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Annual European Union greenhouse gas inventory 1990–2015 and inventory report 2017

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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 2017 under the UNFCCC and the Kyoto Protocol (KP).

The EU, its Member States and Iceland have agreed to fulfil their quantified emission limitation and reduction commitments under Article 3 of the Kyoto Protocol for the second commitment period to the Kyoto Protocol jointly, in accordance with the provisions of Article 4 thereof. The Union, its Member States and Iceland agreed to a quantified emission reduction commitment that limits their average annual emissions of greenhouse gases during the second commitment period to 80 % of the sum of their base year emissions, which is reflected in the Doha Amendment. Article 4 of the Kyoto Protocol requires parties that agree to fulfil their commitments under Article 3 of the Kyoto Protocol jointly to set out in the relevant joint fulfilment agreement the respective emission level allocated to each of the parties. Council Decision (EU) 2015/1339 sets out the terms of the joint fulfilment agreement as well as the respective emission levels of each Party to that agreement. The emission levels define the Member States' and Iceland's assigned amounts for the second commitment period. These emission levels have been determined on the basis of the existing Union legislation for the period 2013-2020 under the 'Climate and Energy package'.

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 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[1].

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;
d) monitoring, reporting, reviewing and verifying GHG emissions and other information pursuant to Article 6 of Decision No 406/2009/EC;

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

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 and Iceland, making up the EU-28 (Convention) and EU-28 plus Iceland (KP), respectively. Energy data from Eurostat are used for the reference approach for CO_2 emissions from fossil fuels, developed by the Intergovernmental Panel on Climate Change (IPCC).

The main institutions involved in the compilation of the EU GHG inventory are the 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:

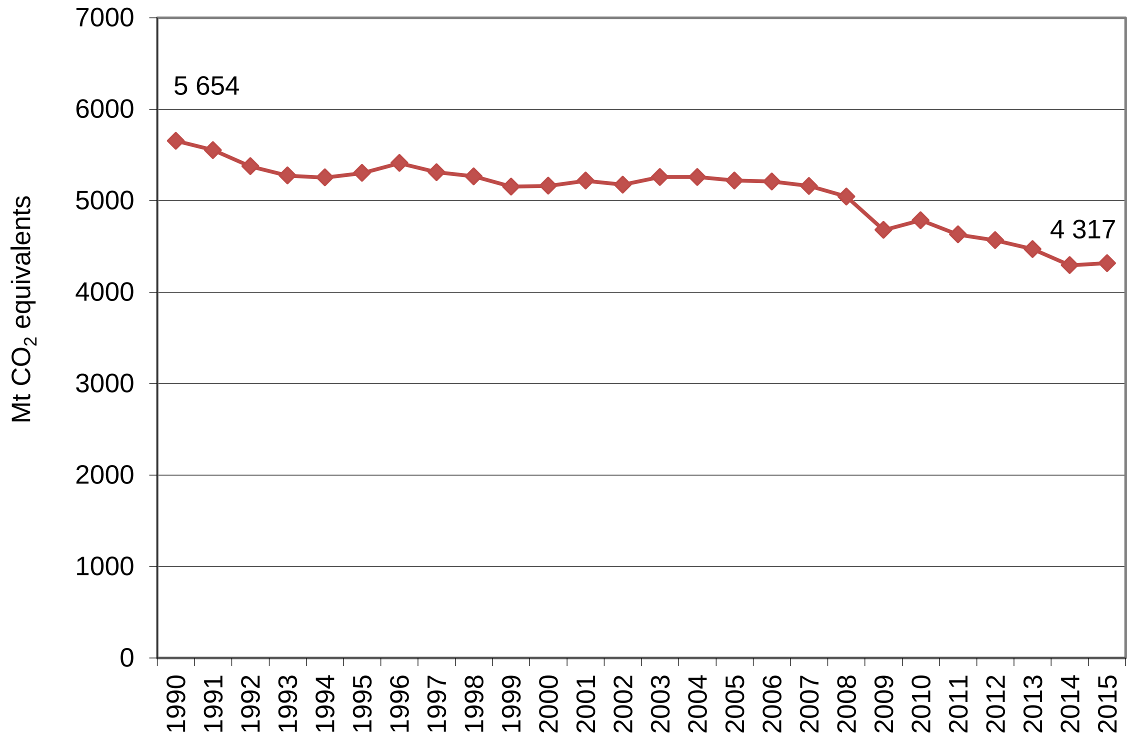
1. Member States submit their draft GHG inventories by 15 January each year to the European Commission (DG CLIMA), with a copy to the EEA.
2. The EEA and its ETC/ACM, Eurostat, and the JRC then perform initial checks on the data submitted. Specific findings from the initial quality assurance/quality 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 final GHG inventories 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, should Member States revise their inventories by 8 May.

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 4 317 million tonnes CO_2 equivalent in 2015 (including indirect CO_2 emissions). All GHG emission totals provided in this report include indirect CO_2 emissions2.

In 2015, total GHG emissions were 23.6 % (1 336 million tonnes CO_2 equivalents) below 1990 levels. Emissions increased by 0.5 % (23 million tonnes CO_2 equivalent) between 2014 and 2015 (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).

[2] According to the UNFCCC reporting guidelines, Annex I Parties may report indirect CO_2 from the atmospheric oxidation of CH_4, CO and NMVOCs. For Parties that decide to report indirect CO_2, the national totals 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.

Main trends by source category, 1990-2015

Total GHG emissions (excluding LULUCF) decreased by 1336 million tonnes since 1990 (or 23.6 %) to reach 4317 Mt CO_2 eq. in 2015. There has been a progressive decoupling of gross domestic product (GDP) and GHG emission compared to 1990, with an increase in GDP of about 50% alongside a decrease in emissions of almost 24 % over the period.

The reduction in GHG emissions over the 25-year period was due to a variety of factors, including the growing share in the use of renewables, the use of less carbon intensive fuels and improvements in energy efficiency, as well as to structural changes in the economy and the economic recession. Demand for energy to heat households has also been lower, as Europe on average has experienced milder winters since 1990, which has also helped reduce emissions.

GHG emissions decreased in the majority of sectors between 1990 and 2015, with the notable exception of transport, including international transport, and refrigeration and air conditioning. At the aggregate level, emission reductions were largest for manufacturing industries and construction, electricity and heat production, and residential combustion. The largest decrease in emissions in relative terms was in waste management (over 40 % reduction compared to 1990)

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 total GDP. The economic recession that began in the second half of 2008 and continued through to 2009 also had an impact on emissions from industrial sectors. Emissions from electricity and heat production decreased strongly since 1990. In addition to improved energy efficiency there has been a move towards less carbon intense fuels. Between 1990 and 2015, the use of solid and liquid fuels in thermal stations decreased strongly whereas natural gas consumption doubled, resulting in reduced CO2 emissions per unit of fossil energy generated. Emissions in the residential sector also represented one of the largest reductions. Energy efficiency improvements from better insulation standards in buildings and a less carbon-intensive fuel mix can partly explain lower demand for space heating in the EU as a whole over the past 25 years. Since 1990 there has been a gradual warming of the autumn/winter period in Europe; although there is high regional variability. The very strong increase in the use of biomass for energy purposes has also contributed to lower GHG emissions in the EU.

In terms of the main GHGs, CO2 was responsible for the largest reduction in emissions since 1990. Reductions in emissions from N2O and CH4 have been substantial, reflecting lower levels of mining activities, lower agricultural livestock, as well as lower emissions from managed waste disposal on land and from agricultural soils. A number of policies (both EU and country-specific) have also contributed to the overall reduction in GHG emissions, including key agricultural and environmental policies in the 1990s and climate and energy policies in the 2000s.

Almost all EU Member States reduced emissions compared to 1990 and thus contributed to the overall positive EU performance. The United Kingdom and Germany accounted for about 48 % of the total net reduction in the EU over the past 25 years.

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 2015.

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 1990–2015

Source category	Million tonnes (CO2 equivalents)
Road Transportation (CO2 from 1.A.3.b)	142
Refrigeration and Air conditioning (HFCs from 2.F.1)	97
Fugitive emisisons from Natural Gas (CH4 from 1.B.2.b)	-21
Aluminium Production (PFCs from 2.C.3)	-21
Agricultural Soils: Direct N2O Emissions From Managed Soils (N2O from 3.D.1)	-26
Cement Production (CO2 from 2.A.1)	-28
Fluorochemical Production (HFCs from 2.B.9)	-29
Commercial/Institutional (CO2 from 1.A.4.a)	-43
Enteric Fermentation: Cattle (CH4 from 3.A.1)	-44
Nitric Acid Production (N2O from 2.B.2)	-45
Adipic Acid Production (N2O from 2.B.3)	-57
Manufacture of Solid Fuels and Other Energy Industries (CO2 from 1.A.1.c)	-62
Coal Mining and Handling (CH4 from 1.B.1.a)	-67
Managed Waste Disposal Sites (CH4 from 5.A.1)	-78
Iron and steel production (CO2 from 1.A.2.a +2.C.1)	-106
Residential: Fuels (CO2 from 1.A.4.b)	-126
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1.A.2 excl. 1.A.2.a)	-279
Public Electricity and Heat Production (CO2 from 1.A.1.a)	-373
Total	**-1336**

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, 2014–2015

Total GHG emissions (excluding LULUCF) increased for the first time since 2010 by 23.1 million tonnes, or 0.5°% compared to 2014, to reach 4317 Mt CO_2 equivalent in 2015. This small increase in emissions came along with an increase in GDP of 2.2°%, the largest increase since the economic crisis started in the second half of 2008.

The increase in emissions was triggered by the higher heat demand by households and services due to slightly colder winter conditions in Europe, as well as by higher road transport demand, which increased for the second year in a row.

Total energy consumption increased overall, with fossil emissions increasing, particularly for natural gas and crude oil. The consumption and emissions of solid fuels decreased in 2015 for the third consecutive year. The sustained increase in renewables, particularly biomass, wind and solar, offset otherwise higher emissions in 2015. Hydro (due to a low rainfall) and nuclear electricity production declined in 2015.

In spite of the 2015 increase in emissions, there were further improvements in the carbon intensity of the EU energy system because of the increased shares of renewables and gas relative to coal in the fuel mix. The energy intensity of GDP also improved as total energy consumption increased less rapidly than economic growth. The improvement in energy intensity was largely driven by lower energy-transformation losses and better energy efficiency of the overall EU economy.

Spain, Italy and the Netherlands accounted for the largest increases in GHG emissions in the EU in 2015. The UK recorded the largest reduction.

Table ES. 2 shows the source categories making the largest contribution to the change in GHG emissions in the EU-28 between 2014 and 2015.

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 2014–2015

Source category	Million tonnes (CO2 equivalents)
Residential: Fuels (CO2 from 1.A.4.b)	20
Road Transportation (CO2 from 1.A.3.b)	14
Commercial/Institutional (CO2 from 1.A.4.a)	6
Managed Waste Disposal Sites (CH4 from 5.A.1)	-4
Refrigeration and Air conditioning (HFCs from 2.F.1)	-5
Public Electricity and Heat Production (CO2 from 1.A.1.a)	-13
Total	**23**

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)	2015 (million tonnes)	2014-2015 (million tonnes)	Change 2014-2015 (%)	Change 1990–2015 (%)
Austria	78.8	78.9	2.5	3.2%	0.1%
Belgium	146.3	117.4	3.4	2.9%	-19.7%
Bulgaria	103.7	61.5	4.0	6.9%	-40.7%
Croatia	31.2	23.5	0.5	2.0%	-24.6%
Cyprus	5.6	8.4	0.0	0.1%	50.0%
Czech Republic	197.9	127.9	1.3	1.0%	-35.4%
Denmark	70.4	48.3	-2.5	-4.9%	-31.3%
Estonia	40.4	18.0	-3.0	-14.4%	-55.3%
Finland	71.3	55.6	-3.6	-6.0%	-22.1%
France	547.1	457.1	3.6	0.8%	-16.4%
Germany	1250.9	901.9	-2.3	-0.3%	-27.9%
Greece	103.1	95.7	-3.6	-3.7%	-7.1%
Hungary	93.9	61.1	3.2	5.6%	-34.9%
Ireland	56.1	59.9	2.1	3.7%	6.7%
Italy	519.9	433.0	9.7	2.3%	-16.7%
Latvia	26.2	11.3	0.1	1.0%	-56.8%
Lithuania	48.0	20.1	0.2	1.1%	-58.2%
Luxembourg	12.7	10.3	-0.5	-4.5%	-19.3%
Malta	2.4	2.2	-0.7	-24.0%	-6.5%
Netherlands	221.4	195.2	7.7	4.1%	-11.8%
Poland	467.9	385.8	2.9	0.8%	-17.5%
Portugal	59.6	68.9	4.6	7.1%	15.7%
Romania	246.3	116.4	1.0	0.9%	-52.7%
Slovakia	74.5	41.3	0.6	1.5%	-44.6%
Slovenia	18.6	16.8	0.2	1.3%	-9.5%
Spain	287.8	335.7	11.4	3.5%	16.6%
Sweden	71.6	53.7	-0.1	-0.3%	-25.1%
United Kingdom	793.6	503.5	-19.4	-3.7%	-36.6%
EU-28	**5647.1**	**4309.6**	**23.2**	**0.5%**	**-23.7%**
Iceland	3.5	4.5	0.1	1.9%	28.1%
United Kingdom (KP)	796.8	506.8	-19.6	-3.7%	-36.4%
EU-28 + ISL	**5653.9**	**4317.4**	**23.1**	**0.5%**	**-23.6%**

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 1990–2015. By far the most important GHG is CO_2, which accounted for 81°% of total EU-28 emissions in 2015, excluding LULUCF. In 2015, EU-28 CO_2 emissions excluding LULUCF were 3 506 million tonnes, which was 22°% below 1990 levels. Compared to 2014, CO_2 emissions increased by 0.8°%. Emissions of CH_4, HFCs, and NF_3 decreased in 2015, while those of N_2O, PFCs and SF_6 increased.

Table ES. 4 Overview of EU-28 plus Iceland GHG emissions and removals from 1990 to 2015 in million tonnes CO_2 equivalent

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Net CO_2 emissions/removals	4 222	3 932	3 857	3 970	3 608	3 474	3 415	3 323	3 157	3 190
CO_2 emissions (without LULUCF)	4 467	4 208	4 171	4 298	3 939	3 795	3 738	3 651	3 476	3 506
CH_4	739	675	617	556	501	491	486	473	467	464
N_2O	399	362	319	299	253	249	247	246	249	250
HFCs	29	44	53	73	102	105	108	111	113	108
PFCs	26	17	12	7	4	4	4	4	4	4
Unspecified mix of HFCs and PFCs	5.8	5.6	1.8	1.0	0.5	0.3	0.3	0.3	0.2	0.2
SF_6	11	15	11	8	6	6	6	6	6	6
NF_3	0.02	0.10	0.10	0.16	0.12	0.13	0.09	0.07	0.07	0.07
Total (with net CO_2 emissions/removals)	**5 432**	**5 050**	**4 872**	**4 915**	**4 476**	**4 331**	**4 266**	**4 164**	**3 995**	**4 023**
Total (without CO2 from LULUCF)	**5 676**	**5 326**	**5 186**	**5 243**	**4 807**	**4 651**	**4 590**	**4 492**	**4 315**	**4 339**
Total (without LULUCF)	**5 654**	**5 302**	**5 162**	**5 221**	**4 785**	**4 630**	**4 567**	**4 472**	**4 294**	**4 317**

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 1990–2015. The most important sector by far is energy (i.e. combustion and fugitive emissions), which accounted for 78°% of total EU emissions in 2015. 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 2015

GHG SOURCE AND SINK	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
1. Energy	4 341	4 075	4 009	4 113	3 795	3 648	3 605	3 518	3 333	3 362
2. Industrial Processes	518	498	454	461	392	389	376	374	380	376
3. Agriculture	549	479	465	441	426	427	425	428	435	438
4. Land-Use, Land-Use Change and Forestr	-222	-252	-291	-306	-310	-299	-301	-308	-299	-295
5. Waste	241	246	231	203	170	164	159	151	145	140
6. Other	0	0	0	0	0	0	0	0	0	0
indirect CO_2 emissions	4.39	3.71	2.71	2.35	2.01	1.91	1.84	1.72	1.65	1.66
Total (with net CO_2 emissions/removals)	**5 432**	**5 050**	**4 872**	**4 915**	**4 476**	**4 331**	**4 266**	**4 164**	**3 995**	**4 023**
Total (without LULUCF)	**5 654**	**5 302**	**5 162**	**5 221**	**4 785**	**4 630**	**4 567**	**4 472**	**4 294**	**4 317**

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 1990–2015. 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 2015 in million tonnes CO_2-equivalent

Member State	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Austria	79	80	81	93	85	83	80	80	76	79
Belgium	146	154	149	145	132	122	119	119	114	117
Bulgaria	104	74	59	64	60	66	61	55	58	61
Croatia	31	22	25	29	27	27	25	24	23	24
Cyprus	5.6	7.0	8.3	9.3	9.6	9.3	8.8	8.0	8.4	8.4
Czech Republic	198	157	149	148	140	138	134	131	127	128
Denmark	70	78	71	66	63	58	53	55	51	48
Estonia	40	20	17	19	21	21	20	22	21	18
Finland	71	72	70	70	76	68	62	63	59	56
France	547	544	552	553	511	484	483	482	453	457
Germany	1 251	1 121	1 043	992	942	922	927	945	904	902
Greece	103	109	126	136	118	115	112	102	99	96
Hungary	94	75	73	76	65	64	60	57	58	61
Ireland	56	60	69	70	62	58	58	58	58	60
Italy	520	531	553	579	505	491	470	440	423	433
Latvia	26	13	10	11	12	11	11	11	11	11
Lithuania	48	22	20	23	21	21	21	20	20	20
Luxembourg	13	10	10	13	12	12	12	11	11	10
Malta	2.4	2.6	2.7	3.0	3.0	3.1	3.2	2.9	2.9	2.2
Netherlands	221	232	220	214	214	200	195	196	188	195
Poland	468	439	391	399	407	406	399	396	383	386
Portugal	60	70	83	86	69	68	66	64	64	69
Romania	246	181	140	146	121	127	124	115	115	116
Slovakia	74	54	50	51	47	45	43	43	41	41
Slovenia	19	19	19	20	20	20	19	18	17	17
Spain	288	328	386	440	357	357	352	323	324	336
Sweden	72	74	69	67	65	61	57	56	54	54
United Kingdom	794	746	710	689	612	564	581	565	523	503
EU-28	**5 647**	**5 295**	**5 155**	**5 214**	**4 777**	**4 622**	**4 559**	**4 464**	**4 286**	**4 310**
Iceland	3.5	3.3	3.9	3.8	4.7	4.4	4.5	4.5	4.5	4.5
United Kingdom (KP)	797	749	713	693	616	568	584	569	526	507
EU-28 + ISL	**5 654**	**5 302**	**5 162**	**5 221**	**4 785**	**4 630**	**4 567**	**4 472**	**4 294**	**4 317**

The overall EU GHG emissions trend is dominated by the two largest emitters, Germany (21 %) and the United Kingdom (12 %), which accounted for nearly one third of total EU-28 GHG emissions in 2015. By 2015, these two Member States had achieved total domestic GHG emissions reductions of 639 million tonnes CO_2 equivalent compared to 1990, not counting carbon sinks and the use of Kyoto mechanisms. The main reasons for the favourable trend in Germany were 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 106% between 1990 and 2015. GHG emissions from international shipping increased by 22 % during the same 25-year period. For the first time in 2014, emissions from international aviation overtook emissions from international shipping. In 2015 international aviation accounted for143 million tonnes CO_2 equivalent and international shipping for135 million tonnes CO_2 equivalent.

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 2017, total EU GHG emissions (excluding LULUCF) for 2014 were 0.1 % higher than those reported in the 2016 GHG inventories. Total EU emissions in 1990, reported in 2017 GHG inventories, were 0.3 % lower than the 1990 emissions reported in 2016 inventories.

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

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

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: not included (see explanation in chapter 1.8.4)

Annex V: Additional information

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 2017 under the UNFCCC and the Kyoto Protocol (KP).

The EU, its Member States and Iceland have agreed to fulfil their quantified emission limitation and reduction commitments under Article 3 of the Kyoto Protocol for the second commitment period to the Kyoto Protocol jointly, in accordance with the provisions of Article 4 thereof. The Union, its Member States and Iceland agreed to a quantified emission reduction commitment that limits their average annual emissions of greenhouse gases during the second commitment period to 80 % of the sum of their base year emissions, which is reflected in the Doha Amendment. Article 4 of the Kyoto Protocol requires parties that agree to fulfil their commitments under Article 3 of the Kyoto Protocol jointly to set out in the relevant joint fulfilment agreement the respective emission level allocated to each of the parties. Council Decision (EU) 2015/1339 sets out the terms of the joint fulfilment agreement as well as the respective emission levels of each Party to that agreement. The emission levels define the Member States' and Iceland's assigned amounts for the second commitment period. These emission levels have been determined on the basis of the existing Union legislation for the period 2013-2020 under the 'Climate and Energy package'.

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 EU should not be held liable for any remaining errors caused by the CRF Reporter in the review of the information submitted.

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 2017 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 the Member States, where additional insights can be gained. In many cases this Member State information is presented in summary overview tables.

The EU greenhouse gas inventory has been compiled under Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC[3]. Decision No 280/2004/EC has been revised in order to enhance the reporting rules on GHG emissions to meet requirements arising from current and future international climate agreements as well as the 2009 EU Climate and energy package. The emissions compiled in the EU GHG inventory are the sum of the respective emissions in 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.

1.1 Background information on greenhouse gas inventories and climate Change

The annual EU GHG inventory is required for two purposes.

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

Secondly, under the EU GHG Monitoring Mechanism Regulation, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the EU's commitments under the UNFCCC and the Kyoto Protocol, and with respect to EU legislation for reduction of GHG emissions[4]. For this purpose, the Commission has to prepare a progress evaluation report, which has to be forwarded to the European Parliament and the Council. The annual EU inventory is used for the evaluation of actual progress.

The legal basis of the compilation of the EU inventory is Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (hereafter referred to as the Monitoring Mechanism Regulation or MMR) [5]. The MMR establishes a mechanism for inter alia: (1) ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its Member States to the UNFCCC Secretariat; (2) reporting and verifying information relating to commitments of the Union and its Member States pursuant to the UNFCCC, to the Kyoto Protocol and to

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

[4] Decision No 406/2009/EC

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 monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NOx) and volatile organic compounds, for the year X-2
- their anthropogenic greenhouse gas emissions by sources and removals of CO_2 by sinks resulting from LULUCF, for the year X-2, in accordance with UNFCCC reporting requirements
- any changes to the information referred to in points above relating to the years between 1990 and the year three-years previous (year X – 3);
- information from their national registry on the issue, acquisition, holding, transfer, cancellation, retirement and carry-over of AAUs, RMUs, ERUs, CERs, tCERs and lCERs for the year X-1;
- the elements of the national inventory report necessary for the preparation of the EU greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

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

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

1.2 A description of the institutional arrangements

1.2.1 Institutional, legal and procedural arrangements

In accordance with the MMR Article 6(1), a Union Inventory system is established to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of national inventories with regard the Union greenhouse gas inventory. The Commission's

Staff Working Document (SWD (2013) 308 final[6]) outlines the main elements of the Union inventory system. An overview is presented in Figure 1.1.

The Directorate General Climate Action of the European Commission has overall responsibility for the inventory of the European Union (EU) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Union. DG Climate Action is supported in the establishment of the inventory by the following main institutions: the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) [7].

In accordance with the MMR Article 6(1), a Union Inventory system is established to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of national inventories with regard the Union greenhouse gas inventory. The Commission's Staff Working

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

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

Document (SWD (2013) 308 final) outlines the main elements of the Union inventory system. An overview is presented in Figure 1.1

Figure 1.1 Inventory system of the European Union

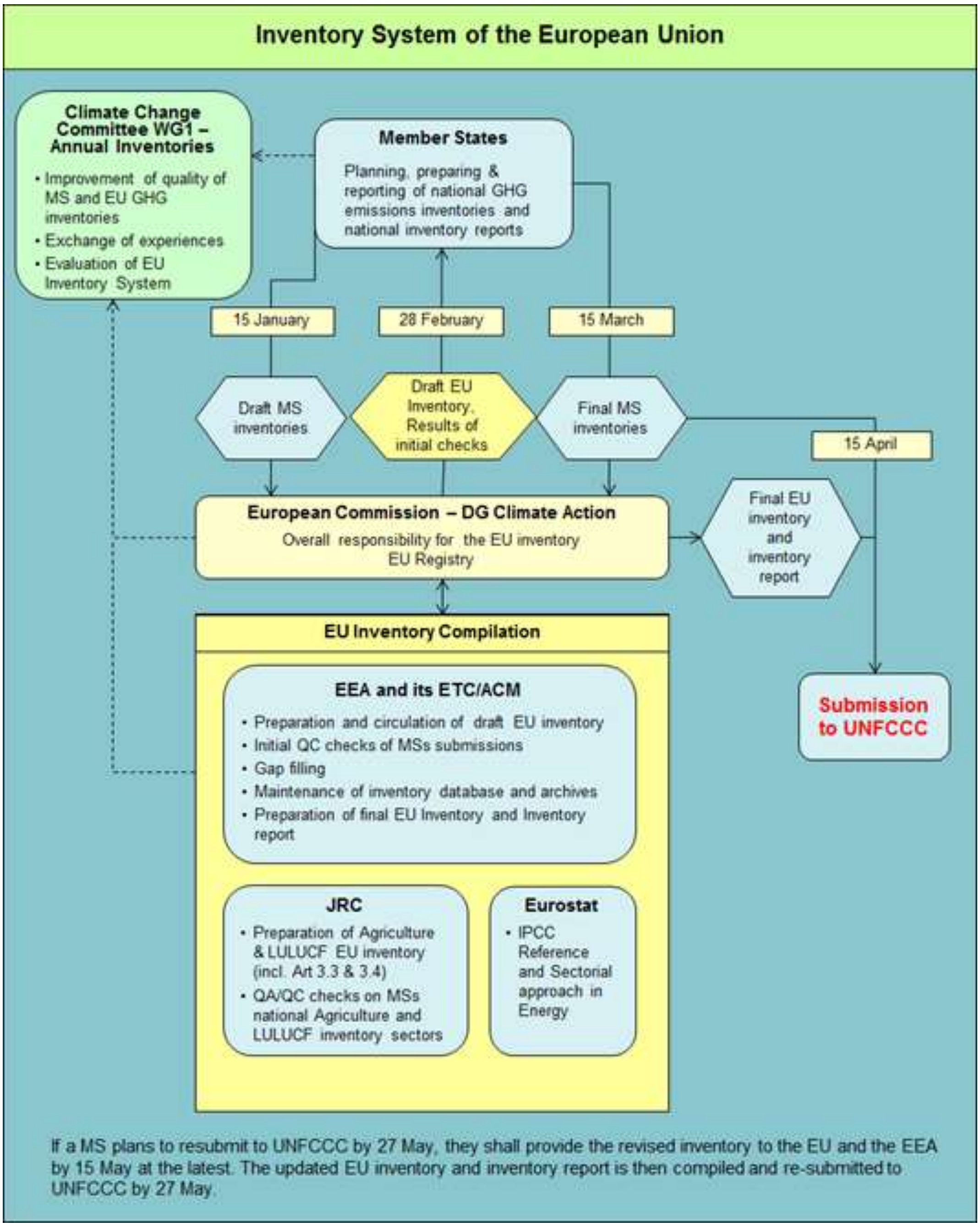


Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EU inventory.

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 Brussels
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 Ministri of Environment and Energy 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

Member State/EU institution	Contact address
	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 Riga
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)

Member State/EU institution	Contact address
	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, Melanie Sporer European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)	Nicole Mandl, Michael Gager, Elisabeth Rigler European Topic Centre on Air Pollution and Climate Change Mitigation Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Michael Goll Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
Joint Research Centre (JRC)	Giacomo Grassi, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA), Italy

1.2.1.1 The Member States

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

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

The European Union's inventory is based on the inventories supplied by Member States. The total estimate of the EU greenhouse gas emissions should accurately reflect the sum of Member States' national greenhouse gas inventories. Member States are responsible for choosing activity data, emission factors and other parameters used for their national inventories as well as the correct application of methodologies provided in the 2006 IPCC Guidelines. Member States are also responsible for establishing quality assurance/quality control (QA/QC) programmes for their inventories. The QA/QC activities of each Member State are described in the respective national inventory reports.

For the EU to be able to provide the GHG inventory to the UNFCCC on time, all Member States are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the European Commission and to the European Environment Agency (EEA) by 15 January every year.

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

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

Apart from the data capturing processes, and as part of its responsibility to compile the GHG inventory and prepare the Union GHG inventory report, the EEA is also 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 deployed in the next paragraph.

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

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

The EEA's European Topic Centre on Air and Climate Change Mitigation (ETC/ACM) was established by a contract between the lead organisation Institute for Public Health and the Environment (RIVM) in the Netherlands and EEA for the years 2014-2018. The EEA's ETC/ACM involves 14 organisations and institutions in eight European countries. The technical annex for the 2014 work plan for the EEA's ETC/ACM and an implementation plan specify the specific tasks of the EEA's ETC/ACM partner organisations with regard to the preparation of the EU inventory. Umweltbundesamt Austria is the task leader for the compilation of the EU annual inventory in the EEA's ETC/ACM. The specific tasks undertaken by EEA's ETC/ACM include:

- Initial QA/QC checks of Member States' submissions in cooperation with Eurostat, and the JRC, up to 28 February documented in the EEA review tool and compilation of results from initial checks (status and consistency reports);
- consultation with Member States in order to clarify data and other information provided;
- preparation of the draft EU inventory and inventory report by 28 February based on Member States' submissions;
- preparation of the final EU inventory and inventory report by 15 April (to be submitted by the Commission to the UNFCCC Secretariat);

The EEA's ETC/ACM provides the CRF Aggregator developed to ensure the EU submission is fully consistent with member state's (MS) submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission.

1.2.1.5 Eurostat

Eurostat collects national energy statistics reported under the EU Energy Statistics Regulation on an annual basis. These data are used for the estimation of the IPCC Reference Approach and the Sectoral Approach. The EEA compares the results of the two approaches with MS CRF submissions. These comparisons are sent to MS during the consultation on the Draft EU GHG inventory by 28/02. The Energy Statistics Regulation (Regulation EC/1099/2008) as amended by Commission Regulation (EU) No 147/2013 of 13 February 2013 is the basis for MS reporting of energy data to Eurostat. Article 6(2) of the Energy statistics regulation stipulates: 'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'. The consistency of energy balances and CRF activity data is essential for good quality GHG estimates in the energy sector, and therefore it is at the core of the QA/QC activities at EU level.

1.2.1.6 Joint Research Center

The Joint Research Centre (JRC) performs the QA/QC of the LULUCF and Agriculture sectors and is responsible of the writing of the respective chapters. The QA/QC main activity is the annual checking of early versions of the each national GHG inventory. Focus is on errors and inconsistencies, with numerous interactions with national representatives for clarifications and improvements. Specific completeness and consistency checks are also carried out. For LULUCF, additional efforts to help member states in improving their reporting include annual technical workshops (http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/), dedicated EU-funded projects, the

AFOLU database, and a forest growth model whose results which may be used by countries to compare with their estimates. More information is provided in the QAQC sections of the LULUCF and Agriculture chapters.

1.2.2 Overview of inventory planning, preparation and management

1.2.2.1 A description of the process of inventory preparation

The annual process of compilation of the EU inventory is summarised in Table 1.2. The Member States submit their annual GHG inventory by 15 January each year to the European Commission's DG Climate Action using the EEA's 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

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	Member States	15 March	Member States respond to 'initial

Element	Who	When	What
'initial checks'			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 estimates for missing data	Member States	7 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
12. Member States responses to follow-up 'initial checks'	Member States	7 April	Member States provide responses to follow up of 'initial checks'.
13. Member States submissions to the UNFCCC	Member States	15 April	Submissions to the UNFCCC (with a copy to EEA)
14. Final annual Union inventory (incl. EU inventory report)	Commission (DG Climate Action) assisted by EEA	15 April	Submission to UNFCCC of the final annual Union inventory.
15. Any resubmissions by Member States	Member States	By 8 May	Member States provide to the Commission the resubmissions which they submit to the UNFCCC secretariat. The Member States must clearly specify which parts have been revised in order to facilitate the use for the Union resubmission. Resubmissions should be avoided to the extent possible. As the Union resubmission also has to comply with the time-limits specified in the guidelines under Article 8 of the Kyoto Protocol, the Member States have to send their resubmission, if any, to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, provided that the resubmission corrects data or information that is used for the compilation of the Union inventory.
16. **Union** inventory resubmission in response to Member States' resubmissions		27 May	If necessary, resubmission to UNFCCC of the final annual Union inventory.
17. Submission of any other resubmission after the initial check phase	Member States	When additional resubmissions occur	Member States provide to the Commission any other resubmission (CRF or national inventory report) which they provide to the UNFCCC secretariat after the initial check phase.

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 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 2017 that were taken into account for the compilation of EU GHG inventory

MS	Date	Submission mode	XML	CRF	NIR
AUT	12.04.2017	CDR	AUT_2017_1_Inventory_11042017_204203890105095560552987.xml	1990-2015	x
BEL	13.04.2017	CDR	BEL_2017_1_Inventory_11042017_0315554567974567439757413.xml	1990-2015	x
BGR	05.05.2017	CDR	BGR_2016_10_Inventory_11042017_1417034735010818282023753.xml	1988-2015	x
CYP	05.05.2017	CDR	CYP_2017_1_Inventory_05052017_094034153437469616357299.xml	1990-2015	x
CZE	05.05.2017	CDR	CZE_2017_4_Inventory_05052017_0907196103533808577115392.xml	1990-2015	
DEU	15.01.2017	CDR	DEU_2016_7_Inventory_11012017_1014213271391322040348047.xml	1990-2015	x
DNM	07.05.2017	CDR	DNM_2017_2_Inventory_03052017_1649483663887085229806430.xml	1990-2015	
ESP	14.04.2017	CDR	ESP_2016_7_Inventory_12042017_1613002717196377669335481.xml	1990-2015	x
EST	15.03.2017	CDR	EST_2016_3_Inventory_14032017_1459034880292814467811176.xml	1990-2015	x
FIN	15.03.2017	CDR	FIN_2017_1_Inventory_14032017_1618398271985388732462811.xml	1990-2015	x
FRK	09.04.2017	CDR	FRK_2017_1_Inventory_08042017_1538507460368030686256696.xml	1990-2015	x (fr)
GBE	15.03.2017	CDR	GBE_2017_1_Inventory_14032017_2314322172781143114863326.xml	1990-2015	x
GBR	14.04.2017	CDR	GBR_2017_2_Inventory_13042017_193352172375273122993807.xml	1990-2015	
GRC	27.04.2017	CDR	GRC_2017_1_Inventory_10042017_2021477700636811127052799.xml	1990-2015	x
HRV	08.05.2017	CDR	HRV_2017_5_Inventory_08052017_101353647342574116003475.xml	1990-2015	x
HUN	08.05.2017	CDR	HUN_2017_2_Inventory_08052017_1427074825607407022340764.xml	1986-2015	x
IRL	14.04.2017	CDR	IRL_2016_2_Inventory_12042017_1513293017145232712886516.xml	1990-2015	x
ITA	12.04.2017	CDR	ITA_2016_4_Inventory_11042017_103350344073598632102145.xml	1990-2015	x
LTU	18.04.2017	CDR	LTU_2016_4_Inventory_13042017_1840266530954325402548656.xml	1990-2015	x
LUX	08.04.2017	CDR	LUX_2016_7_Inventory_06042017_1644546837498728602332220.xml	1990-2015	x
LVA	13.04.2017	CDR	LVA_2017_1_Inventory_13042017_1016582437489899312524028.xml	1990-2015	x
MLT	09.05.2017	CDR	MLT_2017_4_Inventory_05052017_1055083947137629320364951.xml	1990-2015	
NLD	14.04.2017	CDR	NLD_2017_5_Inventory_12042017_2133527634205113828675631.xml	1990-2015	x
POL	08.05.2017	CDR	POL_2017_1_Inventory_08052017_113434704067153313368568.xml	1988-2015	
PRT	05.05.2017	CDR	PRT_2017_2_Inventory_05052017_1615501797779411638431538.xml	1990-2015	
ROU	15.03.2017	CDR	ROU_2016_5_Inventory_13032017_1402122543019810124844266.xml	1989-2015	x

MS	Date	Submission mode	XML	CRF	NIR
SVK	15.03.2017	CDR	SVK_2017_3_Inventory_12032017_1814176638338600385361088.xml	1990-2015	x
SVN	15.03.2017	CDR	SVN_2016_6_Inventory_14032017_123200530172325912786174.xml	1986-2015	
SWE	10.04.2017	CDR	SWE_2017_2_Inventory_28032017_1537505643481532116648326.xml	1990-2015	
ISL	14.04.2017	CDR	ISL_2016_5_Inventory_13042017_20200623799726569592 7114.xml	1990-2015	x

Table 1.4 gives an overview on people involved in the compilation of the EU GHG inventory submission in 2017 and their individual responsibilities in this process.

Table 1.4 Responsibility list for the compilation of the EU GHG inventory submission in 2017

	Name	EU GHG inventory/inventory report compilation				Initial Checks			
		Overall responsibility	Project manager	Sector experts	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts/ expert	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, Chapter 14, EU-SEF Tables					
	Breffni Lynch (DG CLIMA) breffni.lynch@ec.europa.eu			Chapter 12, Chapter 14 , EU-SEF Tables					
	Adrian Leip (JRC) adrian.leip@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@ec.europa.eu			sector 3				sector 3	
	Giacomo Grassi (JRC) giacomo.grassi@ec.europa.eu				**QA NIR:** sector LULUCF and KP LULUCF				**LULUCF** and **KP-LULUCF**
	Tibor Priwitzer (JRC) tibor.priwitzer@ec.europa.eu			LULUCF and KP LULUCF				LULUCF and KP LULUCF	
	Raul Abad-Vinas (JRC) raul.abad-vinas@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	
EEA and ETC-ACM	Ricardo Fernandez (EEA) ricardo.fernandez@eea.europa.eu	**X**			**QA NIR:** Executive summary, chapter 1, trend chapter	**X**			
	Melanie Sporer (EEA) melanie.sporer@eea.europa.eu					**X**			

Name	EU GHG inventory/inventory report compilation				Initial Checks			
	Overall responsibility	Project manager	Sector experts	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts/ expert	Quality expert
Herdis Gudbrandsdottir (EEA) herdis.gudbrandsdottir@eea.europa.eu			ReportNet, Data checks					
Johannes Burgstaller (ETC-ACM; UBA-V) johannes.burgstaller@umweltbundesamt.at			support UBA work, Uncertainties					
Michael Gager (ETC-ACM; UBA-V) michael.gager@umweltbundesamt.at		Data manager						
Bernd Gugele (ETC-ACM, UBA-V) bernd.gugele@umweltbundesamt.at			1A Reference approach	**QA NIR:** sector 1A1, 1A2, 1A4, 1A5				QA UBA work, QA sector 1A1, 1A2, 1A4, 1A5
Nicole Mandl (ETC-ACM, UBA-V) nicole.mandl@umweltbundesamt.at		**X**		Execurive summary, trend chapter		**X**	cross-cutting issues	
Lorenz Moosmann (ETC-ACM, UBA-V lorenz.moosmann@umweltbundesamt.at			2C, 2D, 2G3-2G4, 2H				2C, 2D, 2G3-2G4, 2H	
Henrik Neier (ETC-ACM; UBA-V) henrik.neier@umweltbundesamt.at			1A1, 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		X	1B, 1C support UBA work			X	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
Günther Schmidt (ETC-ACM; UBA-V) guether.schmidt@umweltbundesamt.at			Data manager					
Andreas Zechmeister (ETC-ACM; UBA-V) andreas.zechmeister@umweltbundesamt.at			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	

	Name	EU GHG inventory/inventory report compilation				Initial Checks			
		Overall responsibility	Project manager	Sector experts	Quality expert	Overall responsibility	QA/QC coordinator	Sector experts/ expert	Quality expert
	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	
	Kristina Warncke (ETC-ACM; Oeko Recherche) kristina.warncke@oekorecherche.de			F-gases 2E, 2F, 2G1-3				F-gases 2E, 2F, 2G1-3	
	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				cross-cuttting issues, EU- ETS	QA/QC Oeko work
	Graham Anderson (ETC-ACM; Oeko) g.anderson@oeko.de			sectors 2A, 2B	**QA NIR:** sector 1A3, 1B, 1C, 1D			sectors 2A, 2B	
	Sabine Gores (ETC-ACM; Oeko) s.gores@oeko.de			1A3a + Aviation bunkers comparison with Eurocontrol				1A3a + Aviation bunkers comparison with Eurocontrol	
	Ralph Harthan (ETC-ACM; Oeko) r.harthan@oeko.de								sector 1A3, 1B, 1C, 1D
	Lukas Emele (ETC-ACM; Oeko) l.emele@oeko.de			EU ETS					
	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				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.
In 2017 the first regular annual review has been performed. The ESD review is a two steps process. All 28 MS have to undergo step 1. In 2017 15 MS were subject to step 2.

UNFCCC reviews

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

- Annual compilation of issues identified during the UNFCCC inventory review related to sectors, key source categories and the major inventory principles transparency, consistency, completeness, comparability and accuracy for all Member States;
- Identification of major issues from the compilation and discussion of ways to resolve them in WG1, including identification and documentation of follow-up actions that are considered as necessary within WG1;
- Reviews of the extent to which issues identified through this procedure in previous years have been addressed by Member States;
- Ongoing investigations of ways to produce a more transparent inventory for the unique circumstances of the European Union.

Improvement plan

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

1.2.3.2 Further improvement of the QA/QC procedures

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

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

Table 1.6 Overview of 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	26-27 April 2017, Stresa, Italy
JRC technical LULUCF workshop under the UNFCCC, the Kyoto Protocol (KP) and the EU LULUCF Decision No 529/2013	02-03 May 2016, Stresa, 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[9].

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

In general, no separate methodological information is provided at EU level except summaries of methodologies used by Member States. 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.

Table 1.7 lists the procedures applied for the EU-28 and Iceland.

[9] However, the choice of the emission calculation methodology is made at Member State level and is based on the key category analysis of each individual Member State.

Table 1.7 Manual changes in the CRF Reporter

Year	Sector	Source category	Parameter	Manual changes/inclusion in the CRF Reporter
1990-2015	Energy	1.AB, 1.AC, 1.AD	all	Enter Reference Approach data from EUROSTAT
2013-2015	Energy	2.C.7, 2.H.1, 1.A.1, 1.A.2, 1.B.2	CO_2, CH_4, N_2O, CO	Shift differences due to SE confidential data into 'Other fossil fuels' within the same sub-category, if 'All fuels' values are provided. Shift differences due to SE confidential data into 'Other' sub-category if 'All fuels' values are not provided for 2 or more sub-categories.
1990-2015	IPPU	2.B, 2.C, 2.E, 2.F, 2.G, 2.H	f-gases	Enter country-specific f-gases
1990-2015	IPPU		all	Enter user-specific data from MS to solve difference between EU totals and sum of MS
1990-2015	Agriculture	3	CH_4, N_2O, NMVOC	Enter aggregated data from JRC: Option A - Option B - Option C
1990-2015	Agriculture	3.B.2.2, 3.B.2.3	AD	Correct addition information with aggregated data from JRC
1990-2015	LULUCF	4.G	all	Enter aggregated data for Approach A (consumed) - Approach B (harvest) - Approach C
1990-2015	KP.LULUCF		all	Incorporate aggregated data and comments by JRC
2015	IPPU	2.A, 2.B	AD	Replace aggregated AD data with gap-filled AD data provided by SE
1990-2015	IPPU	2.A, 2.B, 2.C, 2.D, 2.G	AD	Replace aggregated AD data with notation key 'NE' if an aggregation makes no sense due to inhomogeneous AD
2015	Waste	5.A, 5.B, 5.C	AD	Replace aggregated AD data with gap-filled AD data provided by SE
2015	Waste	5.A, 5.B, 5.C	AD	Replace aggregated AD data with notation key 'NE' if an aggregation makes no sense due to inhomogeneous AD

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

For the key categories the most (see Chapter 1.5) the most accurate methods for the estimation of the greenhouse gas inventory should be used. Table 1.8 gives an overview on the share of higher tiers used in the EU 28 and Iceland for all key categories for which this estimation was possible.

Table 1.8 Share of higher tier methodologies used on the total of each EU key category

Source category gas	Share of higher tier
1 A 1 a Public Electricity and Heat Production: Biomass (CH_4)	NE
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	>80%
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: Peat (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)	>85%
1 A 1 b Petroleum Refining: Liquid Fuels (CO_2)	>85%
1 A 1 b Petroleum Refining: Solid Fuels (CO_2)	90%
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Gaseous Fuels (CO_2)	>75%
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)	81%
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	83%
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	93%
1 A 2 b Non-Ferrous Metals: Gaseous Fuels (CO_2)	87%
1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)	61%
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	88%
1 A 2 c Chemicals: Liquid Fuels (CO_2)	93%
1 A 2 c Chemicals: Solid Fuels (CO_2)	71%
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	95%
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	86%
1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)	77%
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	85%
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	80%
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	68%
1 A 2 f Non-metallic minerals: Gaseous Fuels (CO_2)	88%
1 A 2 f Non-metallic minerals: Liquid Fuels (CO_2)	91%
1 A 2 f Non-metallic minerals: Other Fuels (CO_2)	70%
1 A 2 f Non-metallic minerals: Solid Fuels (CO_2)	84%
1 A 2 g Other Manufacturing Industries and Constructions: Gaseous Fuels (CO_2)	95%
1 A 2 g Other Manufacturing Industries and Constructions: Liquid Fuels (CO_2)	90%
1 A 2 g Other Manufacturing Industries and Constructions: Other Fuels (CO_2)	52%
1 A 2 g Other Manufacturing Industries and Constructions: Solid Fuels (CO_2)	92%
1 A 3 a Domestic Aviation: Jet Kerosene (CO_2)	94.1 %
1 A 3 b Road Transportation: Diesel Oil (CO_2)	83%
1 A 3 b Road Transportation: Diesel Oil (N_2O)	95.6 %
1 A 3 b Road Transportation: Gaseous Fuels (CO_2)	91.4 %

Source category gas	Share of higher tier
1 A 3 b Road Transportation: Gasoline (CH_4)	97.4 %
1 A 3 b Road Transportation: Gasoline (CO_2)	90 %
1 A 3 b Road Transportation: Gasoline (N_2O)	99.8 %
1 A 3 b Road Transportation: Liquefied Petroleum Gases (LPG) (CO_2)	95 %
1 A 3 c Railways: Liquid Fuels (CO_2)	73.7 %
1 A 3 d Domestic Navigation: Gas/Diesel Oil (CO_2)	74.30%
1 A 3 d Domestic Navigation: Residual Fuel Oil (CO_2)	65.70%
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	71%
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	67%
1 A 4 a Commercial/Institutional: Other Fuels (CO_2)	97%
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	61%
1 A 4 b Residential: Biomass (CH_4)	45%
1 A 4 b Residential: Gaseous Fuels (CO_2)	78%
1 A 4 b Residential: Liquid Fuels (CO_2)	77%
1 A 4 b Residential: Solid Fuels (CH_4)	12%
1 A 4 b Residential: Solid Fuels (CO_2)	61%
1 A 4 c Agriculture/Forestry/Fishing: Gaseous Fuels (CO_2)	53%
1 A 4 c Agriculture/Forestry/Fishing: Liquid Fuels (CO_2)	45%
1 A 4 c Agriculture/Forestry/Fishing: Solid Fuels (CO_2)	49%
1 A 5 a Other Other Sectors: Solid Fuels (CO_2)	100 %
1 A 5 b Other Other Sectors: Liquid Fuels (CO_2)	32 %
1 B 1 a Coal Mining and Handling: Operation (CH_4)	30%
1 B 2 a Oil: Operation (CO_2)	73%
1 B 2 b Natural Gas: Operation (CH_4)	73%
1 B 2 c Venting and Flaring: Operation (CO_2)	82%
1 B 2 d Other emissions from energy production: Operation (CH_4)	NA
2 A 1 Cement Production: no classification (CO_2)	100%
2 A 2 Lime Production: no classification (CO_2)	99%
2 A 4 Other Process Uses of Carbonates: no classification (CO_2)	NE
2 B 1 Ammonia Production: no classification (CO_2)	97%
2 B 10 Other chemical industry: no classification (CO_2)	NE
2 B 2 Nitric Acid Production: no classification (N_2O)	100%
2 B 3 Adipic Acid Production: no classification (N_2O)	100%
2 B 8 Petrochemical and Carbon Black Production: no classification (CO_2)	NE
2 B 9 Fluorochemical Production: no classification (HFCs)	NE
2 B 9 Fluorochemical Production: no classification (Unspecified mix of HFCs and PFCs)	NE
2 C 1 Iron and Steel Production: no classification (CO_2)	100%
2 C 3 Aluminium Production: no classification (PFCs)	100%
2 D 3 Other non energy products: no classification (CO_2)	62%
2 F 1 Refrigeration and Air conditioning: no classification (HFCs)	>80%
2 F 2 Foam Blowing Agents: no classification (HFCs)	>90%
2 F 4 Aerosols: no classification (HFCs)	>90%
3 A 1 Enteric Fermentation: Dairy Cattle (CH_4)	100%
3 A 1 Enteric Fermentation: Mature Dairy Cattle (CH_4)	
3 A 1 Enteric Fermentation: Non-Dairy Cattle (CH_4)	
3 A 1 Enteric Fermentation: Other Cattle (CH_4)	
3 A 2 Enteric Fermentation: Other Sheep (CH_4)	70%
3 A 4 Enteric Fermentation: Other livestock (CH_4)	NE

Source category gas	Share of higher tier
3 B 1 CH_4 Emissions: Farming (CH_4)	3.B.1.1.1 Manure Management: Dairy Cattle (CH_4): 100% 3.B.1.1.2 Manure Management: Non-Dairy Cattle (CH_4): 100% 3.B.1.3 Manure Management: Swine (CH_4): 93%
3 B 2 N_2O and NMVOC Emissions: Farming (N_2O)	NA
3 D 1 Agricultural Soils: Direct N_2O Emissions From Managed Soils (N_2O)	3.D.1.1 Agricultural Soils: Direct N_2O Emissions, Inorganic N Fertilizers (N_2O): 11% 3.D.1.2 Agricultural Soils: Direct N_2O Emissions, Organic N Fertilizers (N_2O): 4% 3.D.1.3 Agricultural Soils: Urine and Dung Deposited by Grazing Animals (N_2O): 6%
3 D 2 Agricultural Soils: Farming (N_2O)	3.D.2.1 Agricultural Soils: Indirect N_2O Emissions, Atmospheric Deposition (N_2O): 3% 3.D.2.2 Agricultural Soils: Indirect N_2O Emissions, N-Leaching and Run-off (N_2O): 2%
3 G 1 Limestone CaCO3: Farming (CO_2)	NE
5 A 1 Managed Waste Disposal Sites: Waste (CH_4)	96%
5 A 2 Unmanaged Waste Disposal Sites: Waste (CH_4)	100%
5 B 1 Waste Composting: Waste (CH_4)	25%
5 B 1 Waste Composting: Waste (N_2O)	29%
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (CH_4)	38%
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (N_2O)	16%
5 D 2 Wastewater Treatment and Discharge: Industrial Wastewater (CH_4)	25%

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 11,600 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 2015 the main activities, number of entities and verified emissions reported under the EU ETS are presented in Table 1.9.

Table 1.9 Activities and emissions covered by the EU ETS in 2015

Main activity	**Activity code**	**Number of entities**	**Verified emissions (Mt CO_2-eq.)**
Combustion of fuels	20	7,043	1.211
Refining of mineral oil	21	140	128
Production of coke	22	21	12
Metal ore roasting or sintering	23	10	3
Production of pig iron or steel	24	248	111
Production or processing of ferrous metals	25	230	10
Production of primary aluminium	26	23	5
Production of secondary aluminium	27	35	1
Production or processing of non-ferrous metals	28	84	6
Production of cement clinker	29	262	114
Production of lime, or calcination of dolomite/magnesite	30	306	31
Manufacture of glass	31	365	18
Manufacture of ceramics	32	1,075	16
Manufacture of mineral wool	33	45	2
Production or processing of gypsum or plasterboard	34	38	1
Production of pulp	35	143	5
Production of paper or cardboard	36	611	22
Production of carbon black	37	14	1
Production of nitric acid	38	35	5
Production of adipic acid	39	3	0.14
Production of glyoxal and glyoxylic acid	40	1	0.09
Production of ammonia	41	29	23
Production of bulk chemicals	42	357	38
Production of hydrogen and synthesis gas	43	44	9
Production of soda ash and sodium bicarbonate	44	14	3
Capture of greenhouse gases under Directive 2009/31/EC	45	0	0
Other activity opted-in under Art. 24	99	253	1
All stationary installations		11,429	1,775

Source: EEA, 2017

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

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

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

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

EU ETS activity	CRF category	Comment
26 Production of primary aluminium	2.C.3 Aluminium production 1.A.2.b Non-ferrous metals	• In EU ETS operators shall report emissions from the production of electrodes for primary aluminium smelting, including stand-alone-installations for the production of such electrodes. The operator shall considerCO$_2$ emissions from : fuels for the production of heat or steam, electrode production, reduction of Al_2O_3 during electrolysis which is related to electrode consumption, use of soda ash or other carbonates for waste gas scrubbing. • For PFC emissions resulting from anode effects the scope of the EU ETS activity and CRF category 2.C.3 are consistent. • CRF category 1.A.2.b Non-ferrous metals includes combustion emission and emission from waste gas scrubbing. • Emissions from electrode consumption in EU ETS activity code 26 are included in CRF 2.C.3 Aluminium Production. • PFC emissions are allocated to 2.C.3 Aluminium production.
27 Production of secondary aluminium	1.A.2.b Non-ferrous metals	• Emissions are included in EU ETS only for installations exceeding rated thermal input of 20 MW while in GHG inventories there is no threshold. • In secondary aluminium production no process emissions occur therefore all emissions in activity code 27 are from fuel combustion and are reported in CRF category 1.A.2.b Non-ferrous metals.
28 Production or processing of non-ferrous metals	1.A.2.b Non-ferrous metals 2.C.4 Magnesium production 2.C.5 Lead production 2.C.6 Zinc production 2.C.7 Other metal production	• Emissions are included in EU ETS only for non-ferrous metals production or processing installations exceeding rated thermal input of 20 MW (including reducing agents) while in GHG inventories there is no threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 28 are included in CRF 2.C.4 Magnesium Production, 2.C.5 Lead production, 2.C.6 Zinc Production and 2.C.7 Other metal industry. • 2006 IPCC Guidelines do not provide methodologies for metals other than iron and steel, ferroalloys, aluminium, magnesium, lead and zinc while the EU ETS has a broader scope and covers, e.g. copper production.
29 Production of cement clinker in rotary kilns	2.A.1 Cement Production 1.A.2.f Non-metallic minerals	• Emissions are included in EU ETS only for installations with production capacity exceeding 500 tonnes per day or in other furnaces with capacity exceeding 50 tonnes per day. Inventory methodology has no threshold. • EU ETS activity includes combustion and process emissions. • Process related emissions from EU ETS activity code 29 are included in CRF 2.A.1 Cement Production • Combustion related emissions from ETS activity code 29 are included in CRF 1.A.2.f. Non-metallic minerals
30 Production of lime, or calcination of	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

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

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

EU ETS activity	CRF category	Comment

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

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

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

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

Scope of activities and installation boundaries

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

Determination of tiers

Both IPCC guidelines are based on methodological tiers that require higher tier levels of accuracy for emission sources contributing to a significant extent to the total emissions in a country. In the inventory reporting, the key category analysis determines which methodological tier should be used which is based on the contribution of a source category to the total emission level and the emission trend. If a source category is determined as key, all emissions from this source/sector have to be estimated based the same minimum tier methodology.

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

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

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

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

1.4.1.3 Use of EU ETS data in 2017

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 2017 to the European Commission, all 28 Member States indicated that they used EU ETS data at least for QA/QC purposes (see Table 1.11). 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 1.11Use of EU ETS data for the purposes of the national GHG inventory

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

Source: NIR 2017 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) 2017: EU Emissions Trading System (ETS) data viewer http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer-1

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 2017, in November 2016 MS received fuel and emissions data for the years 2005 to 2015 as calculated by EUROCONTROL using a TIER 3b methodology applying the Advanced Emissions Model (AEM). 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 2016 three webinars took place to exchange information between EUROCONTROL and Member States on the data provided.

In the course of the ‘initial checks’ of MS inventories in the first months of 2017 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. In addition 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 2014 and 2015, related CO_2 emissions and implied emission factors of CH_4 and N_2O. For more information on the results of the comparison, see chapter #3.2.

During the whole process 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. 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 2017 and eventually recalculate time series for the period 2005 to 2016 in case of considerable changes in the model.

As explained in the NIR 2014, comparing emissions reported by Member States with independent modelling results such as performed by EUROCONTROL is a genuine quality assurance exercise and assists in identifying areas in need for improvement of aviation emission calculations. In this sense, the EUROCONTROL results are used for identifying ways of checking and improving the accuracy of emission estimates for the EU and its Member States in accordance with the ARR of 2014.

1.5 Description of key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in the 2006 IPCC guidelines. A key category is defined as an emission source that has a significant influence on a country's GHG inventory in terms of the absolute level of emissions, the trend in emissions, or both.

In addition to the key category analysis at EU-28 level, every Member State provides a national key category analysis which is independent from the assessment at EU-28 level. The EU-28 key category analysis is not intended to replace the key category analysis by Member States. The key category analysis at EU-28 level is carried out to identify those categories for which overviews of Member States' methodologies, emission factors, quality estimates and emission trends are provided in this report. In addition, the EU-28 key category analysis helps identifying those categories that should receive special attention with regard to QA/QC at EU level. The Member States use their key category analysis for improving the quality of emission estimates at Member State level.

To identify key categories of the EU-28, the following procedure was applied:

- Starting point for the key category identification for this report was the EEA locator database. All categories where GHG emissions/removals occur were listed, at the most disaggregated level available at EU-28 level and split by gas.
- A level 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 1.12.

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 1.12 Key categories for the EU-28 and Iceland (Gg CO_2 equivalents)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 1 a Public Electricity and Heat Production: Biomass (CH_4)	63	2391	T	0	0
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	107510	177927	T	L	L
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	176990	32743	T	L	L
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	10702	37264	T	L	L
1 A 1 a Public Electricity and Heat Production: Peat (CO_2)	8531	8148	0	0	L
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	1129742	801176	T	L	L
1 A 1 b Petroleum Refining: Gaseous Fuels (CO_2)	5276	23685	T	0	L
1 A 1 b Petroleum Refining: Liquid Fuels (CO_2)	112244	90703	T	L	L
1 A 1 b Petroleum Refining: Solid Fuels (CO_2)	3633	433	T	0	0
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Gaseous Fuels (CO_2)	17159	18797	T	L	L
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Solid Fuels (CO_2)	92187	30648	T	L	L
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	31015	18176	T	L	L
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	8738	979	T	L	0
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	134462	81454	T	L	L
1 A 2 b Non-Ferrous Metals: Gaseous Fuels (CO_2)	3945	6468	T	0	L
1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)	7984	1292	T	0	0
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	56171	35773	T	L	L
1 A 2 c Chemicals: Liquid Fuels (CO_2)	39449	19364	T	L	L
1 A 2 c Chemicals: Solid Fuels (CO_2)	14462	8301	T	L	L
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	13274	18461	T	L	L
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	11657	2080	T	L	0
1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)	8224	2829	T	0	0
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	19411	29308	T	L	L
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	20546	4245	T	L	0
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	12240	4453	T	L	0
1 A 2 f Non-metallic minerals: Gaseous Fuels (CO_2)	27472	27770	T	L	L
1 A 2 f Non-metallic minerals: Liquid Fuels (CO_2)	45349	25514	T	L	L
1 A 2 f Non-metallic minerals: Other Fuels (CO_2)	1250	11059	T	0	L
1 A 2 f Non-metallic minerals: Solid Fuels (CO_2)	58151	17558	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Gaseous Fuels (CO_2)	95159	86206	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Liquid Fuels (CO_2)	114495	48529	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Other Fuels (CO_2)	2527	7723	T	0	L
1 A 2 g Other Manufacturing Industries and Constructions: Solid Fuels (CO_2)	93619	12948	T	L	L
1 A 3 a Domestic Aviation: Jet Kerosene (CO_2)	13723	15003	T	L	L
1 A 3 b Road Transportation: Diesel Oil (CO_2)	298136	603865	T	L	L
1 A 3 b Road Transportation: Diesel Oil (N_2O)	1791	7035	T	0	L
1 A 3 b Road Transportation: Gaseous Fuels (CO_2)	504	3742	T	0	0
1 A 3 b Road Transportation: Gasoline (CH_4)	5786	873	T	0	0
1 A 3 b Road Transportation: Gasoline (CO_2)	405045	230299	T	L	L
1 A 3 b Road Transportation: Gasoline (N_2O)	4772	1133	T	0	0

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 3 b Road Transportation: Liquefied Petroleum Gases (LPG) (CO_2)	7349	15671	T	0	L
1 A 3 c Railways: Liquid Fuels (CO_2)	12840	6055	T	L	0
1 A 3 d Domestic Navigation: Gas/Diesel Oil (CO_2)	14093	9895	0	L	L
1 A 3 d Domestic Navigation: Residual Fuel Oil (CO_2)	8856	4487	0	L	0
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	66896	105580	T	L	L
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	82257	40626	T	L	L
1 A 4 a Commercial/Institutional: Other Fuels (CO_2)	1013	4728	T	0	0
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	47428	3978	T	L	0
1 A 4 b Residential: Biomass (CH_4)	9443	10589	T	L	L
1 A 4 b Residential: Gaseous Fuels (CO_2)	183742	239361	T	L	L
1 A 4 b Residential: Liquid Fuels (CO_2)	181422	101466	T	L	L
1 A 4 b Residential: Solid Fuels (CH_4)	9174	2786	T	L	0
1 A 4 b Residential: Solid Fuels (CO_2)	134402	36000	T	L	L
1 A 4 c Agriculture/Forestry/Fishing: Gaseous Fuels (CO_2)	12539	11037	0	L	L
1 A 4 c Agriculture/Forestry/Fishing: Liquid Fuels (CO_2)	70517	58453	T	L	L
1 A 4 c Agriculture/Forestry/Fishing: Solid Fuels (CO_2)	9755	3840	T	L	0
1 A 5 a Other Other Sectors: Solid Fuels (CO_2)	5983	10	T	0	0
1 A 5 b Other Other Sectors: Liquid Fuels (CO_2)	13804	4828	T	L	0
1 B 1 a Coal Mining and Handling: Operation (CH_4)	95144	28604	T	L	L
1 B 2 a Oil: Operation (CO_2)	9072	11831	T	L	L
1 B 2 b Natural Gas: Operation (CH_4)	45958	24618	T	L	L
1 B 2 c Venting and Flaring: Operation (CO_2)	8733	6355	0	L	L
1 B 2 d Other emissions from energy production: Operation (CH_4)	5557	1056	T	0	0
2 A 1 Cement Production: no classification (CO_2)	102528	74369	0	L	L
2 A 2 Lime Production: no classification (CO_2)	25726	19313	0	L	L
2 A 4 Other Process Uses of Carbonates: no classification (CO_2)	12560	10564	0	L	L
2 B 1 Ammonia Production: no classification (CO_2)	32000	24143	0	L	L
2 B 10 Other chemical industry: no classification (CO_2)	5815	8965	T	0	L
2 B 2 Nitric Acid Production: no classification (N_2O)	49572	4440	T	L	0
2 B 3 Adipic Acid Production: no classification (N_2O)	57555	428	T	L	0
2 B 8 Petrochemical and Carbon Black Production: no classification (CO_2)	14940	15532	T	L	L
2 B 9 Fluorochemical Production: no classification (HFCs)	29034	369	T	L	0
2 B 9 Fluorochemical Production: no classification (Unspecified mix of HFCs and PFCs)	5567	58	T	0	0
2 C 1 Iron and Steel Production: no classification (CO_2)	96167	63255	T	L	L
2 C 3 Aluminium Production: no classification (PFCs)	21277	496	T	L	0
2 D 3 Other non energy products: no classification (CO_2)	8595	5786	0	L	0
2 F 1 Refrigeration and Air conditioning: no classification (HFCs)	3	96636	T	0	L
2 F 2 Foam Blowing Agents: no classification (HFCs)	0	2915	T	0	0
2 F 4 Aerosols: no classification (HFCs)	3	5504	T	0	0
3 A 1 Enteric Fermentation: Dairy Cattle (CH_4)	79813	60867	0	L	L
3 A 1 Enteric Fermentation: Mature Dairy Cattle (CH_4)	10279	7406	0	L	L
3 A 1 Enteric Fermentation: Non-Dairy Cattle (CH_4)	87721	75928	T	L	L
3 A 1 Enteric Fermentation: Other Cattle (CH_4)	20907	13174	T	L	L

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
3 A 2 Enteric Fermentation: Other Sheep (CH_4)	30353	20553	0	L	L
3 A 4 Enteric Fermentation: Other livestock (CH_4)	6298	6627	0	0	L
3 B 1 CH_4 Emissions: Farming (CH_4)	54348	44900	T	L	L
3 B 2 N_2O and NMVOC Emissions: Farming (N_2O)	29555	20905	0	L	L
3 D 1 Agricultural Soils: Direct N_2O Emissions From Managed Soils (N_2O)	159160	133423	T	L	L
3 D 2 Agricultural Soils: Farming (N_2O)	37907	30223	0	L	L
3 G 1 Limestone CaCO3: Farming (CO_2)	8904	4880	0	L	0
4 A 1 Forest Land: Land Use (CO_2)	-357483	-371193	T	L	L
4 A 2 Forest Land: Land Use (CO_2)	-25705	-53578	T	L	L
4 B 1 Cropland: Land Use (CO_2)	21711	14966	0	L	L
4 B 2 Cropland: Land Use (CO_2)	53309	45126	T	L	L
4 C 1 Grassland: Land Use (CO_2)	47378	32864	0	L	L
4 C 2 Grassland: Land Use (CO_2)	-16148	-23882	T	L	L
4 D 1 Wetlands: Land Use (CO_2)	12562	14097	T	L	L
4 E 2 Settlements: Land Use (CO_2)	33493	43347	T	L	L
4 G Harvested Wood Products: Wood product (N_2O)	-26224	-29130	T	L	L
5 A 1 Managed Waste Disposal Sites: Waste (CH_4)	164444	86875	T	L	L
5 A 2 Unmanaged Waste Disposal Sites: Waste (CH_4)	26251	12990	T	L	L
5 B 1 Waste Composting: Waste (CH_4)	361	2820	T	0	0
5 B 1 Waste Composting: Waste (N_2O)	329	2771	T	0	0
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (CH_4)	21907	10884	T	L	L
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (N_2O)	7825	7115	0	0	L
5 D 2 Wastewater Treatment and Discharge: Industrial Wastewater (CH_4)	12108	9107	0	L	L

Note: EU totals for 2015 in sector Energy and IPPU may not include data for Sweden due to confidential reporting.

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 Cyprus, Malta and Island. Since the total emissions of Cyprus, 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 1.13 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 1.13 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 1.13 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 1.14, 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 1.14 .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:

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

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 1.15 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 waste (52.3 %. Overall level uncertainty estimates including LULUCF of all EU-28 GHG emissions is calculated with 6.1 % and excluding LULUCF slightly lower with 5.1 %.

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 (18.6 percentage points). Overall trend uncertainty (including LULUCF) of all EU-28 GHG emissions is estimated to be 1.1 percentage points.

These results of the Tier 1 uncertainty analysis 2015 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 1.15 Tier 1 uncertainty estimates of EU GHG emissions for the main sectors

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A Fuel combustion activities	all	4 135 921	3 235 842	-21.8%	0.9%	0.3%
1.B Fugitive emissions	all	196 697	89 108	-54.7%	18.3%	8.1%
2. Industrial processes	all	517 735	342 609	-33.8%	11.0%	4.9%
3. Agriculture	all	540 946	435 365	-19.5%	45.8%	2.9%
5. Waste	all	239 014	136 092	-43.1%	52.3%	11.9%
4. LULUCF	all	-208 240	-282 549	35.7%	36.7%	18.6%
Total (incl LULUCF)	**all**	**5 422 073**	**3 956 467**	**-27.0%**	**6.1%**	**1.1%**
Total (excl LULUCF)	**all**	**5 630 313**	**4 239 017**	**-24.7%**	**5.1%**	**0.8%**

Note: Emissions are in Gg CO_2 equivalents

Table 1.16 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 1.16 Overview of uncertainty estimates available from EU-28 Member States and Iceland

Member State	**Austria**		**Belgium**	**Bulgaria**		**Croatia**	**Cyprus**	**Czech Republic**		**Denmark**	
Citation	NIR March 2017, pp.58-65		NIR March 2017, pp.37-38	NIR March 2017, pp.65-66		NIR March 2017, pp.83-84	NIR March 2017, pp.46-47	NIR March 2017, pp.44		NIR March 2017, pp.60-66	
Method used	Tier 1		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 1)	Yes (Annex 2)		Yes (Annex 2 with data online)	
Years and sectors included	emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF	emissions: 2015; trends: 1998-2015; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF	emissions: 2014; trends: 1990-2014; excluding LULUCF	emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015 *; including LULUCF	
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 + Tier 2	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2										4.7%	2.3%
CH_4										17.3%	
N_2O										36.3%	
F-gases			35%							41.2%	
Total	23.50%	4.87%	3.95%	26.34%	12.75%	-13.62% +60.80%	6.13%	3.72%	3.39%	5.7%	5.0%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 + Tier 2	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2										1.7%	1.5%
CH_4										11.9%	
N_2O										10.4%	
F-gases										96.7%	
Total	2.15%	2.84%	2.24%	8.90%	1.84%	-22.09% +39.49%	9.30%	2.41%	2.29%	2.0%	1.9%

Member State	**Estonia**		**Finland**				**France**		**Germany**	**Greece**		**Hungary**	**Ireland**	
Citation	NIR (March) 2017, pp.44		NIR March 2017, pp.41-43				NIR March 2017, pp.73-76		NIR March 2017, pp.129-131	NIR March 2017, pp.130		NIR March 2017, pp.21	NIR Apr. 2017, pp.26-27;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 2)				Yes (Annex 7)		Yes	(Annex 4)		Yes	Yes (pp.35-42)	
Years and sectors included	emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF				emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF	emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015; excluding LULUCF	emissions: 2015; trends: 1990-2015; including 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 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2												2.5%		1.27%
CH_4												22.6%	3.10%	3.20%
N_2O												144.9%	8.79%	9.39%
F-gases												12.9%	0.39%	0.42%
Total	11.65%	5.05%	48%	4%	-36% +45%	-3% +4%	12.7%	11.2%	4.5%	13.0%	12.5%	10.8%	9.63%	10.01%
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 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2														1.67%
CH_4													1.08%	0.93%
N_2O													1.91%	1.90%
F-gases													0.60%	0.60%
Total	4.16%	1.81%	34%	5%	-19% +26%	-3% +4%	2.5%	2.2%	5.1%	11.9%	11.7%	2.3%	10.47%	2.76%

Member State	Italy		Latvia		Lithuania		Luxembourg		Malta		Netherlands			Poland	
Citation	NIR (Apr.) 2017, pp.44-46		NIR (March) 2017, pp.67-68		NIR (March) 2017, pp.60-61		NIR DRAFT March 2017, pp.81-104		no NIR 2017		NIR March 2017, pp.50-55			NIR Feb. 2017, pp.25	
Method used	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 (pp.94-104)				Yes			Yes (Annex 8)	
Years and sectors included	emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015 *; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF				emissions: 2015; trends: 1990-2015 *; including LULUCF			emissions: 2015; trends: 1988-2015; 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 (i .L.)	Tier 1 (e. L.)	Tier 2 (e.L.)	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2												2.1%	3.0%	3.4%	1.8%
CH_4												17.6%	15.7%	22.8%	22.8%
N_2O												39.4%	28.3%	45.7%	48.0%
F-gases												47.4%	25.6%		
Total	4.8%	2.6%	23%	8%	40.7%	11.0%	3.90%	2.75%			3%	3.1%	3.2%	4.9%	4.0%
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 (i .L.)	Tier 1 (e. L.)	Tier 2 (e.L.)	Tier 1 (i .L.)	Tier 1 (e. L.)
CO_2														1.25%	1.14%
CH_4														2.75%	2.75%
N_2O														2.31%	2.30%
F-gases															
Total	3.8%	2.0%	13%	3%	8.8%	2.3%	4.53%	3.07%						4.2%	4.0%

Member State	Portugal	Romania		Slovakia	Slovenia	Spain		Sweden		United Kingdom		Iceland
Citation	NIR March 2017, pp."1-5"	NIR March 2017, pp.121-123		NIR March 2017, pp.36	NIR March 2017, pp.28-29	NIR (March) 2017, pp."1.7"		NIR (March) 2017, pp.63-66		NIR March 2017, pp.98		NIR March 2017, pp.11-12
Method used	Tier 1	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	Yes (Annex 2)		Yes (Annex 3)	Yes (Annex 6)	Yes (Annex 6)		Yes (Annex 7)		Yes (Annex 2)		Yes (Annex 2)
Years and sectors included	emissions: 2015; trends: 1990-2015; excluding LULUCF **	emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF	emissions: 2015; trends: 1986-2015; including LULUCF	emissions: 2015; trends: 1990-2015 *; including LULUCF		emissions: 2015; trends: 1990-2015; including LULUCF		emissions: 2015; trends: 1990-2015 *; including LULUCF		emissions: 2012; trends: 1990-2012; including LULUCF
Uncertainty (%)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 2	Tier 1
CO_2											2.0%	
CH_4											15.9%	
N_2O											28.3%	
F-gases												
Total	4.2%	17.5%	11.0%	10.67%	16.27%	18.9%	15.7%	271.4%	5.0%	3.2%	2.7%	33.6%
Uncertainty in trend (%)	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 2	Tier 1
CO_2												
CH_4												
N_2O												
F-gases												
Total	3.5%	5.9%	1.5%	3.46%	14.06%	1.1%	1.2%	21.5%	1.9%	2.5%	3.1%	16.0%

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 Reporting of confidential data

According to the UNFCCC reporting guidelines Parties may report specific categories with the notation key C in case of confidentiality. In 2017 Sweden has reported correct sector totals for all sectors but in the sectors Energy and IPPU on a less aggregated level they reported several sub-categories as confidential. Manual changes have been performed in order to reflect this in the most appropriate way in the EU CRF tables. For further details refer to Table 1.7

Therefore, in the relevant sector chapters, EU trends at fuel level do not always include Sweden for confidentiality reasons and also to preserve time series consistency for the EU. Consequently, the EU CRF tables at sub-category level and data shown on the same level in the NIR are not always consistent. Note that at sector level and at national totals level the EU NIR and the EU CRF tables are fully consistent.

1.7.3 Data gaps and gap-filling

1.7.3.1 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[10].

1.7.3.2 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.

1.7.3.1 Gap filling of activity data

In response to recommendations of the UNFCCC review team the EU elaborated and implemented a gap filling procedure for gaps in activity data (for further details on the methodology also see 4.3). Due to the large resource needs for gap filling the following rules apply:

- Only activity data for key categories will be gap-filled.
- If more than 75 % of the emissions are calculated on basis of consistent activity data.
- If the IEF has a reasonable degree of consistency (i.e. standard deviation divided by mean < 50 %).
- Only for the latest reporting year.

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

1.7.3.2 Gap filling of activity data in GHG inventory submissions 2017

Applying the rules mentioned above activity data of the following categories have been gap-filled in this inventory submission:

- Clinker production in 2A1
- Lime production in 2A2
- Glass production 2A3
- Ammonia production in 2B1

1.7.4 Geographical coverage of the European Union inventory

Table 1.17 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.

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

Table 1.17 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 and the UK Overseas Territories and UK Crown Dependencies to whom the UK's ratification of the Kyoto Protocol has previously extended and whose emissions are provisionally included for the second commitment period (the Cayman Islands, the Falkland Islands, Gibraltar, Jersey, Guernsey and the Isle of Man).	√			GBR
	England, Scotland, Wales and Northern Ireland and the UK Overseas Territories and UK Crown Dependencies for whom the UK's ratification of the UN Framework Convention on Climate Change is extended (the Cayman Islands, the Falkland Islands, Gibraltar, Bermuda, Jersey, Guernsey and the Isle of Man).			√	GBU
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

1.7.5 Completeness of the European Union submission

1.7.5.1 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 1.18 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.18 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.
Annex V: Additional information	Summary Table 2

1.7.5.2 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.

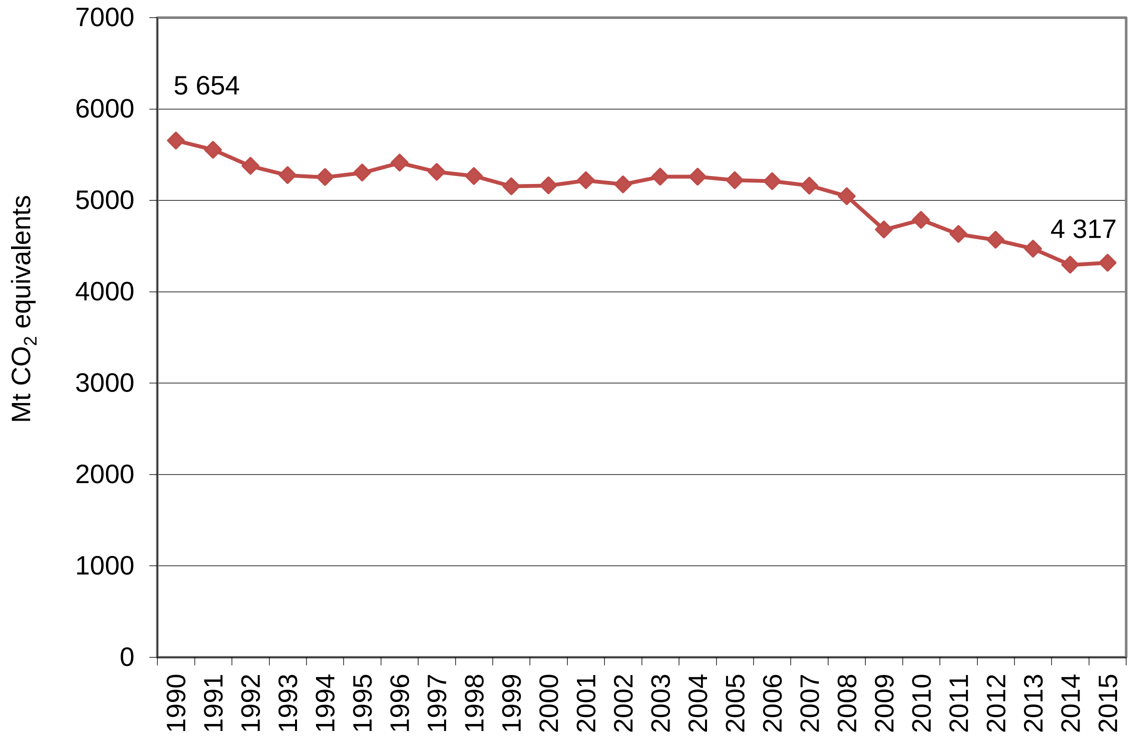
2 EU GREENHOUSE GAS EMISSION TRENDS

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 23.6 % (-1336 million tonnes CO_2 equivalents) below 1990. Emissions increased by 0.5 % (23 million tonnes CO_2 equivalents) between 2014 and 2015 (Figure 2.1).

Figure 2.1 EU-28 and Iceland GHG emissions 1990–2005 (excl. LULUCF)



Notes: GHG emission data for the EU-28 as a whole refer to domestic emissions (i.e. within its 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).

2.1.1 Main trends by source category, 1990-2015

Total GHG emissions (excluding LULUCF) decreased by 1336 million tonnes since 1990 (or 23.6 %) to reach 4317 Mt CO_2 eq. in 2015. There has been a progressive decoupling of gross domestic product (GDP) and GHG emission compared to 1990, with an increase in GDP of about 50% alongside a decrease in emissions of almost 24 % over the period.

The reduction in GHG emissions over the 25-year period was due to a variety of factors, including the growing share in the use of renewables, the use of less carbon intensive fuels and improvements in energy efficiency, as well as to structural changes in the economy and the economic recession. Demand for energy to heat households has also been lower, as Europe on average has experienced milder winters since 1990, which has also helped reduce emissions.

GHG emissions decreased in the majority of sectors between 1990 and 2015, with the notable exception of transport, including international transport, and refrigeration and air conditioning. At the aggregate level, emission reductions were largest for manufacturing industries and construction, electricity and heat production, and residential combustion. The largest decrease in emissions in relative terms was in waste management (over 40 % reduction compared to 1990)

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 total GDP. The economic recession that began in the second half of 2008 and continued through to 2009 also had an impact on emissions from industrial sectors. Emissions from electricity and heat production decreased strongly since 1990. In addition to improved energy efficiency there has been a move towards less carbon intense fuels. Between 1990 and 2015, the use of solid and liquid fuels in thermal stations decreased strongly whereas natural gas consumption doubled, resulting in reduced CO_2 emissions per unit of fossil energy generated. Emissions in the residential sector also represented one of the largest reductions. Energy efficiency improvements from better insulation standards in buildings and a less carbon-intensive fuel mix can partly explain lower demand for space heating in the EU as a whole over the past 25 years. Since 1990 there has been a gradual warming of the autumn/winter period in Europe; although there is high regional variability. The very strong increase in the use of biomass for energy purposes has also 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, as well as lower emissions from managed waste disposal on land and from agricultural soils. A number of policies (both EU and country-specific) have also contributed to the overall reduction in GHG emissions, including key agricultural and environmental policies in the 1990s and climate and energy policies in the 2000s.

Almost all EU Member States reduced emissions compared to 1990 and thus contributed to the overall positive EU performance. The United Kingdom and Germany accounted for about 48 % of the total net reduction in the EU over the past 25 years.

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 2015.

Table 2.1 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 1990-2015

Source category	Million tonnes (CO2 equivalents)
Road Transportation (CO2 from 1.A.3.b)	142
Refrigeration and Air conditioning (HFCs from 2.F.1)	97
Fugitive emisisons from Natural Gas (CH4 from 1.B.2.b)	-21
Aluminium Production (PFCs from 2.C.3)	-21
Agricultural Soils: Direct N2O Emissions From Managed Soils (N2O from 3.D.1)	-26
Cement Production (CO2 from 2.A.1)	-28
Fluorochemical Production (HFCs from 2.B.9)	-29
Commercial/Institutional (CO2 from 1.A.4.a)	-43
Enteric Fermentation: Cattle (CH4 from 3.A.1)	-44
Nitric Acid Production (N2O from 2.B.2)	-45
Adipic Acid Production (N2O from 2.B.3)	-57
Manufacture of Solid Fuels and Other Energy Industries (CO2 from 1.A.1.c)	-62
Coal Mining and Handling (CH4 from 1.B.1.a)	-67
Managed Waste Disposal Sites (CH4 from 5.A.1)	-78
Iron and steel production (CO2 from 1.A.2.a +2.C.1)	-106
Residential: Fuels (CO2 from 1.A.4.b)	-126
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1.A.2 excl. 1.A.2.a)	-279
Public Electricity and Heat Production (CO2 from 1.A.1.a)	-373
Total	**-1336**

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, 2014-2015

Total GHG emissions (excluding LULUCF) increased for the first time since 2010 by 23.1 million tonnes, or 0.5°% compared to 2014, to reach 4317 Mt CO_2 equivalent in 2015. This small increase in emissions came along with an increase in GDP of 2.2°%, the largest increase since the economic crisis started in the second half of 2008.

The increase in emissions was triggered by the higher heat demand by households and services due to slightly colder winter conditions in Europe, as well as by higher road transport demand, which increased for the second year in a row.

Total energy consumption increased overall, with fossil emissions increasing, particularly for natural gas and crude oil. The consumption and emissions of solid fuels decreased in 2015 for the third consecutive year. The sustained increase in renewables, particularly biomass, wind and solar, offset otherwise higher emissions in 2015. Hydro (due to a low rainfall) and nuclear electricity production declined in 2015.

In spite of the 2015 increase in emissions, there were further improvements in the carbon intensity of the EU energy system because of the increased shares of renewables and gas relative to coal in the fuel mix. The energy intensity of GDP also improved as total energy consumption increased less rapidly than economic growth. The improvement in energy intensity was largely driven by lower energy-transformation losses and better energy efficiency of the overall EU economy.

Spain, Italy and the Netherlands accounted for the largest increases in GHG emissions in the EU in 2015. The UK recorded the largest reduction.

Table 2.2 shows the source categories making the largest contribution to the change in GHG emissions in the EU-28 between 2014 and 2015.

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 2014–2015

Source category	Million tonnes (CO2 equivalents)
Residential: Fuels (CO2 from 1.A.4.b)	20
Road Transportation (CO2 from 1.A.3.b)	14
Commercial/Institutional (CO2 from 1.A.4.a)	6
Managed Waste Disposal Sites (CH4 from 5.A.1)	-4
Refrigeration and Air conditioning (HFCs from 2.F.1)	-5
Public Electricity and Heat Production (CO2 from 1.A.1.a)	-13
Total	**23**

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)	2015 (million tonnes)	2014-2015 (million tonnes)	Change 2014-2015 (%)	Change 1990–2015 (%)
Austria	78.8	78.9	2.5	3.2%	0.1%
Belgium	146.3	117.4	3.4	2.9%	-19.7%
Bulgaria	103.7	61.5	4.0	6.9%	-40.7%
Croatia	31.2	23.5	0.5	2.0%	-24.6%
Cyprus	5.6	8.4	0.0	0.1%	50.0%
Czech Republic	197.9	127.9	1.3	1.0%	-35.4%
Denmark	70.4	48.3	-2.5	-4.9%	-31.3%
Estonia	40.4	18.0	-3.0	-14.4%	-55.3%
Finland	71.3	55.6	-3.6	-6.0%	-22.1%
France	547.1	457.1	3.6	0.8%	-16.4%
Germany	1250.9	901.9	-2.3	-0.3%	-27.9%
Greece	103.1	95.7	-3.6	-3.7%	-7.1%
Hungary	93.9	61.1	3.2	5.6%	-34.9%
Ireland	56.1	59.9	2.1	3.7%	6.7%
Italy	519.9	433.0	9.7	2.3%	-16.7%
Latvia	26.2	11.3	0.1	1.0%	-56.8%
Lithuania	48.0	20.1	0.2	1.1%	-58.2%
Luxembourg	12.7	10.3	-0.5	-4.5%	-19.3%
Malta	2.4	2.2	-0.7	-24.0%	-6.5%
Netherlands	221.4	195.2	7.7	4.1%	-11.8%
Poland	467.9	385.8	2.9	0.8%	-17.5%
Portugal	59.6	68.9	4.6	7.1%	15.7%
Romania	246.3	116.4	1.0	0.9%	-52.7%
Slovakia	74.5	41.3	0.6	1.5%	-44.6%
Slovenia	18.6	16.8	0.2	1.3%	-9.5%
Spain	287.8	335.7	11.4	3.5%	16.6%
Sweden	71.6	53.7	-0.1	-0.3%	-25.1%
United Kingdom	793.6	503.5	-19.4	-3.7%	-36.6%
EU-28	**5647.1**	**4309.6**	**23.2**	**0.5%**	**-23.7%**
Iceland	3.5	4.5	0.1	1.9%	28.1%
United Kingdom (KP)	796.8	506.8	-19.6	-3.7%	-36.4%
EU-28 + ISL	**5653.9**	**4317.4**	**23.1**	**0.5%**	**-23.6%**

2.2 Emission trends by gas

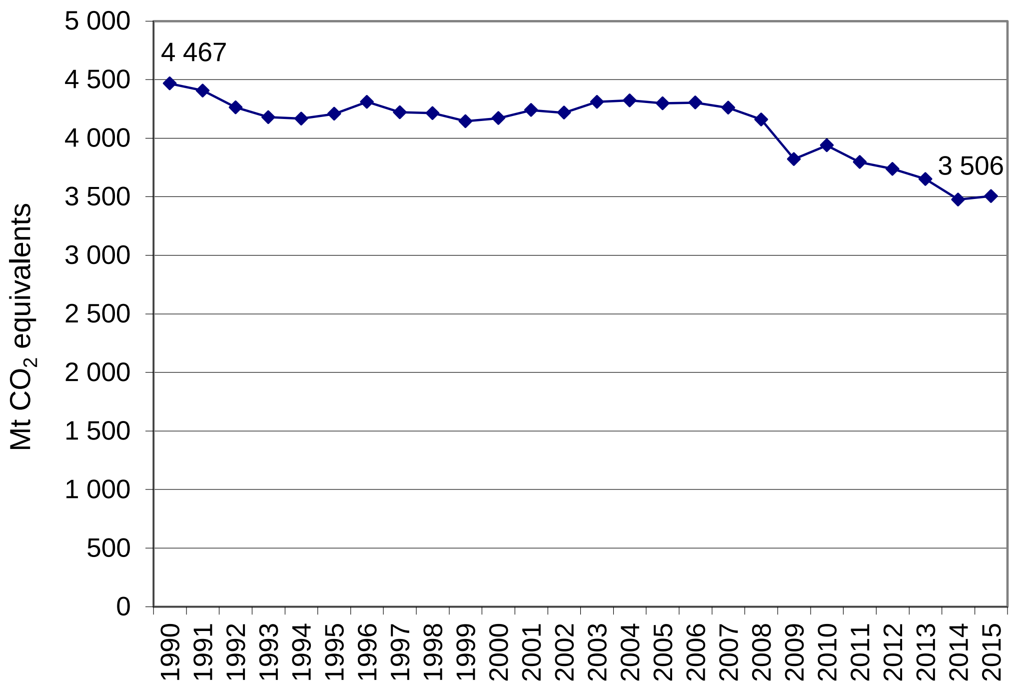
Table 2.4, Figure 2.2 and Figure 2.3 give an overview of the main trends in EUGHG emissions and removals for 1990–2015. In the EU the most important GHG is CO_2, accounting for 81 % of total EU emissions in 2015 excluding LULUCF. In 2015, EU CO_2 emissions excluding LULUCF were 3 506 Mt, which was 22 % below 1990 levels. Compared to 2014, CO_2 emissions increased by 0.8 %.

Table 2.4 Overview of EU-28 and Iceland GHG emissions and removals from 1990 to 2015 in CO_2 equivalent

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Net CO_2 emissions/removals	4 222	3 932	3 857	3 970	3 608	3 474	3 415	3 323	3 157	3 190
CO_2 emissions (without LULUCF)	4 467	4 208	4 171	4 298	3 939	3 795	3 738	3 651	3 476	3 506
CH_4	739	675	617	556	501	491	486	473	467	464
N_2O	399	362	319	299	253	249	247	246	249	250
HFCs	29	44	53	73	102	105	108	111	113	108
PFCs	26	17	12	7	4	4	4	4	4	4
Unspecified mix of HFCs and PFCs	5.8	5.6	1.8	1.0	0.5	0.3	0.3	0.3	0.2	0.2
SF_6	11	15	11	8	6	6	6	6	6	6
NF_3	0.02	0.10	0.10	0.16	0.12	0.13	0.09	0.07	0.07	0.07
Total (with net CO_2 emissions/removals)	**5 432**	**5 050**	**4 872**	**4 915**	**4 476**	**4 331**	**4 266**	**4 164**	**3 995**	**4 023**
Total (without CO2 from LULUCF)	**5 676**	**5 326**	**5 186**	**5 243**	**4 807**	**4 651**	**4 590**	**4 492**	**4 315**	**4 339**
Total (without LULUCF)	**5 654**	**5 302**	**5 162**	**5 221**	**4 785**	**4 630**	**4 567**	**4 472**	**4 294**	**4 317**

Notes: CO_2 emissions include indirect CO_2

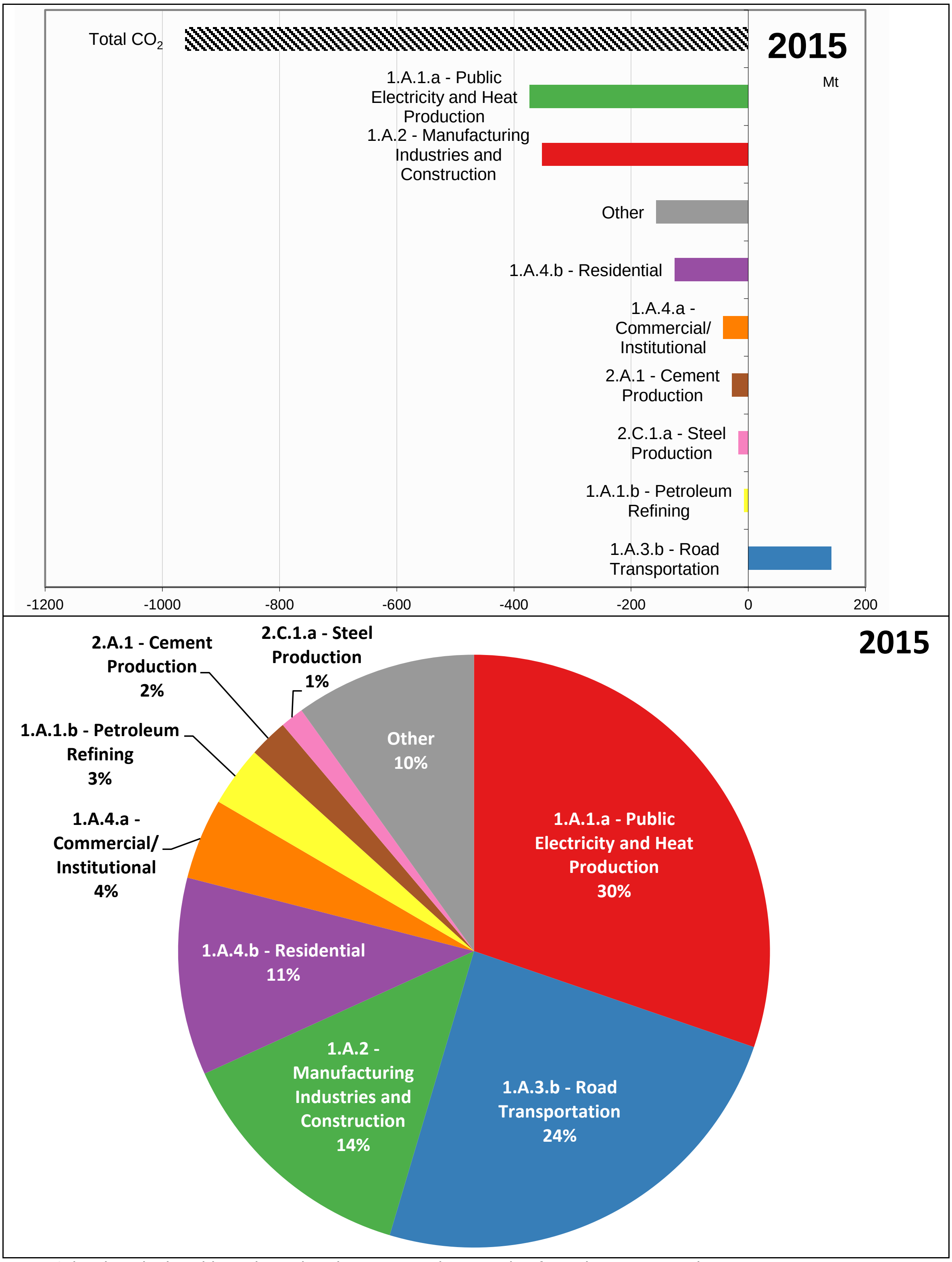
Figure 2.2 CO_2 emissions 1990 to 2015 (Mt)



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 2015 with the exception of 1.A.3.b Road transportation which accounts for 24 % of CO_2 emission in 2015.

Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2015 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest key source categories in 2015 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 2015 and decreased by 37 % since 1990 to 464 Mt CO_2 equivalents in 2015 (Figure 2.4). The two largest key sources are enteric fermentation and anaerobic waste. They account for 53 % of CH_4 emissions in 2015.

Figure 2.4 CH_4 emissions 1990 to 2015 in CO_2 equivalents (Mt)

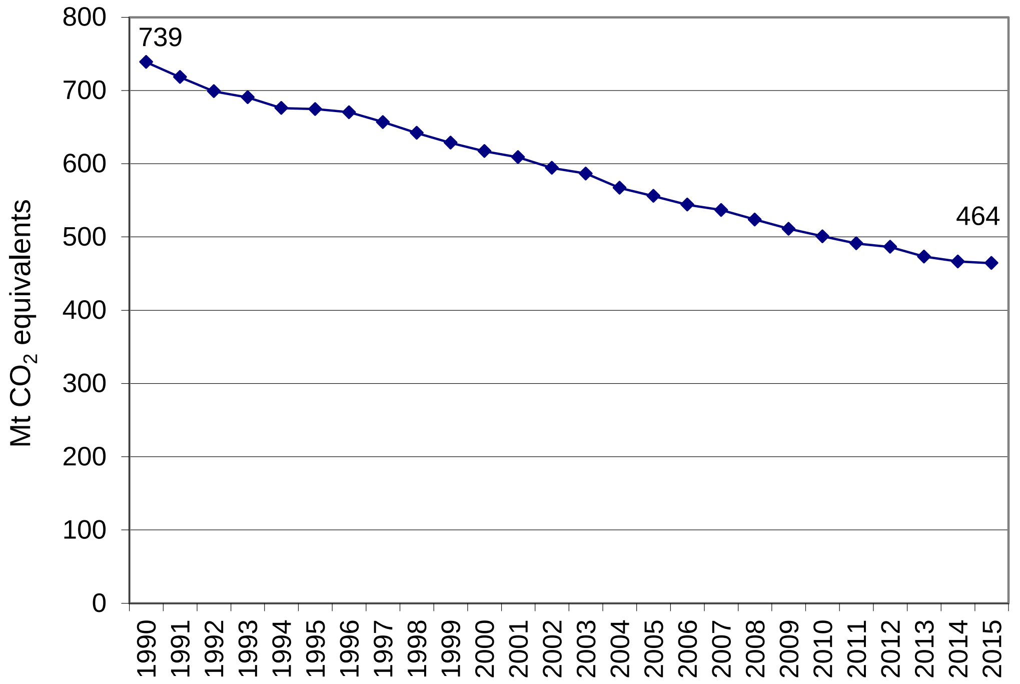
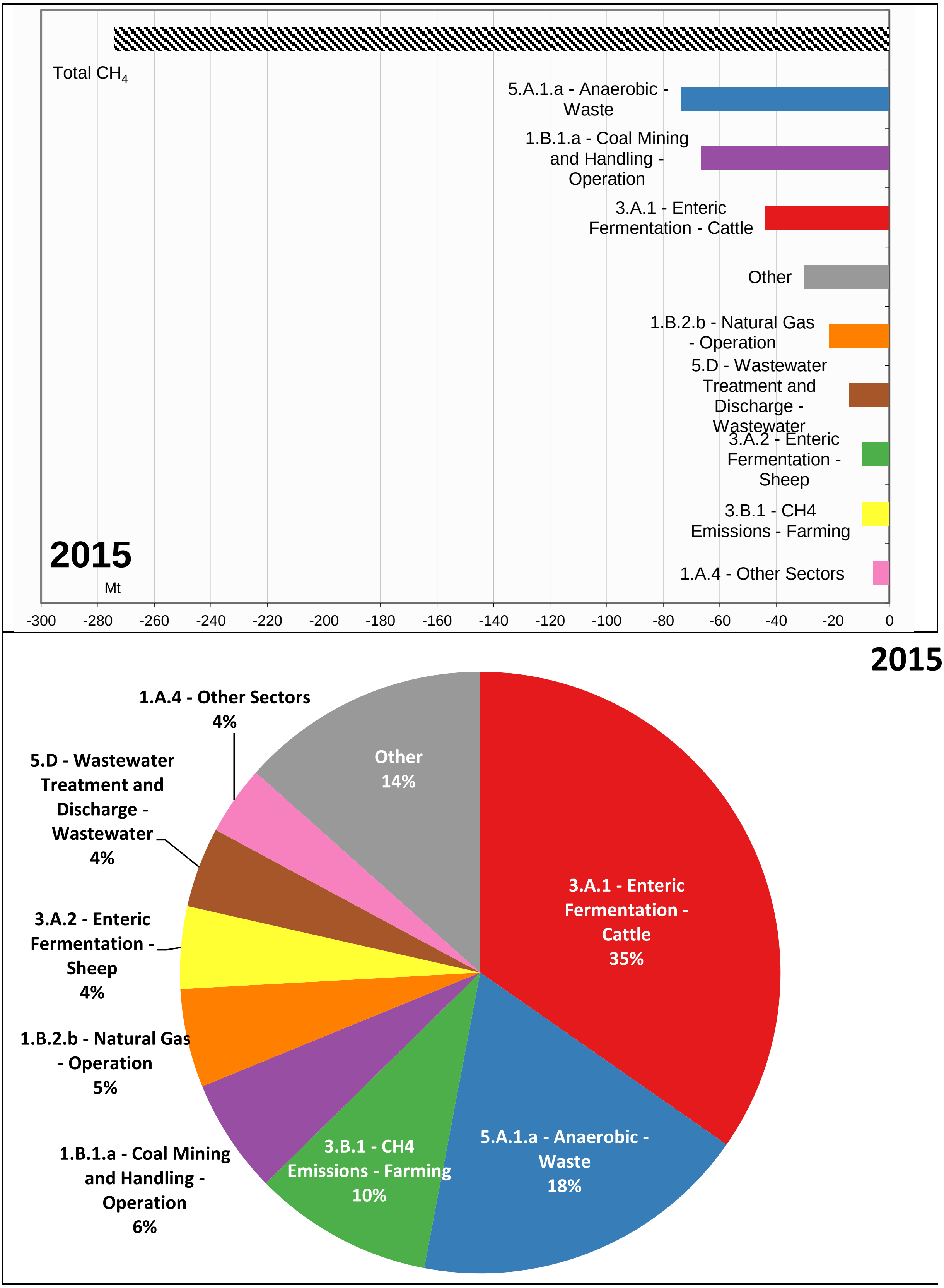


Figure 2.5 shows that the main reasons for declining CH_4 emissions were reductions in coal mining and anaerobic waste.

Figure 2.5 Absolute change of CH_4 emissions by large key source categories 1990 to 2015 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2015 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 250 Mt CO_2 equivalents in 2015 (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 2015. Figure 2.7 shows that the main reason for large N_2O emission cuts were reduction in chemical industry and agricultural soils.

Figure 2.6 N_2O emissions 1990 to 2015 in CO_2 equivalents (Mt)

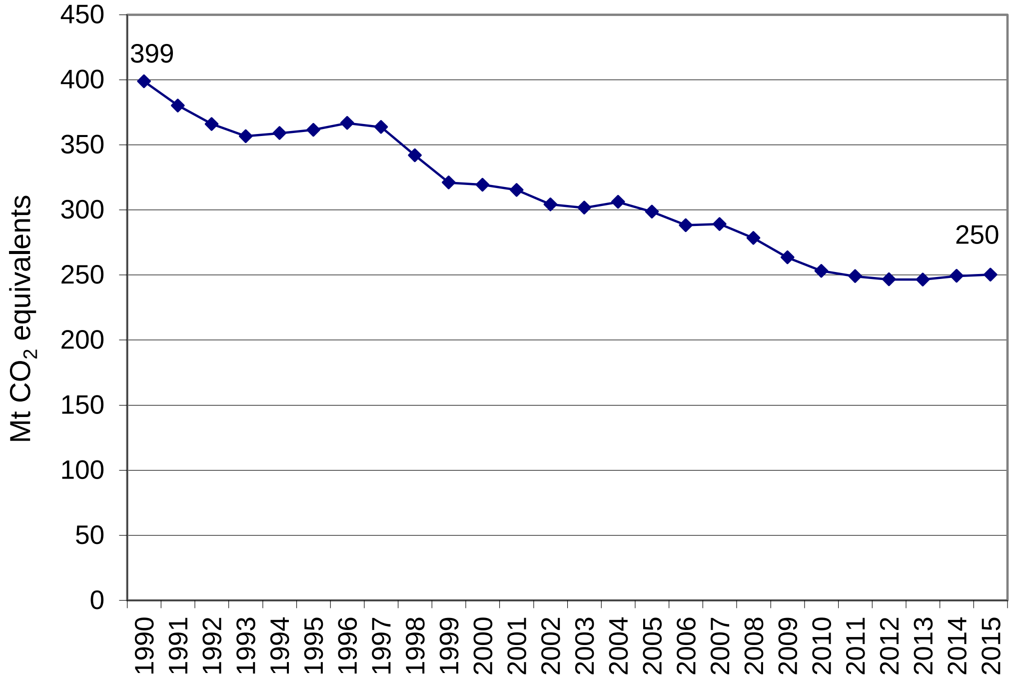
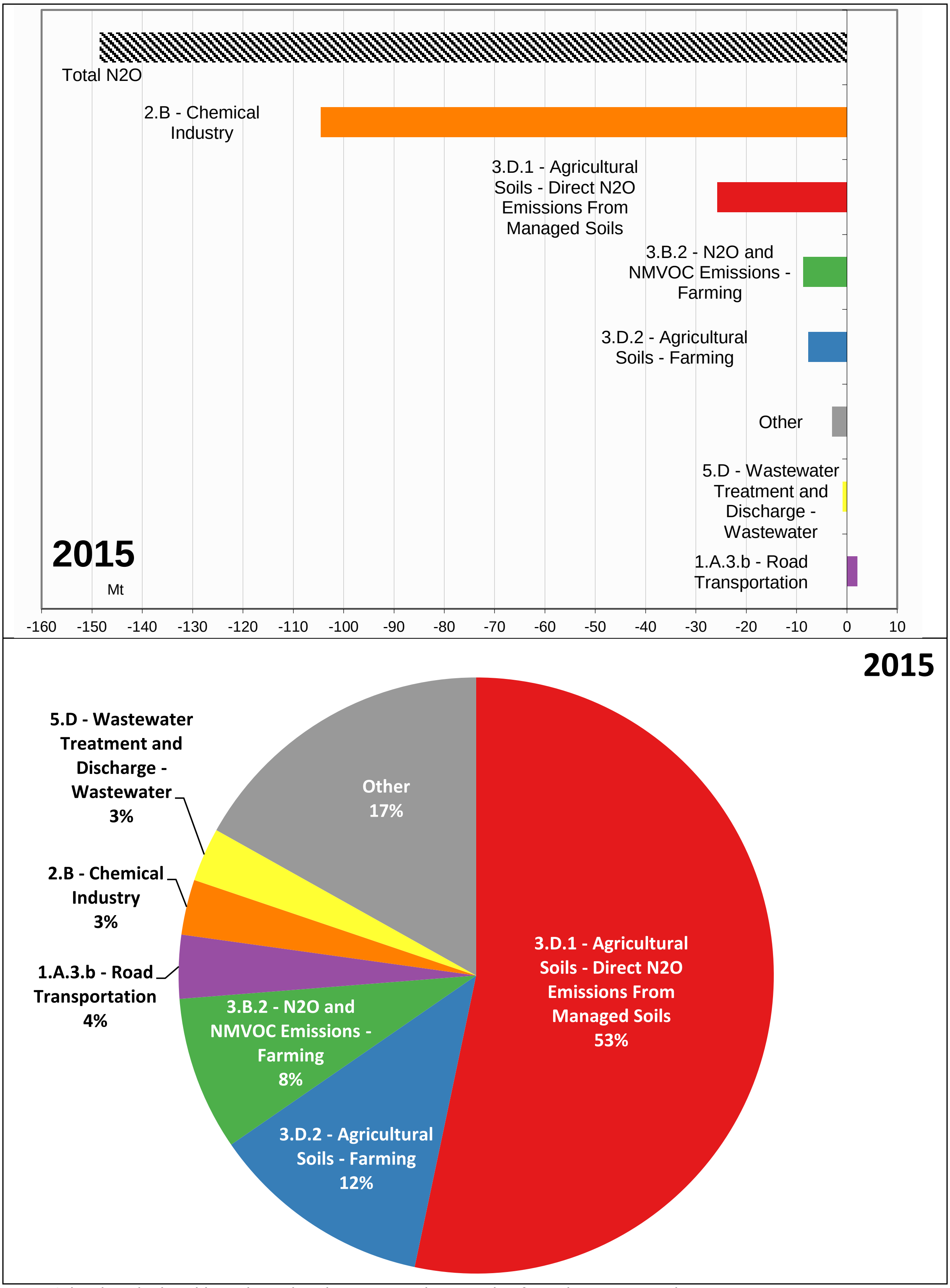


Figure 2.7 Absolute change of N_2O emissions by large key source categories 1990 to 2015 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2015for EU-28 and Iceland



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

Fluorinated gas emissions account for 2.7 % of total EUGHG emissions. In 2015, emissions were 118 Mt CO_2 equivalents, which was 64 % above 1990 levels (Figure 2.8). Refrigeration and air conditioning, the largest key category, accounts for 82 % of fluorinated gas emissions in 2015. Figure 2.9 shows that HFCs from refrigeration and air conditioning showed large increases between 1990 and 2015. 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 2015 in CO_2 equivalents (Mt)

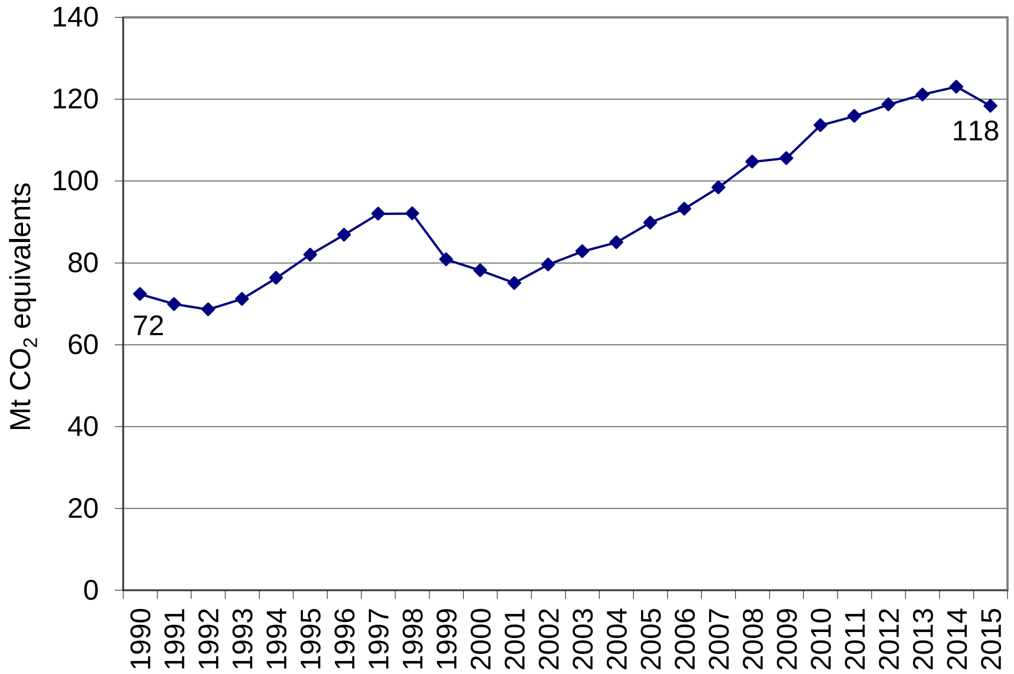
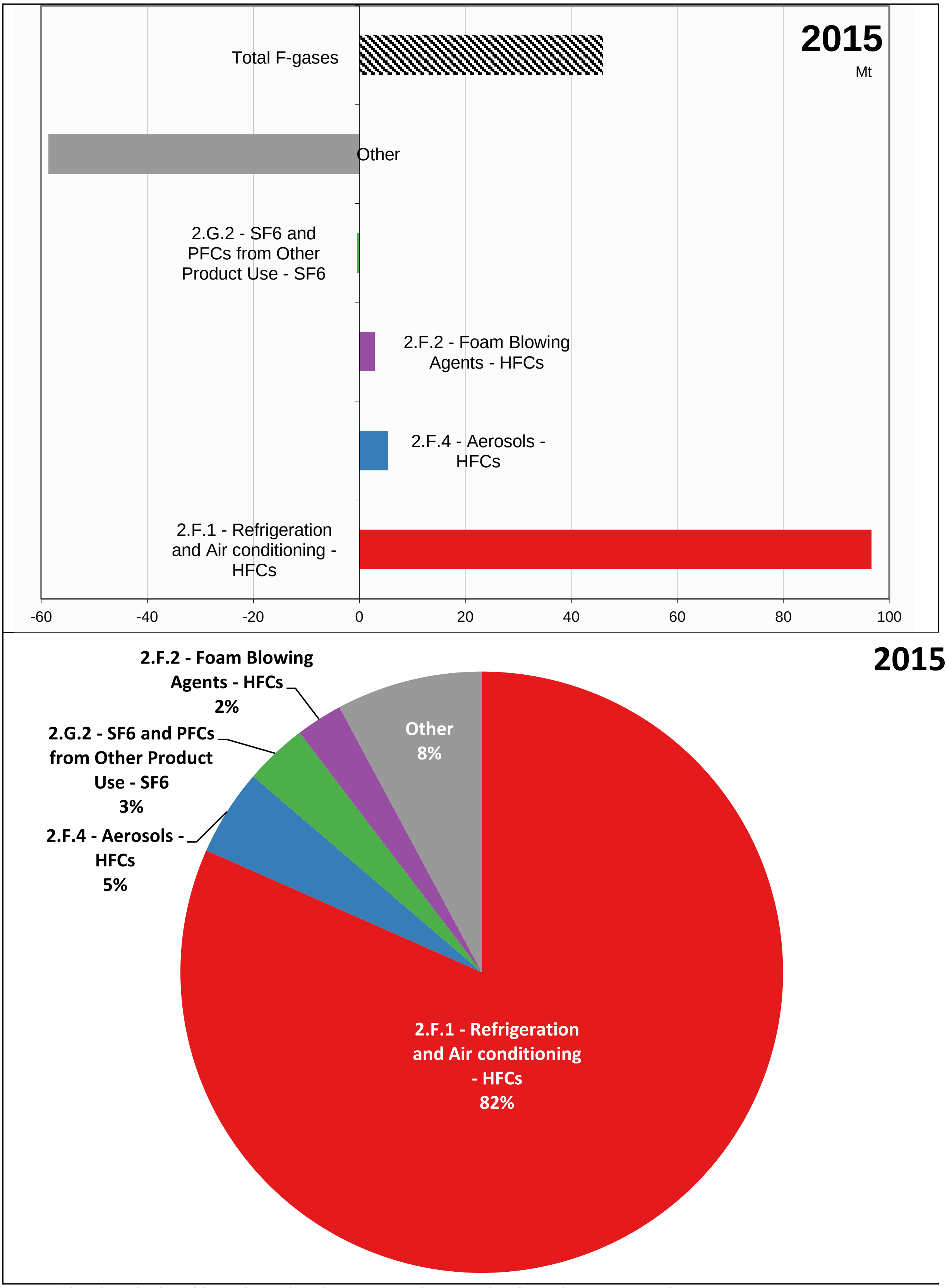


Figure 2.9 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2015 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2015 for EU-28 and Iceland



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 1990–2015. 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 2015

GHG SOURCE AND SINK	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
1. Energy	4 341	4 075	4 009	4 113	3 795	3 648	3 605	3 518	3 333	3 362
2. Industrial Processes	518	498	454	461	392	389	376	374	380	376
3. Agriculture	549	479	465	441	426	427	425	428	435	438
4. Land-Use, Land-Use Change and Forestry	-222	-252	-291	-306	-310	-299	-301	-308	-299	-295
5. Waste	241	246	231	203	170	164	159	151	145	140
6. Other	0	0	0	0	0	0	0	0	0	0
indirect CO_2 emissions	4.39	3.71	2.71	2.35	2.01	1.91	1.84	1.72	1.65	1.66
Total (with net CO_2 emissions/removals)	**5 432**	**5 050**	**4 872**	**4 915**	**4 476**	**4 331**	**4 266**	**4 164**	**3 995**	**4 023**
Total (without LULUCF)	**5 654**	**5 302**	**5 162**	**5 221**	**4 785**	**4 630**	**4 567**	**4 472**	**4 294**	**4 317**

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 1990–2015 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 2015 in million tonnes CO_2-equivalent

Member State	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Austria	79	80	81	93	85	83	80	80	76	79
Belgium	146	154	149	145	132	122	119	119	114	117
Bulgaria	104	74	59	64	60	66	61	55	58	61
Croatia	31	22	25	29	27	27	25	24	23	24
Cyprus	5.6	7.0	8.3	9.3	9.6	9.3	8.8	8.0	8.4	8.4
Czech Republic	198	157	149	148	140	138	134	131	127	128
Denmark	70	78	71	66	63	58	53	55	51	48
Estonia	40	20	17	19	21	21	20	22	21	18
Finland	71	72	70	70	76	68	62	63	59	56
France	547	544	552	553	511	484	483	482	453	457
Germany	1 251	1 121	1 043	992	942	922	927	945	904	902
Greece	103	109	126	136	118	115	112	102	99	96
Hungary	94	75	73	76	65	64	60	57	58	61
Ireland	56	60	69	70	62	58	58	58	58	60
Italy	520	531	553	579	505	491	470	440	423	433
Latvia	26	13	10	11	12	11	11	11	11	11
Lithuania	48	22	20	23	21	21	21	20	20	20
Luxembourg	13	10	10	13	12	12	12	11	11	10
Malta	2.4	2.6	2.7	3.0	3.0	3.1	3.2	2.9	2.9	2.2
Netherlands	221	232	220	214	214	200	195	196	188	195
Poland	468	439	391	399	407	406	399	396	383	386
Portugal	60	70	83	86	69	68	66	64	64	69
Romania	246	181	140	146	121	127	124	115	115	116
Slovakia	74	54	50	51	47	45	43	43	41	41
Slovenia	19	19	19	20	20	20	19	18	17	17
Spain	288	328	386	440	357	357	352	323	324	336
Sweden	72	74	69	67	65	61	57	56	54	54
United Kingdom	794	746	710	689	612	564	581	565	523	503
EU-28	**5 647**	**5 295**	**5 155**	**5 214**	**4 777**	**4 622**	**4 559**	**4 464**	**4 286**	**4 310**
Iceland	3.5	3.3	3.9	3.8	4.7	4.4	4.5	4.5	4.5	4.5
United Kingdom (KP)	797	749	713	693	616	568	584	569	526	507
EU-28 + ISL	**5 654**	**5 302**	**5 162**	**5 221**	**4 785**	**4 630**	**4 567**	**4 472**	**4 294**	**4 317**

The overall EU GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom accounting for almost one third of total EU GHG emissions in 2015. These two Member States have achieved total GHG emission reductions of 639 million tonnes CO_2-equivalents compared to 1990.

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

France and Italy were the third and fourth largest emitters with a share of 11 % and 10 %, respectively. Italy's GHG emissions were 17 % below 1990 levels in 2015. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol refining. However, Italian emissions decreased significantly since 2004 with a significant drop in 2009, which was mainly due to the economic crisis and reductions in industrial output. Since 2010 emissions were decreasing continuously until 2014. France's emissions were 16 % below 1990 levels in 2015. In France, large reductions were achieved in N_2O emissions from the chemical industry, but CO_2 emissions from road transport and HFC emissions from electronics industry and product uses as substitutes of ODS increased considerably between 1990 and 2015.

Poland is the fifth largest emitter in the EU-28, accounting for 9 % of total EUGHG emissions. Poland's GHG emissions were 18 % below 1990 levels in 2015. The main factors for decreasing emissions in Poland — as with other Member States — were the decline of energy-inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport), where emissions increased.

Spain, the sixed largest emitter in the EU-28, increased emissions by 17 % between 1990 and 2015. This was largely due to emission increases from road transport, electricity and heat production, and households and services

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 2015. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-87 %) followed by, CO (-67 %), NO_x (-57 %). and NMVOC (-60 %),

Table 2.7 Overview of EU-28 and Iceland indirect GHG and SO_2 emissions for 1990–2015(kt)

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
NO_x	17 991	15 439	13 394	12 275	9 649	9 267	8 930	8 527	8 003	7 667
CO	63 998	51 875	40 073	31 593	26 765	24 335	24 467	23 138	21 414	21 155
NMVOC	16 952	13 696	11 255	9 277	7 777	7 339	7 204	7 058	6 758	6 751
SO_2	24 876	15 911	9 589	7 407	4 531	4 397	4 056	3 545	3 217	3 114

Table 2.8 shows the NO_x emissions of the EU-28 Member States between 1990 and 2015. The largest emitters, Germany, France, the United Kingdom, Spain, and Italy made up 61 % of total EU NO_x emissions in 2015. All EU-28 Member States reduced their NO_x emissions between 1990 and 2015.

Table 2.8 Overview of Member States' contributions to EU-28 and Iceland NO_x emissions for 1990–2015 (kt)

Party	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Austria	220	199	214	236	179	170	163	163	151	147
Belgium	618	594	536	476	365	338	319	309	168	1
Bulgaria	277	171	146	158	136	146	135	119	126	134
Croatia	87	70	75	85	67	63	58	57	53	53
Cyprus	16	19	23	21	18	21	21	16	17	14
Czech Republic	737	418	338	319	261	247	234	222	211	204
Denmark	300	290	224	202	147	139	128	123	114	114
Estonia	94	49	43	41	44	43	41	37	39	38
Finland	299	252	229	198	178	163	154	149	141	130
France	2069	1897	1739	1548	1203	1139	1095	1073	970	929
Germany	2887	2168	1928	1575	1334	1314	1271	1267	1220	1186
Greece	328	332	363	421	324	303	243	249	243	241
Hungary	235	182	180	169	139	131	122	120	118	122
Ireland	129	123	129	127	80	71	74	73	73	76
Italy	2035	1910	1457	1238	955	921	857	803	791	766
Latvia	93	52	44	45	42	36	36	36	36	36
Lithuania	133	64	55	59	55	52	54	53	53	53
Luxembourg	40	34	41	54	33	33	30	27	25	20
Malta	6	7	7	6	5	5	5	5	5	5
Netherlands	554	458	377	325	263	246	235	225	207	202
Poland	1053	1029	833	848	852	833	804	769	720	714
Portugal	245	276	274	267	189	180	173	171	170	176
Romania	487	392	376	317	245	250	273	231	223	224
Slovakia	239	186	96	107	94	91	87	86	88	63
Slovenia	67	65	54	51	47	47	46	44	39	35
Spain	1505	1570	1545	1556	1068	1048	1016	900	885	909
Sweden	279	252	216	185	156	148	140	138	135	130
United Kingdom	2918	2340	1814	1605	1136	1057	1085	1031	953	914
EU-28	**17951**	**15397**	**13355**	**12238**	**9617**	**9236**	**8900**	**8496**	**7973**	**7636**
Iceland	29	31	30	28	25	23	23	23	23	23
United Kingdom (KP)	2929	2351	1824	1615	1144	1065	1092	1040	961	921
EU-28 + Iceland	**17991**	**15439**	**13394**	**12275**	**9649**	**9267**	**8930**	**8527**	**8003**	**7667**

Table 2.9 shows the CO emissions of the EU-28 Member States between 1990 and 2015. The largest emitters, France, Germany, Poland, Italy and Romania that made up 59 % of the total CO emissions in 2015, reduced their emissions from 1990 levels substantially. But also all other EU-28 Member States reduced emissions.

Table 2.9 Overview of Member States' contributions to EU-28 and Iceland CO emissions for 1990–2015 (kt)

Party	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Austria	1286	987	784	686	581	563	563	584	536	565
Belgium	2001	1648	1574	1352	980	779	719	717	281	1
Bulgaria	820	553	272	214	162	161	154	137	133	133
Croatia	536	436	441	416	300	272	254	232	202	216
Cyprus	43	38	30	26	18	17	15	14	14	14
Czech Republic	1028	892	771	727	640	588	587	594	532	569
Denmark	741	661	488	463	407	370	354	342	315	326
Estonia	239	179	163	132	128	112	115	110	113	111
Finland	709	616	548	469	411	375	372	358	351	335
France	10500	9036	6553	5260	4268	3596	3200	3310	3041	2968
Germany	12498	6436	4790	3718	3317	3230	2855	2828	2715	2678
Greece	1134	956	925	725	557	524	580	466	456	436
Hungary	1368	887	551	486	467	532	552	543	463	455
Ireland	352	296	251	221	147	135	128	120	113	109
Italy	7258	7302	4930	3445	3080	2423	2669	2490	2258	2356
Latvia	375	277	206	196	142	148	152	138	130	126
Lithuania	452	279	200	190	174	156	160	141	135	125
Luxembourg	463	210	41	37	28	26	27	26	25	21
Malta	21	26	26	12	9	8	8	7	8	7
Netherlands	1218	881	807	720	667	642	621	600	585	585
Poland	3593	4386	3209	3051	3057	2771	2787	2650	2407	2401
Portugal	801	800	651	440	323	303	288	281	274	268
Romania	2369	2332	3644	2501	2169	2103	2910	2099	2050	2155
Slovakia	519	427	280	277	227	233	228	224	231	216
Slovenia	324	285	189	154	135	132	129	127	108	110
Spain	4781	4041	2935	2107	1759	1717	1662	1626	1643	1642
Sweden	1104	971	706	586	523	511	487	482	467	462
United Kingdom	7376	5957	4038	2916	1964	1789	1768	1767	1705	1641
EU-28	**63907**	**51795**	**40004**	**31528**	**26641**	**24214**	**24345**	**23014**	**21293**	**21032**
Iceland	59	53	49	50	117	115	116	119	117	120
United Kingdom (KP)	7407	5984	4058	2932	1972	1795	1774	1772	1710	1645
EU-28 + Iceland	**63998**	**51875**	**40073**	**31593**	**26765**	**24335**	**24467**	**23138**	**21414**	**21155**

Table 2.10 shows the NMVOC emissions of the EU-28 Member States between 1990 and 2015. The largest emitters France, Germany, Italy and the United Kingdom that made up 54 % of the total NMVOC emissions in 2015, 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 1990–2015 (kt)

Party	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Austria	280	204	153	136	118	114	113	115	110	112
Belgium	347	288	225	183	151	134	135	135	94	45
Bulgaria	163	131	98	89	77	75	77	72	72	80
Croatia	141	92	89	100	78	72	67	64	58	59
Cyprus	11	12	11	12	9	7	7	6	6	6
Czech Republic	301	207	255	223	185	169	164	162	152	151
Denmark	204	204	174	149	125	118	115	115	106	109
Estonia	50	34	30	26	23	23	23	23	25	26
Finland	225	191	165	138	113	101	99	94	91	85
France	2767	2384	1966	1511	1096	1033	1008	999	952	931
Germany	3389	2025	1599	1311	1216	1130	1105	1092	1016	1020
Greece	238	216	209	179	144	134	128	127	125	122
Hungary	296	204	181	156	142	144	144	146	136	138
Ireland	141	133	117	112	100	97	98	100	99	101
Italy	1935	1967	1515	1231	1001	910	906	876	820	841
Latvia	82	61	51	49	41	40	43	42	42	41
Lithuania	143	103	74	71	63	60	60	56	56	55
Luxembourg	21	17	13	13	9	10	10	10	9	10
Malta	2	2	2	4	4	4	4	6	4	5
Netherlands	476	336	239	178	163	156	152	147	142	139
Poland	484	616	541	543	571	549	546	535	517	531
Portugal	275	274	259	215	186	178	174	175	174	180
Romania	353	203	265	287	275	263	269	256	251	246
Slovakia	184	146	117	105	110	103	92	91	87	94
Slovenia	72	65	54	46	39	37	35	33	32	32
Spain	1048	978	982	812	640	609	582	566	569	584
Sweden	359	268	228	215	188	182	172	167	163	164
United Kingdom	2944	2319	1629	1173	899	878	866	841	840	835
EU-28	**16932**	**13679**	**11243**	**9267**	**7768**	**7331**	**7196**	**7050**	**6751**	**6743**
Iceland	12	11	7	6	5	5	5	5	5	5
United Kingdom (KP)	2951	2325	1634	1177	901	880	868	844	842	837
EU-28 + Iceland	**16952**	**13696**	**11255**	**9277**	**7777**	**7339**	**7204**	**7058**	**6758**	**6751**

Table 2.11 shows the SO_2 emissions of the EU-28 Member States between 1990 and 2015. The largest emitters, Poland, Bulgaria, Germany that made up 47 % of the total SO_2 emissions in 2015, 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 1990–2015 (Gg)

Party	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Austria	75	47	31	26	17	15	15	15	15	15
Belgium	649	468	307	256	102	84	79	78	19	0
Bulgaria	478	377	334	372	411	493	429	369	393	428
Croatia	135	65	52	59	35	29	25	17	14	15
Cyprus	31	42	48	38	22	21	16	14	17	13
Czech Republic	1871	1090	225	208	160	161	155	138	127	123
Denmark	179	147	33	26	16	14	13	13	11	11
Estonia	222	103	80	64	73	64	30	26	31	24
Finland	250	105	81	69	67	60	51	48	43	41
France	1339	985	659	481	297	262	250	220	179	171
Germany	5404	1745	644	472	409	399	381	373	357	352
Greece	478	541	499	541	248	190	151	141	123	120
Hungary	825	616	429	42	31	35	32	31	28	24
Ireland	184	163	142	74	28	27	25	25	19	18
Italy	1784	1322	755	409	218	196	177	146	131	123
Latvia	100	49	18	8	4	4	4	4	4	4
Lithuania	171	69	36	31	22	24	21	19	17	18
Luxembourg	15	9	3	2	2	1	1	1	2	1
Malta	12	11	9	12	8	8	9	4	4	2
Netherlands	189	126	71	62	33	33	33	29	28	29
Poland	2648	2135	1404	1164	866	828	794	759	715	690
Portugal	324	331	264	195	70	64	59	54	48	50
Romania	802	697	491	594	355	345	273	215	186	179
Slovakia	531	250	103	92	73	72	62	57	49	71
Slovenia	201	124	93	41	10	12	11	11	9	5
Spain	2157	1827	1474	1278	426	462	410	262	258	274
Sweden	106	69	42	36	29	26	25	23	21	19
United Kingdom	3683	2367	1219	711	423	392	439	379	305	236
EU-28	**24843**	**15879**	**9545**	**7364**	**4455**	**4322**	**3969**	**3471**	**3150**	**3055**
Iceland	21	19	35	40	74	73	84	72	65	57
United Kingdom (KP)	3696	2379	1229	714	425	394	441	381	306	237
EU-28 + Iceland	**24876**	**15911**	**9589**	**7407**	**4531**	**4397**	**4056**	**3545**	**3217**	**3114**

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 as well as other important subsector specific categories overview tables are presented including the Member States' contributions to the category in terms of level and trend. This chapter includes also, the reference approach, and international bunkers.

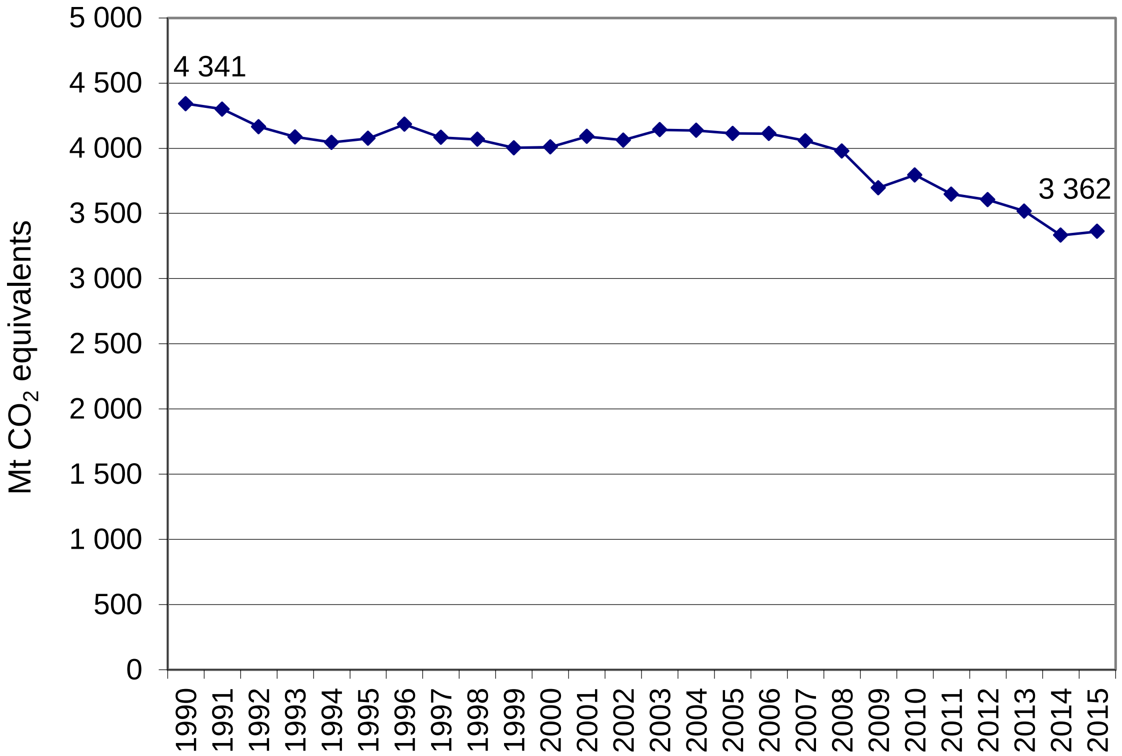
In this chapter, EU trends at fuel level do not always include Sweden for confidentiality reasons and also to preserve time series consistency for the EU. Consequently, the EU CRF tables at sub-category level and data shown on the same level in the NIR are not always consistent. Note that at sector level and at national totals level the EU NIR and the EU CRF tables are fully consistent.

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 23% from 4341 Mt in 1990 to 3362 Mt in 2015 (Figure 3.1). In 2015, emissions increased by 1% compared to 2014.

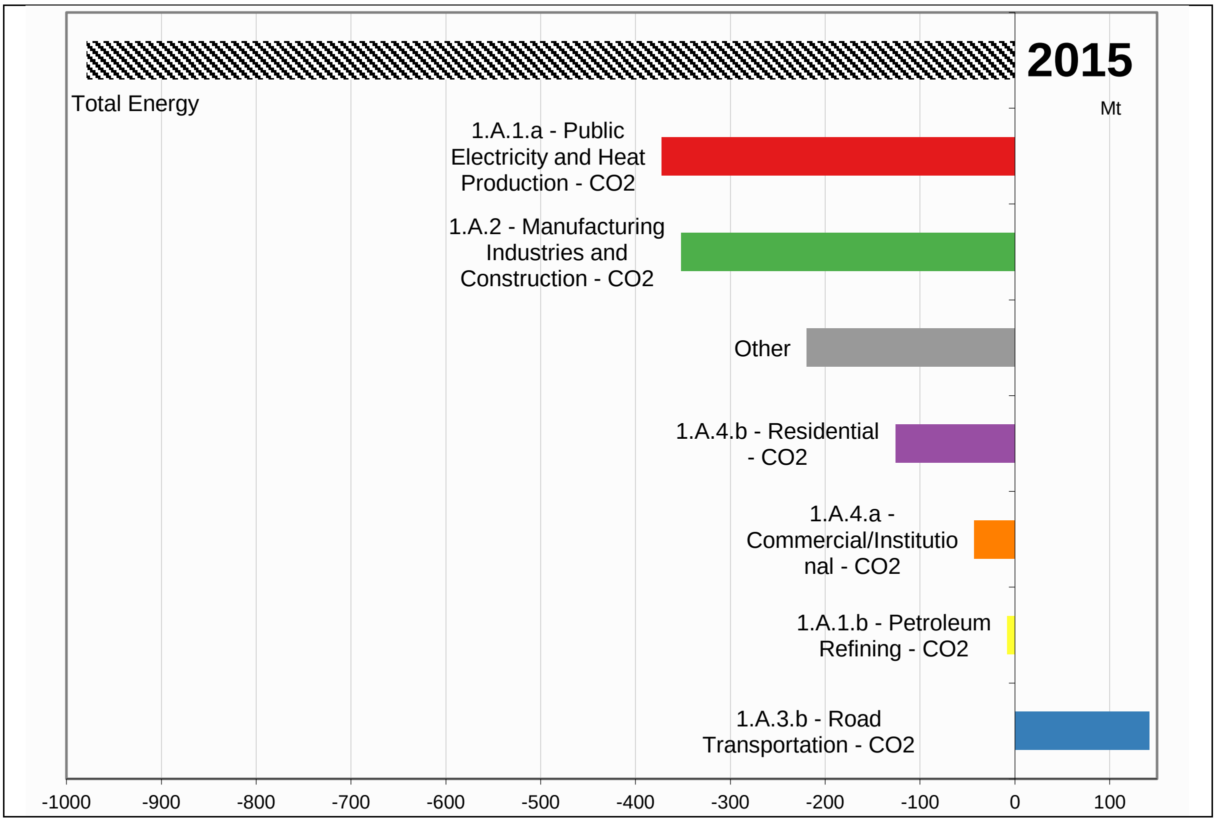
The most important energy-related gas is CO_2 that makes up 75% of the total EU-28 + ISL Greenhouse gas emissions in 2015. CH_4 of the energy sector is responsible for 2% and N_2O for 1% of the total GHG emissions.

Figure 3.1 CRF Sector 1 Energy: EU-28 + ISL GHG emissions in CO_2 equivalents (Mt) for 1990–2015

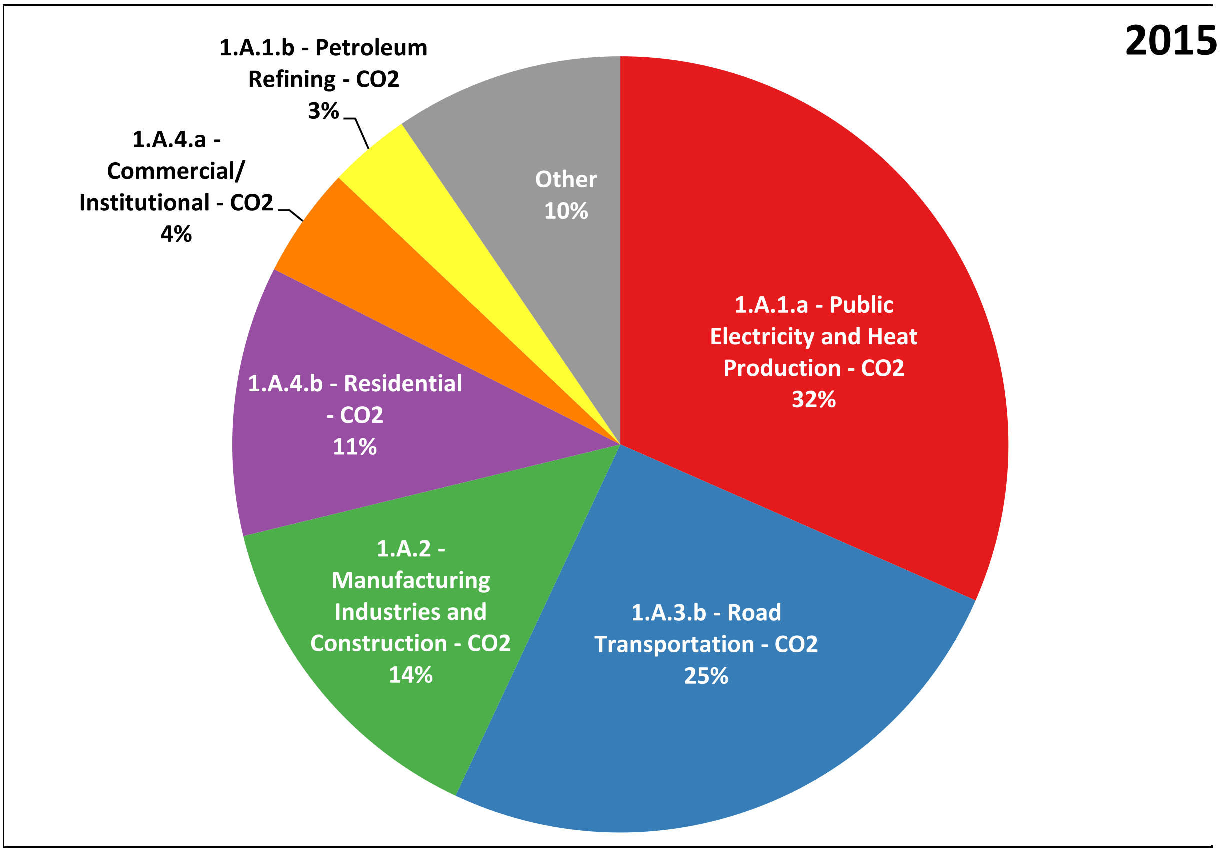


CRF Sector 1 Energy comprises of the three sectors Fuel combustion activities (1.A), Fugitive emissions from fuels (1.B) and CO_2 Transport and storage (1.C). Figure 3.2 shows the share of the largest key categories in the sector Energy in 2015 as well as the absolute change of GHG emissions of these large key categories for 1990-2015. CO_2 emissions from Road Transportation had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A1a Public Electricity and Heat Production as well as 1A2 Manufacturing Industries decreased substantially between 1990 and 2015. The decreases in Public Electricity and Heat Production and 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 as well as the United Kingdom, Czech Republic, Romania, Italy and France, which together account for 70% of the change in the last 25 years. 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"[11] in Figure 3.2. Furthermore, Figure 3.2 (lower chart) shows that the three largest key categories account for more than 68% and the largest six for almost 87% of emissions in Sector 1.

Figure 3.2 CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Mt) by large key categories for 1990-2015 and share of largest key source categories in 2015



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



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

The key categories in the energy sector are as follows:

- 1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Gaseous 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: Peat (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Biomass (CH_4)
- 1 A 1 b Petroleum Refining: Liquid Fuels (CO_2)
- 1 A 1 b Petroleum Refining: Solid Fuels (CO_2)
- 1 A 1 b Petroleum Refining: Gaseous Fuels (CO_2)
- 1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Solid Fuels (CO_2)
- 1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Gaseous 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: Gaseous Fuels (CO_2)
- 1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)
- 1 A 2 c Chemicals: Gaseous Fuels (CO_2)
- 1 A 2 c Chemicals: Liquid Fuels (CO_2)
- 1 A 2 c Chemicals: 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: Gaseous Fuels (CO_2)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Gasoline (N_2O)
- 1 A 3 b Road Transportation: 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 3 d Domestic Navigation: Residual Fuel 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: Biomass (CH_4)
- 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 (CH_4)
- 1 A 4 b Residential: Solid Fuels (CO_2)
- 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 (CO_2)
- 1 B 2 b Natural Gas: Operation (CH_4)
- 1 B 2 c Venting and Flaring: Operation (CO_2)
- 1 B 2 d Other emissions from energy production: 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 subcategories: Public electricity and heat production (CRF 1A1a), Petroleum-refining (CRF 1A1b), and 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 2015, which was mainly dominated by CO_2 emissions from public electricity and heat production. Carbon dioxide from 1A1a currently represents about 85% of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 decreased by 26%, between 1990 and 2015. This was mainly due to a decrease of CO_2 emission from Public Electricity and Heat Production (-373 Mt CO_2) and the manufacturing of solid fuels (-62 Mt CO_2). Carbon dioxide emissions from petroleum refining decreased by 7 Mt in the period 1990-2015.

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

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

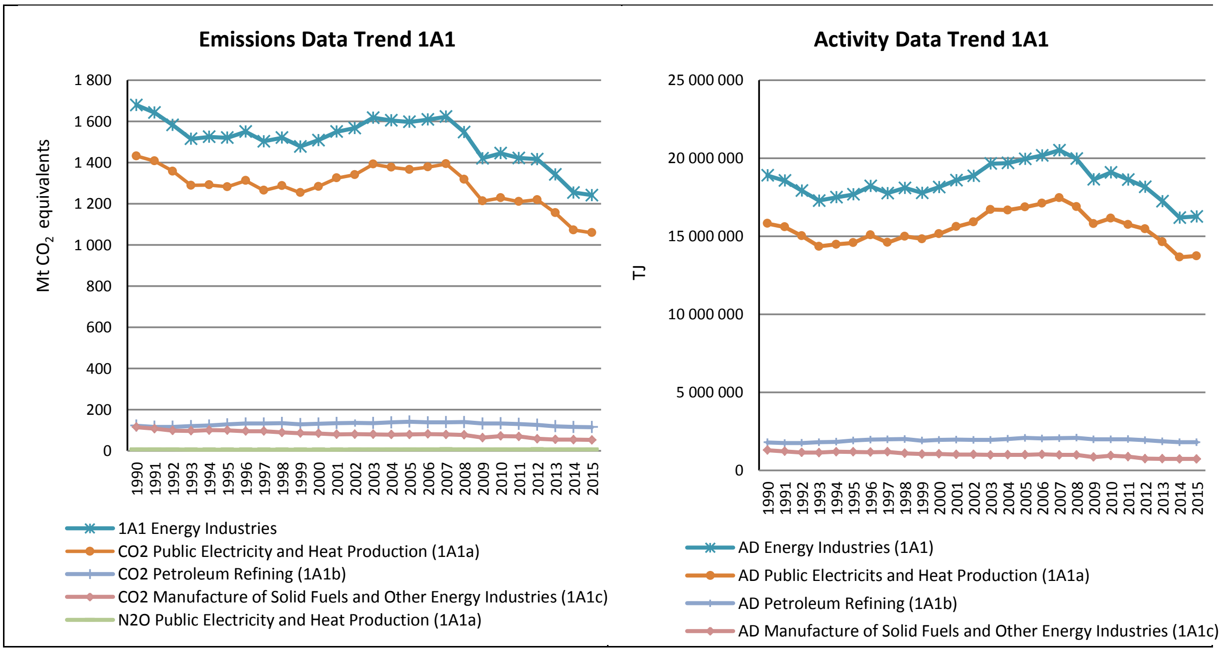


Table 3.1 breaks down the information by Member State. Between 1990 and 2015, greenhouse gas emissions from energy industries increased in five Member States and fell in twenty-four. The highest absolute increase was accounted for by the Netherlands with 15 Mt CO_2 respectively 29%. The United Kingdom, Germany and Poland, account for the largest part of reductions (-269 Mt CO_2). The change in the EU-28 + ISL was a net decrease of about 439 Mt CO_2. The table shows the emissions of CO_2, N_2O and CH_4 separately. The

latter two greenhouse gases only contribute a small part of the total emissions in energy industries.

