Usually, for reporting "lands remaining in the same category", a single data source is used, which facilitate the categorization of the methodologies under a single tier method. By contrary, multiple data sources are often used to derive emissions from “land converted to” which prevents this categorization (e.g. for estimating GHG emissions of living biomass carbon pool from forest land converted to cropland, often, MS implement country-specific values for forest land and default factors for cropland).

Because of different underlying methods applied by each MS, and due to 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, (i) the gain-loss and stock-difference methods may lead to different trends in the short term or (ii) the resulting implied carbon stock change factors may be significantly affected by new areas entering in a given category or, (iii) time series for land under conversions do not sum up for each reported year a 20-years transition period (e.g. datasets on land conversions started in 1990 or 1970). Furthermore, the fact that not all MS use the 20-year default transition period for estimating C stock changes in C pools under land conversions suggests that the corresponding carbon stock change factors may be 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 2016 submissions.

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org	LB	DOM	SOC Min	SOC Org
		(1)		(2)				(2)			(3)	(2)	(4)			(2)			(3)	(2)				(2)
AT	CS	CS,CS	CS	NO	CS	CS	CS	NO	CS	D	CS	NO	CS,CS	CS	CS	NO	D	D	CS	CS	CS	CS	CS	NO
BE	CS	CS,CS	CS	NO	CS	D	CS	NO	CS	D	CS	D	CS,NO	CS	CS	NO	D	D	CS	D	CS	CS	CS	NO
BG	CS	D,D	D	NO	CS	CS	CS	NO	D	D	CS	NO	CS,CS	NO	CS	NO	D	D	NO	NO	CS	NO	CS	NO
CY	D	D,D	D	NO	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CZ	CS	D,D	D	NO	CS	D	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO	D	D	CS,D	NO	CS	CS	CS	NO
DE	CS	CS,CS	CS	CS	CS	CS	CS	CS	NO	D	NO	CS	CS,CS	CS	CS	CS	CS	D	CS	CS	CS	CS	CS	CS
DK	CS	CS,CS	D	CS	CS	CS	CS	CS	CS	D	CS	CS	CS,CS	CS	CS	CS	CS	D	NO	CS	CS	CS	CS	CS
EE	CS	CS,D	CS	CS	CS	CS	CS	CS	CS	D	CS,D	D	CS,CS	CS	CS	CS	CS	CS	CS,D	CS	CS	CS	CS	CS
ES	CS	D,D	D	NO	CS	CS	CS	NO	CS	D	CS,D	NO	CS,CS	CS	CS	NO	D	D	NE	NO	CS	CS	CS	NO
FI	CS	CS,CS	CS	CS	CS	CS	CS	CS	CS	D	CS	CS	CS,CS	CS	CS	CS	CS	D	NO	CS	CS	CS	CS	CS
FR	CS	CS,D	D	NO	CS	CS	CS	CS	D	D	NO	NO	CS,NO	CS	CS	NO	D	D	NO	NO	CS	CS	CS	CS
GR	CS	D,D	D	NO	CS	D	NO	NO	CS	D	NE	D	CS,CS	CS	CS	NO	D	D	NO	NO	NO	NO	CS	NO
HR	CS	D,D	D	NO	CS	D	CS	NO	D	D	CS,D	CS	CS,CS	NO	CS	NO	D	D	NO	CS	CS	NO	CS	NO
HU	CS	D,D	D	CS	CS	CS	CS	NO	CS	D	CD,D	NO	CS,D	CS	CS	NO	D	D	CS,D	NO	CS	CS	CS	NO
IE	CS	CS,CS	D	CS	CS	CS	NO	CS	CS	D	CS,D	NO	NO,NO	NO	NO	NO	D	D	CS,D	CS	CS	CS	NO	CS
IT	CS	CS,CS	D	NO	CS	CS	CS	NO	CS	NO	NO	D	NO,D	NO	CS	NO	CS	CS	NO	NO	CS	NO	CS	NO
LT	CS	CS,D	D	D	CS	D	NO	D	D	D	CS,D	D	NO,CS	D	CS	D	NO	NO	NO	D	NO	NO	CS	D
LU	CS	D,D	D	NO	CS	D	CS	NO	CS	D	CS,D	NO	CS,CS	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
LV	CS	CS,D	D	D	CS	CS	NO	CS	CS	CS	NO	D	NO,NO	NO	CS	D	CS	CS	NO	D	NO	NO	CS	D
MT	D	D,D	D	NO	NO	NO	NO	NO	D	D	NO	NO	NO,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
NL	CS	CS,D	D	NE	CS	D	CS	CS	NE	D	NO	CS	CS,CS	CS	CS	CS	D	D	NO	CS	CS	CS	CS	CS
PL	CS	D,D	D	D	CS	D	D	D	D	D	D,D	D	NO	NO	D	NO	D	D	D,D	D	CS	NO	D	NO
PT	CS	CS,CS	CS	NO	CS	CS	CS	NO	CS	D	CS	NO	CS,CS	CS	CS	NO	D	D	CS	NO	CS	CS	CS	NO
RO	CS	D,D	D	D	CS	CS	CS	NO	CS	CS	CS	CS	CS,CS	CS	CS	NO	CS	D	NO	D	CS	CS	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	CS
SK	CS	D,D	D	NO	CS	CS	CS	NO	D	D	CS,D	NO	CS,CS,	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
SV	CS	CS,D	D	NO	CS	D	CS	NO	D	D	CS,D	D	CS,CS	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
UK	CS	CS,CS	CS	CS	CS	CS	CS	CS	D	D	CS	CS	CS,CS	CS	CS	CS	D	D	CS	CS	CS	CS	CS	CS
IS	CS	D,D	D	D	CS	CS	CS	D	D	D	NE	D	CS,CS	CS	CS	D	CS	CS	CS	D	CS	CS	CS	D

Source: submissions 2016, CRF table 4A-4F

(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 guidelines). However it is expected that if "CS" is reported in table 6.6, 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 the 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 generally 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 identified 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	2014		1990	2014
4 A 1 Forest Land: Land Use (CO2)	-363814	-386179	T	L	L
4 A 2 Forest Land: Land Use (CO2)	-34250	-53485	T	L	L
4 B 1 Cropland: Land Use (CO2)	22609	25524	T	L	L
4 B 2 Cropland: Land Use (CO2)	54333	45168	0	L	L
4 C 1 Grassland: Land Use (CO2)	47392	33224	T	L	L
4 C 2 Grassland: Land Use (CO2)	-19024	-23970	0	L	L
4 D 1 Wetlands: Land Use (CO2)	13102	14695	T	L	L
4 E 2 Settlements: Land Use (CO2)	34839	47068	T	L	L

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 category is the main category in the LULUCF sector. It represents 36% of the total area reported by EU MS + Iceland. According to the data provided in individual 2016 submissions, total forest area increased from 159.298 kha in 1990 to 165.626 kha in 2014, which represent an increase of 4%. About 5% of the total forest area is represented by lands under conversion to forest land. This trend, which is also reflected in different 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).

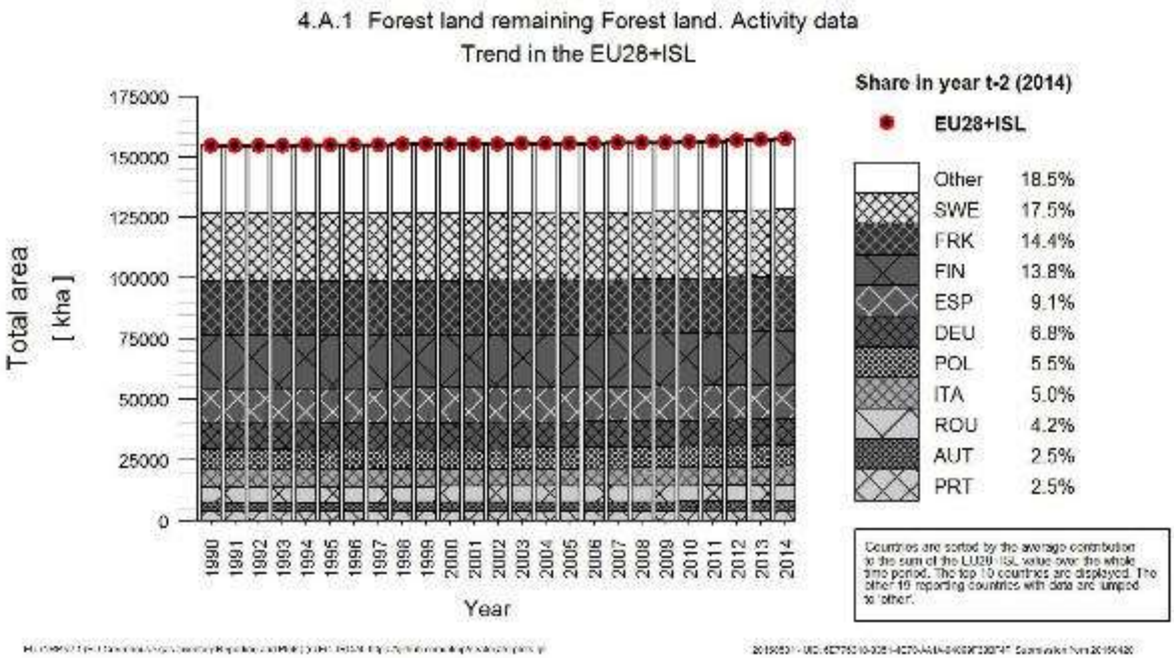
The largest forest area in 2014 is reported by Sweden, France and Finland, which report about 45% of the total forest area at EU level. While deforestation does not appear to be a major issue in Europe, it may be relevant for specific countries; nevertheless, the absolute area under conversion from forest is more than compensated by new planting areas and by 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, reported for the year 2014 at EU level slightly increased by 2% as compared with 1990. However, at the level of individuals MS there are significant differences. For instance, UK reports an increase of 34% while Netherlands reports a decrease of 11% respect to the year 1990. The major contributors, in terms of area, for this subcategory at EU level are Sweden, France and Finland (Figure 6.3)

Figure 6.3 Trend of activity data in subcategory 4A1 "Forest land remaining Forest Land" in EU MS (kha, 1990-2014)



For the year 2014, the total land area reported under the sub- category 4.A1 reached 157.201 Kha out of which about 82% corresponds to the 10 MS with higher contribution.

In terms of GHG emissions the category 4.A1 resulted in a net sink of -386.146 kt CO_2, increasing by 6% as compared in 1990. The major contributors at EU level are France, Germany and Sweden (Table 6.8).

Table 6.8 4A1 Forest Land remaining Forest Land: MS' contributions to net CO_2 emissions (CRF table 4)

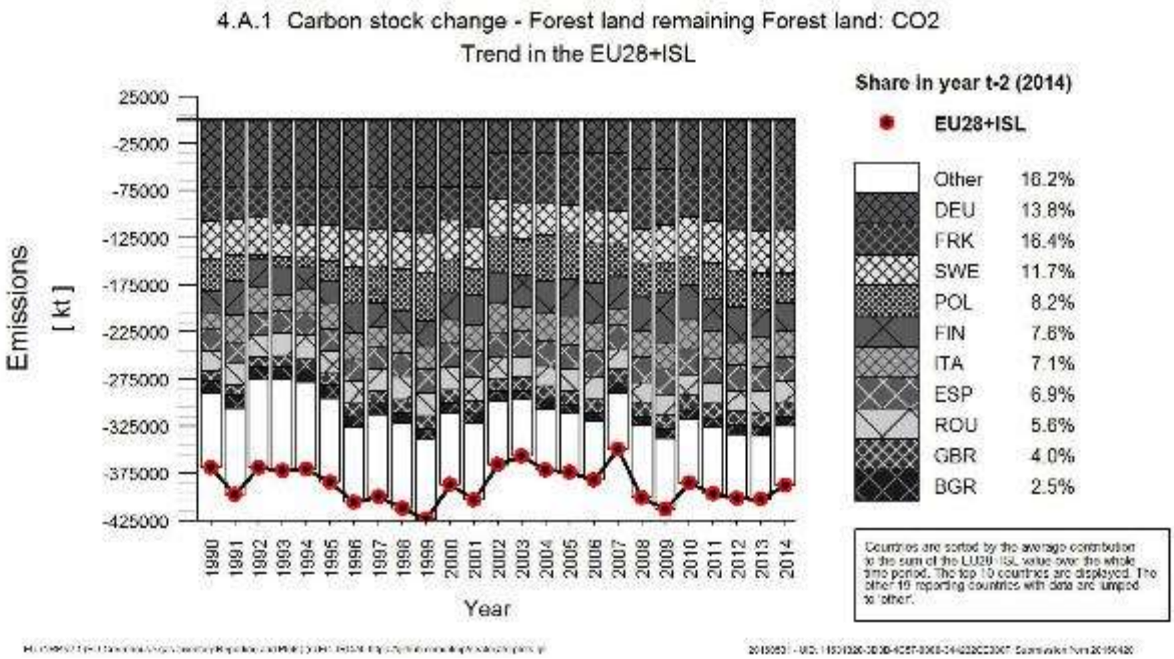
Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	-7 849	-2 561	-2 584	1%	-23	-1%	5 265	67%
Belgium	-2 930	-3 708	-3 707	1%	1	0%	-777	-27%
Bulgaria	-13 835	-9 692	-9 686	3%	6	0%	4 149	30%
Croatia	-6 699	-6 639	-6 323	2%	316	5%	376	6%
Cyprus	-614	-652	-652	0%	1	0%	-38	-6%
Czech Republic	-4 645	-6 980	-6 908	2%	73	1%	-2 263	-49%
Denmark	-233	-3 006	-4 166	1%	-1 160	-39%	-3 933	-1685%
Estonia	-9 271	-901	-496	0%	405	45%	8 775	95%
Finland	-22 793	-29 283	-29 340	8%	-58	0%	-6 548	-29%
France	-35 813	-65 329	-63 318	16%	2 011	3%	-27 504	-77%
Germany	-70 327	-53 367	-53 451	14%	-84	0%	16 877	24%
Greece	-1 139	-2 132	-2 143	1%	-11	-1%	-1 004	-88%
Hungary	-2 971	-2 013	-3 254	1%	-1 242	-62%	-283	-10%
Ireland	-2 720	74	27	0%	-47	-63%	2 747	101%
Italy	-17 659	-30 451	-27 495	7%	2 955	10%	-9 836	-56%
Latvia	-14 658	-2 792	351	0%	3 143	113%	15 009	102%
Lithuania	-7 150	-10 491	-9 043	2%	1 449	14%	-1 893	-26%
Luxembourg	66	-484	-419	0%	65	13%	-486	-731%
Malta	-2	-2	-2	0%	0	0%	0	0%
Netherlands	-1 949	-2 366	-2 373	1%	-7	0%	-424	-22%
Poland	-33 880	-39 182	-31 816	8%	7 366	19%	2 064	6%
Portugal	-2 251	-7 808	-9 911	3%	-2 103	-27%	-7 660	-340%
Romania	-21 162	-21 590	-21 607	6%	-18	0%	-446	-2%
Slovakia	-6 088	-6 481	-4 270	1%	2 211	34%	1 817	30%
Slovenia	-3 797	-5 943	-6 038	2%	-95	-2%	-2 241	-59%
Spain	-23 102	-26 661	-26 773	7%	-112	0%	-3 670	-16%
Sweden	-39 526	-44 181	-45 376	12%	-1 195	-3%	-5 850	-15%
United Kingdom	-10 799	-15 568	-15 373	4%	196	1%	-4 573	-42%
EU-28	**-363 795**	**-400 188**	**-386 146**	**100%**	**14 042**	**4%**	**-22 350**	**-6%**
Iceland	-19	-33	-33	0%	0	1%	-14	-77%
EU-28 + ISL	**-363 814**	**-400 221**	**-386 179**	**100%**	**14 043**	**4%**	**-22 365**	**-6%**

For the year 2014, with the exception of Ireland and Latvia, individual submissions report a net sink of carbon in Forest Land remaining Forest Land.

The largest change in absolute terms reported as compared with 1990 correspond to a significant increase of the carbon sink reported by France. In other cases, for the period 1990-2014, this category has shifted between a net source and a net sink of carbon.

In a good match with the share in total areas, the 10 MS with the largest contribution to the total net sink of carbon account for about 84% of the total EU sink reported for the year 2014 (Figure 6.4).

Figure 6.4 Trend of emissions in subcategory 4A1 "Land converted to Forest Land" in EU MS (kt CO_2, 1990-2014)



The natural disturbance which mostly affect direct GHG emissions in Forest land areas are forest fires (mainly in Southern European countries). The CO_2 emissions from biomass burning are, in many cases, 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). 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).

Wind storms (mainly in central Europe) in particular years affected large forest areas. However, given that most of the biomass affected by storms is either treated as salvage logging or enters the dead organic matter pool (indirect emissions), emissions peaks due to storms are often not visible in GHG inventories. Other type of disturbances generally have a localized effects and low magnitude; in general, they are difficult to quantify in terms of biomass loss (e.g. insect outbreaks), thus they are practically not mentioned in the individual reports.

The largest inter-annual variabilities in GHG estimates that affect the EU trend are due to:

- Forest fires (e.g. Portugal in 1990, 2003 and 2005; Italy in 1990, 1993 and 2007).
- Windstorms (e.g. France in 2000 and 2009, and Denmark in 2000, Sweden in 2005); Or are due 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 all individual submissions. (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 individual MS + ISL

Member State	NIR 2016			
	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[1]	-	-	-	-
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
Iceland	10	2	0.5	20

1 Cyprus uses CLC to assess forest land areas but does not provide quantitative thresholds

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 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.
Iceland	All forested lands, not belonging to Settlement, that is presently covered with trees or woody vegetation that reach the defined thresholds. Natural birch woodland is included in the IFR national forest inventory (NFI). In the NFI the natural birch woodland is defined as one of the two predefined strata to be sampled. The other stratum is the cultivated forest consisting of tree plantation, direct seeding or natural regeneration originating from cultivated forest.

National Forest Inventories 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, in some cases, also taken from forest management plan databases especially, information used to derive activity data and emissions for the base year (e.g. Slovakia).

Data collection in national forest inventories 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 there was steps toward a slight harmonization at European scale (e.g. COST E43 Action)[62].

Given that annual data are barely available for this sector, efforts have been made also to adjust the timing of inventory cycles to the timeline of first commitment period of the Kyoto Protocol. To meet reporting requirement of the time series, annual values are usually obtained by interpolation and extrapolation of available data sets. The main data source for forest land area, the national forest inventories, are in many instances complemented with auxiliary information in the form of national statistics (i.e. surveys) or remote sensing products (i.e. satellite images, aerial photographs) including their derivatives products such as Corine Land Cover maps.

Furthermore, MSs usually have disaggregated 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 trees (i.e. broadleaved/coniferous; evergreen/deciduous; species based 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. 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– 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 carbon 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).

[62] http://www.metla.fi/eu/cost/e43

Table 6.11   Available forest carbon pools definitions as reported by individual MS GHG inventories.

Member State	Description
	Aboveground biomass
Austria	Stem wood over bark with a diameter at breast height over 5 cm.
Belgium	Tree and shrub species with circumference exceeding 20/22 cm at 1.50 m height (i.e. 7 cm in diameter), while in coppices the stems under 7 cm diameter are also included.
Denmark	Living trees with a height over 1.3 m, under different recording schemes (i.e. trees larger than 40 cm are measured only within a 15 m circle). Smaller trees, shrubs and other non woody are not counted. Aboveground biomass is defined as living biomass above stump height (1% of tree height).
Finland	Biomass of living trees with a height over 1.35 m, i.e. those trees that are measured in NFIs, including the stem wood, stem bark, living and dead branches, cones, needles/foliage. Understory is counted only to estimate the emission from forest fire.
France	Trees with DBH over 7.5 cm.
Germany	Trees with DBH over 7 cm.
Greece	Trees with DBH over 10 cm, but in cases of degraded forests (e.g. oak) and coppices (e.g. Castanea) the threshold is 4.6 cm. The trees in the sample area under the minimum diameter are not considered. Understory biomass is considered for GHG emissions from wildfires.
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, Spain	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.
Iceland	dead wood meeting the minimum criteria of 10 cm in diameter and 1 m in length

	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.

Individual submissions of GHG inventories follow 2006 IPCC GL for estimating the carbon stock changes in forest carbon pools. For living biomass, methodologies are based either on the "stock difference" or "gain-loss" methods (Table 6.12)

Table 6.12 Methods used by MS for estimating carbon stock changes in Living Biomass.

MS	Estimation method
Austria	Gain-loss
Belgium	Stock-difference/Gain-loss (Walloon/Flemish region)
Bulgaria	Stock-difference
Croatia	Gain-loss
Cyprus	Gain-loss
Czech Republic	Gain-loss
Denmark	Stock-difference
Estonia	Stock-difference
Finland	Gain-loss
France	Gain-loss
Germany	Stock-difference
Greece	Stock-difference
Hungary	Stock-difference
Ireland	Gain-loss
Italy	Gain-loss
Latvia	Gain-loss
Lithuania	Stock-difference
Luxemburg	Gain-loss
Malta	Gain-loss
Netherlands	Gain-loss
Poland	Gain-loss
Portugal	Gain-loss
Romania	Gain-loss
Slovakia	Gain-loss
Slovenia	Stock-difference
Spain	Stock-difference
Sweden	Stock-difference
UK	Gain-loss
Iceland	Gain-loss

Data sources for the estimation of carbon stock changes in living biomass also differ across MS, upon data availability. Actually, national forest inventories 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 2016 GHG inventory submissions, the implied carbon stock change factors reported for the year 2014 for net carbon stock changes in living biomass range from 1.9 to -0.27 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 carbon stock change factor for living biomass pool in 4A1 (t C ha-1 year-1) reported in individual GHGI 2016.

Member State	Net carbon stock change factor in living biomass t C/ha	
	1990	2014
AUT	0,77	0,31
BEL	0,61	0,94
BGR	1,08	0,72
HRV	0,79	0,75
CYP	1,05	1,15
CZE	0,60	0,79
DNM	0,21	1,64
EST	1,00	-0,02
FIN	0,34	0,34
FRK	0,46	0,80
DEU	1,43	1,03
GRC	0,10	0,17
HUN	0,47	0,47
IRL	2,14	-0,27
ITA	0,66	0,93
LVA	1,67	0,05
LTU	0,93	1,11
LUX	-0,23	1,26
MLT	0,78	0,78
NLD	1,32	1,90
POL	1,04	0,90
PRT	0,28	0,69
ROU	0,89	0,90
SVK	0,92	0,59
SVN	1,06	1,54
ESP	0,43	0,51
SWE	0,35	0,37
GBR	1,10	1,24
ISL	0,06	0,10

Changes of organic carbon stored in mineral soils and dead organic matter are mostly reported by applying Tier 1 methods, which assumes for this land subcategory 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 in the course of the national forest inventories. 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 to the very high uncertainty of existing data.

Furthermore, in some instance, MS document the ongoing efforts to estimate emissions and removals from these pools. When data exists, these 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).

Concerning dead organic matter carbon pool, some MS include its estimates within soil organic carbon (e.g. Finland). Overall, when reported, dead wood and litter are reported as a net carbon sink or a net source, depending on national estimates (Table 6.14).

Table 6.14 Implied carbon stock change factors in DOM carbon pool in 4A1 (t C ha-1 yr-1) reported in individual GHGI 2016.

Member States	Net carbon stock change in dead wood per area (t C/ha)		Net carbon stock change in litter per area (t C/ha)	
	1990	2014	1990	2014
AUT	0,02	0,06	NE,IE	NE,IE
BEL	-0,01	0,00	-0,01	0,00
BGR	NO	NO	NO	NO
HRV	NO	NO	NO	NO
CYP	NO	NO	NO	NO
CZE	NO	NO	NO	NO
DNM	0,01	0,13	-0,01	0,40
EST	0,03	-0,01	NO	NO
FIN	IE	IE	IE	IE
FRK	NO	-0,03	NO	NO
DEU	0,04	-0,05	-0,01	-0,01
GRC	NA,NO	NA,NO	NA,NO	NA,NO
HUN	NO	NO	NO	NO
IRL	IE	IE	-0,16	0,57
ITA	0,02	0,01	0,03	0,01
LVA	-0,01	0,33	NO	NO
LTU	0,07	0,08	NO	NO
LUX	0,00	NO	NO	NO
MLT	0,00	0,00	0,00	0,00
NLD	0,08	0,02	NO	NO
POL	NO	NO	NO	NO
PRT	IE	IE	0,00	0,00
ROU	NO	NO	NO	NO
SVK	NO	NO	NO	NO
SVN	0,00	0,00	NO	NO
ESP	NE	NE	NE	NE
SWE	0,04	0,08	-0,08	-0,07
GBR	IE	IE	0,24	0,23
ISL	NE,IE	NE,IE	NE	NE

Carbon stock changes in mineral soils under forest land remaining forest land for the year 2014 are estimated by 10 MS, generally as a small net sink of carbon (with the exception of Austria) (Table 6.15).

Most of the MS report absence or insignificant areas of organic soils under this land subcategory. 11 MS reports CO_2 emissions from organic soils associated with managed forests (e.g. drainage of soils to establish plantations), and only UK reports a sink from organic soils in this category, justified in its national inventory report.

Table 6.15 Implied carbon stock change factors in mineral and organic soils in 4A1 (t C ha-1 yr-1) reported in individuals GHGI 2016.

Member States	Net carbon stock change in mineral soils per area (t C/ha)		Net carbon stock change in organic soils per area (t C/ha)	
	1990	2014	1990	2014
AUT	-0.19	-0.18	NO	NO
BEL	0.53	0.52	NO	NO
BGR	NO	NO	NO	NO
HRV	NO	NO	NO	NO
CYP	NO	NO	NO	NO
CZE	NO	NO	NO	NO
DNM	NA	NA	-1.95	-1.30
EST	0.16	0.16	-0.17	-0.17
FIN	0.13	0.16	-0.56	-0.30
FRK	NO	NO	NO	NO
DEU	0.41	0.41	-2.10	-2.23
GRC	NA,NO	NA,NO	NA,NO	NA,NO
HUN	NO	NO	-2.60	-2.60
IRL	NO	NO	-0.54	-0.47
ITA	NA,NO	NA,NO	NO	NO
LVA	NO	NO	-2.60	-2.60
LTU	NO	NO	IE	IE
LUX	NO	NO	NO	NO
MLT	0.00	0.00	NO	NO
NLD	NO	NO	NO	NO
POL	0.05	0.11	-0.68	-0.68
PRT	0.02	0.00	NO	NO
ROU	NO	NO	-0.68	-0.68
SVK	NO	NO	NO	NO
SVN	NO	NO	NO	NO
ESP	NE	NE	NO	NO
SWE	0.14	0.14	-0.38	-0.38
GBR	0.24	0.23	1.23	0.77
ISL	NE	NE	-0.37	-0.37

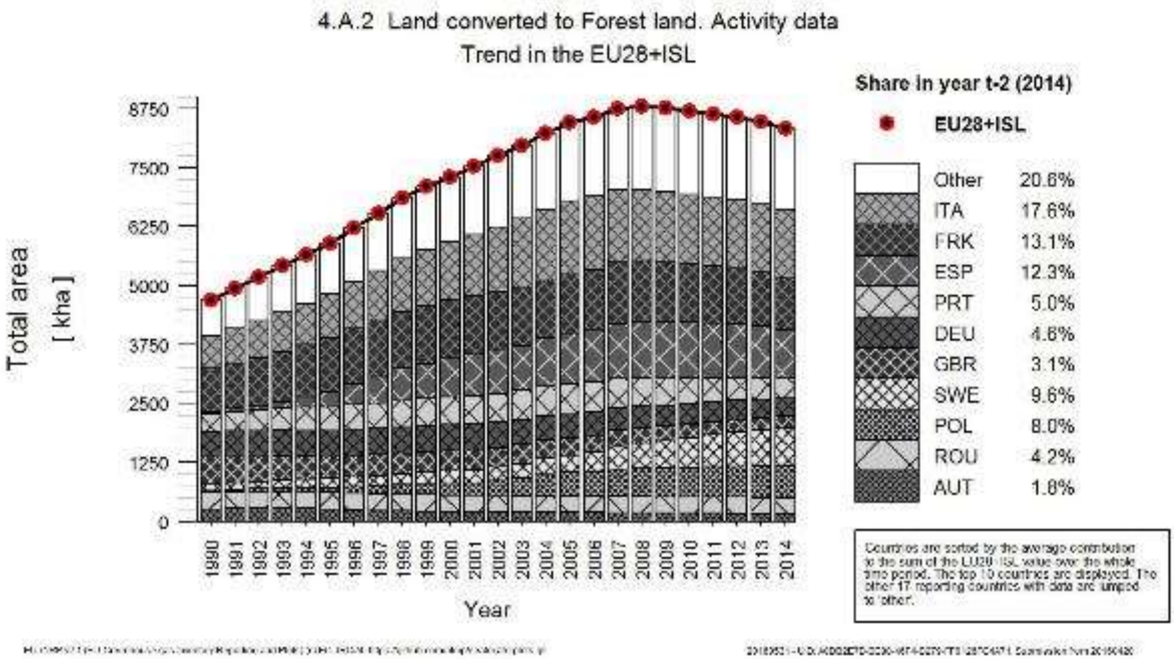
6.2.1.3 Land converted to Forest Land (CRF 4A2)

Overview of Land converted to Forest Land category

In 2014, the area reported under this subcategory represents 5% of the total Forest Land area reported at EU level. This subcategory has increased by 77% as compared with 1990 (Figure 6.5). Main conversions of lands to forest take place from Grasslands and Cropland areas, and despite of its low share in terms of areas, these lands contributed by 12% to the total carbon sink of the reported European forest areas.

For the year 2014, in term of areas, Italy, France and Spain together contribute with about 40% of the total areas of land being converted to forest land.

Figure 6.5 Trend of activity data in subcategory 4A2 "Land converted to Forest Land" in EU MS (kha, 1990-2014)



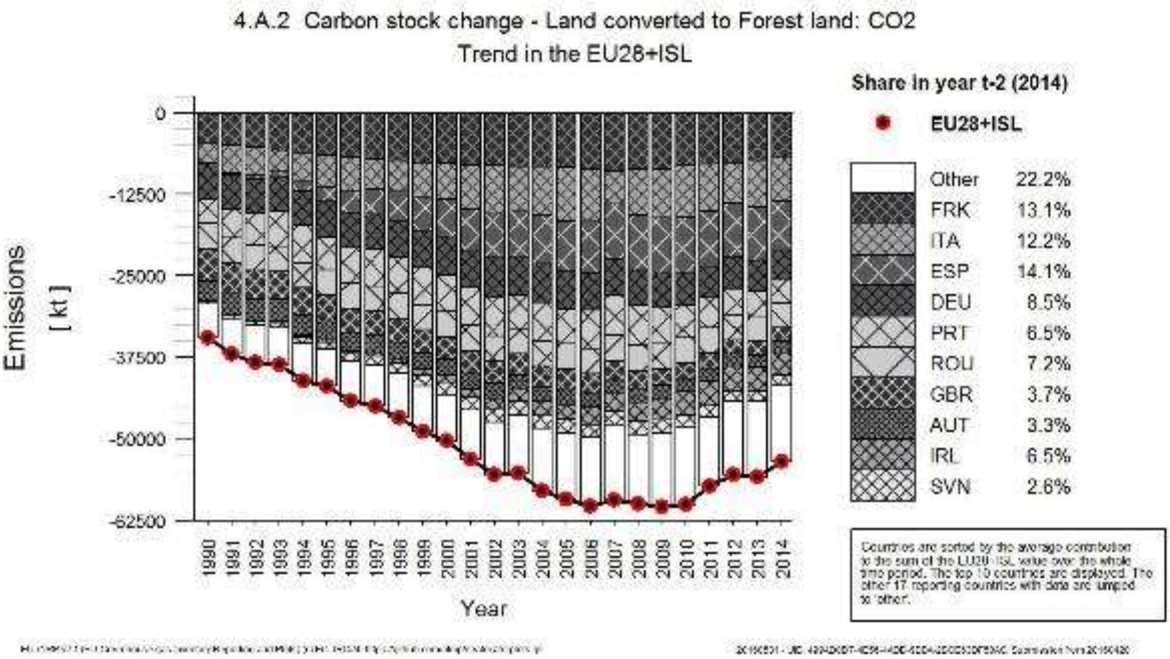
At EU level, this subcategory has been always reported as a net carbon sink. For the year 2014 it reaches 53.221 Kt CO_2 which represent an increase of 56% as compared with 1990 and 4% less than in previous year. This trend in emissions is well associated with the trend on areas (Table 6.16, Figure 6.6).

Nevertheless, some MS (i.e. Ireland and Netherlands) have reported this subcategory as a net source of emissions for the first years of the time series or as a very small sink. This fact is explained by the emissions caused during the preparatory practices of soils previous to afforestation or reforestation activities. The absence of such emissions is associated with natural expansion of forest areas.

Table 6.16 4A2 Land converted to Forest Land: MS' contributions to EU28+ISL net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	-3 081	-1 825	-1 771	3%	54	3%	1 309	42%
Belgium	-17	-288	-292	1%	-4	-1%	-274	-1575%
Bulgaria	-546	-751	-783	1%	-33	-4%	-237	-43%
Croatia	-39	-199	-229	0%	-29	-15%	-190	-492%
Cyprus	NE	NE	NE	-	-	-	-	-
Czech Republic	-321	-464	-482	1%	-18	-4%	-161	-50%
Denmark	-31	491	379	-1%	-111	-23%	410	1318%
Estonia	-1	-788	-768	1%	21	3%	-767	-80985%
Finland	-40	-399	-362	1%	37	9%	-322	-814%
France	-4 655	-7 320	-7 012	13%	308	4%	-2 358	-51%
Germany	-5 212	-4 735	-4 554	9%	180	4%	658	13%
Greece	NE,NO	-136	-124	0%	12	9%	-124	-100%
Hungary	-329	-1 234	-1 239	2%	-6	0%	-911	-277%
Ireland	27	-3 747	-3 441	6%	306	8%	-3 468	-12725%
Italy	-3 141	-7 160	-6 541	12%	619	9%	-3 400	-108%
Latvia	-3	-405	-436	1%	-31	-8%	-432	-13719%
Lithuania	-1 034	-1 142	-1 195	2%	-53	-5%	-161	-16%
Luxembourg	-306	-132	-117	0%	15	11%	189	62%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	59	-309	-313	1%	-4	-1%	-372	-627%
Poland	-141	-2 777	-2 778	5%	-1	0%	-2 637	-1868%
Portugal	-3 569	-3 728	-3 479	7%	249	7%	91	3%
Romania	-3 873	-3 870	-3 871	7%	0	0%	2	0%
Slovakia	-2 210	-353	-363	1%	-10	-3%	1 847	84%
Slovenia	-399	-1 532	-1 378	3%	154	10%	-979	-246%
Spain	-157	-8 144	-7 550	14%	594	7%	-7 393	-4701%
Sweden	-209	-2 359	-2 525	5%	-166	-7%	-2 316	-1108%
United Kingdom	-4 997	-2 086	-1 997	4%	89	4%	2 999	60%
EU-28	**-34 223**	**-55 392**	**-53 220**	**100%**	**2 172**	**4%**	**-18 997**	**-56%**
Iceland	-27	-240	-265	0%	-25	-10%	-238	-885%
EU-28 + ISL	**-34 250**	**-55 632**	**-53 485**	**100%**	**2 147**	**4%**	**-19 235**	**-56%**

Figure 6.6 Trend of emissions in subcategory 4A2 "Land converted to Forest Land" in EU MS (kt CO_2, 1990-2014)



In 2014, about 50% of total carbon sink reported 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 conversions to forest, as well as to report GHG emissions and CO_2 removals from these areas, are generally the same as the ones used for the category 4A.1.

Most of the MS have developed land identification systems that are able to identify and track land use conversions to and from forest. Mainly, as already mentioned, these methods are based on information collected by the national forest inventories on systematic samples plots, and that, in many cases, is complemented by auxiliary information on the form of satellites images or aerial photography.

Estimates of GHG emissions and CO_2 removals from this subcategory are usually reported using tier 2 methods by using country specific data collected during the national forest inventories. Under this subcategory, living biomass and dead organic matter carbon pools are in most of the cases reported as a net carbon sink. Mineral soils are reported either as a net source or a net sink which is related with the presence or absence of disturbed soils on new forest areas (i.e. natural regeneration or, management practices for soil preparation). Concerning organic soils, all the MS, with the exception of UK that use CARBINE model, have reported this carbon pool as a net source of emissions whenever new forest areas were established in this type of soils.

Nevertheless, it should be noted that the heterogeneity in the approaches used by MS under 4A.2 suggests caution in interpreting differences in the implied carbon stock change factors across carbon pools. 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 annual biomass growth, or 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, soil carbon 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 which includes arable lands for annual crops, permanent crops, set aside lands and rice-fields represents the larger source of emissions among the 6 land use categories.

Based on the MS submissions, total Cropland area at the level of EU MS + Iceland covers 126.743 kha in 2014. These areas represent in EU the 28 % of the total land and although, it has shown a constant decreasing trend since 1990. For instance, in 2014 the reported areas on this category decrease by 6% as compared with the year 1990.

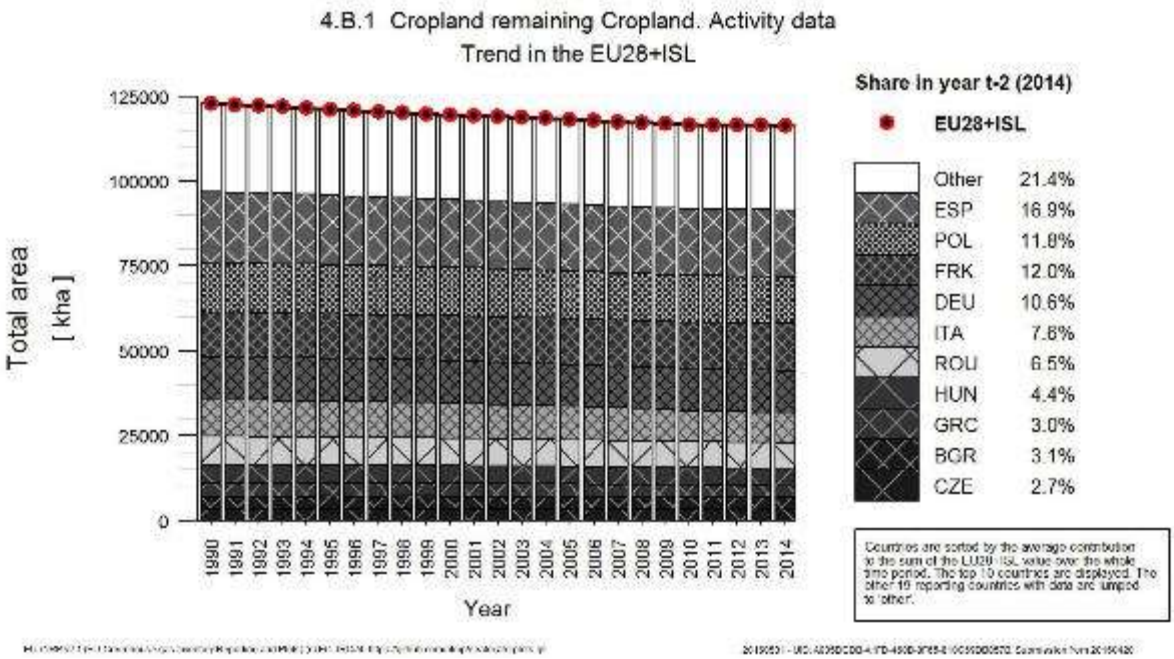
6.2.2.2 Cropland remaining Cropland (CRF 4B1)

Overview of Cropland remaining Cropland category

In line with the overall category, this subcategory has constantly decreased since 1990 (Figure 6.7). From 122.846 kha in 1990 to 116.050 kha in 2014, which represent a decrease of 7%. With the exception of France, UK, Malta, Slovakia and Iceland, all MS report in 2014 a decrease of Cropland area as compared with 1990.

At the level of the EU, the overall trend of this subcategory is driven by 10 MS which together contribute with about 80% of the total area, and more specifically, Spain, Poland, France and Germany which represent more than half of the area reported under this subcategory.

Figure 6.7 Trend of activity data in subcategory 4B1 "Cropland remaining Cropland" in EU MS (kha, 1990-2014)



In term of emissions, at EU level, this subcategory has been always reported as a net source. In the year 2014, GHG emissions reach 24.230 kt CO_2 which represents an increase of 12% as compared to 1990 (Table 6.17).

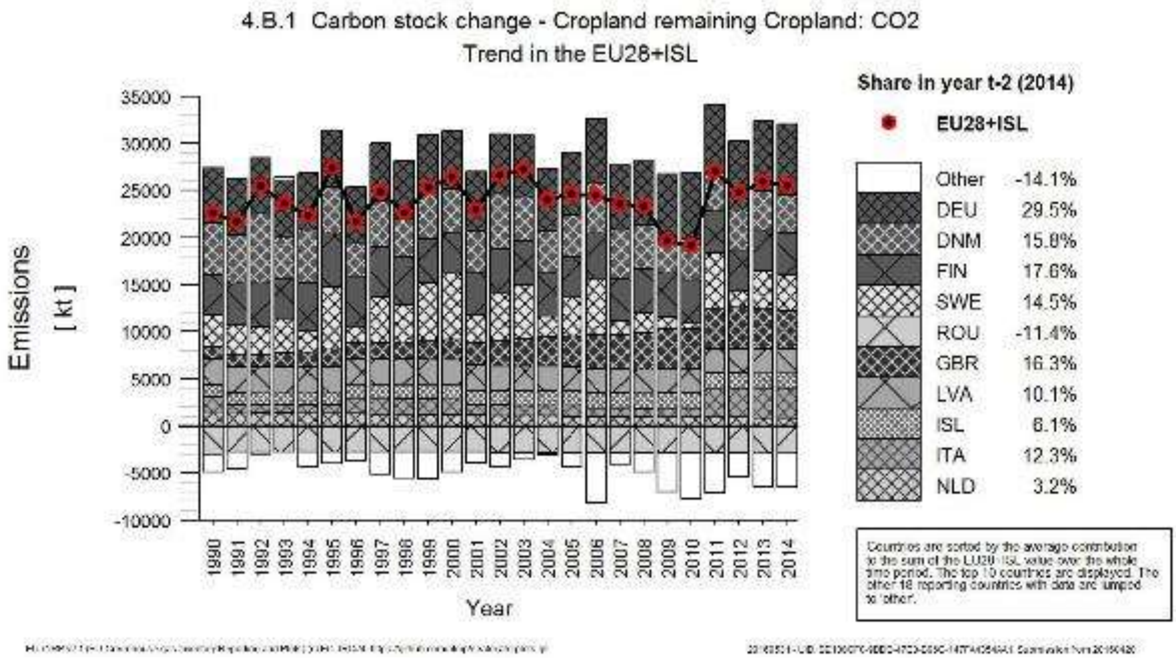
This trend is mainly driven by Germany, Finland, Denmark and UK which together report about 78% of the final emissions resulting from this subcategory (Figure 6.8). In general, emissions are the result of the oxidation of organic matter in soils which are particularly important in those MS with presence of cultivated areas on organic soils.

Nevertheless, some MS report a significant carbon sink in Cropland remaining Cropland. For instance, Romania, Belgium, Hungary and Spain which report a substantial net carbon sink in mineral soils and, in some cases, also in the living biomass carbon pool. This is generally justified by the implementation of IPCC methodologies (i.e. tier 1 and tier 2) that result in a net sink when current management practices of soils are less intense that those implemented 20 years before. And also in MS with significant areas of woody crops (i.e. orchards, vineyards, Christmas trees, fruits, bushes, and plantations) that provide a net sink of carbon.

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	-77	-469	-427	-2%	42	9%	-350	-457%
Belgium	239	-901	-891	-3%	10	1%	-1 130	-473%
Bulgaria	-714	466	492	2%	25	5%	1 206	169%
Croatia	215	120	-12	0%	-132	-110%	-227	-105%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	-2	-77	-76	0%	1	2%	-74	-3235%
Denmark	5 562	4 123	4 024	16%	-99	-2%	-1 537	-28%
Estonia	90	63	47	0%	-16	-26%	-43	-48%
Finland	4 235	4 355	4 503	18%	148	3%	269	6%
France	0	0	0	0%	0	0%	0	0%
Germany	5 909	7 426	7 516	29%	89	1%	1 607	27%
Greece	-908	-311	-317	-1%	-6	-2%	591	65%
Hungary	39	-813	-706	-3%	107	13%	-744	-1932%
Ireland	-4	21	-2	0%	-22	-107%	3	65%
Italy	1 638	3 195	3 150	12%	-45	-1%	1 512	92%
Latvia	2 754	2 577	2 589	10%	12	0%	-165	-6%
Lithuania	451	108	107	0%	-1	-1%	-344	-76%
Luxembourg	2	2	2	0%	0	-9%	-1	-25%
Malta	-1	-1	-1	0%	0	3%	0	-33%
Netherlands	1 467	852	824	3%	-29	-3%	-644	-44%
Poland	800	388	366	1%	-21	-6%	-434	-54%
Portugal	21	-202	-198	-1%	4	2%	-219	-1038%
Romania	-3 015	-2 899	-2 907	-11%	-7	0%	109	4%
Slovakia	-955	-874	-877	-3%	-4	0%	78	8%
Slovenia	-107	-34	-25	0%	9	26%	82	77%
Spain	-929	-1 031	-1 071	-4%	-40	-4%	-142	-15%
Sweden	3 313	3 982	3 703	15%	-279	-7%	391	12%
United Kingdom	1 331	4 329	4 147	16%	-182	-4%	2 817	212%
EU-28	**21 353**	**24 397**	**23 962**	**94%**	**-435**	**-2%**	**2 609**	**12%**
Iceland	1 256	1 573	1 562	6%	-10	-1%	306	24%
EU-28 + ISL	**22 609**	**25 969**	**25 524**	**100%**	**-445**	**-2%**	**2 915**	**13%**

Figure 6.8 Trend of emissions in subcategory 4B1 "Cropland remaining Cropland" in EU MS (kt CO_2, 1990-2014)



Methodological issues for Cropland remaining Cropland category

Lands included under this subcategory generally are in line with the IPCC definition (Table 6.18) however, there may be small national particularities (e.g. treatment of some woody crops) that result in specific differences.

Often, the absence in many cases of annual information on activity data along with the management practices that include crops-rotation cycles, fallow lands; some croplands areas may not be clearly separated from grasslands areas. In some cases, MS have implemented a number of years before a land is shifted from/to cropland and grassland.

In overall, following IPCC approach, the living biomass carbon pool is assumed in balance for annual crops, however carbon stock changes are often reported for conversions of lands among annual and woody crops (e.g. Austria, Croatia, and Bulgaria). Concerning carbon stock changes in woody crops, MS often implement the IPCC approach, either by using country-specific data on biomass accumulation from growth and maturity cycles or by using default data. However, which is not always transparently provided is how the lands in which woody crops have reached the maturity are identified and excluded from those that are still accumulating carbon.

Carbon stock changes in dead organic matter are in most of the cases reported following the IPPC assumption which assumes that the dead wood and litter stocks are not present in croplands or they are in equilibrium. In some cases, however, MS have reported this pool as a net sink (e.g. Latvia and Sweden) or as a net source (e.g. Romania).

About carbon stock change in soils, these have been reported under mineral soils as either a net source or a net sink of emissions, that are typically associated with an increase or decrease of the intensity in the soils management practices along the time series. However, under organic soils in all the cases this carbon pool has resulted in a net source of emissions. Methodologies for reporting this carbon pool follow, in most of the cases, IPCC tier 1 or tier 2 approaches, where the carbon stock change is estimated as the difference among the carbon stock in soils at two moments in time. In few cases, this carbon stock changes have been estimated by using models (e.g. C-tool by Denmark and ICBM by Sweden).

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.
Iceland	All cultivated land not included under Settlements or Forest land and at least 0.5 ha in continuous area and minimum width 20 m. This category includes harvested hayfields with perennial grasses. Two subcategories of Cropland are defined on the Land use map, "Cropland" and "Cropland on drained soils".

When Tier 2 methods were applied, they often 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.

Methods to estimates carbon stock changes in soil organic matter also present variability 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).

Table 6.19 Implied net carbon stock change factor for carbon pools in 4B1 (t C ha-1 yr-1) reported by individual submissions in GHGI 2016.

Member States	Net carbon stock change in living biomass per area (t C/ha)		Net carbon stock change in dead organic matter per area (t C/ha)		Net carbon stock change in mineral soils per area (t C/ha)		Net carbon stock change in organic soils per area (t C/ha)	
	1990	2014	1990	2014	1990	2014	1990	2014
AUT	0.01	-0.02	NO	NO	0.00	0.11	NO	NO
BEL	NO	0.00	NO	NO	-0.05	0.30	-10.00	-10.00
BGR	0.05	-0.04	NO	NO	0.00	0.00	NO	NO
HRV	-0.02	0.02	NO	NO	0.00	0.00	-10.00	-10.00
CYP	NE	NE	NO	NO	NO	NO	NO	NO
CZE	0.00	0.00	NO	NO	0.00	0.01	NO	NO
DNM	0.00	-0.04	NO	NO	-0.15	-0.14	-9.30	-9.30
EST	0.00	0.00	NO	NO	0.09	0.10	-5.00	-5.00
FIN	0.00	0.00	NE	NE	0.02	0.01	-6.49	-6.54
FRK	0.00	0.00	NO	NO	NO	NO	NO	NO
DEU	NO	NO	NO	NO	NO	NO	-8.10	-8.10
GRC	0.08	0.04	NO	NO	NO	NO	-10.00	-10.00
HUN	0.00	0.00	NO	NO	0.00	0.04	NO	NO
IRL	0.00	0.00	NO	NO	0.00	0.00	NO	NO
ITA	-0.02	-0.07	NO	NO	NO	NO	-10.00	-10.00
LVA	0.00	0.00	0.00	0.00	NO	NO	-7.90	-7.90
LTU	-0.02	0.00	NO	NO	-0.04	0.01	-5.00	-5.00
LUX	-0.01	-0.01	NO	NO	0.00	0.00	NO	NO
MLT	0.23	0.22	0.00	0.00	0.00	0.00	NO	NO
NLD	NE	NE	NE	NE	NO	NO	-4.05	-3.98
POL	0.03	0.03	NO	NO	0.00	0.00	-1.00	-1.00
PRT	0.00	0.02	NO	NO	NO	0.01	NO	NO
ROU	0.02	0.03	0.00	0.00	0.08	0.08	-2.50	-2.50
SVK	0.17	0.15	NO	NO	0.00	0.01	NO	NO
SVN	0.18	0.14	NA,NO	NA,NO	0.00	0.00	-10.00	-10.00
ESP	0.01	-0.01	NE	NE	0.00	0.03	NO	NO
SWE	0.00	0.02	0.00	0.00	0.01	-0.09	-6.22	-6.22
GBR	0.00	0.00	NO	NO	-0.13	-0.32	-5.00	-5.00
ISL	NO	NO	NO	NO	NE	NE	-7.90	-7.90

Whenever the Tier 1 assumption for carbon stock changes in living biomass of annual crops or dead organic matter was implemented, MS used the notation key NO (Table 6.19) or in some cases, NE was also used (e.g. Spain).

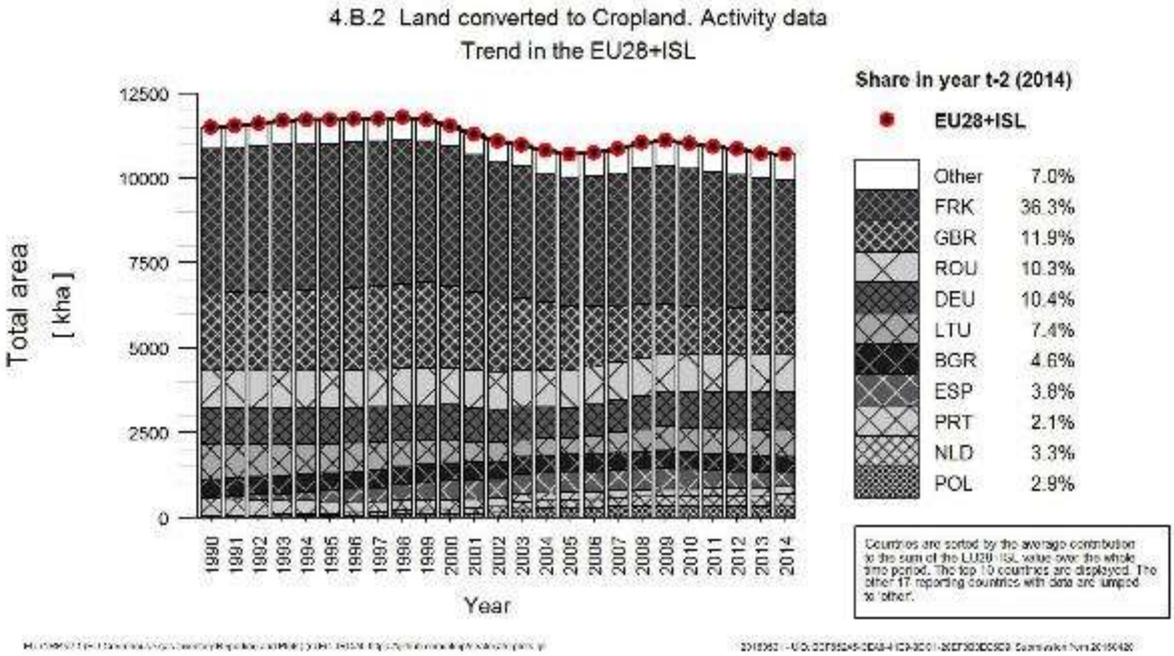
6.2.2.3 Land converted to Cropland (CRF 4B2)

Overview of Land converted to Cropland category

In terms of area, this subcategory represents 8% of the total cropland areas reported at EU level, however it accounts for 63% of the net CO_2 emissions that are reported under this category. In overall, area reported for the year 2014 decreased by 7% as compared with 1990. From 11.310 kha, reported for the year 1990, to 10.567 Kha in 2014 (Figure 6.9). Despite of this, contrary to the trend on areas reported under subcategory 4B.1 this decrease was not constant. At EU level there was a slightly increase of lands converted to croplands in 90s.

Main conversions of lands to cropland take place from areas of Grassland and Forest land. At EU level the trend is mainly driven by France, UK, Romania and Germany which report 60% of total area of land converted to Cropland, often associated with rotation of crops and grasses on the same land.

Figure 6.9 Trend of activity data in subcategory 4A2 "Land converted to Cropland" in EU MS (kha, 1990-2014)



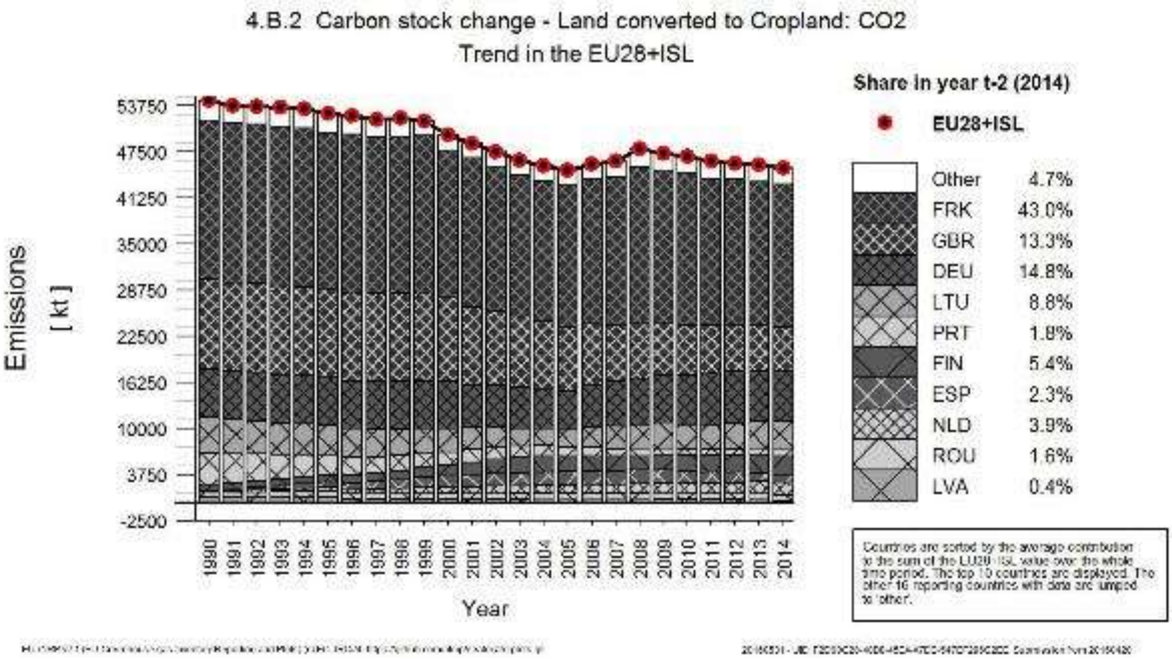
In term of emissions, in the year 2014, this subcategory is reported at EU level as a net source that reaches 44.6,5 Kt CO_2. This represent a decrease of 17% as compared to 1990 (Table 6.20). The major driver of the EU trend is France that reports about 40 % of the total EU emissions in this subcategory; followed by UK and Germany.

Nevertheless some MS report this subcategory as a small carbon sink which is the result of removals from the living biomass carbon pool when Grassland or Other lands are converted to Cropland. With some exceptions, all the other carbon pools have been reported as a net source of emissions.

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	191	182	180	0%	-1	-1%	-11	-6%
Belgium	63	557	559	1%	1	0%	495	785%
Bulgaria	40	343	354	1%	10	3%	313	780%
Croatia	24	22	18	0%	-5	-22%	-6	-26%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	114	92	88	0%	-4	-4%	-26	-23%
Denmark	-10	-16	-145	0%	-128	-780%	-135	-1412%
Estonia	0	89	97	0%	7	8%	97	124179%
Finland	858	2 457	2 451	5%	-6	0%	1 593	186%
France	21 519	19 343	19 368	43%	25	0%	-2 151	-10%
Germany	6 561	6 877	6 686	15%	-191	-3%	125	2%
Greece	0	0	1	0%	0	86%	1	848%
Hungary	132	293	287	1%	-7	-2%	155	117%
Ireland	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Italy	534	132	66	0%	-66	-50%	-468	-88%
Latvia	540	325	177	0%	-147	-45%	-363	-67%
Lithuania	4 847	3 719	3 977	9%	258	7%	-870	-18%
Luxembourg	75	27	26	0%	-1	-5%	-49	-66%
Malta	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Netherlands	169	1 690	1 778	4%	88	5%	1 609	950%
Poland	136	-63	-63	0%	0	0%	-198	-146%
Portugal	4 314	802	800	2%	-2	0%	-3 514	-81%
Romania	744	744	744	2%	0	0%	0	0%
Slovakia	466	74	74	0%	0	0%	-392	-84%
Slovenia	255	98	98	0%	0	0%	-157	-62%
Spain	-29	1 190	1 044	2%	-145	-12%	1 073	3727%
Sweden	41	356	403	1%	47	13%	362	890%
United Kingdom	12 114	6 185	6 011	13%	-174	-3%	-6 103	-50%
EU-28	**53 698**	**45 519**	**45 077**	**100%**	**-441**	**-1%**	**-8 621**	**-16%**
Iceland	635	91	91	0%	0	0%	-544	-86%
EU-28 + ISL	**54 333**	**45 610**	**45 168**	**100%**	**-441**	**-1%**	**-9 164**	**-17%**

Figure 6.10 Trend of emissions in subcategory 4B2 "Land converted to Cropland" in EU MS (kt CO_2, 1990-2014)



Methodological issues for Land converted to Cropland

For estimating and reporting carbon stocks changes in this subcategory, IPCC default methodology is generally used. The implementation of country-specific emissions factors or default factors depend on which type of lands is being converted to Cropland and, the carbon pool that is reported. For instance, concerning the living biomass carbon pool, some MS consider the carbon stocks from one year of growth in Cropland following conversion, while other simply consider that all the carbon stock in the land that is converted to cropland is lost.

Usually MS assume 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)

Under this category MS have included, among others, natural and artificial meadows, range lands, moors, forage crops, that can be subject to economical activities (e.g. grazing lands), or be considered unmanaged lands. In several instances, Grassland areas cover also woody lands (i.e. trees and shrub lands) when they do not fall into the forest thresholds.

In overall, these areas represent, at EU level, a net source of emissions that are below the emissions from the Settlement (i.e. conversions of lands to Settlements) and far from the emissions reported under Cropland.

Based on MS submissions, total Grassland area at the level of EU MS + Iceland covers 96.036 Kha in 2014.This represents 21% of the total reported areas. However, as for Cropland, these areas have constantly decreased since 1990 reaching a decrease of 4% in 2014.

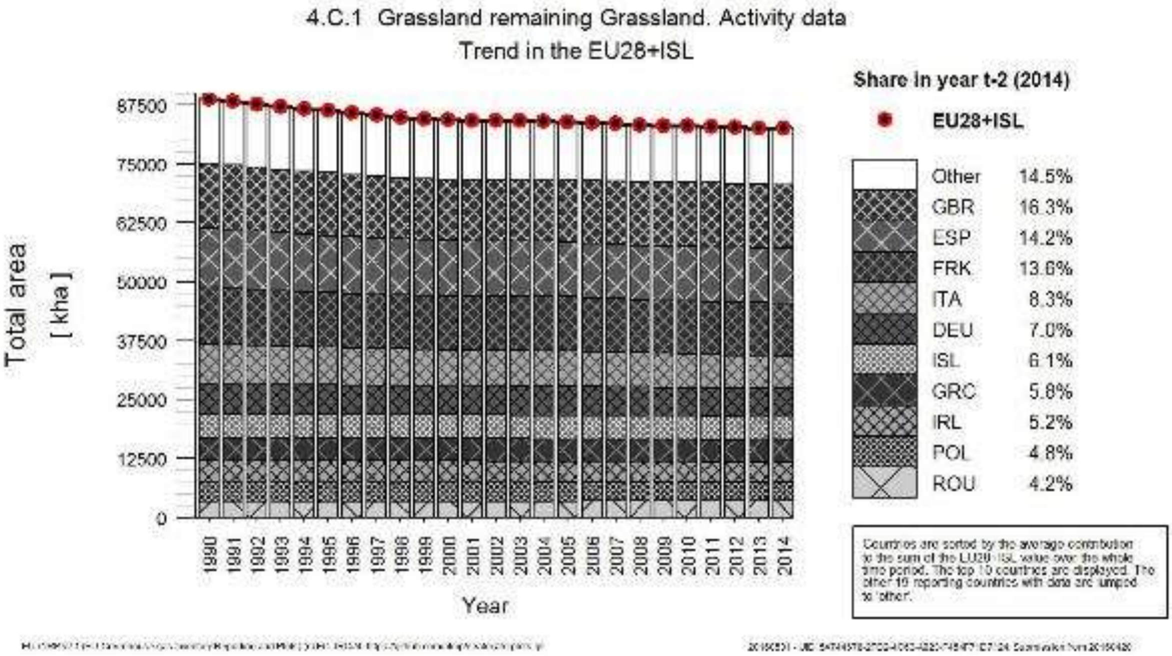
6.2.3.2 Grassland remaining Grassland (CRF 4C1)

Overview of Grassland remaining Grassland category

In 2014, total area reported under this subcategory reaches 82.546 Kha at the level of EU + Iceland. Following the general trend of these lands, this subcategory has also constantly decrease since 1990, and in 2014 it represents 8% less than the areas reported for the year 1990 (Figure 6.11).

Three MS (i.e. UK, Spain and France) reported about 45% of the total area of grassland remaining grassland, while the 10 MS with the larger contribution account for 85 % of the total EU area reported under this subcategory.

Figure 6.11 Trend of activity data in subcategory 4C1 "Grassland remaining Grassland" in EU MS (kha, 1990-2014)



In terms of emissions, this subcategory has been always resulted in a net source. In 2014, emissions reported at EU level reaches 26.489 kt CO_2, which represents a decrease of 39% as compared with the year 1990 (Table 6.21). Nevertheless, individual MS have reported this category either as a net source or as a net sink of emissions.

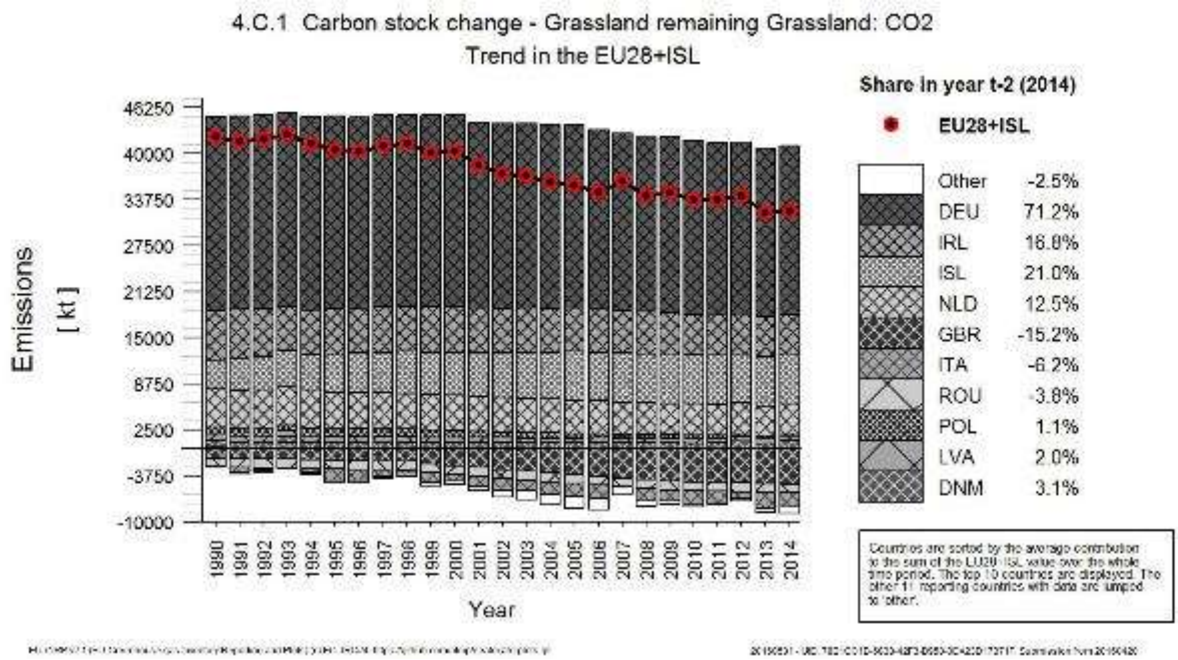
Table 6.21 4C1 Grassland remaining Grassland: MS' contributions to net CO_2 emissions (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	2	4	4	0%	0	0%	2	75%
Belgium	-43	-194	-195	-1%	0	0%	-151	-349%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	2	2	2	0%	0	0%	0	0%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	0	-273	-274	-1%	-1	0%	-274	-100%
Denmark	781	586	997	3%	411	70%	217	28%
Estonia	-39	175	4	0%	-171	-98%	42	110%
Finland	670	373	378	1%	6	1%	-292	-44%
France	0	0	0	0%	0	0%	0	0%
Germany	26 368	22 914	22 852	69%	-61	0%	-3 516	-13%
Greece	0	0	0	0%	0	7461%	0	-22%
Hungary	51	-3	-1	0%	2	61%	-52	-102%
Ireland	6 666	5 369	5 400	16%	30	1%	-1 267	-19%
Italy	5 228	-1 642	-885	-3%	757	46%	-6 113	-117%
Latvia	901	629	633	2%	4	1%	-269	-30%
Lithuania	81	82	82	0%	0	0%	1	1%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	5 196	4 070	4 016	12%	-54	-1%	-1 180	-23%
Poland	979	409	380	1%	-29	-7%	-599	-61%
Portugal	NO	-321	-330	-1%	-9	-3%	-330	-100%
Romania	-1 222	-1 222	-1 222	-4%	0	0%	0	0%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Sweden	-803	-470	-462	-1%	8	2%	341	42%
United Kingdom	-1 369	-4 814	-4 890	-15%	-76	-2%	-3 521	-257%
EU-28	**43 450**	**25 673**	**26 489**	**80%**	**815**	**3%**	**-16 961**	**-39%**
Iceland	3 942	6 725	6 736	20%	11	0%	2 793	71%
EU-28 + ISL	**47 392**	**32 398**	**33 224**	**100%**	**826**	**3%**	**-14 168**	**-30%**

The trend in emissions from this subcategory is driven by Germany, Ireland, Iceland and Netherlands (Figure 6.12). While for some of them, the share on total EU areas of grassland remaining grassland is not significant, all of them report important areas of managed organic soils in grasslands that generate a large amount of emissions.

By contrary some other MS have reported this subcategory as a net carbon sink. For instance, Romania or Italy that reports significant carbon sink from woody vegetation on grassland areas or UK that reports a substantial net sink from mineral soils.

Figure 6.12 Trend of emissions in subcategory 4C1 “Grassland remaining Grassland” in EU MS (1990-2014)



Methodological issues for Grassland remaining Grassland category

Despite different eco-regions and management approaches existing across the EU, definitions provided by MS of Grassland areas show good match with the IPCC land use definition (Table 6.22). One of the most significant differences that should be considered when comparing implied emissions factor is the presence or absence of reported unmanaged grassland.

In general, there are a wide-spread use of Tier 1 method for reporting carbon stock changes in living biomass and dead organic matter, which assumes no carbon stock changes for these pools. However, some MS have developed country-specific data and (or) methodologies to assess the changes in these pools (e.g. Estonia, Italy, Latvia and Sweden). When this is the case, the pools are generally reported as a net sink that is associated with the presence of woody biomass on these areas.

Under mineral soils, a significant number of MS have demonstrated that there are no changes over the time in the type of management practices that impact the carbon storage in the soils, or the absence of managed soils. In these cases, MS have reported the notation key NO. However, some others MS report this carbon pool by using IPCC methodology, with country-specific or default data.

For those MS that report presence of organic soils areas under grassland, this carbon pool has been always reported as a net source of emissions (Table 6.23)

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.
Iceland	All land where vascular plant cover is >20% and not included under the SL, FL, CL or WL categories. This category includes as subcategory land which is being revegetated and meeting the definition of the activity and does not fall into other categories. Drained wetlands not falling into other categories are included in this category. Grassland is represented by five subcategories on the Land use map, i.e. "Other grassland", "Land re-vegetated before 1990", "Land re-vegetated since 1990", "Grassland on drained soils", and "Natural birch shrubland".

Table 6.23 Implied net carbon stock change factors for carbon pools in 4C1 (t C ha-1 yr-1) reported by individual submissions in GHGI 2016.

Member States	Net carbon stock change in living biomass per area (t C/ha)		Net carbon stock change in dead organic matter per area (t C/ha)		Net carbon stock change in mineral soils per area (t C/ha)		Net carbon stock change in organic soils per area (t C/ha)	
	1990	2014	1990	2014	1990	2014	1990	2014
AUT	NO	NO	NO	NO	0.00	0.00	-0.25	-0.25
BEL	NO	NO	NO	NO	0.02	0.10	-2.50	-3.31
BGR	NO	NO	NO	NO	NO	NO	NO	NO
HRV	NO	NO	NO	NO	NO	NO	-2.50	-2.50
CYP	NE	NO	NE	NE	NE	NE	NO	NO
CZE	NO	NO	NO	NO	0.00	0.09	NO	NO
DNM	-0.04	-0.37	NO	NO	NO	NO	-8.40	-8.44
EST	0.12	0.08	0.00	0.01	NO	NO	-0.78	-0.78
FIN	0.39	0.39	NE	NE	NA	NA	-3.50	-3.50
FRK	0.00	0.00	NO	NO	NO	NO	NO	NO
DEU	-0.01	0.03	NO	NO	0.00	0.00	-6.34	-6.19
GRC	0.00	0.00	NO	NO	NO	NO	NO	NO
HUN	NO	NO	NO	NO	-0.01	0.00	NO	NO
IRL	NO	NO	NO	NO	0.00	0.01	-4.75	-3.94
ITA	-0.01	0.07	0.00	0.00	NA,NO	NA,NO	-2.50	-2.50
LVA	0.01	0.02	0.00	0.00	NO	NO	-6.10	-6.10
LTU	NO	NO	NO	NO	NO	NO	-0.25	-0.25
LUX	NO	NO	NO	NO	NO	NO	NO	NO
MLT	NO	NO	NO	NO	NO	NO	NO	NO
NLD	NE	NE	NE	NE	NE,NO	0.00	-4.56	-4.62
POL	NO	NO	NO	NO	-0.05	-0.02	-0.25	-0.25
PRT	NO	NO	NO	NO	NO	0.20	NO	NO
ROU	0.10	0.10	NO	NO	NO	NO	0.25	0.25
SVK	NO	NO	NO	NO	NO	NO	NO	NO
SVN	NA	NA	NA	NA	NA	NA	NA	NA
ESP	NE	NE	NE	NE	NE	NE	NO	NO
SWE	0.17	0.07	0.22	0.25	0.18	0.14	-1.40	-1.55
GBR	-0.01	0.00	NO	NO	0.04	0.11	NO,IE	NO,IE
ISL	0.00	0.00	0.00	0.00	0.00	0.00	-5.70	-5.70

6.2.3.3 Land converted to Grassland (CRF 4C2)

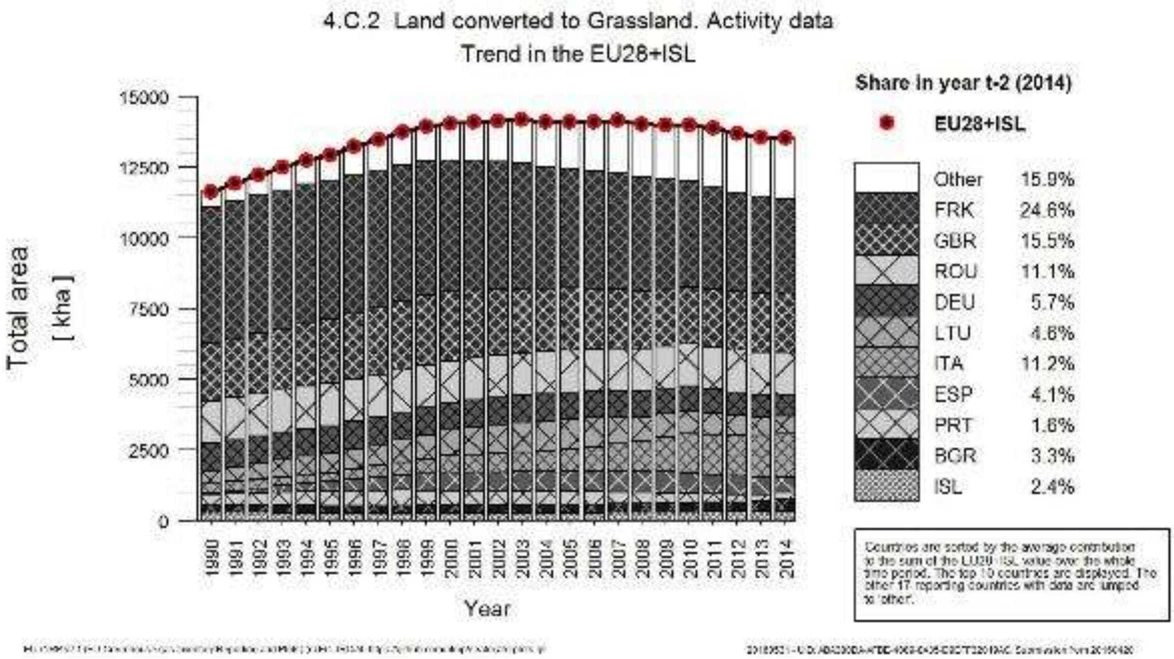
Overview of Land converted to Grassland category

In terms of area, this subcategory represents 14% of the total grassland areas reported at the level of EU MS + Iceland, however the carbon sink reported under this category offsets about 80% of the emissions resulting from grassland remaining grassland.

The area reported under this subcategory in 2014 reaches 13.162 Kha which represents an increase of 17% as compared with 1990 (Figure 6.13). Main conversions to grassland areas take place on original Forest land and Cropland areas.

The main drivers at EU level of the trend of new grassland areas are France, UK and Romania that report more that 50% of the total are converted to Grassland.

Figure 6.13 Trend of activity data in subcategory 4C2 "Land converted to Grassland" in EU MS (kha, 1990-2014)



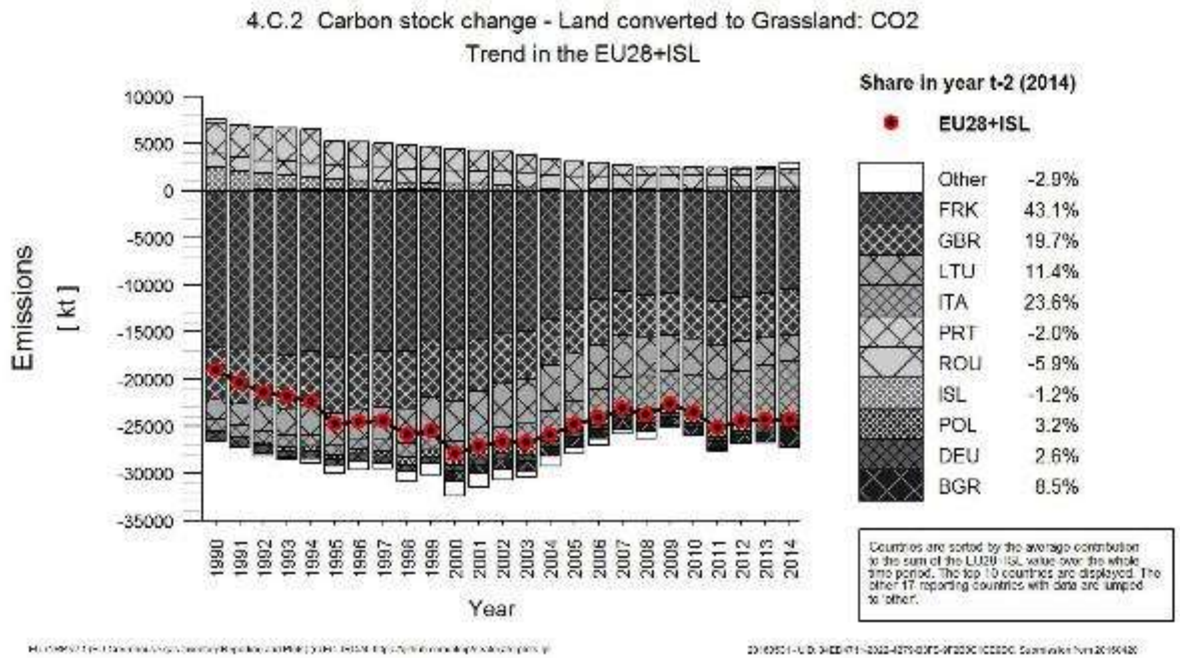
In term of emissions, in the year 2014, the conversions to Grassland represents at EU level a total net sink of 25.771 kt CO_2 that results in an increase of about 21% compared to the year 1990 (Table 6.24, Figure 6.14).

The trend in GHG emissions for this subcategory is driven by France, UK, Italy, Bulgaria and Lithuania which report a significant carbon sink on mineral soils a result of the conversion of croplands areas to grassland. By contrary, final net emissions from this subcategory as it has been reported for several MS (e.g. Romania and Spain) are associated with emissions from the conversion of forest land, and to a lesser extend from woody crops, to Grassland.

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	322	45	45	0%	-1	-1%	-277	-86%
Belgium	85	-281	-280	1%	2	1%	-364	-431%
Bulgaria	45	-1 043	-2 062	9%	-1 019	-98%	-2 107	-4686%
Croatia	-122	-66	-59	0%	8	12%	64	52%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	-145	-319	-295	1%	23	7%	-150	-103%
Denmark	25	30	277	-1%	247	838%	251	990%
Estonia	17	-33	-12	0%	22	65%	-29	-168%
Finland	176	228	234	-1%	5	2%	58	33%
France	-16 656	-10 915	-10 479	44%	435	4%	6 177	37%
Germany	-830	-663	-621	3%	42	6%	209	25%
Greece	0	-776	-851	4%	-74	-10%	-851	-2547695%
Hungary	-34	-242	-227	1%	14	6%	-193	-561%
Ireland	3	59	61	0%	1	2%	58	2137%
Italy	-1 275	-5 583	-5 726	24%	-143	-3%	-4 452	-349%
Latvia	0	-242	-220	1%	22	9%	-220	-9993761%
Lithuania	-2 037	-2 983	-2 770	12%	212	7%	-733	-36%
Luxembourg	49	-36	-32	0%	4	11%	-81	-166%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	287	385	417	-2%	32	8%	130	45%
Poland	-266	-831	-779	3%	52	6%	-513	-193%
Portugal	3 336	573	494	-2%	-79	-14%	-2 842	-85%
Romania	1 423	1 423	1 423	-6%	0	0%	0	0%
Slovakia	-202	-204	-185	1%	20	10%	18	9%
Slovenia	-529	104	119	0%	15	15%	648	123%
Spain	1	1 195	1 398	-6%	203	17%	1 397	97294%
Sweden	480	396	458	-2%	62	16%	-22	-5%
United Kingdom	-5 577	-4 461	-4 593	19%	-132	-3%	985	18%
EU-28	**-21 424**	**-24 241**	**-24 266**	**101%**	**-25**	**0%**	**-2 842**	**-13%**
Iceland	2 400	282	296	-1%	14	5%	-2 104	-88%
EU-28 + ISL	**-19 024**	**-23 960**	**-23 970**	**100%**	**-10**	**0%**	**-4 946**	**-26%**

Figure 6.14 Trend of emissions in subcategory 4C2 "Land converted to Grassland" in EU MS (kt CO_2, 1990-2014)



Methodological issues for Land converted to Grassland category

For estimating and reporting carbon stocks changes in this subcategory, IPCC default methodology is generally used. The implementation of country-specific emissions factors or default factors depend on which type of lands is being converted to Grassland and, the carbon pool that is reported. For instance, some while often MS only consider a gross quantity of the carbon loss from the conversion of forest lands to grassland, some other provide a net estimates on this carbon pool.

Usually MS assume 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.

6.2.4 Wetlands, Settlements and Other land (CRF Tables 4D, 4E, 4F)

6.2.4.1 Wetlands (CRF 4D)

In terms of area, this category reaches at the level of EU + Iceland 24.642 Kha, which represents 5% of the total reported areas. The trend is dominated by Sweden and Finland which, equal that all the others MS, have reported constant values across the time series, at least as regards to the dominant subcategory of wetlands remaining wetlands (Figure 6.15).

The other subcategory, land converted to wetlands, represents only 6% of the wetlands area and 7% of the final net emissions reported within the category. However, these areas that are dominated, in overall, by Romania and France, have increased by 72%, as compared with 1990, as a result of new areas reported by Sweden.

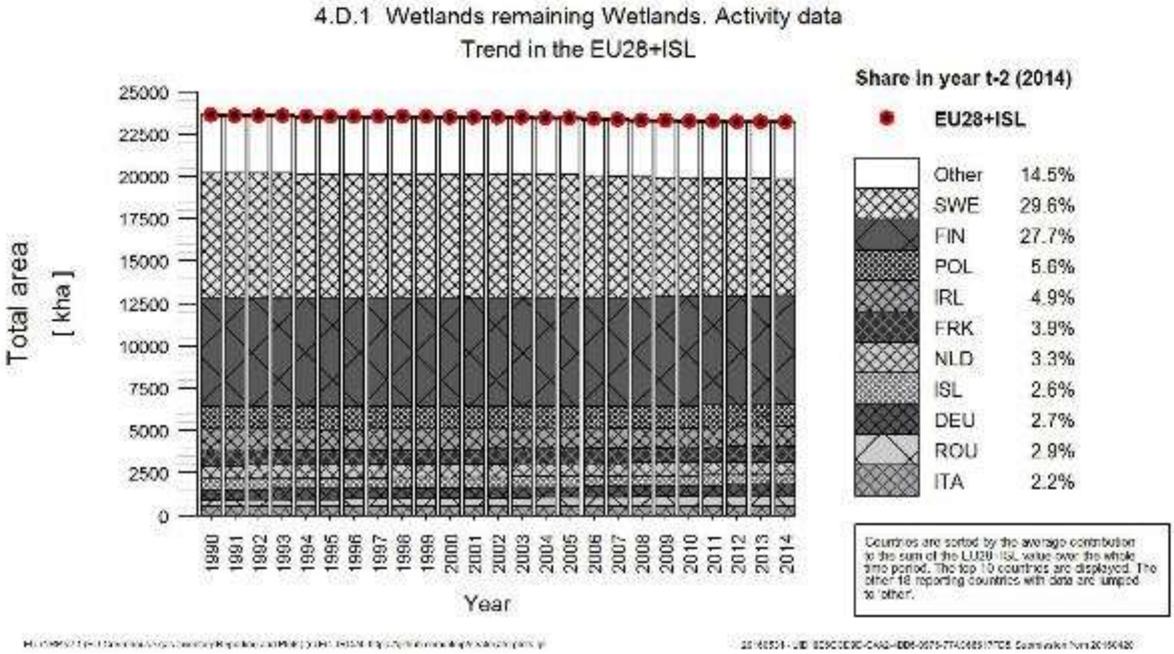
In terms of emissions, Wetlands remaining wetlands reaches for the year 2014 about 16.000 Kt CO_2. Both subcategories, 4A1 and 4D2, have been in overall reported as a net source of emissions, however, in some instances, they have been reported as a net carbon sink.

Under this category, 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. For instance, this happens when areas within wetlands include flooded lands, or other wetlands that are not subject to management activities.

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. Within the EU Poland, Germany, Ireland and Finland are the main driver of the EU trend.

By contrary, Iceland under 4D1, and France under 4D2, report a significant amount of GHG removals as a result respectively of intact mires and the conversion of lands to other wetlands.

Figure 6.15 Trend of activity data and emissions in subcategory 4D1 "Wetlands remaining Wetlands" in EU MS (kha, Kt CO_2, 1990-2014)



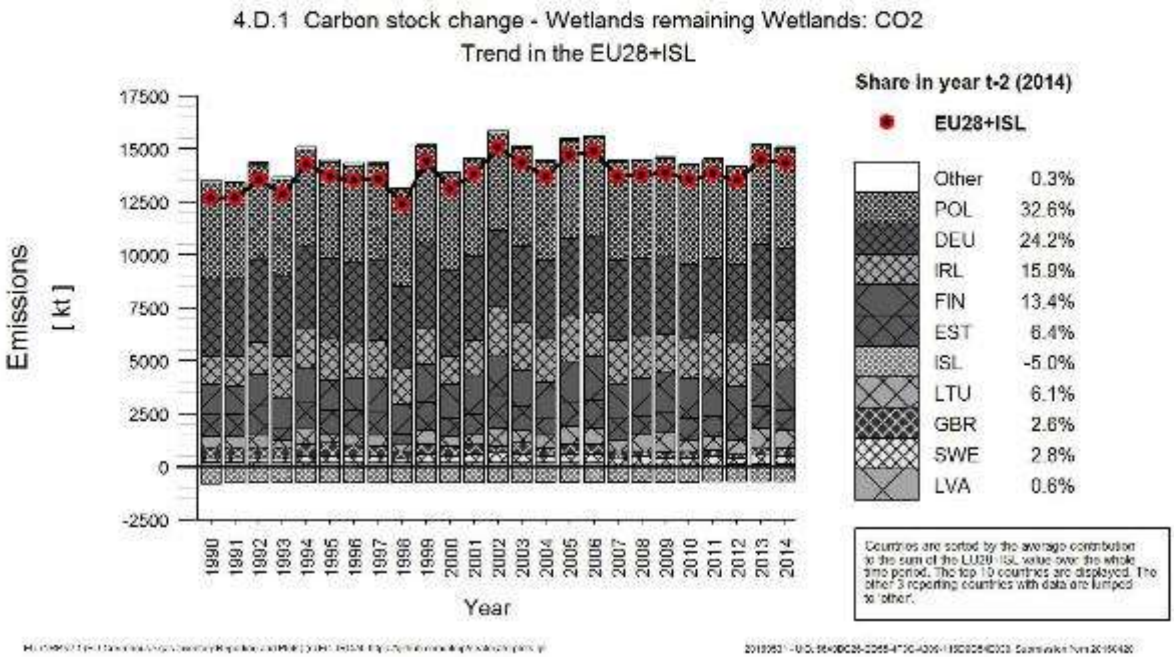
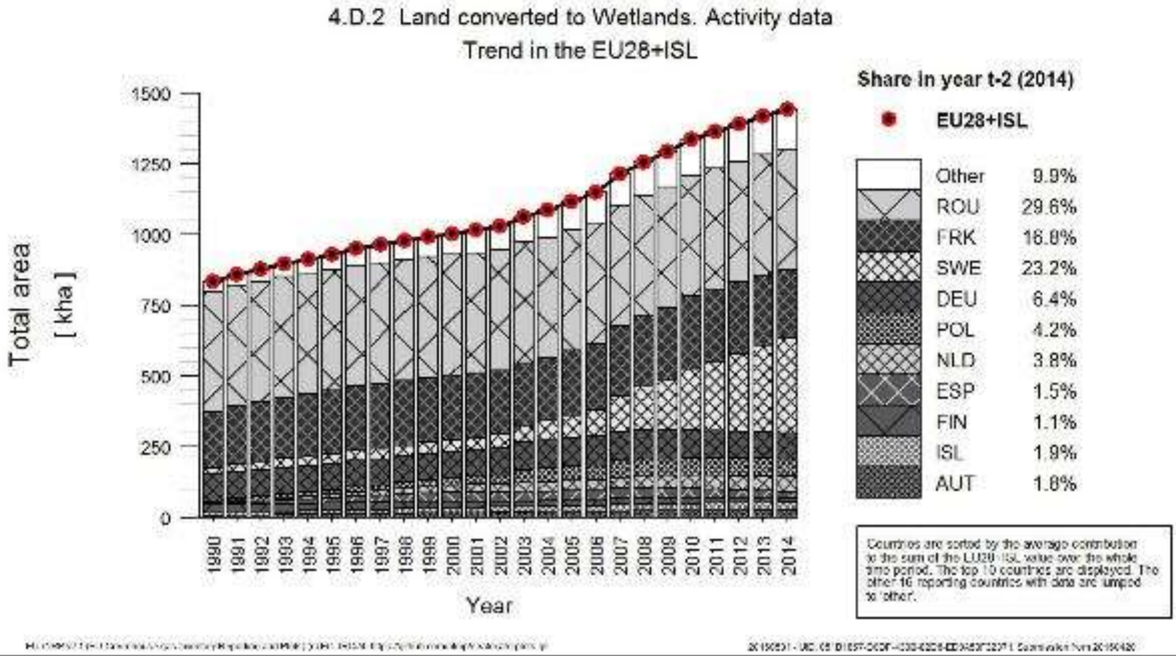


Figure 6.16 Trend of activity data and emissions in subcategory 4D2 "Lands converted to Wetlands" in EU MS (kha, Kt CO_2, 1990-2014)



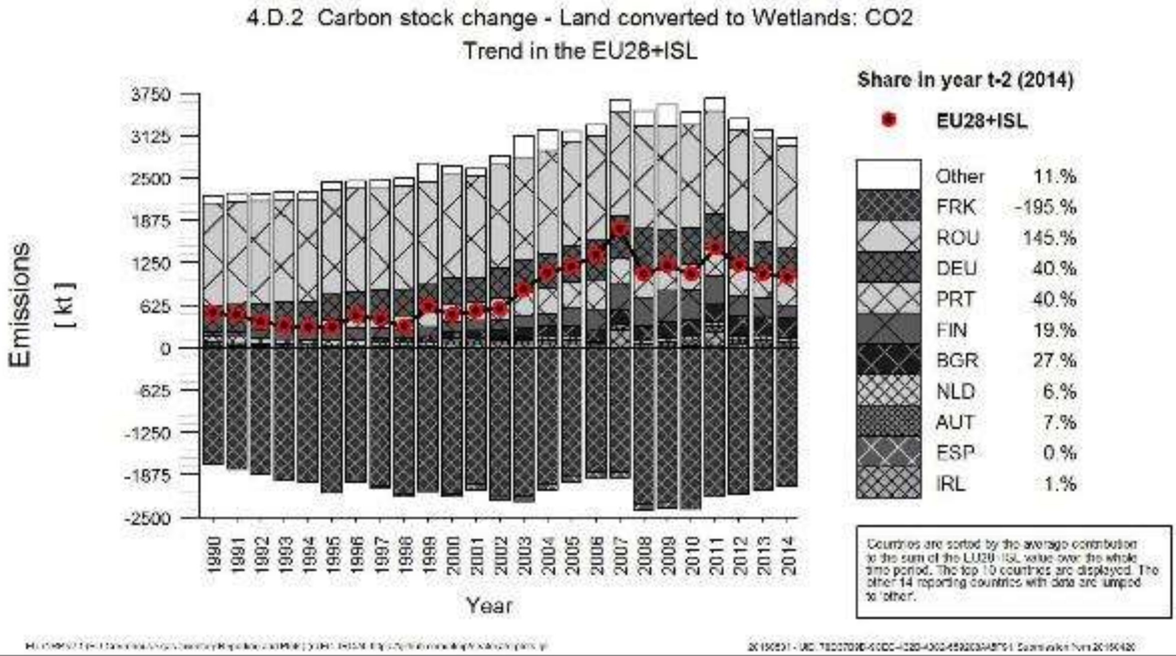


Table 6.25 Definitions of land included by MS under the category 4D Wetlands

Member State	Definition
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.
Iceland	All land that is covered or saturated by water for all or part of the year and does not fall into the SL, FL and CL categories. It includes intact mires and reservoirs as managed subdivisions and natural rivers and lakes as unmanaged subdivision. Wetland is in the land use map represented as three classes; “Lakes and rivers”, “Reservoirs”, and “Other Wetland”.

6.2.4.2 Settlements (CRF 4E)

In terms of area this land use category represents, at the level of EU + Iceland, 29.666 kha, and 6% of the total reported areas. In 2014, Settlement areas have increased by 24 % as compared with 1990.

The expansion of these areas, which generally include urban areas, either sealed or unsealed, transport infrastructures, and industrial and commercial units, has been driven by the abandonment of Cropland and the conversion of Grasslands.

In terms of emissions this land use category is reported a net source of emissions that reaches in 2014 50.244 Kt CO_2. Out of this, 94% are due to emissions resulting from Land converted to Settlement, which in term of areas represent only 22% of the total category, and mainly due to emissions from the loss of 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

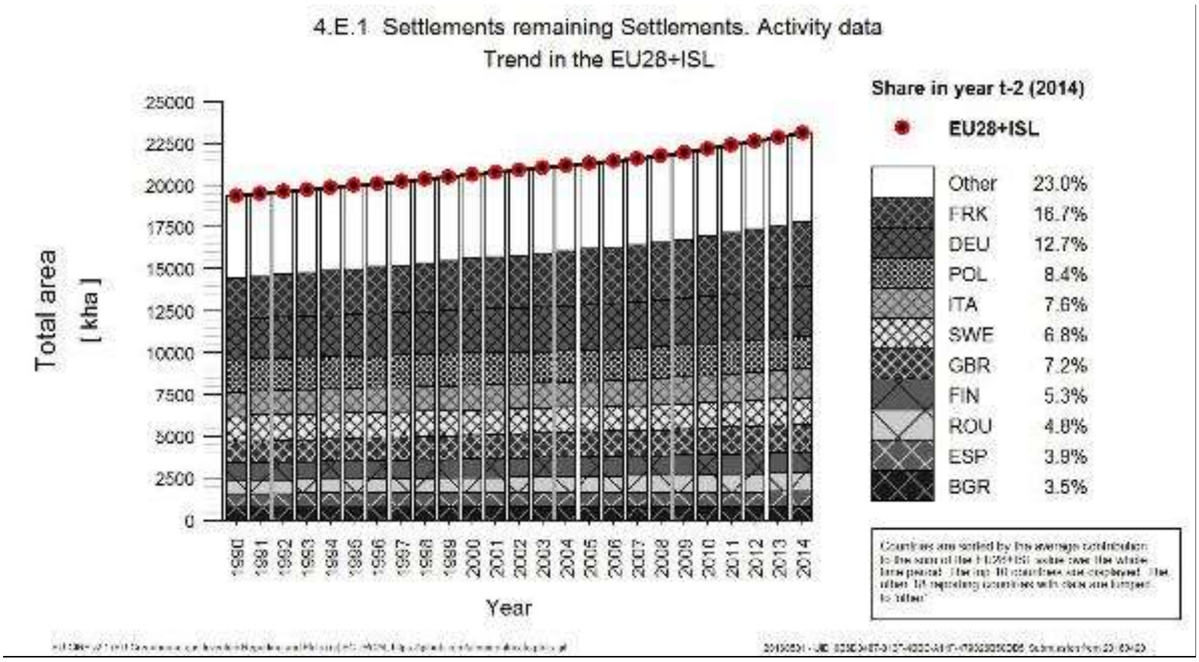
Member State	Definition
Austria	Includes buildings land: sealed, partly sealed and unsealed areas; parks and gardens; roads and railway tracks; excavation areas, and other not further differentiated settlement area.
Belgium	All developed land, including transportation infrastructure and human settlements 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.
Iceland	All areas included within map layers "Towns and villages" and "Airports" as defined in the IS geographical database. Also included as Settlement are roads classified with 15 m wide road zone, including primary and secondary roads. Roads within forest land are excluded as road zone does not reach 20 m. Settlement is in the land use map represented as two classes; "Settlements towns" and "Settlements other".

As regards with the methods used by MS for reporting carbon stock changes in these areas, most of the MS have used the Tier 1 assumption of equilibrium for reporting carbon pools under the subcategory 4E1. Therefore notation key NO is included in the CRF tables.

Nevertheless, some MS have reported this subcategory as a net source of emissions. For instance, Germany and Netherlands that have reported emissions as a result of disturbed organic soils in this areas, and UK from mineral soils.

By contrary, Sweden, Latvia, Poland and Slovenia have reported this subcategory as a net sink of carbon due to removals from living biomass of green areas (Figure 6.17, Figure 6.18).

Figure 6.17 Trend of activity data and emissions in subcategory 4E1 "Settlements remaining Settlements" in EU MS (kha, kt CO_2 1990-2014)



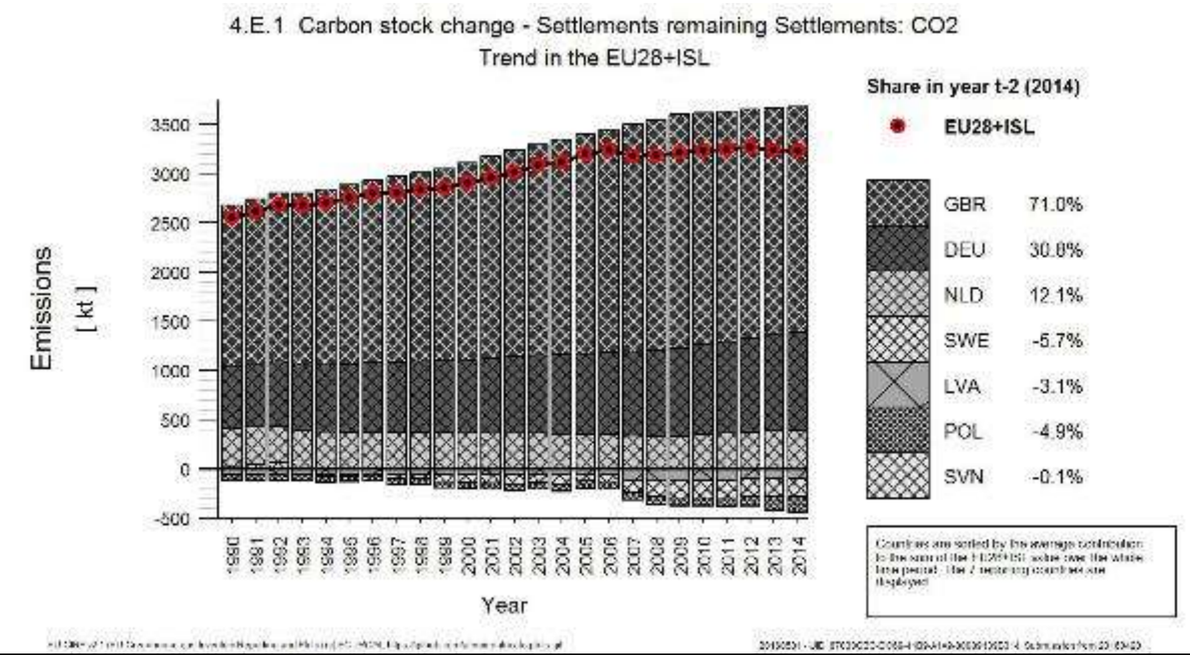
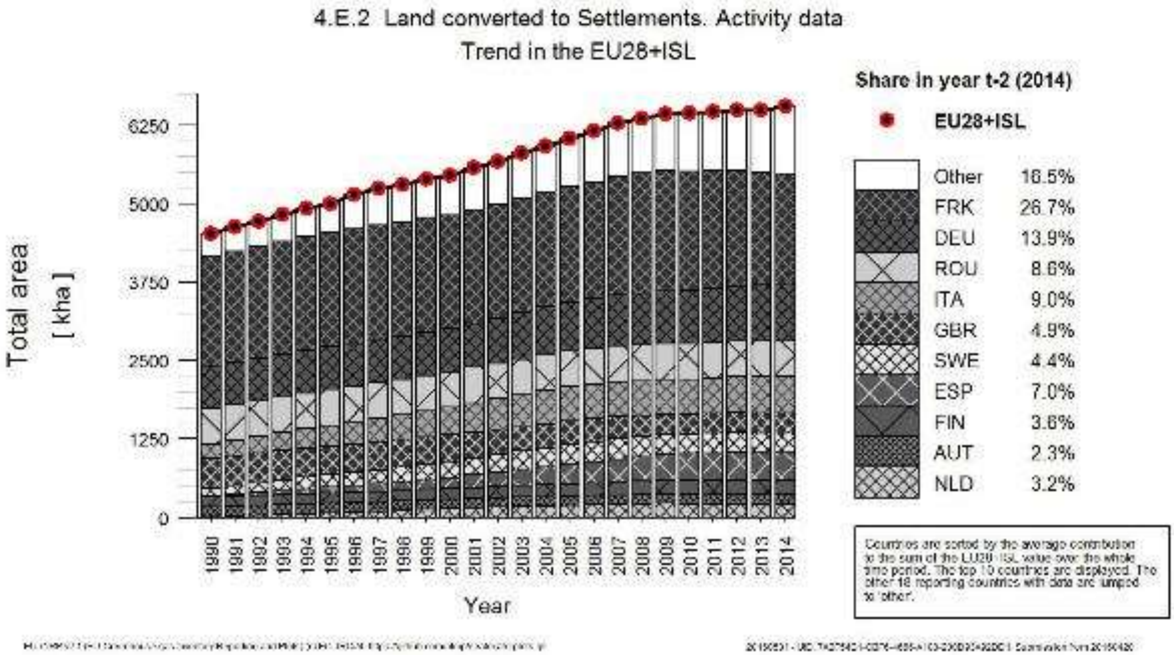
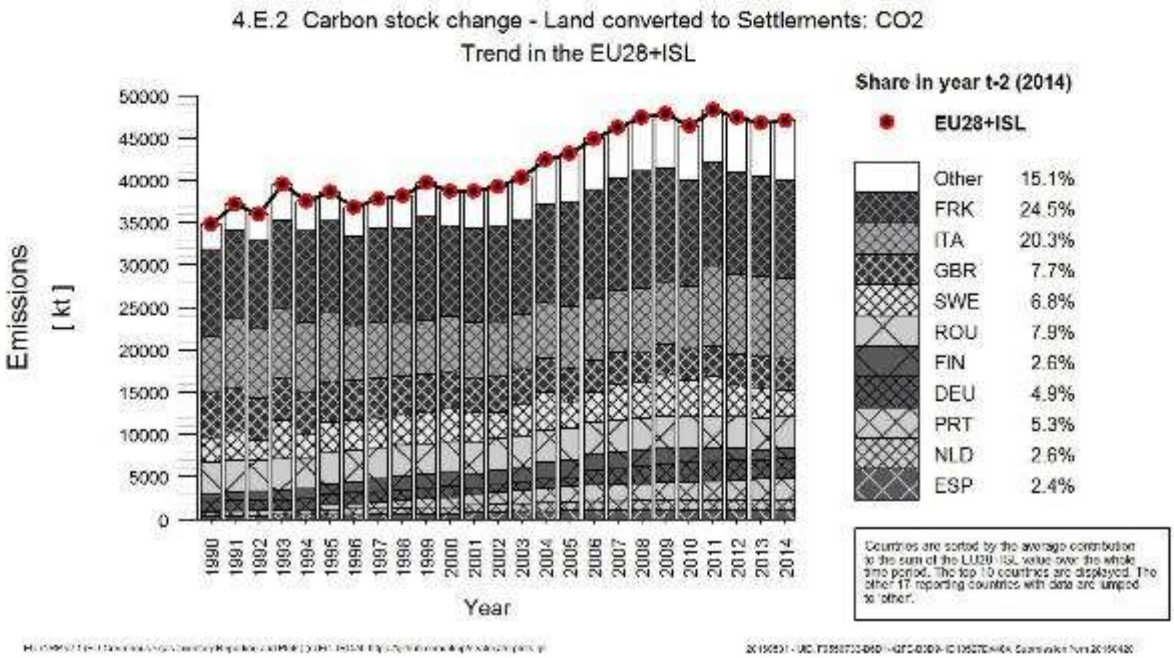


Figure 6.18 Trend of activity data and emissions in subcategory 4E2 "Land converted to Settlements" in EU MS (kha, kt CO_2 1990-2014)





Annual emissions from Land converted to Settlements have increased by 35% since 1990 (Table 6.27, Figure 6.18). In 2014 this subcategory was reported as a net source of emissions of 47.009 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 and loss of living biomass from FOREST LAND (France, Italy, Romania and UK). 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 Land converted 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	390	215	220	0%	4	2%	-170	-44%
Belgium	237	619	620	1%	1	0%	382	161%
Bulgaria	698	1 025	933	2%	-92	-9%	234	34%
Croatia	197	647	645	1%	-1	0%	448	227%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	85	89	128	0%	39	44%	43	50%
Denmark	13	82	44	0%	-38	-46%	32	250%
Estonia	1	320	325	1%	5	2%	324	24832%
Finland	943	1 296	1 217	3%	-79	-6%	274	29%
France	10 266	11 761	11 519	24%	-243	-2%	1 253	12%
Germany	1 175	2 150	2 305	5%	155	7%	1 129	96%
Greece	6	13	11	0%	-2	-15%	5	86%
Hungary	115	235	257	1%	22	9%	142	123%
Ireland	74	63	60	0%	-3	-5%	-14	-19%
Italy	6 641	9 544	9 547	20%	3	0%	2 906	44%
Latvia	167	1 003	952	2%	-51	-5%	785	471%
Lithuania	NO	334	373	1%	39	12%	373	100%
Luxembourg	145	75	72	0%	-3	-4%	-74	-51%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	509	1 205	1 223	3%	18	1%	714	140%
Poland	389	1 097	1 995	4%	898	82%	1 605	412%
Portugal	30	2 428	2 508	5%	80	3%	2 477	8125%
Romania	3 700	3 700	3 700	8%	0	0%	0	0%
Slovakia	96	96	81	0%	-15	-16%	-15	-16%
Slovenia	399	387	379	1%	-8	-2%	-20	-5%
Spain	393	1 127	1 140	2%	13	1%	747	190%
Sweden	2 904	3 633	3 206	7%	-428	-12%	301	10%
United Kingdom	5 250	3 613	3 606	8%	-7	0%	-1 644	-31%
EU-28	**34 826**	**46 756**	**47 063**	**100%**	**307**	**1%**	**12 238**	**35%**
Iceland	13	5	5	0%	0	2%	-8	-64%
EU-28 + ISL	**34 839**	**46 761**	**47 068**	**100%**	**307**	**1%**	**12 229**	**35%**

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 generally 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 land use category Other land reaches in the year 2014 at the level of the EU + Iceland 16.808 Kha, which represents about 4% of the total reported areas. This land use category has been reported as rather constant across the years as a result of the balance among the decrease in the subcategory 4E.1 and the increase in the subcategory. 4E.2 (Figure 6.19, Figure 6.20).

Main areas under Other land category are reported by Sweden and Island, while new areas under the subcategory 4E.2 are mainly reported by Portugal, France and Bulgaria but without a clear pattern on the lands that are converted to Other land.

Definitions implemented to report Other land are close amongst MS and match IPCC general description (Table 6.28). In most of the cases, following the IPCC approach, this category is used to ensure that total area reported for this sector is consistent along the time series, and it matches official country area. To this aim, this land category has the lower hierarchy level and MS include in it all the areas that had not identified under any other land use category (Table 6.6.28).

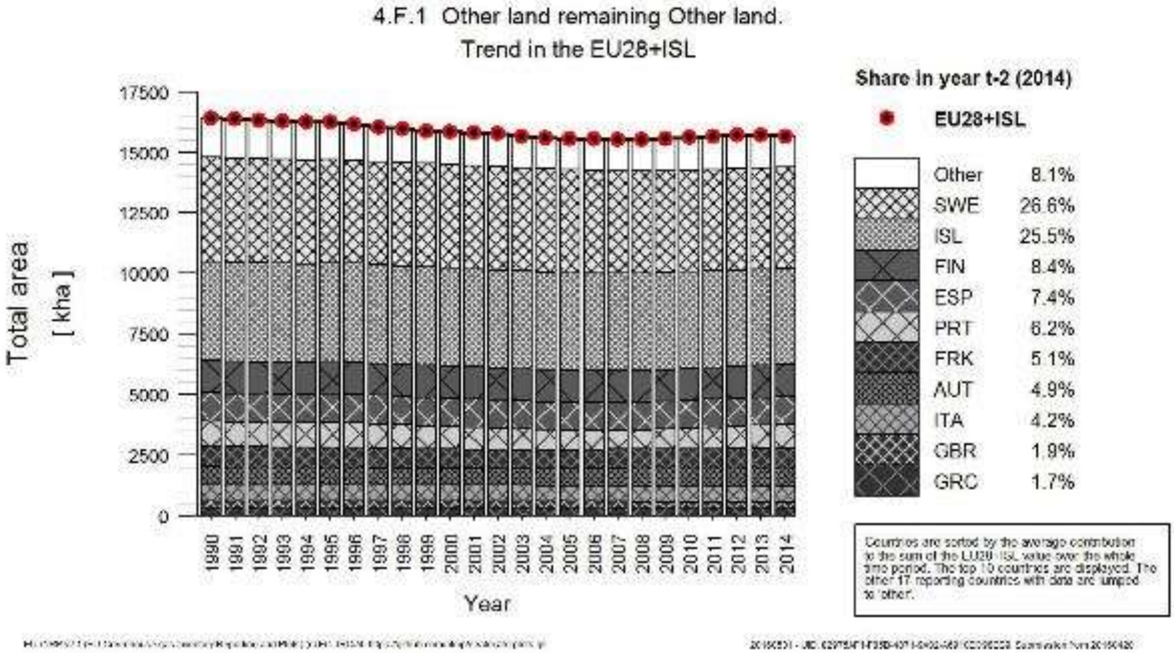
Noteworthy is the case of Ireland, which reports for the year 2006 a significant amount of emissions from Forest land converted to Other land. This is due to a former area of peat extraction (pre-1990) that was abandoned and then (since 1990) classified as forest, subsequently, a dump was built there and the area was reclassified as Other land. Ireland has informed that a process is ongoing to improve the reporting of these emissions..

Table 6.6.28 Definition for the categorization of lands under 4F - Other land

Member State	Definition
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.
Iceland	This category includes bare soil, rock, glaciers and all land that does not fall into any of the other categories. All land in this category is unmanaged. This category allows the total area of identified land to match the area of the country. Other land is represented as two classes; “Glaciers and perpetual snow” and “Other land”.

In terms of emissions, Other land represents a net source of emissions as a result of the conversion from other land use categories to Other land. It reaches for the year 2014, at the level of EU + Iceland, 2.100 kt CO_2. Specifically, emissions are the result of the loss of carbon storage in the living biomass and in the soil of the lands that are converted to Other land. However, some MS have reported a net sink from mineral soils, and Portugal reports all the carbon pools as a net sink under these conversions.

Figure 6.19 Trend of activity data in subcategories 4F1 and 4F2 "Other land remaining Other Land" and "Land converted to Other land in EU MS (kha, kt CO_2 1990-2014)



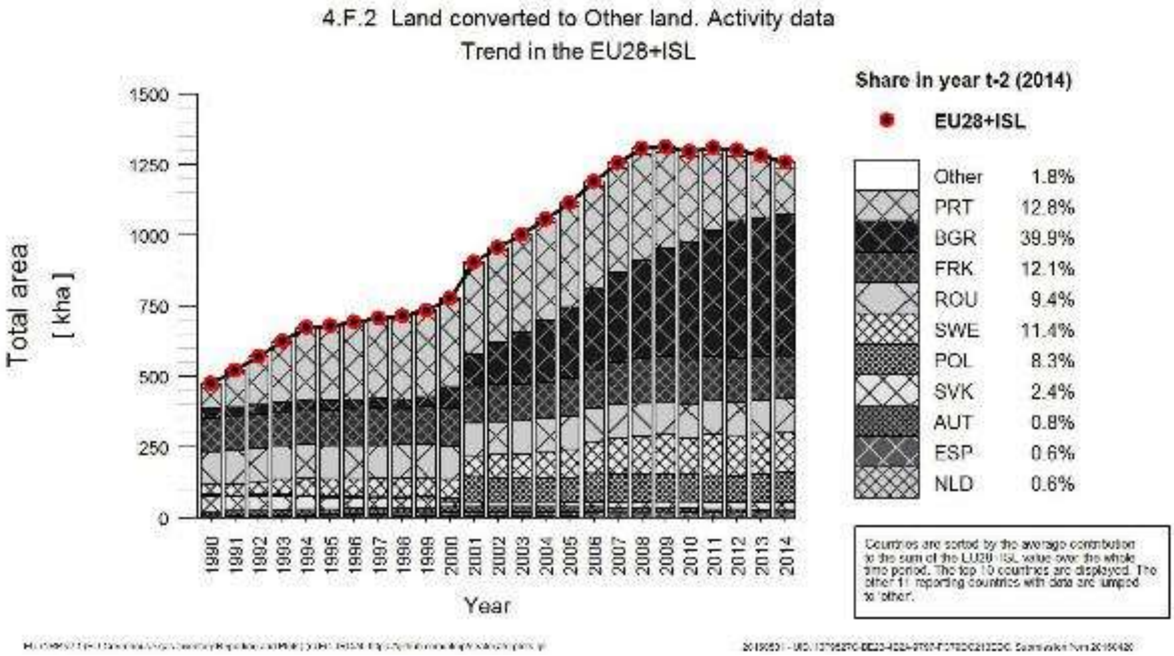
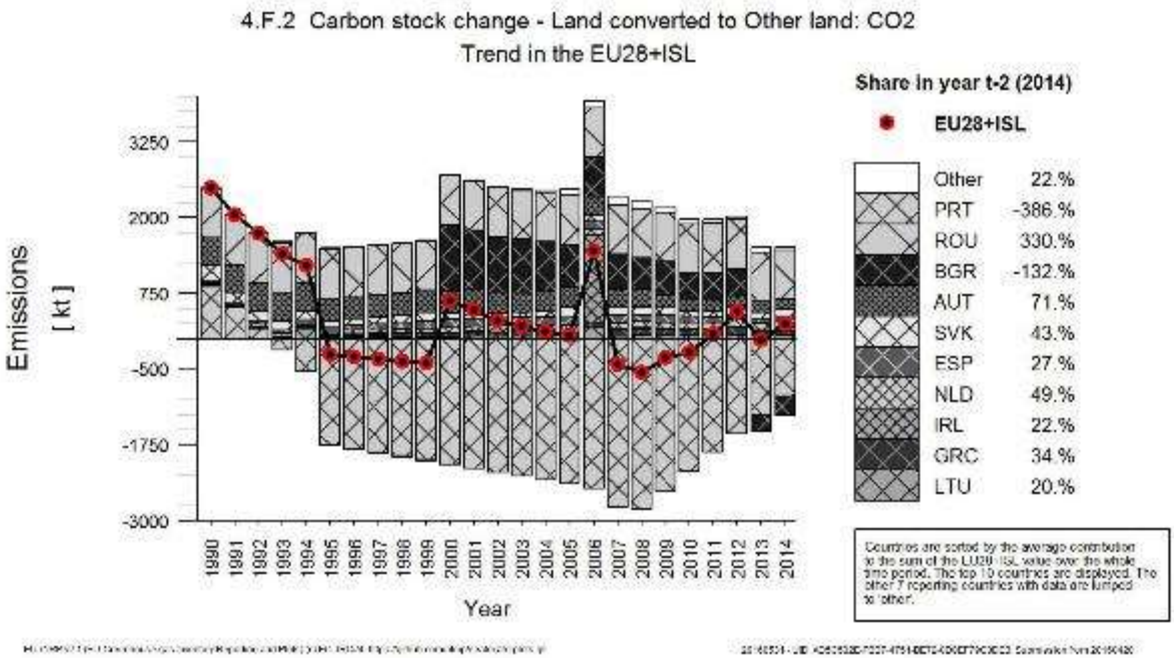


Figure 6.20 Trend of emissions in subcategory 4F2 "Land converted to Other lands" in EU MS (kt CO_2, 1990-2014)



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))

Under CRF table 4(I) MS reports N_2O emissions resulting from the addition of organic and inorganic fertilizers to managed soils under other land use categories than Cropland and Grassland.

The majority of MS stated that fertilization is not a management practice of forests, while if any, emissions from the addition of Nitrogen inputs in Wetlands, and or Settlements (in some case also under forests) are often reported under Agriculture sector when it was not possible to separate emissions by land use category. Therefore under the LULUCF almost all the MS have reported these emissions using the notation key NO or IE (Table 6.29).

Exceptions are given by Finland, Sweden and the UK, which report N_2O emissions under this source category due to forest fertilization. Sweden reports half of the total emissions at the EU level from N fertilization as a result of N inputs occasionally applied to increase the wood production in older forests stands. And, Finland reports almost the other half of emissions as a result of forest growth fertilizations and, to a lesser extent, forest vitality fertilizations.

Activity data for reporting this source of emissions results from national or sectorial statistics (e.g. sales statistics) which provide the total amount and type of fertilizer, which along with the IPCC default value of 0.01 kg N_2O-N/kg N $yr^{-1}$is mainly used to derive N_2O emissions from nitrogen inputs to managed 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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		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	0	NO	NO	-	-	-	0	-
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	21	13	13	44%	0	2%	-7	-35%
France	NO	NO	NO	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	IE,NA,NO	IE,NA,NO	NO,IE	-	-	-	-	-
Ireland	NO,NE,IE	NO,NE,IE	NE,NO,IE	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NA,NO	NA,NO	NO	-	-	-	-	-
Netherlands	NE,NO,IE	NE,NO,IE	NE,NO,IE	-	-	-	-	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Romania	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	49	17	16	52%	-1	-5%	-33	-68%
United Kingdom	5	1	1	4%	0	32%	-3	-70%
EU-28	**74**	**31**	**31**	**100%**	**0**	**-1%**	**-44**	**-59%**
Iceland	0	0	0	0%	0	-5%	0	267%
EU-28 + ISL	**74**	**31**	**31**	**100%**	**0**	**-1%**	**-44**	**-59%**

N_2O emissions from nitrogen inputs to managed soils in 2014 reaches 31 kt CO_2 equivalent, which represents about 60% less than in 1990.

6.2.5.2 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (CRF Table 4(II))

Under CRF table 4(II), MS report CO_2, CH_4 and N_2O emissions and removals from drainage and rewetting and other management of organic and mineral soils areas. However, part of these emissions are already covered under other sectors, so MSs need to avoid double counting (e.g. nitrous oxide emissions from drained cropland and grassland soils are covered in the agriculture sector) or they may be reported under other tables within the LULUCF (e.g. CO_2 emissions or removals from drainage of wetlands areas already included in tables 4.A to 4.F).

For the year 2014, total emissions from this source category reaches 12.949 kt CO_2 equivalent (Table 6.30, Table 6.31, and Table 6.32). These are reported mainly by UK, Finland, Sweden and Iceland

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Cyprus	NO	NO	0	0%	0	-	0	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	-	-	-	-	-	-	-	-
Estonia	IE,NA,NO	IE,NA,NO	NA,NO,IE	-	-	-	-	-
Finland	NA,NO,IE	NA,NO,IE	NA,NO,IE	-	-	-	-	-
France	NO	NO	NO	-	-	-	-	-
Germany	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	2	7	7	0%	0	-3%	5	295%
Ireland	477	407	410	10%	3	1%	-67	-14%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	1 017	936	922	23%	-14	-1%	-95	-9%
Lithuania	406	431	433	11%	2	0%	27	7%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	,NA,NO,IE	,NA,NO,IE	,NA,NO,IE	-	-	-	-	-
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	NA,NO,IE	-	-	-	-	-
United Kingdom	1 879	1 879	1 879	48%	0	0%	0	0%
EU-28	**3 780**	**3 659**	**3 650**	**93%**	**-10**	**0%**	**-130**	**-3%**
Iceland	286	291	292	7%	0	0%	6	2%
EU-28 + ISL	**4 066**	**3 951**	**3 941**	**100%**	**-9**	**0%**	**-124**	**-3%**

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	26	23	23	0%	0	0%	-3	-11%
Estonia	1	2	2	0%	0	0%	0	15%
Finland	1 214	1 207	1 207	23%	-1	0%	-8	-1%
France	NO	NO	NO	-	-	-	-	-
Germany	235	299	304	6%	4	1%	69	29%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	0	1	1	0%	0	0%	1	793%
Ireland	104	182	183	4%	1	0%	79	76%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	571	642	643	12%	1	0%	71	12%
Lithuania	39	40	35	1%	-4	-11%	-4	-9%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	E,NA,NO,IE	E,NA,NO,IE	E,NA,NO,IE	-	-	-	-	-
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	983	1 074	1 083	21%	9	1%	100	10%
United Kingdom	45	46	46	1%	0	0%	1	2%
EU-28	**3 246**	**3 543**	**3 554**	**69%**	**10**	**0%**	**307**	**9%**
Iceland	1 428	1 627	1 634	31%	7	0%	206	14%
EU-28 + ISL	**4 674**	**5 170**	**5 188**	**100%**	**17**	**0%**	**514**	**11%**

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Cyprus	NO	NO	0	0%	0	-	0	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	14	196	242	4%	46	23%	228	1573%
Estonia	0	0	0	0%	0	0%	0	15%
Finland	1 534	921	920	17%	0	0%	-614	-40%
France	NO	NO	NO	-	-	-	-	-
Germany	869	865	864	16%	-1	0%	-5	-1%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NA,NO	NA,NO	NO	-	-	-	-	-
Ireland	117	318	321	6%	3	1%	204	174%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	280	355	370	7%	15	4%	91	32%
Lithuania	NO,NE	NO,NE	NE,NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	NE,NA,NO,IE	NE,NA,NO,IE	NE,NA,NO,IE	-	-	-	-	-
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	458	473	476	9%	3	1%	17	4%
United Kingdom	NE,NA,NO	NE,NA,NO	NE,NA,NO	-	-	-	-	-
EU-28	**3 273**	**3 128**	**3 194**	**59%**	**67**	**2%**	**-79**	**-2%**
Iceland	2 374	2 258	2 254	41%	-3	0%	-120	-5%
EU-28 + ISL	**5 648**	**5 386**	**5 449**	**100%**	**63**	**1%**	**-199**	**-4%**

6.2.5.3 Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils (CRF Table 4(III))

Under CRF table 4(III), direct nitrous oxide emissions from nitrogen mineralization associated with loss of soil organic matter resulting from change of land use or management of mineral soils are reported by almost all the MS.

For the year 2014, this source category reaches a net emission of 8.865 kt CO_2 equivalent, which represent a slightly decrease as compared to 1990. Significant emissions under this category are reported by France, Romania and Ireland (Table 6.33) and in most of the MS report these emissions by using IPCC methodologies and default emissions factors.

In some cases these emissions have not been reported or, they have been estimated only for land converted to Cropland, ever if loss of soil organic matter is reported in CRF table 4A-4F. In these cases, all the MS have been contacted, and they acknowledged the need to implement improvements to deal with this potential underestimation of emissions in future submissions.

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	15	19	19	0%	0	0%	4	26%
Belgium	10	108	108	1%	0	0%	98	984%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	4	6	6	0%	0	1%	2	42%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	9	5	5	0%	0	-1%	-4	-44%
Denmark	0	5	7	0%	1	21%	6	3471%
Estonia	NO	6	6	0%	0	1%	6	100%
Finland	28	31	31	0%	0	0%	3	10%
France	2 137	1 931	1 934	22%	3	0%	-203	-9%
Germany	482	442	443	5%	1	0%	-40	-8%
Greece	0	0	0	0%	0	25%	0	4293%
Hungary	24	45	43	0%	-1	-3%	19	80%
Ireland	18	144	145	2%	1	1%	126	685%
Italy	551	692	686	8%	-6	-1%	135	25%
Latvia	2	44	49	1%	5	12%	48	3194%
Lithuania	426	368	385	4%	17	5%	-42	-10%
Luxembourg	5	3	3	0%	0	-6%	-2	-39%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	6	117	123	1%	6	5%	117	2081%
Poland	2	44	59	1%	15	34%	57	2291%
Portugal	507	341	341	4%	1	0%	-166	-33%
Romania	1 305	1 816	1 816	20%	0	0%	511	39%
Slovakia	75	16	16	0%	1	4%	-59	-78%
Slovenia	3	4	4	0%	0	-1%	1	21%
Spain	17	186	174	2%	-12	-6%	157	920%
Sweden	68	183	179	2%	-4	-2%	110	162%
United Kingdom	1 019	665	655	7%	-10	-2%	-364	-36%
EU-28	**6 715**	**7 219**	**7 237**	**82%**	**18**	**0%**	**522**	**8%**
Iceland	1 427	1 622	1 629	18%	7	0%	202	14%
EU-28 + ISL	**8 142**	**8 841**	**8 865**	**100%**	**24**	**0%**	**723**	**9%**

6.2.5.4 Indirect nitrous oxide (N_2O) emissions from managed soils (CRF Table 4(IV))

This source category covers indirect N_2O emissions from managed soils. Under certain conditions and land use categories, these emissions can be reported under Agriculture sector. For instance, those associated with the addition on nitrogen inputs on Cropland and Grassland or with the mineralization of nitrogen associated with loss of soil organic matter resulting from change of land use or management on mineral soils in Cropland remaining Cropland. Moreover, when the sources of nitrogen cannot be separated other than between cropland and grassland, these emissions should be reported also under Agriculture.