Table 3.1 1A1 Energy industries: Member States' contributions to CO_2, N_2O and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	13 838	10 928	13 791	10 796	39	106	8	26
Belgium	30 059	21 309	29 859	21 115	180	164	20	31
Bulgaria	38 677	30 317	38 530	30 190	133	118	14	9
Croatia	7 094	4 795	7 071	4 772	17	20	5	4
Cyprus	1 767	3 033	1 761	3 023	4	7	2	3
Czech Republic	56 916	53 629	56 654	53 347	245	249	17	33
Denmark	26 251	12 835	26 150	12 668	86	82	16	85
Estonia	29 281	12 237	29 256	12 188	18	33	8	16
Finland	18 969	16 225	18 843	15 953	116	248	10	25
France	66 446	42 088	66 061	41 799	318	260	66	28
Germany	427 353	335 397	423 906	330 018	3 167	2 633	280	2 746
Greece	43 253	40 912	43 094	40 776	145	121	14	14
Hungary	20 687	13 907	20 611	13 816	67	66	9	26
Ireland	11 223	11 760	11 145	11 631	71	122	7	7
Italy	138 860	105 886	138 145	105 321	489	452	227	113
Latvia	6 265	1 773	6 249	1 746	11	16	5	10
Lithuania	13 553	3 155	13 522	3 100	21	34	10	21
Luxembourg	36	457	33	453	1	3	1	2
Malta	1 713	891	1 658	888	5	2	50	1
Netherlands	53 076	68 358	52 856	67 933	147	312	72	112
Poland	236 199	163 581	235 095	162 690	1 022	774	82	118
Portugal	16 383	18 381	16 328	18 234	49	133	6	15
Romania	70 944	29 722	70 723	29 596	183	112	38	14
Slovakia	19 160	7 652	19 055	7 586	86	47	19	20
Slovenia	6 375	4 562	6 348	4 537	25	21	2	3
Spain	78 905	86 224	78 565	85 748	289	378	51	97
Sweden	9 955	8 997	9 815	8 711	124	244	17	43
United Kingdom	236 323	133 000	234 736	131 747	1 385	953	202	300
EU-28	**1 679 561**	**1 242 009**	**1 669 860**	**1 230 382**	**8 445**	**7 709**	**1 257**	**3 919**
Iceland	14	4	14	4	0	0	0	0
United Kingdom (KP)	237 414	134 218	235 823	132 960	1 388	957	203	302
EU-28 + ISL	**1 680 666**	**1 243 231**	**1 670 961**	**1 231 598**	**8 447**	**7 712**	**1 258**	**3 921**

Abbreviations are 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 and the top five Member States account for 66% of the EU's greenhouse gas emissions from energy industries.

Public heat and electricity production is the main source of emissions from energy industries. Furthermore, it is the largest source category in the EU-28 + ISL greenhouse gas inventory. 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, which are used. Some countries rely more on coal than on gas. At the EU-28 + ISL level, 51% of the fuel used in energy industries comes from solid fuels. Its contribution has been declining in favour of the in comparison relatively cleaner natural gas, whose share amounted to 24% in 2015 and biomass which has been constantly increasing with a share of 11% in 2015. 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. In total Germany, Poland and the United Kingdom contribute 51% of the total CO_2 emissions in sector 1A1 Energy industries in the year 2015 (Figure 3.4).

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

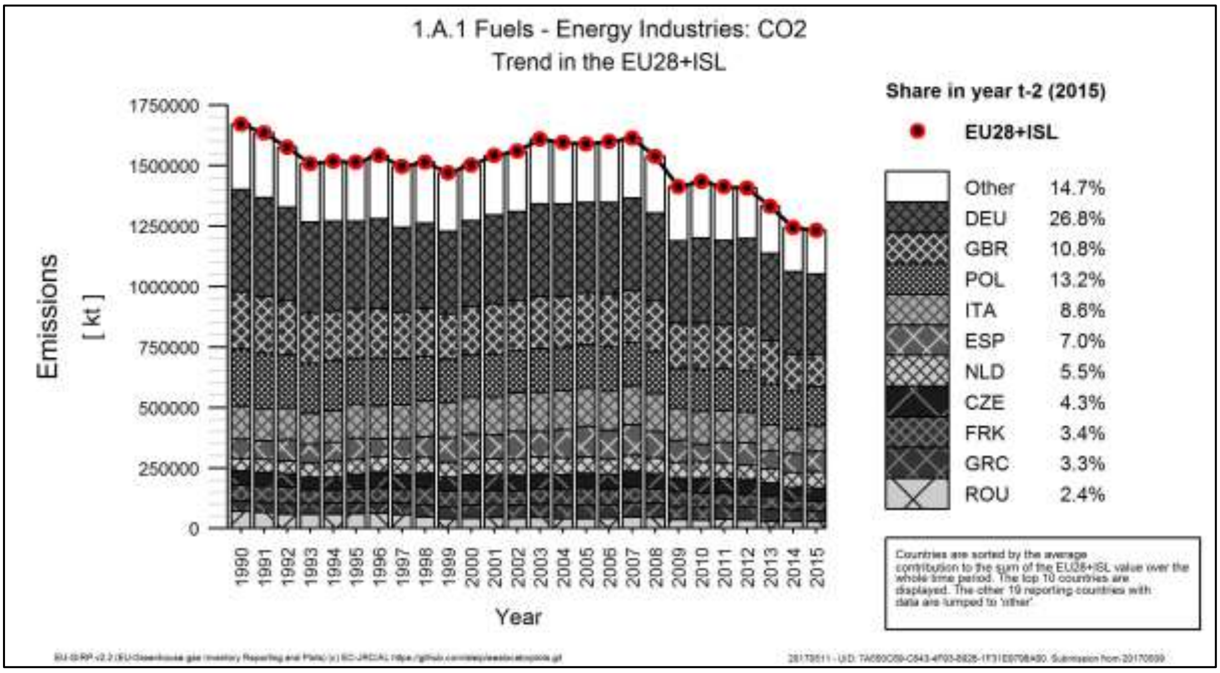


Table 3.2 shows the eleven key categories of sector 1A1, including information on whether the reasons for this categorization lie in their emission trend and/or level.

Table 3.2 Key categories in sector 1A1 (table excerpt),

Source category gas	Mt CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	107510	177927	T	L	L
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	176990	32743	T	L	L
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	10702	37264	T	L	L
1 A 1 a Public Electricity and Heat Production: Peat (CO_2)	8531	8148	0	0	L
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	1129742	801176	T	L	L
1 A 1 a Public Electricity and Heat Production: Biomass (CH_4)	63	2391	T	0	0
1 A 1 b Petroleum Refining: Gaseous Fuels (CO_2)	5276	23685	T	0	L
1 A 1 b Petroleum Refining: Liquid Fuels (CO_2)	112244	90703	T	L	L
1 A 1 b Petroleum Refining: Solid Fuels (CO_2)	3633	433	T	0	0
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Gaseous Fuels (CO_2)	17159	18797	T	L	L
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Solid Fuels (CO_2)	92187	30648	T	L	L

Table 3.3 provides information on the Member States' contribution to EU-28 + ISL recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2014 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 CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
Austria	-1	-0.009	-28	-0.3	revised energy balance
Belgium	0.000	0.000	41	0.2	Inventory with final regional energy balances as a provisional energy balance is made yearly for year (x-1), whereas a final energy balance is made for year (x-2). For the year 2014 the reason for this decrease in emissions is due to a revision/optimization of the emissions of the industrial joint venture installations (combined heat-power) allocated under 1A1a. These emissions are included in ETS-data but they cannot taken out separately. So first indication of these emissions is through default IEF (submission 2016 for 2014 emissions). More accurate estimation of these emissions is reported during the 2017 submission by using the emissions reported in the integrated environmental reports in the Flemish region (local legislation). The sum of ETS-CO_2-emissions reported for 2014 in the categories1A1a and 1A2 remain the same during the 2 submissions but due to an optimization of the emissions of the joint venture installations taken place during the 2017 submission, emissions in the category 1A1a are decreasing and emissions in the categories 1A2 (mainly 1A2c) are increasing accordingly. Mistake in the Walloon CRF table for liquid fuels in 2013
Bulgaria	-136	-0.352	-0.000	-0.000	No information available
Croatia	0	0.000	168	3.7	CO_2 emissions from H2 production added
Cyprus	0	0	0	0	
Czech Republic	-12	-0.022	364	0.7	Expert review team (ERT) during Centralised review in September 2012 raised objection to using IPCC 2006 default emission factors instead of Revised 1996 Guidelines (IPCC, 1997) default emission factors in 1995-2010 period. This issue was identified as potential problem in Saturday paper. In following resubmission in October 2012 the recalculation of the whole sector 1.A Energy – stationary combustion was provide using Revised 1996 Guidelines (IPCC, 1997) default emission factors. Country specific emission factors are used for Coking Coal, Other Bituminous Coal, Brown Coal + Lignite and since this submission also for Natural Gas. For the rest of fuels (rest of Solid Fuels, Liquid Fuels and Biomass) were used default emission factors. This recalculation also affected Reference Approach where emission factors were also revised. Another improvement provided by the Czech Republic consists in new country specific CO_2 emission factor for Natural Gas. The extensive research was performed using data of Natural Gas composition provided by NET4GAS, Ltd. company. This research was part of project assigned by State Environmental Fund of the Czech Republic. Detailed description of the research is given in Annex 2. Since this submission updated emission factor is used for all categories in 1.A Energy. One of the improvements implemented by the Czech Republic considers reallocation of solid fuels and associated emissions between 1.A.1.c and 1.A.2. During QA/QC procedure Energy balance in these two sectors was compared with data provided by Czech Register of individual Sources and Emissions. This QA/QC discovered discrepancy in reporting of solid fuels in 1995-2010 period. There is one installation in CR for which solid fuels are in official statistics (CzSO Questionnaires) included in 1.A.2 autoproducers. The QA/QC procedure ascertained that this consumption of solid fuels should be included in 1.A.1.c

	1990		2014		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
					category; in this submission solid fuels were reallocated. This reallocation affects consumption of solid fuels and associated emissions in 1.A.1.c category and in 1.A.2.a-1.A.2.f (autoproducers consumption).
Denmark	4	0.014	-61	-0.4	For stationary combustion plants, the emission estimates for the years 1990-2014 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and trans-formation sectors as well as a source category update. The changes in the energy statistics are largest for the years 2012, 2013 and 2014. The reported CO_2 emission is higher for all years due to the recalculation of the CO_2 emission factor for residual oil.
Estonia	431	1.497	-8	-0.1	The methodology of shale oil production was enhanced. Oxidation factors have been updated and the carbon conversion factor for CO_2 emission factors has been specified. Oil shale activity data has been updated.
Finland	1	0.006	214	1.1	New data sources for small district heating plants
France	6	0.009	835	2.1	- 1A1a: a correction of the consumption of biomass in 2014 at an electricity production site in Guyana was achieved - The natural gas consumption of an urban heating site was added over several years, including 2014 (completeness of large installations Of combustion). - 1A1c - Processing of solid mineral fuels: update of coke production for the year 2014 following the receipt of the Energies & Matières report from the Professional Federation (A3M), received too late for the 2016 edition.
Germany	0.000	0.000	735	0.2	1A1a: Due to an error correction in the calculation model for the waste fuels, Recalculations were made in the years 2008 - 2014. In 2014 it was as usual recalculations were taking place after replacing the preliminary data with the final data from the energy balance 1A1b: The adjustment of the emission factor for refinery gas to the current calorific value resulted in recalculations for liquid fuels in the years 2013 and 2014. After the availability of the final energy balance for 2014, the provisional values have been replaced. That led to recalculations for all fuels. 1A1c: An error correction in the raw brown coal caused too small losses in 2011. For the year 2014, the provisional data were replaced by the final results of the Energy balance. Thus, calculations were required for almost all energy carriers
Greece	0	0	0	0	
Hungary	-222	-1.068	309	2.4	Revised AD (natural gas) in 1A1c; slightly revised EF for BFG and industrial waste in 1A1a; all fuels (e.g. waste gases and purge gas) included as AD in 1A1b
Ireland	0	0	0	0	
Italy	-0.000	-0.000	13	0.0	No information available
Latvia	48	0.767	9	0.5	Corrected amount of biogas used in 1A1aii; Updated and specified information about natural gas properties and calculated new emission factor accordingly.
Lithuania	-4	-0.026	11	0.3	Revision of CO_2 emission factors for natural gas, wood/wood waste, other solid biomass and municipal waste (biomass fraction and non-biomass fraction) based on study "Update of country specific GHG emission factors for Energy sector" (performed in 2016 by Lithuanian Energy Institute); correction of CO_2 plant specific emission factors for residual fuel oil and not liquefied petroleum gas based on EU ETS data due to typing mistake in 2012 data in previous submission.
Luxembourg	0	0.000	-53	-7.4	revised AD for incinerated MSW
Malta	297	21.788	57	3.5	No information available
Netherlands	-314	-0.591	-138	-0.2	Reallocation of Gastransport emissions to 1A3e
Poland	0.000	0.000	0.31	0.000	Lignite NCV for 2014 was slightly corrected, so CO_2 EF based on empirical functions, that link the amount of carbon in fuel with the corresponding net calorific value, was adjusted as well.

	1990		2014		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
Portugal	36	0.222	42	0.3	Update of gas and biomass fuel consumption activity data for 2012, 2013 and 2014.
Romania	19 518	38.117	4 632	18.6	ETS data were used as activity data in the 1A1a category for some specific fuels. Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A1 categories. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A1 categories.
Slovakia	-1	-0.007	-25	-0.4	MSW incineration with energy use, category 1.A.1a.iv - Other fuels, C-fossil and biogenic MSW incinerated with energy use - Methodological refinement, the previously used method is insufficient to reflect mitigation activities in a transparent manner
Slovenia	0	0.000	0	0.0	
Spain	1 241	1.605	1 111	1.5	Oxidation factor=1 implemented (IPCC 2006)
Sweden	0	0.000	1	0.0	Emission factors for CRF 1A1a was revised for several fuels and whole time series.
United Kingdom	0.002	0.00	452.52	0.30	Revisions to UK energy statistics. Numerous minor revisions, with one notable revision to AD for MSW used to generate electricity.
EU-28	20 890	1.3	8 491	0.7	
Iceland	0	0.000	0	0.0	
EU-28 + ISL	20 890	1.3	8 494	0.7	

Table 3.4 provides information on the Member States' contribution to EU-28 + ISL recalculations in N_2O from 1A1 Energy Industries for 1990 and 2014 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.4 Energy Industries: Contribution of MS to EU-28 + ISL recalculations in N_2O for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
Austria	-4	-9.7	7	8.0	Change of N_2O EF from CS to IPCC 2006 default
Belgium	0.000	0.0	-0.13	-0.08	Inventory with final regional energy balances as a provisional energy balance is made yearly for year (x-1), whereas a final energy balance is made for year (x-2). Optimization of emissions of CH_4 and N_2O of industrial combined heat-power installations (the distinguish between turbines and engines has been looked in more detail from 1996 in). For the year 2014 the reason for this decrease in emissions is due to a revision/optimization of the emissions of the industrial joint venture installations (combined heat-power) allocated under 1A1a. These emissions are included in ETS-data but they cannot taken out separately. So first indication of these emissions is through default IEF (submission 2016 for 2014 emissions). More accurate estimation of these emissions is reported during the 2017 submission by using the emissions reported in the integrated environmental reports in the Flemish region (local legislation). The sum of ETS-CO_2-emissions reported for 2014 in the categories1A1a and 1A2 remain the same during the 2 submissions but due

	1990		2014		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
					to an optimization of the emissions of the joint venture installations taken place during the 2017 submission, emissions in the category 1A1a are decreasing and emissions in the categories 1A2 (mainly 1A2c) are increasing accordingly. - Recalculation of the N_2O emissions of the motors (gas and liquid fuels) following the IPCC guidelines table 2.6 and table 2.7. - mistake in the Walloon CRF table for liquid fuels in 2013
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0.09	0.5	During ESD revision of NIR 2016 it was observed that GHG emissions from production of H2 were not included in inventory. Production of H2 started in 2007 in Croatia, so GHG emissions were calculated for the whole period from 2007 to 2014 and included in NIR 2017.
Cyprus	0	0.0	0	0.0	
Czech Republic	15	6.7	14	5.8	Expert review team (ERT) during Centralised review in September 2012 raised objection to using IPCC 2006 default emission factors instead of Revised 1996 Guidelines (IPCC, 1997) default emission factors in 1995-2010 period. This issue was identified as potential problem in Saturday paper. In following resubmission in October 2012 the recalculation of the whole sector 1.A Energy – stationary combustion was provide using Revised 1996 Guidelines (IPCC, 1997) default emission factors. Country specific emission factors are used for Coking Coal, Other Bituminous Coal, Brown Coal + Lignite and since this submission also for Natural Gas. For the rest of fuels (rest of Solid Fuels, Liquid Fuels and Biomass) were used default emission factors. This recalculation also affected Reference Approach where emission factors were also revised. Another improvement provided by the Czech Republic consists in new country specific CO_2 emission factor for Natural Gas. The extensive research was performed using data of Natural Gas composition provided by NET4GAS, Ltd. company. This research was part of project assigned by State Environmental Fund of the Czech Republic. Detailed description of the research is given in Annex 2. Since this submission updated emission factor is used for all categories in 1.A Energy. One of the improvements implemented by the Czech Republic considers reallocation of solid fuels and associated emissions between 1.A.1.c and 1.A.2. During QA/QC procedure Energy balance in these two sectors was compared with data provided by Czech Register of individual Sources and Emissions. This QA/QC discovered discrepancy in reporting of solid fuels in 1995-2010 period. There is one installation in CR for which solid fuels are in official statistics (CzSO Questionnaires) included in 1.A.2 autoproducers. The QA/QC procedure ascertained that this consumption of solid fuels should be included in 1.A.1.c category; in this submission solid fuels were reallocated. This reallocation affects consumption of solid fuels and associated emissions in 1.A.1.c category and in 1.A.2.a-1.A.2.f (autoproducers consumption).
Denmark	0	0.0	0.007	0.008	For stationary combustion plants, the emission estimates for the years 1990-2014 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and trans-formation sectors as well as a source category update. The changes in the energy statistics are largest for the years 2012, 2013 and 2014.
Estonia	0	0.0	0.27	-0.9	The activity data of 1A1a Other fuels was revised.
Finland	0.09	0.1	0.36	-0.1	New data sources for small district heating plants

	1990		2014		Main explanations
	kt CO_2 equiv.	percent	kt CO_2 equiv.	percent	
France	0	0.0	-1	-0.3	- 1A1a: a correction of the consumption of biomass in 2014 at an electricity production site in Guyana was achieved - The natural gas consumption of an urban heating site was added over several years, including 2014 (completeness of large installations Of combustion). - 1A1c - Processing of solid mineral fuels: update of coke production for the year 2014 following the receipt of the Energies & Matières report from the Professional Federation (A3M), received too late for the 2016 edition.
Germany	0	0.0	3	0.1	1A1a: Due to an error correction in the calculation model for the waste fuels, Recalculations were made in the years 2008 - 2014. In 2014 it was as usual recalculations were taking place after replacing the preliminary data with the final data from the energy balance 1A1b: The adjustment of the emission factor for refinery gas to the current calorific value resulted in recalculations for liquid fuels in the years 2013 and 2014. After the availability of the final energy balance for 2014, the provisional values have been replaced. That led to recalculations for all fuels. 1A1c: An error correction in the raw brown coal caused too small losses in 2011. For the year 2014, the provisional data were replaced by the final results of the Energy balance. Thus, calculations were required for almost all energy carriers
Greece	0	0.0	0	0.0	
Hungary	-0.11	-0.2	0.33	0.5	Revised AD (natural gas) in 1A1c; slightly revised EF for BFG and industrial waste in 1A1a; all fuels (e.g. waste gases and purge gas) included as AD in 1A1b
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	0.000	0.004	0.000	0.000	Corrected amount of biogass used in 1A1aii.
Lithuania	0	0.0	0	0.0	
Luxembourg	0.000	0.0	0.1	4.4	revised AD for incinerated MSW
Malta	1	14.9	0.07	1.8	No information available
Netherlands	0	0.0	0	0.0	
Poland	0	0.0	0	0.0	
Portugal	3	6.3	7	7.9	Update of gas and biomass fuel consumption activity data for 2012, 2013 and 2014.
Romania	5	2.7	13	13.4	ETS data were used as activity data in the 1A1a category for some specific fuels. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A1 categories.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	-11	-3.6	-90	-20.2	EF IPCC 2006 implemented
Sweden	-19	-13.4	-139	-37.4	Emission factors for CRF 1A1a was revised for several fuels and whole time series.
United Kingdom	-28.7	-2.03	54.78	5.93	Several minor revisions, including a revision to the assumed calorific value of wood burnt in power stations based on new information from energy statisticians.
EU-28	-39	-0.5	-131	-1.7	
Iceland	0.000	0.04	0.000	2.4	
EU-28 + ISL	-39	-0.5	-131	-1.7	

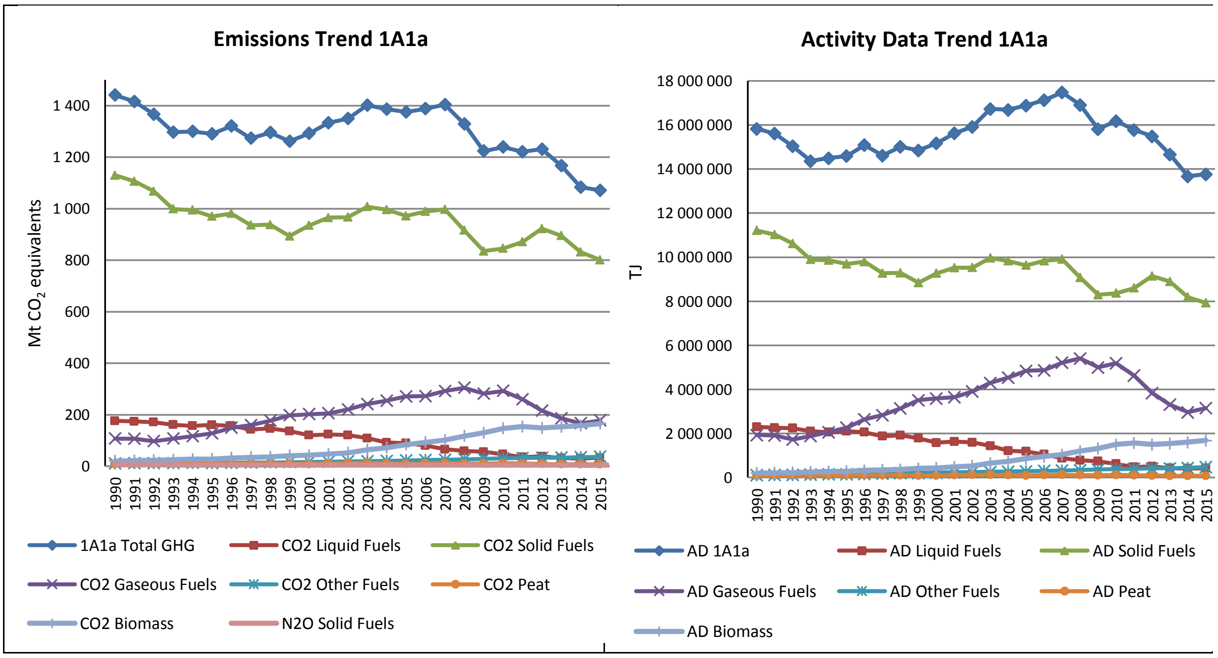
3.2.1.1 Public Electricity and Heat Production (1A1a) (EU-28 + ISL)

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 2015 and for 85% of greenhouse gas emissions of the Energy Industries Sector. Between 1990 and 2015, CO_2 emissions from electricity and heat production decreased by 26% 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 2015 as well as the underlying activity data[12].

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



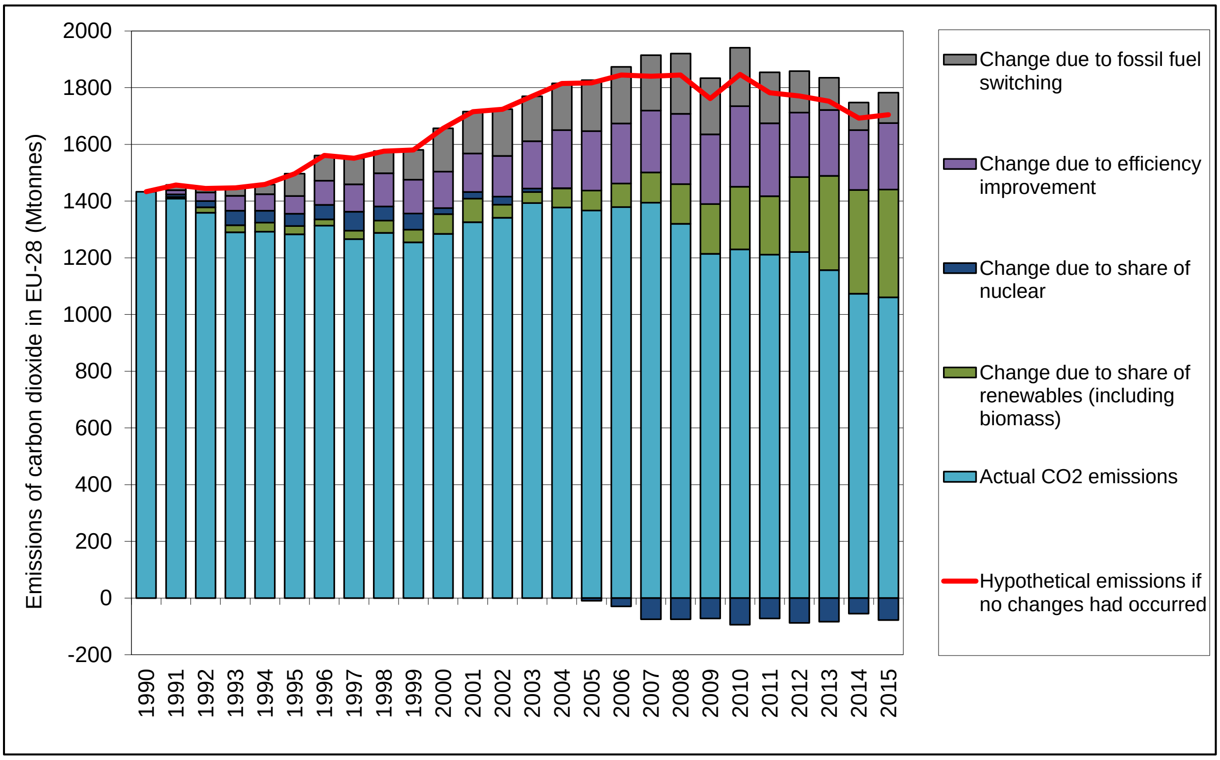
Fuel used for public electricity and heat production decreased by 13% in the EU-28 + ISL between 1990 and 2015. Solid fuels still represent 58% of the fuel used in public conventional thermal power plants, although its combustion has been declining by 29%

[12] 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.

between 1990 and 2015. Gaseous fuels have increased very rapidly, by a factor of almost 3 between 1990 and 2010, but declined in the last years. In 2015 its share amounts to 23% of all the fuel used for the production of heat and electricity in the EU-28 + ISL. 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 2015. The main explanatory factors at the EU-28 level during the past 25 years have been the increased share of renewable energy, improvements in energy efficiency and (fossil) fuel switching from coal to gas. This trend from coal to gas has reversed in recent years up until 2014, as a result of comparably high gas prices and lower coal prices. In 2015, natural gas demand picked up again in the EU-28 + ISL, while world-wide coal demand for the first time this century dropped.

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 2015.



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 2015, 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 light 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 26% during 1990-2015 (light blue bar), but emissions would have risen by over 19%, if the shares of input fuels used to produce electricity and heat as well as the efficiency remained constant and an increase due to the change in electricity consumption (19%), which was in line with the additional amount of electricity and heat produced took place. The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2015 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production; during 1990-2015, there was a 17% 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 9% reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2015.
- 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 2015 compared to 1990[13]. During 1990-2015, 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 = 1.19 (increase in electricity and heat production) X 0.82 (efficiency improvement) X 0.91 (fossil fuel switching) X 0.83 (lower nuclear-renewable share) = 0.74. The combined effect was a decrease of 26% in CO_2 emissions in 2015 compared to the 1990 level.

Returning to the 2017 inventory, Table 3.5 shows emissions arising from the production of public heat and electricity by Member State. Carbon dioxide emissions amount to 99% of greenhouse gas emissions from public electricity and heat production. These emissions increased in six Member States and fell in 23 compared to 1990. Of the six countries where emissions were higher in 2015 than in 1990, 87% of the increase was accounted for by the Netherlands and Spain. Of the countries, where emissions fell, 64% of the total reduction was accounted for by the United Kingdom (25%), Poland (20%), Romania (10%) and

[13] 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) dark blue bars. The positive value indicates that nuclear power had a positive effect with regard to GHG emission reductions between 1990 and 2003. From 2004 onwards the picture changed: the share of nuclear power was below the value of 1990 reaching 26% in 2015. In the figure this is reflected in the (negative) *dark blue* bars. The negative value indicates that nuclear power had a negative effect with regard to GHG emission reductions between 2004 and 2015. 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.

Germany (9%). The change in the EU-28 + ISL between 1990 and 2015 was a net decrease of 373 Mt CO_2 respectively of 26%.

Table 3.5 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	10 887	6 567	7 577	0.7%	1 010	15%	-3 310	-30%
Belgium	23 536	15 435	16 286	1.5%	851	6%	-7 250	-31%
Bulgaria	37 306	27 991	28 834	2.7%	844	3%	-8 472	-23%
Croatia	3 752	3 076	3 149	0.3%	73	2%	-603	-16%
Cyprus	1 676	2 940	3 023	0.3%	83	3%	1 347	80%
Czech Republic	54 645	46 649	46 611	4.4%	-38	0%	-8 035	-15%
Denmark	24 697	13 015	10 254	1.0%	-2 761	-21%	-14 443	-58%
Estonia	29 170	14 043	10 980	1.0%	-3 064	-22%	-18 190	-62%
Finland	16 453	16 462	13 404	1.3%	-3 058	-19%	-3 049	-19%
France	49 376	28 572	31 127	2.9%	2 555	9%	-18 249	-37%
Germany	338 451	313 949	301 706	28.4%	-12 243	-4%	-36 746	-11%
Greece	40 617	40 446	35 493	3.3%	-4 953	-12%	-5 123	-13%
Hungary	17 898	11 546	11 992	1.1%	446	4%	-5 906	-33%
Ireland	10 876	10 642	11 200	1.1%	559	5%	324	3%
Italy	107 158	71 385	78 717	7.4%	7 332	10%	-28 441	-27%
Latvia	6 103	1 603	1 690	0.2%	87	5%	-4 414	-72%
Lithuania	12 003	1 801	1 649	0.2%	-152	-8%	-10 354	-86%
Luxembourg	33	665	453	0.0%	-212	-32%	420	1261%
Malta	1 658	1 657	888	0.1%	-770	-46%	-770	-46%
Netherlands	40 027	51 324	55 624	5.2%	4 301	8%	15 597	39%
Poland	228 055	152 328	153 684	14.5%	1 355	1%	-74 371	-33%
Portugal	14 355	12 310	15 869	1.5%	3 559	29%	1 514	11%
Romania	66 280	26 327	26 993	2.5%	666	3%	-39 287	-59%
Slovakia	14 863	4 607	4 848	0.5%	241	5%	-10 015	-67%
Slovenia	6 096	4 419	4 531	0.4%	112	3%	-1 564	-26%
Spain	65 570	62 730	73 395	6.9%	10 665	17%	7 826	12%
Sweden	7 737	6 312	6 125	0.6%	-187	-3%	-1 612	-21%
United Kingdom	203 097	123 561	103 171	9.7%	-20 390	-17%	-99 925	-49%
EU-28	**1 432 374**	**1 072 359**	**1 059 272**	**100%**	**-13 088**	**-1%**	**-373 102**	**-26%**
Iceland	14	3	4	0.0%	1	44%	-10	-74%
United Kingdom (KP)	204 183	124 936	104 384	9.8%	-20 552	-16%	-99 799	-49%
EU-28 + ISL	**1 433 474**	**1 073 737**	**1 060 488**	**100%**	**-13 249**	**-1%**	**-372 986**	**-26%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

N_2O emissions currently represent 0.6% of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2015, emissions decreased by 2% (Table 3.6). The largest decline in emissions from this source category was reported by the United Kingdom

(-464 kt CO_2eq) and Poland (-244 kt CO_2eq). The biggest increase occurred in the Netherlands (161 kt CO_2eq).

Table 3.6 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	37	96	101	1.5%	5	5%	64	174%
Belgium	53	80	94	1.4%	15	19%	42	79%
Bulgaria	132	113	117	1.7%	4	3%	-15	-11%
Croatia	13	16	18	0.3%	1	9%	5	35%
Cyprus	4	7	7	0.1%	0	0%	3	77%
Czech Republic	242	228	230	3.4%	2	1%	-12	-5%
Denmark	79	78	74	1.1%	-5	-6%	-5	-7%
Estonia	18	30	32	0.5%	1	5%	14	79%
Finland	100	249	226	3.3%	-23	-9%	126	126%
France	290	232	253	3.7%	21	9%	-37	-13%
Germany	2 407	2 451	2 423	35.5%	-28	-1%	16	1%
Greece	142	133	116	1.7%	-17	-13%	-25	-18%
Hungary	63	63	64	0.9%	1	1%	1	2%
Ireland	71	124	122	1.8%	-2	-2%	51	71%
Italy	306	289	287	4.2%	-2	-1%	-18	-6%
Latvia	11	14	16	0.2%	1	9%	5	45%
Lithuania	19	25	32	0.5%	7	28%	14	73%
Luxembourg	1	2	3	0.0%	0	8%	1	75%
Malta	5	4	2	0.0%	-2	-47%	-3	-62%
Netherlands	133	249	294	4.3%	45	18%	161	122%
Poland	1 006	761	762	11.2%	1	0%	-244	-24%
Portugal	46	99	131	1.9%	33	33%	86	188%
Romania	179	108	109	1.6%	2	1%	-69	-39%
Slovakia	80	42	44	0.6%	2	5%	-36	-45%
Slovenia	25	20	21	0.3%	1	6%	-4	-14%
Spain	274	328	365	5.4%	37	11%	92	33%
Sweden	118	229	240	3.5%	11	5%	122	104%
United Kingdom	1 096	676	631	9.3%	-45	-7%	-464	-42%
EU-28	**6 947**	**6 749**	**6 816**	**100%**	**67**	**1%**	**-131**	**-2%**
Iceland	0	0	0	0.0%	0	51%	0	-62%
United Kingdom (KP)	1 098	681	635	9.3%	-46	-7%	-464	-42%
EU-28 + ISL	**6 949**	**6 753**	**6 819**	**100%**	**66**	**1%**	**-130**	**-2%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Finally, CH_4 emissions currently represent 0.3% of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2015, emissions increased by 365%. The biggest increase was reported Germany (2388 kt CO_2eq), which is also responsible for 73.4% of the emissions EU-28 + ISL in 2015.

Table 3.7 1A1a Public Electricity and Heat Production: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	5	21	22	0.6%	1.4	7%	17	316%
Belgium	11	24	27	0.8%	2.3	9%	15	134%
Bulgaria	13	8	8	0.2%	0.1	1%	-5	-36%
Croatia	3	2	3	0.1%	0.9	38%	0	-5%
Cyprus	2	3	3	0.1%	0.1	4%	1	77%
Czech Republic	16	29	31	0.9%	1.7	6%	15	96%
Denmark	15	99	84	2.4%	-15.3	-15%	69	463%
Estonia	8	14	15	0.4%	0.6	4%	7	97%
Finland	9	26	24	0.7%	-2.2	-8%	15	165%
France	14	17	22	0.6%	5.2	31%	9	62%
Germany	172	2 502	2 560	73.4%	57.7	2%	2 388	1387%
Greece	13	12	11	0.3%	-0.8	-7%	-2	-12%
Hungary	7	24	25	0.7%	1.2	5%	18	240%
Ireland	6	7	6	0.2%	-0.2	-3%	0	-1%
Italy	93	90	90	2.6%	-0.8	-1%	-4	-4%
Latvia	5	9	10	0.3%	0.9	10%	5	115%
Lithuania	9	16	20	0.6%	4.4	28%	11	127%
Luxembourg	1	2	2	0.0%	0.1	6%	1	80%
Malta	50	2	1	0.0%	-0.7	-47%	-49	-98%
Netherlands	42	75	67	1.9%	-8.1	-11%	25	60%
Poland	75	112	112	3.2%	0.0	0%	37	49%
Portugal	4	12	14	0.4%	1.5	12%	10	241%
Romania	36	12	13	0.4%	0.2	1%	-23	-65%
Slovakia	16	17	18	0.5%	0.8	5%	2	11%
Slovenia	2	2	3	0.1%	0.3	12%	1	45%
Spain	21	39	59	1.7%	20.1	52%	38	184%
Sweden	16	41	42	1.2%	0.3	1%	26	165%
United Kingdom	86	155	197	5.6%	41.5	27%	111	129%
EU-28	**749**	**3 373**	**3 486**	**100%**	**113**	**3%**	**2 737**	**365%**
Iceland	0.0	0.0	0.0	0.0%	0.0	61%	0.0	-47%
United Kingdom (KP)	87	157	198	5.7%	41.4	26%	111	128%
EU-28 + ISL	**750**	**3 375**	**3 488**	**100%**	**113**	**3%**	**2 738**	**365%**

Abbreviations are 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 81% respectively by 143 Mt CO_2 between 1990 and 2015 (Table 3.8).

Table 3.8 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	1 228	1 558	155	254	0.8%	99	64%	-973	-79%
Belgium	663	706	44	73	0.2%	28	64%	-590	-89%
Bulgaria	3 245	901	743	664	2.0%	-79	-11%	-2 582	-80%
Croatia	2 142	2 282	110	175	0.5%	64	58%	-1 968	-92%
Cyprus	1 676	2 076	2 940	3 023	9.2%	83	3%	1 347	80%
Czech Republic	1 234	1 347	58	71	0.2%	12	21%	-1 164	-94%
Denmark	953	2 770	149	154	0.5%	5	3%	-799	-84%
Estonia	4 897	1 644	247	260	0.8%	14	6%	-4 637	-95%
Finland	1 234	1 280	509	461	1.4%	-48	-9%	-773	-63%
France	8 269	6 623	3 772	4 097	12.5%	326	9%	-4 171	-50%
Germany	8 637	6 217	1 824	1 678	5.1%	-146	-8%	-6 959	-81%
Greece	5 416	6 255	3 512	3 663	11.2%	151	4%	-1 753	-32%
Hungary	1 456	4 710	75	66	0.2%	-9	-12%	-1 390	-95%
Ireland	1 087	1 986	182	250	0.8%	67	37%	-837	-77%
Italy	63 058	73 620	2 028	2 495	7.6%	467	23%	-60 564	-96%
Latvia	3 079	1 567	2	2	0.0%	0	-15%	-3 077	-100%
Lithuania	6 021	3 255	151	181	0.6%	29	19%	-5 841	-97%
Luxembourg	NO	NO	1	2	0.0%	0	12%	2	∞
Malta	1 039	1 453	1 657	888	2.7%	-770	-46%	-151	-15%
Netherlands	233	1 909	1 296	739	2.3%	-556	-43%	506	217%
Poland	5 160	2 028	420	455	1.4%	34	8%	-4 706	-91%
Portugal	6 434	5 918	719	707	2.2%	-12	-2%	-5 727	-89%
Romania	20 356	9 776	1 068	983	3.0%	-85	-8%	-19 374	-95%
Slovakia	1 033	247	13	17	0.1%	4	31%	-1 016	-98%
Slovenia	272	69	44	22	0.1%	-22	-50%	-250	-92%
Spain	6 087	7 979	7 126	9 286	28.4%	2 160	30%	3 199	53%
Sweden	1 277	2 621	341	C	NA	NA	NA	NA	NA
Untited Kingdom	19 716	9 325	910	1 070	3.3%	161	18%	-18 646	-95%
EU-28	**174 625**	**157 500**	**29 757**	**31 733**	**97%**	**1 977**	**7%**	**-142 891**	**-82%**
Iceland	14	16	3	4	0.0%	1	44%	-10	-74%
United Kingdom (KP)	20 791	10 580	2 056	2 077	6.3%	20	1%	-18 714	-90%
EU-28 + ISL	**175 713**	**158 771**	**30 906**	**32 743**	**100%**	**1 837**	**6%**	**-142 969**	**-81%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

Figure 3.7 shows the contribution to the emission trend for liquid fuels by the main Member States. In 2015 Spain, France and Greece are responsible for about 52% 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. In 1990 Italy was responsible for 35% of the emissions in this category and now in 2015 for 7.6%.

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

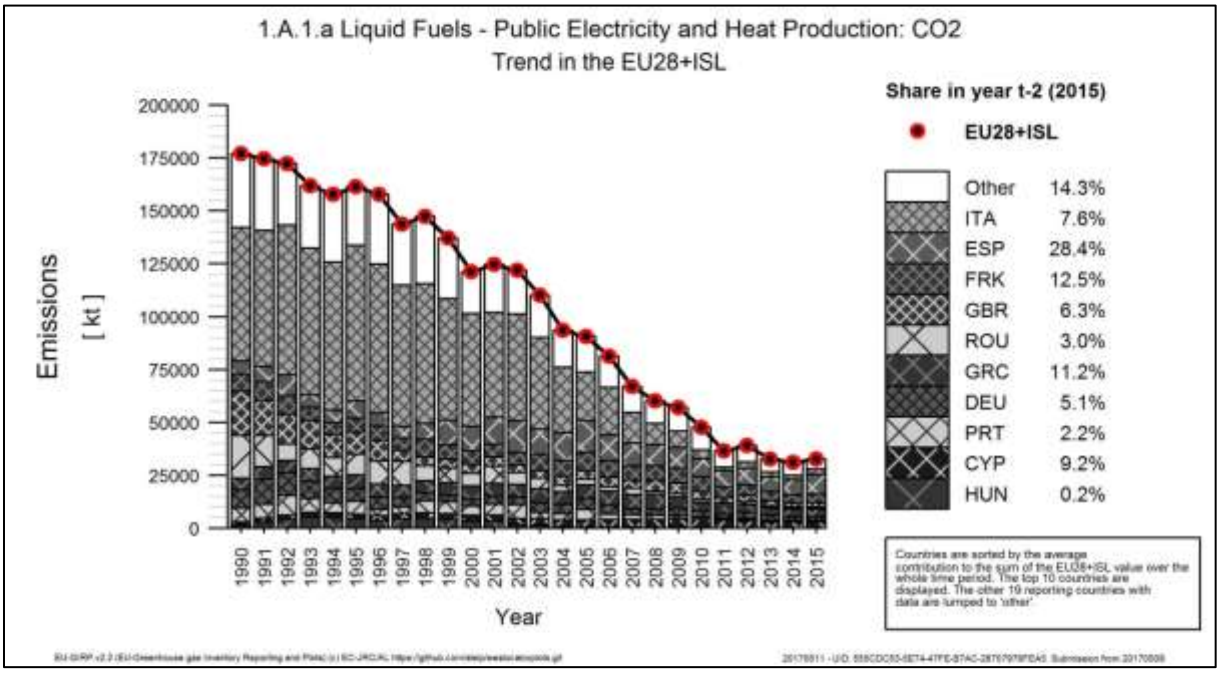
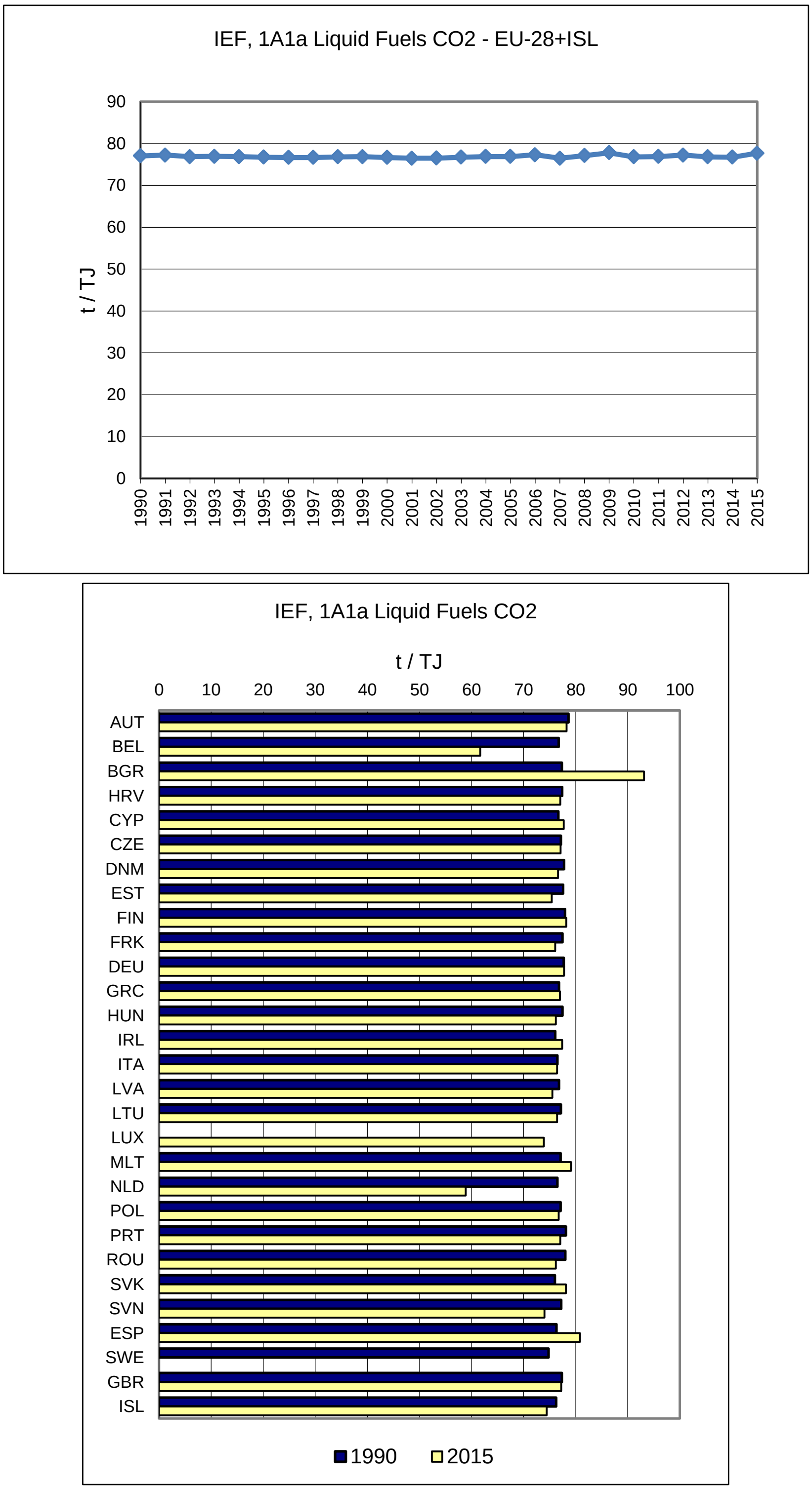


Figure 3.8 (on the next page) shows the implied emission factors for CO_2 emissions from liquid fuels used in public electricity and heat production. The IEFs in most countries range between 76 and 79 t/TJ in 1990 as well as in 2015. Bulgaria has the highest IEF in 2015, which is explained by the relatively 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 implied emission factor of the Netherlands is the lowest among the Member States in the year 2015, it is caused by the high share of waste gas use in the liquid fuel mix, which has a comparatively low IEF (53.0 t/TJ). The IEF of Belgium is similarly low in 2015. 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



Note: Figure 3.8 does not include Sweden's IEF for the year 2015 for confidentiality reasons and to preserve time series consistency for the EU.

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

CO_2 emissions from the combustion of solid fuels represented about 75% of all greenhouse gas emissions from public electricity and heat production. Within the EU-28 + ISL, emissions fell by 29% between 1990 and 2015 (Table 3.9). A reason for the recent decline is that coal is being phased out of the fuel mix in the United Kingdom as well as in Germany. Those two countries are responsible for 65% of the total decline in the EU-28 + ISL between 2014 and 2015.

Table 3.9 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	6 247	4 529	2 305	2 335	0.3%	31	1%	-3 912	-63%
Belgium	19 434	18 525	6 528	6 306	0.8%	-222	-3%	-13 128	-68%
Bulgaria	27 766	21 961	25 233	26 314	3.3%	1 081	4%	-1 452	-5%
Croatia	603	251	2 142	2 064	0.3%	-77	-4%	1 461	242%
Cyprus	NO	NO	NO	NO	-	-	-	-	-
Czech Republic	52 368	54 581	44 335	44 111	5.5%	-224	-1%	-8 257	-16%
Denmark	22 225	23 952	9 628	6 771	0.8%	-2 856	-30%	-15 454	-70%
Estonia	22 109	11 883	12 814	9 863	1.2%	-2 951	-23%	-12 246	-55%
Finland	9 281	9 916	7 927	5 472	0.7%	-2 455	-31%	-3 809	-41%
France	37 572	26 852	14 784	14 160	1.8%	-624	-4%	-23 412	-62%
Germany	307 246	273 571	273 049	261 066	32.6%	-11 983	-4%	-46 180	-15%
Greece	35 201	36 019	33 955	28 755	3.6%	-5 200	-15%	-6 446	-18%
Hungary	12 266	11 513	7 927	8 003	1.0%	76	1%	-4 263	-35%
Ireland	4 845	5 839	3 633	4 359	0.5%	726	20%	-486	-10%
Italy	28 169	20 685	37 726	38 226	4.8%	499	1%	10 057	36%
Latvia	218	132	17	10	0.0%	-7	-40%	-208	-95%
Lithuania	174	43	7	8	0.0%	2	26%	-166	-95%
Luxembourg	NO	NO	NO	NO	-	-	-	-	-
Malta	619	127	NO	NO	-	-	-	-619	-100%
Netherlands	25 862	27 958	30 010	37 297	4.7%	7 287	24%	11 435	44%
Poland	220 928	174 987	148 891	149 661	18.7%	770	1%	-71 266	-32%
Portugal	7 921	11 444	10 028	12 229	1.5%	2 201	22%	4 308	54%
Romania	25 123	29 463	19 830	20 107	2.5%	278	1%	-5 015	-20%
Slovakia	11 542	5 403	3 282	3 421	0.4%	139	4%	-8 121	-70%
Slovenia	5 712	5 372	4 161	4 303	0.5%	142	3%	-1 409	-25%
Spain	58 931	64 373	44 626	51 225	6.4%	6 599	15%	-7 706	-13%
Sweden	4 231	3 547	2 814	C	NA	NA	NA	NA	NA
Untited Kingdom	183 150	127 185	85 791	65 109	8.1%	-20 682	-24%	-118 041	-64%
EU-28	**1 125 511**	**966 565**	**828 627**	**801 176**	**100%**	**-27 451**	**-3%**	**-324 335**	**-29%**
Iceland	NO	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	183 150	127 185	85 791	65 109	8.1%	-20 682	-24%	-118 041	-64%
EU-28 + ISL	**1 125 511**	**966 565**	**828 627**	**801 176**	**100%**	**-27 451**	**-3%**	**-324 335**	**-29%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

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 (19%) and the United Kingdom (8%).

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

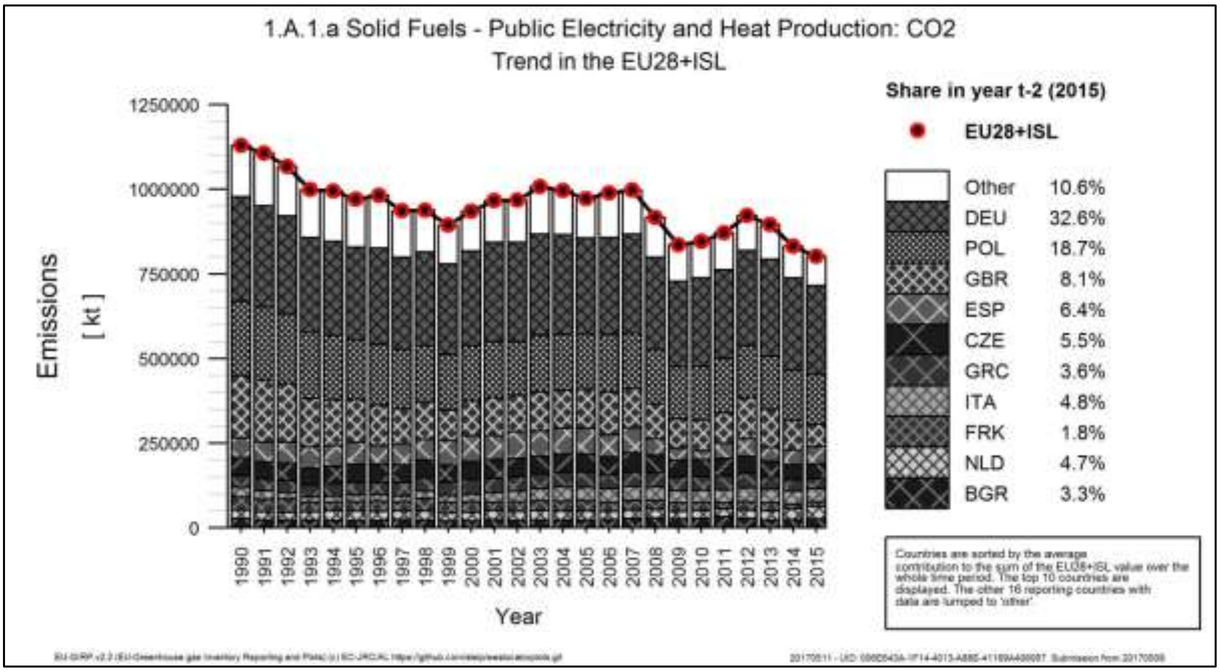
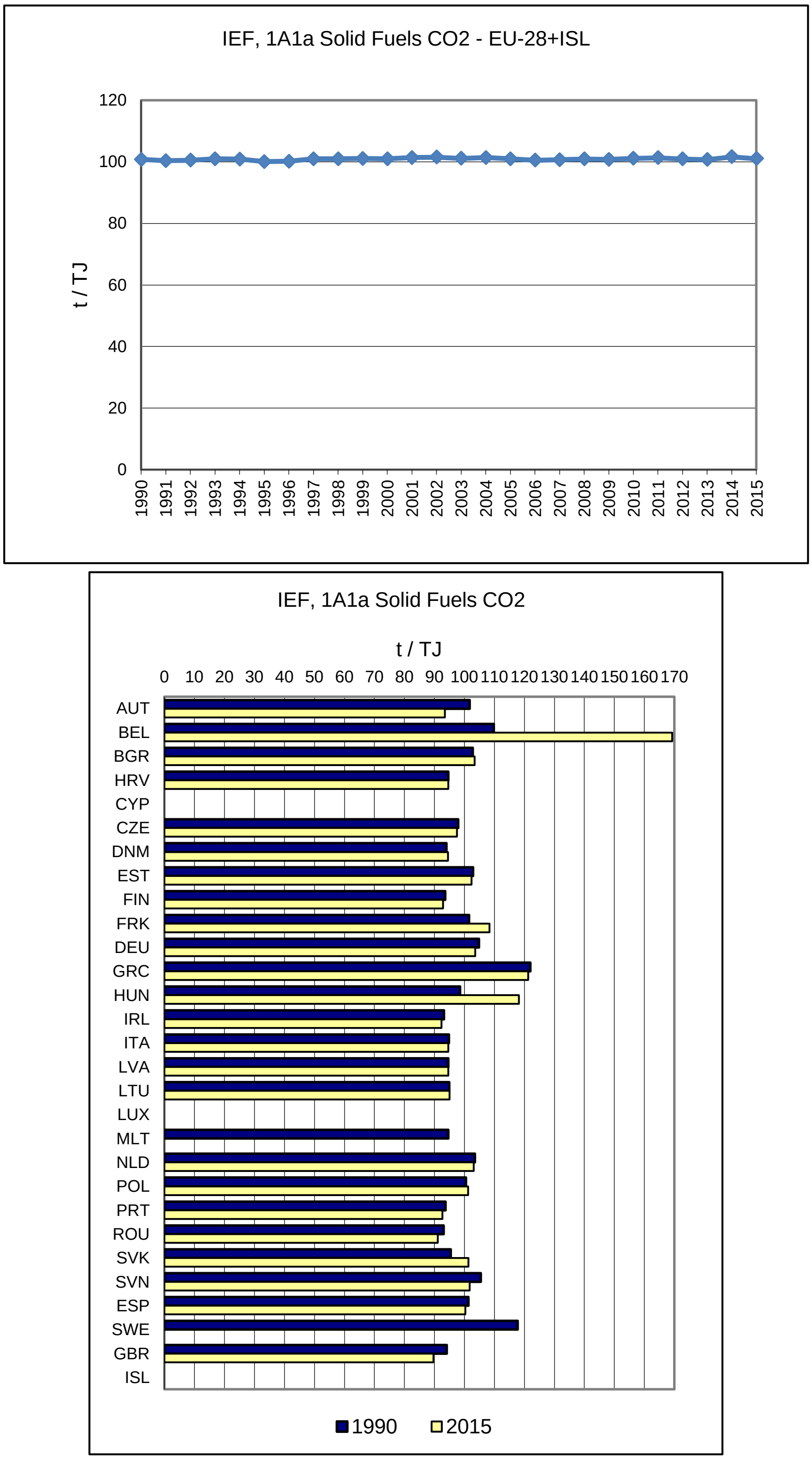


Figure 3.10 shows the relevant implied emission factors for solid fuels. The EU-28 + ISL implied emission factor has remained fairly stable (101 t/TJ in 2015). In Belgium and Sweden, the emission factors increased sharply since the late 1990s due to the use of blast

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



Note: Figure 3.10 does not include Sweden's IEF for the year 2015 for confidentiality reasons and to preserve time series consistency for the EU.

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 and do currently not represent an EU key category. For the EU-28 + ISL, emissions decreased by 27% between 1990 and 2015 (Table 3.10).

Table 3.10 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	27	20	11	11	0.3%	0	1%	-16	-59%
Belgium	37	35	3	3	0.1%	0	-1%	-34	-92%
Bulgaria	121	95	110	114	2.6%	4	4%	-7	-6%
Croatia	3	1	10	10	0.2%	0	-4%	7	242%
Cyprus	NO	NO	NO	NO	-	-	-	-	-
Czech Republic	238	250	201	200	4.6%	-1	0%	-38	-16%
Denmark	57	61	24	17	0.4%	-7	-30%	-40	-70%
Estonia	2	1	7	7	0.2%	1	8%	6	303%
Finland	41	46	49	33	0.8%	-16	-32%	-8	-19%
France	206	128	43	42	1.0%	-2	-4%	-165	-80%
Germany	2 275	1 957	1 950	1 918	44.5%	-32	-2%	-357	-16%
Greece	129	132	123	106	2.5%	-17	-14%	-23	-18%
Hungary	56	51	29	28	0.6%	-1	-4%	-28	-50%
Ireland	8	9	6	7	0.2%	1	20%	-1	-9%
Italy	133	98	179	181	4.2%	1	1%	48	36%
Latvia	1	1	0	0	0.0%	0	-40%	-1	-95%
Lithuania	1	0	0	0	0.0%	0	25%	-1	-95%
Luxembourg	NO	NO	NO	NO	-	-	-	-	-
Malta	3	1	NO	NO	-	-	-	-3	-100%
Netherlands	104	109	107	141	3.3%	34	32%	37	36%
Poland	970	779	642	643	14.9%	1	0%	-327	-34%
Portugal	38	55	48	59	1.4%	11	22%	21	56%
Romania	121	138	97	99	2.3%	2	2%	-22	-18%
Slovakia	54	25	15	15	0.3%	1	4%	-39	-72%
Slovenia	24	24	18	19	0.4%	1	4%	-5	-22%
Spain	257	415	263	295	6.8%	32	12%	38	15%
Sweden	41	44	54	C	NA	NA	NA	NA	NA
Untited Kingdom	1 040	730	481	367	8.5%	-114	-24%	-672	-65%
EU-28	**5 945**	**5 160**	**4 418**	**4 315**	**100%**	**-102**	**-2%**	**-1 630**	**-27%**
Iceland	NO	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	1 040	730	481	367	8.5%	-114	-24%	-672	-65%
EU-28 + ISL	**5 945**	**5 160**	**4 418**	**4 315**	**100%**	**-102**	**-2%**	**-1 630**	**-27%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

The trend for N_2O emissions of solid fuels (Figure 3.11) is closely related to the emission trend of CO_2 emissions. Likewise are the main contributing Member States Germany, with a share of 44%, followed by Poland (15%) and the United Kingdom (9%).

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

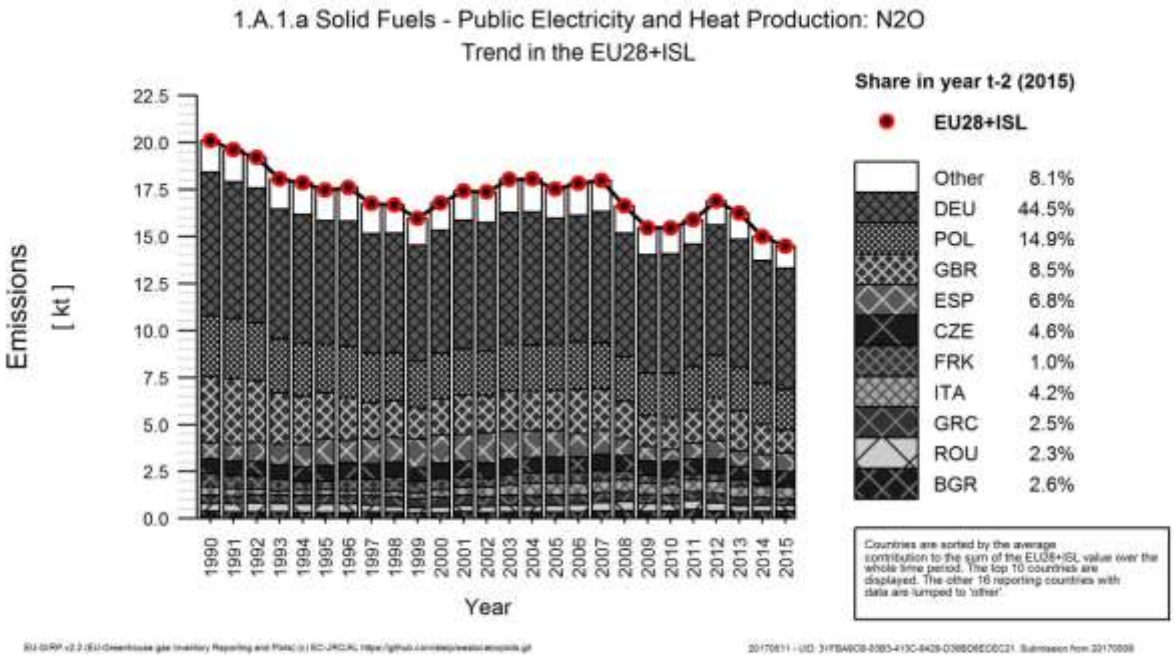
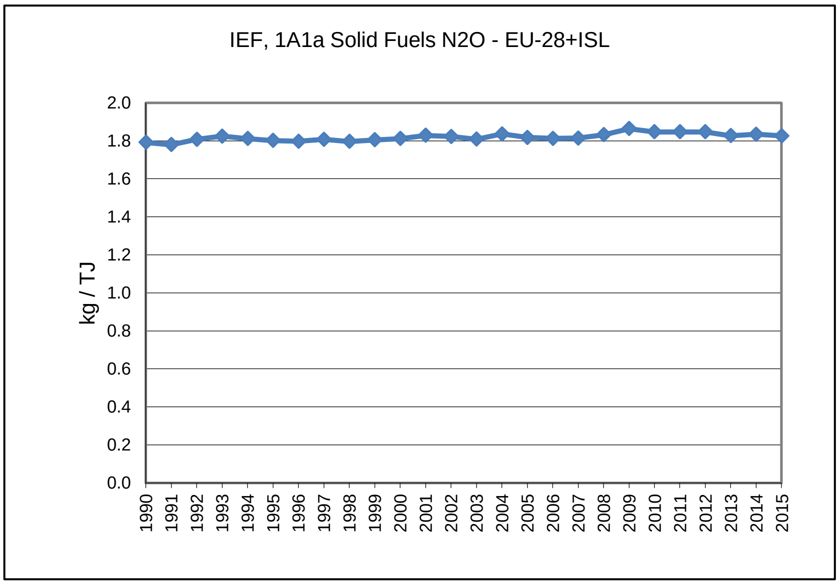
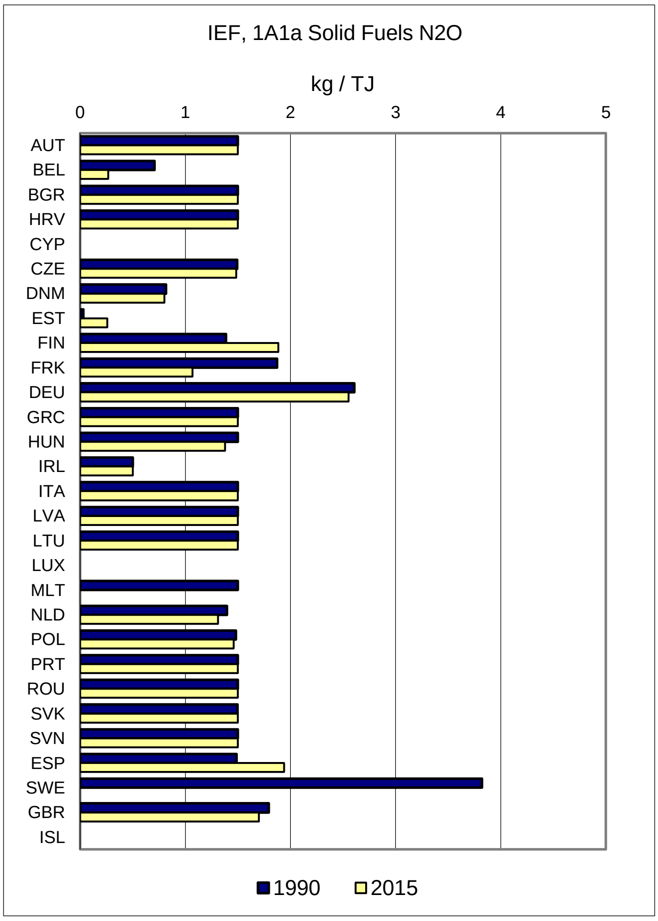


Table 3.12 shows the implied emission factors for N_2O. The EU-28 + ISL implied emission factor remained stable at around 1.82 kg/TJ between 1990 and 2015. Sweden usually has the highest IEF (about 12 kg/TJ in 2014); it gradually increased between 1990 and 2014. This is explained by Sweden as mainly 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. In 2015 Sweden did not report the IEF for solid fuels for confidentiality reasons.

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





Note: Figure 3.12 does not include Sweden's IEF for the year 2015 for confidentiality reasons and to preserve time series consistency for the EU.

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

CO_2 emissions from the combustion of gaseous fuels accounted for 17% of all greenhouse gas emissions from public electricity and heat generation in 2015. Emissions increased by 66% in the EU-28 + ISL between 1990 and 2015 (Table 3.11).

Table 3.11 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	3 294	3 439	2 827	3 650	2.1%	823	29%	356	11%
Belgium	2 765	4 407	6 877	7 850	4.4%	974	14%	5 086	184%
Bulgaria	6 295	2 971	2 015	1 857	1.0%	-158	-8%	-4 439	-71%
Croatia	1 006	484	824	910	0.5%	86	10%	-96	-10%
Cyprus	NO	NO	NO	NO	-	-	-	-	-
Czech Republic	1 019	1 772	2 035	2 210	1.2%	176	9%	1 191	117%
Denmark	980	2 506	1 793	1 753	1.0%	-40	-2%	773	79%
Estonia	1 977	790	722	583	0.3%	-139	-19%	-1 394	-71%
Finland	1 989	3 184	2 521	2 186	1.2%	-334	-13%	198	10%
France	977	1 536	4 339	7 089	4.0%	2 750	63%	6 112	625%
Germany	18 447	20 608	24 489	24 375	13.7%	-114	0%	5 927	32%
Greece	IE,NO	IE,NO	2 979	3 076	1.7%	97	3%	3 076	∞
Hungary	4 148	3 645	3 323	3 709	2.1%	386	12%	-439	-11%
Ireland	1 881	2 420	4 078	3 869	2.2%	-208	-5%	1 989	106%
Italy	15 788	14 813	31 437	37 741	21.2%	6 303	20%	21 953	139%
Latvia	2 658	1 288	1 584	1 678	0.9%	94	6%	-980	-37%
Lithuania	5 797	2 287	1 533	1 338	0.8%	-195	-13%	-4 458	-77%
Luxembourg	NO	60	589	369	0.2%	-220	-37%	369	∞
Malta	NO	NO	NO	NO	-	-	-	-	-
Netherlands	13 330	17 831	17 190	14 727	8.3%	-2 463	-14%	1 397	10%
Poland	1 214	266	2 918	3 390	1.9%	472	16%	2 176	179%
Portugal	NO	NO	1 171	2 521	1.4%	1 349	115%	2 521	∞
Romania	20 801	14 206	5 428	5 903	3.3%	474	9%	-14 898	-72%
Slovakia	2 089	2 692	1 275	1 372	0.8%	98	8%	-717	-34%
Slovenia	112	145	201	194	0.1%	-7	-4%	82	73%
Spain	441	162	9 590	11 408	6.4%	1 818	19%	10 967	2485%
Sweden	486	782	469	C	NA	NA	NA	NA	NA
Untited Kingdom	16	25 857	34 699	34 015	19.1%	-684	-2%	33 999	213252%
EU-28	**107 024**	**127 367**	**166 437**	**177 773**	**100%**	**11 336**	**7%**	**70 749**	**66%**
Iceland	NO	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	16	25 857	34 873	34 169	19.2%	-704	-2%	34 153	214214%
EU-28 + ISL	**107 024**	**127 367**	**166 610**	**177 927**	**100%**	**11 316**	**7%**	**70 902**	**66%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

In eight EU-28 Member States the consumption of gaseous fuels was lower in 2015 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. After a steep decrease the emissions of gaseous fuels increased again by 7% in 2015 compared to 2014. Figure 3.13 shows the trend of emissions from gaseous fuels by the main contributing Member States which are Italy (21%), the United Kingdom (19%) and Germany (14%).

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

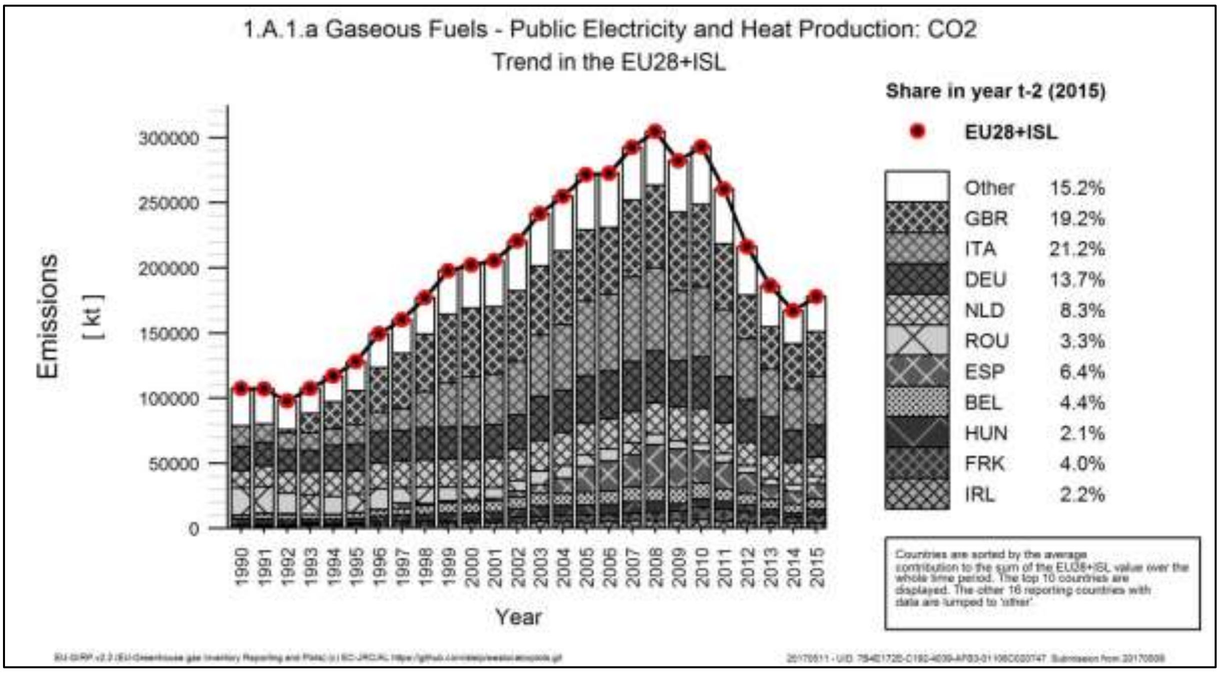
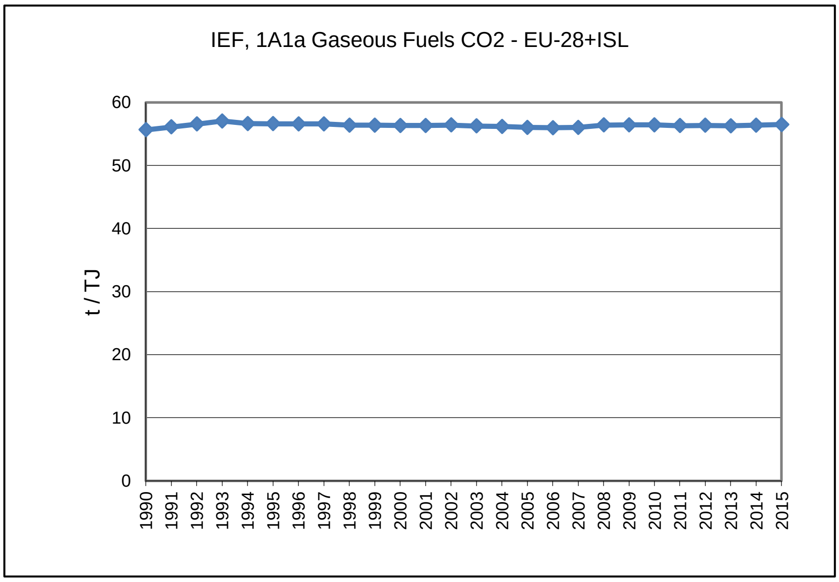
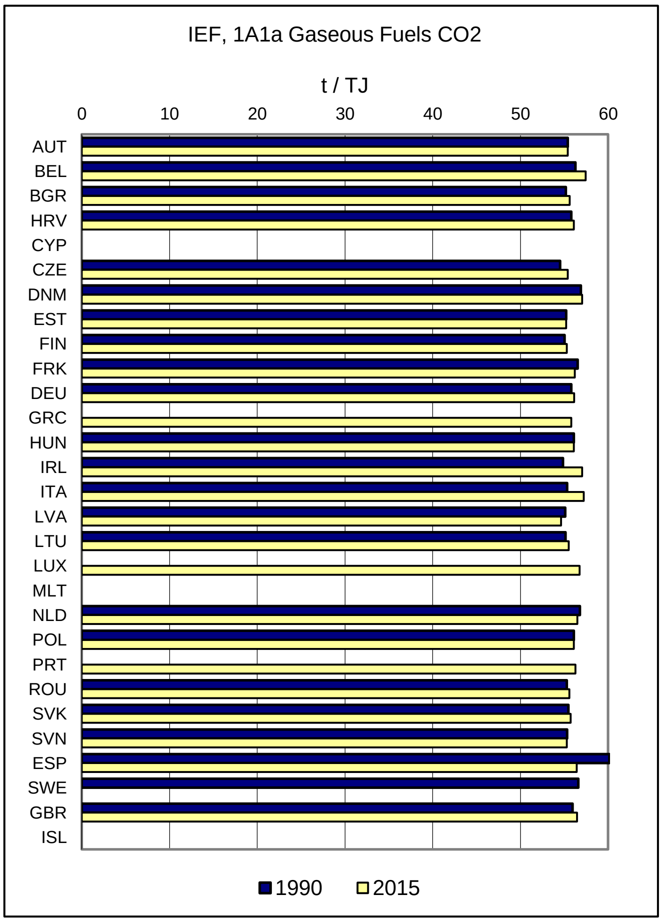


Figure 3.14 shows the implied emission factors from gaseous fuels for CO_2. The EU-28 + ISL implied emission factor has remained fairly stable (56.50 t/TJ in 2015) which is very close to the default emission factor of natural gas (56.1 t/TJ). The slight increase in the EU-28 + ISL factor observed in 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





Note: *Figure 3.14 does not include Sweden's IEF for the year 2015 for confidentiality reasons and to preserve time series consistency for the EU.*

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

In 2015, the share of CO_2 emissions from other fuels amounts to 3% of total greenhouse gas emissions from public electricity and heat generation. Other fuels cover mainly the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.12). Emissions increased by 248% at EU-28 + ISL level between 1990 and 2015 and increased in all countries except for Latvia, Poland and Slovakia.

Table 3.12 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	118	191	1 280	1 337	3.8%	58	4%	1 219	1033%
Belgium	674	545	1 986	2 057	5.9%	71	4%	1 383	205%
Bulgaria	NO	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	NO	-	-	-	-	-
Czech Republic	24	60	221	218	0.6%	-2	-1%	194	808%
Denmark	539	798	1 445	1 576	4.5%	131	9%	1 037	193%
Estonia	NO	NO	131	145	0.4%	14	10%	145	∞
Finland	1	34	364	420	1.2%	56	15%	419	41838%
France	2 558	3 321	5 678	5 781	16.6%	103	2%	3 223	126%
Germany	4 121	4 205	14 587	14 587	41.8%	0	0%	10 466	254%
Greece	NO	NO	NO	NO	-	-	-	-	-
Hungary	28	50	221	214	0.6%	-7	-3%	186	668%
Ireland	NO	NO	88	87	0.2%	-1	-1%	87	∞
Italy	143	348	194	256	0.7%	62	32%	113	79%
Latvia	3	NO	NO	NO	-	-	-	-3	-100%
Lithuania	NO	NO	92	114	0.3%	22	24%	114	∞
Luxembourg	33	31	75	83	0.2%	8	11%	50	149%
Malta	NO	NO	NO	NO	-	-	-	-	-
Netherlands	601	810	2 828	2 861	8.2%	33	1%	2 260	376%
Poland	753	555	99	178	0.5%	79	80%	-575	-76%
Portugal	NO	NO	391	412	1.2%	21	5%	412	∞
Romania	NO	32	1	NO	-	-1	-100%	-	-
Slovakia	198	163	37	37	0.1%	0	1%	-161	-81%
Slovenia	NO	NO	13	13	0.0%	0	-2%	13	∞
Spain	110	203	1 388	1 476	4.2%	88	6%	1 366	1240%
Sweden	570	651	2 103	2 384	NA	NA	NA	NA	NA
Untited Kingdom	215	544	2 162	2 977	8.5%	815	38%	2 762	1286%
EU-28	**10 120**	**11 889**	**33 279**	**34 828**	**100%**	**1 549**	**5%**	**24 708**	**244%**
Iceland	NO	5	NO	NO	-	-	-	-	-
United Kingdom (KP)	227	577	2 216	3 030	8.7%	814	37%	2 803	1235%
EU-28 + ISL	**10 132**	**11 927**	**33 333**	**34 881**	**100%**	**1 547**	**5%**	**24 749**	**244%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: The numbers for 2015 for EU-28 and EU-28 + ISL in this table differ from the numbers in the respective CRF tables because the EU CRF includes under "Other fossil fuels" CO_2 emissions from liquid, gaseous and solid fuels reported by Sweden as confidential. These emissions are not reflected in this table in order to preserve time series consistency.

Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

Figure 3.15 illustrates clearly the strong increase of emissions caused by other fuels over the past 25 years. The largest emitters of other fuels in 2015 were Germany (39%) and France (16%) and the United Kingdom (8%). Together these three Member States accounted for 63% of the total EU-28 + ISL emissions in this category.

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

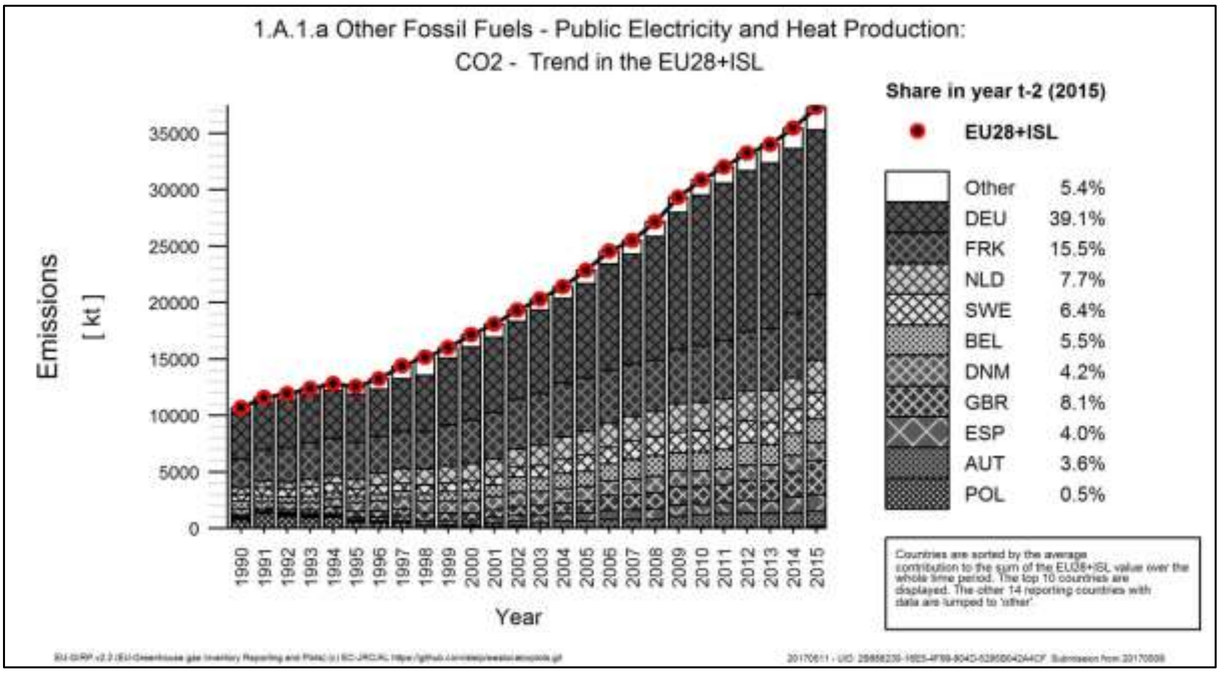
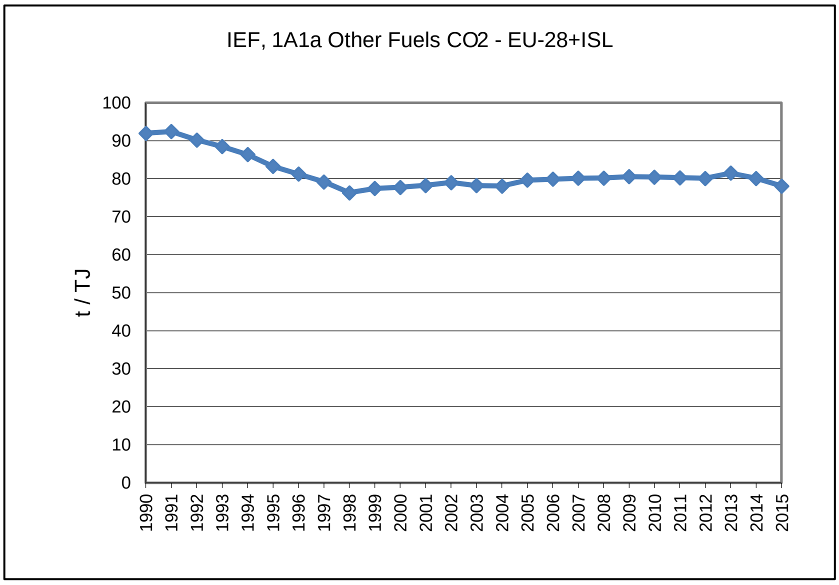
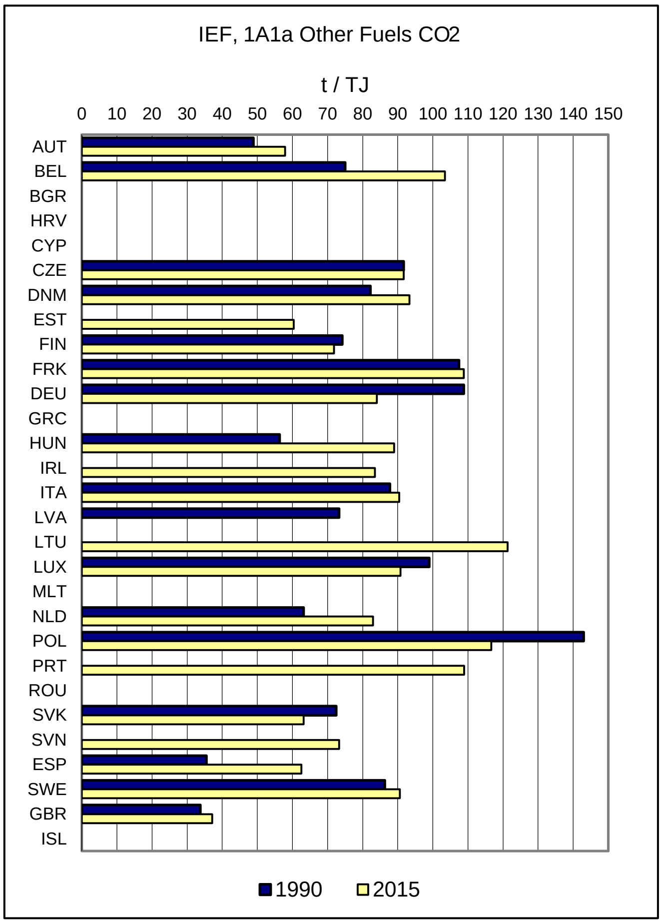


Figure 3.16 shows the implied emission factors of other fuels from CO_2. The EU-28 + ISL implied emission factor has gradually fallen until 1998, then levelled out at around 80 t/TJ, and in 2015 it amounts to 78.1 t/TJ. In Germany, the IEF declined continuously between 1990 and 2015 (from 109 to 84 t/TJ). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

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





1A1a Electricity and Heat Production - Peat (CO_2)

CO_2 emissions from the combustion of peat represented 0.8% of all greenhouse gas emissions from public electricity and heat production. Peat in its raw state is a fossil sedimentary deposit of vegetal origin with high water content. Only 5 Member States report emissions from peat combustion. Within the EU-28 + ISL, emissions declined by 4% respectively 0.4 Mt CO_2 between 1990 and 2015 (Table 3.13).

Table 3.13 1A1a Public Electricity and Heat Production, Peat: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	187	129	129	1.6%	-1	-1%	-58	-31%
Finland	3 950	5 142	4 865	59.7%	-276	-5%	916	23%
France	NO	NO	NO	-	-	-	-	-
Germany	NA	NA	NA	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	3 065	2 660	2 636	32.3%	-25	-1%	-429	-14%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	146	NO	NO	-	-	-	-146	-100%
Lithuania	11	17	7	0.1%	-10	-59%	-4	-37%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	1 173	585	512	6.3%	-72	-12%	-661	-56%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**8 531**	**8 533**	**8 148**	**100%**	**-385**	**-5%**	**-383**	**-4%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**8 531**	**8 533**	**8 148**	**100%**	**-385**	**-5%**	**-383**	**-4%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.
Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

Figure 3.17 illustrates the trend of peat emissions throughout the last 25 years, which is predominately influenced by the emission fluctuation over the years by Finland. In 2015, the two largest emitters, Finland and Ireland, are responsible for 92% of the total emissions in this category.

Figure 3.17 1A1a Public Electricity and Heat Production, Peat: Emission trend and share for CO_2

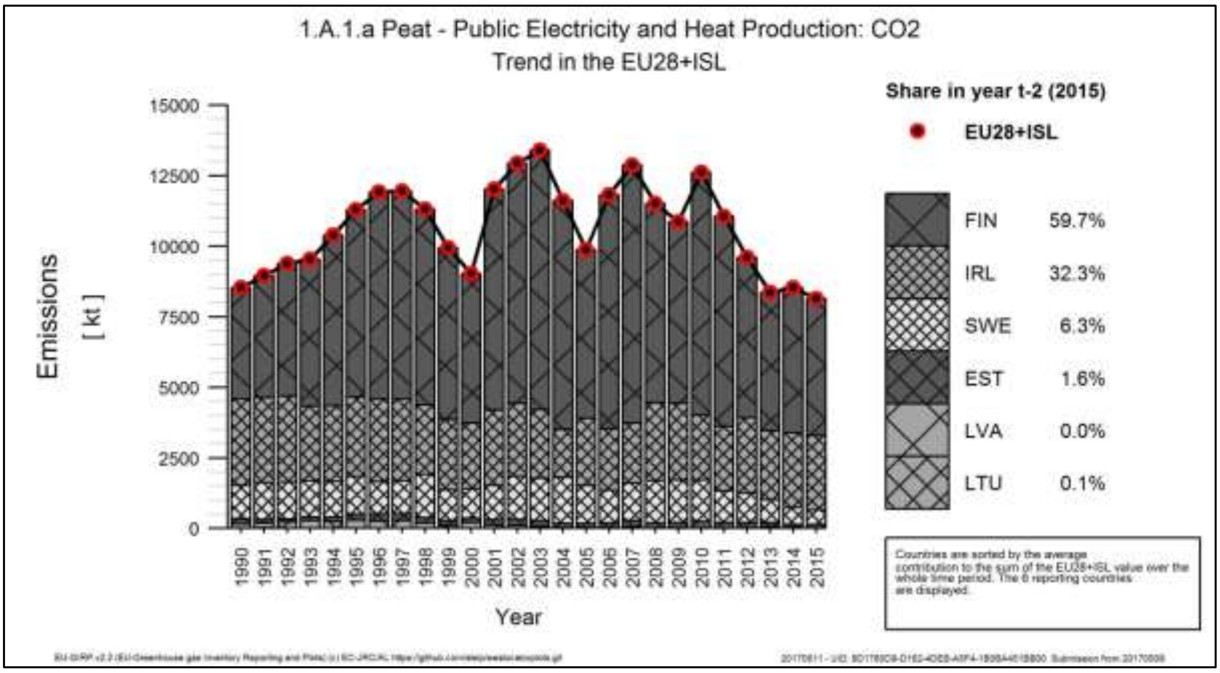
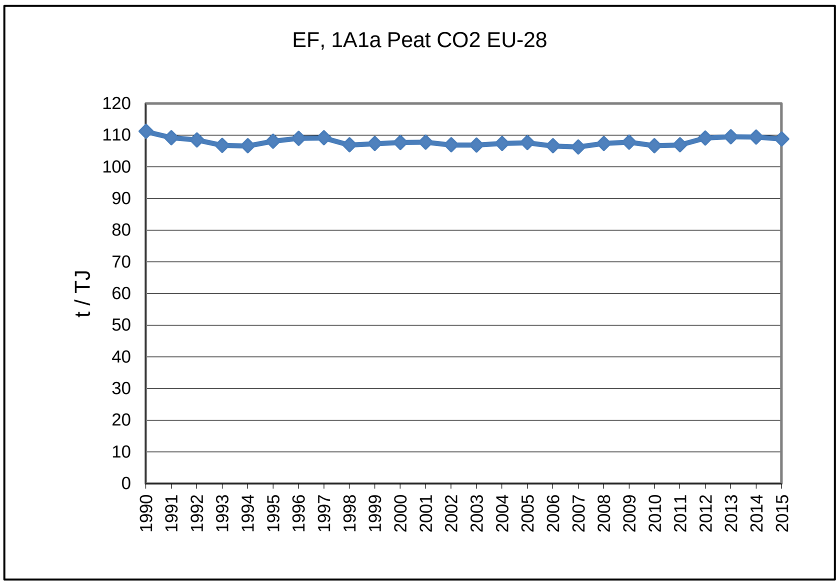
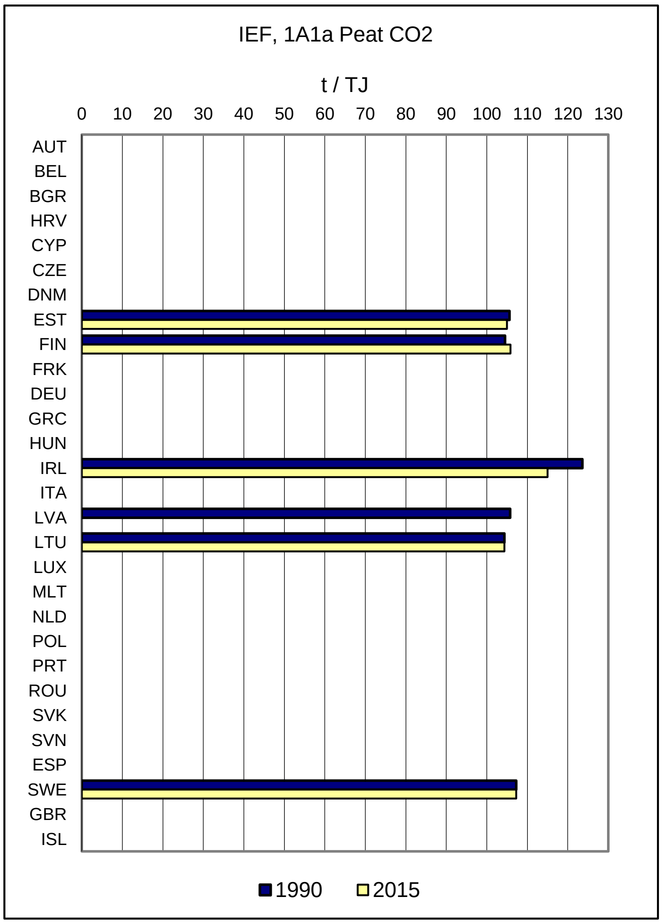


Figure 3.18 shows the implied emission factors of peat from CO_2. The EU-28 + ISL implied emission factor amounts to 108.7 t/TJ in 2015 and has been quite stable over the last 25 years. It is mainly influenced by the IEF of the two largest emitters (Finland and Ireland). The default emission factor for peat is 106 t/TJ according to the 2006 IPCC Guidelines. Only Ireland has an IEF continuously above the default value. The reason for this is the use of the plant specific emission factor (117.3 t/TJ) for three milled peat power plants in use.

Figure 3.18 1A1a Public Electricity and Heat Production, Peat: Implied Emission Factors for CO_2





1A1a Electricity and Heat Production - Biomass (CH_4)

Biomass is a special case when it comes to emission allocation. The CO_2 emissions from biomass fuels are estimated and reported in the LULUCF sector. In the CRF tables, CO_2 emissions from combustion of biofuels are reported as information items, but not included in the sectoral or national totals to avoid double counting. The emissions of CH_4 and N_2O, however, are estimated and included in the energy sector as well as the national totals, because their effect is in addition to the stock changes estimated in the LULUCF sector.

CH_4 emissions from the combustion of biomass represented 0.2% of all greenhouse gas emissions from public electricity and heat production in 2015. Within the EU-28 + ISL, emissions rose strongly by 3682% respectively 2.3 Mt CO_2 equivalent between 1990 and 2015 (Table 3.14).

Table 3.14 1A1a Public Electricity and Heat Production, Biomass: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0	12	13	0.5%	1	6%	12	2821%
Belgium	0	9	10	0.4%	1	15%	10	351199%
Bulgaria	NO	0	0	0.0%	0	-6%	0	∞
Croatia	NO	1	2	0.1%	1	83%	2	∞
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	0	15	16	0.7%	2	12%	16	5317%
Denmark	4	40	42	1.8%	2	5%	38	880%
Estonia	2	12	12	0.5%	0	3%	11	639%
Finland	2	15	14	0.6%	0	-3%	13	728%
France	1	6	7	0.3%	1	8%	6	700%
Germany	9	1 863	1 915	80.1%	51	3%	1 905	20461%
Greece	IE,NO	0	0	0.0%	0	7%	0	∞
Hungary	1	19	20	0.8%	1	4%	19	3251%
Ireland	NO	1	1	0.1%	0	-11%	1	∞
Italy	10	53	47	2.0%	-5	-10%	37	365%
Latvia	0	8	9	0.4%	1	10%	9	2735%
Lithuania	0	14	19	0.8%	4	30%	18	4659%
Luxembourg	1	1	1	0.0%	0	19%	0	20%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	3	16	13	0.6%	-2	-14%	10	340%
Poland	11	73	72	3.0%	-1	-1%	61	558%
Portugal	NO	6	6	0.2%	0	4%	6	∞
Romania	NO	4	4	0.1%	0	-1%	4	∞
Slovakia	10	16	16	0.7%	1	5%	7	70%
Slovenia	0	1	1	0.1%	0	22%	1	1067%
Spain	0	4	4	0.2%	0	0%	4	11777%
Sweden	8	37	37	1.5%	0	0%	29	346%
United Kingdom	0	77	108	4.5%	31	40%	108	22920%
EU-28	**63**	**2 302**	**2 391**	**100%**	**88**	**4%**	**2 327**	**3682%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	0	77	108	4.5%	31	40%	108	22920%
EU-28 + ISL	**63**	**2 302**	**2 391**	**100%**	**88**	**4%**	**2 327**	**3682%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.
Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

Figure 3.19 illustrates the trend of biomass emissions throughout the last 25 years, which is predominately influenced by the step increase of Germany since 2003. In 2015 Germany is responsible for 80% of the total emissions in this category. One reason for the increase from the year 2002 to 2003 is the fact that statistical data for biomass fuel use is only available after 2003 in Germany.

Figure 3.19 1A1a Public Electricity and Heat Production, Biomass: Emission trend and share for CH_4

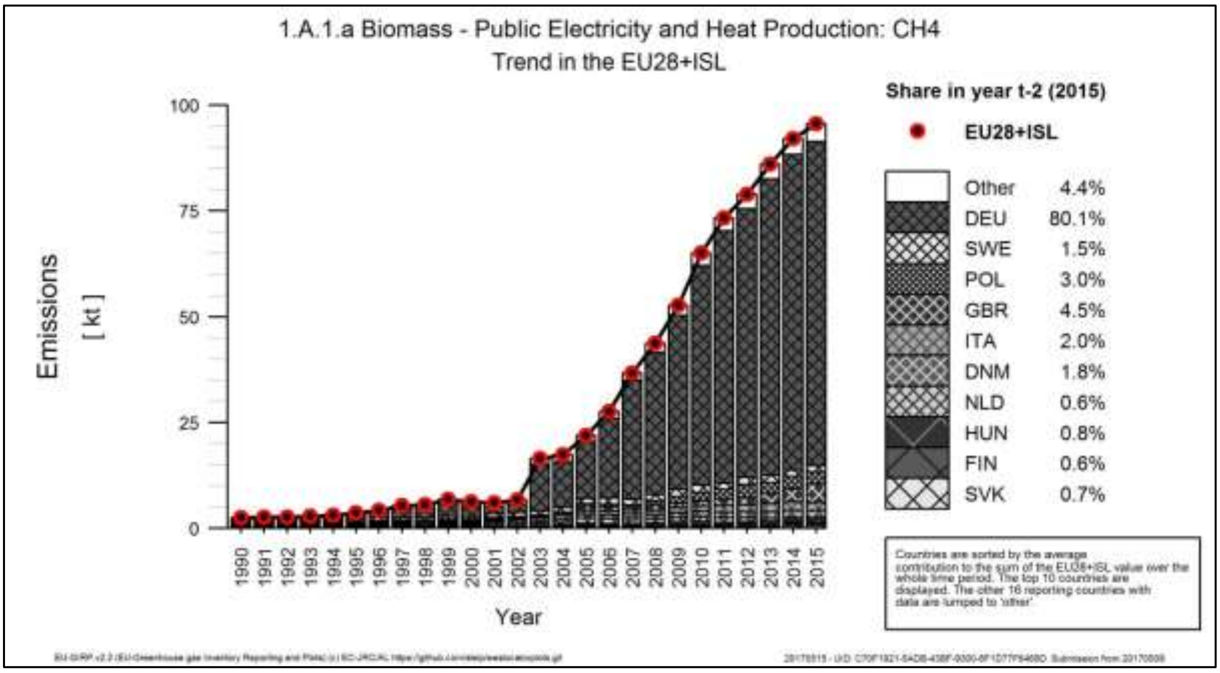
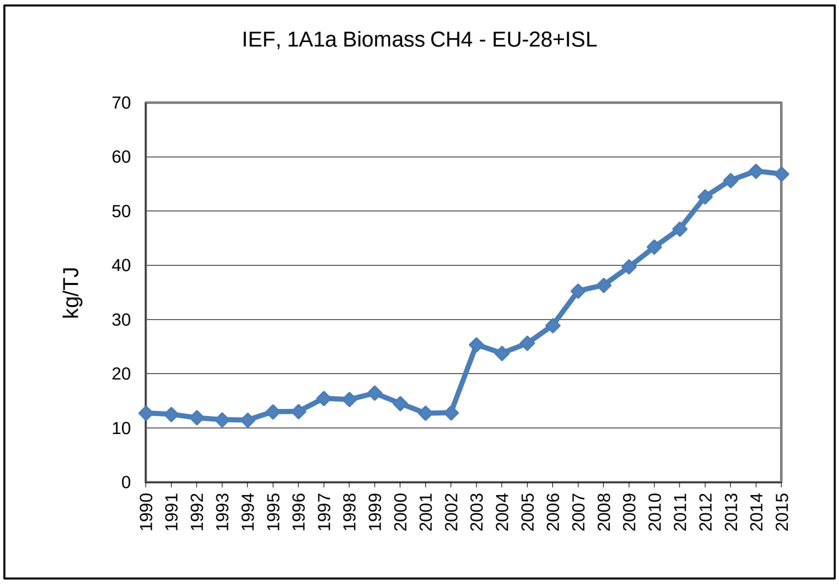
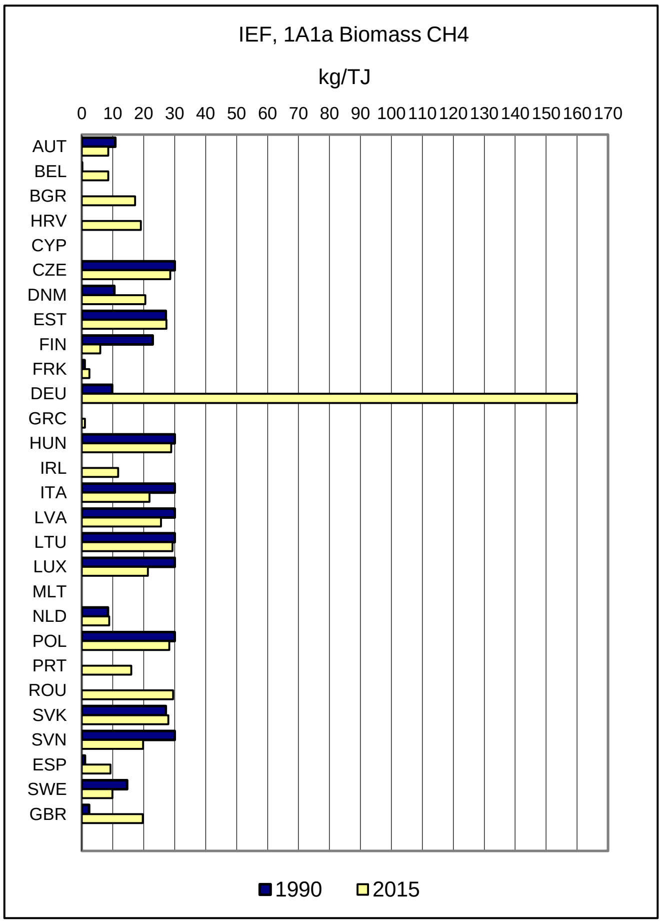


Figure 3.20 shows the implied emission factors of biomass from CH_4. The EU-28 + ISL implied emission factor amounts to 56.8 kg/TJ in 2015 and has steadily increased over the last 25 years. It is mainly influenced by Germany, which IEF as well as its share of emissions grew strongly. The default implied emission factors range between 1 and 30 kg/TJ, with an exception of charcoal with 200 kg/TJ according to the 2006 IPCC Guidelines. Germany reports 160 kg/TJ for the year 2015. A reason for this comparatively high IEF lies in the fact that Germany uses an emission factor for gaseous biomass of 312.3 kg/TJ on average, which reflects the results of a national research project.

Figure 3.20 1A1a Public Electricity and Heat Production, Biomass: Implied Emission Factors for CH_4





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 venting and flaring under 1B2c.

Carbon dioxide emissions from Petroleum Refining are accounting for 3% of total greenhouse gas emissions in year 2015. Between 1990 and 2015, EU-28 + ISL CO_2 emissions decreased by 4% (Table 3.15). Emissions in 2015 were above 1990 levels in twelve Member States, whereas they were decreasing in eleven and reported as not occurring or confidential in six countries.

Table 3.15 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

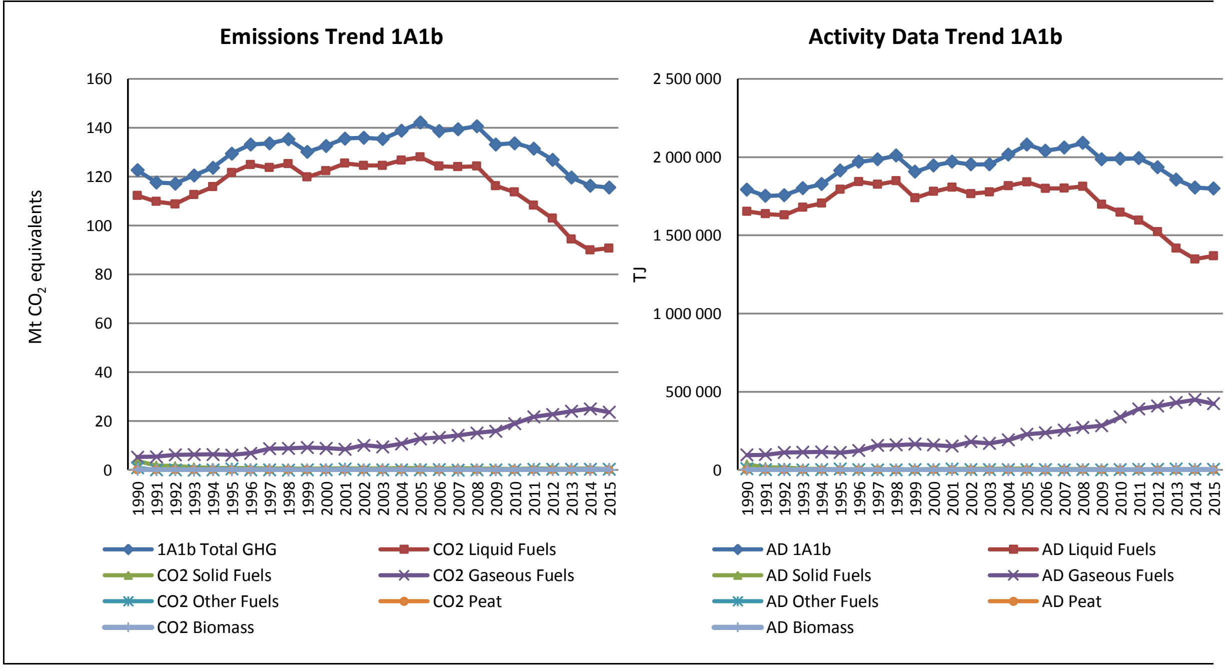
Member State	CO2 emissions in kt				Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	2 394	2 590	2 713	2 804	2.4%	91	3%	410	17%
Belgium	4 299	4 089	4 753	4 682	4.1%	-72	-2%	383	9%
Bulgaria	861	1 015	919	1 352	1.2%	433	47%	491	57%
Croatia	2 446	1 813	1 516	1 387	1.2%	-129	-8%	-1 059	-43%
Cyprus	86	90	NO	NO	-	-	-	-86	-100%
Czech Republic	493	482	806	831	0.7%	25	3%	338	69%
Denmark	908	1 387	920	978	0.8%	58	6%	70	8%
Estonia	NO	NO	NO	NO	-	-	-	-	-
Finland	2 042	2 465	2 546	2 216	1.9%	-329	-13%	174	9%
France	11 935	13 145	7 927	7 605	6.6%	-321	-4%	-4 330	-36%
Germany	20 166	19 131	17 787	18 154	15.8%	367	2%	-2 012	-10%
Greece	2 375	2 484	5 305	5 253	4.6%	-52	-1%	2 878	121%
Hungary	2 376	2 144	1 387	1 436	1.2%	48	3%	-940	-40%
Ireland	168	181	279	358	0.3%	79	28%	190	113%
Italy	17 190	19 542	21 007	20 949	18.2%	-59	0%	3 759	22%
Latvia	NO	NO	NO	NO	-	-	-	-	-
Lithuania	1 510	745	1 306	1 367	1.2%	60	5%	-143	-9%
Luxembourg	NO	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	NO	-	-	-	-	-
Netherlands	11 010	11 568	9 692	9 773	8.5%	81	1%	-1 237	-11%
Poland	2 164	3 699	4 637	5 357	4.7%	720	16%	3 193	148%
Portugal	1 861	2 378	2 123	2 365	2.1%	242	11%	504	27%
Romania	4 297	3 521	1 604	1 525	1.3%	-79	-5%	-2 773	-65%
Slovakia	2 873	2 029	1 216	1 448	1.3%	232	19%	-1 425	-50%
Slovenia	170	93	NO	NO	-	-	-	-170	-100%
Spain	10 858	12 304	11 786	11 803	10.3%	17	0%	945	9%
Sweden	1 778	1 891	2 148	C	NA	NA	NA	NA	NA
Untited Kingdom	17 812	20 147	13 484	13 502	11.7%	17	0%	-4 311	-24%
EU-28	**120 296**	**127 042**	**113 716**	**115 144**	**100%**	**1 428**	**1%**	**-5 152**	**-4%**
Iceland	NO	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	17 812	20 147	13 484	13 502	11.7%	17	0%	-4 311	-24%
EU-28 + ISL	**120 296**	**127 042**	**113 716**	**115 144**	**100%**	**1 428**	**1%**	**-5 152**	**-4%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: The numbers for 2015 for EU-28 and EU-28 + ISL in this table differ from the numbers in the respective CRF tables because the EU CRF includes under "Other fossil fuels" CO_2 emissions from liquid and gaseous fuels reported by Sweden as confidential. These emissions are not reflected in this table in order to preserve time series consistency. In addition, EU trends in this table do not include Sweden to preserve time series consistency for the EU.

Figure 3.21 shows the trends in activity data and the associated emissions originating from the refining of petroleum by fuel in the EU-28 + ISL between the years 1990 and 2015. Fuel used for petroleum refining decreased by 0.3% in the EU-28 + ISL between 1990 and 2015. In the year 2015 fuel use from liquid fuels increased by 1.5%, after a decreasing trend in the recent decade. Liquid fuels represent 76% of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part (23.5%) of the activity data. Gaseous fuels use is more than three times higher in 2015 compared to 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 and lignite) as well as 0.1 % other fuels use.

Figure 3.21 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 2015. Emissions decreased by 19% between 1990 and 2015 (Table 3.16). Greece had the largest emission increase between 1990 and 2015 whereas the United Kingdom reports the largest decrease in emissions in this period.

Table 3.16 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2	%	kt CO2	%		
Austria	1 958	2 169	2 111	2 269	2.5%	158	8%	312	16%	T2	CS
Belgium	4 285	3 924	3 733	3 607	4.0%	-126	-3%	-678	-16%	-	PS
Bulgaria	793	800	791	985	1.1%	193	24%	192	24%	T1	D
Croatia	2 432	1 800	1 075	1 032	1.1%	-44	-4%	-1 401	-58%	T1	D
Cyprus	86	90	NO	NO	-	-	-	-86	-100%	NA	NA
Czech Republic	176	149	595	618	0.7%	22	4%	442	252%	T1	CS,D
Denmark	908	1 387	914	978	1.1%	64	7%	70	8%	T1,T2,T3	CS,D,PS
Estonia	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 383	1 861	1 646	1 593	1.8%	-53	-3%	210	15%	T3	CS,PS
France	11 413	12 486	5 936	5 662	6.2%	-274	-5%	-5 752	-50%	T2,T3	CS,PS
Germany	15 417	18 390	14 832	15 095	16.6%	263	2%	-322	-2%	CS	CS
Greece	2 375	2 484	5 305	5 253	5.8%	-52	-1%	2 878	121%	T2	PS
Hungary	1 683	1 527	1 006	1 054	1.2%	48	5%	-629	-37%	T3	PS
Ireland	168	181	262	339	0.4%	77	29%	170	101%	T3	CS,PS
Italy	17 030	19 206	17 367	17 200	19.0%	-167	-1%	169	1%	T3	CS
Latvia	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 510	745	1 305	1 366	1.5%	60	5%	-144	-10%	T2,T3	CS,PS
Luxembourg	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	9 968	10 345	6 333	6 797	7.5%	465	7%	-3 171	-32%	T2	CS,D
Poland	1 319	3 213	2 650	3 813	4.2%	1 163	44%	2 494	189%	T1	D
Portugal	1 861	2 378	1 029	1 317	1.5%	289	28%	-544	-29%	T2	CR,D,PS
Romania	4 297	2 686	1 202	1 168	1.3%	-34	-3%	-3 129	-73%	T2	CS
Slovakia	2 786	1 897	967	1 208	1.3%	241	25%	-1 578	-57%	T3	PS
Slovenia	43	29	NO	NO	-	-	-	-43	-100%	NA	NA
Spain	10 812	12 243	8 049	8 239	9.1%	190	2%	-2 573	-24%	T1,T2	D,PS
Sweden	1 778	1 891	1 873	C	NA	NA	NA	NA	NA	NA	NA
Untited Kingdom	17 763	19 697	10 918	11 110	12.2%	192	2%	-6 653	-37%	T2	CS
EU-28	**110 466**	**119 689**	**88 027**	**90 703**	**100%**	**2 676**	**3%**	**-19 763**	**-18%**	**-**	**-**
Iceland	NO	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	17 763	19 697	10 918	11 110	12.2%	192	2%	-6 653	-37%	T2	CS
EU-28 + ISL	**110 466**	**119 689**	**88 027**	**90 703**	**100%**	**2 676**	**3%**	**-19 763**	**-18%**	**-**	**-**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Figure 3.22 illustrates that Italy, Germany and the United Kingdom are the countries contributing most in terms of CO_2 emissions in 2015. It also can be seen that the trend for liquid fuels was continuously decreasing since the year 2009 until 2015 emissions increased again.

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

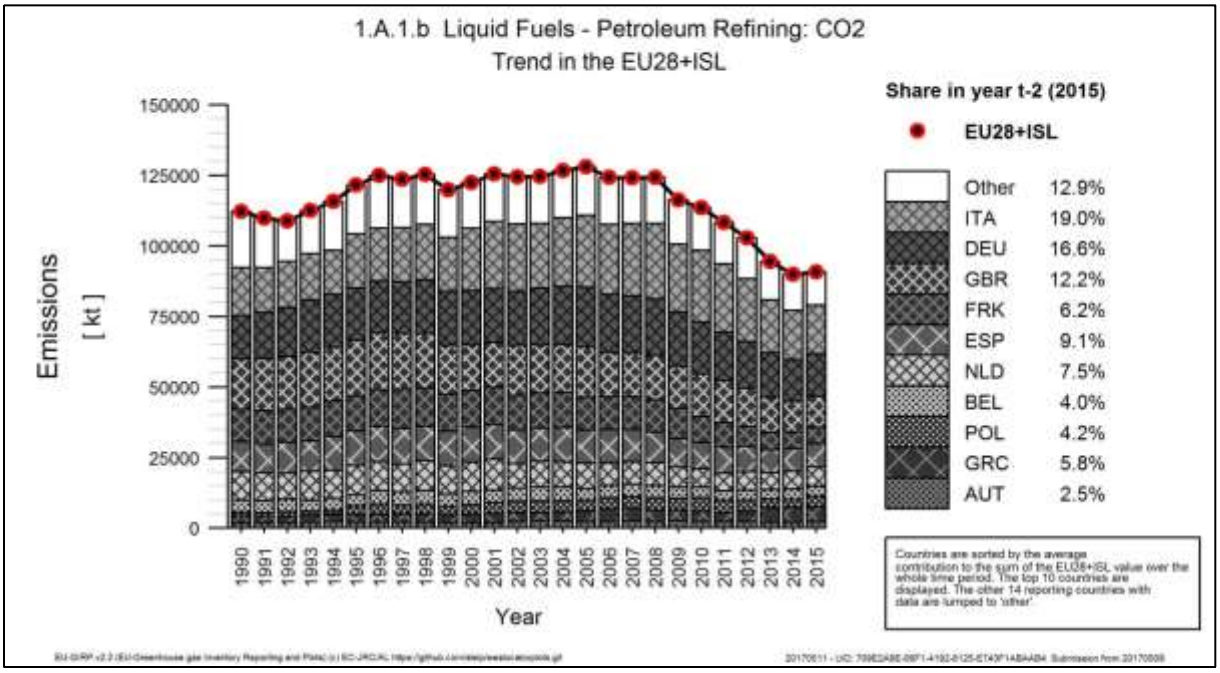
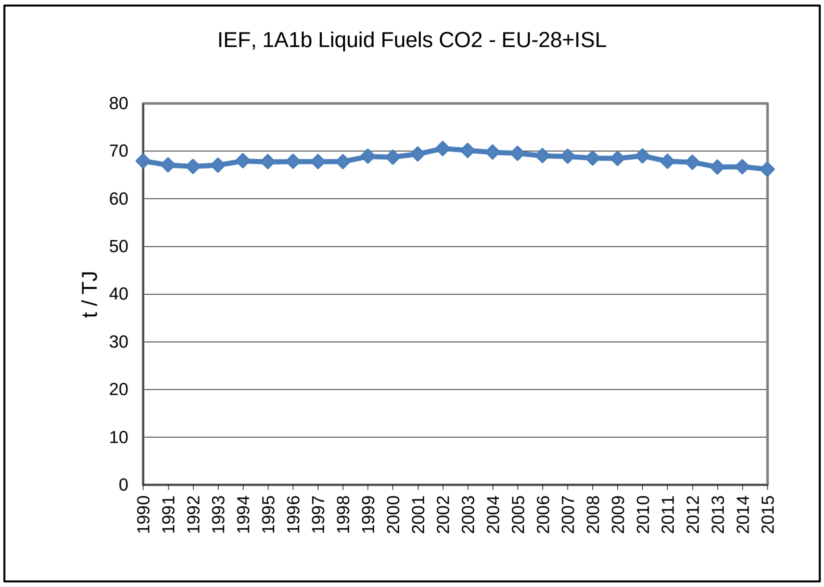
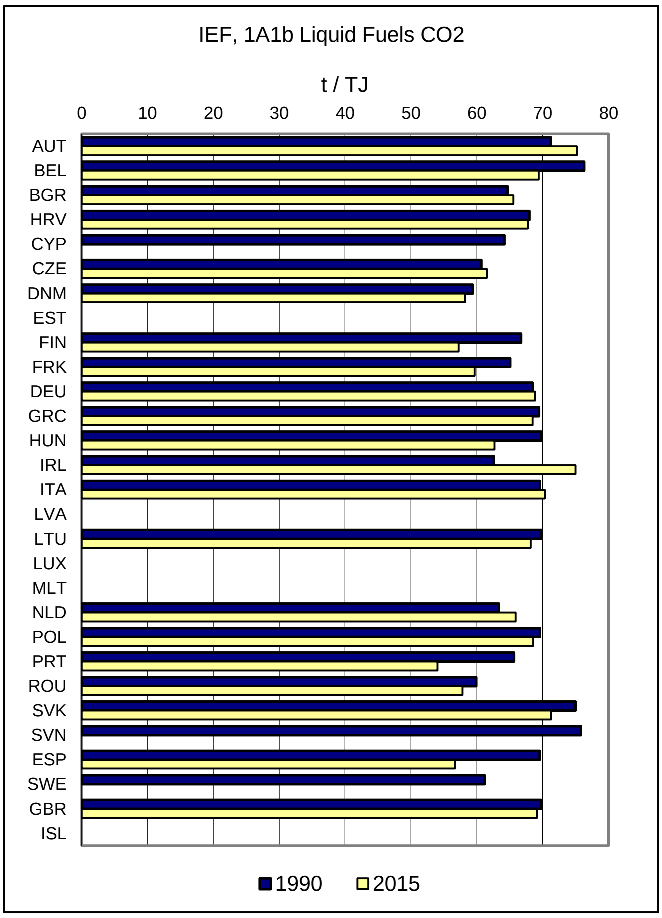


Figure 3.23 shows the emission factors for CO_2 emissions from liquid fuels. The EU-28 + ISL implied emission factor shows small variations around 68 t/TJ over the time series and amounts to 66 t/TJ in 2015. In general the fluctuating IEF is due to the annual variations of fuel consumption with different carbon content. For example in Italy the main fuels used are refinery gases, fuel oil and petroleum coke, which have very different emission factors, and every year their amount which is used changes resulting in an annual variation of the IEF. Ireland reports the highest IEF in 2015 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 3.23 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 0.4% of all greenhouse gas emissions from 1A1b in 2015. Currently it does not represent an EU key category. There are only three countries reporting emissions in the EU-28 + ISL in 2015 (Germany, France and Poland). Only Poland reports increasing emissions between 1990 and 2015. In the EU-28 + ISL emissions fell by 88% on average (Table 3.17).

Table 3.17 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		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	490	288	66.5%	-202.1	-41%	-198	-41%	T2,T3	CS,PS
Germany	3 131	56	57	13.2%	1.0	2%	-3 073	-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	88	20.3%	70.4	402%	84	1920%	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**	**564**	**433**	**100%**	**-131**	**-23%**	**-3 200**	**-88%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**3 633**	**564**	**433**	**100%**	**-131**	**-23%**	**-3 200**	**-88%**	**-**	**-**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Figure 3.24 illustrates the trend of emissions in 1A1b for solid fuels for the past 25 years. The use of solid fuels in petroleum refining has declined markedly since 1990. France contributes 77% to the emissions in this sector, whereas Germany is responsible for the strong declining trend since 1990. In 2015 emissions from Poland grew by 395% compared to 2014. It therefore accounts now for 20% of the total emissions in the EU-28 + ISL for this category.

Figure 3.24 1A1b Petroleum Refining, Solid Fuels: Emission trend and share for CO_2

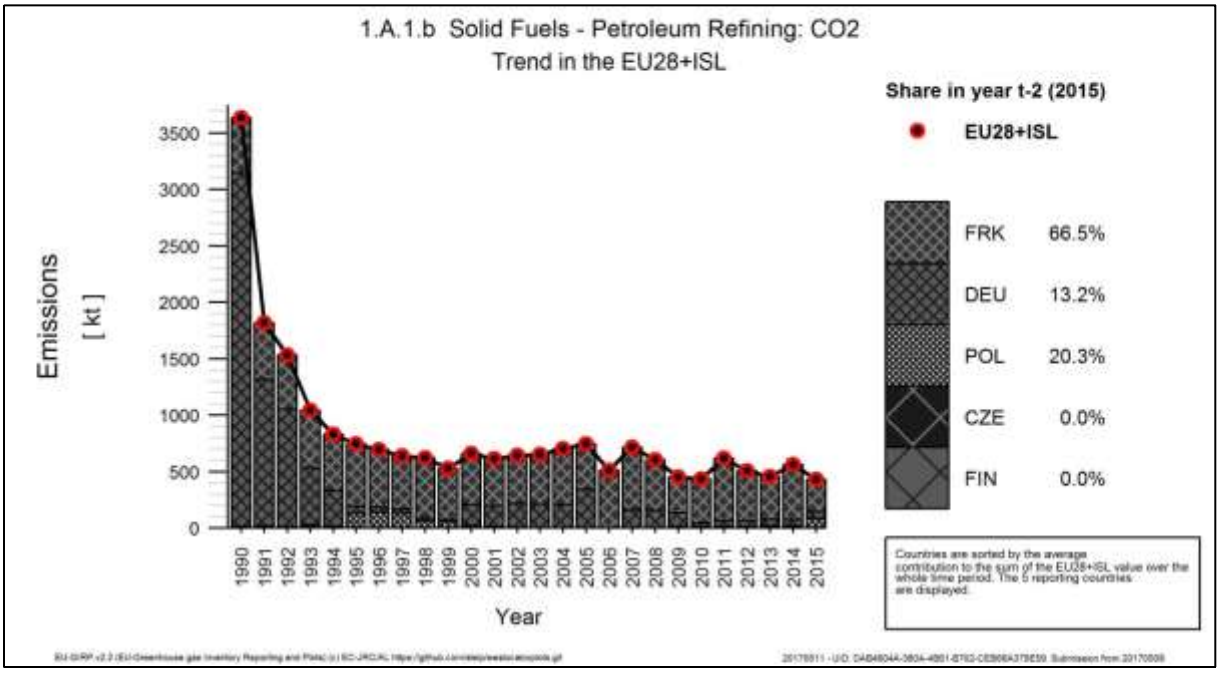
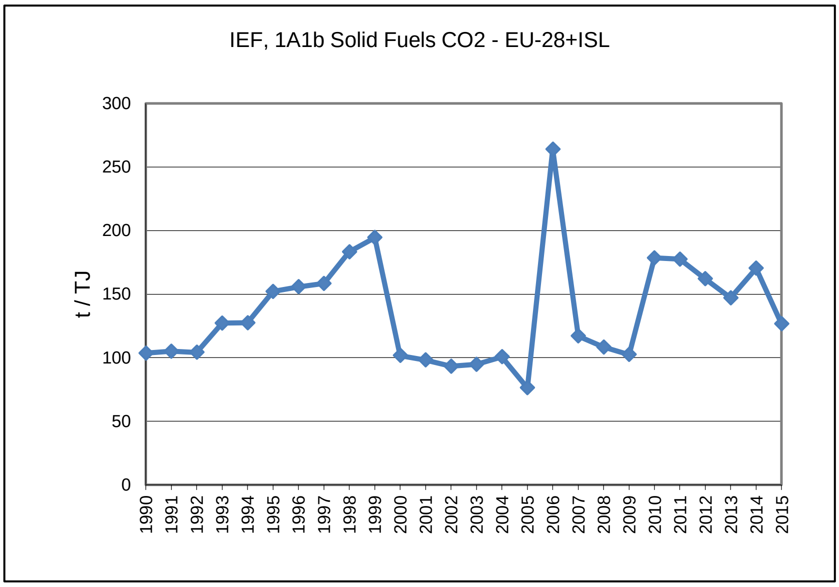
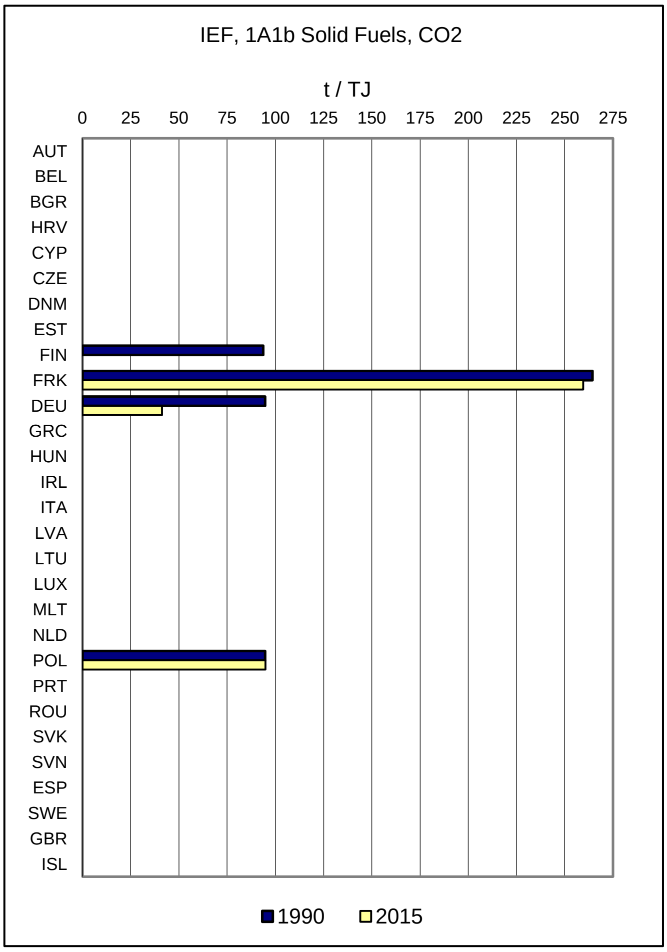


Figure 3.25 (on the next page) shows the relevant implied emission factors. The EU-28 + ISL implied emission factor showed strong fluctuations and amounts to 126.7 t/TJ in 2015. The variation in the EU-28 + ISL factor can be partly explained by the declining use of solid fuels in petroleum refining in 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 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. The drop in the implied emission factor from 2014 to 2015 can be explained by the increased weight of Poland with their lower IEF.

Figure 3.25   1A1b Petroleum Refining, Solid Fuels: Implied Emission Factors for CO_2





1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2015, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 20% of total greenhouse gas emissions from 1A1b. Emissions in the EU-28 + ISL increased by 349% between 1990 and 2015 (Table 3.18), but decreased by 4% from 2014 to 2015. Only four of the EU-28 Member States reduced their emissions: Hungary and Slovenia, Czech Republic and Finland.

Table 3.18 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2	%	kt CO2	%		
Austria	437	421	602	535	2.3%	-67	-11%	98	22%	T2	CS
Belgium	14	165	1 020	1 075	4.5%	54	5%	1 061	7635%	-	PS
Bulgaria	69	214	128	367	1.6%	239	187%	299	435%	T2	CS
Croatia	14	14	441	356	1.5%	-85	-19%	342	2455%	T1	D
Cyprus	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	328	210	213	0.9%	3	1%	-104	-33%	T2	CS
Denmark	NO	NO	6	NO	-	-6	-100%	-	-	NA	NA
Estonia	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	648	602	900	623	2.6%	-277	-31%	-24	-4%	T3	CS
France	36	108	1 499	1 655	7.0%	156	10%	1 619	4473%	T2,T3	CS,PS
Germany	1 444	677	2 899	3 002	12.7%	103	4%	1 558	108%	CS	CS
Greece	NO	NO	IE	IE	-	-	-	-	-	NA	NA
Hungary	693	617	382	382	1.6%	0	0%	-311	-45%	T3	PS
Ireland	NO	NO	17	20	0.1%	2	12%	20	∞	T3	CS,PS
Italy	159	336	3 640	3 749	15.8%	109	3%	3 590	2253%	T3	CS
Latvia	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	1	1	0.0%	0	-16%	1	∞	T2	CS
Luxembourg	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 042	1 223	3 359	2 976	12.6%	-384	-11%	1 934	186%	T2	CS
Poland	94	88	1 969	1 456	6.1%	-513	-26%	1 362	1453%	T1	D
Portugal	NO	NO	1 094	1 048	4.4%	-47	-4%	1 048	∞	T2	CR,D,PS
Romania	NO	647	402	357	1.5%	-45	-11%	357	∞	T2	CS
Slovakia	88	131	249	240	1.0%	-9	-4%	152	174%	T3	PS
Slovenia	127	64	NO	NO	-	-	-	-127	-100%	NA	NA
Spain	46	61	3 380	3 241	13.7%	-139	-4%	3 195	6948%	T1,T2	D,PS
Sweden	NO	NO	275	C	NA	NA	NA	NA	NA	NA	NA
Untited Kingdom	49	450	2 566	2 391	10.1%	-175	-7%	2 342	4738%	T2	CS
EU-28	**5 276**	**6 146**	**24 767**	**23 685**	**100%**	**-1 082**	**-4%**	**18 408**	**349%**	**-**	**-**
Iceland	NO	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	49	450	2 566	2 391	10.1%	-175	-7%	2 342	4738%	T2	CS
EU-28 + ISL	**5 276**	**6 146**	**24 767**	**23 685**	**100%**	**-1 082**	**-4%**	**18 408**	**349%**	**-**	**-**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Figure 3.26 illustrates the trend of increasing emissions from gaseous fuels in category 1.A.1.b in the last 25 years. As can be seen Italy, Spain, Germany, the Netherlands as well as the United Kingdom are the five largest contributors to CO_2 emissions in this sector in 2015. They account together for 65% of the total emissions in this category. The largest absolute decrease in 2015 compared to 2014 was reported by Poland, the Netherlands and Finland (combined -1173 kt CO_2).

Figure 3.26 1A1b Petroleum Refining, Gaseous Fuels: Emission trend and share for CO_2

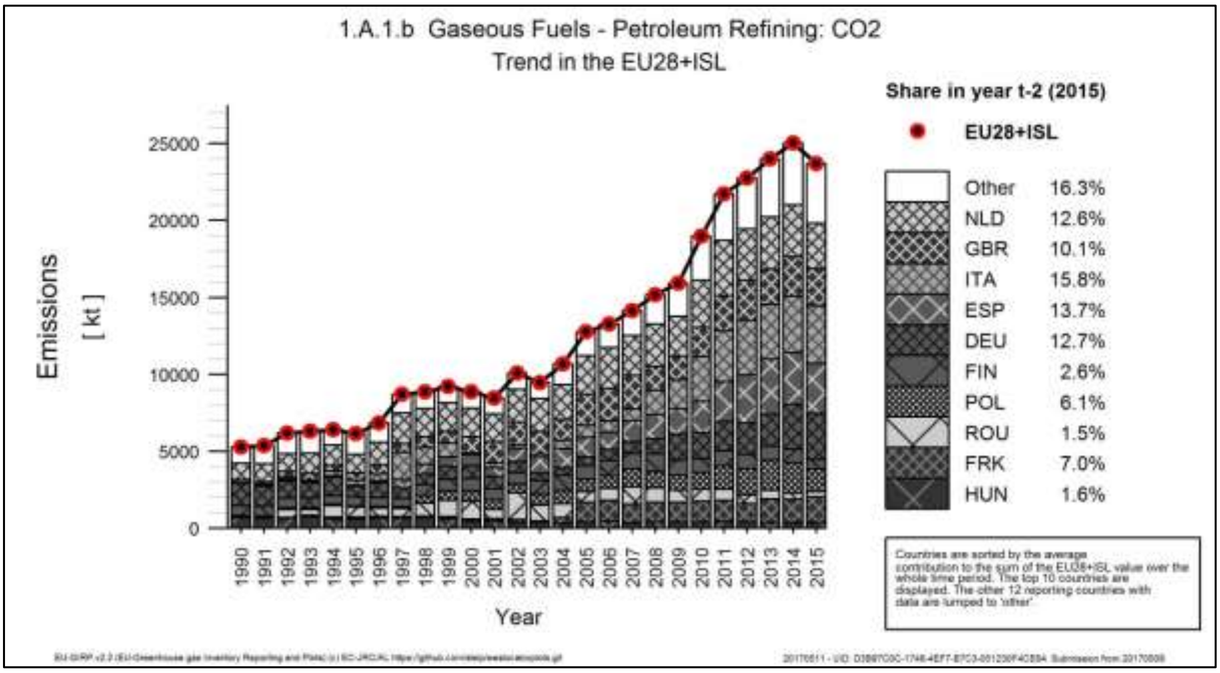
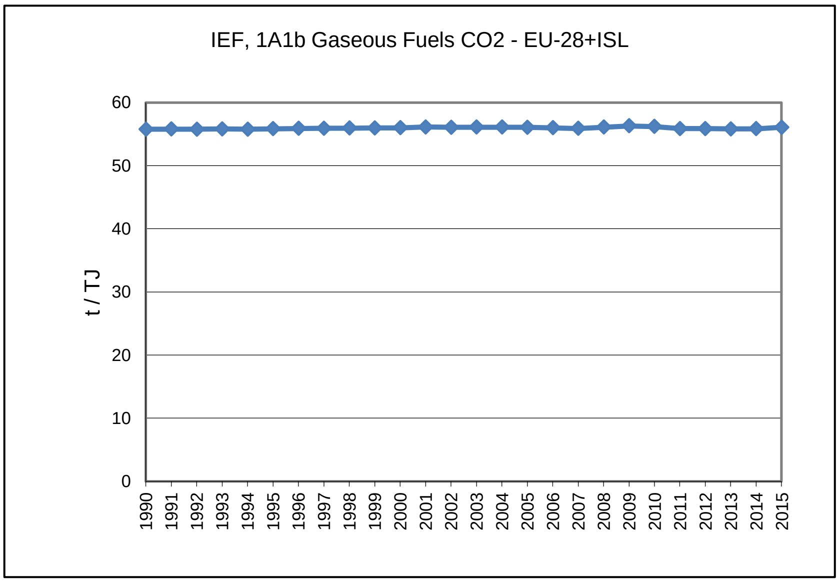
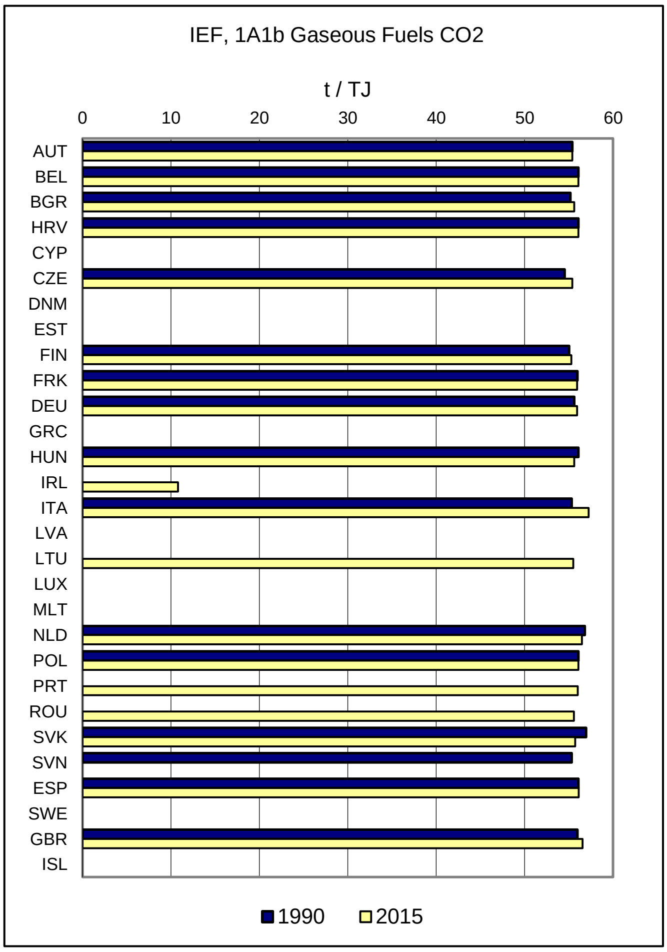


Figure 3.27 shows the implied emission factors for CO_2 emissions from gaseous fuels. The EU-28 + ISL implied emission factor has remained broadly stable and amounts to 56.1 t/TJ in 2015. Ireland reports a comparably low emission factor in 2015 which is due to differences in the data published in the 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.

Figure 3.27 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 2015. Between 1990 and 2015, CO_2 emissions fell by 54% in the EU-28 + ISL (Table 3.19).

Table 3.19 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	510	611	247	416	0.8%	168	68%	-94	-18%
Belgium	2 024	1 115	180	147	0.3%	-33	-18%	-1 876	-93%
Bulgaria	362	304	4	4	0.0%	0	-3%	-358	-99%
Croatia	873	396	178	235	0.4%	57	32%	-638	-73%
Cyprus	NO	NO	NO	NO	-	-	-	-	-
Czech Republic	1 516	3 318	5 802	5 906	11.1%	104	2%	4 389	289%
Denmark	545	746	1 365	1 436	2.7%	70	5%	891	163%
Estonia	86	108	846	1 209	2.3%	362	43%	1 123	1304%
Finland	347	318	304	332	0.6%	28	9%	-15	-4%
France	4 749	4 233	3 269	3 067	5.7%	-202	-6%	-1 683	-35%
Germany	65 289	40 221	10 180	10 158	19.0%	-22	0%	-55 131	-84%
Greece	102	99	33	30	0.1%	-3	-9%	-72	-70%
Hungary	338	330	474	388	0.7%	-86	-18%	50	15%
Ireland	100	69	97	73	0.1%	-24	-25%	-27	-27%
Italy	13 797	12 470	6 846	5 655	10.6%	-1 190	-17%	-8 142	-59%
Latvia	145	149	67	56	0.1%	-10	-15%	-89	-61%
Lithuania	9	16	17	85	0.2%	67	396%	75	806%
Luxembourg	NO	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	NO	-	-	-	-	-
Netherlands	1 818	1 994	2 588	2 536	4.8%	-53	-2%	717	39%
Poland	4 876	9 027	2 876	3 649	6.8%	773	27%	-1 227	-25%
Portugal	112	144	NO	NO	-	-	-	-112	-100%
Romania	146	3 643	1 653	1 079	2.0%	-575	-35%	933	639%
Slovakia	1 319	1 304	1 251	1 290	2.4%	39	3%	-29	-2%
Slovenia	82	21	6	6	0.0%	0	0%	-76	-93%
Spain	2 137	1 510	1 484	550	1.0%	-933	-63%	-1 587	-74%
Sweden	300	341	377	NO	NA	NA	NA	NA	NA
Untited Kingdom	13 827	17 777	14 424	15 074	28.2%	650	5%	1 247	9%
EU-28	**115 112**	**99 922**	**54 193**	**53 380**	**100%**	**-813**	**-2%**	**-61 732**	**-54%**
Iceland	NO	NO	-	-	-	-	-	-	-
United Kingdom (KP)	13 827	17 777	14 424	15 074	28.2%	650	5%	1 247	9%
EU-28 + ISL	**115 112**	**99 922**	**54 193**	**53 380**	**100%**	**-813**	**-2%**	**-61 732**	**-54%**

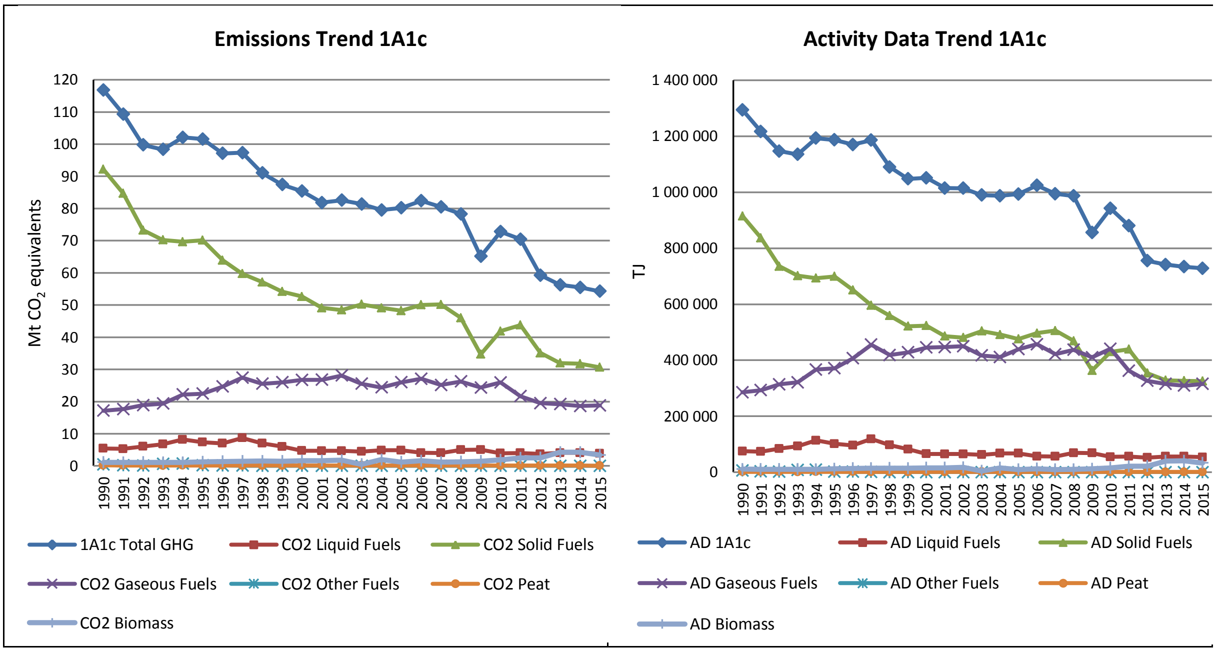
Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: Sweden reported empty cells in 1A1c Solid Fuels, which led to the reporting of NO, which was reported in the other subcategories in 1A1c, instead of C in 1A1c Fuels.EU trends do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU.

Figure 3.28 shows the trends in emissions from this source category by fuel in the EU-28 + ISL between 1990 and 2015. The largest part of greenhouse gas emissions from the manufacture of solid fuels can be accounted for CO_2 emissions from solid (56%) and gaseous (35%) fuels. Emissions from solid fuels fell markedly during the 1990s and then stabilized for a few years. Since 2006 they began to decrease again. The strong drop in 2009 was due to the drop in coke production associated with the iron and steel production triggered by the economic downturn.

Fuel used for manufacturing solid fuels fell by 44% in the EU-28 + ISL between 1990 and 2015. The strongest decline was reported for solid fuels (-64%), followed by liquid fuels (-29%). On the other hand gaseous fuels and biomass increased in the period 1990 to 2015. In the year 2015 solid fuels and gaseous fuels represented 45% and 43% respectively, of all fuel used.

Figure 3.28 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 – Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels used for the manufacture of solid fuels accounted for 56% of total greenhouse gas emissions from 1A1c in 2015. Emissions in the EU-28 + ISL declined by 67% since 1990. This was mainly driven by a strong decline in emissions in Germany (-51 719 kt CO_2).

Table 3.20 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 2015	Change 2014-2015		Change 1990-2015	
	1990	1995	2014	2015		kt CO2	%	kt CO2	%
Austria	IE	IE	IE	IE	-	-	-	-	-
Belgium	1 969	1 026	180	147	0.5%	-33	-18%	-1 822	-93%
Bulgaria	274	238	3	3	0.0%	0	4%	-272	-99%
Croatia	NO	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	NO	-	-	-	-	-
Czech Republic	1 352	3 237	5 742	5 848	19.1%	106	2%	4 496	333%
Denmark	NO	NO	NO	NO	-	-	-	-	-
Estonia	86	108	846	1 209	3.9%	362	43%	1 123	1304%
Finland	347	318	304	332	1.1%	28	9%	-15	-4%
France	4 065	3 653	3 269	3 067	10.0%	-202	-6%	-998	-25%
Germany	61 101	37 081	9 433	9 381	30.6%	-51	-1%	-51 719	-85%
Greece	NO	NO	NO	NO	-	-	-	-	-
Hungary	164	185	253	203	0.7%	-50	-20%	40	24%
Ireland	NO	NO	NO	NO	-	-	-	-	-
Italy	12 240	10 954	5 981	4 967	16.2%	-1 014	-17%	-7 272	-59%
Latvia	NO	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	NO	-	-	-	-	-
Netherlands	633	676	604	743	2.4%	139	23%	111	18%
Poland	4 030	7 854	2 053	2 157	7.0%	104	5%	-1 873	-46%
Portugal	62	73	NO	NO	-	-	-	-62	-100%
Romania	NO	298	1	1	0.0%	0	-2%	1	∞
Slovakia	1 319	1 304	1 210	1 237	4.0%	27	2%	-82	-6%
Slovenia	37	18	NO	NO	-	-	-	-37	-100%
Spain	1 864	1 133	266	275	0.9%	9	3%	-1 589	-85%
Sweden	300	341	377	-	NA	NA	NA	NA	NA
Untited Kingdom	2 344	1 637	1 233	1 078	3.5%	-155	-13%	-1 267	-54%
EU-28	**91 887**	**69 791**	**31 377**	**30 648**	**100%**	**-729**	**-2%**	**-61 239**	**-67%**
Iceland	NO	NO	-	-	-	-	-	-	-
United Kingdom (KP)	2 344	1 637	1 233	1 078	3.5%	-155	-13%	-1 267	-54%
EU-28 + ISL	**91 887**	**69 791**	**31 377**	**30 648**	**100%**	**-729**	**-2%**	**-61 239**	**-67%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

Note: Sweden reported empty cells in 1A1c Solid Fuels instead of C, which was reported for its subcategories. EU trends do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU.

Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

Solid fuels have fallen steadily to less than half of the 1990-level. The decline in emissions (see Figure 3.29) 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 three largest emitters in 2015 were Germany, the Czech Republic and Italy, jointly responsible for 66% of all EU-28 + ISL emissions in this category.

Figure 3.29 1A1c Manufacture of Solid Fuels and Other Energy Industries, Solid Fuels: Emission trend and share for CO_2

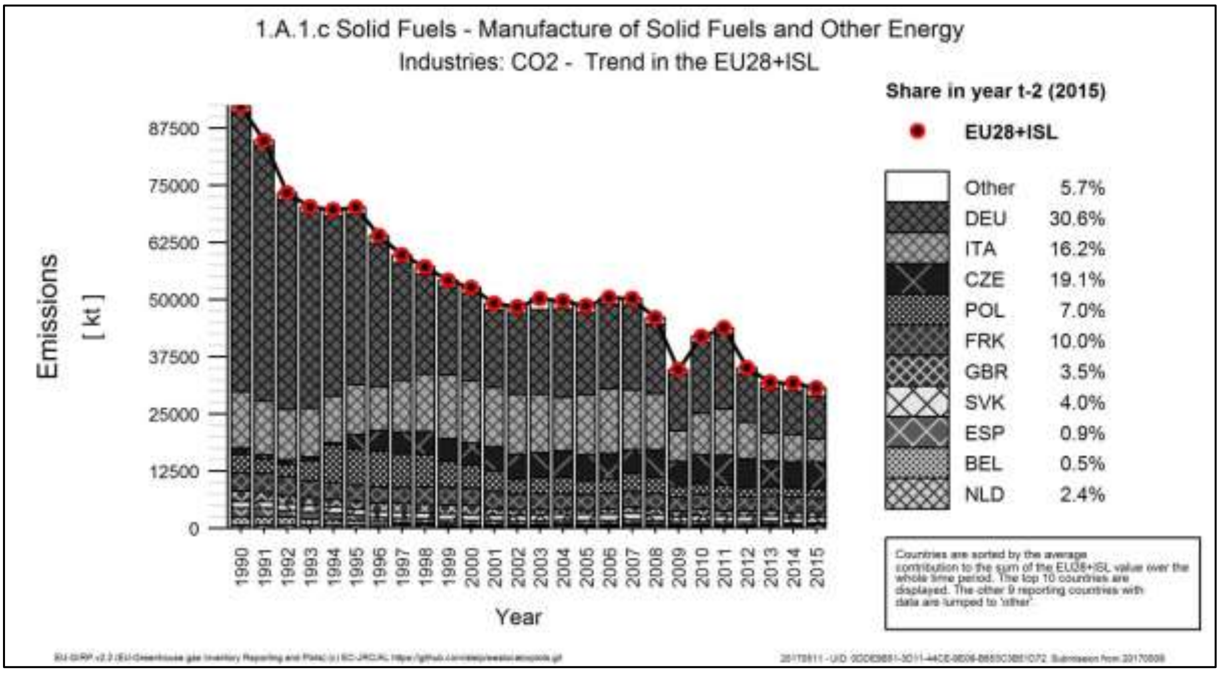
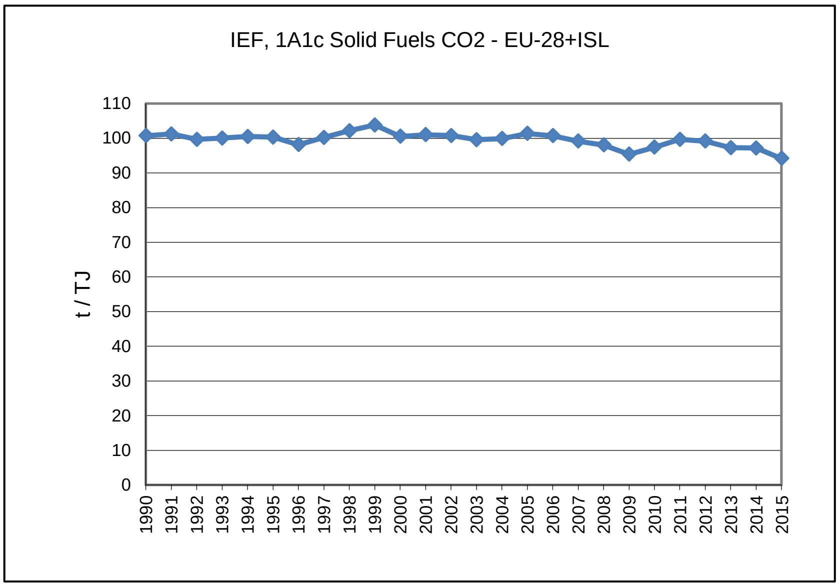
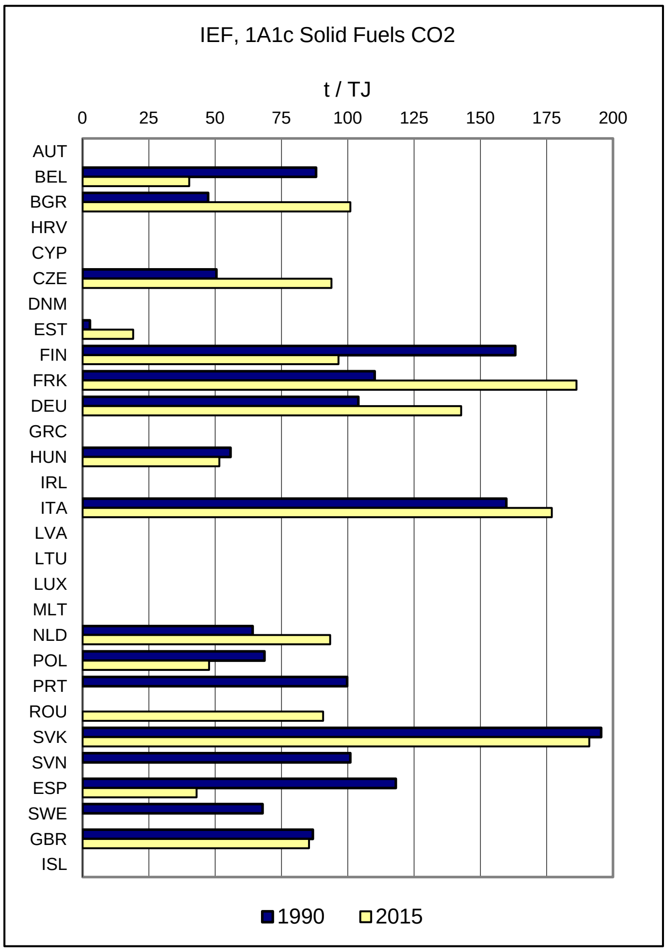


Figure 3.30 (on the next page) shows the relevant implied emission factors for solid fuels. The EU-28 + ISL implied emission factor was relatively stable and amounted 94.16 t/TJ in 2015. Its variation can be explained by the mix of different fuels and the shifts of their energy consumptions between years. The high implied emission factor for solid fuels in Slovakia and France can be explained with the use of blast furnace gas. Alike, 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.

Figure 3.30 1A1c Manufacture of Solid Fuels and Other Energy Industries, Solid Fuels: Implied Emission Factors for CO_2





Note: Figure 3.31 does not include Sweden's IEF for the year 2015 for confidentiality reasons and to preserve time series consistency for the EU.

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

CO_2 emissions from the combustion of gaseous fuels used in category 1A1c accounted for 35% of total greenhouse gas emissions from this category in 2015. Emissions in the EU-28 + ISL increased by 10% (Table 3.21) between the years 1990 and 2015. However, in the last few years there has been a significant reduction. The United Kingdom is the largest emitter in this category and is responsible for 60% of emissions in the EU-28 + ISL. The top three Member States (United Kingdom, the Netherlands and Denmark) together account for 77% of emissions in this category.

Table 3.21 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	506	247	416	2.2%	168.3	68%	-90	-18%
Belgium	51	NO	NO	-	-	-	-51	-100%
Bulgaria	NO	1	1	0.0%	-0.2	-17%	1	∞
Croatia	833	178	235	1.3%	57.5	32%	-598	-72%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	9	8	0.0%	-1.8	-19%	8	∞
Denmark	545	1 365	1 436	7.6%	70.5	5%	891	163%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	531	NO	NO	-	-	-	-531	-100%
Germany	2 622	473	508	2.7%	34.5	7%	-2 115	-81%
Greece	102	33	30	0.2%	-3.1	-9%	-72	-70%
Hungary	134	188	145	0.8%	-42.5	-23%	11	8%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	615	865	688	3.7%	-176.5	-20%	73	12%
Latvia	45	45	37	0.2%	-8.0	-18%	-8	-17%
Lithuania	NO	2	71	0.4%	69.0	3124%	71	∞
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	1 184	1 984	1 792	9.5%	-191.9	-10%	608	51%
Poland	694	717	1 351	7.2%	634.0	88%	657	95%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	851	511	2.7%	-340.3	-40%	511	∞
Slovakia	NO	41	53	0.3%	12.1	30%	53	∞
Slovenia	42	6	6	0.0%	0.0	0%	-36	-86%
Spain	83	1 177	237	1.3%	-939.9	-80%	154	185%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	9 172	10 454	11 271	60.0%	816.7	8%	2 099	23%
EU-28	**17 159**	**18 638**	**18 797**	**100%**	**158**	**1%**	**1 638**	**10%**
Iceland	NO	-	-	-	-	-	-	-
United Kingdom (KP)	9 172	10 454	11 271	60.0%	816.7	8%	2 099	23%
EU-28 + ISL	**17 159**	**18 638**	**18 797**	**100%**	**158**	**1%**	**1 638**	**10%**

Abbreviations are explained in the Chapter 'Units and abbreviations'.
Note: The reasons for missing information on methodologies and emission factors are explained in chapter 10 table 10.7.

Figure 3.32 illustrates the emission trend for gaseous fuels split by Member States over the last 25 years. Although the emissions in the year 2015 compared to 1990 increased moderately by 10% over the whole time series, there was a strong increase in the 1990s and a decline after 2009. The increase in EU-28 + ISL emissions between 1990 and 2002 and the decline until 2014 was heavily driven by the trend in the United Kingdom. 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). The overall decline in the recent years was additionally intensified by Italy and Spain. In general, oil and natural gas production was declining since 2000; therefore also natural gas used in oil and natural gas production was declining. The year 2015 by contrast saw a moderate rise by 1% in emissions in this category.

Figure 3.32 1A1c Manufacture of Solid Fuels and Other Energy Industries, Gaseous Fuels: Emission trend and share for CO_2

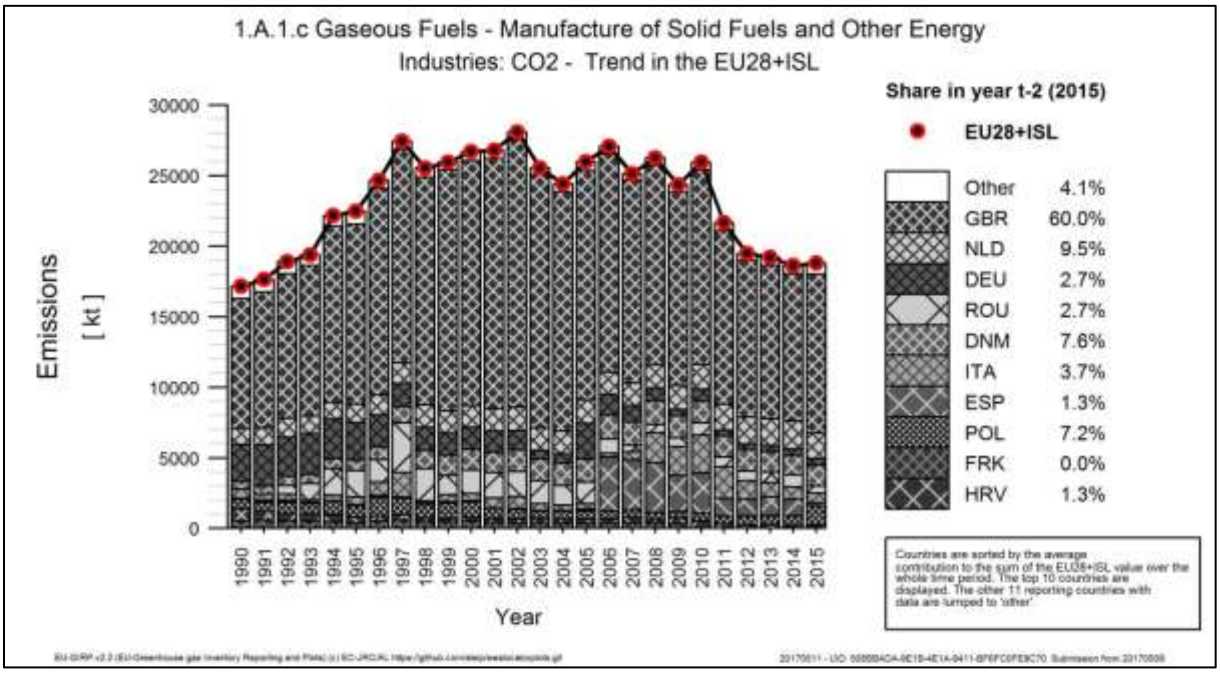
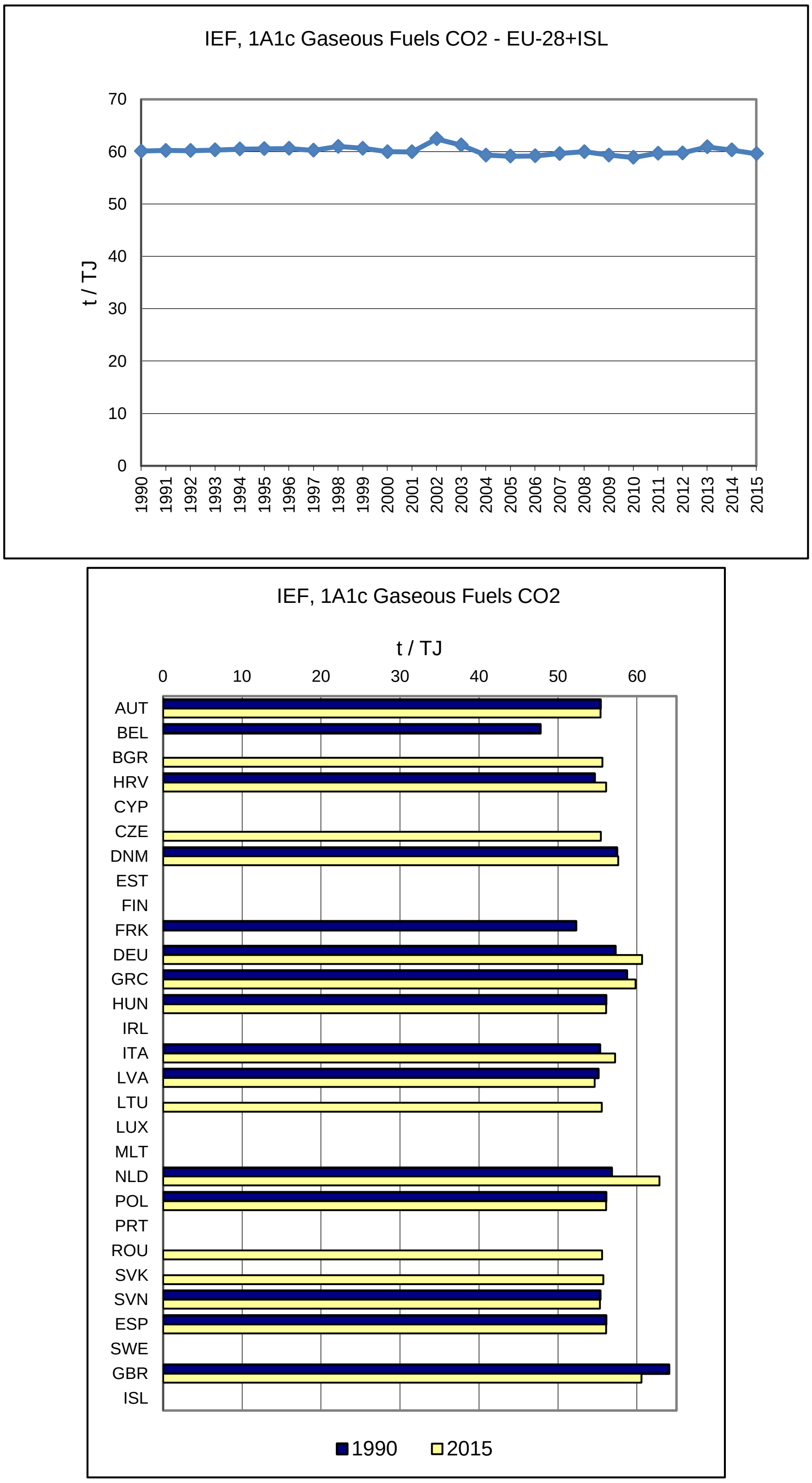


Figure 3.33 (on the next page) shows the implied emission factors for gaseous fuels. The EU-28 + ISL implied emission factor amounts 59.6 t/TJ in 2015 and remained fairly stable over the last 25 years. It is dominated by the IEF of the United Kingdom, which is comparatively high. The explanation for its decrease is as follows: In the United Kingdom 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 in the United Kingdom 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. The comparatively high IEF of the Netherlands in 2015 can be explained, by the interannual variability mainly due to differences in gas composition and the variable losses in the compressor stations of the gas transmission network.

Figure 3.33 1A1c Manufacture of Solid Fuels and Other Energy Industries, Gaseous 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.

Table 3.22: Key categories for sector 1A2 (Table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	31015	18176	T	L	L
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	8738	979	T	L	0
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	134462	81454	T	L	L
1 A 2 b Non-Ferrous Metals: Gaseous Fuels (CO_2)	3945	6468	T	0	L
1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)	7984	1292	T	0	0
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	56171	35773	T	L	L
1 A 2 c Chemicals: Liquid Fuels (CO_2)	39449	19364	T	L	L
1 A 2 c Chemicals: Solid Fuels (CO_2)	14462	8301	0	L	L
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	13274	18461	T	L	L
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	11657	2080	T	L	0
1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)	8224	2829	T	0	0
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	19411	29308	T	L	L
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	20546	4245	T	L	0
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	12240	4453	T	L	0
1 A 2 f Non-metallic minerals: Gaseous Fuels (CO_2)	27472	27770	T	L	L
1 A 2 f Non-metallic minerals: Liquid Fuels (CO_2)	45349	25514	T	L	L

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 2 f Non-metallic minerals: Other Fuels (CO_2)	1250	11059	T	0	L
1 A 2 f Non-metallic minerals: Solid Fuels (CO_2)	58151	17558	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Gaseous Fuels (CO_2)	95159	86206	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Liquid Fuels (CO_2)	114495	48529	T	L	L
1 A 2 g Other Manufacturing Industries and Constructions: Other Fuels (CO_2)	2527	7723	T	0	L
1 A 2 g Other Manufacturing Industries and Constructions: Solid Fuels (CO_2)	93619	12948	T	L	L

In 2015 category 1A2 contributed to 483.602 kt CO_2 equivalents of which 98.7% CO_2, 0.9% N_2O and 0.4% CH_4.

Figure 3.34 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 included elsewhere (Notation key ‘IE’) and reports the specific emissions and activity data under 1A2g. For the years 2013 and 2015 Sweden makes excessive use of confidential reporting (Notation key ‘C’), which implies that sub-categories include emissions without providing detailed fuel specific emissions (1A2a,1A2c, 1A2f and 1A2g) or even that sub categories are reported as confidential while fuel specific emissions are reported as values or as confidential (1A2b, 1A2d and 1A2e).

Figure 3.34 1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends

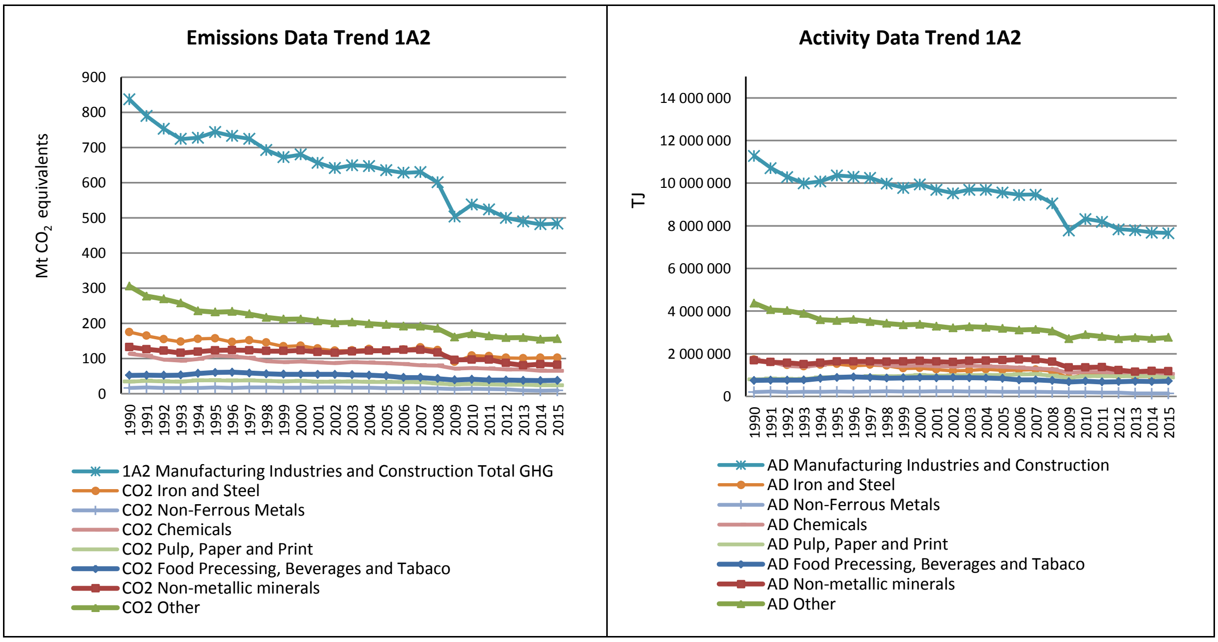


Table 3.1 summarizes information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.23 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)
Austria	9 889	10 467	9 807	10 314
Belgium	23 242	13 638	23 084	13 386
Bulgaria	17 768	2 862	17 670	2 823
Croatia	5 529	2 232	5 502	2 223
Cyprus	515	548	512	546
Czech Republic	51 234	9 922	50 930	9 828
Denmark	5 460	3 887	5 394	3 830
Estonia	2 507	498	2 498	490
Finland	13 663	8 449	13 478	8 287
France	82 110	50 505	81 384	50 035
Germany	186 700	127 061	185 107	125 976
Greece	9 404	5 250	9 338	5 166
Hungary	13 623	4 326	13 587	4 299
Ireland	3 962	4 549	3 943	4 525
Italy	86 041	52 585	84 535	51 515
Latvia	3 928	675	3 914	638
Lithuania	6 165	1 187	6 108	1 172
Luxembourg	6 265	1 116	6 250	1 105
Malta	46	43	46	42
Netherlands	32 124	24 130	32 016	24 022
Poland	43 135	28 112	42 852	27 827
Portugal	9 739	7 871	9 606	7 729
Romania	51 225	12 456	51 118	12 394
Slovakia	15 890	6 755	15 827	6 698
Slovenia	3 150	1 591	3 119	1 570
Spain	45 114	41 173	44 749	40 106
Sweden	11 450	7 644	11 190	7 435
United Kingdom	96 509	53 870	95 310	53 034
EU-28	**836 387**	**483 402**	**828 874**	**477 018**
Iceland	244	68	243	68
United Kingdom (KP)	96 618	54 002	95 419	53 165
EU-28 + ISL	**836 740**	**483 602**	**829 225**	**477 216**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Note: The difference between EU-28 and EU-28 + ISL is not only Iceland but also the different geographical coverage of the UK included in the EU submission (GBE) The EU-28 numbers are the numbers submitted under the UNFCCC and include the EU territory for the UK. The EU-28 + ISL numbers are the numbers submitted under the Kyoto Protocol and include the Kyoto Protocol territory of the UK (GBR).

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the fourth largest sector in the EU-28+ISL accounting for 11.2% of total GHG emissions in 2015. Between

1990 and 2015, CO_2 emissions from manufacturing industries declined by 42%. The emissions from this key source are caused by fossil fuel consumption in manufacturing industries and construction, which was 39% below 1990 levels in 2015. A shift from solid and liquid fuels to mainly natural gas took place and an increase of biomass by 93% and an increase of other fossil fuels by 229% has been recorded.

Between 1990 and 2015, Germany, the Czech Republic, France, Italy, Romania and the United Kingdom show by far the largest emission reductions in absolute terms. Only Austria, Cyprus and Ireland 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 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.

Table 3.24 provides information on Member States recalculations in CO_2 from 1A2 Manufacturing Industries for 1990 and 2014 and main explanations for the largest recalculations in absolute terms. The largest recalculations in 2014 were due to France, the United Kingdom, Romania and Germany. The reason for year 2014 revisions are mostly changes in activity data/revised energy balances.

Table 3.24: 1A2 Manufacturing Industries and Construction: Recalculations in CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	-6	-0.1	-160	-1.5	Revised energy balance. 60kt CO_2 moved to 2.C.1
Belgium	0	0.0	381	2.9	Switch from 1996 to 2006 Guidelines. Revision of preliminary energy balance. Correction of gasoline consumption in offroad sector.
Bulgaria	-158	-0.9	-195	-7.1	Coke oven coke allocation to non-energy use. Removal of double counting with Ind. Processes. Implementation of ESD recommendation for 1.A.2.c and non energy use.
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	-9	-1.3	Implementation of ESD recommendation 1A2g - biomass.
Czech Republic	0	0.0	-339	-3.4	updated activity data available and emission factors, explanation provided in NIR
Denmark	-55	-1.0	-276	-6.6	Revision of energy statistics. Revised CO_2 emission factor for residual fuel oil (following a ESD review recommendation). Revised gasoil and diesel consumption for offroad machinery due to a revised transport model.
Estonia	18	0.7	3	0.4	Oxidation factors have been updated and the carbon conversion factor for CO_2 emission factors has been specified.
Finland	6	0.0	55	0.7	Corrections of preliminary data

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
France	-3 871	-4.5	-8 422	-14.2	Plusieurs modifications et corrections ont été introduites dans la nouvelle édition de l'inventaire pour le secteur 1A2 pouvant affecter l'année 2014 : - liquid fuels : Mise à jour du bilan de l'énergie et correction d'un biais de calcul introduit temporairement dans le bilan de l'énergie de l'édition 2015 pour palier au transfert des consommations des vapocraqueurs en usages non énergétique dans les statistiques alors qu'ils étaient toujours pris en compte dans les usages énergétiques de l'édition 2015 de l'inventaire. - solid fuels : Mise à jour du bilan de l'énergie et transfert de consommations non énergétiques vers CRF 2C (Production de silicium et ferro-silicium) pour toute la série. - Gaseous fuels : Mise à jour du bilan de l'énergie ; transfert de consommations de gaz naturel vers le non énergétique pour la production de HCN sur toute la série ; corrections mineures des quantités de gaz naturel non énergétique pour les productions d'ammoniac et d'hydrogène. - Other fuels : Transfert des émissions de combustion du fuel gaz des vapocraqueurs du 1A2c vers le 2B10 (mise en cohérence de la méthodologie appliquée avec les lignes directrices du GIEC) ; corrections à la baisse sur les consommations d'autres fuels provenant des données du SEQE (principalement secteurs chimie et autres industries) car ces consommations étaient surestimées (erreur dans les PCI considérés). - Biomasse : Transfert de consommations énergétiques vers du non énergétiques (CRF 2C pour la production de silicium et ferrosilicium) pour toute la série. - FE CO_2 : Mise à jour de quelques facteurs d'émission du CO_2.
Germany	19	0.0	1 634	1.4	Revision of preliminary energy balance. Error correction of waste model. Change of CO_2-EF for diesel. Change of NCVs for solid fuels. Revised offroad machinery diesel consumption.
Greece	0	0.0	0	0.0	
Hungary	3	0.0	-143	-3.4	Use of latest energy statistics; all gasoil is allocated to 1A2gvii with revised NCV; T2 method from the EMEP/EEA guidebook is applied to 1A2gvii; revised allocations of natural gas use between 1A3c and the IPPU sector
Ireland	0	0.0	-5	-0.1	Revised fuel consumption in the national energy balance.
Italy	0	0.0	24	0.0	Revision of CO_2 emission factors based on ETS data.
Latvia	30	0.8	3	0.4	Corrected amount of peat use in 1A2c; Updated and precised information about natural gas properties and calculated new emission factor accordingly.
Lithuania	369	6.4	194	17.7	Revision of CO_2 emission factors for natural gas, wood/wood waste and and other solid biomass based on study "Update of country specific GHG emission factors for Energy sector" (performed in 2016 by Lithuanian Energy Institute); correction of activity data on natural gas (for period 2005-2014) based on the newest information provided by the Lithuanian Statistics in November 2016 (the Lithuanian Statistics provided the revised data on natural gas consumption in chemical industries due to revision of activity data performed by JSC Achema).
Luxembourg	-38	-0.6	58	5.4	revised AD for natural gas (energy balance)
Malta	23	103.3	7	22.6	No NIR provided
Netherlands	-313	-1.0	85	0.4	Revision in fuel data from transport affected all combustion emissions for Diesel (allocation issue)
Poland	0	0.0	-510	-1.7	coal used in blast furnaces process (included in 2C1 subcategory) was deducted from 1A2a subsector emission to avoid double counting
Portugal	-28	-0.3	-119	-1.6	Review of the time series of activity data and emission factors for the two main installations in the Chemical sector.
Romania	-23 359	-31.4	-1 426	-10.4	Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A2 categories.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A2 categories. In 1A2a category a double accounting was corrected. It was concluded that quantities of solid fuels reported in the IPPU sector were reported as fuels, too. Further to discussions with the National Institute for Statistics and taking into account the the EU-ETS reports in this category, the corresponding quantities of sub-bituminous coal, coke-oven_coke and anthracite were subtracted from the energy sector, iron &steel category, on the entire time -series.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	2	0.1	Correction of EF for waste solvents
Spain	601	1.4	-535	-1.3	Update of emission factors and oxidation factors. Update of activity data based on new information.
Sweden	46	0.4	-206	-2.7	Activity data for stationary combustion in the construction sector and enterprises with less than 10 employees in all industrial branches have been revised for 2005-2013 following revisions of the annual energy balances. The modelled estimate of used gasoline and diesel in working machinery has been adjusted with regard to volume of low blended biofuels
United Kingdom	-826	-0.9	-896	-1.6	Numerous revisions to UK energy statistics, with decreases in emission estimates for coal and natural gas and increases in those for LPG as a result. Revisions to UK energy statistics for gas oil, plus revisions to the estimated split of gas oil use between 1A2 off-road vehicles & mobile machinery and other sectors, leading to decreased emissions from gas oil. Re-allocation of emissions from use of waste lubricants as fuel from 2D1 to 1A2. The net result of these many changes is a decrease in emissions.
EU28	-27 576	-3.2	-10 775	-2.2	
Iceland	41	20.2	9	33.9	No information provided
EU28+ISL	-27 498	-3.2	-10 784	-2.2	

3.2.2.1 Iron and Steel (1A2a)

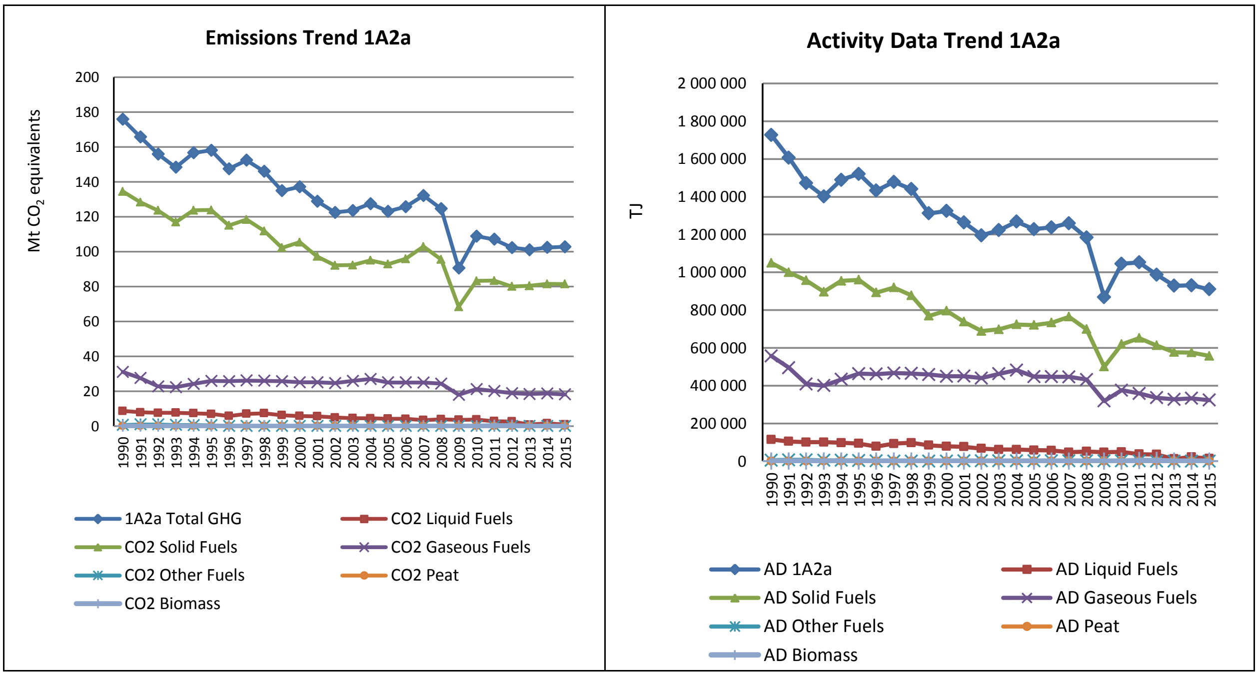
This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. GHG emissions from 1A2a Iron and Steel accounted for 21% of 1A2 source category and 2.9% of total GHG emissions in 2015.

Figure 3.35 shows the emission trend within the category 1A2a, which is dominated by CO_2 emissions from solid fuels. Between 1990 to 2015 total emissions decreased by 42%, 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 2014 and 2015 emissions increased by 0.4% and crude steel production decreased by -1.9%. Between 1990 and 2015, CO_2 emissions from solid fuels decreased by 37%, CO_2 emissions from liquid fuels by 89% and CO_2 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 12% (Austria) to 87% (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 166 million tonnes in 2015 (www.worldsteel.org statistics) as well as blast furnace production (BFI), which decreased from about 126 million tonnes to 93 million tonnes in 2015 (www.worldsteel.org statistics).

Figure 3.35 1A2a Iron and Steel: CO_2 emissions and activity data trends



Between 1990 and 2015, CO_2 emissions from 1A2a Iron and Steel decreased by 42% (Table 3.25), mainly due to decreases in the Czech Republic, France, Poland, Italy, the United Kingdom and Romania. Between 2014 and 2015 emissions increased by 0.4% with the highest increase reported by Germany

Table 3.25 1A2a Iron and Steel: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	2 060	1 649	1 449	1.4%	-200	-12%	-611	-30%
Belgium	5 662	1 096	1 149	1.1%	54	5%	-4 512	-80%
Bulgaria	2 705	117	116	0.1%	-2	-1%	-2 589	-96%
Croatia	NO,IE	56	52	0.1%	-4	-8%	52	∞
Cyprus	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Czech Republic	14 861	1 974	1 928	1.9%	-46	-2%	-12 933	-87%
Denmark	125	87	89	0.1%	2	2%	-36	-29%
Estonia	3	NO	NO	-	-	-	-3	-100%
Finland	2 499	2 309	2 319	2.3%	10	0%	-179	-7%
France	22 374	13 286	12 815	12.5%	-471	-4%	-9 559	-43%
Germany	35 269	33 615	38 576	37.7%	4 961	15%	3 307	9%
Greece	447	148	65	0.1%	-83	-56%	-382	-85%
Hungary	2 341	180	174	0.2%	-6	-3%	-2 166	-93%
Ireland	175	2	2	0.0%	0	0%	-173	-99%
Italy	17 225	11 058	9 209	9.0%	-1 849	-17%	-8 016	-47%
Latvia	391	1	22	0.0%	21	3028%	-369	-94%
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	5 404	275	278	0.3%	3	1%	-5 126	-95%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	3 376	3 597	3 720	3.6%	122	3%	344	10%
Poland	16 230	5 676	5 169	5.1%	-508	-9%	-11 061	-68%
Portugal	1 208	125	134	0.1%	9	7%	-1 074	-89%
Romania	7 813	1 436	1 423	1.4%	-13	-1%	-6 390	-82%
Slovakia	2 682	3 189	2 867	2.8%	-322	-10%	185	7%
Slovenia	421	196	193	0.2%	-4	-2%	-229	-54%
Spain	8 332	5 593	5 680	5.6%	87	2%	-2 652	-32%
Sweden	1 705	1 267	1 585	1.6%	318	25%	-120	-7%
United Kingdom	21 562	14 936	13 220	12.9%	-1 715	-11%	-8 341	-39%
EU-28	**174 869**	**101 869**	**102 234**	**100%**	**365**	**0%**	**-72 635**	**-42%**
Iceland	0	1	1	0.0%	0	0%	1	158%
United Kingdom (KP)	21 562	14 936	13 220	12.9%	-1 715	-11%	-8 341	-39%
EU-28 + ISL	**174 869**	**101 870**	**102 235**	**100%**	**365**	**0%**	**-72 634**	**-42%**

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 2015 CO_2 from liquid fuels had a share of 1% within this category compared to 5% in 1990. Between 1990 and 2015 emissions decreased by 88% (Table 3.26). Significant absolute decreases have been achieved in Belgium, France, Germany, Poland and Spain.

Table 3.26 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	75	7	7	0.7%	0	1%	-69	-91%	T2	CS
Belgium	885	28	32	3.2%	3	12%	-853	-96%	T1,T3	D,PS
Bulgaria	37	NO	NO	-	-	-	-37	-100%	NA	NA
Croatia	IE	13	9	0.9%	-5	-36%	9	∞	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	427	NO	NO	-	-	-	-427	-100%	NA	NA
Denmark	14	1	1	0.1%	0	19%	-13	-94%	T1,T2	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	305	279	292	29.8%	13	5%	-13	-4%	T3	CS
France	1 297	70	66	6.7%	-4	-6%	-1 231	-95%	T2,T3	CS,PS
Germany	916	16	18	1.8%	2	10%	-898	-98%	CS	CS
Greece	447	85	43	4.4%	-42	-49%	-404	-90%	T2	PS
Hungary	392	NO	NO	-	-	-	-392	-100%	NA	NA
Ireland	16	NO	NO	-	-	-	-16	-100%	NA	NA
Italy	156	200	240	24.5%	41	20%	85	54%	T2	CS
Latvia	94	NO	NO	-	-	-	-94	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	48	1	1	0.1%	1	55%	-47	-97%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	19	13	12	1.2%	-1	-9%	-7	-38%	T2	CS,D
Poland	864	16	16	1.6%	0	0%	-849	-98%	T1	D
Portugal	163	0	0	0.0%	0	-48%	-163	-100%	T2	CR,D,PS
Romania	NO	12	18	1.8%	6	47%	18	∞	T2	CS
Slovakia	164	1	1	0.1%	0	4%	-163	-99%	T2	CS
Slovenia	54	4	4	0.4%	0	-1%	-50	-92%	T1	D
Spain	1 069	103	117	12.0%	14	13%	-952	-89%	T1	CS,PS
Sweden	831	656	C	NA	NA	NA	NA	NA	T2,T3	CS,PS
Untited Kingdom	462	64	103	10.5%	38	60%	-359	-78%	T2	CS
EU-28	**7 906**	**913**	**978**	**100%**	**65**	**7%**	**-6 928**	**-88%**	**-**	**-**
Iceland	0	1	1	0.1%	0	0%	1	158%	T1	D
United Kingdom (KP)	462	64	103	10.5%	38	60%	-359	-78%	T2	CS
EU-28 + ISL	**7 907**	**914**	**979**	**100%**	**65**	**7%**	**-6 928**	**-88%**	**-**	**-**

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.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.36 and Figure 3.7 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 88% between 1990 and 2015. The CO_2 implied emission factor for liquid fuels was 72.4 t/TJ in 2015. The comparatively high 2015 implied emission factor of Belgium is due to incorrect activity data reported by the Flemish region.

Figure 3.36 1A2a Iron and Steel, Liquid fuels: Emission trend and share for CO_2

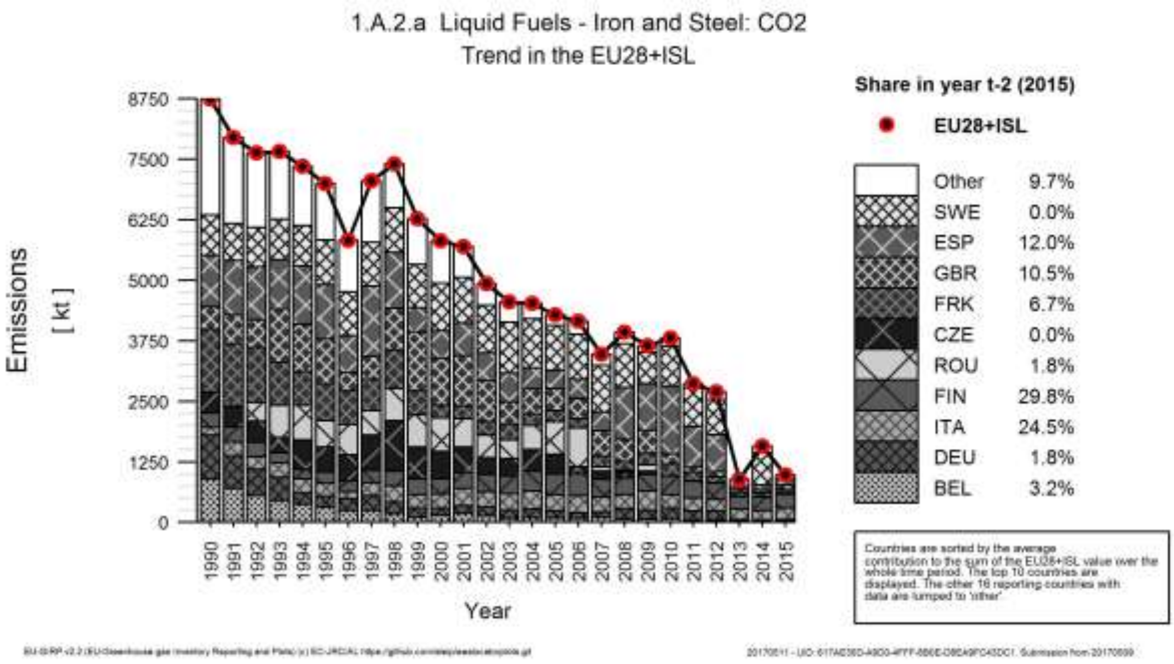
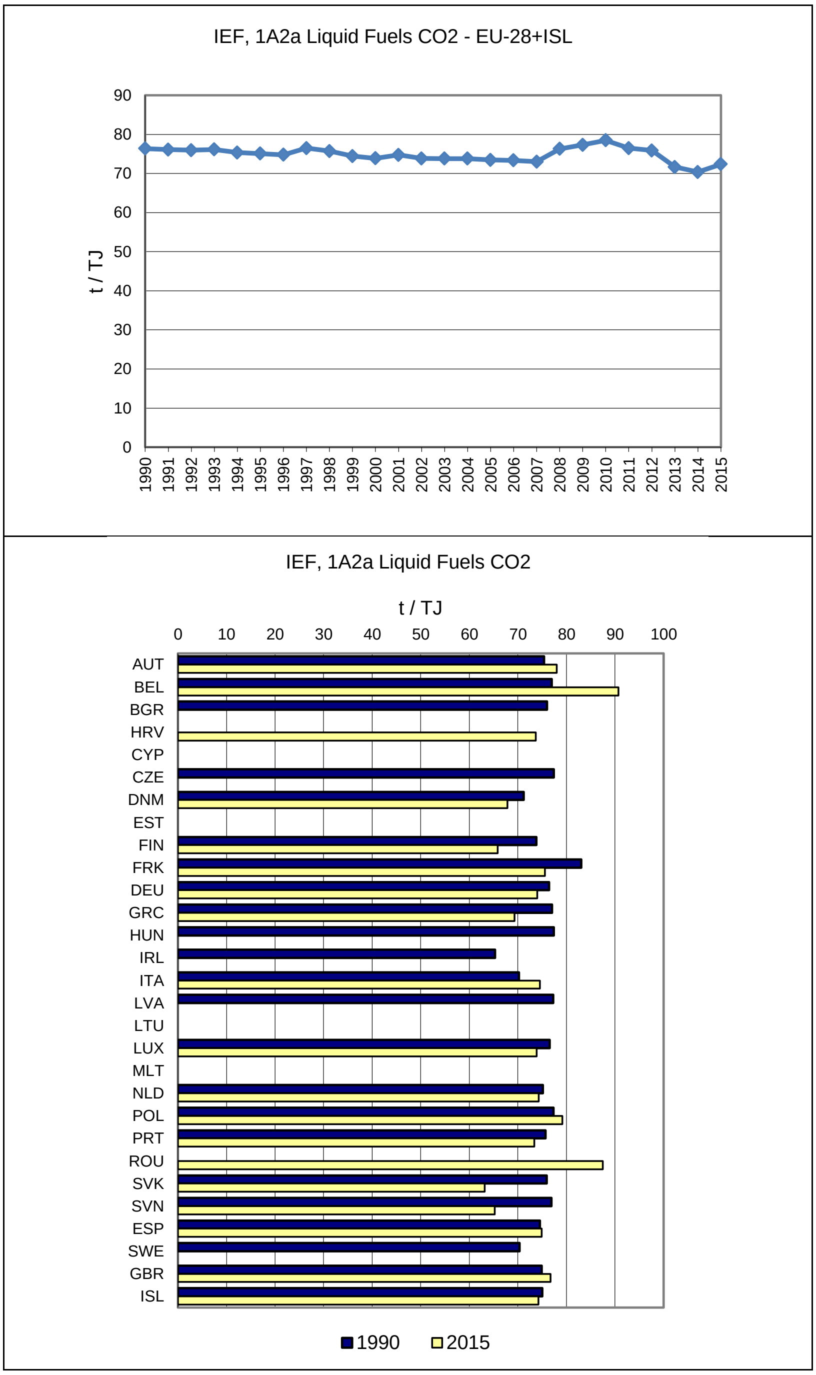


Figure 3.37 1A2a Iron and Steel, Liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2a Iron and Steel - Solid Fuels (CO_2)

In 2015, CO_2 from solid fuels had a share of 79% within this category and a share of 76% in 1990. Between 1990 and 2015 the emissions decreased by 39% (Table 3.27). Between 1990 and 2015 the Czech Republic, Belgium, Poland, Spain, France, Italy, Luxembourg and the United Kingdom showed major decreases. Between 2014 to 2015 Germany shows a significant increase while Italy and the United Kingdom show significant decreases. The increase of Germany in 2015 is due to allocation of two power plants from the public sector (1A1a) to the industry sector (1A2a). Sweden reports 2013 and 2015 emissions as confidential.

Table 3.27 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	1 335	293	330	0.4%	36	12%	-1 006	-75%	T2	CS
Belgium	3 284	52	17	0.0%	-35	-68%	-3 267	-99%	T3	PS
Bulgaria	1 631	NO	NO	-	-	-	-1 631	-100%	NA	NA
Croatia	IE	12	9	0.0%	-3	-26%	9	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	13 709	1 463	1 430	1.8%	-33	-2%	-12 279	-90%	T2	CS,D
Denmark	5	NO	NO	-	-	-	-5	-100%	NA	NA
Estonia	3	NO	NO	-	-	-	-3	-100%	NA	NA
Finland	2 084	1 909	1 906	2.3%	-3	0%	-178	-9%	T3	CS,PS
France	18 998	11 476	10 978	13.5%	-498	-4%	-8 020	-42%	T2,T3	CS,PS
Germany	29 912	30 337	35 233	43.3%	4 896	16%	5 321	18%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	625	85	95	0.1%	10	12%	-530	-85%	T1,T2	CS,D
Ireland	115	NO	NO	-	-	-	-115	-100%	NA	NA
Italy	12 793	7 001	5 542	6.8%	-1 459	-21%	-7 251	-57%	T2	CS
Latvia	NO	NO	NO	-	-	-	-	-	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	2 945	3 079	3.8%	134	5%	389	14%	T2	CS
Poland	11 817	4 758	4 217	5.2%	-541	-11%	-7 601	-64%	T1,T2	CS,D
Portugal	1 041	29	37	0.0%	8	28%	-1 004	-96%	T2	CR,D,PS
Romania	1 149	92	66	0.1%	-25	-27%	-1 082	-94%	T1,T2	CS,D
Slovakia	2 296	3 031	2 775	3.4%	-256	-8%	479	21%	T2	CS
Slovenia	57	29	25	0.0%	-5	-16%	-32	-57%	T1	D
Spain	6 473	3 785	3 720	4.6%	-64	-2%	-2 752	-43%	T1	CS,PS
Sweden	849	526	C	NA	NA	NA	NA	NA	T2,T3	CS,PS
Untited Kingdom	18 637	13 732	11 996	14.7%	-1 736	-13%	-6 641	-36%	T2	CS
EU-28	**133 613**	**81 029**	**81 454**	**100%**	**425**	**1%**	**-52 158**	**-39%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	18 637	13 732	11 996	14.7%	-1 736	-13%	-6 641	-36%	T2	CS
EU-28 + ISL	**133 613**	**81 029**	**81 454**	**100%**	**425**	**1%**	**-52 158**	**-39%**	**-**	**-**

Malta includes emissions under 1.A.2.g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 and Figure 3.9 show 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 2015 the largest emitters are France, Germany, and the UK; together they cause 72% of the CO_2 emissions from solid fuels in 1A2a. Solid fuel consumption decreased by 47% between 1990 and 2015. 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 146.2 t/TJ in 2015.

Figure 3.38 1A2a Iron and Steel, solid fuels: Emission trend and share for CO_2

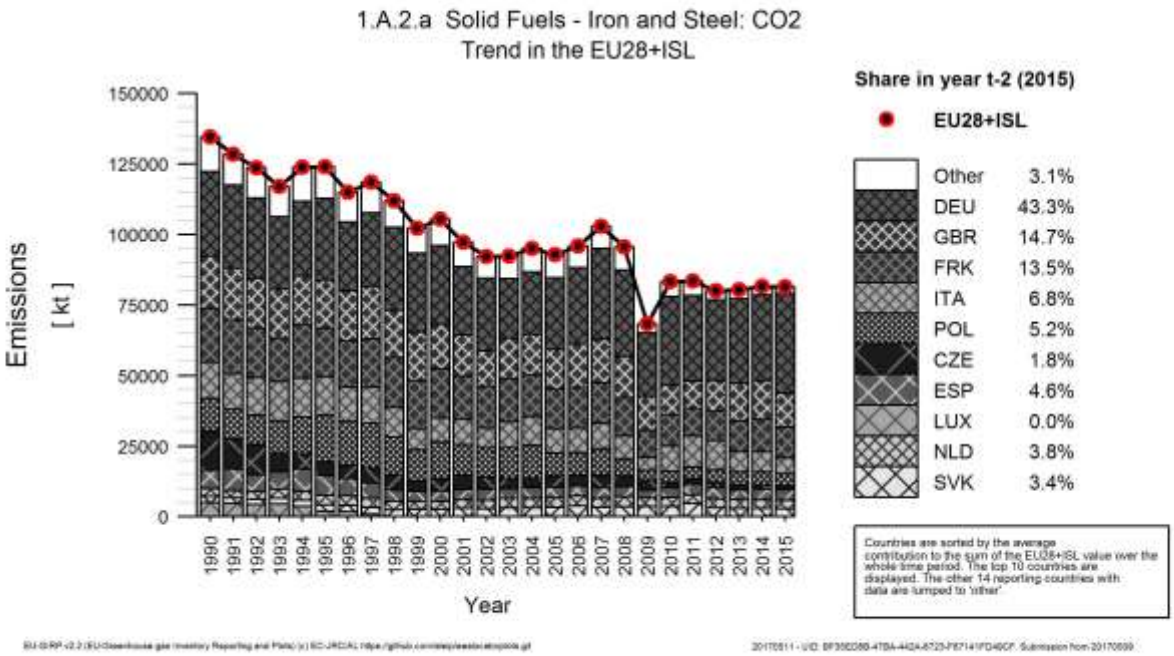
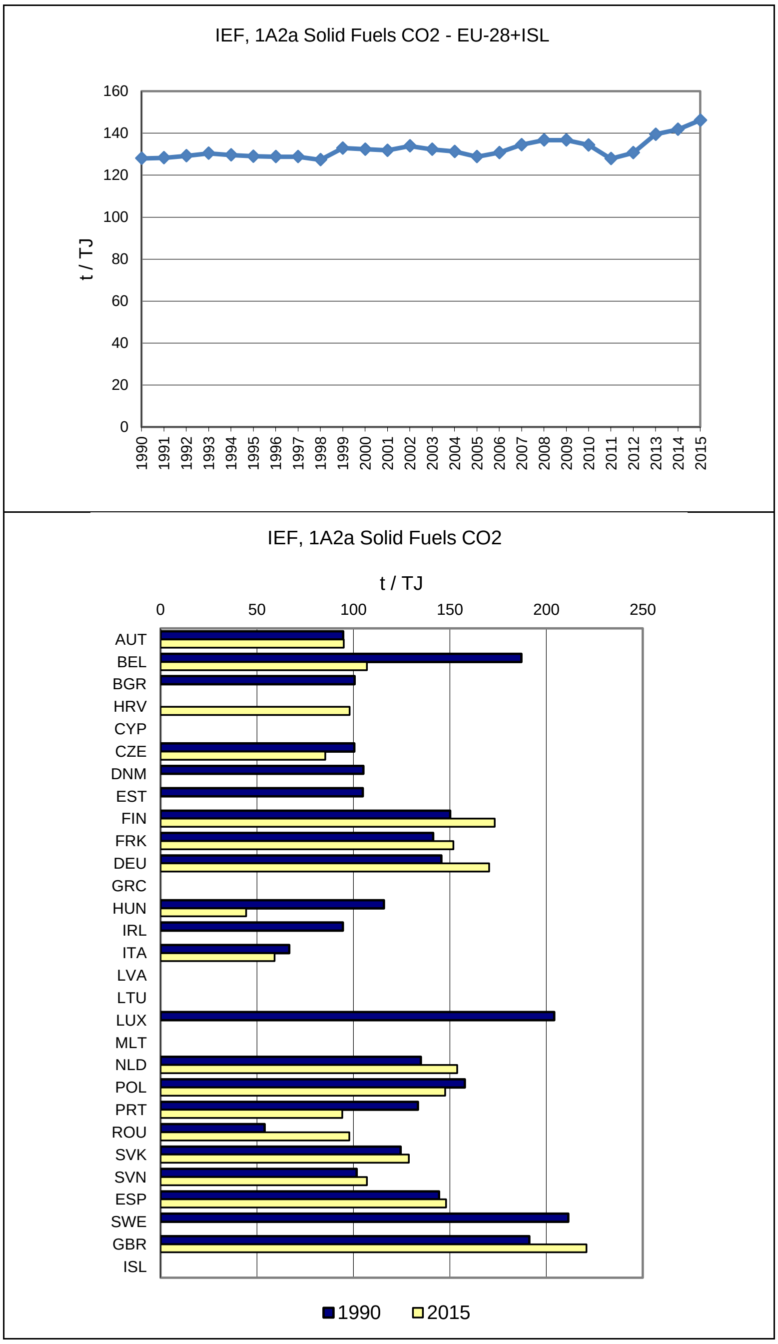


Figure 3.39 1A2a Iron and Steel, Solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2015 CO_2 from gaseous fuels had a share of 18% within source category 1A2a. Between 1990 and 2015 the emissions decreased by 41% (Table 3.28). Sweden reports 2013 and 2015 emissions as confidential.

Table 3.28 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	650	1 349	1 113	6.1%	-236	-18%	463	71%	T2	CS
Belgium	1 493	1 011	1 096	6.0%	85	8%	-397	-27%	T1,T3	D,PS
Bulgaria	1 037	117	116	0.6%	-2	-1%	-921	-89%	T2	CS
Croatia	IE	30	34	0.2%	4	12%	34	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	724	511	498	2.7%	-13	-3%	-226	-31%	T2	CS
Denmark	106	86	88	0.5%	2	2%	-18	-17%	T3	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	110	121	122	0.7%	1	1%	12	11%	T3	CS
France	2 071	1 704	1 739	9.6%	35	2%	-332	-16%	T2,T3	CS,PS
Germany	4 442	3 262	3 326	18.3%	63	2%	-1 116	-25%	CS	CS
Greece	NO	63	22	0.1%	-41	-65%	22	∞	T2	CS
Hungary	1 324	95	79	0.4%	-16	-17%	-1 245	-94%	T1	D
Ireland	44	2	2	0.0%	0	0%	-41	-95%	T2	CS
Italy	4 276	3 857	3 426	18.9%	-431	-11%	-850	-20%	T2	CS
Latvia	236	1	22	0.1%	21	3028%	-213	-91%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	397	274	277	1.5%	3	1%	-120	-30%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	667	639	629	3.5%	-10	-2%	-38	-6%	T2	CS
Poland	2 965	903	937	5.2%	34	4%	-2 028	-68%	T1	D
Portugal	NO	96	96	0.5%	1	1%	96	∞	T2	CR,D,PS
Romania	6 665	1 328	1 335	7.3%	7	1%	-5 329	-80%	T2	CS
Slovakia	221	156	91	0.5%	-66	-42%	-130	-59%	T2	CS
Slovenia	310	163	164	0.9%	1	1%	-146	-47%	T2	CS
Spain	790	1 705	1 843	10.1%	138	8%	1 053	133%	T1	CS,PS
Sweden	25	84	C	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	2 463	1 139	1 122	6.2%	-18	-2%	-1 341	-54%	T2	CS
EU-28	**30 989**	**18 615**	**18 176**	**100%**	**-439**	**-2%**	**-12 814**	**-41%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	2 463	1 139	1 122	6.2%	-18	-2%	-1 341	-54%	T2	CS
EU-28 + ISL	**30 989**	**18 615**	**18 176**	**100%**	**-439**	**-2%**	**-12 814**	**-41%**	**-**	**-**

Malta includes emissions under 1A2g

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.40 and Figure 3.41 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 57% to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-28 decreased by 42% between 1990 and 2015. The CO_2-implied emission factor for gaseous fuels was 56.2 t/TJ in 2015.

Figure 3.40 1A2a Iron and Steel, Gaseous fuels: Emission trend and share for CO_2

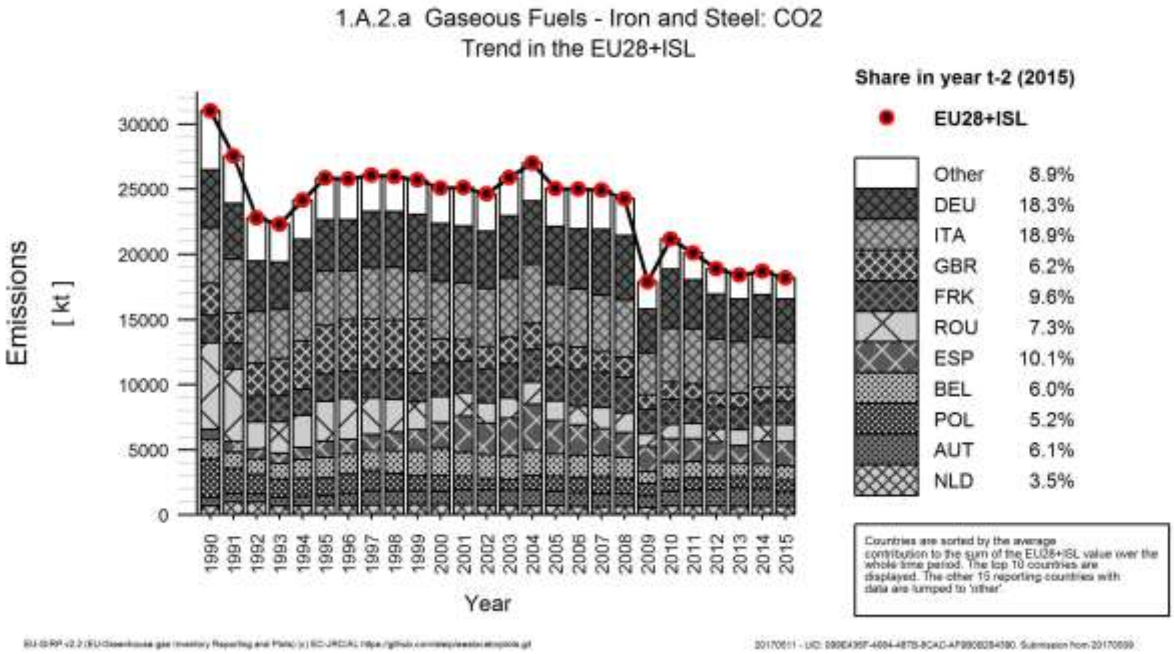
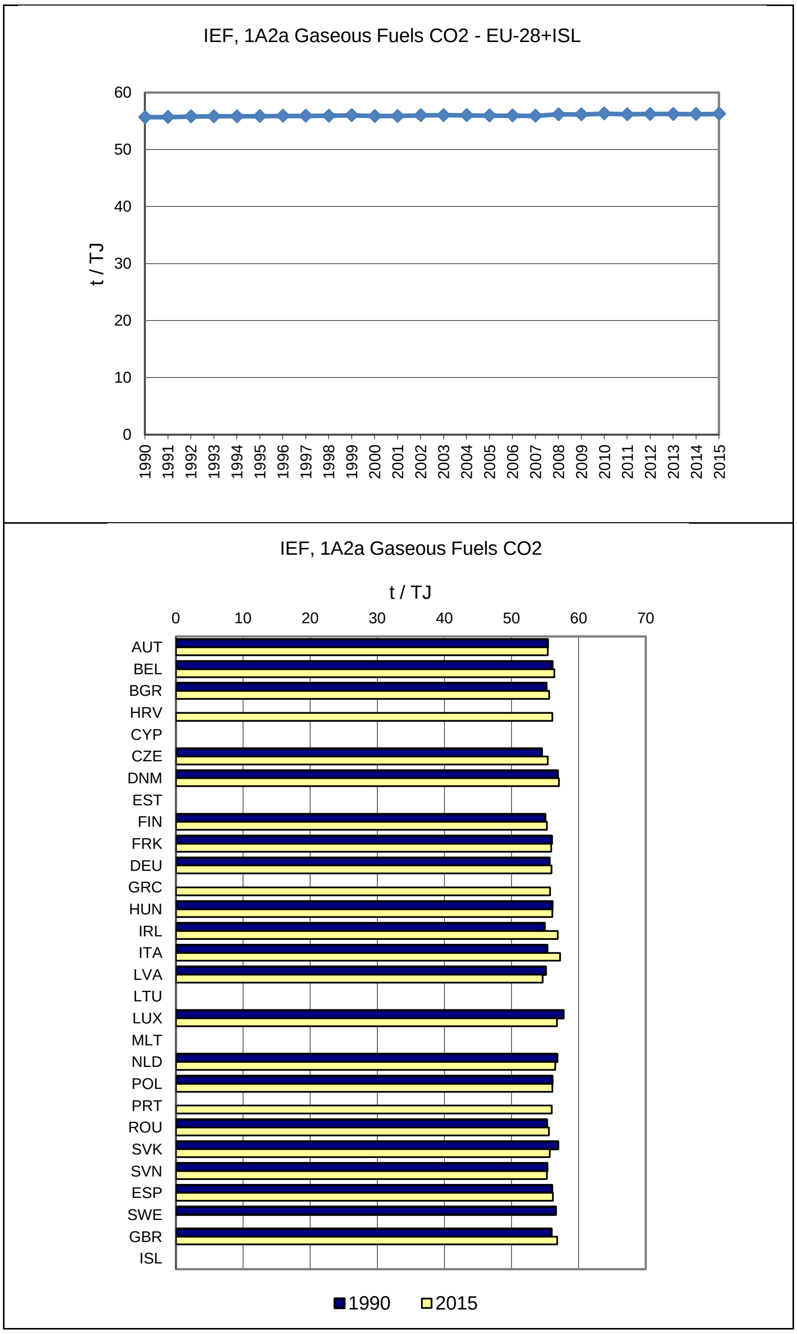


Figure 3.41 1A2a Iron and Steel, Gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)

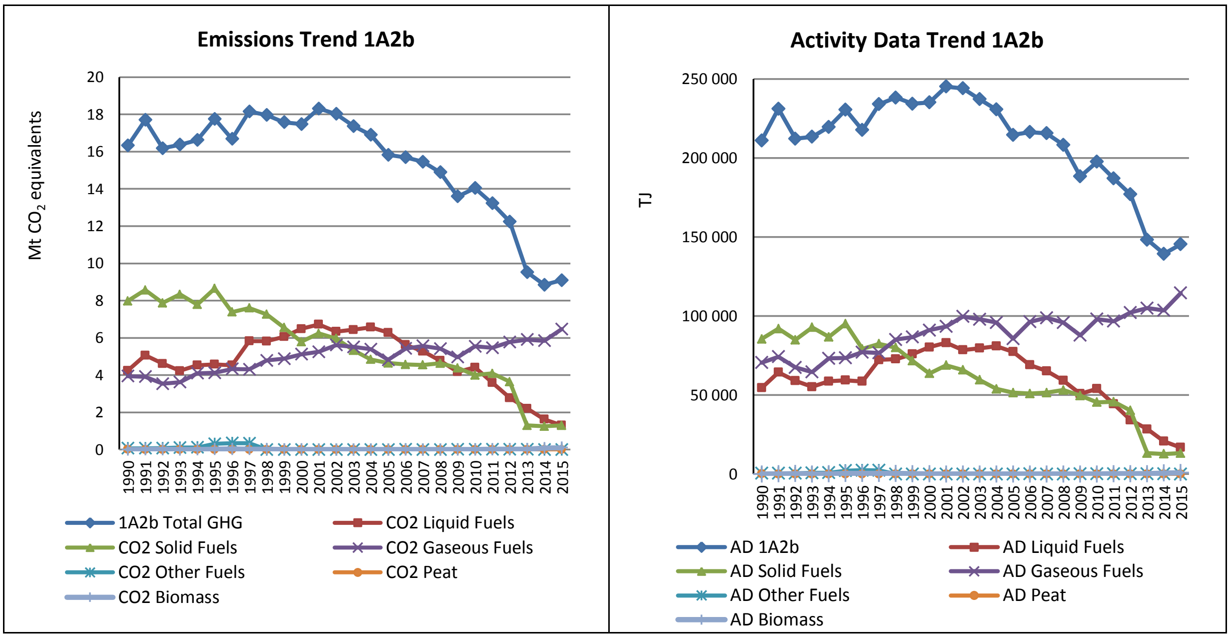


3.2.2.2 Non Ferrous Metals (1A2b)

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 0.3% of total GHG emissions in 2015.

Figure 3.42 shows the emission trend within the category 1A2b, which is in 2015 mainly dominated by CO_2 emissions from gaseous fuels. The share of solid fuels CO_2 emissions decreased from 49% in 1990 to 14% in 2015. In 2015 total GHG emissions were 44% below 1990 level. Increasing emissions were reported for CO_2 from gaseous fuels (+64%) while CO_2 emissions from all other fossil fuels decreased.

Figure 3.42 1A2b Non-ferrous Metals: CO_2 emissions and activity data trends



CO_2 emissions from 1A2b were 44% below 1990 levels in 2015. 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 3.29). Sweden reports 2013 and 2015 emissions as confidential.

Table 3.29 1A2b Non-ferrous Metals: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	132	265	295	3.3%	30	11%	163	123%
Belgium	629	396	421	4.6%	26	6%	-207	-33%
Bulgaria	298	143	146	1.6%	3	2%	-152	-51%
Croatia	NO,IE	19	11	0.1%	-8	-42%	11	∞
Cyprus	5	NO	3	0.0%	3	∞	-2	-39%
Czech Republic	102	95	106	1.2%	11	11%	4	4%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	NO	2	0	0.0%	-2	-89%	0	∞
Finland	337	92	97	1.1%	5	5%	-240	-71%
France	2 086	773	781	8.6%	8	1%	-1 305	-63%
Germany	1 377	97	89	1.0%	-8	-8%	-1 288	-94%
Greece	582	623	587	6.5%	-36	-6%	5	1%
Hungary	239	167	164	1.8%	-3	-2%	-75	-31%
Ireland	809	1 438	1 447	16.0%	9	1%	638	79%
Italy	748	1 070	1 436	15.8%	366	34%	688	92%
Latvia	NO	4	3	0.0%	-1	-14%	3	∞
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	28	49	47	0.5%	-2	-4%	19	67%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	214	122	153	1.7%	31	25%	-61	-28%
Poland	1 089	1 169	1 219	13.4%	50	4%	130	12%
Portugal	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Romania	79	NO,IE	NO,IE	-	-	-	-79	-100%
Slovakia	1 256	148	137	1.5%	-11	-7%	-1 119	-89%
Slovenia	439	96	105	1.2%	9	9%	-334	-76%
Spain	1 323	1 395	1 270	14.0%	-126	-9%	-54	-4%
Sweden	128	94	C	-	-94	-100%	-128	-100%
United Kingdom	4 332	551	538	5.9%	-13	-2%	-3 794	-88%
EU-28	**16 231**	**8 808**	**9 055**	**100%**	**247**	**3%**	**-7 176**	**-44%**
Iceland	14	11	10	0.1%	-1	-5%	-3	-23%
United Kingdom (KP)	4 332	551	538	5.9%	-13	-2%	-3 794	-88%
EU-28 + ISL	**16 244**	**8 819**	**9 065**	**100%**	**246**	**3%**	**-7 179**	**-44%**

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.*

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2015 CO_2 from solid fuels had a share of 14% within source category 1A2b (compared to 49% in 1990). Between 1990 and 2015 the emissions decreased by 84% (Table 3.30). Greece, Malta, Portugal and Romania reported emissions as 'Included elsewhere'. Substantial decreases between 1990 and 2015 were reported by France, Germany, Slovakia and the United Kingdom.

Table 3.30 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	22	15	34	2.6%	19	130%	12	54%	T2	CS
Belgium	147	73	85	6.5%	11	15%	-63	-43%	T1	D
Bulgaria	75	27	30	2.4%	3	11%	-45	-59%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	46	12	12	0.9%	0	1%	-33	-73%	T2	CS,D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	2	NO	-	-2	-100%	-	-	NA	NA
Finland	155	24	23	1.8%	-1	-5%	-132	-85%	T3	CS
France	809	2	2	0.2%	0	0%	-807	-100%	T2,T3	CS,PS
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	11	0.8%	2	20%	-161	-94%	T2	CS
Latvia	NO	NO	0	0.0%	0	∞	0	∞	T1	D
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	760	795	61.5%	35	5%	88	13%	T1,T2	CS,D
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	79	IE	IE	-	-	-	-79	-100%	NA	NA
Slovakia	798	70	55	4.2%	-15	-21%	-744	-93%	T2	CS
Slovenia	154	5	5	0.4%	0	1%	-149	-97%	T1,T2	CS,D
Spain	188	109	108	8.4%	-1	-1%	-79	-42%	T2	CS
Sweden	7	NO	NO	-	-	-	-7	-100%	NA	NA
United Kingdom	3 379	141	133	10.3%	-9	-6%	-3 247	-96%	T2	CS
EU-28	**7 984**	**1 249**	**1 292**	**100%**	**43**	**3%**	**-6 691**	**-84%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	3 379	141	133	10.3%	-9	-6%	-3 247	-96%	T2	CS
EU-28 + ISL	**7 984**	**1 249**	**1 292**	**100%**	**43**	**3%**	**-6 691**	**-84%**	**-**	**-**

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 3.43 and Figure 3.44 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, Spain, Poland and the United Kingdom; together they cause 86% of the CO_2 emissions from solid fuels in 2015. Consumption of solid fuels decreased by 85% between 1990 and 2015. The strong decline in 2013 is mainly due to a high decrease reported by the United Kingdom. The reason for the decrease in the emissions of the UK is due to a change in allocation of an industrial coal power plant which is part of the public electricity grid since 2013 and therefore emissions are allocated to category 1A1a. The CO_2-implied emission factor for solid fuels was 98.2 t/TJ in 2015.

Figure 3.43 1A2b Non-ferrous Metals, solid fuels: Emission trend and share for CO_2

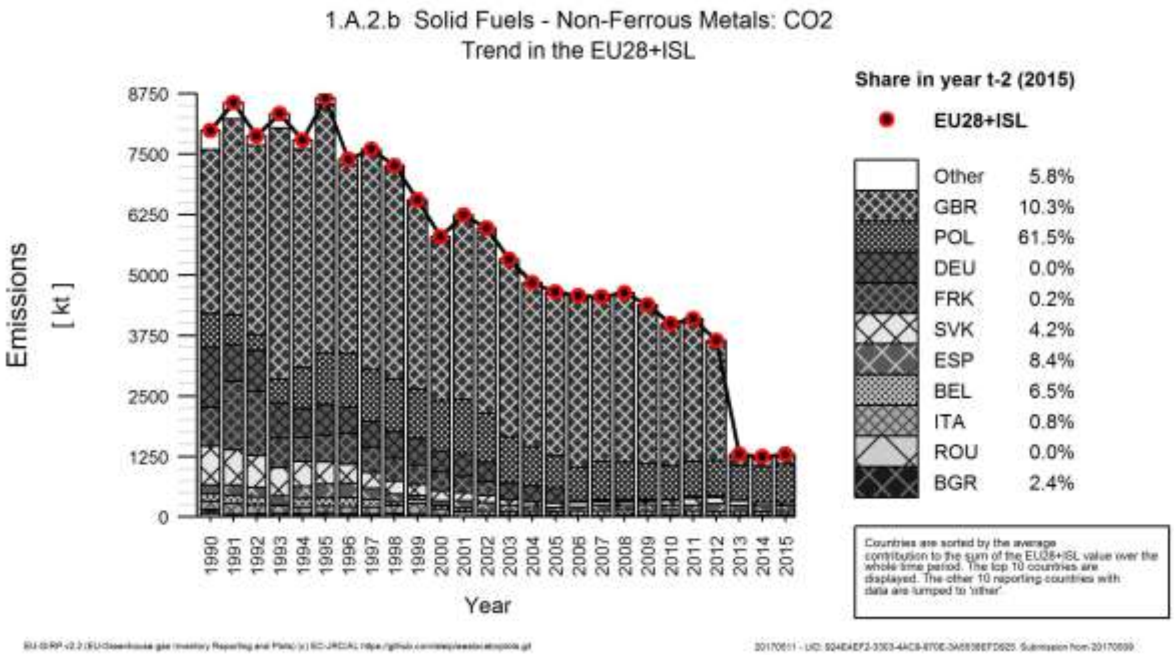
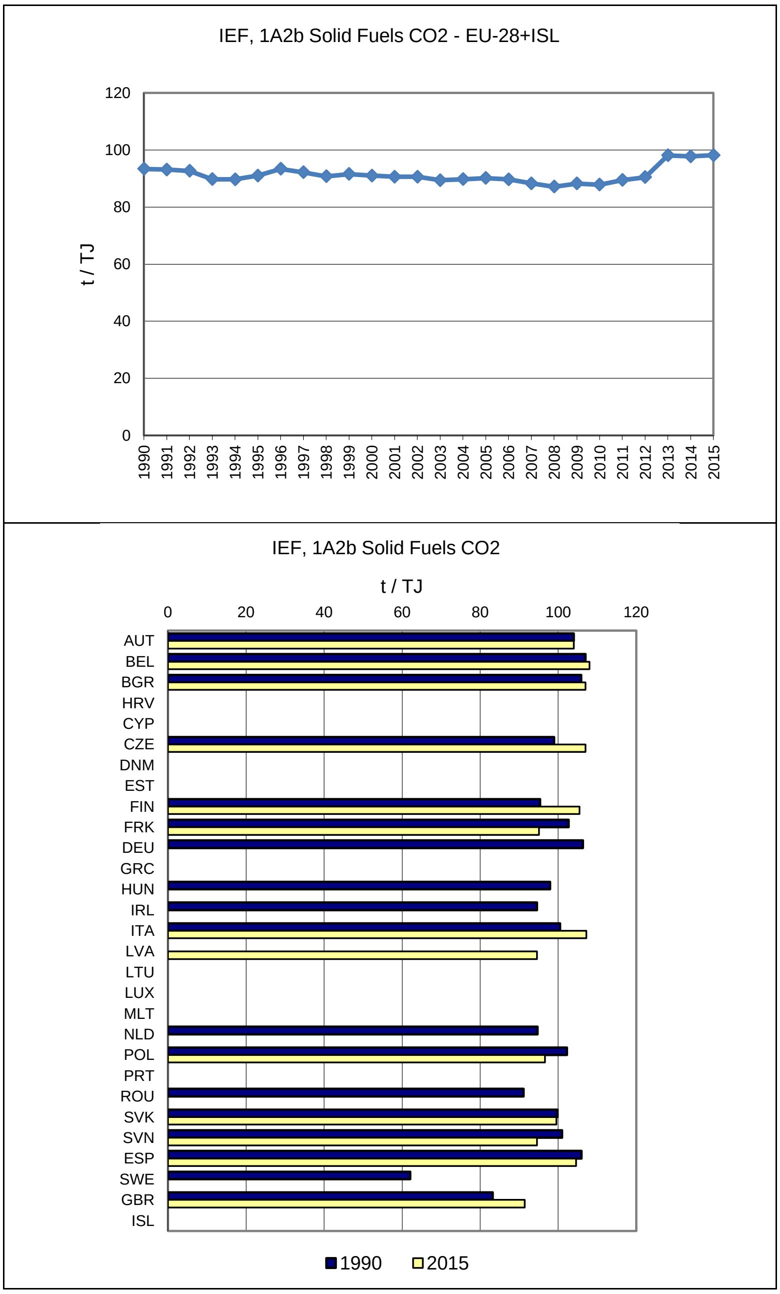


Figure 3.44 1A2b Non-ferrous Metals, solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015 CO_2 from gaseous fuels had a share of 71% within source category 1A2b (compared to 24% in 1990). Between 1990 and 2015 the emissions increased by 64% (Table 3.31). Between 1990 and 2015 the highest absolute increases occurred in Ireland, Greece, Italy and Spain. For confidentiality reasons Germany reports emissions in 1A2g. Sweden reports emissions as confidential.

Table 3.31 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	75	230	247	3.8%	17	8%	173	230%	T2	CS
Belgium	261	279	290	4.5%	11	4%	29	11%	T1	D
Bulgaria	23	66	76	1.2%	10	14%	52	224%	T2	CS
Croatia	IE	2	5	0.1%	3	136%	5	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	53	83	93	1.4%	10	12%	39	74%	T2	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	3	3	0.0%	0	5%	3	∞	T3	CS
France	864	735	744	11.5%	9	1%	-120	-14%	T2,T3	CS,PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	595	578	8.9%	-17	-3%	578	∞	T2	CS
Hungary	87	167	164	2.5%	-3	-2%	77	88%	T1	D
Ireland	39	1 299	1 415	21.9%	117	9%	1 377	3570%	T2	CS
Italy	558	927	905	14.0%	-22	-2%	348	62%	T2	CS
Latvia	NO	4	3	0.1%	-1	-17%	3	∞	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	13	49	47	0.7%	-2	-4%	34	254%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	213	122	153	2.4%	31	25%	-60	-28%	T2	CS
Poland	258	390	405	6.3%	15	4%	147	57%	T1	D
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	IE	IE	IE	-	-	-	-	-	NA	NA
Slovakia	435	65	72	1.1%	6	10%	-363	-84%	T2	CS
Slovenia	164	65	77	1.2%	11	18%	-87	-53%	T2	CS
Spain	73	356	788	12.2%	431	121%	715	980%	T2	CS
Sweden	10	C	C	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	819	406	402	6.2%	-4	-1%	-417	-51%	T2	CS
EU-28	**3 935**	**5 844**	**6 468**	**100%**	**624**	**11%**	**2 533**	**64%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	819	406	402	6.2%	-4	-1%	-417	-51%	T2	CS
EU-28 + ISL	**3 935**	**5 844**	**6 468**	**100%**	**624**	**11%**	**2 533**	**64%**	**-**	**-**

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.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

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 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, Spain and Italy; together they cause around 60% of the CO_2 emissions in 2015 from gaseous fuels in 1A2b. Consumption of gaseous fuels rose by 62% between 1990 and 2015. 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 56.5 t/TJ in 2015.

Figure 3.45 1A2b Non-ferrous Metals, Gaseous fuels: Emission trend and share for CO_2

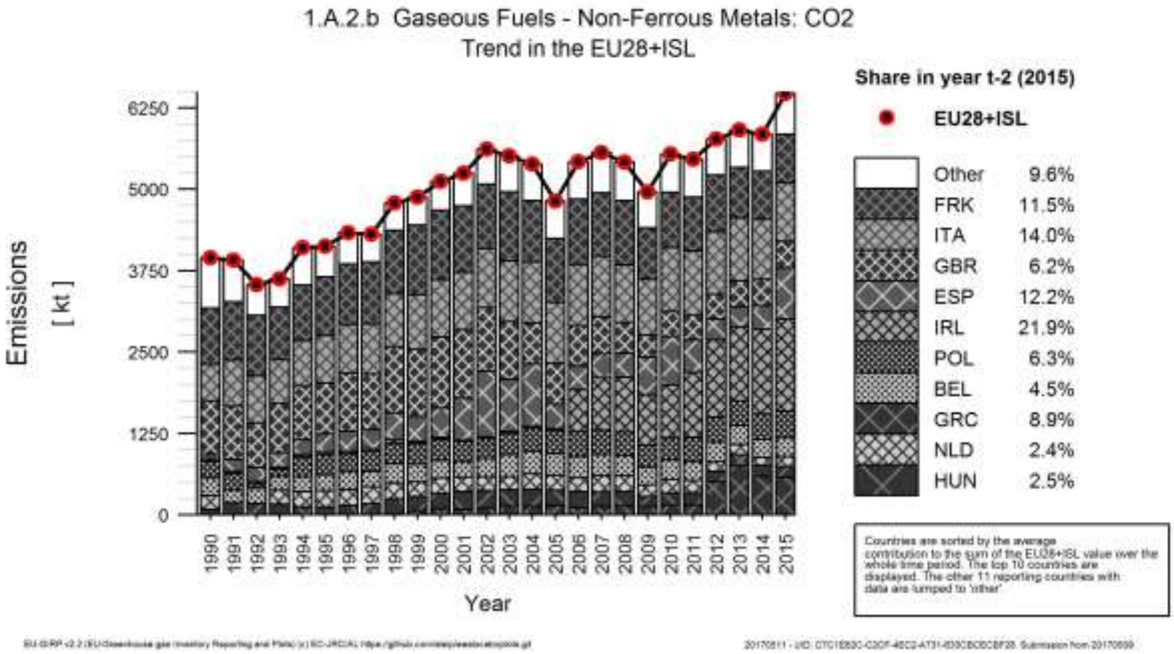
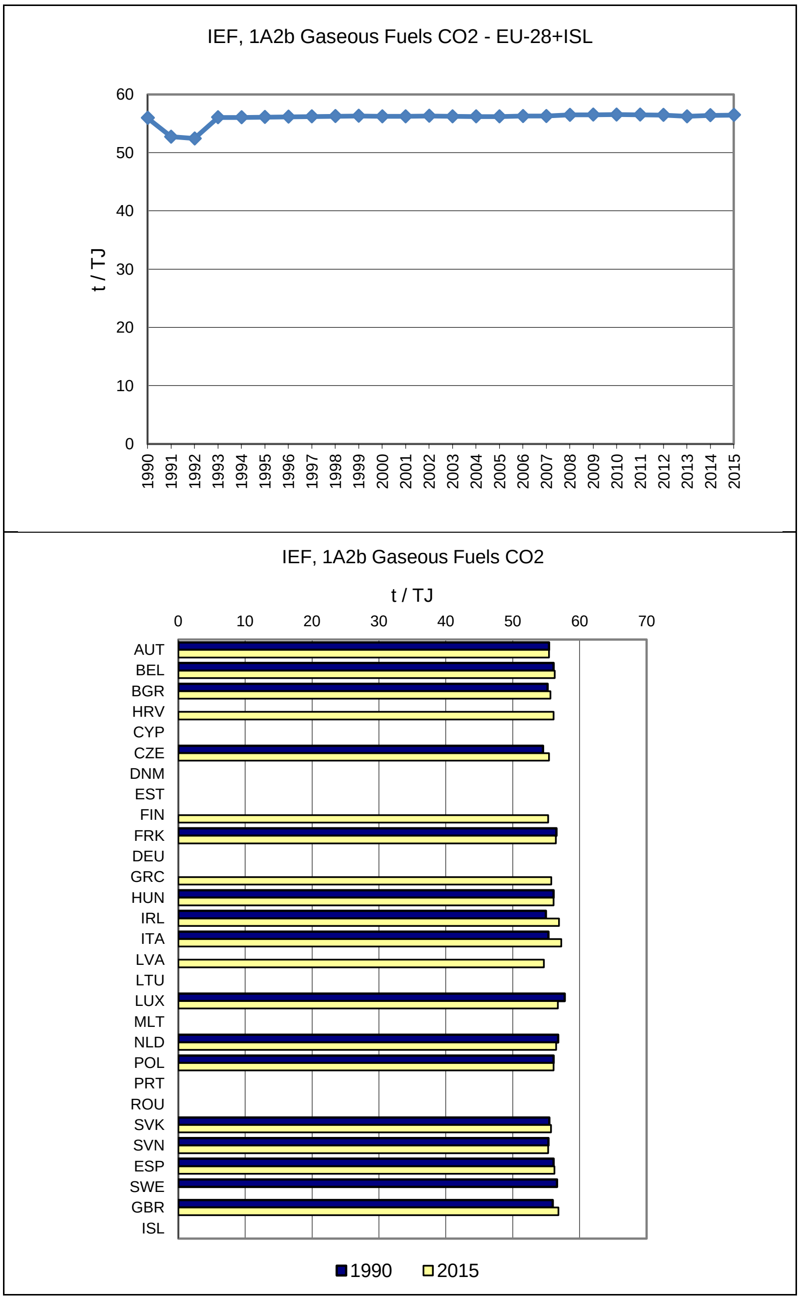


Figure 3.46 1A2b Non-ferrous Metals, Gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)

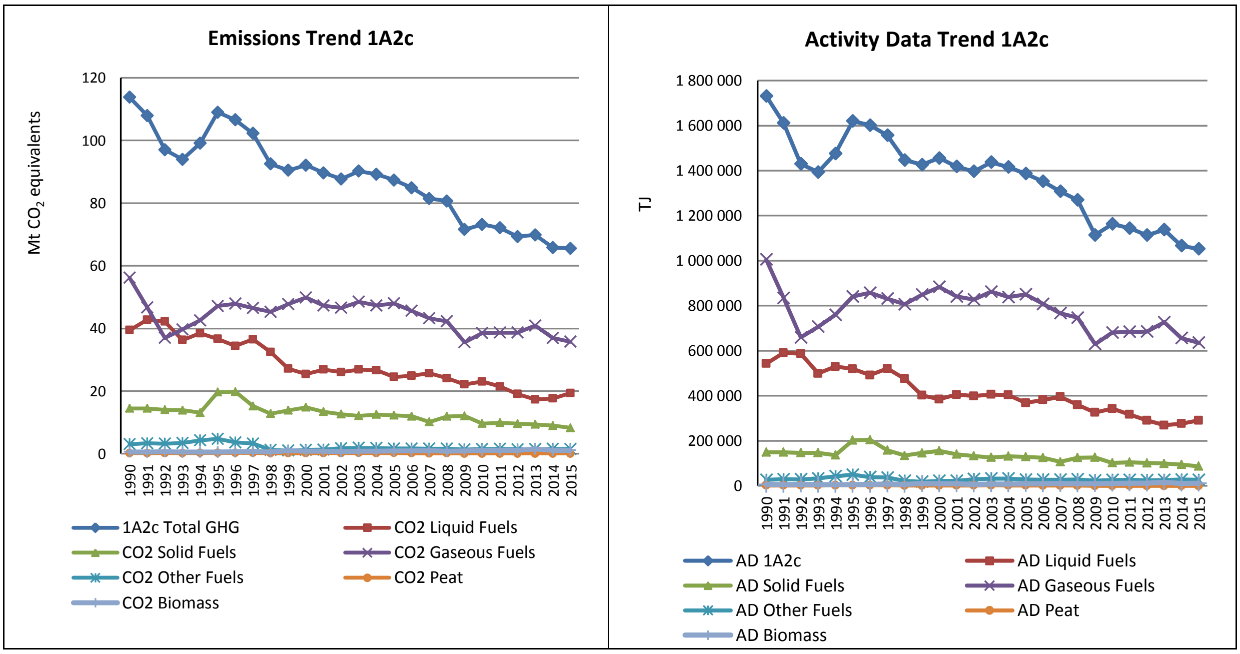


3.2.2.3 **Chemicals (1A2c)**

In this chapter information is provided about emission trends, Member States contribution and activity data for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals accounted for 13% of 1A2 category and 2% of total GHG emissions in 2015.

Figure 3.47 shows the emission trend of category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 42%, mainly due to decreases in emissions from liquid (-51%) and gaseous (-36%) fuels.

Figure 3.47 1A2c Chemicals: Total and CO_2 emission and activity trends



Between 1990 and 2015, CO_2 emissions from 1A2c Chemicals decreased by 43% in the EU-28+ISL (Table 3.32), mainly due to decreases in France, Italy, Romania, the Netherlands and the United Kingdom; Poland and Spain reported substantial emission increases in this period. Between 2014 and 2015 emissions decreased substantially in Spain, Poland and Romania while emissions from Italy increased substantially.

Table 3.32 1A2c Chemicals: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	892	1 429	1 487	2.3%	58	4%	596	67%
Belgium	4 786	3 138	3 175	4.9%	37	1%	-1 611	-34%
Bulgaria	966	222	348	0.5%	126	57%	-618	-64%
Croatia	NO,IE	288	294	0.5%	6	2%	294	∞
Cyprus	2	3	6	0.0%	3	98%	4	187%
Czech Republic	2 996	1 687	1 599	2.5%	-88	-5%	-1 397	-47%
Denmark	315	397	388	0.6%	-9	-2%	74	23%
Estonia	806	15	34	0.1%	18	117%	-773	-96%
Finland	1 245	730	741	1.1%	11	2%	-505	-41%
France	15 293	11 108	10 777	16.6%	-331	-3%	-4 516	-30%
Germany	NA,IE	NA,IE	NA,IE	-	-	-	-	-
Greece	808	357	444	0.7%	87	24%	-364	-45%
Hungary	1 540	359	385	0.6%	26	7%	-1 155	-75%
Ireland	410	256	283	0.4%	27	10%	-127	-31%
Italy	19 263	8 404	10 476	16.1%	2 072	25%	-8 786	-46%
Latvia	303	29	27	0.0%	-1	-4%	-276	-91%
Lithuania	399	315	307	0.5%	-8	-2%	-93	-23%
Luxembourg	170	160	160	0.2%	0	0%	-9	-6%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	17 276	11 958	11 727	18.0%	-231	-2%	-5 549	-32%
Poland	4 020	6 538	6 020	9.3%	-518	-8%	2 000	50%
Portugal	1 346	990	1 029	1.6%	39	4%	-318	-24%
Romania	19 091	2 863	2 320	3.6%	-543	-19%	-16 771	-88%
Slovakia	2 624	502	468	0.7%	-34	-7%	-2 156	-82%
Slovenia	209	75	71	0.1%	-4	-6%	-139	-66%
Spain	5 334	7 946	7 195	11.1%	-751	-9%	1 861	35%
Sweden	1 149	1 173	1 039	1.6%	-134	-11%	-110	-10%
United Kingdom	12 077	4 311	4 237	6.5%	-74	-2%	-7 840	-65%
EU-28	**113 320**	**65 251**	**65 035**	**100%**	**-216**	**0%**	**-48 285**	**-43%**
Iceland	7	NO,NA	NO,NA	-	-	-	-7	-100%
United Kingdom (KP)	12 077	4 311	4 237	6.5%	-74	-2%	-7 840	-65%
EU-28 + ISL	**113 328**	**65 251**	**65 035**	**100%**	**-216**	**0%**	**-48 293**	**-43%**

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

1A2c Chemicals - Liquid Fuels (CO_2)

In 2015, CO_2 from liquid fuels had a share of 30% within source category 1A2c (compared to 35% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 51% (Table 3.33). Most Member States reported decreasing CO_2 emissions from this source category with Italy, France and the United Kingdom showing the highest reduction in absolute terms. Germany includes emissions under 1A2g.

Table 3.33 1A2c Chemicals, Liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	93	72	74	0.4%	2	2%	-19	-20%	T2	CS
Belgium	1 852	165	268	1.4%	102	62%	-1 584	-86%	T1	D
Bulgaria	857	35	41	0.2%	5	15%	-816	-95%	T1	D
Croatia	IE	16	9	0.0%	-7	-42%	9	∞	T1	D
Cyprus	2	3	6	0.0%	3	98%	4	187%	T1	D
Czech Republic	175	170	119	0.6%	-51	-30%	-56	-32%	T1	D
Denmark	198	16	17	0.1%	1	8%	-180	-91%	T1,T2	CS,D
Estonia	13	7	27	0.1%	20	265%	14	112%	T1,T2	CS,D
Finland	731	691	692	3.6%	1	0%	-39	-5%	T3	CS
France	6 425	3 427	3 260	16.8%	-167	-5%	-3 165	-49%	T2,T3	CS,PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	639	72	56	0.3%	-16	-22%	-583	-91%	T2	CS
Hungary	380	3	3	0.0%	0	0%	-377	-99%	T1	D
Ireland	131	77	81	0.4%	4	5%	-50	-38%	T2	CS
Italy	11 212	2 518	4 796	24.8%	2 278	90%	-6 416	-57%	T2	CS
Latvia	279	10	9	0.0%	-1	-8%	-270	-97%	T2	CS
Lithuania	69	2	2	0.0%	0	21%	-66	-97%	T2	CS
Luxembourg	112	13	20	0.1%	7	55%	-92	-82%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	6 493	6 954	6 312	32.6%	-642	-9%	-180	-3%	T2	CS,D
Poland	306	816	654	3.4%	-161	-20%	348	114%	T1	D
Portugal	1 308	643	681	3.5%	38	6%	-627	-48%	T2	CR,D
Romania	NO	678	612	3.2%	-66	-10%	612	∞	T1,T2	D
Slovakia	51	6	5	0.0%	-1	-24%	-46	-91%	T2	CS
Slovenia	32	18	12	0.1%	-6	-32%	-19	-61%	T1	D
Spain	2 831	186	669	3.5%	483	259%	-2 162	-76%	T2	CS
Sweden	861	950	809	4.2%	-141	-15%	-53	-6%	T2	CS
United Kingdom	4 392	112	130	0.7%	17	15%	-4 263	-97%	T2	CS
EU-28	**39 442**	**17 661**	**19 364**	**100%**	**1 703**	**10%**	**-20 077**	**-51%**	**-**	**-**
Iceland	7	NA	NA	-	-	-	-7	-100%	NA	NA
United Kingdom (KP)	4 392	112	130	0.7%	17	15%	-4 263	-97%	T2	CS
EU-28 + ISL	**39 449**	**17 661**	**19 364**	**100%**	**1 703**	**10%**	**-20 085**	**-51%**	**-**	**-**

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

Figure 3.48 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 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 2015. The decline in 1999 is due to the strong decrease reported by Italy. The CO_2-implied emission factor for liquid fuels was 66.7 t/TJ in 2015. Lower implied emissions factors are associated with a high share of refinery gas used within this sector.

Figure 3.48 1A2c Chemicals, Liquid fuels: Emission trend and share for CO_2

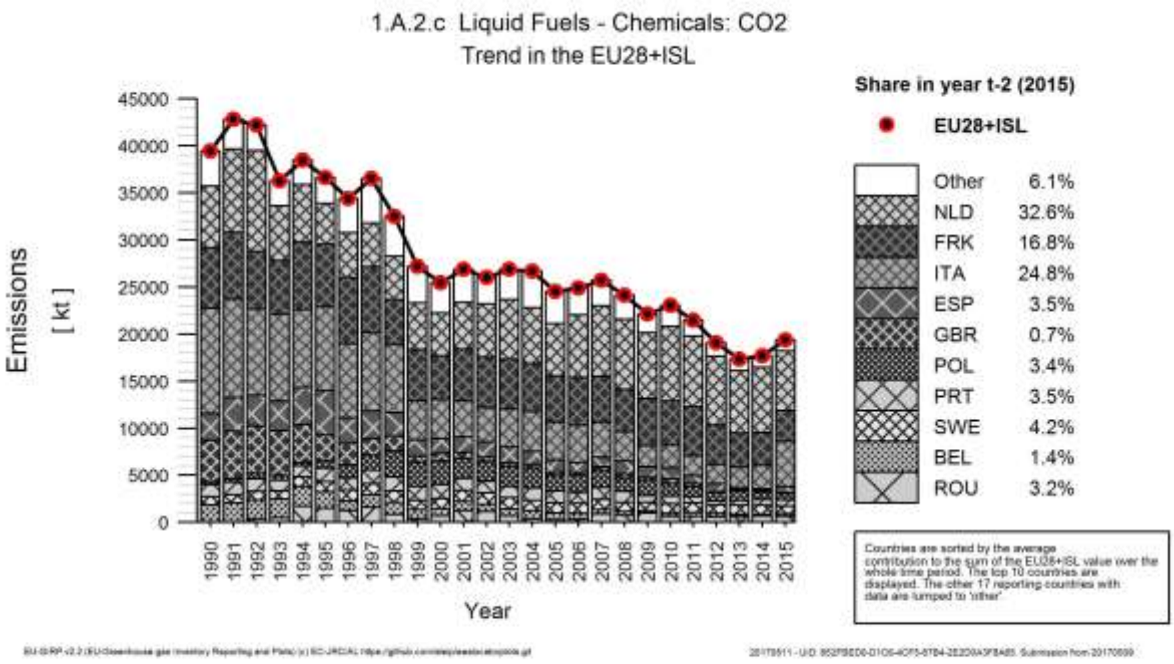
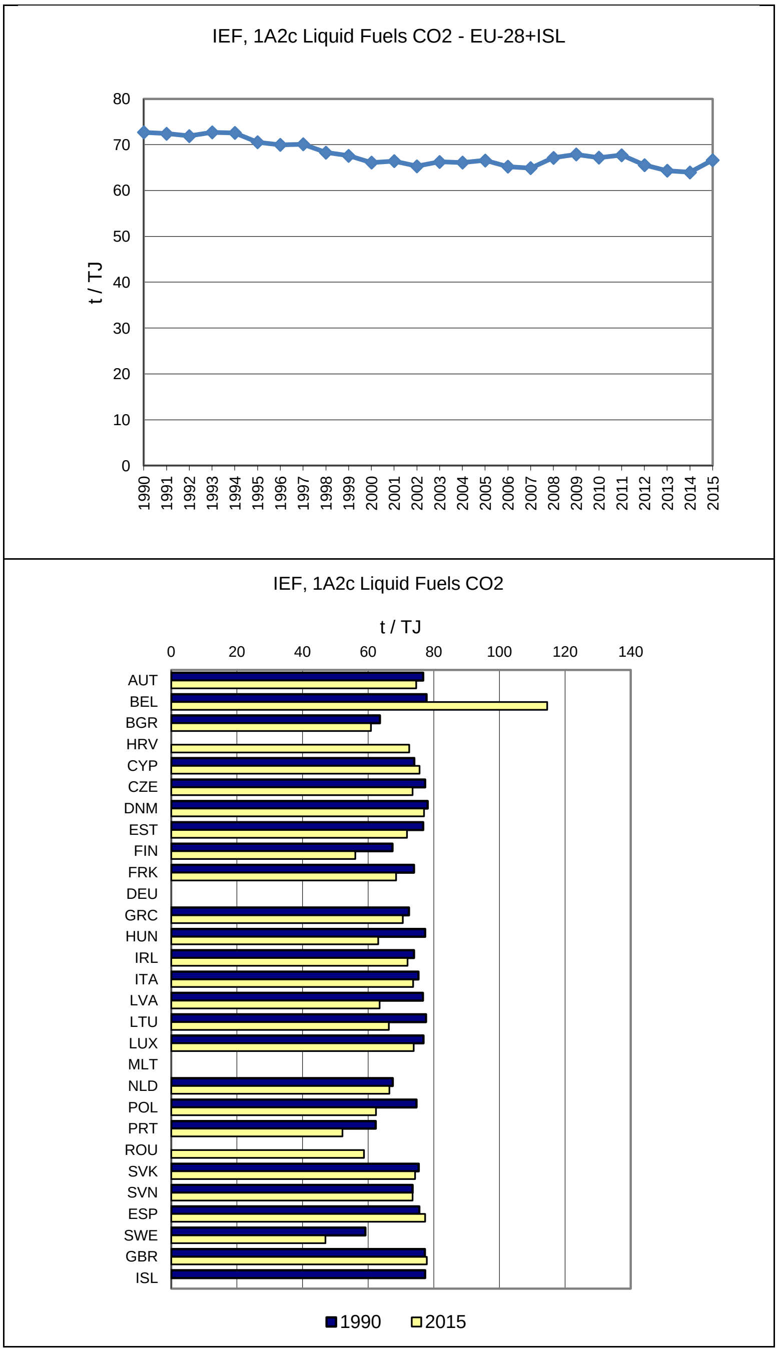


Figure 3.49 1A2c Chemicals, Liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2c Chemicals - Solid Fuels (CO_2)

In 2015, solid fuels had a share of 13% within source category 1A2c (compared to 13% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 42% (Table 3.34). In absolute terms the Czech Republic, Slovakia, the Netherlands 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. Sweden reports 2013 and 2015 emissions as confidential and for other years it reports emissions from peat together with solid fuels (for confidential reasons).

Table 3.34 1A2c Chemicals, Solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	106	123	103	1.2%	-20	-16%	-3	-3%	T2	CS
Belgium	402	3	3	0.0%	0	0%	-399	-99%	T1	D
Bulgaria	79	3	15	0.2%	12	379%	-65	-82%	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 487	845	784	9.4%	-61	-7%	-1 703	-68%	T2	CS,D
Denmark	7	78	76	0.9%	-2	-2%	70	1070%	T1	D
Estonia	626	NO	NO	-	-	-	-626	-100%	NA	NA
Finland	214	NO	NO	-	-	-	-214	-100%	NA	NA
France	1 763	1 741	1 701	20.5%	-40	-2%	-62	-4%	T2,T3	CS,PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	169	NO	NO	-	-	-	-169	-100%	NA	NA
Hungary	96	NO	NO	-	-	-	-96	-100%	NA	NA
Ireland	72	NO	NO	-	-	-	-72	-100%	NA	NA
Italy	489	17	3	0.0%	-14	-84%	-486	-99%	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	4 754	4 398	53.0%	-356	-7%	3 371	328%	T1,T2	CS,D
Portugal	39	3	NO	-	-3	-100%	-39	-100%	NA	NA
Romania	581	269	272	3.3%	3	1%	-309	-53%	T1,T2	CS,D
Slovakia	1 584	59	73	0.9%	14	24%	-1 510	-95%	T2	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NA	NA
Spain	691	639	647	7.8%	8	1%	-44	-6%	T2	CS,PS
Sweden	127	C	C	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	2 815	436	227	2.7%	-209	-48%	-2 588	-92%	T2	CS
EU-28	**14 334**	**8 968**	**8 301**	**100%**	**-667**	**-7%**	**-6 034**	**-42%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	2 815	436	227	2.7%	-209	-48%	-2 588	-92%	T2	CS
EU-28 + ISL	**14 334**	**8 968**	**8 301**	**100%**	**-667**	**-7%**	**-6 034**	**-42%**	**-**	**-**

Emissions of Germany and Malta are included in 1A2g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.50 and Figure 3.51 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 Spain; together they cause 91% of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion decreased by -42% between 1990 and 2015. The CO_2-implied emission factor for solid fuels was 95.3 t/TJ in 2015. The high implied emission factor for Estonia is due to the use of oil shale generator gas which has a high carbon content.

Figure 3.50 1A2c Chemicals, Solid fuels: Emission trend and share for CO_2

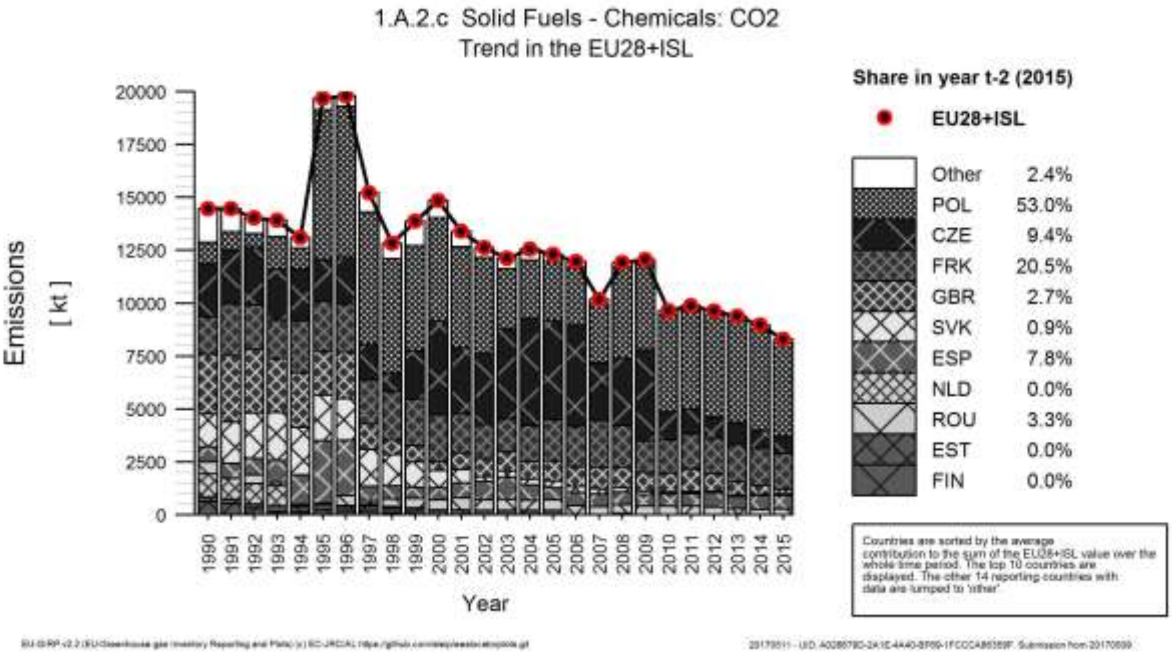
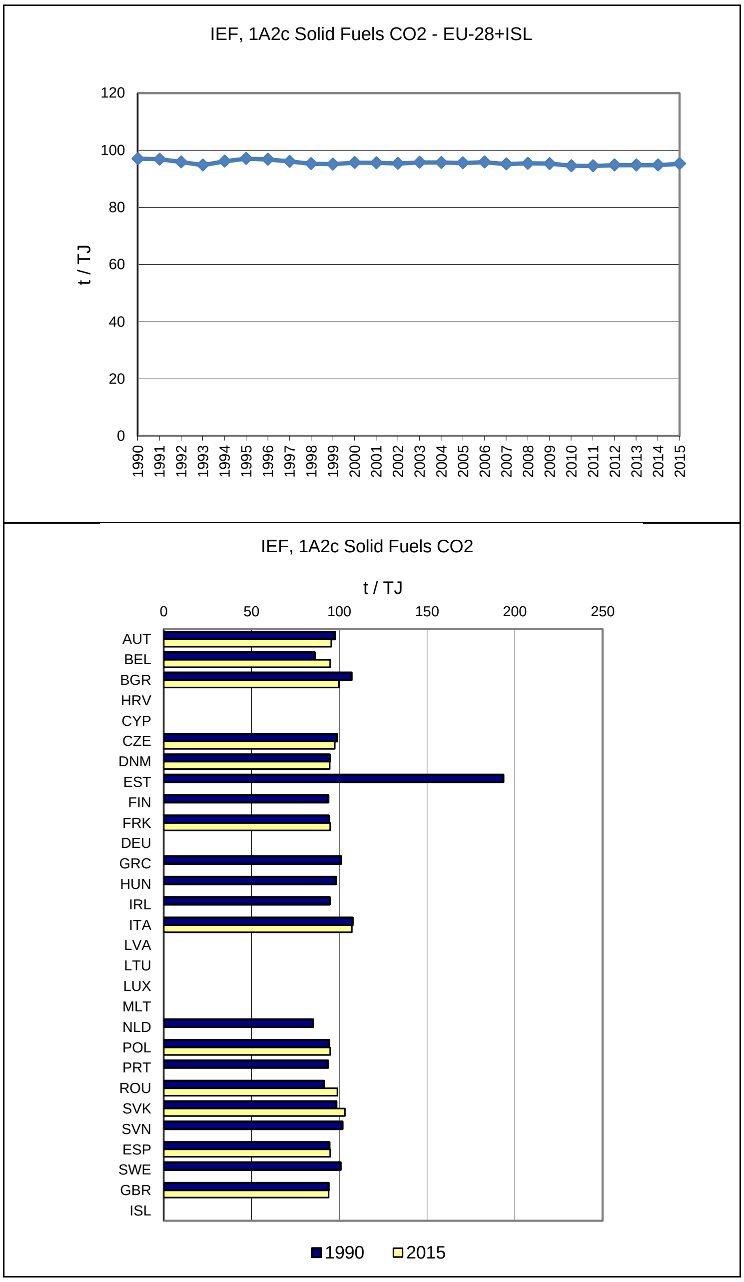


Figure 3.51 1A2c Chemicals, Solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2015, CO_2 from gaseous fuels had a share of 55% within source category 1A2c (compared to 49% in 1990). Between 1990 and 2015, CO_2 emissions decreased by 36% (Table 3.35). Between 1990 and 2015 Italy, France, the Netherlands and Romania reported substantial decreases while the highest increases occurred in Spain, Poland and Austria. Germany and Malta include emissions from this source category in source category 1A2g.

Table 3.35 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	519	1 030	1 071	3.0%	41	4%	552	106%	T2	CS
Belgium	2 532	2 956	2 890	8.1%	-66	-2%	358	14%	-	D,PS
Bulgaria	30	183	293	0.8%	109	60%	263	869%	T2	CS
Croatia	IE	272	285	0.8%	13	5%	285	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	334	673	696	1.9%	24	4%	362	108%	T2	CS
Denmark	110	303	295	0.8%	-8	-3%	185	167%	T3	CS
Estonia	167	8	7	0.0%	-1	-18%	-161	-96%	T2	CS
Finland	99	26	32	0.1%	5	21%	-67	-68%	T3	CS
France	6 631	4 832	4 777	13.4%	-54	-1%	-1 854	-28%	T2,T3	CS,PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	285	388	1.1%	103	36%	388	∞	T2	CS
Hungary	1 064	356	382	1.1%	26	7%	-682	-64%	T1	D
Ireland	207	180	202	0.6%	22	12%	-5	-2%	T2	CS
Italy	7 561	5 869	5 678	15.9%	-191	-3%	-1 884	-25%	T2	CS
Latvia	24	17	18	0.1%	1	5%	-6	-23%	T2	CS
Lithuania	331	313	305	0.9%	-8	-3%	-26	-8%	T2	CS
Luxembourg	57	147	140	0.4%	-7	-5%	83	144%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	9 696	5 003	5 414	15.1%	411	8%	-4 282	-44%	T2	CS
Poland	297	813	834	2.3%	20	2%	537	181%	T1	D
Portugal	NO	344	348	1.0%	4	1%	348	∞	T2	CR,D
Romania	18 510	1 842	1 368	3.8%	-473	-26%	-17 142	-93%	T2	CS
Slovakia	989	437	390	1.1%	-47	-11%	-600	-61%	T2	CS
Slovenia	176	57	58	0.2%	2	3%	-118	-67%	T2	CS
Spain	1 811	7 121	5 878	16.4%	-1 242	-17%	4 067	225%	T2	CS
Sweden	155	145	144	0.4%	-1	-1%	-11	-7%	T2	CS
United Kingdom	4 870	3 762	3 881	10.8%	118	3%	-989	-20%	T2	CS
EU-28	**56 171**	**36 973**	**35 773**	**100%**	**-1 201**	**-3%**	**-20 398**	**-36%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	4 870	3 762	3 881	10.8%	118	3%	-989	-20%	T2	CS
EU-28 + ISL	**56 171**	**36 973**	**35 773**	**100%**	**-1 201**	**-3%**	**-20 398**	**-36%**	**-**	**-**

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 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 36% between 1990 and 2015. The CO_2-implied emission factor for gaseous fuels was 56.3 t/TJ in 2015.

Figure 3.52 1A2c Chemicals, Gaseous fuels: Emission trend and share for CO_2

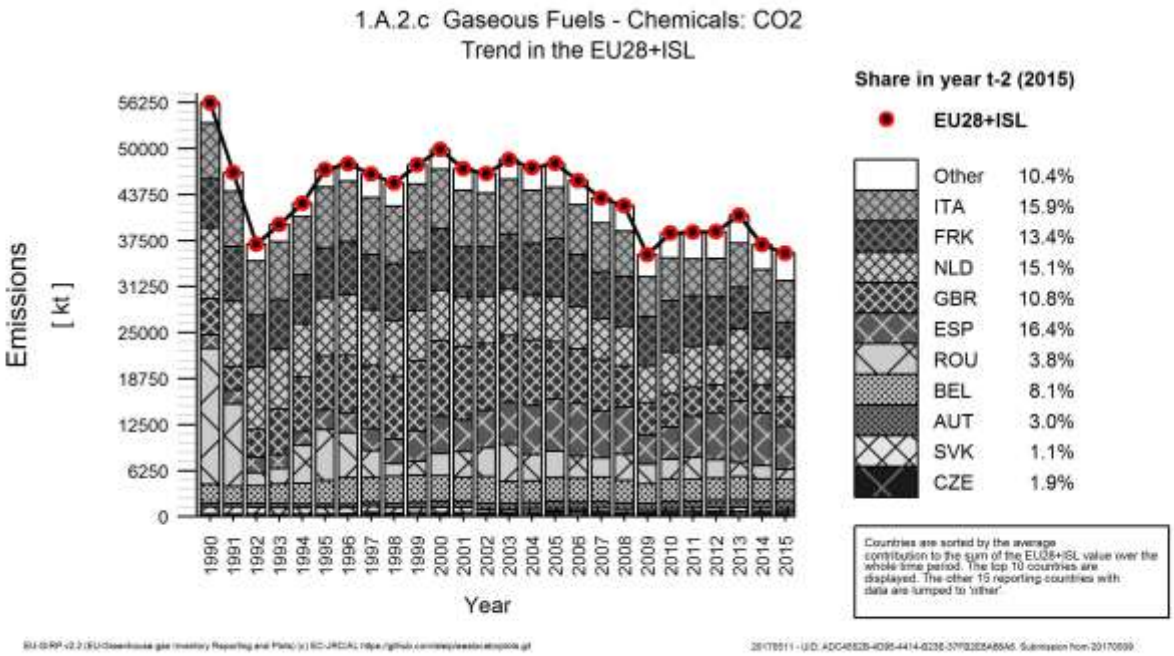
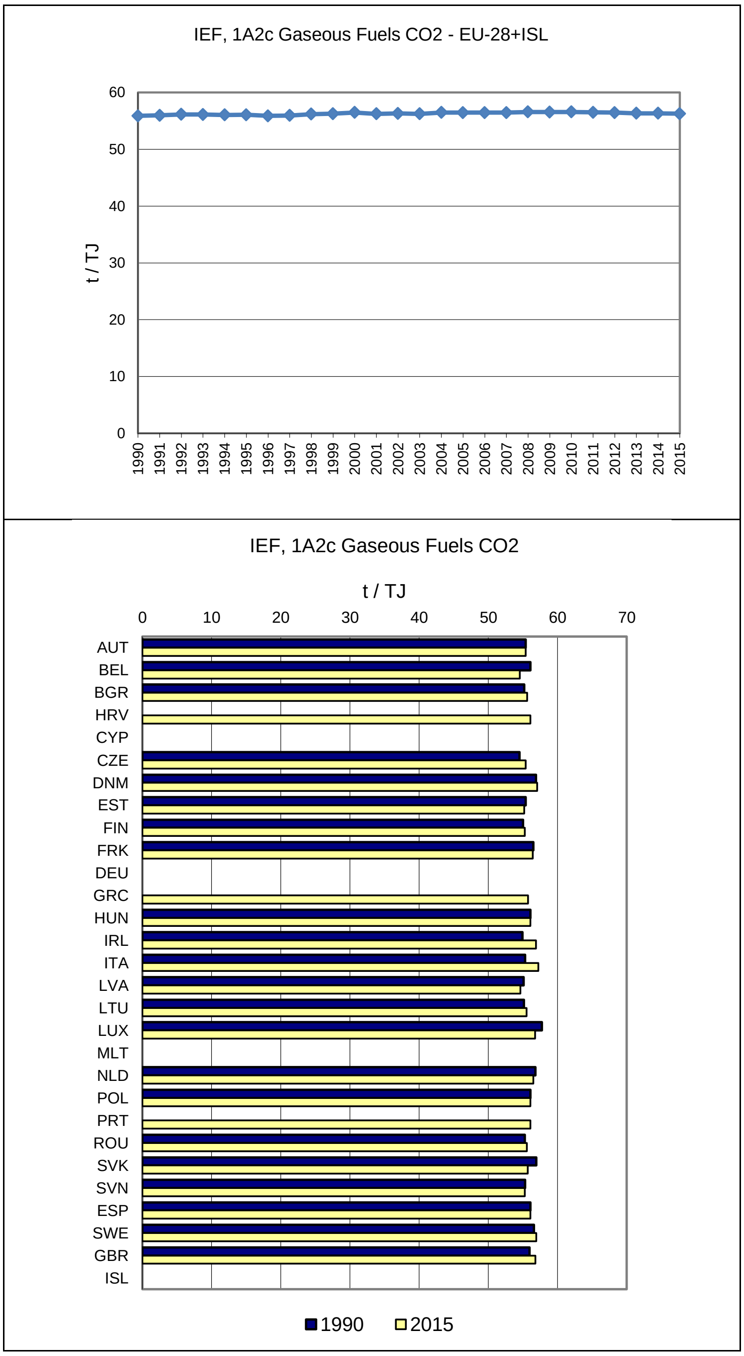


Figure 3.53 1A2c Chemicals, Gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2c Chemicals - Other Fossil Fuels (CO_2)

In 2015, CO_2 from other fossil fuels had a share of 2% within source category 1A2c (compared to 3% in 1990). Between 1990 and 2015, the emissions decreased by 50% (Table 3.36). 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 while Poland reports a significant decrease of emissions. Sweden reports 2013 and 2015 emissions as confidential.

Table 3.36 1A2c Chemicals, other fossil fuels: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	174	205	239	15.8%	35	17%	65	38%
Belgium	-	14	14	0.9%	0	-2%	14	∞
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	13	17	1.1%	4	32%	7	64%
France	474	1 108	1 039	68.7%	-69	-6%	565	119%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	2 390	155	134	8.9%	-21	-13%	-2 256	-94%
Portugal	NO	1	0	0.0%	-1	-83%	0	∞
Romania	NO	74	67	4.5%	-7	-9%	67	∞
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	1	NO	NO	-	-	-	-1	-100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	6	C	C	NA	NA	NA	NA	NA
Untited Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**3 049**	**1 569**	**1 511**	**100%**	**-59**	**-4%**	**-1 538**	**-50%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**3 049**	**1 569**	**1 511**	**100%**	**-59**	**-4%**	**-1 538**	**-50%**

Emissions of Germany and Malta are included in 1A2g.
The numbers for 2015 for EU-28 and EU-28 + ISL in this table differ from the numbers in the respective CRF tables because the EU CRF includes under "Other fossil fuels".CO_2 emissions from solid fuels reported by Sweden as confidential. These emissions are not reflected in this table in order to preserve time series consistency.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.55 and Figure 3.56 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. 69% of CO_2 emissions are reported by France; Other fuel consumption in the EU-28 decreased by 0.1% between 1990 and 2015. The CO_2-implied emission factor for other fossil fuels was 57.6 t/TJ in 2015.

Figure 3.54: 1A2c Chemicals, Gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)

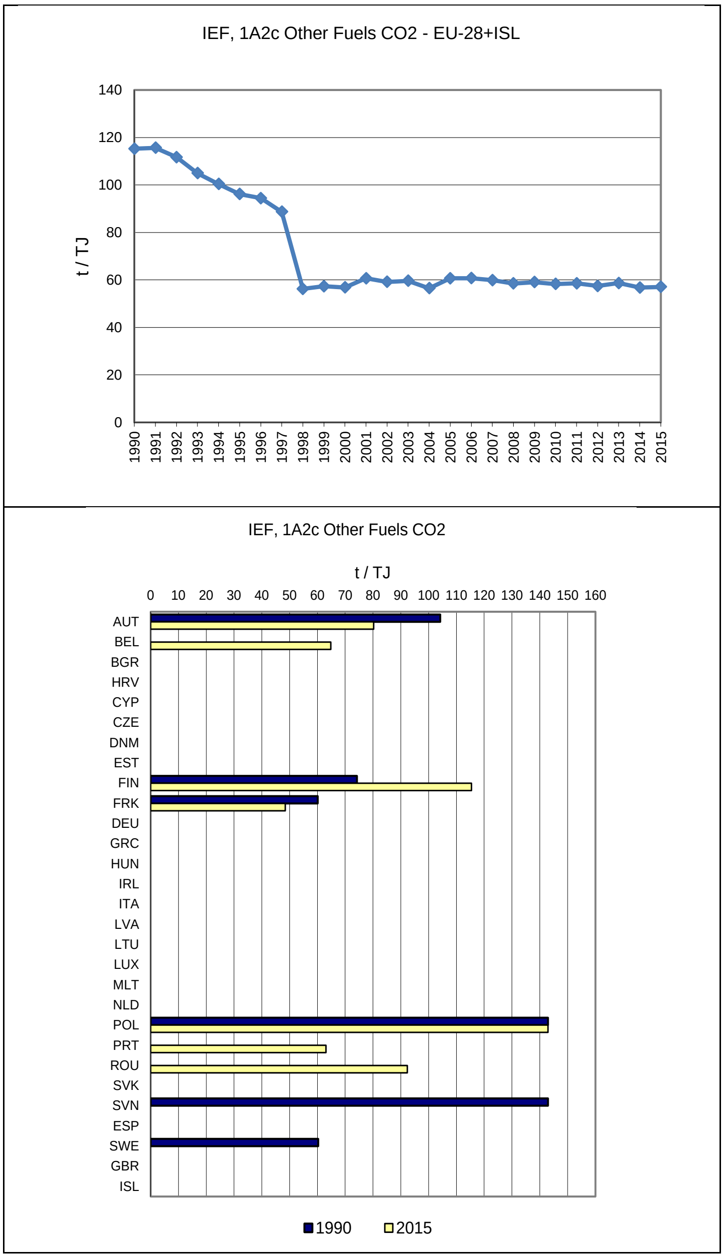
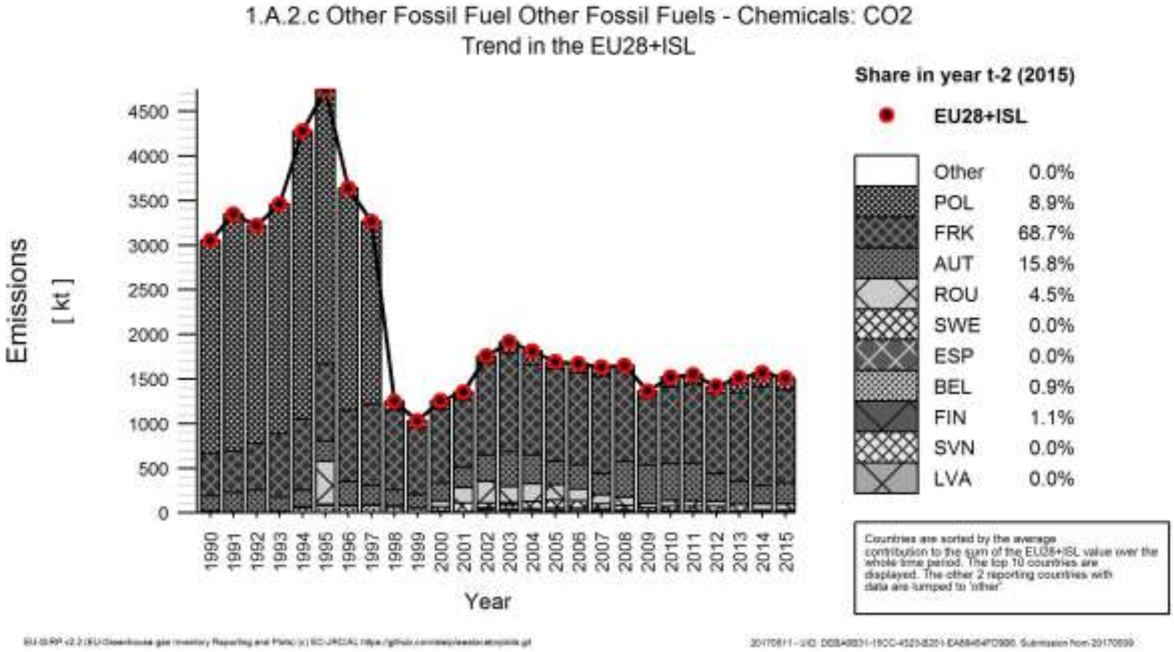


Figure 3.55 1A2c Chemicals, Other fossil fuels: Emission trend and share for CO_2

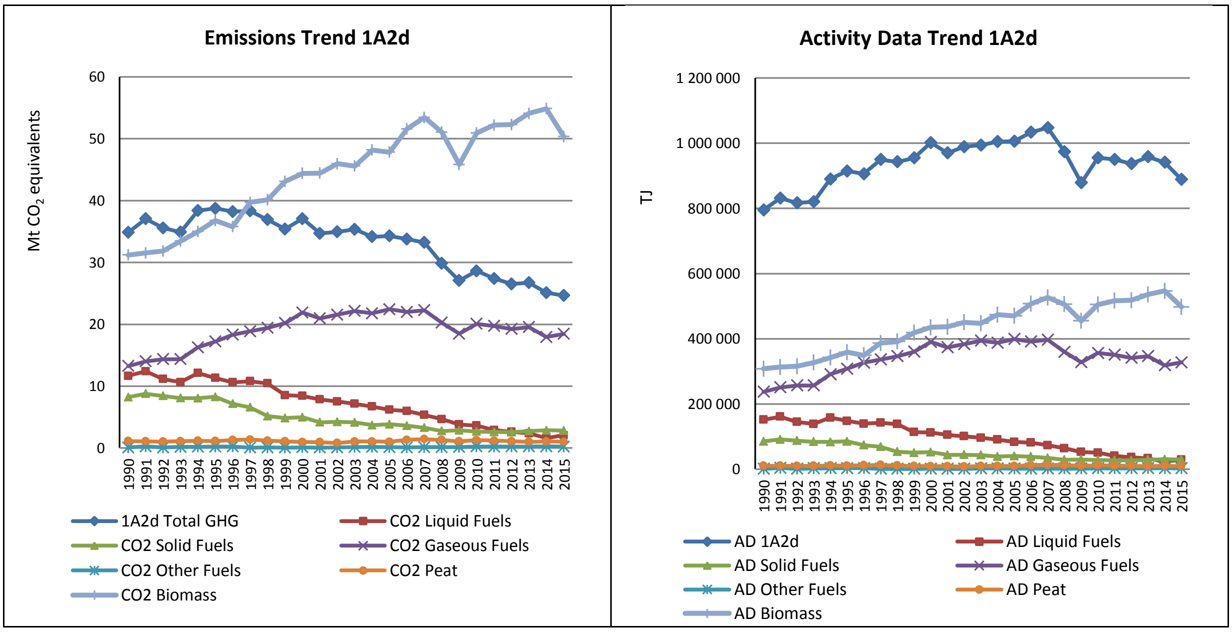


3.2.2.4 Pulp, Paper and Print (1A2d)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print accounted for 5% of 1A2 source category and 0.6% of total GHG emissions in 2015.

Figure 3.56 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous fuels. Total GHG emissions decreased by 29%. 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 3.56 1A2d Pulp, Paper and Print: Total and CO_2 emission trends



Between 1990 and 2015, CO_2 emissions from 1A2d Pulp, Paper and Print decreased by 30% (Table 3.37), mainly due to decreases in the Czech Republic, Finland, France, Sweden, Slovakia and the United Kingdom. Between 2014 and 2015 emissions decreased by 1%. 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'. Sweden reports 2013 and 2015 emissions as confidential.

Table 3.37 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	2 214	1 751	1 853	7.7%	101	6%	-361	-16%
Belgium	644	596	623	2.6%	27	5%	-21	-3%
Bulgaria	16	113	111	0.5%	-2	-2%	96	615%
Croatia	NO,IE	71	70	0.3%	-1	-2%	70	∞
Cyprus	5	3	3	0.0%	0	0%	-2	-35%
Czech Republic	2 285	411	432	1.8%	21	5%	-1 854	-81%
Denmark	330	85	68	0.3%	-17	-20%	-263	-79%
Estonia	NO	4	14	0.1%	10	280%	14	∞
Finland	5 330	2 712	2 680	11.2%	-32	-1%	-2 649	-50%
France	4 836	2 903	2 905	12.1%	1	0%	-1 931	-40%
Germany	4	7	6	0.0%	-1	-16%	2	67%
Greece	306	133	104	0.4%	-29	-22%	-202	-66%
Hungary	74	196	155	0.6%	-41	-21%	81	108%
Ireland	28	15	16	0.1%	1	9%	-12	-43%
Italy	3 077	4 147	4 577	19.1%	431	10%	1 500	49%
Latvia	169	6	6	0.0%	0	-2%	-163	-97%
Lithuania	255	27	22	0.1%	-5	-18%	-234	-91%
Luxembourg	NO,IE	7	7	0.0%	0	-1%	7	∞
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	1 669	1 009	885	3.7%	-125	-12%	-784	-47%
Poland	285	1 598	1 591	6.6%	-7	0%	1 306	458%
Portugal	754	1 007	1 109	4.6%	102	10%	355	47%
Romania	NO	123	156	0.6%	33	27%	156	∞
Slovakia	2 329	480	476	2.0%	-4	-1%	-1 854	-80%
Slovenia	380	324	312	1.3%	-11	-4%	-67	-18%
Spain	2 594	3 846	3 798	15.8%	-47	-1%	1 204	46%
Sweden	2 187	710	C	NA	NA	NA	NA	NA
Untited Kingdom	4 599	2 112	2 039	8.5%	-72	-3%	-2 560	-56%
EU-28	**32 183**	**23 684**	**24 018**	**100%**	**333**	**1%**	**-8 165**	**-25%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	4 599	2 112	2 039	8.5%	-72	-3%	-2 560	-56%
EU-28 + ISL	**32 183**	**23 684**	**24 018**	**100%**	**333**	**1%**	**-8 165**	**-25%**

Emissions of the Luxembourg, Croatia and Malta are included in 1A2g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2d Pulp, Paper and Print – Liquid Fuels (CO_2)

In 2015 CO_2 from liquid fuels had a share of 8% within source category 1A2d (compared to 33% in 1990). Between 1990 and 2015 the emissions decreased by 82% (Table 3.38).

Between 1990 and 2015 all Member States reported decreasing CO_2 emissions from this source category except Croatia, Luxembourg (emissions were IE in 1990), Estonia and Poland.

Table 3.38 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	853	27	41	2.4%	14	50%	-812	-95%	T2	CS
Belgium	235	80	97	5.8%	17	21%	-138	-59%	-	D,PS
Bulgaria	16	12	NO	-	-12	-100%	-16	-100%	NA	NA
Croatia	IE	4	16	1.0%	12	309%	16	∞	T1	D
Cyprus	5	3	3	0.2%	0	0%	-2	-35%	T1	D
Czech Republic	461	3	14	0.8%	11	317%	-447	-97%	T1	CS,D
Denmark	81	0	0	0.0%	0	72%	-80	-100%	T1,T2	CS,D
Estonia	NO	1	1	0.1%	0	40%	1	∞	T1,T2	CS,D
Finland	1 138	294	471	28.3%	178	60%	-666	-59%	T3	CS
France	1 676	280	255	15.3%	-26	-9%	-1 421	-85%	T2	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	302	67	60	3.6%	-6	-10%	-242	-80%	T2	CS
Hungary	19	12	9	0.6%	-3	-25%	-9	-51%	T1	D
Ireland	28	8	8	0.5%	0	3%	-20	-71%	T2	CS
Italy	1 016	172	166	10.0%	-7	-4%	-850	-84%	T2	CS
Latvia	16	0	0	0.0%	0	0%	-15	-97%	T2	CS
Lithuania	69	0	0	0.0%	0	1%	-68	-99%	T2	CS
Luxembourg	IE	0	0	0.0%	0	55%	0	∞	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	2	NO	NO	-	-	-	-2	-100%	NA	NA
Poland	105	118	139	8.4%	22	19%	34	33%	T1	D
Portugal	754	180	217	13.1%	38	21%	-536	-71%	T2	CR,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	985	2	2	0.1%	1	37%	-982	-100%	T2	CS
Slovenia	98	3	4	0.2%	1	37%	-94	-96%	T1	D
Spain	1 246	302	141	8.5%	-161	-53%	-1 105	-89%	T2	CS,PS
Sweden	1 786	C	554	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	769	16	16	1.0%	1	4%	-753	-98%	T2	CS
EU-28	**9 872**	**1 585**	**1 664**	**100%**	**79**	**5%**	**-8 208**	**-83%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	769	16	16	1.0%	1	4%	-753	-98%	T2	CS
EU-28 + ISL	**9 872**	**1 585**	**1 664**	**100%**	**79**	**5%**	**-8 208**	**-83%**	**-**	**-**

Emissions of Germany and Malta are included in 1A2g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.57 and Figure 3.58 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, France, Italy, Portugal, Spain and Sweden; together they cause 80% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-28 decreased by 81% between 1990 and 2015. The CO_2-implied emission factor for liquid fuels was 75.2t/TJ in 2015.

Figure 3.57 1A2d Pulp, Paper and Print, Liquid fuels: Emission trend and share for CO_2

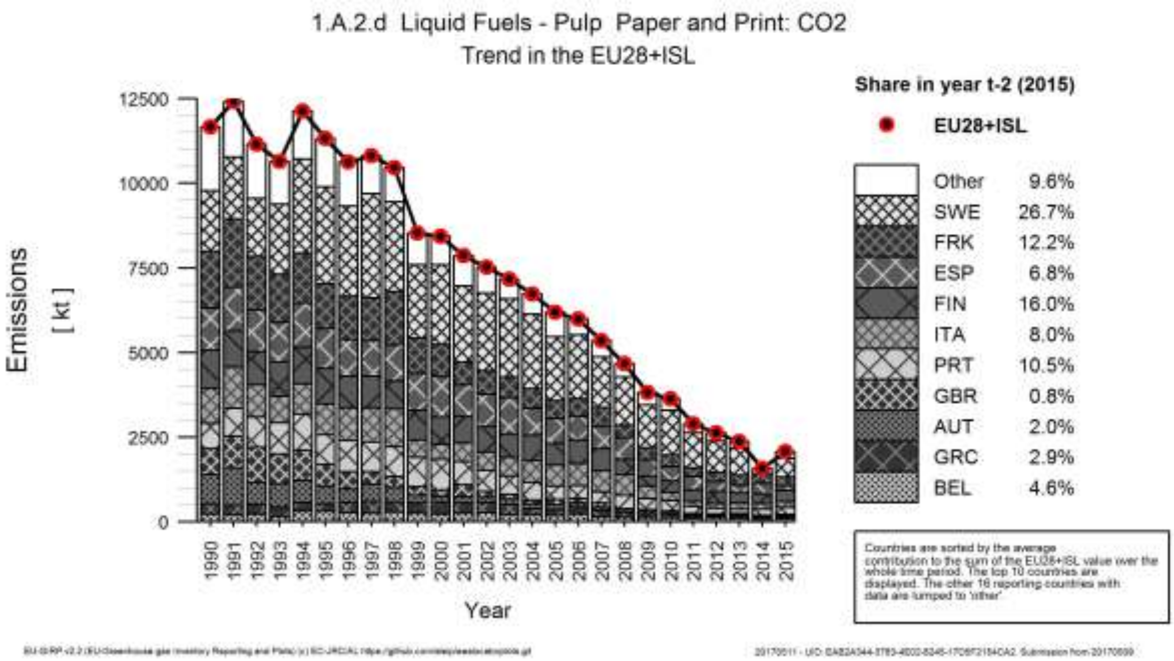
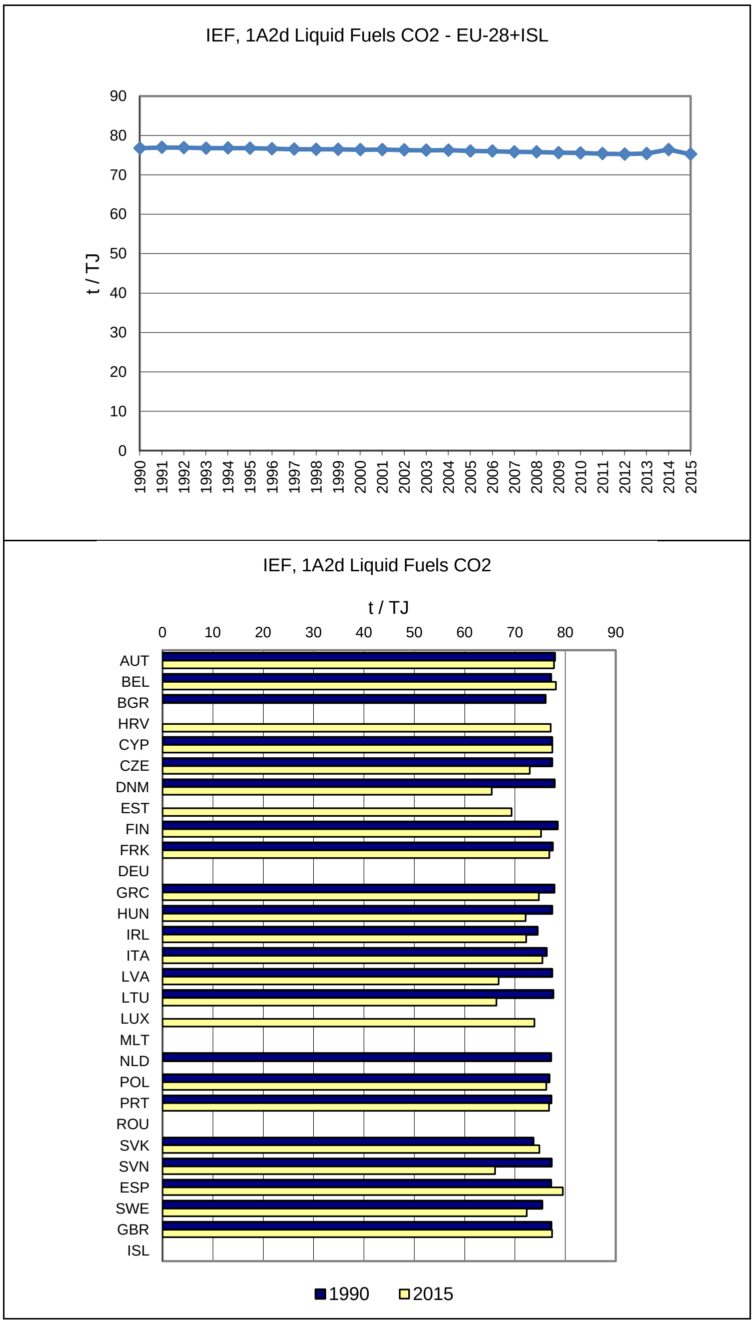


Figure 3.58 1A2d Pulp, Paper and Print, Liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015 CO_2 from solid fuels had a share of 11% within source category 1A2d (compared to 24% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 64% (Table 3.39). Only ten of the EU-28+ISL Member States reported CO_2 emissions from this source category in 2015. All Member States reported decreasing emissions except Poland and Bulgaria. Sweden reports 2013 to 2015 emissions as confidential and for other years it reports emissions from peat together with solid fuels (again for confidential reasons).