Therefore, given that most of the fertilizer are added in Cropland and Grassland areas according to the CRF table 4 (I) and that direct nitrogen emissions are mostly reported so far under Cropland remaining Cropland, the majority of the MS have reported in the CRF table 4(IV) the notation key IE (i.e. included elsewhere)

For the year 2014, indirect N_2O emissions reported under LULUCF reach 119 kt CO_2 equivalent (Table 6.34). These emissions are mainly reported by Germany, and to a lesser extent, by Czech Republic, Latvia, Finland, and Sweden. Others MSs have acknowledged the need to review their methodologies and implement improvements in order to provide an estimates for nitrogen indirect emissions in future submissions.

Table 6.34 Indirect nitrous oxide (N_2O) emissions from managed soils

Member State	N20 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	IE	IE	IE	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	IE	IE	IE	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	4	2	2	42%	0	-1%	-2	-44%
Denmark	IE	IE	IE	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NA	NA	NA	-	-	-	-	-
France	NO	NO	NO	-	-	-	-	-
Germany	IE	IE	IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	IE	IE	IE	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	IE	IE	IE	-	-	-	-	-
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	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Slovakia	IE	IE	IE	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	10	3	3	58%	0	-5%	-7	-68%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-28	**14**	**6**	**5**	**100%**	**0**	**-4%**	**-8**	**-61%**
Iceland	IE	IE	IE	-	-	-	-	-
EU-28 + ISL	**14**	**6**	**5**	**100%**	**0**	**-8%**	**-17**	**-121%**

6.2.5.5 CO_2, CH_4 & N_2O emissions from Biomass Burning (CRF Table 4(V))

This source category covers CO_2, and non-CO_2 emissions from biomass burning as a result of wildfires and controlled burning, on any type of land use.

Following the IPCC approach, many MS that implement the stock-different method to estimate carbon stock changes in forest living biomass use the notation key IE in the CRF table 4 (V) so avoiding double counting of CO_2 emissions.

In general, controlled burning on managed lands is not a common practice in the EU, with few exceptions for confined areas (.e.g. Finland, Sweden, and UK in forest lands and, Spain and UK in grasslands). In addition, northern MS report negligible emissions from biomass burning (i.e. controlled burning and wildfires).

Methodologies used to report CO_2 emissions for fires are always based on Tier 2 methods by using information on activity data provided by national statistics and country-specific emission factors. By contrary, Tier 1 methodologies are mainly used for estimation of CH_4 and N_2O emissions resulting from fires.

Overall, emissions from biomass burning decreased in 2014 compared to 1990 (Table 6.35). Nevertheless, their trends are related to wildfire incidence, which is characterized by a large inter-annual variability driven mainly by climate conditions. MS that often report the larger quantities of emissions as a result of the biomass burning are Italy, France, Spain, and Greece.

Table 6.35 CO_2 emissions from Biomass Burning (in kt CO_2)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2	%	kt CO2	%
Austria	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Belgium	5	NO	NO	-	-	-	-5	-100%
Bulgaria	IE,NO	IE,NO	NO,IE	-	-	-	-	-
Croatia	IE,NO	IE,NO	NO,IE	-	-	-	-	-
Cyprus	1	3	3	0%	0	9%	3	482%
Czech Republic	1 075	604	672	20%	67	11%	-403	-38%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	IE,NE,NO	IE,NE,NO	NE,NO,IE	-	-	-	-	-
Finland	4	5	9	0%	4	74%	5	127%
France	1 596	104	417	12%	312	299%	-1 179	-74%
Germany	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Greece	145	5	3	0%	-2	-36%	-142	-98%
Hungary	IE,NA,NO	IE,NA,NO	NA,NO,IE	-	-	-	-	-
Ireland	530	539	433	13%	-106	-20%	-97	-18%
Italy	5 032	506	1 097	32%	592	117%	-3 934	-78%
Latvia	256	83	89	3%	6	7%	-167	-65%
Lithuania	4	1	6	0%	5	878%	1	26%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO,NE	NO,NE	NE,NO	-	-	-	-	-
Netherlands	4	5	5	0%	0	1%	1	26%
Poland	227	45	73	2%	28	61%	-154	-68%
Portugal	2 030	1 335	134	4%	-1 200	-90%	-1 895	-93%
Romania	4	12	10	0%	-1	-13%	6	168%
Slovakia	7	8	6	0%	-2	-29%	-1	-17%
Slovenia	21	3	1	0%	-2	-72%	-20	-96%
Spain	24	85	147	4%	62	73%	123	523%
Sweden	IE,NA,NO	IE,NA,NO	NA,NO,IE	-	-	-	-	-
United Kingdom	114	304	306	9%	2	1%	192	168%
EU-28	**11 078**	**3 647**	**3 411**	**100%**	**-236**	**-6%**	**-7 667**	**-69%**
Iceland	NE,NA,NO	NE,NA,NO	NE,NA,NO	-	-	-	-	-
EU-28 + ISL	**11 078**	**3 647**	**3 411**	**100%**	**-236**	**-6%**	**-7 667**	**-69%**

Table 6.36 CH_4 emissions from Biomass Burning (in kt CH_4)

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0	0	0	0%	0	-38%	0	-72%
Belgium	1	NO	NO	-	-	-	-1	-100%
Bulgaria	2	8	2	0%	-6	-72%	0	-11%
Croatia	1	2	0	0%	-2	-87%	-1	-80%
Cyprus	0	0	0	0%	0	9%	0	482%
Czech Republic	117	66	73	4%	7	11%	-44	-38%
Denmark	1	0	0	0%	0	-2%	-1	-94%
Estonia	0	0	0	0%	0	1762%	0	-86%
Finland	5	1	1	0%	0	23%	-3	-72%
France	933	806	841	51%	36	4%	-91	-10%
Germany	7	1	1	0%	0	-40%	-6	-90%
Greece	62	16	9	1%	-7	-41%	-53	-85%
Hungary	23	12	17	1%	5	46%	-6	-24%
Ireland	125	129	104	6%	-25	-20%	-21	-17%
Italy	1 671	196	335	20%	139	71%	-1 336	-80%
Latvia	28	11	19	1%	7	62%	-9	-33%
Lithuania	3	1	3	0%	2	268%	0	2%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0	0	0	0%	0	1%	0	41%
Poland	44	37	35	2%	-2	-5%	-9	-20%
Portugal	204	154	16	1%	-138	-90%	-188	-92%
Romania	0	1	1	0%	0	-13%	1	168%
Slovakia	7	9	17	1%	8	90%	10	131%
Slovenia	3	0	0	0%	0	-72%	-3	-96%
Spain	205	66	123	7%	57	86%	-82	-40%
Sweden	2	3	30	2%	27	929%	28	1378%
United Kingdom	18	26	31	2%	6	22%	13	74%
EU-28	**3 464**	**1 547**	**1 662**	**100%**	**115**	**7%**	**-1 802**	**-52%**
Iceland	NE,NA,NO	0	0	0%	0	47%	-	-
EU-28 + ISL	**3 464**	**1 547**	**1 662**	**100%**	**115**	**7%**	**-1 802**	**-52%**

Table 6.37 N_2O emissions from Biomass Burning (in kt N_2O)

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014	
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0	0	0	0%	0	-38%	0	-72%
Belgium	5	NO	NO	-	-	-	-5	-100%
Bulgaria	2	5	1	0%	-4	-72%	0	-11%
Croatia	1	1	0	0%	-1	-88%	-1	-79%
Cyprus	0	0	0	0%	0	9%	0	482%
Czech Republic	10	5	6	1%	1	11%	-4	-38%
Denmark	0	0	0	0%	0	-3%	0	-90%
Estonia	0	0	0	0%	0	1233%	0	-84%
Finland	0	0	0	0%	0	23%	0	-72%
France	525	376	393	59%	16	4%	-133	-25%
Germany	4	1	0	0%	0	-40%	-4	-90%
Greece	5	1	1	0%	-1	-41%	-4	-85%
Hungary	15	8	13	2%	5	66%	-2	-11%
Ireland	21	22	18	3%	-4	-20%	-3	-16%
Italy	261	26	57	8%	30	116%	-204	-78%
Latvia	3	2	3	0%	1	84%	-1	-16%
Lithuania	3	1	3	0%	2	238%	0	-1%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0	0	0	0%	0	1%	0	39%
Poland	10	2	3	0%	1	80%	-6	-66%
Portugal	34	25	3	0%	-23	-90%	-31	-92%
Romania	0	0	0	0%	0	-13%	0	168%
Slovakia	5	6	11	2%	5	90%	6	131%
Slovenia	0	0	0	0%	0	-72%	0	-96%
Spain	211	69	128	19%	59	87%	-83	-39%
Sweden	0	0	2	0%	2	928%	2	1378%
United Kingdom	16	18	24	4%	6	33%	8	52%
EU-28	**1 132**	**570**	**668**	**100%**	**97**	**17%**	**-464**	**-41%**
Iceland	NE,NA,NO	0	0	0%	0	47%	-	-
EU-28 + ISL	**1 132**	**570**	**668**	**100%**	**97**	**17%**	**-464**	**-41%**

6.2.6 Emissions from Harvested Wood Products in the EU GHG inventory

This carbon reservoir covers emissions and removals resulting from carbon stock changes in harvested wood products (HWP) as a result of the annual carbon inflow to the pool (i.e. gains), and carbon outflow from HWP pool (i.e. losses).

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 carbon pool represents at EU level a net carbon sink of about -22.028 kt CO_2 in 2014 (Table 6.38). Most of the MS reported this carbon pool as a net sink, however eight MS estimated it as a net source of emissions in 2014. The largest contributors of the carbon sink are Sweden and Finland, while largest emissions are reported by Romania and Belgium. Cyprus, Luxembourg, Malta, Poland and Iceland do not provide an estimation for this carbon pool in CRF table 4.

The methods and data sources for estimating this carbon pool are consistent with methodologies provided by 2006 IPCC GL. In most of the cases, MS have used the IPCC Approach B (i.e. production approach) to provide estimates consistent with the KP reporting. Two MS have used the Approach A (i.e. stock change approach) according with the information provided in the CRF tables Table4.Gs1 although presumably this election could be due to a misallocation of the information in the tables. Finally, none of them have used the Approach C (i.e. atmospheric flow approach).

Generally, MS reported carbon stock changes in this pool considering individual estimates for the semi-finished wood products categories of (i) Solid wood, disaggregated in sawnwood and wood panels and (ii) Paper and paperboard. To this aim, the IPCC default half-life values have been used by the majority of MS with some exceptions (e.g. Romania, Lithuania and Slovenia).

With regards to the activity data, most of the MS have based their estimates on the information provided by the FAOSTAT database, the TIMBER database of the United Nations Economic Commission for Europe (UNECE, 2011), national statistics when available, or, in specific cases, on information collected by surveying wood industries.

Table 6.38 Net carbon stock change and approach implemented by MS for Harvested Wood Products

Member State	Net CO2 emissions (+) /removals (-) kt CO2	GHG source and sink categories		Approach A	Approach B	Approach C
Austria	-1487.08	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Belgium	336.31	1. Solid wood	x		x	
		2. Paper and paperboard	NA			
		3. Other (please specify)	NO			
Bulgaria	-544.01	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Croatia	69.72	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Cyprus	NE.NO	1. Solid wood	NE			
		2. Paper and paperboard	NE			
		3. Other (please specify)	NE			
Czech Republic	-94.13	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Denmark	-146.45	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Estonia	-738.69	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	x			
Finland	-4164.75	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
France	-2249.58	1. Solid wood	NO		x	
		2. Paper and paperboard	NO			
		3. Other (please specify)	x			
Germany	-2299.88	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Greece	93.27	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Hungary	15.75	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Ireland	-765.99	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Italia	191.40	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Latvia	-1817.58	1. Solid wood	x	x		
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Lithuania	-1399.35	1. Solid wood	x	x		
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Luxembourg	NO	1. Solid wood	NO		x	
		2. Paper and paperboard	NO			
		3. Other (please specify)	NO			
Malta	NO	1. Solid wood	NO			
		2. Paper and paperboard	NO			
		3. Other (please specify)	NO			
Netherlands	97.86	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Poland	NA	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Portugal	253.20	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Romania	1311.75	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA, NO			
Slovakia	-730.64	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Slovenia	-112.21	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Spain	-216.99	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Sweden	-6475.55	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
United Kingdom	-1204.50	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Iceland	NE	1. Solid wood	NE			
		2. Paper and paperboard	NE			
		3. Other (please specify)	NE			

6.2.7 Emissions from organic soils in the EU GHG inventory

At EU level, organic soils reported under the three main land use categories cover about 18.411 kha that are mainly located in northern countries.

Total CO_2 emissions from organic soils areas reported under these land use categories in 2014, reach 96.705 kt CO_2 which represents 30% of total EU net removals from LULUCF (Table 6.40). Emissions from organic soils in these land categories decreased as compared with 1990. Finland and Sweden report together more than half of the total area of organic soil in these categories.

Definitions of organic soils reported by MS are presented in Table 6.39; presumably other MS apply the FAO definition as suggested in the 2006 IPCC GL.

Table 6.39 Elements to define C pool in organic soils

Member State	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)

Organic soils are an important source of emissions when they are under management practices that disturb the organic matter stored in the soil. In general, emissions from these soils are reported using country-specific values when they represent an important share within the total budget of GHG emissions. In contrast, MS with small areas of organic soil often use default IPCC factors to report emissions from this carbon pool.

Overall, in the EU, most of the organic soils area is reported under Forest land, however most of the emissions are due to managed organic soils in Grasslands and Croplands (Table 6.40).

In Finland, organic soils areas 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 measurements from a continuous monitoring system.

Organic soils in Forest land show the lowest values of implied emission factors due to the fact that not the entire area of organic soils under forest land is drained. Positive values of implied emission factor under forest organic soils correspond to UK that reports a net sink in this pool by using CARBINE model.

Table 6.40 Area, CO_2 emissions and average implied C stock change factors in the EU reported for the year 2014 for organic soils.

Land use subcategory	Area (kha)	ICECF (tC/ha) [min; Max]	CO2 emissions (kt CO2)
4A1	11936	[-2.60; 0.77]	-18116
4A2	786		-1781
4B1	1463	[-10.00 ; -1.00]	-24163
4B2	264		-6581
4C1	3609	[-8.44; -0.25]	-41615
4C2	353		-4450

6.3 Uncertainties

For the year 2014 LULUCF uncertainty was estimated in 41.0 % for the level uncertainty estimates and 19.8 % for the trend (Table 6.41).

Table 6.41 Level and trend uncertainty assessment of the annual EU-28 emission/removal on LULUCF land subcategories and GHG sources.

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
4.A Forest Land	CO2	-349 217	-397 411	14%	26%	0.1%
4.A Forest Land	CH4	1 409	698	-50%	85%	0.2%
4.A Forest Land	N2O	1 599	1 485	-7%	122%	0.1%
4.B Cropland	CO2	75 308	71 660	-5%	45%	0.3%
4.B Cropland	CH4	550	578	5%	84%	0.2%
4.B Cropland	N2O	1 754	1 337	-24%	93%	0.3%
4.C Grasland	CO2	12 889	-1 513	-112%	1767%	1.2%
4.C Grasland	CH4	1 385	783	-43%	159%	0.4%
4.C Grasland	N2O	404	-40	-110%	612%	0.6%
4.D Wetlands	CO2	12 602	13 236	5%	46%	0.1%
4.D Wetlands	CH4	75	79	6%	272%	0.1%
4.D Wetlands	N2O	51	39	-22%	129%	0.2%
4.E Settlements	CO2	36 424	48 900	34%	35%	0.1%
4.E Settlements	CH4	29	43	47%	146%	0.8%
4.E Settlements	N2O	1 473	1 847	25%	102%	0.2%
4.F Other Land	CO2	2 528	529	-79%	718%	1.9%
4.F Other Land	CH4	0	0		0%	
4.F Other Land	N2O	0	4		71%	
4.G Harvested wood products	CO2	-28 151	-26 920	-4%	32%	0.2%
4.G Harvested wood products	CH4	0	0	-86%	78%	0.7%
4.G Harvested wood products	N2O	0	0	-84%	78%	0.7%
4.H Other	CO2	2	357	14289%	30%	38.5%
4.H Other	CH4	0	0		0%	0.0%
4.H Other	N2O	104	100	-4%	198%	0.1%
4.I	CO2	0	0		0%	0.0%
4.I	CH4	0	0		0%	0.0%
4.I	N2O	21	13	-35%	199%	0.7%
4.II	CO2	406	433	7%	91%	0.1%
4.II	CH4	1 549	1 162	-25%	98%	0.4%
4.II	N2O	1 274	1 265	-1%	102%	0.0%
4.III	CO2	0	0		0%	0.0%
4.III	CH4	0	0		0%	0.0%
4.III	N2O	93	52	-44%	1239%	1.9%
4.IV	CO2	0	0		0%	0.0%
4.IV	CH4	0	0		0%	0.0%
4.IV	N2O	10	8	-18%	63%	0.4%
4.V	CO2	11	15	33%	83%	0.3%
4.V	CH4	14	19	33%	19%	0.4%
4.V	N2O	7	12	77%	22%	1.0%
4 (werhe no subsector data were submitted)	*all*	*68*	*479*	607%	*46%*	*256%*
Total - 4	**all**	**-225 331**	**-280 750**	**25%**	**41.0%**	**19.8%**

6.4 Sector-specific quality assurance and quality control and verification

6.4.1 Time series consistency

The EU greenhouse gas inventory is compiled by aggregation of national GHG inventories, thus, its consistency strictly depends on the consistency of MS inventories. The time-series consistency is annually checked for every individual submission as part of quality control procedures implemented under the EU GHG Monitoring Mechanism Regulation[63]. Consistency is checked, in terms of land use category 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 country area), as well as trends and outliers in datasets (i.e. reasons for potential outliers of implied carbon stock changes factors). 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 potential problem.

One of the key features of the methodologies implemented by national systems is to ensure full consistency in definitions, parameters and datasets used for preparing the entire time series for the LULUCF sector. The main challenge is to ensure consistency when historical data used are not fully adequate to the reporting requirements or they do not provide data for every year of the time series.

Land use definitions are not fully consistent across the MS (i.e. in the sense of identical quantitative thresholds), but they are consistent with IPCC definitions. 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 2016 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 less than 1-2% from the official geographical area, so the risks that some significant emissions have not been counted is small.

6.4.2 Quality Assurance and Quality control

Information submitted under the LULUCF sector by EU MS are under double QA/QC systems: 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, which is carried out 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 that are submitted in January. The checks focus on completeness, calculation errors and time series consistency. QA/QC procedures are implemented by interacting with

[63] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0525

national experts to get clarifications and to plan possible improvements. During the analysis of the 2016 submissions, around 180 findings (i.e. potential issues) were communicated to the MS on: use and justifications of notations keys, potential inconsistencies in land representation, wrong interpretation on how to fill in some tables, inconsistent reporting of activity data among CRF tables and between CRF tables and NIR, and outliers in IEFs values for all categories.

Specifically, 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, 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.
    b. Among LULUCG and Agriculture (e.g. Histosols areas reported among sectors)
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).
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

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". In 2014 and 2015 assessments were carried out to verify data on burned areas reported by MS in their GHG inventories and those reported in EFFIS[64].
- 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 4(KP-I) of mandatory or elected activities and b) Use of notations keys for GHG sources- Tables 4(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, 02-03 May 2016 Stresa (Italy), Italy.
  - RC 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.

[64] http://forest.jrc.ec.europa.eu/effis/

- 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/.

6.4.3 Verification

Relatively little information on verification is typically included in MS's GHG inventories. For forest land, the JRC has implemented the Carbon Budget Model (CBM), a forest growth model developed by the Canadian Forest Service and adapted to the EU conditions (Pilli et al. 2014[65], Pilli et al. 2016[66]), to estimate C stock changes in all forest C pools for 26 MS (all countries except Malta and Cyprus). The results of this modeling have been offered to MS as a potential verification exercise; in some cases the comparison of model results with GHG inventories resulted in identifying errors in the GHG inventory. It is expected that more comparisons of MS' GHG inventories with CBM results will be carried out in coming years. Another exercise on comparison has been implemented by the EU JRC for biomass burning data[67], carrying out a comparison of the data reported by some MS with the data provided by the European Forest Fire Information system.

Besides that, a comprehensive analysis of MS submissions have been also carried out last year[68]. In this context, some inconsistencies were found that were communicated to MS during the 2016 QA/QC process.

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.

[65] Pilli R., Grassi G., Kurz W.A., Smyth C.E. and Blujdea V. (2013). Application of the CBM-CFS model to estimate Italy's forest carbon budget, 1995 to 2020. Ecological modeling. 266, 144-171.

[66] Pilli R., Grassi G., Kurz W.A., Abad Viñas R., Guerrero, N. (2016) Modelling forest carbon stock changes as affected by harvest and natural disturbances. I. Comparison with countries' estimates for forest management. Carbon Balance and Management 11:5 DOI 10.1186/s13021-016-0047-8

[67] Abad Viñas, R., San-Miguel-Ayanz, J., Grassi, G. (2015) Reporting of Biomass Burning under the LULUCF sector. Comparative assessment of data reported under the UNFCCC and EFFIS. EUR 27170 EN. Luxembourg: Publications Office of the European Union, 2015. JRC95415

[68] Viorel NB Blujdea, Raúl Abad Viñas, Sandro Federici & Giacomo Grassi (2016): The EU greenhouse gas inventory for the LULUCF sector: I. Overview and comparative analysis of methods used by EU member states, Carbon Management, DOI: 10.1080/17583004.2016.1151504

6.5 Sector-specific recalculations, including changes in response of to the review process and impact on emission trend

Table 6.42 to Table 6.47 provide information on the contribution of Member States to EU-28+ISL recalculations in sectors 4A, 4B, 4C, 4D, 4E and 4F (all GHGs) for 1990 and 2013 and main explanations for the largest recalculations in absolute terms.

Table 6.42: 4A Forest Land: Contribution of MS to EU-28+ISL Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	Minor calculation errors were corrected
Belgium	0	0.0	-12	0.3	Update of areas in the three regions following last data available (2008-2013), improvement of N_2O emissions from soil mineralization estimation in Walonia region
Bulgaria	443	-3.0	614	-5.6	Update of some emission coeficeints as C fraction and Root to shoot ratio according to 2006 IPCC, updated emission factors of non-CO_2 emissions from wildfires (2006 IPCC Guidelines), changes in area of FL since 2012 due to a technical error in estimation
Croatia	-1 110	19.7	-1 347	24.5	2006 Guidelines application and use of new values for R factor. Corrections in biomass harvested due to management parctices. Detailed explanations will be provided in NIR 2016 Resubmission
Cyprus	0	0.0	0	0.0	No recalculations were made in this category
Czech Republic	-110	2.3	29	-0.4	Updated activity data available, explanation provided in NIR
Denmark	-596	-179.7	-171	7.3	The land use matrixes were updated, significant changes have been noted related to LU and LUC's, new biomass and expansion functions implemented
Estonia	-508	5.8	-51	3.1	Soil emission factors were updated for remaining Forest land.
Finland	205	-0.9	-1 270	4.5	Changes in activity data, new data for CSC in living biomass. Error corrections. Updates in statistics.
France	1 358	-3.2	-6 274	9.5	Correction LUC matrices over the period 1990-2000, update to lower fuelwood consumption, update the CO_2 EF‘s in biomass burning based on IPCC 2006
Germany	-1 002	1.3	-1 269	2.2	Update of AD – using high-resolution map for organic soils, changes in EF‘s for organic soils (cf. Chapter 6.1.2.2.3), as a result of changes in determination of areas (cf. Chapter 6.3.1), modification of the method for determination of LU and LUC‘s on organic soils
Greece	36	-3.1	-327	16.9	Complete reconstruction of the land use, land-use change matrices for the period 1990 – 2014, update of the FMP‘s database, recalculations of non-CO_2 emissions from wildfires, use of the most updated EF's for the estimation of C stock changes in LB in CL converted to FL category, estimation for the first time of CO_2 and non-CO_2 GHG emissions resulted from DOM pool subject to wildfires in FL category
Hungary	0	0.0	0	0.0	No recalculations were made in this category
Ireland	0	0.0	0	0.0	No recalculations were made in this category
Italy	-51	0.2	-372	1.0	Implementation of the 2006 IPCC Guidelines (IPCC, 2006), in term of updated default values and conversion factors
Latvia	379	-2.5	774	-19.6	Revision of land use category due to manual check of land use categories entered in the NFI database.
Lithuania	0	0.0	0	0.0	Recalculation of CO_2 emissions occurring due to forest wildfires in land converted to forest land subcategory were done due to error in calculation formula. Emissions occurring from burning of forest soil were not included in total emissions from forest wildfires calculation previously,

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					therefore it was included in this year submission (NIR Chapter 6.2.6, Table 6-28).
Luxembourg	-320	-395.2	-99	19.3	The results of the second NFI have been included in order to establish EF for forest growth, dead wood, harvest rate and biomass carbon stock
Malta	0	0.4	0	0.4	Revision in the data on permanent crops. Data for the year 2008 till 2013 data from NSO was revised
Netherlands	0	0.0	0	0.0	No recalculations were made in this category
Poland	-319	0.9	-538	1.3	EF correction (country specific BCEF)
Portugal	-36	0.6	1 074	-8.5	Review of Harvest data with the latest version of the UNECE / FAO database (updated December 2014), review the allocation by species of burnt areas made by ICNF (Forest Authority), review the provisional data on forest fires.
Romania	533	-2.1	1 482	-5.5	New activity data for LULUCF
Slovakia	0	0.0	0	0.0	No recalculations were made in this category
Slovenia	890	-17.5	-316	4.4	Improved activity data for the entire category
Spain	-8	0.0	-712	2.1	Inclusion of 2013 statistical data of afforestation/ reforestation, update the AD from NFI, with implications for the annual increase in living biomass in FL, update 2013 forest fires statistics, implementation of the 2006 IPCC Guidelines (IPCC, 2006) for calculation of biomass burning, updating default C fraction of dry matter (CF) for living biomass (LB)
Sweden	4 150	-9.5	2 153	-4.4	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
United Kingdom	220	-1.4	-357	2.1	Revision of the method for aggregating carbon stock changes to the Forest remaining Forest category
EU28	4 153	-1.0	-6 989	1.6	
Iceland	0	0.0	0	0.0	No recalculations were made in this category
EU28+ISL	4 153	-1.0	-6 989	1.6	

Table 6.43: 4B Cropland: Contribution of MS to EU-28+ISL Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	184	-266.7	-417	-321.4	Refined methodology
Belgium	0	0.0	-20	6.3	Improvement of N_2O emissions from soil mineralization estimation in Walonia region
Bulgaria	-1 488	-182.8	-680	-45.7	Changes in the total CL area due to complete new interpretation of the activity data, new reporting of LUC from OL to CL, recalculation of the LUCs to CL, estimation of N_2O emissions from LU conversions to CL as a result of soil oxidation
Croatia	21	9.5	-18	-11.1	Changes in LUC matrix. Detailed explanations will be provided in NIR 2016 resubmission
Cyprus					
Czech Republic	22	24.2	-55	-78.9	Updated activity data available, explanation provided in NIR
Denmark	92	1.7	36	0.9	Recalculations have been made due to the update to the IPCC 2006 Guide-lines and that Christmas trees on Cropland, which previous was reported under Forest land, has been included in Cropland

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Estonia	6	7.2	6	4.4	The entire time series of AD is annually recalculated for all areas of land categories and land-use conversions, since new data about land use transitions is collected every year and new estimates will be integrated into overall activity data.
Finland	-378	-6.9	382	5.9	Changes in activity data, new data for CSC in living biomass. Error corrections. Updates in statistics
France	8 309	62.9	-1 338	-6.5	Correction LUC matrices over the period 1990-2000, Reintroduction of N_2O emissions from C mineralization during a change of land use, update the EF's in biomass burning based on IPCC 2006
Germany	-3 005	-19.4	632	4.6	Update of AD – using high-resolution map for organic soils, changes in the EF's for the biomass of silage maize and annual GL plants, including fodder plants, modification of the method for determination of LU and LUC's on organic soils
Greece	74	-7.5	-82	35.5	Complete reconstruction of the land use, land-use change matrices for the period 1990 – 2014, Recalculations for Cropland category, due to the application of the new IPCC guidelines
Hungary	0	0.0	0	0.0	No recalculations were made in this category
Ireland	1 520	-99.7	385	-105.7	The complete reassessment of the definition of Cropland and the inclusion of temporary grassland, revision in the emissions due to biomass burning
Italy	0	0.0	392	13.4	implementation of the 2006 IPCC Guidelines (IPCC, 2006), in term of updated default values and conversion factors
Latvia	45	1.4	201	7.4	Revision of land use category due to manual check of land use categories entered in the NFI database.
Lithuania	-86	-1.6	9	0.2	Changes between year 2015 and 2016 submissions occur due to the error in calculations of CO_2 emissions from drainage of organic soils in land converted to cropland subcategory. There were no conversions from wetland to cropland in 2013, however, emissions from drainage of organic soils from wetland converted to cropland were added to total emissions from organic soils in land converted to cropland category. In the submissions of 2016 error in emissions from drainage of organic soils in land converted to cropland subcategory was corrected (NIR Chapter 6.3.5, Table 6-33). There were certain changes done in calculation of CO_2 emissions/removals from cropland category in 2016 submission. In previous NIR submissions CO_2 emissions, resulting from biomass burning (wildfires) were reported under the subcategory of cropland remaining cropland. However, according to 2006 IPCC Guidelines, "emissions from biomass burning do not have to be reported, since the carbon released during the combustion process is assumed to be reabsorbed by the vegetation during the next growing season". Due to such assumptions, CO_2 emissions from biomass burnt in wildfires in cropland remaining cropland subcategory are not reported in this submission, including whole reporting period from 1990 (Chapter 6.3.5, Table 6-34).
Luxembourg	31	68.8	2	6.3	Reporting of land use changes (>269 ha) between grassland and cropland in the category cropland remaining cropland, calculation of a country specific EF for carbon stock on cropland remaining cropland category
Malta	0	0.0	0	-9.4	Revision in the data on permanent crops. Data for the year 2008 till 2013 data from NSO was revised
Netherlands	2	0.1	7	0.3	The reporting on carbon stock gains and losses in living biomass in category 4B and 4C was corrected
Poland	-209	-18.3	761	-174.7	AD correction (reallocation of CSC as a consequence of the LUC matrix improvements.)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Portugal	0	0.0	2	0.3	Some minor mistakes in the calculation spread sheets were detected and corrected
Romania	-794	53.7	356	-14.2	New activity data for LULUCF
Slovakia	0	0.0	0	0.0	No recalculations were made in this category
Slovenia	-136	-47.9	-283	-81.5	Improved activity data for the entire category
Spain	18	-1.8	2 718	-106.2	Update the area estimates for 2004-2014 period, update of EF's for for living biomass, adoption of the new reference values of the factors of land use, management regime and for input of organic matter of the 2006 IPCC Guidelines
Sweden	0	0.0	-613	-12.4	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
United Kingdom	19	0.1	67	0.6	Minor change to the 2013 value of soil C stock changes from cropland management due to a revision of the activity data from the British Survey of Fertiliser practice, Inclusion of LB C carbon stock change from cropland management as activity data and emission factors are now available, soil C stock changes from forest to cropland have been updated as a result of using corrected deforestation areas in the soils model, the methodology and emission factors for calculating emissions from controlled burning for Forest to Cropland have been updated to follow the IPCC 2006 guidelines
EU28	4 246	5.9	2 449	3.5	
Iceland	0	0.0	0	0.0	No recalculations were made in this category
EU28+ISL	4 246	5.7	2 449	3.5	

Table 6.44: 4C Grassland: Contribution of MS to EU-28+ISL Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	-1	-2.7	Error corrected
Belgium	0	-0.1	-3	0.7	Improvement of N_2O emissions from soil mineralization estimation in Walonia region
Bulgaria	203	-128.4	-577	123.9	Changes in the total GL area due to complete new interpretation of the activity data, recalculation of the LUCs to GL, new reporting of LUC from OL to GL, update of the estimate for annual C stock in biomass under GL
Croatia	-16	15.7	39	-38.0	Changes in LUC matrix. Detailed explanations will be provided in NIR 2016 resubmission
Cyprus					
Czech Republic	-11	7.8	-270	83.8	Updated activity data available, explanation provided in NIR
Denmark	-14	-1.8	37	6.4	Recalculated due to the new guidelines
Estonia	6	-21.9	-262	-65.0	The grassland organic soil emission factor from Sweden was updated. Soil emission factors were updated.
Finland	-17	-1.9	-7	-1.1	Changes in activity data, new data for CSC in living biomass. Error corrections. Updates in statistics.
France	-7 799	88.1	306	-2.7	Correction LUC matrices over the period 1990-2000, update the EF's in biomass burning based on IPCC 2006
Germany	4 656	22.3	13	0.1	Update of AD – using high-resolution map for organic soils, changes in EF in GL category (cf. Chapter 6.1.2.2.3), as a result of changes in determination of areas (cf. Chapter 6.3.1)
Greece	0	-3.3	278	-26.4	Complete reconstruction of the land use, land-use change matrices for the period 1990 – 2014
Hungary	0	0.0	0	0.0	No recalculations were made in this category.
Ireland	887	14.4	848	17.3	Incorporation of LPIS data into the analysis of areas of crop and temporary grassland, and the adoption of the revised

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					emission factor associated with drained of organic soils provide in the 2013 Wetlands Supplement, the adoption of the revised emission factors for drained organic soils under Grassland
Italy	-44	-1.1	-22	0.3	Implementation of the 2006 IPCC Guidelines (IPCC, 2006), in term of updated default values and conversion factors
Latvia	50	5.9	199	105.7	Revision of land use category due to manual check of land use categories entered in the NFI database.
Lithuania	-12	0.6	0	0.0	Errors of reported carbon stock changes in organic soils due to the conversion of wetland to grassland were corrected
Luxembourg	14	41.7	7	-16.1	Reporting of land use changes (>269 ha) between grassland and cropland, The results of the second NFI have been included in order to establish EF for forest growth, dead wood, harvest rate and biomass carbon stock
Malta	0	0.0	0	0.0	No significant difference in estimated emissions
Netherlands	32	0.6	47	1.1	The reporting on carbon stock gains and losses in living biomass in category 4B and 4C were corrected
Poland	0	0.0	-73	21.1	AD correction (reallocation of CSC as a consequence of the LUC matrix improvements.)
Portugal	0	0.0	-51	-16.8	Some minor mistakes in the calculation spread sheets were detected and corrected
Romania	-710	-77.9	842	-131.4	New activity data for LULUCF
Slovakia	0	0.0	0	0.0	No recalculations were made in this category
Slovenia	-1 264	-171.9	-866	-89.3	Improved activity data for the entire category
Spain	20	-107.7	53	4.7	Inclusion of 2013 statistical data of afforestation/ reforestation, update the AD from NFI, with implications for the annual increase in living biomass, updating default C fraction of dry matter (CF) for living biomass (LB), adaptation of the methodology of controlled burns to the methodology of the IPCC 2006 Guidelines, incorporating estimation of emissions from fires in GL
Sweden	-193	148.9	-707	-111.5	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
United Kingdom	-3 098	84.5	-3 206	54.6	Inclusion of LB C stock change from grassland management as activity data and emissions factors are now available for some biomass types, soil C stock changes from forest to grassland conversion have been updated as a result of using corrected deforestation areas in the soils model, the methodology and emissions factors for calculating emissions from controlled burning for forest to grassland have been updated to follow the IPCC 2006 guidelines, Carbon stock changes from conversion of wetland to grassland have been revised due to updated area activity data and a more consistent approach to tracking between WL and GL, the emissions factor used for calculating emissions from drainage of Grassland on organic soils has been corrected as previously the cultivated soils emissions factor had been used in error
EU28	-7 310	-24.4	-3 376	-63.4	
Iceland	0	0.0	0	0.0	No recalculations were made in this category
EU28+ISL	-7 310	-20.1	-3 376	-27.0	

Table 6.45: 4D Wetlands: Contribution of MS to EU-28+ISL Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	23	29.6	Revised activity data
Belgium	0	0.0	1	-15.3	Improvement of N_2O emissions from soil mineralization estimation in Walonia region
Bulgaria	0	0.0	-3	-1.1	Changes in the area distribution of the total LUCs to WL
Croatia	13	43.6	1	4.9	Changes in LUC matrix. Detailed explanations will be provided in NIR 2016 resubmission
Cyprus					
Czech Republic	-1	-4.1	2	6.9	Updated activity data available, explanation provided in NIR
Denmark	-1	-1.4	14	70.7	Recalculated due to the new guidelines
Estonia	6	0.6	-4	-0.4	Updated activity data, growing stocks and dead wood volumes from the NFI was used for estimating carbon losses due to land conversion to wetlands and peatlands.
Finland	-9	-0.6	36	1.6	Changes in activity data, new data for CSC in living biomass. Error corrections. Updates in statistics.
France	-791	84.9	95	-4.3	Correction LUC matrices over the period 1990-2000
Germany	1 438	54.7	1 509	61.5	Modification of the method for determination of LU and LUC's on organic soils, as a result of introduction of a high-resolution map of Germany's organic soils (cf. the remarks in Chapter 6.3.1), update of AD – using high-resolution map for organic soils, changes in EF for organic soils in WL category, as a result of changes in determination of areas (cf. Chapter 6.3.1)
Greece	0	0.0	-1	-19.1	Complete reconstruction of the land use, land-use change matrices for the period 1990 – 2014
Hungary	0	0.0	0	-1.6	Change of input data in area of peat extration lands and in amount of extrated peat
Ireland	-471	-20.6	-33	-1.2	The revision of emissions associated with the extraction and use of peat for horticultural use, revision in the emissions due to biomass burning,
Italy	0	0.0	0	0.0	No recalculations were made in this category
Latvia	0	0.0	0	0.0	Revision of land use category due to manual check of land use categories entered in the NFI database.
Lithuania	0	0.0	2	0.2	Recalculation was made due to the C stock changes in living biomass in GL converted to flooded land misreported in 2013 (no conversion was reported, however, 0.399 thous. ha of grasslands were converted to flooded land in 2013). In the submission of 2016 error in carbon stock changes in living biomass due to the grassland conversion to flooded land was corrected (Chapter 6.5.5, Table 6-46)
Luxembourg	0	2.7	0	0.3	The results of the second NFI have been included in order to establish EF for forest growth, dead wood, harvest rate and biomass carbon stock
Malta	0	0.0	0	0.0	No recalculations were made in this category
Netherlands	0	0.2	0	-0.3	Minor differences in output for all categories were caused by an increase in the precision of the internal representation of values from 6 to 9 digits.
Poland	45	1.0	359	8.3	AD correction (reallocation of CSC as a consequence of the LUC matrix improvements.)
Portugal	0	0.0	0	0.0	No recalculations were made in this category
Romania	1 180	352.2	1 180	352.2	New activity data for LULUCF
Slovakia	0	0.0	0	0.0	No recalculations were made in this category
Slovenia	-44	-96.3	-28	-49.9	Improved activity data for the entire category
Spain	-3	-7.2	-1	6.8	Update the C stocks in LB for FL, CL and GL used for the conversion to WL
Sweden	0	0.0	0	0.0	No recalculations were made in this category
United Kingdom	5	1.1	79	26.3	The methodology for estimating areas of peat extraction has been updated following new datasets becoming available
EU28	1 368	9.7	3 230	22.3	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Iceland	0	0.0	0	0.0	No recalculations were made in this category
EU28+ISL	1 368	10.1	3 230	23.2	

Table 6.46: 4E Settlements: Contribution of MS to EU-28+ISL Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	5	1.3	0	0.1	Revised activity data
Belgium	1	0.6	26	4.3	Improvement of N_2O emissions from soil mineralization estimation in Walonia region
Bulgaria	20	3.0	46	4.7	Changes in the total SL area due to complete new interpretation of the activity data, changes in the area distribution of the total LUCs to SL between categories, reporting of LUC from OL to SL
Croatia	-43	-17.9	101	18.6	Changes in LUC matrix. Detailed explanations will be provided in NIR 2016 resubmission
Cyprus					
Czech Republic	1	0.8	5	6.5	Updated activity data available, explanation provided in NIR
Denmark	0	-1.9	8	11.1	Recalculated due to the new guidelines
Estonia	1	337.6	-32	-9.2	Updated activity data, growing stocks and dead wood volumes from the NFI were used for estimating carbon losses due to land conversion to Settlements.
Finland	-33	-3.3	349	36.8	Changes in activity data, new data for CSC in living biomass. Error corrections. Updates in statistics.
France	3 156	44.4	-788	-6.3	Correction LUC matrices over the period 1990-2000, update the EF's in biomass burning based on IPCC 2006
Germany	-737	-28.9	-451	-12.6	Modification of the method for determination of LU and LUC's on organic soils, as a result of introduction of a high-resolution map of Germany's organic soils (cf. the remarks in Chapter 6.3.1), update of AD – using high-resolution map for organic soils, correction of EF's for calculation of CO_2 emissions from biomass
Greece	0	-4.8	3	23.6	Complete reconstruction of the land use, land-use change matrices for the period 1990 – 2014
Hungary	1	0.5	3	1.3	Country specific stock change factors to estimate soil carbon stock changes have been revised by re-aggregating currently available SOC data
Ireland	0	0.0	8	15.5	Change in the assessment of emissions and removals associated with deforestation to Settlement
Italy	0	0.0	2 119	28.5	implementation of the 2006 IPCC Guidelines (IPCC, 2006), in term of updated default values and conversion factors
Latvia	3	3.1	-104	-10.4	Revision of land use category due to manual check of land use categories entered in the NFI database.
Lithuania	0	0.0	16	5.0	Recalculations were done due to the C stock changes in LB in CL converted to SL and GL converted to SL misreported in 2013 (no conversion of cropland to settlements was reported, however, 0.399 thous. ha of croplands were converted to settlements in 2013; smaller area of grassland converted to settlements was reported - 0.399 thous. ha instead of 3.595 thous. ha). In the submission of 2016 errors in C stock changes in living biomass due to the cropland and grassland conversion to settlements were corrected (Chapter 6.6.5, Table 6-48)
Luxembourg	-5	-3.2	-1	-0.7	The results of the second NFI have been included in order to establish EF for forest growth, dead wood, harvest rate and biomass carbon stock

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Malta	0	0.0	0	0.0	No recalculations were made in this category
Netherlands	0	0.0	0	0.0	No recalculations were made in this category
Poland	-71	-17.8	697	265.7	AD correction (reallocation of CSC as a consequence of the LUC matrix improvements.)
Portugal	0	0.0	0	0.0	No recalculations were made in this category
Romania	150	4.2	150	4.2	New activity data for LULUCF
Slovakia	0	0.0	0	0.0	No recalculations were made in this category
Slovenia	-333	-45.7	-495	-56.4	Improved activity data for the entire category; in SL=SL Tier 1 was applied
Spain	-18	-4.4	-26	-2.2	Update the C stocks in LB for FL, CL and GL used for the conversion to SL
Sweden	37	1.3	-1 427	-29.2	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
United Kingdom	24	0.4	71	1.2	Soil C stock changes from Forest to Settlement conversion have been updated as a result of using corrected deforestation areas in the soils model, the methodology and emissions factors for calculating emissions from controlled burning for Forest to Settlement have been updated to follow the IPCC 2006 guidelines
EU28	2 158	6.1	279	0.6	
Iceland	0	0.0	0	0.0	No recalculations were made in this category
EU28+ISL	2 158	6.1	279	0.6	

Table 6.47: 4F Other land: Contribution of MS to EU-28+ISL Recalculations in CO_2 for 1990 and 2013 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	No recalculations were made in this category
Belgium	0	0.0	0	0.0	No recalculations were made in this category
Bulgaria	-3	100.0	-275	100.0	Changes in land area representation, correction of technical errors in estimation tables, which are related to area representation, update of the default emission factors to mach those in 2006 IPCC Guidelines, implementation of the new GWPs for CH_4 and N_2O gases
Croatia	0	0.0	0	0.0	Changes in LUC matrix. Detailed explanations will be provided in NIR 2016 resubmission
Cyprus					
Czech Republic	0	0.0	42	100.0	Updated activity data available, explanation provided in NIR
Denmark	0	0.0	0	0.0	No recalculations were made in this category
Estonia	0	0.0	-4	-14.8	Updated activity data, growing stocks and dead wood volumes from the NFI were used for estimating carbon losses due to land conversion to Other Land.
Finland	0	0.0	0	0.0	No recalculations were made in this category
France	0	0.0	0	0.0	No recalculations were made in this category
Germany	0	0.0	0	0.0	No recalculations were made in this category
Greece	-1	-4.0	-120	-59.2	Complete reconstruction of the land use, land-use change matrices for the period 1990 – 2014
Hungary	0	0.0	0	0.0	No recalculations were made in this category
Ireland	0	0.0	0	0.0	No recalculations were made in this category
Italy	0	0.0	0	0.0	No recalculations were made in this category
Latvia	0	0.0	0	0.0	No recalculations were made in this category
Lithuania	0	0.0	0	0.0	No recalculations were made in this category
Luxembourg	0	6.2	0	1.2	The results of the second NFI have been included in order

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					to establish EF for forest growth, dead wood, harvest rate and biomass carbon stock
Malta	0	0.0	0	0.0	No recalculations were made in this category
Netherlands	0	0.2	0	0.1	Minor differences in output for all categories were caused by an increase in the precision of the internal representation of values from 6 to 9 digits.
Poland	0	0.0	0	0.0	No recalculations were made in this category
Portugal	0	0.0	0	0.0	No recalculations were made in this category
Romania	-80	-9.0	-80	-9.0	New activity data for LULUCF
Slovakia	0	0.0	0	0.0	No recalculations were made in this category
Slovenia	-138	-90.4	-151	-87.4	Improved activity data for the entire category
Spain	-1	-3.3	0	0.0	Update the C stocks in GL used for the conversion to OL, new estimation of N_2O emissions from mineralization included
Sweden	0	0.0	0	0.0	Not used any longer
United Kingdom	0	0.0	0	0.0	No recalculations were made in this category
EU28	-221	-8.2	-588	-104.4	
Iceland	0	0.0	0	0.0	No recalculations were made in this category
EU28+ISL	-221	-8.2	-588	-104.4	

7 Waste (CRF Sector 5)

This chapter starts with an overview on emission trends in CRF Sector 5 Waste for EU-28 Member States plus Iceland. For each EU-28 key category, overview tables are presented including the Member States and Iceland's 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+ISL, after energy, agriculture and industrial processes, contributing 3.4 % to total GHG emissions without LULUCF in 2014. Total emissions from waste have been decreasing by 40 % from 244 Mt in 1990 to 146 Mt in 2014 (Figure 7.1). In 2014, emissions decreased by 3.3 % compared to 2013.

Figure 7.1 Sector 5 Waste: EU-28+ISL GHG emissions, 1990-2014

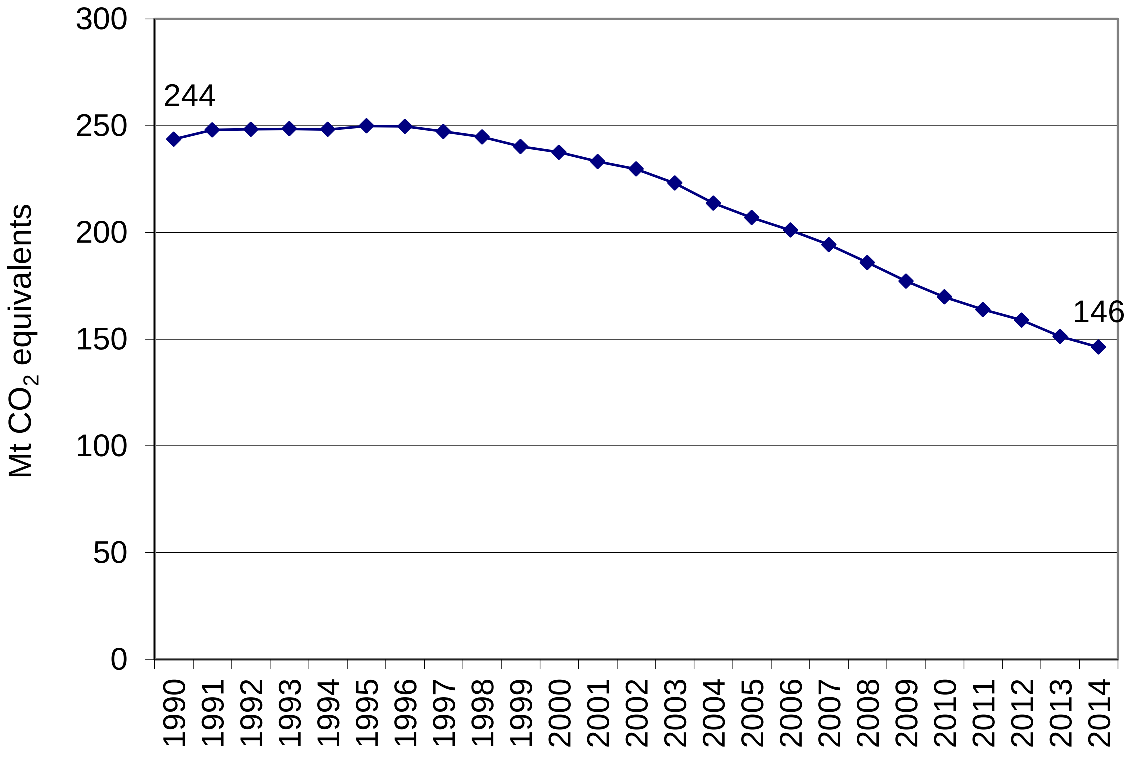
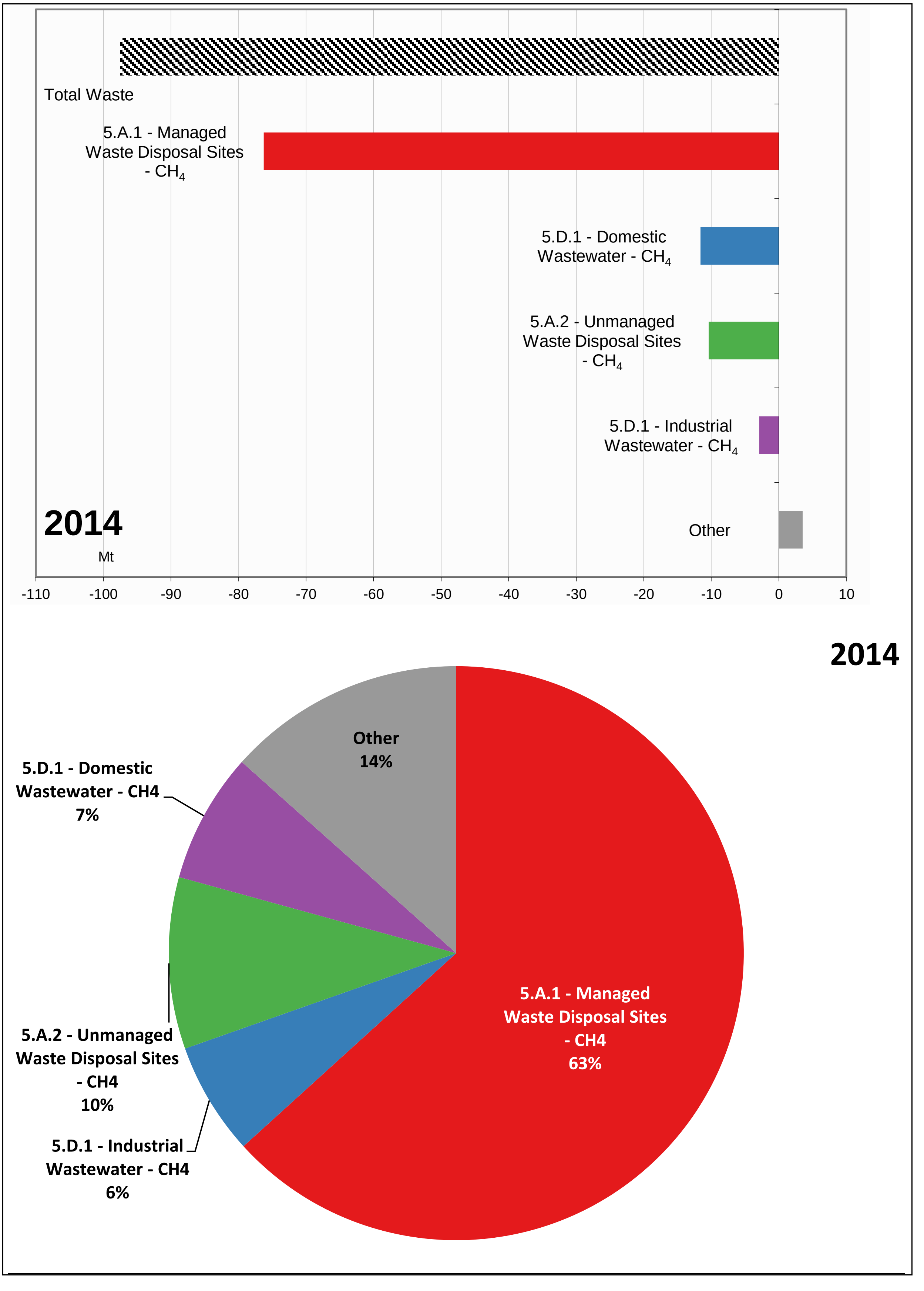


Figure 7.2 shows that CH_4 emissions from 5A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 61 % of waste-related GHG emissions in the EU-28+ISL in 2014.

Figure 7.2 Sector 5 Waste: Absolute change of GHG emissions (in CO_2 equivalents) by large key source categories, 1990–2014, and share of largest key source categories in 2014

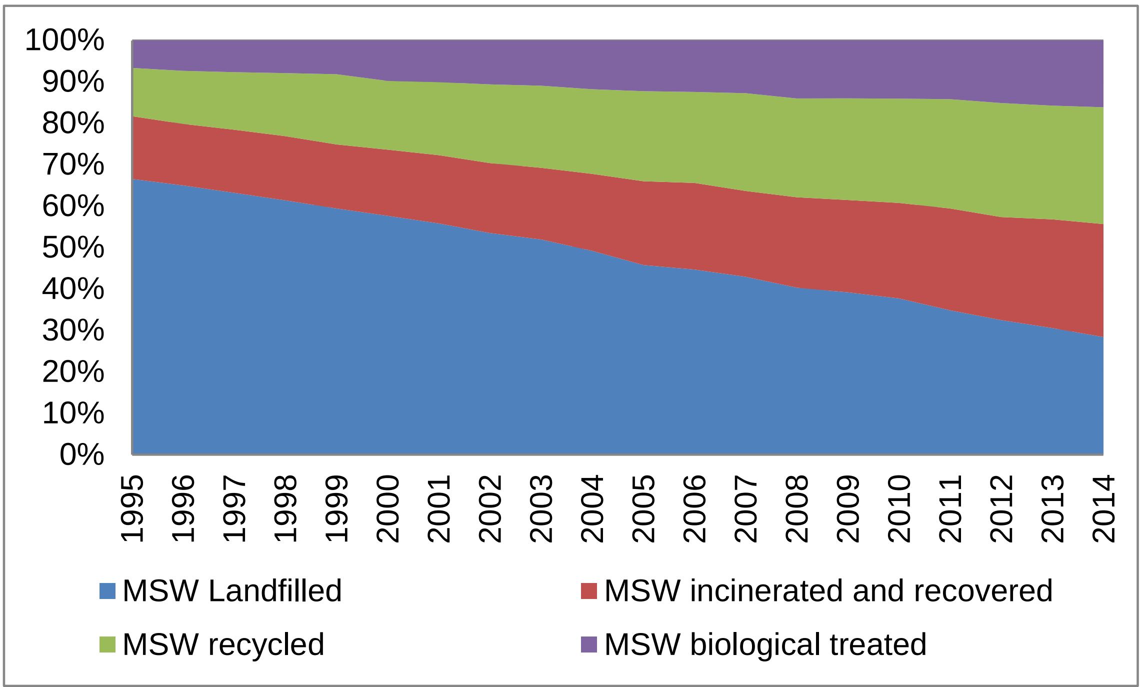


GHG emissions in the waste sector are generated from the treatment and disposal of liquid and solid waste. According to the IPCC 2006 Guidelines emission estimates in the waste sector need to be carried out for four subcategories:

- 5.A Solid waste disposal
- 5.B Biological treatment of solid waste
- 5.C Incineration and open burning
- 5.D Wastewater treatment and discharge.

Of the above, the first three categories mainly refer to possible routes for treatment and disposal of solid and liquid 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 1995 to 2014 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 to Eurostat. 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 reported to Eurostat 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 applying different waste treatment methods like recycling or biological treatment of waste increases. In 1995 67 % of waste has been landfilled, 15 % was incinerated, 12 % recycled and only 7 % of the waste has been composted or digested. In 2014 the share of waste landfilled decreased to 28 % of total waste treated while incineration including energy recovery increased to 27 %, recycling increased to 28 % and biological treatment of waste makes up 16 % of total solid waste treated in 2014.

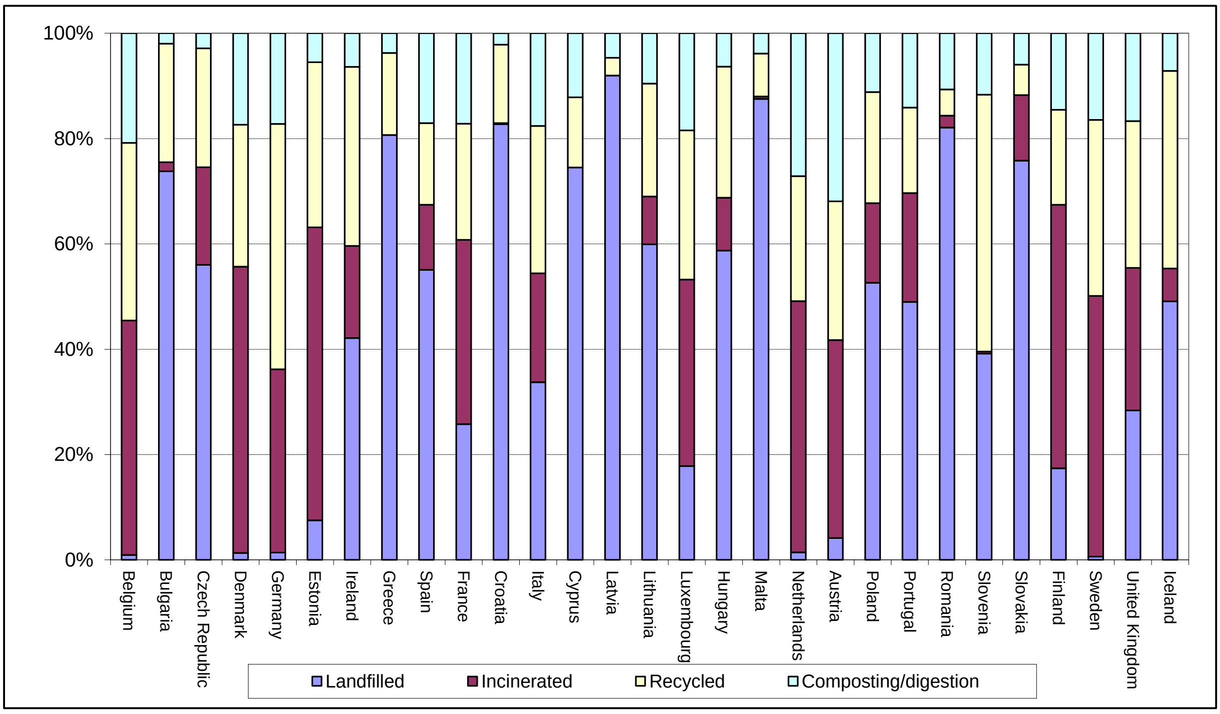
Figure 7.3 Sector 5 Waste: Development of waste treatment in the EU-28+ISL



Note: Missing 2014 data for Ireland, Greece, Romania and Iceland has been gap filled by using 2013 value
Source: EUROSTAT 2016, own calculation

The share of the single waste treatment routes differs significantly among Member States in 2014 (compare Figure 7.4).

Figure 7.4 : Waste management practices in the EU-28+ISL (shares) in 2014

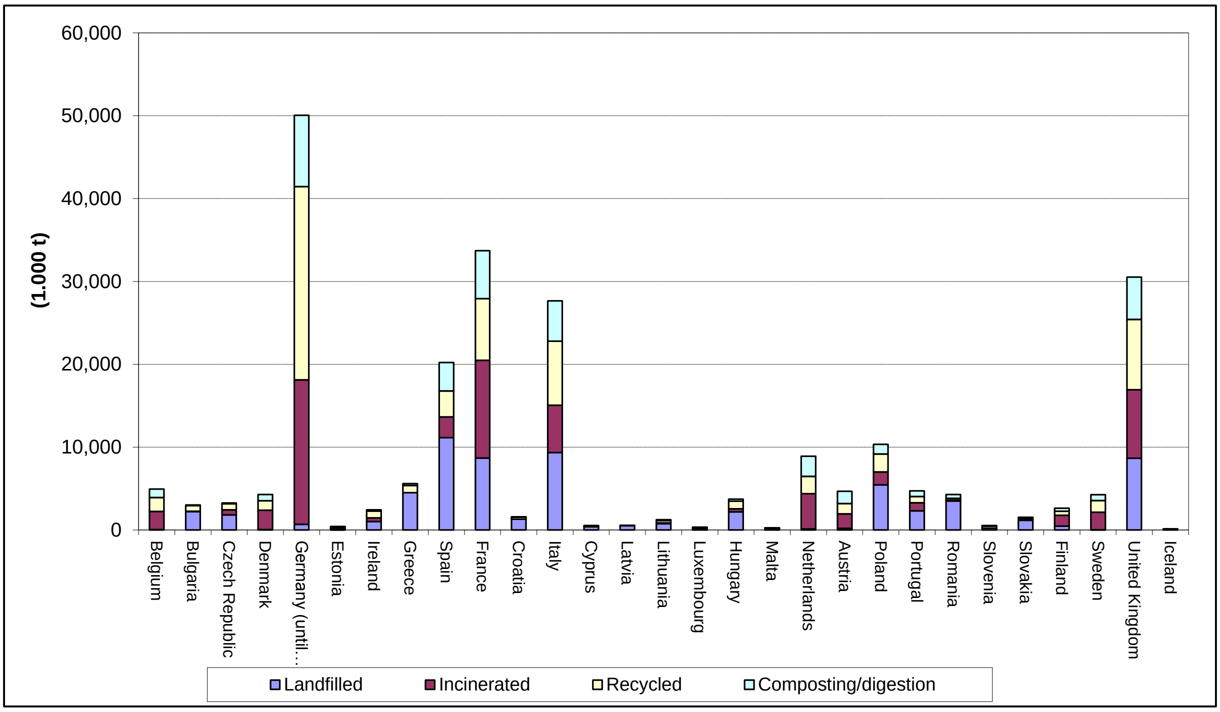


Source: EUROSTAT 2016, own calculations

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 (>70%) waste disposal route in Bulgaria, Greece, Croatia, Cyprus, Latvia, Malta Romania and Slovakia with correspondingly fewer quantities of waste incinerated, recycled or with biological treatment. In Belgium, Denmark, Germany, Estonia, the Netherlands, Austria and Sweden, (see also Figure 7.5) 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. by limiting the authorized organic fraction of landfilled waste and by raising the landfill tariff to comply with the incineration of waste.