Table 3.39 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	398	361	384	13.6%	23	6%	-14	-4%	T2	CS
Belgium	128	96	121	4.3%	25	26%	-6	-5%	T1	D
Bulgaria	NO	4	4	0.1%	-1	-12%	4	∞	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 646	146	138	4.9%	-8	-6%	-1 508	-92%	T2	CS,D
Denmark	125	NO	NO	-	-	-	-125	-100%	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 318	33	153	5.4%	120	358%	-1 165	-88%	T3	CS
France	848	293	291	10.3%	-2	-1%	-556	-66%	T2	CS
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%	0	100%	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	1 070	1 034	36.5%	-36	-3%	860	493%	T1,T2	CS,D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	1 142	319	272	9.6%	-47	-15%	-870	-76%	T2	CS
Slovenia	172	132	121	4.3%	-10	-8%	-51	-29%	T3	PS
Spain	277	NO	NO	-	-	-	-277	-100%	NA	NA
Sweden	263	C	C	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	1 708	401	311	11.0%	-90	-23%	-1 397	-82%	T2	CS
EU-28	**7 961**	**2 856**	**2 829**	**100%**	**-27**	**-1%**	**-5 132**	**-64%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	1 708	401	311	11.0%	-90	-23%	-1 397	-82%	T2	CS
EU-28 + ISL	**7 961**	**2 856**	**2 829**	**100%**	**-27**	**-1%**	**-5 132**	**-64%**	**-**	**-**

Emissions of Germany and Malta are included in 1A2g. Sweden reports confidential data in other solid fuels.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.59 and Figure 3.60 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, France, Slovakia, Poland and the United Kingdom; together they cause around 81% of CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption decreased by 65% between 1990 and 2015. The CO_2-implied emission factor for solid fuels was 94.3 t/TJ in 2015.

Figure 3.59 1A2d Pulp, Paper and Print, Solid fuels: Emission trend and share for CO_2

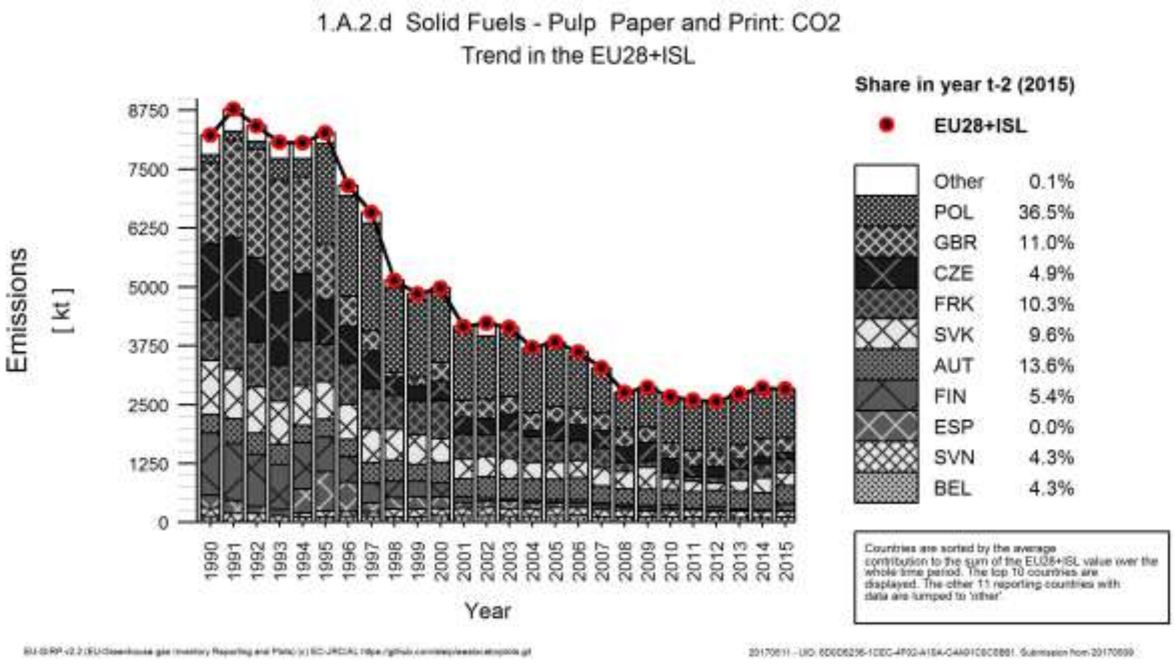
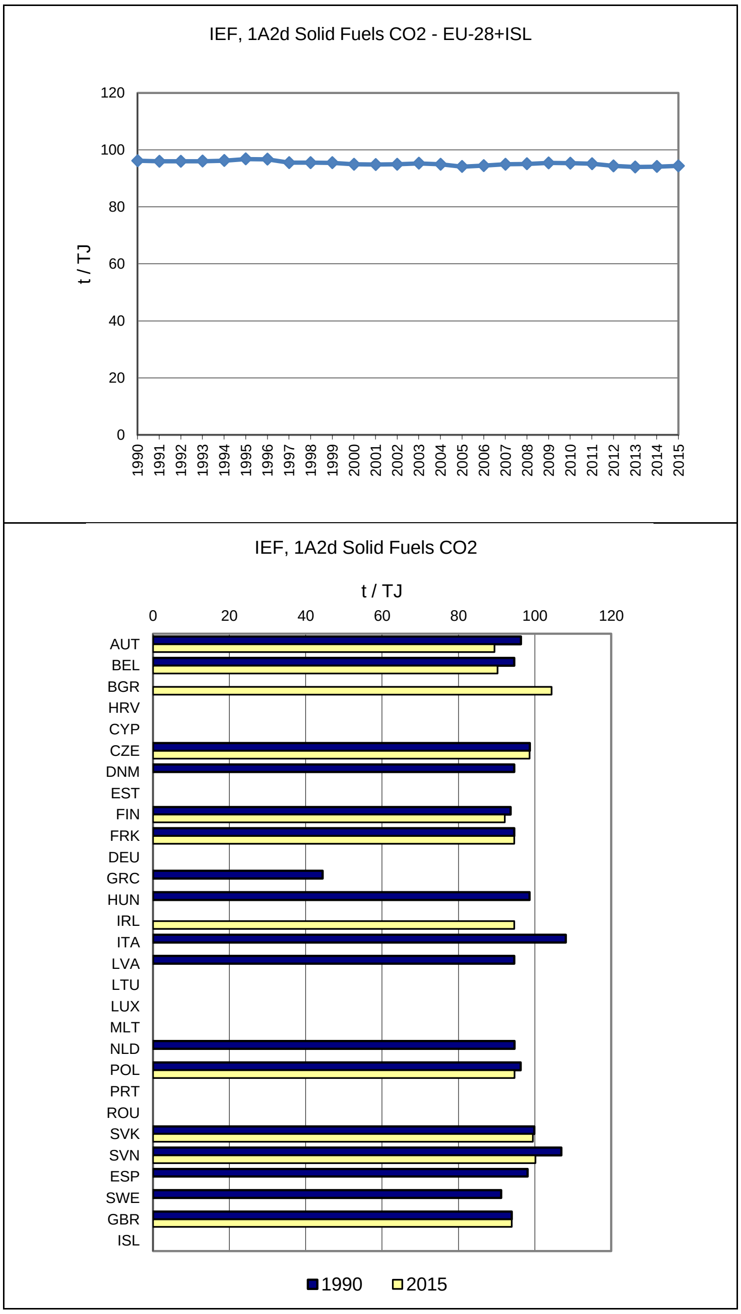


Figure 3.60 1A2d Pulp, Paper and Print, Solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015, CO_2 from gaseous fuels had a share of 75% within source category 1A2d (compared to 38% in 1990). Between 1990 and 2015, the emissions increased by 39% (Table 3.40). Germany and Malta include emissions in 1A2g.

Table 3.40 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	943	1 340	1 403	7.6%	63	5%	460	49%	T2	CS
Belgium	282	312	313	1.7%	0	0%	31	11%	T1	D
Bulgaria	NO	97	108	0.6%	11	11%	108	∞	T2	CS
Croatia	IE	67	54	0.3%	-14	-20%	54	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	179	261	280	1.5%	19	7%	101	56%	T2	CS
Denmark	124	84	68	0.4%	-17	-20%	-57	-46%	T3	CS
Estonia	NO	3	13	0.1%	10	346%	13	∞	T2	CS
Finland	1 757	1 235	1 108	6.0%	-127	-10%	-649	-37%	T3	CS
France	2 313	2 326	2 354	12.8%	28	1%	42	2%	T2	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	67	44	0.2%	-22	-34%	44	∞	T2	CS
Hungary	50	183	146	0.8%	-38	-21%	96	191%	T1	D
Ireland	NO	7	8	0.0%	1	15%	8	∞	T2	CS
Italy	2 055	3 974	4 411	23.9%	437	11%	2 356	115%	T2	CS
Latvia	150	5	5	0.0%	0	-2%	-145	-97%	T2	CS
Lithuania	187	26	21	0.1%	-5	-19%	-165	-89%	T2	CS
Luxembourg	IE	7	7	0.0%	0	-1%	7	∞	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 659	1 009	885	4.8%	-125	-12%	-774	-47%	T2	CS
Poland	6	392	402	2.2%	10	2%	396	6995%	T1	D
Portugal	NO	827	891	4.8%	64	8%	891	∞	T2	CR,D
Romania	NO	123	155	0.8%	32	26%	155	∞	T2	CS
Slovakia	203	131	186	1.0%	55	42%	-17	-8%	T2	CS
Slovenia	110	189	187	1.0%	-2	-1%	78	71%	T2	CS
Spain	1 071	3 543	3 657	19.8%	113	3%	2 586	241%	T2	CS
Sweden	66	35	45	0.2%	10	29%	-21	-32%	T2	CS
United Kingdom	2 122	1 695	1 712	9.3%	17	1%	-410	-19%	T2	CS
EU-28	**13 274**	**17 941**	**18 461**	**100%**	**520**	**3%**	**5 186**	**39%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	2 122	1 695	1 712	9.3%	17	1%	-410	-19%	T2	CS
EU-28 + ISL	**13 274**	**17 941**	**18 461**	**100%**	**520**	**3%**	**5 186**	**39%**	**-**	**-**

Emissions of Germany and 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 Austria, 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 38% between 1990 and 2015. The CO_2-implied emission factor for gaseous fuels was 56.4 t/TJ in 2015.

Figure 3.61 1A2d Pulp, Paper and Print, Gaseous fuels: Emission trend and share for CO_2

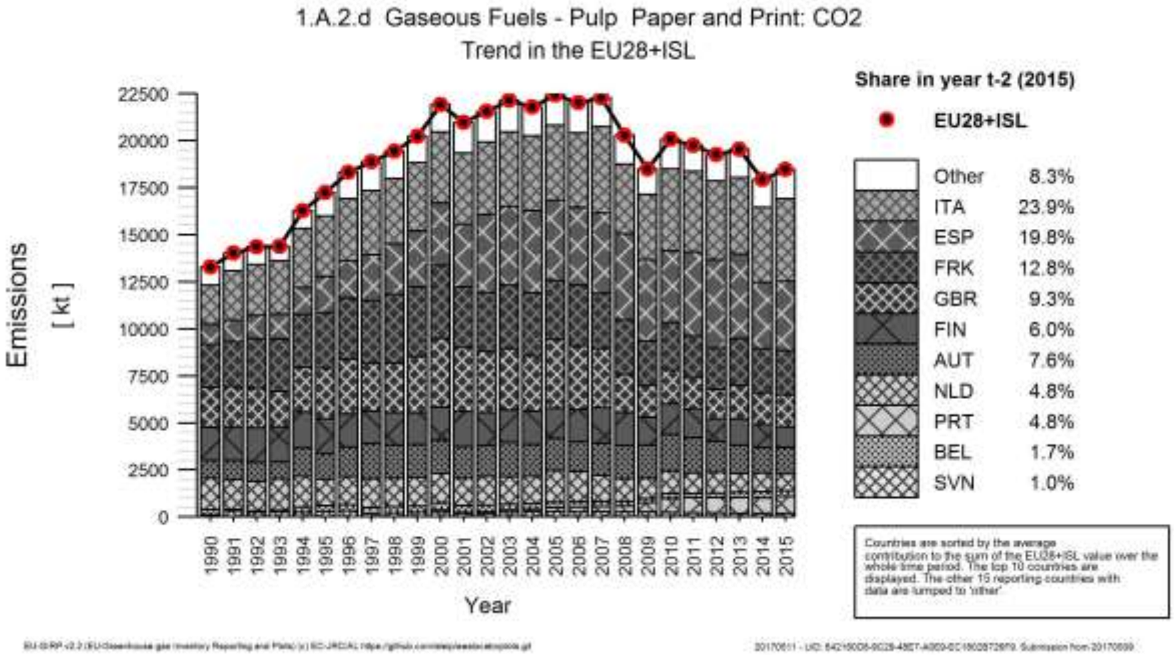
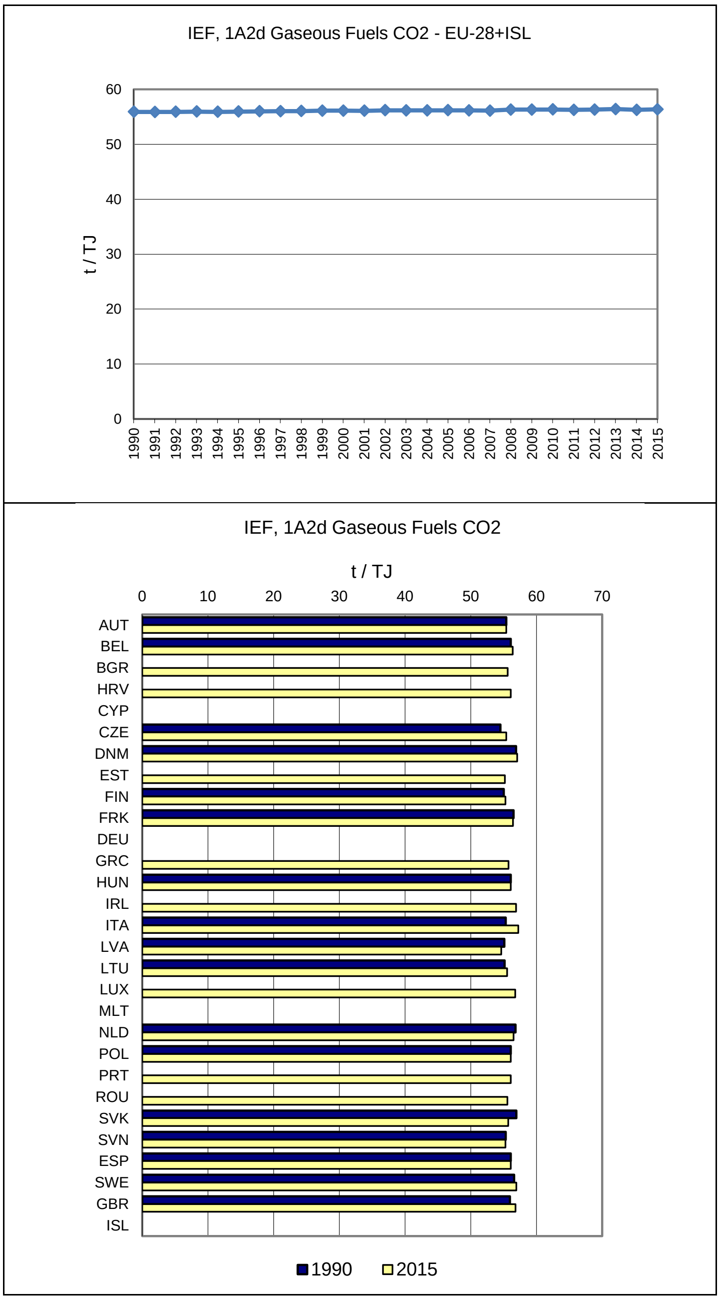


Figure 3.62 1A2d Pulp, Paper and Print, Gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)

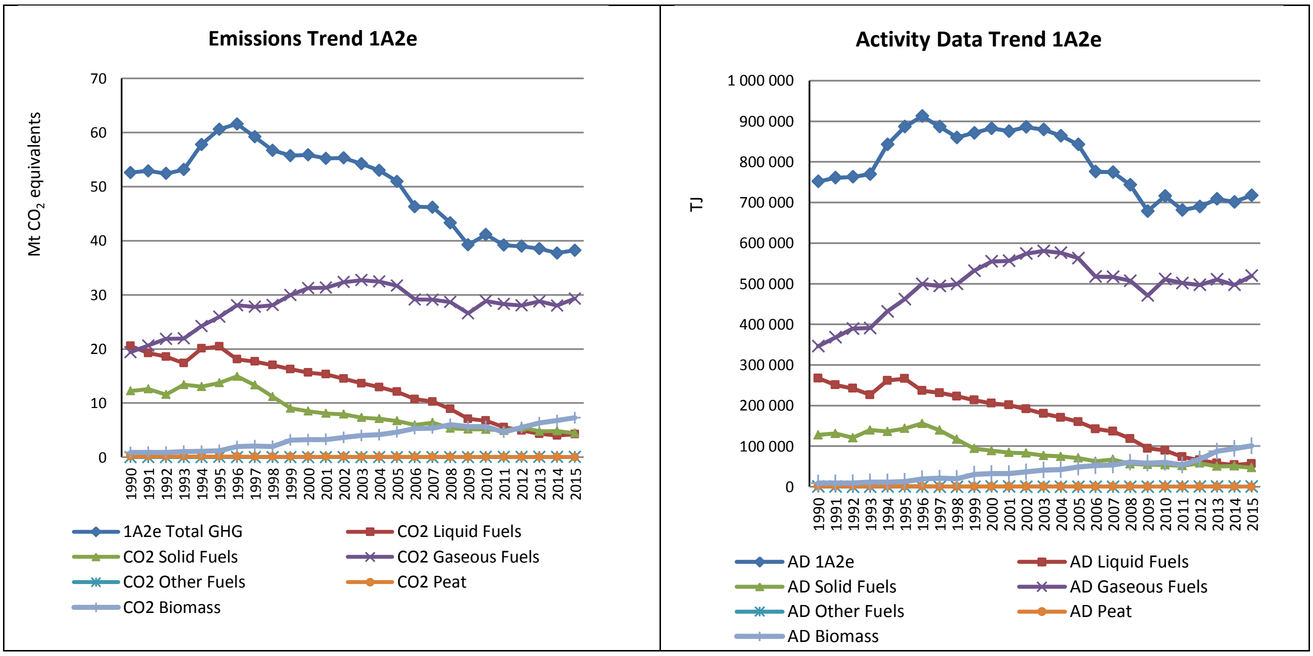


3.2.2.5 Food Processing, Beverages and Tobacco (1A2e)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 7.8% of 1A2 source category and for 0.9% of total GHG emissions in 2015.

Figure 3.63 shows the emission trend within the category 1A2e, which is dominated by CO_2 emissions from gaseous fuels. Total GHG emissions decreased by 27% between 1990 and 2015. Emissions from gaseous fuels increased by 51%, whereas emissions from liquid and solid fuels significantly decreased. The use of biomass is increasing continuously within this category. For confidentiality reasons Germany reports emissions from gaseous fuels under 1A2g. For confidentiality reasons Sweden reports emissions from solid fuels together with liquid fuels and for 2013 and 2015 it reports total emissions as confidential.

Figure 3.63 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2015, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco decreased by 27% in the EU-28+ISL (Table 3.41). Between 2014 and 2015 CO_2 emissions increased by 2%. Emissions of Malta are included in 1A2g.

Table 3.41 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	868	913	1 018	2.7%	105	11%	150	17%
Belgium	3 023	2 226	2 141	5.7%	-85	-4%	-882	-29%
Bulgaria	454	256	259	0.7%	3	1%	-194	-43%
Croatia	NO,IE	400	351	0.9%	-49	-12%	351	∞
Cyprus	73	53	75	0.2%	22	42%	2	3%
Czech Republic	2 988	985	1 014	2.7%	30	3%	-1 974	-66%
Denmark	1 540	1 064	1 009	2.7%	-55	-5%	-531	-34%
Estonia	457	5	10	0.0%	5	117%	-447	-98%
Finland	828	238	161	0.4%	-77	-32%	-667	-81%
France	8 947	7 404	7 162	19.0%	-242	-3%	-1 785	-20%
Germany	2 016	202	204	0.5%	2	1%	-1 812	-90%
Greece	917	646	620	1.6%	-25	-4%	-296	-32%
Hungary	1 888	701	717	1.9%	16	2%	-1 170	-62%
Ireland	1 017	800	884	2.3%	85	11%	-133	-13%
Italy	3 857	3 476	3 740	9.9%	263	8%	-117	-3%
Latvia	1 084	125	111	0.3%	-14	-11%	-973	-90%
Lithuania	676	248	239	0.6%	-9	-4%	-437	-65%
Luxembourg	8	21	21	0.1%	1	4%	13	162%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	4 009	3 482	3 574	9.5%	92	3%	-435	-11%
Poland	3 734	4 021	3 813	10.1%	-208	-5%	79	2%
Portugal	830	787	800	2.1%	14	2%	-30	-4%
Romania	110	850	837	2.2%	-13	-2%	727	662%
Slovakia	1 140	326	329	0.9%	3	1%	-811	-71%
Slovenia	221	105	89	0.2%	-16	-15%	-131	-60%
Spain	2 989	2 904	3 986	10.6%	1 082	37%	997	33%
Sweden	948	437	C	NA	NA	NA	NA	NA
Untited Kingdom	7 594	4 515	4 473	11.9%	-42	-1%	-3 121	-41%
EU-28	**51 267**	**36 751**	**37 638**	**100%**	**887**	**2%**	**-13 630**	**-27%**
Iceland	128	14	31	0.1%	17	126%	-97	-76%
United Kingdom (KP)	7 594	4 515	4 473	11.9%	-42	-1%	-3 121	-41%
EU-28 + ISL	**51 396**	**36 765**	**37 669**	**100%**	**904**	**2%**	**-13 727**	**-27%**

Emissions of Malta are included in 1A2g.
The numbers for 2015 for EU-28 and EU-28 + ISL in this table differ from the numbers in the respective CRF tables because the EU CRF includes CO_2 emissions from liquid and gaseous fuels reported by Sweden. Note that Sweden reports for all fuels C which is reflected in this table. In general, EU trends in this table do not include Sweden to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF for the years 1990 and 2014.
Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2015 CO_2 from liquid fuels decreased to a share of 11% within source category 1A2e (compared to 39% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 79%

(Table 3.42). Between 1990 and 2015 all Member States showed a reduction of emissions except for Romania, Cyprus and Croatia. Emissions of Malta are included in 1A2g.

Table 3.42 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	343	157	156	3.7%	0	0%	-187	-54%	T2	CS
Belgium	1 689	254	85	2.0%	-169	-66%	-1 604	-95%	T1	D
Bulgaria	409	31	34	0.8%	3	10%	-375	-92%	T1	D
Croatia	IE	57	60	1.4%	3	6%	60	∞	T1	D
Cyprus	73	53	75	1.8%	22	42%	2	3%	T1	D
Czech Republic	472	12	22	0.5%	10	80%	-450	-95%	T1	CS,D
Denmark	673	211	173	4.1%	-38	-18%	-499	-74%	T1,T2	CS,D
Estonia	437	1	2	0.1%	1	58%	-435	-99%	T1,T2	CS,D
Finland	365	85	80	1.9%	-6	-7%	-285	-78%	T3	CS
France	3 583	452	295	6.9%	-157	-35%	-3 288	-92%	T2	CS
Germany	908	23	21	0.5%	-2	-8%	-887	-98%	CS	CS
Greece	863	483	464	10.9%	-19	-4%	-398	-46%	T2	CS
Hungary	463	30	24	0.6%	-6	-21%	-440	-95%	T1	D
Ireland	433	357	376	8.9%	19	5%	-57	-13%	T1,T2	CS,D
Italy	1 423	163	520	12.2%	357	219%	-903	-63%	T2	CS
Latvia	806	26	18	0.4%	-8	-31%	-788	-98%	T2	CS
Lithuania	174	38	42	1.0%	4	12%	-132	-76%	T2	CS
Luxembourg	4	1	2	0.1%	1	55%	-2	-50%	T1,T2	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	165	NO	NO	-	-	-	-165	-100%	NA	NA
Poland	231	251	203	4.8%	-48	-19%	-28	-12%	T1	D
Portugal	829	266	261	6.1%	-5	-2%	-569	-69%	T2	CR,D
Romania	NO	106	97	2.3%	-9	-9%	97	∞	T1,T2	CS,D
Slovakia	359	0	0	0.0%	0	4%	-358	-100%	T2	CS
Slovenia	146	28	28	0.7%	0	-1%	-118	-81%	T1	D
Spain	2 238	400	743	17.5%	343	86%	-1 495	-67%	T2	CS
Sweden	596	207	167	3.9%	-40	-19%	-429	-72%	T2	CS
United Kingdom	2 735	293	266	6.3%	-27	-9%	-2 470	-90%	T2	CS
EU-28	**20 417**	**3 986**	**4 214**	**99%**	**228**	**6%**	**-16 204**	**-79%**	**-**	**-**
Iceland	128	14	31	0.7%	17	126%	-97	-76%	T1	D
United Kingdom (KP)	2 735	293	266	6.3%	-27	-9%	-2 470	-90%	T2	CS
EU-28 + ISL	**20 546**	**4 000**	**4 245**	**100%**	**245**	**6%**	**-16 301**	**-79%**	**-**	**-**

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

Figure 3.64 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, Spain, Greece, Italy and Ireland; together they cause 81% of CO_2 emissions from liquid fuels in 1A2e. Fuel consumption decreased by 79% between 1990 and 2015. The CO_2-implied emission factor for liquid fuels was 74.2 t/TJ in 2015.

Figure 3.64 1A2e Food Processing, Beverages and Tobacco, Liquid fuels: Emission trend and share for CO_2

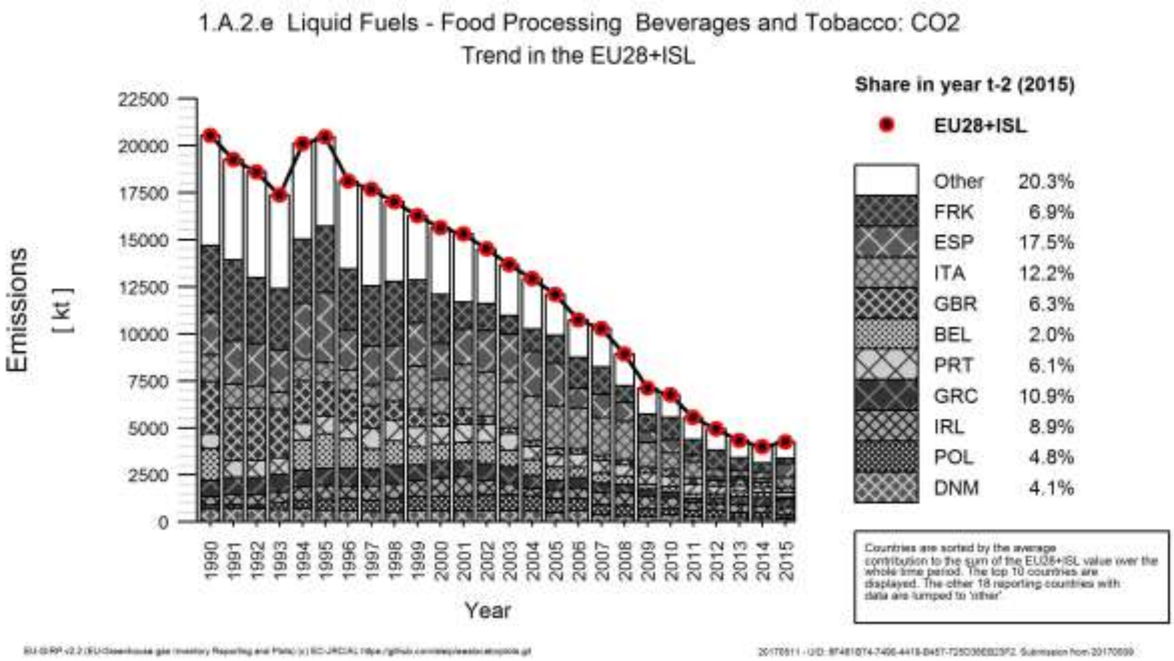
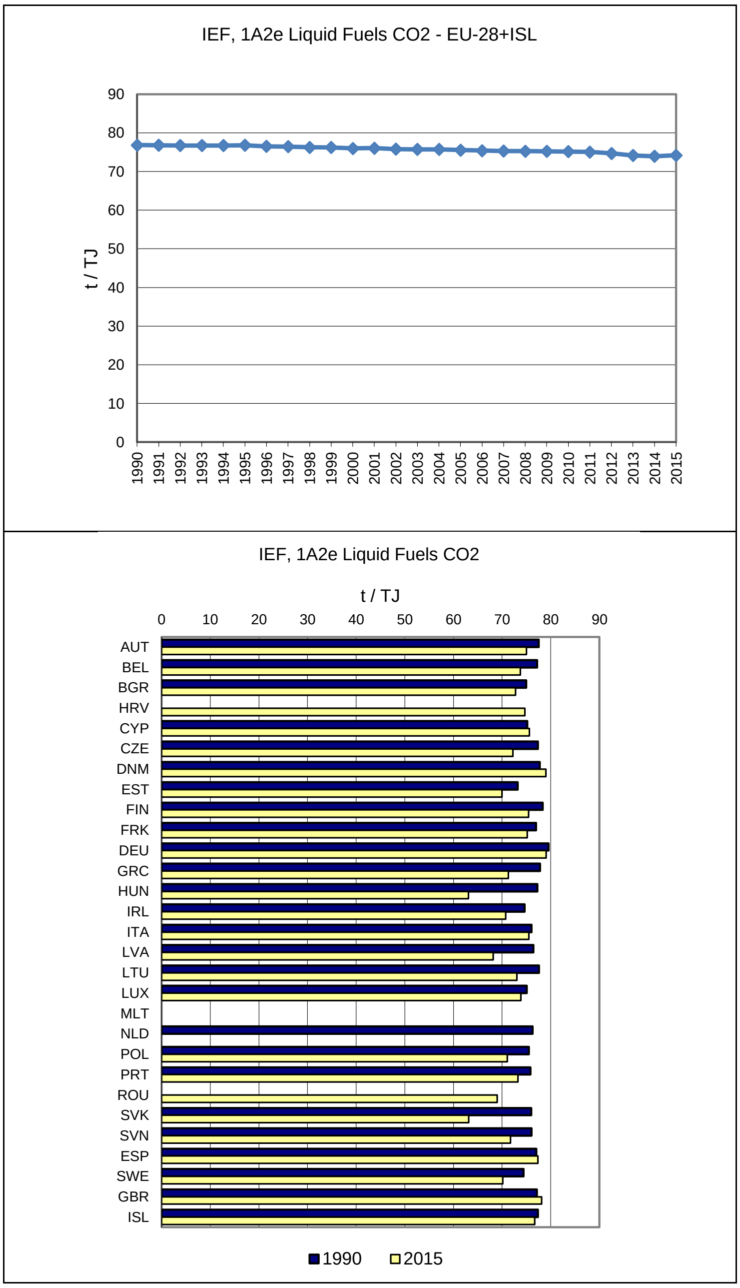


Figure 3.65 1A2e Food Processing, Beverages and Tobacco, Liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015 solid fuels had a share of 12% within source category 1A2e (compared to 23% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 63% (Table 3.43) and all Member States reported decreasing CO_2 emissions from this source category. Sweden reports emissions from solid fuels as confidential. Emissions of Malta are included in 1A2g.

Table 3.43 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	18	19	23	0.5%	5	25%	5	29%	T2	CS
Belgium	651	102	105	2.4%	4	3%	-545	-84%	T1	D
Bulgaria	33	4	7	0.2%	3	80%	-25	-77%	T1,T2	CS,D
Croatia	IE	75	68	1.5%	-7	-10%	68	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 789	193	219	4.9%	26	13%	-1 570	-88%	T2	CS,D
Denmark	402	134	128	2.9%	-6	-5%	-273	-68%	T1	D
Estonia	5	0	NO	-	0	-100%	-5	-100%	NA	NA
Finland	257	94	69	1.6%	-25	-27%	-188	-73%	T3	CS
France	1 735	1 145	991	22.2%	-154	-13%	-745	-43%	T2	CS
Germany	1 108	179	183	4.1%	4	2%	-925	-83%	CS	CS
Greece	54	6	4	0.1%	-2	-28%	-50	-92%	T2	PS
Hungary	185	9	6	0.1%	-3	-33%	-179	-97%	T1,T2	CS,D
Ireland	292	84	87	2.0%	4	5%	-204	-70%	T2	CS
Italy	88	22	11	0.2%	-11	-50%	-76	-87%	T2	CS
Latvia	103	2	2	0.1%	0	0%	-101	-98%	T1	D
Lithuania	33	12	8	0.2%	-4	-32%	-25	-75%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	227	97	77	1.7%	-19	-20%	-150	-66%	T2	CS
Poland	3 392	2 363	2 151	48.3%	-212	-9%	-1 241	-37%	T1,T2	CS,D
Portugal	1	NO	NO	-	-	-	-1	-100%	NA	NA
Romania	110	35	41	0.9%	6	16%	-69	-63%	T1	D
Slovakia	312	40	53	1.2%	13	33%	-259	-83%	T2	CS
Slovenia	9	NO	NO	-	-	-	-9	-100%	NA	NA
Spain	94	33	32	0.7%	-1	-4%	-62	-66%	T2	CS
Sweden	90	C	C	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	1 254	210	186	4.2%	-25	-12%	-1 068	-85%	T2	CS
EU-28	**12 150**	**4 859**	**4 453**	**100%**	**-406**	**-8%**	**-7 697**	**-63%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	1 254	210	186	4.2%	-25	-12%	-1 068	-85%	T2	CS
EU-28 + ISL	**12 150**	**4 859**	**4 453**	**100%**	**-406**	**-8%**	**-7 697**	**-63%**	**-**	**-**

Emissions of Malta are included in 1A2g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

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 Poland and France which contribute 67% of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption decreased by 63% between 1990 and 2015.The CO_2-implied emission factor for solid fuels was 95.2 t/TJ in 2015.

Figure 3.66   1A2e Food Processing, Beverages and Tobacco, solid fuels: Emission trend and share for CO_2

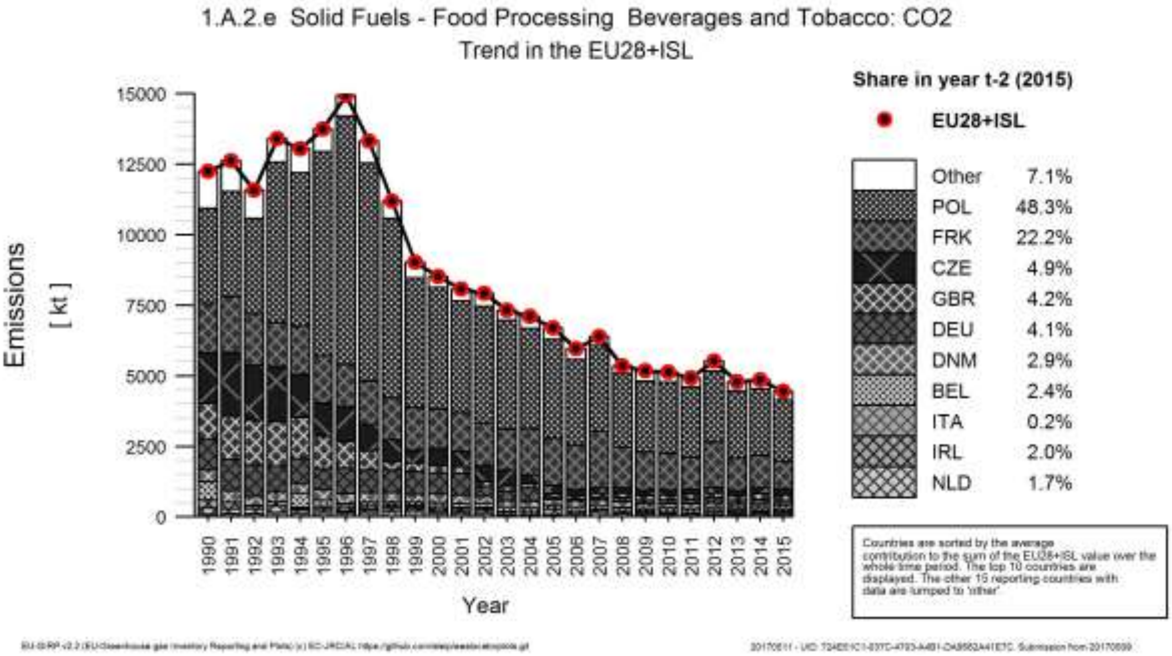
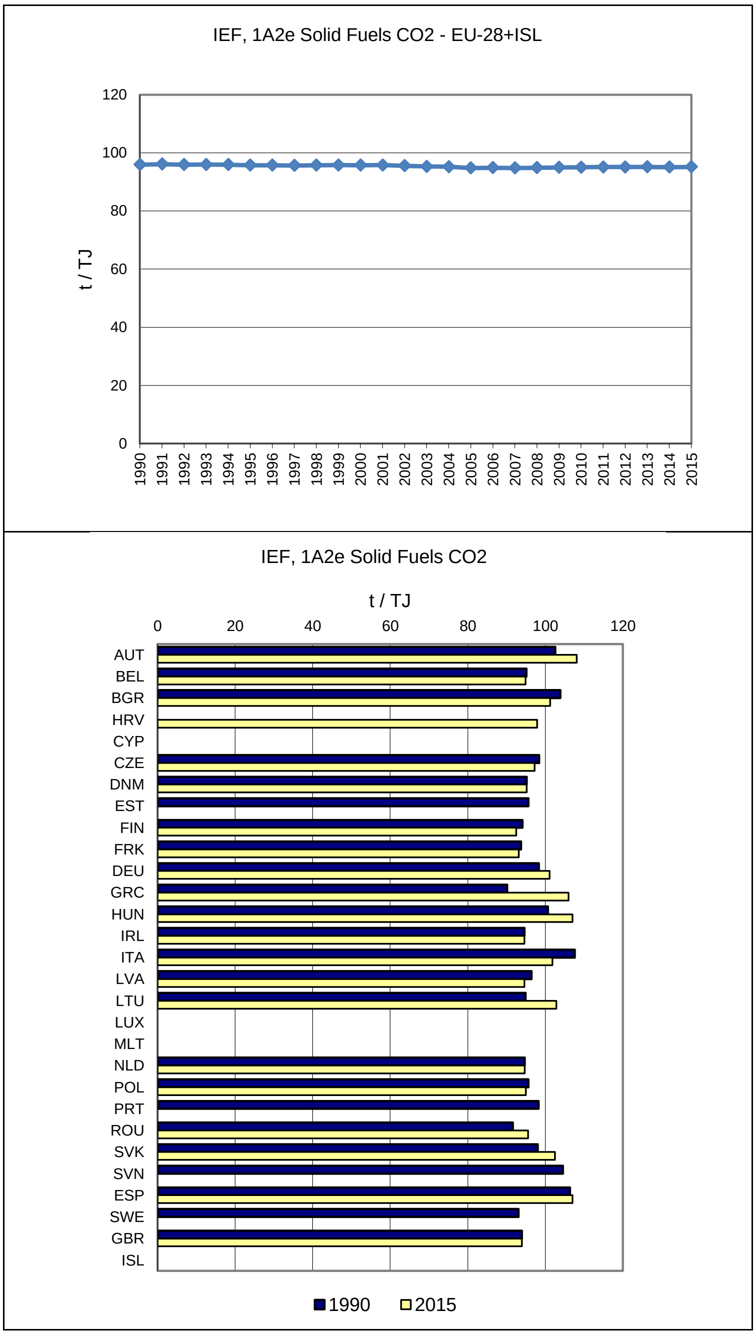


Figure 3.67 1A2e Food Processing, Beverages and Tobacco, Solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015 CO_2 from gaseous fuels had a share of 77% within source category 1A2e (compared to 37% in 1990). Between 1990 and 2015 CO_2 emissions increased by 52% (Table 3.44). Between 1990 and 2015 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. Sweden reports 2014 emissions as confidential.

Table 3.44 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	507	738	838	2.9%	100	14%	331	65%	T2	CS
Belgium	684	1 870	1 951	6.7%	80	4%	1 266	185%	-	D,PS
Bulgaria	11	222	218	0.7%	-4	-2%	206	1807%	T2	CS
Croatia	IE	268	223	0.8%	-45	-17%	223	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	727	780	774	2.7%	-6	-1%	47	6%	T2	CS
Denmark	466	719	707	2.4%	-11	-2%	242	52%	T3	CS
Estonia	15	3	8	0.0%	5	153%	-7	-48%	T2	CS
Finland	67	14	12	0.0%	-2	-13%	-55	-82%	T3	CS
France	3 629	5 807	5 876	20.2%	70	1%	2 248	62%	T2	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	157	152	0.5%	-5	-3%	152	∞	T2	CS
Hungary	1 239	662	687	2.4%	26	4%	-552	-45%	T1	D
Ireland	293	356	418	1.4%	62	17%	125	43%	T2	CS
Italy	2 347	3 291	3 209	11.0%	-82	-2%	862	37%	T2	CS
Latvia	175	94	89	0.3%	-5	-6%	-86	-49%	T2	CS
Lithuania	469	197	188	0.6%	-9	-5%	-281	-60%	T2	CS
Luxembourg	4	19	19	0.1%	0	1%	15	407%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	3 617	3 385	3 497	12.0%	111	3%	-121	-3%	T2	CS
Poland	111	1 408	1 459	5.0%	51	4%	1 349	1220%	T1	D
Portugal	NO	521	540	1.9%	19	4%	540	∞	T2	CR,D
Romania	NO	670	673	2.3%	4	1%	673	∞	T2	CS
Slovakia	470	286	276	0.9%	-10	-4%	-194	-41%	T2	CS
Slovenia	65	77	61	0.2%	-16	-21%	-4	-6%	T2	CS
Spain	657	2 470	3 211	11.0%	741	30%	2 554	389%	T2	CS
Sweden	254	C	202	NA	NA	NA	NA	NA	T2	CS
Untited Kingdom	3 605	4 012	4 021	13.8%	9	0%	416	12%	T2	CS
EU-28	**19 157**	**28 024**	**29 106**	**100%**	**1 082**	**4%**	**9 949**	**52%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	3 605	4 012	4 021	13.8%	9	0%	416	12%	T2	CS
EU-28 + ISL	**19 157**	**28 024**	**29 106**	**100%**	**1 082**	**4%**	**9 949**	**52%**	**-**	**-**

Emissions of Germany and Malta are included in 1A2g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

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 France, Italy, the Netherlands, Spain and the United Kingdom; together they cause about 68% of CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption rose by 50% between 1990 and 2015. The CO_2-implied emission factor for gaseous fuels was 56.4 t/TJ in 2015.

Figure 3.68 1A2e Food Processing, Beverages and Tobacco, Gaseous fuels: Emission trend and share for CO_2

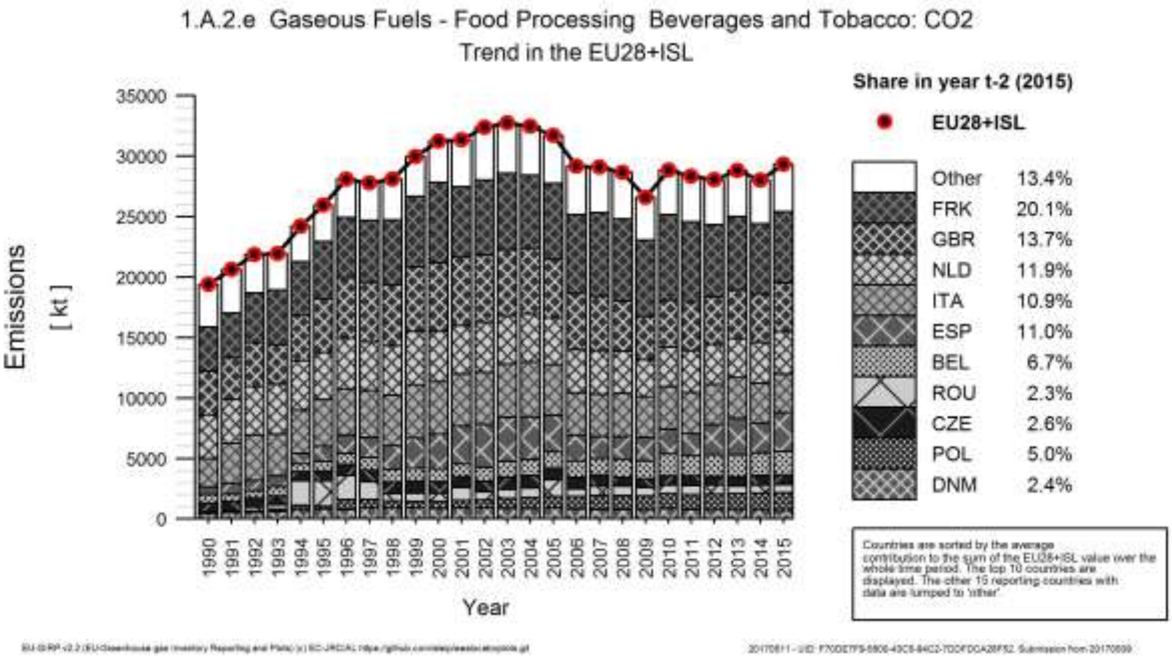
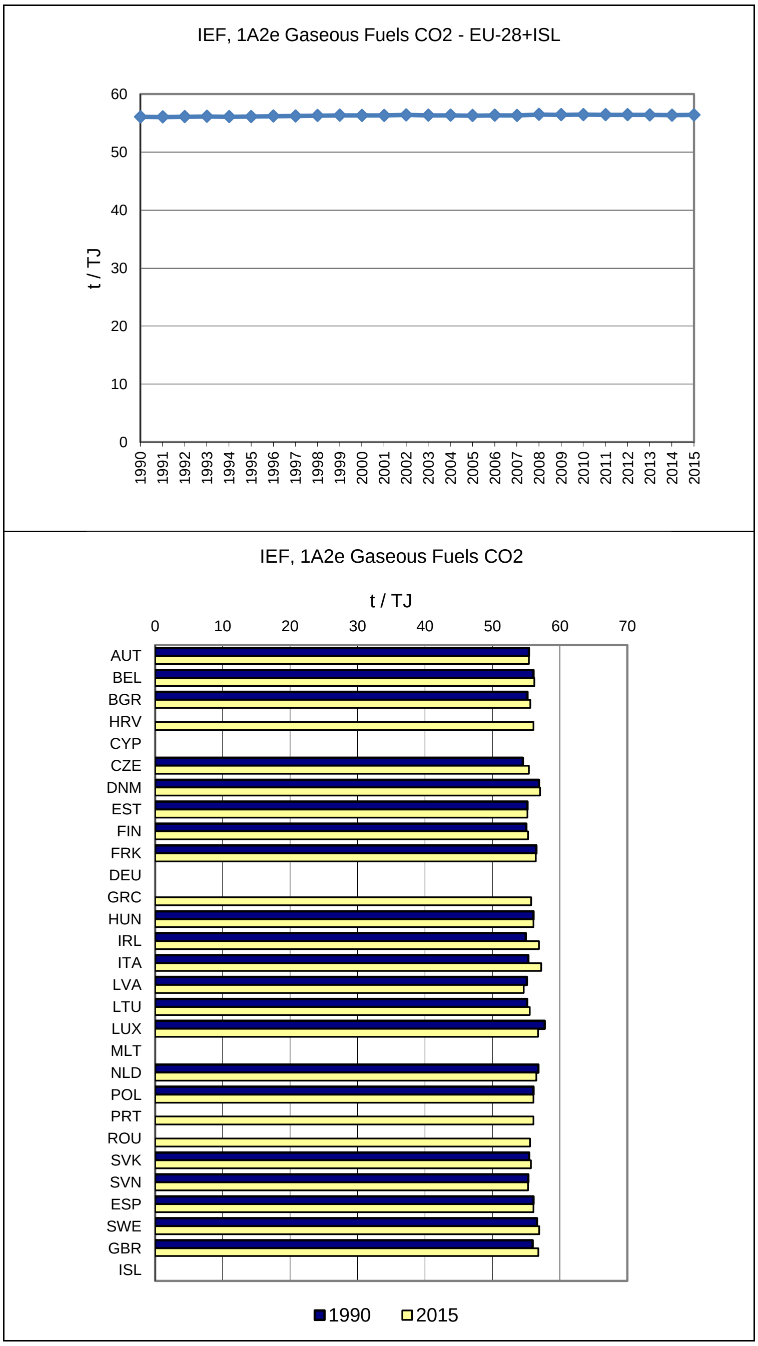


Figure 3.69 1A2e Food Processing, Beverages and Tobacco, Gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)

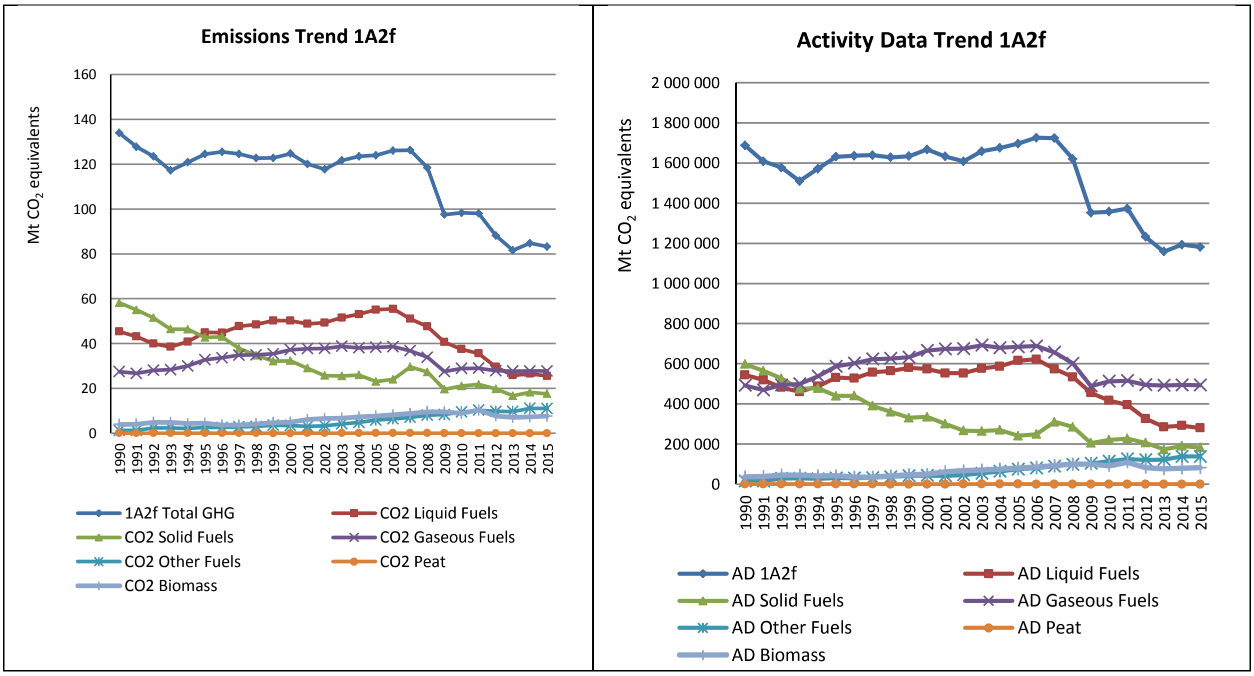


3.2.2.6 Non-metallic Minerals (1A2f)

In this chapter information about emission trends, Member States contribution and activity data is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Non-metallic Minerals accounted for 17 % for 1A2 source category and for 2% of total GHG emissions in 2015.

Figure 3.70 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 2015 total GHG emissions decreased by 38%, mainly due to decreases in CO_2 emissions from solid (-70%) and liquid (-44%) fuels while CO_2 emissions from other fossil fuels (non-renewable waste) increased by 785% and emissions of biomass (renewable waste) increased by 96%.

Figure 3.70 1A2f Non-metallic Minerals: Activity data and CO_2 emission trends



Between 1990 and 2015, CO_2 emissions from 1A2f Non-metallic Minerals decreased by 38% in the EU-28+ISL (Table 3.45), 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 3.45 1A2f Non-metallic Minerals : Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	1 669	1 613	1 599	1.9%	-14	-1%	-70	-4%
Belgium	5 525	3 694	3 451	4.2%	-243	-7%	-2 075	-38%
Bulgaria	2 646	1 254	1 228	1.5%	-25	-2%	-1 417	-54%
Croatia	NO,IE	95	82	0.1%	-13	-14%	82	∞
Cyprus	380	584	433	0.5%	-151	-26%	54	14%
Czech Republic	4 527	2 218	2 351	2.9%	133	6%	-2 176	-48%
Denmark	1 291	1 140	1 162	1.4%	21	2%	-130	-10%
Estonia	952	513	270	0.3%	-243	-47%	-681	-72%
Finland	1 368	591	588	0.7%	-3	-1%	-780	-57%
France	15 512	9 079	8 988	11.0%	-91	-1%	-6 524	-42%
Germany	18 507	13 243	13 145	16.0%	-97	-1%	-5 362	-29%
Greece	6 278	3 490	3 346	4.1%	-145	-4%	-2 932	-47%
Hungary	2 326	925	1 031	1.3%	106	11%	-1 295	-56%
Ireland	819	1 105	1 154	1.4%	50	4%	335	41%
Italy	21 225	14 109	12 985	15.8%	-1 124	-8%	-8 240	-39%
Latvia	609	321	284	0.3%	-37	-12%	-325	-53%
Lithuania	3 210	527	440	0.5%	-87	-17%	-2 770	-86%
Luxembourg	537	390	361	0.4%	-28	-7%	-175	-33%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	2 298	1 124	1 160	1.4%	36	3%	-1 138	-50%
Poland	10 433	7 602	7 364	9.0%	-238	-3%	-3 069	-29%
Portugal	3 279	3 000	2 981	3.6%	-19	-1%	-297	-9%
Romania	265	2 271	2 463	3.0%	192	8%	2 198	831%
Slovakia	3 236	1 366	1 235	1.5%	-132	-10%	-2 001	-62%
Slovenia	296	435	399	0.5%	-36	-8%	103	35%
Spain	16 144	9 199	9 716	11.8%	517	6%	-6 428	-40%
Sweden	1 826	1 313	1 239	1.5%	-74	-6%	-587	-32%
United Kingdom	7 041	2 433	2 592	3.2%	159	7%	-4 449	-63%
EU-28	**132 197**	**83 633**	**82 046**	**100%**	**-1 587**	**-2%**	**-50 151**	**-38%**
Iceland	52	0.2	0.3	0.0004%	0.1	42%	-52	-99%
United Kingdom (KP)	7 041	2 433	2 592	3.2%	159	7%	-4 449	-63%
EU-28 + ISL	**132 249**	**83 633**	**82 046**	**100%**	**-1 587**	**-2%**	**-50 203**	**-38%**

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

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

In 2015 CO_2 emissions from liquid fuels had a share of 31% within source category 1A2f (compared to 34% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 44% (Table 3.46). Between 1990 and 2015 the highest absolute decreases were achieved by France, Italy, Lithuania and Spain. Romania is the only member state which reports a significant increase in emissions from this source.

Table 3.46 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	508	157	153	0.6%	-4	-2%	-355	-70%	T2	CS
Belgium	1 509	394	275	1.1%	-119	-30%	-1 234	-82%	T1,T3	D,PS
Bulgaria	666	417	354	1.4%	-63	-15%	-312	-47%	T1	D
Croatia	IE	1	1	0.0%	0	0%	1	∞	T1	D
Cyprus	148	519	414	1.6%	-105	-20%	266	180%	CS	CS
Czech Republic	1 029	33	43	0.2%	10	30%	-986	-96%	T1	CS,D
Denmark	480	634	632	2.5%	-3	0%	151	32%	T1,T2	CS,D
Estonia	140	3	2	0.0%	-1	-25%	-137	-98%	T1,T2	CS,D
Finland	437	251	230	0.9%	-22	-9%	-207	-47%	T3	CS
France	7 040	2 832	2 800	11.0%	-32	-1%	-4 239	-60%	T2,T3	CS,PS
Germany	2 663	1 167	874	3.4%	-293	-25%	-1 789	-67%	CS	CS
Greece	2 914	3 123	3 011	11.8%	-112	-4%	98	3%	T2	PS
Hungary	423	248	306	1.2%	58	24%	-117	-28%	T1,T3	CS,D
Ireland	312	583	634	2.5%	51	9%	322	103%	T1,T2	CS,D
Italy	11 367	7 116	6 521	25.6%	-595	-8%	-4 846	-43%	T2	CS
Latvia	276	21	21	0.1%	0	2%	-255	-92%	T2	CS
Lithuania	2 750	15	10	0.0%	-5	-33%	-2 740	-100%	T2	CS
Luxembourg	23	4	3	0.0%	-1	-20%	-20	-85%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	468	15	15	0.1%	0	0%	-453	-97%	T2	CS
Poland	392	178	143	0.6%	-35	-19%	-248	-63%	T1	D
Portugal	1 309	1 679	1 587	6.2%	-92	-5%	279	21%	T2,T3	CR,D,PS
Romania	NO	1 009	1 180	4.6%	171	17%	1 180	∞	T1,T2	CS,D
Slovakia	1 219	222	180	0.7%	-42	-19%	-1 039	-85%	T2	CS
Slovenia	63	157	99	0.4%	-58	-37%	36	56%	T1	D
Spain	8 460	5 275	5 504	21.6%	230	4%	-2 956	-35%	T2	CS,M
Sweden	625	365	346	1.4%	-19	-5%	-279	-45%	T1,T2	CS
United Kingdom	127	115	174	0.7%	59	51%	47	37%	T2	CS
EU-28	**45 349**	**26 535**	**25 514**	**100%**	**-1 021**	**-4%**	**-19 835**	**-44%**	**-**	**-**
Iceland	IE	IE	IE	-	-	-	-	-	NA	NA
United Kingdom (KP)	127	115	174	0.7%	59	51%	47	37%	T2	CS
EU-28 + ISL	**45 349**	**26 535**	**25 514**	**100%**	**-1 021**	**-4%**	**-19 835**	**-44%**	**-**	**-**

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

Figure 3.71 and Figure 3.72 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 70% of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption decreased by 49% between 1990 and 2015. The CO_2-implied emission factor for liquid fuels was 91.2 t/TJ in 2015. The high IEF is mainly due to the consumption of petrol coke in cement kilns.

Figure 3.71 1A2f Non-metallic Minerals, liquid fuels: Emission trend and share for CO_2

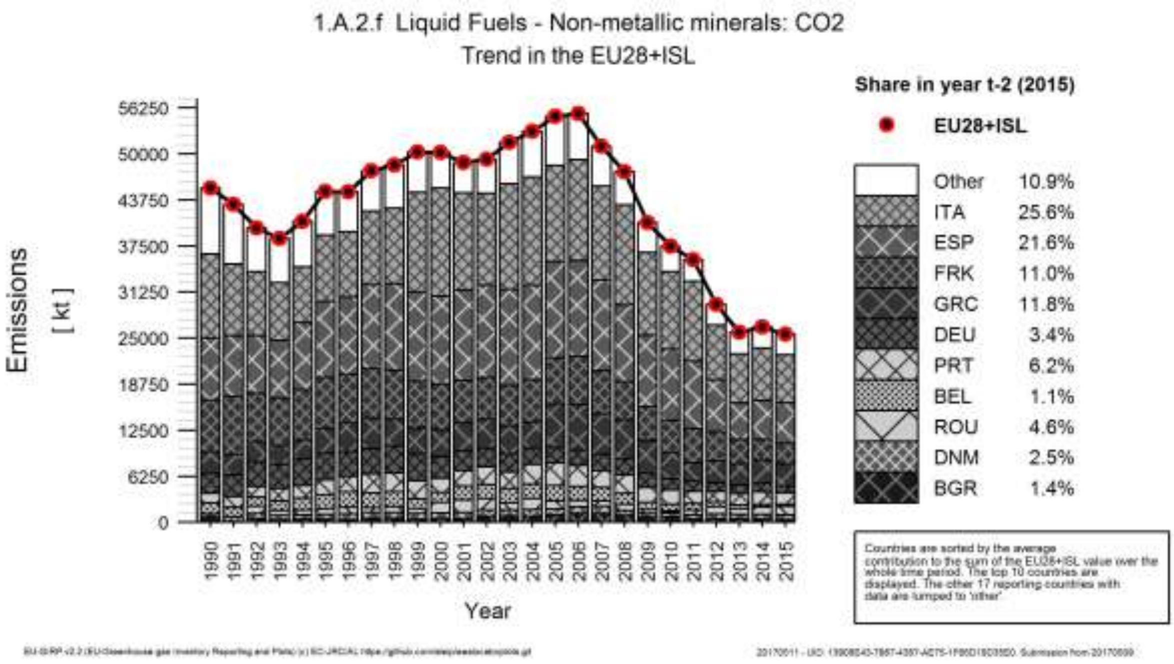
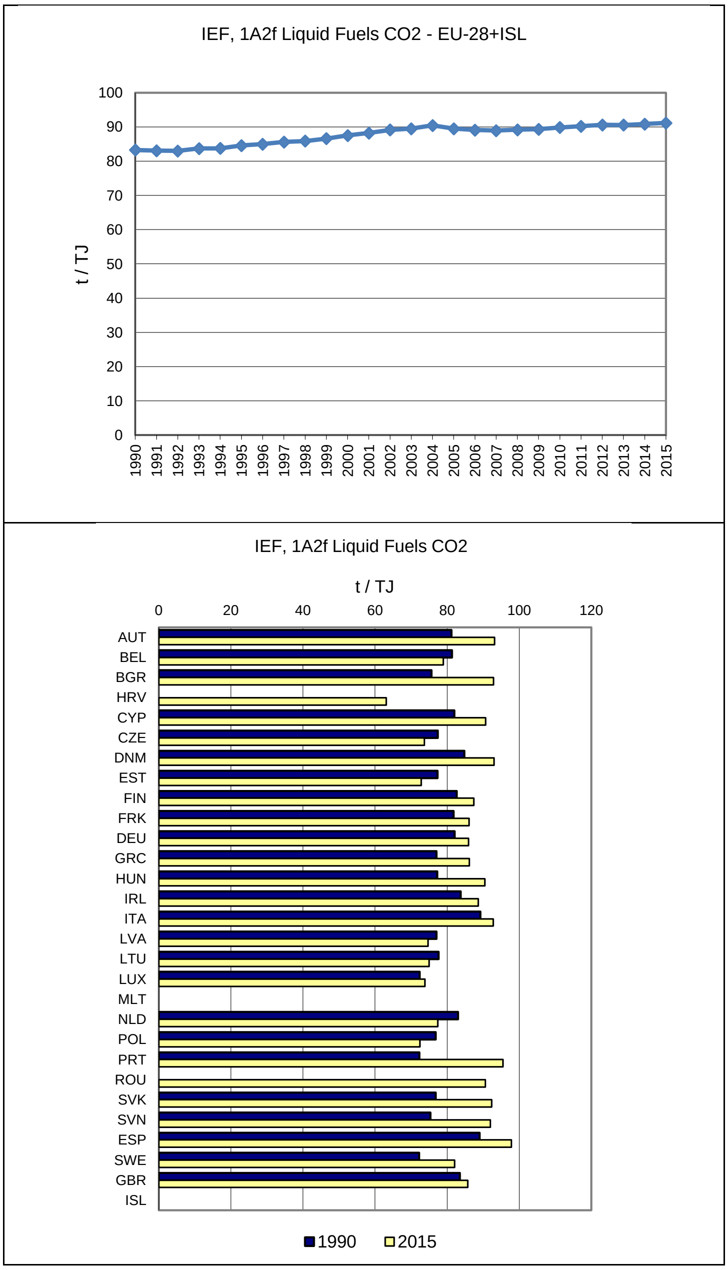


Figure 3.72 1A2f Non-metallic Minerals, liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015 CO_2 from solid fuels had a share of 21% within source category 1A2f (compared to 43% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 70% (Table 3.47). Between 1990 and 2015 almost all Member States reported decreases of emissions; the highest absolute decreases were reported by Germany, Poland, Spain and the UK. Between 2014 and 2015 emissions increased by 4%.

Table 3.47 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	535	278	266	1.5%	-12	-4%	-269	-50%	T2	CS
Belgium	2 466	1 731	1 639	9.3%	-92	-5%	-828	-34%	T1,T3	D,PS
Bulgaria	295	279	286	1.6%	7	3%	-9	-3%	T1,T2	CS,D
Croatia	IE	NO	NO	-	-	-	-	-	NA	NA
Cyprus	232	9	15	0.1%	6	61%	-217	-94%	CS	CS
Czech Republic	2 209	682	624	3.6%	-58	-9%	-1 585	-72%	T2	CS,D
Denmark	574	145	145	0.8%	1	1%	-428	-75%	T1,T3	D,PS
Estonia	756	313	124	0.7%	-189	-60%	-632	-84%	T1,T2	CS,D
Finland	806	225	251	1.4%	26	11%	-555	-69%	T3	CS
France	4 112	1 344	1 243	7.1%	-101	-8%	-2 869	-70%	T2,T3	CS,PS
Germany	12 053	4 830	4 970	28.3%	140	3%	-7 083	-59%	CS	CS
Greece	3 364	230	183	1.0%	-47	-21%	-3 181	-95%	T2	PS
Hungary	230	112	136	0.8%	25	22%	-94	-41%	T1,T3	D,PS
Ireland	375	340	333	1.9%	-7	-2%	-42	-11%	T2	CS
Italy	3 947	1 219	1 058	6.0%	-162	-13%	-2 889	-73%	T2	CS
Latvia	16	119	91	0.5%	-28	-24%	74	451%	T1	D
Lithuania	60	455	374	2.1%	-81	-18%	314	527%	T2	CS
Luxembourg	312	170	144	0.8%	-25	-15%	-168	-54%	T1	D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	346	148	151	0.9%	3	2%	-195	-56%	T2	CS
Poland	8 653	2 589	2 425	13.8%	-164	-6%	-6 228	-72%	T1,T2	CS,D
Portugal	1 958	NO	NO	-	-	-	-1 958	-100%	NA	NA
Romania	265	245	233	1.3%	-12	-5%	-32	-12%	T1,T2	CS,D
Slovakia	1 474	482	498	2.8%	17	3%	-976	-66%	T2	CS
Slovenia	113	70	51	0.3%	-19	-27%	-62	-55%	T1,T3	D,PS
Spain	5 211	128	125	0.7%	-2	-2%	-5 086	-98%	T2	CS
Sweden	1 135	599	641	3.6%	42	7%	-495	-44%	T2	CS
United Kingdom	6 601	1 467	1 551	8.8%	84	6%	-5 050	-76%	T2	CS
EU-28	**58 099**	**18 207**	**17 558**	**100%**	**-650**	**-4%**	**-40 541**	**-70%**	**-**	**-**
Iceland	52	0.2	0.3	0.0019%	0.1	42%	-52	-99%	T1	D
United Kingdom (KP)	6 601	1 467	1 551	8.8%	84	6%	-5 050	-76%	T2	CS
EU-28 + ISL	**58 151**	**18 207**	**17 558**	**100%**	**-650**	**-4%**	**-40 593**	**-70%**	**-**	**-**

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

Figure 3.73 and Figure 3.74 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, Belgium and the United Kingdom; together they cause about 60% of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption decreased by 69% between 1990 and 2015. The CO_2-implied emission factor for solid fuels was 95.9 t/TJ in 2015. The comparatively high implied emission factor of Finland for 2015 is due to the use of CO waste gas from a steel plant.

Figure 3.73 1A2f Non-metallic Minerals, solid fuels: Emission trend and share for CO_2

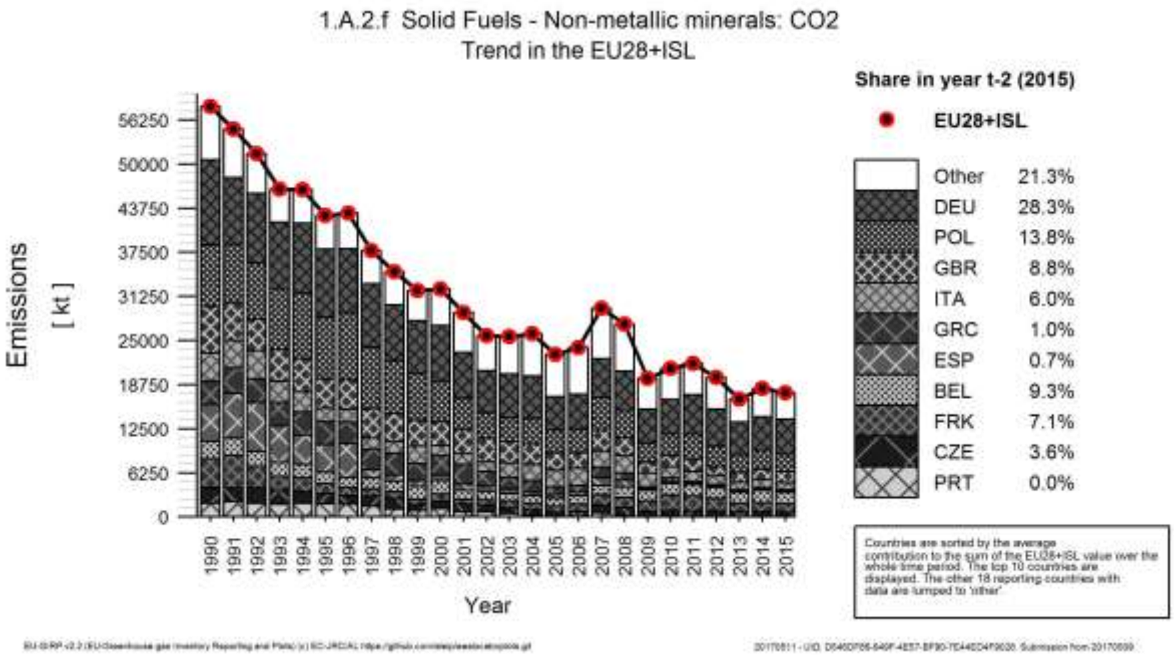
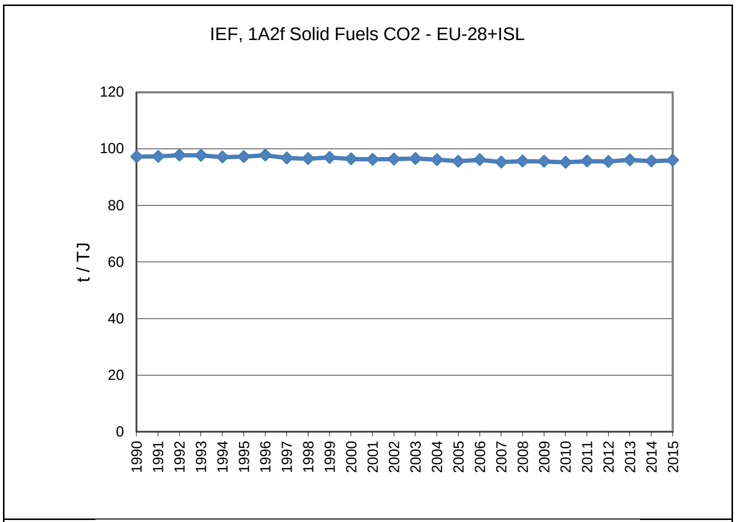
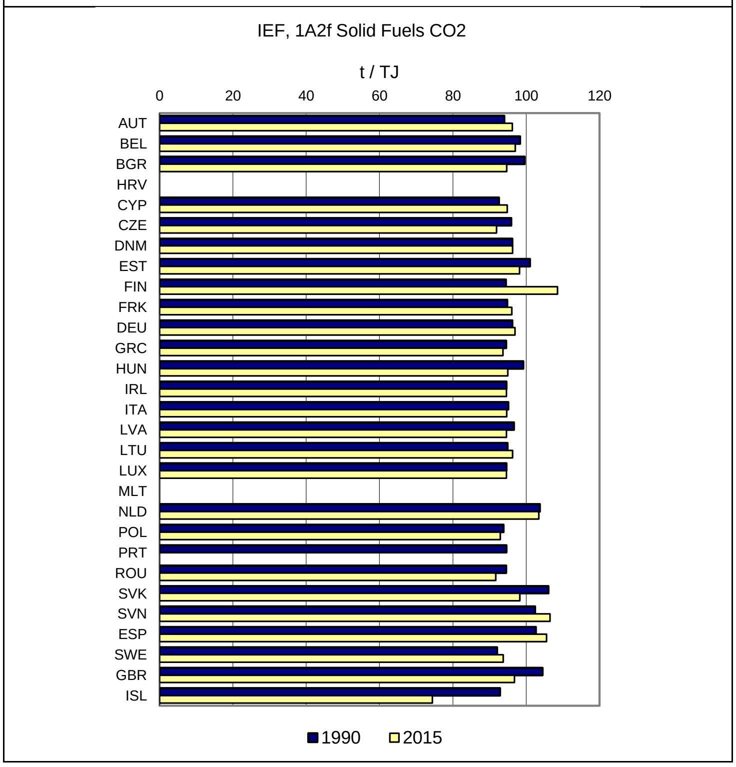


Figure 3.74 1A2f Non-metallic Minerals, solid fuels: Implied Emission Factors for CO_2 (in t/TJ)





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

In 2015 CO_2 from gaseous fuels had a share of 33% within source category 1A2f (compared to 21% in 1990). Between 1990 and 2015, the emissions increased by 1% (Table 3.48). Between 1990 and 2015 Hungary and Bulgaria showed the highest absolute decreases while Germany, Portugal and Spain showed the highest absolute increases.

Table 3.48 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	559	636	625	2.2%	-11	-2%	66	12%	T2	CS
Belgium	1 364	1 185	1 154	4.2%	-31	-3%	-210	-15%	T1,T3	D,PS
Bulgaria	1 684	558	588	2.1%	30	5%	-1 096	-65%	T2	CS
Croatia	IE	94	81	0.3%	-13	-14%	81	∞	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 289	1 223	1 297	4.7%	74	6%	7	1%	T2	CS
Denmark	237	270	261	0.9%	-9	-3%	24	10%	T3	CS
Estonia	46	31	29	0.1%	-2	-6%	-18	-38%	T2	CS
Finland	126	57	53	0.2%	-4	-7%	-72	-58%	T3	CS
France	4 037	3 722	3 764	13.6%	42	1%	-273	-7%	T2,T3	CS,PS
Germany	3 265	4 610	4 692	16.9%	83	2%	1 427	44%	CS	CS
Greece	NO	110	114	0.4%	3	3%	114	∞	T2	CS
Hungary	1 673	449	424	1.5%	-25	-6%	-1 249	-75%	T1	D
Ireland	132	35	40	0.1%	5	15%	-92	-70%	T2	CS
Italy	5 911	5 401	5 027	18.1%	-374	-7%	-884	-15%	T2	CS
Latvia	316	74	66	0.2%	-8	-11%	-250	-79%	T2	CS
Lithuania	382	53	52	0.2%	0	-1%	-330	-86%	T2	CS
Luxembourg	201	164	167	0.6%	3	2%	-34	-17%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	1 484	961	994	3.6%	33	3%	-490	-33%	T2	CS
Poland	1 379	2 293	2 273	8.2%	-20	-1%	894	65%	T1	D
Portugal	NO	1 057	1 100	4.0%	43	4%	1 100	∞	T2,T3	CR,D,PS
Romania	NO	567	572	2.1%	5	1%	572	∞	T2	CS
Slovakia	542	378	359	1.3%	-19	-5%	-183	-34%	T2	CS
Slovenia	115	140	162	0.6%	23	16%	47	41%	T2	CS
Spain	2 352	3 215	3 484	12.5%	269	8%	1 131	48%	T2	CS
Sweden	65	212	110	0.4%	-102	-48%	45	69%	T1,T2	CS
United Kingdom	311	289	281	1.0%	-8	-3%	-30	-10%	T2	CS
EU-28	**27 472**	**27 782**	**27 770**	**100%**	**-12**	**0%**	**298**	**1%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	311	289	281	1.0%	-8	-3%	-30	-10%	T2	CS
EU-28 + ISL	**27 472**	**27 782**	**27 770**	**100%**	**-12**	**0%**	**298**	**1%**	**-**	**-**

Malta includes emissions under 1A2g.
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, Italy, Spain and France; together they cause 61% of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion increased by 0.3% between 1990 and 2015. The CO_2-implied emission factor for gaseous fuels was 56.3 t/TJ in 2015.

Figure 3.75 1A2f Non-metallic Minerals, gaseous fuels: Emission trend and share for CO_2

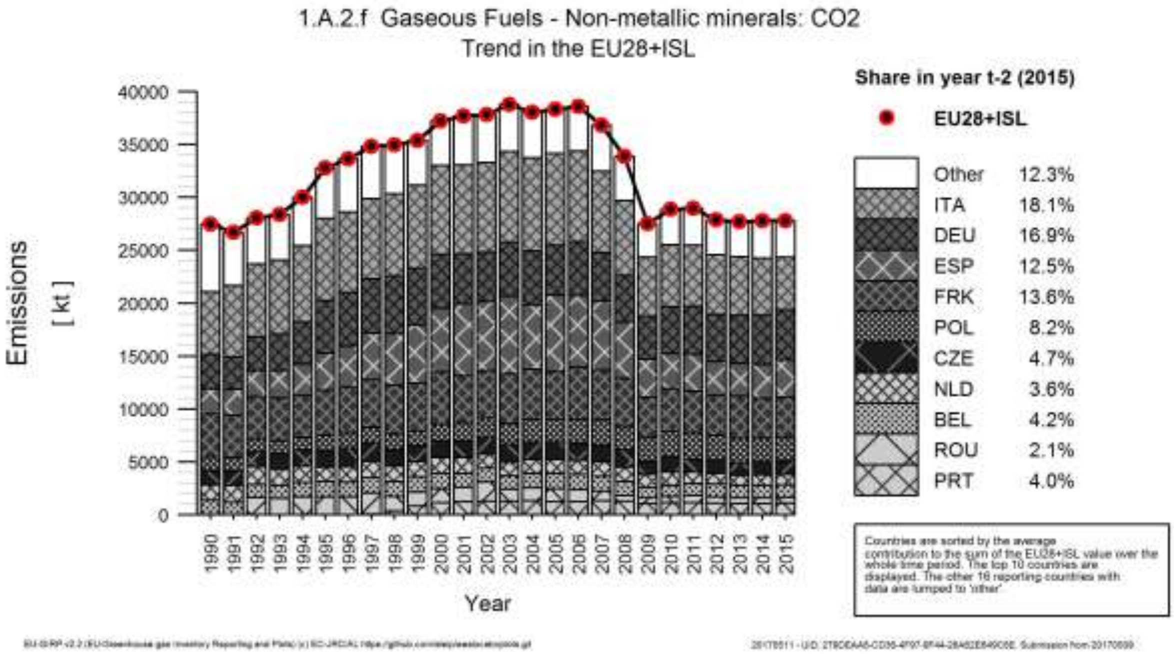
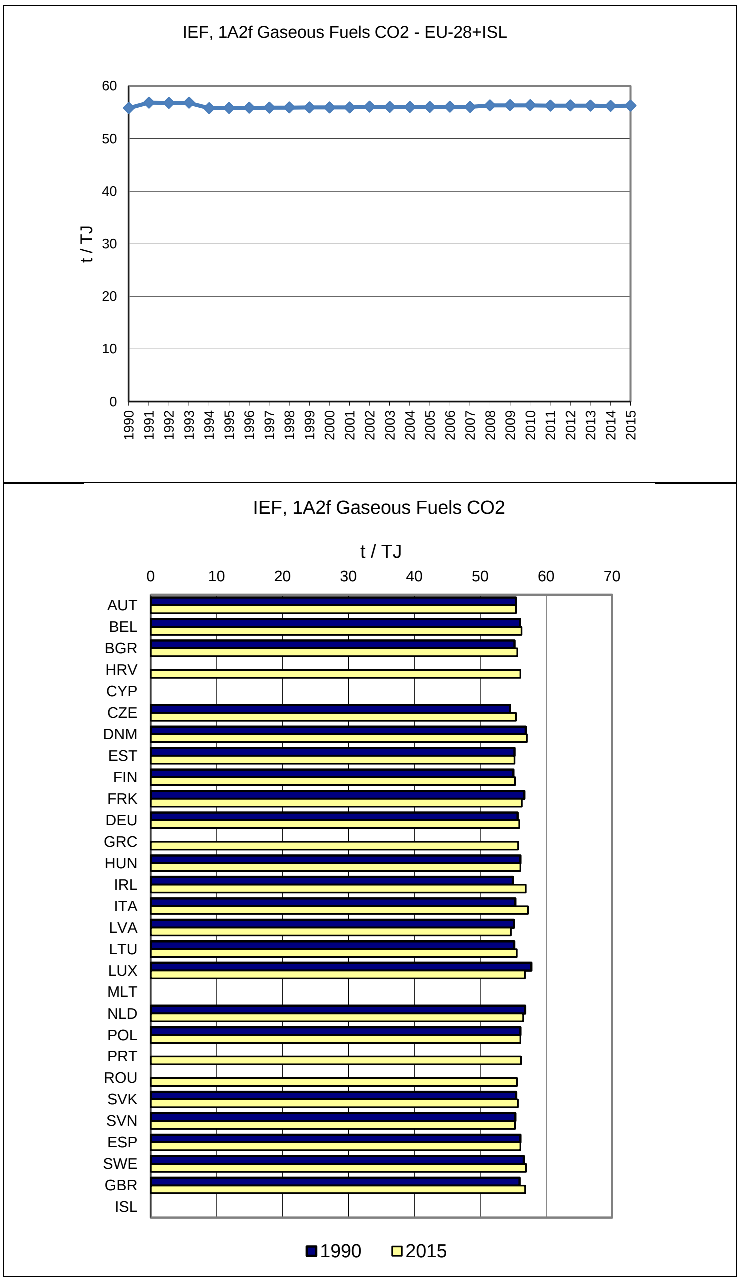


Figure 3.76 1A2f Non-metallic Minerals, gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2f Non-metallic Minerals – Other Fossil Fuels (CO_2)

In 2015 CO_2 from other fossil fuels had a share of 13% within source category 1A2f (compared to 1% in 1990). Between 1990 and 2015, the emissions increased by 785% (Table 3.49). Between 1990 and 2015 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 3.49 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	67	542	555	5.0%	13	2%	488	726%	CS	T2
Belgium	186	384	382	3.5%	-2	0%	196	105%	CS	NA
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	56	5	0.0%	-51	-92%	5	∞	NA	T1
Czech Republic	NO	280	387	3.5%	108	39%	387	∞	D	T2
Denmark	NO	91	124	1.1%	32	36%	124	∞	CS	T2
Estonia	NO	166	115	1.0%	-51	-31%	115	∞	CS	T3
Finland	NO	58	54	0.5%	-4	-6%	54	∞	PS	T3
France	323	1 181	1 181	10.7%	0	0%	857	265%	CS	T2,T3
Germany	526	2 637	2 609	23.6%	-27	-1%	2 084	396%	CS,PS	CS
Greece	NO	26	38	0.3%	12	44%	38	∞	CS	T2
Hungary	NO	116	164	1.5%	48	41%	164	∞	PS	T3
Ireland	NO	147	148	1.3%	1	0%	148	∞	PS	T3
Italy	NO	372	379	3.4%	6	2%	379	∞	PS	NA
Latvia	NO	108	106	1.0%	-1	-1%	106	∞	NA	T3
Lithuania	NO	NO	NO	-	-	-	-	-	PS	NA
Luxembourg	NO	52	46	0.4%	-5	-10%	46	∞	NA	T1,T2
Malta	IE	IE	IE	-	-	-	-	-	D,PS	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	10	2 542	2 523	22.8%	-19	-1%	2 513	25841%	NA	T1
Portugal	12	264	294	2.7%	30	11%	282	2306%	D	T2,T3
Romania	NO	450	478	4.3%	28	6%	478	∞	CR,D,PS	T2
Slovakia	NO	285	198	1.8%	-87	-31%	198	∞	CS	T2
Slovenia	5	68	86	0.8%	18	26%	82	1745%	CS	T1,T3
Spain	120	582	602	5.4%	20	4%	483	404%	D,PS	T2
Sweden	NO	136	C	-	-136	-100%	-	-	CS,PS	T2
United Kingdom	1	562	585	5.3%	23	4%	584	54332%	NA	T2
EU-28	**1 250**	**11 104**	**11 059**	**100%**	**-46**	**0%**	**9 809**	**785%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	CS	NA
United Kingdom (KP)	1	562	585	5.3%	23	4%	584	54332%	NA	T2
EU-28 + ISL	**1 250**	**11 104**	**11 059**	**100%**	**-46**	**0%**	**9 809**	**785%**	**-**	**-**

Emissions of Malta are included in 1A2g.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

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+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Germany, France and Poland; they cause 57% of the CO_2 emissions from other fossil fuels in 1A2f. The CO_2-implied emission factor for other fossil fuels was 78.4 t/TJ in 2015.

Figure 3.77 1A2f Non-metallic Minerals, other fossil fuels: Emission trend and share for CO_2

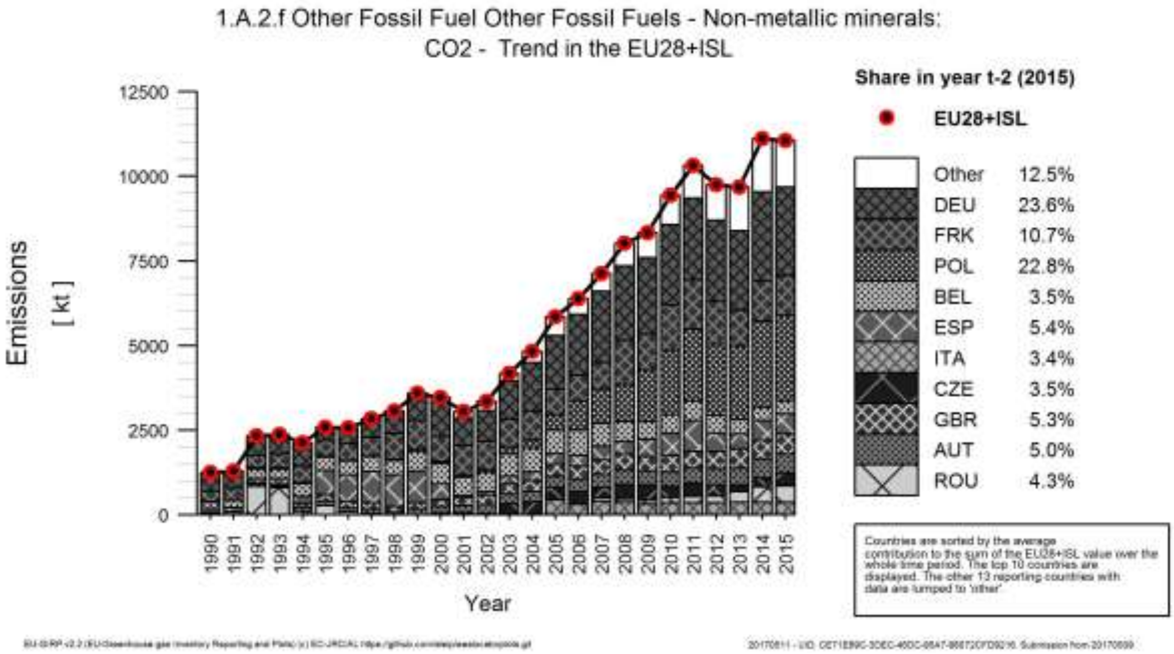
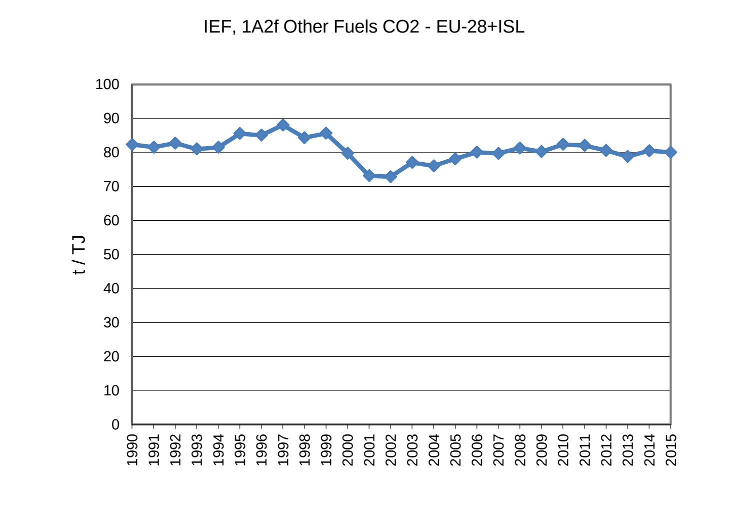
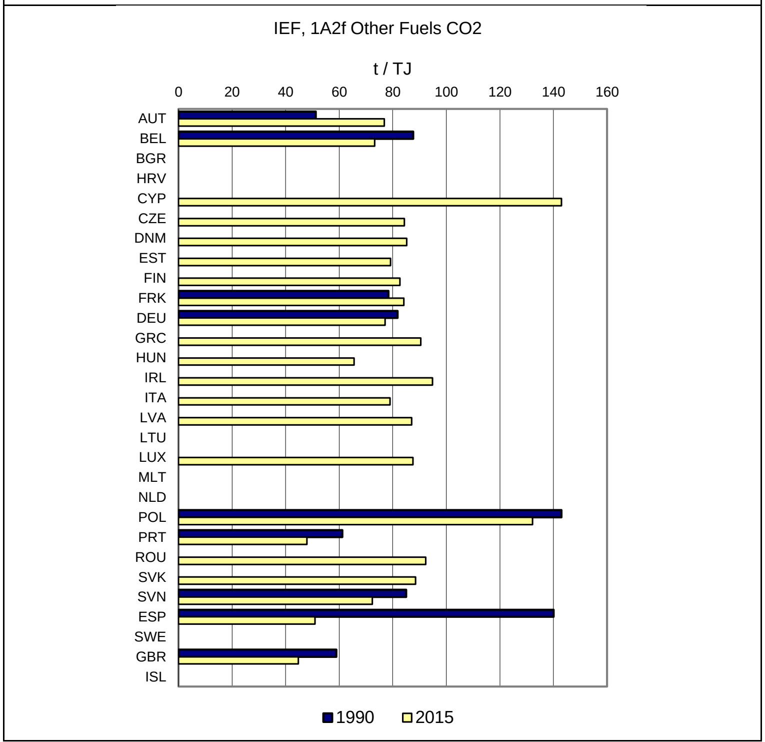


Figure 3.78 1A2f Non-metallic Minerals, other fossil fuels: Implied Emission Factors for CO_2 (in t/TJ)





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. CO_2 emissions from 1A2g Other accounted for 32.2% for 1A2 source category and for 4% of total GHG emissions in 2015.

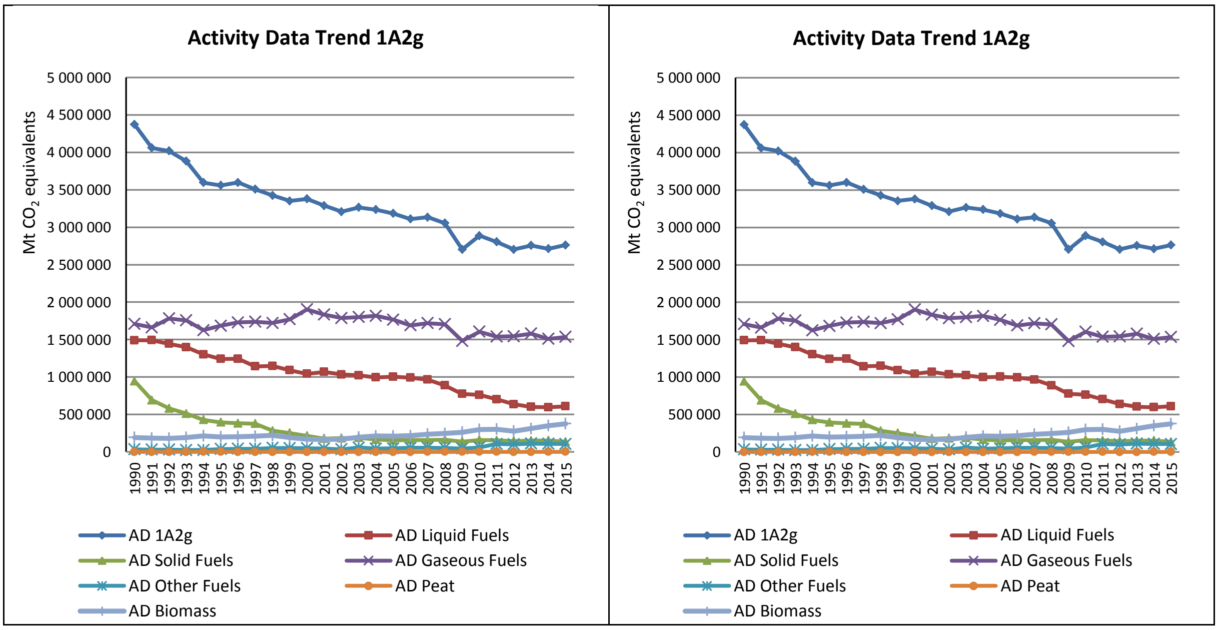
This category includes emissions from stationary combustion but also may include emissions from mobile sources (e.g. construction machinery). Some Member States use this category to report emissions which cannot be allocated to the categories 1A2a to 1A2f due to lack of detailed data, e.g. IEA data provides 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 3.50 presents 1A2g GHG emissions and the share of mobile machinery (off road vehicles) by Member State. Most Member States are reporting emissions from off road vehicles separately.

Table 3.50: 1A2g Other: CO_2, CH_4 and N_2O emissions

Member State		Emissions in kt		
		CO2	CH4	N2O
AUT	g. Other	2 613	0.364	0.276
	1.A.2.g.vii Off-road vehicles and other machinery	1 064	0.023	0.155
BEL	g. Other	2 425	0.357	0.063
	1.A.2.g.vii Off-road vehicles and other machinery	493	0.088	0.040
BGR	g. Other	614	0.131	0.042
	1.A.2.g.vii Off-road vehicles and other machinery	65	0.004	0.025
HRV	g. Other	1 363	0.105	0.016
	1.A.2.g.vii Off-road vehicles and other machinery	298	0.012	0.002
CYP	g. Other	25	0.001	0.000
	1.A.2.g.vii Off-road vehicles and other machinery			
CZE	g. Other	2 399	0.365	0.049
	1.A.2.g.vii Off-road vehicles and other machinery			
DNM	g. Other	1 115	0.189	0.082
	1.A.2.g.vii Off-road vehicles and other machinery	718	0.029	0.032
EST	g. Other	162	0.052	0.007
	1.A.2.g.vii Off-road vehicles and other machinery			
FIN	g. Other	1 701	0.534	0.050
	1.A.2.g.vii Off-road vehicles and other machinery	1 236	0.098	0.021
FRK	g. Other	6 609	0.565	0.783
	1.A.2.g.vii Off-road vehicles and other machinery			
DEU	g. Other	73 956	7.464	1.870
	1.A.2.g.vii Off-road vehicles and other machinery	3 132	0.066	0.129
GRC	g. Other	IE	IE	IE
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
HUN	g. Other	1 673	0.105	0.034
	1.A.2.g.vii Off-road vehicles and other machinery	503	0.006	0.022
IRL	g. Other	738	0.162	0.022
	1.A.2.g.vii Off-road vehicles and other machinery			
ITA	g. Other	9 093	0.214	0.571
	1.A.2.g.vii Off-road vehicles and other machinery			
LVA	g. Other	185	0.461	0.061
	1.A.2.g.vii Off-road vehicles and other machinery	3	0.003	0.000
LTU	g. Other	164	0.079	0.026
	1.A.2.g.vii Off-road vehicles and other machinery	43	0.004	0.016
LUX	g. Other	230	0.030	0.023
	1.A.2.g.vii Off-road vehicles and other machinery	157	0.003	0.019
MLT	g. Other	42	0.002	0.000
	1.A.2.g.vii Off-road vehicles and other machinery			
NLD	g. Other	2 804	0.632	0.123
	1.A.2.g.vii Off-road vehicles and other machinery	1 429	0.042	0.064
POL	g. Other	2 652	0.964	0.130
	1.A.2.g.vii Off-road vehicles and other machinery			
PRT	g. Other	1 676	0.109	0.043
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
ROU	g. Other	5 196	0.375	0.051
	1.A.2.g.vii Off-road vehicles and other machinery			
SVK	g. Other	1 187	0.097	0.012
	1.A.2.g.vii Off-road vehicles and other machinery	IE	IE	IE
SVN	g. Other	401	0.078	0.039
	1.A.2.g.vii Off-road vehicles and other machinery	76	0.005	0.029
ESP	g. Other	8 463	9.786	0.221
	1.A.2.g.vii Off-road vehicles and other machinery	1 650	0.025	0.071
SWE	g. Other	2 396	0.613	0.162
	1.A.2.g.vii Off-road vehicles and other machinery	1 231	0.092	0.058
GBR	g. Other	26 065	3.248	2.336
	1.A.2.g.vii Off-road vehicles and other machinery	5 693	0.874	2.009
ISL	g. Other	25.610	0.001	0.000
	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 49%, mainly due to decreases in CO_2 emissions from solid (-86%) and liquid (-58%) fuels.

Figure 3.79 1A2g Other: Total and CO_2 emission trends



Between 1990 and 2015, CO_2 emissions from 1A2g Other decreased by 49% in the EU-28+ISL (Table 3.51). Romania, Germany, the Czech Republic, Bulgaria, Italy and the United Kingdom 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. This category also includes confidential data from Sweden which could not be allocated to other subcategories under 1A2.

Table 3.51 1A2g Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	1 972	2 620	2 613	1.7%	-7	0%	641	33%	T1,T2,T3	CS,D
Belgium	2 816	2 383	2 425	1.6%	43	2%	-391	-14%	CS,T1,T3	D
Bulgaria	10 585	442	614	0.4%	172	39%	-9 971	-94%	T1,T2	CS,D
Croatia	5 502	1 396	1 363	0.9%	-33	-2%	-4 138	-75%	T1	D
Cyprus	48	47	25	0.0%	-22	-46%	-22	-47%	T1	D
Czech Republic	23 171	2 245	2 399	1.5%	154	7%	-20 772	-90%	T1,T2	CS,D
Denmark	1 793	1 129	1 115	0.7%	-14	-1%	-678	-38%	CR,M,T1,T2,T3	CS,D
Estonia	280	160	162	0.1%	2	2%	-118	-42%	T1,T2	CS,D
Finland	1 872	1 733	1 701	1.1%	-33	-2%	-171	-9%	CS,M,T2,T3	CS,D
France	12 337	6 510	6 609	4.2%	98	2%	-5 729	-46%	T2	CS
Germany	127 935	73 153	73 956	47.4%	803	1%	-53 979	-42%	CS,T1	CS,D
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	5 180	1 508	1 673	1.1%	165	11%	-3 507	-68%	T1,T2	CS,D
Ireland	684	683	738	0.5%	54	8%	54	8%	T1,T2	CS,D
Italy	19 141	8 548	9 093	5.8%	544	6%	-10 048	-52%	T2	CS
Latvia	1 358	204	185	0.1%	-20	-10%	-1 173	-86%	T1,T2	CS,D
Lithuania	1 567	176	164	0.1%	-12	-7%	-1 403	-90%	T1,T2	CS
Luxembourg	103	237	230	0.1%	-7	-3%	127	123%	T1,T2	CS,D
Malta	46	40	42	0.0%	3	6%	-4	-8%	T1	D
Netherlands	3 174	2 919	2 804	1.8%	-114	-4%	-370	-12%	T2	CS
Poland	7 061	2 707	2 652	1.7%	-55	-2%	-4 409	-62%	T1,T2	CS,D
Portugal	2 189	1 529	1 676	1.1%	147	10%	-513	-23%	T2	D,OTH
Romania	23 761	4 731	5 196	3.3%	465	10%	-18 565	-78%	T1,T2	CS,D
Slovakia	2 560	1 224	1 187	0.8%	-38	-3%	-1 373	-54%	T2	CS
Slovenia	1 153	397	401	0.3%	4	1%	-752	-65%	T1,T2	CS,D
Spain	8 033	8 275	8 463	5.4%	188	2%	430	5%	T2	CS,M,OTH,PS
Sweden	3 247	2 426	2 396	1.5%	-30	-1%	-851	-26%	T1,T2	CS
United Kingdom	38 106	26 833	25 935	16.6%	-899	-3%	-12 171	-32%	T1,T2,T3	CS,D
EU-28	**305 672**	**154 257**	**155 817**	**100%**	**1 559**	**1%**	**-149 855**	**-49%**	**-**	**-**
Iceland	41	7.9	25.6	0.0164%	17.7	224%	-15	-37%	T2	CS
United Kingdom (KP)	38 214	26 963	26 065	16.7%	-898	-3%	-12 149	-32%	T1,T2,T3	CS,D
EU-28 + ISL	**305 821**	**154 395**	**155 973**	**100%**	**1 577**	**1%**	**-149 848**	**-49%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Greece includes emissions of 1A2g in category 1A2f
The CRF includes for this category also confidential data from Sweden which could not be allocated to other subcategories under 1A2. This explains the differences between this table (which includes for Sweden the data actually reported by Sweden under this category) and the CRF.

1A2g Other – Liquid Fuels (CO_2)

In 2015 CO_2 from liquid fuels decreased to a share of 30% within source category 1A2g (compared to 37% in 1990). Between 1990 and 2015, CO_2 emissions decreased by 58% (Table 3.52). Between 1990 and 2015 all Member States showed a reduction of emissions except for Austria, the Netherlands and Luxembourg. Fuel consumption decreased by 59% between 1990 and 2015.

Table 3.52 1A2g Other, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	862	1 478	1 447	3.0%	-31	-2%	584	68%
Belgium	1 579	946	1 022	2.1%	76	8%	-557	-35%
Bulgaria	8 638	140	157	0.3%	17	12%	-8 481	-98%
Croatia	2 158	850	885	1.8%	35	4%	-1 273	-59%
Cyprus	48	47	25	0.1%	-22	-46%	-22	-47%
Czech Republic	7 041	545	600	1.2%	54	10%	-6 442	-91%
Denmark	1 177	747	730	1.5%	-17	-2%	-447	-38%
Estonia	188	122	129	0.3%	7	6%	-59	-31%
Finland	1 713	1 415	1 393	2.9%	-22	-2%	-320	-19%
France	6 961	2 803	2 742	5.7%	-61	-2%	-4 219	-61%
Germany	30 317	15 132	15 344	31.6%	212	1%	-14 973	-49%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	1 900	518	564	1.2%	46	9%	-1 336	-70%
Ireland	512	356	361	0.7%	5	2%	-150	-29%
Italy	9 462	1 554	2 030	4.2%	476	31%	-7 432	-79%
Latvia	804	106	97	0.2%	-9	-9%	-707	-88%
Lithuania	812	68	63	0.1%	-5	-7%	-748	-92%
Luxembourg	59	171	171	0.4%	0	0%	112	189%
Malta	46	40	42	0.1%	2	6%	-4	-9%
Netherlands	1 423	1 482	1 430	2.9%	-53	-4%	7	0%
Poland	1 026	716	617	1.3%	-99	-14%	-409	-40%
Portugal	2 139	574	695	1.4%	121	21%	-1 445	-68%
Romania	4 805	965	1 065	2.2%	100	10%	-3 740	-78%
Slovakia	66	8	9	0.0%	1	19%	-57	-86%
Slovenia	647	142	137	0.3%	-6	-4%	-510	-79%
Spain	5 928	2 158	2 433	5.0%	275	13%	-3 495	-59%
Sweden	3 040	1 914	1 882	3.9%	-32	-2%	-1 158	-38%
United Kingdom	20 994	12 292	12 302	25.3%	10	0%	-8 693	-41%
EU-28	**114 346**	**47 290**	**48 372**	**100%**	**1 083**	**2%**	**-65 973**	**-58%**
Iceland	41	7.9	25.6	0.0528%	17.7	224%	-15	-37%
United Kingdom (KP)	21 103	12 422	12 432	25.6%	10	0%	-8 671	-41%
EU-28 + ISL	**114 495**	**47 427**	**48 529**	**100%**	**1 101**	**2%**	**-65 967**	**-58%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Greece includes emissions of 1A2g in category 1A2f

Figure 3.80 and Figure 3.81 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 57% of the CO_2 emissions from liquid fuels in 1A2g. The CO_2 implied emission factor for liquid fuels was 79.4 t/TJ in 2015. The high IEF of Germany is due to inclusion of residual gases of chemical industry.

Figure 3.80 1A2g Other, liquid fuels: Emission trend and share for CO_2

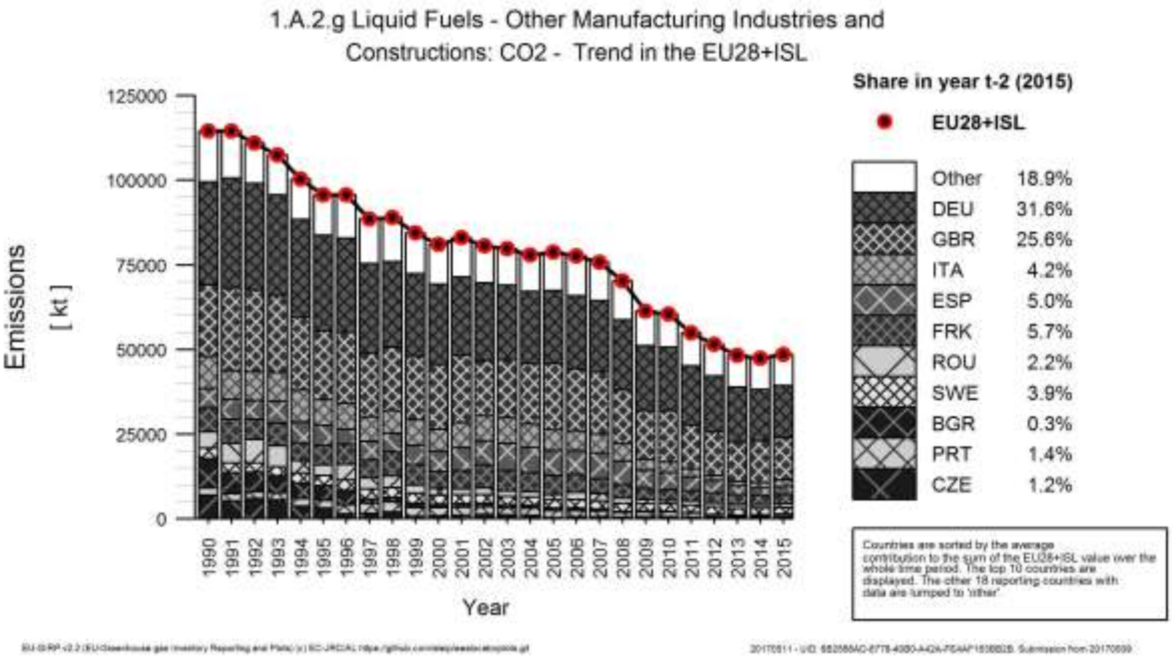
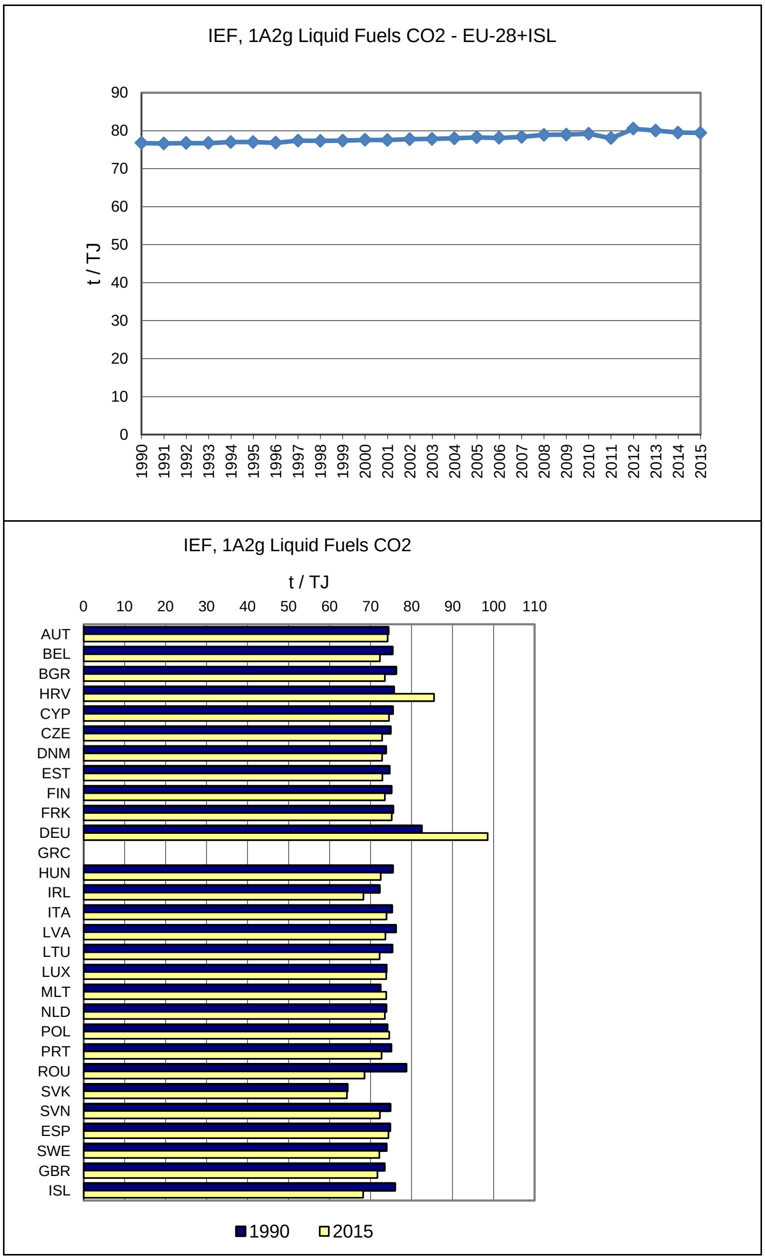


Figure 3.81 1A2g Other, liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2g Other – Solid Fuels (CO_2)

In 2015 CO_2 from solid fuels decreased to a share of 8% within source category 1A2g (compared to 30% in 1990). Between 1990 and 2015, CO_2 emissions decreased by 86% (Table 3.53). Between 1990 and 2015 all Member States showed a reduction of emissions except for the. Fuel consumption decreased by 86% between 1990 and 2015.

Table 3.53 1A2g Other, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	91	1	21	0.2%	20	3139%	-70	-77%
Belgium	33	12	13	0.1%	1	9%	-20	-59%
Bulgaria	1 858	10	16	0.1%	6	58%	-1 843	-99%
Croatia	1 703	333	258	2.0%	-76	-23%	-1 445	-85%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	13 750	142	134	1.0%	-8	-6%	-13 617	-99%
Denmark	326	62	59	0.5%	-2	-4%	-267	-82%
Estonia	38	0.47	0.09	0.0%	0	-80%	-38	-100%
Finland	8	NO	0.36	0.0%	0	∞	-8	-96%
France	577	2	121	0.9%	120	7781%	-455	-79%
Germany	57 580	7 345	7 614	58.8%	270	4%	-49 966	-87%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	677	28	30	0.2%	2	6%	-647	-96%
Ireland	14	0.00	0.3	0.00%	0	1.4E+11%	-14	-98%
Italy	299	319	3	0.03%	-315	-99%	-296	-99%
Latvia	27	5	3	0.02%	-2	-45%	-24	-89%
Lithuania	79	6	5	0.03%	-2	-27%	-74	-94%
Luxembourg	20	14	18	0.1%	4	28%	-2	-8%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	42	64	63	0.5%	0	-1%	22	52%
Poland	5 154	670	753	5.8%	83	12%	-4 401	-85%
Portugal	49	19	19	0.1%	-1	-3%	-31	-62%
Romania	5 313	925	524	4.1%	-400	-43%	-4 788	-90%
Slovakia	1 422	470	419	3.2%	-51	-11%	-1 004	-71%
Slovenia	89	0	0	0.0%	0	-58%	-88	-100%
Spain	258	NO	NO	-	-	-	-258	-100%
Sweden	94	430	C	NA	NA	NA	NA	NA
Untited Kingdom	4 118	3 615	2 874	22%	-741	-20%	-1 244	-30%
EU-28	**93 525**	**14 042**	**12 948**	**100%**	**-1 094**	**-8%**	**-80 577**	**-86%**
Iceland	-	-	-	-	-	-	-	-
United Kingdom (KP)	4 118	3 615	2 874	22%	-741	-20%	-1 244	-30%
EU-28 + ISL	**93 525**	**14 042**	**12 948**	**100%**	**-1 094**	**-8%**	**-80 577**	**-86%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Greece includes emissions of 1A2g in category 1A2f

Figure 3.82 and Figure 3.83 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 81% of the CO_2 emissions from liquid fuels in 1A2g. The CO_2-implied emission factor for solid fuels was 96.0 t/TJ in 2015.

Figure 3.82 1A2g Other, solid fuels: Emission trend and share for CO_2

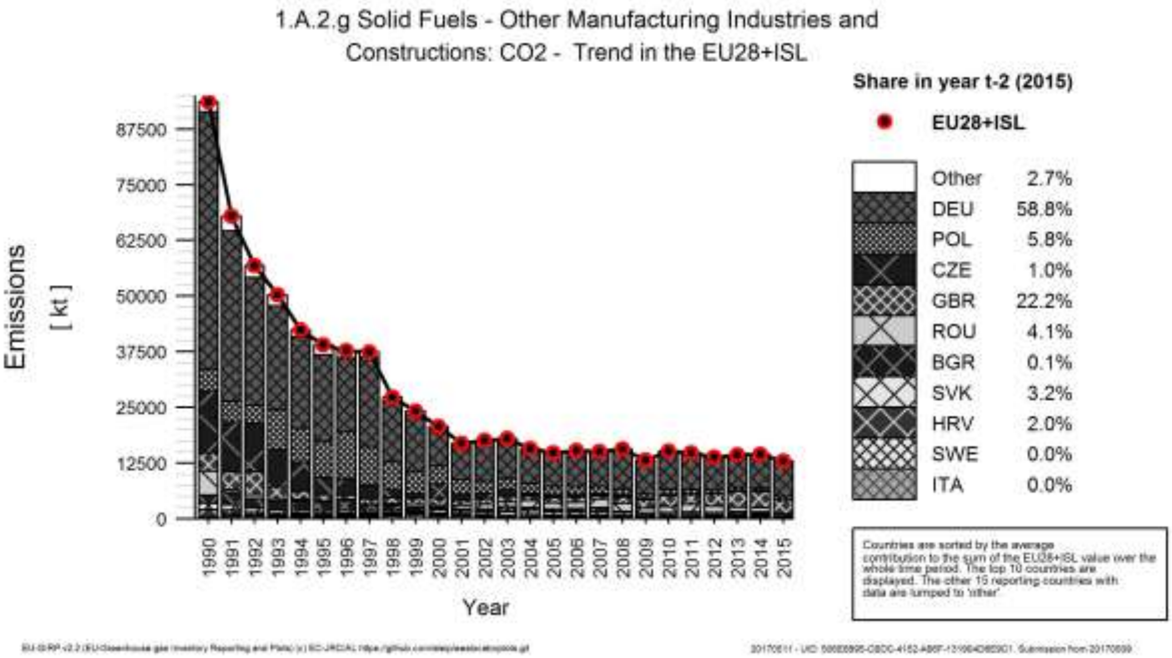
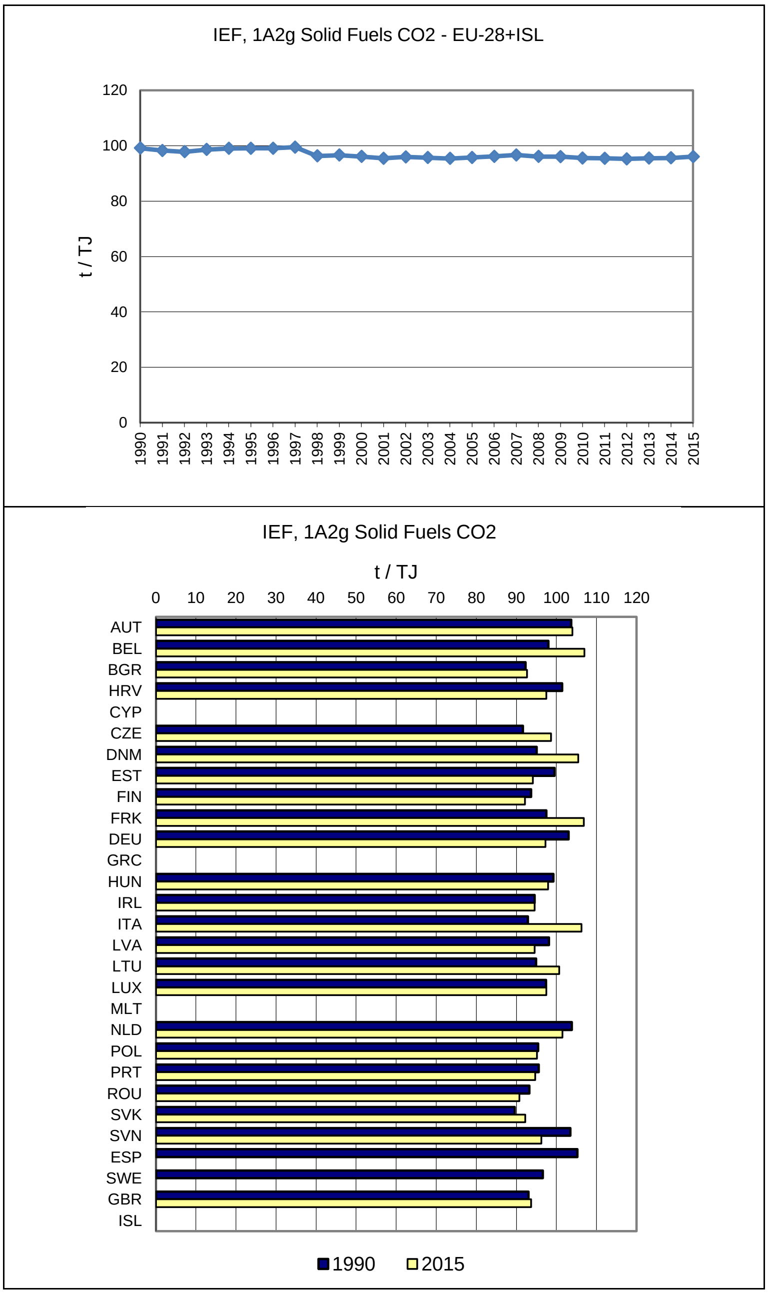


Figure 3.83 1A2g Other, solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2g Other – Gaseous Fuels (CO_2)

In 2015 CO_2 from gaseous fuels increased to a share of 54% within source category 1A2g (compared to 31% in 1990). Between 1990 and 2015, the emissions decreased by 9% (Table 3.54). Between 1990 and 2015 Romania shows the most significant decrease (-74%) while Germany (+16%) and Spain (+226%) show the most significant increase of emissions. Sweden reports 2013 and 2015 emissions as confidential.

Table 3.54 1A2g Other, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	1 014	1 121	1 118	1.3%	-3	0%	104	10%
Belgium	1 204	1 380	1 349	1.6%	-31	-2%	145	12%
Bulgaria	89	243	373	0.4%	130	54%	284	319%
Croatia	1 641	152	165	0.2%	13	8%	-1 476	-90%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	2 379	1 558	1 666	1.9%	108	7%	-713	-30%
Denmark	289	320	326	0.4%	6	2%	37	13%
Estonia	54	37	33	0.0%	-5	-12%	-21	-40%
Finland	41	33	33	0.0%	-1	-2%	-8	-20%
France	4 790	3 690	3 730	4.3%	40	1%	-1 060	-22%
Germany	37 693	43 495	43 837	50.9%	342	1%	6 144	16%
Greece	IE	IE	IE	-	-	-	-	-
Hungary	2 603	962	1 021	1.2%	59	6%	-1 581	-61%
Ireland	158	327	376	0.4%	49	15%	218	138%
Italy	9 380	6 675	7 059	8.2%	383	6%	-2 321	-25%
Latvia	527	92	84	0.1%	-8	-8%	-443	-84%
Lithuania	677	100	94	0.1%	-6	-6%	-583	-86%
Luxembourg	24	51	40	0.0%	-11	-22%	16	69%
Malta	NO	0	0	0.0%	0	37%	0	∞
Netherlands	1 710	1 373	1 312	1.5%	-61	-4%	-398	-23%
Poland	878	1 312	1 276	1.5%	-36	-3%	399	45%
Portugal	NO,IE	928	956	1.1%	28	3%	956	∞
Romania	13 643	2 840	3 605	4.2%	764	27%	-10 038	-74%
Slovakia	1 071	747	759	0.9%	12	2%	-312	-29%
Slovenia	417	248	256	0.3%	8	3%	-161	-39%
Spain	1 848	6 117	6 030	7.0%	-87	-1%	4 182	226%
Sweden	113	70	C	NA	NA	NA	NA	NA
Untited Kingdom	12 918	10 866	10 708	12%	-157	-1%	-2 210	-17%
EU-28	**95 046**	**84 670**	**86 206**	**100%**	**1 536**	**2%**	**-8 840**	**-9%**
Iceland	-	-	-	-	-	-	-	-
United Kingdom (KP)	12 918	10 866	10 708	12%	-157	-1%	-2 210	-17%
EU-28 + ISL	**95 046**	**84 670**	**86 206**	**100%**	**1 536**	**2%**	**-8 840**	**-9%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Greece includes emissions of 1A2g in category 1A2f

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

Figure 3.84 and Figure 3.85 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 10% between 1990 and 2015. The CO_2 implied emission factor for gaseous fuels was 56.2 t/TJ in 2015. The high IEF of Malta is due to the inclusion of LPG.

Figure 3.84 1A2g Other, gaseous fuels: Emission trend and share for CO_2

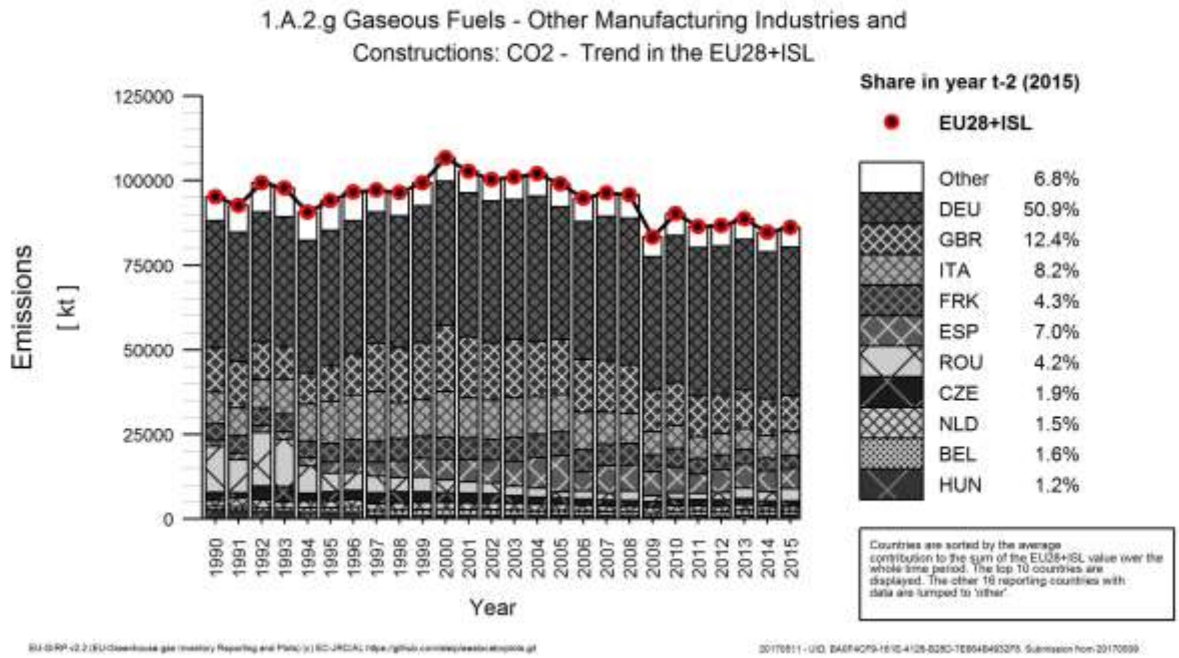
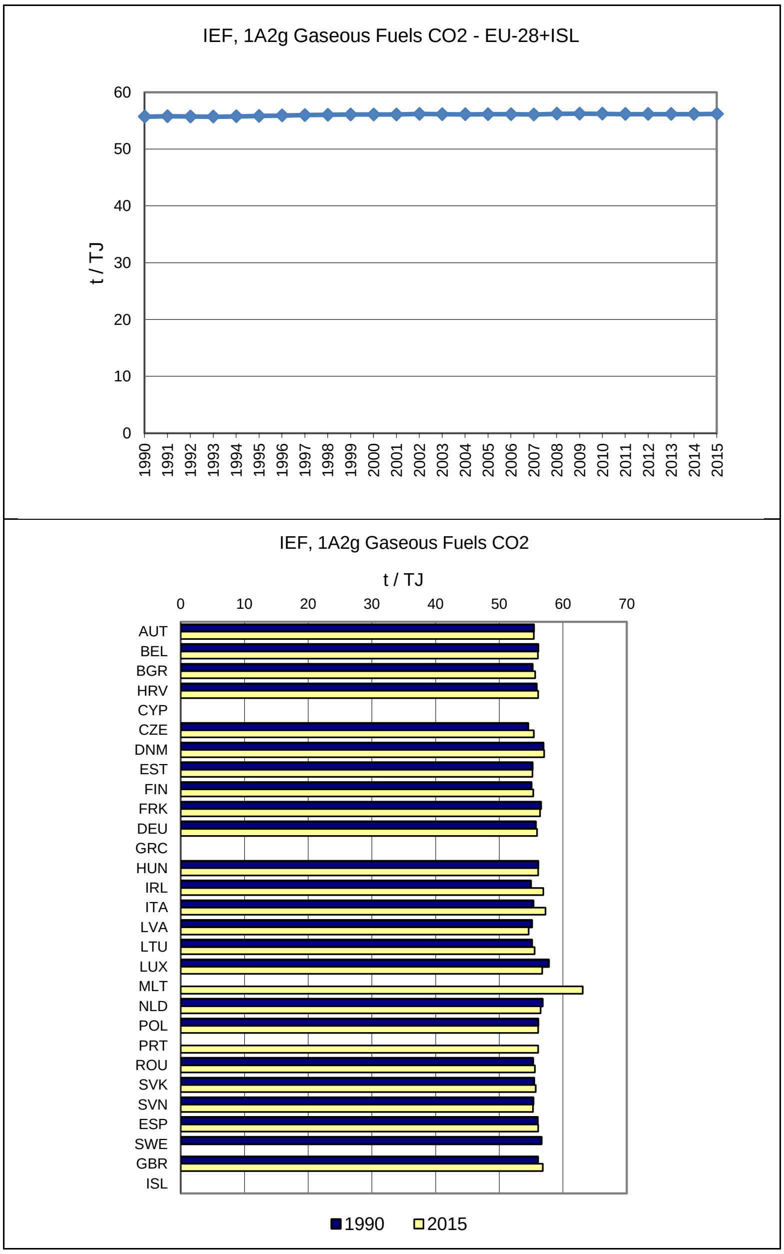


Figure 3.85 1A2g Other, gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A2g Other – Other fossil fuels (CO_2)

In 2015 CO_2 from other fossil fuels increased to a share of 5% within source category 1A2g (compared to 1% in 1990). Between 1990 and 2015, CO_2 emissions increased by 206% (Table 3.55). Only 15 Member States reported emissions from this source and almost all of these Member States also reported an increase of emissions between 1990 and 2015. The trend and absolute values of emissions are dominated by Germany.

Table 3.55 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	5	21	28	0.4%	7	34%	23	476%
Belgium	NO	44	41	0.5%	-3	-7%	41	∞
Bulgaria	NO	49	69	0.9%	19	39%	69	∞
Croatia	NO	61	56	0.7%	-5	-8%	56	∞
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	1	NO	NO	-	-	-	-1	-100%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	88	240	222	2.9%	-18	-8%	134	152%
France	10	16	16	0.2%	0	-1%	6	61%
Germany	2 344	7 181	7 160	92.7%	-21	0%	4 816	205%
Greece	-	-	-	-	-	-	-	-
Hungary	NO	NO	58	0.7%	58	∞	58	∞
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	1	0.0%	1	∞	1	∞
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	3	9	6	0.1%	-3	-30%	3	105%
Portugal	NO,IE	7	6	0.1%	-1	-14%	6	∞
Romania	NO	0	1	0.0%	1	250%	1	∞
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	7	8	0.1%	2	22%	8	∞
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	12	C	NA	NA	NA	NA	NA
Untited Kingdom	76	61	51	1%	-10	-16%	-25	-33%
EU-28	**2 527**	**7 696**	**7 723**	**100%**	**26**	**0%**	**5 196**	**206%**
Iceland	-	-	-	-	-	-	-	-
United Kingdom (KP)	76	61	51	1%	-10	-16%	-25	-33%
EU-28 + ISL	**2 527**	**7 696**	**7 723**	**100%**	**26**	**0%**	**5 196**	**206%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.86 and Figure 3.87 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 93% of the CO_2 emissions from other fossil fuels in 1A2g. Fuel consumption in the EU-28 increased by 206% between 1990 and 2015. The CO_2-implied emission factor for other fossil fuels was 72.4 t/TJ in 2015.

Figure 3.86 1A2g Other, other fossil fuels: Emission trend and share for CO_2

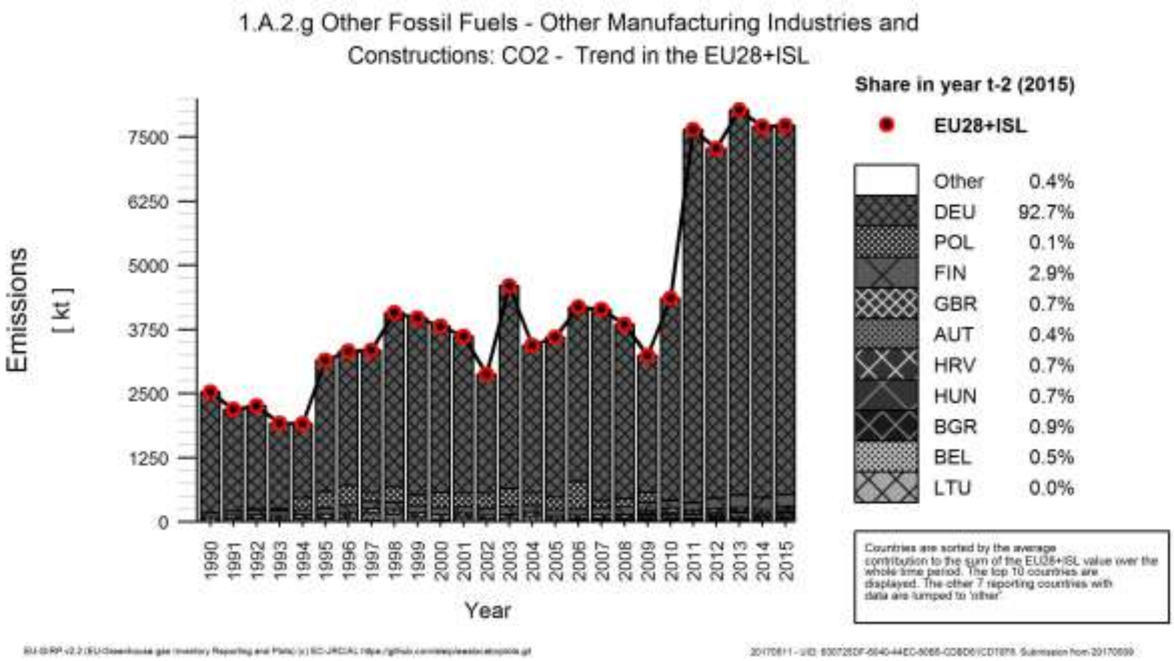
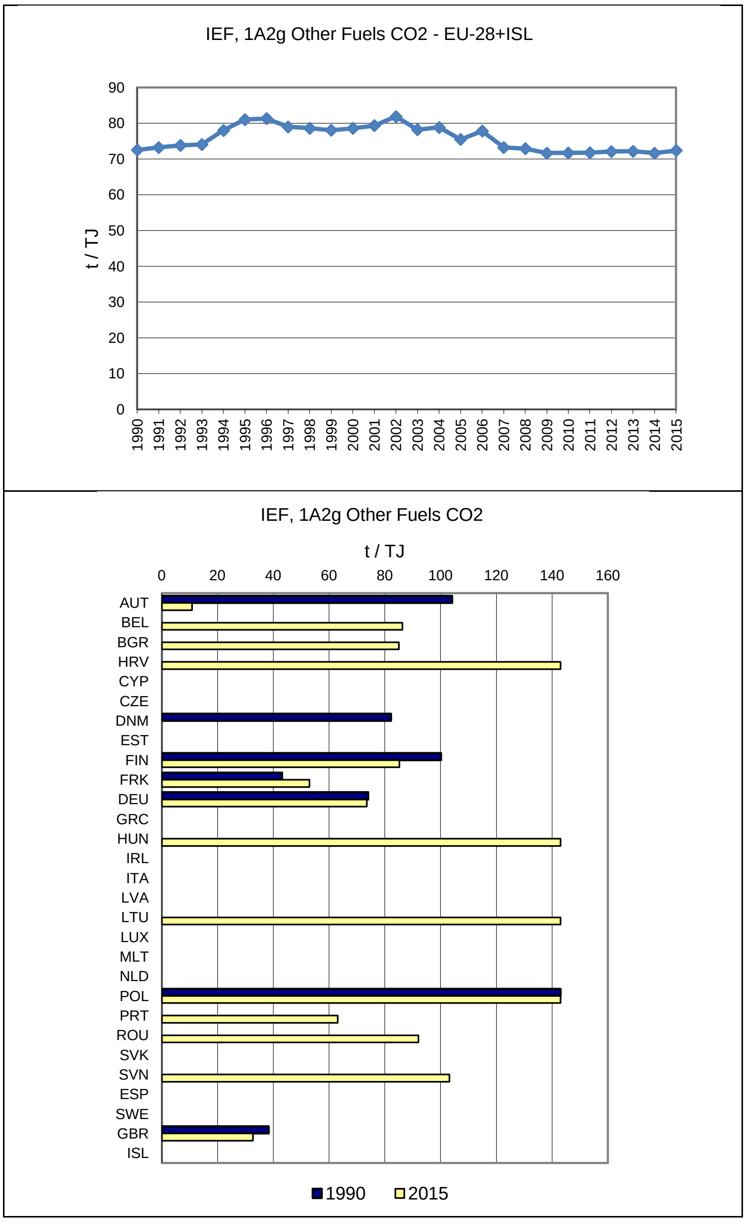


Figure 3.87 1A2g Other, other fossil fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.88. CO_2 emissions from this source category account for 21%, CH_4 for 0.03 %, N_2O for 0.2 % of total GHG emissions (without LULUCF). Between 1990 and 2015, GHG from transport increased by 16 % in the EU-28+ISL.

Figure 3.88 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Mt) and Activity Data in TJ

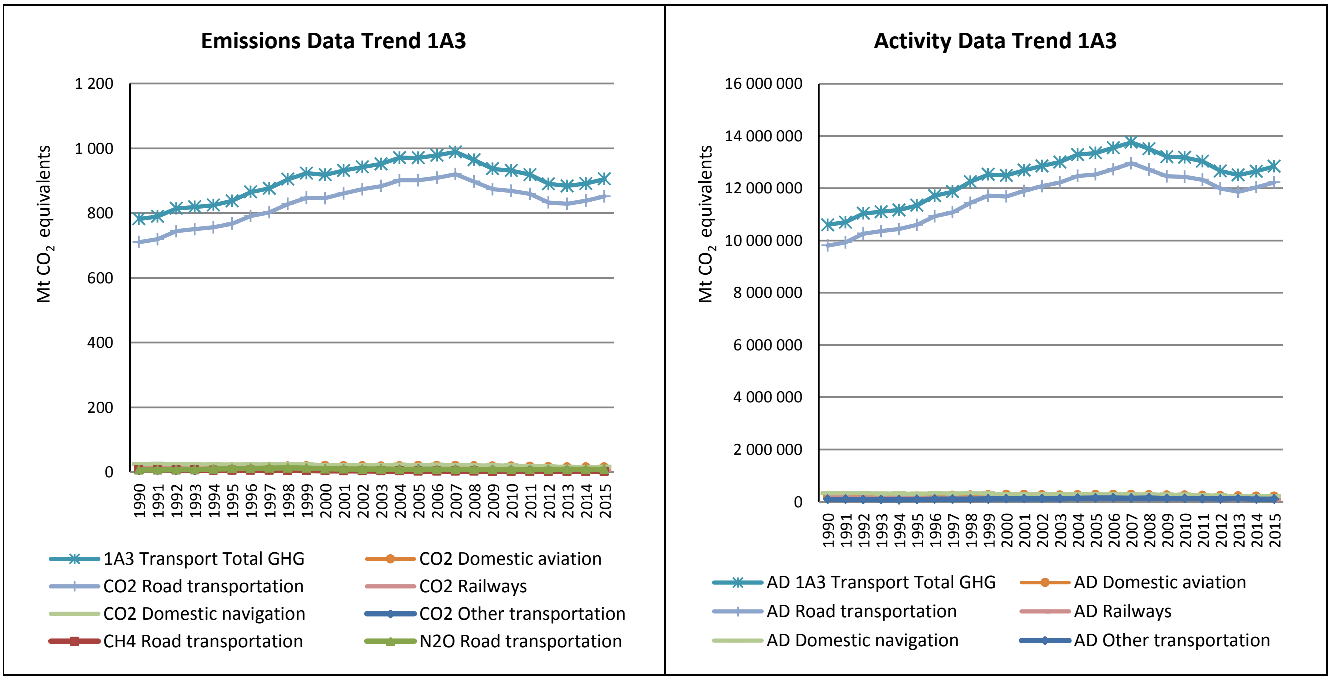


Table 6. 1 Key category analysis for the EU (1A3 sector excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 3 a Domestic Aviation: Jet Kerosene (CO_2)	13723	15003	T	L	L
1 A 3 b Road Transportation: Diesel Oil (CO_2)	298136	603865	T	L	L
1 A 3 b Road Transportation: Diesel Oil (N_2O)	1791	7035	T	0	L
1 A 3 b Road Transportation: Gaseous Fuels (CO_2)	504	3742	T	0	0
1 A 3 b Road Transportation: Gasoline (CH_4)	5786	873	T	0	0
1 A 3 b Road Transportation: Gasoline (CO_2)	405045	230299	T	L	L
1 A 3 b Road Transportation: Gasoline (N_2O)	4772	1133	T	0	0
1 A 3 b Road Transportation: Liquefied Petroleum Gases (LPG) (CO_2)	7349	15671	T	0	L
1 A 3 c Railways: Liquid Fuels (CO_2)	12840	6055	T	L	0
1 A 3 d Domestic Navigation: Gas/Diesel Oil (CO_2)	14093	9895	0	L	L
1 A 3 d Domestic Navigation: Residual Fuel Oil (CO_2)	8856	4487	0	L	0

Table 3.56 shows total GHG, CO_2, CH_4 and N_2O emissions from 1A3 Transport.

Table 3.56 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	13 976	22 587	13 777	22 378	133	201	65	9
Belgium	20 657	26 488	20 318	26 192	218	278	121	17
Bulgaria	6 573	9 362	6 396	9 251	107	84	70	27
Croatia	3 881	5 952	3 787	5 884	53	56	41	12
Cyprus	1 214	1 889	1 181	1 830	28	49	5	11
Czech Republic	7 284	17 748	7 032	17 344	214	378	39	26
Denmark	10 734	12 336	10 576	12 192	101	134	57	11
Estonia	2 477	2 324	2 416	2 293	38	27	23	4
Finland	12 101	11 111	11 827	11 012	161	78	113	21
France	120 655	132 502	118 705	130 731	956	1 606	994	165
Germany	164 404	160 807	161 882	159 111	1 192	1 549	1 329	147
Greece	14 507	17 098	14 124	16 805	272	213	110	81
Hungary	8 878	12 203	8 678	12 042	131	135	69	26
Ireland	5 135	11 827	5 022	11 693	66	118	48	16
Italy	102 702	105 990	100 771	104 836	965	935	967	219
Latvia	3 031	3 132	2 931	3 072	80	55	20	5
Lithuania	5 835	5 114	5 706	5 048	80	52	49	14
Luxembourg	2 585	5 693	2 556	5 643	18	49	11	1
Malta	320	632	313	625	4	5	2	2
Netherlands	28 140	31 160	27 838	30 847	106	251	196	61
Poland	20 497	46 638	19 986	46 034	331	498	180	107
Portugal	10 075	16 193	9 883	16 021	88	145	104	28
Romania	12 439	15 730	12 059	15 501	285	194	94	35
Slovakia	6 824	6 705	6 693	6 622	100	68	30	15
Slovenia	2 734	5 359	2 666	5 296	38	57	29	7
Spain	58 967	83 386	58 050	82 464	532	834	384	88
Sweden	19 333	18 168	18 997	17 975	180	149	156	43
United Kingdom	115 851	117 754	113 232	116 520	1 376	1 119	1 243	116
EU-28	**781 808**	**905 888**	**767 405**	**895 261**	**7 854**	**9 315**	**6 549**	**1 312**
Iceland	617	886	600	856	14	29	4	2
United Kingdom (KP)	116 891	118 605	114 252	117 363	1 385	1 125	1 253	117
EU-28 + ISL	**783 465**	**907 625**	**769 024**	**896 960**	**7 877**	**9 349**	**6 563**	**1 316**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.57 provides information on the contribution of Member States to EU-28+ISL recalculations in CO_2 from 1A3 Transport for 1990 and 2015 and main explanations for the largest recalculations in absolute terms.

Table 3.57 1A3 Transport: Contribution of MS to EU-28+ISL recalculations in CO_2 for 1990 and 2014(difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	For the year 2014 marginal changes in emissions (−0.001%) are caused by revised levels for liquefied petroleum gas (LPG) and biogas in the national energy balance.
Belgium	2	0.0	-436	-1.7	See chapter 3.2.8 in NIR
Bulgaria	-209	-3.2	0	0.0	Following a recommendation from FCCC/ARR/2010/BGR §79, a recalculation of the entire time series is undertaken due to implementation of higher tier method and incorporation of model COPERT, version 11 into the national road transport inventory.
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	89	0.5	Updated activity data available and emission factors, explanation provided in NIR
Denmark	0	0.0	3	0.0	See NIR

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Estonia	-2	-0.1	-2	-0.1	The emission factors of 1A3a were revised. Oxidation factors have been updated and the carbon conversion factor for CO_2 emission factors has been specified.
Finland	2	0.0	1	0.0	Corrections of preliminary data
France	-14	0.0	423	0.3	Main changes affecting GHGs: - correction of the incorporation rates of biofuels for the years 2013 and 2014 - correction of the diesel consumption for Guadeloupe on the time series
Germany	0	0.0	-1 001	-0.6	For 1.A.3.b iii, a recalculation occur due to revised subsector-specific consumption data for all years from 2011 onwards.
Greece	-28	-0.2	-1 030	-6.0	Recalculations for road transport included a) the subtraction of biodiesel consumption from diesel consumption and b) diesel and gasoline consumption based on energy balance data. Domestic aviation emissions were recalculated from 2008 according to EUROCONTROL calculations and non-ETS aviation emissions were reallocated to 1A5 category.
Hungary	124	1.5	35	0.3	Revised CO_2 EF for gasoline; revised and new reallocations between 1A3 to 1A2gvii and 1A4bii; revised NCV values for gasoline and gasoil; revised AD in domestic aviation; inclusion of lubricants in 2-strokes engines
Ireland	0	0.0	0	0.0	
Italy	-536	-0.5	3 802	3.7	Revision of AD for road transport
Latvia	0	0.0	1	0.0	Minor correction in fuel consumption and corrected IEF for LPG; road transport
Lithuania	-1 679	-22.7	-187	-3.8	Update of diesel oil consumption from road transportation in 2014; Application of new CO_2 EF for natural gas from pipelines transportation (according to new study); Off-road EF revision and emission allocation by sector
Luxembourg	-102	-3.8	21	0.3	revised CO_2 EF for motor gasoline and aviation gasoline; revised split of fuels between road and off-road
Malta	-22	-6.6	-47	-7.5	No NIR was provided by Malta for 2017.
Netherlands	469	1.7	230	0.8	Reallocation of Gas transport emissions from 1A1, and revision of fuel data in transport
Poland	-278	-1.4	200	0,5	new methodology for road transport
Portugal	56	0.6	302	1.9	Revision of vkm values for Heavy duty trucks by INE in Road Transportation and update and correction of a compilation error in Navigation
Romania	0	0.0	-20	-0.1	Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A3 categories. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A3 categories.
Slovakia	-8	-0.1	-37	-0.6	Several recalculation and revision of NCVs, EFs and biomass share in the categories 1.A.3.a, 1.A.3.b, 1.A.3.c and 1.A.3.d
Slovenia	0	0.0	1	0.0	Mopeds and Motorcycles: Lubricant from 2 stroke engines; Addition of jet kerosene for domestic aviation
Spain	-177	-0.3	359	0.5	Recalculations in 1A3b Road transportation have been performed according to the following reasons: (i) Technical correction from 2016 ESD review indicated that emissions from military

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					aviation should be reported under 1A5b, according to IPCC Guidelines. (ii) In this Inventory edition, the Spanish Inventory has reallocated CO_2 emissions from lubricant use from 1A3b to 2D, with the exception of those regarding 2-stroke engines. This recalculation applies to the years 1990-2015. (iii) Finally, additional recalculations have been performed in years 2013-2015. New disaggregation in the Spanish International annual oil questionnaire has been performed regarding diesel consumption in the transport sector. Therefore, in order to avoid inconsistencies, Inventory road diesel consumption has been tallied to road diesel consumption data included in the aforementioned international.
Sweden	-104	-0.5	236	1.3	Emissions of greenhouse gases from the use of LPG by road traffic (passenger cars) are estimated for the first time in submission 2017 and are based on national statistics on supply and delivery of LPG for road traffic. The emissions of CO_2 are estimated using country-specific thermal value and emission factor, while emission factors from IPCC 2006 guidebook are used to estimate the emissions of CH_4 and N_2O.
United Kingdom	1	0,0	-39	0,0	Minor revisions to off-road fuel use estimates and fuel use in Crown Dependencies impact on fuel estimates for UK road transport.
EU28	-2 506	-0.3	2 120	0.2	
Iceland	0	0.0	0	0.0	
EU28+ISL	-2 759	-0.4	2 052	0.2	

Table 3.58 provides information on the contribution of Member States to EU-28+ISL recalculations in N_2O from 1A3 Transport for 1990 and 2015.

Table 3.58 1A3 Transport: Contribution of MS to EU-28+ISL recalculations in N_2O for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.2	-2	-0.9	For the year 2014 small changes in emissions are caused by revised levels for diesel in the national energy balance. Moreover, due to a transcription error the CH_4 and N_2O emissions from solid fuels (coal) were lacking in previous submission, but are included in this years' submission.
Belgium	4	1.7	-2	-0.8	See chapter 3.2.8 in NIR
Bulgaria	0	-0.3	0	0.1	Following a recommendation from FCCC/ARR/2010/BGR §79, a recalculation of the entire time series is undertaken due to implementation of higher tier method and incorporation of model COPERT, version 11 into the national road transport inventory.
Croatia	0	0.0	-1	-1.5	In Road transport sector recalculation was performed due to wrong density of CNG used for the period from 2011 to 2014.
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	-280	-43.7	Updated activity data available and emission factors, explanation provided in NIR

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Denmark	0	0.3	1	1.0	See NIR
Estonia	0	0.0	0	0.0	Due to revised 1A3a emission factors, the category 1A3a has been recalculated. Revised emission factors are presented in NIR, Table 3.33.
Finland	-2	-0.9	-1	-1.1	Corrections of preliminary data
France	0	0.0	10	0.7	Main changes affecting GHGs: - correction of the incorporation rates of biofuels for the years 2013 and 2014 - correction of the diesel consumption for Guadeloupe on the time series
Germany	0	0.0	-4	-0.3	Completion of the 2016 submission was based both on revised activity data and on emission factors.
Greece	-1	-0.3	-16	-7.3	Recalculations for road transport included a) the subtraction of biodiesel consumption from diesel consumption and b) diesel and gasoline consumption based on energy balance data. Domestic aviation emissions were recalculated from 2008 according to EUROCONTROL calculations and non-ETS aviation emissions were reallocated to 1A5 category.
Hungary	1	0.6	-1	-0.8	Revised CO_2 EF for gasoline; revised and new reallocations between 1A3 to 1A2gvii and 1A4bii; revised NCV values for gasoline and gasoil; revised AD in domestic aviation; inclusion of lubricants in 2-strokes engines
Ireland	0	0.0	1	0.7	*No information was found in the NIR.*
Italy	10	1.0	23	2.5	Revision of AD for road transport
Latvia	0	0.0	0	0.0	Minor correction in fuel consumption; road transport
Lithuania	-187	-69.9	-19	-25.5	Update of diesel oil consumption from road transportation in 2014; Off-road EF revision and emission allocation according to IPCC 2006 guidebook to 1A4
Luxembour g	-1	-5.5	2	3.0	Revised split of fuels between road and off-road
Malta	0	-9.7	-6	-51.2	No NIR was provided by Malta in 2017.
Netherlands	1	1.1	1	0.3	Revision in fuel data from transport affected all combustion emissions for Diesel (allocation issue)
Poland	-4	-1,1	-99	-17,1	new methodology for road transport
Portugal	0	-0.4	0	-0.2	Revision of vkm values for Heavy duty trucks by INE in Road Transportation and update and correction of a compilation error in Navigation
Romania	0	0.0	0	0.2	Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A3 categories.
Slovakia	-6	-5.3	-2	-3.4	Several recalculation and revision of NCVs, EFs and biomass share in the categories 1.A.3.a, 1.A.3.b, 1.A.3.c and 1.A.3.d
Slovenia	0	0.0	0	0.0	Addition of jet kerosene for domestic aviation
Spain	-2	-0.3	2	0.3	In this edition of the Inventory, the emissions have been recalculated because since 2013 the fuel consumption (diesel) is not fully charged to the road transport sector in the international questionnaires produced annually by the focal point (MINETAD) EUROSTAT and the IEA.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Sweden	0	0.0	-12	-7.6	Emissions of greenhouse gases from the use of LPG by road traffic (passenger cars) are estimated for the first time in submission 2017 and are based on national statistics on supply and delivery of LPG for road traffic. The emissions of CO_2 are estimated using country-specific thermal value and emission factor, while emission factors from IPCC 2006 guidebook are used to estimate the emissions of CH_4 and N_2O.
United Kingdom	0	0,0	-3	-0.3	Minor revisions to traffic data
EU28	-170	-2.1	-421	-4.5	
Iceland	-2	-11.4	-5	-15.8	*No information was found in the NIR.*
EU28+ISL	-173	-2.1	-427	-4.5	

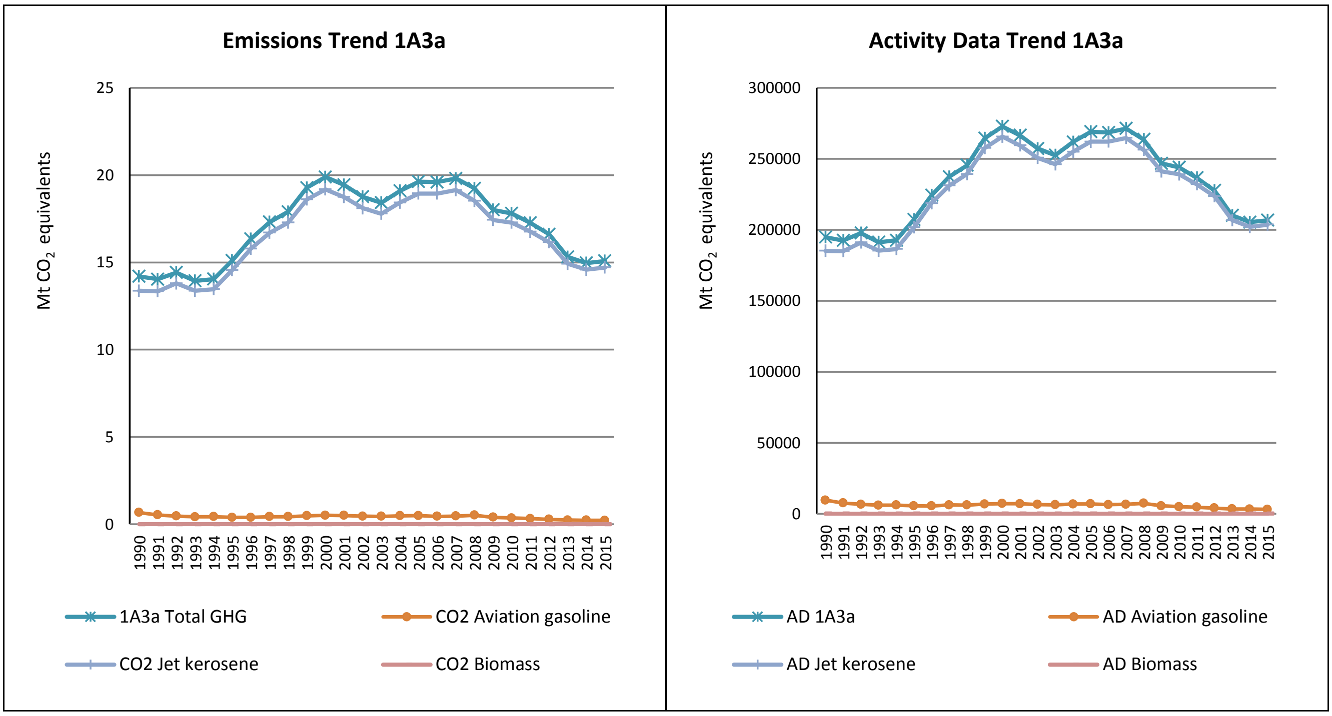
3.2.3.1 Civil Aviation (1A3a) (EU-28+ISL)

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 2015. Between 1990 and 2015, CO_2 emissions from civil aviation increased by 6 % in the EU-28+ISL (Table 3.59, Figure 3.89).

CO_2 emissions from Jet Kerosene account for 99 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2014 and 2015, CO_2 emissions from civil aviation increased by 1 % in the EU-28+ISL (Table 3.59, Figure 3.89).

Figure 3.89 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 74 % to the emissions from this source. Most Member States (15 in total) increased emissions from civil aviation between 1990 and 2015 (Table 3.59).

Table 3.59 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	32	50	50	0.3%	0	0%	18	56%
Belgium	12	11	9	0.1%	-2	-19%	-3	-27%
Bulgaria	135	28	40	0.3%	12	44%	-95	-70%
Croatia	7	30	31	0.2%	0	1%	24	367%
Cyprus	11	1	1	0.0%	0	50%	-10	-92%
Czech Republic	139	7	10	0.1%	3	46%	-129	-93%
Denmark	248	136	128	0.8%	-9	-6%	-120	-49%
Estonia	6	1	1	0.0%	0	1%	-4	-77%
Finland	385	188	186	1.2%	-2	-1%	-199	-52%
France	4 306	4 519	4 550	29.9%	31	1%	244	6%
Germany	2 374	2 209	2 215	14.5%	6	0%	-159	-7%
Greece	323	361	390	2.6%	28	8%	66	20%
Hungary	4	4	4	0.0%	1	13%	1	14%
Ireland	51	9	10	0.1%	1	11%	-41	-80%
Italy	1 613	2 193	2 052	13.5%	-141	-6%	439	27%
Latvia	0	3	2	0.0%	-2	-49%	2	2529%
Lithuania	8	2	2	0.0%	0	-20%	-7	-81%
Luxembourg	0	1	1	0.0%	0	20%	0	181%
Malta	1	3	4	0.0%	1	23%	3	217%
Netherlands	85	41	31	0.2%	-10	-25%	-54	-64%
Poland	65	137	124	0.8%	-12	-9%	59	92%
Portugal	178	341	366	2.4%	25	7%	188	106%
Romania	25	73	126	0.8%	53	74%	101	407%
Slovakia	4	3	4	0.0%	0	6%	0	-2%
Slovenia	1	2	2	0.0%	0	6%	1	84%
Spain	1 856	2 369	2 504	16.4%	135	6%	648	35%
Sweden	673	516	503	3.3%	-13	-2%	-170	-25%
United Kingdom	1 502	1 576	1 584	10.4%	8	1%	82	5%
EU-28	**14 044**	**14 815**	**14 928**	**98%**	**113**	**1%**	**883**	**6%**
Iceland	31	40	20	0.1%	-20	-49%	-11	-36%
United Kingdom (KP)	1 837	1 865	1 864	12.2%	-1	0%	27	1%
EU-28 + ISL	**14 410**	**15 143**	**15 228**	**100%**	**84**	**1%**	**817**	**6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2015 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 99 % of CO_2 emissions in 1A3a. Within the EU-28+ISL the emissions increased between 1990 and 2015 by 9 % (Table 3.60). By far the largest absolute increase occurred in Spain. Between 2014 and 2015, EU-28+ISL emissions increased by 1 %.

Table 3.60 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	24	42	42	0.3%	-1	-2%	17	72%	T3	CS
Belgium	9	8	6	0.0%	-2	-23%	-3	-34%	T2	D
Bulgaria	114	25	37	0.2%	12	50%	-77	-67%	T2	D
Croatia	6	27	30	0.2%	3	9%	24	375%	T1	D
Cyprus	11	1	1	0.0%	0	50%	-10	-92%	T1	D
Czech Republic	1	1	1	0.0%	0	16%	0	-24%	T1	D
Denmark	240	133	124	0.8%	-9	-7%	-115	-48%	CR,M,T2	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	377	185	184	1.2%	-1	-1%	-193	-51%	T1	CS
France	4 200	4 459	4 490	29.9%	31	1%	290	7%	T3	M
Germany	2 203	2 176	2 176	14.5%	0	0%	-27	-1%	CS,T2	CS,M
Greece	311	355	383	2.6%	28	8%	72	23%	T3	D
Hungary	1	1	2	0.0%	1	48%	0	40%	T1	D
Ireland	48	7	8	0.1%	1	15%	-40	-83%	T3	CS
Italy	1 579	2 187	2 045	13.6%	-142	-7%	465	29%	T1,T2	CS
Latvia	0	3	1	0.0%	-2	-58%	1	2291%	T1	D
Lithuania	7	1	0	0.0%	0	-63%	-7	-97%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	1	3	4	0.0%	1	23%	3	228%	T1	D
Netherlands	73	36	27	0.2%	-9	-25%	-46	-63%	T1	D
Poland	40	122	112	0.7%	-9	-8%	72	178%	T1	D
Portugal	176	340	365	2.4%	25	7%	189	107%	T3	D
Romania	25	70	123	0.8%	53	77%	98	394%	T2	OTH
Slovakia	4	3	4	0.0%	0	5%	0	0%	T3	D
Slovenia	NO	0	1	0.0%	0	53%	1	∞	T1	D
Spain	1 823	2 361	2 493	16.6%	132	6%	669	37%	T2	D
Sweden	658	510	498	3.3%	-12	-2%	-160	-24%	T1	D
United Kingdom	1 439	1 528	1 553	10.4%	25	2%	114	8%	T3	CS
EU-28	**13 373**	**14 585**	**14 709**	**98%**	**125**	**1%**	**1 336**	**10%**	**-**	**-**
Iceland	26	38	19	0.1%	-20	-51%	-8	-29%	T1	D
United Kingdom (KP)	1 763	1 809	1 829	12.2%	19	1%	66	4%	T3	CS
EU-28 + ISL	**13 723**	**14 904**	**15 003**	**100%**	**99**	**1%**	**1 280**	**9%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 87 % of CO_2 emissions from jet kerosene in 2015 (Figure 3.91). Table **3.60** shows that the majority of emissions from Civil Aviation jet kerosene were calculated using a higher tier method. In Figure 3.90 the IEF is depicted, showing a mean value of 71.9 t/TJ, with Spain having the higher emission factor (73.91 t/TJ) and Iceland the lower (70.8 t/TJ).

Figure 3.91 1A3a Civil Aviation, Jet Kerosene: Emission trend and share for CO_2

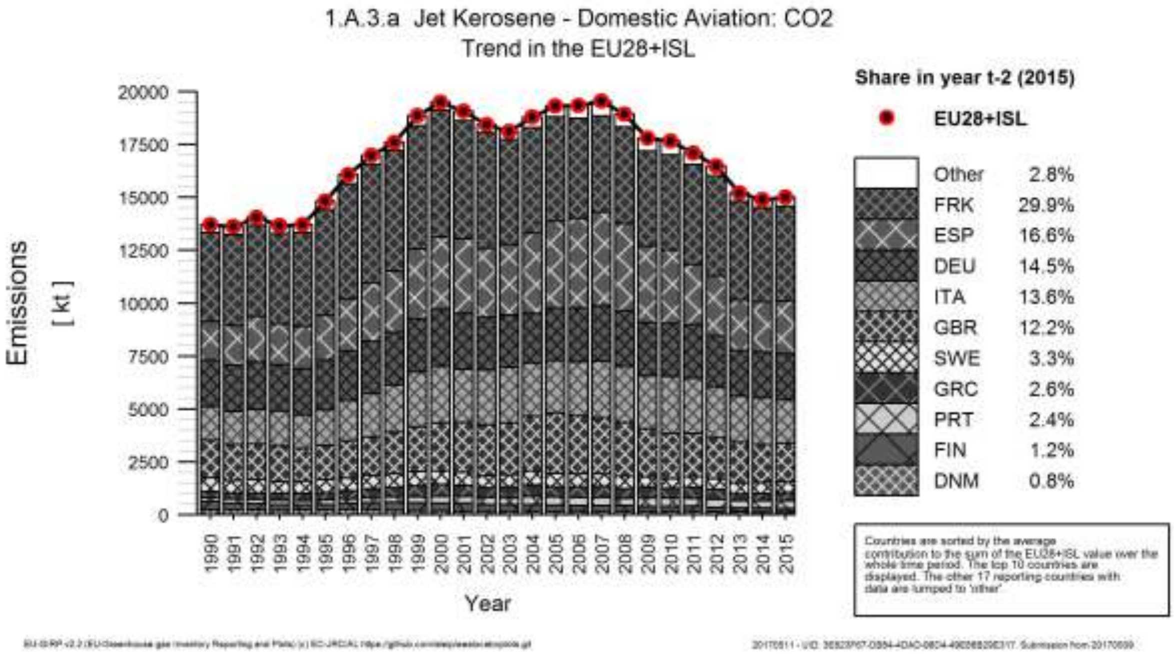
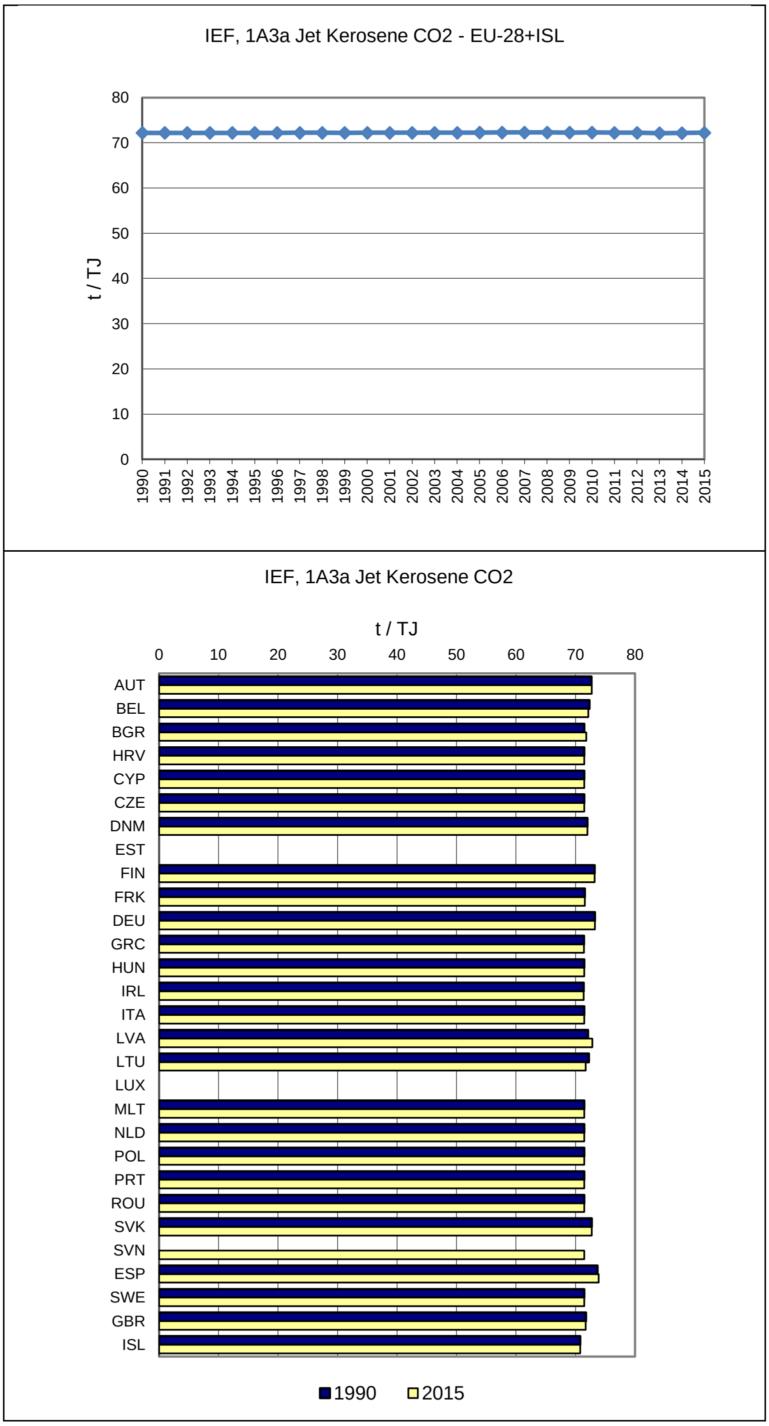


Figure 3.92 1A3a Civil Aviation, Jet Kerosene: Implied Emission Factors for CO_2 (in t/TJ)



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

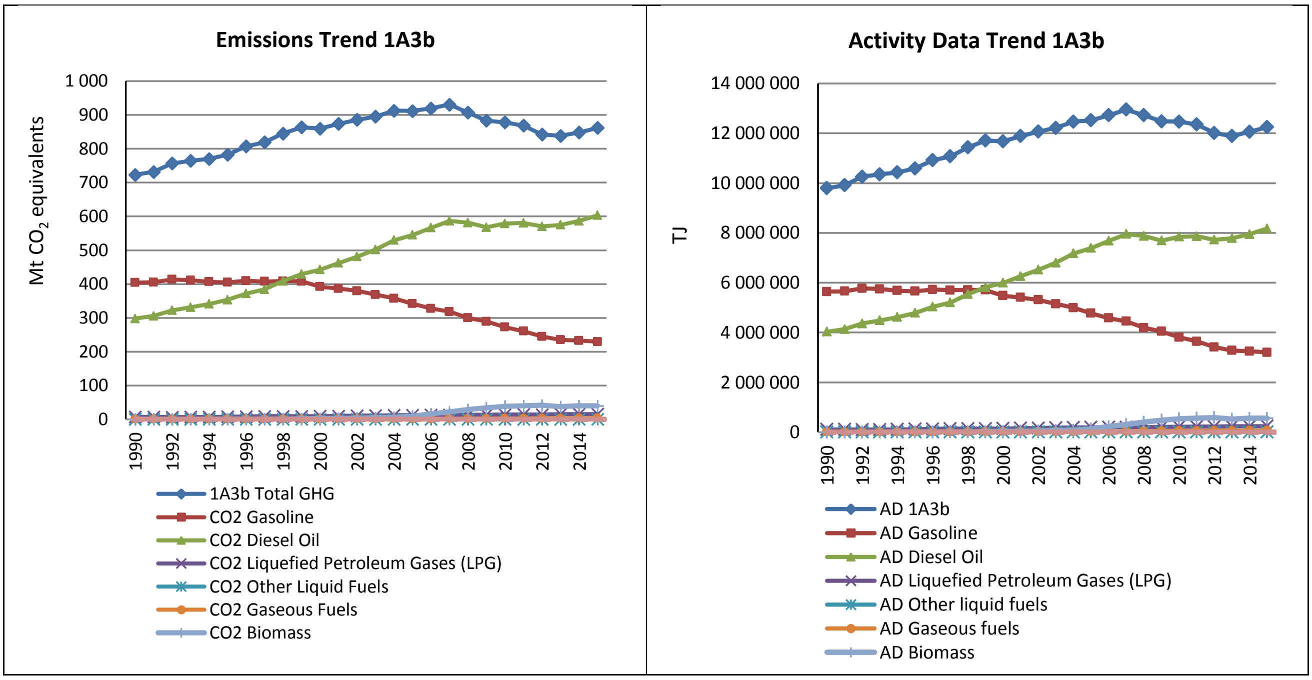
CO_2 emissions from 1A3b Road Transportation

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 21 % of total GHG emissions in 2015. Between 1990 and 2015, CO_2 emissions from road transportation increased by 20 % in the EU-28+ISL (Table 3.61). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 25 % between 1990 and 2015.

Figure 3.93 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 3.93 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 (66 %). All Member States, except for Estonia (-2%), Finland (-4%), Lithuania (-8%) and Sweden (-3%), show increased emissions from road transportation between 1990 and 2015. 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 United Kingdom (Table 3.61).

Table 3.61 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	13 328	21 294	21 617	2.5%	323	2%	8 289	62%	T1,T2	CS,D
Belgium	19 493	23 886	25 535	3.0%	1 649	7%	6 042	31%	NA	NA
Bulgaria	5 750	7 945	8 810	1.0%	864	11%	3 060	53%	T2	CR
Croatia	3 506	5 342	5 667	0.7%	325	6%	2 161	62%	T1	D
Cyprus	1 167	1 759	1 827	0.2%	68	4%	660	57%	T1	D
Czech Republic	6 177	16 206	16 986	2.0%	779	5%	10 809	175%	T1	CS,D
Denmark	9 283	11 236	11 442	1.3%	207	2%	2 159	23%	CR,M,T2	CS
Estonia	2 235	2 141	2 193	0.3%	52	2%	-42	-2%	T1,T2	CS,D
Finland	10 808	10 259	10 333	1.2%	74	1%	-474	-4%	M,T2	CS
France	112 120	123 001	124 065	14.5%	1 064	1%	11 945	11%	T3	M
Germany	151 881	152 257	152 955	17.9%	698	0%	1 075	1%	CS,M,T2,T3	CS,D
Greece	11 793	14 318	14 556	1.7%	238	2%	2 763	23%	T1,T2,T3	CS,D
Hungary	7 828	10 761	11 796	1.4%	1 034	10%	3 968	51%	T1,T2	CS,D
Ireland	4 690	10 723	11 212	1.3%	488	5%	6 521	139%	T2,T3	CS,M
Italy	92 671	100 665	98 301	11.5%	-2 364	-2%	5 630	6%	T1,T3	CS,D
Latvia	2 398	2 664	2 856	0.3%	192	7%	458	19%	T1,T2	CS,D,OTH
Lithuania	5 247	4 528	4 802	0.6%	274	6%	-445	-8%	T1,T2	CS,D
Luxembourg	2 530	6 054	5 634	0.7%	-420	-7%	3 105	123%	T2	CS,D
Malta	292	544	571	0.1%	28	5%	279	96%	T3	CR
Netherlands	26 463	29 046	29 383	3.4%	337	1%	2 920	11%	T2	CS
Poland	18 150	42 533	44 831	5.3%	2 298	5%	26 681	147%	T1,T3	D
Portugal	9 266	15 203	15 358	1.8%	156	1%	6 092	66%	T2	D
Romania	10 366	14 838	14 908	1.7%	70	0%	4 542	44%	T1,T3	D,OTH
Slovakia	4 503	6 153	6 343	0.7%	189	3%	1 840	41%	M	D
Slovenia	2 600	5 277	5 254	0.6%	-23	0%	2 654	102%	M	M
Spain	50 474	75 432	78 084	9.1%	2 651	4%	27 609	55%	T1	M
Sweden	17 370	16 732	16 783	2.0%	51	0%	-587	-3%	T2	CS
United Kingdom	107 892	107 956	110 171	12.9%	2 215	2%	2 279	2%	T1,T3	CS,OTH
EU-28	**710 281**	**838 753**	**852 273**	**100%**	**13 520**	**2%**	**141 992**	**20%**	**-**	**-**
Iceland	509	765	809	0.1%	45	6%	300	59%	NA	NA
United Kingdom (KP)	108 569	108 519	110 728	13.0%	2 209	2%	2 160	2%	T1,T3	CS,OTH
EU-28 + ISL	**711 467**	**840 080**	**853 640**	**100%**	**13 560**	**2%**	**142 173**	**20%**	**-**	**-**

In Table 3.62 the fuel share is presented per Member State. It is clear that diesel oil accounts for 67 % for EU-28+ISL and gasoline for 26 %. The highest LPG consumption is observed in Bulgaria (15 %) and Poland (11 %). The share of biomass is around 4 % for EU-28+ISL with Sweden having the highest percentage (13 %).

Table 3.62: 1A3b Road Transport: Member States' share of different fuel in the total consumption

Member State	Gasoline (%)	Diesel oil (%)	LPG (%)	Gaseous fuels (%)	Biomass (%)
Austria	20.3%	72.4%	0.2%	0.2%	6.9%
Belgium	15.4%	80.9%	0.8%	0.0%	3.0%
Bulgaria	18.3%	59.1%	15.3%	3.0%	4.3%
Croatia	29.2%	65.4%	4.0%	0.2%	1.3%
Cyprus	58.7%	39.8%	NO	NO	1.6%
Czech Republic	26.4%	66.1%	1.8%	0.6%	5.0%
Denmark	31.6%	62.9%	0.001%	0.1%	5.5%
Estonia	33.2%	66.4%	0.0%	NO	0.4%
Finland	34.2%	52.9%	NA,NO	0.04%	12.8%
France	16.1%	77.4%	0.2%	0.2%	6.1%
Germany	32.7%	61.3%	0.9%	0.3%	4.8%
Greece	50.8%	40.3%	5.3%	0.3%	3.2%
Hungary	31.5%	63.3%	0.7%	0.09%	4.32%
Ireland	28.0%	68.6%	0.1%	NO	3.34%

Member State	Gasoline (%)	Diesel oil (%)	LPG (%)	Gaseous fuels (%)	Biomass (%)
Italy	23.9%	64.5%	5.4%	2.69%	3.49%
Latvia	21.3%	69.6%	6.7%	NO	2.2%
Lithuania	12.0%	75.4%	8.0%	0.5%	4.1%
Luxembourg	15.6%	84.3%	0.0%	NO	NO,IE
Malta	42.7%	54.5%	0.2%	NO,IE	2.5%
Netherlands	39.4%	55.7%	1.5%	0.4%	3.0%
Poland	24.1%	64.4%	11.4%	0.1%	0.004%
Portugal	21.3%	72.3%	0.7%	0.2%	5.3%
Romania	25.6%	69.1%	1.3%	NO	4.1%
Slovakia	23.9%	68.0%	1.7%	0.5%	6.0%
Slovenia	25.5%	71.9%	0.8%	0.1%	1.7%
Spain	17.3%	78.3%	0.2%	0.4%	3.9%
Sweden	36.2%	49.7%	0.03%	0.6%	13.4%
United Kingdom	33.1%	64.1%	0.2%	IE	2.5%
EU-28	**26%**	**67%**	**2%**	**0.5%**	**4.1%**
Iceland	51.9%	48.1%	NO	NO	NO
EU-28 + ISL	**26%**	**67%**	**2%**	**0.5%**	**4.1%**

1A3b Road Transportation – Gaseous Fuels (CO_2)

CO_2 emissions from Gaseous fuels account for 0,4 % of CO_2 emissions from 1A3b Road Transport in 2015 (Figure 3.93). Between 2014 and 2015 CO_2 emissions from Gaseous fuels have increased by 3 %, between 1990 and 2015 emissions show an increase of 642% in EU-28+ISL. Most Member States showed increased emissions, whereas 8 Member States reported emissions as “Not occurring” or “Included elsewhere”.

Table 3.63: 1A3b Road Transport, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	NO	39	40	1.1%	1	3%	40	∞
Belgium	NO	5	7	0.2%	2	47%	7	∞
Bulgaria	NO	237	218	5.8%	-19	-8%	218	∞
Croatia	NO	7	8	0.2%	0	4%	8	∞
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	IE,NO	57	84	2.2%	27	48%	84	∞
Denmark	0	4	7	0.2%	3	86%	7	32770%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO,NA	5	4	0.1%	-1	-26%	4	∞
France	NO	228	235	6.3%	7	3%	235	∞
Germany	NA	418	414	11.1%	-4	-1%	414	∞
Greece	NO	36	35	0.9%	0	-1%	35	∞
Hungary	0	3	7	0.2%	3	101%	7	2150%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	483	2 055	2 158	57.7%	102	5%	1 674	346%
Latvia	18	NA,NO	NA,NO	-	-	-	-18	-100%
Lithuania	NO	11	18	0.5%	7	65%	18	∞
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Netherlands	NO	89	95	2.6%	7	8%	95	∞
Poland	NO	NO	38	1.0%	38	∞	38	∞
Portugal	NO	29	31	0.8%	2	8%	31	∞
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	28	26	0.7%	-2	-8%	26	∞
Slovenia	NO	3	5	0.1%	2	81%	5	∞
Spain	NO	222	221	5.9%	-1	0%	221	∞
Sweden	3	132	91	2.4%	-41	-31%	88	3033%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-28	**504**	**3 607**	**3 742**	**100%**	**135**	**4%**	**3 238**	**642%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	IE	IE	IE	-	-	-	-	-
EU-28 + ISL	**504**	**3 607**	**3 742**	**100%**	**135**	**4%**	**3 238**	**642%**

The Member States Germany, France, Italy and Spain contributed most to the CO_2 emissions from this source (81 %). All Member States, except for Latvia, show increased emissions from road transportation between 1990 and 2015. The Member States with the highest increases in absolute terms were Italy, Germany and France. (Table 3.61).

In Figure 3.7 it is depicted that the share of gaseous fuels is constantly increasing from 1990 to 2015. In Figure 3.10 the IEF is depicted and the mean value is around 56 t/TJ.

Figure 3.94: 1A3b Road Transport, gaseous fuels: Emission trend and share for CO_2

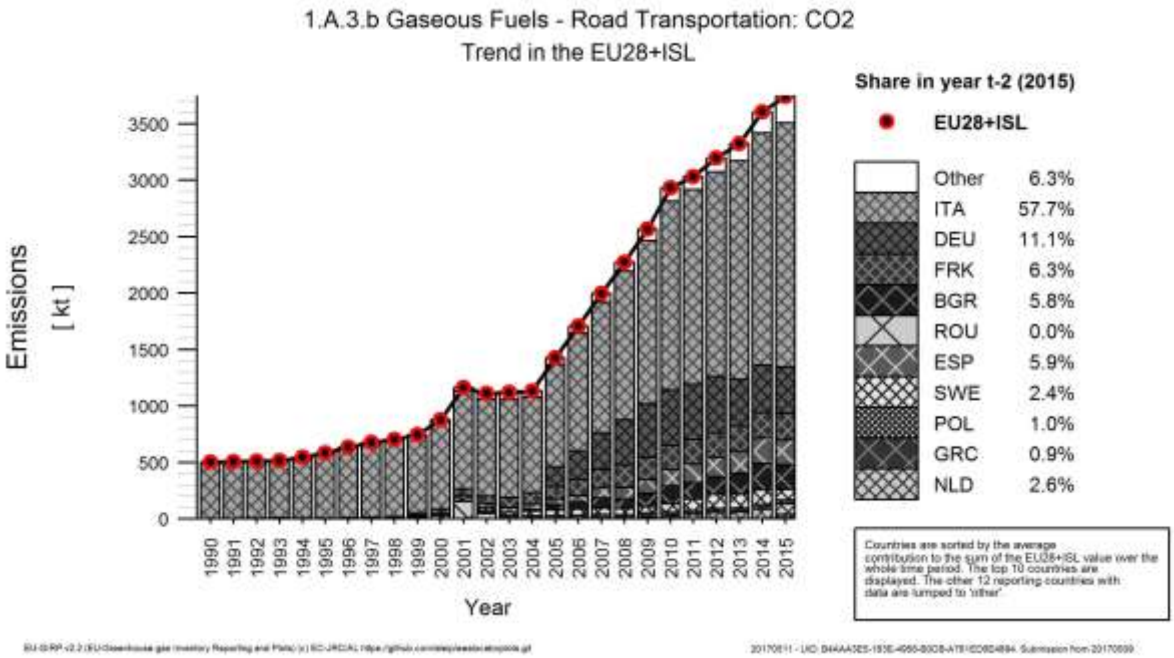
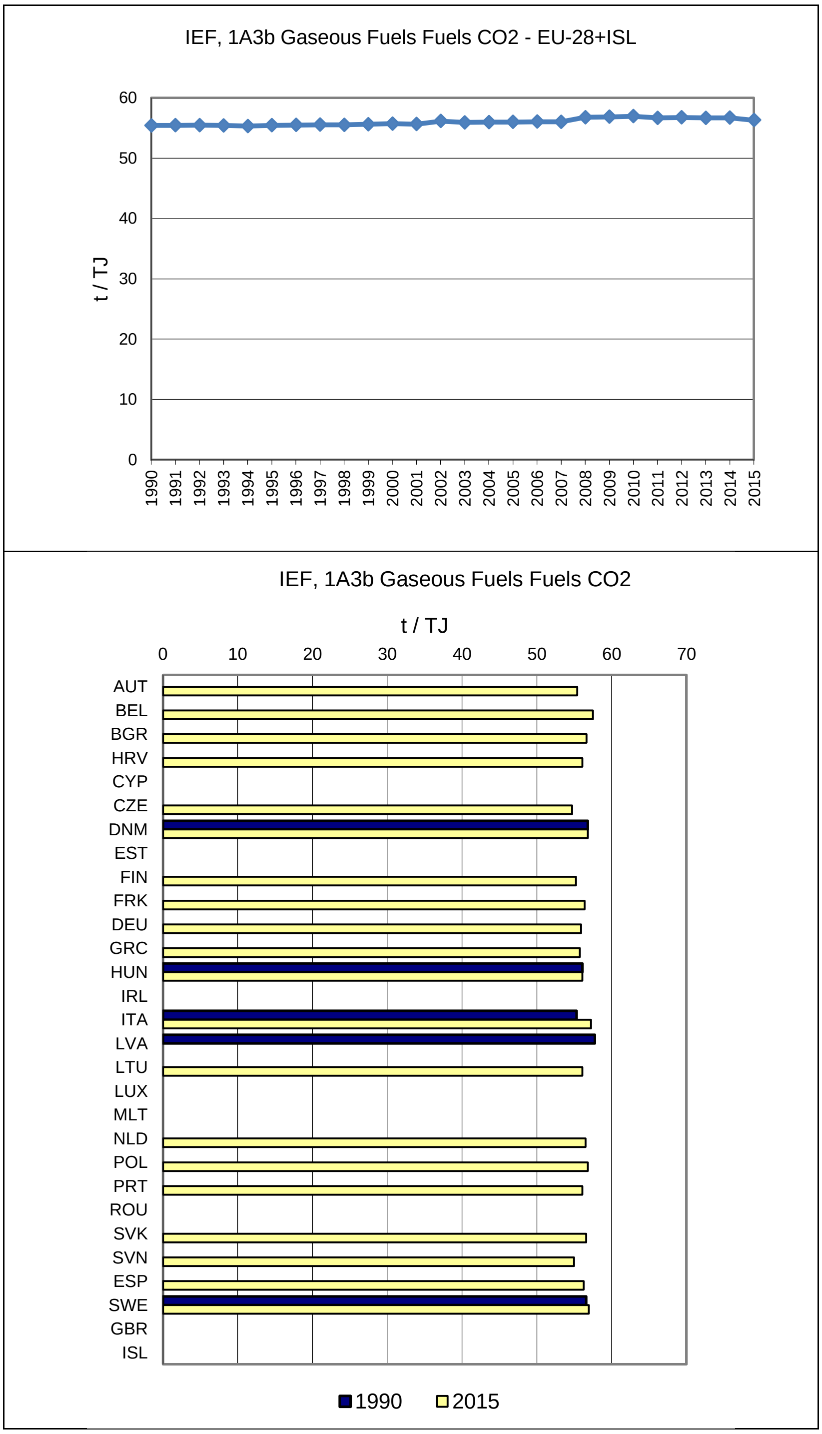


Figure 3.95 1A3b Road Transport, gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)



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 2015 (Figure 3.93). All Member States show increased emissions from Diesel oil between 1990 and 2015 (Table 3.). 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 3.8 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	5 378	16 471	16 760	2.8%	289	2%	11 382	212%
Belgium	10 964	20 074	21 438	3.6%	1 365	7%	10 475	96%
Bulgaria	1 509	4 935	5 612	0.9%	677	14%	4 104	272%
Croatia	1 159	3 545	3 854	0.6%	309	9%	2 695	233%
Cyprus	667	712	768	0.1%	56	8%	101	15%
Czech Republic	2 690	11 373	12 089	2.0%	716	6%	9 399	349%
Denmark	4 436	7 430	7 648	1.3%	218	3%	3 212	72%
Estonia	697	1 400	1 463	0.2%	62	4%	766	110%
Finland	4 923	6 189	6 286	1.0%	97	2%	1 363	28%
France	54 220	102 521	103 399	17.1%	878	1%	49 179	91%
Germany	54 478	96 000	99 121	16.4%	3 121	3%	44 643	82%
Greece	4 264	5 798	6 105	1.0%	307	5%	1 841	43%
Hungary	2 388	6 985	7 896	1.3%	911	13%	5 508	231%
Ireland	1 914	7 399	8 059	1.3%	660	9%	6 145	321%
Italy	47 776	68 393	66 579	11.0%	-1 815	-3%	18 803	39%
Latvia	616	1 880	2 072	0.3%	192	10%	1 456	236%
Lithuania	2 134	3 501	3 808	0.6%	307	9%	1 674	78%
Luxembourg	1 264	5 111	4 748	0.8%	-362	-7%	3 484	276%
Malta	119	324	341	0.1%	17	5%	223	188%
Netherlands	13 025	16 920	17 134	2.8%	214	1%	4 110	32%
Poland	8 633	27 561	29 609	4.9%	2 048	7%	20 975	243%
Portugal	5 060	11 743	11 927	2.0%	184	2%	6 867	136%
Romania	3 648	10 643	10 950	1.8%	307	3%	7 301	200%
Slovakia	3 123	4 567	4 668	0.8%	101	2%	1 545	49%
Slovenia	904	3 908	3 913	0.6%	5	0%	3 009	333%
Spain	24 422	61 324	63 861	10.6%	2 537	4%	39 439	161%
Sweden	4 603	9 385	9 653	1.6%	268	3%	5 049	110%
United Kingdom	32 773	70 413	73 468	12.2%	3 055	4%	40 695	124%
EU-28	**297 787**	**586 506**	**603 229**	**100%**	**16 723**	**3%**	**305 443**	**103%**
Iceland	117	359	403	0.1%	43	12%	286	246%
United Kingdom (KP)	33 006	70 643	73 701	12.2%	3 058	4%	40 695	123%
EU-28 + ISL	**298 136**	**587 095**	**603 865**	**100%**	**16 770**	**3%**	**305 729**	**103%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 67 % of CO_2 emissions from diesel oil in 2015 (). **In Figure 3.96 the IEF is depicted and** the mean value is around 73.7 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 3.97). In Figure 3.96 the IEF is depicted and the mean value is around 73.7 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 3.97 1A3b Road Transport, Diesel Oil: Emission trend and share for CO_2

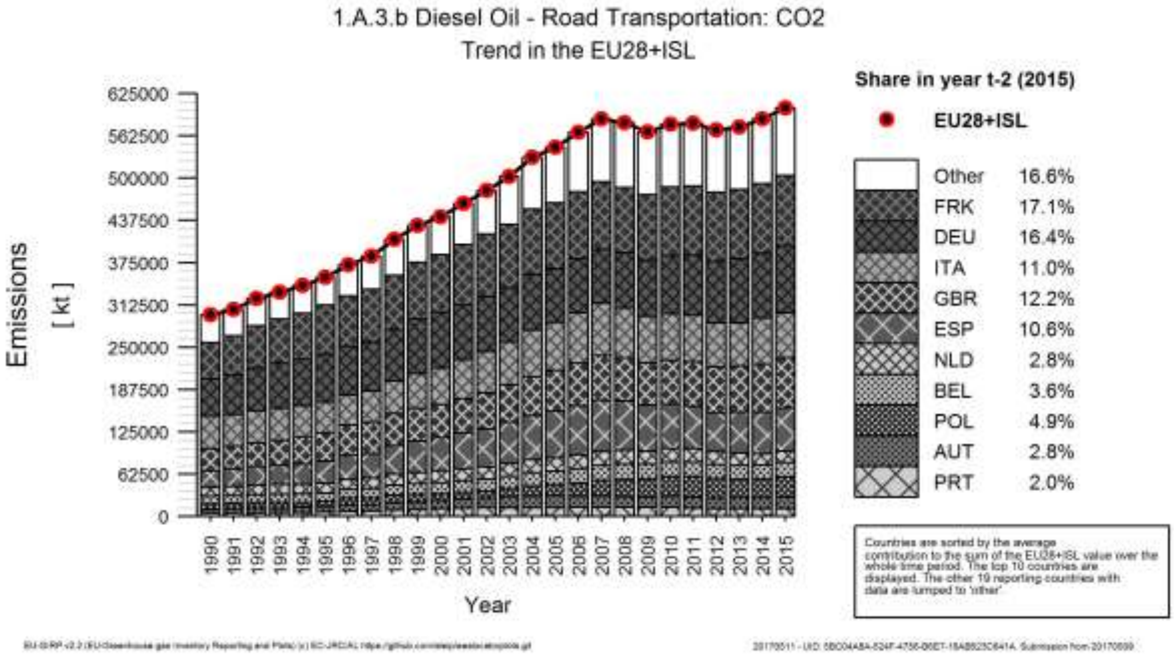
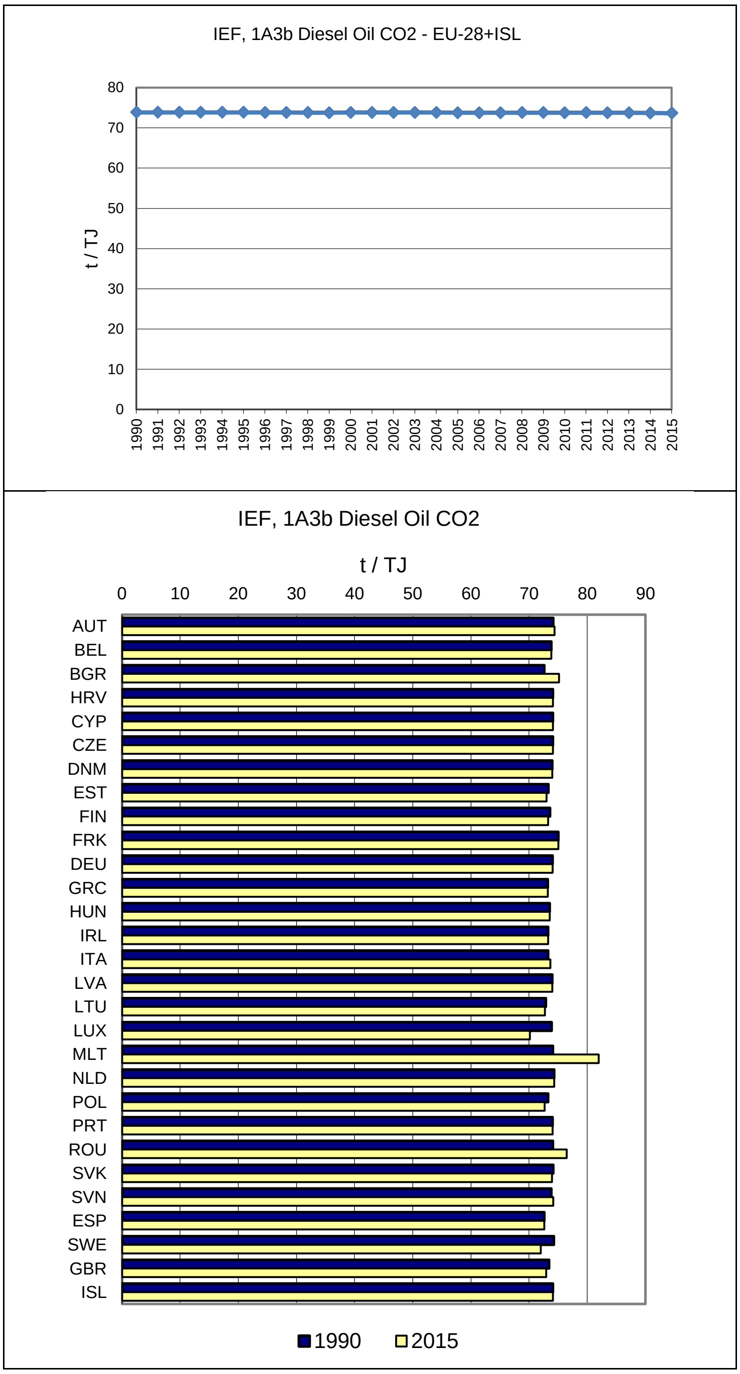


Figure 3.98 1A3b Road Transport, Diesel Oil: Implied Emission Factors for CO_2 (in t/TJ)



1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2015, CO_2 emissions from gasoline decreased by 43 % in the EU-28+ISL (Table 3.).

Table 3.9 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	7 924	4 734	4 777	2.1%	44	1%	-3 146	-40%
Belgium	8 360	3 673	3 914	1.7%	240	7%	-4 446	-53%
Bulgaria	4 241	1 575	1 702	0.7%	127	8%	-2 539	-60%
Croatia	2 347	1 610	1 607	0.7%	-3	0%	-740	-32%
Cyprus	500	1 047	1 059	0.5%	12	1%	559	112%
Czech Republic	3 487	4 480	4 517	2.0%	36	1%	1 030	30%
Denmark	4 838	3 802	3 788	1.6%	-15	0%	-1 051	-22%
Estonia	1 529	739	730	0.3%	-10	-1%	-799	-52%
Finland	5 884	4 065	4 043	1.8%	-22	-1%	-1 841	-31%
France	57 738	19 972	20 182	8.8%	210	1%	-37 556	-65%
Germany	97 217	54 428	52 113	22.6%	-2 315	-4%	-45 104	-46%
Greece	7 438	7 884	7 709	3.3%	-175	-2%	271	4%
Hungary	5 404	3 692	3 811	1.7%	119	3%	-1 593	-29%
Ireland	2 758	3 318	3 146	1.4%	-173	-5%	388	14%
Italy	40 317	25 447	24 524	10.6%	-923	-4%	-15 793	-39%
Latvia	1 724	613	610	0.3%	-3	0%	-1 113	-65%
Lithuania	3 053	626	608	0.3%	-18	-3%	-2 445	-80%
Luxembourg	1 254	940	884	0.4%	-56	-6%	-370	-30%
Malta	173	219	229	0.1%	10	5%	56	32%
Netherlands	10 785	11 572	11 742	5.1%	170	1%	957	9%
Poland	9 517	10 239	10 583	4.6%	344	3%	1 066	11%
Portugal	4 196	3 328	3 291	1.4%	-37	-1%	-905	-22%
Romania	6 591	4 040	3 792	1.6%	-249	-6%	-2 799	-42%
Slovakia	1 380	1 467	1 546	0.7%	79	5%	166	12%
Slovenia	1 695	1 331	1 296	0.6%	-35	-3%	-400	-24%
Spain	25 974	13 780	13 872	6.0%	91	1%	-12 103	-47%
Sweden	12 764	7 214	7 033	3.1%	-181	-3%	-5 730	-45%
United Kingdom	75 119	37 284	36 461	15.8%	-823	-2%	-38 658	-51%
EU-28	**404 208**	**233 119**	**229 567**	**100%**	**-3 552**	**-2%**	**-174 641**	**-43%**
Iceland	392	405	407	0.2%	1	0%	14	4%
United Kingdom (KP)	75 563	37 617	36 786	16.0%	-831	-2%	-38 777	-51%
EU-28 + ISL	**405 045**	**233 858**	**230 299**	**100%**	**-3 559**	**-2%**	**-174 746**	**-43%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 64 % for CO_2 emissions from gasoline in 2015 (). **In Figure 3.99 the IEF is depicted and** the mean value is around 71.2 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 3.100). In Figure 3.99 the IEF is depicted and the mean value is around 71.2 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 3.100 1A3b Road Transport, Gasoline: Emission trend and share for CO_2

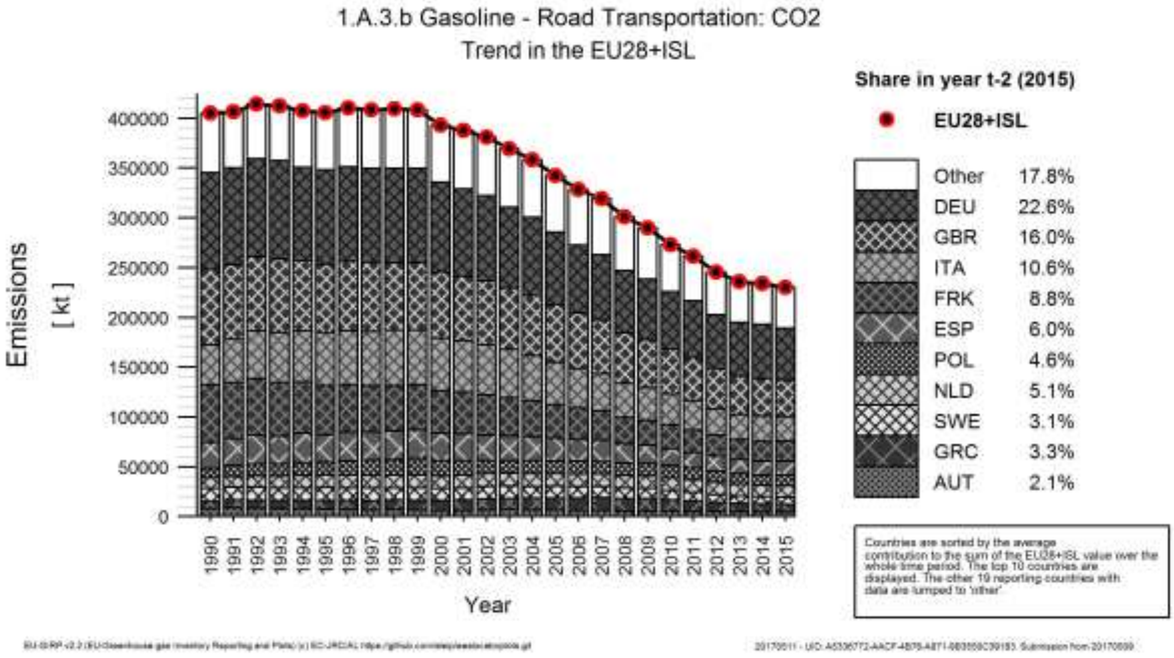
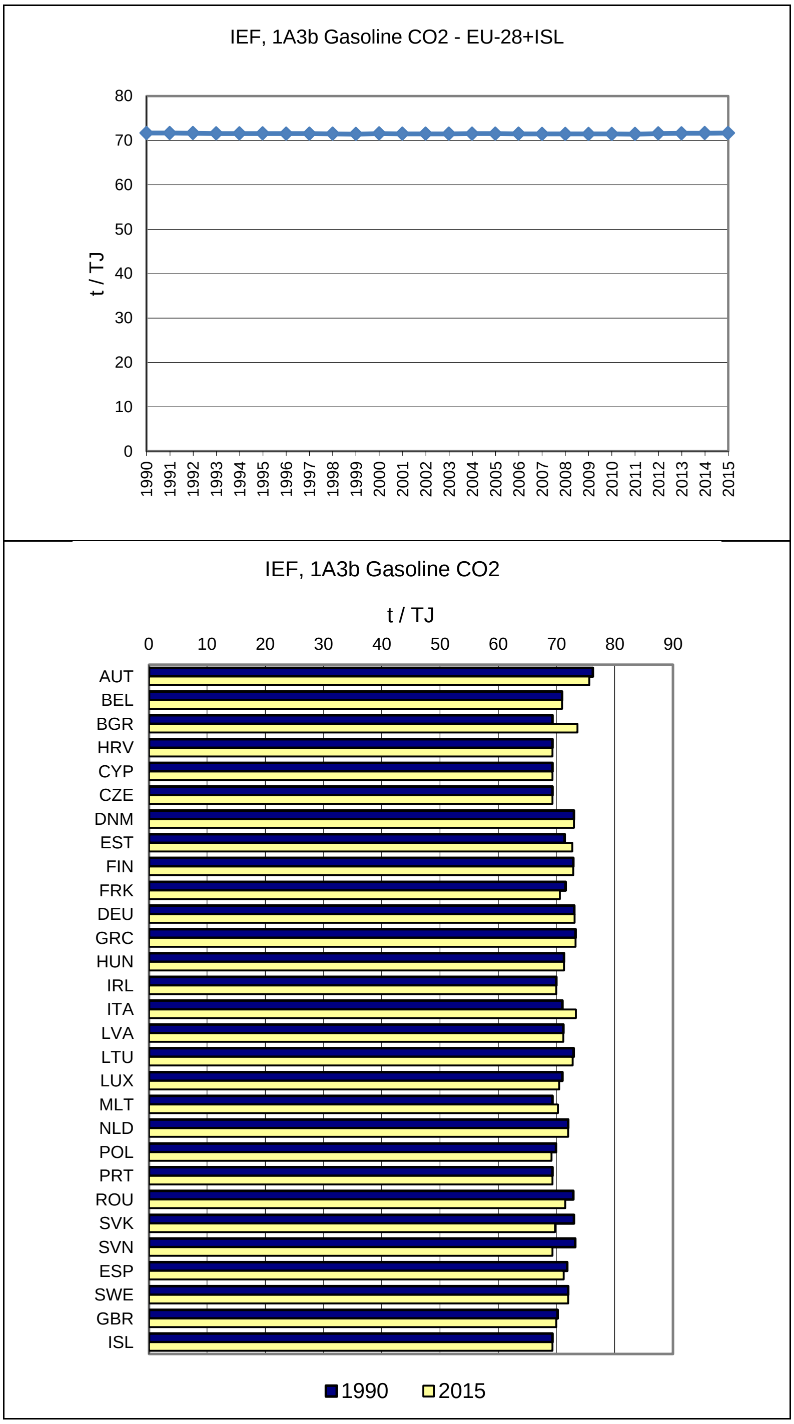


Figure 3.101 1A3b Road Transport, Gasoline: Implied Emission Factors for CO_2 (in t/TJ)



1A3b Road Transportation – LPG (CO_2)

Between 1990 and 2015, CO_2 emissions from LPG increased by 113 % in the EU-28+ISL. Three Member States report emissions as ‘Not occurring’. Between 2014 and 2015 EU-28+ISL emissions increased by 1 % (Table 3.).

Table 3.10 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	26	50	40	0.3%	-11	-22%	13	50%
Belgium	169	133	175	1.1%	42	32%	6	4%
Bulgaria	NO	1 198	1 277	8.1%	79	7%	1 277	∞
Croatia	NO	179	198	1.3%	20	11%	198	∞
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	IE,NO	297	297	1.9%	0	0%	297	∞
Denmark	9	0	0	0.0%	0	-24%	-9	-99%
Estonia	9	1	1	0.0%	0	-20%	-9	-94%
Finland	NO,NA	NA,NO	NA,NO	-	-	-	-	-
France	150	274	243	1.6%	-31	-11%	93	62%
Germany	9	1 405	1 301	8.3%	-104	-7%	1 292	14277%
Greece	91	600	706	4.5%	106	18%	615	678%
Hungary	NO	80	80	0.5%	0	0%	80	∞
Ireland	19	6	7	0.0%	1	20%	-12	-64%
Italy	4 026	4 730	5 002	31.9%	272	6%	976	24%
Latvia	37	166	169	1.1%	3	2%	131	354%
Lithuania	60	390	368	2.3%	-22	-6%	308	511%
Luxembourg	11	4	2	0.0%	-2	-50%	-9	-82%
Malta	NO,IE	1	1	0.0%	0	47%	1	∞
Netherlands	2 654	464	411	2.6%	-53	-11%	-2 242	-84%
Poland	NO,IE	4 733	4 602	29.4%	-131	-3%	4 602	∞
Portugal	0	97	104	0.7%	7	7%	104	168733%
Romania	NO	154	166	1.1%	12	8%	166	∞
Slovakia	NO	91	103	0.7%	11	13%	103	∞
Slovenia	NO	35	40	0.3%	5	15%	40	∞
Spain	78	106	130	0.8%	24	23%	51	65%
Sweden	0	1	6	0.0%	5	325%	6	1878%
United Kingdom	NO	259	242	1.5%	-18	-7%	242	∞
EU-28	**7 349**	**15 456**	**15 671**	**100%**	**215**	**1%**	**8 322**	**113%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	NO	259	242	1.5%	-18	-7%	242	∞
EU-28 + ISL	**7 349**	**15 456**	**15 671**	**100%**	**215**	**1%**	**8 322**	**113%**

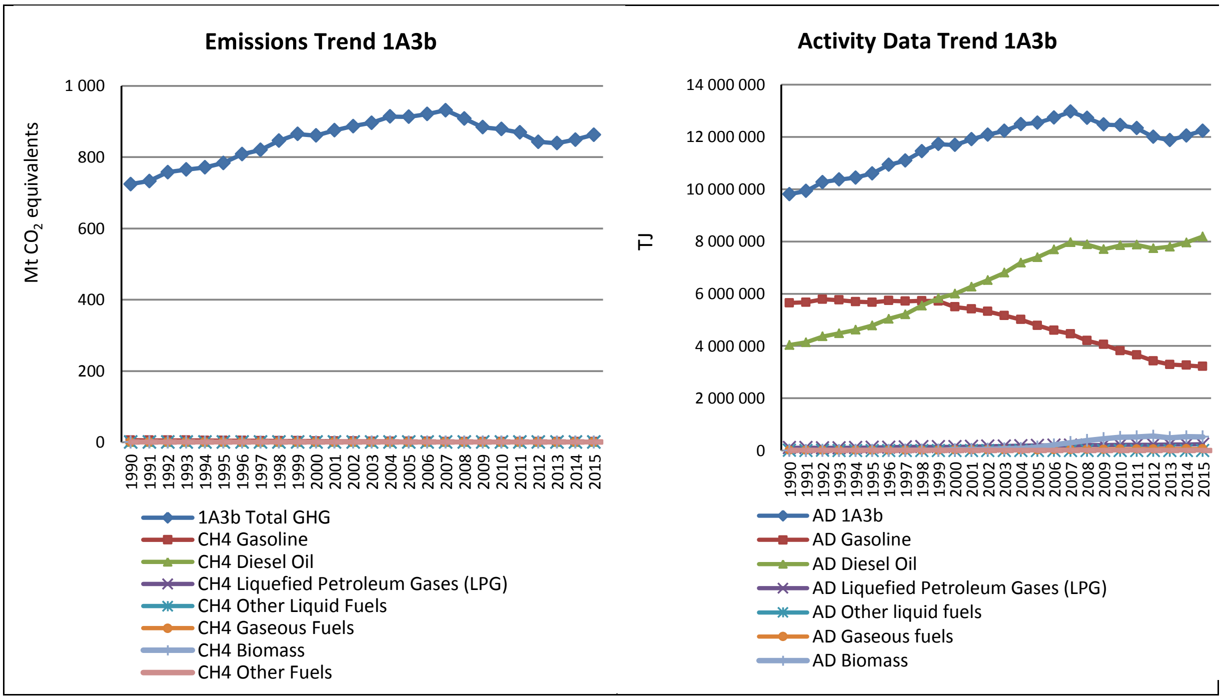
Abbreviations explained in the Chapter 'Units and abbreviations'.

, Italy accounts for 32 % and Poland for 29 % of CO_2 emissions from LPG in 2015 whereas France, Germany, Spain and the United Kingdom account for only 12 % of CO_2 emissions (Table 3.).

CH_4 emissions from 1A3b Road Transportation

CH_4 emissions from 1A3b Road Transportation account for 0.03 % of total EU-28+ISL GHG emissions in 2015 Figure 3.105 gives an overview of the CH_4 trend caused by different fuels, as well as the activity data trend, where it is clear that the gasoline share is decreasing, whereas the diesel oil is increasing.

Figure 3.102 1A3b Road Transport: CH_4 Emissions Trend and Activity Data Trend



CH_4 emissions decreased between 1990 and 2015 by 81 % (Table 3.67). All Member States, expert for Cyprus (increase by 97 %) showed a decrease in CH_4 emissions from 1990 to 2015. Between 2014 and 2015, CH_4 emissions decreased by 3 %. In the same time period the largest decrease in relative terms was reported by Luxembourg and Malta.

Table 3.64 1A3b Road Transport: 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	65	9	8	0.7%	0	-3%	-57	-87%	T3	CS
Belgium	120	17	17	1.4%	0	0%	-104	-86%	NA	NA
Bulgaria	69	27	27	2.2%	0	1%	-42	-61%	T2	CR
Croatia	41	12	12	1.0%	0	-3%	-29	-70%	T1,T3	CR,D
Cyprus	5	10	11	0.9%	0	2%	5	97%	T1	D
Czech Republic	38	24	25	2.1%	1	6%	-12	-33%	T1,T2	CS,D
Denmark	56	11	10	0.8%	-1	-8%	-46	-81%	CR,M,T3	CR
Estonia	23	4	4	0.3%	0	-3%	-19	-84%	T1,T3	CS,D
Finland	107	18	17	1.4%	-1	-5%	-89	-84%	M,T2	D
France	968	142	135	11.0%	-7	-5%	-834	-86%	T3	M
Germany	1 317	145	138	11.3%	-7	-5%	-1 179	-90%	CS,M,T2,T3	CS,M
Greece	107	76	77	6.3%	1	2%	-30	-28%	M,T1	D,M
Hungary	67	28	25	2.1%	-2	-8%	-42	-63%	T1,T3	D,M
Ireland	48	15	15	1.3%	0	1%	-32	-68%	T3	M
Italy	930	207	200	16.4%	-8	-4%	-730	-79%	T3	M
Latvia	19	4	4	0.4%	0	-4%	-15	-78%	T1,T2	CR,OTH
Lithuania	48	14	13	1.1%	-1	-7%	-35	-72%	T1,T3	CR,D
Luxembourg	11	1	1	0.1%	0	-10%	-10	-90%	T3	M
Malta	2	2	2	0.1%	0	-9%	-1	-29%	T3	CR
Netherlands	193	57	57	4.7%	0	0%	-136	-70%	T3	CS
Poland	178	108	106	8.7%	-2	-2%	-72	-40%	T1,T3	D
Portugal	102	28	27	2.2%	-1	-3%	-75	-74%	T3	CR
Romania	90	37	34	2.8%	-3	-8%	-56	-62%	T1,T3	D,OTH
Slovakia	29	16	15	1.2%	-1	-6%	-14	-49%	M	D
Slovenia	29	7	7	0.5%	0	-4%	-22	-77%	M	M
Spain	371	87	85	6.9%	-3	-3%	-286	-77%	T3	M
Sweden	152	39	40	3.3%	1	3%	-112	-74%	M,T1,T2	CS,D
United Kingdom	1 234	112	106	8.7%	-6	-5%	-1 128	-91%	T3	CS
EU-28	**6 419**	**1 257**	**1 218**	**100%**	**-39**	**-3%**	**-5 201**	**-81%**	**-**	**-**
Iceland	4	2	2	0.1%	0	1%	-2	-50%	NA	NA
United Kingdom (KP)	1 244	114	108	8.8%	-6	-5%	-1 136	-91%	T3	CS
EU-28 + ISL	**6 433**	**1 261**	**1 221**	**100%**	**-39**	**-3%**	**-5 211**	**-81%**	**-**	**-**

1A3b Road Transportation – Gasoline (CH_4)

Between 1990 and 2015, CH_4 emissions from gasoline decreased by 85 % in the EU-28+ISL. All Member States reported decreasing emissions, apart from Cyprus (increase by 112 %). Between 2014 and 2015 EU-28+ISL emissions decreased by 3 % (Table 3.). The largest decreases in per cent were reported by Lithuania (-14 %) and Romania (-10 %).

Table 3.65 1A3b Road Transport, gasoline: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	62	7	7	0.8%	0	-3%	-55	-89%
Belgium	97	11	12	1.3%	0	2%	-85	-88%
Bulgaria	65	9	9	1.1%	0	2%	-56	-86%
Croatia	38	8	8	0.9%	0	-3%	-30	-78%
Cyprus	5	9	10	1.1%	0	1%	5	112%
Czech Republic	27	7	7	0.8%	0	-3%	-20	-74%
Denmark	46	9	8	0.9%	0	-5%	-37	-82%
Estonia	21	3	3	0.3%	0	-2%	-18	-86%
Finland	93	14	13	1.5%	-1	-4%	-80	-86%
France	856	101	98	11.2%	-3	-3%	-758	-89%
Germany	1 289	129	123	14.1%	-6	-5%	-1 165	-90%
Greece	97	63	63	7.2%	-1	-1%	-35	-36%
Hungary	61	19	17	2.0%	-2	-9%	-44	-72%
Ireland	43	13	12	1.4%	0	0%	-31	-71%
Italy	754	150	143	16.3%	-8	-5%	-611	-81%
Latvia	17	2	2	0.2%	0	-4%	-15	-88%
Lithuania	41	7	6	0.7%	-1	-14%	-35	-85%
Luxembourg	10	1	1	0.1%	0	-8%	-9	-91%
Malta	2	1	1	0.1%	0	-8%	-1	-45%
Netherlands	157	48	48	5.5%	-1	-1%	-109	-70%
Poland	154	62	61	7.0%	-1	-2%	-93	-60%
Portugal	92	19	18	2.1%	-1	-6%	-74	-81%
Romania	81	26	23	2.7%	-3	-10%	-58	-72%
Slovakia	21	6	6	0.7%	0	4%	-14	-70%
Slovenia	27	5	5	0.6%	0	-3%	-22	-82%
Spain	322	58	58	6.7%	0	0%	-264	-82%
Sweden	149	15	14	1.6%	-1	-8%	-134	-90%
United Kingdom	1 147	96	93	10.6%	-3	-3%	-1 054	-92%
EU-28	**5 773**	**901**	**869**	**100%**	**-31**	**-3%**	**-4 904**	**-85%**
Iceland	4	2	2	0.2%	0	1%	-2	-51%
United Kingdom (KP)	1 156	97	94	10.8%	-3	-3%	-1 062	-92%
EU-28 + ISL	**5 786**	**904**	**873**	**100%**	**-32**	**-3%**	**-4 913**	**-85%**

France, Germany, Italy, Spain and the United Kingdom account for 59 % of CH_4 emissions from gasoline in 2015 (Table 3.). In Figure 3.17 the IEF is depicted and the mean value is around 22.9 kg/TJ.

Figure 3.103 1A3b Road Transport, gasoline: Emission trend and share for CH_4 emission

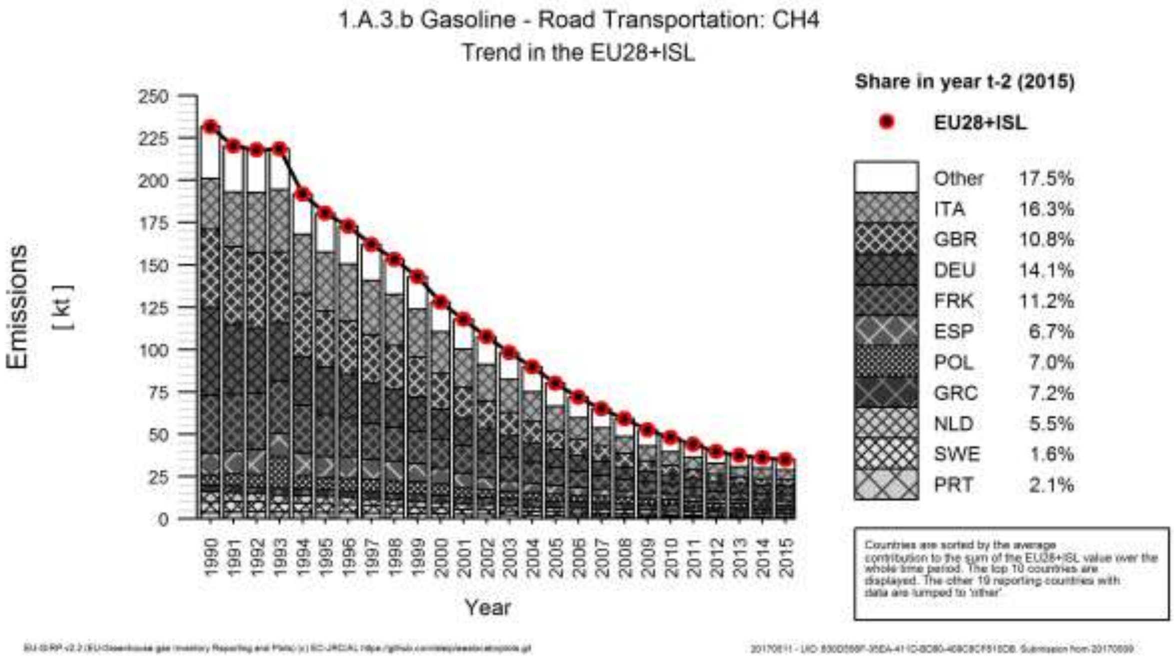
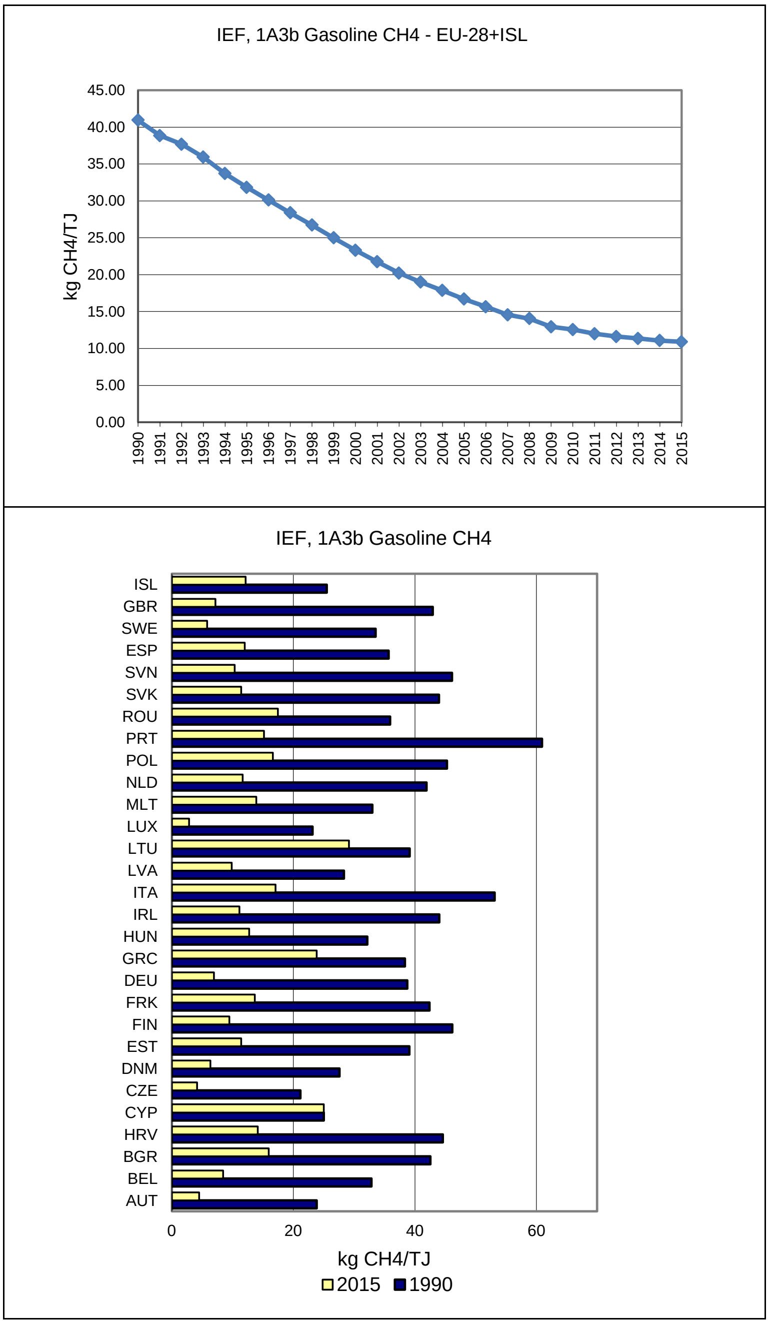


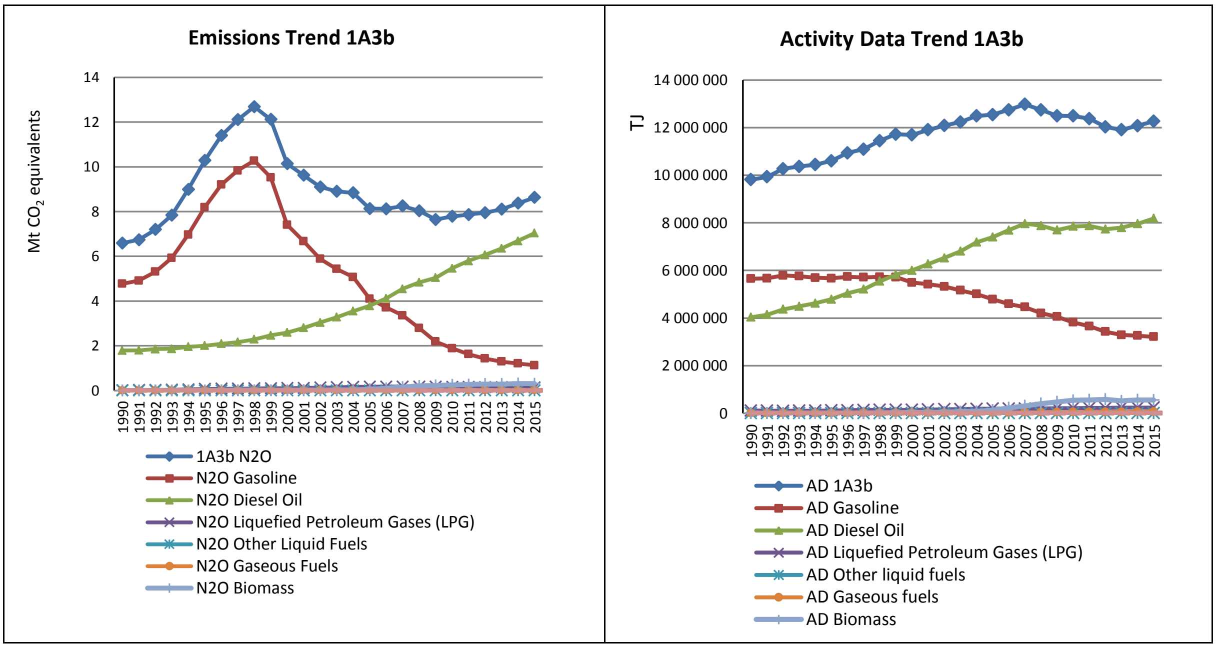
Figure 3.104 1A3b Road Transport, Gasoline: Implied Emission Factors for CH_4 (in kg/TJ)



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 2015. Figure 3.105 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 3.105 1A3b Road Transport: N_2O Emissions Trend



N_2O emissions increased between 1990 and 2015 by 31 % (Table 3.67). 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 3.66.

Table 3.66: 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://emisia.com/products/copert/versions	
Version: 5.0	Date: December2007
METHODOLOGY: Update of the diesel HDV emission factors based on Dutch study	
Reference: http://emisia.com/products/copert/versions	
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://emisia.com/products/copert/versions	
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://emisia.com/products/copert/versions	
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://emisia.com/sites/default/files/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://emisia.com/sites/default/files/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://emisia.com/sites/default/files/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://emisia.com/sites/default/files/COPERT4_v10_0.pdf	

Table 3.67 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	114	183	191	2.2%	8	4%	76	67%	T3	CS
Belgium	196	254	269	3.1%	15	6%	73	37%	NA	NA
Bulgaria	53	69	77	0.9%	8	12%	24	45%	T2	CR
Croatia	39	45	48	0.6%	3	7%	10	25%	T1,T3	CR,D
Cyprus	28	48	49	0.6%	1	3%	21	78%	T1	D
Czech Republic	137	330	348	4.0%	17	5%	211	154%	T1,T2	CS,D
Denmark	89	122	127	1.5%	4	4%	37	42%	CR,M,T3	CR
Estonia	22	18	20	0.2%	1	7%	-2	-9%	T1,T3	CS,D
Finland	154	72	73	0.8%	1	2%	-81	-53%	M,T2	D
France	893	1 499	1 544	17.9%	45	3%	651	73%	T3	M
Germany	1 113	1 450	1 497	17.3%	47	3%	383	34%	CS,M,T2,T3	CS,M
Greece	117	104	105	1.2%	1	1%	-12	-10%	M,T1	D,M
Hungary	68	103	117	1.4%	14	13%	48	71%	T1,T3	D,M
Ireland	48	103	102	1.2%	-1	-1%	54	111%	T3	M
Italy	835	882	872	10.1%	-10	-1%	37	4%	T3	M
Latvia	19	27	30	0.3%	3	9%	11	56%	T1,T2	CR,OTH
Lithuania	39	35	33	0.4%	-3	-7%	-6	-16%	T1,T3	CR,D
Luxembourg	15	51	49	0.6%	-2	-4%	34	222%	T3	M
Malta	4	5	5	0.1%	0	-6%	1	13%	T3	CR
Netherlands	98	237	241	2.8%	5	2%	143	146%	T2	CS
Poland	176	447	466	5.4%	19	4%	290	165%	T1,T3	D
Portugal	64	138	136	1.6%	-2	-2%	71	111%	T3	CR
Romania	227	165	151	1.8%	-13	-8%	-76	-33%	T1,T3	D,OTH
Slovakia	56	52	58	0.7%	5	10%	1	2%	M	D
Slovenia	31	51	52	0.6%	1	2%	22	70%	M	M
Spain	474	762	801	9.3%	40	5%	328	69%	T3	M
Sweden	154	125	132	1.5%	7	6%	-21	-14%	M,T1,T2	CS,D
United Kingdom	1 304	964	1 006	11.7%	42	4%	-298	-23%	T3	CR,CS
EU-28	**6 568**	**8 341**	**8 598**	**100%**	**256**	**3%**	**2 030**	**31%**	**-**	**-**
Iceland	13	28	28	0.3%	0	0%	15	117%	NA	NA
United Kingdom (KP)	1 310	967	1 009	11.7%	42	4%	-301	-23%	T3	CR,CS
EU-28 + ISL	**6 587**	**8 373**	**8 629**	**100%**	**257**	**3%**	**2 042**	**31%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 81 % of N_2O emissions from 1A3b "Road Transportation" in 2015. Between 1990 and 2015 N_2O emissions from Diesel oil increased in all Member States, except for Finland (decrease by 29 %) and Slovakia (decrease by 4 %); within the EU-28+ISL the emission increased by 293 %. The largest increase in absolute terms was reported by France and Germany. Between 2014 and 2015, EU-28+ISL emissions rose by 5 % (Table 3.68).

Table 3.68 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	13	170	178	2.5%	8	5%	165	1237%
Belgium	59	226	247	3.5%	21	9%	188	317%
Bulgaria	13	34	40	0.6%	6	19%	27	217%
Croatia	10	30	33	0.5%	4	12%	23	231%
Cyprus	10	11	12	0.2%	1	8%	2	15%
Czech Republic	30	238	254	3.6%	17	7%	224	750%
Denmark	33	97	103	1.5%	6	7%	70	213%
Estonia	7	14	15	0.2%	1	10%	8	108%
Finland	65	44	47	0.7%	3	6%	-19	-29%
France	256	1 259	1 311	18.6%	52	4%	1 055	412%
Germany	119	1 211	1 277	18.2%	66	5%	1 158	970%
Greece	39	39	39	0.6%	0	0%	0	1%
Hungary	21	70	84	1.2%	14	20%	63	306%
Ireland	13	81	80	1.1%	-1	-1%	67	506%
Italy	339	698	693	9.8%	-6	-1%	353	104%
Latvia	6	19	22	0.3%	3	15%	17	300%
Lithuania	19	22	21	0.3%	-1	-4%	2	11%
Luxembourg	3	49	47	0.7%	-2	-4%	44	1675%
Malta	2	3	2	0.0%	0	-13%	0	23%
Netherlands	23	174	181	2.6%	7	4%	157	672%
Poland	73	281	317	4.5%	36	13%	244	333%
Portugal	16	107	106	1.5%	-1	-1%	90	569%
Romania	31	107	110	1.6%	3	3%	79	257%
Slovakia	41	36	40	0.6%	3	9%	-2	-4%
Slovenia	11	43	45	0.6%	1	3%	34	322%
Spain	201	687	727	10.3%	39	6%	526	261%
Sweden	14	100	109	1.5%	9	9%	95	702%
United Kingdom	321	838	892	12.7%	54	6%	571	178%
EU-28	**1 789**	**6 687**	**7 033**	**100%**	**345**	**5%**	**5 243**	**293%**
Iceland	0	0	0	0.0%	0	12%	0	318%
United Kingdom (KP)	323	840	894	12.7%	54	6%	571	177%
EU-28 + ISL	**1 791**	**6 690**	**7 035**	**100%**	**345**	**5%**	**5 244**	**293%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 70 % of N_2O emissions from diesel oil in 2015 (Figure 3.107). In Figure 3.106 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 Cyprus 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 3.107 1A3b Road Transport, diesel oil: Emission trend and share for N_2O emission

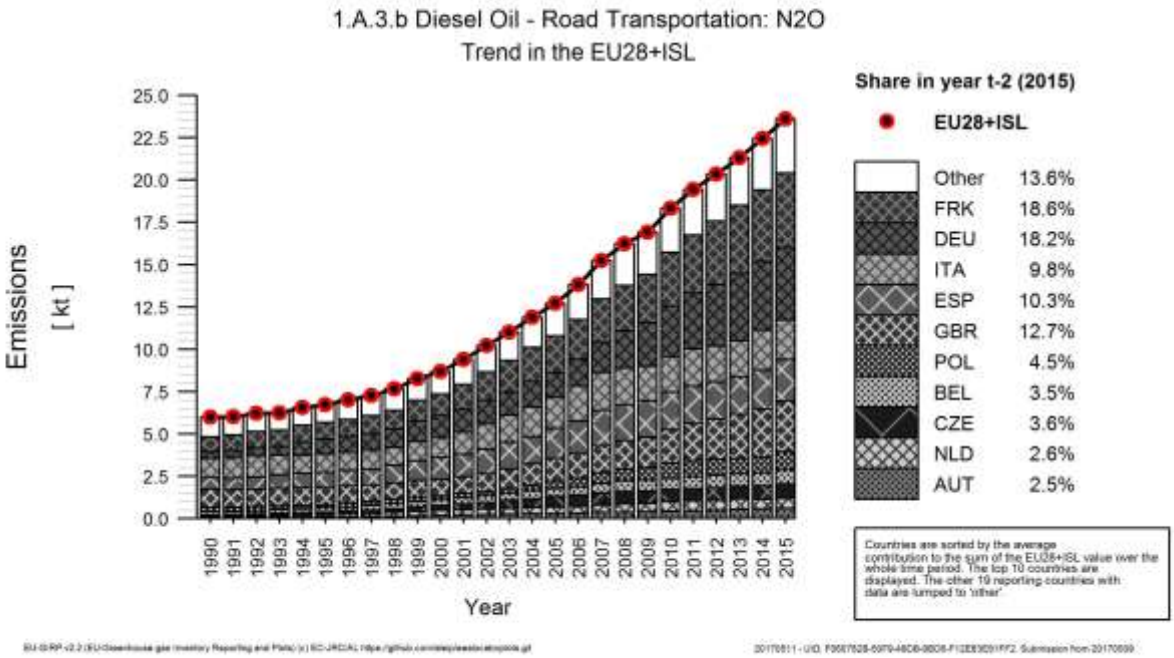
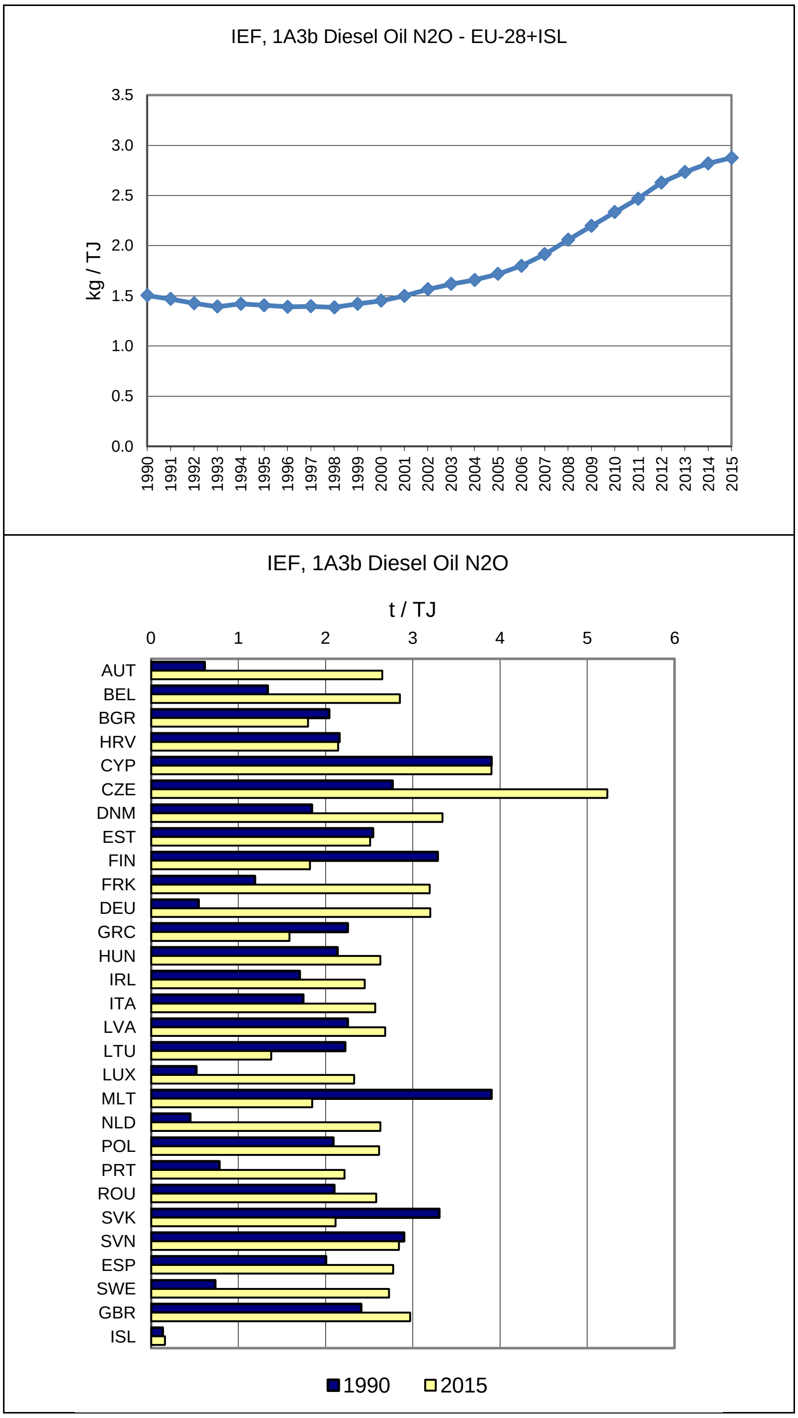


Figure 3.108 1A3b Road Transport, Diesel Oil: Implied Emission Factors for N_2O (in kg/TJ)



1A3b Road Transportation – Gasoline (N_2O)

N_2O emissions from Gasoline account for 13 % of N_2O emissions from 1A3b Road Transportation in 2015. Between 1990 and 2015, N_2O emissions from gasoline decreased by 76 % 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 2014 and 2015, most Member States, (20 in total), showed a decreasing trend. The EU-28+ISL total N_2O emissions dropped by 6 % (Table 3.69).

Table 3.69 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	100	13	12	1.1%	-1	-5%	-88	-88%
Belgium	135	11	11	1.0%	0	-2%	-124	-92%
Bulgaria	41	17	18	1.5%	0	3%	-23	-57%
Croatia	29	13	12	1.1%	-1	-4%	-16	-57%
Cyprus	17	36	36	3.2%	0	1%	19	112%
Czech Republic	107	89	89	7.9%	1	1%	-17	-16%
Denmark	56	18	16	1.4%	-2	-12%	-40	-72%
Estonia	14	5	5	0.4%	0	-3%	-10	-68%
Finland	88	17	16	1.4%	-2	-11%	-73	-82%
France	637	132	122	10.8%	-10	-8%	-515	-81%
Germany	994	148	134	11.9%	-14	-9%	-860	-86%
Greece	78	57	56	5.0%	0	-1%	-22	-28%
Hungary	48	26	26	2.3%	0	-1%	-22	-46%
Ireland	35	18	18	1.6%	0	0%	-17	-48%
Italy	492	124	116	10.3%	-7	-6%	-376	-76%
Latvia	13	5	4	0.4%	0	-6%	-9	-67%
Lithuania	19	8	6	0.5%	-2	-21%	-13	-68%
Luxembourg	12	2	2	0.2%	0	-11%	-11	-86%
Malta	2	2	2	0.2%	0	1%	0	4%
Netherlands	58	51	51	4.5%	0	-1%	-7	-13%
Poland	103	94	86	7.6%	-8	-8%	-17	-16%
Portugal	48	23	20	1.8%	-3	-12%	-28	-58%
Romania	196	48	30	2.6%	-18	-38%	-166	-85%
Slovakia	15	11	13	1.1%	2	15%	-2	-15%
Slovenia	20	4	4	0.4%	1	13%	-16	-78%
Spain	273	68	68	6.0%	0	0%	-204	-75%
Sweden	140	18	16	1.4%	-2	-11%	-124	-89%
United Kingdom	983	124	113	10.0%	-11	-9%	-870	-88%
EU-28	**4 754**	**1 183**	**1 104**	**97%**	**-78**	**-7%**	**-3 650**	**-77%**
Iceland	13	28	28	2.5%	0	0%	15	116%
United Kingdom (KP)	988	125	114	10.1%	-11	-9%	-873	-88%
EU-28 + ISL	**4 772**	**1 212**	**1 133**	**100%**	**-78**	**-6%**	**-3 638**	**-76%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom accounted for 49 % of N_2O emissions (Figure **3.110**). In Figure 3.109 the IEF is depicted and it is clear that high variability exists for all Member States through the whole time series.

Figure 3.110 1A3b Road Transport, Gasoline: Emission trend and share for N_2O emissions

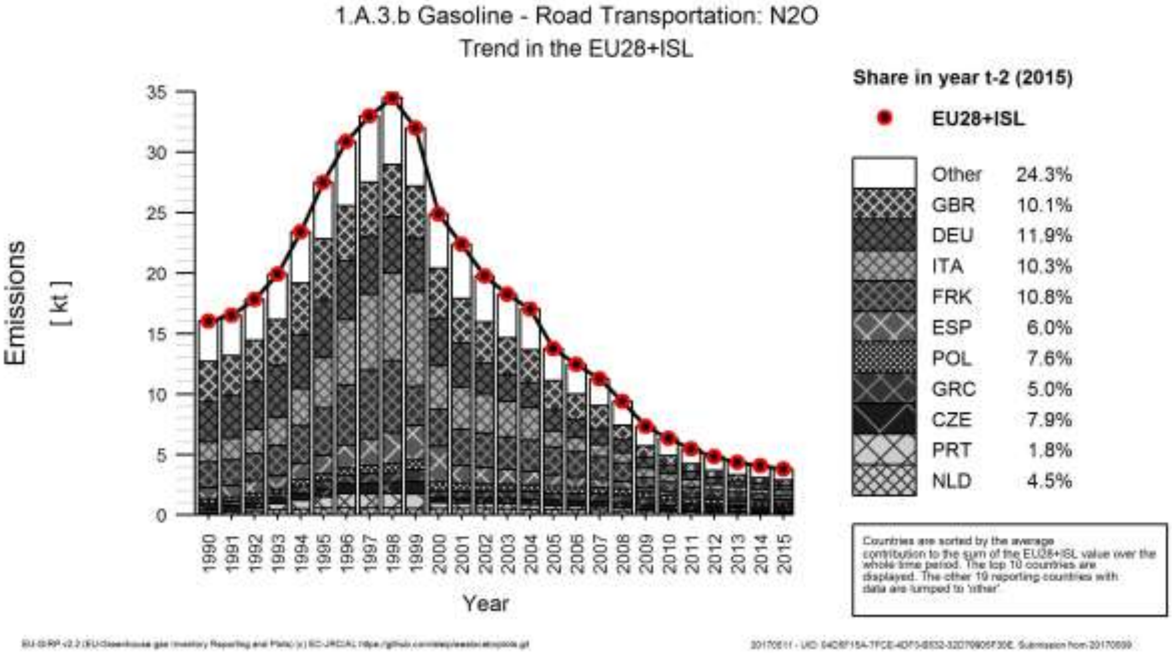
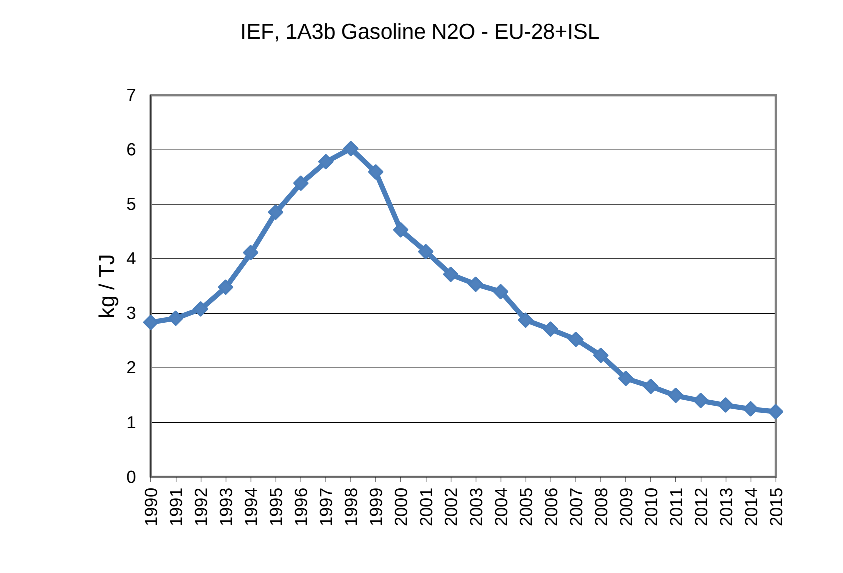
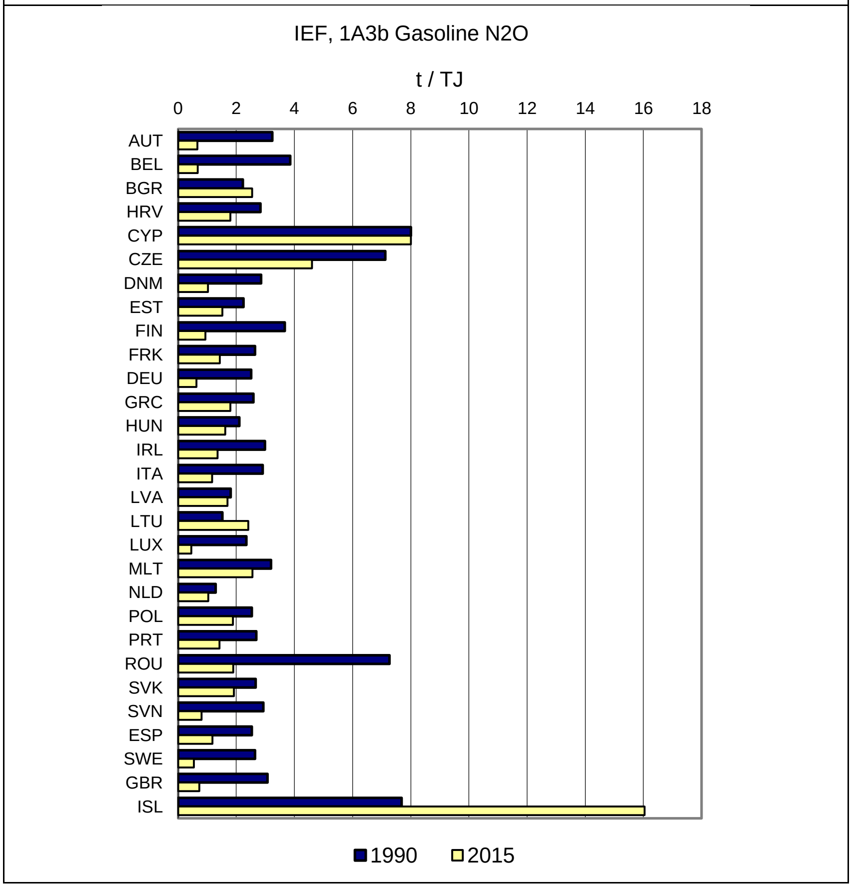


Figure 3.111 1A3b Road Transport, Gasoline: Implied Emission Factors for N_2O (in kg/TJ)





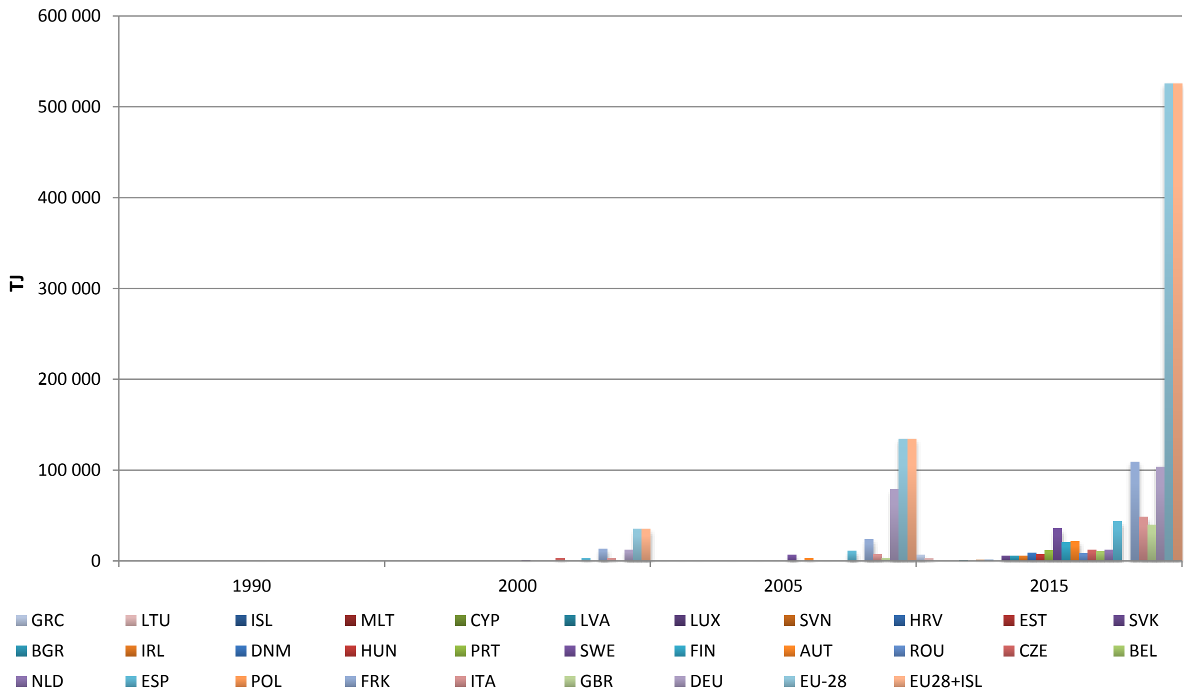
1A3b Road Transportation – Activity Data Biofuels

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 2015, combustion of biofuels increased from 41 TJ to 525 568 TJ in the EU-28+ISL (Figure 3.112). France reports most of total amount of biofuels (20.7 % of total EU-28+ISL activity in 2015), followed by Germany (19.8 %). All Member States but Luxembourg report biofuels activity under 1A3b for 2015.

Figure 3.112 1A3b Road Transport, Biofuels: Trend of Activity data of Biofuels



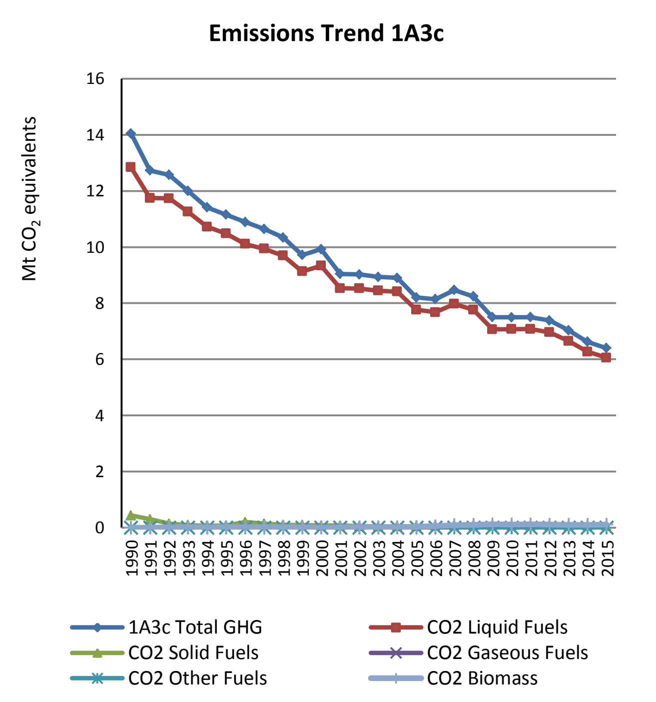
3.2.3.1

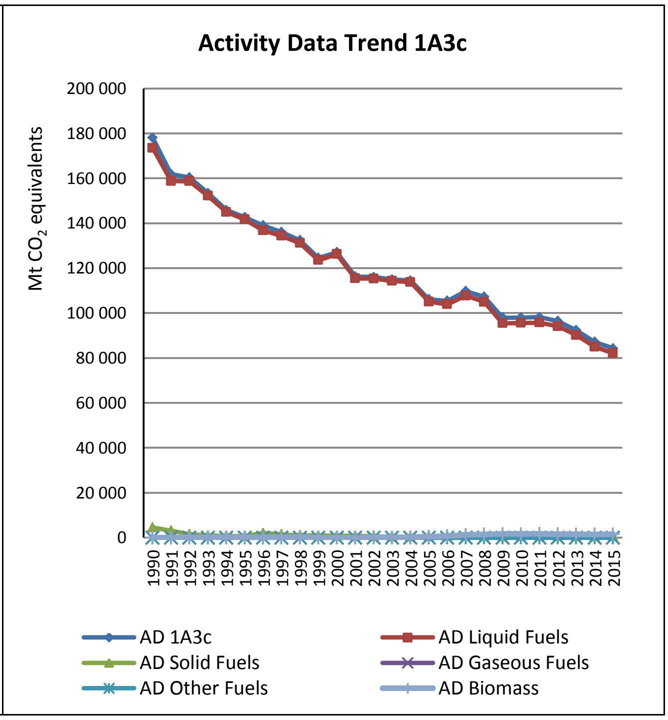
3.2.3.3 Railways (1A3c) (EU-28+ISL)

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 0.1 % of total EU-28+ISL GHG emissions in 2015. Between 1990 and 2015, CO_2 emissions from rail transportation decreased by 54 % in the EU-28+ISL. The total trend is dominated by CO_2 emissions from liquid fuels (Figure 3.113). The emissions from this key category are due to fossil fuel consumption in rail transport, which decreased by 53 % between 1990 and 2015.

Figure 3.113 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 (53 %). Between 1990 and 2015, Germany had by far the highest decreases in absolute terms (Table 3.70).

Table 3.70 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	178	119	118	1.9%	-1	-1%	-60	-34%
Belgium	222	68	65	1.1%	-3	-4%	-157	-71%
Bulgaria	323	37	50	0.8%	12	33%	-273	-85%
Croatia	140	67	55	0.9%	-12	-17%	-85	-60%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	654	274	264	4.3%	-10	-4%	-390	-60%
Denmark	297	252	248	4.1%	-4	-2%	-48	-16%
Estonia	154	61	59	1.0%	-2	-3%	-95	-61%
Finland	191	85	68	1.1%	-16	-19%	-123	-64%
France	1 070	410	410	6.7%	0	0%	-660	-62%
Germany	2 901	941	919	15.0%	-22	-2%	-1 981	-68%
Greece	199	135	125	2.0%	-9	-7%	-74	-37%
Hungary	537	163	156	2.6%	-6	-4%	-381	-71%
Ireland	133	108	110	1.8%	2	2%	-23	-17%
Italy	613	57	69	1.1%	13	22%	-544	-89%
Latvia	531	214	205	3.3%	-9	-4%	-327	-61%
Lithuania	350	174	162	2.6%	-12	-7%	-188	-54%
Luxembourg	25	10	7	0.1%	-3	-32%	-18	-73%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	91	85	100	1.6%	15	18%	9	10%
Poland	1 621	286	261	4.3%	-24	-9%	-1 359	-84%
Portugal	177	32	30	0.5%	-2	-5%	-147	-83%
Romania	452	325	333	5.4%	8	3%	-119	-26%
Slovakia	372	77	84	1.4%	8	10%	-288	-77%
Slovenia	65	41	37	0.6%	-4	-11%	-29	-44%
Spain	423	248	245	4.0%	-3	-1%	-178	-42%
Sweden	101	47	46	0.8%	-1	-2%	-55	-54%
United Kingdom	1 455	2 021	1 891	30.9%	-130	-6%	436	30%
EU-28	**13 275**	**6 334**	**6 118**	**100%**	**-216**	**-3%**	**-7 157**	**-54%**
Iceland	NO,NA	NO,NA	NO,NA	-	-	-	-	-
United Kingdom (KP)	1 455	2 021	1 891	30.9%	-130	-6%	436	30%
EU-28 + ISL	**13 275**	**6 334**	**6 118**	**100%**	**-216**	**-3%**	**-7 157**	**-54%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2015, CO_2 emissions from liquid fuels decreased by 53 % in the EU-28+ISL. Between 2014 and 2015, EU-28+ISL emissions decreased by 3 % (Table 3.71).

Table 3.71 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	171	118	117	1.9%	-1	-1%	-54	-32%	T2	CS
Belgium	222	68	65	1.1%	-3	-4%	-157	-71%	T3	CS,D
Bulgaria	323	37	50	0.8%	12	33%	-273	-85%	T1	D
Croatia	119	67	55	0.9%	-12	-17%	-64	-53%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	654	274	264	4.4%	-10	-4%	-390	-60%	T1	D
Denmark	297	252	248	4.1%	-4	-2%	-48	-16%	CR,T2	CS
Estonia	143	61	59	1.0%	-2	-3%	-83	-58%	T2	CS
Finland	191	85	68	1.1%	-16	-19%	-123	-64%	M,T2	CS
France	1 070	410	410	6.8%	0	0%	-660	-62%	T1	OTH
Germany	2 847	909	888	14.7%	-22	-2%	-1 959	-69%	CS,M	CS,M
Greece	199	135	125	2.1%	-9	-7%	-74	-37%	T2	CS
Hungary	532	163	156	2.6%	-6	-4%	-376	-71%	T1	D
Ireland	133	108	110	1.8%	2	2%	-23	-17%	T2	CS
Italy	613	57	69	1.1%	13	22%	-544	-89%	T2	CS
Latvia	531	214	205	3.4%	-9	-4%	-327	-61%	T2	CS
Lithuania	350	174	162	2.7%	-12	-7%	-188	-54%	T2	CS
Luxembourg	25	10	7	0.1%	-3	-32%	-18	-73%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	91	85	100	1.6%	15	18%	9	10%	T2	CS
Poland	1 316	286	261	4.3%	-24	-9%	-1 055	-80%	T1	D
Portugal	177	32	30	0.5%	-2	-5%	-147	-83%	T1	D
Romania	420	325	333	5.5%	8	3%	-86	-21%	T1,T2	CS,D
Slovakia	372	77	84	1.4%	8	10%	-288	-77%	T1	D
Slovenia	65	41	37	0.6%	-4	-11%	-28	-44%	T1	D
Spain	423	248	245	4.0%	-3	-1%	-178	-42%	T1	D
Sweden	101	47	46	0.8%	-1	-2%	-55	-54%	T2	CS
United Kingdom	1 455	1 990	1 860	30.7%	-130	-7%	405	28%	T2	CS
EU-28	**12 840**	**6 271**	**6 055**	**100%**	**-216**	**-3%**	**-6 785**	**-53%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	1 455	1 990	1 860	30.7%	-130	-7%	405	28%	T2	CS
EU-28 + ISL	**12 840**	**6 271**	**6 055**	**100%**	**-216**	**-3%**	**-6 785**	**-53%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Poland, Romania and the United Kingdom account for 62 % of CO_2 emissions from liquid fuels in 2015 (Figure 3.115).

Table 3.71 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 3.114 the IEF is depicted where the mean value is around 73.8 t/TJ.

Figure 3.115 1A3c Railways, Liquid Fuels: Emission trend and share for CO_2

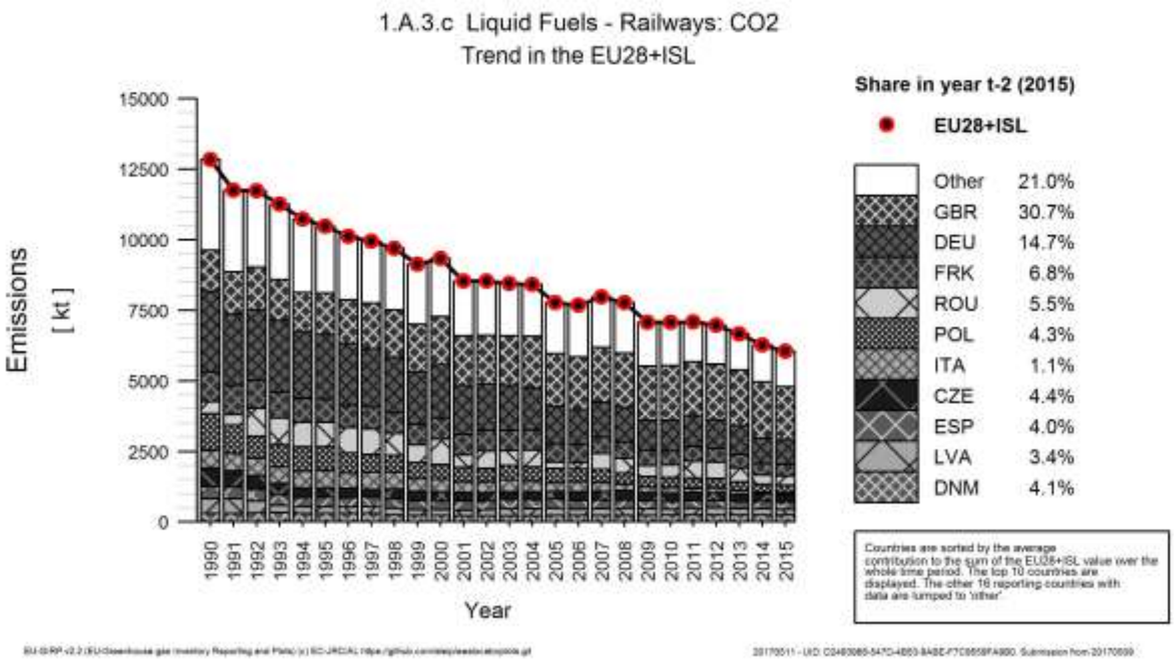
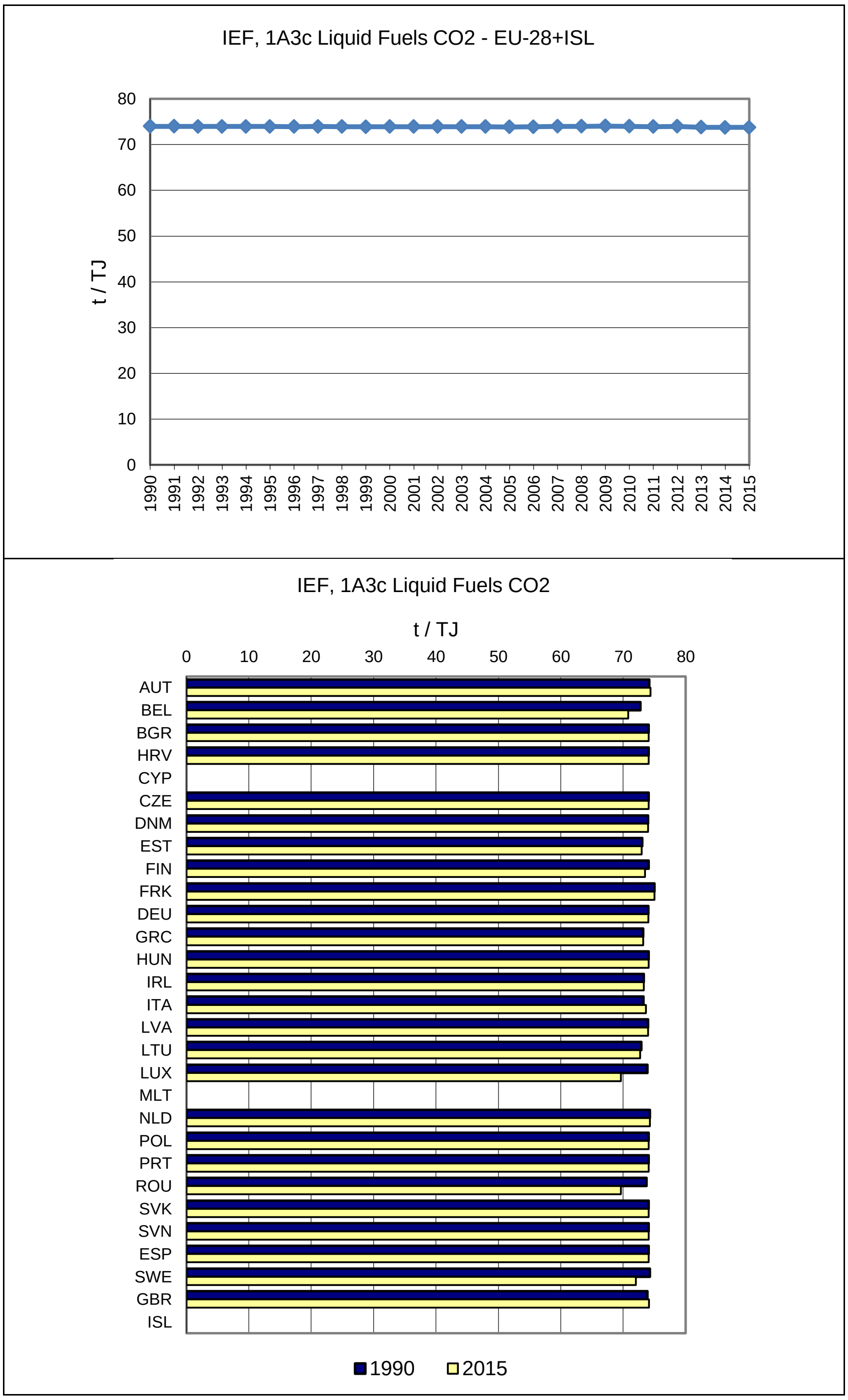


Figure 3.116 1A3c Railways, Liquid Fuels: Implied Emission Factors for CO_2 (in t/TJ)

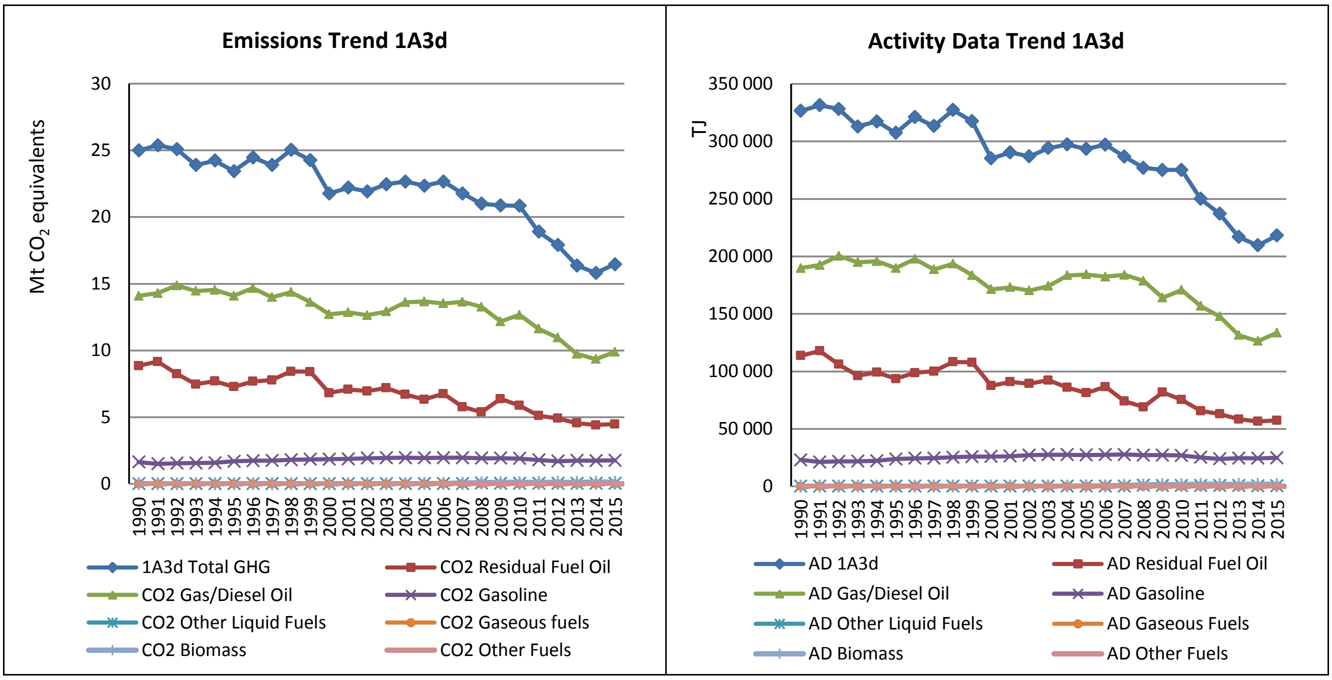


3.2.3.4 Navigation (1A3d) (EU-28+ISL)

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 2015. Between 1990 and 2015, CO_2 emissions from navigation decreased by 34 % in the EU-28+ISL (Table 3.72). 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 3.117).

Figure 3.117 1A3d Navigation: CO_2 Emission Trend and Activity Data



Five Member States (Germany, Greece, Italy, Spain and the United Kingdom) contributed the most to the emissions from this source (69 %). Most Member States (18 in total) had decreasing emissions from navigation between 1990 and 2015. The Member States with the highest decreases in absolute terms were Germany, Italy and Spain (Table 3.72).

Table 3.72 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	15	11	11	0.1%	0	-4%	-4	-26%
Belgium	362	415	407	2.5%	-8	-2%	45	13%
Bulgaria	56	9	10	0.1%	2	18%	-46	-82%
Croatia	134	136	130	0.8%	-6	-4%	-4	-3%
Cyprus	2	1	2	0.0%	0	7%	-1	-29%
Czech Republic	57	10	13	0.1%	3	33%	-44	-78%
Denmark	748	365	374	2.3%	9	2%	-375	-50%
Estonia	22	32	40	0.2%	8	25%	18	82%
Finland	441	411	419	2.6%	8	2%	-22	-5%
France	998	1 283	1 293	8.0%	10	1%	295	30%
Germany	3 645	1 865	1 798	11.1%	-67	-4%	-1 846	-51%
Greece	1 809	1 457	1 734	10.7%	277	19%	-75	-4%
Hungary	209	19	19	0.1%	0	0%	-190	-91%
Ireland	85	222	219	1.4%	-3	-1%	135	158%
Italy	5 466	4 082	3 861	23.9%	-221	-5%	-1 606	-29%
Latvia	1	13	10	0.1%	-3	-25%	9	870%
Lithuania	15	15	14	0.1%	-1	-6%	-2	-12%
Luxembourg	1	1	1	0.0%	0	-13%	0	-21%
Malta	20	42	50	0.3%	7	17%	30	152%
Netherlands	857	1 081	1 241	7.7%	160	15%	384	45%
Poland	151	11	11	0.1%	0	3%	-139	-92%
Portugal	263	263	266	1.6%	3	1%	4	1%
Romania	1 151	110	128	0.8%	18	16%	-1 023	-89%
Slovakia	0	4	6	0.0%	2	42%	6	27547%
Slovenia	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Spain	5 277	1 020	1 366	8.4%	347	34%	-3 911	-74%
Sweden	577	399	361	2.2%	-38	-9%	-216	-37%
United Kingdom	2 158	2 249	2 369	14.6%	120	5%	211	10%
EU-28	**24 522**	**15 528**	**16 154**	**100%**	**625**	**4%**	**-8 368**	**-34%**
Iceland	59	20	26	0.2%	6	30%	-33	-56%
United Kingdom (KP)	2 167	2 251	2 375	14.7%	124	5%	208	10%
EU-28 + ISL	**24 590**	**15 550**	**16 186**	**100%**	**635**	**4%**	**-8 404**	**-34%**

1A3d Navigation – Residual Fuel Oil (CO_2)

CO_2 emissions from residual oil account for 27 % of CO_2 emissions from 1A3d Navigation in 2015. Between 1990 and 2015, CO_2 emissions from residual fuel oil decreased by 49 % in the EU-28+ISL. The countries with the highest decrease in absolute terms were Romania, Spain and Italy. 16 Member States reported emissions as 'Not Occurring' (Table 3.73) for 2015, 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 3.73 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		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	166	166	3.7%	0	0%	-190	-53%	CR,T2	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	123	50	35	0.8%	-15	-30%	-88	-71%	M,T2	CS
France	157	67	67	1.5%	0	0%	-90	-57%	T1	CS
Germany	935	502	506	11.3%	4	1%	-429	-46%	CS	CS,M
Greece	746	862	1 041	23.2%	179	21%	296	40%	T1	CS
Hungary	3	NO	NO	-	-	-	-3	-100%	NA	NA
Ireland	63	NO	NO	-	-	-	-63	-100%	NA	NA
Italy	2 574	1 824	1 716	38.2%	-109	-6%	-858	-33%	T1,T2	CS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	5	11	12	0.3%	1	7%	6	121%	D,T1	D
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	70	1	NO	-	-1	-100%	-70	-100%	NA	NA
Portugal	190	190	192	4.3%	2	1%	3	1%	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	1 244	271	345	7.7%	75	28%	-899	-72%	T1	OTH
Sweden	194	157	71	1.6%	-86	-55%	-123	-63%	T1	CS
United Kingdom	1 134	305	328	7.3%	22	7%	-806	-71%	T2	CS
EU-28	**8 825**	**4 407**	**4 480**	**100%**	**73**	**2%**	**-4 345**	**-49%**	**-**	**-**
Iceland	22	7	1	0.0%	-5	-79%	-21	-94%	T1	D
United Kingdom (KP)	1 142	307	333	7.4%	26	8%	-809	-71%	T2	CS
EU-28 + ISL	**8 856**	**4 416**	**4 487**	**100%**	**71**	**2%**	**-4 369**	**-49%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Greece, Italy and Spain account for 80 % of CO_2 emissions from residual fuel oil in 2015 (Figure 3.119).

Table **3.73** 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 3.118 the IEF is depicted where the mean value is around 77.8 t/TJ.

Figure 3.119 1A3d Navigation, Residual Fuel Oil: Emission trend and share for CO_2

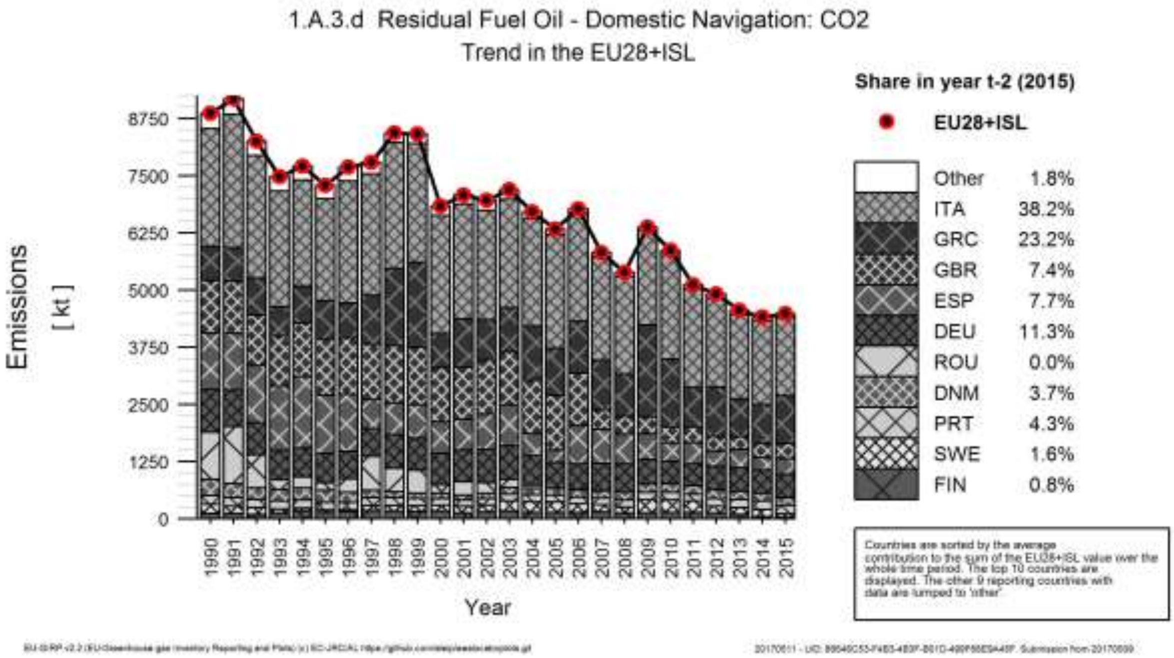
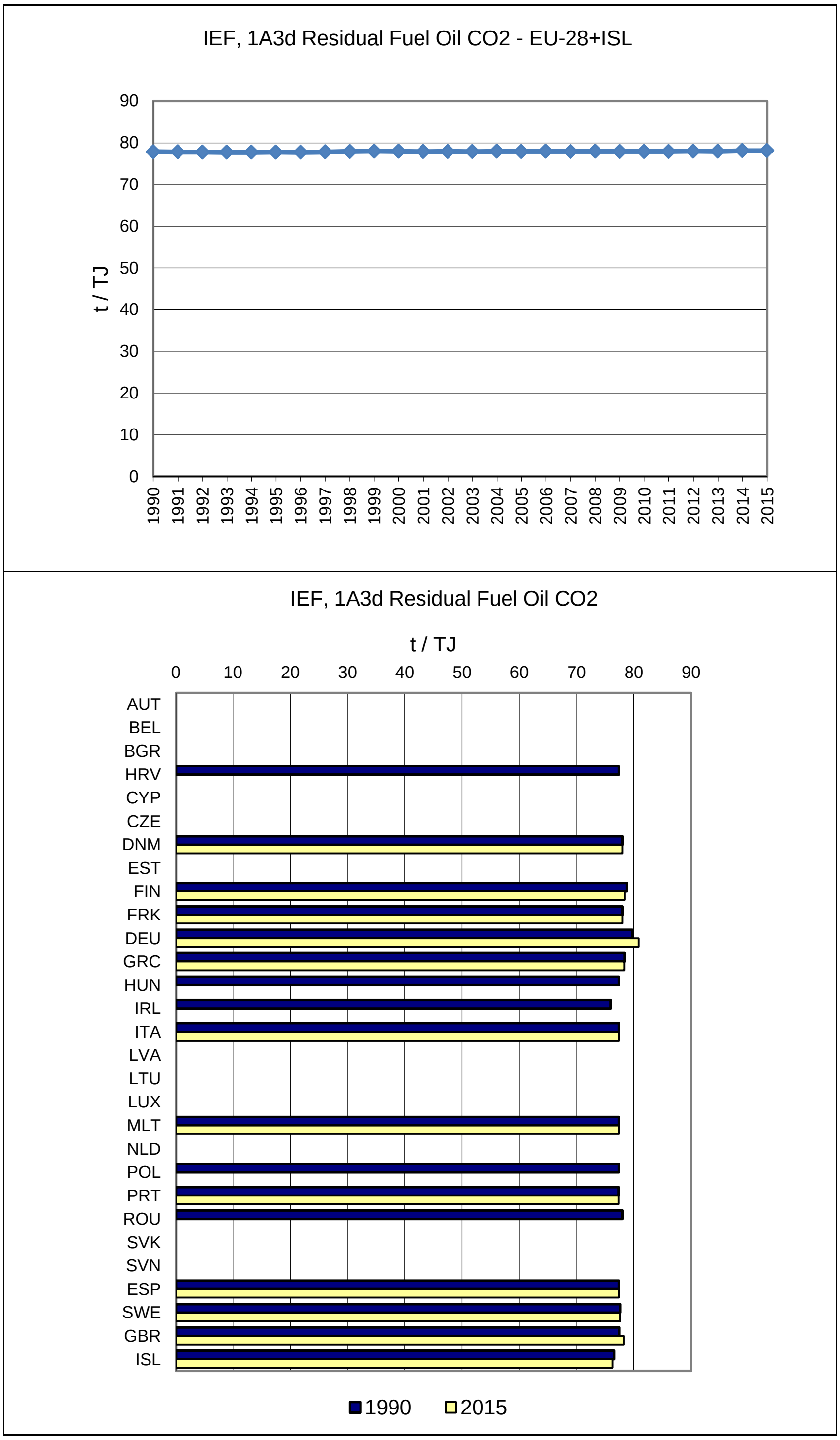


Figure 3.120 1A3d Navigation, Residual Fuel Implied Emission Factors for CO_2 (in t/TJ)



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 2015 (Table 3.74). The CO_2 emissions from Gas/Diesel oil decreased by 30 % between 1990 and 2015.

Table 3.74 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	5	4	4	0.0%	0	-8%	-1	-27%	T2	CS
Belgium	362	415	407	4.1%	-8	-2%	45	13%	T1,T3	CS,D
Bulgaria	56	9	10	0.1%	2	18%	-46	-82%	T1	D
Croatia	128	136	130	1.3%	-6	-4%	3	2%	T1	D
Cyprus	2	1	2	0.0%	0	7%	-1	-29%	T1	D
Czech Republic	57	10	13	0.1%	3	33%	-44	-78%	T1	D
Denmark	392	199	203	2.1%	5	2%	-188	-48%	CR,M,T2	CS
Estonia	22	32	40	0.4%	8	25%	18	82%	T2	CS
Finland	186	237	256	2.6%	20	8%	70	38%	M,T2	CS
France	315	368	373	3.8%	5	1%	58	18%	T1	CS
Germany	2 710	1 363	1 292	13.1%	-71	-5%	-1 417	-52%	CS	CS,M
Greece	1 063	595	693	7.0%	98	16%	-370	-35%	T1	CS
Hungary	29	19	19	0.2%	0	0%	-10	-33%	T1	D
Ireland	22	222	219	2.2%	-3	-1%	197	887%	T2	CS
Italy	2 324	1 939	1 826	18.5%	-113	-6%	-498	-21%	T1,T2	CS
Latvia	1	13	10	0.1%	-3	-24%	9	1046%	T2	CS
Lithuania	15	15	14	0.1%	-1	-6%	-2	-12%	T2	CS
Luxembourg	1	1	1	0.0%	0	-14%	0	-10%	T2	CS
Malta	14	30	37	0.4%	6	21%	23	159%	D,T1	D
Netherlands	812	1 014	1 174	11.9%	160	16%	362	45%	T2	CS
Poland	81	10	11	0.1%	1	13%	-69	-86%	T1	D
Portugal	73	73	74	0.7%	1	1%	1	1%	T2	D
Romania	125	110	128	1.3%	18	16%	3	2%	T2	CS
Slovakia	0	4	6	0.1%	2	42%	6	27547%	T1	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
Spain	4 033	749	1 021	10.3%	272	36%	-3 012	-75%	T1	D
Sweden	306	152	200	2.0%	48	31%	-106	-35%	T1	CS
United Kingdom	921	1 625	1 706	17.2%	81	5%	785	85%	T2	CS
EU-28	**14 056**	**9 345**	**9 870**	**100%**	**524**	**6%**	**-4 186**	**-30%**	**-**	**-**
Iceland	37	14	25	0.3%	11	84%	-12	-33%	T1	D
United Kingdom (KP)	921	1 625	1 706	17.2%	81	5%	785	85%	T2	CS
EU-28 + ISL	**14 093**	**9 359**	**9 895**	**100%**	**536**	**6%**	**-4 198**	**-30%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Italy, Netherlands, Spain and the United Kingdom account for 71 % of the CO_2 emissions from gas/diesel oil in 2015 (Figure 3.122).

Table 3.74 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 3.121 the IEF is depicted where the mean value is around 74 t/TJ.

Figure 3.122 1A3d Navigation, Gas/Diesel Oil: Emission trend and share for CO_2

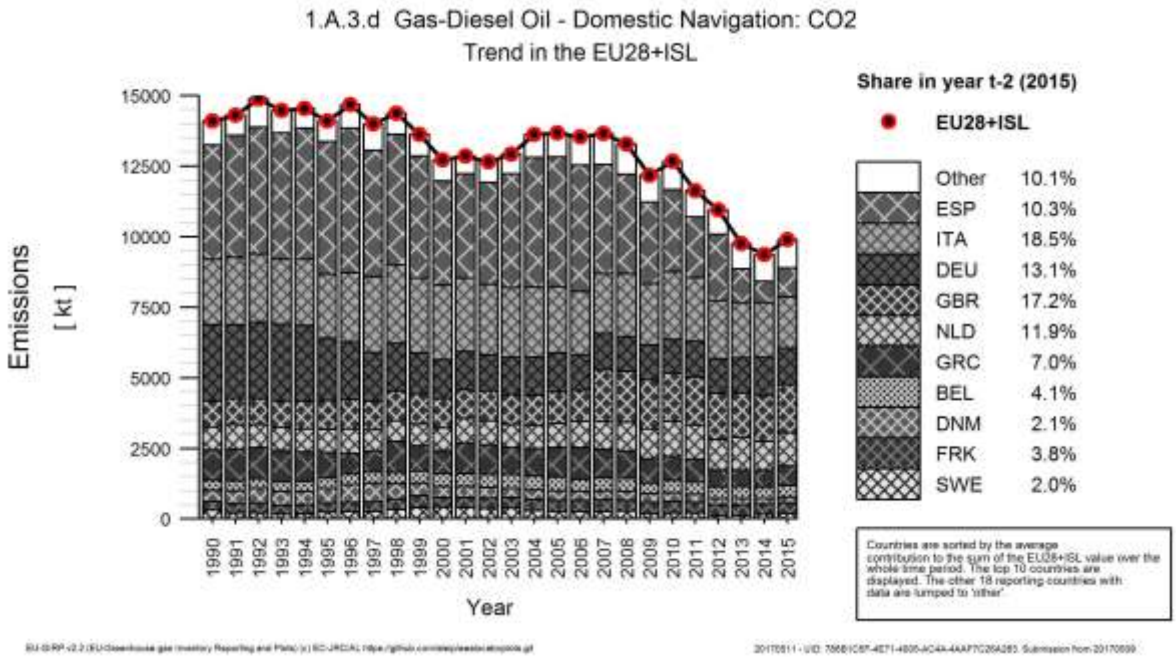
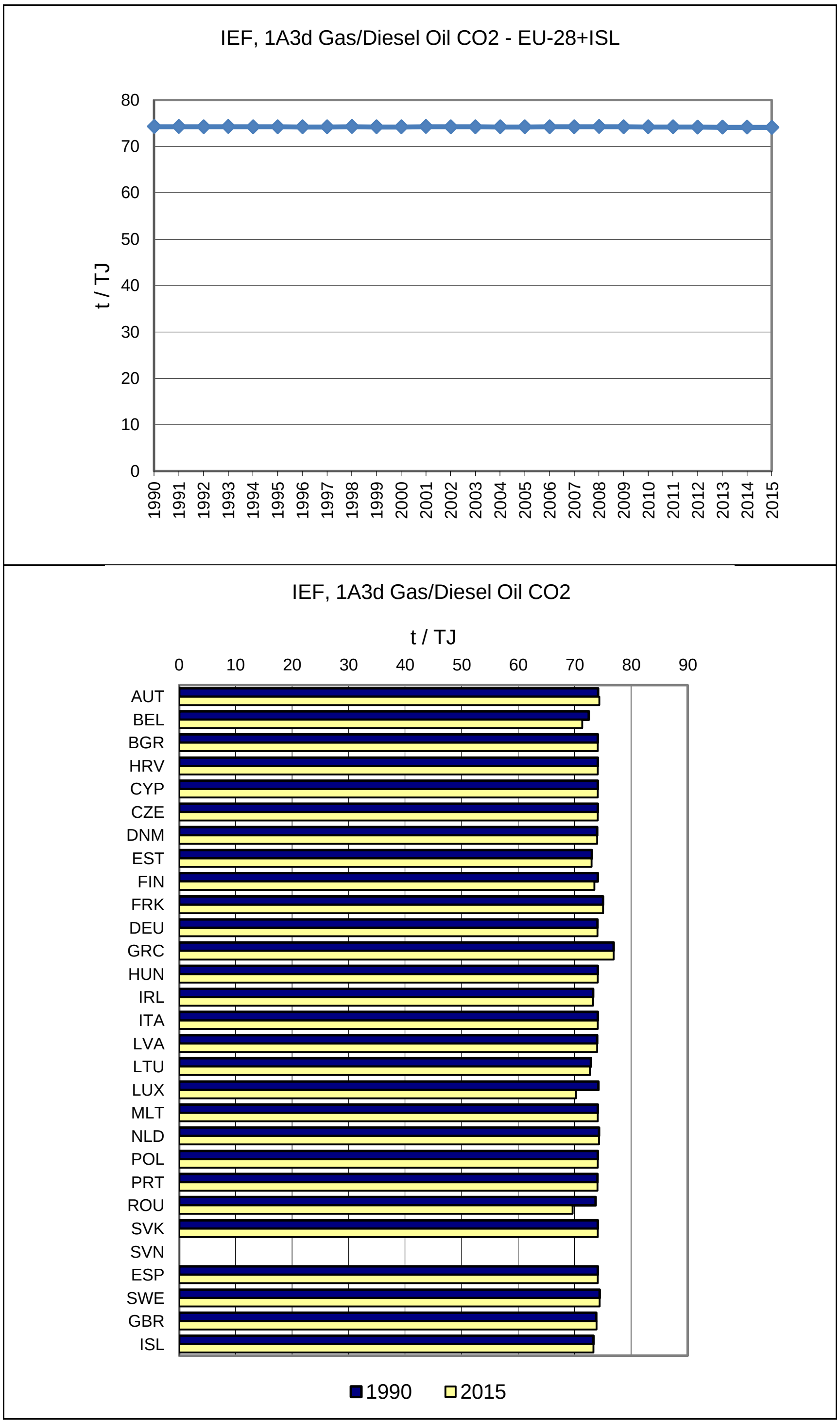


Figure 3.123 1A3d Navigation, Gas/Diesel Oil: Implied Emission Factors for CO_2 (in t/TJ)



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

CO_2 emissions from 1A3e Other account for only 0.1 % of total EU-28+ISL GHG emissions in 2015. This source includes mainly pipeline transport and ground activities in airports and harbours. The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 13 % between 1990 and 2015.

Germany contributed 21 % and Poland 14 % to the EU-28+ISL emissions from this source in 2015 (Table 3.75). Between 1990 and 2015 the EU-28+ISL emissions increased by 10 %. 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 3.75 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	224	503	582	10.1%	79	16%	358	160%	T2	CS
Belgium	228	128	176	3.0%	48	38%	-53	-23%	CS,T3	D
Bulgaria	132	390	342	5.9%	-48	-12%	210	159%	T2	CS
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	5	84	71	1.2%	-13	-15%	66	1210%	T2	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	2	12	5	0.1%	-6	-54%	3	139%	T1	CS
France	212	461	413	7.1%	-48	-10%	201	95%	T2	CS
Germany	1 083	1 195	1 224	21.1%	29	2%	140	13%	CS	CS
Greece	NO	NO,IE	NO,IE	-	-	-	-	-	NA	NA
Hungary	100	90	67	1.2%	-23	-25%	-33	-33%	T1	D
Ireland	62	149	142	2.4%	-8	-5%	80	128%	T2	CS
Italy	407	505	553	9.6%	49	10%	146	36%	T2	CS
Latvia	IE,NO	NO,IE	NO,IE	-	-	-	-	-	NA	NA
Lithuania	85	68	69	1.2%	1	2%	-16	-19%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	342	118	93	1.6%	-26	-22%	-249	-73%	T2	CS
Poland	NO	848	806	13.9%	-43	-5%	806	∞	T1	D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	66	10	6	0.1%	-4	-43%	-60	-91%	T1,T2	CS,D
Slovakia	1 814	178	184	3.2%	7	4%	-1 630	-90%	T2	CS
Slovenia	NO	2	3	0.1%	1	66%	3	∞	T2	CS
Spain	20	292	265	4.6%	-26	-9%	245	1240%	T1	D
Sweden	275	271	282	4.9%	11	4%	8	3%	T2	CS
United Kingdom	225	479	505	8.7%	26	5%	280	125%	T3	CS
EU-28	**5 283**	**5 782**	**5 788**	**100%**	**6**	**0%**	**505**	**10%**	**-**	**-**
Iceland	NA	NA	NA	-	-	-	-	-	NA	NA
United Kingdom (KP)	225	479	505	8.7%	26	5%	280	125%	T3	CS
EU-28 + ISL	**5 283**	**5 782**	**5 788**	**100%**	**6**	**0%**	**505**	**10%**	**-**	**-**

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 2015 category 1A4 contributed to 631 391kt CO_2 equivalents of which 96% CO_2, 2.7% CH_4 and 1.3% N_2O.