Figure 7.5 Waste management practices in the EU-28+ISL in 2014



Source: EUROSTAT 2016, own calculations

7.2 Source categories and methodological issues

This chapter includes information on emission levels and emission trends for all 28 Member States plus Iceland for the EU key source categories. Additionally information for EU key source categories on national methods and circumstances which are available in the Member States' national inventory reports will be provided in the Annex III.

In this section we present information relevant for the EU-28+ISL key source categories in the sector 5 Waste[69]. Source categories considered in detail are:

- 5A1 CH_4 emissions from managed solid waste disposal sites
- 5A2 CH_4 emissions from unmanaged solid waste disposal sites
- 5D1 CH_4 Domestic Wastewater Treatment and Discharge
- 5D2 CH_4 Industrial Wastewater

Other source categories in the waste sector are not contributing to a key source and only information on total emissions from these categories is provided for completeness reasons. Further information on emission trends and methodological information on other source categories from the waste sector are not provided.

[69] 5D1 N_2O Domestic Wastewater Treatment and Discharge is a new key category and will be considered in detail in the EU NIR 2017

7.2.1 Solid waste disposal on land (CRF Source Category 5A)

Source category 5A Solid waste disposal on land includes two key categories: CH_4 from 5A1 Managed waste disposal on land and CH_4 from 5A2 Unmanaged waste disposal on land, and contribute 2.2 % and 0.33 % to total GHG emissions in 2014, respectively. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 5A1 includes CH_4 emission arising from waste disposal on 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 Cyprus, Estonia (1990-1993) and Poland report emissions from this category. Cyprus reports all CH_4 emissions from solid waste disposal under 5.A.3. As this is no EU key category no further information on 5A3 is included in the following chapters.

The EU-28+ISL (except Cyprus) report 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 (1996-1998) and Latvia (2002-2006) report CH_4 recovery from unmanaged landfills for a few years in the time series, as there were no managed landfills 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 44 % between 1990 and 2014 in the EU-28+ISL. 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, Spain and Iceland did not.

Table 7.1 5A Solid Waste Disposal on Land: Member States' + ISL contributions to total GHG emissions and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	3 880	1 404	3 880	1 404
Belgium	3 053	1 064	3 053	1 064
Bulgaria	3 564	3 102	3 564	3 102
Croatia	349	1 189	349	1 189
Cyprus	251	456	251	456
Czech Republic	1 979	3 331	1 979	3 331
Denmark	1 774	826	1 774	826
Estonia	214	219	214	219
Finland	4 328	1 824	4 328	1 824
France	12 735	14 302	12 735	14 302
Germany	33 525	9 200	33 525	9 200
Greece	2 244	3 182	2 244	3 182
Hungary	2 898	3 349	2 898	3 349
Ireland	1 396	1 259	1 396	1 259
Italy	18 158	13 487	18 158	13 487
Latvia	393	541	393	541
Lithuania	1 029	834	1 029	834
Luxembourg	80	29	80	29
Malta	17	141	17	141
Netherlands	14 299	3 146	14 299	3 146
Poland	10 688	8 558	10 688	8 558
Portugal	2 728	3 806	2 728	3 806
Romania	1 372	3 387	1 372	3 387
Slovakia	669	1 048	669	1 048
Slovenia	433	328	433	328
Spain	6 057	13 067	6 057	13 067
Sweden	3 422	1 094	3 422	1 094
United Kingdom	62 849	13 654	62 849	13 654
EU-28	**194 383**	**107 826**	**194 383**	**107 826**
Iceland	142	232	142	232
EU-28 + ISL	**194 525**	**108 059**	**194 525**	**108 059**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.1.1 Managed waste disposal sites (CRF Source Category 5A1)

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 2.2 % of total EU-28+ISL GHG emissions. Between 1990 and 2014, CH_4 emissions from managed landfills declined by 45 % in the EU-28+ISL.

Thirteen EU-28 Member States reduced their emissions from this source during that period, Croatia, the Czech Republic, France, Greece, Hungary, Portugal, Spain and Iceland did not while Bulgaria, Estonia, Ireland, Latvia, Malta, Romania and Slovakia did not report CH_4 emissions from managed landfills in 1990. Cyprus reports all CH_4 emissions from landfilled waste under 5D3. In 2014, CH_4 emissions from managed landfills decreased by 5 % compared to 2013.

Table 7.2 5A1 Managed Waste Disposal on Land: Member States'+ ISL contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	3 880	1 501	1 404	2%	-98	-7%	-2 477	-64%	NA	NA
Belgium	3 053	1 141	1 064	1%	-76	-7%	-1 989	-65%	T2	D
Bulgaria	NO	630	664	1%	35	6%	664	100%	T2	CS,D
Croatia	17	855	929	1%	74	9%	912	5284%	T2	CS
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	1 979	3 364	3 331	4%	-33	-1%	1 352	68%	T1	CS,D
Denmark	1 774	847	826	1%	-22	-3%	-949	-53%	CS,T2	CS,D
Estonia	NO	243	219	0%	-24	-10%	219	100%	T2	D
Finland	4 328	1 952	1 824	2%	-129	-7%	-2 504	-58%	T2	CS,D
France	12 735	14 806	14 302	15%	-504	-3%	1 567	12%	-	-
Germany	33 525	9 850	9 200	10%	-650	-7%	-24 325	-73%	T2	CS
Greece	81	1 392	1 497	2%	105	8%	1 416	1751%	T2	CS,D
Hungary	2 898	3 437	3 349	4%	-88	-3%	451	16%	T2	D
Ireland	NO	960	1 121	1%	161	17%	1 121	100%	T2	CS,D
Italy	11 974	12 268	11 958	13%	-310	-3%	-16	0%	T2	CS
Latvia	NO	187	212	0%	25	14%	212	100%	T2	CS,D
Lithuania	879	806	748	1%	-58	-7%	-131	-15%	T2	D
Luxembourg	80	31	29	0%	-2	-5%	-51	-64%	T2	D
Malta	NO	98	107	0%	9	10%	107	100%	T2	PS
Netherlands	14 299	3 383	3 146	3%	-237	-7%	-11 153	-78%	T2	CS
Poland	4 662	4 515	4 510	5%	-6	0%	-152	-3%	T2	CS,D
Portugal	722	3 002	2 872	3%	-129	-4%	2 151	298%	T2	CS,D
Romania	NO	1 002	1 069	1%	67	7%	1 069	100%	T2	CS,D
Slovakia	NO	557	590	1%	34	6%	590	100%	T2	CS,D
Slovenia	433	367	328	0%	-39	-11%	-105	-24%	T2	CS,D
Spain	5 003	12 165	12 089	13%	-76	-1%	7 086	142%	T2	CS,D,OTH
Sweden	3 422	1 193	1 094	1%	-99	-8%	-2 328	-68%	T2	CS,D
United Kingdom	62 849	16 219	13 654	15%	-2 565	-16%	-49 195	-78%	T2	CS
EU-28	**168 592**	**96 768**	**92 135**	**100%**	**-4 633**	**-5%**	**-76 457**	**-45%**		
Iceland	15	175	199	0%	24	14%	184	1193%	T2	CS,D
EU-28 + ISL	**168 608**	**96 943**	**92 334**	**100%**	**-4 609**	**-5%**	**-76 273**	**-45%**		

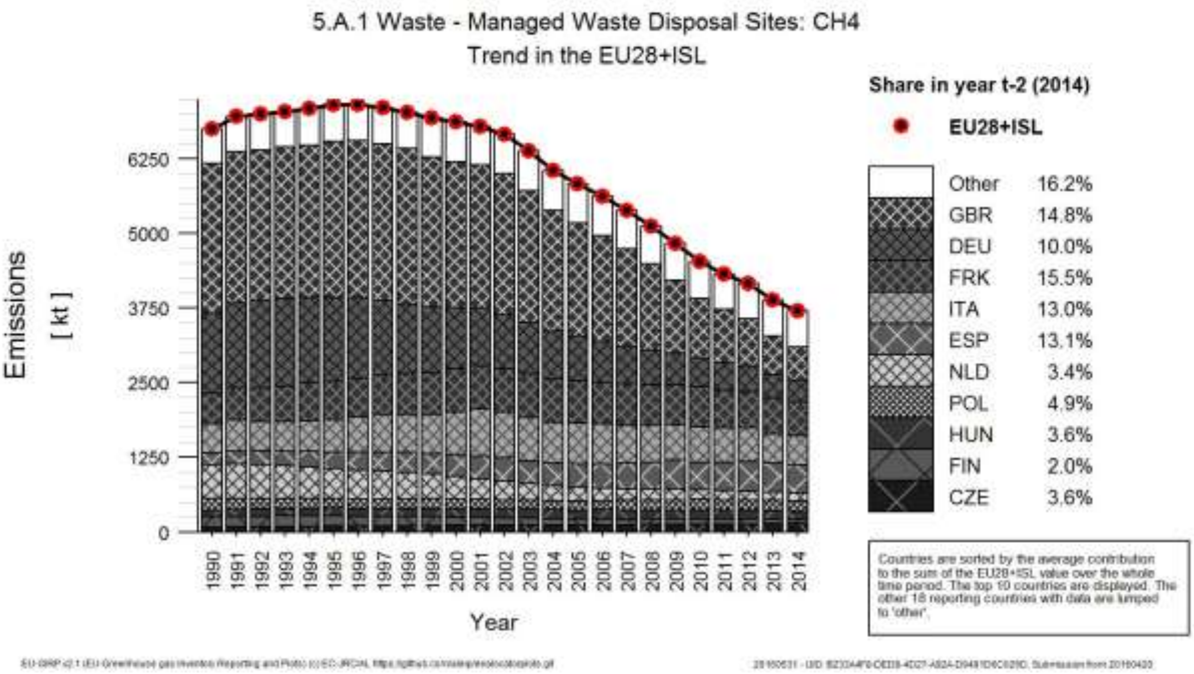
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trends in Emissions and Activity Data

CH_4 emissions from solid waste disposal on managed land decreased considerably between 1990 and 2014 by 45 %. *Figure 7.6* shows the trend of emissions indicating the countries contributing most to EU-28 total.

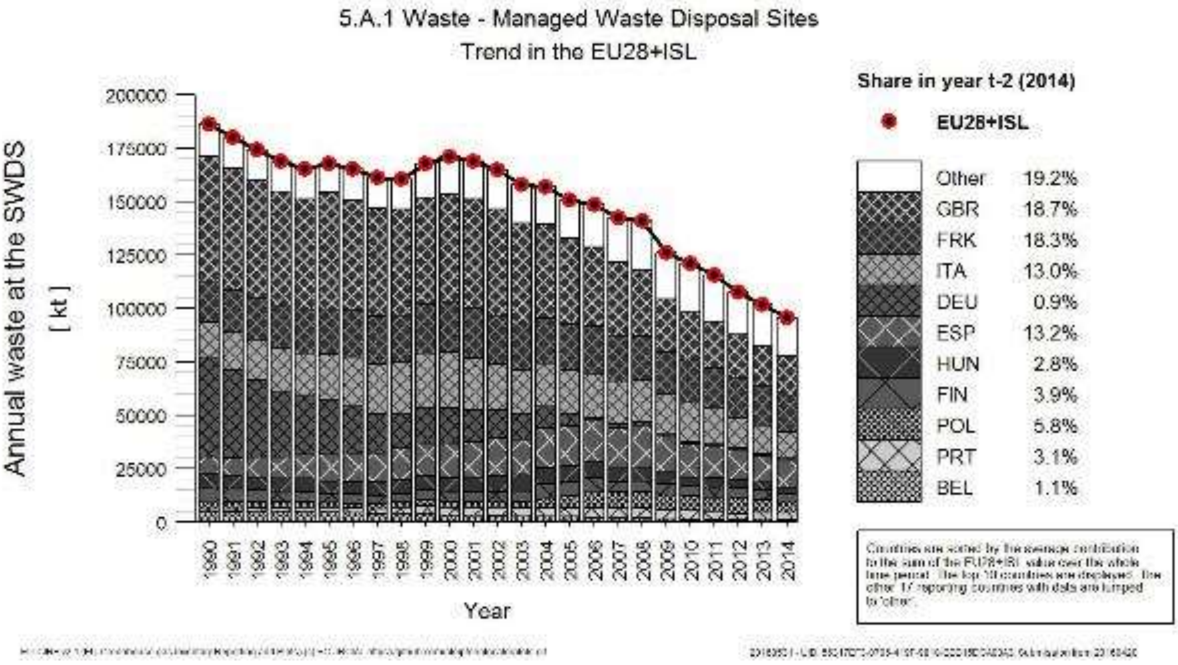
The Member States with highest emissions from this source in 2014 were France, the United Kingdom, Spain, Italy and Germany. These MS account for 66 % of EU-28+ISL CH_4 emissions from 5A1 in 2014. The largest reductions in absolute terms between 1990 and 2014 were reported by the United Kingdom and Germany. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation in the Member States. The landfill waste directive was adopted in 1999 and requires the Member States to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

Figure 7.6 5A1 Managed waste disposal on land: CH_4 emissions (Trend in relevant MS)



A main driving force of CH_4 emissions from managed waste disposal on land is the amount of waste, especially of biodegradable waste going to landfills. According to the CRF Tables submitted in 2016 total municipal waste disposal on managed landfills declined by 49 % between 1990 and 2014 (see *Figure 7.7*). 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 7.8).

*Figure 7.7	5A1 Managed waste disposal on land: Waste disposal (Trend in relevant Member States)*



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.

CH_4 emissions in **Spain**, contributing with 13 % to EU-28 emissions in 2014, increased almost continuously between 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 1990-2014. 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. In 2014 CH_4 emissions from solid waste disposal decreased by 1 % compared to 2013.

Portugal, contributing with 3 % to EU-28 emissions in 2014, 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 2014 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 **United Kingdom** has also a high share of CH_4 emissions from managed landfills among Member States with 15 % in 2014. 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-28 emissions in 2014, 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.

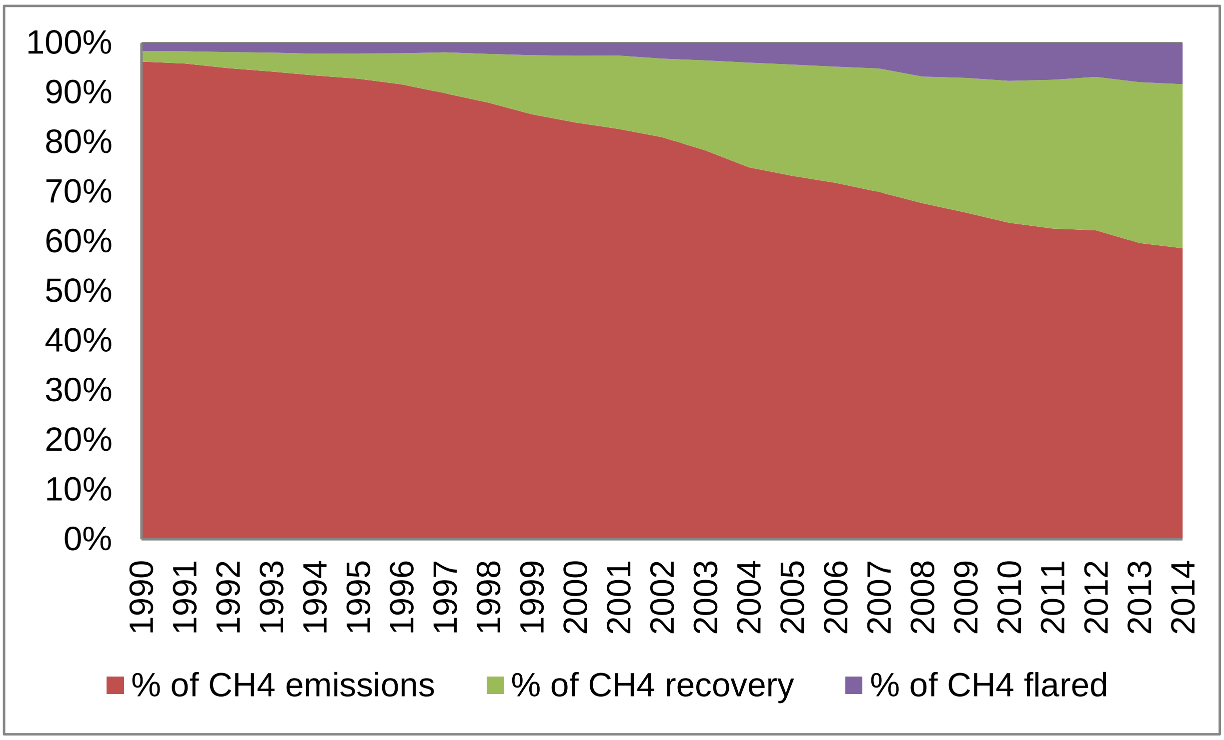
Germany, contributing with 10 % to EU-28 emissions in 2014, managed to reduce CH_4 emissions steadily until now from 1993 onwards. The amount of waste disposed on landfills shows a strong decrease from 1990 onwards, while in parallel CH_4 recovery increased. The highest share of CH_4 recovery could be found in 2002 and declined thereafter due to a decreasing amount of waste landfilled.

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.

CH_4 recovery in EU-28+ISL increased from 2 % of total CH_4 generated in managed landfills in 1990 to 33 % of generated CH_4 from managed SWDS (only 5A1) in 2014. 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 2013, CH_4 recovery of generated CH_4 for the EU-28+ISL decreased by 1 % in 2014. This is caused by reduced amounts of waste landfilled and the ban of organic material in the landfilled waste.

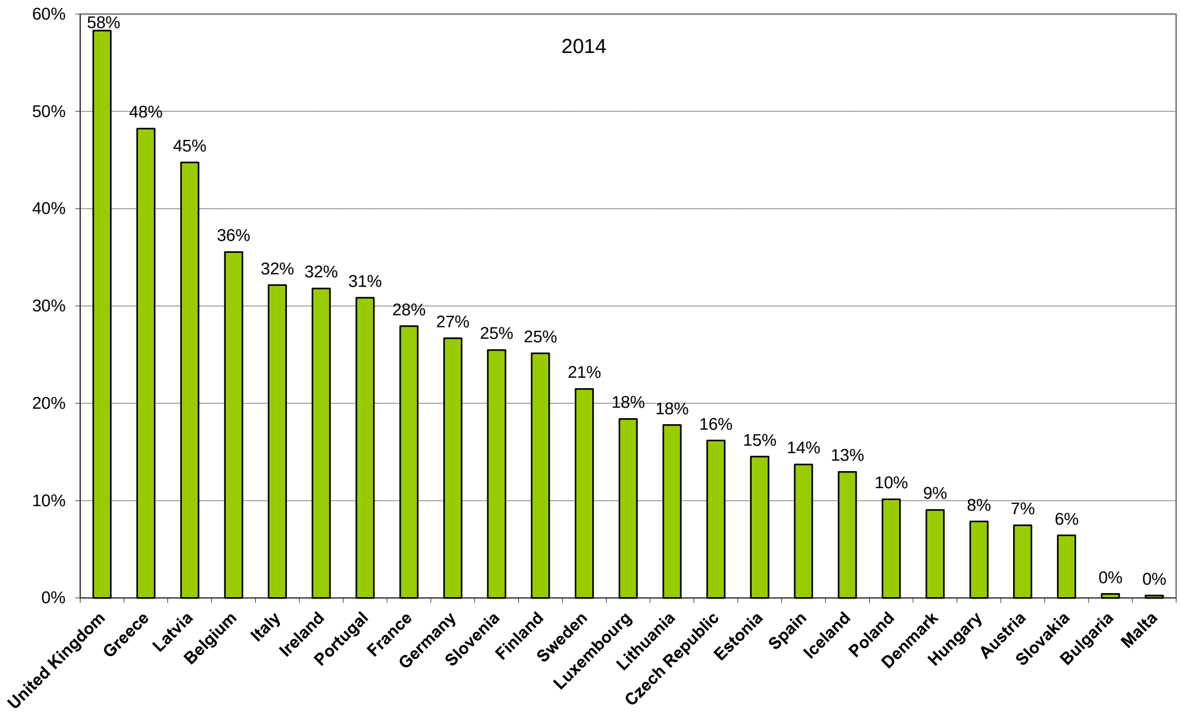
Figure 7.8 5A1 Managed Solid Waste Disposal: Development of the share of methane recovery, methane flared and CH_4 emissions on total CH_4 produced in managed landfills in the EU 28



Source: CRF 2016, Table 5A

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 7.9, varies among the Member States between 0.2 % in Malta and 58 % in the United Kingdom and depends - amongst other - on the share of solid waste disposal sites where flaring or recovery installations exist. Croatia, Cyprus and Romania do not report any data under 5.A CH_4 recovery, but Croatia indicates that the amount of CH_4 that is recovered with energy recovery is included in energy sector 1.A.2. Additionally Croatia and Romania report CH_4 data under 5.A flaring in their CRF tables.

Figure 7.9 5A1 Managed Solid Waste Disposal: Methane recovery rates for 2014



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 2016 Table 5A

Compared to 2013 the methane recovery in 2014 increased for nine Member States, with a significant absolute increase in France. In 15 Member States the amount of CH_4 recovery decreased in comparison to 2013.

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 applies 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, the 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. Further methodological information for all EU Member States and Iceland is provided in the Annex III of this submission.

Municipal Waste landfilled

The amount of waste disposed on SWDS depends on the total amount of waste generated and the share of waste disposed. 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. 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.

Member States that do not have historic data on waste generation and waste disposal available use the default IPCC values for the waste generation rate per capita and the share of waste disposed and apply inter- or extrapolation methods to create a time series. Recent data on waste generation and waste disposal is available in most EU-28 Member States and is not estimated based on the per capita waste generation rate and a share of waste landfilled, but on direct measurements.

The data sources used for generating time series of activity data by the Member States and Iceland is summarized in the Annex III.

Industrial waste

Data on industrial waste may be difficult to obtain in many countries and 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. Many Member States do not provide any information on industrial waste landfilled, while other Member States report that industrial waste is not reported separately and included under municipal solid waste. Further information on the reporting of industrial waste by the Member States and Iceland is summarized in the Annex III.

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. This leads also to varying waste compositions along the time series. Based on the information provided in the CRF tables and the NIR it is not possible to conduct a time series for waste composition in the EU-28+ISL. Country specific information on waste composition is provided in the Annex III.

Landfill gas recovery

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, while other 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. Further information on CH_4 recovery in the single Member States is provided in the Annex III of this 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 landfilled 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 dissimiable 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 this submission a table in the Annex III is 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 (also referred to as k-value or half-life value). 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 this submission a table in the Annex III is 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)

CH_4 emissions from 5A2 Unmanaged Waste Disposal on Land account for 0.33 % of total EU-28+ISL GHG emissions in 2014. Between 1990 and 2014, CH_4 emissions from this source decreased by 42 % (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 Malta and Romania showed an increase of CH_4 emissions from unmanaged landfills. In Malta CH_4 emissions from unmanaged landfills increased until 2004, whereas between 2004 and 2014 CH_4 emissions decreased by 37 %. In Romania CH_4 emissions from unmanaged waste disposal sites increased until 2010, but showed a decreasing trend from 2010 onwards. Between 2010 and 2014 the CH_4 emissions decreased by 11 %.

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 EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	3 564	2 526	2 437	17%	-88	-4%	-1 126	-32%	T2	CS,D
Croatia	331	300	260	2%	-40	-13%	-71	-21%	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	1 748	1 686	12%	-62	-4%	-477	-22%	T2	CS,D
Hungary	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	1 396	147	138	1%	-9	-6%	-1 258	-90%	T2	CS,D
Italy	6 184	1 604	1 528	11%	-75	-5%	-4 655	-75%	T2	CS
Latvia	393	346	329	2%	-17	-5%	-63	-16%	T2	CS,D
Lithuania	150	95	87	1%	-8	-8%	-63	-42%	T2	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	17	36	34	0%	-2	-5%	18	108%	M	M
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	5 038	3 134	2 890	20%	-243	-8%	-2 147	-43%	T2	CS,D
Portugal	2 007	1 002	934	7%	-68	-7%	-1 073	-53%	-	-
Romania	1 372	2 410	2 318	16%	-92	-4%	946	69%	T2	CS,D
Slovakia	669	476	457	3%	-18	-4%	-212	-32%	T2	CS,D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 054	1 029	978	7%	-50	-5%	-75	-7%	T2	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**24 337**	**14 852**	**14 078**	**100%**	**-774**	**-5%**	**-10 259**	**-42%**		
Iceland	127	33	33	0%	-1	-2%	-94	-74%	T2	CS,D
EU-28 + ISL	**24 464**	**14 885**	**14 111**	**100%**	**-774**	**-5%**	**-10 353**	**-42%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Trends in Emissions and Activity Data

CH_4 emissions from solid waste disposal on unmanaged land decreased considerably between 1990 and 2014 by 42 %. *Figure 7.10* shows the trend of emissions indicating the countries contributing most to EU-28+ISL total. In comparison to the rather drastic decrease of the amount of waste disposed on unmanaged landfills (see *Figure 7.11*) CH_4 emissions from unmanaged landfills show only a moderate decrease during the time series.

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 76 % of the total EU-28+ISL emissions from unmanaged waste disposal sites. Italy and Poland show large absolute reductions between 1990 and 2014. In these two countries, waste is not disposed on unmanaged landfill sites any more (in Italy since 2000, in Poland since 2012).

Figure 7.10 5A2 Waste disposal on unmanaged landfills: CH_4 emissions (Trend in relevant MS)

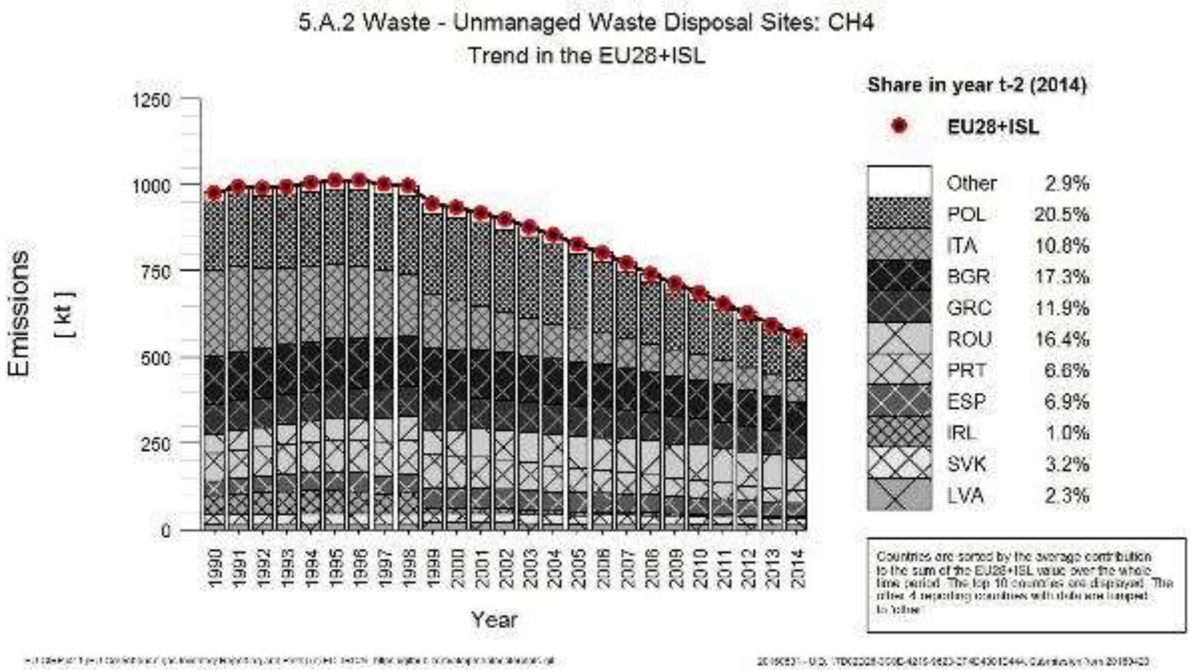
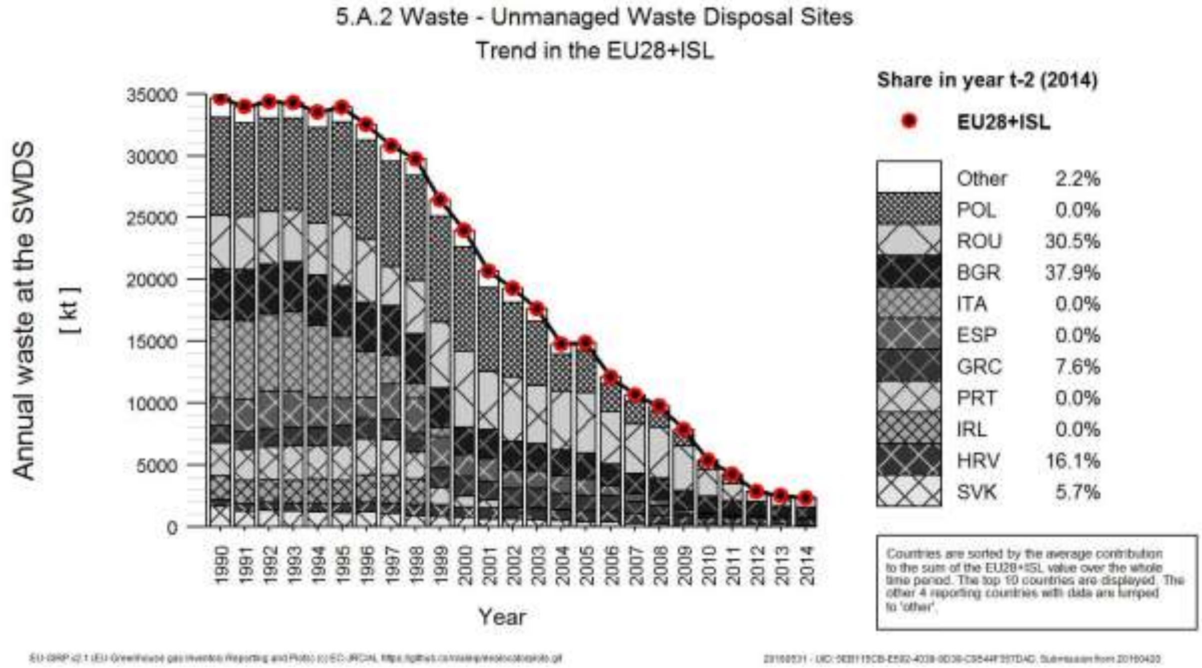


Figure 7.11 shows the relevant trends for the amount of waste disposed on unmanaged landfills, where the highest reductions in waste disposal between 1990 and 2014 are found for Italy and Poland. In Bulgaria, Croatia, Greece, Iceland, Lithuania, Romania and Slovakia solid waste disposal on unmanaged landfills is still practiced, but the amount of waste disposed is considerably decreasing since 1995. While in the year 1995 almost 34.7 Mt have been disposed on unmanaged landfills only 2.3 Mt were disposed in 2014. However, emissions are still produced from the waste disposed in the past.

Figure 7.11 5A2 Waste disposal on unmanaged landfills: Total waste disposed on unmanaged landfills (Trend in relevant MS)



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.

Methodological issues

CH_4 emissions from unmanaged solid waste disposal were reported in thirteen Member States and Iceland in 2014 (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) and Iceland 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+ISL emissions from this category are calculated using higher tier methods.

CH_4 emissions from waste disposal on unmanaged landfills are calculated similar to CH_4 emissions from managed landfills, using the amount of waste disposed on unmanaged landfills. If no other data is available the same data on waste composition and the same parameters as used for managed landfills can be applied in the calculation. The Methane Correction Factor (MCF) is the relevant parameter that differentiates between managed and unmanaged landfills. The Methane Correction Factor 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. Table 7.4 shows the different MCFs used by countries to estimate CH_4 emissions from waste disposal on unmanaged landfills in 2014. All Member States use a MCF between 0.4 and 0.8, except for Iceland (MCF = 0.2). Iceland refers to two landfill gas studies that found out that unmanged landfills in Iceland have reduced CH_4 production in comparison to the default IPCC MCF value.

Table 7.4 5A2 Waste disposal on unmanaged landfills: MCFs applied by countries in 2014

Member State	MCF
Bulgaria	0.8
Croatia	0.7
Czech Republic	0.6
France	0.4
Greece	0.8
Iceland	0.2
Italy	0.6
Latvia	0.6
Lithuania	0.4
Poland	0.8
Portugal	0.6
Romania	
Slovakia	0.4

Source: CRF Table 5.A 2016

7.2.1.3 Recalculations (CRF Source Category 5A)

Table 7.5 provides information on the contribution of Member States to EU recalculations in CH_4 emissions from 5A Solid Waste Disposal on Land for 1990 and 2013 and main explanations (as available in the national inventory reports) for the largest recalculations in absolute terms. Member States contributing most to the recalculations in the year 2013 for the sector 5.A in absolute terms are the United Kingdom, Bulgaria, Poland and Croatia.

Table 7.5: 5A Solid Waste Disposal on Land: Contribution of member states to EU recalculations in CH_4 emissions for 1990 and 2013 (difference between latest submission and previous submission)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	-65	-1.7	168	12.6	Revised methodology (2006 IPCC GL)
Belgium	0	0.0	0	0.0	-
Bulgaria	-396	-10.0	-361	-10.3	After the ESD review in 2015 and the TERT recommendations have been implemented following recalculations: 1) oxidation factor OX=0.1 has been used for both managed and unmanaged landfills; 2) for calculation of weighted half-time is based on k=0.09 and half-life (t 1/2) =7 for bulk waste in estimation of the emissions from SWDS.
Croatia	60	20.7	208	21.9	5A Solid waste disposal - New value for methane generation rate constant (k) has been included.

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Cyprus	251	100.0	-30	-6.3	The emissions from this source have been recalculated due to the following changes: a) change in the solid waste production data for the year 2013, b) change of the methane generation rate constant, c) change on the time series on waste disposal data and d) change of methane oxidation factor.
Czech Republic	0	0.0	39	1.2	Year 2013 was recalculated due to changes in last year activity data. This is fairly regular recalculation as some data needed for this source category are available only in preliminary version before inventory is submitted.
Denmark	0	0.0	3	0.4	The recalculation of emissions from Solid Waste Disposal on Land is caused by an update in the activity data in the new waste reporting system 2011-2013.
Estonia	0	0.0	0	0.0	-
Finland	0	0.0	0	0.0	
France	56	0.4	101	0.7	No information provided.
Germany	0	0.0	0	0.0	
Greece	0	0.0	35	1.1	Updated activity data are used for the CH_4 recovery from biogas flaring in managed SWDS for 2012 and 2013.
Hungary	58	2.0	90	2.7	The Hungarian municipal waste composition statistics usually does not contain a separate category for wood. For this submission, it was assumed that within the municipal waste category about half of the "bulky waste" (EWC 200307) is similar to wood waste and was as such included into the IPCC waste model. The amount of industrial waste was updated for 2013.
Ireland	0	0.0	2	0.1	Recalculations in this category are associated with a minor revision to the quantities of MSW accepted at three SWDS for the years 2010-2013.
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	92	221.3	An error in the calculation of CH_4 recovery has been identified, which gave a 10 fold increase in the results of recovered methane from SWDS. This issue has been resolved in the 2016 submission and resulted in recalculations of CH_4 emissions.
Netherlands	0	0.0	0	0.0	
Poland	322	3.1	277	3.2	Recalculation of waste composition trend
Portugal	0	0.0	-1	0.0	Correction of a small link error in calculation file.
Romania	0	0.0	105	3.2	The amount of MSW deposited in managed and unmanaged SWDS in 2010-2013 periods was updated based on recalculations made by Waste directorate of NEPA. The amount of CH_4 recovery was changed for 2013 year due to an error of reporting data in this year. The NMVOC emissions were updated based on revised methane emissions for 2010-2014 year.
Slovakia	0	0.0	0	0.0	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Slovenia	0	0.0	1	0.3	Improved data of screening analyzes for mixed MSW.
Spain	0	0.0	-142	-1.1	2013 has been recalculated according to new activity data provided by Subdirectorate General of Waste, the National Focal Point.
Sweden	0	0.0	0	0.0	
United Kingdom	139	0.2	-483	-2.9	Decrease in emissions due to an update to using the IPCC 2006 calculation methodology for calculating methane formation.
EU28	424	0.2	105	0.1	
Iceland	0	0.0	3	1.4	No information provided.
EU28+IS	424	0.2	108	0.1	

7.2.2 Biological treatment of solid waste (CRF Source Category 5B)

Source category 5B Biological treatment of solid waste includes CH_4 and N_2O from 5B1 Composting, from 5B2 anaerobic digestion and also emissions from mechanical-biological treatment according to the IPCC 2006 Guidelines. The whole sector 5.B contributes only 0.2 % to EU+ISL total GHG emissions without LULUCF in 2014. 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.

Table 7.6 provides total GHG and CH_4 and N_2O emissions by Member State and Iceland from 5B Biological treatment of solid waste. Total emissions from this category increased considerably since 1990. Eleven countries (Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Iceland, Ireland, 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 increased considerably during the last years and all countries report emissions from this category in 2014.

Table 7.6 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 2014 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	36	172	23	94	13	79
Belgium	7	62	4	37	3	25
Bulgaria	0	10	NO	4	NO	6
Croatia	0	6	IE,NE,NA	2	IE,NE	4
Cyprus	0	12	NO	6	NO	6
Czech Republic	0	654	NE,IE	36	NE,IE	618
Denmark	51	303	12	123	38	180
Estonia	1	25	0	10	1	15
Finland	45	130	20	55	26	75
France	82	753	54	493	29	261
Germany	41	1 023	16	311	25	712
Greece	0	38	NO	18	NO	20
Hungary	9	133	4	34	5	100
Ireland	0	25	NO	12	NO	13
Italy	19	546	17	483	2	63
Latvia	21	23	9	10	12	13
Lithuania	7	35	3	15	4	20
Luxembourg	0	10	NE,NO	4	NE,NO	6
Malta	0	1	NO	NA,NO	NO	1
Netherlands	20	159	7	83	14	76
Poland	8	222	3	92	5	129
Portugal	21	42	10	16	11	26
Romania	0	82	NO	39	NO	43
Slovakia	123	165	58	78	65	87
Slovenia	0	12	NO	5	NO	7
Spain	146	758	69	340	77	418
Sweden	13	129	6	45	7	84
United Kingdom	9	1 281	4	518	5	764
EU-28	**660**	**6 812**	**318**	**2 963**	**342**	**3 849**
Iceland	0	2	NO	2	-	-
EU-28 + ISL	**660**	**6 814**	**318**	**2 964**	**342**	**3 849**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.2.1 Recalculations (CRF Source Category 5B)

Table 7.7 provides information on the contribution of Member States to EU recalculations in N_2O from 5B Biological treatment of solid waste for 1990 and 2013 and main explanations (if available in Member States' inventories) for the largest recalculations in absolute terms.

Table 7.7: 5B Biological treatment: Contribution of Member States to EU recalculations in N_2O for 1990 and 2013 (difference between latest submission and previous submission)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.0	0.0	-10.9	-10.7	Correction of activity data
Belgium	0.0	0.0	-0.7	-1.7	Emissions of N_2O from composting activities are newly added in the greenhouse gas inventory during the 2015 submission.
Bulgaria	0.0	0.0	-1.9	-20.0	Recalculations of N_2O emissions from biological treatment of waste are made due to updated EF for N_2O – 0.24 g N_2O/kg treated waste.
Croatia	0.0	0.0	-1.6	-44.4	5B1 Composting - AD and EF have been corrected.

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Cyprus	0.0	0.0	4.4	99 900.0	Revised data for the year 2012 has been used.
Czech Republic	0.0	0.0	-8.0	-20.0	5. B.1: This year recalculation was done due to errata in IPCC methodology. Default factor for N_2O from composting was changed from 0.3 kg N_2O/ton to 0.24 kg N_2O/ton. 5.B.2: The time series from year 2007 to year 2003 has been prolonged. The same method and activity data for estimation that are used for normal inventory are used.
Denmark	0.0	0.0	0.0	0.0	-
Estonia	-0.1	-20.0	-3.2	-20.0	Recalculation due to updated 2006 IPCC N_2O emission factor.
Finland	0.0	0.0	0.0	0.0	
France	-3.6	-6.2	0.1	0.0	Composting: The activity data prior to 1995 were carried out. Biogas: the composition of the waste is now methanized considered.
Germany	0.0	0.0	-6.2	-2.0	Recalculations due to update of activity data for the year 2013.
Greece	0.0	0.0	0.0	0.0	-
Hungary	0.0	0.0	0.0	0.0	As the EU trial review pointed out, some double counting occurred in the previous submission as regards biogas leakage. In this submission, leakage from only 'other' biogas production is taken into account in the category 5B Biological Treatment of Solid Waste. Landfill biogas has been removed, and leakage from sludge digestion has been reallocated to 5D.
Ireland	0.0	0.0	0.0	0.0	-
Italy	0.0	0.0	4.5	1.0	Minor recalculations occurred in the sector because of the update of 2013 activity data.
Latvia	8.5	100.0	6.5	504.9	Recalculation is done due to new activity data estimation become available. Emissions from household composting are added to submission.
Lithuania	-0.7	-20.0	-2.2	-20.0	N_2O emissions were recalculated due to 9th Corrigenda of 2006 IPCC Guidelines. Impact of recalculations on N_2O emissions is provided in NIR Chapter 7.3.5, Table 7-29.
Luxembourg	0.0	0.0	-2.6	-41.5	No information provided.
Malta	0.0	0.0	0.0	0.0	-
Netherlands	0.0	0.0	0.0	0.0	-
Poland	-0.9	-20.0	-24.5	-20.0	Correction of emission factor according to corrigenda to IPCC 2006 guidelines
Portugal	0.0	0.0	0.9	5.4	Small revision of AD for 2013 from data received for one of the Portuguese islands.
Romania	0.0	0.0	40.7	100.0	CH_4 and N_2O emissions for the entire period have been calculated for the first time using methodology and default EFs from 2006 IPCC GL.
Slovakia	0.0	0.0	0.0	0.0	-
Slovenia	0.0	0.0	0.5	11.3	Correction of default N_2O EF for composting. Improved data on amount of composting waste.
Spain	0.0	0.0	-59.6	-14.9	As with other categories for which the SGR is the focal point, the year 2013 has been recalculated as new activity data becomes available.
Sweden	0.0	0.0	0.0	0.0	-
Great Britain	-1.0	-20.0	-135.0	-22.3	Revision to emission factor from composting. Update to activity data to ensure consistency with data used by CEH in the LULUCF sector
EU28	2.3	0.7	-199.1	-6.5	
Iceland	0.0	0.0	0.0	0.0	-
EU28+IS	2.3	0.7	-199.1	-6.5	

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 7.8 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 0.1 % of total EU-28+ISL GHG emissions in 2014. Total emissions decreased by 35 % between 1990 and 2014. Most Member States decreased their emissions from waste incineration and open burning between 1990 and 2014, except for Czech Republic, Denmark, Greece, Hungary, Malta, Poland, Portugal, Slovenia and Sweden. The United Kingdom, France, Italy and Spain feature the largest decreases in absolute terms; these Member States account for 65 % of emissions from this source in 2014.

Table 7.8 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	27	2	27	2	0	0	0	0
Belgium	302	220	299	220	3	0	NA,NO	NA,NO,IE
Bulgaria	21	12	20	11	2	1	0	0
Croatia	1	0	1	0	0	NA,NO,IE	NA,NO	NA,NO
Cyprus	0	0	NO	NO	NO	NO	NO	NO
Czech Republic	24	134	23	132	0	2	0	0
Denmark	0	0	NO	NO	0	0	0	0
Estonia	4	2	2	1	0	0	1	0
Finland	0	0	NO,NE,IE	IE,NE,NO	NO,NE,IE	IE,NE,NO	NO,NE,IE	IE,NE,NO
France	2 323	1 795	2 209	1 731	92	36	22	28
Germany	0	0	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Greece	0	4	0	3	0	1	0	0
Hungary	122	201	121	198	1	2	0	0
Ireland	92	36	91	36	1	0	1	0
Italy	594	304	507	229	37	22	50	52
Latvia	6	5	1	1	5	4	NA,NO	NA,NO
Lithuania	3	2	3	2	0	0	0	0
Luxembourg	0	0	IE,NO	NO,IE	IE,NO	NO,IE	IE,NO	NO,IE
Malta	0	1	0	1	0	0	0	0
Netherlands	0	0	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE
Poland	358	580	350	524	7	56	NO,NA	0
Portugal	8	20	7	14	1	5	0	1
Romania	0	10	NO	9	NO,NE	2	NE,NO	NE,NO
Slovakia	68	12	60	6	6	5	2	1
Slovenia	1	14	1	14	NO	0	NO	NO
Spain	345	10	305	NO,IE	25	9	16	1
Sweden	45	63	44	58	1	5	0	0
United Kingdom	1 524	369	1 357	305	30	55	137	9
EU-28	**5 868**	**3 796**	**5 427**	**3 496**	**211**	**206**	**229**	**93**
Iceland	13	8	11	7	1	0	-	-
EU-28 + ISL	**5 881**	**3 804**	**5 439**	**3 496**	**213**	**207**	**229**	**93**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.3.1 Recalculations (CRF Source Category 5C)

Table 7.9 provides information on the contribution of Member States to EU recalculations in CO_2, CH_4 and N_2O emissions from 5C Waste incineration for 1990 and 2013 and main explanations (if available in Member States' inventories) for the largest recalculations in absolute terms.

Table 7.9: 5C Waste incineration: Contribution of Member States to EU recalculations in CO_2 equiv. for 1990 and 2013 (difference between latest submission and previous submission)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	12.1	4.2	0.0	0.0	No information available.
Bulgaria	0.0	0.0	0.0	0.0	
Croatia	0.0	0.0	0.0	0.0	
Cyprus	0.0	0.0	0.0	0.0	
Czech Republic	0.0	0.0	-45.6	-26.0	Time period 2005-2013 was recalculated to be fully consistent with data from ISOH category D10 – incineration on land. Data and results prior 2005 were not changed.
Denmark	0.0	0.0	0.0	0.0	
Estonia	1.2	118.8	0.7	226.8	Calculation error due to misapprehension of IPCC 2006 Guidelines.
Finland	0.0	0.0	0.0	0.0	
France	79.1	3.7	17.4	1.1	Sludge incineration (5C1.1b) Activity data quantities of sludge burned in 2013 for submission in 2015 was an extension of the value of 2012. In the 2016 submission, the 2013 values have been updated on the basis of data published by the Ministry. There is a sharp decline in quantities of incinerated sludge (-35%) between 2012 and 2013. Hazardous waste incineration (5C1.1b) Activity data quantities of hazardous waste incinerated in 2013 for submission in 2015 was an extension of the value of 2012. In the submission 2016 2013 values have been updated on the basis of data published by the SYPRED. There is a slight decrease in quantities incinerated in specific center (-15%) in in situ incinerators (-10%) between 2012 and 2013.
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Hungary	0.0	0.0	-4.3	-2.2	Amount of incinerated clinical waste has been updated for years 2012 and 2013 on the basis of the latest information contained in the Hungarian waste information system.
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	24.5	12.6	Rearrangement of incinerators database has been made. During this process an in depth analysis about all incineration plants has been carried out with the target to eliminate double counting and to add eventual not counted plants
Latvia	0.0	0.0	0.0	0.0	
Lithuania	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Malta	0.2	166.6	0.2	45.5	No information provided.
Netherlands	0.0	0.0	0.0	0.0	
Poland	0.0	0.0	0.1	0.0	
Portugal	0.0	0.0	0.0	0.0	
Romania	0.0	0.0	-0.3	-3.1	CO_2 emissions were recalculated for 2013 year because preliminary data related to the amount of incinerated hazardous waste became final data.

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Slovakia	0.0	0.0	0.0	0.0	
Slovenia	0.0	0.0	0.0	0.0	
Spain	-0.2	-0.1	-3.4		A double counting of emissions reported under 5C and 1A4 has been observed. This issue is now corrected.
Sweden	0.0	0.0	0.0	0.0	
Great Britain	52.4	4.1	59.0	23.4	Revision to activity and emission factor data for chemical waste; Revision to activity data by site reported by the Environment Agency.
EU28	144.9	2.7	48.3	1.4	
Iceland	0.0	0.0	0.3	5.2	To be checked.
EU28+IS	144.9	2.7	48.6	1.4	

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 systems and facilities. N_2O is also indirectly released from disposal of wastewater effluents into aquatic environments70. According to the key category analysis CH_4 emissions from 5D1 Domestic wastewater and 5D2 Industrial 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. Industrial wastewater can also be released into domestic sewer systems and included under domestic wastewater. On the other hand it can be treated on site and then it will be accounted under the separate category 5D2 industrial wastewater.

Table 7.10 shows total GHG, CH_4 and N_2O emissions by Member State from 5D Wastewater Handling. Between 1990 and 2014, total emissions from wastewater handling decreased by 36% in EU-28+ISL. All Member States except for Denmark, France, Ireland, Portugal and Iceland decreased their emissions from wastewater treatment and discharge between 1990 and 2014. Due to the implementation of new wastewater treatment technologies CH_4 emission decreased considerably by 42 % between 1990 and 2014, while N_2O emissions decreased moderately by 8 %.

[70] In most countries, indirect N2O emissions from disposal of wastewater effluents are the major source of N_2O emissions from wastewater handling, whereas direct N_2O emissions from wastewater treatment plants are small or not relevant.

Table 7.10 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 2014 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (kt CO2 equivalents)
Austria	217	187	96	161	121	25
Belgium	1 082	477	247	270	835	207
Bulgaria	3 430	1 122	199	145	3 232	977
Croatia	305	291	67	83	238	208
Cyprus	126	37	12	16	114	21
Czech Republic	1 372	935	234	204	1 138	731
Denmark	157	170	61	60	96	109
Estonia	151	92	39	30	113	62
Finland	300	248	79	76	221	172
France	2 254	2 611	729	457	1 525	2 154
Germany	2 745	504	970	441	1 775	63
Greece	4 255	1 861	279	323	3 976	1 538
Hungary	1 198	601	260	224	938	376
Ireland	157	172	96	119	61	53
Italy	4 488	3 850	1 266	1 347	3 222	2 504
Latvia	372	265	27	17	345	248
Lithuania	609	265	67	45	542	220
Luxembourg	16	11	9	8	7	4
Malta	25	13	8	12	17	1
Netherlands	478	273	172	70	306	203
Poland	3 658	1 405	723	738	2 936	667
Portugal	3 285	3 308	326	403	2 960	2 905
Romania	3 652	2 278	505	516	3 146	1 761
Slovakia	604	360	138	49	466	311
Slovenia	210	140	50	49	159	91
Spain	2 386	1 850	733	959	1 653	891
Sweden	261	236	226	208	35	28
United Kingdom	4 733	3 842	514	411	4 219	3 432
EU-28	**42 528**	**27 404**	**8 132**	**7 442**	**34 396**	**19 962**
Iceland	7	11	5	7	2	4
EU-28 + ISL	**42 535**	**27 415**	**8 138**	**7 449**	**34 398**	**19 967**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.4.1 Domestic wastewater (CRF Source Category 5D1)

CH_4 emissions from 5D1 Domestic Wastewater account for 0.2 % of total EU-28+ISL GHG emissions in 2014. Between 1990 and 2014, CH_4 emissions decreased by 52 %. 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***). In 2014, CH_4 emissions decreased by 2 % in comparison to 2013.

Table 7.11 5D1 Domestic and commercial wastewater: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	121	25	25	0%	0	1%	-96	-79%	-	-
Belgium	835	215	207	2%	-8	-4%	-628	-75%	CR,T1	CR,D
Bulgaria	722	646	620	6%	-27	-4%	-103	-14%	T2	D
Croatia	141	112	111	1%	-1	-1%	-30	-21%	T1	D
Cyprus	113	29	18	0%	-11	-37%	-94	-84%	T1	D
Czech Republic	527	432	423	4%	-8	-2%	-104	-20%	T1	CS,D
Denmark	96	108	109	1%	1	1%	14	14%	CS	CS
Estonia	113	51	50	0%	-1	-1%	-63	-56%	T1	D
Finland	194	150	149	1%	-1	-1%	-46	-24%	CS,T2	CS,D
France	1 435	2 051	2 057	19%	6	0%	622	43%	-	-
Germany	1 766	24	21	0%	-3	-12%	-1 745	-99%	CS,D	CS,D
Greece	2 959	522	522	5%	0	0%	-2 437	-82%	D	D
Hungary	803	360	350	3%	-11	-3%	-453	-56%	T1	D
Ireland	61	51	53	0%	2	3%	-8	-14%	-	-
Italy	1 702	1 113	1 114	10%	2	0%	-588	-35%	T1	D
Latvia	208	115	110	1%	-5	-5%	-98	-47%	D	CS
Lithuania	542	221	220	2%	-1	0%	-322	-59%	T1	D
Luxembourg	7	4	4	0%	0	-2%	-3	-47%	T1	CS
Malta	17	NA	1	0%	1	100%	-16	-92%	D	CS
Netherlands	298	186	194	2%	7	4%	-104	-35%	T2	CS
Poland	2 309	577	408	4%	-169	-29%	-1 901	-82%	T1	CS,D
Portugal	1 258	879	875	8%	-5	-1%	-383	-30%	T2	CS,D
Romania	2 768	1 592	1 572	15%	-20	-1%	-1 196	-43%	D	D
Slovakia	437	311	305	3%	-6	-2%	-132	-30%	CS,T2	D
Slovenia	152	87	89	1%	2	2%	-63	-41%	T1	CS,D
Spain	1 167	301	301	3%	0	0%	-866	-74%	T1,T2	D
Sweden	31	23	23	0%	0	1%	-8	-27%	T2	CS
United Kingdom	1 499	757	767	7%	11	1%	-732	-49%	CS	CS
EU-28	**22 281**	**10 941**	**10 698**	**100%**	**-243**	**-2%**	**-11 583**	**-52%**		
Iceland	2	4	4	0%	0	1%	3	157%	T1	CS,D
EU-28 + ISL	**22 283**	**10 946**	**10 702**	**100%**	**-243**	**-2%**	**-11 580**	**-52%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

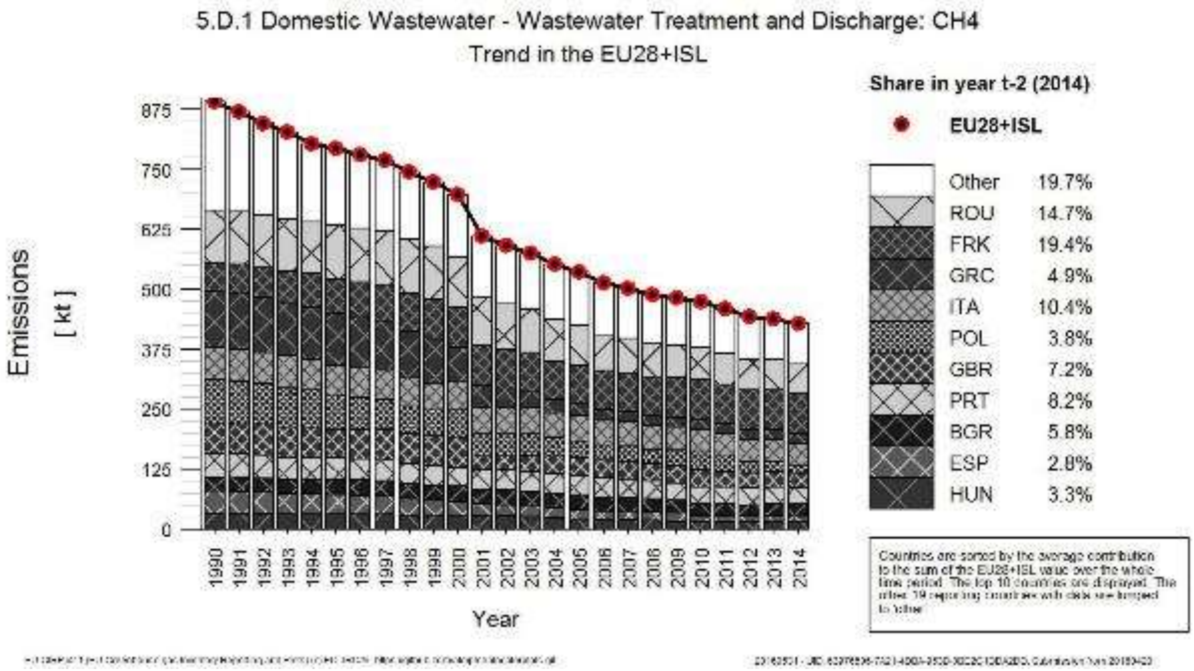
Trends in Emissions and Activity Data

CH_4 emissions from domestic wastewater treatment and discharge decreased considerably between 1990 and 2014 by 52 %. Figure 7.12 shows the trend of emissions indicating the countries contributing most to EU-28+ISL total.

Large decreases in absolute terms are reported by Germany, Greece Poland and Romania, contributing together to only 24 % of EU-28+ISL emissions from source 5D1 in 2014, whereas France shows significant emission increases (Table 7.11). France is responsible for 19 %, Italy for 10 % and Romania for 15 % of EU-28+ISL emissions from this source in 2014. Although France increased its emissions between 1990 and 2014, the trend of EU-28+ISL emissions is dominated by the large emission reductions in Germany, Greece, Poland and

Romania. Also Belgium, Italy, Spain and the United Kingdom achieved significant reductions in emissions compared to 1990.

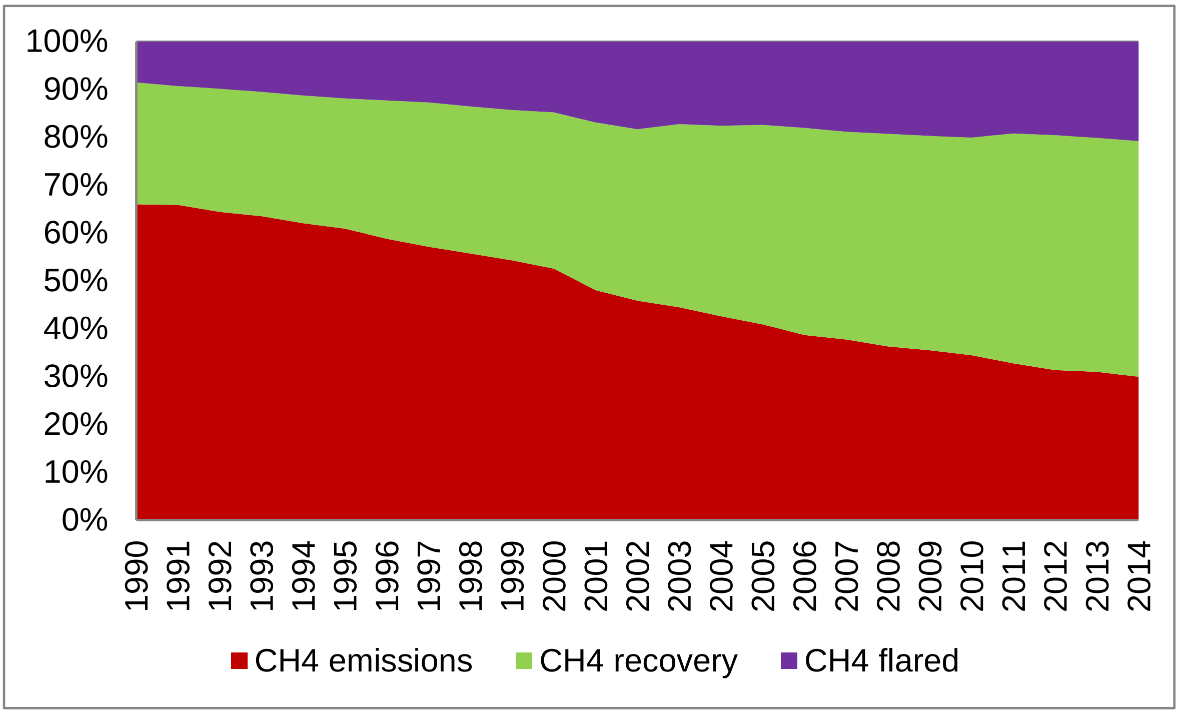
Figure 7.12 5D1 Domestic wastewater: CH_4 emissions (Trend in relevant MS)



The decreasing trend of CH_4 emissions from wastewater is not related to a decreasing quantity of wastewater and the amount of the total organic product in the wastewater. In fact the decrease is based on several reasons:

- Increased share of CH_4 flared or recovered (see *Figure **7.13***)
- Improvements of wastewater disposal routes
- Amount of sludge removed

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



Source: CRF 2016, Table 5D

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 and other important countries is presented.

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 2006). 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 2014. Wastewater treatment in collective systems increased slightly from 79 % in 1990 to 81 % in 2014. Furthermore France applies CH_4 recovery and flaring for generated CH_4 from wastewater since 1990. CH_4 recovery peaks in 2011 and decreases afterwards, which leads to slightly higher CH_4 emissions from 2012 onwards.

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 55 % of the total wastewater has been treated appropriate in 2014. Between 2000 and 2014 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 1990 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 2014 about 81 % of population is served by wastewater treatment plants.

CH_4 emissions from domestic wastewater handling in **Poland** decreased continuously throughout the time series. Between 1990 and 2014 CH_4 emissions decreased by 82 % because of significant developments in the wastewater collection and treatment system. The share of rural population using latrines for domestic wastewater storage decreased from 96 % in 1990 to 63 % in 2014 and the share of urban populations using latrines decreased from 19 % to 10 % in the same period. Instead the treatment pathway using high nutrient removal increased for rural population from 1 % to 18 % and from 0 % in 1990 for urban population to 81 %.

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 amount of 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 Annex III of this submission a table on Member States specific methodology is provided.