Almost all countries report increases for 1A4b fuel consumption in 2015. The main reason might be the lower temperatures in the heating period within most European countries. The following Table **3.76** presents the (15°/18°) heating degree days in 2014 and 2015 for EU-28 Member States and the population-weighted calculated values for EU-28 as well as the trend in 1A4b total fuel consumption.

Table 3.76: EU-28 heating degree days 2014 and 2015 and 1A4b trend in total fuel consumption.

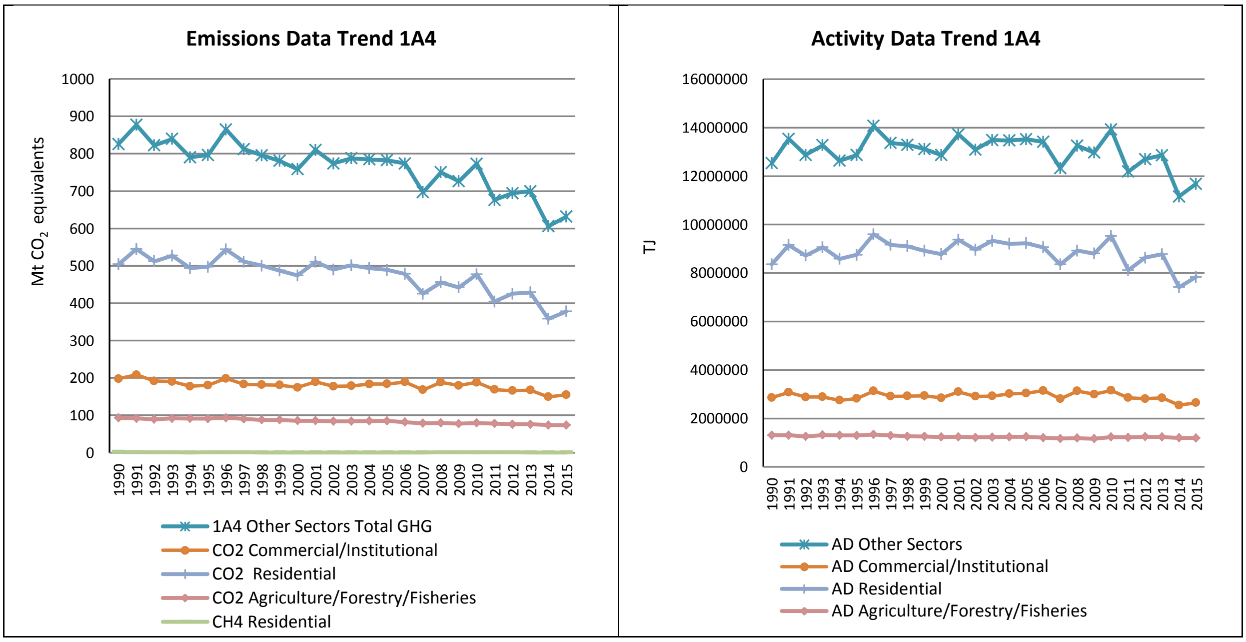
	2014	2015	Trend 2014 – 2015	Trend fuel consumption 1A4b
Austria	3 554	3 666	3%	10%
Belgium	2 333	2 641	13%	6%
Bulgaria	2 413	2 594	8%	0%
Croatia	2 119	2 402	13%	11%
Cyprus	no data	795	-	18%
Czech Republic	3 159	3 267	3%	4%
Denmark	2 664	2 966	11%	22%
Estonia	4 061	3 691	-9%	-3%
Finland	5 315	5 104	-4%	-7%
France	2 102	2 249	7%	7%
Germany	2 812	3 026	8%	5%
Greece	1 833	2 033	11%	30%
Hungary	2 242	2 582	15%	10%
Ireland	2 787	3 041	9%	6%
Italy	2 017	2 040	1%	11%
Latvia	3 911	3 655	-7%	-16%
Lithuania	3 729	3 506	-6%	-4%

	2014	2015	Trend 2014 – 2015	Trend fuel consumption 1A4b
Luxembourg	2 686	2 946	10%	9%
Malta	no data	983	-	17%
Netherlands	2 344	2 681	14%	6%
Poland	3 068	3 153	3%	-1%
Portugal	1 314	1 294	-2%	-2%
Romania	2 851	2 915	2%	-1%
Slovakia	2 952	3 296	12%	1%
Slovenia	2 768	3 052	10%	6%
Spain	1 695	1 782	5%	2%
Sweden	4 986	5 020	1%	18%
United Kingdom	2 777	3 047	10%	5%
EU-28 (weighted)	2 532	2 683	6%	6%

Source: EEA 2016

Figure XXX 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 2015. Between 1990 and 2015 emissions from 1A4 decreased by 24%. From 2014 to 2015 emissions increased by 4.2% (+26 Mt CO_2 equivalents) which is mainly due to an increase of category 1A4b CO_2 emissions which increased by 5.5% (+20 Mt CO_2) and category 1A4a CO_2 emissions which increased by 3.7% (+6 Mt CO_2). The increase of 1A4b CO_2 emissions in the year 2015 is mostly influenced by Germany (+3 Mt CO_2), France (+3 Mt CO_2), Italy (+5 Mt CO_2) and the United Kingdom (+1 Mt CO_2). The trend of 1A4a CO_2 emissions in the year 2015 is mostly influenced by Spain (+2 Mt CO_2) and Italy (+2 Mt CO_2).

Figure 3.124 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



In 2015 GHG emissions from source category 1A4 accounted for 15 % of total GHG emissions. This source category includes twelve key sources which contributed to 98% of total 1A4 GHG emissions in 2015. The following list shows the key sources and their contribution to total 1A4 GHG emissions for the year 2015:

- 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 (16.7%)
- 1 A 4 a Commercial/Institutional: Other Fuels – CO_2 (0.8%)
- 1 A 4 b Residential: Liquid Fuels - CO_2 (16.0%)
- 1 A 4 b Residential: Solid Fuels - CO_2 (5.7%)
- 1 A 4 b Residential: Solid Fuels – CH_4 (0.4%)
- 1 A 4 b Residential: Gaseous Fuels - CO_2 (38.0%)
- 1 A 4 b Residential: Biomass - CH_4 (1.7%)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels - CO_2 (9.2%)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels - CO_2 (0.6%)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels - CO_2 (1.8%)

Table 3.77: Key categories for sector 1A4 (Table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	66896	105580	T	L	L
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	82257	40626	T	L	L
1 A 4 a Commercial/Institutional: Other Fuels (CO_2)	1013	4728	T	0	0
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	47428	3978	T	L	0
1 A 4 b Residential: Biomass (CH_4)	9443	10589	T	L	L
1 A 4 b Residential: Gaseous Fuels (CO_2)	183742	239361	T	L	L
1 A 4 b Residential: Liquid Fuels (CO_2)	181422	101466	T	L	L
1 A 4 b Residential: Solid Fuels (CH_4)	9174	2786	T	L	0
1 A 4 b Residential: Solid Fuels (CO_2)	134402	36000	T	L	L
1 A 4 c Agriculture/Forestry/Fishing: Gaseous Fuels (CO_2)	12539	11037	0	L	L
1 A 4 c Agriculture/Forestry/Fishing: Liquid Fuels (CO_2)	70517	58453	T	L	L
1 A 4 c Agriculture/Forestry/Fishing: Solid Fuels (CO_2)	9755	3840	T	L	0

Table 3.78 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2015 CO_2 emissions from 1A4 Other Sectors decreased by 24%, CH_4 decreased by 25% and N_2O emissions decreased by 5%.

Table 3.78 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	14 586	8 842	13 786	8 446	606	241
Belgium	28 149	24 132	27 730	23 632	318	406
Bulgaria	8 103	1 859	7 624	1 496	286	279
Croatia	4 218	3 220	3 719	2 720	358	373
Cyprus	434	547	430	541	3	5
Czech Republic	31 274	11 907	29 651	10 970	1 457	808
Denmark	9 270	4 827	9 049	4 588	159	154
Estonia	2 038	762	1 881	591	103	119
Finland	7 565	3 779	7 258	3 543	223	175
France	100 163	87 589	93 997	84 680	4 710	1 409
Germany	208 174	127 282	203 012	125 694	4 186	1 131
Greece	8 496	6 449	8 066	6 263	104	117
Hungary	22 349	12 047	21 390	11 317	859	620
Ireland	10 586	8 362	10 031	8 132	451	162
Italy	78 976	81 747	76 093	76 962	1 141	2 363
Latvia	5 915	1 424	5 620	1 227	221	145
Lithuania	7 289	1 266	6 902	1 063	210	163
Luxembourg	1 356	1 568	1 339	1 552	11	11
Malta	146	198	146	196	0	1
Netherlands	39 627	34 367	38 994	32 861	569	1 438
Poland	57 215	54 925	53 729	50 755	2 811	3 274
Portugal	4 683	4 361	4 063	3 973	414	246
Romania	11 315	10 378	10 852	9 243	417	980
Slovakia	11 966	4 682	11 457	4 443	462	191
Slovenia	1 851	1 510	1 646	1 312	147	149
Spain	26 101	39 754	25 065	38 464	828	1 010
Sweden	11 132	3 101	10 676	2 709	296	295
United Kingdom	111 460	89 532	109 008	87 897	1 557	978
EU-28	**824 439**	**630 418**	**793 214**	**605 270**	**22 906**	**17 242**
Iceland	841	572	818	555	2	1
United Kingdom (KP)	111 784	89 934	109 328	88 297	1 560	979
EU-28 + ISL	**825 603**	**631 391**	**794 352**	**606 225**	**22 911**	**17 244**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.79 provides information on the contribution of Member States to EU-28+ISL recalculations in CO_2 from 1A4 Other sectors for 1990 and 2014 and main explanations for the largest recalculations in absolute terms.

Table 3.79 1A4 Other Sectors: Contribution of MS to EU-28 recalculations in CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	2	0.0	71	0.9	Revised energy balance
Belgium	175	0.6	271	1.2	Switch from 1996 to 2006 Guidelines. Revision of preliminary energy balance. Small corrections in off-road emissions. Correction of 1A4c - Fishing in Flemish region (consistency of energy balance with model data). Correction of gasoil consumption.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Bulgaria	-5	-0.1	-3	-0.2	See NIR chapter 3.3.11 (Revised methodology in order to remove double counting with the IP sector. Elimination of double-counting of CH_4 and N_2O emissions from alternative fuels).
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	9	2.1	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	944	9.7	updated activity data available and emission factors, explanation provided in NIR
Denmark	80	0.9	279	6.9	Revision of energy statistics. Revised CO_2 emission factor for residual fuel oil (following a ESD review recommendation). Revised gasoil and diesel consumption for offroad machinery due to a revised transport model.
Estonia	-1	0.0	1	0.1	Oxidation factors have been updated and the carbon conversion factor for CO_2 emission factors has been specified.
Finland	-8	-0.1	-14	-0.4	Corrections of preliminary data
France	-238	-0.3	-1 560	-1.9	1A4a:-update the balance of energy for oil products and natural gas. -Modification of consumption of district heating for 2014 which have an impact on the consumption of the 1A4a/1A4b. -Addition of the consumptions of biogas since 1994. 1A4b:-update of the energy balance. -Modification of consumption of district heating for 2014 which have an impact on the consumption of the 1A4a/1A4b. 1A4c:-update of the energy balance.
Germany	-19	0.0	358	0.3	Revision of preliminary energy balance. Change of CO_2-EF for diesel. Revised offroad machinery diesel consumption.
Greece	0	0.0	0	0.0	
Hungary	344	1.6	198	1.9	First estimate for 1A4bii; use of latest energy statistics; revised NCV for gasoil; application of T2 methodology from the EMEP/EEA guidebook for 1A4cii
Ireland	0	0.0	-1	0.0	
Italy	-840	-1.1	507	0.7	Update of activity data
Latvia	25	0.5	8	0.7	Corrected amount of biogas (1A4ai), biofuel (1A4ci) and gasoline (1A4cii) use in apropriate sectors; Updated and precised information about natural gas properties and calculated new emission factor accordingly.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Lithuania	1 304	23.3	121	11.5	Revision of CO_2 emission factors for natural gas, wood/wood waste and other solid biomass based on study "Update of country specific GHG emission factors for Energy sector" (performed in 2016 by Lithuanian Energy Institute); reallocation of off-road emissions according to 1.A.4 sectors instead 1.A.3.
Luxembourg	22	1.7	-70	-4.8	revised AD for natural gas (energy balance)
Malta	9	7.0	-22	-10.7	No NIR provided
Netherlands	183	0.5	246	0.8	Revision in fuel data from transport affected all combustion emissions for Diesel (allocation issue)
Poland	0	0.0	0	0.0	
Portugal	1	0.0	33	0.8	NIR chapter 3.3.2.6 (Revisions were made in the Chemical sector, namely updating of the time series of activity data and revision of some emission factors).
Romania	-102	-0.9	-13	-0.1	Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A4 categories. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A4 categories.
Slovakia	101	0.9	91	2.1	Natural gas in category 1.A.4.a was recalculated for year 2014. The reason for this recalculation was modification of the energy balance (fuel consumptions) provided by the Statistical Office of the Slovak Republic. In addition, recalculations in off-road transportation included in the subcategory 1.A.4.c.ii was implemented in the connection with the recalculations made in road transport category.
Slovenia	0	0.0	0	0.0	
Spain	-28	-0.1	159	0.4	Modification of CO_2 and CH_4 emission factors of stationary sources (categories 1A4a, 1A4b and 1A4ci). These emission factors have been updated according to the IPCC 2006 guidelines. Modification of CO_2, CH_4 and N_2O emission factors of mobile sources (categories 1A4cii and 1A4ciii). The set of emission factors used to estimate emissions derived from the use of agricultural and forestry machinery (category 1A4cii), has been updated according to the methodology of Level 2 proposed in EMEP/EEA 2016 Guidebook. The emission factors corresponding to 1A4ciiiI category have been updated according to the values proposed by the IPCC 2006 Guidelines.
Sweden	59	0.6	-157	-5.4	Following revisions of the energy balances, the activity data for stationary combustion within 1.A.4 was revised for all fuels for the year 2014.
United Kingdom	1	0.0	-201	-0.2	Revisions to UK energy data, most significantly for gas oil and fuel oil where consumption and therefore emissions are slightly lower.
EU28	1 039	0.1	1 262	0.2	
Iceland	0	0.0	0	0.0	
EU28+ISL	1 053	0.1	1 241	0.2	

Table 3.80 provides information on the contribution of Member States to EU-28+ISL recalculations in CH_4 from 1A4 Other sectors for 1990 and 2014.

Table 3.80 1A4 Other Sectors: Contribution of MS to EU-28 recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	145	31.4	14	6.9	Change of CH_4 EF from CS to IPCC 2006 default
Belgium	1	0.2	0	0.0	See chapter 3.2.9 in NIR
Bulgaria	0	0.0	0	0.0	
Croatia	-1	-0.4	-1	-0.3	Technical correction
Cyprus	0	0.0	0	-3.0	
Czech Republic	70	5.0	231	40.9	updated activity data available and emission factors, explanation provided in NIR
Denmark	0	-0.1	4	3.0	See NIR chapter 3.2.8 (revised energy statistics for residential wood consumption)
Estonia	0	0.0	0	0.0	-
Finland	0	0.0	-111	-37.5	CH_4 emissions factor of small scale combustion was revised.
France	6	0.1	-9	-0.6	1A4a:-update of the energy balance for oil products and natural gas. -Modification of consumption of district heating for 2014 which has an impact on the consumption of 1A4a/1A4b. -Addition of the consumptions of biogas since 1994. 1A4b:-update of the energy balance. -Modification of consumption of district heating for 2014 which has an impact on the consumption of 1A4a/1A4b.. 1A4c:-update of the energy balance.
Germany	1 055	33.7	55	5.4	Revision of preliminary energy balance.
Greece	1	1.3	-5	-4.4	See NIR chapter 3.2.4.5.2 (correction of biomass CH_4 emission factor. Revised biomass consumption of residential sector).
Hungary	2	0.3	302	106.9	First estimate for 1A4bii; use of latest energy statistics; revised NCV for gasoil; application of T2 methodology from the EMEP/EEA guidebook for 1A4cii
Ireland	0	0.0	0	0.0	
Italy	-7	-0.6	-16	-0.8	Update of activity data
Latvia	0	0.0	0	-0.1	Corrected amount of biogas (1A4ai), biofuel (1A4ci) and gasoline (1A4cii) use in apropriate sectors.
Lithuania	3	1.5	0	0.1	Off-road EF revision and emission allocation to 1A4 sectors
Luxembourg	0	1.2	0	0.1	revised AD for natural gas (energy balance)
Malta	0	8.6	0	17.2	No NIR provided
Netherlands	27	4.9	10	0.7	Error correction of emissions from Gas engines
Poland	0	0.0	0	0.0	

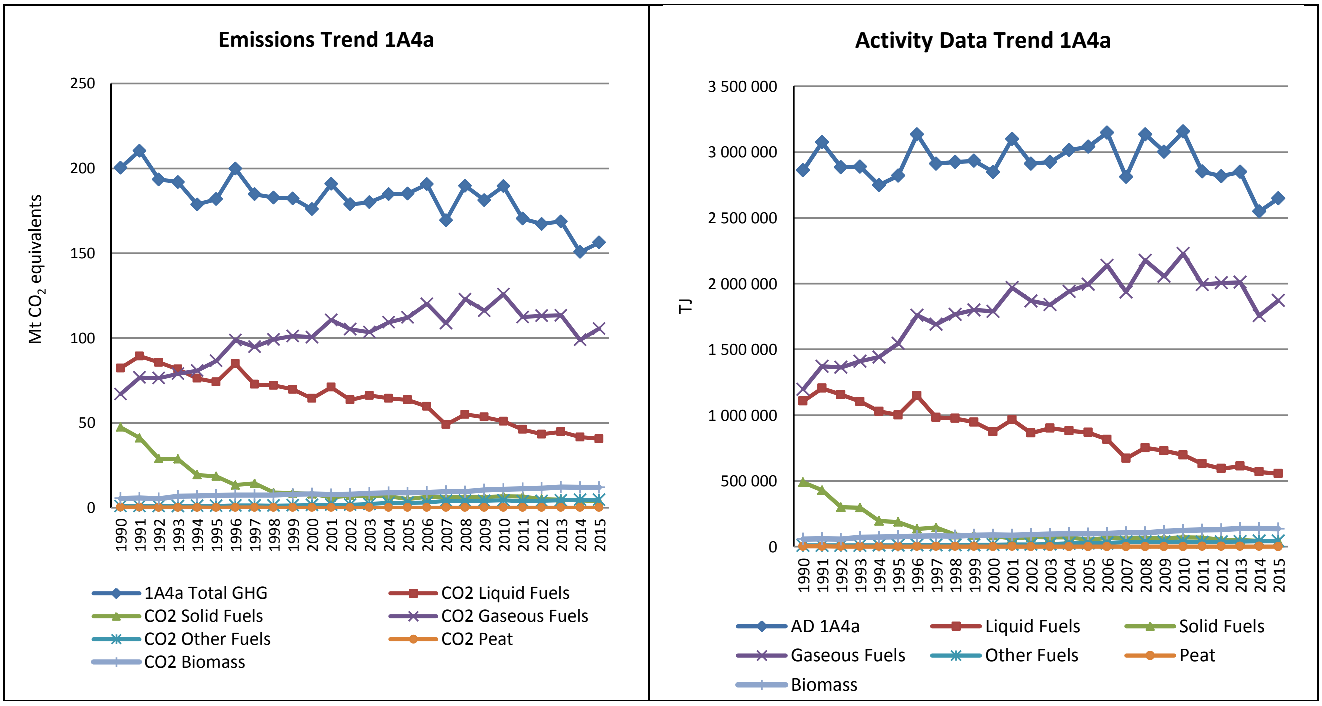
	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Portugal	0	-0.1	1	0.3	Review of the CH_4 and N_2O emission factors of the Domestic, Commercial and Fisheries Sectors
Romania	-9	-2.0	-1	-0.1	Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A4categories.
Slovakia	1	0.2	1	0.6	Natural gas in category 1.A.4.a was recalculated for year 2014. The reason for this recalculation was modification of the energy balance (fuel consumptions) provided by the Statistical Office of the Slovak Republic. In addition, recalculations in off-road transportation included in the subcategory 1.A.4.c.ii was implemented in the connection with the recalculations made in road transport category.
Slovenia	0	0.0	0	0.0	Small correction of biomass used in the commercial and residential sector
Spain	9	1.1	31	3.1	Modification of CO_2 and CH_4 emission factors of stationary sources (categories 1A4a, 1A4b and 1A4ci). These emission factors have been updated according to the IPCC 2006 guidelines. Modification of CO_2, CH_4 and N_2O emission factors of mobile sources (categories 1A4cii and 1A4ciii). The set of emission factors used to estimate emissions derived from the use of agricultural and forestry machinery (category 1A4cii), has been updated according to the methodology of Level 2 proposed in EMEP/EEA 2016 Guidebook. The emission factors corresponding to 1A4ciiiI category have been updated according to the values proposed by the IPCC 2006 Guidelines.
Sweden	0	0.0	6	2.2	Following revisions of the energy balances, the activity data for stationary combustion within 1.A.4 was revised for all fuels for the year 2014.
United Kingdom	25	1.7	50	5.7	Revisions to UK energy statistics and revised assumption for calorific value of wood.
EU28	1 327	6.2	562	3.5	
Iceland	0	-0.1	0	0.1	No specific information provided.
EU28+ISL	1 327	6.2	562	3.5	

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 3.6% of total GHG emissions in 2015.

Figure 3.125 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Between 1990 and 2015 GHG emissions decreased by 22%, mainly due to decreases in CO_2 emissions from solid (-92%) and liquid (-51%) fuels while CO_2 emissions from gaseous fuels increased by 58% and showed a continuous uptrend for the whole time series until 2013. Between 2014 and 2015 the CO_2 emissions increased by 3.7%, mainly driven by an increase in gaseous fuel consumption.

Figure 3.125 1A4a Commercial/Institutional: Total and CO_2 emission and activity trends



Between 1990 and 2015, CO_2 emissions from 1A4a decreased by 22% 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 10% between 1990 and 2015 and biomass consumption increased by 136%

France, Germany, Italy and the United Kingdom contributed the most to the CO_2 emissions from this source (67%). The Member States with the highest increases in absolute terms were Spain, Italy and Romania. The Member States with the highest reduction in absolute terms were Germany, the Czech Republic, France and the United Kingdom (Table 3.81).

Table 3.81 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	2 570	2 084	1 838	1.2%	-246	-12%	-732	-28%	T1,T2	CS,D
Belgium	4 288	5 313	5 707	3.7%	394	7%	1 419	33%	T1	D
Bulgaria	3 084	247	288	0.2%	41	16%	-2 796	-91%	T1,T2	CS,D
Croatia	855	471	584	0.4%	113	24%	-271	-32%	T1	D
Cyprus	75	87	106	0.1%	19	22%	31	41%	T1	D
Czech Republic	10 024	2 583	2 581	1.7%	-2	0%	-7 443	-74%	T1,T2	CS,D
Denmark	1 488	1 128	803	0.5%	-325	-29%	-684	-46%	CR,M,T1,T2,T3	CS,D
Estonia	48	59	91	0.1%	33	56%	44	92%	T1,T2	CS,D
Finland	2 250	1 016	944	0.6%	-72	-7%	-1 306	-58%	CS,M,T1,T2	CS,D
France	28 705	24 765	25 212	16.3%	447	2%	-3 493	-12%	T1,T2	CS,D
Germany	64 106	34 493	34 519	22.3%	25	0%	-29 587	-46%	CS,M,T2,T3	CS,D
Greece	519	561	713	0.5%	152	27%	194	37%	T1,T2	CS,D
Hungary	2 936	3 009	3 088	2.0%	79	3%	152	5%	T1,T3	CS,D
Ireland	2 232	1 755	1 728	1.1%	-27	-2%	-504	-23%	T2	CS
Italy	12 190	21 163	22 931	14.8%	1 767	8%	10 740	88%	T2	CS
Latvia	2 831	437	424	0.3%	-13	-3%	-2 407	-85%	T1,T2	CS,D
Lithuania	3 059	321	277	0.2%	-45	-14%	-2 782	-91%	T2,T3	CS
Luxembourg	637	387	474	0.3%	87	22%	-163	-26%	T1,T2	CS,D
Malta	108	131	135	0.1%	4	3%	28	26%	T1	D
Netherlands	8 417	7 186	7 507	4.8%	321	4%	-910	-11%	T1,T2	CS,D
Poland	9 838	7 785	7 880	5.1%	94	1%	-1 958	-20%	T1,T2	CS,D
Portugal	745	1 145	1 132	0.7%	-13	-1%	387	52%	T1	D
Romania	NO	2 054	2 006	1.3%	-48	-2%	2 006	∞	T1,T2	CS
Slovakia	4 148	1 470	1 487	1.0%	17	1%	-2 661	-64%	T2	CS
Slovenia	503	347	391	0.3%	44	13%	-112	-22%	T1,T2	CS,D
Spain	3 834	8 694	11 028	7.1%	2 334	27%	7 194	188%	T2	CS,D,OTH
Sweden	2 815	723	675	0.4%	-48	-7%	-2 140	-76%	T1,T2	CS
United Kingdom	25 429	19 944	20 384	13.2%	440	2%	-5 045	-20%	T2	CS
EU-28	**197 731**	**149 361**	**154 933**	**100%**	**5 572**	**4%**	**-42 798**	**-22%**	**-**	**-**
Iceland	16	2.0	2.1	0.0013%	0.1	6%	-14	-87%	T1,T2	D
United Kingdom (KP)	25 508	19 959	20 397	13.2%	438	2%	-5 112	-20%	T2	CS
EU-28 + ISL	**197 827**	**149 378**	**154 948**	**100%**	**5 570**	**4%**	**-42 879**	**-22%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2015 CO_2 emissions from liquid fuels had a share of 26% within source category 1A4a (compared to 41% in 1990). Between 1990 and 2015, CO_2 decreased by 51% (Table 3.82). Five Member States had increases in this period, with the highest absolute increase in Poland and Romania. The highest absolute decreases were achieved in France, Germany, Bulgaria 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 2014 and 2015 EU-28+ISL CO_2 emissions decreased by 2%.

Table 3.82 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	1 423	802	733	1.8%	-69	-9%	-690	-48%
Belgium	2 315	1 440	1 561	3.8%	121	8%	-754	-33%
Bulgaria	2 986	46	58	0.1%	12	27%	-2 927	-98%
Croatia	526	160	186	0.5%	26	16%	-340	-65%
Cyprus	75	87	106	0.3%	19	22%	31	41%
Czech Republic	2 116	49	64	0.2%	16	32%	-2 052	-97%
Denmark	1 083	719	361	0.9%	-358	-50%	-722	-67%
Estonia	19	3	15	0.0%	11	328%	-4	-22%
Finland	2 189	930	864	2.1%	-66	-7%	-1 325	-61%
France	19 380	13 483	13 506	33.2%	23	0%	-5 873	-30%
Germany	28 133	13 524	13 255	32.6%	-270	-2%	-14 878	-53%
Greece	499	268	324	0.8%	56	21%	-175	-35%
Hungary	1 124	80	115	0.3%	35	43%	-1 009	-90%
Ireland	1 870	770	745	1.8%	-25	-3%	-1 125	-60%
Italy	1 529	1 642	1 600	3.9%	-42	-3%	71	5%
Latvia	1 017	157	166	0.4%	9	6%	-851	-84%
Lithuania	1 166	15	7	0.0%	-8	-53%	-1 160	-99%
Luxembourg	467	162	243	0.6%	80	49%	-225	-48%
Malta	108	131	135	0.3%	4	3%	27	25%
Netherlands	557	399	396	1.0%	-3	-1%	-161	-29%
Poland	IE,NO	1 326	1 259	3.1%	-67	-5%	1 259	∞
Portugal	745	454	435	1.1%	-19	-4%	-310	-42%
Romania	NO	224	236	0.6%	12	5%	236	∞
Slovakia	384	28	31	0.1%	3	12%	-353	-92%
Slovenia	270	264	278	0.7%	14	5%	8	3%
Spain	3 284	3 559	2 966	7.3%	-593	-17%	-319	-10%
Sweden	2 729	469	436	1.1%	-33	-7%	-2 293	-84%
United Kingdom	6 169	383	533	1.3%	150	39%	-5 636	-91%
EU-28	**82 162**	**41 573**	**40 612**	**100%**	**-961**	**-2%**	**-41 550**	**-51%**
Iceland	16	2.0	2.1	0.0051%	0.1	6%	-14	-87%
United Kingdom (KP)	6 247	397	545	1.3%	147	37%	-5 703	-91%
EU-28 + ISL	**82 257**	**41 589**	**40 626**	**100%**	**-963**	**-2%**	**-41 631**	**-51%**

Notes: 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 3.126 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 France, Germany and Spain; together they cause 73% of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption decreased by 50% between 1990 and 2015. 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 2015.

Figure 3.126 1A4a Commercial/Institutional, liquid fuels: Emission trend and share for CO_2

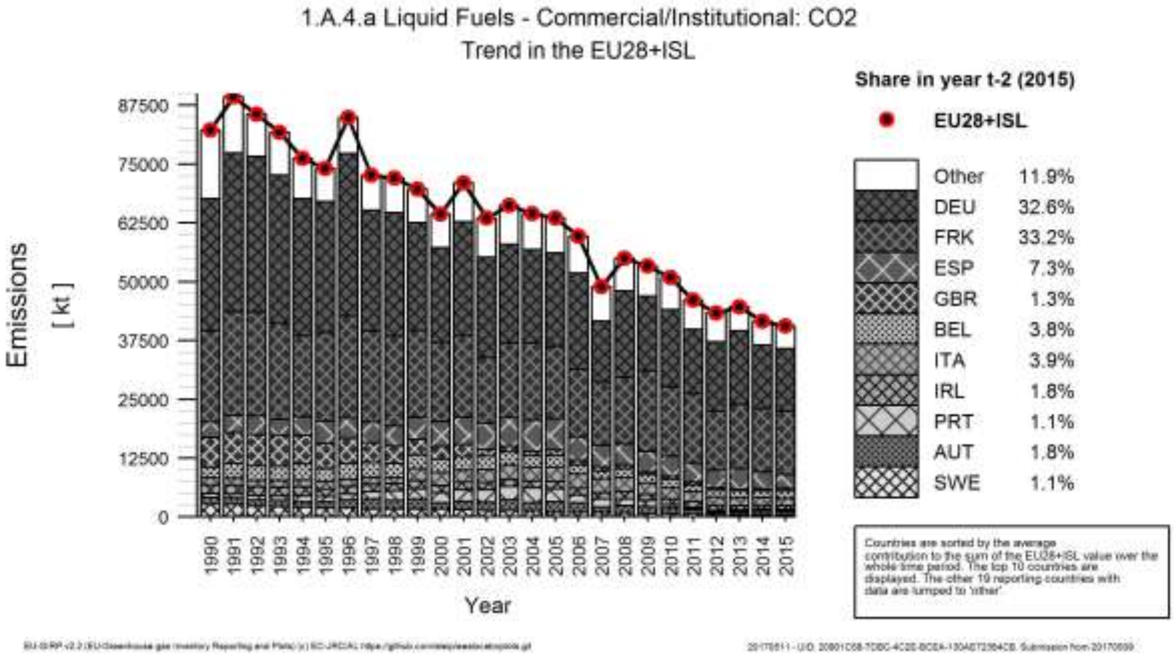
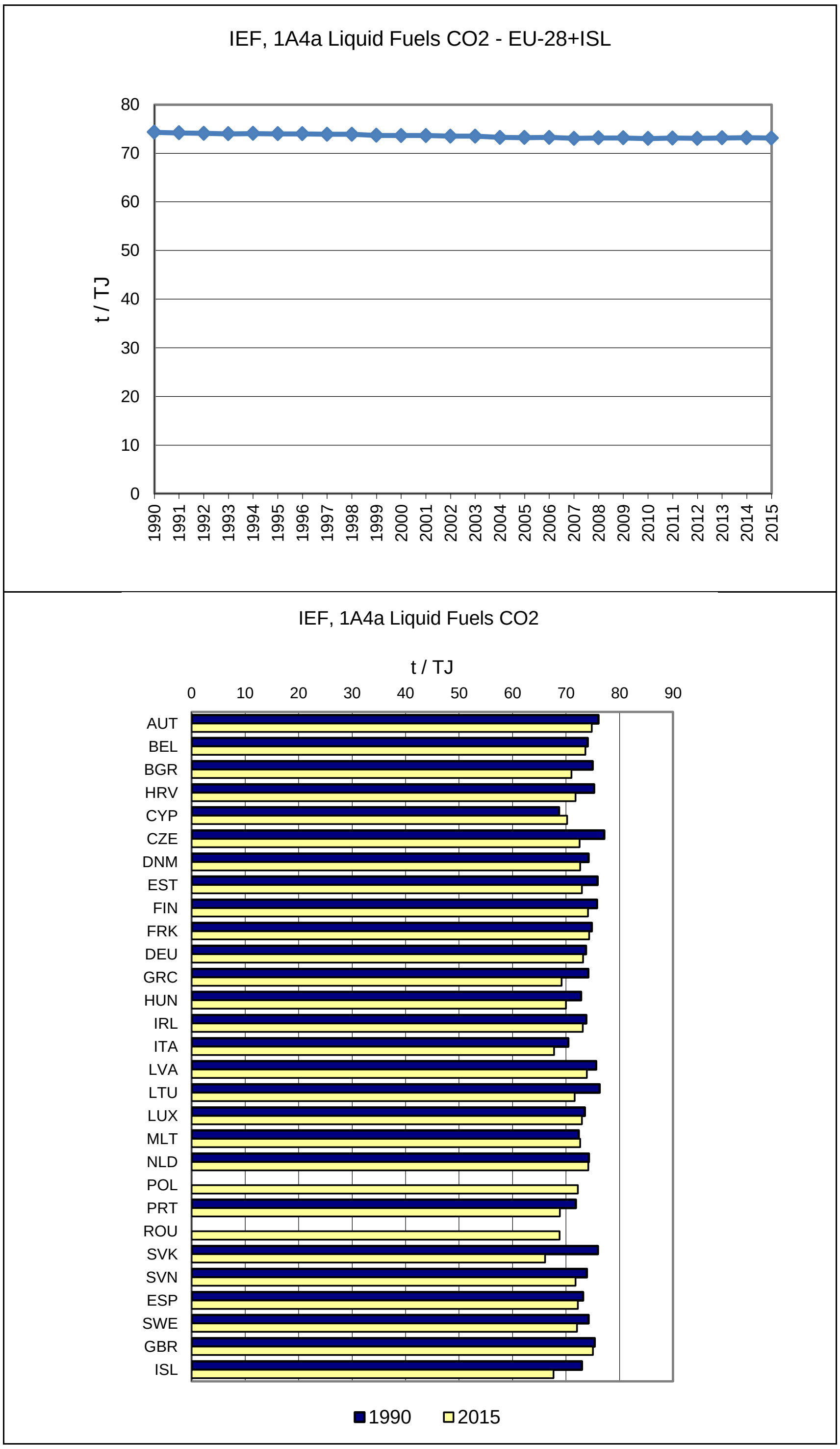


Figure 3.127 1A4a Commercial/Institutional, liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2015, CO_2 from solid fuels had a share of 3% within source category 1A4a (compared to 24% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 92% (Table 3.83). Twelve Member States and Island report emissions as ‘Not occurring’ in 2015; all other Member States reduced emissions between 1990 and 2015 except Romania. Between 2014 and 2015 CO_2 emissions decreased by 4%.

Table 3.83 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	91	11	12	0.3%	1	10%	-79	-87%
Belgium	9	NO	NO	-	-	-	-9	-100%
Bulgaria	60	9	22	0.6%	14	158%	-38	-63%
Croatia	88	0	0	0.0%	0	-60%	-88	-100%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	6 237	110	96	2.4%	-13	-12%	-6 141	-98%
Denmark	8	NO	NO	-	-	-	-8	-100%
Estonia	5	0	NO	-	0	-100%	-5	-100%
Finland	NO	NO	NO	-	-	-	-	-
France	706	147	282	7.1%	135	92%	-424	-60%
Germany	22 426	183	96	2.4%	-87	-48%	-22 330	-100%
Greece	20	NO,IE	NO,IE	-	-	-	-20	-100%
Hungary	475	9	12	0.3%	3	27%	-463	-98%
Ireland	3	NO	NO	-	-	-	-3	-100%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	1 411	39	31	0.8%	-8	-21%	-1 380	-98%
Lithuania	1 173	129	104	2.6%	-25	-20%	-1 069	-91%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	101	5	3	0.1%	-2	-32%	-98	-97%
Poland	8 992	2 651	2 566	64.5%	-85	-3%	-6 426	-71%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	1	2	0.0%	0	23%	2	∞
Slovakia	1 729	298	258	6.5%	-40	-13%	-1 471	-85%
Slovenia	203	NO	NO	-	-	-	-203	-100%
Spain	147	171	140	3.5%	-31	-18%	-7	-5%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	3 543	394	353	8.9%	-41	-10%	-3 190	-90%
EU-28	**47 427**	**4 157**	**3 977**	**100%**	**-180**	**-4%**	**-43 450**	**-92%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	3 544	395	354	8.9%	-41	-10%	-3 190	-90%
EU-28 + ISL	**47 428**	**4 158**	**3 978**	**100%**	**-180**	**-4%**	**-43 450**	**-92%**

Greece reports emissions from stationary combustion as 'NO' and emissions from mobile sources as 'IE'
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.128 and Figure 3.129 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, Poland, Slovakia and the United Kingdom in 2015; together they cause 87% of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-28 decreased by 91% between 1990 and 2015. The CO_2 implied emission factor for solid fuels was 95.4 t/TJ in 2015. The comparatively low IEFs of Spain and Greece in 1990 are due to a high share of gas works gas consumption in the 1990s.

Figure 3.128 1A4a Commercial/Institutional, solid fuels: Emission trend and share for CO_2

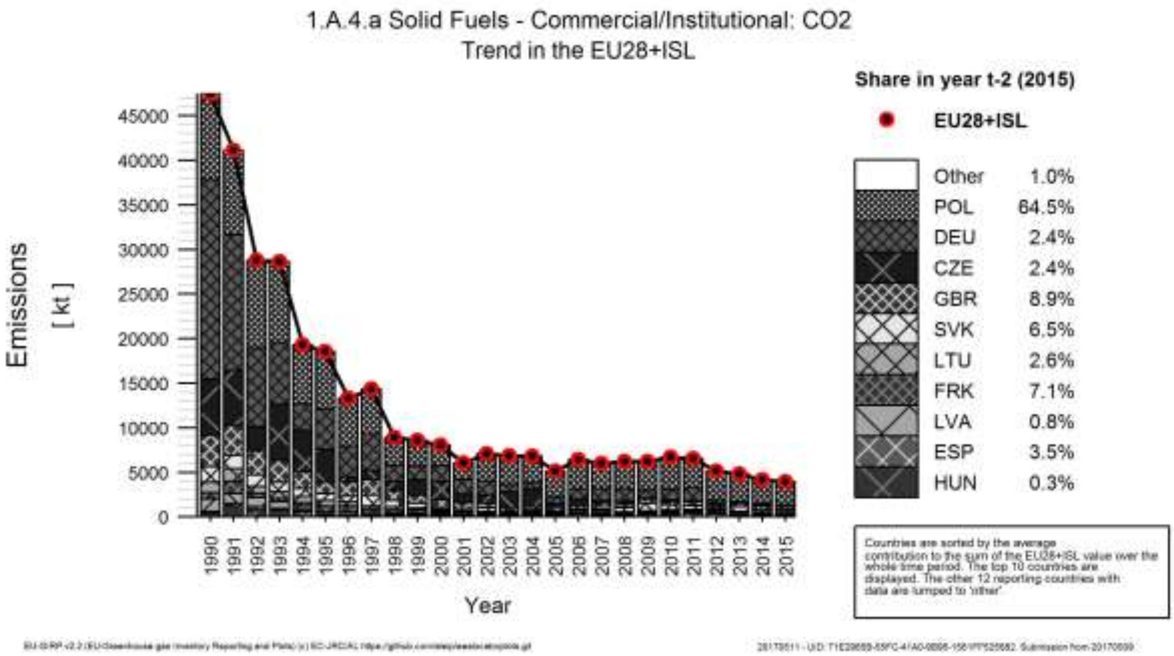
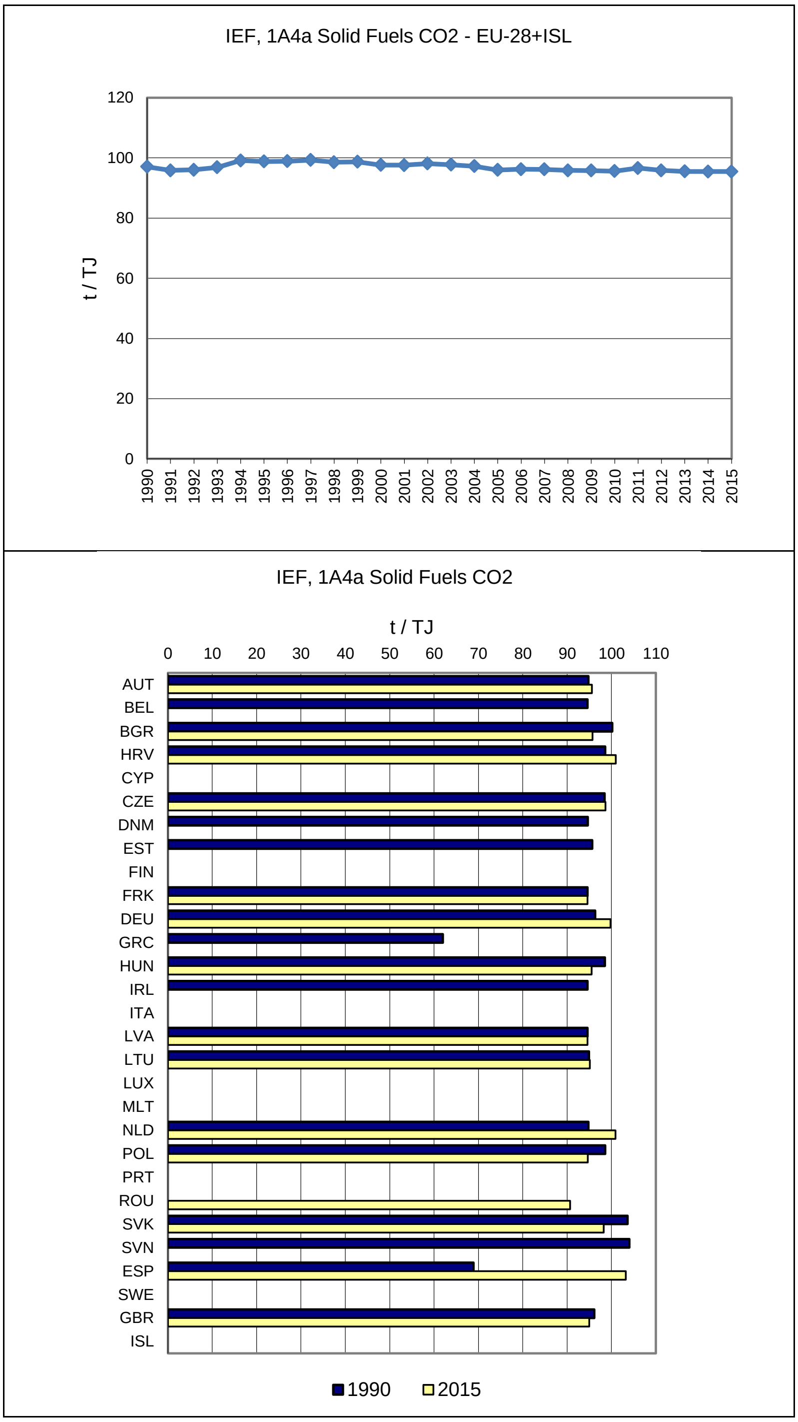


Figure 3.129 1A4a Commercial/Institutional, solid fuels: of Implied Emission Factors for CO_2 (in t/TJ)



1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2015 CO_2 from gaseous fuels had a share of 68% within source category 1A4a (compared to 33% in 1990). Between 1990 and 2015, the emissions increased by 58% (Table 3.84). 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 2014 and 2015 CO_2 emissions increased by 7%.

Table 3.84 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	707	1 265	1 087	1.0%	-178	-14%	380	54%
Belgium	1 934	3 771	4 024	3.8%	253	7%	2 090	108%
Bulgaria	39	193	207	0.2%	14	7%	168	432%
Croatia	241	311	398	0.4%	87	28%	157	65%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	1 670	2 425	2 420	2.3%	-5	0%	750	45%
Denmark	363	395	442	0.4%	47	12%	80	22%
Estonia	20	55	76	0.1%	22	39%	56	274%
Finland	45	75	67	0.1%	-8	-11%	22	49%
France	8 619	11 135	11 423	10.8%	288	3%	2 804	33%
Germany	13 547	20 786	21 168	20.0%	382	2%	7 622	56%
Greece	IE,NO	293	389	0.4%	96	33%	389	∞
Hungary	1 337	2 920	2 962	2.8%	42	1%	1 625	121%
Ireland	223	986	983	0.9%	-3	0%	759	340%
Italy	10 135	15 045	16 784	15.9%	1 739	12%	6 649	66%
Latvia	336	240	228	0.2%	-12	-5%	-108	-32%
Lithuania	708	135	143	0.1%	8	6%	-565	-80%
Luxembourg	170	225	231	0.2%	6	3%	61	36%
Malta	NO	0	1	0.0%	0	84%	1	∞
Netherlands	7 758	6 782	7 108	6.7%	325	5%	-651	-8%
Poland	773	3 783	4 029	3.8%	247	7%	3 256	421%
Portugal	NO	691	697	0.7%	6	1%	697	∞
Romania	NO	1 806	1 747	1.7%	-59	-3%	1 747	∞
Slovakia	2 035	1 144	1 198	1.1%	54	5%	-837	-41%
Slovenia	29	83	113	0.1%	30	36%	84	289%
Spain	403	4 964	7 922	7.5%	2 958	60%	7 519	1865%
Sweden	86	249	234	0.2%	-15	-6%	147	171%
United Kingdom	15 717	19 167	19 498	18.5%	331	2%	3 781	24%
EU-28	**66 896**	**98 924**	**105 580**	**100%**	**6 656**	**7%**	**38 684**	**58%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	15 717	19 167	19 498	18.5%	331	2%	3 781	24%
EU-28 + ISL	**66 896**	**98 924**	**105 580**	**100%**	**6 656**	**7%**	**38 684**	**58%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.130 and Figure 3.131 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 72% of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion rose by 57% between 1990 and 2015. The CO_2 implied emission factor for gaseous fuels was 56.4 t/TJ in 2015. The comparatively high IEF of Malta is because LPG is included under gaseous fuels.

Figure 3.130 1A4a Commercial/Institutional, gaseous fuels: Emission trend and share for CO_2

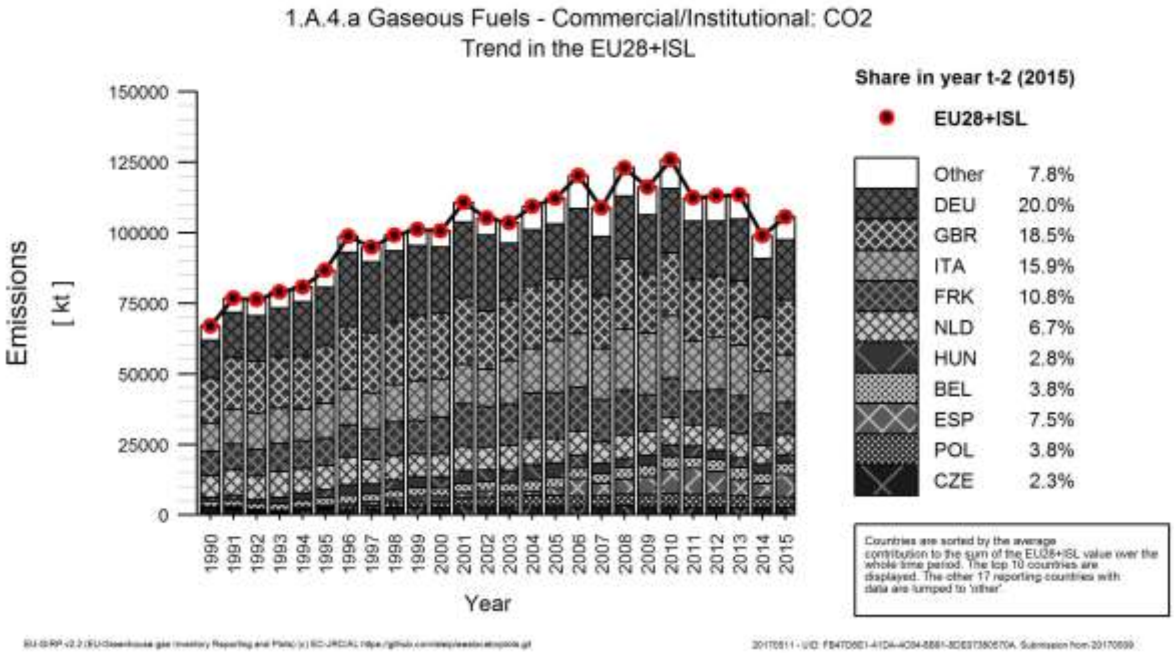
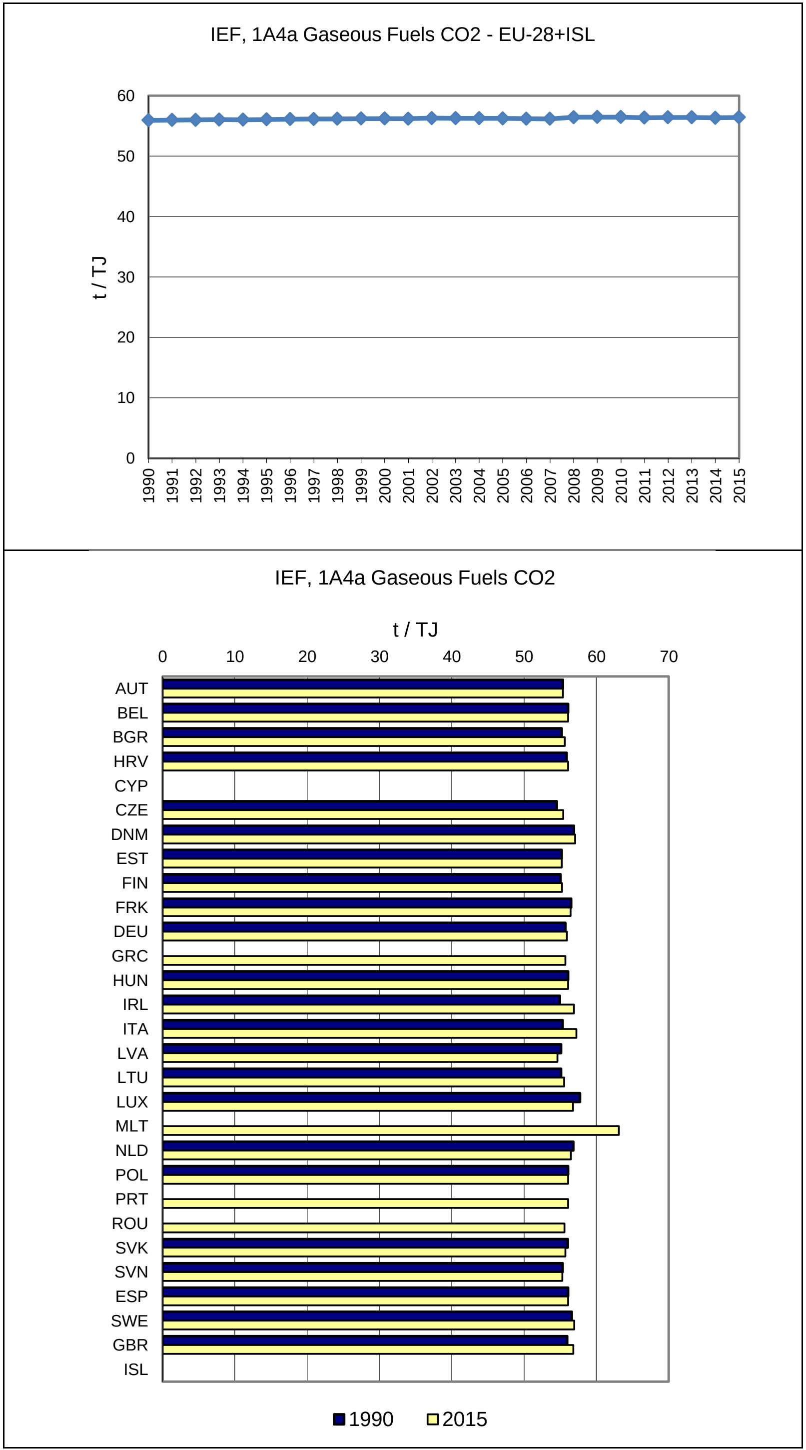


Figure 3.131 1A4a Commercial/Institutional, gaseous fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)



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 2015, CO_2 from other fossil fuels had a share of 3% within category 1A4a. Between 1990 and 2015 CO_2 increased by 367% (Table 3.85). 22 Member States and Island report emissions as ‘Not occurring’ in 2015; Between 2014 and 2015 CO_2 increased by 2%. Emissions trend and emissions level are strongly dominated by Italy.

Table 3.85: 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	350	6	6	0.1%	0.1	1%	-344	-98%
Belgium	31	102	123	2.6%	21	20%	92	300%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	34	14	NO	-	-14	-100%	-34	-100%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	0	NO	NO	-	-	-	0	-100%
France	NO	NO	NO	-	-	-	-	-
Germany	NA	NA	NA	-	-	-	-	-
Greece	IE,NO	NO,IE	NO,IE	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	526	4 477	4 547	96.2%	70	2%	4 021	764%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-
Poland	72	25	25	0.5%	0.1	0%	-47	-65%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	22	22	0.5%	-1	-4%	22	∞
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	6	6	0.1%	0.1	1%	6	∞
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**1 013**	**4 652**	**4 728**	**100%**	**76**	**2%**	**3 716**	**367%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**1 013**	**4 652**	**4 728**	**100%**	**76**	**2%**	**3 716**	**367%**

Greece reports emissions from stationary combustion as ‘NO’ and emissions from mobile sources as ’IE’

Figure 3.132 and

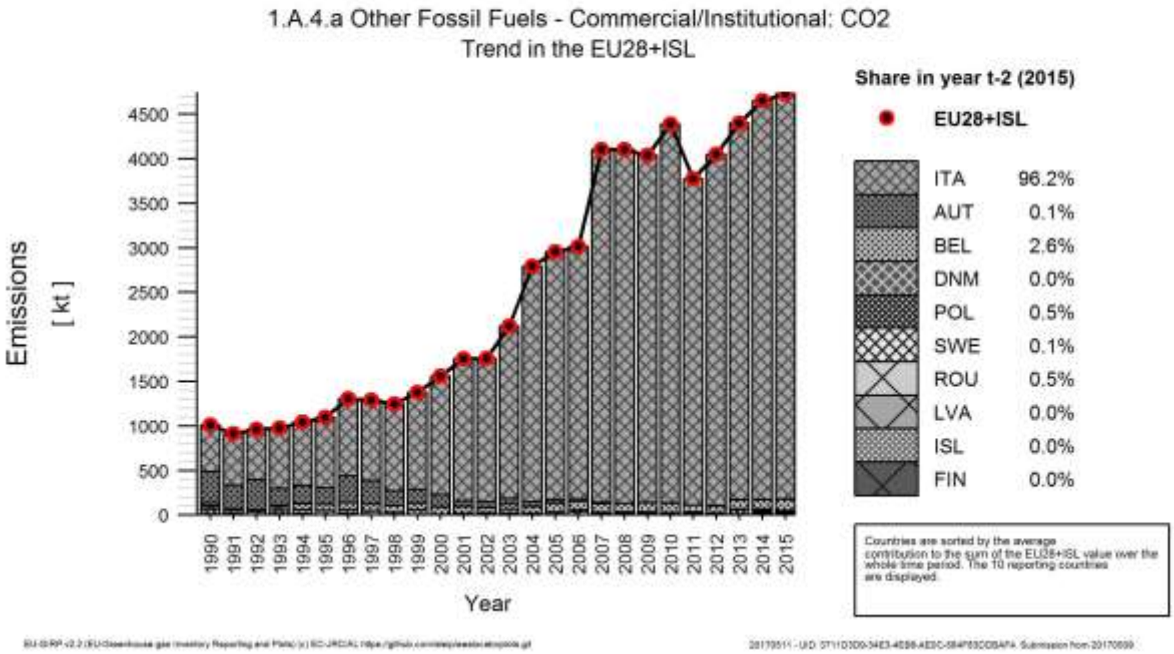


Figure 3.133 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Italy; it causes 96% of the CO_2 emissions from other fuels in 1A4a. The CO_2 implied emission factor for other fossil fuels was 112.3 t/TJ in 2015.

Figure 3.132 1A4a Commercial/Institutional, other fuels: Emission trend and share for CO_2

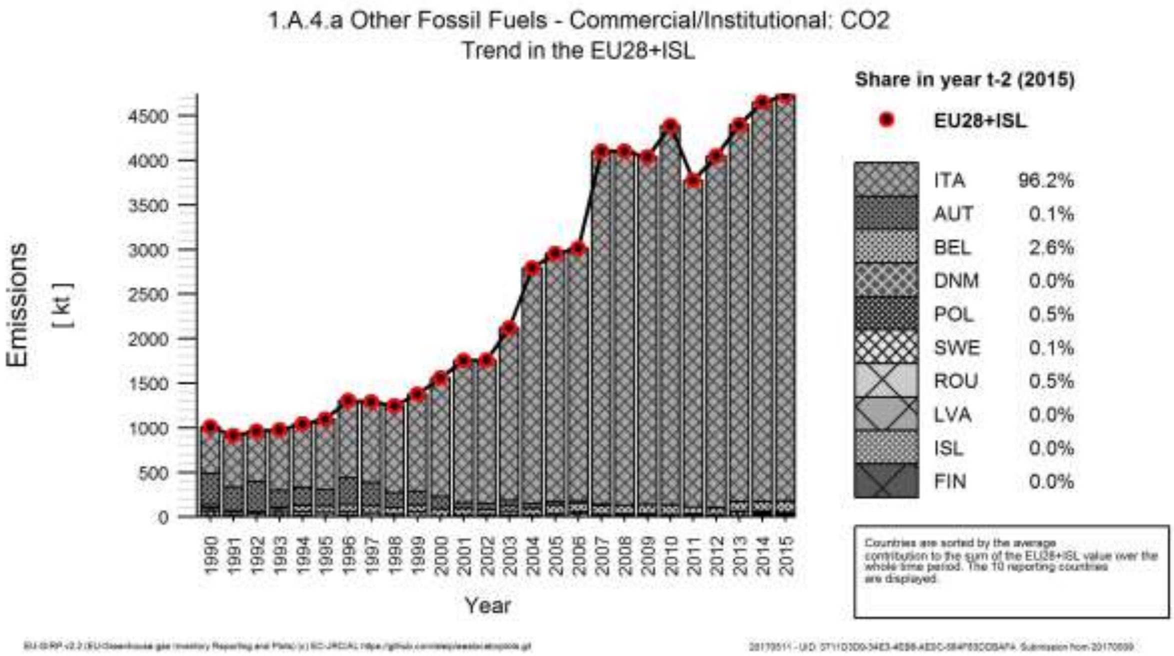
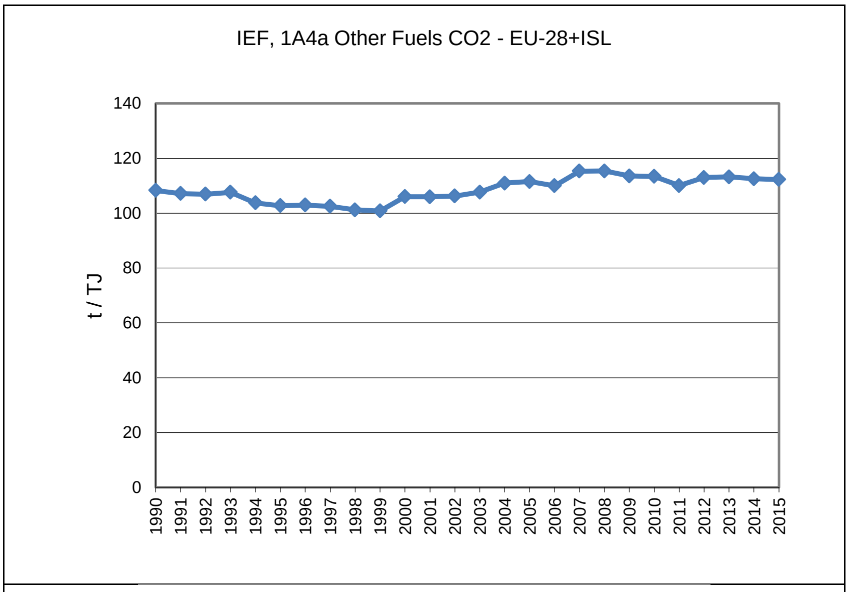
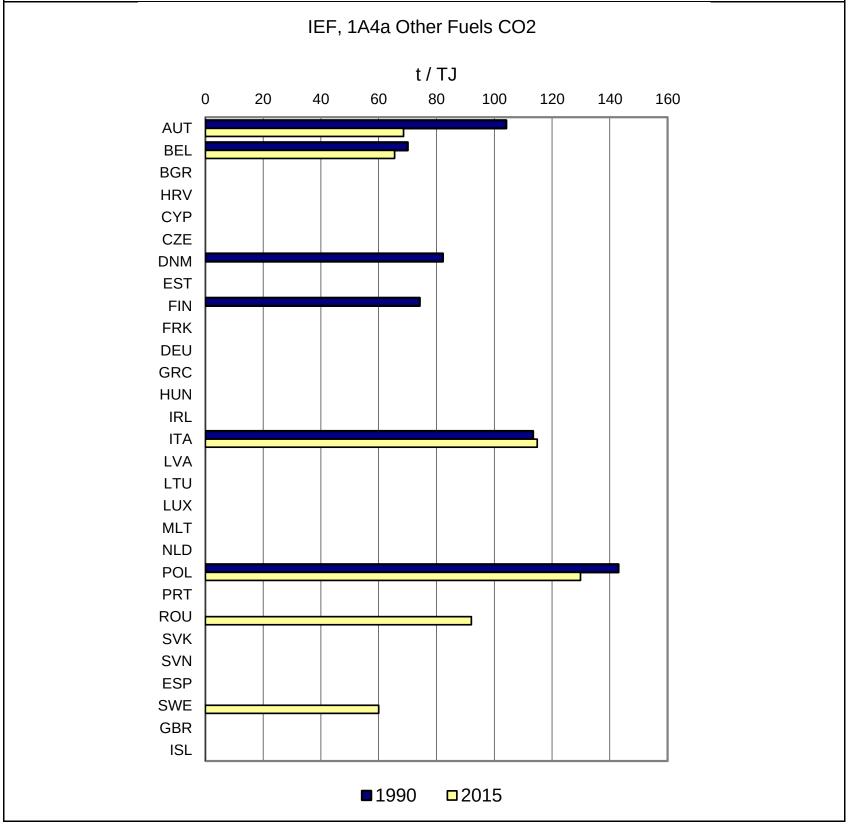


Figure 3.133 1A4a Commercial/Institutional, other fuels: Overview of outliers of Implied Emission Factors for CO_2 (in t/TJ)





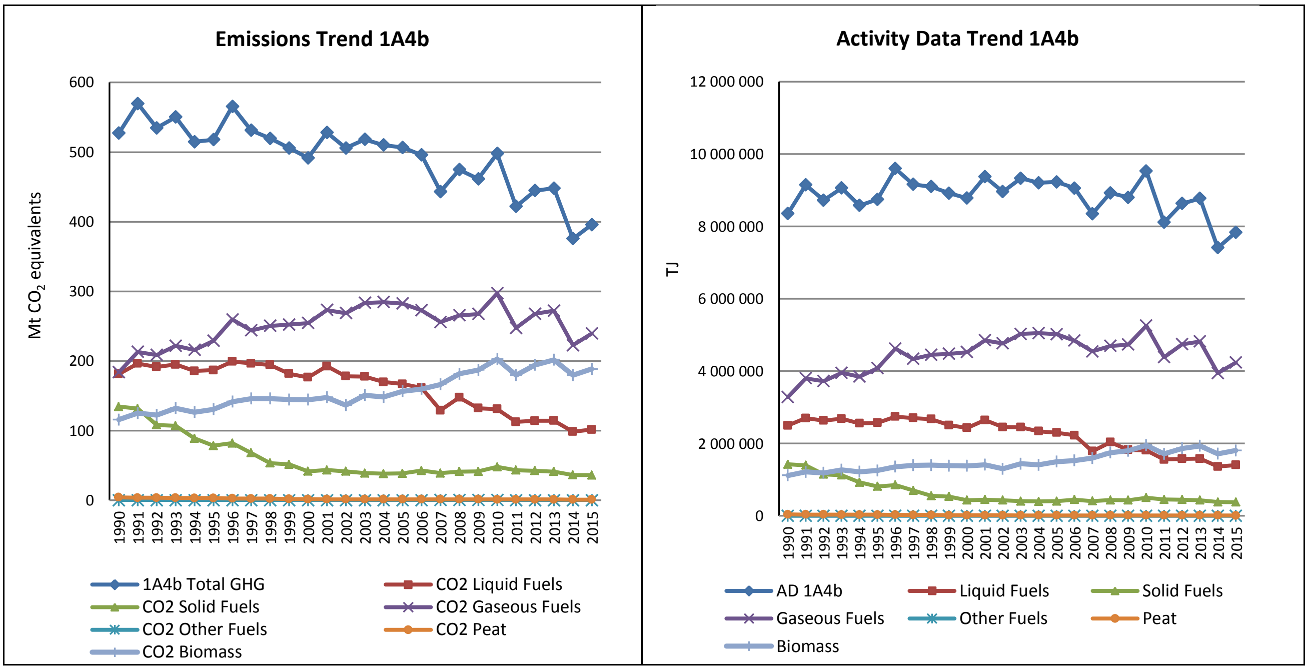
3.2.4.2 Residential (1A4b)

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 third largest key category of GHG emissions in the EU-28+ISL and account for 8.7% of total GHG emissions in 2015.

Figure 3.134 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 25%

since 1990, although CO_2 emissions from gaseous fuels increased strongly (+30%) which was counterbalanced by decreasing emissions from other fossil fuels. From 2014 to 2015 CO_2 emissions increased by 5.5% and energy consumption increased by 5.7% which is correlating with the trend in EU-28 heating degree days (+6%). Biomass consumption reached a share of 23% in the year 2015 while the share of solid fuels consumption dropped to 5%.

Figure 3.134 1A4b Residential: Total, CO_2 and CH_4 emission and activity trends



CO_2 emissions from 1A4b Residential

Between 1990 and 2015, CO_2 emissions from households decreased by 25% in the EU-28+ISL Table 3.86). 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 17% between 1990 and 2015, with a fuel shift from coal and oil to natural gas and biomass.

Between 1990 and 2015, the largest CO_2 reduction in absolute terms was reported by Germany reducing emissions by 43.3 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 2014 and 2015 all Member States except Estonia, Finland, Lithuania, Poland and Portugal show increasing emissions with the largest increase reported by France, Italy, Germany and the United Kingdom.

Table 3.86 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	9 963	5 297	5 804	1.5%	507	10%	-4 159	-42%	T1,T2	CS,D
Belgium	20 471	15 281	15 954	4.2%	673	4%	-4 517	-22%	CS,T1,T3	D
Bulgaria	2 887	699	743	0.2%	44	6%	-2 144	-74%	T1,T2	CS,D
Croatia	2 029	1 425	1 503	0.4%	77	5%	-526	-26%	T1	D
Cyprus	300	302	353	0.1%	50	17%	53	18%	T1	D
Czech Republic	15 837	6 838	7 198	1.9%	360	5%	-8 639	-55%	T1,T2	CS,D
Denmark	5 004	1 470	1 995	0.5%	525	36%	-3 009	-60%	CR,M,T1,T2,T3	CS,D
Estonia	1 338	193	182	0.0%	-11	-6%	-1 156	-86%	T1,T2	CS,D
Finland	3 146	1 406	1 264	0.3%	-141	-10%	-1 881	-60%	CS,M,T1,T2	CS,D
France	54 478	44 964	48 413	12.8%	3 450	8%	-6 064	-11%	T1, T2	CS, D
Germany	128 636	82 469	85 364	22.6%	2 895	4%	-43 272	-34%	CS,T2	CS
Greece	4 654	3 781	5 050	1.3%	1 269	34%	397	9%	T1,T2	CS,D
Hungary	15 798	6 202	6 878	1.8%	676	11%	-8 920	-56%	T1,T2,T3	CS,D
Ireland	7 052	5 579	5 874	1.6%	295	5%	-1 178	-17%	T2	CS
Italy	55 556	42 279	47 103	12.5%	4 824	11%	-8 453	-15%	T2	CS
Latvia	1 201	440	416	0.1%	-25	-6%	-786	-65%	T1,T2	CS,D
Lithuania	2 361	644	591	0.2%	-53	-8%	-1 770	-75%	T2	CS
Luxembourg	668	959	1 055	0.3%	96	10%	387	58%	T1,T2	CS,D
Malta	34	38	44	0.0%	7	18%	10	30%	T1	D
Netherlands	20 729	15 279	16 325	4.3%	1 046	7%	-4 404	-21%	T1,T2	CS,D
Poland	35 383	34 116	33 571	8.9%	-545	-2%	-1 812	-5%	T1,T2	CS,D
Portugal	1 639	1 871	1 791	0.5%	-80	-4%	152	9%	-	-
Romania	8 853	5 897	6 217	1.6%	320	5%	-2 636	-30%	T1,T2	CS,D
Slovakia	7 163	2 651	2 703	0.7%	52	2%	-4 460	-62%	T2	CS
Slovenia	809	656	703	0.2%	47	7%	-106	-13%	T1,T2	CS,D
Spain	12 826	15 432	16 172	4.3%	740	5%	3 346	26%	T2	CS,D,OTH
Sweden	6 238	708	709	0.2%	2	0%	-5 528	-89%	T1,T2	CS
United Kingdom	78 347	60 984	63 401	16.8%	2 417	4%	-14 946	-19%	T1,T2,T3	CS,D
EU-28	**503 399**	**357 859**	**377 377**	**100%**	**19 518**	**5%**	**-126 022**	**-25%**	**-**	**-**
Iceland	31	16	7	0.0%	-9	-56%	-24	-77%	T1,T2	D
United Kingdom (KP)	78 587	61 365	63 788	16.9%	2 423	4%	-14 799	-19%	T1,T2,T3	CS,D
EU-28 + ISL	**503 670**	**358 257**	**377 772**	**100%**	**19 515**	**5%**	**-125 899**	**-25%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2015 CO_2 from liquid fuels had a share of 26% within source category 1A4b (compared to 34% in 1990). Between 1990 and 2015 emissions decreased by 44% (Table 3.87). France, Germany and Italy show the highest absolute decreases. Only five Member States reported increasing emissions since 1990. Between 2014 and 2015 EU-28+ISL CO_2 emissions increased by 3%. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oil tanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

Table 3.87 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	5 605	2 885	3 155	3.1%	270	9%	-2 450	-44%
Belgium	12 800	8 161	8 173	8.1%	12	0%	-4 627	-36%
Bulgaria	158	64	90	0.1%	26	40%	-68	-43%
Croatia	1 137	396	445	0.4%	49	12%	-692	-61%
Cyprus	300	302	353	0.3%	50	17%	53	18%
Czech Republic	239	130	130	0.1%	0	0%	-109	-46%
Denmark	3 944	97	563	0.6%	467	483%	-3 381	-86%
Estonia	544	40	45	0.0%	5	14%	-499	-92%
Finland	3 021	1 323	1 188	1.2%	-136	-10%	-1 834	-61%
France	31 003	15 027	15 582	15.4%	555	4%	-15 421	-50%
Germany	56 382	36 409	35 688	35.2%	-721	-2%	-20 694	-37%
Greece	4 565	3 229	4 197	4.1%	967	30%	-369	-8%
Hungary	3 540	182	179	0.2%	-3	-2%	-3 361	-95%
Ireland	1 175	2 569	2 863	2.8%	294	11%	1 688	144%
Italy	28 425	6 561	6 965	6.9%	404	6%	-21 460	-75%
Latvia	332	158	144	0.1%	-15	-9%	-189	-57%
Lithuania	397	132	116	0.1%	-16	-12%	-281	-71%
Luxembourg	472	477	521	0.5%	44	9%	49	10%
Malta	34	38	44	0.0%	7	18%	10	30%
Netherlands	772	179	206	0.2%	27	15%	-566	-73%
Poland	107	1 647	1 573	1.6%	-74	-5%	1 465	1364%
Portugal	1 639	1 263	1 171	1.2%	-91	-7%	-468	-29%
Romania	922	591	691	0.7%	99	17%	-231	-25%
Slovakia	93	12	12	0.0%	0	0%	-81	-87%
Slovenia	439	450	462	0.5%	13	3%	23	5%
Spain	9 856	7 701	8 631	8.5%	930	12%	-1 225	-12%
Sweden	6 151	629	637	0.6%	8	1%	-5 514	-90%
United Kingdom	7 127	7 459	7 297	7.2%	-161	-2%	171	2%
EU-28	**181 181**	**98 112**	**101 121**	**100%**	**3 009**	**3%**	**-80 059**	**-44%**
Iceland	31	16.3	7.1	0.007%	-9.2	-56%	-24	-77%
United Kingdom (KP)	7 338	7 792	7 635	7.5%	-156	-2%	298	4%
EU-28 + ISL	**181 422**	**98 462**	**101 466**	**100%**	**3 005**	**3%**	**-79 956**	**-44%**

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. The largest emissions are reported by Belgium, France, Germany, Italy, Spain and the United Kingdom; together they cause 82% of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-28+ISL decreased by 44% between 1990 and 2015. The CO_2 implied emission factor for liquid fuels was 72.3 t/TJ in 2015.

Figure 3.135 1A4b Residential, liquid fuels: Emission trend and share for CO_2

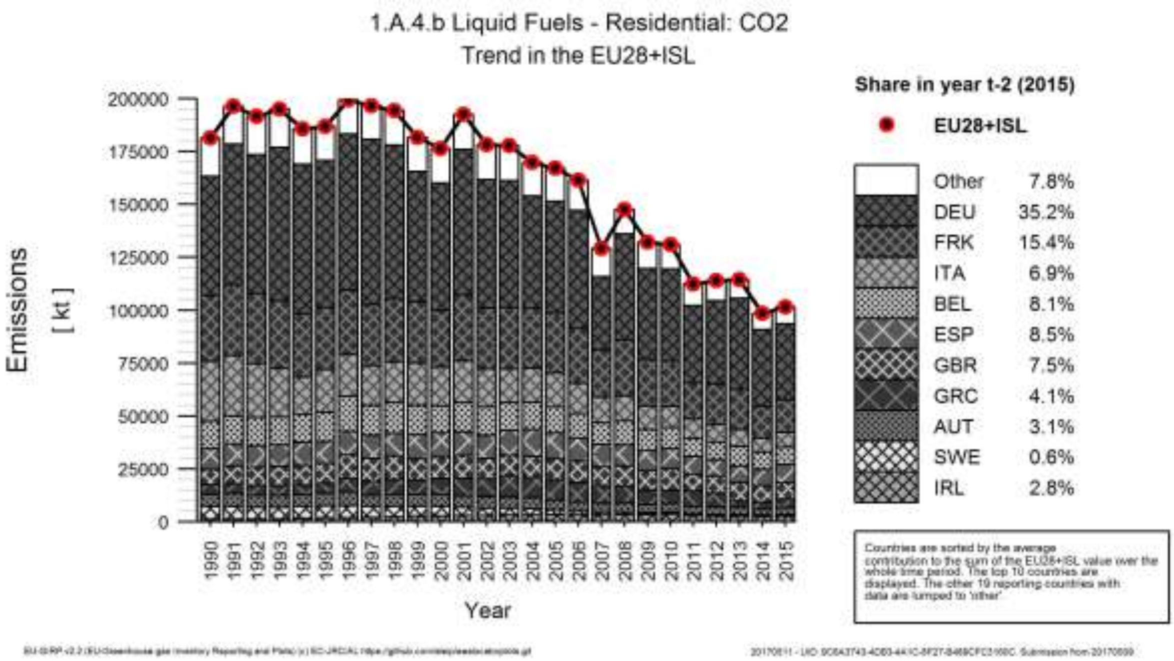
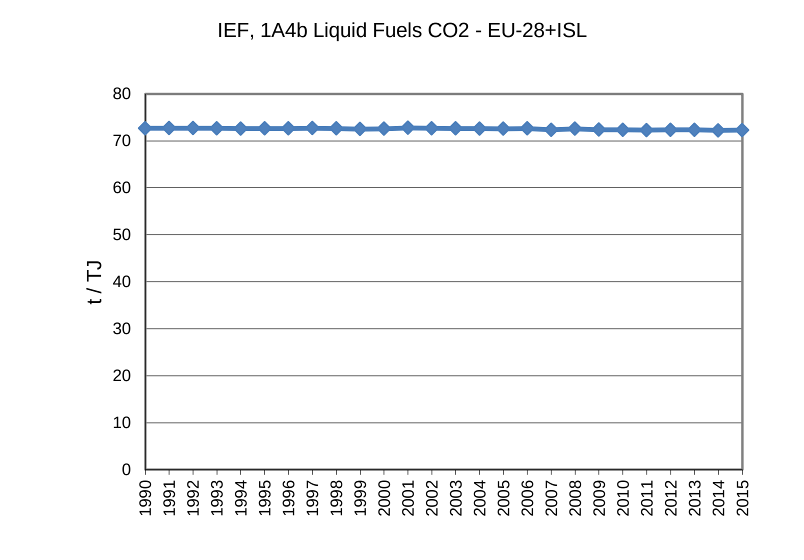
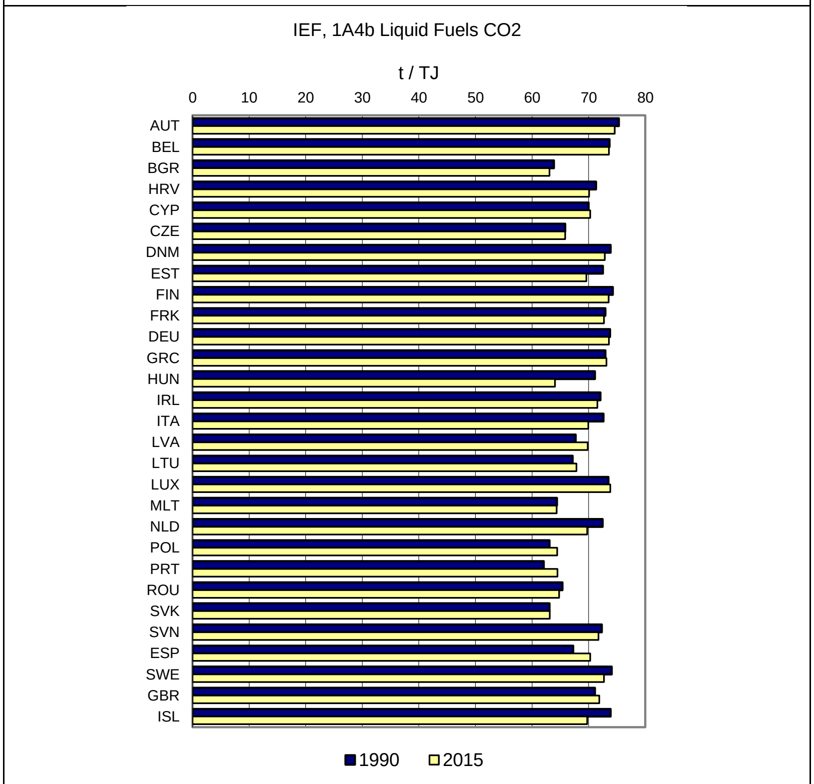


Figure 3.136 1A4b Residential, liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)





1A4b Residential –Solid Fuels (CO_2)

In 2015 CO_2 from solid fuels had a share of 9% within source category 1A4b (compared to 26% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 73% (Table 3.88). 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 2014 and 2015 CO_2 emissions decreased by 1%. Iceland, Cyprus, Malta, Sweden, Denmark, Italy and Portugal report emissions as 'Not occurring' in 2015.

Table 3.88 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	2 511	90	101	0.3%	11	12%	-2 409	-96%
Belgium	1 796	273	237	0.7%	-36	-13%	-1 559	-87%
Bulgaria	2 730	530	533	1.5%	3	1%	-2 197	-80%
Croatia	436	11	9	0.0%	-2	-15%	-427	-98%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	13 500	2 887	2 906	8.1%	19	1%	-10 594	-78%
Denmark	72	0	NO	-	0	-100%	-72	-100%
Estonia	338	19	11	0.0%	-8	-40%	-326	-97%
Finland	33	1	1	0.0%	0	-10%	-32	-97%
France	3 388	257	494	1.4%	237	92%	-2 894	-85%
Germany	40 661	2 388	2 430	6.7%	42	2%	-38 231	-94%
Greece	89	12	24	0.1%	12	96%	-65	-73%
Hungary	8 107	446	412	1.1%	-34	-8%	-7 695	-95%
Ireland	2 483	882	831	2.3%	-52	-6%	-1 653	-67%
Italy	899	NO	NO	-	-	-	-899	-100%
Latvia	606	50	47	0.1%	-3	-6%	-558	-92%
Lithuania	1 440	168	139	0.4%	-30	-18%	-1 301	-90%
Luxembourg	26	2	3	0.0%	1	28%	-24	-90%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	61	3	2	0.0%	-1	-26%	-59	-96%
Poland	28 420	25 087	24 582	68.3%	-505	-2%	-3 838	-14%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	2 703	248	306	0.9%	58	24%	-2 397	-89%
Slovakia	5 441	222	245	0.7%	24	11%	-5 196	-95%
Slovenia	345	1	1	0.0%	0	-11%	-344	-100%
Spain	2 035	452	436	1.2%	-16	-3%	-1 598	-79%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	16 254	2 299	2 250	6.3%	-49	-2%	-14 003	-86%
EU-28	**134 373**	**36 327**	**36 000**	**100%**	**-327**	**-1%**	**-98 373**	**-73%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	16 283	2 299	2 250	6.3%	-49	-2%	-14 033	-86%
EU-28 + ISL	**134 402**	**36 327**	**36 000**	**100%**	**-327**	**-1%**	**-98 402**	**-73%**

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 Poland, Germany, the Czech Republic and the United Kingdom; together they cause 89% of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-28 decreased by 73% between 1990 and 2015. The CO_2 implied emission factor for solid fuels was 95.3 t/TJ in 2015. 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 3.137 1A4b Residential, solid fuels: Emission trend and share for CO_2

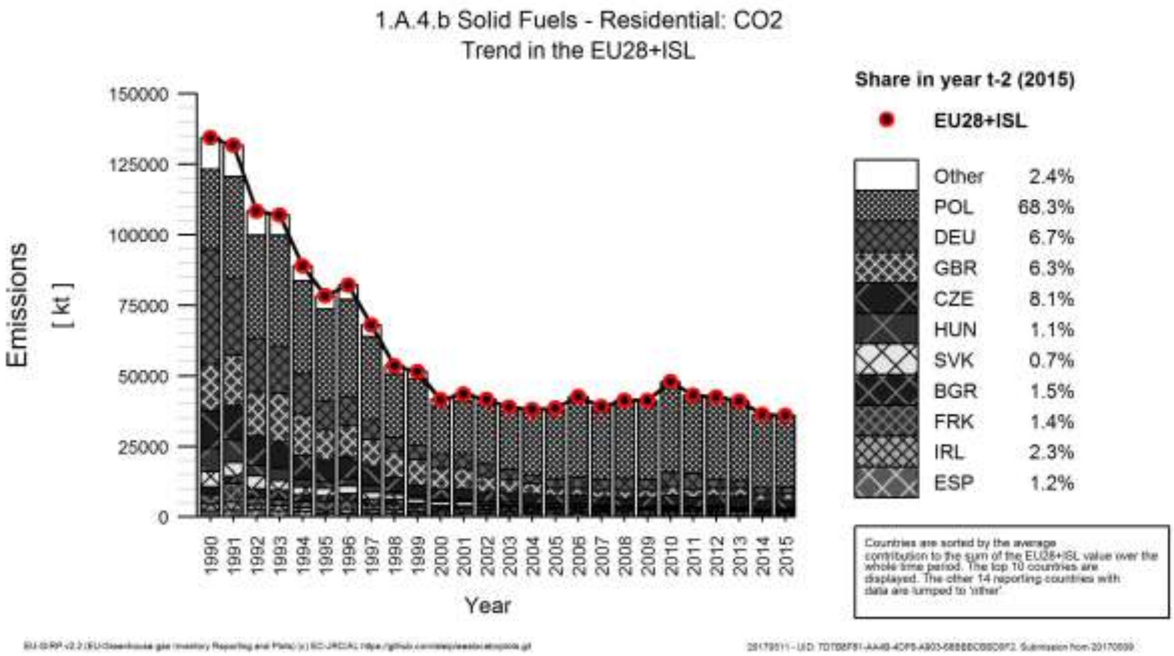
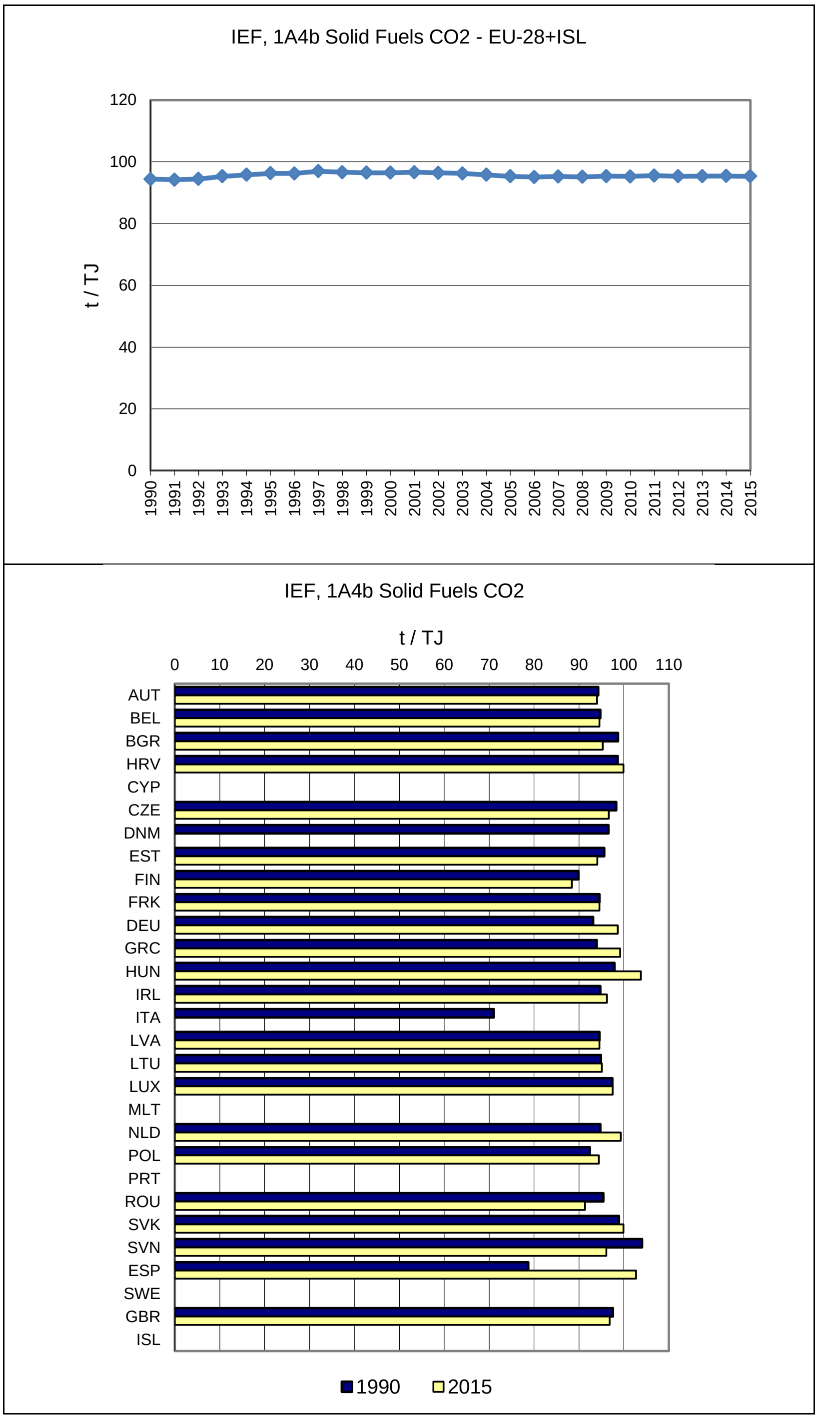


Figure 3.138 1A4b Residential, solid fuels: Implied Emission Factors for CO_2 (in t/TJ)



1A4b Residential – Gaseous Fuels (CO_2)

In 2015, CO_2 from gaseous fuels had a share of 61% within source category 1A4b (compared to 35% in 1990). Between 1990 and 2015, the emissions increased by 30% (Table 3.89). All Member States except Estonia, Lithuania, the Netherlands, Sweden and the United Kingdom reported increasing emissions. The highest absolute increase occurred in Germany, France, Spain and Italy. Between 2014 and 2015 EU-28+ISL emissions increased by 8%.

Table 3.89 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	1 847	2 321	2 547	1.1%	226	10%	700	38%
Belgium	5 874	6 847	7 544	3.2%	696	10%	1 669	28%
Bulgaria	NO	105	121	0.1%	16	15%	121	∞
Croatia	456	1 018	1 048	0.4%	30	3%	592	130%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	2 098	3 821	4 161	1.7%	341	9%	2 063	98%
Denmark	988	1 373	1 432	0.6%	59	4%	444	45%
Estonia	117	118	115	0.0%	-3	-3%	-2	-2%
Finland	25	64	60	0.0%	-5	-7%	34	136%
France	20 087	29 680	32 337	13.5%	2 657	9%	12 251	61%
Germany	31 564	43 672	47 246	19.7%	3 574	8%	15 682	50%
Greece	IE,NO	540	830	0.3%	290	54%	830	∞
Hungary	4 152	5 574	6 287	2.6%	713	13%	2 136	51%
Ireland	270	1 272	1 323	0.6%	51	4%	1 053	390%
Italy	26 232	35 718	40 138	16.8%	4 420	12%	13 906	53%
Latvia	221	232	225	0.1%	-7	-3%	4	2%
Lithuania	509	278	285	0.1%	7	3%	-224	-44%
Luxembourg	170	479	531	0.2%	52	11%	361	213%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	19 896	15 097	16 117	6.7%	1 020	7%	-3 778	-19%
Poland	6 856	7 383	7 417	3.1%	34	0%	561	8%
Portugal	NO	609	620	0.3%	11	2%	620	∞
Romania	5 228	5 058	5 220	2.2%	162	3%	-8	0%
Slovakia	1 628	2 418	2 446	1.0%	28	1%	818	50%
Slovenia	25	205	240	0.1%	35	17%	214	854%
Spain	936	7 279	7 105	3.0%	-174	-2%	6 169	659%
Sweden	86	78	72	0.0%	-6	-8%	-14	-16%
United Kingdom	54 478	51 218	53 845	22.5%	2 627	5%	-633	-1%
EU-28	**183 742**	**222 458**	**239 312**	**100%**	**16 854**	**8%**	**55 570**	**30%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	54 478	51 266	53 894	22.5%	2 628	5%	-584	-1%
EU-28 + ISL	**183 742**	**222 506**	**239 361**	**100%**	**16 855**	**8%**	**55 619**	**30%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.139 shows CO_2 emissions for EU-28 and the Member States as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Germany, Italy and the United Kingdom; together they cause 73% of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-28+ISL rose 29% between 1990 and 2015. The CO_2 implied emission factor for gaseous fuels was 56.5 t/TJ in 2015.

Figure 3.139 1A4b Residential, gaseous fuels: Emission trend and share for CO_2

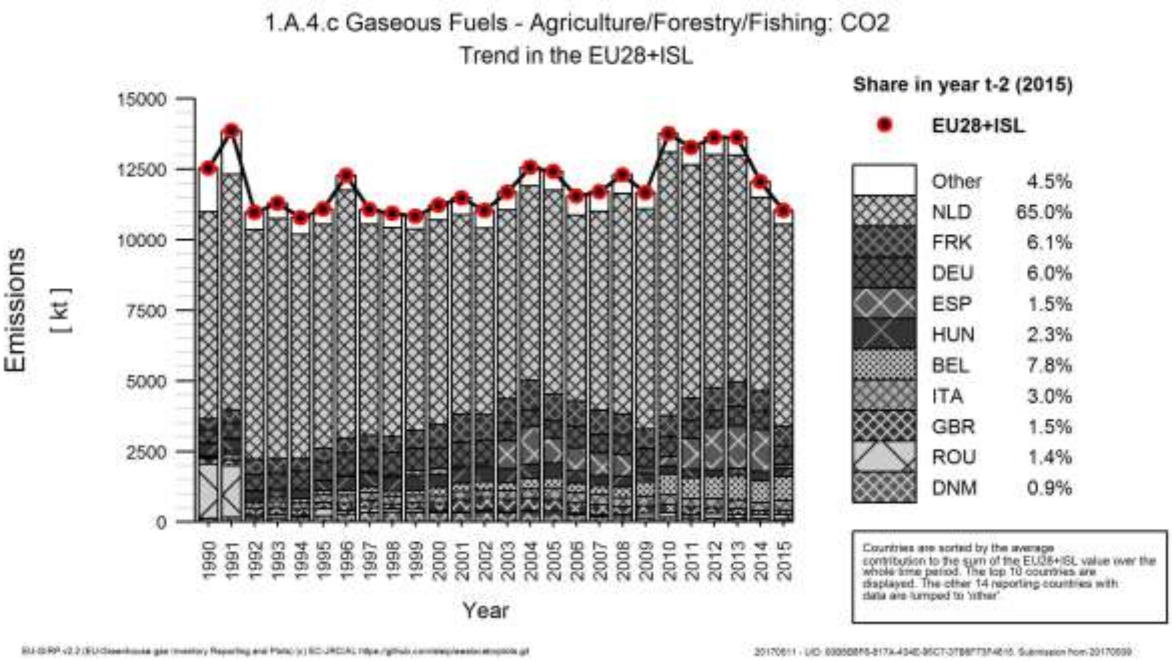
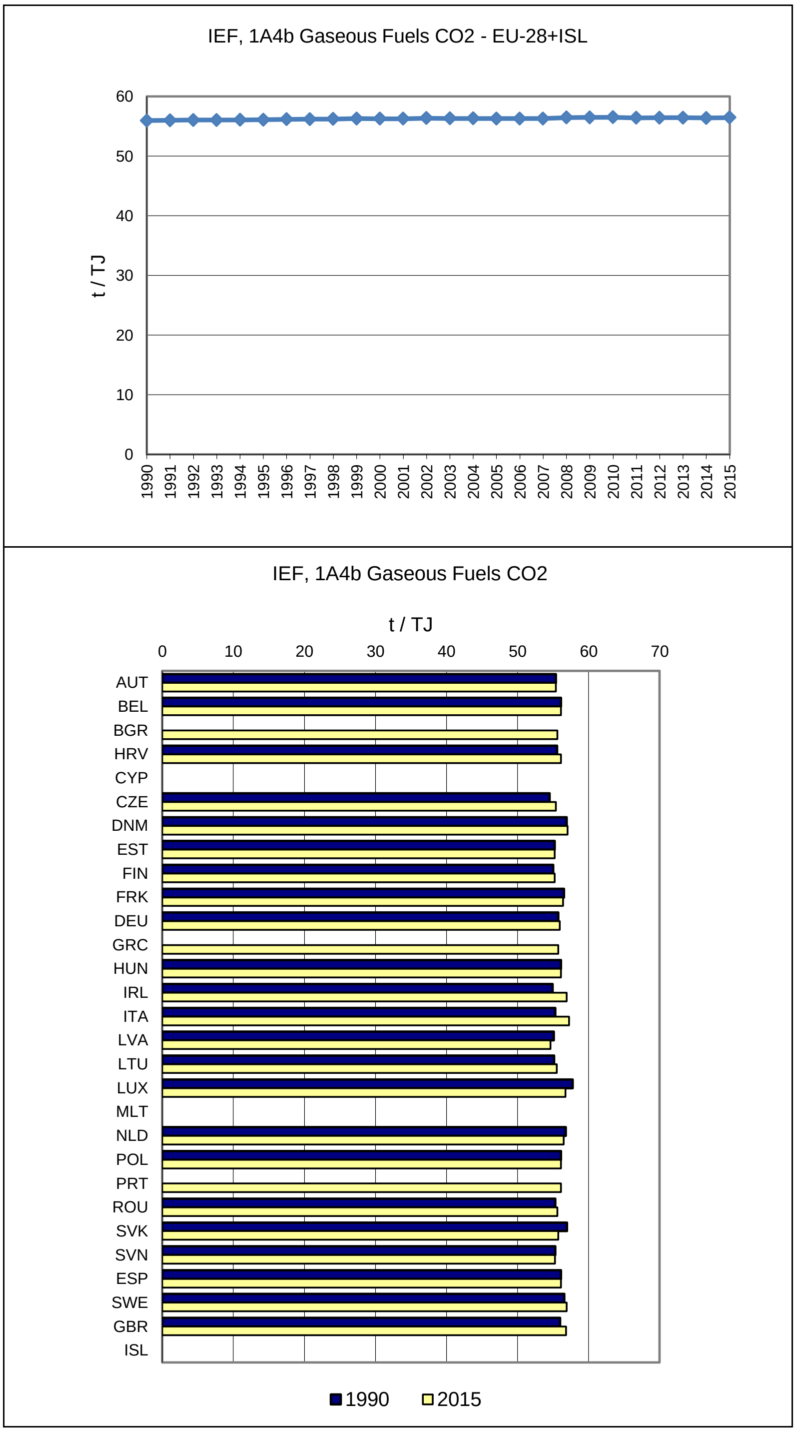


Figure 3.140 1A4b Residential, gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)



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 2015. Between 1990 and 2015, CH_4 emissions from households decreased by 28% in the EU-28 (Table 3.90). France, Germany, the Check Republic and the United Kingdom reported the highest decrease in emissions while Italy, Poland and Romania reported the highest increase in emissions. Between 2014 and 2015 CH_4 emissions decreased by 3%.

Table 3.90 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	588	197	218	1.5%	21	10%	-370	-63%	T1,T2,T3	CS,D
Belgium	270	206	227	1.6%	21	10%	-43	-16%	CS,T1,T3	CR,D
Bulgaria	262	272	267	1.9%	-5	-2%	5	2%	T1	D
Croatia	354	322	369	2.6%	47	15%	15	4%	T1	D
Cyprus	2	2	3	0.0%	1	38%	1	67%	T1	D
Czech Republic	1 296	778	789	5.5%	11	1%	-507	-39%	T1	D
Denmark	119	101	112	0.8%	11	11%	-6	-5%	CR,M,T1,T2,T3	CS,D,OTH
Estonia	95	120	116	0.8%	-4	-3%	21	22%	T1	D
Finland	198	163	154	1.1%	-9	-6%	-44	-22%	CS,M,T1,T2	CS,D
France	4 601	1 270	1 318	9.2%	47	4%	-3 284	-71%	-	-
Germany	2 484	688	744	5.2%	55	8%	-1 740	-70%	T2,T3	CS,M
Greece	94	93	107	0.7%	14	15%	13	14%	T1	D
Hungary	829	565	600	4.2%	35	6%	-229	-28%	T1	D
Ireland	443	151	151	1.1%	-1	0%	-292	-66%	T1	D
Italy	1 094	1 950	2 196	15.3%	246	13%	1 102	101%	T2	CR
Latvia	149	107	105	0.7%	-2	-2%	-44	-30%	T1,T2	CS,D
Lithuania	175	157	149	1.0%	-8	-5%	-26	-15%	T1,T2	CS,D
Luxembourg	9	9	10	0.1%	0.09	1%	1	8%	T1	D
Malta	0.07	0.22	0.21	0.0%	- 0.01	-5%	0.1	186%	T1	D
Netherlands	456	423	431	3.0%	7	2%	-25	-6%	T1,T2	CS,D
Poland	2 445	2 802	2 762	19.3%	-40	-1%	317	13%	T1	D
Portugal	410	244	243	1.7%	-1	-1%	-167	-41%	-	-
Romania	407	1 012	965	6.7%	-47	-5%	558	137%	T1	D
Slovakia	452	173	175	1.2%	2	1%	-277	-61%	T1,T2	CS,D
Slovenia	128	140	148	1.0%	8	5%	19	15%	T1	D
Spain	794	865	861	6.0%	-5	-1%	66	8%	T2	D
Sweden	284	252	252	1.8%	0.38	0.1%	-31	-11%	M,T1	CS
United Kingdom	1 463	810	870	6.1%	60	7%	-593	-41%	T1,T2,T3	CS,D
EU-28	**19 901**	**13 877**	**14 340**	**100%**	**464**	**3%**	**-5 560**	**-28%**	**-**	**-**
Iceland	0.03	0.02	0.01	0.000%	- 0.01	-63%	0	-82%	T1,T2	D
United Kingdom (KP)	1 465	811	871	6.1%	60	7%	-594	-41%	T1,T2,T3	CS,D
EU-28 + ISL	**19 904**	**13 878**	**14 342**	**100%**	**464**	**3%**	**-5 562**	**-28%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2015 CH_4 from biomass had a share of 2.7% within source category 1A4b (compared to 1.8% in 1990). Between 1990 and 2015 CH_4 emissions increased by 12% (Table 3.91). France reported the highest absolute decrease, while CH_4 emissions of Italy, Romania, Poland and the United Kingdom increased significantly. Between 2014 and 2015, CH_4 emissions increased by 4%.

Table 3.91 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	373	181	200	1.9%	19	10%	-173	-46%
Belgium	71	141	163	1.5%	22	15%	92	129%
Bulgaria	54	230	225	2.1%	-5	-2%	171	315%
Croatia	316	318	365	3.4%	47	15%	48	15%
Cyprus	1	1	2	0.0%	1	50%	1	108%
Czech Republic	324	546	554	5.2%	8	2%	230	71%
Denmark	109	96	109	1.0%	13	13%	0	0%
Estonia	40	117	113	1.1%	-3	-3%	73	183%
Finland	181	154	145	1.4%	-9	-6%	-36	-20%
France	4 181	1 127	1 148	10.8%	21	2%	-3 033	-73%
Germany	280	488	527	5.0%	40	8%	247	88%
Greece	85	91	104	1.0%	13	14%	18	21%
Hungary	186	519	554	5.2%	36	7%	368	197%
Ireland	14	8	10	0.1%	2	26%	-4	-27%
Italy	995	1 901	2 142	20.2%	240	13%	1 146	115%
Latvia	96	102	100	0.9%	-2	-2%	3	3%
Lithuania	58	138	134	1.3%	-5	-3%	75	128%
Luxembourg	5	7	6	0.1%	0	-3%	2	33%
Malta	NO	0	0	0.0%	0	-19%	0	∞
Netherlands	98	136	139	1.3%	3	2%	41	42%
Poland	258	791	791	7.5%	0	0%	533	207%
Portugal	407	242	241	2.3%	-1	0%	-166	-41%
Romania	181	979	927	8.8%	-53	-5%	746	413%
Slovakia	36	153	152	1.4%	-1	-1%	116	323%
Slovenia	102	138	145	1.4%	7	5%	44	43%
Spain	651	794	787	7.4%	-6	-1%	136	21%
Sweden	277	247	248	2.3%	0	0%	-29	-10%
United Kingdom	62	499	558	5.3%	59	12%	496	803%
EU-28	**9 443**	**10 145**	**10 589**	**100%**	**444**	**4%**	**1 146**	**12%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	62	499	558	5.3%	59	12%	496	802%
EU-28 + ISL	**9 443**	**10 145**	**10 589**	**100%**	**444**	**4%**	**1 146**	**12%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.141 and

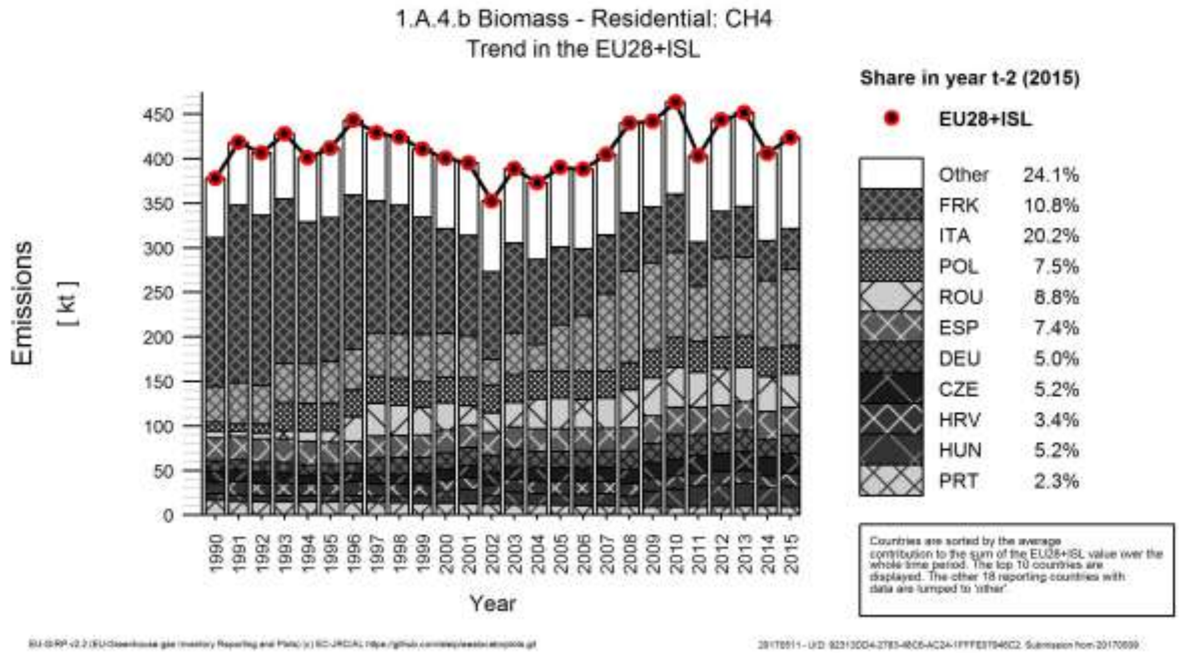


Figure 3.142 shows CH_4 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Poland, Italy, Romania and Spain; together they cause 55% of the CH_4 emissions from biomass fuels in 1A4b. Biomass fuel consumption in the EU-28 rose by 62% between 1990 and 2015. The CH_4 implied emission factor for biomass fuels was 234.5 kg/TJ in 2015.

The implied emission factors are decreasing because old biomass boilers and stoves are replaced by modern technologies (pellets, automatic boilers), which have lower CH_4 (as well as NMVOC) emissions from incomplete combustion. However, this change in improved technologies is not reflected by the member states which are using the default emission factor value (300 kg/TJ) for the whole time series.

Figure 3.141 1A4b Residential, biomass: Emission trend and share for CH_4

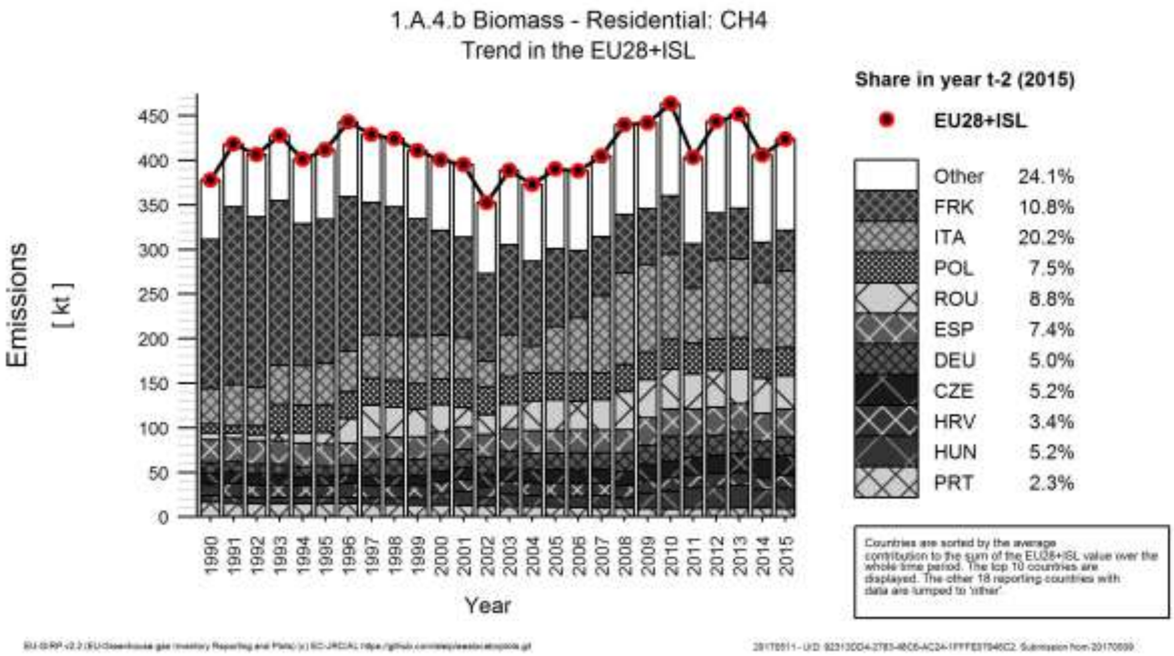
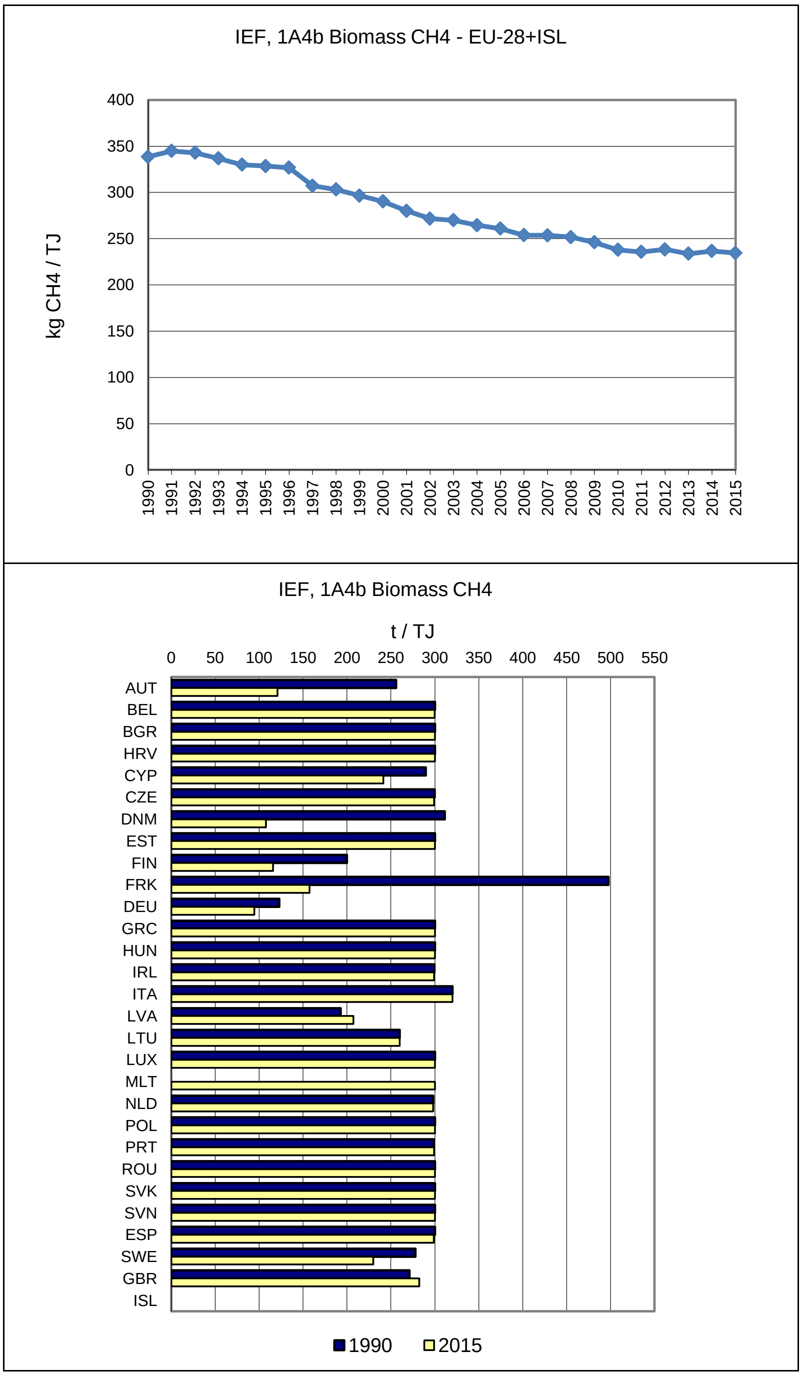


Figure 3.142 1A4b Residential, biomass: Implied Emission Factors for CH_4 (in kg/TJ)



1A4b Residential – Solid Fuels (CH_4)

In 2015 CH_4 from solid fuels had a share of 1% within source category 1A4b (compared to 1.7% in 1990). Between 1990 and 2015 CH_4 emissions decreased by 70% (Table 3.91). All Member States reported decreasing emissions since 1990 with Germany, the Czech Republic and the United Kingdom showing the largest absolute decreases. Between 2014 and 2015, CH_4 emissions increased by 0.5%.

Table 3.92: 1A4b Residential, solid fuels: Member States' contributions to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	200	7	8	0.3%	1	12%	-192	-96%
Belgium	142	22	19	0.7%	-3	-13%	-123	-87%
Bulgaria	207	41	42	1.5%	1	1%	-165	-80%
Croatia	33	1	1	0.0%	0	-16%	-32	-98%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	967	223	226	8.1%	2	1%	-741	-77%
Denmark	6	0	NO	-	0	-100%	-6	-100%
Estonia	26	1	1	0.0%	-1	-40%	-26	-97%
Finland	3	0	0	0.0%	0	-9%	-3	-97%
France	269	20	39	1.4%	19	92%	-229	-85%
Germany	2 168	133	144	5.2%	12	9%	-2 024	-93%
Greece	7	1	2	0.1%	1	96%	-5	-75%
Hungary	621	32	30	1.1%	-2	-8%	-591	-95%
Ireland	197	69	65	2.3%	-4	-6%	-132	-67%
Italy	10	NO	NO	-	-	-	-10	-100%
Latvia	48	4	4	0.1%	0	-6%	-44	-92%
Lithuania	114	13	11	0.4%	-2	-18%	-103	-90%
Luxembourg	2	0	0	0.0%	0	28%	-2	-90%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	0	0	0	0.0%	0	-31%	0	-75%
Poland	2 172	1 991	1 952	70.1%	-39	-2%	-221	-10%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	212	20	25	0.9%	5	24%	-187	-88%
Slovakia	412	15	17	0.6%	3	17%	-395	-96%
Slovenia	25	0	0	0.0%	0	-11%	-25	-100%
Spain	116	33	32	1.1%	-1	-3%	-84	-72%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	1 215	173	169	6.1%	-4	-2%	-1 047	-86%
EU-28	**9 172**	**2 800**	**2 786**	**100%**	**-15**	**-1%**	**-6 386**	**-70%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	1 218	173	169	6.1%	-4	-2%	-1 049	-86%
EU-28 + ISL	**9 174**	**2 800**	**2 786**	**100%**	**-15**	**-1%**	**-6 388**	**-70%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.141 and

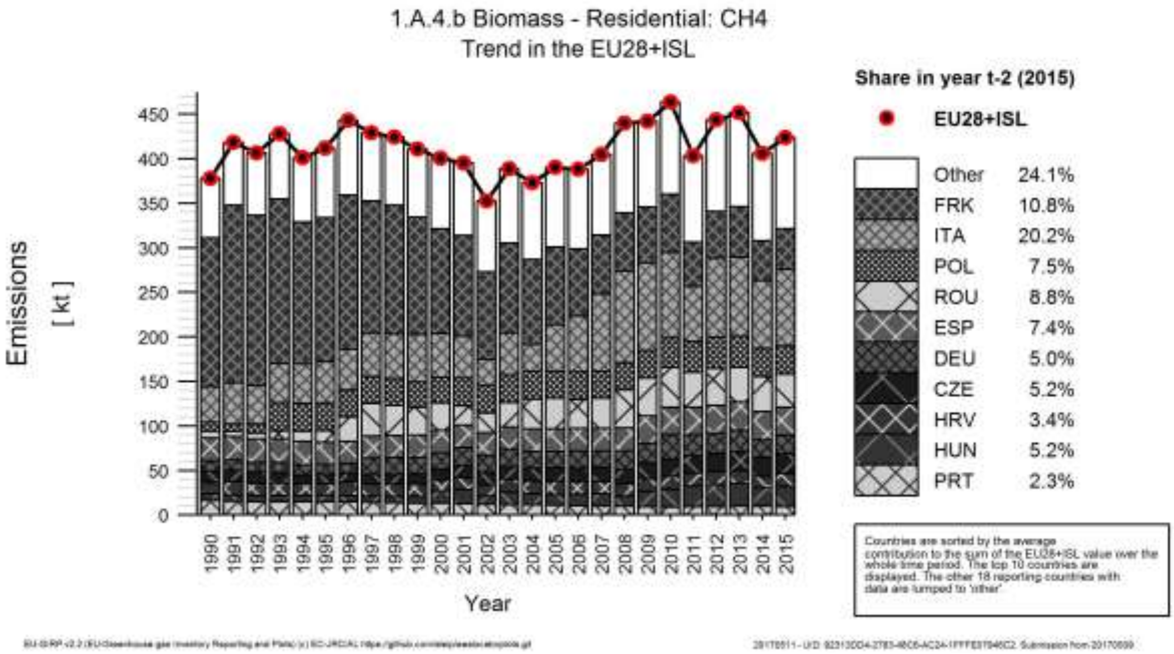


Figure 3.142 shows CH_4 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by Poland with a share of 70% of total CH_4 emissions from solid fuels in 1A4b. Solid fuel consumption in the EU-28 decreased by 73% between 1990 and 2015. The CH_4 implied emission factor for solid fuels was 295 kg/TJ in 2015.

Figure 3.143: 1A4b Residential, solid fuels: Emission trend and share for CH_4

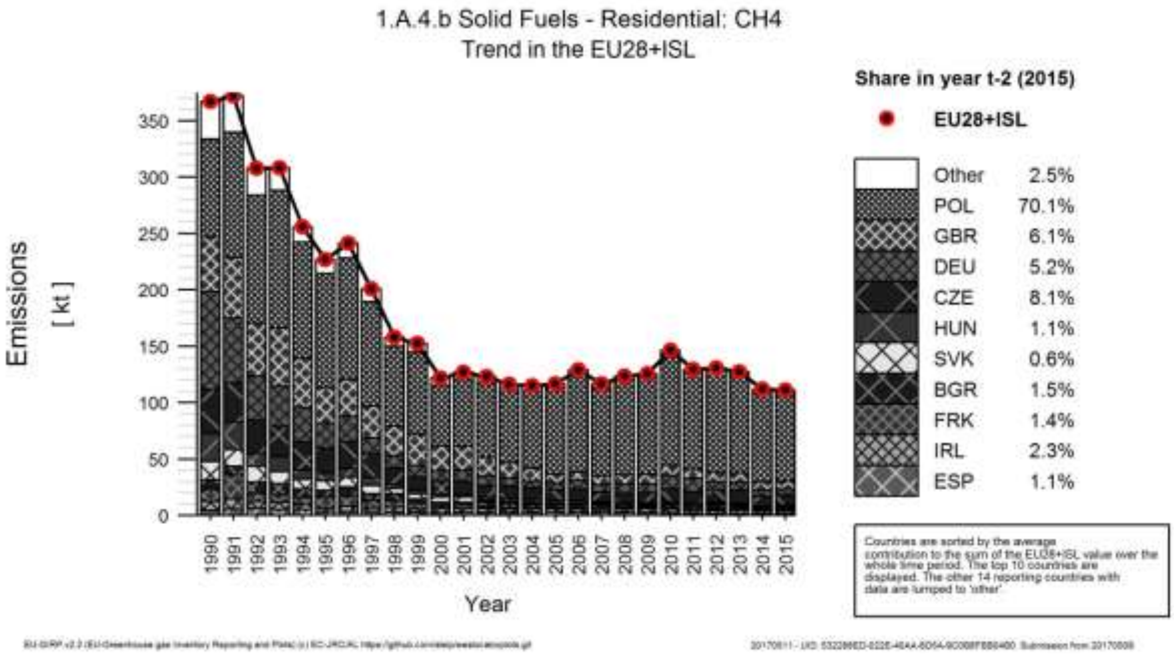
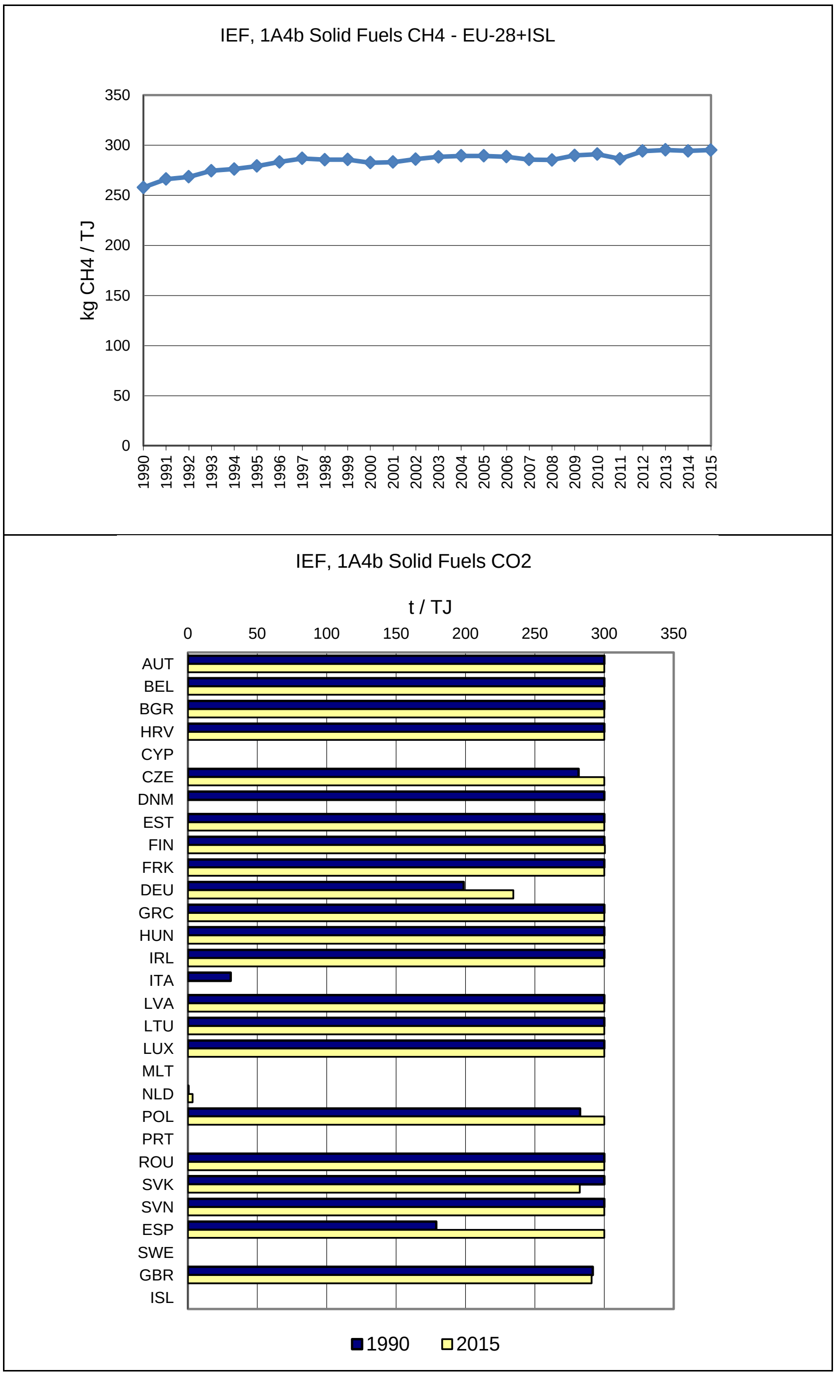


Table 3.93: 1A4b Residential, solid fuels: Implied Emission Factors for CH_4 (in kg/TJ)

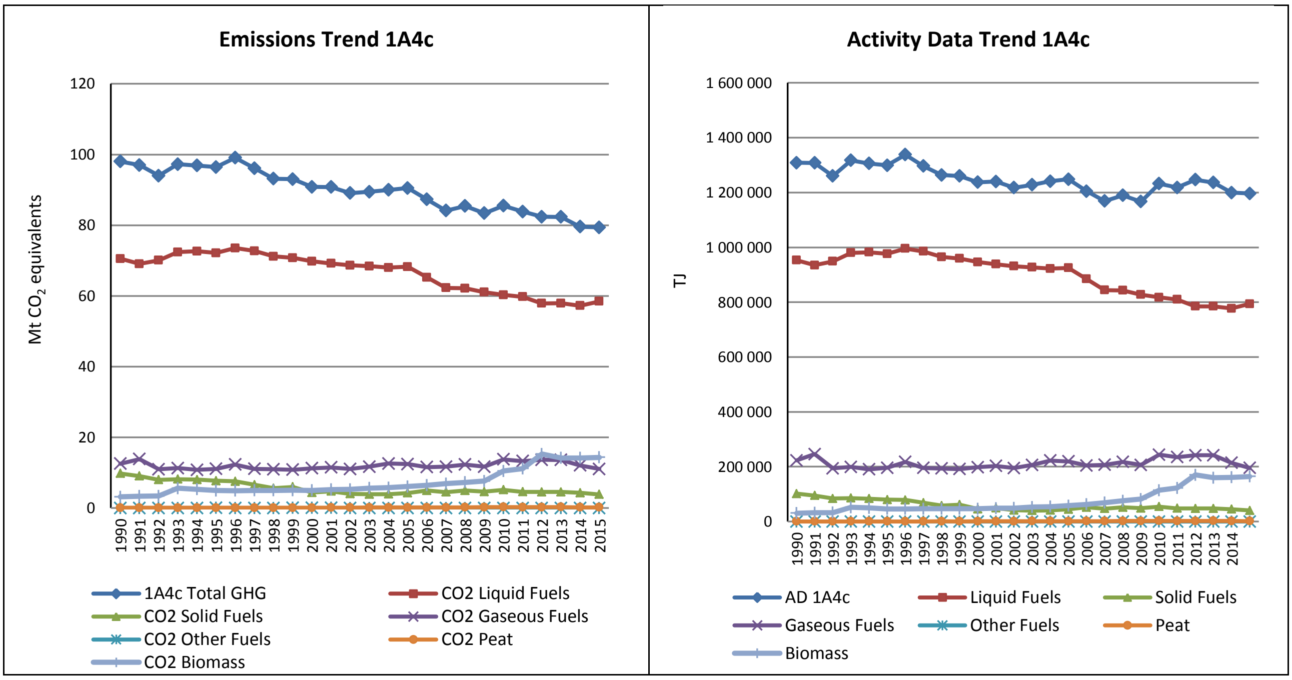


3.2.4.3 Agriculture/Forestry/Fisheries (1A4c)

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 2015. Between 1990 and 2015, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 21% in the EU-28+ISL (Table 3.94).

Figure 3.144 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 19%, mainly due to decreases in CO_2 emissions from liquid fuels (-17%).

Figure 3.144 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



The five Member States, France, Poland, Italy, the Netherlands and Spain together contributed 65% to the emissions from this source in 2015. Spain and Poland were the Member States with the highest increase in absolute terms between 1990 and 2015, while the highest decreases were achieved in the Czech Republic, Germany and Greece.

Table 3.94 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	1 253	811	805	1.1%	-6	-1%	-448	-36%	D,T1,T2,T3	CS,D
Belgium	2 971	1 794	1 971	2.7%	177	10%	-1 001	-34%	CS,T1,T3	D
Bulgaria	1 652	461	465	0.6%	4	1%	-1 188	-72%	T1,T2	CS,D
Croatia	835	634	633	0.9%	-1	0%	-202	-24%	T1	D
Cyprus	55	67	82	0.1%	16	23%	27	49%	T1	D
Czech Republic	3 790	1 238	1 192	1.6%	-46	-4%	-2 598	-69%	T1,T2	CS,D
Denmark	2 557	1 711	1 789	2.4%	79	5%	-768	-30%	CR,M,T1,T2,T3	CS,D
Estonia	495	307	318	0.4%	11	4%	-177	-36%	T1,T2	CS,D
Finland	1 863	1 373	1 335	1.8%	-39	-3%	-528	-28%	CS,M,T1,T2,T3	CS,D
France	10 815	11 159	11 055	15.0%	-104	-1%	240	2%	T1,T2	CS,D
Germany	10 270	5 606	5 812	7.9%	206	4%	-4 458	-43%	CS,T1,T2,T3	CS,D
Greece	2 893	469	499	0.7%	31	7%	-2 393	-83%	T1,T2	CS,D,NO
Hungary	2 656	1 382	1 351	1.8%	-32	-2%	-1 305	-49%	T1,T2	CS,D
Ireland	747	556	530	0.7%	-27	-5%	-217	-29%	T1,T2	CS,D
Italy	8 346	6 794	6 928	9.4%	135	2%	-1 418	-17%	T2	CS
Latvia	1 588	381	387	0.5%	6	2%	-1 201	-76%	T1,T2,T3	CS,D
Lithuania	1 482	214	195	0.3%	-19	-9%	-1 287	-87%	T2	CS
Luxembourg	34	23	24	0.0%	1	3%	-10	-30%	T1,T2	CS,D
Malta	4	18	17	0.0%	-1	-8%	13	306%	T1	D
Netherlands	9 848	8 724	9 029	12.3%	305	3%	-819	-8%	T1,T2	CS,D
Poland	8 508	9 764	9 304	12.7%	-460	-5%	796	9%	T1,T2	CS,D
Portugal	1 679	1 028	1 049	1.4%	21	2%	-630	-38%	T1,T2	CR,D
Romania	1 999	921	1 019	1.4%	98	11%	-980	-49%	T1,T2	CS,D
Slovakia	146	278	253	0.3%	-25	-9%	107	73%	T1,T2	CS,D
Slovenia	334	220	218	0.3%	-2	-1%	-116	-35%	T1	D
Spain	8 405	11 901	11 263	15.3%	-638	-5%	2 859	34%	T2,T3	CS,D,M,OTH
Sweden	1 624	1 311	1 324	1.8%	13	1%	-300	-18%	T1,T2	CS
United Kingdom	5 232	4 045	4 112	5.6%	67	2%	-1 121	-21%	T1,T2,T3	CS,D
EU-28	**92 083**	**73 190**	**72 959**	**99%**	**-231**	**0%**	**-19 124**	**-21%**	**-**	**-**
Iceland	772	565.6	546.0	0.743%	-19.5	-3%	-225	-29%	T1,T2	D
United Kingdom (KP)	5 232	4 045	4 112	5.6%	67	2%	-1 121	-21%	T1,T2,T3	CS,D
EU-28 + ISL	**92 855**	**73 756**	**73 505**	**100%**	**-250**	**0%**	**-19 350**	**-21%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2015 CO_2 from liquid fuels had a share of 73% within source category 1A4c (compared to 72% in 1990). Between 1990 and 2015 CO_2 decreased by 17% (Table 3.95). Six Member States reported increasing emissions with the highest increases in absolute terms in Spain, Poland and Romania. Between 2014 and 2015 EU-28+ISL emissions increased by 2%.

Table 3.95 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	1 182	783	774	1.3%	-9	-1%	-408	-35%
Belgium	2 692	996	1 073	1.8%	78	8%	-1 618	-60%
Bulgaria	1 498	389	401	0.7%	12	3%	-1 097	-73%
Croatia	788	592	592	1.0%	0	0%	-196	-25%
Cyprus	55	67	82	0.1%	16	23%	27	49%
Czech Republic	1 655	1 074	1 045	1.8%	-29	-3%	-609	-37%
Denmark	2 192	1 509	1 632	2.8%	123	8%	-560	-26%
Estonia	476	304	313	0.5%	9	3%	-163	-34%
Finland	1 777	1 213	1 188	2.0%	-25	-2%	-589	-33%
France	10 435	10 452	10 380	17.8%	-72	-1%	-56	-1%
Germany	6 926	4 934	5 140	8.8%	206	4%	-1 787	-26%
Greece	2 882	457	498	0.9%	40	9%	-2 384	-83%
Hungary	2 085	1 038	1 090	1.9%	52	5%	-995	-48%
Ireland	747	556	530	0.9%	-27	-5%	-217	-29%
Italy	8 294	6 505	6 597	11.3%	92	1%	-1 698	-20%
Latvia	701	324	342	0.6%	18	6%	-359	-51%
Lithuania	1 172	156	137	0.2%	-20	-13%	-1 035	-88%
Luxembourg	34	23	24	0.0%	1	3%	-10	-30%
Malta	4	18	17	0.0%	-2	-8%	12	305%
Netherlands	2 519	1 869	1 859	3.2%	-10	-1%	-659	-26%
Poland	4 709	5 647	5 589	9.6%	-58	-1%	879	19%
Portugal	1 679	1 010	1 029	1.8%	19	2%	-649	-39%
Romania	9	750	826	1.4%	76	10%	817	8722%
Slovakia	104	186	179	0.3%	-7	-4%	75	72%
Slovenia	334	220	218	0.4%	-2	-1%	-116	-35%
Spain	8 361	10 425	11 100	19.0%	675	6%	2 739	33%
Sweden	1 434	1 291	1 304	2.2%	13	1%	-129	-9%
United Kingdom	5 001	3 881	3 949	6.8%	67	2%	-1 052	-21%
EU-28	**69 746**	**56 670**	**57 907**	**99%**	**1 237**	**2%**	**-11 839**	**-17%**
Iceland	772	565.6	546.0	0.934%	-19.5	-3%	-225	-29%
United Kingdom (KP)	5 001	3 881	3 949	6.8%	67	2%	-1 052	-21%
EU-28 + ISL	**70 517**	**57 236**	**58 453**	**100%**	**1 217**	**2%**	**-12 064**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.145 and

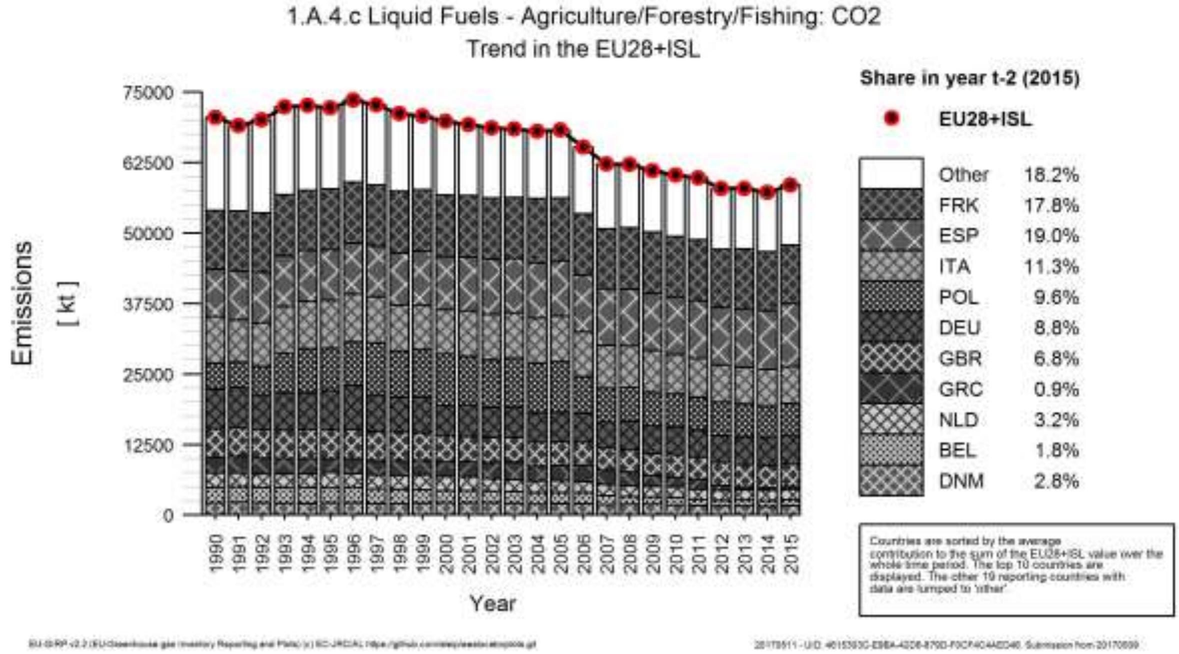


Figure **3.146** shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by France, Germany, Italy, Poland and Spain; together they cause 66% of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-28+ISL decreased by 17% between 1990 and 2015. The CO_2 implied emission factor for liquid fuels was 73.6 t/TJ in 2015.

Figure 3.145 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Emission trend and share for CO_2

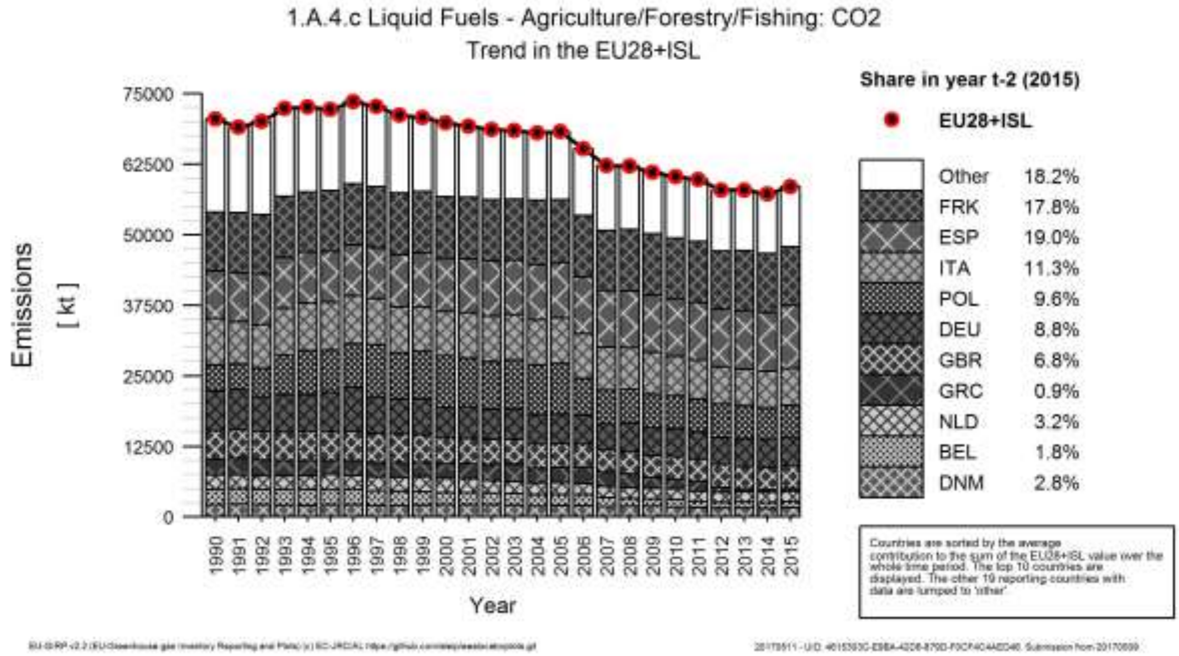
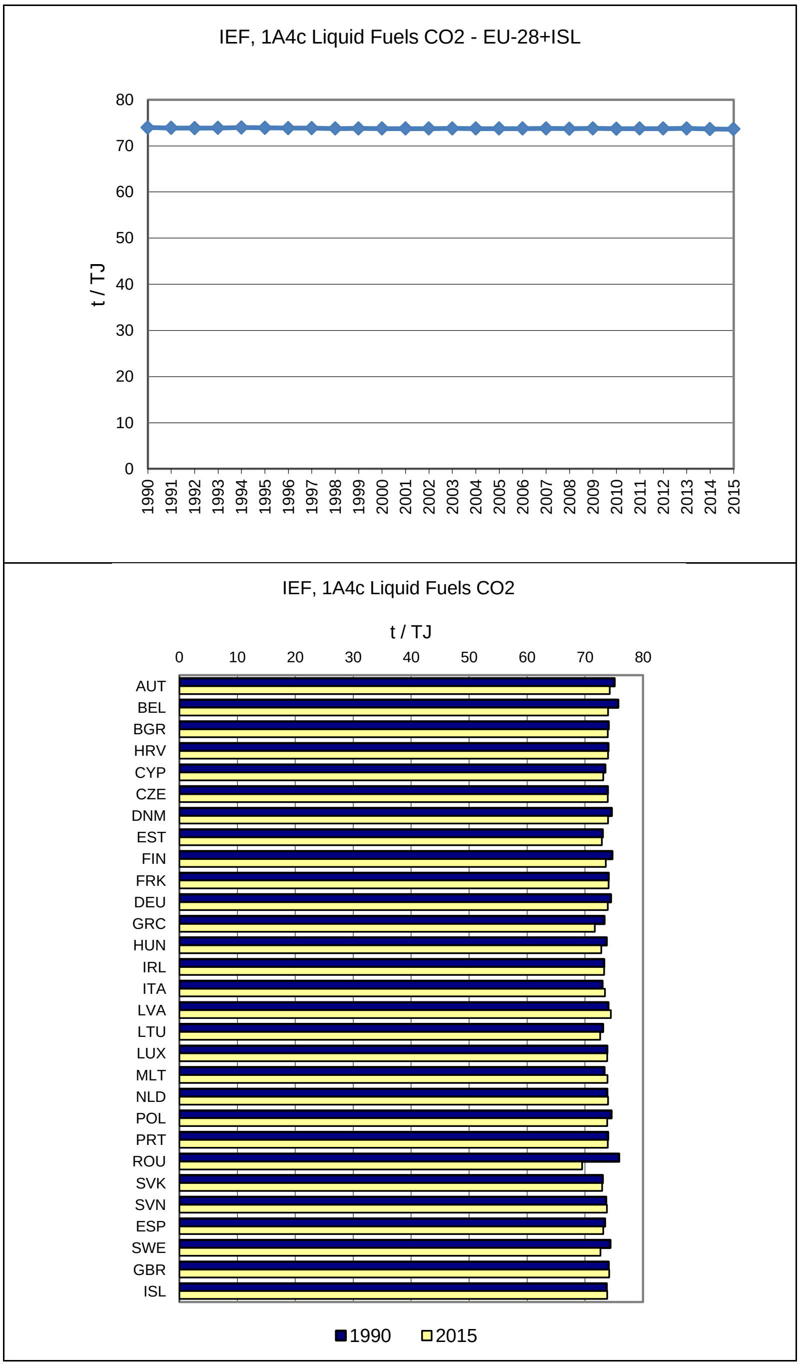


Figure 3.146 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)



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

In 2015 CO_2 from solid fuels had a share of 5% within source category 1A4c (compared to 10% in 1990). Between 1990 and 2015 CO_2 decreased by 61% (Table 3.96). Fifteen member states and Iceland reported CO_2 emissions from this source category as 'Not occurring' in 2015. All Member States except for Slovakia reported decreasing emissions between 1990 and 2015. Between 2014 and 2015 EU-28+ISL emissions decreased by 10%, mainly due to decreases reported by Poland. The strong decrease in 1990 to 1992 emissions is due to the reporting of Germany.

Table 3.96 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	51	2	2	0.1%	0	10%	-49	-96%
Belgium	212	35	35	0.9%	0	0%	-177	-84%
Bulgaria	151	23	27	0.7%	4	19%	-124	-82%
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	1 730	32	31	0.8%	-1	-2%	-1 699	-98%
Denmark	238	98	58	1.5%	-41	-41%	-180	-76%
Estonia	16	NO	NO	-	-	-	-16	-100%
Finland	13	8	8	0.2%	0	-1%	-5	-40%
France	NO	NO	NO	-	-	-	-	-
Germany	2 861	25	13	0.3%	-13	-50%	-2 848	-100%
Greece	11	11	2	0.0%	-10	-87%	-9	-86%
Hungary	134	NO	2	0.0%	2	∞	-132	-99%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Latvia	102	2	1	0.0%	-2	-71%	-102	-99%
Lithuania	148	8	8	0.2%	0	5%	-140	-94%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	3 773	4 037	3 651	95.1%	-385	-10%	-122	-3%
Portugal	NO	NO	NO	-	-	-	-	-
Romania	69	NO	NO	-	-	-	-69	-100%
Slovakia	1	3	3	0.1%	-1	-16%	2	109%
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	**9 755**	**4 285**	**3 840**	**100%**	**-445**	**-10%**	**-5 915**	**-61%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	50	NO	NO	-	-	-	-50	-100%
EU-28 + ISL	**9 755**	**4 285**	**3 840**	**100%**	**-445**	**-10%**	**-5 915**	**-61%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.147 and Figure 3.148 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 2015. Fuel consumption in the EU-28+ISL decreased by 60% between 1990 and 2015. The CO_2 implied emission factor for solid fuels was 94.8 t/TJ in 2015.

Figure 3.147 1A4c Agriculture/Forestry/Fisheries, solid fuels: Emission trend and share for CO_2

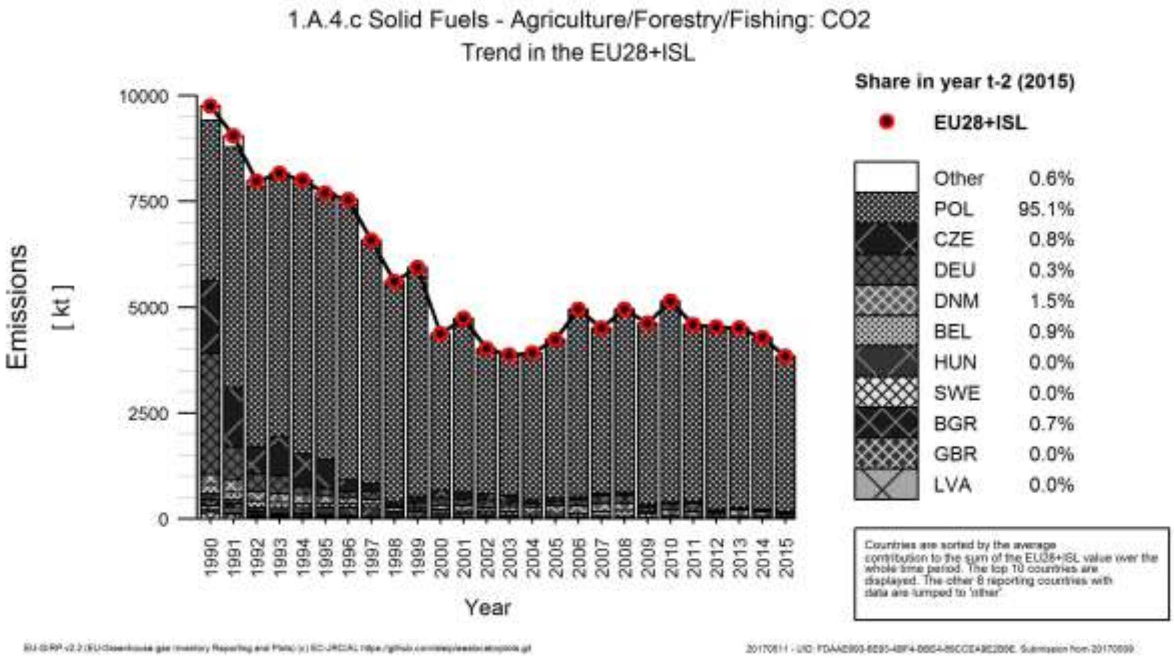
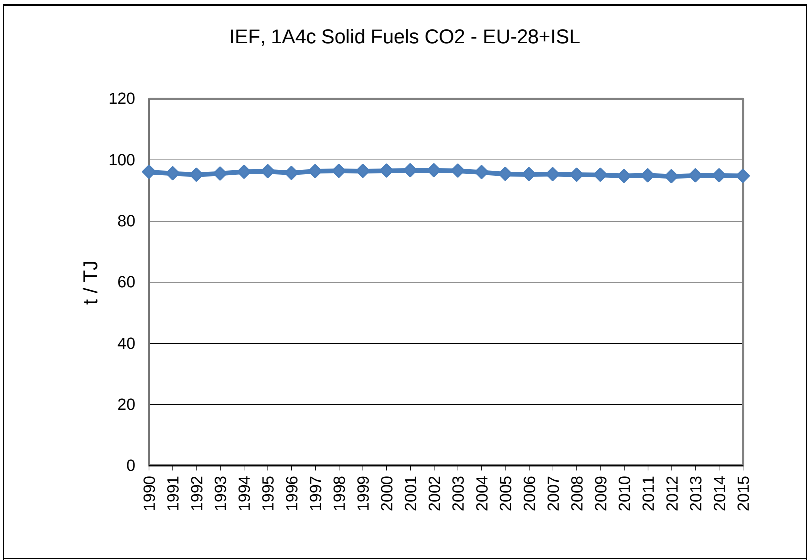
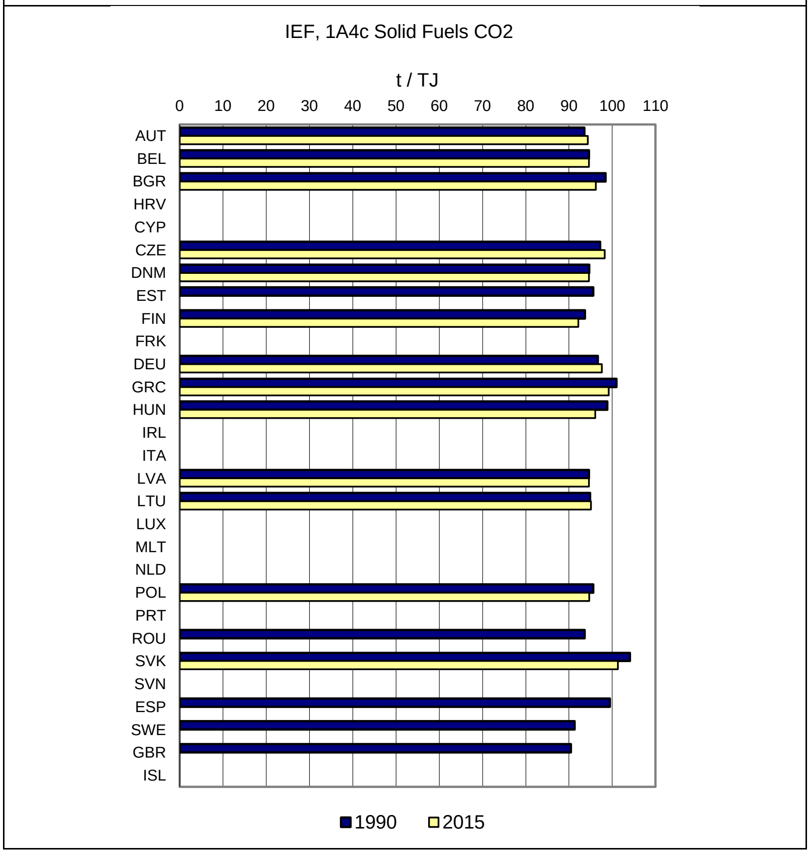


Figure 3.148 1A4c Agriculture/Forestry/Fisheries, solid fuels: Implied Emission Factors for CO_2 (in t/TJ)





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

In 2015, CO_2 from gaseous fuels had a share of 14% within source category 1A4c (compared to 13% in 1990). Between 1990 and 2015 CO_2 emissions decreased by 12% (Table 3.97). The highest increase occurred in Spain (+2493%). Between 2014 and 2015 EU-28+ISL emissions decreased by 8%.

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

Table 3.97 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	20	26	29	0.3%	3	10%	9	42%
Belgium	67	763	863	7.8%	99	13%	795	1180%
Bulgaria	3	49	36	0.3%	-13	-27%	33	1001%
Croatia	48	42	42	0.4%	-1	-1%	-6	-13%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	405	131	115	1.0%	-16	-12%	-290	-72%
Denmark	126	103	100	0.9%	-4	-3%	-27	-21%
Estonia	4	3	5	0.0%	2	79%	1	39%
Finland	32	3	2	0.0%	-1	-24%	-30	-93%
France	380	707	675	6.1%	-32	-4%	296	78%
Germany	483	647	659	6.0%	12	2%	177	37%
Greece	IE,NO	NO,IE	NO,IE	-	-	-	-	-
Hungary	437	344	259	2.3%	-85	-25%	-178	-41%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	52	289	332	3.0%	43	15%	280	543%
Latvia	782	55	45	0.4%	-11	-19%	-738	-94%
Lithuania	162	48	48	0.4%	0	1%	-114	-70%
Luxembourg	NO	0	0	0.0%	0	3%	0	∞
Malta	NO,IE	0	0	0.0%	0	85%	0	∞
Netherlands	7 329	6 855	7 170	65.0%	315	5%	-159	-2%
Poland	25	81	64	0.6%	-16	-20%	39	155%
Portugal	NO	18	20	0.2%	1	6%	20	∞
Romania	1 920	140	157	1.4%	17	12%	-1 763	-92%
Slovakia	41	88	72	0.6%	-17	-19%	31	76%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	6	1 476	163	1.5%	-1 313	-89%	157	2493%
Sweden	33	20	20	0.2%	0	-2%	-14	-41%
United Kingdom	182	163	163	1.5%	0	0%	-19	-10%
EU-28	**12 539**	**12 053**	**11 037**	**100%**	**-1 016**	**-8%**	**-1 501**	**-12%**
Iceland	NO	NO	NO	-	-	-	-	-
United Kingdom (KP)	182	163	163	1.5%	0	0%	-19	-10%
EU-28 + ISL	**12 539**	**12 053**	**11 037**	**100%**	**-1 016**	**-8%**	**-1 501**	**-12%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Greece reports emissions from stationary combustion and off road machinery as 'NO' and emissions from fishing as 'IE.'

Figure 3.149 and

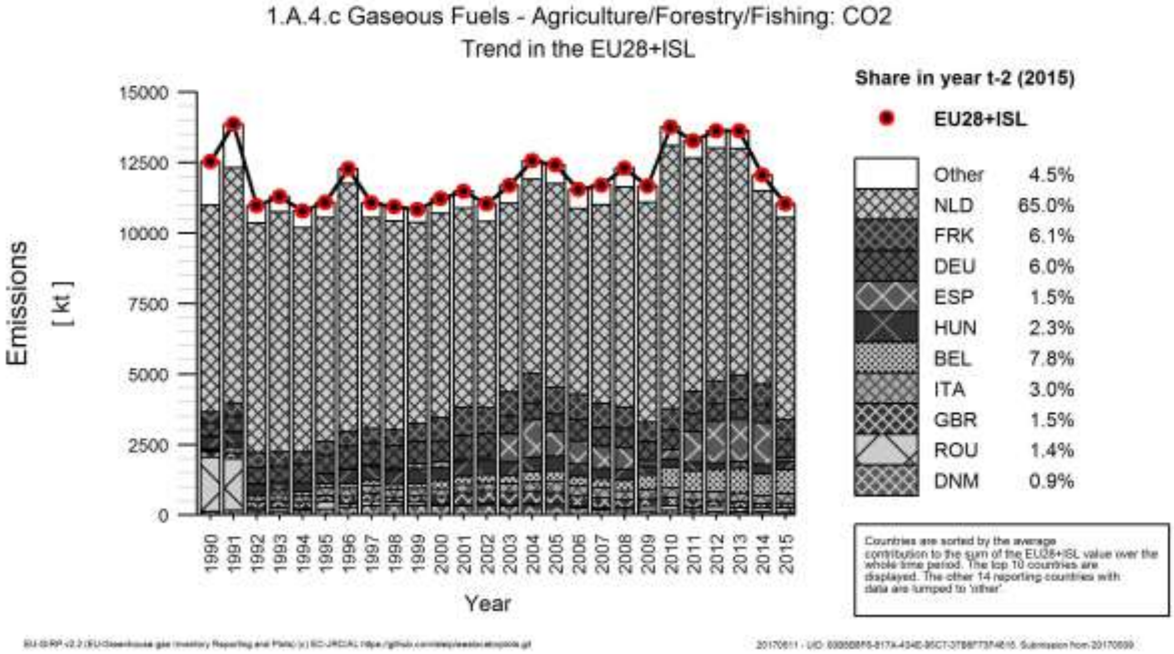


Figure 3.150 shows CO_2 emissions and implied emission factors for EU-28+ISL as well as the share of the Member States with the highest contributions. The largest emissions are reported by the Netherlands, France and Germany, accounting for 77% of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-28+ISL decreased by 12% between 1990 and 2015. The CO_2 implied emission factor for gaseous fuels was 56.4 t/TJ in 2015. The comparatively high IEF of Malta is because LPG is included under gaseous fuels.

Figure 3.149 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Emission trend and share for CO_2

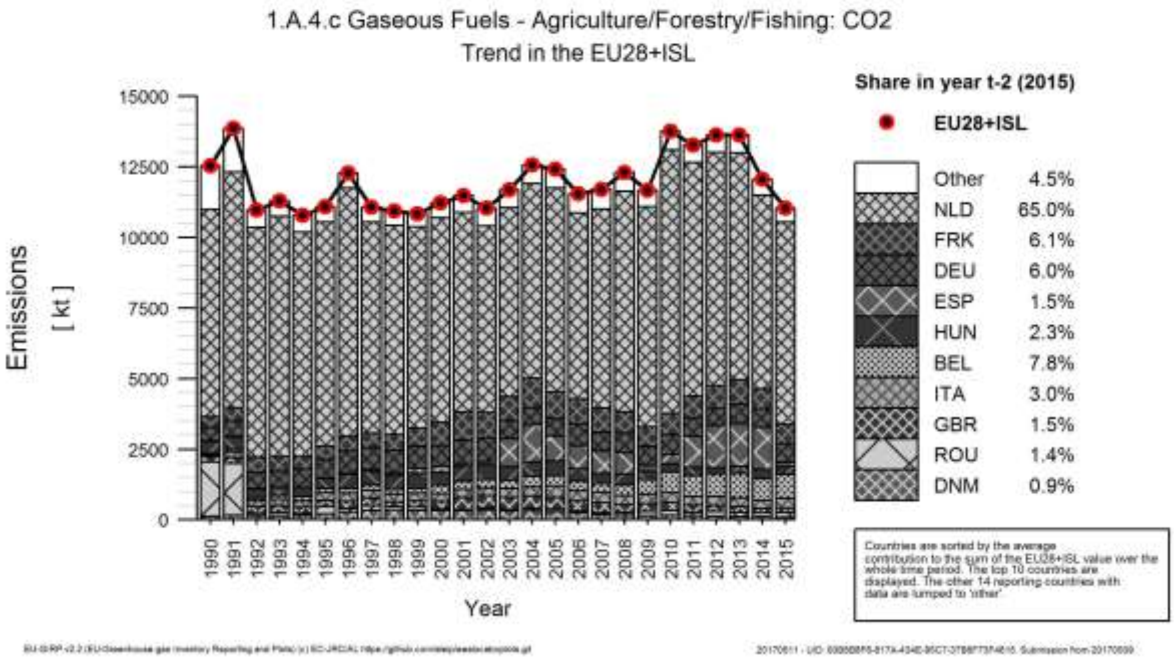
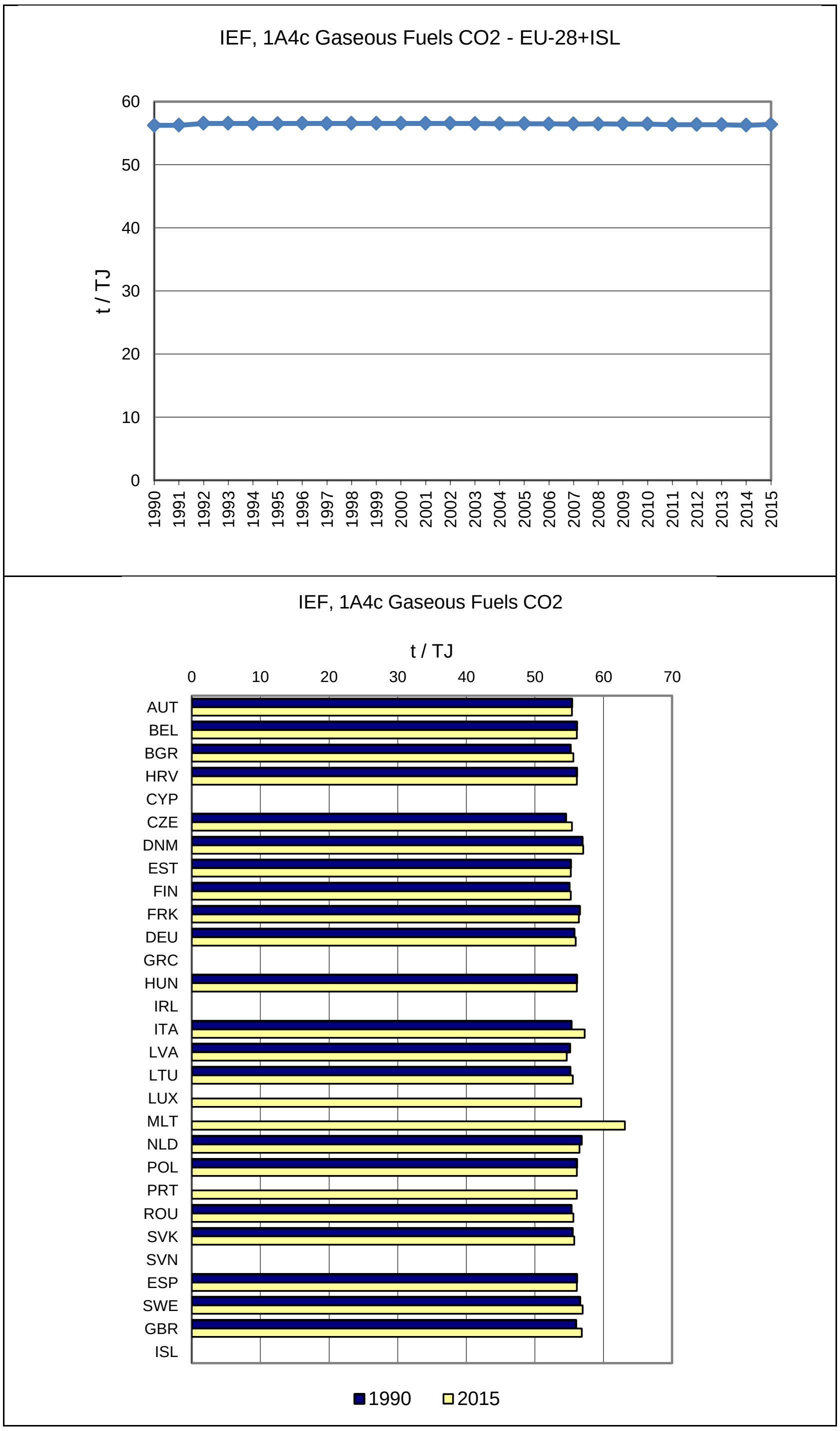


Figure 3.150 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Implied Emission Factors for CO_2 (in t/TJ)



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 6 990 kt CO_2 equivalents of which 98.2% CO_2, 0.6% CH_4 and 1.1% N_2O.:

Table 3.98: Key categories for sector 1A5 (Table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 A 5 a Other Other Sectors: Solid Fuels (CO_2)	5983	10	T	0	0
1 A 5 b Other Other Sectors: Liquid Fuels (CO_2)	13804	4828	T	L	0

Table 3.99 provides an overview of Member States' source allocation to Source Category 1A5 Other as reported in CRF Table1.A(a)s4.

Table 3.99 1A5 Other: Member States' allocation of sources

Member State	Source allocation to 1A5 Other
Austria	Stationary: Emissions are 'Not occurring' Mobile: Military use
Belgium	Stationary: Emissions are 'Not occurring' Mobile: Military use
Bulgaria	Emissions are 'Not occurring'
Croatia	Emissions are 'Not occurring'
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-specified Mobile: other non-specified: Emissions are ‚Included elsewhere'
France	Emissions are 'Not occurring'
Germany	Military: stationary and mobile
Greece	Mobile: Military use
Hungary	Mobile: Military use
Ireland	Emissions are 'Included elsewhere'
Iceland	No data.
Italy	Stationary: Emissions are 'Not occurring' Mobile (no further specification)
Latvia	Mobile (no further specification)
Lithuania	Mobile: Military use
Luxembourg	Mobile: Unspecified mobile
Malta	Mobile: Military use of fuels
Netherlands	Stationary: Emissions are 'Not occurring' Mobile: military use
Poland	Stationary: Emissions are 'Included elsewhere' Mobile: Emissions are 'Not occurring'
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 occurring'
Slovakia	Stationary: Other Mobile: Military use Jet Kerosene
Slovenia	Stationary: Emissions are 'Not occurring' Mobile: Military use of fuels
Spain	Mobile: Military use of fuels

Member State	Source allocation to 1A5 Other
Sweden	Stationary: Emissions are 'Not occurring' Mobile: Military use
United Kingdom	Stationary: Emissions are 'Included elsewhere' Mobile: Military aviation and naval shipping

Figure 3.151 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 70% between 1990 and 2015. 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 29% to CO_2 emissions in 2015. The United Kingdom reports military aircraft and naval vessels within this category.

Figure 3.151 1A5 Other: Total and CO_2 emission and activity trends

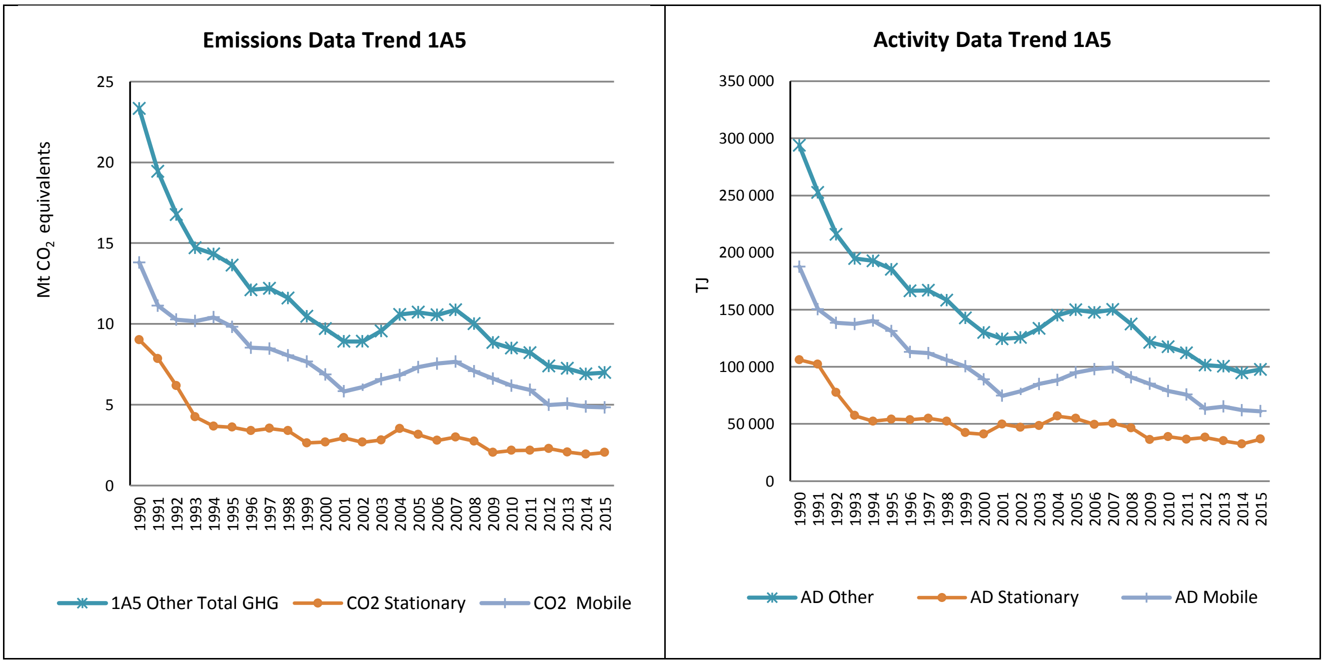


Table 3.100 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.16% of total EU-28+ISL GHG emissions in 2015. Between 1990 and 2015, CO_2 emissions from this source decreased by 70% in the EU-28+ISL. Between 1990 and 2015 the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.100 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)
Austria	36	50	35	49
Belgium	173	100	172	99
Bulgaria	30	62	30	62
Croatia	0	0	NO,IE	NO,IE
Cyprus	11	22	11	22
Czech Republic	0	381	NO	369
Denmark	170	199	167	197
Estonia	44	27	43	27
Finland	1 136	1 106	1 124	1 096
France	0	0	NO	NO
Germany	12 138	982	11 797	976
Greece	0	208	NO,IE	206
Hungary	14	18	14	18
Ireland	0	0	IE	IE
Italy	1 142	478	1 070	459
Latvia	0	10	NO,NE	10
Lithuania	0.4	36	0.4	36
Luxembourg	3	0.13	3	0.1
Malta	3	4	3	4
Netherlands	318	178	312	175
Poland	0	0	NO,IE	NO,IE
Portugal	105	77	105	76
Romania	1 220	461	1 212	421
Slovakia	415	48	413	47
Slovenia	32	4	32	4
Spain	152	343	151	340
Sweden	863	191	846	188
United Kingdom	5 336	2 004	5 285	1 985
EU-28	**23 343**	**6 990**	**22 825**	**6 866**
Iceland	0	0	NO,NA	-
United Kingdom (KP)	5 336	2 004	5 285	1 985
EU-28 + ISL	**23 343**	**6 990**	**22 825**	**6 866**

Croatia reports 'IE' for liquid fuels because 'Data on disaggregated level are not available'.
Poland reports emissions from stationary combustion as 'IE' without specification of the allocation.
Ireland includes emissions of military use stationary combustion in 1A4a and mobile military use is included in 1A3
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.101 provides information on the contribution of Member States to EU-28 recalculations in CO_2 from 1A5 Other for 1990 and 2015 and main explanations for the largest recalculations in absolute terms.

Table 3.1011A5 Other: Contribution of MS to EU-28 recalculations in CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

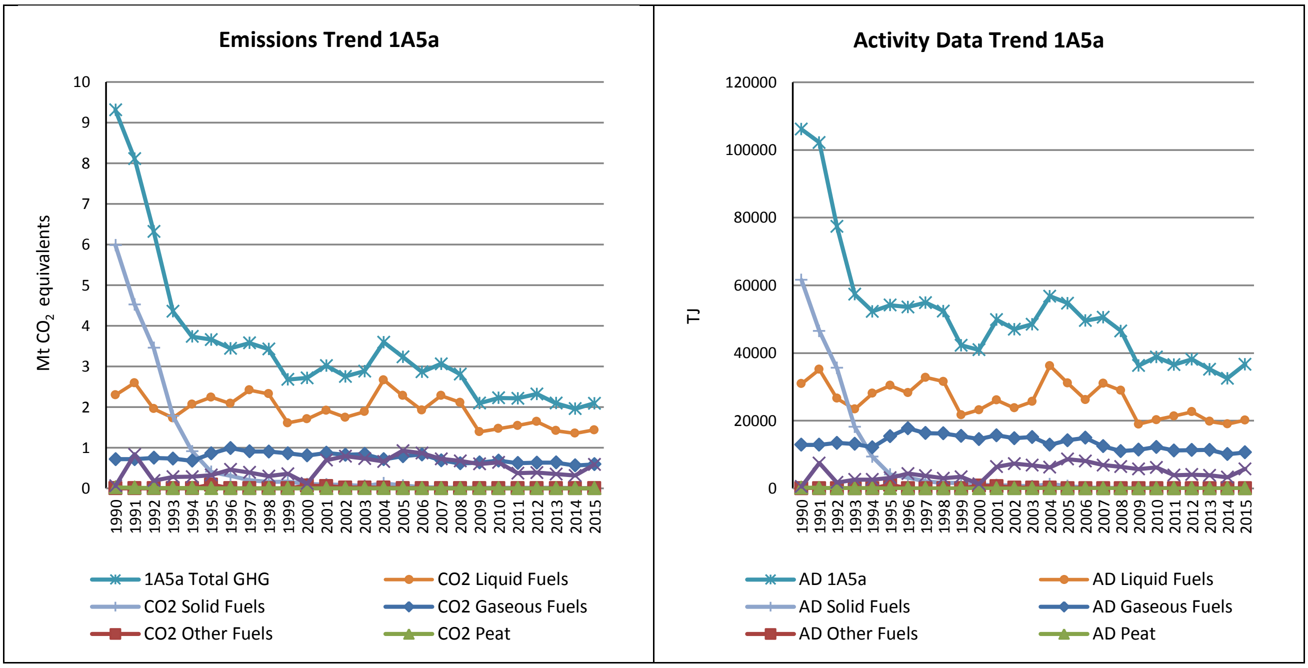
	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	5	2.8	65	192.1	Switch from 1996 to 2006 Guidelines. Correction of offroad. Revision of military aviation dur to new transport model.
Bulgaria	0	-0.1	0	0.0	
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	-22	-6.7	updated activity data available and emission factors, explanation provided in NIR
Denmark	0	0.0	0	0.0	
Estonia	0	-0.1	0	-0.1	Oxidation factors have been updated and the carbon conversion factor for CO_2 emission factors has been specified.
Finland	-3	-0.2	-97	-8.6	Updates in other categories are reflected here. Statistical corrections in total consumption of residual fuel oil and gasoil
France	0	0.0	0	0.0	
Germany	0	0.0	-34	-3.3	Actual data from military services.
Greece	0	0.0	189	100.0	NonETS aviation emissions were reallocated from 1A3 category.
Hungary	14	100.0	18	100.0	Military aviation reported for the first time
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	-23	-88.3	0	100.0	revised AD in 1A5b
Malta	3	100.0	4	100.0	No NIR provided
Netherlands	-135	-30.2	-56	-23.7	Final fuel data for 2014
Poland	0	0.0	0	0.0	
Portugal	1	0.8	1	1.0	Revised CO_2 EF.
Romania	-20	-1.7	-16	-4.1	Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for 1A5 category. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A5 categories.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	151	100.0	320	100.0	This category includes emissions due to military traffic, both aerial and wheeled. This edition of the inventory excludes

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					these emissions from the categories 1A3a and 1A3b, following the recommendations of the ESD and UNFCCC reviews of 2016.
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	0	0.0	
EU28	-8	0.0	371	5.8	
Iceland	0	0.0	0	0.0	
EU28+ISL	-8	0.0	371	5.8	

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 2015. Figure 3.152 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 70%, mainly due to decreases in emissions from solid fuels (-100%) and liquid fuels (-37%).

Figure 3.152 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 2015 (Table 3.102). Between 1990 and 2015

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 2015 CO_2 emissions increased by 6%.

Table 3.102 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	30	3	62	3.0%	59	1900%	32	110%	T1,T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	11	35	22	1.1%	-13	-36%	11	103%	T1	D
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 124	1 039	1 096	53.8%	57	5%	-28	-2%	T1	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	6 227	413	391	19.2%	-21	-5%	-5 836	-94%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	-	-	-	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-	NA	NA
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	-	-	-	-	-	NA	NA
Portugal	8	NO	NO	-	-	-	-8	-100%	NA	NA
Romania	1 212	385	421	20.7%	36	9%	-790	-65%	T1,T2	CS,D
Slovakia	406	51	46	2.2%	-5	-10%	-360	-89%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NO,IE	NO,IE	NO,IE	-	-	-	-	-	NA	NA
Sweden	NO	NO	-	-	-	-	-	-	NA	NA
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28	**9 020**	**1 925**	**2 039**	**100%**	**113**	**6%**	**-6 982**	**-77%**	**-**	**-**
Iceland	NO	-	-	-	-	-	-	-	-	-
United Kingdom (KP)	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28 + ISL	**9 020**	**1 925**	**2 039**	**100%**	**113**	**6%**	**-6 982**	**-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 0.5% within source category 1A5a (compared to 64% in 1990). Between 1990 and 2015, CO_2 decreased by nearly 100% (Table 3.103). In 2015 only Germany and Slovakia reported emissions for this key source.

Spain reports, that military reference activity data are not separated from civil data and that those emissions are estimated together in 1A4ai by applying the same methodology.

The United Kingdom reports, that stationary combustion for military purposes is not reported separately in UK energy statistics and that it is allocated under 1A4a.

Table 3.103 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	30	NO	NO	-	-	-	-30	-100%
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
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	67%	0	-5%	-4 546	-100%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	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	IE	-	-	-	-	-
Portugal	8	NO	NO	-	-	-	-8	-100%
Romania	1 174	NO	NO	-	-	-	-1 174	-100%
Slovakia	216	2	3	33%	1	48%	-213	-99%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	IE	IE	IE	-	-	-	-	-
Sweden	NO	NO	-	-	-	-	-	-
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-28	**5 983**	**9**	**10**	**100%**	**1**	**7%**	**-5 973**	**-100%**
Iceland	NO	-	-	-	-	-	-	-
United Kingdom (KP)	IE	IE	IE	-	-	-	-	-
EU-28 + ISL	**5 983**	**9**	**10**	**100%**	**1**	**7%**	**-5 973**	**-100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.153 shows CO_2 emissions for EU-28 and the Member States. Germany accounts for 67% of EU-28 CO_2 emissions from this source category. Fuel combustion in the EU-28+ISL decreased by 99.8% between 1990 and 2015. The CO_2 implied emission factor for solid fuels was 97.7 t/TJ in 2015.

Figure 3.153 1A5a Stationary, solid fuels: Emission trend and share for CO_2

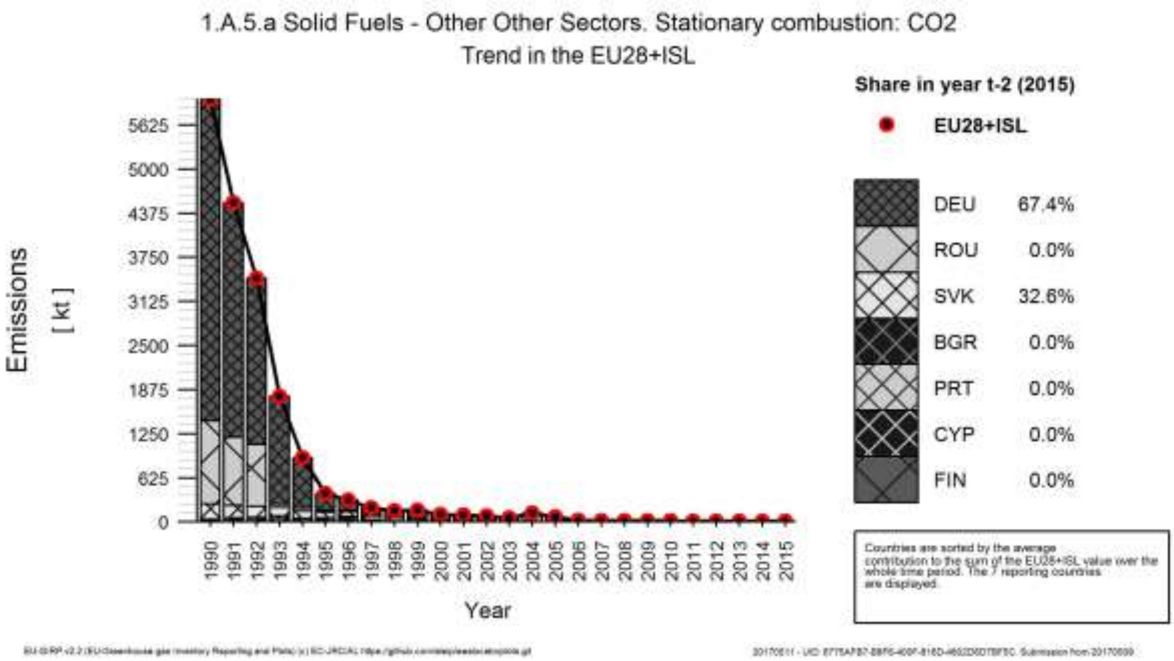
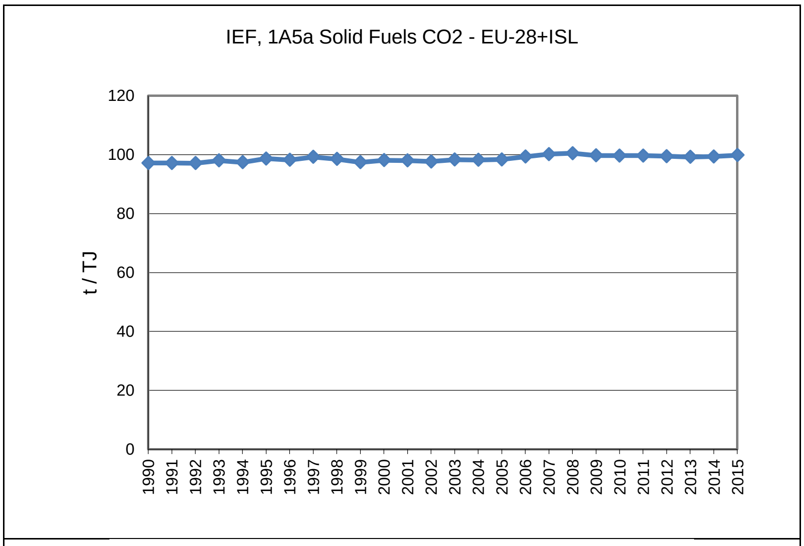
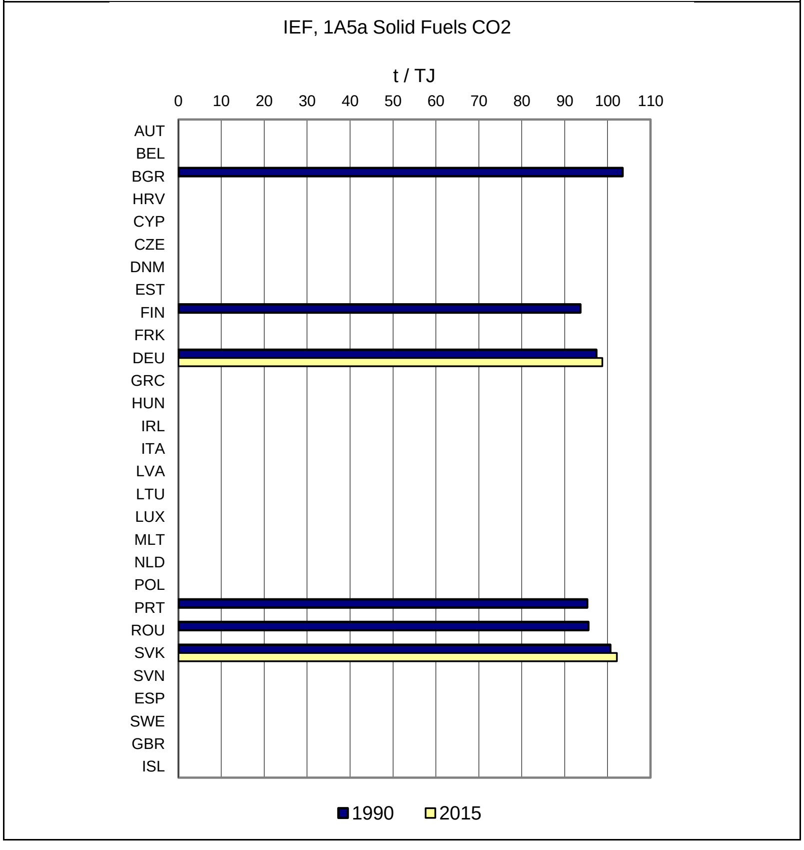


Figure 3.154 1A5a Stationary, solid fuels: Implied Emission Factors for CO_2 (in t/TJ)

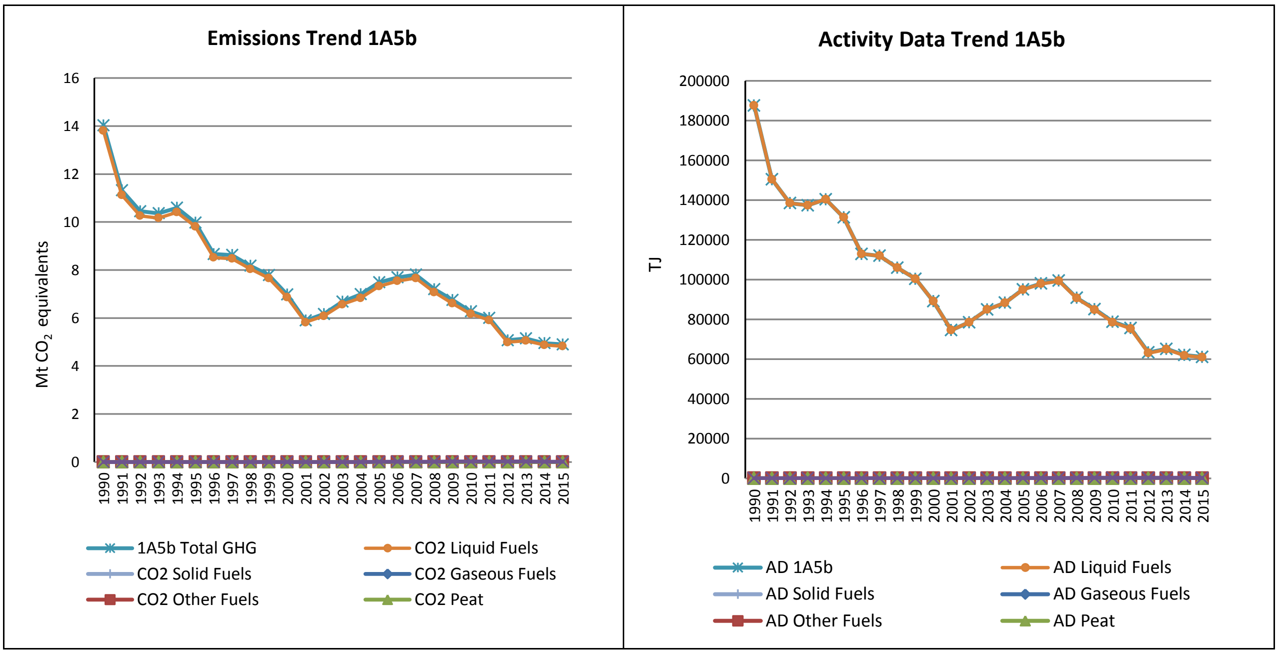




3.2.5.2 **Mobile (1A5b)**

In this chapter information about emission trends, Member States' contribution and activity data is provided for category 1A5b by fuels. CO_2 emissions from 1A5b Mobile accounted for 0.1% of total EU-28+ISL GHG emissions in 2015. Figure 3.155 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 65%.

Figure 3.155 1A5b Mobile: Total and CO_2 emission trends



Eight Member States and Iceland reported emissions as ‘Not occurring’ or "Included elsewhere". The United Kingdom had the highest emissions in 2015 and – together with Germany - decreased the most in absolute terms between 1990 and 2015. Between 2014 and 2015 Italy had the highest absolute decrease. The EU-28+ISL emissions decreased by 1% between 2014 and 2015 (Table 3.104).

Croatia reports emissions from military aviation in category 1A3a and emissions from military naval vessels under category 1A3d.

Table 3.104 1A5b Mobile: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	35	49	49	1.0%	1	1%	14	40%	T1,T2	CS,D
Belgium	172	99	99	2.1%	0	0%	-72	-42%	T1	D
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO,IE	NO,IE	NO,IE	-	-	-	-	-	NA	NA
Cyprus	-	-	-	-	-	-	-	-	-	-
Czech Republic	NO	309	369	7.6%	59	19%	369	∞	T1	D
Denmark	167	230	197	4.1%	-34	-15%	30	18%	CR,T2	CS
Estonia	43	33	27	0.6%	-6	-18%	-17	-38%	T2	CS
Finland	NO,IE	NO,IE	NO,IE	-	-	-	-	-	NA	NA
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	5 570	570	585	12%	15	3%	-4 986	-90%	CS,D,M	CS,D,M
Greece	NO,IE	189	206	4.3%	18	9%	206	∞	T1	D
Hungary	14	18	18	0.4%	0	0%	4	25%	T1	D
Ireland	IE	IE	IE	-	-	-	-	-	NA	NA
Italy	1 070	573	459	9.5%	-114	-20%	-611	-57%	T2	CS
Latvia	NO,NE	9	10	0.2%	0	1%	10	∞	T1	D
Lithuania	0	35	36	0.7%	1	3%	36	9871%	T2	CS
Luxembourg	0	0	0	0.0%	0	0%	0	-4%	NA	NA
Malta	3	4	4	0.1%	1	14%	2	66%	NA	NA
Netherlands	312	182	175	3.6%	-7	-4%	-137	-44%	T2	CS
Poland	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	96	69	76	1.6%	7	11%	-20	-21%	-	-
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	7	1	2	0%	0	25%	-5	-76%	T2	D
Slovenia	32	4	4	0.1%	0	-1%	-28	-88%	T1	D
Spain	151	320	340	7.0%	20	6%	189	125%	T1,T2,T3	D,M
Sweden	846	164	188	3.9%	24	15%	-658	-78%	T1,T2	CS
United Kingdom	5 285	2 019	1 985	41.1%	-35	-2%	-3 300	-62%	T1	CS
EU-28	**13 804**	**4 877**	**4 828**	**100%**	**-49**	**-1%**	**-8 976**	**-65%**	**-**	**-**
Iceland	NA	-	-	-	-	-	-	-	-	-
United Kingdom (KP)	5 285	2 019	1 985	41.1%	-35	-2%	-3 300	-62%	T1	CS
EU-28 + ISL	**13 804**	**4 877**	**4 828**	**100%**	**-49**	**-1%**	**-8 976**	**-65%**	**-**	**-**

Finland reports emissions from military activities in category 1A5a for reasons of confidentiality.
Ireland reports emission from military activities in category 1A3.
Croatia reports 'IE' for liquid fuels because 'Data on disaggregated level are not available'.
Poland reports emissions from stationary combustion as 'IE' without specification of the allocation.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2015, CO_2 from liquid fuels had a share of 99% within source category 1A5b (compared to 98% in 1990). Between 1990 and 2015 CO_2 decreased by 65% (Table 3.105). Twenty Member States reported emissions in 2015 while other Member States report emissions as 'Not occurring' or 'Included Elsewhere'. 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 3.105 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	35	49	49	1.0%	1	1%	14	40%
Belgium	172	99	99	2.1%	0	0%	-72	-42%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	IE	IE	IE	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	309	369	7.6%	59	19%	369	∞
Denmark	167	230	197	4.1%	-34	-15%	30	18%
Estonia	43	33	27	0.6%	-6	-18%	-17	-38%
Finland	IE	IE	IE	-	-	-	-	-
France	NO	NO	NO	-	-	-	-	-
Germany	5 570	570	585	12%	15	3%	-4 986	-90%
Greece	IE	189	206	4.3%	18	9%	206	∞
Hungary	14	18	18	0.4%	0	0%	4	25%
Ireland	IE	IE	IE	-	-	-	-	-
Italy	1 070	573	459	9.5%	-114	-20%	-611	-57%
Latvia	NE	9	10	0.2%	0	1%	10	∞
Lithuania	0	35	36	0.7%	1	3%	36	9871%
Luxembourg	0	0	0	0.0%	0	0%	0	-4%
Malta	3	4	4	0.1%	1	14%	2	66%
Netherlands	312	182	175	3.6%	-7	-4%	-137	-44%
Poland	NO	NO	NO	-	-	-	-	-
Portugal	96	69	76	1.6%	7	11%	-20	-21%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	7	1	2	0%	0	25%	-5	-76%
Slovenia	32	4	4	0.1%	0	-1%	-28	-88%
Spain	151	320	340	7.0%	20	6%	189	125%
Sweden	846	164	188	3.9%	24	15%	-658	-78%
United Kingdom	5 285	2 019	1 985	41.1%	-35	-2%	-3 300	-62%
EU-28	**13 804**	**4 877**	**4 828**	**100%**	**-49**	**-1%**	**-8 976**	**-65%**
Iceland	NA	-	-	-	-	-	-	-
United Kingdom (KP)	5 285	2 019	1 985	41.1%	-35	-2%	-3 300	-62%
EU-28 + ISL	**13 804**	**4 877**	**4 828**	**100%**	**-49**	**-1%**	**-8 976**	**-65%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.156 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 63% of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-28+ISL decreased by 68% between 1990 and 2015. The CO_2 implied emission factor for liquid fuels was 79.3 t/TJ in 2015. The high 2015 implied emission factor of Belgium is due to incorrect activity data reported by the Flemish region.

Figure 3.156 1A5b Mobile, liquid fuels: Emission trend and share for CO_2

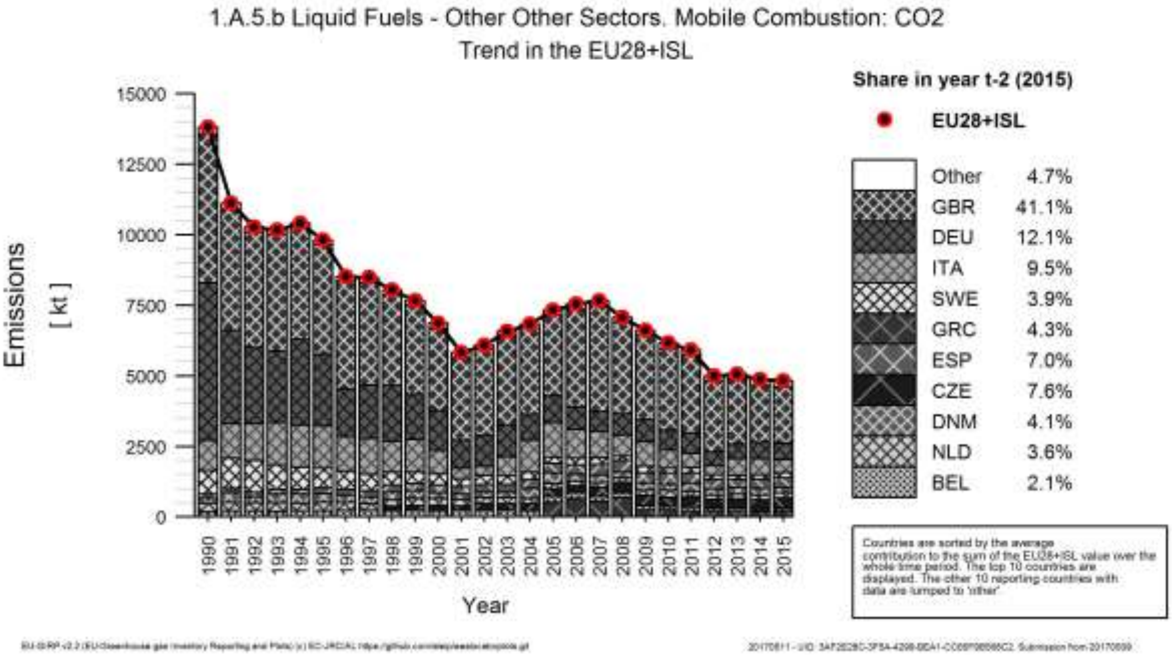
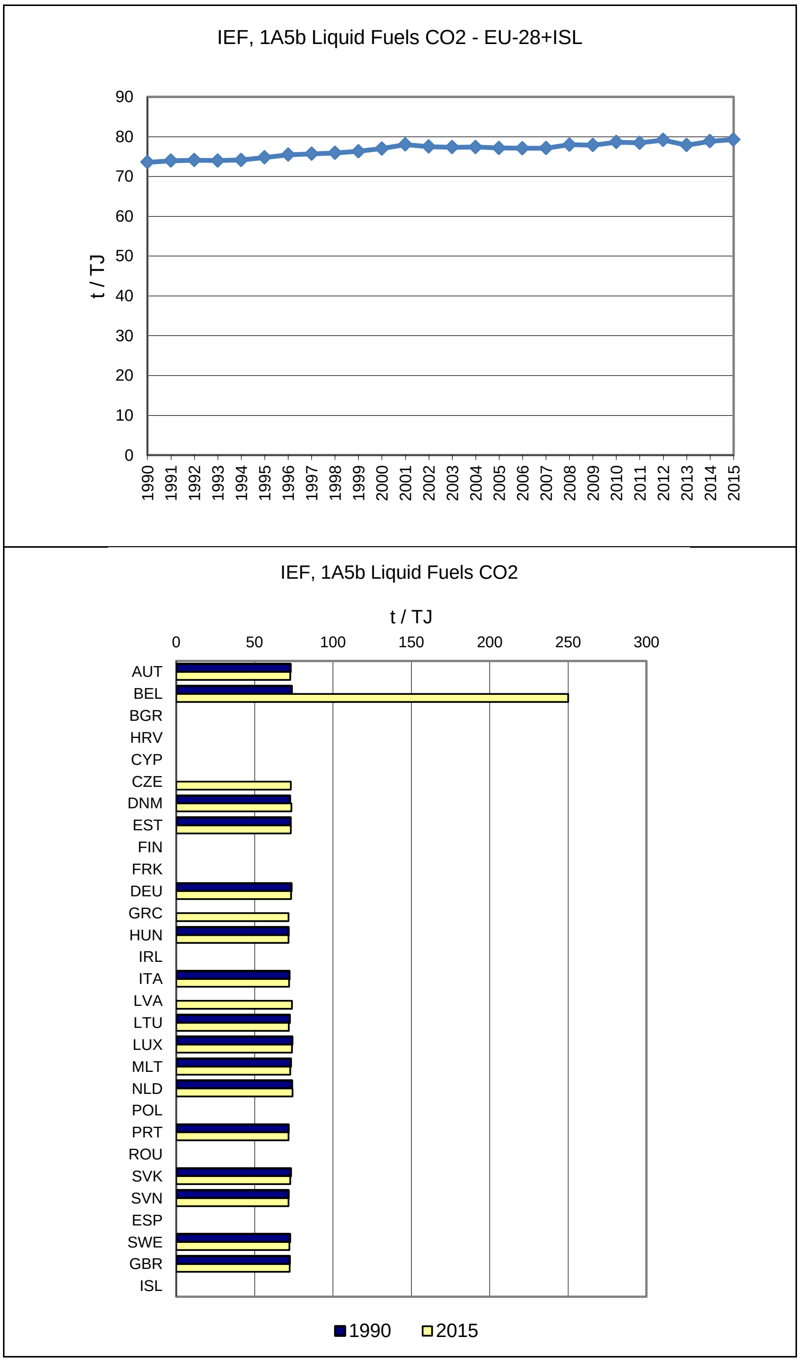


Figure 3.157 1A5b Mobile, liquid fuels: Implied Emission Factors for CO_2 (in t/TJ)

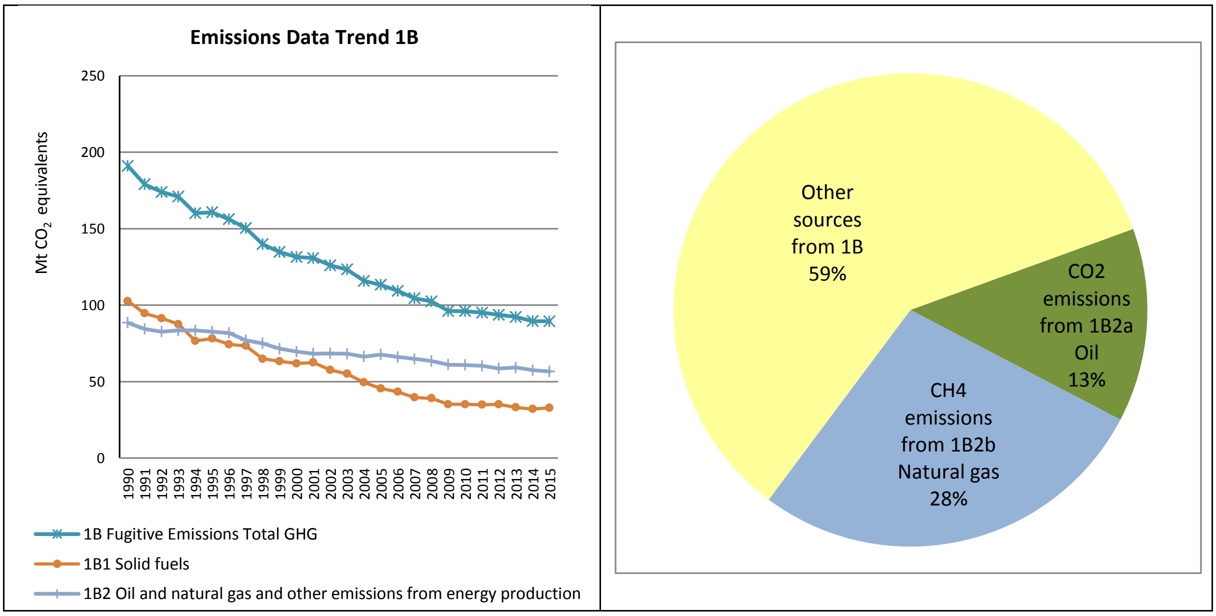


3.2.6 Fugitive emissions from fuels (CRF Source Category 1.B)

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 2015, in terms of CO_2 equivalents, about 70.2% of emissions from source category 1B were fugitive CH_4 emissions while 29.7% 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 3.158). Between 1990 and 2015, the total fugitive GHG emissions decreased by 53 %. This was mainly due to the decrease in underground mining activities: CH_4 emissions from underground mining activities have decreased by 70 % since 1990 (Figure 3.161) and decreases in CH_4 emissions from category 1B1a i underground mines are responsible for 54 % of the total decrease of fugitive emissions. Between 1990 and 2015, GHG emissions from 1B1 Solid Fuels decreased by 68 % Figure 3.159), while emissions from 1B2 Oil and Natural Gas decreased only by 36 % (Figure 3.159). 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 37 % of total fugitive emissions in 2015 (Figure 3.158).

Figure 3.158 1B Fugitive Emission from Fuel: GHG Emissions trend and proportion of fugitive emissions within source category



Fugitive emissions includes five key sources:

Table 3.106: Key categories in sector 1B (table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 B 1 a Coal Mining and Handling: Operation (CH_4)	95144	28604	T	L	L
1 B 2 a Oil: Operation (CO_2)	9072	11831	T	L	L
1 B 2 b Natural Gas: Operation (CH_4)	45958	24618	T	L	L
1 B 2 c Venting and Flaring: Operation (CO_2)	8733	6355	0	L	L
1 B 2 d Other emissions from energy production: Operation (CH_4)	5557	1056	T	0	0

The two largest key sources (CH_4 emissions from 1B1a Coal Mining and Handling and 1B2b Natural Gas) account together for 41 % of total fugitive GHG emissions (Figure 3.158).

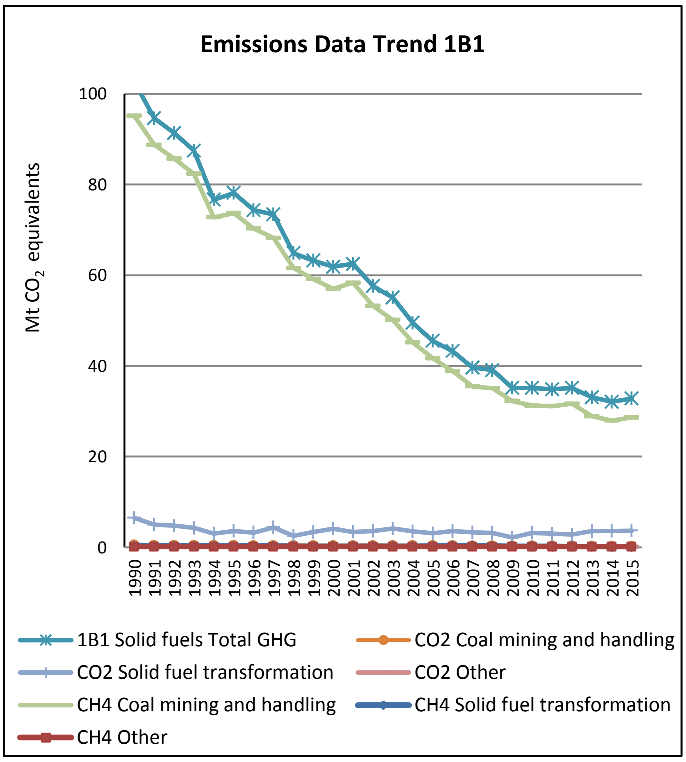
3.2.6.1 Fugitive emissions from Solid Fuels (1B1)

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 2015 fugitive emissions from solid fuels accounted for 0.8 % of the total GHG emissions in the EU-28+ISL and 37 % of total fugitive emissions:

- 88 % 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.
- 11 % 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

Figure 3.159   1B1 Fugitive Emissions from Solid Fuels: Trend



In 2015 four countries, Poland, Germany Czech Republic and the UK represented 83 % of total fugitive GHG emissions from solid fuels (Table 3.107).

Table 3.107 1B1 Fugitive Emissions from Solid Fuel   s: Member States Contribution

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	333	0	NO,NA	NO,NA	NO,NA	NO,NA	333	NO,NA
Belgium	400	6	0	NO,NA	NO,NA	NO,NA	399	6
Bulgaria	2 047	984	NO	NO	NO	NO	2 047	984
Croatia	60	0	NO	NO	NO,NA	NA,NO	60	NO
Cyprus	0	0	NO	NO	NO	NO	NO	NO
Czech Republic	10 779	3 774	456	189	NA,NO	NO,NA	10 323	3 586
Denmark	0	0	NO	NO	NO	NO	NO	NO
Estonia	0	0	NO	NO	NO	NO	NO	NO
Finland	0	0	NO	NO	NO	NO	NO	NO
France	4 810	15	NO,NA	NO,NA	NO,NA	NO,NA	4 810	15
Germany	27 386	3 801	1 833	705	NA,NO	NA,NO	25 553	3 096
Greece	1 130	1 007	NO	NO	NA,NO	NO,NA	1 130	1 007
Hungary	896	57	7	NO,IE,NA	NO,NA,IE	NO,IE,NA	889	57
Ireland	56	20	NO	NO	NO	NO	56	20
Italy	132	53	0	0	NA	NA	132	52
Latvia	0	0	NO	NO	NO,NA	NA,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	413	816	403	811	NO	NO	11	5
Poland	23 891	18 575	2 561	1 679	NA	NA	21 330	16 896
Portugal	89	9	NO	NO	NO	NO	89	9
Romania	3 899	1 005	NA,NO	NO,NA	NA,NO	NO,NA	3 899	1 005
Slovakia	699	341	19	20	NO	NO	680	322
Slovenia	459	334	98	115	NO,NA	NO,NA	361	218
Spain	1 638	183	18	29	NA,NE	NE,NA	1 620	154
Sweden	5	24	5	24	0.00	0.02	0	0
United Kingdom	23 525	1 819	1 699	434	0.09	0.07	21 827	1 384
EU-28	**102 648**	**32 820**	**7 099**	**4 004**	**0.1**	**0.1**	**95 549**	**28 815**
Iceland	0	0	NO,NA	NO	NO,NA	NA,NO	NO,NA	NO
United Kingdom (KP)	23 526	1 819	1 699	434	0	0	21 827	1 385
EU-28 + ISL	**102 648**	**32 820**	**7 099**	**4 004**	**0.1**	**0.1**	**95 549**	**28 815**

Abbreviations explained in the Chapter 'Units and abbreviations'

Between 1990 and 2015 fugitive CH_4 emissions from solid fuels decreased by 70% (Table 3.108). Large reductions (in absolute terms) were observed in Czech Republic, Germany, and in the United Kingdom, while emissions actually increased in the Netherlands (+97%) and Sweden (+346%) (Table 3.107).

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

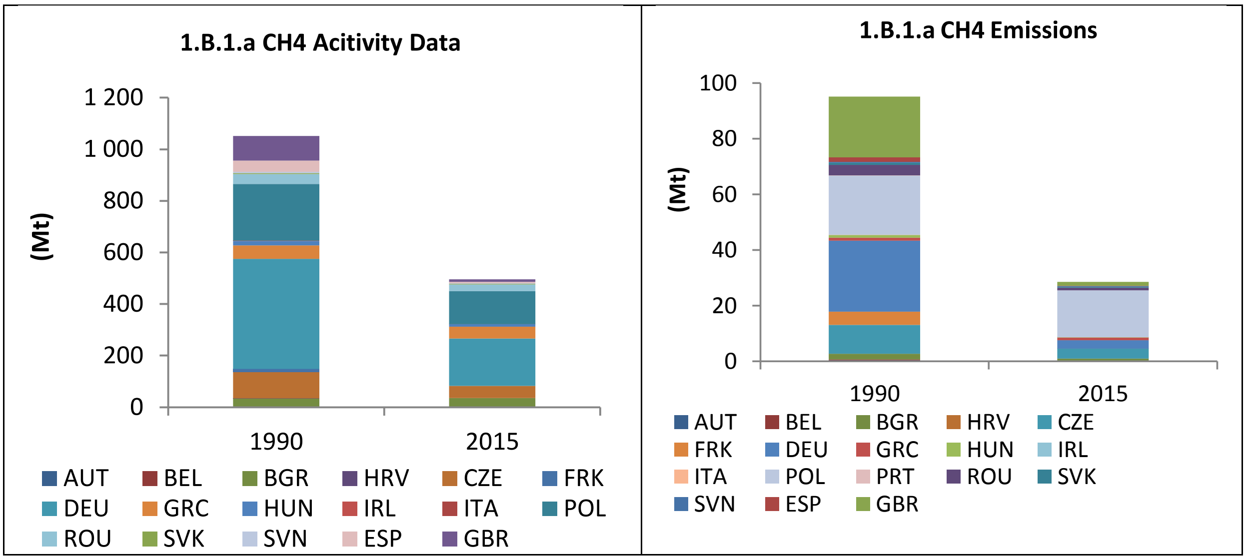
CH_4 emissions from 1B1a coal-mining accounted for 0.7 % of total GHG emissions in 2015 and for 32 % of all fugitive emissions in the EU-28+ISL. CH_4 emissions from this source decreased by 70 % in the EU-28+ISL between 1990 and 2015 but increased by 2 % between 2014 and 2015 due to increases in Germany, Poland and Bulgaria (Table 3.108). In 2015 Poland, Germany and the Czech Republic accounted together for 82 % of CH_4 emissions from 1B1a. They had substantially reduced their emissions between 1990 and 2015 due to the decline of coal mining (Figure 3.90).

Table 3.108 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	333	NA,NO	NO,NA	-	-	-	-333	-100%	NA	NA
Belgium	363	6	6	0.0%	0	0%	-357	-98%	D	D
Bulgaria	2 031	888	980	3.4%	92	10%	-1 052	-52%	OTH,T1	D,OTH
Croatia	60	NO	NO	-	-	-	-60	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	10 322	3 681	3 581	12.5%	-99	-3%	-6 741	-65%	T1,T2	CS,D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	4 780	10	10	0.0%	0	0%	-4 770	-100%	T2,T3	CS,PS
Germany	25 494	2 742	3 037	10.6%	295	11%	-22 457	-88%	T2,T3	CS
Greece	1 130	1 107	1 007	3.5%	-100	-9%	-123	-11%	T1	D
Hungary	889	65	57	0.2%	-9	-13%	-832	-94%	CS,T1,T2	CS,D
Ireland	56	20	20	0.1%	0	-2%	-36	-65%	T1	D
Italy	53	30	28	0.1%	-2	-6%	-25	-47%	T1	D
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	21 217	15 929	16 799	58.7%	870	5%	-4 418	-21%	T1	D
Portugal	89	9	9	0.0%	0	-2%	-80	-90%	NO	NO
Romania	3 857	1 030	1 005	3.5%	-26	-2%	-2 853	-74%	T1	D
Slovakia	680	381	319	1.1%	-62	-16%	-361	-53%	T2	CS
Slovenia	361	215	218	0.8%	3	1%	-143	-40%	T2,T3	CS,D,PS
Spain	1 620	157	154	0.5%	-3	-2%	-1 466	-90%	CS,NE,T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	21 809	1 670	1 375	4.8%	-296	-18%	-20 434	-94%	T2,T3	CS
EU-28	**95 144**	**27 939**	**28 604**	**100%**	**665**	**2%**	**-66 541**	**-70%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	21 809	1 670	1 375	4.8%	-296	-18%	-20 434	-94%	T2,T3	CS
EU-28 + ISL	**95 144**	**27 939**	**28 604**	**100%**	**665**	**2%**	**-66 541**	**-70%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.160 1B1a Coal Mining and Handling: Contribution of MS to CH_4 Emission and Activity Data



In 2015 most fugitive emissions from coal mines were due to underground mines. Within the EU-28 coal mining in underground mines decreased substantially (-73 %) (Figure 3.161).

Poland, Germany and Czech Republic are the biggest contributors to this sector (Table **3.109**).

Table 3.109 1B1a1 Coal Mining – underground mining: Member States contribution to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	299	NA,NO	NO,NA	-	-	-	-299	-100%	NA	NA
Belgium	363	6	6	0.0%	0	0%	-357	-98%	D	D
Bulgaria	1 425	217	209	0.9%	-9	-4%	-1 217	-85%	OTH,T1	D,OTH
Croatia	60	NO	NO	-	-	-	-60	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7 544	2 338	2 241	9.6%	-97	-4%	-5 303	-70%	T1,T2	CS,D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	4 734	10	10	0.0%	0	0%	-4 724	-100%	T2,T3	CS,PS
Germany	25 396	2 693	2 988	12.7%	295	11%	-22 408	-88%	T3	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	889	65	57	0.2%	-9	-13%	-832	-94%	CS,T1,T2	CS,D
Ireland	56	20	20	0.1%	0	-2%	-36	-65%	T1	D
Italy	20	30	28	0.1%	-2	-6%	8	40%	T1	D
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	19 743	14 535	15 424	65.8%	889	6%	-4 319	-22%	T1	D
Portugal	89	9	9	0.0%	0	-2%	-80	-90%	NO	NO
Romania	3 233	524	450	1.9%	-74	-14%	-2 783	-86%	T1	D
Slovakia	680	381	319	1.4%	-62	-16%	-361	-53%	T2	CS
Slovenia	361	215	218	0.9%	3	1%	-143	-40%	T2,T3	CS,D,PS
Spain	1 620	153	150	0.6%	-3	-2%	-1 469	-91%	CS,T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	21 616	1 586	1 313	5.6%	-273	-17%	-20 303	-94%	T2,T3	CS
EU-28	**88 127**	**22 780**	**23 441**	**100%**	**660**	**3%**	**-64 686**	**-73%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	21 616	1 586	1 313	5.6%	-273	-17%	-20 303	-94%	T2,T3	CS
EU-28 + ISL	**88 127**	**22 780**	**23 441**	**100%**	**660**	**3%**	**-64 686**	**-73%**	**-**	**-**

Figure 3.161 1B1a1i Mining activities - Underground Mines: Emission trend and share for EU-28 and the emitting countries of CH_4

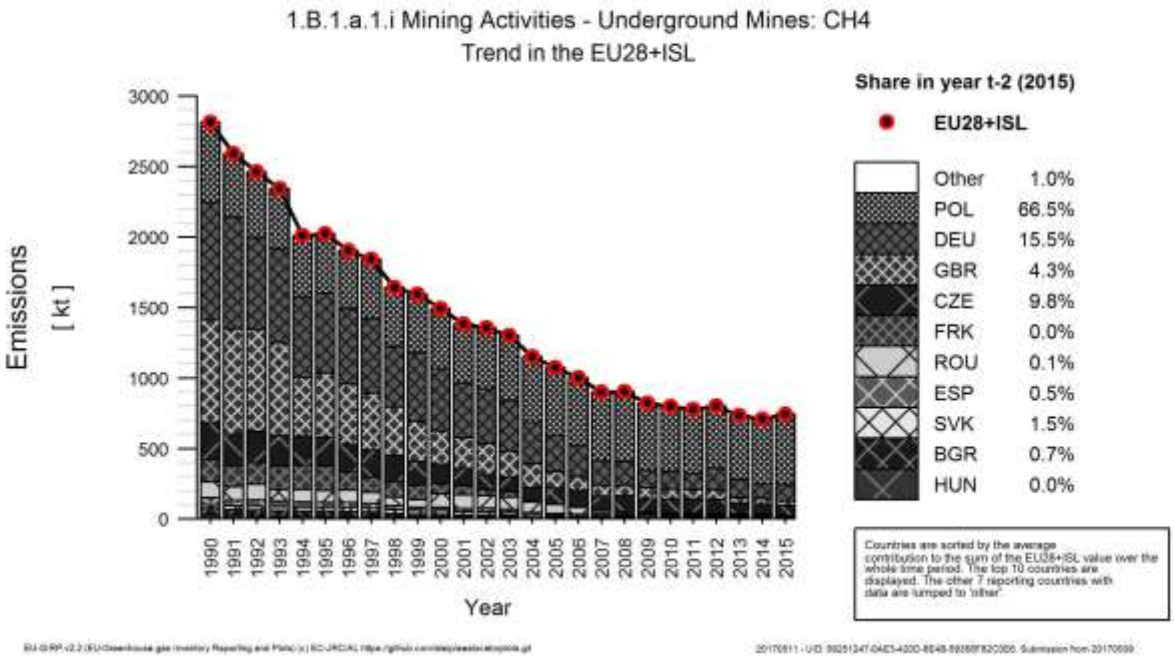
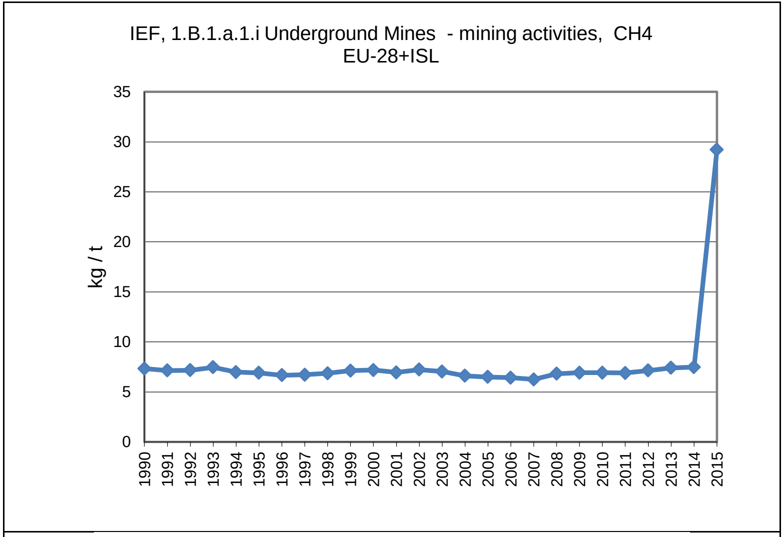
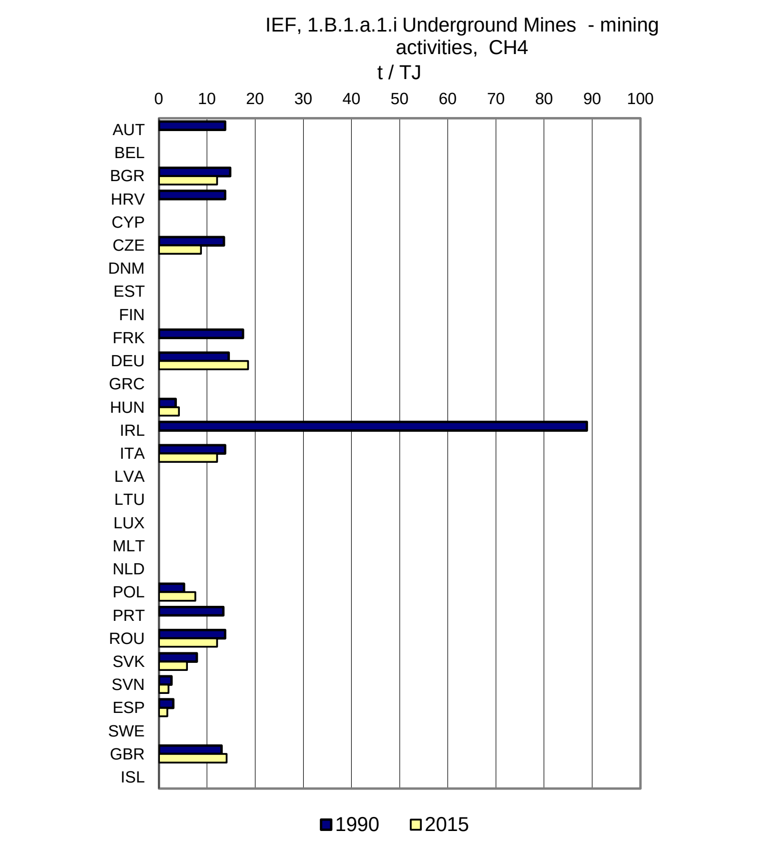


Figure 3.162 shows the Implied Emission factor of EU28+ISL and also the implied Emission factor for each Member State for CH_4 emissions in 1B1a1i – underground mines, mining activities, which are responsible for 78 % of total GHG emissions from 1.B.1.a.1. The jump of the IEF for EU28+ISL in 2015 is caused due to missing reporting of Activity Data from Poland for this year.

Figure 3.162: 1B1a1i Mining activities – Underground mines - Implied Emission Factors for CH_4 (in kg/t)





Overall, the coal production from surface mines decreased by 26 % between 1990 and 2015 (Figure 3.163). CH_4 emissions from coal mining in surface mines decreased in all Member States except in Bulgaria and Romania between 2014 and 2015 (Table **3.110**).

Table 3.110 1B1a2 Coal Mining – surface mining: Member States contribution to CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	34	NO	NO	-	-	-	-34	-100%	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	606	671	771	14.9%	101	15%	165	27%	T1	D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 778	1 343	1 340	26.0%	-3	0%	-1 438	-52%	T1	D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	47	NO	NO	-	-	-	-47	-100%	NA	NA
Germany	98	49	49	0.9%	0	0%	-49	-50%	T2	CS
Greece	1 130	1 107	1 007	19.5%	-100	-9%	-123	-11%	T1	D
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	33	NO	NO	-	-	-	-33	-100%	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	1 474	1 394	1 375	26.6%	-19	-1%	-99	-7%	T1	D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	624	507	555	10.7%	48	10%	-70	-11%	T1	D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1	4	4	0.1%	0	0%	3	400%	CS,NE,T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	193	85	62	1.2%	-23	-27%	-131	-68%	T2	CS
EU-28	**7 018**	**5 158**	**5 163**	**100%**	**4**	**0%**	**-1 855**	**-26%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	193	85	62	1.2%	-23	-27%	-131	-68%	T2	CS
EU-28 + ISL	**7 018**	**5 158**	**5 163**	**100%**	**4**	**0%**	**-1 855**	**-26%**	**-**	**-**

Figure 3.163 1B1a2i Mining activities - Surface Mines: Emission trend and share for the emitting countries of CH_4

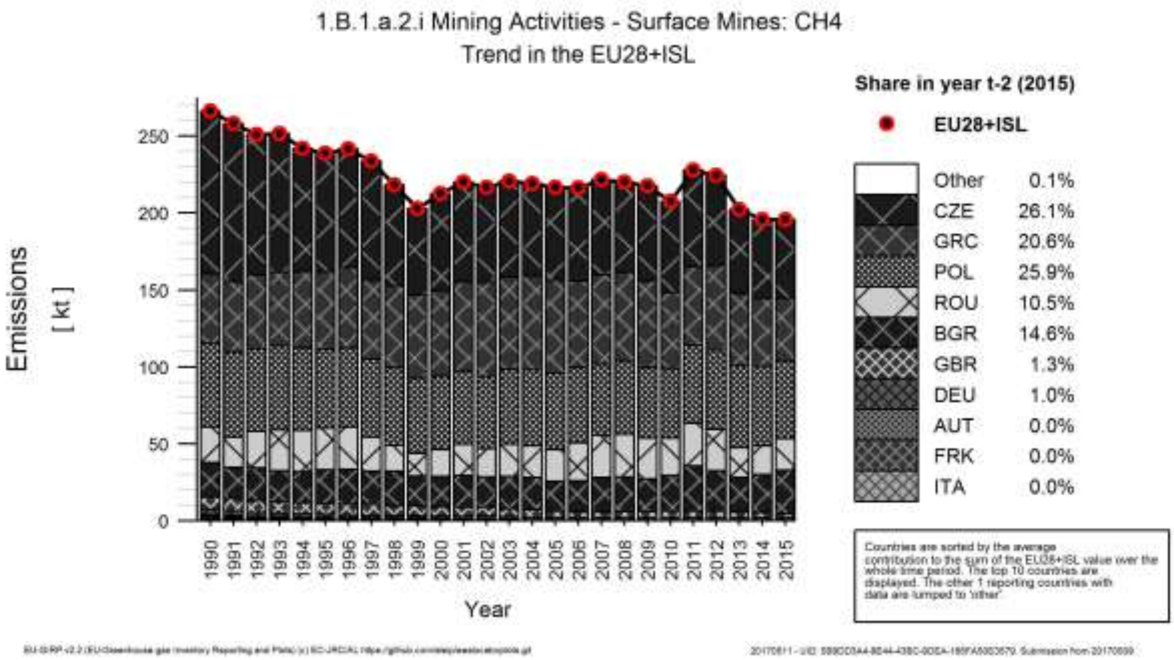


Figure **3.158** shows the Implied Emission factor of EU28+ISL and also the implied Emission factor for each Member State for CH_4 emissions in 1B1a2i – mining activities from surface mines, which are responsible for 95 % of total GHG emissions from 1.B.1.a.2. The jump of the IEF for EU28+ISL in 2015 is caused due to missing reporting of Activity Data from Poland for this year.

Figure 3.164: 1B1a2i Mining activities – Surface mines - Overview of outliers of Implied Emission Factors for CH_4 (in kg/t)

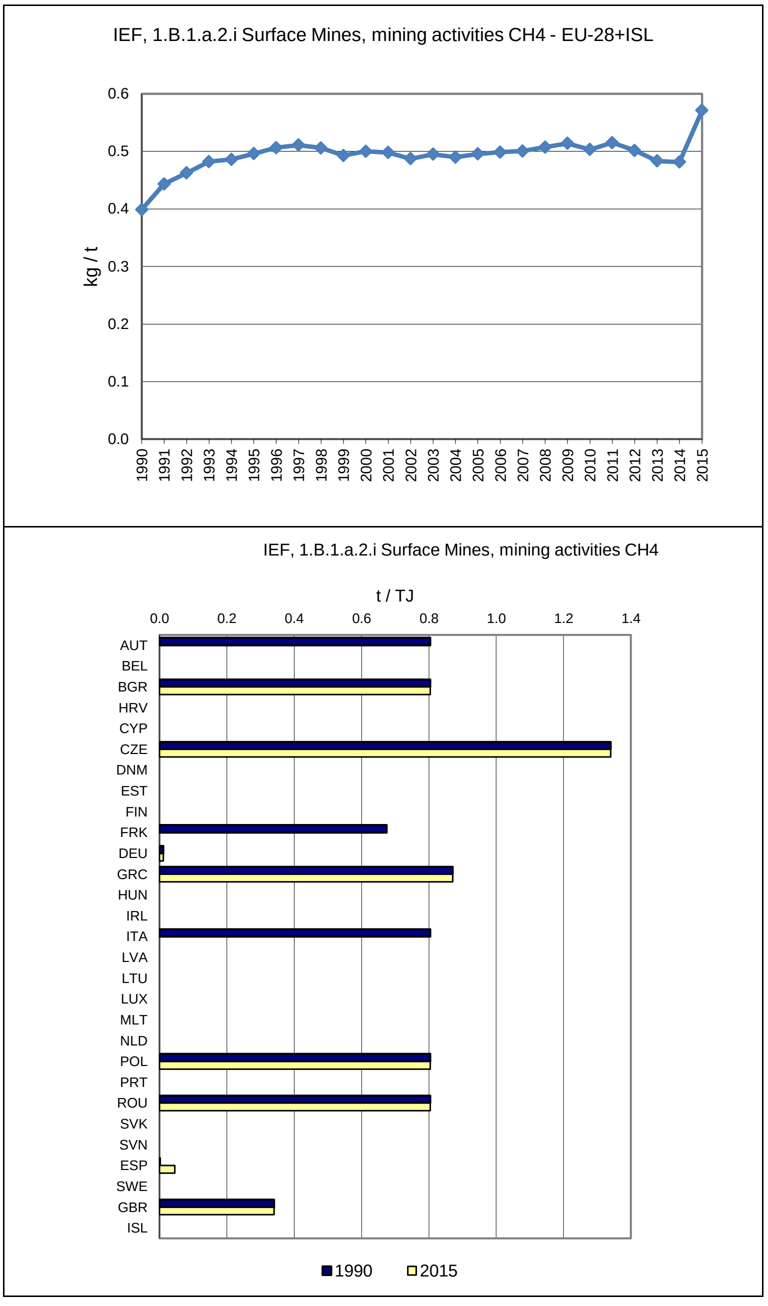


Table 3.111 provides information on the contribution of Member States to EU-28+ISL recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2014.

Table 3.1111B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-28+ISL recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	7	1.8	6	409.9	The CH_4 emissions from abandoned underground mines were newly estimated during this submission in the Walloon region.
Bulgaria	104	5.4	55	6.6	For category 1.B.1.a.2.1 Fugitive emissions from surface mines, the previous emission factor of 1.2 m3/t was changed to 1.5 m3/t (IPCC GPG 2000, p.2.75), following a recommendation of the ERT during the Centralized review in 2012. For the 2014 submission the EF was changed back to 1.2 m3/t following the adoption of the 2006 IPCC Guidelines.
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	0	0.0	
Czech Republic	1 203	13.2	551	17.6	updated activity data available and emission factors
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	-3.4	- 1B1a - coal extraction: update of the activity data following a new communication from the BRGM. - 1B1b - Processing of solid mineral fuels: update of coke production for the year 2014 following balance input of the Energies & Matières report from the Professional Federation (A3M), received too late for the 2016 edition.
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	-19	-12.3	6	11.8	Update of activity data
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	7	192.0	5	100.0	Reallocation of emissions of Coke production from 2B8g to 1B1b
Poland	-4 090	-16.1	4 106	34.5	implementation new methodology of estimating domestic methane emission from coal mining (1.B.1.a.i Coal mining and handling, Underground mines, Mining activities)
Portugal	0	0.0	0	0.0	
Romania	0	0.0	0	0.0	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	-28	-1.7	-81	-34.1	Update of activity data in 1B1a; update of emission factor using the default emission factor for CH_4 emissions from the 2006 IPCC Guidelines of 0.1gCH_4/t coke.
Sweden	0	0.0	0	0.0	
United Kingdom	39	0.2	17	1.0	Revised assumptions following UNFCCC ERT review, to increase the AD for open cast mining to account for material lost during washing and coal preparation to generate saleable coal.
EU28	-2 777	-2.8	4 664	19.9	
Iceland	0	0.0	0	0.0	
EU28+ISL	-2 777	-2.8	4 664	19.9	

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 3.112.

Table 3.112 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	SO_2 scrubbing
Sweden	CO_2, CH_4	Flaring of gas

3.2.6.2 Fugitive emissions from oil and natural gas (1B2)

Fugitive emissions from oil and natural gas correspond to the total fugitive emissions from oil and natural gas activities. Fugitive emissions may arise from equipment leaks, evaporation losses, venting, flaring and accidental releases (2006 IPCC Guidelines for National Greenhouse Gas Inventories).

Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and handling of oil and natural gas. They account for 1.3 % of the total GHG emissions in 2015 and for 63 % (Figure 3.165) of all fugitive emissions in the EU-28+ISL.

Of all fugitive emissions from oil and natural gas, in 2015:

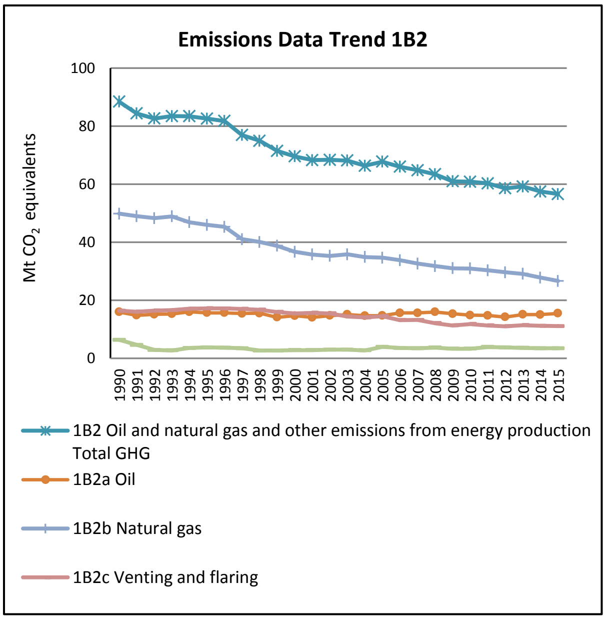
- 43 % were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution)
- 21 % were CO_2 emissions from oil (exploration, production, transport, refining and storage and distribution)
- 2 % were CH_4 emissions due to Other emissions

This source category includes four key source categories:

Table 3.113: Key categories in sector 1B2 (table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
1 B 2 a Oil: Operation (CO_2)	9072	11831	T	L	L
1 B 2 b Natural Gas: Operation (CH_4)	45958	24618	T	L	L
1 B 2 c Venting and Flaring: Operation (CO_2)	8733	6355	0	L	L
1 B 2 d Other emissions from energy production: Operation (CH_4)	5557	1056	T	0	0

Figure 3.165 1B2-Fugitive Emissions Oil and Natural Gas: Trend



Fugitive emissions from oil and natural gas occurs in all Member States but Malta (Table 3.114). Total greenhouse gas emissions from 1B2 decreased by 36 % between 1990 and 2015 (Figure **3.165**). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 48 % over that period.

In 2015, 60% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: Germany, Italy, Romania and the United Kingdom (Table 3.114). 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 3.114).

Table 3.114 1B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	369	477	102	214	NA,NO,IE	NO,IE,NA	266	263
Belgium	805	626	85	88	NO,IE,NA	NO,IE,NA	720	537
Bulgaria	274	201	4	6	0	0	270	195
Croatia	1 050	529	680	327	1	0	369	202
Cyprus	0	0	NO,NE	NO,NE	NE,NO	NO,NE	0	NO,NE
Czech Republic	1 082	613	2	5	0	0	1 080	608
Denmark	516	391	341	247	53	43	123	101
Estonia	50	16	0	0	NO	NO	50	16
Finland	123	145	111	108	1	1	11	37
France	6 132	4 161	4 330	2 960	26	15	1 776	1 186
Germany	10 581	6 903	2 234	1 846	1	0	8 346	5 057
Greece	79	99	43	4	0	0	36	95
Hungary	1 750	718	478	132	1	0	1 271	586
Ireland	156	24	0	0	NO	NO	156	23
Italy	12 745	7 497	4 013	2 573	12	10	8 720	4 915
Latvia	248	103	0	0	NO	NO	248	103
Lithuania	266	298	1	4	0	0	265	294
Luxembourg	19	35	0	0	NO	NO	19	35
Malta	0	0	NO	NO	NO	NO	NO	NO
Netherlands	2 707	1 960	775	1 315	NO,IE,NA	NO,IE,NA	1 932	644
Poland	1 063	4 280	41	1 857	0	1	1 022	2 423
Portugal	148	1 266	119	1 172	2	3	27	90
Romania	25 544	10 346	1 177	937	3	2	24 363	9 408
Slovakia	1 714	1 261	5	1	0	0	1 708	1 260
Slovenia	50	36	0	0	0	0	50	35
Spain	2 377	4 390	1 759	3 692	0	0	617	697
Sweden	384	852	292	788	0.4	0.7	92	63
United Kingdom	18 164	9 218	5 778	4 126	41	35	12 345	5 057
EU-28	**88 396**	**56 443**	**22 369**	**22 403**	**142**	**110**	**65 884**	**33 930**
Iceland	62	165	61	160	NA,NO	NA,NO	1	5
United Kingdom (KP)	18 164	9 218	5 778	4 126	41	35	12 345	5 057
EU-28 + ISL	**88 458**	**56 608**	**22 431**	**22 564**	**142**	**110**	**65 885**	**33 935**

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 2015 and for 13 % of all fugitive emissions. Between 1990 and 2015, CO_2 emissions from this source increased by 30 % in the EU-28+ISL (Table 3.115). By contrast, during the same period 1990-2015, CH_4 emissions of this source category were reduced by 47 %.

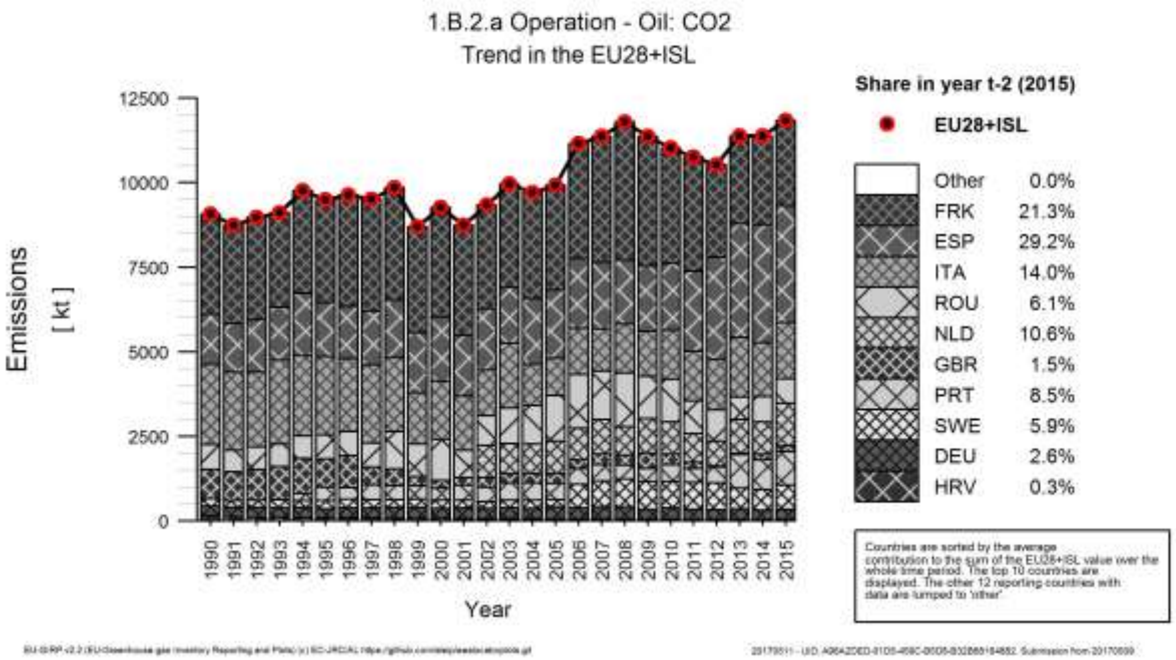
Together France, Italy, the Netherlands and Spain accounted for 75 % of the EU-28+ISL total CO_2 emissions of 1B2a 'Fugitive CO_2 emissions from oil' (Table 3.115, Figure 3.166). During the period 1990-2015, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Netherlands and Spain (Table 3.115).

Table 3.115 1B2a Fugitive CO_2 emissions from oil: Member States' contributions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	0.004	0.005	0.005	0.0%	0	2%	0.001	19%	T1	D
Belgium	0.01	0.02	0.02	0.0%	0	0%	0.004	28%	T1	D
Bulgaria	1	0.3	0.3	0.0%	0	-4%	-0.4	-58%	T1	D
Croatia	158	35	39	0.3%	5	13%	-119	-75%	T1	D
Cyprus	NO,NE	NE,NO	NO,NE	-	-	-	-	-	NA	NA
Czech Republic	0.02	0.05	0.05	0.0%	-0.01	-14%	0.03	128%	T1	D
Denmark	5	0.005	1	0.0%	1	16021%	-4	-84%	T2,T3	D,PS
Estonia	NO,NA	NO,NA	NO,NA	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	2 951	2 621	2 519	21.3%	-102	-4%	-432	-15%	T1,T2,T3	CS,D,PS
Germany	283	290	313	2.6%	23	8%	30	11%	T2	CS
Greece	0.00004	0.000003	0.000003	0.0%	0	-3%	-0.00004	-92%	T1	D
Hungary	5	1	1	0.0%	0.1	13%	-5	-89%	T1	CS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	2 368	1 587	1 658	14.0%	70	4%	-710	-30%	T1,T2	CS,D
Latvia	NO,NA	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Lithuania	0.1	1	1	0.0%	-0.1	-11%	1	460%	T1	D
Luxembourg	NO,NA	NA,NO	NO,NA	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	0	953	1 258	10.6%	306	32%	1 258	6991873%	T1	D
Poland	0	0	0	0.0%	0	-2%	0	300%	T1,T2	CS,D
Portugal	0	880	1 001	8.5%	121	14%	1 001	206705%	D	D
Romania	746	751	721	6.1%	-30	-4%	-26	-3%	T1,T2	CS,D
Slovakia	0.03	0.01	0.01	0.0%	0.0005	6%	-0.02	-69%	T1	CS
Slovenia	0.01	0.02	0.02	0.0%	0.0018	10%	0.01	140%	T1	D
Spain	1 477	3 481	3 449	29.2%	-32	-1%	1 973	134%	T1,T2	D,PS
Sweden	219	608	698	5.9%	90	15%	479	218%	T3	PS
United Kingdom	859	168	172	1.5%	4	2%	-687	-80%	T2	CS,PS
EU-28	**9 072**	**11 375**	**11 831**	**100%**	**456**	**4%**	**2 759**	**30%**	**-**	**-**
Iceland	0.002	0.002	0.002	0.0%	0.0003	14%	0	25%	NA	NA
United Kingdom (KP)	859	168	172	1.5%	4	2%	-687	-80%	T2	CS,PS
EU-28 + ISL	**9 072**	**11 375**	**11 831**	**100%**	**456**	**4%**	**2 759**	**30%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.166 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 2015 and for4 % of all fugitive emissions. Between 1990 and 2015, CH_4 emissions from this source decreased by 47 % in the EU-28+ISL (Table 3.115).

Together Romania, Italy and Germany accounted for 83 % of the EU-28+ISL total CH_4 emissions of 1B2a 'Fugitive CH_4 emissions from oil' (Table 3.116). During the period 1990-2015, the largest decreases in CH_4 emissions (in absolute terms) were observed in the United Kingdom and Romania, while emissions increased most in Poland (Table 3.116).

Table 3.116 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	7	8	8	0.2%	0	5%	1	13%	T1,T2	CS,D
Belgium	11	7	7	0.2%	0	2%	-4	-37%	T1,T3	D,PS
Bulgaria	9	5	6	0.2%	0	10%	-4	-41%	T1	D
Croatia	221	50	56	1.6%	7	13%	-164	-75%	T1	D
Cyprus	0	NE,NO	NO,NE	-	-	-	0	-100%	NA	NA
Czech Republic	23	7	6	0.2%	0	-5%	-16	-73%	T1	D
Denmark	31	34	29	0.8%	-4	-13%	-2	-7%	T1,T2	CS,D
Estonia	NO,NA	NO,NA	NO,NA	-	-	-	-	-	NA	NA
Finland	6	9	8	0.2%	-1	-11%	1	23%	T3	CS
France	189	49	54	1.5%	6	11%	-134	-71%	T1,T2,T3	CS,D,PS
Germany	404	227	230	6.3%	3	1%	-175	-43%	CS	CS
Greece	10	13	14	0.4%	1	5%	4	43%	T1	D
Hungary	179	37	39	1.1%	2	5%	-140	-78%	T1	D
Ireland	0	0	0	0.0%	0	21%	0	85%	T1	D
Italy	295	303	292	8.1%	-11	-3%	-3	-1%	T2	CR,D
Latvia	NO,NA	NA,NO	NA,NO	-	-	-	-	-	T1	D
Lithuania	4	3	3	0.1%	0	3%	-1	-25%	NA	NA
Luxembourg	NO,NA	NA,NO	NO,NA	-	-	-	-	-	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	20	11	12	0.3%	1	8%	-8	-40%	T2	CS
Poland	36	114	114	3.2%	0	0%	79	221%	T1	D
Portugal	26	27	35	1.0%	8	29%	9	33%	T2	CR,D
Romania	4 818	2 506	2 483	68.7%	-24	-1%	-2 335	-48%	T1	D
Slovakia	15	8	9	0.2%	1	12%	-6	-42%	T1	CS,D
Slovenia	0	NO,NA	NO,NA	-	-	-	0	-100%	T1	D
Spain	4	4	4	0.1%	0	6%	0	3%	T1,T2	CS,D
Sweden	25	25	26	0.7%	2	6%	1	5%	T2	CS
United Kingdom	500	223	180	5.0%	-44	-20%	-320	-64%	T1,T2	CS,D
EU-28	**6 834**	**3 668**	**3 615**	**100%**	**-53**	**-1%**	**-3 218**	**-47%**	**-**	**-**
Iceland	0	1	1	0.0%	0	15%	0	25%	T2	D
United Kingdom (KP)	500	223	180	5.0%	-44	-20%	-320	-64%	T1,T2	CS,D
EU-28 + ISL	**6 834**	**3 669**	**3 616**	**100%**	**-53**	**-1%**	**-3 218**	**-47%**	**-**	**-**

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 2015 and for 28 % of all fugitive emissions in the EU-28+ISL. Between 1990 and 2015, CH_4 emissions from this source decreased by 46 % (Table 3.117).

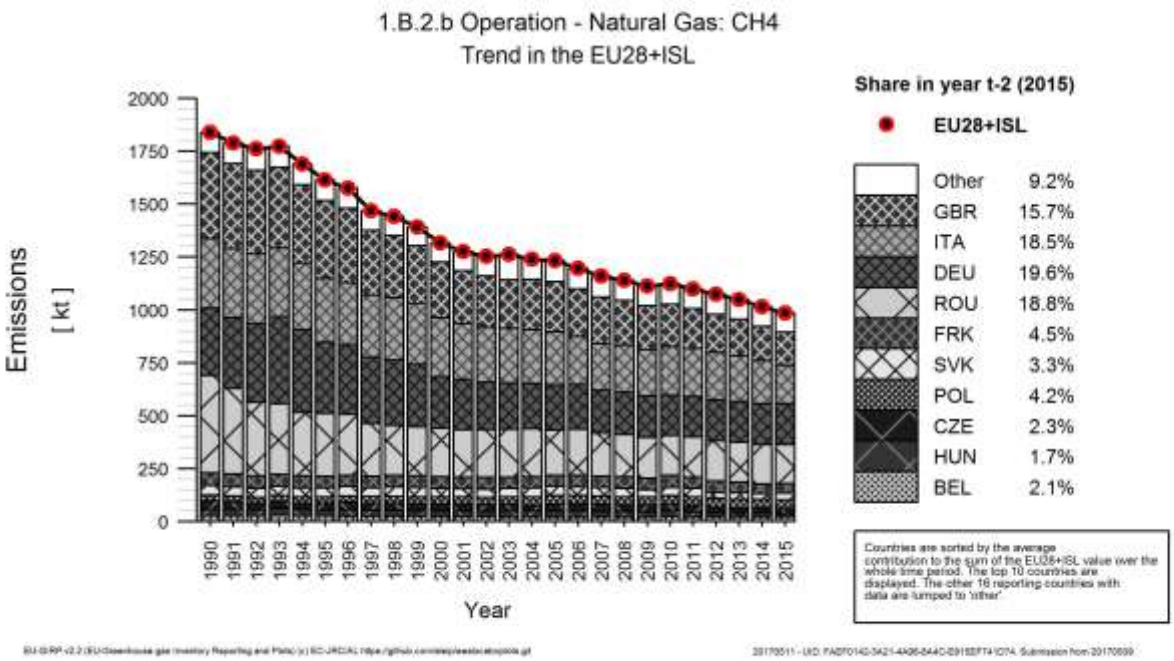
In 2015, 73% of the EU-28+ISL CH_4 emissions from 1B2b were emitted by four Member States: Germany, Italy, Romania and the United Kingdom (Table 3.117, Figure 3.167). The emission decreases between 1990 and 2015 observed in Romania (-60 %), the United Kingdom (-62 %), Germany (-39 %) and in Italy (-45 %) contributed most significantly to the overall reduction in the EU-28+ISL between 1990 and 2015.

Table 3.117 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	259	261	254	1.0%	-7	-3%	-4.693	-2%	T1,T2	CS,D
Belgium	709	518	529	2.1%	11	2%	-179.734	-25%	CS	CS
Bulgaria	245	189.3	182.4	0.7%	-7	-4%	-62.9	-26%	T1	D
Croatia	148	142	146	0.6%	4	3%	-2	-1%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 045	581	570	2.3%	-12	-2%	-475.16	-45%	T1,T2	CS
Denmark	61	50	48	0.2%	-2	-5%	-13	-22%	T3	CS,D,PS
Estonia	50	17	16	0.1%	-2	-11%	-35	-69%	T1	D
Finland	4	23	29	0.1%	5	23%	25	578%	T1,T2	CS,D,PS
France	1 512	1 144	1 109	4.5%	-35	-3%	-403	-27%	T2,T3	CS,PS
Germany	7 940	4 822	4 825	19.6%	2	0%	-3 115	-39%	T2,T3	CS
Greece	9	60	66	0.3%	5	9%	56.40584	612%	T1	D
Hungary	735	503	423	1.7%	-80	-16%	-312	-42%	T1	CS
Ireland	156	28	23	0.1%	-5	-19%	-133	-85%	CS,T2	CS
Italy	8 235	5 102	4 545	18.5%	-558	-11%	-3 690	-45%	T2	CS
Latvia	177	109	87	0.4%	-23	-21%	-91	-51%	T3	CS
Lithuania	261	277	289	1.2%	13	5%	29	11%	T2	CS
Luxembourg	19	38	35	0.1%	-4	-10%	15	78%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	421	350	323	1.3%	-27	-8%	-98	-23%	T3	CS
Poland	678	1 032	1 046	4.2%	14	1%	369	54%	T1	D
Portugal	NO	51	54	0.2%	3	6%	54	∞	CR,NO,OTH	CR,NO,OTH
Romania	11 483	4 635	4 633	18.8%	-1	0%	-6 850	-60%	T1	D
Slovakia	1 103	691	805	3.3%	114	16%	-298.48	-27%	T1	CS
Slovenia	42	29	30	0.1%	2	6%	-12.15	-29%	T1	D
Spain	429	627	654	2.7%	26	4%	224	52%	CS,T1	CS,D
Sweden	67	40	36	0.1%	-4	-11%	-31	-47%	T2,T3	CS,PS
United Kingdom	10 168	4 037	3 863	15.7%	-174	-4%	-6 305	-62%	T2,T3	CS,PS
EU-28	**45 958**	**25 359**	**24 618**	**100%**	**-741**	**-3%**	**-21 340**	**-46%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	10 168	4 037	3 863	16%	-174	-4%	-6 305	-62%	T2,T3	CS,PS
EU-28 + ISL	**45 958**	**25 359**	**24 618**	**100%**	**-741**	**-3%**	**-21 340**	**-46%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.167 1B2b Natural Gas: Emission trend and share for the emitting countries of CH_4



CO_2 Emissions from Venting and Flaring (1B2c)

Fugitive Emissions from this source correspond to Emissions from venting and flaring of associated gas and waste gas/vapour streams at oil and gas facilities.

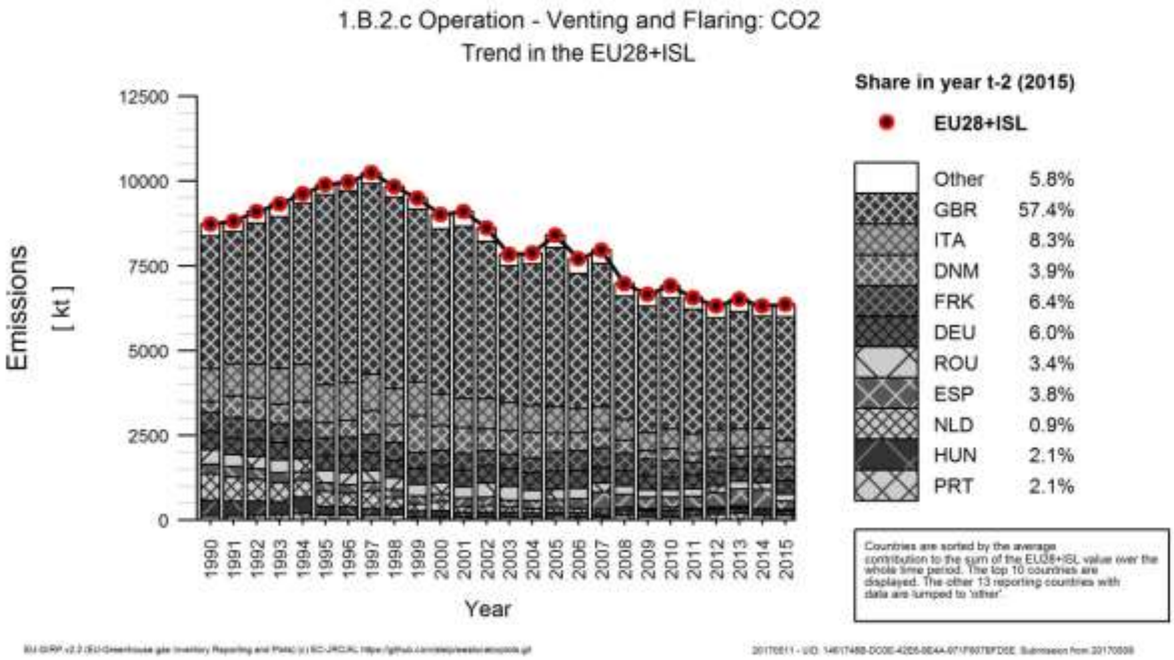
CO_2 emissions from 1B2c – Venting and Flaring – account for 0.1% of total EU-28+ISL GHG emissions in 2015 and for 7 % of all fugitive emissions in the EU28+ISL. Between 1990 and 2015 CO_2 emissions from this source decreased by 27%.

All but five Memberstates (Austria, Cyprus, Estonia, Luxembourg, Malta) - are reporting CO_2 emissions in this category. In 2015, 57% of the EU-28+ISL CO_2 emissions from 1B2c were emitted by the UK (***Table 3.118***, Figure **3.168**.) The emission decreases between 1990 and 2015 observed in the Netherlands (-93%), Italy (-45%), the UK (-7%), Hungary (-72%) and Romania (-50 %) contributed most significantly to the overall reduction in the EU-28+ISL between 1990 and 2015.

Table 3.118: 1B2c Fugitive CO_2 emissions from Other emissions: Member States' contributions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	84	75	88	1.4%	13	17%	4	5%	NA	PS
Bulgaria	3	10	6	0.1%	-4	-43%	2	79%	T1	D
Croatia	0	0	0	0.0%	0	0%	0	-95%	T1	D
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-	NA	NA
Czech Republic	2	6	5	0.1%	-1	-15%	3	161%	T1	D
Denmark	328	250	246	3.9%	-4	-2%	-81	-25%	T3	PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	111	84	108	1.7%	25	29%	-3	-2%	CS	CS
France	560	405	408	6.4%	3	1%	-152	-27%	T1,T2,T3	CS,D,PS
Germany	544	367	381	6.0%	14	4%	-163	-30%	T2	CS
Greece	43	3	3	0.0%	0	-4%	-39	-93%	T1	D
Hungary	471	127	130	2.1%	3	2%	-341	-72%	T1	CS
Ireland	NO	NO	0	0.0%	0	∞	0	∞	CS,T3	CS,PS
Italy	956	558	528	8.3%	-30	-5%	-427	-45%	T1	D
Latvia	0	0	0	0.0%	0	-24%	0	-28%	T3	CS
Lithuania	1	4	4	0.1%	0	-11%	3	509%	T1	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	774	61	57	0.9%	-4	-6%	-718	-93%	T2	PS
Poland	39	59	61	1.0%	2	3%	21	54%	T1	D
Portugal	118	139	135	2.1%	-4	-3%	17	14%	NO	NO
Romania	424	216	214	3.4%	-2	-1%	-210	-50%	T1	D
Slovakia	5	1	1	0.0%	0	1%	-4	-79%	T1	CS
Slovenia	0	0	0	0.0%	0	9%	0	-97%	T1	D
Spain	283	576	242	3.8%	-334	-58%	-40	-14%	CS,T1,T2	CS,D,PS
Sweden	70	77	90	1.4%	14	18%	21	30%	CS,T2,T3	CS,PS
United Kingdom	3 920	3 302	3 648	57.4%	346	10%	-272	-7%	T2	CS,PS
EU-28	**8 733**	**6 320**	**6 355**	**100%**	**35**	**1%**	**-2 379**	**-27%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	3 920	3 302	3 648	57.4%	346	10%	-272	-7%	T2	CS,PS
EU-28 + ISL	**8 733**	**6 320**	**6 355**	**100%**	**35**	**1%**	**-2 379**	**-27%**	**-**	**-**

Figure 3.168: 1B2c Venting and Flaring: Emission trend and share for the emitting countries of CO_2



CH_4 Emissions from Other (1B2d)

Fugitive emissions from other correspond to emissions from geo thermal energy production and all other energy production that is not included in categories 1B1 and 1B2..

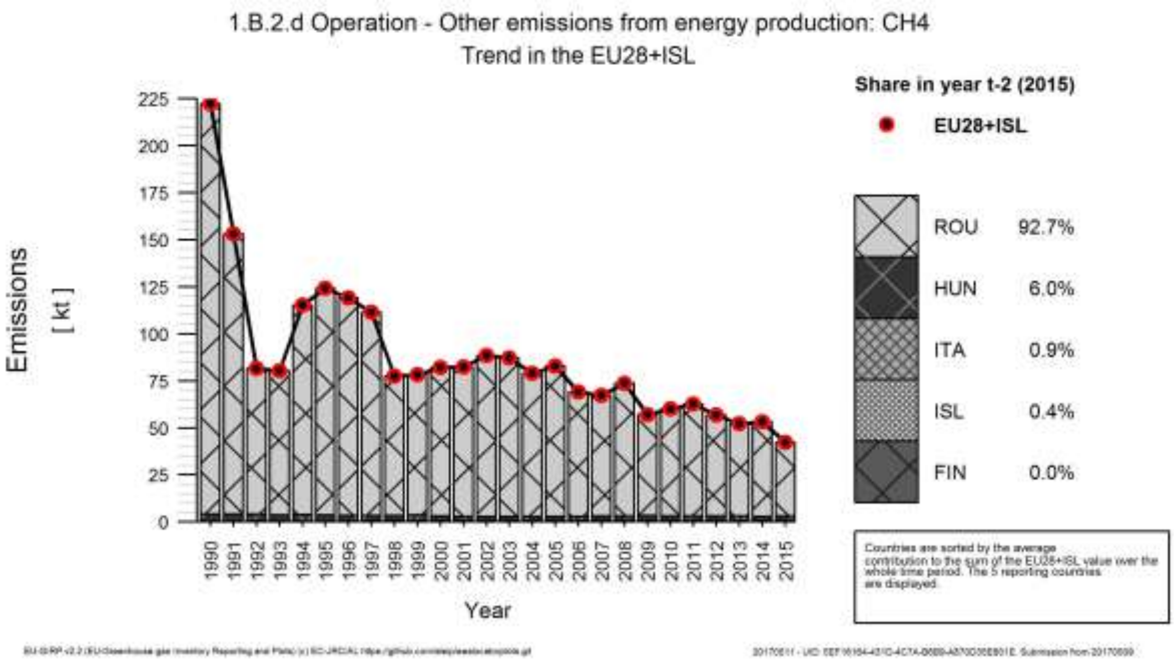
CH_4 emissions from 1B2d 'Other emissions from energy production' is a key category only on trend level and account for 0.02 % of total EU-28+ISL GHG emissions in 2015 and for 1 % of all fugitive emissions in the EU-28+ISL. Between 1990 and 2015, CH_4 emissions from this source decreased by 81 % (Table 3.119).

Only five countries – Finland, Hungary, Italy, Romania and Iceland - are reporting CH_4 emissions in this category. In 2015, 93% of the EU-28+ISL CH_4 emissions from 1B2d were emitted by Romania (Table 3.117, Figure 3.167.) The emission decreases between 1990 and 2015 observed in Romania (-82 %) contributed most significantly to the overall reduction in the EU-28+ISL between 1990 and 2015.

Table 3.119 1B2d Fugitive CH_4 emissions from Other emissions: Member States' contributions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	CS,D
Belgium	NO	NO	NO	-	-	-	-	-	NA	D
Bulgaria	-	-	-	-	-	-	-	-	NA	D
Croatia	NO	NO	NO	-	-	-	-	-	NA	D
Cyprus	-	-	-	-	-	-	-	-	NA	D
Czech Republic	NO	NO	-	-	-	-	-	-	NA	D
Denmark	NO	NO	NO	-	-	-	-	-	NA	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	D
Finland	0	NO	NO	-	-	-	0	-100%	NA	CS
France	NO	NO	NO	-	-	-	-	-	NA	D
Germany	NO	NE	NE	-	-	-	-	-	NA	CS
Greece	NA	NA	NA	-	-	-	-	-	NA	D
Hungary	95	62	64	6.0%	2	3%	-31	-33%	NA	D
Ireland	NO	NO	NO	-	-	-	-	-	NA	D
Italy	12	9	9	0.9%	1	10%	-2	-19%	NA	CR,D
Latvia	NO	NO	NO	-	-	-	-	-	NA	D
Lithuania	NO	NO	NO	-	-	-	-	-	NA	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	CS,D
Poland	NA	NA	NA	-	-	-	-	-	NA	D
Portugal	NO	NO	NO	-	-	-	-	-	NA	CR,D
Romania	5 450	1 256	979	92.7%	-277	-22%	-4 471	-82%	NA	D
Slovakia	NO	NO	NA	-	-	-	-	-	NA	D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	D
Spain	NO	NO	NO	-	-	-	-	-	NA	CS,D
Sweden	NO	NO	-	-	-	-	-	-	NA	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	CS,D
EU-28	**5 557**	**1 327**	**1 052**	**100%**	**-275**	**-21%**	**-4 505**	**-81%**	**-**	**-**
Iceland	0	4	4	0.4%	0	0%	4	1500%	NA	NA
United Kingdom (KP)	IE	IE	IE	-	-	-	-	-	NA	CS,D
EU-28 + ISL	**5 557**	**1 331**	**1 056**	**100%**	**-275**	**-21%**	**-4 501**	**-81%**	**-**	**-**

Figure 3.169: 1B2d Operation: Emission trend and share for the emitting countries of CH_4



Six countries report CO_2 emissions in this sector, five are reporting CH_4 emissions, three countries also report N_2O emissions. The description of the subcategories is presented in Table 3.120.

Table 3.120 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 3.121 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**					**2015**				
Member State			**Activity data**			**Implied emission factor (kg/unit)**	**CH4 emissions (kt)**	**Activity data**			**Implied emission factor (kg/unit)**	**CH4 emissions (kt)**
		GHG source category	**Description**	**Unit**	**Value**			**Description**	**Unit**	**Value**		
AUT	**Austria**	**Natural Gas**					**10.36**					**10.17**
		1. Exploration	Mm3 natural gas	Mm3	248.09	IE	IE	Mm3 natural gas	Mm3	279.10	IE	IE
		2. Production	Mm3 natural gas	Mm3	1288.00	4478.94	5.77	Mm3 natural gas	Mm3	1166.00	4059.18	4.73
		3. Processing	Mm3 natural gas	Mm3	1288.00	NA	NA	Mm3 natural gas	Mm3	1166.00	NA	NA
		4. Transmission and storage	km pipeline length	km	3628.00	718.43	2.61	km pipeline length	km	7241.86	537.91	3.90
		5. Distribution	km distribution network length	km	11672.00	170.22	1.99	km distribution network length	km	30067.07	51.42	1.55
		6. Other	Mm3 natural gas stored	Mm3	1500.00	NO	NO	Mm3 natural gas stored	Mm3	5316.58	NO	NO
BEL	**Belgium**	**Natural Gas**					**28.35**					**21.16**
		1. Exploration			NO	NO	NO			NO	NO	NO
		2. Production			NO	NO	NO			NO	NO	NO
		3. Processing			NO	NO	NO			NO	NO	NO
		4. Transmission and storage		PJ	342.62	16575.78	5.68		PJ	571.58	11516.26	6.58
		5. Distribution		PJ	342.62	66163.74	22.67		PJ	571.58	25502.55	14.58
		6. Other			NO	NO	NO			NO	NO	NO
BGR	**Bulgaria**	**Natural Gas**					**9.82**					**7.30**
		2. Exploration		NA	IE	IE	IE		NA	IE	IE	IE
		3. Production	Indigenous production	106m3	14.00	1340.00	0.02	Indigenous production	106m3	103.00	1340.00	0.14
		4. Processing	Indigenous production	106m3	14.00	590.00	0.01	Indigenous production	106m3	103.00	590.00	0.06
		5. Transmission and storage	Transmission and storage	106m3	8789.55	273.00	2.40	Transmission and storage	106m3	13505.09	273.00	3.69
		6. Distribution	Inland consumption	106m3	6717.00	1100.00	7.39	Inland consumption	106m3	3102.00	1100.00	3.41
		7. Other		NO	NO	NO	NO		NO	NO	NO	NO
CYP	**Cypress**	**Natural Gas**					**NO**					**NO**
		2. Exploration		NO	NO	NO	NO		NO	NO	NO	NO
		3. Production		NO	NO	NO	NO		NO	NO	NO	NO
		4. Processing		NO	NO	NO	NO		NO	NO	NO	NO
		5. Transmission and storage		NO	NO	NO	NO		NO	NO	NO	NO
		6. Distribution		NO	NO	NO	NO		NO	NO	NO	NO
		7. Other		NO	NO	NO	NO		NO	NO	NO	NO
CZE	**Czech Republic**	**Natural Gas**					**41.80**					**22.79**
		2. Exploration		PJ	NO	NO	NO		PJ	NO	NO	NO
		3. Production	(e.g. PJ gas produced)	PJ	7.84	39365.45	0.31	(e.g. PJ gas produced)	PJ	8.41	38649.05	0.33
		4. Processing		PJ	NO	NA	NA		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	1214.96	5115.72	6.22
		6. Distribution	(e.g. PJ gas consumed)	PJ	55.77	517563.35	28.86	(e.g. PJ gas consumed)	PJ	116.35	139667.38	16.25
		7. Other	(e.g. PJ gas consumed)	PJ	29.68	IE	IE	(e.g. PJ gas consumed)	PJ	185.90	IE	IE
DEU	**Germany**	**Natural Gas**					**317.60**					**192.99**
		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	8557887.89	0.12	1.03
		5. Processing	gas produced	1000 m³	15262000.00	0.35	5.34	gas produced	1000 m³	8557887.89	0.04	0.38
		6. Transmission and storage	length of transmission pipelines	km	22696.00	1957.42	44.43	length of transmission pipelines	km	35595.00	2137.84	76.10
		7. Distribution	length of distribution pipelines	km	282612.00	824.05	232.89	length of distribution pipelines	km	505000.00	175.78	88.77
		8. Other	gas consumed	TJ	893519.00	32.62	29.15	gas consumed	TJ	1240006.00	21.55	26.72

DNM	Denmark	**Natural Gas**					**2.43**					**1.90**
		3. Exploration		m3	2892051.56	0.01	0.03		m3	29220.00	0.01	0.00
		4. Production	Gas produced	10^6 m3	5137.00	380.00	1.95	Gas produced	10^6 m3	4522.00	380.00	1.72
		5. Processing	Gas produced	10^6 m3	5137.00	NA	NA	Gas produced	10^6 m3	4522.00	NA	NA
		6. Transmission and storage	Gas transmission	10^6 m3	2739.00	69.45	0.19	Gas transmission	10^6 m3	4796.00	6.51	0.03
		7. Distribution	Gas distributed	10^6 m3	1749.06	145.93	0.26	Gas distributed	10^6 m3	2325.00	66.54	0.15
		8. Other	Incl. In transmission	m3	NO	NO	NO	Incl. In transmission	m3	NO	NO	NO
ESP	Spain	**Natural Gas**					**17.18**					**26.14**
		3. Exploration	Mm3 gas produced	Mm3	NA	NE	NE	Mm3 gas produced	Mm3	NA	NE	NE
		4. Production	Mm3 gas produced	Mm3	1314.69	461.95	0.61	Mm3 gas produced	Mm3	65.79	2096.50	0.14
		5. Processing	Mm3 gas produced	Mm3	1314.69	150.00	0.20	Mm3 gas produced	Mm3	65.79	150.00	0.01
		6. Transmission and storage	PJ gas (NCV)	PJ	197.90	837.97	0.17	PJ gas (NCV)	PJ	1029.94	1519.12	1.56
		7. Distribution	PJ of gaseous fuels (natural gas, LPG, gas	PJ	205.31	78930.47	16.21	PJ of gaseous fuels (natural gas, LPG, gas	PJ	1038.29	23528.81	24.43
		8. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EST	Estonia	**Natural Gas**					**2.01**					**0.62**
		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	15.83	2217.60	0.04
		8. Distribution	Amount of natural gas distributed	PJ	51.23	36960.00	1.89	Amount of natural gas distributed	PJ	15.83	36960.00	0.59
		9. Other	Other	NA	NO	NO	NO	Other	NA	NO	NO	NO
FIN	Finland	**Natural Gas**					**0.17**					**1.15**
		4. Exploration		NO	NO	NO	NO		NO	NO	NO	NO
		5. Production		NO	NO	NO	NO		NO	NO	NO	NO
		6. Processing		NA	NO	NO	NO		NA	NA	NA	0.00
		7. Transmission and storage	PJ gas consumed	PJ	91.58	1856.22	0.17	PJ gas consumed	PJ	93.82	3959.88	0.37
		8. Distribution	PJ gas distributed	NO	NO	NO	NO	PJ gas distributed	NO	7.60	102720.03	0.78
		9. Other		NO	NO	NO	NO		NO	NO	NO	NO
FRK	France	**Natural Gas**					**60.47**					**44.35**
		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	5.97	303.96	0.00
		7. Transmission and storage	Gas consumed	PJ	1055.46	25248.13	26.65	Gas consumed	PJ	1464.61	16356.45	23.96
		8. Distribution	Gas consumed	PJ	1055.46	31352.87	33.09	Gas consumed	PJ	1464.61	13920.81	20.39
		9. Other	NO	PJ	NO	NO	NO	NO	PJ	NO	NO	NO

GBR	**United Kingdom**	**Natural Gas**					**406.73**					**154.52**
		5. Exploration	Exploration drilling: fuel use	t	225517.62	15.66	3.53	Exploration drilling: fuel use	t	18934.06	45.00	0.85
		6. Production	Gas produced	PJ	1709.37	IE	IE	Gas produced	PJ	1491.27	IE	IE
		7. Processing	Gas produced	PJ	1709.37	12756.73	21.81	Gas produced	PJ	1491.27	1617.54	2.41
		8. Transmission and storage	Natural gas supply	GWh	387730.56	23.58	9.14	Natural gas supply	GWh	490309.12	4.74	2.32
		9. Distribution	Natural gas supply	GWh	387730.56	960.08	372.25	Natural gas supply	GWh	490309.12	303.75	148.93
		10. Other		NA	NO	NO	NO		NA	NO	NO	NO
GRC	**Greece**	**Natural Gas**					**0.37**					**2.63**
		5. Exploration			NE	NE	NE			NE	NE	NE
		6. Production		mil_m3	123.00	1930.00	0.24		mil_m3	4.00	1930.00	0.01
		7. Processing		mil_m3	123.00	IE	IE		mil_m3	4.00	IE	IE
		8. Transmission and storage		mil m3	123.00	298.00	0.04		mil m3	3138.00	298.00	0.94
		9. Distribution		mil m3	86.24	1100.00	0.09		mil m3	1529.36	1100.00	1.68
		10. Other			IE	IE	IE			IE	IE	IE
HRV	**Croatia**	**Natural Gas**					**5.92**					**5.84**
		5. Exploration		1000000 m3	1982.30	194.00	0.38		1000000 m3	1780.50	194.00	0.35
		6. Production	gas produced	1000000 m3	1982.30	1340.76	2.66	gas produced	1000000 m3	1780.50	1340.76	2.39
		7. Processing	gas produced	1000000 m3	1982.30	592.00	1.17	gas produced	1000000 m3	1780.50	592.00	1.05
		8. Transmission and storage	marketable gas	1000000 m3	2686.60	480.00	1.29	marketable gas	1000000 m3	2519.20	480.00	1.21
		9. Distribution	utility sales	1000000 m3	379.30	1100.00	0.42	utility sales	1000000 m3	766.20	1100.00	0.84
		10. Other		NO	NO	NO	NO		NO	NO	NO	NO
HUN	**Hungary**	**Natural Gas**					**29.39**					**16.93**
		6. Exploration		NA	IE	IE	IE		NA	IE	IE	IE
		7. Production	Gas production (million m3)	million m3	4874.00	1340.00	6.53	Gas production (million m3)	million m3	1758.00	1340.00	2.36
		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	639.00	918.79	0.59
		9. Transmission and storage	Marketable gas (million m3)	million m3	11278.00	674.50	7.61	Marketable gas (million m3)	million m3	8548.00	298.00	2.55
		10. Distribution	Utility sales (million m3)	million m3	12507.10	1100.00	13.76	Utility sales (million m3)	million m3	10402.33	1100.00	11.44
		11. Other		NO	NO	NO	NO		NO	NO	NO	NO
IRL	**Ireland**	**Natural Gas**					**6.24**					**0.91**
		6. Exploration	Natural gas exploration	PJ	IE	IE	IE	Natural gas exploration	PJ	IE	IE	IE
		7. Production		PJ	78.58	14330.75	1.13		PJ	4.50	75795.30	0.34
		8. Processing		PJ	IE	IE	IE		PJ	IE	IE	IE
		9. Transmission and storage		PJ	IE	IE	IE		PJ	IE	IE	IE
		10. Distribution		PJ	23.85	214519.35	5.12		PJ	75.74	7549.49	0.57
		11. Other		PJ	NO	NO	NO		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		PJ	NO	NO	NO		PJ	NO	NO	NO
		8. Processing		PJ	NO	NO	NO		PJ	NO	NO	NO
		9. Transmission and storage		PJ	NO	NO	NO		PJ	NO	NO	NO
		10. Distribution		PJ	NO	NO	NO		PJ	NO	NO	NO
		11. Other		PJ	NO	NO	NO		PJ	NO	NO	NO

ITA	Italy	**Natural Gas**					**329.41**					**181.79**
		6. Exploration	Wells explored	Number	36.00	158.15	0.01	Wells explored	Number	3.00	0.43	0.00
		7. Production	Gas produced	Mm3	17296.39	1726.36	29.86	Gas produced	Mm3	6876.61	906.05	6.23
		8. Processing	Gas produced	Mm3	17296.39	773.26	13.37	Gas produced	Mm3	6876.61	405.75	2.79
		9. Transmission and storage	Gas transported	Mm3	45683.58	822.12	37.56	Gas transported	Mm3	67250.00	460.84	30.99
		10. Distribution	Gas distributed	Mm3	20632.00	12049.80	248.61	Gas distributed	Mm3	32366.90	4380.35	141.78
		11. Other	other	NA	NO	NO	NO	other	NA	NO	NO	NO
LTU	Lithuania	**Natural Gas**					**10.42**					**11.57**
		7. Exploration		NO	NO	NO	NO		NO	NO	NO	NO
		8. Production		NO	NO	NO	NO		NO	NO	NO	NO
		9. Processing		NO	NO	NO	NO		NO	NO	NO	NO
		10. Transmission and storage	Natural gas leakages	thous.t	2.01	977699.00	1.97	Natural gas leakages	thous.t	3.71	954480.90	3.54
		11. Distribution	Natural gas leakages	thous.t	8.65	977699.00	8.46	Natural gas leakages	thous.t	8.41	954480.90	8.03
		12. Other	Natural gas leakages	thous.t	IE	IE	IE	Natural gas leakages	thous.t	IE	IE	IE
LUX	Luxembourg	**Natural Gas**					**0.77**					**1.38**
		7. Exploration	gas exploration	NA	NO	NO	NO	gas exploration	NA	NO	NO	NO
		8. Production	gas produced	NA	NO	NO	NO	gas produced	NA	NO	NO	NO
		9. Processing	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	32201.18	13.04	0.42
		11. Distribution	gas consumed	TJ	17933.32	30.07	0.54	gas consumed	TJ	32201.18	29.88	0.96
		12. Other	NO	NA	NO	NO	NO	NO	NA	NO	NO	NO
LVA	Latvia	**Natural Gas**					**7.09**					**3.47**
		7. Exploration	Exploration	m3	NO	NO	NO	Exploration	m3	NO	NO	NO
		8. Production	Production	m3	NO	NO	NO	Production	m3	NO	NO	NO
		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	44242.00	0.68	0.03
		11. Distribution	Distribution	m3	694188.00	0.69	0.48	Distribution	m3	714231.00	0.68	0.48
		12. Other	Other	m3	12435406.00	0.52	6.53	Other	m3	4352798.00	0.68	2.95
MLT	Malta	**Natural Gas**					**NO**					**NO**
		8. Exploration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		9. Production	gas produced	NO	NO	NO	NO	gas produced	NO	NO	NO	NO
		10. Processing	NO	no	NO	NO	NO	NO	no	NO	NO	NO
		11. Transmission and storage	gas consumed	NO	NO	NO	NO	gas consumed	NO	NO	NO	NO
		12. Distribution	gas consumed	NO	NO	NO	NO	gas consumed	NO	NO	NO	NO
		13. Other		NO	NO	NO	NO		NO	NO	NO	NO
NLD	Netherlands	**Natural Gas**					**16.84**					**12.93**
		8. Exploration		number	NA	IE	IE		number	NA	IE	IE
		9. Production		PJ	2300.00	IE	IE		PJ	2409.00	IE	IE
		10. Processing		PJ	IE	IE	IE		PJ	IE	IE	IE
		11. Transmission and storage		PJ	2648.08	4121.34	10.91		PJ	3029.00	2378.67	7.21
		12. Distribution		10^3 km	99.98	59294.88	5.93		10^3 km	124.92	45854.45	5.73
		13. Other		PJ	NA	NO	NO		PJ	IE	NO	NO

POL	**Poland**	**Natural Gas**					**27.10**					**41.85**
		8. Exploration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		9. Production	Production	PJ	99.56	66879.91	6.66	Production	PJ	154.20	66879.91	10.31
		10. Processing		PJ	99.56	29950.57	2.98		PJ	154.20	29950.57	4.62
		11. Transmission and storage	gas consumed	PJ	374.21	13957.55	5.22	gas consumed	PJ	576.76	13957.55	8.05
		12. Distribution	gas consumed	PJ	374.21	31986.04	11.97	gas consumed	PJ	576.76	31986.04	18.45
		13. Other	NA	PJ	374.21	726.96	0.27	NA	PJ	576.76	726.96	0.42
PRT	**Portugal**	**Natural Gas**					**NO**					**2.15**
		9. Exploration		NO	NO	NO	NO		NO	NO	NO	NO
		10. Production		NO	NO	NO	NO		NO	NO	NO	NO
		11. Processing		NO	NO	NO	NO		NO	NO	NO	NO
		12. Transmission and storage		toe NG Transm	NO	NO	NO		G Transmitted	4015.68	16.46	0.07
		13. Distribution		toe NG Distrib	NO	NO	NO		NG Distributed	1617.85	1289.51	2.09
		14. Other		NO	NO	NO	NO		NO	NO	NO	NO
ROU	**Romania**	**Natural Gas**					**459.31**					**185.33**
		9. Exploration	gas produced		IE	IE	IE	gas produced		IE	IE	IE
		10. Production	gas produced	106m3	28336.00	12190.00	345.42	gas produced	106m3	11092.00	12190.00	135.21
		11. Processing	gas produced and processed	106m3	28336.00	250.00	7.08	gas produced and processed	106m3	11092.00	250.00	2.77
		12. Transmission and storage	gas produced	106m3	35667.00	633.00	22.58	gas produced	106m3	11295.00	633.00	7.15
		13. Distribution	gas supplied	106m3	35667.00	1800.00	64.20	gas supplied	106m3	11295.00	1800.00	20.33
		14. Other	gas consumed	PJ	143.63	139500.00	20.04	gas consumed	PJ	142.39	139500.00	19.86
SVK	**Slovakia**	**Natural Gas**					**44.14**					**32.20**
		9. Exploration		NA	NO	NO	NO		NA	NO	NO	NO
		10. Production	Production/Processing	mil m3	444.00	2300.00	1.02	Production/Processing	mil m3	93.00	2300.00	0.21
		11. Processing		mil m3	444.00	1030.00	0.46		mil m3	93.00	1030.00	0.10
		12. Transmission and storage	Transfer	mil m3	73600.00	480.00	35.33	Transfer	mil m3	55800.00	480.00	26.78
		13. Distribution	Distribution	mil m3	6666.00	1100.00	7.33	Distribution	mil m3	4639.00	1100.00	5.10
		14. Other	Storage	mil m3	1.00	25.00	0.00	Storage	mil m3	139.00	25.00	0.00
SVN	**Slovenia**	**Natural Gas**					**1.70**					**1.21**
		10. Exploration		1000 m3	NO	NO	NO		1000 m3	NO	NO	NO
		11. Production	Gas production	1000 m3	23631.00	12.19	0.29	Gas production	1000 m3	3000.00	1.34	0.00
		12. Processing		1000 m3	NO	NO	NO		1000 m3	NO	NO	NO
		13. Transmission and storage	Marketable gas	1000 m3	892000.60	0.48	0.43	Marketable gas	1000 m3	816000.00	0.38	0.31
		14. Distribution	Utility sale	1000 m3	892000.60	1.10	0.98	Utility sale	1000 m3	816000.00	1.10	0.90
		15. Other		1000 m3	NO	NO	NO		1000 m3	NO	NO	NO
SWE	**Sweden**	**Natural Gas**					**2.69**					**1.44**
		10. Exploration		NA	NO	NO	NO		NA	NO	NO	NO
		11. Production		NA	NO	NO	NO		NA	NO	NO	NO
		12. Processing		NA	NO	NO	NO		NA	NO	NO	NO
		13. Transmission and storage	Length of gas transmission network	km			0.05	Length of gas transmission network	km			0.08
		14. Distribution		NA			2.65		NA			1.36
		15. Other		NA	NO	NO	NO		NA	NO	NO	NO

Table 3.122 and Table 3.123 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 2014 and main explanations for the largest recalculations in absolute terms.

Table 3.1221B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EU recalculations in CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	-22	-22.5	A recalculation was performed for the complete time series in the category 1B2b4 Natural Gas Transmission.
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	0.0	data on oil transported was recalculated
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	0	-0.1	Activity data for the oil terminal are updated for 2011-2014 according to the annual environmental report. The recalculation is of minor importance (<0.001 % of the total CH_4 emission from 1B2b2).
Estonia	0	0.0	0	0.0	-
Finland	0	0.0	0	0.0	
France	0	0.0	-3	-0.1	- 1B2b3 - Extraction of natural gas: Update of the activity data with the new edition of the CPDP. - 1B2b4 - Natural gas transportation: Addition of residual micro-leaks from the transmission network and modification of data sources for compressor station discharges. - 1B2b5 - Distribution of natural gas: Addition of Type III micro-leaks in the natural gas distribution network and modification of emissions for 2014 following a new communication of data by GRDF.
Germany	2	0.1	1	0.1	Transport crude oil: During the ESD Review 2015 it was noted that the emission factors used were not converted with the density of crude oil. In addition, the emissions from the distribution using Binnentank ships are not considered. Now the conversion and the consideration Of the emissions from the tank ships lead to losses over the complete time series under 1.B.2.a.iii. Sour gas processing: In the calculation of methane emissions, instead of the amount of sour gas, the amount of natural gas was applied. This led to an overestimation of emissions in the total time series of 60%. Transmission, storage and distribution of natural gas: In the ESD Review 2015 it was noted that the carbon dioxide emissions are not negligible. Therefore emissions were calculated with the mean natural gas composition and the Notation Key NE is replaced by corresponding values.
Greece	0	0.0	0	0.0	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Hungary	0	0.0	0	0.0	
Ireland	0	100.0	0	100.0	Emissions of CO_2 from the distribution of natural gas were included in this submission for the first time resulting in an average increase of 0.04 kt CO_2e across the time-series.
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	0	14.9	1	21.0	Correction of emission factors for fugitive emissions from oil based on the 2006 IPCC Guidelines instead of emission factors based on 2000 IPCC Good Practice Guidance following recommendations provided by the review experts.
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Poland	-42	-50.3	-246	-13.3	No explanation provided
Portugal	-89	-42.7	-305	-22.4	Correction of CO_2 emissions compilation error in Refineries (1.B.2.a.4)The methodology for estimating the fugitive emissions from the transportation and distribution of Natural Gas was revised (1. B. 2. b)
Romania	-36	-3.0	-8	-0.8	Recalculation have been made for the entire period 1989-2014. Recalculations were made as a result of due to the improvements on estimating CO_2 emissions at the AD level (CRF category 1B2a2, 1B2b3), at the EFs level (CRF category 1B2a; 1B2b3, 1B.2c)
Slovakia	0	0.0	0	2.2	Revision of the NG distribution quantity based on the revision of the National Energy Statistics
Slovenia	0	0.0	0	0.0	
Spain	103	6.2	100	2.5	IPCC 2006 implemented
Sweden	0	0.0	-24	-3.4	1.B.2.A.4: In order to ensure consistency in the calculations (either standard values or values from EU ETS for both calorific values and CO_2 emission factors), corrections have been made for the years 2010-2012, which resulted in decrease of all emissions (by ~15-17 kt CO_2-eq. for GHG). For one of the largest facilities, emissions of CO_2 reported to EU ETS are used instead of standard emission factors (as in earlier submissions) for the years 2013 and 2014, which resulted in emission decrease by 19 and 26 kt CO_2-eq, respectively. For the same facility, amount of combusted cracker coke has been updated for 2014, resulting in increase of other emissions (CH_4, N_2O) by ~0.002 kt CO_2-eq. 1.B.2.A.5: Minor corrections of NMVOC emissions from gasoline depots were made for 2012 and 2014. 1.B.2.B.4, 1.B.2.C.1.2: The method for calculation of diffuse emissions from natural gas transmission and storage has been revised. Part of the emissions, reported by the operator and earlier considered as diffuse emissions, has been re-allocated to the sector 1.B.2.C.1.2 venting. Diffuse emissions in submission 2017 are calculated via emission factors based on the measurement results,

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
United Kingdom	0	0.0	0	0.0	No significant recalculations
EU28	-61	-0.3	-506	-2.2	
Iceland	0	0.0	0	0.0	
EU28+ISL	-61	-0.3	-506	-2.2	

Table 3.1231B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-28+ISL recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	91	14.5	0	0.0	A recalculation was performed for the complete time series in the category 1B2b4 Natural Gas Transmission.
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	0	0.1	Activity data for the oil terminal are updated for 2011-2014 according to the annual environmental report. The recalculation is of minor importance (<0.001 % of the total CH_4 emission from 1B2b2).
Estonia	0	0.0	0	0.0	-
Finland	0	0.0	-1	-2.0	In Fugitive emissions from fuels (CRF 1.B), emissions of distribution of natural gas for 2011 to 2014 were recalculated due to new information on released natural gas.
France	311	21.2	316	35.2	- 1B2b3 - Extraction of natural gas: Update of the activity data with the new edition of the CPDP. - 1B2b4 - Natural gas transportation: Addition of residual micro-leaks from the transmission network and modification of data sources for compressor station discharges. - 1B2b5 - Distribution of natural gas: Addition of Type III micro-leaks in the natural gas distribution network and modification of emissions for 2014 following a new communication of data by GRDF.
Germany	-5	-0.1	-29	-0.6	Transport crude oil: During the ESD Review 2015 it was noted that the emission factors used were not converted with the density of crude oil. In addition, the emissions from the distribution using Binnentank ships are not considered. Now the conversion and the consideration Of the emissions from the tank ships lead to losses over the complete time series under 1.B.2.a.iii.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					Sour gas processing: In the calculation of methane emissions, instead of the amount of sour gas, the amount of natural gas was applied. This led to an overestimation of emissions in the total time series of 60%. Transmission, storage and distribution of natural gas: In the ESD Review 2015 it was noted that the carbon dioxide emissions are not negligible. Therefore emissions were calculated with the mean natural gas composition and the Notation Key NE is replaced by corresponding values.
Greece	0	0.0	0	0.0	
Hungary	0	0.0	-3	-0.5	Revised activity data
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-363	-6.2	Update of activity data
Latvia	0	0.0	0	0.0	
Lithuania	-7	-2.5	-5	-1.8	Correction of emission factors for fugitive emissions from oil based on the 2006 IPCC Guidelines instead of emission factors based on 2000 IPCC Good Practice Guidance following recommendations provided by the review experts.
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Poland	30	3.0	22	0.9	No explanation provided
Portugal	-34	-55.8	-123	-60.7	The methodology for estimating the fugitive emissions from the transportation and distribution of Natural Gas was revised (1. B. 2. b)
Romania	-4 382	-15.2	-42	-0.4	Recalculation have been made for the entire period 1989-2014. Recalculations were made as a result of due to the improvements on estimating CH_4 emissions at the AD level (CRF category 1B2a2, 1B2b3), at the EFs level (CRF category 1B2a; 1B2b3, 1B.2c)
Slovakia	0	0.0	14	1.4	Revision of the NG distribution quantity based on the revision of the National Energy Statistics
Slovenia	0	0.0	0	0.0	
Spain	-113	-15.5	1	0.1	IPCC 2006 implemented
Sweden	1	1.2	2	3.0	1.B.2.A.4: In order to ensure consistency in the calculations (either standard values or values from EU ETS for both calorific values and CO_2 emission factors), corrections have been made for the years 2010-2012, which resulted in decrease of all emissions (by ~15-17 kt CO_2-eq. for GHG). For one of the largest facilities, emissions of CO_2 reported to EU ETS are used instead of standard emission factors (as in earlier submissions) for the years 2013 and 2014, which

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					resulted in emission decrease by 19 and 26 kt CO_2-eq, respectively. For the same facility, amount of combusted cracker coke has been updated for 2014, resulting in increase of other emissions (CH_4, N_2O) by ~0.002 kt CO_2-eq. 1.B.2.A.5: Minor corrections of NMVOC emissions from gasoline depots were made for 2012 and 2014. 1.B.2.B.4, 1.B.2.C.1.2: The method for calculation of diffuse emissions from natural gas transmission and storage has been revised. Part of the emissions, reported by the operator and earlier considered as diffuse emissions, has been re-allocated to the sector 1.B.2.C.1.2 venting. Diffuse emissions in submission 2017 are calculated via emission factors based on the measurement results,
United Kingdom	0	0.0	-85	-1.6	New information provided by gas distributors indicates lower leakage emissions in 2014 and other recent years, following a programme of closures of LNG storage facilities.
EU28	-4 108	-5.9	-296	-0.8	
Iceland	0	-9.0	0	-2.2	No explanation provided
EU28+ISL	-4 108	-5.9	-296	-0.8	

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). Finland is the only member state reporting CO_2 emissions in this category for the years 1993 to 2015.