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 Industrial wastewater (CRF Source Category 5D2)

CH_4 emissions from 5D2 Industrial Wastewater account for 0.2 % of total EU-28+ISL GHG emissions in 2014. Between 1990 and 2014, CH_4 emissions decreased by 24 %. Key drivers for the development of CH_4 emissions are economic activities. CH_4 emissions are related to production data in certain industries with high organic contents in the wastewater. Therefore the trend in CH_4 emissions is fluctuating throughout the time series based on the economic situation in the countries. In 2014, CH_4 emissions increased by 3 % in comparison to 2013 (see Table 7.12).

Table 7.12 5D2 Industrial wastewater: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2014	Change 2013-2014		Change 1990-2014		Method applied	Emission factor
	1990	2013	2014		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA
Bulgaria	2 510	335	358	4%	23	7%	-2 152	-86%	T2	D
Croatia	97	88	97	1%	8	9%	0	0%	T2	D
Cyprus	1	3	3	0%	0	0%	2	195%	T1	D
Czech Republic	611	281	308	3%	26	9%	-304	-50%	T1,T2	CS,D
Denmark	IE	IE	IE	-	-	-	-	-	NA	NA
Estonia	NO	14	12	0%	-2	-15%	12	100%	T1	D
Finland	27	24	24	0%	-1	-2%	-3	-11%	CS,T2	CS,D
France	90	97	97	1%	0	0%	7	8%	-	-
Germany	9	41	42	0%	1	2%	33	357%	CS	CS
Greece	1 017	1 016	1 016	11%	0	0%	-1	0%	D	D
Hungary	135	27	27	0%	0	0%	-108	-80%	T2	D
Ireland	IE	IE	IE	-	-	-	-	-	NA	NA
Italy	1 520	1 398	1 389	15%	-9	-1%	-131	-9%	T1	D
Latvia	137	136	139	1%	2	2%	2	1%	D	CS
Lithuania	IE	IE	IE	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	7	9	9	0%	0	-1%	2	29%	T2	CS
Poland	627	248	259	3%	11	4%	-367	-59%	T1	CS,D
Portugal	1 702	2 065	2 030	22%	-35	-2%	328	19%	T2	CS,D
Romania	378	182	189	2%	8	4%	-189	-50%	D	D
Slovakia	29	6	6	0%	-1	-8%	-24	-81%	CS,T2	D
Slovenia	8	2	2	0%	0	4%	-6	-74%	T1	D
Spain	486	567	590	6%	23	4%	104	21%	T1	CS,D
Sweden	4	4	5	0%	0	5%	1	24%	T2	CS
United Kingdom	2 720	2 483	2 664	29%	181	7%	-56	-2%	T1	D
EU-28	**12 115**	**9 028**	**9 264**	**100%**	**236**	**3%**	**-2 851**	**-24%**		
Iceland	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28 + ISL	**12 115**	**9 028**	**9 264**	**100%**	**236**	**3%**	**-2 851**	**-24%**		

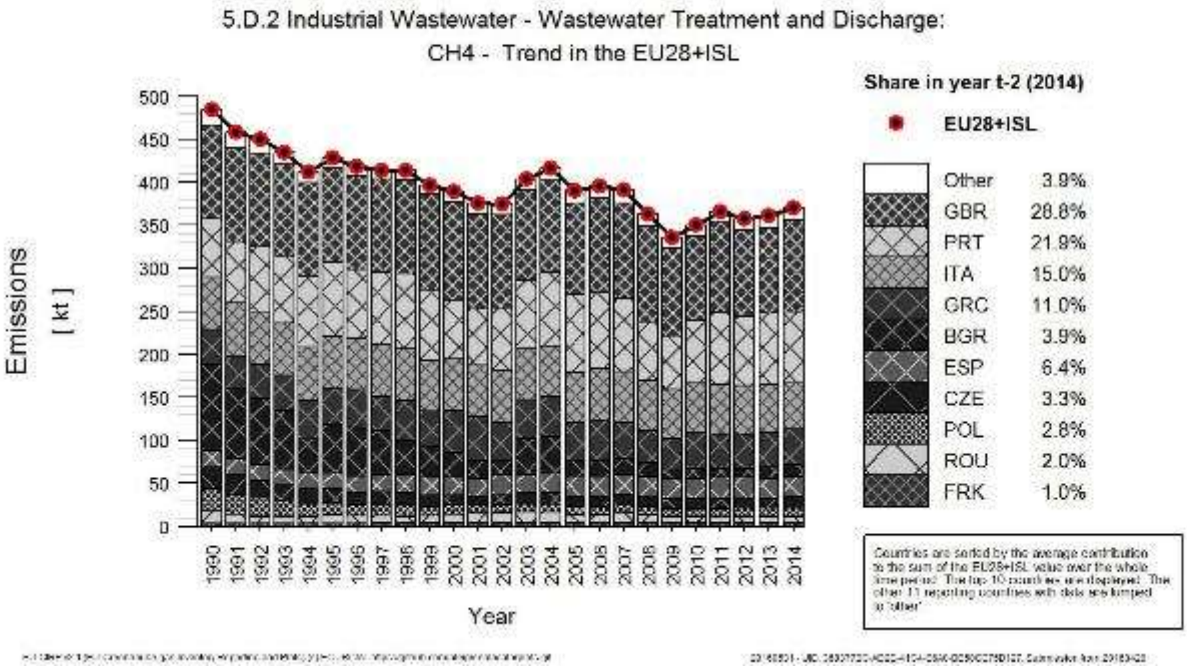
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trends in Emissions and Activity Data

CH_4 emissions from industrial wastewater treatment and discharge decreased between 1990 and 2014 by 24 %. *Figure **7.14*** shows the trend of emissions indicating the countries contributing most to EU-28+ISL total.

The largest decrease in absolute terms is reported by Bulgaria, followed by Poland and the Czech Republic contributing together to only 10 % of EU-28+ISL emissions from source 5D2 in 2014, whereas Portugal and Spain show emission increases between 1990 and 2014 (Table 7.12). The United Kingdom is responsible for 29 %, Portugal for 22 %, Italy for 15 % and Greece for 11 % of EU-28+ISL CH_4 emissions from this source in 2014. The emission trends in this sector are mainly influenced by the strong decrease in Bulgaria, the Czech Republic and Spain and increasing emissions in Portugal, while in other relevant countries CH_4 emissions are almost constant or slightly decreased (United Kingdom, Italy, Greece).

Figure 7.14 5D2 Industrial wastewater: CH_4 emissions (Trend in relevant MS)



Information for the trends of CH_4 emissions from industrial wastewater is provided for Bulgaria, the United Kingdom, Portugal, Italy and Greece.

Bulgaria decreased its CH_4 emissions from industrial wastewater until 2012 and shows slight increases in 2013 and 2014. In 2003 and 2004 CH_4 emissions show a peak compared to the preceding years due to the discharge of industrial wastewater into several big tailing ponds by mining companies. The strong decrease of CH_4 emissions from industrial wastewater is caused by decreasing quantities of total industrial wastewater in the country, which decreased from 1 Mio m3 in 1990 to 0.15 Mio in 2014. The increases in 2013 are caused by an increasing amount of industrial wastewater while in 2014 the amount decreases again, but the share of industrial wastewater treated on site increases.

CH_4 emissions from industrial wastewater in the **United Kingdom** are fluctuating throughout the time series 1990 and 2014 with lowest emissions in 2010. Between 1990 and 2014 CH_4 emissions slightly decreased by 2 %. Given the high share of UKs CH_4 emissions in EU-28+ISL of 30 % the United Kingdom points out that this estimate is very conservative and likely to be over-estimated as there is a lack of data.

In **Italy** CH_4 emissions from industrial wastewater decreased until 2014 by 9 % in comparison to 1990. This is caused by a decreasing amount of wastewater from industries. Main reductions in industrial wastewater load can be found in the pulp and paper and in the textiles industry.

Also **Portugal** shows fluctuating CH_4 emissions from industrial wastewater based on the economic development. In comparison to the base year 1990, CH_4 emissions from industrial wastewater increased by 19 %. The industrial wastewater load from wood and wood derivatives showed an increasing trend until 2007. From 2008 -2010 the emissions from wood and wood derivate decreased before they increased until 2014 again.

CH_4 emissions from industrial wastewater in **Greece** are also fluctuating. In 2008 and 2009 CH_4 emissions show a strong decline due to the economic situation and stabilize afterwards. The highest wastewater load is from the food and beverage industry.

Methodological information

Emissions from industrial wastewater include all wastewater that is treated/disposed of on site and not sent to public sewers. The main sources for methane emissions from industrial wastewater are:

- pulp and paper manufacture;
- food and drink processing (e.g. meat and poultry processing, alcohol/starch production and dairy products); and
- organic chemicals production.

Activity data is based on production output from the relevant industries and a Chemical Oxygen Demand per unit of output for each industry. Default IPCC values are provided and it is good practice to use them in the absence of national data.

CH_4 missions from industrial wastewater handling are reported by 21 Member States, while Austria, Belgium report CH_4 emissions as not applicable, Luxembourg reports CH_4 emissions under 5D2 as not occurring and Denmark, Ireland, Lithuania and Malta report CH_4 emissions from industrial wastewater elsewhere.

According to the IPCC 2006 Guidelines, the emission factor for determining CH_4 emissions from wastewater is composed of the maximum methane producing potential (B0) and the methane conversion factor (MCF). There is an IPCC default value available for the maximum methane producing potential which is applied in most of the Member States. In contrast, the MCF has to be determined country specifically and varies strongly among the Member States depending on wastewater treatment systems used.

7.2.4.3 Recalculations CH_4 emissions (CRF Source Category 5D)

Table 7.13: 5D Waste water treatment: Contribution of member states to EU recalculations in CH_4 for 1990 and 2013 (difference between latest submission and previous submission)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Bulgaria	-944	-22.6	73	8.1	Recalculations were performed due to application of the 2006 IPCC Guidelines. For Submission 2015 for estimation of CH_4 emissions from industrial wastewater handling MCF = 0.5 is used for stagnant sewer, which do not correspond with default MCF values for the type of treatment and discharge pathway or system for industrial wastewater given in the 2006 IPCC Guidelines.
Croatia	0	0.0	0	0.0	
Cyprus	102	834.9	26	476.2	The emissions from this source have been recalculated due to the change of the %BOD reduction following the TERT's recommendation in trial review. Emissions estimates from this source have been revised due to availability of new data on industrial production for 2013.
Czech Republic	156	15.8	124	21.0	5.B.1: This year whole time series were recalculated to better suit activity data available in the country and to be more in line with default IPCC method. Previous methodological approach was creating increasing discrepancy between assumed biogas production (R) and real measured amount of captured biogas and was creating review questions about sludge management. New methodological approach tackles both problems by including biogas production from sludge as an activity data that is effectively reducing amount of TOW that is treated in central plants and is therefore closer to reality. 5.B.2: Year 2000 and 2013 were as recalculated, due to obtaining of new activity data.
Denmark	-4	-3.8	-4	-3.8	For Wastewater treatment and discharge recalculations have been due to methodological a minor correction of the COD/BOD conversion factor for scattered houses.
Estonia	0	0.0	1	1.7	Updated activity data on centralized wastewater treatment.
Finland	0	0.0	0	0.0	
France	0	0.0	-12	-0.5	The 2013 values were updated due to the availability of data. The 2012 values were reported in 2013 in the previous submission.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Hungary	-134	-12.5	-2	-0.6	Following a recommendation from the EU review, MCF=0 is used now (instead of MCF=0.1) for river and lake discharge as Hungarian rivers and lakes cannot be considered as oxygen-deficient aquatic environment
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-4	-0.2	Minor recalculation is occurred due to update of activity data.
Latvia	-15	-4.2	49	24.0	Recalculated due to adjusted activity data both of Domestic and Industrial Waste Water Handling
Lithuania	0	0.0	0	0.2	CH_4 emissions were recalculated for the year 2013 due to wastewater discharge data correction provided by the Lithuanian EPA. Impact of recalculations on CH_4 emissions is provided in NIR Chapter 7.5.5, Table 7-44.
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	-9	-4.3	CH_4 emissions from domestic wastewater treatment have been recalculated for 2013 as data on the Total organics in wastewater (TOW) and sludge (S) became available

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Poland	0	0.0	-61	-6.9	update of amount of recovered methane (statistical data)
Portugal	0	0.0	14	0.5	Revision of AD time series for Kraft pulping production.
Romania	0	0.0	-206	-10.4	The CH_4 emissions were recalculated based on the study “The estimation of methane emissions in industrial wastewater in accordance with the IPCC 2006 methodology” finished in 2014. The number of population in 2002-2013 periods was updated based on recalculations made by National Institute for Statistics.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	-13	-0.8	29	3.5	Recalculations due to correction of small error.
Sweden	0	0.0	0	0.0	
Great Britain	50	1.2	-119	-3.6	Decrease in emissions in industrial wastewater treatment due to update in national statistics index of production figures.
EU28	-804	-2.3	-101	-0.5	
Iceland	0	0.0	0	0.0	
EU28+IS	-804	-2.3	-101	-0.5	

Table 7.14: 5D Waste water treatment: Contribution of member states to EU recalculations in N_2O for 1990 and 2013 (difference between latest submission and previous submission)

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.1	Transcription error
Belgium	0	0.0	0	0.0	
Bulgaria	199	99 999 900.3	146	99 999 900.6	A technical mistake in N_2O emission estimation from wastewater treatment is made. Recalculations have been made for the whole time series.
Croatia	0	0.0	0	0.0	
Cyprus	-2	-11.8	-4	-17.5	The emissions from this source have been recalculated due to the change of the protein supply quantity. Emissions estimates from this source have been revised due to availability of new data on industrial production for 2013.
Czech Republic	0	0.0	0	0.0	
Denmark	-40	-39.2	-14	-19.2	The most significant change is due to a change of the EF value for indirect N_2O emissions according to the IPPC 2006 guidelines.
Estonia	0	0.0	0	0.0	-
Finland	0	0.0	0	-0.5	Protein consumption and N load in fish farming corrected
France	0	0.0	7	1.5	The 2013 values were updated due to the availability of data. The 2012 values were reported in 2013 in the previous submission

	1990		2013		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Germany	-98	-9.2	-80	-15.5	Update of FAO data for protein intake 2008-2013, correction of number of habitants for 2013, correction of double counting.
Greece	0	0.0	0	0.0	
Hungary	0	0.0	-3	-1.3	Also protein consumption data for the year 2013 was updated which led to minor changes in N_2O emissions in this category.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-5	-0.4	Minor recalculation is occurred due to update of activity data.
Latvia	21	331.0	10	148.7	Recalculated due to correction of mistake in applying emission factors
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	23	15.7	2	2.6	Indirect N_2O from surface water as a result of discharge of domestic and industrial effluents have been recalculated.
Poland	0	0.0	0	0.0	
Portugal	-175	-34.9	-204	-33.5	N_2O emissions from Human sewage: changed EF Effluent from 96IPCC default (0.01) to 2006 IPCC def. (0.005).
Romania	0	0.0	-34	-6.2	The N_2O emissions from wastewater treatment and discharged were recalculated for 2013 year taking into account the final data associated to total number of population, data provided by National Institute of Statistics.
Slovakia	0	0.0	0	-0.9	Previous year estimates of protein consumption were replaced by reported figures. This recalculation has minimal impact on sectoral emissions.
Slovenia	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
Great Britain	-596	-54.6	-650	-62.5	Update to using 2006 IPCC default emission factor for domestic waste water.
EU28	-668	-7.6	-830	-10.1	
Iceland	-1	-14.1	-1	-13.7	No information provided.
EU28+IS	-669	-7.6	-831	-10.1	

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 2014 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 7.15 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 2014 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2014 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2014 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2014 (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	24	18	21	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	78	NA	NA	NO	73	NO	4
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	NA	NA	NA	NA	NA	NA
Slovakia	0	0	NO	NO	NO	NO	NO	NO
Slovenia	0	0	NO	NO	NO	NO	NO	NO
Spain	44	1	NA	NA	0	0	44	1
Sweden	0	0	-	-	-	-	-	-
United Kingdom	0	0	NO	NO	NO	NO	NO	NO
EU-28	**63**	**102**	**18**	**21**	**0**	**74**	**46**	**8**
Iceland	0	0	NA	NA	NO	NO	-	-
EU-28 + ISL	**63**	**102**	**18**	**21**	**0**	**74**	**46**	**8**

7.3 EU-28 uncertainty estimates

Table 7.16 shows the total EU-28 uncertainty estimates for the sector Waste and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for N_2O from 5D and the lowest for CH_4 from 5C. With regard to the uncertainty on trend N_2O from 5E shows the highest uncertainty estimates, CH_4 from 5A, CO_2 from 5C and CH_4 from 5D the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-28 see Chapter **Error! Reference source not found.**.

Table 7.16 Sector 5 -Waste: EU-28uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2014	Emission trends 1990-2014	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
5.A Solid Waste Disposal	CO2	1 979	3 331	68%	50%	0.3%
5.A Solid Waste Disposal	CH4	193 483	104 517	-46%	39%	0.1%
5.A Solid Waste Disposal	N2O	0	0		0%	
5.B Waste Water Handling	CO2	0	0		0%	
5.B Waste Water Handling	CH4	386	3 163	719%	55%	2.2%
5.B Waste Water Handling	N2O	289	2 055	611%	69%	2.5%
5.C Waste Incineration	CO2	5 196	3 376	-35%	22%	0.1%
5.C Waste Incineration	CH4	192	66	-66%	21%	0.3%
5.C Waste Incineration	N2O	119	287	141%	77%	0.8%
5.D Wastewater treatment and discharge	CO2	0	0		0%	
5.D Wastewater treatment and discharge	CH4	32 467	19 392	-40%	41%	0.1%
5.D Wastewater treatment and discharge	N2O	7 731	7 355	-5%	711%	1.6%
5.E Other	CO2	18	21	21%	300%	0.6%
5.E Other	CH4	3	7	154%	186%	1.3%
5.E Other	N2O	11	73	576%	60%	3.5%
Total - 5	**all**	**241 873**	**143 643**	**-41%**	**46.5%**	**12.9%**

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions of the EU-NIR because uncertainty estimates are not available for all source categories in each of this 28 EU Member States;*

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 2016, 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.

8 Other

Sector Other is not an EU key category (see Annex 1.1). In 2016 the only Member State that reports N_2O emissions under this category is Germany.

9 Indirect CO_2 and nitrous oxide emissions

9.1 Description of sources of indirect emissions in the GHG inventory

The CO_2 resulting from the atmospheric oxidation of CH_4, CO and NMVOC is referred to as indirect CO_2. Indirect CO_2 resulting from the oxidation of CH_4, CO and NMVOCs produced by fossil fuel combustion are included in the general methodological approach which assumes that all the carbon in the fuel (minus the portion that remains as soot or ash) is oxidized to CO_2 whereas actually a fraction of this carbon is initially emitted as CH_4, CO or NMVOC.

Other sources of indirect CO_2 emissions are not yet captured by the general inventory methodologies. According to the 2006 IPCC Guidelines such sources include:

- Fugitive emissions from energy use, e.g. NMVOC emissions from oil refineries, storage of chemicals at refineries, road traffic evaporative emissions from cars, emissions from gasoline distribution network and refueling of cars, ships and aircrafts, CH_4 emissions from natural gas transmission and distribution or coke production.
- Carbon from Non-energy products from fuels and solvent use in IPPU: The production and use of asphalt for road paving and roofing and the use of solvents derived from petroleum and coal are sometimes substantial sources of NMVOC and CO emissions which oxidise to CO_2 in the atmosphere. The resulting CO_2 input can be estimated from the emissions of these non-CO_2 gases.

AFOLU emissions where non-CO_2 gases have been explicitly deducted (Such NMVOC emissions are considered as biogenic in MS reporting and resulting indirect CO_2 emissions are not included in MS GHG inventories).

Indirect N_2O emissions address nitrous oxide (N_2O) emissions that result from the deposition of the nitrogen emitted as $_X$ and NH_3. Indirect N_2O emissions in the agriculture sector address nitrous oxide (N_2O) emissions that result from the deposition of the nitrogen emitted as $_X$ and NH_3. N_2O is produced in soils through the biological processes of nitrification and denitrification. One of the main controlling factors in this reaction is the availability of inorganic nitrogen in the soil and therefore deposition of nitrogen resulting from NO_x and ammonia (NH_3) will enhance emissions.

The Revised 1996 IPCC Guidelines only estimated indirect N_2O emissions from agricultural sources of nitrogen. The 2006 Guidelines include guidance for estimating N_2O emissions resulting from nitrogen deposition of all anthropogenic sources of NO_x and NH_3 (in particular from sources in the energy and IPPU sectors).The 2006 IPCC Guidelines, Volume 5, also address indirect N_2O emissions which occur from the release of wastewater effluents into waterways, lakes or the sea.

The EU national total includes indirect CO_2, if these emissions were reported by MS. Both national totals, including and excluding indirect CO_2, are reported in the CRF tables. This is to ensure consistency with the scope of reported greenhouse gas emissions during the first commitment period. Indirect N_2O emissions are not included in national totals.This chapter refers to the indirect emissions that are reported in Table 6 of the EU CRF tables. Indirect emissions may also be included in other sectors, such as indirect CO_2 in IPPU (i.e. under ‘2D Non-energy products from fuels and solvents‘) and indirect N_2O in the agriculture and LULUCF sectors (i.e. in CRF tables 3.D and 3.B.b or table 4(IV)). These emissions are dealt to in the corresponding sectoral chapters.

9.2 Methodological issues

Table 9.1 summarizes indirect CO_2 and nitrous oxide emissions reported from the EU countries. Eight countries provided values for indirect CO_2 emissions. The highest shares of the EU-28 total of indirect CO_2 emissions are held by the Czech Republic (54%), France (23%) and Denmark (10%). Eight countries reported indirect N_2O emissions in 2014, with Denmark, the United Kingdom, Czech Republic and Italy covering for more than 80% of the total EU-KP indirect N_2O emissions.

Indirect CO_2 is not an EU key category.

Table 9.1 Indirect CO_2 and N_2O emission for EU-28

Member States	indirect CO_2 [kt CO_2 equ.]	Share in EU-28 [%]	indirect N_2O [kt CO_2 equ.]	Share in EU-28 [%]
Austria	NE,NA,NO,IE	-	NE,NO,IE	-
Belgium	NE,NO	-	NE,NO	-
Bulgaria	NO	-	2	7%
Croatia	NA,NO	-	NA,NO	-
Cyprus	NE,NO	-	NE,NO	-
Czech Republic	2 234	54%	5	14%
Denmark	421	10%	15	43%
Estonia	NE,NO,IE	-	NE,NO	-
Finland	76	2%	0.7	2%
France	949	23%	NO	-
Germany	NA,NO	-	NA,NO,IE	-
Greece	NE,NO	-	NE,NO	-
Hungary	NE,NO	-	NE,NO	-
Ireland	65	2%	NO,NE	-
Italy	NO	-	4	12%
Latvia	20	0%	IE,NA,NO	-
Lithuania	NE,NO,IE	-	NE,NO	-
Luxembourg	NO	-	NO	-
Malta	NO,NE	-	NO,NE	-
Netherlands	211	5%	NE,NO	-
Poland	NA	-	NA	-
Portugal	128	3%	NE,NA,NO	-
Romania	NE,NO	-	3	7%
Slovakia	NE,NO,IE	-	NE,NO,IE	-
Slovenia	NE,NO	-	NE,NO	-
Spain	NE,IE	-	NE	-
Sweden	NO	-	0.005	0.02%
United Kingdom	NE,NO	-	5	15%
EU-28	**4 105**	**100%**	**34**	**100%**
Iceland	NE	-	NE	-
EU-28+ISL	**4 105**	**100%**	**34**	**100%**

In general, the methodologies for the estimation of indirect emissions in EU countries is in line with the 2006 IPCC Guidelines.

For the estimation of indirect CO_2 emissions EU countries follow the basic principle proposed by the IPCC for calculating the CO_2 inputs from the atmospheric oxidation of CH_4, CO or NMVOC (2006 IPCC Guidelines, Volume 1, Chapter 7, p. 7.6):

From CH_4:	$Inputs_{CO2} = Emissions_{CH4} \bullet 44/16$
From CO:	$Inputs_{CO2} = Emissions_{CO} \bullet 44/28$
From NMVOC:	$Inputs_{CO2} = Emissions_{NMVOC} \bullet C \bullet 44/12$
Where C is the fraction carbon in NMVOC by mass (default = 0.6)	

Some countries (i.e. CZ, DK) explicitly mention that the precursor gases emissions (CO, $_X$ and NMVOC) used in the above equations are consistent with the the precursor gases emissions reported under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP) and the CH_4 emissions reported to the UNFCCC.

In general, emissions reported in table 6 refer to indirect emissions from energy, IPPU and waste, while some countries report the indirect CO_2 emissions in other categories too (mainly in IPPU category 2.D.3).

9.3 Uncertainties and time-series consistency

Indirect CO_2 emissions have been importantly decreased since 1990 in all countries. The highest percentage decrease has been noted in Finland, while in absolute terms the Czech Republic had the biggest share in the EU reduction, decreasing its indirect CO_2 emissions by more than 1.6 Mt. The main reason for the decrease in indirect CO_2 emissions is the decrease of the precursor gases emissions. The uncertainty of the indirect emission estimates is also based on the calculation of emissions from these gases.

9.4 Category specific planned improvements

The separate reporting of indirect CO_2 and nitrous oxide emissions (from sources other than agriculture and LULUCF)[71] to the UNFCCC under CRF Table 6 has been performed for the first time in 2015 and is in line with paragraph 29 of the UNFCCC reporting guidelines (Decision 24/CP.19). Following this reporting the EU team analysed the ways that Member States reported these emissions and presented the results in Working Group 1. The different approaches have been discussed and guidance was provided to Member States in order to improve the consistency in the reporting of these emissions.

[71] As explained in paragraph 9.1, methodologies for the indirect nitrous oxide emissions from agriculture and LULUCF were available in the 1996 IPCC Guidelines as well.

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Table 10.1 to Table 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2013 for each EU-28 Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 kt CO_2 equiv.). For more details see the information provided by the Member States' submissions.

Table 10.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	United Kingdom	-6,362	-27.5	Default EF1 (0.01), EF3 (cattle and sheep), FracGasF, FracGasM and FracLossMS, FracLeach (0.30) have been replaced by country specific values. Revised activity data for urea and UAN use as part of ensuring consistency with the ammonia inventory. Also minor revisions to AWMS, milk yield, livestock numbers, crop production, mineralisation data.
3D_Agricultural soils N_2O	Spain	-4,760	-27.5	Se ha actualizado el cálculo de las emisiones de N_2O directas (3D1) e indirectas (3D2) de los suelos gestionados atendiendo a las directrices de la Guía IPCC 2006. Se ha optado por actualizar todos los factores de emisión y fracciones de volatilización de NH_3 y $_X$ y re-deposición como N_2O, según Guía IPCC 2006. Esto ha inducido a una reducción sustancial en las emisiones producidas por esta actividad entre el 25-30% a lo largo del período inventariado. Finalmente, las variaciones anteriormente reseñadas suponen una variación en la variable de actividad de las emisiones indirectas, dando lugar, por tanto, a variaciones en las emisiones de deposición atmosférica y lixiviación y escorrentía.
3D_Agricultural soils N_2O	France	-2,678	-6.8	Deux erreurs de calcul significatives ont été corrigées, elles concernent la pâture et les émissions indirectes liées au ruissellement. Les émissions liées à la minéralisation des sols sur les terres devenant culture ont été supprimées pour être réintroduites dans le secteur de l'utilisation des terres. Les émissions de N_2O indirectes liées à la redéposition ont également éte modifiées suite aux ajustements réalisés sur les émissions d'ammoniac.
3B_Manure management CH_4	Bulgaria	-1,819	-47.0	CH_4 emissions have been recalculated for the enthire time series due to the implementation of new VS values for swine
1A3_Transport CO_2	Netherlands	-1,443	-5.0	Reallocation of NRMM to 1.A.2 and 1.A.4

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	Romania	-1,403	-15.8	Have been made changes since the latest submission due to of the errors of the livestock (Cattle between 1 and 2 years-for slaugther); Have been made recalculation at the level N_2O Indirect emissions from N leaching/Runoff from Managed Soils; because there is not the data for the calculation of the N_2O emissions from N leaching from all AWMS not in Managed soils are not calculated.
1B2_Oil and natural gas CH_4	Germany	-1,319	-13.6	Change of statistics regarding line lengths and -composition (1.B.2.b) Correction of unit error of EF(CH_4) for natural gas compressor (1.B.2.b)
1A2_Manufacturing Industries and Construction CO_2	Bulgaria	-1,105	-5.8	For the 2016 submission was identified an error in the calculation files - the quantities for liquid fuels for off-road machinery for the construction sector was erroneously linked to off-road machinery in Agriculture. An additional error was identified and corrected regarding the consumption of solid fuels in CRF category 1.A.2.c.
3A_Enteric fermentation CH_4	Bulgaria	-1,001	-18.3	Implementation of new values from 2006 IPCC guidelines for degistebility (DE%) and CH_4 conversation factors (YM) for cattle.
5D_Waste water treatment and discharge CH_4	Bulgaria	-944	-22.6	Change in the method for estimation of CH_4 emissions from industrial wastewater handling
1A1_Energy Industries CO_2	Belgium	-747	-2.441	See chapter 3.1.3 in NIR
3B_Manure management CH_4	Hungary	-655	-36.1	As a consequence of a finding of the Step 1 ESD review, 2016 the volatile solid excretion rate (VS) for Swine was revised. The formerly applied default value of the 2006 IPCC Guidelines for breeding swine (0.5 kg head-1 day-1) was replaced with another default from the Guidelines for market swine (0.3 kg head-1 day-1) for the whole time series.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	Lithuania	-654	-21.1	3.D.1.2.a Animal manure applied to soils sub-category N amounts that arise from bedding materials was excluded from estimation in relation to double accounting. In 3.D.1.5 Mineralized N resulting from loss of soil organic C stocks in mineral soils sub-category emissions from LUC and cropland remaining cropland were reported, as was clarified that only cropland remaining cropland N_2O emissions should be reported in Agriculture sector the mistake was corrected. Forest land area was included in 3.D.1.6 Cultivation of Organic soils sub-category estimates, also Cropland organic area and Grassland organic area data from LULUCF sector was taken for the estimation of emissions. As it was clarified that Cropland remaining Cropland and Grassland remaining Grassland organic soil areas should be taken for the emission estimates, the mistake was corrected. (NIR Chapter 5.6.1.5, Table 5-59).
5D_Waste water treatment and discharge N_2O	United Kingdom	-596	-54.6	Update to using 2006 IPCC default emission factor for domestic waste water.
3D_Agricultural soils N_2O	Ireland	-593	-8.3	Revised estimate of the amount of N in animal applied to soils for all years of the timeseries in 3.D.1.2.a due to the revision of the emission factor associated with NH_3 losses from dairy collecting yards
3B_Manure management CH_4	Belgium	-553	-29.9	Flemish region: (1) Revision of livestock and milk production (per cow) from 2007 on; (2) Correction of the feed digestibility for swine; (3) Update of NH_3-emissions from indoor stable from 2007 on. Walloon region: Revision of livestock from 2013
3D_Agricultural soils N_2O	Bulgaria	-534	-9.5	Direct emissions of N_2O fom Agriculture soils have been recalculated for the entire time series due to implementation of new estimates for Nitrogen in crop residues returned to soils and Nitrogen input of manure applied to soils according 2006 IPCC GL; Indirect emissions of N_2O from Agriculture soils have been recalculated for the entire time series due to implementation of new estimates for FracGASF (Volatilisation from synthetic fertiliser), according recommendations of the FCCC/ARR/2014/BGR.
3B_Manure management N_2O	United Kingdom	-532	-23.0	Default FracGasMS values replaced by country-specific values. Also minor revisions to AWMS timeseries, milk yield, livestock numbers.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3A_Enteric fermentation CH_4	Croatia	-524	-20.9	Emissions were recalculated for the entire due to further improvents in Tier 2 methodology for emission calculation of all cattle categories (improvements in digestibility, methane conversion factors and milk yield parameters.)
3B_Manure management CH_4	Poland	-523	-18.7	correction Vs for market swine according to IPCC 2006, correction of population of fur animals and poultry
1B1_Solid Fuels CH_4	Spain	-516	-23.8	Se han re-estimado las emisiones de CH_4 proveniente de las minas activas en España, en base al estudio "Revisión de las estimaciones de las emisiones de gases de efecto invernadero procedentes la minas en España", llevado a cabo por AITEMIN, actualmente denominada, Asociación para la Investigación y Desarrollo Industrial de los Recursos Naturales.
1A4_Other sectors CH_4	Italy	565	96.7	In 2014 the national Institute of Statistics (ISTAT) carried out a survey, funded by the Ministry of Economic Development and infrastructure (MSE), on the final energy consumption of households for residential heating which include the fuel consumption of solid biomass, as wood and pellets (ISTAT, 2014). Revised activity data from this study was taken into acount for the whole time series.
3D_Agricultural soils N_2O	Belgium	605	15.9	See chapter 5.1.5 in NIR
3A_Enteric fermentation CH_4	Czech Republic	732	14.6	updated CH_4 emission factor (IPCC 2006 Gl.) used, explanation provided in NIR
1A2_Manufacturing Industries and Construction CO_2	Netherlands	1,323	4.3	Revision of energy statistics
1A4_Other sectors CO_2	Netherlands	1,986	5.4	Revision of energy statistics

Table 10.2 Main recalculations by source category for 2013 and Member States' explanations for recalculations given in the CRF or in the NIR

Category	MS	2013		Main explanations
		kt CO_2 equiv.	Percent	
1A4_Other sectors CO_2	Germany	-5,981	-4.0	Revision of energy statistics

Category	MS	2013		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	United Kingdom	-5,636	-28.9	Default EF1 (0.01), EF3 (cattle and sheep), FracGasF, FracGasM and FracLossMS, FracLeach (0.30) have been replaced by country specific values. Revised activity data for urea and UAN use as part of ensuring consistency with the ammonia inventory. Also minor revisions to AWMS, milk yield, livestock numbers, crop production, mineralisation data.
3D_Agricultural soils N_2O	Spain	-4,445	-25.9	Se ha actualizado el cálculo de las emisiones de N_2O directas (3D1) e indirectas (3D2) de los suelos gestionados atendiendo a las directrices de la Guía IPCC 2006. Se ha optado por actualizar todos los factores de emisión y fracciones de volatilización de NH_3 y $_X$ y re-deposición como N_2O, según Guía IPCC 2006. Esto ha inducido a una reducción sustancial en las emisiones producidas por esta actividad entre el 25-30% a lo largo del período inventariado. Finalmente, las variaciones anteriormente reseñadas suponen una variación en la variable de actividad de las emisiones indirectas, dando lugar, por tanto, a variaciones en las emisiones de deposición atmosférica y lixiviación y escorrentía.
1A2_Manufacturing Industries and Construction CO_2	Germany	-3,813	-3.0	Revision of energy statistics
1A3_Transport CO_2	Netherlands	-2,859	-8.1	Reallocation of NRMM to 1.A.2 and 1.A.4
1B2_Oil and natural gas CH_4	Germany	-2,564	-33.4	Change of statistics regarding line lengths and -composition (1.B.2.b) Correction of unit error of EF(CH_4) for natural gas compressor (1.B.2.b)
3D_Agricultural soils N_2O	France	-2,454	-6.8	Deux erreurs de calcul significatives ont été corrigées, elles concernent la pâture et les émissions indirectes liées au ruissellement. Les émissions liées à la minéralisation des sols sur les terres devenant culture ont été supprimées pour être réintroduites dans le secteur de l'utilisation des terres. Les émissions de N_2O indirectes liées à la redéposition ont également éte modifiées suite aux ajustements réalisés sur les émissions d'ammoniac.

Category	MS	2013		Main explanations
		kt CO_2 equiv.	Percent	
1A4_Other sectors CO_2	Spain	-2,323	-5.8	Revisión de los consumos de biomasa de 2012 y 2013 para el sector residencial y de 2013 también para el sector comercial e institucional; y además en 2013, de los consumos de residuos municipales, gasóleo, gas natural, y biogás para el sector comercial e institucional, y de biogás y keroseno para instalaciones estacionarias en el sector agrícola. Al haberse modificado la información original publicada por los cuestionarios internacionales remitidos por MINETUR a los organismos internacionales, AIE y EUROSTAT, y sobre los cuales se construyen los balances energéticos nacionales. Revisión de la serie de superficie de regadío, indicador de actividad empleado para los motores de riego (encuadrados dentro de la categoría 1A4c). Esta modificación tiene por objeto actualizar las superficies para el año 2013 con la nueva información disponible en el Anuario Estadístico de MAGRAMA. Modificación de la cantidad de combustible asignada a maquinaria móvil agroforestal (dentro de la categoría 1A4c) para el año 2012 y 2013. Se ha revisado el consume de combustibles estimado para los equipos destinados a labores de reforestación, tala y arrastre de madera al estar disponible en el Anuario Estadístico del MAGRAMA la información de base correspondiente al año 2012 y 2013 para estas actividades (volumen de madera cortada y superficie repoblada). Modificación del factor de emisión de CH_4 y N_2O de las fuentes estacionarias. Se habían utilizado factores seleccionados de las diferentes guías metodológicas (EMEP/CORINAIR, EMEP/EEA, IPCC) y de fuentes sectoriales e institucionales (API, CITEPA) sobre la variable de actividad energía (GJ) en términos de PCI. Se han actualizado estos factores de emisión según la Guía IPCC 2006.
2F_Product uses as substitute for ODS HFC	Poland	-1,651	-17.2	Main reason for change was revised assumption on share of transport equipment containing refrigerant mix 44a. In prevoius submissions it was assumed that from the beginning of the timeseries (2000) mentioned share was 94%, what was not realistic and led to overestimation. Now share of equipment containing HFC is increasing gradually form 25% in 2000 to 94% in 2014. Decreased share of equipment resulted in reduced emission from operating systems. New updated and verified data available on import and use of f-gases.
1A2_Manufacturing Industries and Construction CO_2	France	-1,542	-2.4	mise à jour du bilan énergétique national du SOeS (en particulier les produits pétroliers)

Category	MS	2013		Main explanations
		kt CO_2 equiv.	Percent	
2B_Chemical industries CO_2	Germany	-1,030	-11.2	Adjustment of emission factor: The EF has increased from 14.89 kg/t product to 28.00 kg/t product, and thus the CO_2 emissions have increased by a factor of 1.88. The emission factor had to be adjusted because flare-emissions data became available for additional installations and because an error in calculation of flare emissions was corrected.
1A4_Other sectors CO_2	United Kingdom	-902	-0.9	Overall change mostly due to revisions in 1A4ai, 1A4bi and 1A4cii. 1A4ai - large decrease in emissions from this sector due to revisions in activity data and also updates to the natural gas emission factor following new data from gas companies. 1A4bi - decrease to emission from this sector due to revisions to national statistics and also revisions to emission factors for coal, natural gas, coke, anthracite. 1A4cii - increase in emissions from this sector due to a revision in national statistics
3D_Agricultural soils N_2O	Romania	-812	-16.5	Have been made changes since the latest submission due to of the errors of the livestock (Cattle between 1 and 2 years-for slaugther); Have been made recalculation at the level N_2O Indirect emissions from N leaching/Runoff from Managed Soils; because there is not the data for the calculation of the N_2O emissions from N leaching from all AWMS not in Managed soils are not calculated.
3B_Manure management CH_4	France	-719	-13.0	Différentes estimations ont été corrigées ou ajustées lors de la dernière édition d'inventaire: (1) Certaines températures régionales utilisées pour le calcul du MCF ont été corrigées, (2) Le facteur d'excrétion des ovins a été modifié sur la base du GIEC 2006, (3) La quantité de paille utilisée dans les bâtiments d'élevage a été corrigée ce qui impacte le calcul des émissions de NH_3 et donc les émissions de N_2O, (4) Le facteur d'émission pour les volailles au stockage a été corrigé.

Category	MS	2013		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	Lithuania	-655	-27.1	3.D.1.2.a Animal manure applied to soils sub-category N amounts that arise from bedding materials was excluded from estimation in relation to double accounting. In 3.D.1.5 Mineralized N resulting from loss of soil organic C stocks in mineral soils sub-category emissions from LUC and cropland remaining cropland were reported, as was clarified that only cropland remaining cropland N_2O emissions should be reported in Agriculture sector the mistake was corrected. Forest land area was included in 3.D.1.6 Cultivation of Organic soils sub-category estimates, also Cropland organic area and Grassland organic area data from LULUCF sector was taken for the estimation of emissions. As it was clarified that Cropland remaining Cropland and Grassland remaining Grassland organic soil areas should be taken for the emission estimates, the mistake was corrected. (NIR Chapter 5.6.1.5, Table 5-59).
5D_Waste water treatment and discharge N_2O	United Kingdom	-650	-62.5	Update to using 2006 IPCC default emission factor for domestic waste water.
2F_Product uses as substitute for ODS HFC	France	-612	-3.1	Recalculations were made because updated activity data became available for certain refrigeration and air conditioning subsectors. This relates in particular to the types of refrigerants used for retrofit, the use of R404A in new installations in recent years and the recovery efficiency. Updated information and/or new activity data was also included for 2.F.2 Foam blowing, 2.F.3 Fire extinguishing, 2.F.4 Aerosols and 2.F.5 Solvents.
3B_Manure management CH_4	Belgium	-594	-31.8	Flemish region: (1) Revision of livestock and milk production (per cow) from 2007 on; (2) Correction of the feed digestibility for swine; (3) Update of NH_3-emissions from indoor stable from 2007 on. Walloon region: Revision of livestock from 2013
1A1_Energy Industries CO_2	Netherlands	-563	-0.9	Revision of energy statistics
1A2_Manufacturing Industries and Construction CO_2	United Kingdom	700	1.2	The difference is mostly due to changes in 1A2gviii, 1A2gvii and 1A2d 1A2gviii - There was an increase in emissions from this category. There were revisions to both activity data and emission factors. Activity data revisions were mostly due to revisions in national statistics. Revisions to emission factors occured for natural gas, coke, petroleum coke and coke oven gas. 1A2gvii - Revision to activity data for industrial class of off-road caused a decrease in emissions from this category. 1A2d - small increase in emissions caused by revisions to both activity

Category	MS	2013		Main explanations
		kt CO_2 equiv.	Percent	
				data and emission factors.
2C_Metal industry CO_2	Germany	710	4.7	Updated activity data available
3B_Manure management N_2O	Spain	744	49.2	Se ha actualizado la excreta de nitrógeno de los équidos y los factores de emisiones directas con los valores proporcionados por la Guía IPCC 2006. Por primera vez, se estiman las emisiones indirectas de N_2O debidas a esta actividad.
1A2_Manufacturing Industries and Construction CO_2	Italy	1,312	2.7	Update of the carbon balance for the iron and steel sector for 2013 as a consequence of an error detected
1A2_Manufacturing Industries and Construction CO_2	Spain	1,747	4.3	Los cambios producidos por nuevos cálculos, básicamente son debidos a actualización de algún dato en 2013 y por la actualización de los factores de emisión en la presente edición.
1A2_Manufacturing Industries and Construction CO_2	Netherlands	1,972	8.6	Revision of energy statistics
1A1_Energy Industries CO_2	Germany	5,320	1.5	Revision of energy statistics for 2013
2F_Product uses as substitute for ODS HFC	Spain	9,205	108.6	Emission estimates in the stationary refrigeration and air conditioning subcategories of 2.F.1 for the entire time series have been based on sales data for 1996-1997 and the trend of HFC-134a consumption in 2.F.1.e was used as a proxy for the extrapolation until 2014.

10.2 Implications for emission levels

Table 10.3 provides the differences in total GHG emissions between the latest submission and the previous submission in absolute and relative terms for EU-28 + ISL. The table shows that due to recalculations, total 1990 GHG emissions with indirect CO_2 excluding LULUCF have decreased in the latest submission compared to the previous submission by 23 729 kt (-0.4 %). EU-28 + ISL GHG emissions for 2013 decreased by 14 696 Gg (-0.3 %) due to recalculations.

Table 10.3 Overview of recalculations of EU-28 and Iceland total GHG emissions (difference between latest submission and previous submission in kt CO_2 equivalents)

	1990	1995	2000	2005	2010	2011	2012	2013
Total CO_2 equivalent emissions with indirect CO2 including LULUCF (absolute in kt)	-19,430	-16,338	-19,051	-12,927	-12,066	-12,432	-9,971	-13,121
Total CO_2 equivalent emissions with indirect CO2 including LULUCF (percent)	-0.4	-0.3	-0.4	-0.3	-0.3	-0.3	-0.2	-0.3
Total CO_2 equivalent emissions with indirect CO2 excluding LULUCF (absolute in kt)	-23,729	-16,818	-16,035	-14,515	-8,717	-11,715	-10,527	-14,696
Total CO_2 equivalent emissions with indirect CO2 excluding LULUCF (percent)	-0.4	-0.3	-0.3	-0.3	-0.2	-0.3	-0.2	-0.3

Table 10.4 provides an overview of recalculations for the key categories for 1990 and 2013. The table shows that the largest recalculations in absolute terms were made in the key category N_2O from 3D 'Agricultural Soils' for both years 1990 and 2013.

Table 10.5 and Table 10.6 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2013. Large recalculations in absolute terms were made in Germany, France, the UK and Spain. Recalculations in relative terms of more than 2 % were made in Bulgaria, Croatia, Cyprus, Latvia, Lithuania and Malta.

Table 10.4 Recalculations for the EU-28 and Iceland key source categories 1990 and 2013 (difference between latest submission and previous submission in kt of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2013	
		(kt CO_2 equivalents)	(%)	(kt CO_2 equivalents)	(%)
1.A.1. Energy Industries	CO_2	-683	0.0%	5530	0.4%
1.A.1. Energy Industries	N_2O	-542	-6.0%	-437	-5.1%
1.A.1. Energy Industries	CH4	150	12.8%	402	11.3%
1.A.2. Manufacturing Industries	CO_2	-533	-0.1%	-255	-0.1%
1.A.3. Transport	CO_2	-1950	-0.3%	-3676	-0.4%
1.A.3. Transport	CH_4	411	6.7%	45	3.3%
1.A.3. Transport	N_2O	125	1.6%	97	1.1%
1.A.4. Other Sectors	CO_2	2517	0.3%	-8204	-1.2%
1.A.4. Other Sectors	CH_4	304	1.4%	145	0.8%
1.A.5. Other	CO_2	1	0.0%	187	2.8%
1.B.1. Solid Fuels	CH_4	-684	-0.7%	-333	-1.3%
1.B.2. Oil and Natural Gas	CH_4	-1130	-1.5%	-2607	-6.6%
1.B.2. Oil and Natural Gas	CO2	115	0.5%	229	1.0%
2.A. Mineral Industry	CO_2	429	0.3%	406	0.4%
2.B. Chemical Industry	CO_2	346	0.7%	-461	-0.9%
2.B. Chemical Industry	Unspecified mix of HFCs and PFCs	0	0.0%	0	0.0%
2.B. Chemical Industry	N_2O	1	0.0%	-55	-0.7%
2.B. Chemical Industry	HFCs	0	0.0%	0	0.0%
2.C. Metal Industry	CO_2	-253	-0.2%	756	1.1%
2.C. Metal Industry	PFC	144	0.7%	23	4.4%
2.C. Metal Industry	SF_6	0	0.0%	-48	-16.1%
2.F. Product uses as substitute for ODS	HFC	-202	-97.3%	6662	6.5%
3.A. Enteric Fermentation	CH_4	-1209	-0.5%	435	0.2%
3.B. Manure Management	CH_4	-3564	-6.0%	-1835	-4.0%
3.B. Manure Management	N_2O	-80	-0.3%	61	0.3%
3.D. Agricultural Soils	N_2O	-16959	-7.9%	-12884	-7.4%
5.A. Solid Waste Disposal	CH_4	424	0.2%	108	0.1%
5.B. Biological Treatment of Solid Waste	N2O	2	0.7%	-199	-6.5%
5.D. Waste Water treatment and discharge	CH4	-804	-2.3%	-101	-0.5%

Note: Many of these source categories are more aggregated than the EU-28 + ISL key source categories identified in Section 1.5.

Table 10.5 Contribution of Member States to EU-28 recalculations of total GHG emissionswith indirect CO_2 and without LULUCF for 1990–2013 (difference between latest submission and previous submission kt of CO_2 equivalents)

	1990	1995	2000	2005	2010	2011	2012	2013
Austria	161	357	305	315	158	44	104	443
Belgium	-1,096	-250	-136	-214	-80	-115	-459	-49
Bulgaria	-5,337	-1,952	-1,506	-1,512	-748	-1,096	-1,106	-926
Croatia	-281	-142	-65	325	663	642	563	552
Cyprus	130	2	-86	-278	-371	-436	-393	-335
Czech Republic	2,268	1,658	2,362	1,906	2,472	2,075	2,166	1,344
Denmark	156	226	402	495	590	452	370	402
Estonia	-85	-46	-37	-114	8	7	1	-78
Finland	11	21	-135	96	128	-98	-45	208
France	-3,382	-2,787	-2,126	-1,863	-3,398	-3,647	-2,617	-5,198
Germany	-1,767	-1,630	-3,294	-2,777	-3,285	-2,562	-3,391	-7,153
Greece	-181	-359	-249	-301	-382	-384	-388	-441
Hungary	-88	-29	-93	-16	31	-99	120	124
Ireland	-583	145	234	-1,031	-638	-633	-914	-274
Italy	862	778	737	647	1,935	497	-195	1,620
Latvia	-149	48	151	242	255	242	323	300
Lithuania	-721	-779	-870	-903	-809	-850	-800	-813
Luxembourg	-17	-79	24	-137	-47	-11	27	65
Malta	0	87	52	44	73	134	153	166
Netherlands	1,643	841	759	824	-379	-358	-1,310	-1,097
Poland	-1,034	-145	-572	-1,327	-1,914	-1,845	-1,909	-1,455
Portugal	-68	-51	21	28	-141	-268	-127	-332
Romania	-1,403	-935	-631	-731	-708	-874	-910	-897
Slovakia	-806	-317	-319	-146	-404	-489	-434	-788
Slovenia	54	66	52	67	125	127	137	148
Spain	-4,806	-4,892	-4,709	-2,353	3,980	5,122	6,687	5,445
Sweden	80	121	182	144	15	193	253	165
United Kingdom	-7,075	-6,598	-6,320	-5,816	-5,779	-7,416	-6,370	-5,817
EU-28	**-23,514**	**-16,641**	**-15,866**	**-14,387**	**-8,649**	**-11,647**	**-10,466**	**-14,671**
Iceland	-215	-177	-168	-128	-68	-67	-61	-25
EU-28 + ISL	**-23,729**	**-16,818**	**-16,035**	**-14,515**	**-8,717**	**-11,715**	**-10,527**	**-14,696**

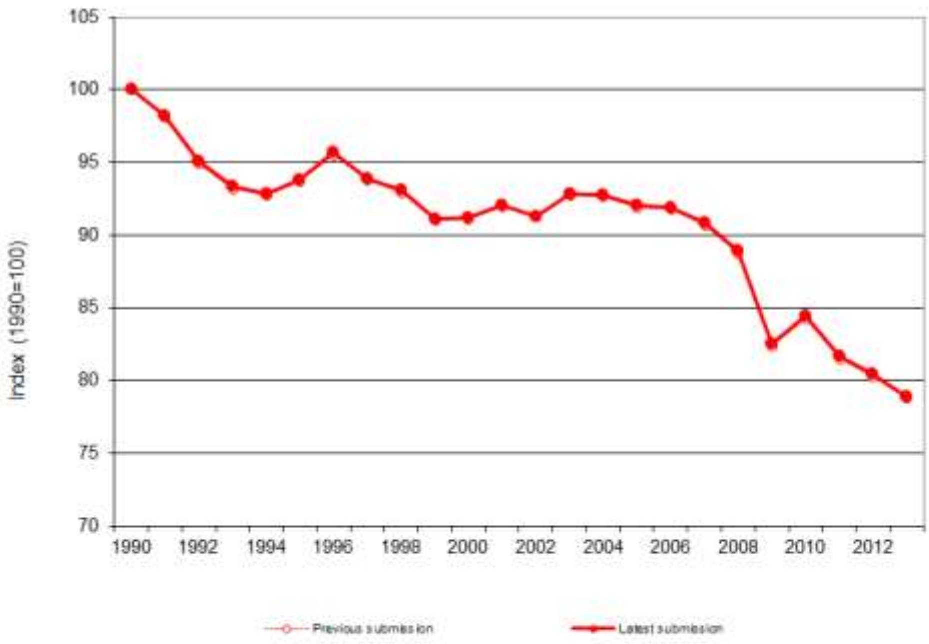
Table 10.6 Contribution of Member States to EU-28 recalculations of total GHG emissions with indirect CO_2 and without LULUCF for 1990–2013 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2010	2011	2012	2013
Austria	0.2	0.4	0.4	0.3	0.2	0.1	0.1	0.6
Belgium	-0.7	-0.2	-0.1	-0.1	-0.1	-0.1	-0.4	0.0
Bulgaria	-4.9	-2.6	-2.5	-2.4	-12	-17	-18	-17
Croatia	-0.8	-0.6	-0.2	11	2.3	2.3	2.2	2.3
Cyprus	2.3	0.0	-10	-2.9	-3.7	-4.5	-4.3	-4.0
Czech Republic	12	11	16	13	18	15	16	10
Denmark	0.2	0.3	0.6	0.7	0.9	0.8	0.7	0.7
Estonia	-0.2	-0.2	-0.2	-0.6	0.0	0.0	0.0	-0.4
Finland	0.0	0.0	-0.2	0.1	0.2	-0.1	-0.1	0.3
France	-0.6	-0.5	-0.4	-0.3	-0.7	-0.7	-0.5	-11
Germany	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.4	-0.8
Greece	-0.2	-0.3	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4
Hungary	-0.1	0.0	-0.1	0.0	0.0	-0.2	0.2	0.2
Ireland	-10	0.2	0.3	-14	-10	-11	-15	-0.5
Italy	0.2	0.1	0.1	0.1	0.4	0.1	0.0	0.4
Latvia	-0.6	0.4	15	2.2	2.1	2.2	2.9	2.7
Lithuania	-15	-3.5	-4.4	-3.9	-3.9	-4.0	-3.8	-4.1
Luxembourg	-0.1	-0.8	0.2	-10	-0.4	-0.1	0.2	0.6
Malta	0.0	3.6	2.0	15	2.4	4.4	4.8	5.9
Netherlands	0.7	0.4	0.3	0.4	-0.2	-0.2	-0.7	-0.6
Poland	-0.2	0.0	-0.1	-0.3	-0.5	-0.5	-0.5	-0.4
Portugal	-0.1	-0.1	0.0	0.0	-0.2	-0.4	-0.2	-0.5
Romania	-0.6	-0.5	-0.4	-0.5	-0.6	-0.7	-0.8	-0.8
Slovakia	-11	-0.6	-0.6	-0.3	-0.9	-11	-10	-18
Slovenia	0.3	0.4	0.3	0.3	0.6	0.6	0.7	0.8
Spain	-17	-15	-12	-0.5	11	14	19	17
Sweden	0.1	0.2	0.3	0.2	0.0	0.3	0.4	0.3
United Kingdom	-0.9	-0.9	-0.9	-0.8	-0.9	-13	-11	-10
EU-28	**-0.4**	**-0.3**	**-0.3**	**-0.3**	**-0.2**	**-0.3**	**-0.2**	**-0.3**
Iceland	-5.6	-5.0	-4.1	-3.2	-14	-15	-13	-0.5
EU-28 + ISL	**-0.4**	**-0.3**	**-0.3**	**-0.3**	**-0.2**	**-0.3**	**-0.2**	**-0.3**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both 1990 and 2013 emissions have been recalculated in the same order of magnitude the emission trend in the EU-28 + ISL did hardly change. In the previous submission the trend of GHG with indirect CO_2 and excluding LULUCF between 1990 and 2013 was – 11.2 %. In the latest submission the trend is -11.1 %.

Figure 10.1: Comparison of EU-28 and Iceland GHG emission trends 1990–2013 (with indirect CO_2, excl. LULUCF) of the latest and the previous submission



10.4 Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1 EU response to UNFCCC review

A list of recommendations and improvements is presented in Table 10.7.

The table focuses on UNFCCC recommendations from the review reports 2013 and 2014.

Table 10.7 Improvements in 2015 and 2016 in response to UNFCCC review findings

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
General	Completeness/ notation keys	For each category, the NIR presents lists of methods and emission factors (EFs) summarizing the individual annual submissions by member States. During the preparation of the European Union annual submission, these tables are circulated across the member States for checking and to ensure that methods and EFs are correctly and consistently classified in these NIR tables. All codes used in the tables are explained in the chapter "units and abbreviations" as recommended in the previous review report. For instance, while reporting under the Kyoto Protocol (EU-15) the notation key "NE" was used in CRF table 6.B to report CH_4 emissions from domestic and commercial wastewater (sludge) for Belgium. Although Belgium reports "NE" for these emissions in its CRF table, Belgium's NIR (chapter 8.3.2) states that sludge in the country is mostly treated aerobically and no CH_4 emissions occur. The ERT considers that that there are inconsistencies in the notation keys resulting from their use by Member States. The ERT therefore recommends that the Party work with member States in order to report consistent notation keys that transparently describe the completeness of the overall inventory, and encourages the Party to develop specific guidance to ensure consistency in the use of notation keys for these tables across member States. (para 14)	ARR 2014	Due to the delay of the 2015 inventory submissions this exercise will be most probably carried out in the course of 2016 in order to be effective for the 2017 inventory submissions.
General	Transparency / activity data	The European Union applies a gap-filling procedure for activity data (AD) in the CRF tables for a limited number of categories and only for 2012 and for key categories. For the 2014 annual submission, gap filling was used to complete AD for a number of categories: clinker production in cement production; lime production; ammonia production; and protein consumption and nitrogen fraction for human sewage. The ERT noted that AD for a significant number of categories are still reported with the notation key "NE" in the CRF tables, particular in the following sectors: energy (fugitive emissions from oil, natural gas and other sources) (see para. 51 below); industrial processes (soda ash, asphalt roofing, road paving with asphalt, glass production, nitric acid production, adipic acid production, other chemical industry, metal production, other production, aluminium and magnesium production); and waste (other solid waste disposal, other waste incineration, wastewater handling). Information on AD by member State is provided in the NIR. The ERT notes that this creates a report that is not easily comparable to the other Annex I Parties: for example, implied emission factors (IEFs) are not reported and it is difficult to compare the Party's annual submission with those of other Parties and the IPCC defaults. In response to a question raised by the ERT during the review, the Party explained that reporting of AD from international data sources such as Eurostat (the statistical office of the European Union), the International Energy Agency (IEA), the Food and Agriculture Organization of the United Nations (FAO) might lead to inconsistency with data reported by member States. The ERT encourages the EU to periodically analyse other sources of AD at EU level that may allow the development of approaches to derive AD and IEFs in those cases where different choices of AD by member States currently do not permit an aggregation of AD and the calculation of IEFs at EU level. The ERT recommends that the Party provide justifications in the NIR as to why the use of international data sources to report AD at Party's level would lead to strongly inaccurate reporting (see paras. 52 and 56 below for sector-specific issues). (para 15)	ARR 2014	ongoing

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
General	Uncertainties	The ERT noted discrepancies between uncertainty estimates using the tier 1 and tier 2 approaches for the agriculture sector (80.0 per cent and 32.9 per cent, respectively) and for the industrial processes sector (8.8 per cent and 4.8 per cent, respectively) (NIR, chapter 1.7). In response to a question raised by the ERT during the review, the Party explained that the tier 2 approach delivers lower estimates for uncertainty for the total including all sectors compared with the tier 1 approach because the tier 2 uncertainty analysis is not yet complete and final. The ERT recommends that the Party report only tier 1 to report total uncertainty of the inventory. Meanwhile, the tier 2 uncertainty analysis should be used for reporting purposes only after completion of its development; the incomplete tier 2 uncertainty analysis may be used as a QC procedure. The ERT encourages the Party to report on any significant discrepancies found between tier 1 and tier 2 analyses in the NIR to improve transparency.(para 32)	ARR 2014	Implemented
General	Uncertainties	The ERT noted that the increase in the uncertainty of the overall inventory with and without the LULUCF sector in the 2014 annual submission compared with the previous 2013 annual submission8 is not explained in the NIR. In response to a question raised by the ERT during the review, the Party stated that the slight increase of the overall uncertainty is mainly due to the agriculture sector. In particular, country-specific methods used by member States for the category agricultural soils in the previous submission were assumed to be statistically uncorrelated. After improving the model, it was noted by the European Union inventory team that just a small proportion of the total emissions are calculated using a country-specific method/EF. In defining the remaining categories to be correlated the overall uncertainty has increased. Moreover, the share of agricultural emissions (with the highest uncertainty among all sectors) increased in the last year, which raised total uncertainty. The ERT recommends that the European Union describe any changes in overall uncertainty estimates in the NIR to improve transparency. (para 33)	ARR 2014	Planned for 2017
General	Inventory management / Archiving	During the review the Party provided the ERT with the document “Quality management system for GHG Inventory of the EU, Part I - Quality management manual, v.1.2 as of 2012”, chapter ETC-12 of which describes the procedure for preparing documentation and archiving inventories. The submissions of member States and all correspondence are stored in the subdirectory “Archive”. The central tool for documenting all the material received from member States (including correspondence) is the member States archive database, which includes references, short characterizations and links to e-mails for all submissions from member States. The member States archive database can be searched for documents or for e-mails. Each submission is numbered consecutively. All documents are confidential so only personnel directly involved with the inventory preparation and the ERT have access to the inventory documents. The ERT recommends that the Party include in the next NIR more details regarding archiving from the document “Quality management manual” with supporting references. (para 35)	ARR 2014	Implemented. See NIR section 1.4.1
General		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 implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
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	Implemented
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	Implemented
Energy	1A3b / Transport - Road Transport diesel N_2O IEF	The European Union also has procedures in place to ensure the consistency of the time series. The EC identifies problems with the consistency of the time series of emissions and IEFs upon receiving the individual annual submissions from member States and all the outstanding issues are resolved in close collaboration with the member States via a web-based quality assurance/quality control (QA/QC) communication tool. However, the ERT identified that some substantial inter-annual changes in emissions and EFs are not transparently described within the energy and agriculture sectors of the NIR. In particular, the decrease of emissions in the energy sector for 2009 (figure 3.2 in the NIR) as well as a peak for the IEF (6.02 t/TJ) for road transportation (gasoline – N_2O) for 1998 (figure 3.61 of the NIR), are not explained in the NIR. In addition, table 6.22 of the NIR does not include explanations for the trends of CH_4 emissions from livestock enteric fermentation for France, Greece and Luxembourg. The ERT recommends that the Party improve the transparency of its reporting for the cases mentioned above by ensuring that explanatory information regarding the emission and IEF trends is included in the NIR.	ARR 2014	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
Energy	1A3b / Transport - Recalculations	The European Union has made recalculations between the 2013 and 2014 annual submissions for this sector. The two most significant recalculations made by the Party between the 2013 and 2014 annual submissions were in the following categories: other sectors and manufacturing industries and construction. The recalculations were made following changes in AD mainly by Germany, Spain and the United Kingdom, which cite, inter alia, the availability of final data from their national energy balances. Compared with the 2013 annual submission, the recalculations increased emissions in the energy sector by 8,511.61 Gg CO_2 eq (0.3 per cent), and increased total national emissions by 0.2 per cent in 2011. The recalculations were mostly transparently explained. However, the ERT noted that some improvements which 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 transparently explained in the European Union NIR under recalculations. Therefore, the ERT recommends that the Party enhance transparency and consistency with reporting by member States in its reporting of the recalculations, by working with its member States to achieve the enhancement of the European Union QA/QC system. (para 39)	ARR 2014	Implemented
Energy	International bunker fuels	Consistent with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories” (hereinafter referred to as the UNFCCC reporting guidelines) and the Revised 1996 IPCC Guidelines, the European Union regards international travel as movements being between countries, including trips between member States, which are also regarded as international. The European Union reported in the NIR on the collaboration with Eurocontrol on a project aiming to improve the accuracy of estimates of domestic and international aviation across member States. The NIR reported that a tier 3 methodology was developed and results were available in November 2013. Although this effort is highly commended, it was not clear in the NIR what the impact of this higher-tier method was on the split between domestic and international aviation for the European Union as a whole or for individual member States. In response to a question raised by the ERT during the review, the European Union explained that results released in 2013 were only for 2011 and 2012, with the full time series results were only released in July 2014. The use of the results of the collaboration with Eurocontrol in the 2014 annual submission, which was prepared before July 2014, would therefore have resulted in time-series inconsistency; hence the results were only used for QA purposes. The ERT recommends that the European Union use and report on the most recent results 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.	ARR 2014	Implemented
Energy	1A3a / Transport - Civil Aviation	The ERT noted the late release of the results of the collaboration between the European Union and Eurocontrol, which had been set up, inter alia, to improve the split of AD between international and domestic aviation (see para. 44 above). The ERT commends the European Union for this collaboration. The ERT recommends that the Party promote the use of the results of this collaboration to improve the accuracy of the inventory and report on these results in the NIR.	ARR 2014	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
Energy	Recalculations	The European Union has made recalculations between the 2013 and 2014 annual submissions for this sector. The two most significant recalculations made by the Party between the 2013 and 2014 annual submissions were in the following categories: other sectors and manufacturing industries and construction. The recalculations were made following changes in AD mainly by Germany, Spain and the United Kingdom, which cite, inter alia, the availability of final data from their national energy balances. Compared with the 2013 annual submission, the recalculations increased emissions in the energy sector by 8,511.61 Gg CO_2 eq (0.3 per cent), and increased total national emissions by 0.2 per cent in 2011. The recalculations were mostly transparently explained. However, the ERT noted that some improvements which 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 transparently explained in the European Union NIR under recalculations. Therefore, the ERT recommends that the Party enhance transparency and consistency with reporting by member States in its reporting of the recalculations, by working with its member States to achieve the enhancement of the European Union QA/QC system.(para 39)	ARR 2014	Implemented
Energy	Transparency / methodological description	The ERT noted that the transparency of reporting varies between categories and it is not consistent. The European Union provided in the NIR a good summary of the methodology for fugitive emissions from solid fuels (table 3.93), oil and gas (table 3.98) and for feedstocks and non-energy use of fuels (table 3.120). However, methodology summaries for the other categories were not included. In response to a question raised by the ERT during the review, the European Union indicated that the methodologies were presented in the NIRs of the individual member States, which are provided as annexes to the European Union NIR. The ERT notes that this manner of reporting is not transparent and does not support the review process, because the NIRs of member States, in total, consist of several thousands of pages. Therefore, the ERT recommends that the European Union present methodological summaries that are consistent among member States and categories, at least for key categories, in order to improve the transparency of the NIR.(para 40)	ARR 2014	The NIR now includes an Annex with summary information on emission factors used by MS
Energy	Feedstocks and non-energy use of fuels	The European Union made some recalculations for its reporting of feedstocks and non-energy use of fuels in CRF table 1.A(d), which resulted in a reduction of the 2011 AD between the 2013 and 2014 annual submission. In aggregate, the AD were reduced by 24.6 per cent (–951,251.78 TJ), with naphtha having the largest reduction (–435,092.25 TJ). In response to questions raised by the ERT during the review, the European Union indicated that this is as a result of revisions in the AD of two of its member States (Austria and France), who are the main users of naphtha. Austria collects refinery data, a process completed after the submission of the national inventory; while France used provisional data and these were validated after submission. The ERT recommends that the Party provide transparent information on recalculations for CRF table 1.A(d) in the NIR. (para 45)	ARR 2014	not yet implemented, planned for 2017, the reporting of non-energyuse of fuels has changed considerable with the new guidlines. The EU is looking into the reporting of MS during 2016 in order to improve transparency of table 1. A(d)

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	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.10 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 of reporting among member States. (para 46)	ARR 2014	see above
Energy	Feedstocks and non-energy use of fuels	The previous review report noted that the allocation of emissions between the energy and industrial processes sectors is not entirely consistent among member States. The ERT commends the European Union for reporting some reallocation of emissions from the energy sector (category public electricity and heat production) to the industrial processes sector (limestone and dolomite use) by Portugal. The ERT recommends that the Party continue with efforts to ensure the consistency of reporting among member States, in particular with regards to the allocation of emissions between the energy and industrial processes sectors. (para 47)	ARR 2014	Allocation issues will be reconsidered in the coming years due the use of the new guidelines.
IPPU - Other production (2H, former 2D)	Inconsistency in "food and drink" category (Netherlands) (former 2D)	Reallocate CO_2 emissions from coke use for food and drink to "other production"	ARR 2013	Implemented
IPPU - Metal Industry (2C)	Incomplete methodology overview for aluminium production (2.C.3)	73. The ERT observed in the NIR that the European Union did not provide adequate methodology overviews for aluminium production emissions for Greece, the Netherlands and Sweden. The reported information on Greece mentions emission estimates based on the anode effect without giving specific methodological details. The reported information on the Netherlands reports use of a tier 2 approach based on measured data, and does not provide any further details. The reported information on Sweden only mentions the number of ovens and production statistics provided by the company. The ERT found that the information provided is not transparent enough for it to conduct a thorough methodology review. The ERT recommends that the European Union provide in the NIR adequate methodology overviews to enable the ERT to make a thorough review of the AD and EF used in the aluminium production emission estimations provided by Greece, the Netherlands and Sweden.	ARR 2014	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
IPPU - Metal Industry (2C)	SF_6 emissions from aluminium and magnesium foundries in Denmark	79. The ERT noted in the NIR that the European Union did not provide an adequate methodology overview of the SF_6 emission trend from aluminium and magnesium foundries for Denmark. In response to a question raised by the ERT during the review on why the SF_6 emissions have been decreasing while activities under magnesium foundries no longer exits (which could imply there should be not occurring rather than decreasing SF_6 emissions), the European Union stated that Denmark explained that the total emissions of SF_6 decreased in Denmark because of the closure of the magnesium production foundries, and that SF_6 used in aluminium and magnesium foundries has been reported as “NO” since 2001. The ERT encourages the European Union to improve the transparency of information in its NIR by providing information on the SF_6 emissions trend in Denmark from aluminium and magnesium foundries only.	ARR 2014	Implemented See the explanation in the NIR, chapter 4.2.3 (last paragraph before chapter 4.2.3.1)
IPPU - Product uses as substitutes to ODS (2F)	Emissions from solvents in France and UK	59. HFC emissions from solvents are reported by two member States (France and the United Kingdom). The emissions reported are the same in 2010 and 2011 while the entire time series shows an increasing trend. In response to questions raised by the ERT during the review, the Party explained that in the concerned countries no data were available for 2011 and emissions were assumed to remain constant from 2010. The European Union also clarified that there is an increase of closed equipment which would generate a reduction of emissions not taken into account in the estimates. The Party confirmed that there is currently research underway to improve the estimates and obtain more detailed data on HFC emissions in both countries. The ERT welcomes the planned improvements and recommends that the Party either implement them or provide additional justification in the NIR as to why the current estimates are an accurate assessment of emissions.	ARR 2013	Partly resolved, subchapter on solvents and other applications included in the NIR but not described in detail because many MS report these emission sources together with others for confidentiality reasons.
IPPU - Product uses as substitutes to ODS (2F)	Emissions from fire extinguishing (2F3) in Denmark and Luxembourg	58. Denmark and Luxembourg report HFC emissions from fire extinguishers as not occurring (“NO”). In response to questions raised by the ERT during the review, the European Union explained that HFCs are not allowed in fire extinguishers and no separate permissions have been granted to use such gases in fire extinguishers in these member States. As all Parties report HFC emissions under this category, the ERT considers that additional documentation is needed to justify the use of the notation key “NO”. Thus the ERT strongly recommends that the European Union document in the NIR the non-existence of HFC emissions from this subcategory in Denmark and Luxembourg (e.g. by listing the agents in use in fire extinguishers used in these countries).	ARR 2013	Implemented
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.	ARR 2014	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
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.	ARR 2014	There are significant problems in the CRF reporter software related to the use of notation keys in 2.F. this year. The issue was followed up during the initial checks 2015/2016.
IPPU - Product uses as substitutes to ODS (2F)	Transparency of reporting done by Luxembourg	76. On the basis of the status report provided by the European Union in table 4.71 of the NIR (on the implementation of previous recommendations), the ERT reiterates the recommendation made in previous review reports that the European Union improve the transparency of its reporting regarding Luxembourg by providing background tables of consumption of halocarbons and SF_6. Further, the ERT reiterates the recommendation made in the previous review report that the European Union work with Luxembourg in order to enhance the transparency of its reporting of fluorinated gases (F-gases) by providing all the relevant background information used for the calculations in both the NIR and CRF tables.	AAR 2013, AAR 2014	Implemented
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 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.	ARR 2014	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
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.	ARR 2014	Ongoing.
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. During the initial checks 2016, particular attention has been paid to issues related to large inter-annual changes

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
Agriculture		85. The ERT noted that in CRF table 4.B(a) the total allocation of manure from swine, expressed as a percentage, only summed to 94.4 per cent for 2012. In response to a question raised by the ERT during the review, the European Union explained that for 2012 only, one member State (Belgium) did not report the allocation of manure by climate region for swine for 2012, but the error did not affect the estimate of emissions. Furthermore, the ERT noted that table 21.16 of the NIR stated that Hungary was planning to develop country-specific EFs and implement these by 2007, and table 21.12 stated that Latvia used a tier 1 methodology for all livestock, whereas Latvia uses a tier 2 methodology for dairy and non-dairy cattle. In response to questions raised by the ERT during the review regarding these errors, the European Union explained that the information on Hungary was out of date and that the information on Latvian methods for livestock emission calculations was not correct. Also during the review the ERT noted that the absolute value of the recalculation changes in the NIR did not reconcile with the recalculation estimates reported in the CRF tables. In response to a question raised by the ERT during the review, the European Union indicated that there was an error in the NIR recalculations and these had not been multiplied by 100. The ERT recommends that the Party correct the errors and update the information on the EU-15 member States and improve the implementation of QC procedures in order to prevent such errors.	ARR 2014	No further action required
Agriculture		86. During the review the ERT noted that there were references to European-based institutions and programmes, sometimes only by their acronyms, and their functions were not described in the NIR. Some examples included JRC, CAPRI and NUTS. In response to questions raised by the ERT during the review, the European Union provided some good background summaries on the roles and functions of these institutions or programmes. To improve transparency for audiences less familiar with the European Union systems, the ERT recommends that the European Union provide such summary information in the annual submission.	ARR 2014	Implemented
Agriculture		Enteric fermentation – CH_4 88.The NIR does not, however, explain the potential reasons for the differences; for example, in the case of swine the European Union indicates that the biggest source of difference is the swine population in Germany whereas the FAO livestock data report 20 per cent more swine than the CRF tables. In response to a question raised by the ERT during the review regarding the differences in swine numbers in Germany, the European Union explained that the FAO data are for 30 September every year while the German statistics are for November and piglets under 8 kg are included with sow numbers (i.e. the total German swine population excludes the number of piglets under 8 kg). The ERT reiterates the encouragement in the previous review report that the European Union investigate differences between AD reported in the CRF tables and FAO data as a QA/QC and verification procedure and report such reasons for the differences in livestock numbers.	ARR 2014	The FAO does not have consistent background information on the data submitted by the countries. The 2016 submission contains an updated comparison between activity data reported to the FAO and in the National GHG inventories, however, in case of differences, it cannot analyse the reason why different data are reported. This specific case (swine numbers for Germany) is addressed in the 'methodology table' which is annexed to the NIR.

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
Agriculture		Manure management – N_2O 90. The ERT noted that the trend of nitrogen excretion rates for swine in Sweden (NIR, figure 6.27) showed a stepwise increase in nitrogen excretion rates from 7.7 kg N/year to 9.0 kg N/year between 2001 and 2002, and the explanation in the text of the NIR showed that the estimate of the nitrogen excretion rate had been updated only from 2002 and possibly may have resulted in a time-series consistency problem. In response to a question raised by the ERT during the review, the European Union indicated that Sweden increased the intensification of production systems from 2.5 to 3.0 production cycles in 2002 for swine for meat production and this resulted in a 16 per cent increase in the rate of nitrogen excretion. The ERT considered that the explanation provided by the European Union was reasonable and recommends that the European Union include this explanation in the NIR.	ARR 2014	During the 2016 initial checks, considerable attention has been paid to trend 'issues'. In the course of the harmonisation and simplification of the NIR chapters however, this information has not yet been incorporated into the chapter. in future submission we will further improve the information presented in order to keep the report 'manageable' yet including relevant information.
Agriculture		Agricultural soils – N_2O 91. The European Union has reported in CRF table 4.D that the fraction of livestock nitrogen excreted and deposited onto soil during grazing (FracGRAZ) is 0.34; however, the proportion of manure excreted during animal grazing, calculated based on the data reported in CRF table 4.B(b), equals 0.36. In response to a question raised by the ERT during the review, the European Union indicated that the value for FracGRAZ is based on an average of FracGRAZ values across all member States. Although the identified difference does not cause any errors in the calculation of emissions, in order to improve the transparency and comparability of the annual submission the ERT recommends that the European Union report the fraction so that FracGRAZ is consistent between CRF table 4.D and CRF table 4.B(b) for the total for the European Union. The ERT also recommends that the European Union improve the QA/QC system to ensure that the AD reported in the CRF tables are internally consistent.	ARR 2014	No further action required
Agriculture		92. The ERT observed that there was a discrepancy in the total area of organic cultivated soils, which is reported in CRF table 4.D as 2,360.99 kha and is reported as the area of organic soils in CRF tables 5.B and 5.C as 2,855.31 kha for 2012. In response to a question raised by the ERT during the review, the European Union explained that some member States use country-specific definitions of cultivation and some use different sources of data for the agriculture and LULUCF sectors. The European Union also explained that it had previously identified this in its 2013 QA/QC. The ERT recommends that the European Union continue to work with member States to ensure more consistent reporting of the area of organic soils between the agriculture and LULUCF sectors.	ARR 2014	Implemented/ ongoing

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF	Sector overview / Completeness	76. Following the recommendations made in previous review reports, the Party's 2013 NIR showed improvements in the completeness of the reporting of emissions and removals for all categories and subcategories and of the reporting of all carbon pools. For example, Germany has reported emissions from mineral soils for forest land remaining forest land for the first time. Some mandatory categories, subcategories and carbon pools are still reported as "NE" by member States (e.g. biomass, dead organic matter and carbon in mineral soils for grasslands remaining grasslands). In response to questions raised by the ERT during the review, the European Union explained that the use of the notation key "NE" is carefully monitored and followed up where necessary with the relevant member State. The ERT commends the European Union for the improvements in the reporting and recommends that the Party continue to work with member States with a view to reporting pools which are currently not estimated.	ARR 2013	Implemented/ ongoing
LULUCF	5A1 / Consistency	78. The area of forest land remaining forest land has slightly increased by 1.6 per cent at the EU-15 level since 1990. About half of the member States reflect the overall trend showing little change since 1990. The largest percentage increases in land area for forest land remaining forest land were in the United Kingdom (26.3 per cent) and in Italy (10.2 per cent), whereas the largest percentage decreases in land area were in Portugal (10.4 per cent) and in the Netherlands (10.2 per cent). The ERT noted that the text in the Party's NIR describing the trends is not consistent with the data provided in the CRF tables and in table 7.10 in the NIR. Although the ERT commends the European Union for the improvements in the reporting of the reasons for inter-annual variation in removals in the NIR it reiterates the recommendation made in the previous review report to improve the accuracy and consistency between the NIR and the CRF tables.	ARR 2013	Implemented
LULUCF	5A1 / Transparency	79. At the EU-15 level this category was a net sink of 227,507.99 Gg CO_2 eq in 2011, which represents a decrease of 1.3 per cent from 1990 levels and a 5.0 per cent increase from 2010. Austria, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Portugal and the United Kingdom show fluctuating trends in net CO_2 emissions and removals, while the remainder show more steady trends. The NIR provides information on the reasons, by pool, for the inter-annual variation but the description is not fully transparent to let the ERT assess the consistency of the time-series. When member States' emissions are aggregated to the EU-15 level the inter-annual variation is averaged out showing relatively constant removals. The ERT recommends that the European Union work to improve the transparency in the NIR.	ARR 2013	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF	5A2 / Accuracy	80. The European Union reports that the area of land converted to forest land in 2011 was 6,604.24 kha, which is 5.3 per cent of the total forest area, and increased by 51.5 per cent since 1990. Italy reports the largest area (1,560.76 kha), which is 23.6 per cent of the EU-15 total. The largest increases in the area were in Spain, Italy, France and Ireland, while the largest decrease was in the United Kingdom. At the EU-15 level, for 2011, land converted to forest land is reported as a net removal of 43,743.50 Gg CO_2 and in 2010, a sink of 46,658.62 Gg CO_2, with an increase of 98.4 per cent since 1990 (net removals were 22,045.26 Gg CO_2). Correction of a mistake in emission calculations by Italy resulted in an increase in net removals to 7,338.63 Gg CO_2 in 2010, compared to the previous annual submission where the sink was reported as 1,189.69 Gg CO_2. The ERT commends the European Union for the improvements in the accuracy of its reporting. However, the ERT noted that the reporting of the changes in net removals was not transparent in the NIR, especially for Italy. In response to a question raised by the ERT during the review, the Party explained that Italy calculates the emissions for the entire forest land and then splits the sink proportional to the areas of forest land remaining forest land and land converted to forest land. The JRC further acknowledged that this approach may not be satisfactory because the assumption of an equal sink between lands remaining forest land and lands converted to forest land is not justified. The ERT recommends that the Party work with Italy on the methodology, since it is not reasonable to consider missions/removals from land converted to forest land and forest land remaining forest land to be the same because increment and harvest values are likely to be very different in newly established forests.	ARR 2013	Implemented
LULUCF	5B2/ Completeness	81. The area of land converted to cropland has decreased by 22.2 per cent since 1990 for the EU-15. The converted area in 2011 was 8.0 per cent of the total cropland area. Conversion from grassland covers most of the area, which accounts for 5,845.78 kha of the total converted area of 6,804.05 kha in 2011. France and the United Kingdom reported the largest areas (3,778.12 kha and 1,309.01, respectively). Total emissions at the EU-15 level in 2011 were 30,145.34 Gg CO_2 compared with emissions from cropland remaining cropland, which were 42,056.27 Gg CO_2. The ERT noted that some member States reported pools using only a lower-tier method (e.g. Ireland, Italy, Luxemburg and Netherlands) and some reporting was incomplete (e.g. soil organic carbon on mineral soils in the Netherlands). The ERT reiterates the recommendation made in the previous review report that the Party continue to work with the member States to improve the completeness of their reporting and use higher tiers.	ARR 2013	Implemented / ongoing

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF	5B2/ Completeness	82. According to the NIR (page 354), Spain does not account for CO_2 emissions from lime production in sugar mills because it is captured in a by-product used for soil improvement. At sugar plants producing lime as a non-marketed intermediate, 90 per cent of the carbonates contained in the raw material are fed into the kiln and are partly retained in a by-product from the production process, the carbonation foam (the remaining 10 per cent of emissions are reported under lime production). In response to questions raised by the ERT during the review, Spain indicated that research is underway into the destination and application of the carbonation foam, so as to close the carbonate cycle starting from the use of limestone in the kiln for sugar production. The ERT noted that there might be an underestimation of emissions in agricultural lime application if this lime is applied to cropland or grassland (see para. 99 below). The ERT recommends that the European Union work with Spain to ensure that these emissions from lime application are reported transparently under the LULUCF sector and the KP-LULUCF activities.	ARR 2013	Implemented
LULUCF	5C1/ Completeness	83. The reported area under this subcategory in 2011 (53,351.25 kha) is 6.2 per cent less than in 1990 (56,905.64 kha). The category was a small source of emissions in 2011, amounting to 11,089.64 Gg CO_2. The major contributors to the emissions were Germany (10,325.49 Gg CO_2) and the Netherlands (4,246.00 Gg CO_2). The emissions have decreased by 47.1 per cent from 1990, mainly as a result of decreases in Italy and the United Kingdom. The carbon stock change (CSC) in mineral soils was reported as "NE" by Spain and several member States report "NO" for this category (e.g. France reports no change in all pools based on country-specific datasets). Some member States report changes in the soil carbon pool but assume no change in living biomass or dead organic matter pools, assuming a steady state, which is in line with IPCC good practice guidance for LULUCF. The ERT reiterates the recommendations made in the previous review reports that the European Union support member States in improving the completeness of their reporting and also recommends that the Party ensure that the assumptions and methods are transparently described in the NIR.	ARR 2013	Implemented / ongoing
LULUCF	5C1/ Transparency	84. There was also large inter-annual variability in the net CSC in living biomass in several years (e.g. in 2007 the net CSC was 0.0017 Mg C/ha and in 2008 0.0110 Mg C/ha). In response to a question raised by the ERT during the review, the Party responded that the main contributor to the inter-annual change is Italy, which includes estimates from other wooded land under this subcategory, causing variation. The European Union indicated its intent to work further with Italy on grassland issues. The ERT commends the European Union for its efforts to improve the transparency of member States' reporting. The ERT recommends that the Party work with Italy on its reporting of CSC in living biomass and document the reasons for fluctuations in the NIR.	ARR 2013	Implemented/ ongoing

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF	5F2 / Transparency	85. There were large inter-annual fluctuations in CO_2 emissions in this category. For example, the European Union reported net removals of 2,605.55 Gg CO_2 in 2009 and net removals of 3,606.26 Gg CO_2 in 2010. The Party reported net removals of 3,804.26 Gg CO_2 in 2011 but net emissions of 1,656.68 Gg CO_2 in 1990. The inconsistency in the time series was also observed in the net CSC in living biomass (e.g. the Party reported a net CSC of –0.1796 Mg C/ha in 2009 and –0.0771 Mg C/ha in 2010). In response to questions raised by the ERT during the review, the Party explained that the inconsistency originated from Portugal, whose national system for reporting was under development. The area reported by Portugal increased from 69.58 kha in 1990 to 1,033.85 kha in 2011, which partly explains the trend at the European Union level. Increases in other land are mostly explained by agriculture abandonment and degradation of forests to non-forest land, mostly due to recurring forest fires. Part of the inter-annual variation is also explained by France, which reports a higher IEF for 2009 and 2010 corresponding to country-specific biomass data. The ERT recommends that the European Union transparently explain significant interannual fluctuations and also work with member States to improve the consistency of their reporting.	ARR 2013	Implemented/ ongoing
Chapter 11 /KP LULUCF	Cropland management/ completeness	99. Only three member States elected this activity; Denmark, Portugal and Spain. Spain reported net removals, whereas the others reported net emissions from this activity in 1990, 2008, 2009, 2010 and 2011. Spain has reported “NE” for CSC in litter and dead wood. As discussed in paragraph 82 above, Spain produces lime as a by-product from sugar refineries and allocates 10 per cent of emissions under the industrial processes sector and assumes that the remaining 90 per cent is applied to soils (although the exact destination is not known). As described above, the ERT strongly recommends that the European Union work with Spain on this issue to determine whether there are CO_2 emissions from lime application and, if so, under which KP-LULUCF activity (or activities) or sector the remaining 90 per cent of lime should be allocated. The ERT also strongly reiterates the recommendation made in the previous review report that the Party work with Spain to provide more transparent and verifiable information in the NIR that litter and dead wood pools are not a net source of emissions.	ARR 2013	Implemented This issue was highlighted during the QA /QC process. Spain has increased the completeness by reporting carbon stock changes in litter and emissions from Liming, although the last is not relevant for the KP-LULUCF reporting. Spain also provide a justification in the NIR on how the "not a source" provision is applied when reporting carbon stock changes under dead wood.

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF		Forest land remaining forest land – CO_2 96. The area and net CO_2 removals have increased between 1990 and 2012; in 2012 the area under this category was 120,457.84 kha and the net CO_2 removals amounted to 279,340.14 Gg CO_2 which are 1.0 per cent and 14.8 per cent higher than the values for 1990, respectively. The trend is mostly affected by the trend in the pools living biomass and soil organic carbon. Previous stages of the review identified significant inter-annual variations for the IEFs for some of the pools: for living biomass, the 2012 value (0.59 Mg C/ha) is 13.0 per cent higher than the 1990 value (0.52 Mg C/ha). Also, the following inter-annual changes have been identified as statistical outliers: 1990–1991 (13.3 per cent); 1998–1999 (–22.6 per cent); 1999–2000 (29.5 per cent); 2001–2002 (–13.2 per cent); 2006–2007 (–9.4 per cent); and 2007–2008 (23.2 per cent). For dead organic matter, the trend of IEFs is very unstable and the following inter-annual changes are outstanding: 1998–1999 (1,653.1 per cent); 1999–2000 (–101.2 per cent); 2007–2009 (1,676.1 per cent); and 2009–2010 (–105.7 per cent). For organic soils, the overall trend of the carbon stock change IEF is decreasing and the 2012 value (–0.39 Mg C/ha) represents a 26.7 per cent decrease in emissions per unit area compared with the 1990 value (–0.53 Mg C/ha). In response to a question raised by the ERT during the review, the European Union explained that inter-annual variations are the result of the aggregation of data (AD and emissions) by member States and that any change of values reported by member States also affects the values the member States provide to the European Union. The ERT understands the particular situation for the European Union, which arises because the inventory is based on a compilation of member States' inventories, but, given the importance of this key category, reiterates the recommendation made in the previous review report that the Party improve the transparency in the NIR. In particular, the ERT recommends that the main drivers leading to inter-annual variations be discussed in detail, in particular for the most recent years.	ARR 2014	Implemented / ongoing

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF		Land converted to forest land – CO_2 97. The area of land converted to forest land in 2012 is 6,267.67 kha, which is 4.9 per cent of the total forest area in the EU-15 and represents an increase of 80.5 per cent compared with 1990. Net removals are 42,497.18 Gg CO_2, with the major contributions from Spain (–8,511.03 Gg CO_2) and France (–7,958.81 Gg CO_2). In the previous annual review report, a problem was identified regarding the report of Italy: Italy calculates the emissions for the entire forest land and then splits the sink proportional to the areas of forest land remaining forest land and land converted to forest land. The previous review report concluded that this approach may not be satisfactory since it is not reasonable to consider emissions/removals from land converted to forest land and forest land remaining forest land to be the same because the increment and harvest values are likely to be very different in newly established forests and because the assumption of an equal sink between lands remaining forest land and lands converted to forest land was not justified in the NIR. The previous review report recommended that the Party work with Italy to improve the methodology. However, the ERT noted that there is no information in the NIR to confirm whether the European Union made progress with Italy on this methodological issue. In response to a question raised by the ERT during the review, the European Union explained that Italy is still verifying the calculations and that reported emissions are not underestimated or removals overestimated. The ERT reiterates the recommendation made in the previous review report that the European Union continue to improve the transparency of reporting, including the provision of updated information from member States and internal QA/QC checks in order to ensure that the aggregated reporting is complete and consistent among member States.	ARR 2014	Implemented / ongoing
LULUCF		Cropland remaining cropland – CO_2 98. The area of cropland remaining cropland constantly decreased by 5.0 per cent between 1990 (79,407.21 kha) and 2012 (75,454.18 kha). Net emissions have increased from 35,401.24 Gg CO_2 in 1990 to 38,874.97 Gg CO_2 in 2012 (i.e. by 9.8 per cent). The pools dead organic matter and soil organic carbon show the same overall tendency; while for living biomass, net removals were reported in the period 1990–2010 and net emissions in 2011 and 2012. In response to a question raised by the ERT during the review, the European Union explained that the change for living biomass is the result of a significant increase of emissions from woody crops in Italy for 2011 and 2012 in accordance with the methodology used by Italy. Given that the value reported by Italy represents a significant change in the trend and that this increase is the maximum reported for any European Union member State for the period 1985–2012, the ERT recommends that the European Union provide justifications for the overall trends.	ARR 2014	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF		Land converted to cropland – CO_2 99. The area of land converted to cropland has increased by 30.4 per cent between 1990 (6,597.60 kha) and 2012 (8,603.09 kha) for the EU-15. This is an important shift in the trend compared with the values reported in the 2013 annual submission, when the area of land converted to cropland in 2011 was 22.2 per cent lower than 1990. Recalculations have also affected emissions/removals: the differences in net emissions/removals reported for land converted to cropland for 2011 between the 2014 and 2013 annual submissions represents an increase of emissions of 12,696.11 Gg CO_2 (59.5 per cent). The NIR does not explain this significant recalculation, but explanations were provided in response to a question raised by the ERT during the review: the European Union informed the ERT of the factors affecting the inventories of France, Germany and Spain that justified the changes. The ERT recommends that the Party provide transparent explanations in its annual submission, indicating the key drivers for the changes in the trend and recalculations.	ARR 2014	Implemented / ongoing
LULUCF		100. The ERT noted that the European Union continues to report carbon stock changes in pools for this category using the notation key "NE" for some member States (e.g. soil organic carbon on organic soils in the Netherlands). In addition, the ERT noted that the methods used by member States are mostly tier 2 or enhanced default methods using country-specific data combined with default methods for some categories, while some other member States reported emissions and removals for pools using only a lower-tier method (e.g. Ireland, Italy and Luxemburg). The ERT reiterates the recommendation made in the previous review report that the Party continue to work with the member States to improve the completeness of their reporting and use higher-tier methods in order to enhance accuracy.	ARR 2014	Implemented/ongoing
LULUCF		Grassland remaining grassland – CO_2 102. The previous review report indicated that there was a large inter-annual variability in the net carbon stock change in living biomass for several years, which was related to the inventory of Italy. In response to questions raised by the current ERT during the review, the European Union explained that Italy has provided information clarifying that the main driver for the inter-annual variance is the biomass burned as a result of fires. The European Union acknowledged that more information should have been added to its NIR. The ERT recommends that the Party continue to progress efforts with Italy (main contributor to the inter-annual change) on its reporting of carbon stock change in living biomass and document the reasons for inter-annual variations in the NIR.	ARR 2014	Implemented/ongoing

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
LULUCF		103. The ERT noted other significant inter-annual variations for some pools, such as: a decreasing trend for living biomass and dead organic matter (the overall trend of the carbon stock change IEF is decreasing and the 2012 value (0.0018 Mg C/ha) is 6.1 per cent lower than the 1990 value (0.0019 Mg C/ha)); an unstable trend for living biomass (inter-annual variations are high for the entire period, such as 1990–1991 (217.2 per cent), 1992–1993 (–695.6 per cent), 1998–1999 (332.4 per cent), 2007–2008 (146.2 per cent), 2008–2009 (–52.4 per cent), 2010–2011 (–49.1 per cent) and 2011–2012 (45.9 per cent)); an increasing trend for soil organic carbon in mineral soils (the 2012 value (0.023 Mg C/ha) is 430.4 per cent higher than the 1990 value (0.004 Mg C/ha)). During the review, in response to questions raised by the ERT, the European Union explained that inter-annual variations of its values are the result of the aggregation of data by member States. The ERT acknowledges that the changes in trends will vary with every member State in every year; nevertheless, the ERT recommends that the Party provide general information about the key drivers that explain the variations in each member State when significantly affecting the European Union aggregate estimates.	ARR 2014	Implemented / ongoing
LULUCF		Land converted to other land – CO_2 104. The area under the category land converted to other land represents 639.47 kha in 2012, which is 0.2 per cent of the total area of the European Union (this category is a key category according to the trend). The category changed from being a net source of CO_2 emissions in 1990 (1,405.78 Gg CO_2) to a net sink in 2012 (–984.87 Gg CO_2). In the previous review report it is explained that the European Union said that the reason was Portugal and the development of its national system: the area reported by Portugal increased from 69.58 kha in 1990 to 1,033.85 kha in 2011. The previous review report also recommended that the European Union explain significant inter-annual variances to improve transparency and also work with member States to improve the consistency of their reporting. The ERT noted that the explanations, reiterated by the European Union during the current review, were not included in the NIR. The ERT reiterates the recommendation made in the previous review report that the European Union include transparent explanations in the NIR for the inter-annual variations and also work with the member States to improve the consistency of their reporting.	ARR 2014	Implemented / ongoing
LULUCF		Biomass burning – CO_2, CH_4 and N_2O 105. For CO_2, some member States report emission estimates or report using the notation keys “NO” or “IE” for emissions from burning biomass, while CH_4 and N_2O emissions are often reported as “NE”. Although the Party comments in the NIR about the use of notation keys, nothing is provided regarding these “NEs”. Therefore, the ERT recommends that the Party include the reasons for the use of the notation key “NE” when applicable and make efforts to increase the completeness of reporting.	ARR 2014	Implemented / ongoing
Waste	5 and 5 A Solid waste disposal, consistency and completeness	The ERT observed some apparent errors in figure 8.2 of the NIR (page 819): the key category CH_4 from industrial wastewater is missing. The ERT also observed an error in table 8.1 of the NIR (page 820), specifically an inconsistency between the table title and the contents of the table, since no information is provided in this table on methods applied and EFs. The ERT recommends that the European Union enhance its QA/QC procedures in order	ARR 2014, para 110	Implemented

NIR chapter / Sectors	Category / Issue	Reccomendation/ improvements planned	Reference	Status
		to ensure consistency between the NIR and the CRF tables.		
Waste	5 A Solid waste disposal, AD	The EU-15 Member States all used the IPCC tier 2 first order decay (FOD) method or a tier 2-equivalent method with a combination of default and country-specific EFs for estimating CH_4 emissions (e.g. Belgium uses a country-specific method which is in line with the tier 2 method). These approaches are in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. CH_4 emissions from this category have decreased by around 46 per cent between 1990 and 2012 because total municipal waste disposal on land has decreased over this period. The ERT noticed that the European Union reported that the total municipal waste disposal on land declined by around 52 per cent between 1990 and 2012, but there is no information about these AD in the NIR. The ERT recommends that the European Union provide relevant AD in the NIR.	ARR 2014, para 111	Implemented
Waste	5 C1 Waste incineration, duplication	The European Union included in the NIR an overview of GHG emissions from waste incineration by member States. The ERT observed that there is some duplication between NIR table 8.12 and table 8.13, and there is no description about CH_4 and N_2O emissions in the NIR. The ERT recommends that the European Union combine NIR table 8.12 and table 8.13 and also recommends that the European Union add sufficient descriptions about the CH_4 and N_2O emissions and enhance its QA procedures to avoid such errors in reporting in the future.	ARR 2014, para 117	Implemented

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:

- Include new key categories in the NIR giving detailed information like for other key categories
- 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 2015/2016
- Streamline the NIR to make it more user friendly

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

For each Article. 3.3, and Article. 3.4 activities, estimates reported in the EU GHG inventory result from summing up all GHG emissions and CO_2 removals reported by individual Member States (MS) and Iceland. For the voluntary activities under the Article. 3.4, information is included only for MS that elected to account for these activities during the second commitment period (CP2) of the KP.

It is important to note that the EU will neither issue nor cancel units based on the credits and debits accounted for by any MS under KP-LULUCF activities. Therefore, all the GHG estimates, and any information on KP-LULUCF activities presented here, are shown for information purpose.

This chapter provides an overview of EU relevant supplementary information for KP-LULUCF activities, as reported by EU MS and Iceland. In the absence of an official annotated outline for the provision of supplementary information under the KP, and although the JRC has provided MS with a proposal annotated outline for reporting KP-LULUCF supplementary information within their national inventory reports (NIR), the type and amount of information reported by MS significantly differs among MS. Therefore, this chapter does not contain an exhaustive compilation of all supplementary information reported by MS, although it provide an overview of the most important. For more detailed information, it is therefore suggested to refer to MS NIRs.

In particular, this chapter includes:

- General information concerning KP-LULUCF activities, (i.e. elected activities under Article 3.4, completeness of reporting of carbon pools and other sources of GHG emissions, areas reported under each activity, accounting quantities, key category analysis, definition of forest by MS).
- Information related to the land representation approach for KP-LULUCF activities.
- Activity-specific information, (i.e. methodologies for estimating carbon stock change and other source of GHG emissions, justification for omitting a carbon pool, information on whether indirect and natural CO_2 removals have been factored out, information on the year of the onset of the activity, and information on other methodological issues).
- A synthesis of supplementary information required for Article 3.3 and 3.4 activities (i.e. information on natural disturbance, information on HWPs, methods for the construction of the FMRL, whether MS have implemented technical corrections, and information on whether and how MS and applied the carbon equivalent forest conversion and information about conversion from natural to planted forest).

The main assumption when reporting under the KP is that the consistency of the information reported in the EU GHG inventory with the IPCC good practices is ensured when individual GHG inventories are consistent with those good practices. Nevertheless, the consistency of the MS national GHG inventories with good practices is checked twice every year, before national GHG inventories are officially submitted to UNFCCC. One in the context of own QA/QC procedures implemented by MS, and, a second one in the context of the EU QA/QC procedures as implemented by the EU JRC experts.

11.1 General information

11.1.1 Elected activities under Article 3.4 of the Kyoto Protocol

As shown in Table 11.1, with regard to voluntary activities under the Article 3.4 during the CP2; 7 MS have elected to account for Cropland Management, 6 MS for Grazing Land Management, 1 MS and Iceland for Revegetation, and 1 MS for Wetland Drainage and Rewetting. Concerning the accounting frequency, with the exception of 2 MS, all other MS have elected to account at the end of the commitment period.

Table 11.1 Activities elected under Art. 3.4, and accounting frequency. FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation, WDR: wetlands drainage and rewetting.

Member State	Art 3.4 elected activities [1]	Accounting frequency
Austria	---	end of CP
Belgium	---	end of CP
Bulgaria	---	end of CP
Croatia	---	end of CP
Cyprus	---	end of CP
Czech Republic	---	end of CP
Denmark	CM, GM	annual
Estonia	---	end of CP
Finland	---	end of CP
France	---	end of CP
Germany	CM, GM	end of CP
Greece	---	end of CP
Hungary	---	annual
Ireland	CM,GM	end of CP
Italy	CM, GM	end of CP
Latvia	---	end of CP
Lithuania	---	end of CP
Luxemburg	---	end of CP
Malta	---	end of CP
Netherlands	---	end of CP
Poland	---	end of CP
Portugal	CM, GM	end of CP
Romania	RV	end of CP
Slovakia	---	end of CP
Slovenia	---	end of CP
Spain	CM	end of CP
Sweden	---	end of CP
United Kingdom	CM, GM, WDR	end of CP
Iceland	RV	end of CP

[1]*FM activity has become mandatory to all MS for CP2*

11.1.2 Activity coverage under Article 3.3 and Article 3.4. (CRF table NIR-1)

Table 11.2 presents an assessment of completeness of C pools and GHG reported for each mandatory and elected activities. Carbon stock changes are in most cases estimated for biomass pools; whereas for DOM and SOM pools notation keys are largely used. “NE” is mainly used when the “not a source” provision is applied, while “IE” is mainly used for belowground biomass, being it included in estimates reported under aboveground biomass, or for biomass annual gain or loss when the stock difference method is applied and net gain or net loss is reported, or when litter and dead wood C stock changes are reported together under one of the two pools or even when dead organic matter and soil organic matter pools are estimated by using models not capable to apportion net C stock changes among pools.

Despite continuous improvements implemented by MS in their national GHG inventories, when implementing the “not a source” provision, both, the EU QA/QC procedures, and the UNFCCC expert review teams, have highlighted the need for providing more transparent information to demonstrate that omitted carbon pools are not a net source of emissions. A synthesis of the information reported by MS and Iceland for such demonstration is presented in Table 11.17.

Concerning to other sources of emissions, completeness is not yet achieved by some MS, especially for N_2O emissions from management of soils. Notation keys are also used when a specific source does not occur within the national territories (e.g. fertilization of natural forest) or is already reported under the agriculture sector (e.g. fertilization of forest plantations).

Table 11.2 *Synthesis of C pools and other sources of GHG emissions reported for KP-LULUCF activities in EU MS and Iceland, based on table NIR-1 and sectorial tables (for the year 2014)*

MS	CHANGE IN CARBON POOL REPORTED							GREENHOUSE GAS SOURCES REPORTED							
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		HWP	Fertilization	Drained, rewetted and other soils		Nitrogen mineralization in mineral soils	Indirect N2O emissions from managed soil	Biomass burning		
					Mineral	Organic		N2O	CH4	N2O	N2O	N2O	CO2	CH4	N2O
Afforestation/Reforestation															
Austria	R	R	R	R	R	NO	R	NO	NO	NO	NO	NO	NO	NO	NO
Belgium	R	R	R	R	R	NO	NR	NO	NO	NO	R	NO	NO	NO	NO
Bulgaria	R	IE	R	NO	R	NO	R	NO	NO	NO	NO	NO	IE	R	R
Croatia	R	IE	IE	NO	R	NO	NO	NO	NO	NO	NO	NO	R	R	R
Cyprus	NR	NR	NR	NR	NR	NO	NR	NE	NE	NE	NE	NE	NE	NE	NE
Czech Republic	R	R	R	R	R	R	R	NO	NO	NO	NO	NO	NO	NO	NO
Denmark	R	R	R	R	R	R	R	IE	R	R	NO	R	IE	IE	IE
Estonia	R	R	R	R	R	R	R	NO	NA	NA	NO	NO	IE	R	R
Finland	R	R	IE	IE	R	R	IE	NO	R	R	R	NO	R	R	R
France	R	R	R	R	R	NO	NO	NO	NO	NO	NO	NO	R	R	R
Germany	R	R	R	R	R	R	NA	NO	NO,R	NO,R	R	R	IE,NO	IE,NO	IE,NO
Greece	R	R	NR	NR	NR	NO	NO	NO	NO	NO	NO	NO	R	R	R
Hungary	R	R	NR	NR	NR	NO	IE	IE	NO	NO	NO	NO	IE	R	R
Ireland	R	R	R	R	NO	R	R	IE	R	R	NO	IE	R	R	R
Italy	R	R	R	R	R	NO	R	NO	NO	NO	R	R	R	R	R
Latvia	R	R	R	R	NO	R	NO	NO	R	R	NO	NO	NO	NO	NO
Lithuania	R	R	R	NO	R	R	IE	NO	R	R	NO	NO	R	R	R
Luxemburg	R	R	R	R	R	NO	IO	NO	NO	NO	NO	NO	NO	NO	NO
Malta	NR	NR	NR	NR	NR	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE
Netherlands	R	R	R	R	R	R	IE	NO	NE	NE	R	NO	R	R	R
Poland	R	R	R	R	R	R	NO	NO	NO	NO	NO	NO	R	R	R
Portugal	R	R	R	IE	R	NO	R	IE	NO	NO	R	IE	R	R	R
Romania	R	R	R	NO	R	NR	R	IE	NO	NO	R	R	R	R	R
Slovakia	R	R	R	NO,NR	R	NO,NR	NR	NO	NO	NO	NO	NO	R	R	R
Slovenia	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Spain	R	IE	NR,R	NR,R	NR,R	NO	NR	NO	NO	NO	NE,R	IE,NE	IE,NO,R	NO,R	NO,R
Sweden	R	R	R	R	R	R	NO	NO	R	R	R	NO	NO	NO	NO
United Kingdom	R	IE	R	IE	R	R	R	R	NE	R	R	NE	R	R	R
Iceland	R	R	R	NO	R	R	NO	R	NE	NE	NE	NE	NO	NO	NO
Deforestation															
Austria	R	R	R	R	R	NO	R	NO	NO	NO	R	NO	NO	NO	NO
Belgium	R	R	R	R	R	NO	IO	IE	NO	NO	R	NO	NO	NO	NO
Bulgaria	R	IE	R	R	R	NO	R	NO	NO	NO	NO	NO	NO	NO	NO
Croatia	R	IE	IE	IE	R	NO	R	NO	NO	NO	R	NO	NO	NO	NO
Cyprus	NR	NR	NR	NR	NR	NO	NR	NE	NE	NE	NE	NE	NE	NE	NE
Czech Republic	R	R	R	R	R	R	R	NO	NO	NO	R	NO	NO	NO	NO
Denmark	R	R	R	R	R	R	R	IE	R	R	R	IE	IE	IE	IE
Estonia	R	R	R	R	R	R	R	NO	NA	NA	NO	NO	NO	NO	NO
Finland	R	R	IE	IE,R	R	R	IO	IE	R	R	R	NO	R	R	R
France	R	R	R	R	R	IE	NO	NO	NO	NO	R	NO	IE	R	R
Germany	R	R	R	R	R	R	NA	NO	NO,R	NO,R	R	R	NO	NO	NO
Greece	R	R	R	R	R	NO	NO	NO	NO	NO	R	NO	NO	NO	NO
Hungary	R	R	R	R	R	NO	IO	IE	NO	NO	R	R	IE	R	R
Ireland	R	R	R	R	R	R	IO	IE	R	R	R	IE	NO	NO	NO
Italy	R	R	R	R	R	NO	R	NO	NO	NO	NO	NO	NO	NO	NO
Latvia	R	R	R	R	R	R	R	IE	R	R	IE	IE	NO	NO	NO
Lithuania	R	R	R	R	R	R	IO	NO	NO	NO	NO	NO	NO	NO	NO
Luxemburg	R	R	R	R	R	NO	IO	NO	NO	NO	NO	NO	NO	NO	NO
Malta	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Netherlands	R	R	R	R	R	R	IO	IE	NE	NE	R	IE	R	R	R
Poland	R	R	R	R	R	R	R	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	R	R	R	IE	R	NO	R	IE	NO	NO	R	IE	R	R	R
Romania	R	R	R	NO	R	NR	R	IE	NO	NO	R	R	R	R	R
Slovakia	R	R	R	R	R	NO,NR	NR	NO	NO	NO	NO	NO	NO	NO	NO
Slovenia	R	R	R	R	R	NO	IO	NO	NO	NO	R	NO	NO	NO	NO
Spain	NR,R	IE,NR	NR,R	NR,R	NR,R	NO	NR	NO	NO	NO	NE,R	IE,NE	NE,NO,R	IE,NE,NO,R	IE,NE,NO,R
Sweden	R	R	R	R	R	R	IO	NO	R	R	R	NO	NO	NO	NO
United Kingdom	R	IE	R	IE	R	IE	IO	NO	NO	NO	NO	NO	R	R	R
Iceland	NO	NO	NO	NO	R	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Forest Management															
Austria	R	R	NO	R	R	NO	R	NO	NO	NO	NO	NO	IE	R	R
Belgium	R	R	R	R	R	NO	R	NO	NO	NO	R	NO	NO	NO	NO
Bulgaria	R	IE	NO	NO	NO	NO	R	NO	NO	NO	NO	NO	IE	R	R
Croatia	R	IE	NO	NO	NO	NO	R	NO	NO	NO	NO	NO	R	R	R
Cyprus	R	R	NR	NR	NO	NO	NR	NE	NE	NE	NE	NE	R	R	R
Czech Republic	R	R	IE	R	R	R	R	NO	NO	NO	NO	NO	R	R	R
Denmark	R	R	R	R	R	R	R	IE	R	R	NO	IE	IE	R	R
Estonia	R	R	R	R	R	R	R	NO	NA	NA	NO	NO	IE	R	R
Finland	R	R	IE	IE	R	R	R	IE,R	NO,R	NO,R	NO	NO	R	R	R
France	R	R	R	R	R	IE	R	NE	NE	NE	NE	NE	R	R	R
Germany	R	R	R	R	R	R	R	NO	NO,R	NO,R	R	R	IE,NO	NO,R	NO,R
Greece	R	R	NR	NR	NR	NO	R	NO	NO	NO	NO	NO	IE	R	R
Hungary	R	R	NR	NR	NR	R	R	IE	NO	NO	NO	NO	IE	R	R
Ireland	R	R	R	R	NA	R	R	IE	R	R	NO	IE	R	R	R
Italy	R	R	R	R	NR	NR	R	NO	NO	NO	NO	NO	R	R	R
Latvia	R	R	R	R	NO	R	R	NO	R	R	R	R	R	R	R
Lithuania	R	R	R	R	NO	R	R	NO	R	R	NO	NO	R	R	R
Luxemburg	R	R	R	R	R	NO	IO	NO	NO	NO	NO	NO	NO	NO	NO
Malta	NR	NR	NR	NR	NR	NR	NR	NO	NO	NO	NO	NO	NE	NE	NE
Netherlands	R	R	R	R	R	R	R	NO	NE	NE	R	NO	R	R	R
Poland	R	R	R	R	R	R	R	NO	R	NO	NO	NO	R	R	R
Portugal	R	R	R	IE	R	NO	R	IE	NO	NO	R	IE	R	R	R
Romania	R	R	R	NO	R	NR	R	IE	NO	NO	R	R	R	R	R
Slovakia	R	R	NO,NR	NO,NR	NO,NR	NO,NR	R	NO	NO	NO	NO	NO	R	R	R
Slovenia	R	R	NR	R	NR	NO	R	NO	NO	NO	NO	NO	R	R	R
Spain	NR,R	IE,NR	NR,R	NR,R	NR,R	NO	R	NO	NO	NO	NE,R	IE,NE	IE,NE,R	NO,R	NO,R
Sweden	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
United Kingdom	R	IE	R	IE	R	R	R	NO	NE	R	R	NO	R	R	R
Iceland	R	R	R	NE	R	R	NE	NO	R	R	NE	NE	NO	NO	NO
Cropland Management															
Denmark	R	IE	NO	NO	R	R			R		IE		NO	NO	NO
Germany	R	R	IE	IE,NO	R	R			NO,R		R		NO	NO	NO
Ireland	R	IE	NO	NO	R	NO			NO		IE		NO	R	R
Italy	R	R	NO	NO	R	R			NO		NO		R	R	R
Portugal	R	R	R	NO	R	NO			NO		R		R	R	R
Spain	NR,R	IE,NR	NR,R	NR,R	R	NO			NO		NE,R		NE,NO	IE,NE,NO	IE,NE,NO
United Kingdom	R	IE	NE	NE	R	NO			NE		R		NE	R	R
Grassland Management															
Denmark	R	IE	NO	NO	R	R			R		IE		IE	R	R
Germany	R	R	IE	IE,NO	R	R			NO,R		NO		NO	NO	NO
Ireland	R	IE	NO	NO	R	R			R		IE		NO	R	R
Italy	NO	NO	NO	NO	R	NO			NO		NO		NO	NO	NO
Portugal	R	R	R	NO	R	NO			NO		R		R	R	R
United Kingdom	R	IE	NE	NE	R	NO			NE		R		NE	R	R
Revegetation Management															
Romania	R	R	R	R	R	NO		R	NO	NO	R	R	R	R	R
Iceland	R	IE	IE	NO	R	NO		R	NO	NO	NO	NO	NE	R	R
Wedlands Drainage and Rewetting															
United Kingdom	NR	NR	NR	NR		NR		NE	NE	NE		NE	NE	NE	NE

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported (under assumption of not a source); NE – removal/emission is not estimated; IE – included elsewhere; NO –not occurring; NA – not applicable.

11.1.3 Areas reported under the KP-LULUCF activities (KP CRF table NIR-2)

Total land area reported under KP-LULUCF activities by EU MS and Iceland is about 248.000 kha, which is approximately 55% of their total area (Table 11.3).

The activity that covers the largest area at EU level is Forest Management (62%), followed by Cropland Management (22%), Grazing land Management (11%), Afforestation/Reforestation (4%) Deforestation (1%), while Wetland Drainage and Rewetting and Revegetation cover less than 1%.

With the exception of Finland, Latvia, the Netherlands and Romania all GHG inventories are reporting larger areas under afforestation/reforestation than under deforestation. Consequently, the forest area reported under KP increases across time at EU level.

Regardless of specific activities, most of the EU area under KP accounting is reported by Spain and Germany. While the largest area under AR is reported by Italy, that one under D is reported by France, and that one under FM by Finland and Sweden.

Table 11.3 Synthesis of total area (kha) reported under KP-LULUCF activities by EU MS and Iceland at the end of 2014, based on CFR sectorial tables. Grey cells indicate that the activity has not been elected.

Member State	Art. 3.3 activities		Art. 3.4 activities					TOTAL
	AR	D	FM	CM	GM	RV	WDR	
Austria	210,839	72,349	3813,161					4096,349
Belgium	37,797	27,469	686,665					751,931
Bulgaria	263,272	4,538	3618,561					3886,371
Croatia	51,506	4,426	2309,606					2365,537
Cyprus	NO	NO	154,945					154,945
Czech Republic	55,451	16,890	2610,925					2683,266
Denmark	86,896	3,364	528,080	2564,429	347,949			3530,717
Estonia	33,687	20,509	2275,940					2330,136
Finland	170,189	384,201	21692,025					22246,415
France	1432,912	1080,888	21552,885					24066,685
Germany	520,071	278,617	10634,924	14616,118	6350,206			32399,935
Greece	33,248	5,186	1234,487					1272,921
Hungary	173,329	11,273	1767,687					1952,289
Ireland	305,161	16,836	449,403	674,644	4295,508			5741,552
Italy	1936,060	51,474	7464,065	8863,486	427,917			18743,001
Latvia	40,936	101,134	3258,441					3400,510
Lithuania	41,108	1,984	2156,057					2199,149
Luxemburg	8,787	5,770	87,347					101,905
Malta	NE	NE,NO	NE					0,000
Netherlands	60,114	69,109	326,716					455,939
Poland	721,323	17,244	8661,256					9399,823
Portugal	603,690	354,561	3760,118	2337,314	597,434			7653,117
Romania	32,006	365,075	7064,390			104,510		7565,981
Slovakia	39,440	8,363	1985,295					2033,098
Slovenia	NA,NO	26,275	1067,155					1093,430
Spain	1234,634	111,041	14438,686	20163,948				35948,308
Sweden	336,227	284,085	28393,244					29013,557
United Kingdom	350,339	54,234	2321,212	5230,838	14799,197		NE,NA	22755,820
EU	**8779,023**	**3376,893**	**154313,275**	**54450,776**	**26818,211**	**104,510**	**0,000**	**247842,687**
Iceland	44,172	0,049	87,721			256,83		388,772
EU+Iceland	**8823,195**	**3376,943**	**154400,995**	**54450,776**	**26818,211**	**361,340**	**0,000**	**248231,460**

11.1.4 Summary overview of Key categories for KP-LULUCF activities (KP CRF table NIR-3)

Information included in Table 11.4 relies on the information reported by MS and Iceland in CRF table NIR-3.

Table 11.4 Synthesis of KP-LULUCF activities being key category as reported by EU MS and Iceland (from table NIR-3) in 2016 submissions. "KC" indicates a key category. Grey cells indicate that the activity has not been elected.

Member State	AR	D	FM	CM	GM	RV	WDR	Comments
Austria								KC analysis is not available in the NIR 3
Belgium								KC analysis is not available in the NIR 3
Bulgaria								KC analysis is not available in the NIR 3
Croatia								KC analysis is not available in the NIR 3
Cyprus								KC analysis is not available in the NIR 3
Czech Republic			KC					Corresponding land category is key under GHG inventory
Denmark			KC	KC	KC			Level assessment
Estonia	KC	KC	KC					Corresponding land category is key under GHG inventory. Quantitative Tier 2 method was used
Finland	KC	KC	KC					Level, trend
France								KC analysis is not available in the NIR 3
Germany	KC	KC	KC	KC	KC			Corresponding land category is key under GHG inventory
Greece								KC analysis is not available in the NIR 3
Hungary	KC	KC	KC					Corresponding land category is key under GHG inventory
Ireland								KC analysis is not available in the NIR 3
Italy								KC analysis is not available in the NIR 3
Latvia	KC	KC	KC					Corresponding land category is key under GHG inventory
Lithuania								KC analysis is not available in the NIR 3
Luxemburg	KC		KC					Corresponding land category is key under GHG inventory
Malta								KC analysis is not available in the NIR 3
Netherlands	KC	KC	KC					
Poland								KC analysis is not available in the NIR 3
Portugal								KC analysis is not available in the NIR 3
Romania	KC		KC			KC		Corresponding land category is key under GHG inventory
Slovakia								KC analysis is not available in the NIR 3
Slovenia			KC					
Spain	KC	KC	KC	KC				Corresponding land category is key under GHG inventory
Sweden								KC analysis is not available in the NIR 3
United Kingdom	KC	KC	KC	KC	KC			Corresponding land category is key under GHG inventory
Iceland								KC analysis is not available in the NIR 3

11.1.5 Summary of net emissions and removals (kt CO_2 eq.), and accounting quantities for KP-LULUCF activities (KP CRF table "Accounting")

Table 11.5 and Table 11.6 show respectively net emissions and removals, ad accounted quantities for each MS and each KP activity and the sum for total EU and total EU plus Iceland.

Total net accounted amount at EU level as reported so far for CP2 by EU MS is -159.483 kt CO_2eq. With the addition of Iceland the total net accounting results in a net sink of -160.761 kt CO_2eq.

Emissions from deforestation offset about 69% of removals accounted in afforestation/reforestation. By far, the largest contributors to emissions from deforestation are France and Romania that are responsible of about 50% of total GHG emissions from this activity in EU and Iceland.

Table 11.5 Net emissions and removals (kt CO_2eq.) from KP-LULUCF activities for 2013-2014, as reported by EU MS and Iceland. Based on MS CRF accounting tables

MS	Net emissions (+) and removals (-), kt CO2eq																	
	A. Art 3.3 activities																	
	A.1 AR		A.2 D		B.1 FM		B.2 CM			B.3 GM			B.4 RV			B.5 WDR		
	2013	2014	2013	2014	2013	2014	1990	2013	2014	1990	2013	2014	1990	2013	2014	1990	2013	2014
Austria	-2067.71	-2076.39	524.23	509.60	-3397.55	-3750.92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Belgium	-436.42	-488.75	325.67	328.34	-3041.06	-3041.59	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bulgaria	-1186.12	-1326.78	155.03	87.11	-7696.03	-7769.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Croatia	-204.44	-235.39	67.71	37.66	-7083.65	-6967.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyprus	--	--	NO	--	NO	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Czech Republic	-492.61	-549.75	234.27	231.19	-6405.52	-6282.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denmark	-6.89	-117.43	31.35	114.05	-2591.11	-3786.48	5558.53	4192.15	3994.57	816.97	635.88	1187.38	NA	NA	NA	NA	NA	NA
Estonia	-175.33	-208.43	291.44	290.92	-1688.84	-1247.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Finland	-549.73	-567.98	3970.05	3824.13	-47896.80	-44697.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
France	-9777.89	-10257.11	10884.70	10803.54	-64639.88	-64952.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Germany	-6228.31	-6449.29	1969.47	1996.54	-54371.21	-55069.68	12702.32	14629.39	14519.86	25766.35	22362.30	22314.01	NA	NA	NA	NA	NA	NA
Greece	-136.22	-133.50	43.81	43.79	-2470.16	-2468.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hungary	-1233.03	-1069.10	119.26	145.00	-1534.90	-3181.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ireland	-3708.62	-3702.66	189.51	221.77	-435.55	-256.60	-4.30	20.71	-1.46	7076.41	5939.32	5964.47	NA	NA	NA	NA	NA	NA
Italy	-8079.38	-7837.24	2030.30	2039.44	-29013.78	-29144.89	-119.52	1406.24	1345.79	-3.41	-636.93	-675.04	NA	NA	NA	NA	NA	NA
Latvia	-85.68	-89.64	1383.41	1404.83	-3492.58	-428.40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lithuania	-219.84	-252.56	207.17	265.18	-10209.88	-8981.10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Luxemburg	-179.37	-176.28	44.12	42.14	-436.29	-359.70	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Malta	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Netherlands	-753.60	-779.20	1533.10	1566.80	-1901.70	-1882.30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Poland	-2817.75	-2855.32	245.01	257.98	-43597.03	-36135.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Portugal	-4742.14	-4952.60	2267.35	2092.19	-6274.61	-8018.90	3620.92	356.92	361.65	1551.37	67.57	23.19	NA	NA	NA	NA	NA	NA
Romania	-352.31	-346.17	8076.26	8076.26	-27459.97	-27479.10	NA	NA	NA	NA	NA	NA	--	-1211.36	-1222.00	NA	NA	NA
Slovakia	-443.07	-441.81	43.04	62.80	-6859.20	-4924.15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Slovenia	NA,NO	NA,NO	510.65	519.15	-5968.15	-6150.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Spain	-8389.44	-7935.45	597.13	595.45	-24832.64	-24742.63	-1107.73	621.40	448.75	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden	-1304.29	-1402.08	3420.00	3204.36	-49085.55	-51471.40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
United Kingdom	-3148.16	-3344.69	1025.47	934.09	-17637.45	-17050.50	401.85	8074.21	7930.01	105.42	-2470.12	-2599.57	NE	NE	NE	NA	NA	NA
EU	**-56718.32**	**-57595.60**	**40189.51**	**39694.30**	**-430021.11**	**-420239.63**	**21052.08**	**29301.02**	**28599.17**	**35313.11**	**25898.02**	**26214.45**	**0.00**	**-1211.36**	**-1222.00**	**0.00**	**0.00**	**0.00**
Iceland	-183.33	-209.41	0.24	0.11	-82.03	-82.44	NA	NA	NA	NA	NA	NA	-347.70	-548.93	-560.33	NA	NA	NA
EU+Iceland	**-56901.65**	**-57805.01**	**40189.75**	**39694.41**	**-430103.14**	**-420322.07**	**21052.08**	**29301.02**	**28599.17**	**35313.11**	**25898.02**	**26214.45**	**-347.70**	**-1760.29**	**-1782.33**	**0.00**	**0.00**	**0.00**

NE – removals/emissions are not estimated; IE – removals/emissions are included elsewhere; NO – removals/emissions are not occurring; NA – MS does not account for the activity

Table 11.6 Accounting quantities for 2012-2020 of KP-LULUCF activities as reported by EU MS and Iceland ($Kt CO_2eq$), based on 2016 MS and Iceland CRF accounting tables*

MS	Accounting quantity							
	Article 3.3		Article 3.4					MS accounting amount on LULUCF activities (RMUs)
	AR	D	FM	CM	GM	RV	WDR	
Austria	-4144,10	1033,83	-5762,47					-8872,74
Belgium	-925,17	654,01	-1084,65					-1355,81
Bulgaria	-2512,90	242,14	17286,45					15015,69
Croatia	-439,82	105,37	-3282,36					-3616,81
Cyprus	--	NO	314,00					314,00
Czech Republic	-1042,37	465,46	-3315,71					-3892,62
Denmark	-124,32	145,40	-7030,36	-2930,35	189,32			-9750,30
Estonia	-383,76	582,36	2546,14					2744,75
Finland	-1117,71	7794,18	-19974,80					-13298,33
France	-20035,01	21688,24	140047,49					141700,73
Germany	-12677,60	3966,01	-64620,89	3744,60	-6856,38			-76444,26
Greece	-269,71	87,60	-1615,29					-1797,40
Hungary	-2302,13	264,26	-2636,14					-4674,01
Ireland	-7411,28	411,28	301,41	27,86	-2249,03			-8919,76
Italy	-15916,62	4069,73	-58158,67	2871,55	-1308,56			-68442,56
Latvia	-175,32	2788,23	8839,01					11451,92
Lithuania	-472,40	472,36	-8102,97					-8103,01
Luxemburg	-355,65	86,26	40,01					-229,39
Malta	NE,NO	NE,NO	101,62					101,62
Netherlands	-1532,80	3099,90	-3784,00					-2216,90
Poland	-5673,07	502,99	-25466,70					-30636,78
Portugal	-9694,74	4359,54	-7507,27	-6523,27	-3011,98			-22377,73
Romania	-698,48	16152,52	-16720,56			-2433,36		-3699,88
Slovakia	-884,88	105,83	-11783,35					-12562,39
Slovenia	NA,NO	1029,81	-5776,30					-4746,49
Spain	-16324,89	1192,58	-3375,27	3285,61				-15221,96
Sweden	-2706,37	6624,36	-32421,52					-28503,53
United Kingdom	-6492,85	1959,57	-6835,95	15200,51	-5280,53		NE	-1449,25
EU	**-114313,91**	**79883,81**	**-119779,10**	**15676,51**	**-18517,16**	**-2433,36**	**NE**	**-159483,20**
Iceland	-392,74	0,35	-472,47			-413,85		-1278,72
EU + Iceland	**-114706,66**	**79884,16**	**-120251,57**	**15676,51**	**-18517,16**	**-2847,21**	**NE**	**-160761,92**

**any information on EU KP-LULUCF activities presented here is shown for information purpose only*

** CRF tables of Romania do not provide information on emissions/removals from Revegetation for the base year, consequently the reported accounting quantity for this activity is presumably overestimated.*

11.1.6 Definition of forest and any other criteria

The threshold values applied to define "forest" under the Kyoto Protocol by EU MS and Iceland are summarized in Table 11.7.

With few exceptions, threshold values and definitions applied for reporting forest areas under the Kyoto Protocol are identical to those used to report forest area under the Convention. An exception is Finland that applies 0.5 ha as minimum forest area under KP, whereas two different values are used for reporting forest land under the Convention i.e. 0.25 ha in Southern and 0.5 ha in Northern Finland.

Table 11.7 Threshold values applied to define "forest" under the Kyoto Protocol

Member State	Minimum crown cover (%)	Minimum height (m)	Minimum area (ha)	Minimum width (m)
Austria	30	2	0.05	10
Belgium	20	5	0.5	--
Bulgaria	10	5	0.1	--
Croatia	10	2	0.1	20
Cyprus	10	5	0.3	--
Czech Republic	30	2	0.05	20
Denmark	10	5	0.5	20
Estonia	30	2	0.5	--
Finland	10	5	0.5	20
France	10	5	0.5	20
Germany	10	5	0.1	--
Greece	25	2	0.3	--
Hungary	30	5	0.5	10
Ireland	20	5	0.1	20
Italy	10	5	0.5	--
Latvia	20	5	0.1	--
Lithuania	30	5	0.1	--
Luxemburg	10	5	0.5	--
Malta	30	5	1.0	--
Netherlands	20	5	0.5	30
Poland	10	2	0.1	10
Portugal	10	5	1.0	20
Romania	10	5	0.25	20
Slovakia	20	5	0.3	20
Slovenia	30	2	0.25	--
Spain	20	3	1.0	25
Sweden	10	5	0.5	--
United Kingdom	20	2	0.1	20
Iceland	10	2	0.5	20

Only few MS provided explicit definitions on what is considered natural forests, the vast majority of MS reported that the conversions of natural to planted forest do not take place in their territories because all the natural forests are under strict protection (e.g. Czech Republic) or because there are not natural forests.

When definitions are provided, natural forest are considered as those matching the definition of primary forests used by FAO (e.g. Finland), or forest lands with specific silvicultural features related to age of trees, stand structure, species compositions, etc., (e.g. Estonia). In some case, natural forests are defined by exclusion from what is defined as planted forest (e.g. Hungary).

11.1.7 Information on how definitions of each activity under Article 3.3, and each mandatory and elected activity under Article. 3.4 have been implemented and applied consistently over time

Lands subject to KP-LULUCF activities have been generally identified considering that because the entire national territory is subject to direct anthropogenic influence, all land under a specific land use category have to be reported in the corresponding direct human-induced activities. For instance, some countries considered directly "human-induced" AR any expansion of forest areas since 1990 (see following chapters for more details). Most of the MS considered all national forest area as subject to management and therefore, associated to FM activity. Only in few cases, MS do not include the entire forest area under KP LULUCF activities; e.g. Greece reports under FM and AR only one third of its forest land area.

Consistency of the land representation systems (i.e., identification and tracking of lands) is also enhance with the use of the same activity definitions along the time series and data sources. Some MS have also performed comparison and internal verification exercises of activity data with other national datasets, to ensure the consistency (e.g. Finland compared AR and D data generated from NFI with statistics from the forest authority).

11.1.8 Description of precedence conditions and/or hierarchy among elected Article. 3.4 activities, and how they have been consistently applied in determining how each land has been classified

According with good practice, MS that have elected voluntary activities under Art.3.4, (see Table 11.1) have established a hierarchy among activities, in some cases driven by the degree of intensity of the human intervention, which ensures that there is not double accounting of lands. In general, the highest hierarchy is assigned to CM followed by GM and RV. WDR is by definition at the lowest level.

All National systems of MS ensure that once a unit of land has been accounted for under any KP activity, it has consistently tracked and accounted for in subsequent years]. To this purpose, MS implement methods to avoid double counting (or omission) of lands under different activities (i.e. based on repeated field assessments and remote sensing products). In addition, also the implementation of a hierarchy among mandatory and elected activities ensure a consistent classification of lands.

The CRF table NIR-2 implicitly fulfills the obligation to demonstrate that emissions by sources and removals by sinks resulting from activities elected under Art. 3.4 are not accounted for under Art. 3.3 activities. As long as: (i) the total area reported in this table is constant over time and match official country area; and that, (ii) the total area for each activity “at the end of the current inventory year”, as reported for the year X-1, is the same to “total area at the end of the previous inventory year” reported for the year X.

11.2 Land-related information

11.2.1 Spatial assessment unit used for the determining the area of the units of land under Article 3.3

For each MS, the spatial assessment unit applied for identifying and tracking lands under Afforestation/Reforestation and Deforestation as well as for Forest management, is the threshold value of minimum area, and minimum width (if applicable), used by the MS to define forest.

11.2.2 Methodology used to develop the land transition matrix

Areas of KP-LULUCF activities have to be fully consistent with areas of correspondent land categories reported under the Convention. This is an issue subject to the QA/QC checks implemented by the EC JRC before the final version of the EU inventory is compiled.

The land transition matrix reported under the Convention and that one reported under KP allow to check the consistency of the reported areas for land categories and KP activities across the time series.

Annual areas for KP activities are estimated by MS either based on extrapolation or interpolation of available datasets at different times (e.g. remote sensing products) or based on annual estimates provided by specific land surveys (i.e. sampling grids, subsidies records, land registries/cadaster). Sometimes, MS combine several data sources involving also expert judgment (e.g. Italy's assumption that conversions to forest can only occur from grasslands).

A synthesis of the methodologies for land identification and tracking of lands used by MS is provided in Table 11.8. For more detailed information on data sources and methods applied the MS NIRs should be consulted.

Table 11.8 Methodologies for land identification and tracking of lands subject to KP-activities by the EU MS and Iceland

Member State	Methods			Land identification and tracking features for the "lands" or "units of lands"
	NFI	Mapping by Earth Observations methods	Land registry systems, including surveys	
Austria	X			Statistical methods
Belgium	X	X		Statistical methods
Bulgaria	X			maps and forest management plans
Croatia	X	X		Statistical methods
Cyprus	---	---	---	---
Czech Republic			X	Wall-to-wall mapping approach
Denmark	X	X		Statistical methods
Estonia	X			Statistical methods
Finland	X	X		Statistical methods
France			X	Statistical methods
Germany	X	X		Wall-to-wall mapping approach
Greece			X	Afforestation registry and Land Use Change Database
Hungary			X	Statistical methods
Ireland	X			Statistical methods, Land Parcel Information System and Central Statistics Office analysis of Utilised Agricultural Area (CL and GLM)
Italy	X		X	Statistical methods
Latvia	X			Statistical methods
Lithuania	X	X		Wall-to-wall mapping approach (ARD) and statistical methods (FM)
Luxemburg		X		Geoprocessing based on successive land use maps
Malta		X		Malta use mainly CLC product to assess areas subject to KP
Netherlands	X			Wall-to-wall approach
Poland	X		X	Statistical methods
Portugal	X	X		Wall-to-wall maps
Romania	X		X	Statistical methods
Slovakia			X	Statistical methods
Slovenia	X			Statistical methods
Spain		X	X	Wall-to-wall approach
Sweden	X			Statistical methods
United Kingdom			X	National planting statistics (AR) multiple sources (D), agricultural census data and countryside survey data (CM,GM), and research program (WDR)
Iceland	X	X		Statistical methods

11.2.3 Maps and/or databases to identify the geographical locations, and the system of identification codes for the geographical locations

The majority of MS reported a single geographical boundary at country level (Table 11.9), although in some cases, underlying data might provide information at higher spatial disaggregation. On the other hand some MS report two (e.g. Finland) or more geographical boundaries (e.g. Italy, and UK) that often correspond to administrative regions and that are summed up in CRF tables to provide a total national value.

MS rely on various methods and approaches to identify and track land under Art 3.3 and Art 3.4 of the Kyoto Protocol according to availability of data and resources (Table 11.8). Generally, the data source used for the identification of KP-LULUCF activities are the same, or in line with those, used under the Convention; nevertheless, because of specific requirements existing under the KP, in some instances, MS have implemented dedicated projects aimed to collect additional data that allow to comply with KP reporting requirements.

Reporting method 1 is based on the use of grid-based assessments, usually by Approach 3 or sometimes Approach 2 with supplementary information. Most of the national systems rely on NFI grids to identify and track lands under AR, D and FM, very often complemented by remote sensing datasets (especially to derive 1990), so most MS being reporting applying method 1 and approach 3 (being this approach the only one that allow tracking land across time) or approach 2 plus additional information to allow tracking land. National systems for approach 3 may rely on land parcel identification system (e.g. as used for subsidy payments or licensing), which allow recording and tracking individual parcels in time and space since the onset of the subsidized activity and for which the information is in some cases in digital format (e.g. in Ireland). Such systems are supported by adequate verification procedures at the country level as they are under public funding. Additional information when approach 2 is used is like license database, payment scheme database, forest management planning related databases, expert judgment.

Reporting method 2 is used in only few cases, when, each single area subject to a KP activity is identified and tracked, usually, based on a geographical information system with wall-to-wall datasets derived from remotely sensed data.

Table 11.9 Information on reporting methods and approaches used for reporting KP activities (based on the information available in NIRs)

Member State	Reporting Method used for identifying the geographical locations
Austria	1
Belgium	1
Bulgaria	1
Croatia	1
Cyprus	---
Czech Republic	1
Denmark	1
Estonia	1
Finland	1
France	1
Germany	2
Greece	1
Hungary	1
Ireland	2
Italy	1
Latvia	1
Lithuania	2
Luxemburg	1
Malta	1
Netherlands	2
Poland	1
Portugal	1
Romania	1 (FM,D)/2 (AR)
Slovakia	1
Slovenia	1
Spain	1
Sweden	1
United Kingdom	1
Iceland	1

11.3 Activity-specific information

11.3.1 Methods for carbon stock change and GHG emissions and CO_2 removal estimates

Methods used for the estimation of emissions and removals related to Art 3.3 and Art 3.4 activities are consistent with those used for reporting the corresponding land use categories under the Convention. In Chapter 6, methods and datasets used are described for each of the relevant land use categories, in addition, more detailed information on such methodologies can be found as an annex to this report (Annex III).

11.3.2 Description of the methodologies and the underlying assumptions used

Information used to estimate carbon stock changes under ARD & FM

The main data source for reporting carbon stock changes in ARD and FM activities are the national forest inventories. In few cases, annual net CO_2 emissions and removals are modeled based on non-NFI data (i.e. modeling based on yield tables and age-classes distribution from plantation plans and national statistics). Carbon stock changes from mineral soils associated with any conversion to and from forest lands are estimated by modeling or by using the IPCC default methodology together with country-specific reference carbon stocks values. When these activities occur in organic soils, the resulting GHG emissions are estimated using country-specific factors or in few cases with IPCC default factors.

The reporting of carbon stock change in litter, dead wood, and mineral soils C pools was improved considerably in the last years as proven by the reduced number of MS using notation keys for these carbon pools.

The range of the implied emission factors reported for AR (Table 11.10) is similar to the one reported in the Convention tables for land converted to forest land. Among MS, there are notable differences on the net biomass increment that are due to the type of species, climatic conditions and other specific characteristics (e.g. non-uniform rate of harvesting, different management practices). One additional reason for large differences is the use of either time averaged or actual annual growth data, depending on the methodology applied by the MS. More information is also provided in Table 11.17.

Table 11.10 IEF for net C stock changes (tC $ha^{-1}yr^{-1}$) by pool reported under AR activity by EU MS and Iceland (for the year 2014), based on KP CRF tables.

	AR					
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
Austria	0,96	0,26	0,89	0,02	0,53	NO
Belgium	1,75	0,35	NA,NO	NA,NO	1,42	NA,NO
Bulgaria	2,22	NO,IE	0,23	NO	-1,01	NO
Croatia	0,53	NA,IE	NA,IE	NA,NO	0,72	NA,NO
Cyprus	NE	NE	NE	NE	NE	NO
Czech Republic	1,73	0,35	0,50	0,01	0,12	NO
Denmark	0,26	0,05	0,15	0,00	0,09	-1,30
Estonia	1,35	0,57	0,30	0,00	-0,55	-0,48
Finland	1,11	0,38	IE	IE	0,09	-1,52
France	1,10	0,47	0,17	0,03	0,18	NO,IE
Germany	2,86	0,52	0,47	0,03	-0,27	-2,23
Greece	0,93	0,17	NE,NA	NE,NA	NE,NA	NA
Hungary	1,34	0,34	NE,NA	NE,NA	NE,NA	NA,NO
Ireland	1,73	0,71	0,78	0,27	NO,NA	-0,73
Italy	9,82	1,97	0,17	0,11	0,15	NA,NO
Latvia	0,31	0,07	0,08	0,10	NA,NO	2,60
Lithuania	1,24	0,28	1,10	NA,NO	-0,63	-2,23
Luxemburg	3,07	0,62	0,58	0,17	1,03	NO
Malta	NE	NE	NE	NE	NE	NO
Netherlands	NO	NO	NO	NO	NO	NO
Poland	0,82	0,22	NO	NO	0,06	-0,68
Portugal	1,74	0,24	-0,01	IE	0,26	NO
Romania	1,83	NO,IE	0,05	NO,IE	1,11	NO,IE
Slovakia	1,12	0,25	0,41	NA,NO	1,26	NA,NO
Slovenia	NA	NA	NA	NA	NA	NA
Spain	NA	IE,NA	NA	NA	0,54	NA,NO
Sweden	0,89	0,30	0,30	0,03	-0,15	-2,48
United Kingdom	1,41	NA,IE	0,09	NA,IE	1,00	2,28
Iceland	0,70	0,18	0,16	NO	0,40	-0,49

Notation keys for all tables below: IE – data is reported elsewhere i.e. included in other pools. NO – no net carbon stock change. NA- not applicable, NE-not estimated (the MS using NE, NA, NO justify these pools as being "not a source" or negligible; although the correct notation key would be NE with information, explaining that the pool is not a net source of CO_2 or negligible, reported in the documentation box).

Under Deforestation, there is a rather full reporting of carbon pools (Table 11.11). Both Germany and Denmark reported a sink in mineral soils associated with conversions of cropland to grassland, as estimated based on country-specific data.

Table 11.11 IEF for net C stock changes (tC ha-1yr-1) by pool reported under D activity in EU MS and Iceland (for the year 2014), based on KP CRF tables.

D						
Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	-0,69	-0,17	-0,54	0,00	-0,57	NO
Belgium	-1,12	-0,22	0,01	-0,11	-1,60	NA,NO
Bulgaria	-1,84	NO,IE	-0,19	-0,09	-3,29	NO
Croatia	0,42	NA,IE	NA,IE	NA,IE	-2,85	NA,NO
Cyprus	NE	NE	NE	NE	NE	NO
Czech Republic	-2,70	-0,54	-0,37	-0,07	-0,04	NA,NO
Denmark	-5,67	-1,24	-1,90	-0,17	0,10	-6,03
Estonia	-1,71	-0,40	-1,05	-0,06	-0,69	-0,80
Finland	-0,96	-0,29	IE	-0,01	-0,36	-5,01
France	-1,48	-0,35	-0,17	-0,05	-0,63	IE
Germany	-1,01	-0,12	-0,52	-0,06	0,15	-4,94
Greece	-0,08	-0,03	-0,03	0,00	-2,15	NA,NO
Hungary	-1,64	-0,41	-0,47	-0,14	-0,83	NO
Ireland	-0,64	-0,12	-0,08	-0,03	-0,37	-1,05
Italy	-43,41	-9,17	-2,71	-1,37	-6,39	NA,NO
Latvia	-2,88	-0,65	-0,70	-0,73	-0,75	-5,92
Lithuania	-12,89	-2,96	-4,97	-0,67	-14,97	-14,97
Luxemburg	-0,65	-0,16	-0,13	-0,04	-1,00	NA,NO
Malta	NO	NO	NO	NO	NO	NO
Netherlands	NO	NO	NO	NO	NO	NO
Poland	-1,91	-0,38	0,00	-0,01	-1,76	NO
Portugal	-0,29	-0,04	-0,03	IE	-1,13	NO
Romania	-3,85	NA,IE	-0,33	NA,IE	-1,61	NA,NO
Slovakia	-1,45	-0,33	-0,15	-0,09	-0,02	NA,NO
Slovenia	-3,05	-0,28	-0,34	-0,15	-1,56	NA
Spain	NA	NA,NO,IE	NA	NA	-0,34	NA,NO
Sweden	-0,77	-0,26	-1,13	0,00	-0,80	-1,35
United Kingdom	-1,59	NA,NO,IE	-0,25	NA,NO,IE	-1,59	NA,NO,IE
Iceland	NO,IE	NO,IE	NO	NO,IE	-0,61	NO

As expected, for Forest Management (Table 11.12), more carbon pools are reported with notation keys as compared to AR and D. Mineral soils, litter and dead wood C pools when reported are estimated to be a net sink under FM. Organic soils are always reported as a net source whenever drainage is carried out on such areas.

Concerning the reporting of carbon pools for agricultural activities (Table 11.13, Table 11.14), biomass is reported mainly as a net source of emissions under GM and as a net sink under CM. By contrary, mineral soils are mainly reported as a net sink under GM and as a net source under CM.

Table 11.12. IEF for net C stock changes (tC ha^{-1}yr-^{1}) by pool reported under FM activity in EU MS and Iceland (for the year 2014), based on MS CRF tables.

FM						
Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	0,26	0,03	IE	0,06	-0,18	NO
Belgium	0,79	0,03	0,00	-0,01	0,53	NA
Bulgaria	0,55	NO,IE	NO	NO	NO	NO
Croatia	0,74	NA,IE	NA,NO	NA,NO	NA,NO	NA,NO
Cyprus	NE	NE	NE	NE	NE	NO
Czech Republic	0,60	0,12	NO	NO	NO	NO
Denmark	1,18	0,26	0,39	0,13	NA,NO	-1,30
Estonia	-0,02	NA,IE	NE,NA	-0,01	0,61	-0,04
Finland	0,28	0,05	NA,NO,IE	NA,NO,IE	0,16	-0,30
France	0,59	0,21	0,00	-0,03	0,00	IE
Germany	0,90	0,13	-0,01	-0,05	0,41	-2,23
Greece	0,35	0,12	NE,NA,NO	NE,NA,NO	NE,NA,NO	NA,NO
Hungary	0,38	0,13	NA,NE	NA,NE	NA,NE	-2,60
Ireland	-0,78	0,51	0,47	0,09	NO,NA	-0,47
Italy	10,52	2,12	0,03	0,02	NE,NA,NO	NA,NO
Latvia	0,04	0,01	NA,NO	0,31	NA,NO	-2,60
Lithuania	0,92	0,22	0,04	0,08	NA,NO	-1,46
Luxemburg	0,92	0,20	NO	0,00	NO	NO
Malta	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Netherlands	NO	NO	NO	NO	NO	NO
Poland	0,71	0,19	NA,NO	NA,NO	0,11	-0,68
Portugal	0,44	0,18	0,00	NO,IE	-0,01	NO
Romania	0,98	NA,NO,IE	0,00	NA,NO	0,09	-0,68
Slovakia	0,48	0,10	NA,NO	NA,NO	NA,NO	NA,NO
Slovenia	1,25	0,29	NA,NO	0,00	NA,NO	NA,NO
Spain	NA,NO	IE,NA,NO	NA,NO	NA,NO	0,00	NA,NO
Sweden	0,27	0,09	-0,07	0,08	0,14	-0,38
United Kingdom	1,15	NA,NO,IE	0,24	NA,NO,IE	0,20	0,68
Iceland	0,18	0,05	0,01	NO,IE	0,01	-0,37

Table 11.13 IEF for net C stock changes (tC ha^{-1}yr^{-1}) by pool reported under CM activity in EU MS (for the year 2014), based on MS CRF tables.

CM						
Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Denmark	0.003	-0.025	NO	NO	-0.140	-7.314
Germany	0.005	-0.005	NO,IE	NO,IE	-0.053	-7.465
Ireland	0.003	IE	NO	NO	-0.002	NO
Italy					NO	NO
Portugal	0.013	-0.001	-0.003	IE	-0.041	
Spain	-0.014	IE	0.000	0.000	0.010	NO
United Kingdom	-0.004	NE,IE	NE	NE	-0.386	NE,NO

Table 11.14 IEF for net C stock changes (tC ha^{-1}yr^{-1}) by pool reported under GM activity in EU MS (for the year 2014), based on MS CRF tables.

GM						
Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Denmark	-0.317	-0.065	NO	NO	-0.012	-8.404
Germany	-0.009	0.003	NO,IE	NO,IE	0.087	-6.399
Ireland	0.000	NO,IE	NO	NO	0.009	-4.059
Italy					0.456	NO
Portugal	-0.017	-0.004	-0.006	IE	0.039	NO
United Kingdom	0.005	NE,IE	NE	NE	0.051	NE

Table 11.15 IEF for net C stock changes (tC $ha^{-1}yr^{-1}$) by pool reported under RV activity in EU MS and Iceland (for the year 2014), based on MS CRF tables.

RV						
Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Romania	2.960	IE	0.013	NO	0.237	NO
Iceland	0.000	IE	IE	NO	0.000	NA

Table 11.16 IEF for net C stock changes (tC $ha^{-1}yr^{-1}$) by pool reported under WDR activity in EU MS (for the year 2014), based on MS CRF tables.

WDR						
Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Net carbon stock change in organic soils per area Drained	Net carbon stock change in organic soils per area Rewetted
United Kingdom	NE	NE	NE	NE	NE	NE

Information used to estimate direct and indirect N_2O emissions from N fertilization (4(KP-II)1)

Only few MS report fertilization of mature forests (e.g. Sweden) or young plantations (e.g. UK). For the majority of MS, N fertilization of forests does not occur, or if any, N_2O emissions are expected to be extremely low and are in any case reported under the Agriculture sector. For instance, the last occurs in cases when a MS is not able to separate fertilizers applied to forest lands from those applied in agriculture (e.g. a unique national total value is available).

Information used to estimate CH_4 and N_2O emissions from drained and rewetted organic soils (4(KP-II)2)

Total area of drained organic soils on forest related activities for which emissions are reported is about 6,200 kha that are reported mainly by Finland and Germany. Emissions are estimated based on IPCC default factors or country-specific factors, but in any case, estimation methods are consistent with those used to report under Convention.

In general, most of the drainage area is associated with agricultural activities. Therefore, only MS that elected to account for CM or GM report estimates under this table of CH_4 emissions (i.e. associated CO_2 emissions are reported in the background activity table together with C stock changes in other C pools and N_2O emissions are reported under agriculture).

N_2O emissions from N mineralization/immobilization due to carbon loss/gain associated with land-use conversions and management change in mineral soils (4(KP-II)3)

N_2O emissions, from N mineralization, are expected to be reported for those MS for which a loss of soil carbon stock is reported under the KP activities. These emissions are mainly reported for Deforestation.

In some instances, acknowledging the need to report this source of emissions, some MS have used the notation key NE in the CRF table 4(KP-II)3), along with an explanation provided in the NIR on the efforts that are ongoing to report this source of emissions in the next years.

Information used to estimate GHG emissions from biomass burning (4(KP-II)4)

Estimation methods are consistent with those used to report biomass burning under the Convention. In general, monitoring systems on burned areas are not able to discriminate whether the fire occurred on AR lands or on lands subject to FM so that burnt areas are apportioned on the basis of their share on total forest areas.

In Europe usually burned areas are protected by law, so that there is not the possibility of land use change after a fire event. Accordingly, just in few cases GHG emissions from biomass burning are reported under Deforestation. Besides that, emissions from biomass burning under this activity relate to “controlled burning” as a practice of management of forest residues.

A small share of total emissions from biomass burning under non forest-related activities is also reported in the CRF table 4(KP-II)4.

11.3.3 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected and mandatory activities under Article 3.4

A decision tree guiding the use of the “not a source” provision was elaborated by JRC and MS were encouraged to follow it (http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/) whenever such provision was applied.

Accordingly, during the EU QA/QC process, MS have been recommended to use the notation key “NR” in NIR-1 CRF table for pools reported under the “not a source” provision and to use the notation key NE in the background tables. Further, it was requested to provide information on the reasons for omitted carbon pools in the CRF documentation box and in the NIR.

Table 11.17 summarized demonstrations provided by the MS when a carbon pool is omitted.

Table 11.17 Overview of information provided by MS and Iceland to demonstrate that omitted carbon pools are not a net source of emissions.

Member State	Activity	Pool	Reasoning
Belgium	AR	DW, LT	Regarding deadwood and litter, Belgium opted for a conservative approach , considering no change in carbon stock is considered in these pools in the case of afforestation/reforestation
Bulgaria	AR	DW	Deadwood is assumed not to occur on AR areas.
Croatia	AR, FM	DW	It is assume that the carbon stock on DW can only increases after AR and in remaining FL.
Czech Republic	FM	DW	The assumption that the deadwood carbon pool does not represent a source of emissions is based on both reasoning, sound knowledge of probable system responses and empirical data.
Denmark	CM, GM	DW, LT, SOC	No litter and dead organic matter are reported under CM as this is seen as not occurring or as very insignificant as it is only related to the small area with fruit plantations and hedges. In Grassland it is assumed that no changes in soil carbon stock in mineral soils are occurring.
Germany	CM, GM		Dead wood and litter do not occur in connection with cropland management and grassland management
Greece	AR, D	SOC, DW, LT	Based on several studies SOC and DOM increase in AR. For FM, selcicultural practices promotes the carbon accumulation in both those carbon pools, which is even more justified by the fact that the living biomass pool in forest under management acts as a net sink. Consequently, the dead organic matter pool and mineral soils in soil organic matter pools in Greece cannot be a net source of carbon. Quantitaive demostration is also provided in the NIR
Hungary	FM, AR	SOC, DW, LT	To demonstrate that soils are not a source, a conservative approach is taken based on the IPCC 2006GL methodology using country-specific and other data. The demonstration for DW and LT is based on expert judgment which is a practicable method in our situation
Ireland	AR, FM, CM, GM	SOC, DW, LT	Information supporting this assumption are based on the new SOC database from the For CRep project and also from published literature. Based on the decision tree in Section 2.9.4.1 of the 2013 KP Supplement to the 2006 IPCC Guidelines, and Section 5.2.2.4, Vol 4 of the 2006 Guidelines, changes in Litter and Dead Matter carbon pools are assumed to be stable.
Italy	FM, CM, GM	SOC, DW, LT	Italy has decided not to account for the soil carbon stock changes from activities under Article 3.4, providing transparent and verifiable information to demonstrate that soils pool is not a source in Italy
Latvia	AR, FM	SOC	The soil monitoring study initiated in 2012 by the Joint stock company "Latvia state forests" and Ministry of Agriculture demonstrates no statistically significant difference in carbon stock in mineral soil in grassland, forest land remaining forest in fertile stand types and in afforested lands, i.e. no changes appear in soil organic matter (SOM) due to afforestation. The results are based on 95 plots in forest, 34 plots in afforested lands and 40 plots in grassland; for each plot 4 repetitions have been taken.
Lithuania	AR	DW	Based on NFI 1998-2011 data changes of dead wood are not significant in the afforested and reforested lands. For estimation of carbon stock change of dead wood it was assumed to be zero and reported as 'NO'.
Netherlands	AR	DW, LT	Justification based on NFI data that shows that the conversion of non-forest to forest always involves a build-up of carbon.
Poland	AR	DW, LT	When an area is afforested, first it is cleared of all above-ground biomass in case there was any, however, no DW and LI are usually present on these lands prior to afforestation. After afforestation, dead woody debris, litter as well as dead trees start to accumulate.
Romania	AR,RV, FM	DW, SOC, LT	DW eported as not occurring or it is considered as a very small sink in AR and RV since initial mass is null, then it could only increase in time, or in any case it cannot decrease. Under FM, Quantitative and qualitative arguments are involved to demonstrate that SOC, DW and LT are not sources of emissions over CP
Slovenia	FM	LT, SOC	Results of our preliminary expertise for period 1996 – 2006 (Kobal M., Simoncic P., 2011), show relative stable carbon stocks in litter in forest land remaining forest land. Estimates under FM for carbon stock changes in litter and soils were therefore not reported.
Spain	CM	DW	The carbon stock in this pool increased since the base year therefore it would result in a sink, however the quantity of this sink is not yet estimated.
United Kingdom	CM, GM, WDR	LB, DOM, SOC	The UK has elected three additional Article 3.4 activities: Cropland Management, Grazing Land Management and Wetland Drainage and Rewetting. We are not yet in a position to report emissions and removals from all of these activities and the relevant tables are filled in with the notation key NE. The UK is putting in place a research and methodological development programme for these activities to enable full reporting by the end of the commitment period.
Iceland	AR, FM	HWP	Harvest Wood Products are not estimated in this year submission. Data on domestic wood utilization and production of wood products from domestic wood are not official data and the official statistical agency in Iceland (Statistics Iceland (http://www.statice.is/)) has fragmented, unverified and incomplete reporting of these data

For a consistent demonstration of 'not a source', MS have been encouraged to avoid simple assumption of "equilibrium" following IPCC Tier 1 methods, but to demonstrate, based on qualitative information, reasoning and, to the extent possible, quantitative estimates from any available documentation (i.e. scientific papers, reports, etc.) that the pool does not result in a net source of emissions. Since 2010, EU has performed annual assessments of the implementation of the 'not a source' provision and has provided support for improving and harmonizing the information provided by MS to justify any omission of carbon pools.

11.3.4 Information on whether or not indirect and natural CO_2 removals have been factored out

MS have not factored out from the reported estimates indirect and natural CO_2 removals. In most cases, they argued the lack of methods to do so, or that due to the reporting period the magnitude of these removals is insignificant.

In general, it is recognized that the issue of factor out removals from elevated carbon dioxide concentrations above pre-industrial levels, indirect nitrogen deposition, and the dynamic effects of age structure resulting from KP activities prior to 1 January 1990 is addressed in the accounting of Art. 3.4., as the effects of such process on the emissions and removals occurring during the commitment period are compared which benchmarks that already include that effects.

11.3.5 Changes in data and methods since the previous submission (recalculations)

Not applicable

11.3.6 Improvement status and plan

Not applicable

11.3.7 Uncertainty estimates

For information on uncertainties please refer to chapter 1.6

11.3.8 Information on other methodological issues

During the EU QA/QC process a large number of checks are implemented every year to ensure accuracy, transparency, completeness and consistency of KP information. For instance, the consistency among the information submitted under the KP and the Convention is assessed. Also other checks are implemented to ensure that estimates are prepared by applying methodologies that are consistent with IPCC methods, and adequate to the significance of the category or carbon pool to be estimated.

11.3.9 The year of the onset of an activity, if after 2013

This information is implicitly achieved by each individual MS, and consequently by the EU inventory, through the provision of the estimates in the NIR-2 CRF table. The onset of any activity on any land is reported according to the year when the land is reported as subject to the activity for the first time.

11.4 Article 3.3

11.4.1 Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December of the last year of the commitment period, and are direct human-induced

Land representation methods implemented at national level are able to determine the onset for any KP activity along time series, and starting from 1990 onwards.

For example, planting year is mentioned as the information used to assess the onset of AR activity (e.g. DK, UK, GR, IE), or the year when the encroaching woody vegetation meets the definition of forest, as detected by NFI or remote sensing, in case of natural assisted afforestation (i.e. in the latter case techniques for interpolation/extrapolation are applied since those datasets are usually not annual).

For D, information come from direct field assessment (when national statistics are based on license for clear-felling and change in use) or datasets on land cover and land use compiled by sampling or wall-to-wall techniques with ground data and, or remotely sensed data (techniques for interpolation/extrapolation are applied to those datasets since they are usually not annual).

According to the IPCC, it is good practice to provide documentation that all land reported under afforestation and reforestation are subject to direct human-induced activities. Relevant documentation often includes forest management records or other documentation that demonstrates that a decision had been taken to replant or to allow forest regeneration by other means. Table 11.18 shows a synthesis of current information reported by EU MS on the direct-human induced origin of AR lands.

Table 11.18 Summary of current information reported by EU MS aimed at demonstrating that Afforestation/Reforestation activities are direct human-induced

MS	Type of information/justification provided				
	Areas converted, either subject to subsidies or not, have been reported in registries either for authorization or compilation of land use changes	Whole national territory covered by legal instruments for Land planning and/or management, therefore any change in land use is directly human-induced	Where a conversion results in a land use subject to management practice, the conversion is considered directly human-induced	As all land area is under management (i.e. subject to some kind of human interactions), all changes are considered as directly human-induced	A decision to change the use of a land or a decision not to continue the previous management practices has been made, which allow for conversion
Austria		x			
Belgium				x	
Bulgaria		x		x	
Croatia	x	x			
Cyprus	--	--	--	--	--
Czech Republic	x	x			
Denmark				x	
Estonia				x	x
Finland	x			x	x
France			x		
Germany		x			
Greece	x				
Hungary	x				
Ireland	x	x		x	
Italy			x		
Latvia	x				
Lithuania		x			
Luxemburg			x	x	
Malta	--	--	--	--	--
Netherlands					x
Poland	x				
Portugal				x	
Romania	x				
Slovakia	x				
Slovenia		x		x	
Spain	x				
Sweden			x	x	
United Kingdom	x			x	
Iceland			x		

In general, a rather “broad” interpretation of “direct human-induced” AR is applied so that around 90% of the total area reported by EU under conversion to forest land is assumed as directly human-induced AR. For instance, UK does not report under AR the areas of planting that are not state-owned or grant-aided (i.e. whether these woodlands are explicitly managed is unknown). If not included under AR, MS natural forest expansion has been reported by MS under FM.

Some MS differentiate also among direct human-induced and indirect or natural deforestation. In such case, areas naturally converted from forest to other land uses are kept under the FM reporting.

11.4.2 Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Although the loss of forest cover is often readily identified by the land monitoring system, the classification of an area as deforested is more challenging. MS provided information on the criteria by which temporary removal or loss of tree cover can be distinguished from deforestation and how these criteria are consistently applied, see Table 11.19.

The simple combination of NFI data with remote sensing data may not be fully adequate to assess the areas which can be classified as deforested, and thus these data are often complemented by other type of information (i.e. a deforested area typically requires a specific permit or specific visible changes on the use of land). For instance, in the absence of detailed information on the future use of the land, some MS defined an expected time period (in years) within which the removal of tree cover has to be followed by natural regeneration or planting, once such time period is passed and trees are not yet growing again on the land, the land is considered deforested.

By other hand, most of the MS reported that there are legal obligations to restore the forest on harvested areas, or on areas burnt, so that such kind of forest cover loss are never identified as deforestation.

Table 11.19 Information on differentiation between temporary forest cover loss and deforestation provided by MS and Iceland in their national NIR.

Member State	Short description
Austria	In Austria temporarily unstocked areas (e.g. harvested area, disturbances) remain forests and are not accounted as deforestation. NFI teams are trained to distinguish between the results of forest management operations and Land Use Changes.
Belgium	It is assumed that forest has been planted and can be recognized on all areas that have been harvested or have been subject to other human disturbance but for which it was expected that a forest would be replanted. In this view no plantation is expected on areas identified as deforested. About one third of the deforested areas were replaced by settlements, for which no re-establishment of forest will occur. Each point identified by the geoprocessing tool as being subject to LUC is verified through photo-interpretation to confirm the interpretation.
Bulgaria	Deforestation areas that followed all administrative steps needed to get the permission for deforestation. Only such areas are accounted as D areas in Bulgaria.
Croatia	The main criteria for distinguishing the harvesting or forest disturbance followed by the re-establishment of forest from deforestation is whether or not the land use has changed, which is strictly regulated by
Cyprus	---
Czech Republic	The main criteria for distinguishing the harvesting or forest disturbance followed by the re-establishment of forest from deforestation is whether or not the land use has changed, which is strictly regulated by the legal framework.
Denmark	Deforestation is detected by analysis of satellite images. Furthermore deforestation of larger areas is confirmed by e.g. projects on nature restoration. Temporarily unstocked areas are typically located within larger forest areas and will in most cases be reforestated within a period of 10 years as accord-ing to the Forest Act of Denmark, which applies to all Legal Forest Reserves (Fredsskov) and equals approximately 70 % of the total forest area. Clear-cuts outside forests - e.g. small plantations of conifers on former cropland - is considered deforestation.
Estonia	According to Estonian legislation, the land category change by humans is allowed only with orders from local authorities and/or the Minister of the Environment. This must be preceded by the reassignment of the land (e.g. commercial, residential or transport land), which is reflected both in the Land Cadastre and Land Registry. When a NFI sample plot is located in a clear-cut area, the surveyor assesses whether the cutting has been done for regeneration purpose or for land-use change. Clear signs of a land-use change can be seen in the surrounding and location of the area; also the data from Land Cadastre and Land Registry is checked. According to the Forest Act, the forest owner is obliged to implement reforestation techniques to the extent that within five years after logging or forest death a renewed forest is ensured. Re-establishment of a forest usually starts within 2 years after harvesting.
Finland	When a clear-cut area is located in a NFI sample plot, the surveyor assesses whether the cutting has been done for regeneration purpose or for land-use change. The distinction between these two cases can generally be made on a reliable basis. The distinction between these two cases can generally be made on a reliable basis. Clear signs of a land-use change can be seen in the surroundings and location of the area: construction projects, stacked cutting residuals or if the area is under a regional or town plan. The re-establishment of a forest usually starts within two years after the harvesting. The Forest Act lays down provisions that a new forest must be established within three years after the regeneration cutting. In the case the land-use change occurs after a clear-cut, this can be taken into account by classifying the sample plot as non-forest.
France	The method used to monitoring lands, works over two features, land use and land cover, therefore it is able to differentiate forest cover loss from deforestation.
Germany	Länder laws are to be enacted that set forth obligations for all forest owners whereby clear-cut or degraded forest areas are to be reforested, or replenished, in cases in which natural regrowth remains incomplete, within a reasonable period of time, unless conversion to another type of use has been approved or is otherwise permitted. In general, reforestation is called for on all forest areas that are to remain in use as forest land. That is a legal requirement, and it is the customary practice in the German forestry sector. Forest land that is temporarily unstocked thus continues to fall within the scope of required reporting on forest management pursuant to Art. 3.4 KP. The situation is different in cases in which forest land becomes unstocked and planning calls for subsequent use of the land to fall within the category "non-forest land". Such land is to be considered deforested land, with the relevant deforestation directly human-induced, regardless of whether the deforestation was caused by harvesting or by natural disturbances.
Greece	According to the national legislative framework the forest land use after any disturbance cannot be changed. More specifically in the cases of wildfire events, the areas affected, are instantly declared to be reforested by the responsible authority which is the Forest Service, with this decision being published in the Official Government Gazette. Harvesting, either in public or private forests, is regulated through national laws (Presidential Degree No 126/1986) and regulations, according to which, specific, and discrete procedures have to be followed only after the authorization of the Forest Service.
Hungary	In Hungary, all forests must be regenerated after clearing mature stands by law. All AR and D areas, as well as those under regeneration are identified by categorizing forest compartments. These compartments have been surveyed since 1 Jan 2008 for all information that is relevant for assigning them to the respective Kyoto forest categories (AR or D and, in case of regenerations, FM), as well as their location within each geographical area. It is also possible to identify each compartment in both the underlying database of this report (which is part of the documentation) and on the forest management maps since 2008.
Ireland	NFI identifies if the lands are unstocked or deforested (5 years periodicity)
Italy	Extensive forest disturbances have been rare in Italy, except for wildfires. Land-use changes after damage do not occur; concerning wildfires, national legislation doesn't allow any land use change after a fire event for 15 years. Harvesting is regulated through regional rules, which establish procedures to follow in case of harvesting. Although different rules exist at regional level, a common denominator is the requirement of an explicit written communication with the localization and the extent of area to be harvested, existing forest typologies and forestry treatment. Deforestation is allowed only in very limited circumstances (i.e. in construction of railways the last years) and has to follow several administrative steps before being legally permitted. In addition, clear-cutting is a not allowed practice.
Latvia	In Latvia temporarily unstocked areas (e.g. harvested area) remain forests and are not accounted as deforestation if no other activities prohibiting forest regeneration are implemented. The NFI teams are trained to distinguish between forest management and land use changes.
Lithuania	According to Lithuanian Forest Law the clear cut areas should be reforested during 3 years and are under strict control of forest management and State inspection. Temporarily unstocked areas after harvesting remain forests and are not accounted as deforestation. Every deforestation case must be reported to LSFC and is very rare. Any deforested area must follow the afforestation of three time larger area than the one was deforested.
Luxemburg	Art 13 of the National Nature Conservation Act states that 3 years after a clear cut on forestland, the owner is pledged to reconstruct the forestland. This means that areas of forestland, where a clear-cut has occurred, has to be considered as forestland, as no other use of forestland after a clear-cut is permitted. In addition, after a period of three years, the owner is forced to take measures to restore forestland, if it hasn't occurred already. So no deforestation can occur by law, except if permitted by a ministerial act. If this is the case, this is documented by the Ministry.
Malta	---
Netherlands	Following the Forest definition and the mapping practice applied in the Netherlands, areas subject to harvesting or forest disturbance are still classified as Forest and as such will not result in a change in land use in the overlay of the land-use maps (Kramer et al., 2009; Arets et al., 2016).
Poland	Since no remote sensing technology is directly involved in the KP LULUCF emission inventory, there is no issue related to distinguishing harvesting or forest disturbance from deforestation. Harvesting and forest disturbance always occur on forest land, while deforestation is a cadastral change of land use from forest land to other land use categories
Portugal	Some losses of forest cover are obvious deforestation events and are classified as deforestation as soon as they are detected (e.g. convertions to settlements, flooding by a recently constructed water reservoir, convertion to irrigated farmland). In other situations the land use following forest cover loss is less obvious. In those situations, and consistent with the KP forest definition, land is considered as "temporarily unstocked" for a period of up to 5 years. After such period the land should be confirmed as forest land (i.e., no deforestation has occurred) or non-forest land. In the later case the land is considered deforested and the time series for area of FM is recalculated since the year when the event was first detected.
Romania	The forest disturbance alone cannot trigger land conversions from forestland. Thus distinction between harvested and disturbance affected areas, on the one hand, and deforestation, on the other, is made as follows: for the former, there is legal obligation for the forest owner/administrator to maintain the land under forests category and forestry regime (including tree harvest based on permit), to apply the forest management plans specifications and regenerate it within a given timeframe (maximum 2 years); for the latter, following legal procedure with the issuance of the approval, a new land use category is assigned to that land, and the forestry regime is no longer applicable.
Slovakia	The temporarily (no more than 2 years) unstocked areas (e.g. harvested area, disturbances) are still considered as forest area and are not accounted as deforestation. According to the cadastral law deforestation means that the category of forest land was definitely and permanently changed to another land use category.
Slovenia	Extensive forest disturbances have been rare in Slovenia. If a large forest area is mainly or tottaly damaged, the legislation on prevention of insect and fungus disturbances binds owners to remove the rest of the damaged trees. After that, the reastablishment work should be started immediatelly if possible. That areas remain registrated as forest land in forestry spatial information system database.
Spain	After a disturbance, the land does not change its use. By other hand all deforested land are assessed on the basis of cartography where unless a change of the land use is detected, the land would continue to be considered as forest land.
Sweden	Final felling is a natural step in the rotation cycle of forestry. Also storms may result in large areas of felled trees (wind-throws). If final felling or disturbances as storms have been identified between two consecutive inventories this is not enough to classify the plot as D. However, if for instance a new road, a power line or other land use preceding the definition of forest is located on the former Forest land, then the plot is considered D. The emission from "loss of biomass" is matched to the conversion year. If final felling has occurred on a plot between two consecutive inventories with no sign of D, but D is confirmed at the next re-inventory, then the year of D is "re-calculated" to match the "loss of biomass" to the conversion year.
UK	The data sources used for estimating Deforestation do not confuse between harvesting or forest disturbance and deforestation. This is because the unconditional felling licences used for the estimation of rural deforestation are only given when no restocking will occur, and the survey of land converted to developed use describes the conversion of forest land to the settlement category, which precludes re-establishment. The Countryside Survey data (used for gap filling) are adjusted in order that deforestation is not over-estimated. New data sources (post-2000) have been used that clearly identify the post-deforestation land use.
Iceland	Deforestation is estimated by special inventory where the change in the area of forest where deforestation has been reported is estimated by GPS delineation of a new border between forest and the new land use which is dominantly settlements (new power lines, roads or buildings). Major forest disturbances will be detected in the NFI but local forest disturbances (wildfires etc) will be handled with special inventory as done for deforestation

11.4.3 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

Methodology adopted by each MS ensures consistent reporting in time and space of KP lands declared as temporary un-stocked areas. Such post-disturbance areas correspond to all areas reported as harvested under clear-felling and all those areas where natural disturbances caused a complete loss of forest cover, e.g. windfall, destructive fires, and that are kept under AR or FM reporting. In general, the distinction between deforested areas and temporarily un-stocked areas is achieved by national methodologies, which implement multiple assessment criteria and hierarchical phases (including precise guidelines for field checks or plot data processing). Supplementary arguments for correct classification of the land status are given by law requirements and enforcement. More information is available in MS and Iceland NIRs.

11.4.4 Information related to the natural disturbances provision under article 3.3

In accordance with decision 2/CMP.7; 15 MS and Iceland have stated their intention of excluding emissions resulting from natural disturbances under AR during CP2 (Table 11.20)

In general, MS argued that areas affected by natural disturbance are always understood as “beyond the control” since those areas are direct human-induced and subject to management plans that implement prevention measurements to avoid the damages. In addition, MS also argue that according to current laws it is not allowed to change the use of a disturbed land, but just to implement measures to rehabilitate that forest areas.

The types of disturbance for which MS intends to exclude emissions from the accounting of AR activities vary among the MS. In general, wildfires seem to be the most important natural disturbance that is expected to affect AR areas. By contrast, several MS intend to exclude emissions only from areas affected by windstorms while some others considered all disturbance types as a safeguard measure for the future, i.e. in case some of these events will occur.

Overall, MS have developed a consistent time series of emissions from natural disturbances that cover different lengths depending on data availability. Annual emissions included in the time series were based on country-specific activity data, collected by national authorities, and emissions that are calculated in line with the methods used for reporting these emissions under the Convention for the forest land category.

Regarding the development of the background level and the margin, the vast majority of MS have used the default method as described in the 2013 KP Supplement. In the case of Luxembourg the background level has been set as zero due to the low incidence of natural disturbances that emerged from the analysis of the time series.

MS have also demonstrated to avoid the expectation of net credits by implementing the default method (i.e. ensuring that annual emissions in the background group used to calculate the background level are always lower or equal to the background level plus the margin). In some instance, MS have also stated that:

- No trend was observed in natural disturbance emissions during the calibration period or is expected during the commitment period.
- The background level of emissions for FM included in the FMRL after technical correction is equal to the average of annual emissions from natural disturbances during the calibration period which are in the background group.

Besides that, in line with requirements for the exclusion of emissions from natural disturbances, some MS have argued that salvage logging does not occur in lands subjected to forest fires as all biomass and DOM is immediately oxidised when affected by wildfires. By contrary, some other MS wishing to exclude emissions from windstorms usually applied a percentage of wood that is not subject to salvage logging (e.g. Netherlands and Romania) and for which emissions can be excluded.

Table 11.20 Synthesis of Information from MS and Iceland that intends to apply the natural disturbance provision under AR activities during CP2, as reported in NIR

Member States	Approach for the development of the BL and the Margin	BL+Margin	Type of disturbance
Belgium	---	---	---
Bulgaria	Default method	0.50 kt CO2 eq.	wildfires, extreme weather events – windstorms, wet snowfall, ice, others
Cyprus	---	---	---
France	---	---	---
Greece	Default method	1.58 kt CO2 eq.	Wildfires
Ireland	Default method	0.25 kt CO2	Wildfires
Italy	Default method	1.22 kt CO2 eq.	
Luxembourg	Minimum level of historical time series (zero)	(zero)	Extreme weather events
Malta	---	---	---
Netherlands	Default method	0.012 kt CO2 eq.	Wildfires
Portugal	---	---	---
Romania	Default method	0.64 kt CO2 eq.	Wildfires
Spain	Default method	0,034 t CO2 eq./ha	All considered in the 2013 KP supplement
Sweden	---	---	---
United Kingdom	Default method	54 kt CO2 eq.	Wildfires, insect attacks and disease infestations, windstorms and geological disturbances
Iceland	---	---	---

So far, emissions from natural disturbances have not been excluded from the accounting of AR activities. Some MS have stated that although their emissions from natural disturbances, in some of the reporting years, have exceeded the calculated background level plus the margin, the method used to track the disturbance events does not allow to geo-referent the areas affected as required under the decision 2/CMP.8., (e.g. Ireland). By contrary, some other MS informed that irrespective to their intention to implement the natural disturbances provision, it seems unlike that emissions will be excluded pursuant this provision due to the low incidence of disturbances or because most emissions are associated to salvage logging after disturbance (e.g. Luxembourg).

11.4.5 Information on Harvested Wood Products under article 3.3

Methodologies to estimates carbon stock changes from HWP originated from AR lands are in line with methods used for reporting this carbon pool under the LULUCF sector. MS used the "Production approach" to estimates net emissions and removals from this carbon pool. The methodology corresponds to the Tier 2 method, where first-order decay functions with default half-life values are used, along with activity data that are often collected from international data sources (i.e. FAO, UNECE, etc.). More details can be found in section 6.2.6 of this document.

Nevertheless, most of the MS have informed that it is not possible to separate HWP originated from AR lands from those originated from FM lands and that therefore, following a conservative approach, all the emissions and removals from this pool have been assigned to FM lands. Some MS have also assumed that HWP are not originated from AR lands as the age of the trees does not allow harvesting practices (e.g. Croatia). Finally, when HWP carbon stock changes are reported separated between AR and FM, the default IPCC method (equation 2.8.3 of the 2013 KP Supplement) has been used.

Concerning HWP originated from deforestation events, these have been mainly reported on the basis of instantaneous oxidation, although the quantities have been often reported in table 4(KP-I)C for information purposes. In some instances, the share of HWP originating from D within the total budget of the country is estimated on an area-based share of lands under D and FM for individual reporting years (e.g. Czech Republic). Besides this, some MS report, and account, for emissions and removals from HWP originated from reforested trees on lands subject to deforestation (e.g. Finland). By other hand, some MS justified that, by law, HWP cannot be linked to Deforestation (e.g. Greece).

Instantaneous oxidation approach has been used to estimate carbon stock changes from wood products in solid waste disposal sites and harvested wood used for energy purposes as stated in individual NIR.

11.5 Article 3.4

11.5.1 Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

Land representation methods that are implemented at national level are able to determine the onset of the activities along the time series.

Because FM, CM, GM and WDR, and Revegetation as understood by Romania and Iceland, are management activities they always qualify as direct human-induced. In most of the cases, MS implement the broad approach, described in the 2013 IPCC KP Supplement, to define FM.

11.5.2 Information relating to Forest Management

Forest management is understood as the set of forest practices and operations, which occur at the stand-level: harvesting, natural and human-induced regeneration, site and soil preparation (including drainage, burning of slash), seeding, thinning, pruning, fertilization and liming, conservation of important habitats, and fire prevention.

Sustainable forestry has a long tradition in Europe, indeed, there are management plans dating from hundreds years ago. Currently, each MS has in force its own legislation on forest lands, as well as other laws supporting in general the sustainable management and protection of forests. At the EU level, forestry is not regulated directly by specific laws, but there are strong requirements for sustainable management of forests via European regulations on environmental obligations (on nature protection, biodiversity protection etc.), sustainable rural development, and renewable energy policies. Some MS report forest certification as an additional tool to highlight the sustainability of the whole chain of forestry and their products.

Data reported under different international processes (e.g. FAO, MCFPE, CBD) may be different due to different reference time and definitions underlying each of the reporting obligations. Thus, any comparisons have to be done cautiously.

11.5.2.1 Conversion of natural forest to planted forest

The vast majority of MS has reported that these conversions do not take place in their territories. The main reasons are, either that these forests do not exist (i.e. as all the forests are under more or less intensive management plans), or because of all the natural forests are under strict conservation and protection regimes (e.g. Czech Republic) that prevent such conversions.

In 2014, only Cyprus (0.9 Kha), Latvia (242.1 Kha) and Romania (1,538.2 Kha) have provided estimates of such areas in the CRF table NIR2.1, and when this was the case, corresponding estimates of emissions/removals were included under the FM activity. However, some of these numbers seem unrealistic, and they could be associated with a misinterpretation of the information that should be provided in that table.

11.5.2.2 Forest Management Reference Level (FMRL)

For the construction of the FMRL, EU MS and Iceland implemented different approaches, although all of them were based on projections under a “business-as-usual” scenario (Table 11.21). This section provides a synthesis of information on values and approaches used for the construction of FMRL for EU MS and Iceland. For more detailed information, it is suggested refer to the individual submissions of information on FMRL, as submitted by the EU, EU MS, and Iceland; or to the individual NIR.

As regards with approaches used in the construction of the FMRL; 11 MS and Iceland prepared model-based projections using country-specific methodologies. In these cases, national forest inventory data, remote sensing information, and other available national statistics were the main data sources used. 14 MS prepared model-based projections using a common approach developed by JRC in collaboration with International Institute for Applied System Analysis (IIASA) and European Forest Institute (EFI). To this purpose G4M and EFISCEN model were implemented on the basis of information on wood production and prices of the land and timber, derived from GLOBIOM model. Finally, three MS used historical data projections based on the elaboration of historical data, assumed as proxy for a “business-as-usual” scenario. Specifically, Greece used the historical average of net removals from forests for the period 1990-2009, while Cyprus and Malta based their FMRL on the linear extrapolation of historical net emissions from forest for the period 1990-2008.

Overall, in line with requirements of the Decision 2/CMP.7, all MS have assessed the consistency between the FMRL and the reporting of FM activity in terms of methodological elements (e.g. pools and gases included, area considered, natural disturbances, etc.), as a result, 15 MS implemented technical corrections to the FMRL value (Table 11.21Table 11.21) in order to ensure such consistency.

Besides that, and noting the selection of accounting frequency for KP activities at end of CP2, some MS have informed that regardless of some inconsistencies that were found among the methodological elements, this year it was not possible to develop a technical correction, due to constrains on time and resources, but that a TC is expected to be implemented in the coming years (e.g. the Netherlands, Spain).

Table 11.21 Synthesis of information related to the construction of the FMRL values as reported by EU MS and Iceland in 2016 submissions.

Member State	Value inscribed in the Appendix to the annex to decision 2/CMP.7 (kt CO2 eq/yr)	Technical correction	FMRL based on projections under a "Business-as-usual" scenario		
			Model-based projections using country-specific methodology	Model-based projections using JRC approach	Projections based on historical data assumed as proxy for a "business-as-usual"
Austria	-6516,00	5823,00	X		
Belgium	-2499,00	NE		X	
Bulgaria	-8169,00	-8207,00		X	
Croatia	-6289,00	904,83	X		
Cyprus	-157,00	NA			X
Czech Republic	-4686,00	NA		X	
Denmark	409,00	-82,62	X		
Estonia	-2741,00	NE		X	
Finland	-20466,00	-10975,00	X		
France	-67410,00	NE		X	
Germany	-22410,00	NE	X		
Greece	-1830,00	168,47			X
Hungary	-1000,00	-40,00		X	
Ireland	-142,07	-354,71	X		
Italy	22166,00	NE		X	
Latvia	-16302,00	9922,00		X	
Lithuania	-4552,00	-992,00		X	
Luxemburg	-418,00	NA		X	
Malta	-49,00	-1,81			X
Netherlands	-1425,00	NE		X	
Poland	-27133,00	NA	X		
Portugal	-6826,92	3433,80	X		
Romania	-15444,00	-3665,25		X	
Slovakia	358,00	NA		X	
Slovenia	-3171,00	NE	X		
Spain	-23100,00	NO		X	
Sweden	-41336,10	7268,39	X		
UK	-8268,00	-5658,00	X		
Iceland	154,00	NE	X		

**According with Bulgaria's NIR, the TC reported by Bulgaria is likely the value of the FMRL corrected and not the TC.*

11.5.2.3 Technical Corrections of FMRL

15 MS have implemented TC to address inconsistencies among the FMRL value and the reporting of emissions and removals from FM activity during CP2 (Table 11.21). Reasons for these inconsistencies vary among MS (Table 11.22), but overall, they relate to the inclusion of emissions and removals from previously unaccounted carbon pools, the use of the new methodological guidance, especially on HWP and BL of natural disturbances, and the

availability of updated data for FM reporting as compared with the data used for the construction of the FMRL.

Likely all MS are expected to implement a TC correction, as a minimum, at the time of the accounting (i.e. annual or end of the CP) because the abovementioned issues.

Table 11.22 Information on inconsistencies among the FMRL and the reporting of FM activity that have triggered the need of TC.

Member State	Information on the need for TC
Austria	Improvements and updates in the forest land remaining forest land category have impacts on accounting for Forest Management in the second commitment period which require the following adjustments: 1) Inclusion of the litter and soil pools. 2) Updated expansion ratios: 3) Updated data on 'drain': 4) Updated dead wood pool: 5) Corrections in the calculations of the 'increment' 6) Update of harvested wood products:
Bulgaria	Bulgaria in cooperation with JRC plan to have two technical corrections up to the end of the commitment period. In period 2017-2018 it is planned to make TC in order to update the FMRL according to the new NFI data (2016) and to update the HWPs estimates according to the 2013 KP Supplement. Meanwhile in order to ensure the consistency of the reported information, as an interim solution, Bulgaria has carried out a re-calibration of the model results used in construction of the FMRL in 2011. The result of the re-calibration is -8.145 Mt CO2 eq.
Croatia	Since its submission of Initial Report submitted during the first commitment period, Croatia performed several changes in its estimation in LULUCF sector and activities connected with forestry sector. Due to these changes and improvements Croatia decided to submit its first technical correction of Forest Reference Management Level within the 2016 report (NIR 2016 Resubmission) since for NIR 2015 countries are not submitting their data for KP in the CRF database. One of the reasons for the FMRL technical correction arises from the application of 2006 Guidelines, specifically equation 2.12 that addresses annual carbon loss in biomass due to wood removal in a way that includes R/S factor which differs comparing to the equation 3.2.7 from the previously used GPG 2003.
Denmark	For the accounting of emissions a FMRL is constructed specifying the expected average annual net emissions from the HWP pool for the second commitment period. Due to the data corrections it was decided to correct the original FMRL reported in 2011 (Johansen et al. 2011). This correction also entailed a change in the reference period used to project the inflow to the HWP pool – from 2005-2009 to 2008-2012 – in order to provide a more accu-rate reference level using the most recently collected data. Had the reference period not been changed, the FMRL would have significantly underestimat-ed the inflow for 2013 and thus caused a significant gap between the report-ed net emissions and the projected net emissions by the FMRL. This means that the HWP pool would actually have been projected to decrease as op-posed to the expected increase in the pool during the second commitment period.
Finland	In the technical assessment report over Finland's FMRL submission, two issues were brought out expressing possible inconsistency between the projected FMRL and historical emissions and removals from FM, namely the predicted increment of growing stock and amount of natural losses. Both remarks apply to the estimates produced by models. These issues were not yet processed for this submission. After the adoption of FMRL, further research to develop these models was started and it is expected that the results will resolve the possible problems. Results are expected to be ready to be implemented in GHG inventory within three years. In the construction of the corrected FMRL, the effects of the changes in estimation of carbon stock changes in mineral and organic forest soils were assessed as a proportional change in estimates. Other emissions and removals were estimated employing the same methods as was used for the construction of the FMRL.
Greece	The changes that have occurred in relation to methodological elements, which are triggering a technical correction are: 1 The update of the Forest Management Plans database. The new data incorporated in the database have resulted in the recalculation of the whole time series for the 4.A.1 "Forest land remaining Forest land/managed" category which is equivalent to the Forest Management activity. 2 The area of forest land remaining forest land/managed that equals to Forest Management area has changed. 3 In the current submission, CO2 and non-CO2 emissions from dead wood and litter subject to wildfires in lands under 3.4 have been reported for the first time. 4 There has been a recalculation of the whole time series of emissions from wildfires. 5 The period 1990-2014 has been considered for the technical correction of the FMRL, while the FMRL value inscribed in the appendix of 2/CMP.7 is based on the average of emissions/removals of the period 1990-2009. 6 In the estimation of emissions/removals from Forest land remaining forest land, the updated emission and conversion factors from 2006 GL AFOLU and KP Supplement have been used. In addition, the new global warming potential values for CH4 and N2O from the 4th AR IPCC have been used. 7 In the current submission, both a FMRL assuming instantaneous oxidation and applying the FOD function for HWP is submitted. It should be noted that a forest management reference level applying first-order decay function for HWP was not included in the appendix of 2/CMP.7,
Hungary	A technical correction was necessary for the FMRL because there are several methodological changes that have been implemented in the estimation of emissions and removals from FM, including the HWP pool.
Ireland	Ireland has performed recalculations for the historic time series and 2013 and will apply a technical correction when accounting for the second commitment period. The requirement to apply a recalculation is based on conditions as outlined in the IPCC 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (IPCC 2013 GPG KP-LULUCF): 1 Use of new models to derive the reported carbon stock (CSC) changes in the inventory 2013. 2 There have been a range of methodological changes for estimation CO2, N2O and CH4 emissions from organic and mineral soils. 3 Ireland has obtained new historical data for several elements included in the contruction of the FMRL
Latvia	The need for Technical Correction is determined by following reasons: 1.- The method used for GHG reporting changed after the adoption of FMRL as part of improving inventory quality and due to conversion of calculations from the IPCC GPG LULUCF 2003 to 2006 IPCC Guidelines and IPCC Wetlands Supplement. 2.- New non-CO2 GHG sources are included in reporting for FM in the second commitment period. 3.- Recalculated historical data was done for the most important parameters. 4.- The accounting of HWP has been also improved since estimation of the FMRL which was submitted before Decision 2/CMP.7. Technical Correction was calculated based on a model re-calibration. A full re-run of the model will be carried in the future to allow Latvia to implement a complete Technical Correction.
Lithuania	ND
Malta	Malta is seeking a correction of the Forest Management Reference Level (FMRL) currently inscribed under the Kyoto Protocol, Since the national GHG inventory submission of 2011, Malta has changed the methodology for estimating emissions and removals for the sector LULUCF. Unit that time the category 'Forestland remaining forestland' was taken to include coniferous forest, mixed forest and shrubland (maquis). Malta has now a national definition which states that a forest is defined as an area of minimum 1 hectare with a tree crown cover of more than 30% and minimum tree height of 5 meters. This has resulted in shrubland no longer being considered as part of the category 'Forestland', now being classified as part of the category 'Grassland'.
Portugal	All spreadsheets for estimating emissions and removals from KP LULUCF have been adapted so that they recalculate automatically the FMRL if and when the base information changes. Folowing the specifications of Decision 2/CMP.7, the assumptions used in FMRL construction are kept constant. All changes to the FMRL value are therefore due to changes in the base information (historical time series) or changes in methodologies in use, which then apply both to the historic time series and to reporting in the commitment period. Since the communication of the FMRL by Portugal in 2011, several changes have been introduced in the reporting by Portugal.
Romania	A technical correction is planned in the light of new data available from NFI (for 2008-on).
Sweden	Sweden has performed a technical correction for the forest management reference level due to the following reasons: - The historical dataset for Living biomass representing the period 2005-2009 has been updated using new inventory data from the NFI. - The historical dataset for Litter representing the period 2000-2009 has been updated using new inventory data from the soil inventory. - The historical dataset for Soil organic carbon representing the period 2000-2009 has been updated using new inventory data from the soil inventory. The method to calculate emissions/removals from the harvested products pool was slightly revised in Submission 2015. T - New sources of greenhouse gases was amended in the reporting in Submission 2015. - The emission factor for drained organic forest soils and nitrogen fertilization was changed in Submission 2015. - Biomass burning now includes only emissions of N2O and CH4. - The GWPs for CH4 and N2O have been changed according to decision 4/CMP.7 and affects all estimates of emissions of CH4 and N2O.
UK	The UK has calculated a technical correction (TC) to the FMRL for the 2016 inventory. The FMRL submitted by the UK in 2011 was based on the 1990-2008 UK greenhouse gas inventory, since which, the following data and assumptions have changed that necessitate a technical correction: 1.- A switch in the model used from CFlow to CARBINE; 2.- Inclusion of pre-1921 forest area; 3.- Change in tree growth assumptions; 4.- Change in the assumptions about harvesting rates; 5.- Updated information on the rate of deforestation; 6.- Updated approach to estimating the incidence of emissions from wildfires;

11.5.2.4 Carbon equivalent Forest Conversion

This provision is relevant neither for EU MS nor for Iceland.

11.5.3 Information related to the natural disturbances provision under article 3.4

In accordance with decision 2/CMP.7; 18 MS and Iceland have stated their intention of excluding emissions resulting from natural disturbances that affect areas subject to FM during CP2, (Table 11.23).

Most detailed information on the approach used for the development of the background level and the margin, as well as, on other requirements for Parties wishing to apply this provision can be found in section 11.4.4 of this report.

So far, for CP2, emissions from natural disturbances have not been excluded from the accounting of FM activity.

Table 11.23 Synthesis of Information from MS and Iceland that intends to apply the natural disturbance provision under FM activities during CP2.

Member States	Approach for the development of the BL and the Margin	BL+Margin	Type of disturbance
Austria	Default method	0.171 t CO2eq/ha	All considered in the 2013 KP supplement
Belgium	---	---	---
Bulgaria	Default method	1255 kt CO2 eq	Wildfires, extreme weather events – windstorms, wet snowfall, ice, others
Croatia	---	---	---
Estonia	Default method	294.2 kt CO2 eq.	Biotic or abiotic damages being the most critical Extreme weather events (storms)
Finland	Default method	846 kt CO2 eq.	Windstorms, insect attacks and wildfires
France	---	---	---
Greece	Default method	233 kt CO2 eq.	Wildfires
Ireland	Default method	136 kt CO2	Wildfires
Italy	Default method	3,380 kt CO2 eq.	Wildfires
Luxembourg	Minimum level of historical time series (zero)	(zero)	Extreme weather events
Malta	---	---	---
Netherlands	Default method	4.38 kt CO2 eq.	Wildfires and wind storms
Portugal	---	---	---
Romania	Default method	188 kt CO2 eq.	Wildfires and windfalls
Spain	Default method	551.70 kt CO2 eq.	All considered in the 2013 KP supplement
Sweden	---	---	---
United Kingdom	Default method	382 kt CO2eq.	Wildfires, insect attacks and disease infestations, windstorms and geological disturbances
Iceland	---	---	---

11.5.4 Information on Harvested Wood Products under article 3.4

Methodologies to estimate carbon stock changes from harvested wood products originated from FM lands are in line with methods used for reporting this carbon pool under the LULUCF sector (i.e. IPCC default method). MS use also the default IPCC method (equation 2.8.3 of the 2013 KP Supplement), to allocate the carbon stock changes to specific forest activities under Art. 3.3, and Art. 3.4.

As regard with harvest from lands not included under forest management or under Art. 3.3 activities, only 5 MS have reported information on CRF table 4(KP-I) C.

11.5.5 Information relating to Cropland Management, Grazing Land Management and Revegetation, Wetland Drainage and Rewetting if elected, for the base year

For CP2, emissions and removals from CM are reported and accounted for by Denmark, Germany, Ireland, Italy, Portugal, Spain and UK. With the exception of Spain, these countries also elected to account for emissions and removals from the activity GM. By other hand, RV activity has been elected only by Romania and Iceland; whereas only United Kingdom will account for emissions and removals from the activity WDR. Nevertheless, United Kingdom has informed that they are not yet in a position to report emissions/removals from this activity, but a full reporting is expected by the end of the commitment period as a result of an ongoing programme of research and methodological development.

Definitions implemented by the MS follow are consistent with those contained in decision 16/CMP.1. Cropland and Grazing land management activities consist in the implementation of specific practices and operations, which differ substantially from country to country. CM is dedicated to agricultural crops, perennial and annual, woody and non-woody crops, including lands temporary under reserve or out of the productive cycle (fallow lands). GM is the system of practices consisting in manipulating site features and the amount of vegetation on lands for livestock production (include e.g. drainage of organic soils, vegetation improvement).

As regard of the activity RV, as stated in its NIR, Iceland includes the activity to increase carbon stocks on eroding or eroded/desertified sites through the establishment of vegetation or the restoration of existing vegetation that covers a minimum area of 0.5 hectares and does not meet the definitions of afforestation or reforestation. It includes also, activities related to emissions of greenhouse gas and/or decreases in carbon stocks on sites which have been categorized as revegetation areas and do not meet the definition of deforestation. For Romania this activity corresponds with plantation of trees on non-forest lands and can be associated with forest belts.

The area under CM corresponds, in overall, to the area reported under Cropland minus the cropland area originated from forest conversion since 1990, while GM areas may likely not correspond to Grassland since usually not the entire area of grassland of a country is managed for grazing.

Activity data for CM and GM in the base year, and all the years of the CP, are compiled from remote sensing products, or NFIs grids, coupled with any available ancillary data. Agriculture census, national statistics, cadastre data, result-based payments information, and some European initiatives (e.g. LPIS) have also a very significant role on data acquisition.

Concerning RV, Iceland use national registry to collect the area subject to this activity, while in Romania activity data is available either as number of planted trees or km of tree lines or ha and as recorded in statistical reports.

11.6 Other information

11.6.1 Key category analysis for Art. 3.3 activities and any elected Art. 3.4 activity

MS apply mainly quantitative criteria for the assessment of key categories among KP-LULUCF activities (see Table 11.4), based on the correspondence between KP activities and land categories in the Convention. When elected, FM, CM and GM, as well as, ARD are key categories in most of the cases. Further information regarding KC analysis can be found in section 1.1.3.

11.6.2 Information related to Article 6

With the exception of Romania, all other MS do not report information on JI projects.

In the case of Romania, a Joint Implementation AR project is being carried out, which lasts from 2012-2017. Estimates of GHG emissions and removals are calculated for the commitment period and reported as a separate division in CRF Table 4(KP-I) A1.1

12 Information on accounting of Kyoto units

Background information

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2015 for the EU[72] registry is submitted together with this report (Annex 'SEF submission'). The data in the EU registry reflect only the transactions to and from the EU registry, but not the sum of all Member States' transactions. Member States' separately submit information on Kyoto units in SEF tables to the UNFCCC.

Summary of information reported in the SEF tables for the EU registry

The standard electronic format tables for the EU are included in the submission. The SEF reporting software has been used for this purpose. The tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Union registry at 31.12.2015 as well as information on transfers of the units in 2015 to and from other Parties of the Kyoto Protocol.

The joint assigned amount for the European Union, its Member States and Iceland for the second commitment period of the Kyoto Protocol is equal to the percentage inscribed for the Union in Annex B of the Doha Amendment (80 %) of its base year emissions multiplied by eight. According to the terms of the joint fulfilment, the assigned amount of the European Union will be counted against the emissions of greenhouse gases from sources under the European Union Emissions Trading Scheme, in which its Member States and Iceland participate, to the extent that those emissions are covered under the Kyoto Protocol. The assigned amount of the European Union, as determined in line with the terms of the joint fulfilment shall be described in the initial report.

The total quantities of AAUs acquired and transferred during the reporting period are provided in SEF table 2b and 2c.

Summary of information reported in the CP2 SEF tables of the EU registry.

SEF tables for the EU registry are provided in Annex 'SEF submission'. Table 12.1 provides an overview of transactions included in Table 2(b) in the EU registry.

Table 12.1 Transactions included in Table 2(b) in the EU registry.

[72] The Community registry was replaced by the Union registry in 2012

		Additions						Subtractions					
	Total transfers and acquisitions	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**ICERs**	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**ICERs**
1	**CDM**	NO	NO	NO	136.554	NO	NO	NO	NO	NO	NO	NO	NO
2	**FR**	NO	NO	NO	1.071.564	NO	NO	NO	NO	NO	106.092	NO	NO
3	**SE**	NO	NO	NO	2.091.044	NO	NO	NO	NO	NO	12.246	NO	NO
4	**DK**	NO	NO	NO	45.156	NO	NO	NO	NO	NO	548.202	NO	NO
5	**NO**	NO	NO	NO	753.110	NO	NO	NO	NO	NO	40.385	NO	NO
6	**DE**	NO	NO	NO	5.336.978	NO	NO	NO	NO	NO	514.092	NO	NO
7	**GB**	NO	NO	NO	12.377.526	NO	NO	NO	NO	NO	675.749	NO	NO
8	**NL**	NO	NO	NO	9.557.045	NO	NO	NO	NO	NO	261.062	NO	NO
9	**AU**	NO	NO	NO	1.799.631	NO	NO	NO	NO	NO	1.394.059	NO	NO
10	**ES**	NO	NO	NO	997.749	NO	NO	NO	NO	NO	1.350	NO	NO
11	**BE**	NO	NO	NO	130.368	NO	NO	NO	NO	NO	5.465	NO	NO
12	**CH**	NO	NO	NO	9.203.722	NO	NO	NO	NO	NO	5.696.488	NO	NO
13	**PT**	NO	NO	NO	935.000	NO	NO	NO	NO	NO	NO	NO	NO
14	**IT**	NO	NO	NO	1.836.849	NO	NO	NO	NO	NO	1	NO	NO
15	**FI**	NO	NO	NO	52.378	NO	NO	NO	NO	NO	31.924	NO	NO
16	**Subtotal**	NO	NO	NO	46.324.674	NO	NO	NO	NO	NO	9.287.115	NO	NO

Discrepancies and notifications

With respect to the respective paragraphs of Annex to decision 15/CMP.1 the following information is provided for the EU registry:

- **Paragraph 12:** No discrepancies identified by the transaction log.
- **Paragraph 13**: No notifications directed to the Party to replace ICERs in accordance with Paragraph 49 of the annex to decision 5/CMP.1.
- **Paragraph 14:** No notifications directed to the Party to replace ICERs in accordance with para 50 of the annex to decision 5/CMP.1.
- **Paragraph 15:** No issue of non-replacement.
- **Paragraph 16**: No KP Units that are not valid.
- **Paragraph 17:** No actions were necessary to correct any problem causing a discrepancy.

Publicly accessible information

The information based on the requirements in the annex to decision 13/CMP.1 and annex to decision 3/CMP.11 is publicly available on the European Commission website: https://ets-registry.webgate.ec.europa.eu/euregistry/EU/public/reports/publicReports.xhtml [73].

Article 6 project information

[73] The list of information that is made publicly available has not changed compared to previous submissions

No ERUs have been issued in the EU Registry in 2013

No ERUs have been issued in the EU Registry in 2014

No ERUs have been issued in the EU Registry in 2015

The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year

This information is confidential.

The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8

No AAUs have been issued in the EU Registry in 2013

No AAUs have been issued in the EU Registry in 2014

No AAUs have been issued in the EU Registry in 2015

The total quantity of ERUs issued on the basis of Article 6 projects

No ERUs have been issued in the EU Registry in 2013

No ERUs have been issued in the EU Registry in 2014

No ERUs have been issued in the EU Registry in 2015

The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries.

YEAR	Registry	AAU	ERU	RMU	CER
2013	GB	0	0	0	29.448
2013	CH	0	0	0	172.337
2014	AT	0	0	0	1
2014	FR	0	0	0	165.465
2014	DK	0	0	0	3.142
2014	DE	0	0	0	39.320
2014	SE	0	0	0	122.180
2014	GB	0	0	0	2.256.786
2014	AU	0	0	0	120.870

2014	NO	0	0	0	167.074
2014	CH	0	0	0	1.790.323
2014	NL	0	0	0	575.673
2014	IT	0	0	0	168.671
2014	ES	0	0	0	60.966
2014	CDM	0	0	0	14.921
2015	CDM	0	0	0	136.554
2015	FR	0	0	0	1.071.564
2015	SE	0	0	0	2.091.044
2015	DK	0	0	0	45.156
2015	NO	0	0	0	753.110
2015	DE	0	0	0	5.336.978
2015	GB	0	0	0	12.377.526
2015	NL	0	0	0	9.557.045
2015	AU	0	0	0	1.799.631
2015	ES	0	0	0	997.749
2015	BE	0	0	0	130.368
2015	CH	0	0	0	9.203.722
2015	PT	0	0	0	935.000
2015	IT	0	0	0	1.836.849
2015	FI	0	0	0	52.378

The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4

No RMUs have been issued in the Union registry in 2013

No RMUs have been issued in the Union registry in 2014

No RMUs have been issued in the Union registry in 2015

The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries.

YEAR	Registry	AAU	ERU	RMU	CER
2014	GB	0	0	0	135.000
2014	CH	0	0	0	1.397.541
2015	FR	0	0	0	106.092
2015	SE	0	0	0	12.246
2015	DK	0	0	0	548.202

2015	NO	0	0	0	40.385
2015	DE	0	0	0	514.092
2015	GB	0	0	0	675.749
2015	NL	0	0	0	261.062
2015	AU	0	0	0	1.394.059
2015	ES	0	0	0	1.350
2015	BE	0	0	0	5.465
2015	CH	0	0	0	5.696.488
2015	IT	0	0	0	1
2015	FI	0	0	0	31.924

No ERUs, CERS, AAUs or RMUs were transferred to other registries in 2013.

The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4

YEAR	AAU	ERU	RMU	CER
2015	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1

YEAR	AAU	ERU	RMU	CER
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

The total quantity of other ERUs, CERs, AAUs and RMUs cancelled

YEAR	AAU	ERU	RMU	CER
2013	0	0	0	0
2014	0	0	0	1.892
2015	0	0	0	487.961

The total quantity of ERUs, CERs, AAUs and RMUs retired

YEAR	AAU	ERU	RMU	CER
2013	0	0	0	0

2014	0	0	0	0
2015	0	0	0	0

Calculation of commitment period reserve (CPR)

The EU commitment period reserve will be communicated in the initial report of the European Union. The commitment period reserve equals the lower of either 90% of a Party's assigned amount pursuant to Article 3(7bis), (8) and (8bis) or 100% of its most recently reviewed inventory, multiplied by 8.

KP-LULUCF accounting

As in the first commitment period, Member States and Iceland will continue to apply Article 3(3) and (4) of the Kyoto Protocol and decisions agreed thereunder individually. Member States will account individually for emissions by sources and removals by sinks from Kyoto LULUCF activities and will individually decide on accounting modalities and elections where foreseen under the Kyoto Protocol. Any issuance of RMUs or cancellation of units resulting from the accounting under Articles 3(3) and (4) should be made to the Member States' and Iceland's Kyoto registries.The EU will neither issue nor cancel units based on the reported emissions and removals from activities under Article 3, paragraph 3 and paragraph 4. The EU will report the sum of Member States' cumulative accounting quantities for these activities at the end of the commitment period, representing the Member States' cumulative additions to or subtractions from their assigned amount at the end of the commitment period.

13. Information on changes in national system

The European Union already had a quantified emission limitation and reduction target in the first commitment period and provided a description of its national system in the report to calculate the assigned amount of the first commitment period. Subsequently, any changes that occurred to the EU national system were reported as part of the annual supplementary information under Article 7 of the Kyoto Protocol and included in the national inventory report.

Changes compared to the previous inventory submissions related to the national system are the following:

A key change to previous inventory submissions of the EU under the Kyoto Protocol is that the Kyoto greenhouse inventory for the second commitment period has a different coverage of countries due to the scope of the terms of the joint fulfilment agreement for the second commitment period which includes 28 Member States[74] and Iceland.

As part of the agreement between the European Union, its Member States and Iceland (Council Decision (EU) 2015/1340), regulation (EU) No 525/2013 on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level relevant to climate change (Monitoring Mechanism Regulation) as well as current and future delegated and implementing acts based on this regulation are binding upon Iceland.

The institutions which were part of the EU inventory system and responsible for the EU inventory preparation during the first commitment period remain the same at the start of the second commitment period. The Directorate General Climate Action of the European Commission has overall responsibility for the inventory of the European Union (EU) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Union. DG Climate Action is supported in the establishment of the inventory by the following main institutions: the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) as well as the following other Directorates General of the European Commission: Eurostat, and the Joint Research Centre (JRC) .

[74] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

14 Information on changes in national registry

The following changes to the national registry of EU have therefore occurred in 2015.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	None
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	There was no change to the database structure as it pertains to KP functionality in 2015. Versions of the CSEUR released after 6.3.3.2 (the production version at the time of the last Chapter 14 submission) introduced minor changes in the structure of the database. These changes were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. The database model is provided in Annex A. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced since version 6.3.3.2 of the national registry are listed in Annex B. Each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B). Annex H testing was carried out in February 2016 and the test report is attached. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	No change of security measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced since version 6.3.3.2 of the national registry are listed in Annex B. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission; the report is attached as Annex B. Annex H testing was carried out in February 2016 and the test report is attached.

15 Information on minimizing adverse impacts in accordance with Article 3, paragraph 14

15.1 Information on how the EU is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement the commitments mentioned in Article 3, paragraph 1, of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention

Editorial comment: The EU is only required to report changes related to the information on minimizing adverse impacts in accordance with Article 3, paragraph 14. However for an improved understanding, 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 **in 2009, called "Impact Assessment Guidelines"**(European Commission 2009a). **The Imact Assessment guidelines were revised in May 2015, since then called "Better Regulation Guidelines" (European Commission 2015a)**.

Assessing systematically the likely effects of different policy initiatives on developing countries is a requirement based on Article 208(1) TFEU (##), which stipulates that the EU "shall take account of the objectives of development co-operation in the policies that it implements which are likely to affect developing countries". This constitutes the legal basis of a concept generally known as "Policy Coherence for Development" (PCD). Practically, the application of the PCD principle means recognizing that some EU policy measures can have a significant impact outside of the EU which may contribute to or undermine the Union's policy objectives concerning development. Through PCD, the EU seeks to take account of development objectives in all of its policies that are likely to affect developing countries, by minimising contradictions and building synergies between different EU policies to benefit developing countries and by increasing the effectiveness of development cooperation. Measures regarding climate change mitigation and affecting adaptation needs in developing countries have been identified as "measures known to have impacts on developing countris". The assessment of impacts on developing countries includes economic, social and environmental impacts.

Related to economic impacts the following guiding questions have to be assessed (European Commission 2015a, Better Regulation "Toolbox", p. 221ff):

- **Who are the developing countries' producing (and exporting to the EU) the goods/services affected? Are these least developed countries?**
- **What is the impact on proportion (esp. in value) of the trade between these developing countries and the EU, in particular regarding the trade balance of developing countries?**
- **What is the likely impact on price volatility?**
- **What are the impacts on proportion between the purchase of raw materials and finished products from developing countries?**
- **What is the impact on the competiveness of exporters in developing countries in terms of intended or unintended trade barriers?**
- **What are the impacts on the initiative on intellectual property rights, standards, and technology and business skills in developing countries and on their capacity to trade their goods (towards the EU or between themselves)?**
- **What is the impact on food security for local population (e.g. by impacting on price of commodities or food on world and regional/local markets or by limiting access to land, water or other assets)?**
- **What is the impact on different population groups (urban vs. rural, small vs. large scale farmers)?**
- **What are the impacts on international and domestic investment flows (outflows and inflows including FDI) in the developing countries?**
- **What are the impacts on the private sector in developing countries (including competitiveness, access to finance, access to market)?**

Related to social impacts the following guiding questions have to be assessed:

- **What are the impacts on labour market (e.g. creation of job or decrease in employment level, impacts on different groups of workforce – low-skilled vs. high skilled workforce, wages level, working conditions)?**
- **What are the impacts on main stakeholders and institutions affected by the proposal?**
- **What is the impact on poverty levels and inequality in developing countries?**
- **What are the impacts on gender equality and on the most vulnerable groups of society?**
- **What is the impact on human rights in the development countries?**
- **What is the impact on migration in developing countries (rural-urban or international)?**
- **What is the impact on food security for the local population (e.g. by impacting on price of commodities or food on world and regional/local markets or by limiting access to land, water or other assets)?**
- **What is the impact on different population groups (urban vs. rural, small vs. large scale farmers)?**

Related to environmental impacts the following guiding questions have to be assessed:

- **How does it impact ecosystem approach?**
- **What is the impact on emission targets in developing countries?**
- **What is the impact on chemicals authorisation as well as on use and waste management?**
- **What is the impact on green economy development, both globally and in partner countries?**
- **What is the impact on the low carbon technology transfer and its availability in developing countries?**
- **What is the impact on the biodiversity (mono-cropping, deforestation) and global or local food security?**
- **What is the impact on the management and use of natural resources, e.g. minerals, timber, water, land, etc.?**
- **Are these options consistent with our support (under development cooperation policy) to responsible approaches to natural resources management such as FLEGT[75], EITI[76] or Kimberley agreement[77]?**

Depending on the case, a comprehensive literature review is conducted, while in some cases a detailed, substantial and quantified analysis including detailed quantitative data to establish the causal link betwee the poicy option and its impacts. A range of analytical approach can be used for this purpose, such as econometric analysis or computable general equilibrium (CGE) models

Consulting interested parties is an obligation for every impact assessment and all affected stakeholders should be engaged. **Each consultation includes a 12-week internet-based public consultation and can be complemented by other approachs and tools.** 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.

---

[75] The Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT) is the European Union response to illegal logging that was adopted in 2003. http://ec.europa.eu/environment/forests/illegal_logging.htm

[76] The Extractive Industries Transparency Initiative is a global coalition of governments, companies and civil society working together to improve openness and accountable management of revenues from natural resources. https://eiti.org/eiti.

[77] The Kimberley Process (KP) is a joint government, industry and civil society initiative to stem the flow of conflict diamonds – rough diamonds used by rebel movements to finance wars against legitimate governments. http://www.kimberleyprocess.com/

The EU’s **Second Biennial Report** 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_2015_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 in the UNFCCC reporting guidelines for GHG inventories 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.

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). **A new Directive amending** the current legislation on biofuels through the Renewable Energy and the Fuel Quality Directives **was adopted in 2015 (Directive (Eu) 2015/1513) with the objectives**:

- 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 directive 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 Directive analysed social, economic and environmental impacts on third countries in detail[78].

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, **on 15 June 2015, the second Renewable Energy Progress Report (European Commission 2015c) followed. The reports** include information on biofuels and bioliquids sustainability criteria. The **2015** report and its accompanying staff working document analyses *inter alia* the origin of biofuel foodstock consumed in the EU, whereby **79**% of EU consumed biodiesel in 201**3** was produced within the EU and **71**% 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. **In 2013, biodiesel imports still came primarily from Argentina or Indonesia and ethanol was still imported primarily from either the United States or Brazil.** The **2013** report states that "**While the total amount of land worldwide under cultivation for biofuel production continues to grow, the amount of land used for biofuel exports to the EU has actually declined on a land per energy basis, with 0.16 Mha/Mtoe required in 2012 compared to 0.18 Mha/Mtoe in 2010" (Ecofys et al. 2014)**.

78 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0296&from=EN

Whilst imported mineral oil still constitutes the vast bulk of fuel used in the transport sector, the **5.4**% share of biofuels **in 2012** is estimated to have generated **34** Mt CO_2eq savings, based on national reporting, not taking into account indirect land use change effects.

Both progress report**s** find 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 reports, 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 **and 2014**). The Ecofys stud**ies** revealed *inter alia* that:

- In 201**2**, the use of renewable energy in transport was **5.11**%, consisting of:
  - **11.6** Mtoe of sustainable biofuels or **4.63**%;
  - 1.3**5** Mtoe of renewable electricity, or 0.4**7**%;
- 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%;
- **Both the production and consumption of biofuels in the EU has continued to grow during 2011 and 2012, but at a much slower pace than in the preceding years: Between 2010 and 2012, the share of renewable energy in transport only increased slightly by 0.41 percentage points,**
- **The volume of sustainable biofuels even decreased by 1.4 Mtoe because the sustainability of a significant biofuels volume could not be demonstrated to many newly implemented sustainability administrations in several countries. Comparison of the numbers between 2010 and 2012 are however difficult because for the biofuels in 2009 and 2010, the sustainability did not play a role, as the Directive was not yet implemented. This became especially apparent in 2011 where a few countries show a dip in the use of sustainable biofuels, most notably France, Czech Republic, Portugal, Romania and Cyprus.**
- **Furthermore, use of double counting biofuels increased significantly (mainly biodiesel that has been used as cooking oil before)**
- **An analysis of the world trade in biofuels shows that 21% of the biodiesel in the EU was imported, especially from Argentina and Indonesia, with few changes between 2011 and 2012. Whereas the EU import from Argentinean biodiesel moderately increased from 1,179 ktonne in 2010 to 1,476 ktonne in 2012 the import of Indonesian biodiesel more than doubled in 3 years from 495 ktonne in 2010 to 1,134 ktonne in 2012. Both countries have Differential Export Taxes (DETs) in place that incentivise the export of biodiesel, by making the raw materials (soy and palm oil respectively) more expensive than the finished product. Following legal complaints by the biodiesel industry the EC launched an assessment of the matter mid 2012 which lead to provisional anti-dumping duty on imports of biodiesel from Argentina and Indonesia in May 2013 (EC Regulation No 490/2013). The provisional duties were confirmed by steeper five-year tariffs in November 2013. The biodiesel imports from these countries strongly declined. The exports from the US, which were large in previous years, almost disappeared from 2011 onwards.**

- **2011 saw a large import of US subsidised ethanol to the EU , which was similar to the "splash-and-dash" practice of US biodiesel until 2009. Now, E90 from the USA and Brazil, which was blended in the USA received a Volumetric Ethanol Excise Tax Credit (VEETC). The VEETC, together with low EU import duties for high ethanol blends (not administrated as ethanol), resulted in a drastic increase of ethanol import from the USA to the EU, thereby reducing the market share of domestically produced but more expensive ethanol. As the VEETC expired at the end of 2011, the EC stopped their anti-subsidy investigation on US ethanol. The import of ethanol immediately decreased to about 18% of the EU ethanol market.The anti-dumping investigation continued and in February 2013 the EC imposed an anti-dumping duty of 9.6% on US ethanol imports.**
- **The international biofuel market is quite dynamic and trade routes change continuously. Most of the volatility should be attributed to the nature of agricultural commodities and the ways that governments regulate (i.e. support) agricultural production and export.** The most important feedstock for biodiesel is rapeseed originating from the **EU but also from Australia, Canada, Ukraine and Russia with a share of more than 70%, the second most important feedstock is used cooking oil with an 11.4% share in 2012. There was a steady increase of this feedstock so that it became the second most important from 2011 on, leading also to a decrease in the share of (mainly)** Argentinean soy **and** Indonesian and Malaysian palm oil. 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 maize originating from **the USA and** Ukraine and **of sugar cane originating from Guatemala and** a few other countries;
- Statistical analysis reveals that the total land use worldwide to produce the feedstock for EU-consumed biofuels in 201**2**, is about **7.8** Mha. Of this, **4.3** Mha (5**8**%) is within the EU and **3.1** Mha (4**2**%) 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 **0.5**% of the cropland **in 2012. A n**otable exception **is** Argentina where 3% of the total cropland produces soybean for EU biodiesel in 201**2**;
- **The comparison of a composite food price index with global annual biofuels production volumes shows that any obvious correlation between crop prices and biofuels volume is absent after 2008, while crop prices correlate strongly with the prices of all commodities, suggesting that the underlying issue is not biofuels. After early 2011, no notable spikes are observed until at least end of 2013, while the world's production and consumption of biofuels has continuously increased;**
- **B**ased 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 direct gross employment related to the 2012 EU biofuel consumption in the main countries of supply (Indonesia, Malaysia, Argentina, Brazil, USA and the EU itself) is estimated to be at around 160,000 people. EurObserv'Er (2012) indicates a total of 114.955 direct and indirect jobs in the EU related to the biofuel sector in 2012. Most of this employment is located in France (24%) and Germany (20%). IRENA (2014) indicates a total of 108.000 jobs. These estimates relate to the total amount of biofuels produced in the EU;**
- **Maximally around 10 percent of biofuel projects outside the EU have been developed with the EU market in mind. As Member States continue down the path to the 2020 objective, the Commission's regular monitoring of the EU biofuel origin and consumption trends since 2010 tend to suggest that, although there is some impact of increased biofuel consumption on food prices, the overall impact of the EU biofuel market is relatively small compared to the other systematic factors driving global commodity prices like reduced reserves, food waste, speculation, oil prices, transportation issues, storage costs, and hoarding.**

The EU's biofuel sustainability criteria form the first global initiative to address the climate change and sustainability issues surrounding crop production.

The Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01)[79] 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 **are implemented**.

The European Commission has so far (April 2014) recognised **19** 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 (RBSA), 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, RSPO RED (Roundtable on Sustainable Palm Oil RED), Biograce GHG calculation tool, HVO Renewable Diesel Scheme for Verification of Compliance with the RED sustainability criteria for biofuels**, Gafta Trade Assurance Scheme, KZR INIG System, Trade Assurance Scheme for Combinable Crops and Universal Feed Assurance Scheme**[80].

In line with Article 19(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources[81] the Commission published in 2010 a report on the feasibility of drawing up lists of areas in third countries with low greenhouse gas emissions from cultivation (COM(2010) 427 final) concluding that, "while desirable, it is not yet feasible to set up legally binding lists of areas for third countries where a major component of the underlying calculation is uncertain and can easily be questioned, and where third countries have had no possibility to contribute on the methodology and data used. It is therefore not appropriate, at least at this stage, to produce legislative lists for third countries based on the current modelling of N_2O emissions from agriculture. However, it is important to enhance the understanding of the topic and survey the data used in view of a new assessment in 2012. The Commission has thus published the preliminary results of the JRC work together with all necessary data and description of methodology to support such a process on the webpage of the JRC. It will use this as the basis for a discussion with third countries in the framework of its dialogue and exchange with them under Article 23(2) of the Renewable Energy Directive."

Another way the EU will strive to minimize potential adverse impacts of biomass use is to promote second generation biomass technologies. Within the renewable energy Directive, second generation biofuels are promoted through Article 21, paragraph 2 which establishes that the contribution made by biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels for the purposes of demonstrating compliance with national renewable energy targets; and EU research also has a major focus on bioenergy technologies. The goal of

---

79 OJ C160, 19.6.2010, p.1

80 https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes

81 OJ L 140, 5.6.2009, p. 16

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 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 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[82] so that only the part of a

[82] 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

flight that takes place in European regional airspace is covered by the EU ETS. In **April** 2014 the **"Regulation (EU) No 421/2014 of the European Parliament and the Council of 16 April 2014 amending the 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" entered into force**.

The regulation limit**s** 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.

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 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, investment 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

---

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

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 **as well as an energy efficiency target of at least 27% until 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.

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 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.[83]

[83] 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

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. **The "2030 climate & energy framework" was adopted by EU leaders in October 2014. The methodology to set the national reduction targets for the non-ETS sectors, with all the elements as applied in the Effort Sharing Decision for 2020, will be continued until 2030, with efforts distributed on the basis of relative GDP per capita. All Member States will contribute to the overall EU reduction in 2030 with the targets spanning from 0% to -40% compared to 2005. Targets for the Member States with a GDP per capita above the EU average will be relatively adjusted to reflect cost-effectiveness in a fair and balanced manner, moreover the availability and use of existing flexibility instruments within the non-ETS sectors will be significantly enhanced in order to ensure cost-effectiveness of the collective EU effort and convergence of emissions per capita by 2030.**

The European Council will keep all the elements of the framework under review and will continue to give strategic orientations as appropriate, notably with respect to consensus on ETS, non-ETS, interconnections and energy efficiency. The indicative energy savings target of 27% by 2030 will be reviewed in 2020 having in mind a 30% target. The Commission will continue to have a regular dialogue with stakeholders.

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 **(MSR) will be established from 2018 onwards – the placing of allowances in the reserve shall operate from 1 January 2019 –** which provides an automatic adjustment of the supply of auctioned allowances based on a pre-defined set of rules with the aim to avoid large supply/demand imbalances in the ETS. **The legislative proposal[84], put forward in January 2014 at the same time as the framework for climate and energy policies up to 2030, was approved by the European Parliament on 7 July 2015 and by the Council on 6 October 2015.**

As another step in delivering on the EU's target to reduce greenhouse gas emissions by at least 40% domestically by 2030 (with the sectors covered by the ETS having to reduce their emissions by 43% compared to 2005) in line with the 2030 climate and energy policy framework the European Commission presented in July 2015 a legislative proposal[85] to revise the EU emissions trading system for the period after 2020. It mainly includes a more ambitious annual factor to reduce the cap on the maximum permitted emissions. The factor will be changed from 1.74% to 2.2% from 2021 onwards which will lead to an additional emissions reduction in the sectors covered by the ETS of some 556 million tonnes over the decade − equivalent to the annual emissions of the UK.

Regulation for energy efficiency labelling

[84] 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

[85] http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/com_2015_0337_en.pdf

In July 2015 the Commission made a Proposal for a Regulation setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU[86]. This review of the Energy Labelling Directive aims at further exploiting the potential of energy efficiency especially with regard to the EU target of improving energy efficiency by 27% by 2030 compared to 2005. Consequently, it will lead to a moderation of energy demand and a reduction of the energy dependency of the European Union. The proposal follows up on the Energy Union Framework Strategy and intends to replace Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products. This proposal is made now following the evaluation of the Directive. Product specific regulations made under the Directive remain in force but will be reviewed. By common energy labelling within the EU customers can obtain accurate, relevant and comparable information on the energy efficiency and consumption of energy-related products wherever they are in the Union.

The Commission carried out an ex-post evaluation of the Energy Labelling Directive and specific aspects of the Ecodesign Directive, furthermore it carried out an impact assessment accompanying the proposal[87]. The final option chosen was to improve the existing regulatory framework on energy labelling, to require labelled products to be registered in a new database, improve the legal structure by changing the current Energy Labelling Directive to a Regulation, to align it with the market surveillance regulation, and to fund EU joint market surveillance actions.

Third countries are affected, because the A-G energy labelling scheme has been followed as a model in many different countries around the world and some countries have also implemented EU ecodesign regulations[88]. They are also affected through the Agreement on Technical Barriers to Trade which is to ensure that regulations, standards, testing and certification procedures do not create unnecessary obstacles, while also providing the right to implement measures to achieve legitimate policy objectives.

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.

---

[86] http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/com_2015_0341_en.pdf

[87] http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/swd_2015_0139_en.pdf

[88] http://www.ecofys.com/files/files/ec-2014-impacts-ecodesign-energy-labelling-on-third-jurisdictions.pdf

For the purposes of completeness in reporting, the EU addresses all subparagraphs specified in the reporting requirements, however the main ways how the EU is striving to minimize adverse impacts are described in the previous section.

a. **The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities**

The actions addressed in subparagraph a) also form part of the commitment to implement policies and measures requested under Article 2, paragraph 1(a) (v), however Article 2 specifies that Annex I Parties shall "implement and/or further elaborate policies and measures in accordance with national circumstances, such as progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors that run counter to the objective of the Convention and application of market instruments." Subparagraph a) in the reporting requirements lacks such objective and therefore seems somewhat inconsistent with the commitment under Article 2. The promotion of research, demonstration projects, fiscal incentives or carbon taxes is important instrument to advance the objectives of the Convention, e.g. the use of renewable energies. A progressive reduction of all fiscal incentives or subsidies in all GHG emitting sectors would run counter the objective of the Convention and counter the ability of the EU to meet its commitment under Article 3, paragraph 1 of the Kyoto Protocol. Therefore the EU interprets this reporting requirement in a way consistent with Article 2 paragraph 1(a)(v) that the EU should focus on the progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies that run counter the objectives of the Convention and application of market instruments.

The 2009 Review of the EU Sustainable Development Strategy assesses that *"the Commission has been mainstreaming the progressive reform of environmentally harmful subsidies into its sectoral policies"*. For instance, environmental concerns have been gradually incorporated into the EU Common Agricultural Policy, including "decoupled" direct payments which have replaced price support; environmental cross compliance; a substantial increase in budget for rural development. As part of 2008 Common Agriculture Policy Health Check, additional part of direct aid has been shifted to climate change, renewable energy, water management, biodiversity, innovation; - transparency of agricultural subsidies has improved. It is important to note that in the other areas most subsidies are within the competence of the Member States and not of the EU, within the limits established by EU state aid rules.

EU policies aim to address market imperfections and to reflect externalities. For example the EU has made significant efforts to liberalise the internal energy market and to create a genuine internal market for energy as one of its priority objectives. The existence of a competitive internal energy market is a strategic instrument both in terms of giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, but also in terms of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.

With the implementation of the EU Emissions Trading Scheme, the EU uses a market instrument to implement the objective of the Convention and its commitment under Article 3, paragraph 1 of the Kyoto Protocol which aims at creating the right incentives for forward looking low carbon investment decisions by reinforcing a clear, undistorted and long-term carbon price signal.

With respect to financial support provided by the Member States to undertakings, the EU Treaty pronounces a general prohibition of "State aid". This concept encompasses a broad range of financial support measures adopted at national or sub-national level (i.e. not at EU level), and which can take various forms (subsidies, tax relieves, soft loans…). The Treaty provides for exceptions to this general prohibition. When State aid measures can contribute in an appropriate manner to the furtherance of objectives of common interest for the EU, and provided that they comply with certain strict conditions, they may be authorised by the Commission. By complementing the fundamental rules through a series of legislative acts and guidelines, the EU has established a worldwide unique system of rules under which State aid is monitored and assessed in the European Union. This legal framework is regularly reviewed to improve its efficiency. EU State aid control is an essential component of competition policy and a necessary safeguard for effective competition and free trade.

State aid reform in the EU aims to redirect aid to objectives of common interest which are related to the EU Lisbon Treaty, such as R&D&I, risk capital measures, training, and environmental protection. Environmental protection, and in particular, the promotion of renewable energy and the fight against climate change, is considered one of the objectives of common interest for the EU which may, under certain circumstances, justify the granting of State aid.

Specific “Community Guidelines on State aid for Environmental Protection”[89] 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 State aid for environmental protection and energy 2014-2020” that intend to replace the 2008 Guidelines from 1 July 2014 **onwards**. 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)

[89] Official Journal No C 82, 1.4.2008, p.1

- o 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
- o Aid to energy infrastructure
- o Aid for generation adequacy
- 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. The final carbon leakage list for 2015-19 **was** adopted by the Commission **on October 27th,** 2014[90] **after the draft list had been published on** 5 May 2014 and applie**s** to free allocation for the first time in 2015. **According to the ETS Directive, it will be possible to add further sectors to the list if they comply with the criteria stated in the Directive, but it will not be possible to remove sectors from the list until its expiration.**

The Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments builds on the positive experience with the harmonised rules implemented since 2013, by further developing predictable, robust and fair rules for free allocation of allowances to industry during the fourth trading period (2021-2030) to address the potential risk of carbon leakage in an adequate manner. This includes:

- **Revising the system of free allocation to focus on sectors at highest risk of relocating their production outside the EU – around 50 sectors in total.**

---

[90] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0746&from=EN

- **A considerable number of free allowances set aside for new and growing installations.**
- **More flexible rules to better align the amount of free allowances with production figures.**
- **Update of benchmarks to reflect technological advances since 2008.**

Several support mechanisms will be established to help the industry and the power sectors meet the innovation and investment challenges of the transition to a low-carbon economy. These include two new funds:

- **Innovation Fund – extending existing support for the demonstration of innovative technologies to breakthrough innovation in industry.**
- **Modernisation Fund – facilitating investments in modernising the power sector and wider energy systems and boosting energy efficiency in 10 lower-income Member States.**

b. **Removing subsidies associated with the use of environmentally unsound and unsafe technologies**

There is no clear definition of environmentally unsound and unsafe technologies; therefore the EU interprets this provision in the context of the Kyoto Protocol that unsound and unsafe technologies would be those increasing GHG emissions.

The phase-out of subsidies to fossil fuel production and consumption by 2010 was one of the objectives in the Communication from the Commission "A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development (Commission's proposal to the Gothenburg European Council, 2001)".[91]

Council Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of uncompetitive coal mines adopted a new coal regulation enabling Member States to grant State aid to facilitate the closure of uncompetitive mines until 2018, following the expiry of the current Coal Regulation (Council Regulation (EC) N° 1407/2002 of 23 July 2002) on 31 December 2010. The decision includes the following main elements:

- the possibility of continuing to grant, under certain conditions, public aid to the coal industry with a view to facilitating the closure of uncompetitive hard coal mines until December 2018;
- the modalities for the phasing-out of the aid, under which the overall amount of aid granted by a member state must follow a downward trend, in order to prevent undesirable effects of distortion of competition in the internal market. Subsidies will have to be lowered by at least 25% until 2013, by 40% until 2015, by 60% by 2016 and by 75% by 2017;
- the obligation for member states granting aid to provide a plan on intended measures to mitigate the environmental impact of the production of coal; and
- the possibility of allowing subsidies, until December 2027, in order to cover exceptional expenditure in connection with the closure of mines that are not related to production, such as social welfare benefits and rehabilitation of sites.

In March 2015 the European Commission's Directorate-General for Economic and Financial Affairs published an article called "Measuring Fossil Fuel Subsidies"[92] in its Economic Brief which aims to shed some light on the true magnitude and allocation of

[91] See http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0264en01.pdf

[92] http://ec.europa.eu/economy_finance/publications/economic_briefs/2015/pdf/eb40_en.pdf

fossil fuel subsidies so as to enable comparisons between countries and regions to provide background to policy discussions.

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. **The first phase of NZEC was completed between 2006 and 2009. Four research and development projects financed by the European Commission and UK involving Chinese and European academic organizations, companies and government bodies made significant progress in identifying options and constraints for CCS in China.**

Phase II of NZEC **(planned between 2010 and 2012)** 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 **(to be completed by 2020)** 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 2009b). 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.. 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.

The EU is cooperating with other Annex I and Non-Annex I Parties (Australia, Brazil, Canada, China, France, Germany, Greece, India, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, **Romania,** Russian Federation, Saudi Arabia, **Serbia,** 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 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 **are** held **each year**, such as the 2013 and 2014 CSLF Technical Group Meeting, **the 2014 CSLF Policy Group Meeting,** the **6th** CSLF Ministerial Meeting **in 2015 and others**. 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 across 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 2013a). 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 **(enhanced oil recovery)** 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 **(CSLF 2013b)**. **Following up on this the Task Force on Technical Barriers and R&D Opportunities for Offshore, Sub-Seabed Storage of CO_2 provides an overview of the current technology status, technical barriers, and research and development (R&D) opportunities associated with offshore, sub-seabed geologic storage of carbon dioxide (CO_2) in a 2015 report. Recommendations are the development of public-private partnerships to provide a number of pre-qualified storage locations and thereby reducing the uncertainty regarding the availability of storage. It is also recommends that an increased level of knowledge sharing and discussion be implemented among the international community to outline the potential for international collaboration in offshore storage. The authors state furthermore that especially during the early phase of CCS, public-private partnership is essential to generate large infrastructural works concerning the CO_2 transport and that financial incentives as well as funding mechanisms should be**

implemented. It is furthermore recommended to expand upon modeling efforts to understand CO_2 dispersion in an ocean environment (CSLF 2015a).

The Task Force on Supporting Development of 2nd and 3rd Generation Carbon Capture Technologies identified around 30 groups of 2nd and 3rd generation CO_2 capture technologies in a report published in 2015. The overview given also shows their potential for energy savings and their possible applications. A central finding of the report is that many technologies are developed by universities or small R&D companies that do not have the facilities, financial resources, and competence, to develop technologies beyond the lab or small bench scale without external support by others and access to larger test facilities. The authors recommend that mechanisms are implemented which help to establish cooperation of developers by bi- and/or multi-lateral agreements and funding mechanisms that allow emerging technologies to be tested at another nation's facilities (CSLF 2015b).

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)[93], 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 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

[93] The Gulf Cooperation Council covers Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

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. The dialogue focused on energy efficiency and natural gas, and included EU market regulators and the private sector, as well as representatives of the EU-GCC clean energy network. **In December 2015, the European Union launched the "EU GCC Clean Energy Network II" (CENII) project aiming at further developing the activities of the Network and at supporting its sustainability over the mid-term.**

Energy efficiency activities in the upstream or downstream sector are also candidates for CDM projects. Thus, the development of the CDM under the Kyoto Protocol and the demand of CERs by Annex I Parties under the Kyoto Protocol as well as by operators under the EU ETS have fostered such activities performed by the private sector. Related CDM projects are for example:

- Rang Dong Oil Field Associated Gas Recovery and Utilization Project in Vietnam: The purpose of this project activity is the recovery and utilization of gases produced as a by-product of oil production activities at the Rang Dong oil field in Vietnam with the involvement of ConocoPhillips (UK).
- Recovery of associated gas that would otherwise be flared at Kwale oil-gas processing plant in Nigeria involves the capture and utilisation of the majority of associated gas previously sent to flaring at Kwale OGPP plant. The Kwale OGPP plant receives oil with associated gas from oil fields operated by Eni Nigeria Agip Oil Company.
- Recovery and utilization of associated gas produced as by-product of oil recovery activities at the Al-Shaheen oil field in Qatar.
- Flare gas recovery and utilisation project at Uran oil and gas processing plant in India which is handling the oil and gas produced in the Mumbai High offshore oil field.
- Flare gas recovery and utilisation project at Hazira gas and condensate processing plant in India.
- Flare gas recovery and utilisation project from Kumchai oil field in India.
- Flare gas recovery and utilisation project at the Ovade-Ogharefe oil field operated by Pan Ocean Oil Corporation in Nigeria.
- Flare gas recovery and utilisation project at Soroosh and Nowrooz offshore oil fields in Iran.
- Leak reduction in aboveground gas distribution equipment in the KazTransgaz-Tbilisi gas distribution system in Georgia where leakages at gate stations, pressure regulator stations, valves, fittings as well at connection points with consumers are reduced.
- There are currently 21 Coal Mine Methane Utilization Project in China which use coalmine methane previously released to the atmosphere.

Improved energy efficiency in the energy and the transport sector in a more general way is one of the priorities in the EU's development assistance as well as for the EIB (European Investment Bank) and the EBRD (European Bank for Reconstruction and Development). The EIB has also developed other means of financing, such as equity and carbon funds, to further support renewable energy and energy-efficiency projects (see here GEEREF and the Mediterranean Solar Plan, MSP). Related projects and specific activities can be found for example at

http://www.eib.org/projects/topics/environment/renewable-energy/index.htm or
http://www.ebrd.com/saf/search.html?type=eia

***f.* Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.**

The EU actively undertakes a large number of activities aiming at reducing dependence on the consumption of fossil fuels, in particular the EU supports 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 **and 2nd** Biennial Report**s** several support programmes exist in this respect. These include:

- *Cooperation with the EU neighbouring 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.[94]

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 **(IRENA)** 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.

[94] http://www.eib.org/infocentre/publications/all/mediterranean-solar-plan-project-preparation-initiative.htm

- *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. **Following the successful implementation of the first EF, it was decided to create a second EF, which has later been extended to include more projects than originally foreseen. Therefore, a total of four Calls for Proposals have been made under the EF: one under the first EF with a budget of EUR 196 million and three under the second EF with a budget of EUR 100 million for the 1st call (launched in November 2009, resulted in the selection of 65 projects for funding), EUR 132 million for the 2nd call (targeting rural electrification) and EUR 15 million for the 3rd call (targeting fragile states). A total of 173 projects were selected to receive support to increase the population's access to energy, and a total project budget of app. EUR 800 million has been funded by the EU and other donors. Most projects of the first EF have now ended or are about to be finalized. Many of the projects from the second EF first call have also ended or have been extended. The second and third call projects of the second EF are either under implementation or about to start.** . Almost 15 million people should benefit of an improved access to energy mostly utilising Renewable Energy technologies.

The main activities performed through Energy Facility projects can be classified into three different groups: (1) energy production, transformation and distribution, (2) extension of existing electricity grids and (3) "soft" activities such as governance, capacity building or feasibility studies. The sources of energy used for electricity generation were mainly renewable energies (77 % of the projects). Only one project using exclusively fossil fuels was funded. In total, € 81 million of commitments have been marked as climate change related under the Energy Facility, covering support to enhance use of renewable energies or increase energy efficiency. A replenishment of the ACP-EU Energy Facility has been decided under the 10th European Development Fund for the period of 2009-2013. Endowed **originally** with € 200 Million, it focuses on improving access to safe and sustainable energy services in rural and peri-urban areas. The second 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 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) **in 2010. The European Commission allocated to LAIF for the period 2009-2014 an overall amount of €227.7 million, while the initial allocation for the year 2015 is €30 million.**

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).

For the period 2010-2014, 25 projects were approved for grant financing of €190.1 million, representing total lending of approximately €5 billion and total investment cost of approximately €6.3 billion.

- *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 **Emerging Energy** 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 €10 million from GEEREF for their South East Asia Clean Energy Fund.
- **GEEREF has also committed USD 13 million to the Caucasus Clean Energy Fund, managed by Schulze Global Investments which is a private equity fund that invests in small and medium scale hydropower plants in the Republic of Georgia.**
- **€10.0 million were furthermore committed to the MGM Sustainable Energy Fund, managed by MGM Innova Capital LLC providing equity and mezzanine financing to projects in the demand-side energy efficiency and renewable energy sectors in Colombia, Mexico, Central America and the Caribbean region.**
- **Additionally, €12 million were committed to SolarArise India Projects Private Limited, an India focused solar asset vehicle.**

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. Further financing from other public and private sources **was fundraised by** GEEREF **increasing the total funds under management to € 222 million as of May 2015. GEEREF invests in private equity funds which, in turn, invest in private sector projects, thereby further enhancing the leveraging effect of GEEREF's investments. It is estimated that, with € 222 million of funds under management, over €10 billion could be mobilised through the funds in which GEEREF participates and the final projects in which these funds invest.**

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

15.3 EU neighbourhood policy

Through its European Neighbourhood Policy (ENP), the EU works with its southern and eastern neighbours to achieve the closest possible political association and the greatest possible degree of economic integration. Energy policy and diplomacy also plays an important role in ENP especially in relation to the newly established Energy Union.

The Energy Union Communication ("A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy") of 25 February 2015 and the European Council Conclusions of 19-20 March 2015 recognised the importance of the external dimension of the Energy Union and asked for greater engagement on energy and climate diplomacy. In particular, Action Point 15 of the Energy Union Communication states:

- **The EU will use all external policy instruments to ensure that a strong, united EU engages constructively with its partners and speaks with one voice on energy and climate.**
- **The Commission, with the HR/VP, and the Member States will revitalise the EU's energy and climate diplomacy.**
- **The Commission, with the HR/VP, will develop an active agenda to strengthen EU energy cooperation with third countries, including on renewable energy and energy efficiency.**
- **The Commission will make full use of the EU's external trade policy to promote access to energy resources and to foreign markets for European energy technology and services.**

On 20 July 2015, the Foreign Affairs Council adopted Council Conclusions on EU Energy Diplomacy, which included an EU Energy Diplomacy Action Plan. The Action Plan has four pillars:

1. **Strengthen strategic guidance through high-level engagement.**
2. **Establish and further develop energy cooperation and dialogues, particularly in support of diversification of sources, suppliers and routes.**
3. **Support efforts to enhance the global energy architecture and multilateral initiatives.**
4. **Strengthen common messages and energy diplomacy capacities.**

The EEAS (European External Action Service) works closely with the Commission and the EU Member States to ensure the follow-up of the EU Energy Diplomacy Action Plan.

IRENA is the International Renewable Energy Agency that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA, founded in 2009, promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. 145 countries of the world (including the EU) are members of IRENA, 31 more are states in accession. The permanent headquarter is located in Masdar City, Abu Dhabi.

16 References

Council of the European Union 2015: Council conclusions on Energy Diplomacy / EU Energy Diplomacy Action Plan. Available at:
http://data.consilium.europa.eu/doc/document/ST-10995-2015-INIT/en/pdf

CSLF (Carbon Sequestration Leadership Forum) 2013a: Technical Group – 2013 Annual Report by the CSFL Task Force on Reviewing Best Practices and Standards for Geological Storage and Monitoring of CO_2. Available at:
http://www.cslforum.org/publications/documents/ReviewingBestPracticesStandards_2013Report.pdf

CSLF (Carbon Sequestration Leadership Forum) 2013b: Final report by the Task Force on Technical Challenges of Conversion of CO_2-EOR Projects to CO_2 Storage Projects. Available at:
http://www.cslforum.org/publications/documents/CO2-EORtoCCS_FinalReport.pdf

CSLF (Carbon Sequestration Leadership Forum) 2015a: Final report by the Task Force on Technical Barriers and R&D Opportunities for Offshore, Sub-Seabed Storage of CO_2. Available at:
http://www.cslforum.org/publications/documents/OffshoreStorageTaskForce_FinalCombinedReport.pdf

CSLF (Carbon Sequestration Leadership Forum) 2015b: Task Force on Supporting Development of 2nd and 3rd Generation Carbon Capture Technologies. Available at:

http://www.cslforum.org/publications/documents/2nd3rdGenerationCO2CaptureTechnologies-FinalReport.pdf

Ecofys and consortium 2012: Renewable energy progress and biofuels sustainability, Report produced for the European Commission, September 2012. Available at: http://ec.europa.eu/energy/renewables/reports/doc/2013_renewable_energy_progress.pdf

Ecofys and consortium 2014a: Renewable energy progress and biofuels sustainability. Report produced for the European Commission, November 2014. Available at:
https://ec.europa.eu/energy/sites/ener/files/documents/Final%20report%20-November%202014.pdf

Ecofys and consortium 2014b: Impacts of the EU's Ecodesign and Energy/Tyre labelling legislation on third jurisdictions. Available at:
http://www.ecofys.com/files/files/ec-2014-impacts-ecodesign-energy-labelling-on-third-jurisdictions.pdf

European Commission 2002 (Directorate General for Energy and transport): Inventory of public aid granted to different energy sources. Working document from the services of the Commission.

European Commission 2006: Commission staff working document, Accompanying document to the proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community Impact Assessment of the inclusion of aviation activities in the scheme for greenhouse gas emission allowance trading within the Community SEC(2006) 1648, COM(2006) 818 final.

European Commission 2007a: Commission Report on the Application of Council Regulation (EC) No 1407/2002 on State Aid to the Coal Industry, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 21.5.2007, SEC(2007) 602, COM(2007) 253 final.

European Commission 2007b: Commission staff working document, Annex to the Commission Report on the Application of Council Regulation (EC) No 1407/2002 on State Aid to the Coal Industry, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 21.5.2007, SEC(2007) 602, COM(2007) 253 final

European Commission 2009a: Impact Assessment Guidelines, 15 January 2009, (SEC(2009)92)

European Commission 2009b: Carbon Capture and Geological Storage (CCS) in emerging developing countries: financing the EU-China Near Zero Emissions Coal Plant project. IP/09/1022. Available at:http://europa.eu/rapid/press-release_IP-09-1022_en.htm?locale=en

European Commission 2011a: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions: A Roadmap for moving to a competitive low carbon economy in 2050 (COM(2011)112 final, available at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF

European Commission 2011b: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions: A

resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy. COM (2011)21. Available at:
http://ec.europa.eu/resource-efficient-europe/pdf/resource_efficient_europe_en.pdf

European Commission 2012a: Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. Brussels, 17.10.2012, COM(2012) 595 final. Available at:
http://ec.europa.eu/energy/renewables/biofuels/doc/biofuels/com_2012_0595_en.pdf

European Commission 2012b: Communication from the Commission: Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012. 2012/C 158/04, OJ 5.6.2012, C 158/4) available at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2012:158:0004:0022:EN:PDF

European Commission 2013a: 2013 Renewable Energy Progress Report, COM(2013) 175, 27.3.2013 Available at:
http://eur-lex.europa.eu/legal-content/EN/X/PDF/?uri=CELEX:52013DC0175&from=EN.

European Commission 2014a: 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 2020 to 2030. Available at :
http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2014/com_2014_0015_en.pdf

European Commission 2014b: Commission staff working document – Impact Assessment accompanying the document A policy framework for climate and energy in the period from 2020 up to 2030 (SWD(2014) final. Available at :
http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2014/swd_2014_0015_en.pdf

European Commission 2014c: Paper of the Services of DG Competition containing draft Guidelines on envrionmental and energy aid for 2014-2020. Available at :
http://ec.europa.eu/competition/consultations/2013_state_aid_environment/draft_guidelines_en.pdf

European Commission 2015a: Better Regulation Guidelines. Available at:
http://ec.europa.eu/smart-regulation/guidelines/toc_guide_en.htm

with the accompanying toolbox, available at:
http://ec.europa.eu/smart-regulation/guidelines/docs/br_toolbox_en.pdf

European Commission 2015b: Second Biennial Report of the European Union under the UN Framework Convention on Climate Change. Submission date: 17 Dec. 2015. Available at :
http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/eu_second_biennial_report_under_the_unfccc_%282%29.pdf

European Commission 2015c: 2015 Renewable Energy Progress Report, COM(2015) 293, 15.6.2015 Available at:
http://eur-lex.europa.eu/resource.html?uri=cellar:4f8722ce-1347-11e5-8817-01aa75ed71a1.0001.02/DOC_1&format=PDF

with its Annex, 15.6.2015, available at:
http://eur-lex.europa.eu/resource.html?uri=cellar:4f8722ce-1347-11e5-8817-01aa75ed71a1.0001.02/DOC_2&format=PDF

and its accompanying Staff Working Document, 15.6.2015, available at:
http://eur-lex.europa.eu/legal-content/EN/x/PDF/?uri=CELEX:52015SC0117&rid=2

European Commission 2015d: Proposal for a Regulation setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU. COM(2015)341. Available at:
http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/com_2015_0341_en.pdf

European Commission 2015e: Impact Assessment accompanying the document Proposal for a Regulation setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU. Available at:
http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/swd_2015_0139_en.pdf

European Commission 2015f: Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments. Available at:
http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/com_2015_0337_en.pdf

European Commission 2015g: Measuring Fossil Fuel Subsidies. In : ECFIN Economic Briefs 40. March 2015. Brussels. Available at:
http://ec.europa.eu/economy_finance/publications/economic_briefs/2015/pdf/eb40_en.pdf

European Commission 2015h: A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy. Energy Union Package. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank. Available at:
http://eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF

European Union (2009): Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, available at:
http://eur-lex.europa.eu/legal-content/EN/x/PDF/?uri=CELEX:32009L0028&from=EN

European Union (2015): Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources, available at:
http://eur-lex.europa.eu/legal-content/EN/x/PDF/?uri=CELEX:32015L1513&from=EN

Hamelinck, C., Koper, M., Berndes, G., Englund, O., Diaz-Chavez, R., Kunen, E., Walden, D. 2011: Biofuels Baseline 2008. Report from Ecofys, Winrock International, Chalmers University, Centre for Climate Science and Policy Research, Linköping University, ICRISAT, Potsdam-Institute for Climate Impact Research and Stockholm Environment Institute for DG TREN), available at:
http://ec.europa.eu/energy/renewables/studies/doc/biofuels/2011_biofuels_baseline_2008.pdf

Luciani, G. 2005: EUROGULF: An EU-GCC Dialogue for energy stability and sustainability. Final research report as presented at the concluding conference in Kuweit, 2-3 April 2005.

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
CAPRI	Common Agricultural Policy Regional Impact Assessment model (http://www.capri-model.org/)
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
NUTS	Nomenclature of Territorial Units for Statistics
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				

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**
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				
T2 — IPCC Tier 2				
T3 — IPCC Tier 3				