The amount of CO_2 captured reflects the CO_2 captured in pulp and paper mills in Finland, where precipitated calcium carbonate (PCC) is formed and then used in the paper and paperboard industry. The final use of the CO_2 captured is considered as long-term storage except if the products are combusted. The resulting fossil CO_2 emissions from combustion of products containing PCC are taken into account in the corresponding categories in the greenhouse gas inventory of Finland. A detailed description of the methodology is provided in Finland's NIR.

CO_2 emissions from 1C 'CO_2 capture and storage' account for 0.003 % of total EU-28+ISL GHG emissions in 2015. The emission increased between 1993 and 2015 by 16 018%.

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 3.124 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 1A2c and the lowest for CO_2 from 1A2e. 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 1.6.

Table 3.124 Sector 1 Energy (excl. 1A3b and 1B): Uncertainty estimates for EU-28

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	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	544 497	489 569	-10.1%	2.93%	0.003%
1.A.1.a Public electricity and heat production	CH_4	314	2 665	747%	69%	5.2%
1.A.1.a Public electricity and heat production	N_2O	2 495	2 853	14%	32%	0.1%
1.A.1.b Petroleum refining	CO_2	50 615	46 542	-8%	4%	0.02%
1.A.1.b Petroleum refining	CH_4	18	14	-18%	18%	0.06%
1.A.1.b Petroleum refining	N_2O	191	126	-34%	31%	0.1%
1.A.1.c Manufacture of solid fuels and other energy industries	CO_2	46 809	16 614	-65%	5%	0.04%
1.A.1.c Manufacture of solid fuels and other energy industries	CH_4	145	178	22%	133%	0.3%
1.A.1.c Manufacture of solid fuels and other energy industries	N_2O	369	157	-57%	22%	0.1%
1.A.2.a Iron and Steel	CO_2	50 663	42 879	-15%	5%	0.01%
1.A.2.a Iron and Steel	CH_4	79	74	-6%	27%	0.1%
1.A.2.a Iron and Steel	N_2O	204	235	15%	231%	1.3%
1.A.2.b Non-ferrous Metals	CO_2	2 899	1 938	-33%	9%	0.022%
1.A.2.b Non-ferrous Metals	CH_4	3	2	-30%	66%	0.1%
1.A.2.b Non-ferrous Metals	N_2O	16	9	-48%	98%	0.3%
1.A.2.c Chemicals	CO_2	31 619	6 508	-79%	2%	0.0%
1.A.2.c Chemicals	CH_4	20	17	-18%	68%	0.4%
1.A.2.c Chemicals	N_2O	35	30	-15%	380%	1.6%
1.A.2.d Pulp, Paper and Print	CO_2	2 672	1 404	-47%	2%	0.02%
1.A.2.d Pulp, Paper and Print	CH_4	5	8	63%	55%	0.3%
1.A.2.d Pulp, Paper and Print	N_2O	42	31	-27%	191%	0.5%
1.A.2.e Food Processing, Beverages and Tobacco	CO_2	7 687	3 758	-51%	1%	0.02%
1.A.2.e Food Processing, Beverages and Tobacco	CH_4	9	9	-3%	62%	0.4%
1.A.2.e Food Processing, Beverages and Tobacco	N_2O	41	13	-69%	192%	0.6%
1.A.2.f Non-metallic minerals	CO2	28 020	20 709	-26%	3%	0.01%
1.A.2.f Non-metallic minerals	CH4	35	51	47%	39%	0.26%
1.A.2.f Non-metallic minerals	N2O	211	180	-15%	59%	0.34%
1.A.2.g Other	CO_2	130 625	83 014	-36%	3%	0.01%
1.A.2.g Other	CH_4	210	232	10%	30%	0.10%
1.A.2.g Other	N_2O	819	662	-19%	35%	0.1%
1.A.4.a Commercial/Institutional	CH_4	385	235	-39%	51%	1.0%
1.A.4.a Commercial/Institutional	N_2O	220	105	-52%	105%	0.4%
1.A.4.b Residential	CO_2	168 224	110 994	-34%	7%	0.02%
1.A.4.b Residential	CH_4	2 618	2 927	12%	65%	0.2%
1.A.4.b Residential	N_2O	702	641	-9%	118%	0.3%
1.A.4.c Agriculture/forestry/fishing	CO_2	29 551	19 722	-33%	6%	0.02%
1.A.4.c Agriculture/forestry/fishing	CH_4	294	1 483	405%	44%	1.6%
1.A.4.c Agriculture/forestry/fishing	N_2O	238	235	-1%	170%	0.2%
1.A.5 Other	CO_2	15 593	4 097	-74%	18%	0.12%
1.A.5 Other	CH_4	36	42	18%	135%	4.8%
1.A.5 Other	N_2O	150	59	-60%	286%	1.8%
1.A (where no subsector data were submitted)	*all*	746 803	*473 626*	*-37%*	*1%*	*0.8%*
1.A.1 (where no subsector data were submitted)	*all*	*625 047*	*422 903*	*-32%*	*1%*	*0.6%*
1.A.2 (where no subsector data were submitted)	*all*	*393 939*	*235 964*	*-40%*	*2%*	*0.8%*
1.A.3 (where no subsector data were submitted)	*all*	*249 304*	*286 821*	*15%*	*3%*	*0.6%*
1.A.4 (where no subsector data were submitted)	*all*	*399 699*	*307 382*	*-23%*	*3%*	*1.4%*
Total - 1.A (where no subsector data were submitted)	**all**	**746 803**	**473 626**	**-37%**	**1.3%**	**0.8%**
Total - 1.A.1	**all**	**1 270 500**	**981 622**	**-23%**	**1.6%**	**0.4%**
Total - 1.A.2	**all**	**649 854**	**397 726**	**-39%**	**1.5%**	**0.6%**
Total - 1.A.3	**all**	**780 139**	**884 243**	**13%**	**2.3%**	**0.6%**
Total - 1.A.4	**all**	**672 846**	**494 426**	**-27%**	**2.6%**	**1.1%**
Total - 1.A.5	**all**	**15 779**	**4 199**	**-73%**	**4.6%**	**3.0%**
Total - 1.A	**all**	**4 135 921**	**3 235 842**	**-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 3.125 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 CO_2 from 1B1.

Table 3.125 1B Fugitive Emissions: Uncertainty estimates for EU-28

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid Fuels	CO_2	6 755	4 645	-31%	6%	0.03%
1.B.1 Solid Fuels	CH_4	92 107	27 610	-70%	46%	0.2%
1.B.1 Solid Fuels	N_2O	0.1	0.1	-4%	103%	0.2%
1.B.2. Oil and Natural Gas and other emissions from energy production	CO_2	18 943	20 078	6%	13%	0.14%
1.B.2. Oil and Natural Gas and other emissions from energy production	CH_4	64 754	28 119	-57%	32%	0.10%
1.B.2. Oil and Natural Gas and other emissions from energy production	N_2O	130	99	-24%	465%	0.71%
1.B (werhe no subsector data were submitted)	*all*	*14 007*	*8 557*	*-39%*	*55%*	*13.6%*
Total - 1.B	**all**	**196 697**	**89 108**	**-55%**	**18.3%**	**8.1%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.126 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 1A3e. With regard to trend N_2O from 1A3d show the highest uncertainty estimates, CO_2 from 1A3b the lowest.

Table 3.126 1A3 Transport: Uncertainty estimates for EU-28

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Domestic aviation	CO_2	8 142	8 039	-1%	12%	0.02%
1.A.3.a Domestic aviation	CH_4	8	4	-55%	66%	0.3%
1.A.3.a Domestic aviation	N_2O	73	63	-15%	133%	0.2%
1.A.3.b Road transport	CO_2	487 169	568 992	17%	3%	0.01%
1.A.3.b Road transport	CH_4	3 348	687	-79%	29%	0.3%
1.A.3.b Road transport	N_2O	4 683	4 873	4%	42%	0.2%
1.A.3.c Railways	CO_2	7 166	3 149	-56%	4%	0.02%
1.A.3.c Railways	CH_4	9	4	-54%	79%	0.3%
1.A.3.c Railways	N_2O	489	213	-56%	122%	0.4%
1.A.3.d Domestic navigation	CO_2	15 285	8 058	-47%	17%	0.2%
1.A.3.d Domestic navigation	CH_4	22	18	-16%	86%	0.2%
1.A.3.d Domestic navigation	N_2O	211	145	-31%	233%	0.6%
1.A.3.e Other transportation	CO_2	4 193	3 151	-25%	2%	0.02%
1.A.3.e Other transportation	CH_4	9	7	-14%	60%	0.1%
1.A.3.e Other transportation	N_2O	27	20	-29%	75%	0.3%
Total - 1.A.3	**all**	**780 139**	**884 243**	**13%**	**2.3%**	**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 2005, 2008-2010, 2013 and 2014 in order to track progress of the EU Member States under the EU Effort Sharing Decision. (ESD review 2016). In 2017, an annual review was carried out for all significant issues identified the initial checks phase with a focus on the year 2015 in order to track progress of the EU Member States under the EU Effort Sharing Decision. (ESD review 2017).

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, 2016 and 2017 and during the initial checks 2015, 2016 and 2017 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[14]. 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 are 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.

[14] 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.

The energy statistics regulation helps improving the QA/QC of the EU inventory as it:

- makes available more detailed energy statistics by fuel,
- allows the estimation of CO_2 emissions from energy with the reference and sectoral approach,
- assures the quality of the underlying energy statistics,
- improves timeliness of energy statistics,
- provides a formal legal framework assuring consistency between national and Eurostat data.

Moreover, Article 6, paragraph 2 stipulates that:

'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'.

In addition, Article 7(1)(m)(iii) of the MMR in conjunction with Article 12 of the implementing regulation requires Member States to report to the European Commission textual information on the comparison between the reference approach calculated on the basis of the data included in the greenhouse gas inventory and the reference approach calculated on the basis of the data reported pursuant to the Energy Statistics Regulation. Member States with differences of more than +/- 2% in the total national apparent fossil fuel consumption have to provide quantitative information and explanations for the year X-2 in accordance with the tabular format set out in Annex VI of the implementing regulation.

Eurocontrol data

Since 2010 there are framework contracts in place between the European Commission and EUROCONTROL, the European organization for the safety of air navigation, pertaining to the improvement of GHG and air pollutant emissions inventories submitted by the 28 Member States and the European Union to the UNFCCC and to the UNECE. EU Member States shall be assisted to improve the reporting of annual greenhouse gas (and other air pollutant) emission inventories by e.g. estimating the fuel split domestic/international using real flight data from EUROCONTROL. For this, the European Environment Agency and its 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 Chapter 1.4.2.

In November 2016 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 2015 by EU Member States and other EEA member countries (Iceland, Liechtenstein, Switzerland, Norway and Turkey). Recalculations took place to reflect i.a. corrections of aircraft types and their relation to engine types and corrections of the calculation of CH_4 and N_2O.

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 2015 has been prepared by the European Environment Agency and its ETC/ACM in February 2017. 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 both domestic and 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 identical between EU inventory and EUROCONTROL results. For domestic aviation the difference in CO_2 emissions is 0.3 Mt CO_2 in 2015. 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 2015 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. With the new methodology applied for the calculation of N_2O and CH_4 emissions by EUROCONTROL, implied emission factors for these gases are now much more comparable with Member State results.

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 and 2017 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 2017.

3.5 Sector-specific recalculations

Table 3.127 shows that in the energy sector the largest recalculations in absolute terms in 1990 were made for CO_2 and in 2014 for CH_4. In relative terms, the largest recalculations in 1990 were made for CH_4 (-2.8 %) and in 2014 for CH_4 (+6.4 %).

Table 3.127 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2014 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	14 507	0.3%	-5 960	-0.8%	-3 392	-0.8%	0	0.0%	501	1.9%	84	0.8%	135	2.4%	0	0.0%
Energy	-8 117	-0.2%	-5 566	-2.8%	-341	-1.1%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2014																
Total emissions and removals	2 360	0.1%	5 458	1.2%	-4 686	-1.8%	492	0.4%	16	0.5%	-5	-0.1%	68	45.0%	0	0.0%
Energy	1 873	0.1%	5 252	6.4%	-900	-3.0%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Note: The 2014 recalculations in this table slightly differ from the CRF table 8 because the previous year values used for this table do not include emissions from Mayotte.

NO: not occurring

Table 3.128 provides an overview of Member States' contributions to EU-28 and Iceland recalculations. In absolute terms, France had the most influence on CO_2 recalculations in the EU-28 + ISL in 2014. Explanations for recalculations by Member State are provided in Chapters 3.2and 10.1.

Table 3.128 Sector 1 Energy: Contribution of Member States to EU-28 and Iceland recalculations for 1990 and 2014 by gas (difference between latest submission and previous submission kt of CO_2 equivalents)

	1990								2014							
	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	-5.2	151.8	-36.2	NO	NO	NO	NO	NO	-117	33	-9	NO	NO	NO	NO	NO
Belgium	182.3	99.3	8.8	NO	NO	NO	NO	NO	300	-3	8	NO	NO	NO	NO	NO
Bulgaria	-508.3	103.3	-0.9	NO	NO	NO	NO	NO	-198	53	-1	NO	NO	NO	NO	NO
Croatia	0.0	-1.4	82.9	NO	NO	NO	NO	NO	168	-14	64	NO	NO	NO	NO	NO
Cyprus	0.0	0.0	0.0	NO	NO	NO	NO	NO	0	0	0	NO	NO	NO	NO	NO
Czech Republic	-12.5	1 273.7	42.7	NO	NO	NO	NO	NO	1 036	789	-233	NO	NO	NO	NO	NO
Denmark	28.5	-0.1	-1.6	NO	NO	NO	NO	NO	-56	5	0	NO	NO	NO	NO	NO
Estonia	446.8	0.0	0.0	NO	NO	NO	NO	NO	-6	0	0	NO	NO	NO	NO	NO
Finland	-2.1	-0.1	-1.6	NO	NO	NO	NO	NO	159	-110	-1	NO	NO	NO	NO	NO
France	-4 117.5	313.9	-7.7	NO	NO	NO	NO	NO	-8 911	305	-28	NO	NO	NO	NO	NO
Germany	2.2	1 050.0	0.1	NO	NO	NO	NO	NO	1 752	270	49	NO	NO	NO	NO	NO
Greece	-28.4	1.2	-17.9	NO	NO	NO	NO	NO	-842	-7	-35	NO	NO	NO	NO	NO
Hungary	263.5	1.8	-155.8	NO	NO	NO	NO	NO	417	298	-89	NO	NO	NO	NO	NO
Ireland	0.0	0.0	0.0	NO	NO	NO	NO	NO	-6	0	1	NO	NO	NO	NO	NO
Italy	-1 376.0	-39.8	-133.5	NO	NO	NO	NO	NO	4 347	-380	-173	NO	NO	NO	NO	NO
Latvia	102.7	0.3	0.0	NO	NO	NO	NO	NO	21	0	0	NO	NO	NO	NO	NO
Lithuania	-9.2	-6.8	0.0	NO	NO	NO	NO	NO	139	-5	0	NO	NO	NO	NO	NO
Luxembourg	-141.0	-0.7	-5.7	NO	NO	NO	NO	NO	-43	-1	0	NO	NO	NO	NO	NO
Malta	310.1	49.3	0.3	NO	NO	NO	NO	NO	-2	0	-6	NO	NO	NO	NO	NO
Netherlands	-109.9	33.9	0.1	NO	NO	NO	NO	NO	367	15	5	NO	NO	NO	NO	NO
Poland	-320.0	-3 996.5	-3.5	NO	NO	NO	NO	NO	-478	4 139	-99	NO	NO	NO	NO	NO
Portugal	-22.6	-34.8	-39.3	NO	NO	NO	NO	NO	-45	-121	-25	NO	NO	NO	NO	NO
Romania	-4 000.5	-4 398.5	-19.5	NO	NO	NO	NO	NO	3 149	-45	8	NO	NO	NO	NO	NO
Slovakia	91.4	0.5	3.6	NO	NO	NO	NO	NO	29	15	16	NO	NO	NO	NO	NO
Slovenia	0.3	0.0	0.0	NO	NO	NO	NO	NO	3	0	0	NO	NO	NO	NO	NO
Spain	1 890.8	-227.7	-13.4	NO	NO	NO	NO	NO	1 514	45	-100	NO	NO	NO	NO	NO
Sweden	0.6	-8.4	-18.9	NO	NO	NO	NO	NO	-150	-46	-163	NO	NO	NO	NO	NO
United Kingdom	-823.2	70.2	-22.2	NO	NO	NO	NO	NO	-684	19	-84	NO	NO	NO	NO	NO
EU28	-8 223.2	-5 565.8	-339.2	NO	NO	NO	NO	NO	1 865	5 253	-894	NO	NO	NO	NO	NO
Iceland	40.8	-0.2	-1.7	NO	NO	NO	NO	NO	9	-1	-5	NO	NO	NO	NO	NO
EU28+ISL	-8 116.5	-5 565.8	-340.9	NO	NO	NO	NO	NO	1 873	5 252	-900	NO	NO	NO	NO	NO

Note: The 2014 recalculation values for EU-28 and Iceland in this table slightly differ from the CRF table 8 because the previous year values used for this table do not include emissions from Mayotte.

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 2017). This submission includes the reference approach tables for 1990–2015.

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 2017.
- 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).
- Eurostat data is also used for table 1.A(d) (columns D-H) with the exception of the fuel "Coke oven coke"; for this fuel we used the sum of the Member States because Eurostat includes all coke use in iron and steel production under final energy consumption. In addition, 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 2015. The percentage differences for both energy consumption and CO_2 emissions are low.

Table 3.129 provides an overview for EU-28 Member States and Iceland on differences between the Eurostat and national reference approach for 2015. 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.

Iceland does not include liquid fuels from international fishing in the CRF reference approach but Eurostat includes this data

Table 3.129 Comparison between Eurostat and national reference approach for apparent consumption for EU-28 for 2015 (CRF 1.A) [15]

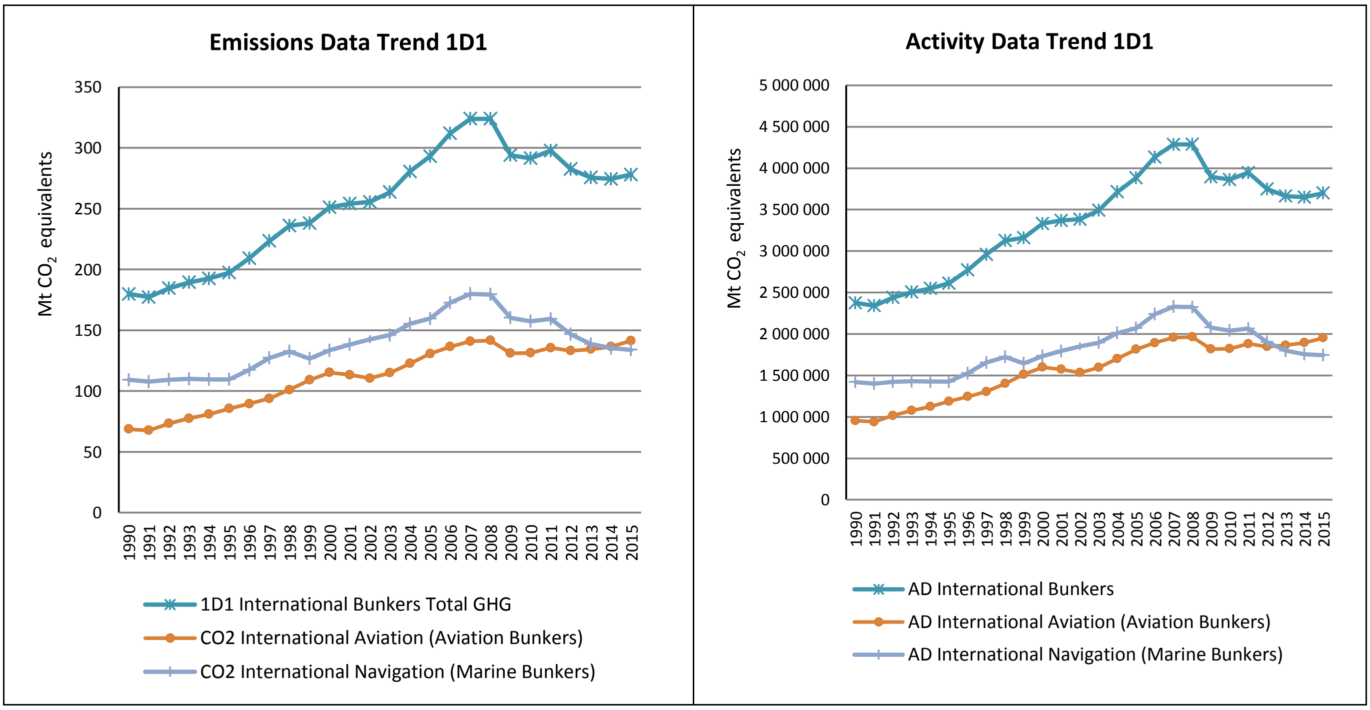
	Total gaseous			Total liquid			Total solid		
MS	**Eurostat TJ**	**Crf TJ**	**Difference %**	**Eurostat TJ**	**Crf TJ**	**Difference %**	**Eurostat TJ**	**Crf TJ**	**Difference %**
AT	287 931	287 931	0%	471 219	487 889	4%	132 968	135 038	2%
BE	584 776	581 851	-1%	953 099	960 773	1%	132 929	133 999	1%
BG	108 637	108 637	0%	163 464	175 663	7%	275 726	275 464	0%
CY	- -	- -	0%	77 859	78 755	1%	154	155	1%
CZ	271 420	272 007	0%	361 670	354 757	-2%	684 984	684 584	0%
DE	2 727 882	2 811 535	3%	4 142 537	4 076 237	-2%	3 329 144	3 283 924	-1%
DK	119 426	119 425	0%	233 973	244 899	5%	72 291	76 101	5%
EE	16 348	15 826	-3%	9 702	12 213	26%	159 860	161 650	1%
ES	1 027 361	1 029 645	0%	2 015 606	1 969 950	-2%	554 226	546 863	-1%
FI	93 628	93 647	0%	327 173	311 791	-5%	110 827	117 436	6%
FR	1 467 062	1 434 662	-2%	3 024 155	3 087 836	2%	377 629	394 517	4%
GR	112 077	112 077	0%	487 231	481 323	-1%	234 728	245 479	5%
HR	87 165	87 164	0%	129 552	132 413	2%	25 343	25 332	0%
HU	313 621	313 622	0%	280 404	287 522	3%	98 938	98 594	0%
IE	157 100	157 447	0%	257 997	253 262	-2%	59 923	59 717	0%
IS	- -	0	0%	23 645	21 383	-10%	3 938	3 896	-1%
IT	2 315 364	2 314 079	0%	2 260 603	2 290 447	1%	515 014	535 969	4%
LT	86 562	86 562	0%	105 003	104 601	0%	6 700	6 742	1%
LU	32 194	32 194	0%	91 103	90 789	0%	2 044	2 056	1%
LV	45 988	46 096	0%	57 432	53 761	-6%	1 937	1 950	1%
MT	- -	- -	0%	22 194	22 968	3%	- -	- -	0%
NL	1 210 647	1 210 533	0%	1 119 087	1 152 340	3%	458 146	461 074	1%
PL	576 764	576 764	0%	945 371	987 928	5%	2 008 774	2 022 082	1%
PT	170 575	172 791	1%	383 190	395 532	3%	134 282	136 463	2%
RO	373 686	373 685	0%	367 850	351 021	-5%	247 281	248 486	0%
SE	30 296	30 450	1%	396 877	421 586	6%	82 938	67 940	-18%
SI	27 814	27 814	0%	94 740	95 020	0%	44 955	44 541	-1%
SK	162 425	162 154	0%	122 512	129 495	6%	137 132	136 805	0%
UK	2 565 661	2 574 231	0%	2 462 948	2 501 973	2%	996 593	1 003 145	1%

[15] 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[16]. Between 1990 and 2015, greenhouse gas emissions from international bunker fuels increased by 55 % in the EU-28+ISL. CO_2 emissions from "Marine bunkers" account for 48 % of total greenhouse gas emissions from international bunkers in 2015, CO_2 from "Aviation bunkers" accounts for 51 % (Figure 3.170).

Figure 3.170 1D1 International bunker fuels: GHG emission trend and activity data



3.7.1 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 2015 but are not included in the national total of GHG emissions (Table 3.130).

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 2015.

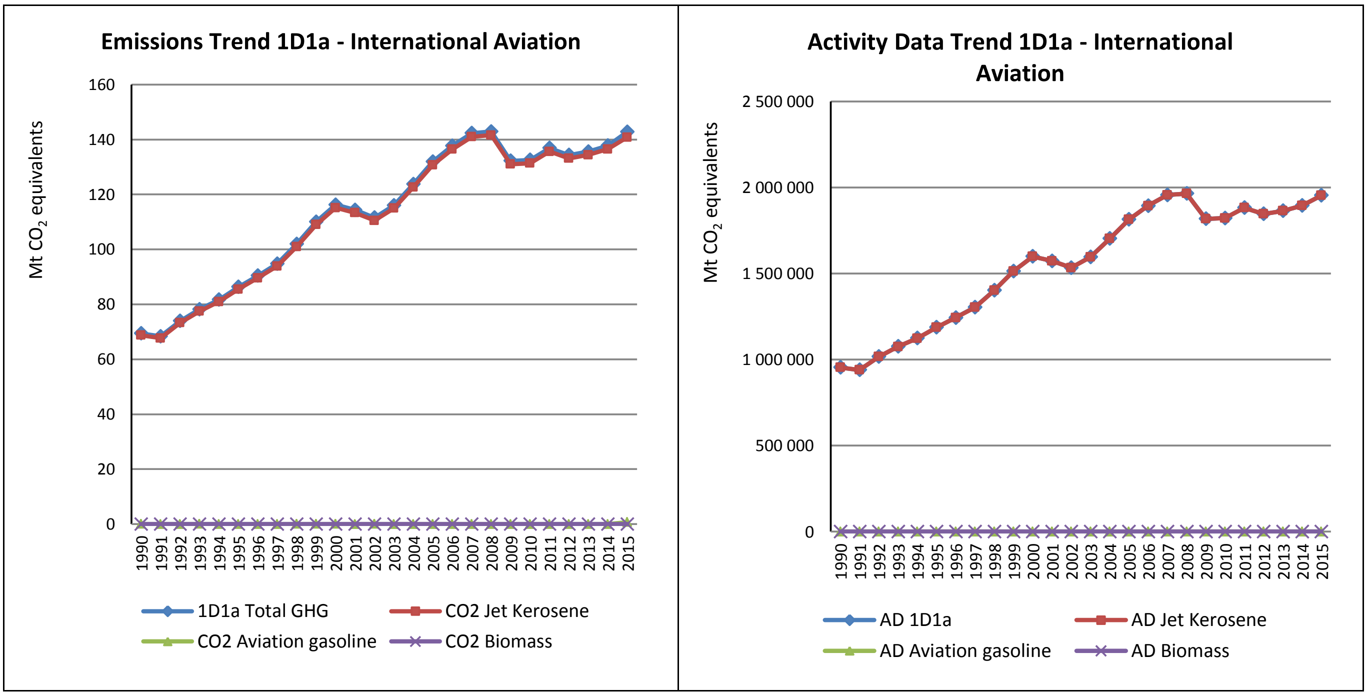
[16] The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within 'one country". This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers 'national fuel statistics' for domestic 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 3.130 Aviation bunkers: Member States' contributions to CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	886	1 977	2 128	1.5%	151	8%	1 242	140%
Belgium	2 487	4 049	4 175	3.0%	127	3%	1 688	68%
Bulgaria	713	512	533	0.4%	22	4%	-180	-25%
Croatia	497	368	354	0.3%	-14	-4%	-143	-29%
Cyprus	733	776	752	0.5%	-25	-3%	19	3%
Czech Republic	524	875	887	0.6%	12	1%	364	69%
Denmark	1 731	2 681	2 626	1.9%	-55	-2%	895	52%
Estonia	107	122	74	0.1%	-49	-40%	-33	-31%
Finland	1 008	1 921	1 963	1.4%	42	2%	955	95%
France	8 609	16 391	17 308	12.2%	918	6%	8 700	101%
Germany	11 960	24 333	24 317	17.2%	-16	0%	12 358	103%
Greece	2 475	2 830	2 869	2.0%	39	1%	394	16%
Hungary	497	531	543	0.4%	12	2%	46	9%
Ireland	1 070	2 229	2 522	1.8%	293	13%	1 453	136%
Italy	4 161	9 119	9 673	6.8%	554	6%	5 513	132%
Latvia	221	333	327	0.2%	-6	-2%	106	48%
Lithuania	399	234	245	0.2%	11	5%	-154	-39%
Luxembourg	403	1 242	1 400	1.0%	158	13%	997	247%
Malta	216	335	350	0.2%	15	4%	134	62%
Netherlands	4 605	10 827	11 370	8.0%	544	5%	6 766	147%
Poland	621	1 692	1 874	1.3%	182	11%	1 253	202%
Portugal	1 533	3 002	3 141	2.2%	140	5%	1 609	105%
Romania	790	619	1 376	1.0%	758	122%	586	74%
Slovakia	67	118	144	0.1%	26	22%	77	115%
Slovenia	49	72	74	0.1%	3	4%	25	52%
Spain	5 575	13 947	14 622	10.3%	675	5%	9 046	162%
Sweden	1 335	2 266	2 164	1.5%	-102	-4%	829	62%
United Kingdom	15 378	32 615	33 087	23.4%	472	1%	17 709	115%
EU-28	**68 647**	**136 015**	**140 901**	**100%**	**4 887**	**4%**	**72 255**	**105%**
Iceland	217	554	667	0.5%	113	20%	450	207%
United Kingdom (KP)	15 272	32 559	33 041	23.3%	482	1%	17 768	116%
EU-28 + ISL	**68 758**	**136 513**	**141 522**	**100%**	**5 009**	**4%**	**72 764**	**106%**

CO_2 emissions from jet kerosene account for 99 % of total emissions from "Aviation bunkers" in 2015 (Figure 3.171). All Member States but Bulgaria, Croatia, Estonia and Lithuania increased emissions from jet kerosene between 1990 and 2015. Member States with the highest increase between 1990 and 2015 in percent were Iceland, Luxembourg, Poland and Spain.

Figure 3.171 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 106 % between 1990 and 2015.

In Figure 3. the IEF is depicted, showing a mean value of around 72 t/TJ for 2015.

Figure 3.3 Aviation bunkers, Jet kerosene: Emission trend and share for CO_2

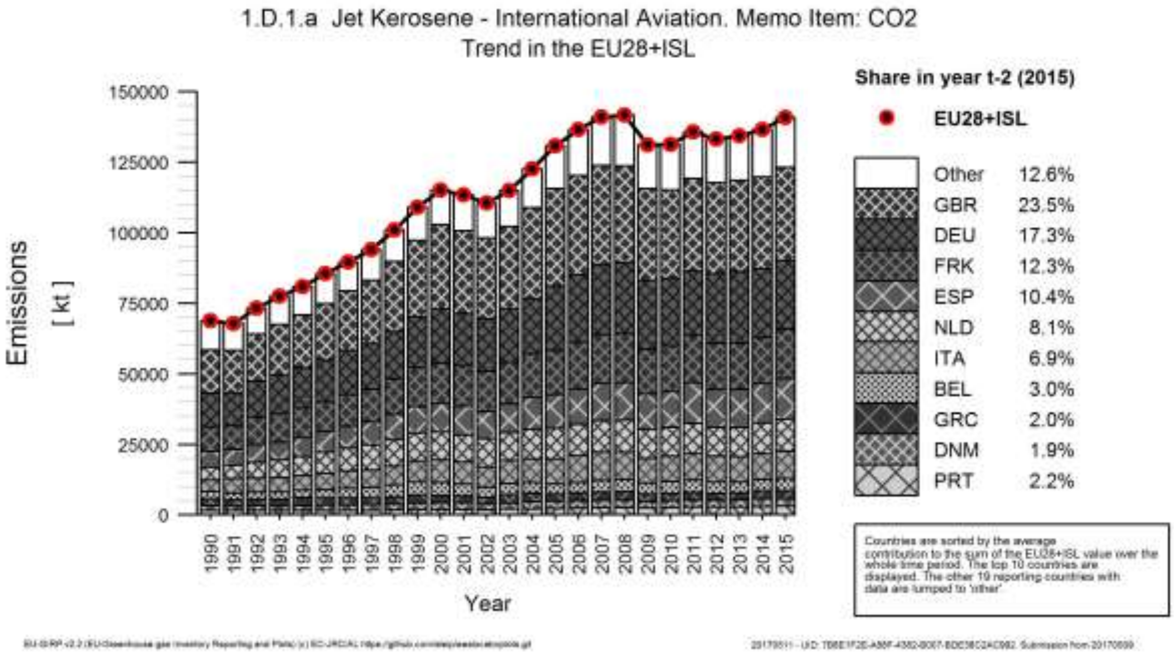
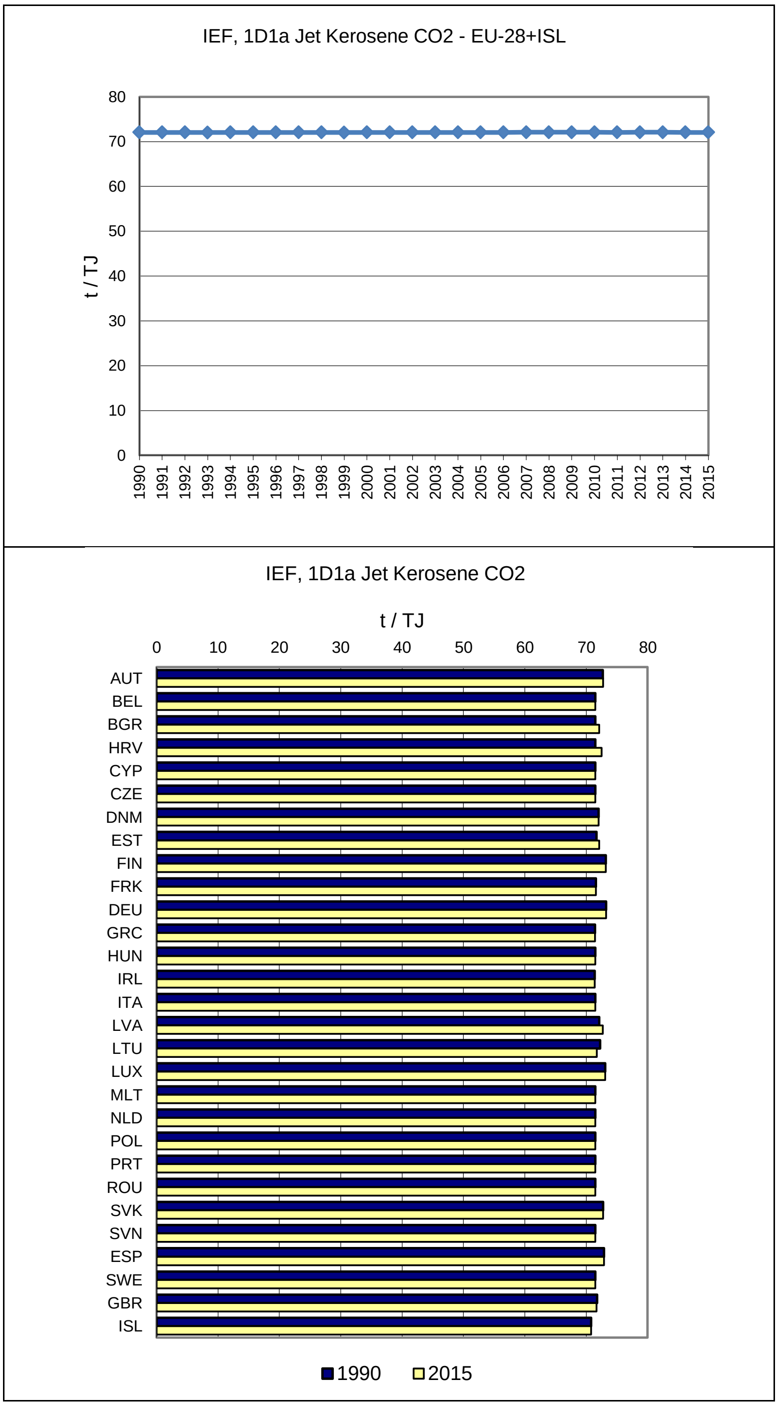


Figure 3.4: 1D1a Aviation bunkers – Jet kerosene: Implied Emission Factors for CO_2 (in t/TJ)



3.7.2 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 2015 and are also not included in the national total of GHG emissions. Between 1990 and 2015, CO_2 emissions from Marine bunkers increased by 23 % in the EU-28+ISL (Table 3.131).

The Member States Belgium, the Netherlands and Spain contributed most to the emissions from this source (61 %) in 2015. Between 1990 and 2015, most Member States (17 in total) increased emissions from Marine bunkers. The Member States with the highest increase in absolute terms were Belgium, Malta and Spain.

Table 3.131 Marine bunkers: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	49	64	53	0.0%	-11	-17%	3	7%
Belgium	13 313	17 590	18 058	13.5%	468	3%	4 745	36%
Bulgaria	183	255	271	0.2%	16	6%	88	48%
Croatia	147	NO	5	0.0%	5	∞	-142	-96%
Cyprus	183	733	767	0.6%	34	5%	585	320%
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	3 012	2 247	2 312	1.7%	65	3%	-700	-23%
Estonia	552	979	885	0.7%	-94	-10%	332	60%
Finland	1 832	271	920	0.7%	649	240%	-912	-50%
France	8 142	6 314	5 640	4.2%	-674	-11%	-2 502	-31%
Germany	6 405	6 626	6 922	5.2%	296	4%	517	8%
Greece	8 106	6 048	5 788	4.3%	-260	-4%	-2 318	-29%
Hungary	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Ireland	57	415	491	0.4%	76	18%	435	765%
Italy	4 284	4 406	5 570	4.2%	1 164	26%	1 285	30%
Latvia	1 512	742	808	0.6%	66	9%	-704	-47%
Lithuania	302	35	241	0.2%	205	580%	-61	-20%
Luxembourg	0	0	0	0.0%	0	2%	0	43%
Malta	736	4 005	5 097	3.8%	1 092	27%	4 361	592%
Netherlands	34 956	41 688	39 064	29.2%	-2 624	-6%	4 108	12%
Poland	1 256	467	585	0.4%	119	25%	-671	-53%
Portugal	1 400	1 961	2 100	1.6%	139	7%	700	50%
Romania	NO	238	132	0.1%	-105	-44%	132	∞
Slovakia	65	14	22	0.0%	8	54%	-43	-66%
Slovenia	NO,NA	184	206	0.2%	22	12%	206	∞
Spain	11 666	25 013	23 939	17.9%	-1 074	-4%	12 273	105%
Sweden	2 228	5 850	6 075	4.5%	225	4%	3 847	173%
United Kingdom	8 697	8 912	7 525	5.6%	-1 387	-16%	-1 172	-13%
EU-28	**109 084**	**135 058**	**133 477**	**100%**	**-1 582**	**-1%**	**24 393**	**22%**
Iceland	98	229	307	0.2%	78	34%	209	213%
United Kingdom (KP)	8 763	8 976	7 697	5.7%	-1 279	-14%	-1 066	-12%
EU-28 + ISL	**109 249**	**135 351**	**133 956**	**100%**	**-1 395**	**-1%**	**24 707**	**23%**

CO_2 emissions from residual fuel oil account for 74 % of total emissions from “Marine bunkers” in 2015 (Figure 3.). Between 1990 and 2015, CO_2 emissions from residual fuel oil increased by 18 % in the EU-28+ISL. Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Latvia, Lithuania, Poland and the United Kingdom decreased their emissions. Austria, Czech Republic, Hungary, Luxembourg, Romania and Slovakia reported in 1990 and 2015 notation keys. All other Member states increased emissions from residual oil between

1990 and 2015. Member States with the highest increase in percent were Slovenia, Iceland, Malta, Cyprus, Spain and Sweden.

CO_2 emissions from gas/diesel oil account for 25 % of total emissions from “Marine bunkers” in 2015. Between 1990 and 2015, CO_2 emissions from gas/diesel oil increased by 40 % in the EU-28+ISL.

Figure 3.5 1D1b Marine bunkers: Trend of CO_2 Emissions and Activity Data

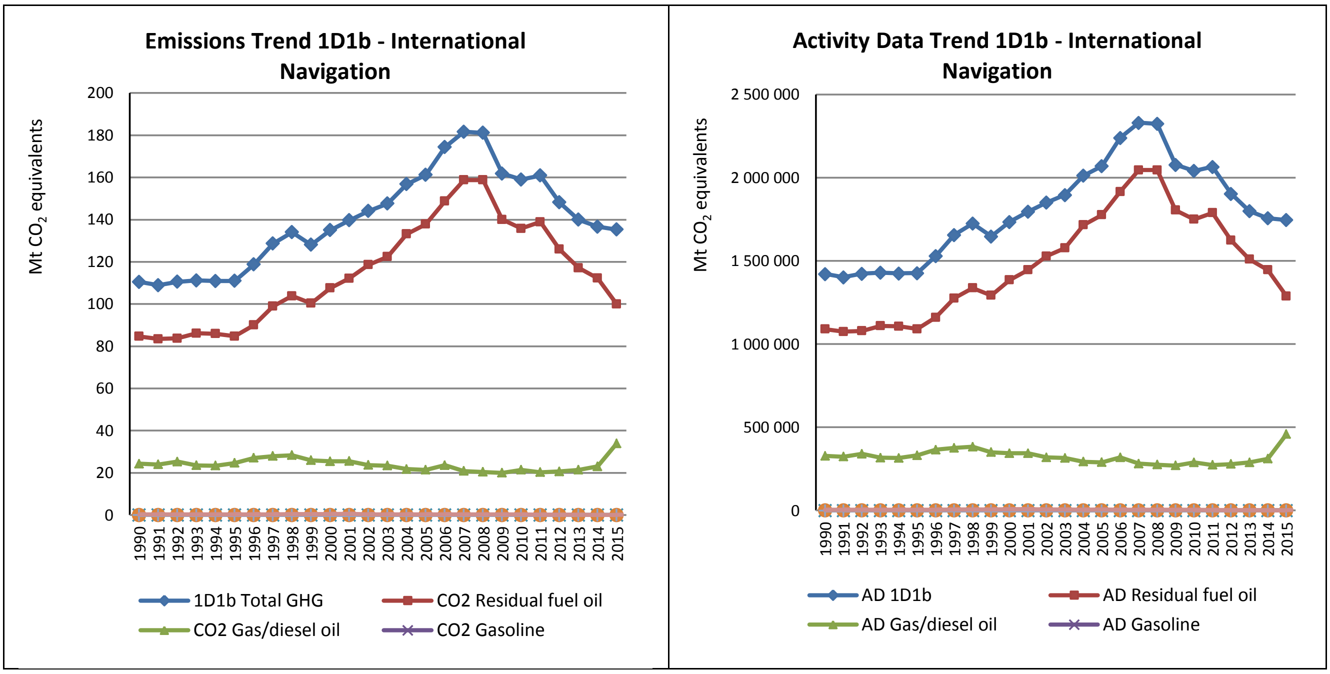


Figure 3. and Figure 3. provide an overview of emissions for residual oil and gas/diesel oil for EU-28 and those Member States contributing most to EU-28 emissions.

3.8.2.1 Marine Bunkers – Residual Oil (CO_2)

Combustion of residual oil in the EU-28+ISL increased by 18 % between 1990 and 2015. In Figure 3. the IEF is depicted, with a mean value of 77.5 t/TJ.

Figure 3.6 Marine bunkers' – Residual Oil: Emission trend and share for CO_2

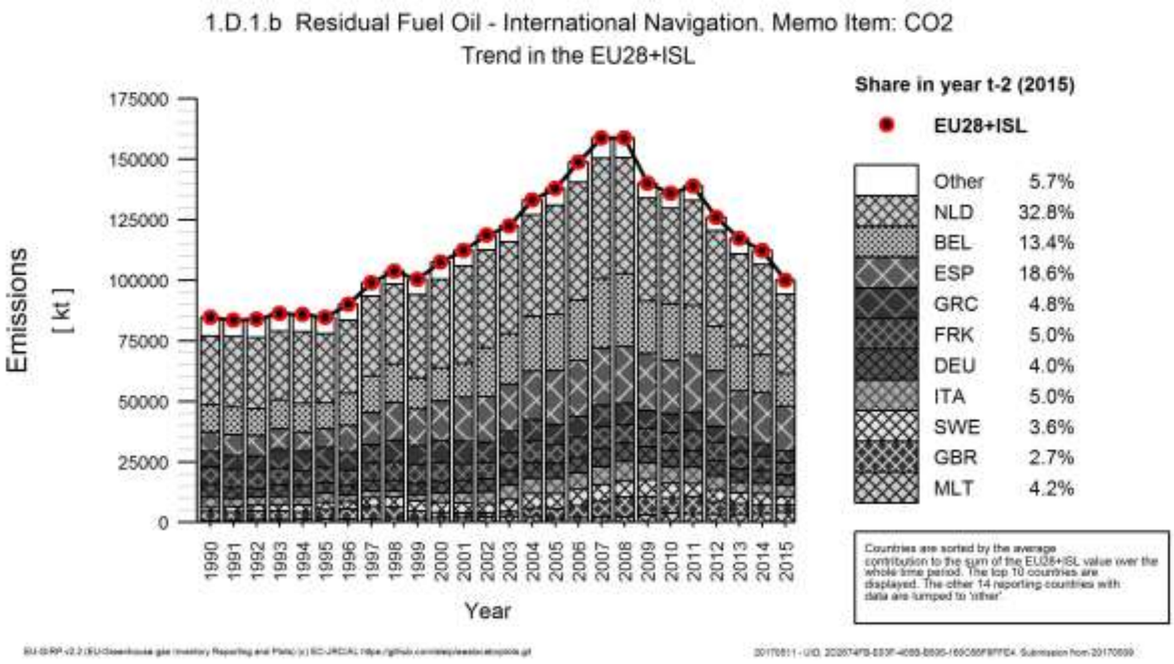
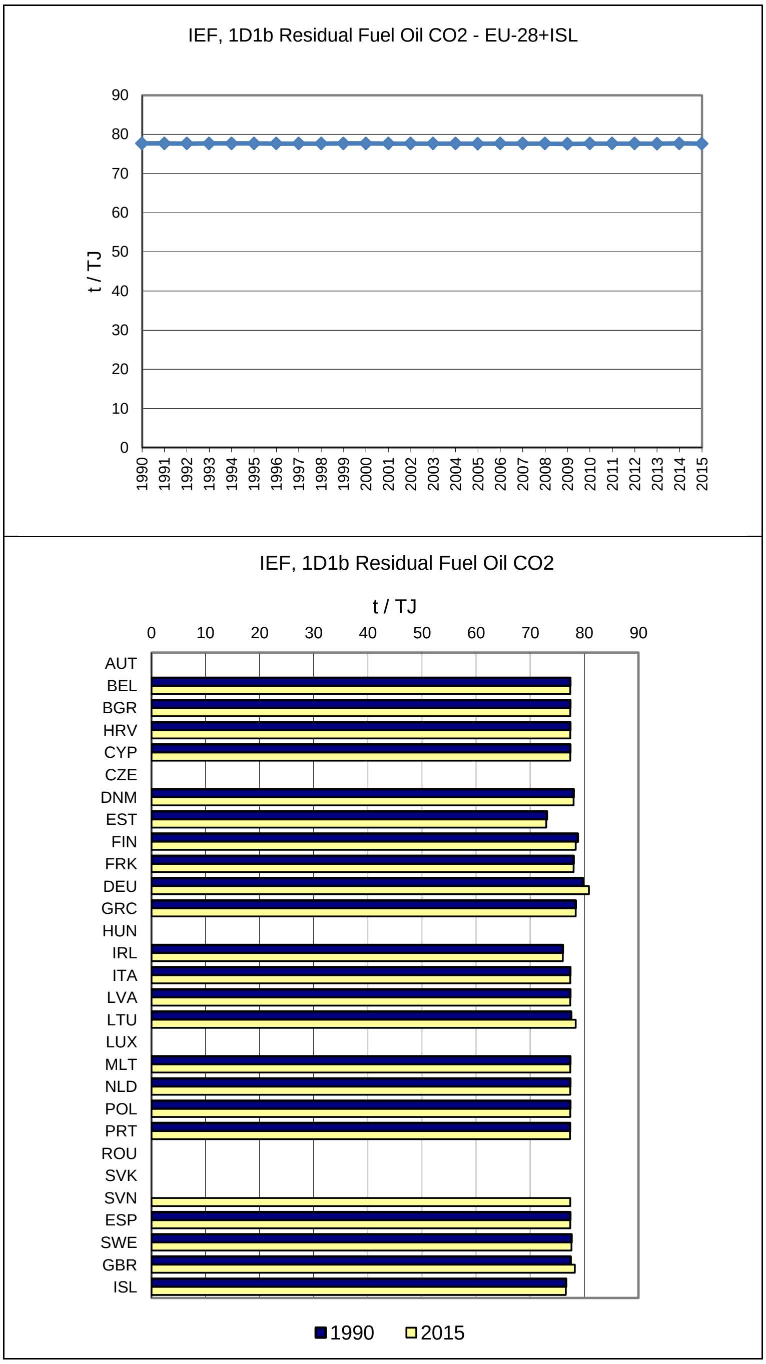


Figure 3.7: 1D1b Marine bunkers – Residual Oil: Implied Emission Factors for CO_2 (in t/TJ)



3.8.2.2 Marine Bunkers – Gas/Diesel Oil (CO_2)

Combustion of gas/diesel oil in the EU-28 increased by 40 % between 1990 and 2015. In Figure 3. the IEF is depicted, with a mean value of 74 t/TJ.

Figure 3.8 Marine bunkers, Gas/Diesel Oil: Emission trend and share for CO_2

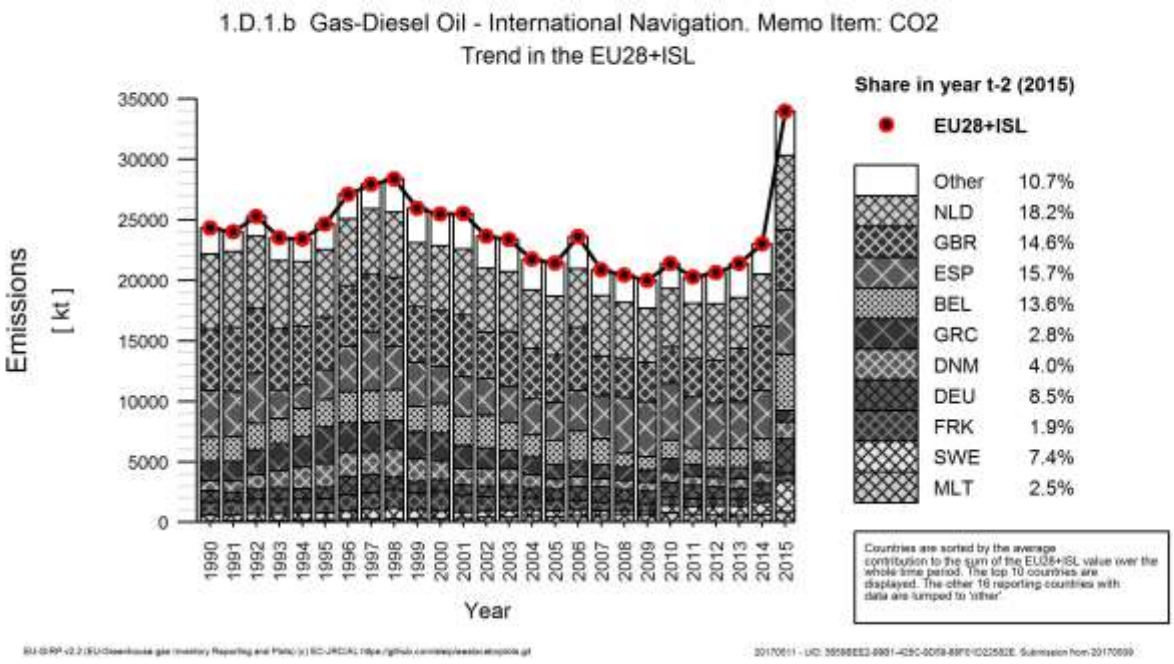
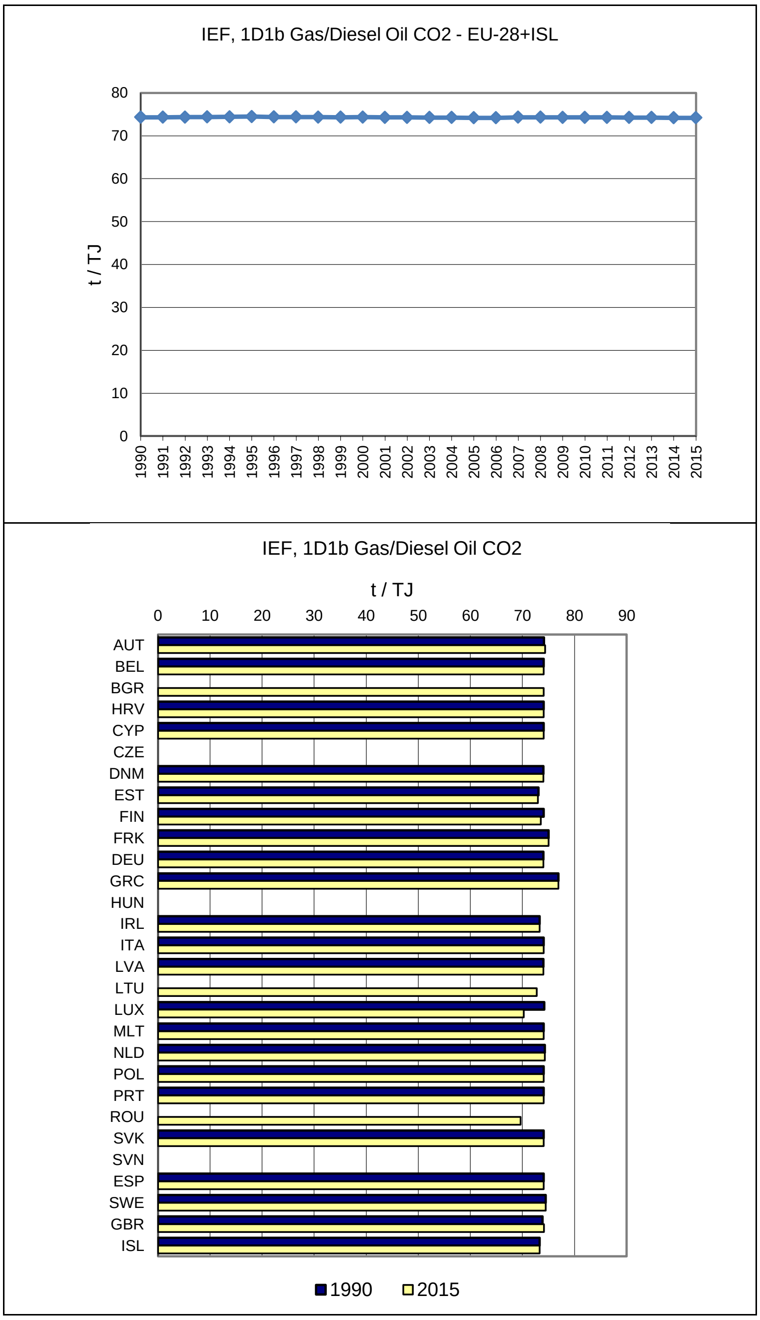


Figure 3.9: 1D1b Marine bunkers – Gas/Diesel Oil: Implied Emission Factors for CO_2 (in t/TJ)



3.7.3 QA/QC activities

For more information on QA/QC activities refer to chapter 3.4

3.8 Feedstocks and non-energy use of fuels

Following a recommendation of the expert review team the EU uses weighted average fractions of carbon stored in order to potentially reduce the differences for apparent consumption between the reference approach and the sectoral approach for all fuels and for the complete time series from 1990-2015.

Table **3.132** provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.132 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. CO_2 from lubricants which are used in engines are considered in category *2.D.1* 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 fuel or to a minor degree reported under category *5.C* 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 (2016) 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 - to a minor degree - waste incineration without energy recovery is considered in category *5.C*. **Solvents** manufacture: emissions from the production of solvents are considered in sector *2.D.3* use: CO_2 emissions from solvent use are considered in sector *2.D.3*. disposal: emissions from the disposal of solvents are considered in 5.A. **Paraffin wax** use: CO_2 emissions from paraffin wax use are considered in sector *2.D.2*.	Austria's National Inventory Report 2017 April 2017 p. 78f

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 re-allocation 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 assessment). 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) since last submission. 3. Waste treatment of final products was 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 1990-2015 April 2017 p. 62f
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 for 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 8.19% of the total apparent energy consumption during the period 1988-2015 and 6.67% for 2015. 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 wax), 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 2017 April 2017 p. 86ff

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 3.33). Non-energy fuel use, carbon dioxide emissions and the amount of carbon stored in the final products are presented in Table 3.34. 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 Greenhouse Gases Inventory Report 1990-2015 April 2017 p. 103
Croatia	Non-energy fuel consumptions (fuels used as feedstock) and appropriate emissions, where onepart 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 2017 April 2017 p. 115
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 2015. The CO_2 emission from oxidation of lube oil during use was 31.7 Gg in 2015 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 60.6 Gg in 2015. 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 0.17 Gg in 2015. Methodology and emission data for non-energy use of bitumen are shown in NIR Chapter 4.5.6.	Denmark's National Inventory Report 2017 April 2017 p. 247
Estonia	The following fuels are reported under CRF 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 sends to IEA annually). Data on natural gas that is used for the category non-energy use, is taken from the national energy balance sheet. Activity data on oil shale reported in the CRF 1.AD is calculated on the basis of plant-specific data. This reported amount consists of oil shale semi coke – the by-product of shale oil production which 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 was used for ammonia production and is reported in the CRF category 2.B.1. Natural gas was only used in the company Nitrofert AS. In 2010 and 2011 the factory was temporarily closed down due to low ammonia price in the World market. In 2012 the ammonia production factory was reopened and during 2013 it was closed again and has remained closed ever since.Lubricants are used in the 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 1990-2015 April 2017 p. 66
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 are used as feedstocks in the metal industry and corresponding amounts are 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, heavy fuel oil, LPG, naphtha and other oil products are used as feedstock in the chemical industry. Carbon included in these feedstocks is subtracted from the reference approach. Most of carbon is stored in the products, but certain process emissions are reported in sector 2.B.10 (see section 4.3.5). From other feedstocks, 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 we use top-down calculation methodology, presuming that 33% of carbon is stored in products (recycled lubricants) and 67% of carbon is released as CO_2 either in burning of lubricants in motors	Greenhouse Gas emissions in Finland 1990-2015, 15 March 2017 p. 70f

	(two-stroke oil and part of motor oil in four-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). According to IPCC 2006 Revised Guidelines emissions from 2-stroke oil should be reported in the Energy Sector. We do not have data on sales of 2-stroke oil separately, thus we have not separated these emissions from the use of 4-stroke oil and other lubricants. However, we have made a rough estimate for 2013, showing that CO_2 emissions from 2-stroke oil might be around (less than) 7 kt. To be able to reallocate these emissions to Energy Sector, we would have to split the figure to four subsectors (road transport, residential non-road machinery, commercial non-road machinery and leisure boats). As we do not have full time series of activity data to allocate these emissions to Energy subsectors, we are not able to do the split and have included them in 2.D.1, correspondingly to the top-down calculation methodology described above. This misallocation should not result in over- or underestimation of emissions.	
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.	National Inventory Report for the German Greenhouse Gas Inventory 1990-2014 March 2016 p. 816f

	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.	
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 2017 p.107f
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. 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 1985-2015 April 2017 p. 44f

Ireland	This category includes fossil fuels used for non-energy purposes; without the combustion and oxidation process. There are a number of fuel types applicable in Ireland: • Lubricants – IPCC default oxidation value of 0.2 is used, see category 2.D.1; • Bitumen – IPCC default value of 1.0 is used for the proportion of carbon stored; • Paraffin wax – IPCC oxidation value of 0.9 is used for candles and 0.2 for all other paraffin wax, see category 2.D.2; • White spirit – IPCC default value of 1.0 is used for the proportion of carbon stored; • Natural Gas – a significant amount of natural gas feedstock was used in ammonia production from 1990-2003. Emissions from the non-energy use of fossil fuels have been included in the Industrial Processes and Product Use sector, CRF Category 2.D (Chapter 4 of this report).	Ireland National Inventory Report 2017 April 2017 p. 70
Italy	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 5,078 Gg of products, for the year 2015, is 58% bigger than the quantities reported, 3,197 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 1990-2015 April 2017 p.111ff
Latvia	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 1990–2015. 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 (20t/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 2010 increase of bitumen use can be seen, it can be explained with increased financial resource to road paving. Lubricants are mainly used in transport sector and IPPU. 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. Therefore in last two years there has been no usage of coke. Paraffin waxes and white spirits mainly are used as feedstocks in chemical industry and wood processing..	Latvia´s National Inventory Report 1990-2015 15 March 2017 p. 111

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 2015, natural gas amounted about 84.3% 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. It is necessary to mentioned that JSC Achema revised data for non-energy use for 2005-2014 in 2016, therefore in this submission revised data are reported in CRF 1.AD Feedstocks, reductants and other non-energy use of fuels. The amounts of excluded carbon were calculated in accordance with the methodology provided in 2006 IPCC Guidelines Volume 2 (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 2017 April 2017 p. 84f
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 1990-2015 15 March 2017 p. 188ff

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 in the petro-chemical industry (naphtha) 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 in 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 RA, these product flows are excluded from the calculation of CO_2 emissions.	Greenhouse Gas Emissions in the Netherlands 1990-2015 15 March 2017 p. 73
Poland	As the use of energy products for non-energy purposes can lead to emissions, Poland has calculated emissions from lubricant and paraffin waxes use and report them under category 2D Non-energy products from fuels and solvent use.For more description see chapter 4.5.	Poland´s National Inventory Report 2017 February 2017 p. 51
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.	Portuguese National Inventory Report on Greenhouse Gases 1990-2015 March 2017 p. 3-179

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. At 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 on the entire time-series: 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 back time series; it is the case of the following fuels: Transport Diesel, Refinery Gas, Petroleum Coke, Residual Fuel Oil, Heating and Other Gasoil. For 2015 the determined values of NCVs and CO_2 CSEFs determined for 2014 were used. 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. 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 an average of 11% from 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. In 2015 the share of the non-energy use of the fuels in total consumption is about 5%. 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 1989-2015 March 2017 p.152ff
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 2 009.99 Gg in 2015, which represents 7 369.96 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 (50.7% and 52.6%, respectively) The other significant source of carbon excluded is using of natural gas (22.4% in fuel consumption and 18.4% in quantity of carbon). Details on the share in fuel units and carbon units are presented on Figures 3.30 and 3.31. The CO_2 emissions excluded from the RA are presented in Figure 3.32 for the whole time series 1990 – 2015. 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 3.64 and 3.65. 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.	Slovak republic national Inventory report 2017 April 2017 P 108ff

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. Stored CO_2 has been calculated on the basis of the formula from IPCC guidelines. We have assumed that all methane used for methanol production is stored in the product or in CO in emitted gas. This fact was confirmed also by expert from the company Nafta-Petrochem. 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. 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 2015, 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 2017 April 2017 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 2017 Sweden April 2017 p.126f

	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, 2016) 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; and, • 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 industrial combustion sources in the energy balance are missing for many 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, chemical manufacturing processes, domestic fuel manufacturers).	UK Greenhouse Gas Inventory, 1990 to 2015 March 2017 pp. 120f

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 (without LULUCF) emissions in 2015. 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 518 Mt in 1990 to 376 Mt in 2015 (Figure 4.1). In 2015, the emissions decreased by 1.0 % compared to 2014. 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 B 10 Other chemical industry (CO_2)
- 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 2 Foam Blowing Agents (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 1990–2015 in CO_2 equivalents (Mt)

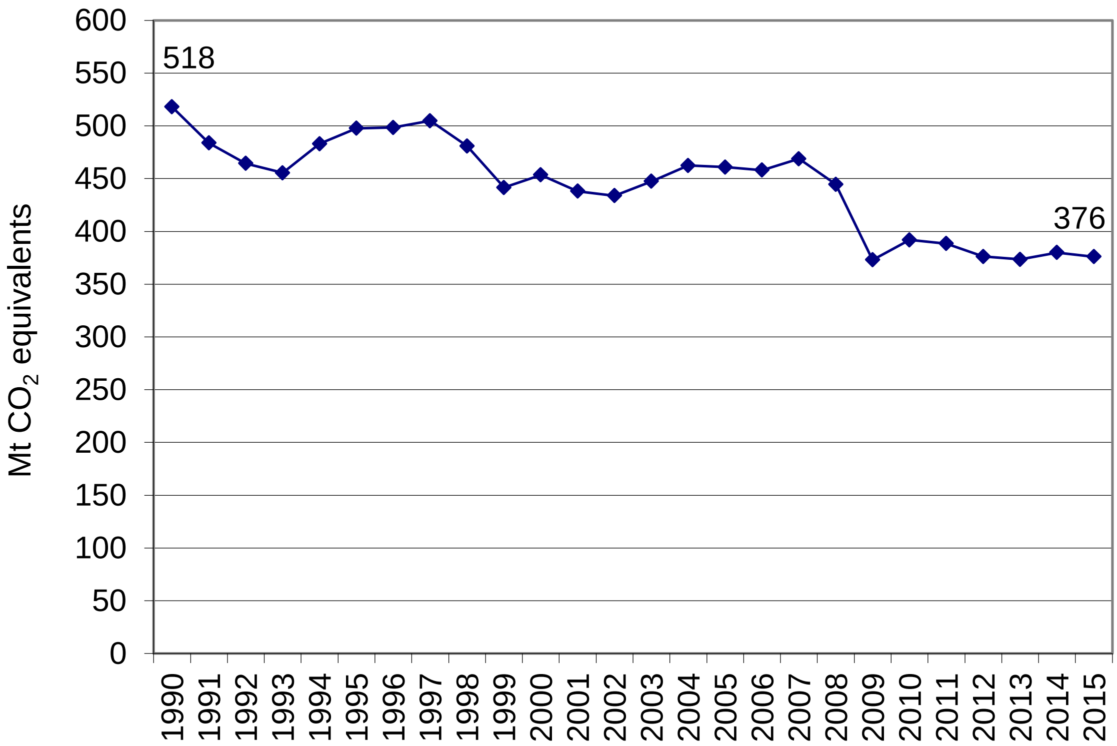
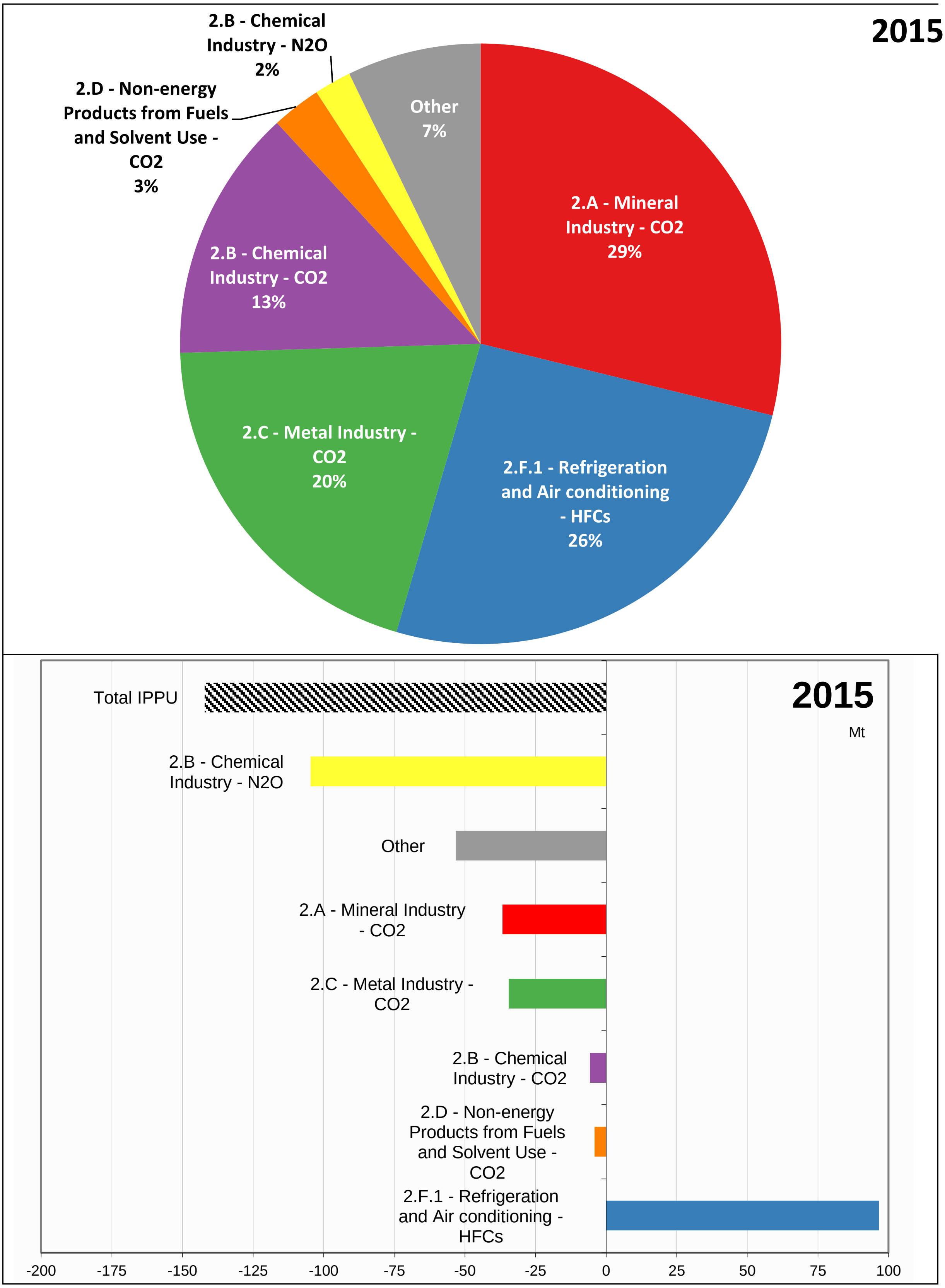


Figure 4.2: CRF Sector 2 Industrial processes and Product Use: Share of largest key categories in 2015 and absolute change of GHG emissions by large key categories 1990–2015 in CO_2 equivalents (Mt)



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

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:

Table 4.1: Key categories for sector 2A (Table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
2 A 1 Cement Production: no classification (CO_2)	102528	74369	T	L	L
2 A 2 Lime Production: no classification (CO_2)	25726	19313	0	L	L
2 A 4 Other Process Uses of Carbonates: no classification (CO_2)	12560	10564	0	L	L

This sector is dominated by cement production which contributes nearly 70% of emissions. 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 18% of the sector where CO_2 emitted during the calcination of the calcium in limestone or dolomite for lime production. The source category 2A4 Other process uses of carbonates accounts for 10% of the sector and is composed of several sources with independent estimation methods.

While CO_2 emissions from Mineral industry have fallen by 25 % since 1990, they decreased by less than 1% between 2014 and 2015. Mineral sector emissions appear to have reached a post economic crisis plateau (Figure **4.3**). Only six countries have higher Mineral industry CO_2 emissions in 2015 compared to 1990, (Table 4.2).

Figure 4.3 2A Mineral industry CO_2 emissions

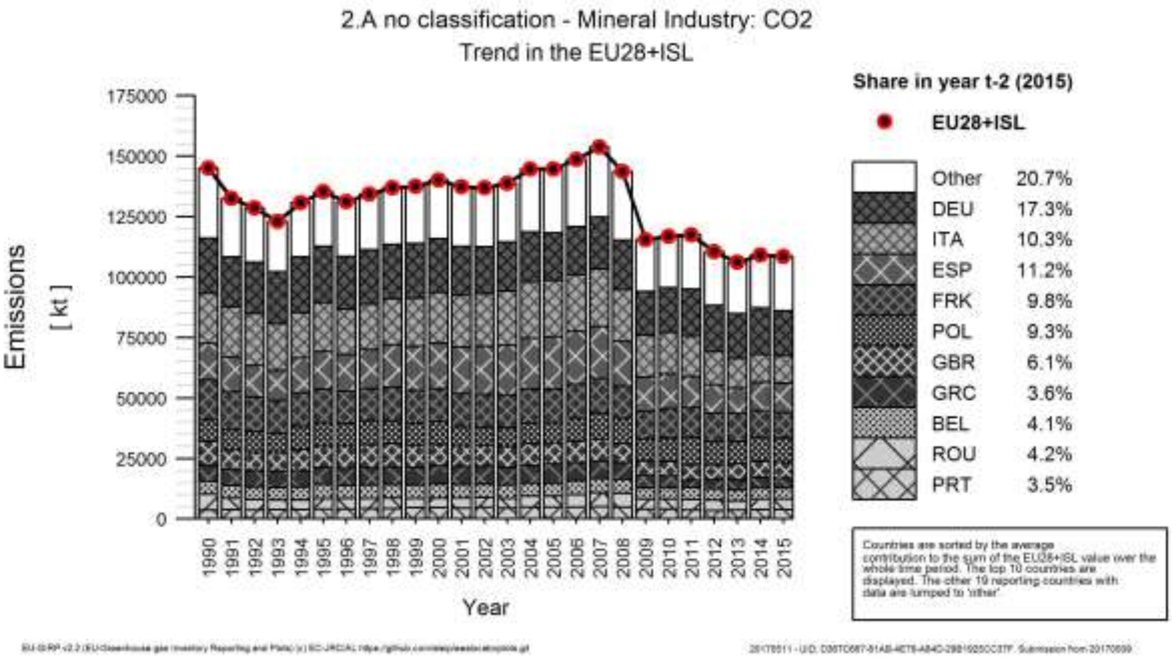


Table 4.2 2A Mineral industry: Member States total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)
Austria	3 092	2 740	3 092	2 740
Belgium	5 323	4 400	5 323	4 400
Bulgaria	3 236	2 386	3 236	2 386
Croatia	1 281	1 313	1 281	1 313
Cyprus	717	887	717	887
Czech Republic	4 059	2 534	4 059	2 534
Denmark	1 082	1 052	1 082	1 052
Estonia	614	263	614	263
Finland	1 196	963	1 196	963
France	16 404	10 625	16 404	10 625
Germany	22 780	18 739	22 780	18 739
Greece	6 775	3 957	6 775	3 957
Hungary	2 895	1 140	2 895	1 140
Ireland	1 117	1 830	1 117	1 830
Italy	20 720	11 126	20 720	11 126
Latvia	584	476	584	476
Lithuania	2 142	578	2 142	578
Luxembourg	623	395	623	395
Malta	1	0.02	1	0.02
Netherlands	1 248	1 157	1 248	1 157
Poland	8 855	10 089	8 855	10 089
Portugal	3 669	3 795	3 669	3 795
Romania	6 531	4 515	6 531	4 515
Slovakia	2 714	2 265	2 714	2 265
Slovenia	695	453	695	453
Spain	15 157	12 142	15 157	12 142
Sweden	1 684	1 986	1 684	1 986
United Kingdom	9 804	6 638	9 804	6 638
EU-28	**144 999**	**108 442**	**144 999**	**108 442**
Iceland	52	1	52	1
United Kingdom (KP)	9 804	6 638	9 804	6 638
EU-28 + ISL	**145 052**	**108 443**	**145 052**	**108 443**

Abbreviations explained in the Chapter 'Units and abbreviations'.
For consistency with other sub-sectors this table shows both CO_2e and CO_2, however as there are no N_2O or CH_4 emissions for this category, the two sets of columns in this table show the same numbers.

Table 4.3 provides information on the Member States' contribution to EU-28+ISL recalculations in CO_2 from 2A Mineral industry for 1990 and 2014 as well as some explanations for the largest recalculations in absolute terms provided by Member States.

Table 4.3 2A Mineral industry: Contribution of MS to EU-28+ISL recalculations in CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		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	2A3 and 2A4, has a small correction in CO_2 emissions for the years 2013 and 2014 due to a miss allocation of one company between those 2 categories.
Bulgaria	-40	-1.2	19	1.0	Changed to now use the default emission factor for 1988-2015
Croatia	0	0.0	1	0.1	Data on soda ash use was recalculated
Cyprus	-42	-5.5	0	0.0	Cement production emissions were recalculated according to recommendation by ERT to use emissions data from the National Allocation Plan for 1997–2004 and annual IEF for 1997 to calculate emissions in the period 1990–1996. Ceramics production emissions were recalculated according to a recommendation made by the ERT to use the 2001 IEF for calculating the CO_2 emissions from ceramic production for the period 1990-2000. CY NIR 2017
Czech Republic	0	0.0	-5	-0.2	An error in the amount of CO_2 emissions in category 2.A.1 for year 2014, recalculation in category 2.A.4 due to double counting, updated activity data for mineral wool production in 2.A.4.d for time period 2000-2006, explanation provided in NIR
Denmark	2	0.2	0	0.0	2A4 Other process uses of carbonates – an error in soda ash consumption in the glass industry was corrected: no influence for emissions from the glass industry but influences the calculated amount of soda ash used for other purposes.
Estonia	0	0.0	0	0.0	-
Finland	-4	-0.4	-1	-0.1	New method, ETS data used
France	-64	-0.4	-41	-0.4	2A2: Updating of CO_2 emissions induced by decarbonation for lime producers in sugar mills over the period 1990-2014. 2A3: Update of CO_2 emission data related to decarbonation over the period 2004-2014 (better taking into account individual declarations). 2A4a: For the tile and brick production sector and for the year 2014, the remaining production to be allocated (domestic production - declared by the sites) was corrected following an error detected. 2A4b: Data on the consumption of sodium carbonate and sodium bicarbonate over the entire period 1990-2014 have been updated, taking into account the data on imports and exports of these products and the deduction of Consumption of these products in activities other than those of glass production. 2A4d: Consideration of new sites in the chemistry sector that consume carbonates and therefore impact on the entire period 1990-2014.
Germany	0	0.0	26	0.1	Minor updates of production figures in the glass industry
Greece	0	0.0	-135	-3.0	An error concerning double counting has been identified during QAQC tests concerning magnesia production included in 2.A.2.a and 2.A.4.c. These emissions are currently correctly reported under 2.A.4.c.
Hungary	115	4.1	0	0.0	New emitter was identified in the EU ETS in 2014 and one other emission was missing in category of Other process uses of carbonates; revised time-series of soda ash export and import.
Ireland	0	0.0	0	0.0	
Italy	7	0.0	10	0.1	Minor recalculations for the whole timeseries for Other processes use of carbonates, related to emissions from other uses of soda ash, which have been allocated under this category in the present submission.
Latvia	-5	-0.8	1	0.2	Recalculations were done according to ERT recommendations during 2016 centralized review in 2.A.2 sector to recalculate CO_2 emissions from lime production from dolomite, to correct EF from lime production facility using dolomite consumption according to the 2006 IPCC Guidelines and to submit the corrected emission estimation of CO_2 from lime production using correct activity data and disaggregate the activity data from the 2.A.2 category to identify limestone and dolomite. CO_2 emissions from used limestone, dolomite and produced quicklime in steel production process were allocated from 2.A.1 to 2.C.1 sector.
Lithuania	0	0.0	0	0.0	

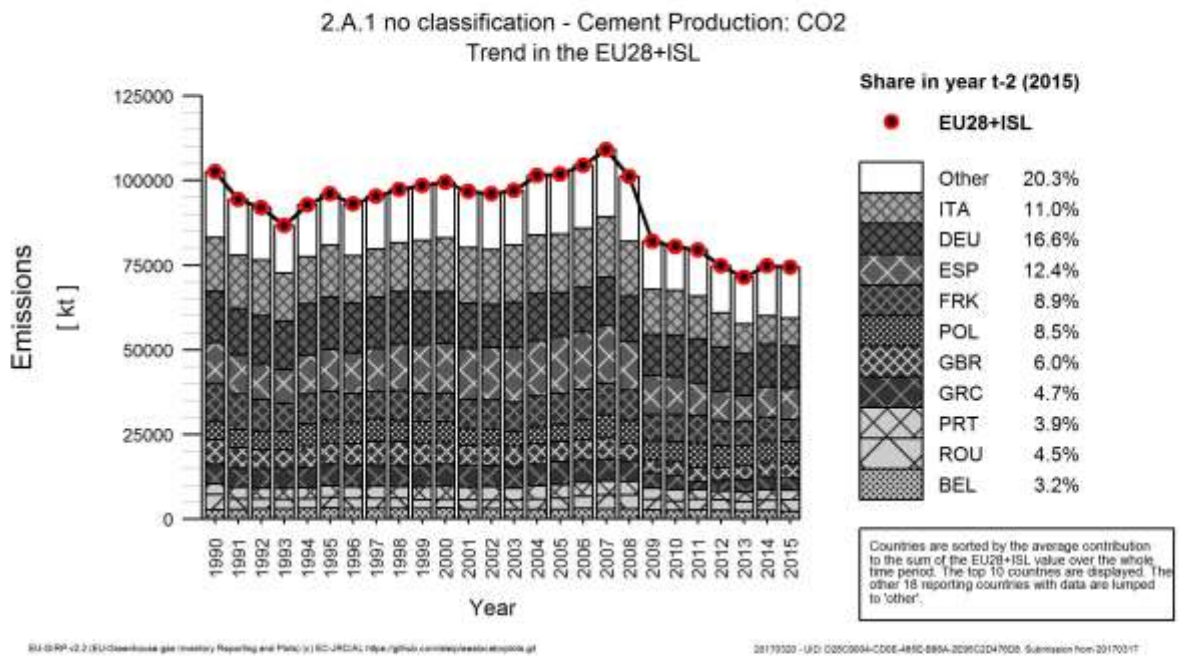
	1990		2014		Main explanations
	kt CO_2 equiv.	Percent (*)	kt CO_2 equiv.	Percent (*)	
Luxembourg	0	0.0	8	2.0	Change of methodology in 2.A.1 for 2014
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	6	0.5	Error correction in soda ash production index
Poland	63	0.7	164	1.6	Cullet ratio in glass production was changed - value of 20% was assumed instead of default value (50%)
Portugal	-341	-8.5	-14	-0.4	Revision of ceramics production (2A4a) emission factors based on ETS data. Review of other process uses of carbonates (2A4d) activity data.
Romania	1	0.0	36	0.9	Recalculations have been made for the 2005-2014 period due to the changes in activity data for those years. (CRF Category 2.A.4 b)
Slovakia	0	0.0	0	0.0	
Slovenia	-12	-1.6	0	0.0	2A1 emission factors revised as one cement plant updated correction factor for CaO and MgO content in the raw material. CO_2 recalculated for the period 1986-2011.
Spain	0	0.0	11	0.1	2A1. Update of production data and emission factor in one of the plants for the years 2013 and 2014.
Sweden	0	0.0	0	0.0	
United Kingdom	-3	0.0	0	0.0	No significant recalculations
EU28	-322	-0.2	87	0.1	
Iceland	0	0.0	0	0.0	
EU28+ISL	-322	-0.2	87	0.1	

(*) 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 contributed 1.7% of total EU 28+ISL (without LULUCF) emissions in 2015. In 2015, CO_2 emissions from Cement production were 27% 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 and Table 4.4). Cement production saw only a small -1% decrease in overall emissions in 2015 compared to 2014, with decreases balancing increases. The three countries with the largest absolute growth (2015-2014) were Romania, Spain, and the United Kingdom. The three countries with the largest absolute reductions were Belgium, France and Greece.

Table 4.4 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	2 033	1 639	1 701	2.3%	63	4%	-332	-16%	T3	PS
Belgium	2 824	2 643	2 348	3.2%	-295	-11%	-476	-17%	T3	PS
Bulgaria	2 100	911	1 105	1.5%	194	21%	-995	-47%	T2	PS
Croatia	1 086	1 225	1 169	1.6%	-56	-5%	83	8%	T2	CS
Cyprus	668	974	877	1.2%	-97	-10%	209	31%	CS	CS
Czech Republic	2 489	1 477	1 550	2.1%	73	5%	-940	-38%	T3	PS
Denmark	882	887	932	1.3%	44	5%	49	6%	T3	PS
Estonia	483	422	206	0.3%	-216	-51%	-277	-57%	T2	PS
Finland	729	469	462	0.6%	-7	-1%	-267	-37%	T3	PS
France	10 937	6 975	6 606	8.9%	-369	-5%	-4 331	-40%	T2,T3	CS,PS
Germany	15 146	12 652	12 378	16.6%	-274	-2%	-2 768	-18%	T2	CS
Greece	5 762	3 822	3 467	4.7%	-355	-9%	-2 294	-40%	CS	PS
Hungary	1 751	566	676	0.9%	110	19%	-1 075	-61%	CS	CS
Ireland	884	1 461	1 652	2.2%	191	13%	768	87%	T3	PS
Italy	15 846	8 339	8 196	11.0%	-142	-2%	-7 650	-48%	T2	CS,PS
Latvia	346	556	467	0.6%	-89	-16%	121	35%	T2	PS
Lithuania	1 668	401	518	0.7%	117	29%	-1 150	-69%	T2	PS
Luxembourg	570	360	329	0.4%	-30	-8%	-240	-42%	T2	CS,PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	416	282	249	0.3%	-33	-12%	-166	-40%	CS	PS
Poland	5 453	6 456	6 342	8.5%	-115	-2%	888	16%	T2	CS
Portugal	3 176	3 096	2 921	3.9%	-175	-6%	-255	-8%	T3	OTH
Romania	4 445	2 944	3 337	4.5%	394	13%	-1 108	-25%	CS,T2	PS
Slovakia	1 464	1 267	1 309	1.8%	42	3%	-156	-11%	T2	PS
Slovenia	470	418	367	0.5%	-51	-12%	-103	-22%	T3	CS
Spain	12 279	8 897	9 216	12.4%	319	4%	-3 063	-25%	T2	CS
Sweden	1 272	1 396	1 527	2.1%	130	9%	255	20%	T3	PS
United Kingdom	7 295	4 215	4 461	6.0%	246	6%	-2 835	-39%	T3	CS
EU-28	**102 476**	**74 748**	**74 369**	**100%**	**-379**	**-1%**	**-28 107**	**-27%**	**-**	**-**
Iceland	52	NO	NO	-	-	-	-52	-100%	NA	NA
United Kingdom (KP)	7 295	4 215	4 461	6.0%	246	6%	-2 835	-39%	T3	CS
EU-28 + ISL	**102 528**	**74 748**	**74 369**	**100%**	**-379**	**-1%**	**-28 159**	**-27%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.5 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement production for 1990 and 2015. 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 2015 range from 0.48 t CO_2/t of clinker produced for Netherlands to 0.59 t CO_2/t of clinker produced for the United Kingdom. Countries use country-specific and plant-specific emission factors (typically based on raw meal carbon content characterization), they also provide clinker production data which allows for the calculation of comparative IEFs. In 2015 the EU-28+ISL IEF remained at 0.53 t CO_2/t of clinker produced.

Table 4.5 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 emissions (kt)	2015 Activity data Description	2015 Activity data (kt)	2015 Implied emission factor (t/t)	2015 CO2 emissions (kt)
Austria	T3	PS	Clinker production	3 694	0.55	2 033	Clinker production	3 257	0.52	1 701
Belgium	T3	PS	Clinker production	5 292	0.53	2 824	Clinker production	4 396	0.53	2 348
Bulgaria	T2	PS	Clinker production	3 987	0.53	2 100	Clinker production	2 074	0.53	1 105
Croatia	T2	CS	Clinker production	2 062	0.53	1 086	Clinker production	2 159	0.54	1 169
Cyprus	CS	CS	Clinker production	1 249	0.53	668	Clinker production	1 641	0.53	877
Czech Republic	T3	PS	Clinker production	4 726	0.53	2 489	Clinker production	2 919	0.53	1 550
Denmark	T3	PS	Clinker production	1 406	0.63	882	Clinker production	1 715	0.54	932
Estonia	T2	PS	Clinker production	790	0.61	483	Clinker production	356	0.58	206
Finland	T3	PS	Clinker production	1 470	0.50	729	Clinker production	934	0.49	462
France	T2,T3	CS,PS	Clinker production	20 854	0.52	10 937	Clinker production	12 513	0.53	6 606
Germany	T2	CS	Clinker production	28 577	0.53	15 146	Clinker production	23 355	0.53	12 378
Greece	CS	PS	Clinker production	10 645	0.54	5 762	Clinker production	6 554	0.53	3 467
Hungary	CS	CS	Clinker production	3 210	0.55	1 751	Clinker production	1 331	0.51	676
Ireland	T3	PS	Clinker production	1 610	0.55	884	Clinker production	3 021	0.55	1 652
Italy	T2	CS,PS	Clinker production	29 786	0.53	15 846	Clinker production	15 527	0.53	8 196
Latvia	T2	PS	Clinker production	669	0.52	346	Clinker production	918	0.51	467
Lithuania	T2	PS	Clinker production	3 058	0.55	1 668	Clinker production	963	0.54	518
Luxembourg	T2	CS,PS	Clinker production	1 048	0.54	570	Clinker production	678	0.49	329
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	CS	PS	Clinker production	770	0.54	416	Clinker production	517	0.48	249
Poland	T2	CS	Clinker production	10 309	0.53	5 453	Clinker production	11 278	0.56	6 342
Portugal	T3	OTH	Clinker production	6 128	0.52	3 176	Clinker production	5 626	0.52	2 921
Romania	CS,T2	PS	Clinker production	8 379	0.53	4 445	Clinker production	6 203	0.54	3 337
Slovakia	T2	PS	Clinker production	2 836	0.52	1 464	Clinker production	2 506	0.52	1 309
Slovenia	T3	CS	Clinker production	891	0.53	470	Clinker production	713	0.51	367
Spain	T2	CS	Clinker production	23 212	0.53	12 279	Clinker production	17 650	0.52	9 216
Sweden	T3	PS	Clinker production	2 348	0.54	1 272	Clinker production	2 826	0.54	1 527
United Kingdom	T3	CS	Clinker production	13 199	0.55	7 295	Clinker production	7 617	0.59	4 461
EU-28			**Clinker production**	**192 203**	**0.53**	**102 476**	**Clinker production**	**139 247**	**0.53**	**74 369**
Iceland	NA	NA	Clinker production	97	0.53	52	Clinker production	NO	NO	NO
United Kingdom (KP)	T3	CS	Clinker production	13 199	0.55	7 295	Clinker production	7 617	0.59	4 461
EU-28+ISL			**Clinker production**	**192 300**	**0.53**	**102 528**	**Clinker production**	**139 247**	**0.53**	**74 369**

Abbreviations are explained in the Chapter 'Units and abbreviations'.

4.2.1.2 **2A2 Lime production**

CO_2 emissions from 2A2 Lime production account for only 0.4% of total EU 28+ISL (without LULUCF) emissions in 2015. Between 1990 and 2015, CO_2 emissions from this source decreased by 25%.

Lime production CO_2 emissions saw a 1.5% decrease in overall emissions in 2015 with increases outweighed by decreases. Emissions increased in ten countries in 2015 compared to 2014, twelve decreased and three changed by less than 1%. Lime production emissions have stabilised in recent years having decreased sharply with the economic crisis (Figure 4.5).

Figure 4.5 2A2 Lime production: EU-28+ISL CO_2 emissions

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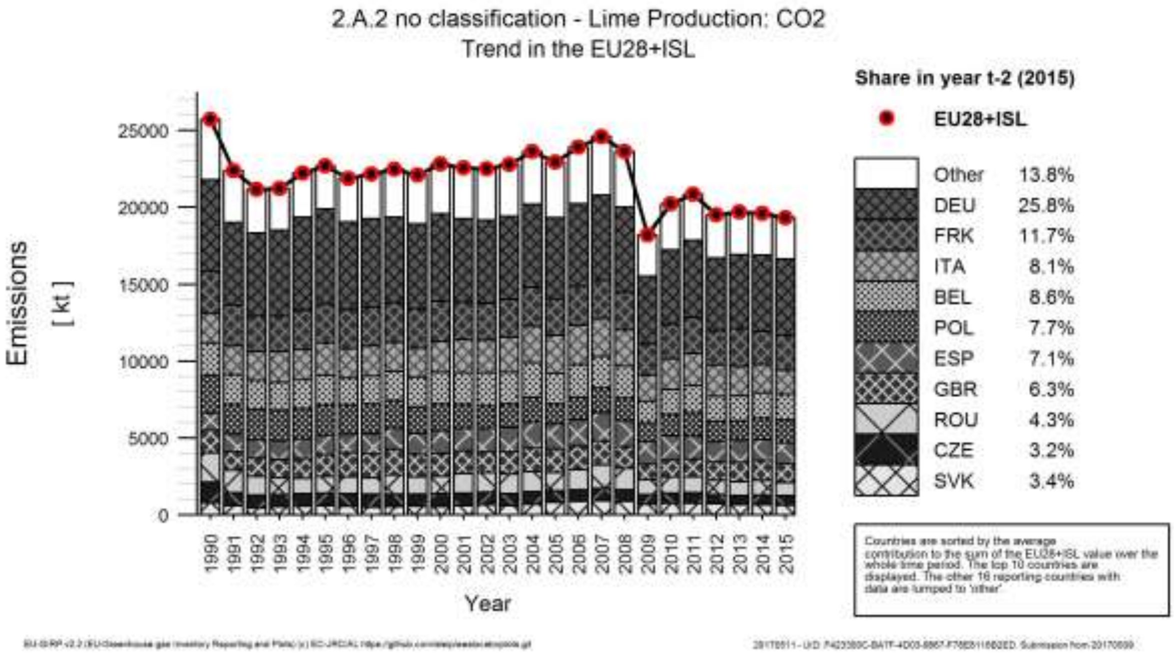


The decrease of emissions in the early nineties was dominated by the drop in German lime production due to the sector’s restructuring following German reunification, as well as economic factors and development of competing and substitute products. Romania also contributed considerably to the drop in the early nineties. Germany, France and Belgium are the largest emitters contributing 26 %, 12 % and 9 % of the sector respectively (Table 4.6).

Table 4.6 2A2 Lime production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	396	589	579	3.0%	-11	-2%	182	46%	T3	PS
Belgium	2 097	1 642	1 665	8.6%	23	1%	-433	-21%	T3	PS
Bulgaria	390	204	204	1.1%	1	0%	-186	-48%	T2	D
Croatia	153	71	73	0.4%	2	3%	-80	-52%	T2	CS
Cyprus	5	3	2	0.0%	0	-4%	-3	-56%	T1	D
Czech Republic	1 337	629	610	3.2%	-19	-3%	-727	-54%	T3	PS
Denmark	105	58	51	0.3%	-8	-13%	-55	-52%	T3	CS
Estonia	130	34	39	0.2%	5	13%	-91	-70%	T2	PS
Finland	383	386	358	1.9%	-28	-7%	-24	-6%	T2	CS
France	2 743	2 150	2 253	11.7%	104	5%	-490	-18%	T2,T3	CS,PS
Germany	5 987	4 973	4 976	25.8%	3	0%	-1 011	-17%	T2	D
Greece	404	176	163	0.8%	-14	-8%	-241	-60%	CS	PS
Hungary	614	141	151	0.8%	9	7%	-463	-75%	CS	CS
Ireland	214	189	177	0.9%	-12	-6%	-37	-17%	T3	PS
Italy	1 877	1 841	1 566	8.1%	-275	-15%	-311	-17%	T2	CS,PS
Latvia	169	1	1	0.0%	0	10%	-168	-100%	T2	D,PS
Lithuania	223	41	39	0.2%	-2	-5%	-184	-82%	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	1 372	1 495	7.7%	123	9%	-966	-39%	T2	CS
Portugal	203	346	351	1.8%	5	1%	148	73%	T3	OTH
Romania	1 898	952	831	4.3%	-121	-13%	-1 066	-56%	T2	CS,D
Slovakia	795	667	648	3.4%	-19	-3%	-147	-18%	T2	PS
Slovenia	201	56	60	0.3%	4	7%	-141	-70%	T3	CS
Spain	1 146	1 381	1 380	7.1%	-1	0%	234	20%	T2	D,PS
Sweden	331	415	421	2.2%	6	1%	90	27%	T3	D
United Kingdom	1 462	1 284	1 220	6.3%	-64	-5%	-242	-17%	T3	CS
EU-28	**25 726**	**19 602**	**19 313**	**100%**	**-289**	**-1%**	**-6 413**	**-25%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	1 462	1 284	1 220	6.3%	-64	-5%	-242	-17%	T3	CS
EU-28 + ISL	**25 726**	**19 602**	**19 313**	**100%**	**-289**	**-1%**	**-6 413**	**-25%**	**-**	**-**

Abbreviations are explained in the Chapter 'Units and abbreviations'. Emissions of the Netherlands are included in 2D2 Food industries.

Table 4.7 shows information on methods applied and emission factors for CO_2 emissions from 2A2 Lime production for 1990 and 2015. While production data is not necessarily explicitly used for emissions calculations (plant-specific emission factors are typically derived from raw meal carbon content characterization), countries that report emissions from lime production provide activity data for calculating comparative IEFs. Lime production data is the combined figure for the three types of lime: quicklime (high-calcium lime), dolomitic lime and hydraulic lime production The weighted average IEF in 2015 is 0.71 t CO_2/t of lime produced. The lime production activity data for each country reflect a mix of lime types, and so the implied emission factors per tonne of lime produced range from 0.45 for UK to 0.83 for Latvia. Of the twenty-five countries which report lime production emissions, all but one use higher tier methodologies (country or plant specific emission factors or Tier 2 or Tier 3) which accounts for more than 99.9 % of emissions from this category.

Table 4.7 2A2 Lime production: Information on methods applied, activity data, emission factors for CO_2 emissions

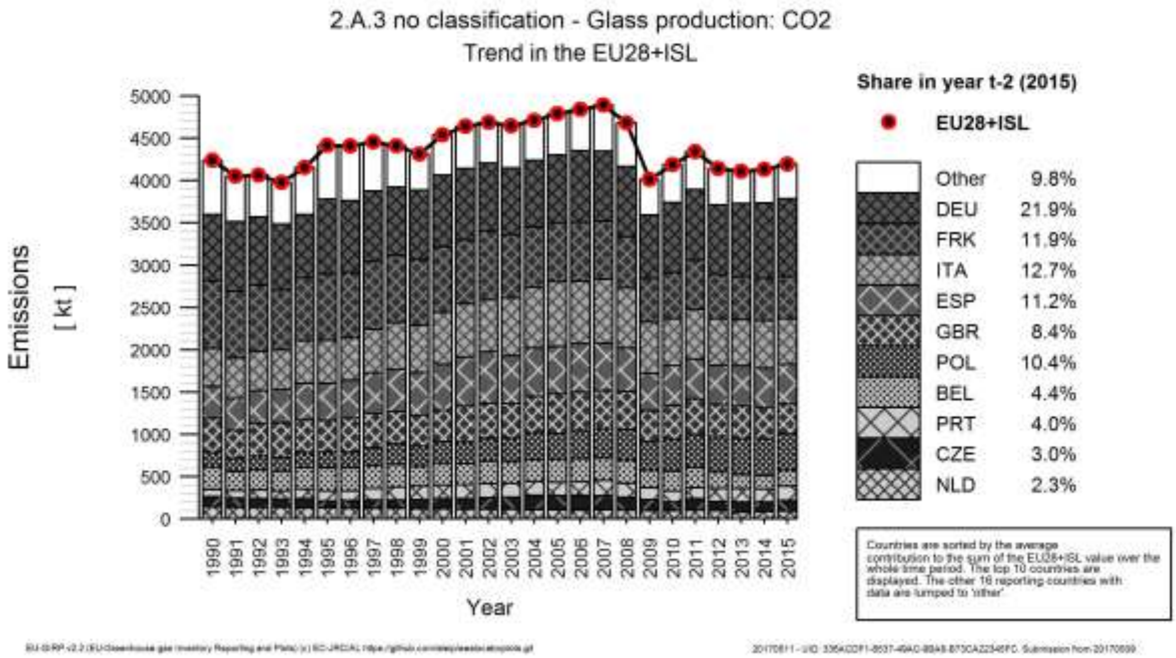
			1990				2015			
Member State	**Method applied**	**Emission factor**	**Activity data**		**Implied emission factor (t/t)**	**CO2 emissions (kt)**	**Activity data**		**Implied emission factor (t/t)**	**CO2 emissions (kt)**
			Description	**(kt)**			**Description**	**(kt)**		
Austria	T3	PS	Lime Production	513	0.77	396	Lime Production	772	0.75	579
Belgium	T3	PS	Lime Production	2 660	0.79	2 097	Lime Production	2 079	0.80	1 665
Bulgaria	T2	D	Lime Production	490	0.80	390	Lime Production	262	0.78	204
Croatia	T2	CS	Lime Production	232	0.66	153	Lime Production	134	0.55	73
Cyprus	T1	D	Lime Production	7	0.75	5	Lime Production	3	0.75	2
Czech Republic	T3	PS	Lime Production	1 823	0.73	1 337	Lime Production	790	0.77	610
Denmark	T3	CS	Lime Production	134	0.79	105	Lime Production	64	0.79	51
Estonia	T2	PS	Lime Production	185	0.70	130	Lime Production	54	0.71	39
Finland	T2	CS	Lime Production	488	0.78	383	Lime Production	456	0.78	358
France	T2,T3	CS,PS	Lime Production	3 589	0.76	2 743	Lime Production	3 378	0.67	2 253
Germany	T2	D	Lime Production	7 927	0.76	5 987	Lime Production	6 629	0.75	4 976
Greece	CS	PS	Lime Production	491	0.82	404	Lime Production	218	0.75	163
Hungary	CS	CS	Lime Production	831	0.74	614	Lime Production	205	0.73	151
Ireland	T3	PS	Lime Production	255	0.84	214	Lime Production	236	0.75	177
Italy	T2	CS,PS	Lime Production	2 583	0.73	1 877	Lime Production	2 216	0.71	1 566
Latvia	T2	D,PS	Lime Production	214	0.79	169	Lime Production	1	0.83	1
Lithuania	T2	D	Lime Production	288	0.77	223	Lime Production	51	0.77	39
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	T2	CS	Lime Production	3 464	0.71	2 461	Lime Production	2 037	0.73	1 495
Portugal	T3	PS	Lime Production	298	0.68	203	Lime Production	506	0.69	351
Romania	T2	CS,D	Lime Production	2 414	0.79	1 898	Lime Production	1 056	0.79	831
Slovakia	T2	PS	Lime Production	1 076	0.74	795	Lime Production	828	0.78	648
Slovenia	T3	CS	Lime Production	275	0.73	201	Lime Production	80	0.75	60
Spain	T2	D,PS	Lime Production	1 601	0.72	1 146	Lime Production	1 952	0.71	1 380
Sweden	T3	D	Lime Production	439	0.75	331	Lime Production	538	0.78	421
United Kingdom	T3	CS	Lime Production	3 282	0.45	1 462	Lime Production	2 738	0.45	1 220
EU-28				**35 563**	**0.72**	**25 726**		**27 284**	**0.71**	**19 313**
Iceland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
United Kingdom (KP)	T3	CS	Lime Production	3 282	0.45	1 462	Lime Production	2 738	0.45	1 220
EU-28+ISL				**35 563**	**0.72**	**25 726**		**27 284**	**0.71**	**19 313**

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 2015. As can be seen in Figure 4.6, emissions in 2015 were similar to 1990 levels (just 1% lower). CO_2 emissions from glass production in 2015 increased by 1.6% on 2014 levels.

Figure 4.6 2A3 Glass production: EU-28+ISL CO_2 emissions



In 2015, Germany was responsible for 22%, Italy for 13 % 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 (298kt or 37%),

Table 4.8 2A3 Glass production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	39	37	40	1.0%	3	8%	1	4%	T3	PS
Belgium	266	160	186	4.4%	27	17%	-80	-30%	T3	CS,PS
Bulgaria	138	69	80	1.9%	12	17%	-58	-42%	T3	CS
Croatia	36	30	31	0.7%	0.2	1%	-5	-14%	T3	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	124	112	125	3.0%	14	12%	2	1%	T1	D
Denmark	20	8	9	0.2%	1	11%	-11	-56%	T3	PS
Estonia	1	8	10	0.2%	2	29%	9	715%	T3	PS
Finland	21	3	2	0.05%	-0.5	-19%	-19	-90%	T3	CS
France	797	496	499	11.9%	3	1%	-298	-37%	T2,T3	CS,PS
Germany	780	892	920	21.9%	28	3%	139	18%	T2	CS
Greece	20	17	16	0.4%	-1	-3%	-4	-19%	CS	CS
Hungary	82	59	55	1.3%	-4	-6%	-27	-33%	CS	CS
Ireland	13	NO	NO	-	-	-	-13	-100%	NA	NA
Italy	453	562	534	12.7%	-28	-5%	80	18%	T2	CS,PS
Latvia	0	1	0.5	0.01%	-0.5	-51%	0	29%	D	D,PS
Lithuania	12	7	6	0.2%	-1	-13%	-5	-45%	T2	D
Luxembourg	54	63	65	1.6%	2	3%	11	21%	CS	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	142	86	95	2.3%	9	10%	-47	-33%	CS	CS
Poland	169	437	434	10.4%	-3	-1%	265	157%	T2	D
Portugal	84	157	167	4.0%	10	7%	84	100%	T3	OTH
Romania	150	56	59	1.4%	3	5%	-91	-61%	T2	CS,D
Slovakia	8	12	12	0.3%	-0.3	-3%	4	51%	T3	PS
Slovenia	3	9	10	0.2%	1	16%	7	211%	T3	D
Spain	374	471	472	11.2%	1	0.2%	97	26%	D	CS,D,PS
Sweden	45	16	17	0.4%	0.4	2%	-28	-63%	T3	CS,D
United Kingdom	406	363	351	8.4%	-12	-3%	-54	-13%	T3	CS
EU-28	**4 238**	**4 131**	**4 197**	**100%**	**66**	**2%**	**-41**	**-1%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	406	363	351	8.4%	-12	-3%	-54	-13%	T3	CS
EU-28 + ISL	**4 238**	**4 131**	**4 197**	**100%**	**66**	**2%**	**-41**	**-1%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.9 provides information on the methods applied, activity data, and the emissions factors for CO_2 emissions from 2A3 Glass production for 1990 to 2015. 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 of several sources with independent estimation methods, using partly higher tiers, partly default methods.

The table below shows activity data as production (glass) or inputs (carbonate use). An EU IEF for each of the activity types has been calculated.

Table 4.9 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 CO2 emission (kt)	2015 Activity data Description	2015 Activity data (kt)	2015 Implied emission factor (t/t)	2015 CO2 emission (kt)
Austria	T3	PS	Glass Production	399	0.10	39	Glass Production	497	0.08	40
Belgium	T3	CS,PS	Glass Production	1993	0.13	266	Glass Production	1846	0.10	186
Bulgaria	T3	CS	-	818	0.17	138	-	540	0.15	80
Croatia	T3	CS	Glass Production	275	0.13	36	Glass Production	238	0.13	31
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	T1	D	Glass Production	1237	0.10	124	Glass Production	1255	0.10	125
Denmark	T3	PS	Glass Production	200	0.10	20	Glass Production	189	0.05	9
Estonia	T3	PS	Glass Production	12	0.10	1	Glass Production	88	0.11	10
Finland	T3	CS	Used Carbonates	48	0.44	21	Used Carbonates	5	0.40	2
France	T2,T3	CS,PS	Glass Production	4307	0.19	797	Glass Production	2671	0.19	499
Germany	T2	CS	Glass Production	6562	0.12	780	Glass Production	7433	0.12	920
Greece	CS	CS	Glass Production	135	0.15	20	Glass Production	106	0.15	16
Hungary	CS	CS	Glass Production	418	0.20	82	Glass Production	484	0.11	55
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	5244	0.10	534
Latvia	D	D,PS	Glass Production	44	0.01	0	Glass Production	C	C	0.5
Lithuania	T2	D	Glass Production	66	0.18	12	Glass Production	48	0.13	6
Luxembourg	CS	PS	Glass Production	377	0.14	54	Glass Production	421	0.15	65
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	CS	CS	-	1095	0.13	142	-	1403	0.07	95
Poland	T2	D	Glass Production	1058	0.16	169	Glass Production	2715	0.16	434
Portugal	T3	OTH	-	615	0.14	84	-	1705	0.10	167
Romania	T2	CS,D	Glass Production	926	0.16	150	Glass Production	395	0.15	59
Slovakia	T3	PS	Used Carbonates	18	0.44	8	Used Carbonates	28	0.42	12
Slovenia	T3	D	Glass Production	25	0.13	3	Glass Production	79	0.13	10
Spain	D	CS,D,PS	Glass Production	2866	0.13	374	Glass Production	4546	0.10	472
Sweden	T3	CS,D	-	NE	NE	45	-	NE	NE	17
United Kingdom	T3	CS	Glass Production	1942	0.21	406	Glass Production	2131	0.16	351
EU-28				**29277**	**0.14**	**4238**		**34066**	**0.12**	**4197**
Iceland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
United Kingdom (KP)	T3	CS	Glass Production	1942	0.21	406	Glass Production	2131	0.16	351
EU-28+ISL				**29277**	**0.14**	**4238**		**34066**	**0.12**	**4197**

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 2015. Emissions from this sector in 2015 were 16% lower than 1990 levels. It is not necessarily useful 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 4.10 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	624	457	420	4.0%	-37	-8%	-205	-33%
Belgium	136	172	202	1.9%	30	17%	66	49%
Bulgaria	607	822	996	9.4%	174	21%	389	64%
Croatia	6	33	40	0.4%	7	20%	34	590%
Cyprus	44	10	7	0.1%	-2	-25%	-37	-84%
Czech Republic	109	321	249	2.4%	-72	-22%	140	128%
Denmark	73	67	61	0.6%	-7	-10%	-13	-17%
Estonia	0.3	1	8	0.1%	8	1012%	8	2630%
Finland	63	167	140	1.3%	-27	-16%	77	122%
France	1 927	1 327	1 267	12.0%	-61	-5%	-660	-34%
Germany	867	564	465	4.4%	-99	-18%	-402	-46%
Greece	590	344	310	2.9%	-34	-10%	-279	-47%
Hungary	449	248	259	2.4%	11	4%	-190	-42%
Ireland	5	0.3	1	0.01%	1	187%	-4	-81%
Italy	2 544	864	830	7.9%	-34	-4%	-1 714	-67%
Latvia	69	12	8	0.1%	-3	-28%	-61	-88%
Lithuania	240	17	15	0.1%	-3	-16%	-225	-94%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	0.2	0.04	0.02	0.0002%	-0.01	-34%	-0.2	-86%
Netherlands	690	776	812	7.7%	36	5%	122	18%
Poland	771	1 835	1 817	17.2%	-18	-1%	1 046	136%
Portugal	205	332	355	3.4%	23	7%	150	73%
Romania	38	249	288	2.7%	39	16%	249	651%
Slovakia	447	331	297	2.8%	-35	-10%	-150	-34%
Slovenia	20	18	16	0.1%	-3	-14%	-5	-24%
Spain	1 358	990	1 074	10.2%	84	8%	-283	-21%
Sweden	36	20	22	0.2%	1	6%	-15	-41%
United Kingdom	641	700	607	5.7%	-94	-13%	-34	-5%
EU-28	**12 559**	**10 679**	**10 563**	**100%**	**-116**	**-1%**	**-1 996**	**-16%**
Iceland	1	1	1	0.01%	0.2	30%	0.03	4%
United Kingdom (KP)	641	700	607	5.7%	-94	-13%	-34	-5%
EU-28 + ISL	**12 560**	**10 680**	**10 564**	**100%**	**-116**	**-1%**	**-1 996**	**-16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2 Chemical industry (CRF Source Category 2B)

The key categories in the chemical industry include:

Table 4.11: Key categories for sector 2B (Table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
2 B 1 Ammonia Production: no classification (CO_2)	32000	24143	0	L	L
2 B 2 Nitric Acid Production: no classification (N_2O)	49572	4440	T	L	0
2 B 3 Adipic Acid Production: no classification (N_2O)	57555	428	T	L	0
2 B 8 Petrochemical and Carbon Black Production: no classification (CO_2)	14940	15532	T	L	L

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
2 B 9 Fluorochemical Production: no classification (HFCs)	29034	369	T	L	0
2 B 9 Fluorochemical Production: no classification (Unspecified mix of HFCs and PFCs)	5567	58	T	0	0
2 B 10 Other chemical industry: no classification (CO_2)	5815	8965	T	0	L

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 is 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 accounts for the N_2O emitted 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 4.12 presents a summary of emissions 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

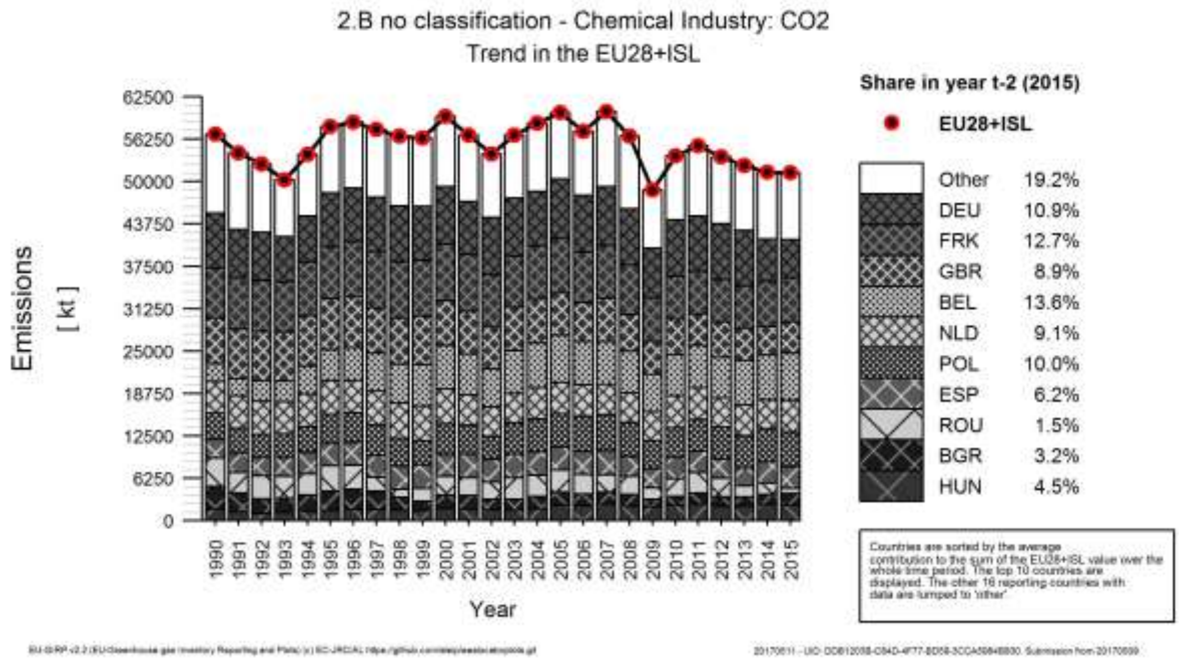


Table 4.12 presents chemical industry CO_2, CH_4, N_2O and total GHG emissions (including F-gases) as CO_2e. Between 1990 and 2015 GHG emissions from the chemical industry sector decreased markedly largely due to the significant reduction in N_2O emissions which fell by 93%. The greatest absolute decreases in N_2O emissions were in UK, France and Germany.

Table 4.12 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	1 555	794	643	700	877	47	35	47
Belgium	10 076	8 236	2 590	6 985	3 807	978	0.02	7
Bulgaria	4 943	1 790	3 283	1 665	1 647	126	13	NO,NA
Croatia	1 532	849	772	537	754	312	6	0.2
Cyprus	-	-	NO	NO	NO	NO	NO	NO
Czech Republic	2 944	2 071	1 783	1 680	1 125	355	36	37
Denmark	1 003	2	1	2	1 003	NO,NA	NO,NA	NO,NA
Estonia	308	-	308	NO	NO	NO	NO	NO
Finland	1 862	1 175	270	916	1 592	259	NO,NA	NA,NO
France	36 789	7 942	7 363	6 534	23 649	1 148	81	49
Germany	35 681	6 966	8 109	5 571	21 557	754	334	485
Greece	2 931	516	681	495	1 066	20	1	NO,NA
Hungary	4 867	2 421	1 759	2 326	3 090	50	18	45
Ireland	1 986	-	990	NO	995	NO	NO	NO
Italy	10 546	2 959	2 577	1 256	6 418	146	61	4
Latvia	-	-	NO	NO	NO	NO	NO	NO
Lithuania	2 176	2 278	1 278	2 020	893	258	5	NO
Luxembourg	-	-	NO	NO	NO	NO	NO	NO
Malta	0.2	0.1	0.2	0.1	NO,NA	NO,NA	NO,NA	NO,NA
Netherlands	17 524	6 499	4 713	4 657	6 825	1 272	380	409
Poland	7 378	5 941	3 802	5 141	3 536	749	40	51
Portugal	1 725	715	1 201	650	498	38	26	27
Romania	8 393	1 122	4 208	775	4 135	336	50	11
Slovakia	2 020	1 525	878	1 384	1 142	140	0.3	1
Slovenia	70	48	66	48	NO	NO	4	NO,NA
Spain	8 774	3 772	2 773	3 191	2 829	424	131	156
Sweden	930	200	126	159	803	41	1	-
United Kingdom	45 181	4 861	6 765	4 583	23 797	45	214	61
EU-28	**211 191**	**62 682**	**56 940**	**51 275**	**112 037**	**7 498**	**1 436**	**1 390**
Iceland	47	-	0.4	NO,IE	46	NO	NO,NA	NO,IE
United Kingdom (KP)	45 181	4 861	6 765	4 583	23 797	45	214	61
EU-28 + ISL	**211 238**	**62 682**	**56 941**	**51 275**	**112 084**	**7 498**	**1 436**	**1 390**

Abbreviations explained in the Chapter 'Units and abbreviations'. Note that emissions from F-gases are included in the total.

Table 4.13 lists information on recalculations in CO_2 from 2B Chemical industry for 1990 and 2014 and with explanations for large recalculations.

Table 4.13 2B Chemical Industry: Contribution of MS to EU recalculations of CO_2 emissions for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent (*)	kt CO_2 equiv.	Percent (*)	
Austria	0	0.0	1	0.1	Revision of Urea use AD
Belgium	0	0.0	-108	-1.6	- 2B1 small correction in CO_2 emissions from from 2013 on. Time consistency is now guaranteed for the complete timeseries. Inconsistency corrected between the ETS-methodologies and the IPCC 2006 guidelines with respect to the reported emissions from the production of ammonia. Subtraction of CO_2 (further used in the process to produce a.o. lime) need to be carried out when reporting these emissions - not the case for ETS - 2B10 emissions were too high from 2013 on (about 100 kton CO_2) and N_2O emissions in in the year 2014 were corrected (error corrected for 1 company). - Re-allocation between process emissions (2B) and energetic emissions/other fuels (1A2c) in 2013 - A review of 2B (one company produces nitric acid) showed missing emissions for 1990-1999 increasing the emissions estimates by 62 ton N_2O (18 kt CO_2 eq) for 1990-1999 and of 17 ton (5 kt CO_2 eq) for 2007. - 2B2 for 2013 are corrected and brought in line with ETS- emissions.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent (*)	kt CO_2 equiv.	Percent (*)	
Bulgaria	394	13.6	12	0.8	2.B.5.b for 1988-20013 an anthracite coal calorific value and emission factor are now used (previously calorific value and emission factor for black coal were used). 2.B.7 previously calorific values and emission factors of fuels, described in chapter “Energy”, were used. The recalculations are based on data from verified EU ETS reports on emissions trading. The LKD coefficient – 1.02, used for calculation of the lime production emissions, is removed. Ethylene (2.B.8.b) Ethylene Dichloride (2.B.8.c) Calculations of the emissions of these two productions are included for the first time in the reported period.
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Estonia	4	1.3	0	0.0	
Finland	0	0.0	0	0.0	
France	3 378	84.8	3 721	128.6	-2B1: correction of CO_2 emission data process and emission data converted into liquefied CO_2 and urea for a site in 2014 - 2B8: Transfer of process emissions from steam crackers to CRF 2B10 - 2B10: Transfer of process emissions and combustion of steam crackers (ethylene / propylene + fuel gas) from CRF 2.B.8.b / 2.B.8.g and 1A2c to CRF 2.B.10 .
Germany	0	0.0	1	0.0	
Greece	0	0.0	0	0.0	
Hungary	0	0.0	18	0.8	Corrected NCV of the used natural gas for hydrogen production
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	0	0.0	0	0.0	
Lithuania	-2	-0.2	-7	-0.4	Correction of activity data on natural gas (for period 2005-2014) based on the newest information provided by the company in October 2016. Recalculation in urea use in agriculture (recalculated CO_2 emissions from urea application in year of 1990-2014 (see Agriculture sector 5.10 CO_2 emissions from urea application)); Correction of data on exported urea for the period 2007-2014 based on the data provided by company.
Luxembourg	0	0.0	0	0.0	
Malta	0	100.0	0	100.0	
Netherlands	0	0.0	0	0.0	
Poland	-566	-13.0	-823	-14.5	CO_2 recovered for fertilizer urea production was deducted in calculation of emission for 2B1 subcategory

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent (*)	kt CO_2 equiv.	Percent (*)	
Portugal	562	87.8	592	2 790.3	In ammonia production subsector (2B1), We implemented the deduction of the CO_2 used for the urea production. This led to a decrease of 29.7 kt of CO_2 in 1990 and 20.7 kt of CO_2 in 2008 (last year with ammonia production). New CO_2 emissions from ethylene production (2B8b), based on 2006 IPCC Guidelines emission factor. Revision of the vinyl chloride monomer (2B8c) activity data for all the period 1990-2014. Review of the time series of activity data and emission factors for the Carbon Black (2B8f) sector.
Romania	-62	-1.5	-29	-1.7	Recalculation have been made for the entire period 1989-2014. Recalculations were made as a result of due to recalculate the amount of CO_2 from urea use as fertilizer. (CRF category 2B.1)
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	-371	-11.8	-351	-10.1	CO_2 recovery in Ammonia production implemented
Sweden	24	23.6	30	24.3	
United Kingdom	388	6.1	3	0.1	Minor revision to the estimate of use of process off-gases in chemical and petrochemical production
EU28	3 748	7.0	3 060	6.3	
Iceland	0	0.0	0	0.0	
EU28+ISL	3 748	7.0	3 060	6.3	

(*) contribution of the recalculation as percentage of the total emissions of category 2B for the respective year and MS

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 0.6 % of total EU-28+ISL emissions in 2015. Between 1990 and 2015, CO_2 emissions from this source decreased by 25%

Figure 4.8 2B1 Ammonia production: CO_2 emissions

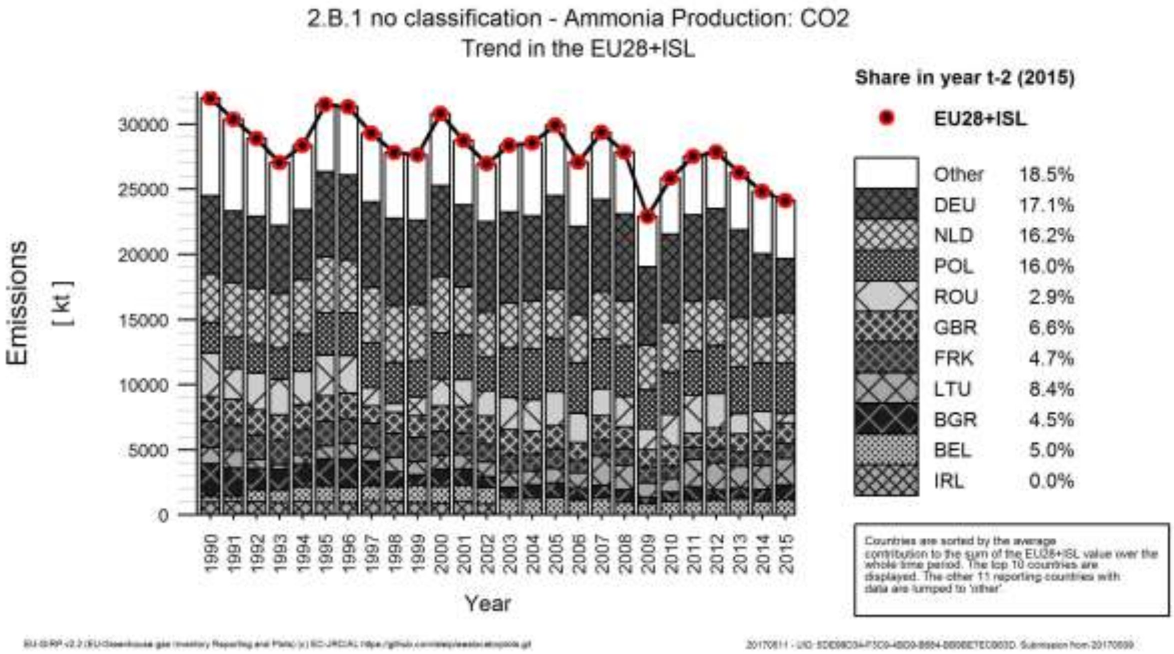


Figure 4.8 and Table 4.15 show that in 2015 Germany was responsible for 17% of this category's emissions. The next largest contributors, Poland and Netherlands both contribute 16%. Bulgaria, Germany, Romania, Italy and Ireland all had large reductions in absolute terms between 1990 and 2015. The reasons 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 2015 were in Poland, Belgium, Lithuania and Slovakia.

Table 4.14 2B1 Ammonia production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2	%	kt CO2	%		
Austria	467	526	504	2.1%	-22	-4%	37	8%	T3	PS
Belgium	423	1 049	1 213	5.0%	165	16%	791	187%	T3	D,PS
Bulgaria	2 508	873	1 085	4.5%	212	24%	-1 423	-57%	T2	PS
Croatia	552	534	537	2.2%	3	1%	-15	-3%	T3	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	991	689	742	3.1%	53	8%	-249	-25%	T1	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	308	NO	NO	-	-	-	-308	-100%	NA	NA
Finland	93	NO	NO	-	-	-	-93	-100%	NA	NA
France	2 019	1 041	1 145	4.7%	104	10%	-874	-43%	T1,T2,T3	CS,D,PS
Germany	6 025	4 797	4 135	17.1%	-662	-14%	-1 890	-31%	T3	PS
Greece	652	241	241	1.0%	-1	0%	-412	-63%	T1a	CS
Hungary	1 255	1 139	960	4.0%	-179	-16%	-295	-24%	T3	D
Ireland	990	NO	NO	-	-	-	-990	-100%	NA	NA
Italy	1 892	711	496	2.1%	-216	-30%	-1 396	-74%	T2	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 254	1 868	2 020	8.4%	152	8%	766	61%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 730	3 564	3 921	16.2%	357	10%	191	5%	T3	CS
Poland	2 344	3 742	3 870	16.0%	129	3%	1 526	65%	T2	CS
Portugal	540	NO	NO	-	-	-	-540	-100%	NA	NA
Romania	3 323	1 629	699	2.9%	-930	-57%	-2 624	-79%	T2	PS
Slovakia	332	530	639	2.6%	109	21%	307	92%	T3	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	408	400	348	1.4%	-52	-13%	-60	-15%	D	PS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	1 895	1 482	1 590	6.6%	107	7%	-305	-16%	T3	CS
EU-28	**32 000**	**24 814**	**24 143**	**100%**	**-671**	**-3%**	**-7 856**	**-25%**	**-**	**-**
Iceland	NA	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	1 895	1 482	1 590	6.6%	107	7%	-305	-16%	T3	CS
EU-28 + ISL	**32 000**	**24 814**	**24 143**	**100%**	**-671**	**-3%**	**-7 856**	**-25%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.15 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia production for 1990 to 2015. Not all countries show ammonia production as activity data for this emissions category. A gap-filled EU IEF for ammonia production was calculated. In 2015 of the seventeen countries which report ammonia production emissions all but one are estimated with higher Tier methods (country or plant specific emission factors and/or Tier 2 or Tier 3), which accounts for 97% of emissions in this category. Note that the low IEF for Hungary is due to the fact that a significant amount of the hydrogen used for ammonia production is synthesized by another company.

Table 4.15 2B1 Ammonia production: Information on methods applied, activity data, emission factors for CO_2 emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor	1990 CO2 emissions (kt)	2015 Activity data Description	2015 Activity data (kt)	2015 Implied emission factor	2015 CO2 emissions (kt)
Austria	T3	PS	Ammonia Production	461	1.01	467	Ammonia Production	520	0.97	504
Belgium	T3	D,PS	Ammonia Production	360	1.17	423	Ammonia Production	1 047	1.16	1 213
Bulgaria	T2	PS	-	C	C	2 508	-	C	C	1 085
Croatia	T3	PS	Ammonia Production	345	2.24	552	Ammonia Production	455	2.00	537
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	T1	CS	Ammonia Production	336	3.27	991	Ammonia Production	227	3.27	742
Denmark	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Estonia	NA	NA	Ammonia Production	294	1.44	308	Ammonia Production	NO	NO	NO
Finland	NA	NA	Ammonia Production	28	3.27	93	Ammonia Production	NO	NO	NO
France	T1,T2,T3	CS,D,PS	Ammonia Production	1 928	1.05	2 019	Ammonia Production	1 069	1.07	1 145
Germany	T3	PS	Ammonia Production	2 705	2.41	6 025	Ammonia Production	2 742	1.88	4 135
Greece	T1a	CS	Ammonia Production	313	2.08	652	Ammonia Production	145	1.66	241
Hungary	T3	D	-	25 334	0.06	1 255	-	18 320	0.06	960
Ireland	NA	NA	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	NO	NO	NO
Italy	T2	PS	Ammonia Production	1 455	1.94	1 892	Ammonia Production	396	1.92	496
Latvia	NA	NA	Ammonia Production	NO	NO	NO	Ammonia Production	NO	NO	NO
Lithuania	T3	CS	Ammonia Production	568	2.27	1 254	Ammonia Production	1 064	2.05	2 020
Luxembourg	NA	NA	Ammonia Production	NO	NO	NO	Ammonia Production	NO	NO	NO
Malta	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Netherlands	T3	CS	-	C	C	3 730	-	C	C	3 921
Poland	T2	CS	Ammonia Production	1 532	1.90	2 344	Ammonia Production	2 720	1.73	3 870
Portugal	NA	NA	-	C	C	540	-	C	NO	NO
Romania	T2	PS	Natural Gas Consumption	1 511	2.20	3 323	Natural Gas Consumption	338	2.07	699
Slovakia	T3	PS	Ammonia Production	360	1.71	332	Ammonia Production	477	1.86	639
Slovenia	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Spain	D	PS	Ammonia Production	573	1.24	408	Ammonia Production	488	1.25	348
Sweden	NA	NA	-	NO	NO	NO	-	NO	NO	NO
United Kingdom	T3	CS	Ammonia Production	1 328	1.43	1 895	Ammonia Production	1 022	1.56	1 590
EU-28				**NE**	**NE**	**32 000**	**Ammonia Production**	**40 189**	**0.60**	**24 143**
Iceland	NA	NA	-	IE	NA,NO	NA	-	NO	NO	NO
United Kingdom (KP)	T3	CS	Ammonia Production	1 328	1.43	1 895	Ammonia Production	1 022	1.56	1 590
EU-28+ISL				**NE**	**NE**	**32 000**		**40 189**	**0.60**	**24 143**

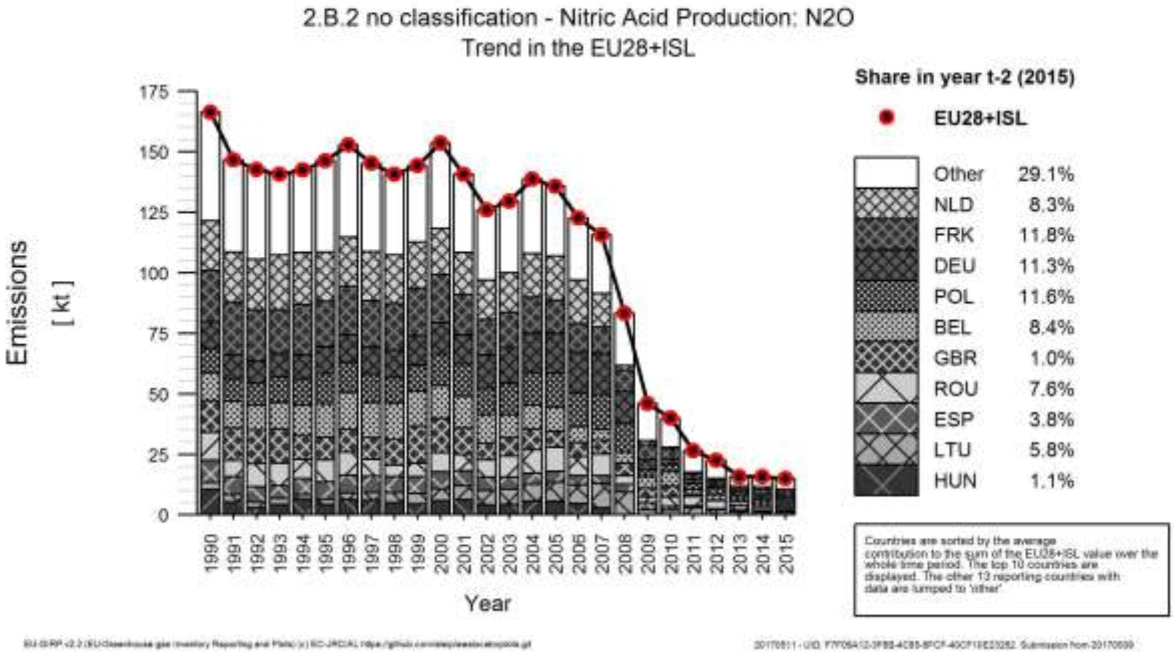
Abbreviations explained in the Chapter 'Units and abbreviations'.

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 only 0.1% of total EU 28+ISL (without LULUCF) emissions in 2015. (Figure **4.9** and Table 4.16). 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 seen 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 has slowed in recent years with emissions decreasing by -5% between 2014 and 2015. Eight countries reported small emission increases in this period.

Table 4.16 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	877	48	47	1.1%	-1	-2%	-830	-95%	T3	PS
Belgium	3 440	473	375	8.4%	-98	-21%	-3 065	-89%	T3	PS
Bulgaria	1 647	125	126	2.8%	1	1%	-1 522	-92%	T3	PS
Croatia	754	266	311	7.0%	45	17%	-443	-59%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 050	256	280	6.3%	24	10%	-770	-73%	T1	PS
Denmark	1 003	NO	NO	-	-	-	-1 003	-100%	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 592	205	259	5.8%	54	26%	-1 333	-84%	T3	PS
France	6 316	571	523	11.8%	-48	-8%	-5 793	-92%	T2,T3	CS,D,PS
Germany	3 258	535	504	11.3%	-31	-6%	-2 755	-85%	T3	PS
Greece	1 066	27	20	0.5%	-6	-24%	-1 046	-98%	CS	CS
Hungary	3 090	64	50	1.1%	-14	-22%	-3 039	-98%	CS	PS
Ireland	995	NO	NO	-	-	-	-995	-100%	NA	NA
Italy	2 005	53	36	0.8%	-17	-32%	-1 970	-98%	T2	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	893	332	258	5.8%	-74	-22%	-635	-71%	T3	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	6 085	356	370	8.3%	14	4%	-5 714	-94%	T2	PS
Poland	3 041	492	517	11.6%	25	5%	-2 524	-83%	T1	CS
Portugal	498	54	38	0.9%	-16	-30%	-460	-92%	D	PS
Romania	3 473	405	336	7.6%	-69	-17%	-3 137	-90%	T2,T3	D,PS
Slovakia	1 142	145	140	3.1%	-5	-3%	-1 002	-88%	T3	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	2 704	177	171	3.8%	-6	-3%	-2 533	-94%	T3	PS
Sweden	782	52	36	0.8%	-16	-31%	-746	-95%	T2	PS
United Kingdom	3 860	40	44	1.0%	3	8%	-3 816	-99%	T3	CS
EU-28	**49 572**	**4 675**	**4 440**	**100%**	**-235**	**-5%**	**-45 132**	**-91%**	**-**	**-**
Iceland	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom (KP)	3 860	40	44	1.0%	3	8%	-3 816	-99%	T3	CS
EU-28 + ISL	**49 572**	**4 675**	**4 440**	**100%**	**-235**	**-5%**	**-45 132**	**-91%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.17 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric acid production for 1990 to 2015. The table shows that while most countries report nitric acid production as activity data; for many countries this information is confidential. The IEFs are shown as kg N_20 per tonne of production as recommended by the ERT. A gap filled UE IEF has not been calculated because the standard deviation divided by mean is less than 50%. The low IEFs are 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 all emissions are estimated with higher tier methods (country or plant specific emission factors and/or Tier 2 or Tier 3).

Table 4.17 2B2 Nitric acid production: Information on methods applied, activity data, emission factors for N_2O emissions

Member State	Method applied	Emission factor	1990				2015			
			Activity data		Implied emission factor	N2O emissions	Activity data		Implied emission factor	N2O emissions
			Description	(kt)	(kg/t)	(kt)	Description	(kt)	(kg/t)	(kt)
Austria	T3	PS	Nitric Acid Production	530	0.01	877	Nitric Acid Production	562	0.28	47
Belgium	T3	PS	Nitric Acid Production	1 436	0.01	3 440	Nitric Acid Production	2 040	0.62	375
Bulgaria	T3	PS	-	C	C	1 647	-	C	-	126
Croatia	T2	PS	Nitric Acid Production	332	0.01	754	Nitric Acid Production	345	3.03	311
Cyprus	NA	NA	-	NO	NO	NO	-	NO	NO	NO
Czech Republic	T1	PS	Nitric Acid Production	530	0.01	1 050	Nitric Acid Production	563	1.67	280
Denmark	NA	NA	-	450	0.01	1 003	-	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	1 592	Nitric Acid Production	621	1.40	259
France	T2,T3	CS,D,PS	Nitric Acid Production	3 200	0.01	6 316	Nitric Acid Production	2 039	0.86	523
Germany	T3	PS	Nitric Acid Production	1 698	0.01	3 258	Nitric Acid Production	2 522	0.67	504
Greece	CS	CS	Nitric Acid Production	511	0.01	1 066	Nitric Acid Production	199	0.35	20
Hungary	CS	PS	-	732	0.01	3 090	-	670	0.25	50
Ireland	NA	NA	Nitric Acid Production	339	0.01	995	Nitric Acid Production	NO	NO	NO
Italy	T2	D,PS	Nitric Acid Production	1 037	0.01	2 005	Nitric Acid Production	390	0.31	36
Latvia	NA	NA	Nitric Acid Production	NO	NO	NO	Nitric Acid Production	NO	NO	NO
Lithuania	T3	PS	Nitric Acid Production	355	0.01	893	Nitric Acid Production	1 195	0.72	258
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	6 085	-	C	C	370
Poland	T1	CS	Nitric Acid Production	1 577	0.01	3 041	Nitric Acid Production	2 396	0.72	517
Portugal	D	PS	-	C	C	498	-	C	C	38
Romania	T2,T3	D,PS	Nitric Acid Production	1 261	0.01	3 473	Nitric Acid Production	735	1.54	336
Slovakia	T3	PS	Nitric Acid Production	401	0.01	1 142	Nitric Acid Production	634	0.74	140
Slovenia	NA	NA	Nitric Acid Production	NO	NO	NO	Nitric Acid Production	NO	NO	NO
Spain	T3	PS	Nitric Acid Production	1 329	0.01	2 704	Nitric Acid Production	700	0.82	171
Sweden	T2	PS	Nitric Acid Production	374	0.01	782	Nitric Acid Production	239	0.51	36
United Kingdom	T3	CS	Nitric Acid Production	2 408	0.01	3 860	Nitric Acid Production	1 127	0.13	44
EU-28				**NE**	**NE**	**49 572**		**NE**	**NE**	**4 440**
Iceland	NA	NA	-	NO	NO	NO	-	NO	NO	NO
United Kingdom (KP)	T3	CS	Nitric Acid Production	2 408	0.01	3 860	Nitric Acid Production	1 127	0.13	44
EU-28+ISL				**NE**	**NE**	**49 572**		**NE**	**NE**	**4 440**

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 2015, N_2O emissions from this source decreased by 99% (Figure 4.10 and Table **4.18**). 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

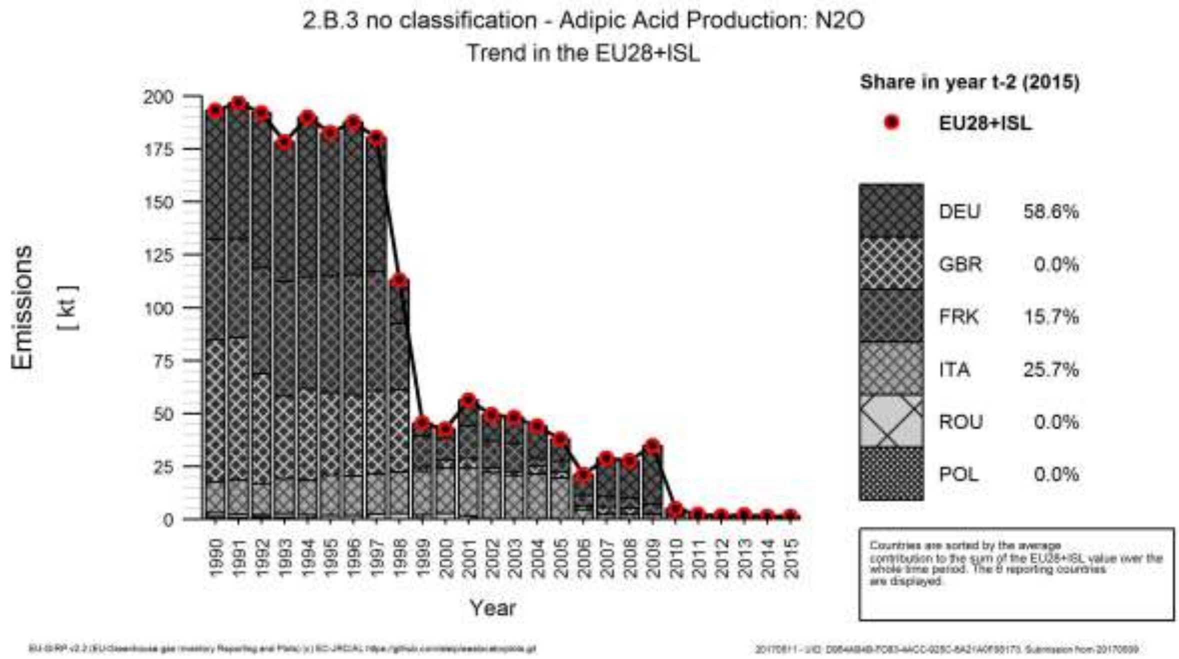


Table 4.18 2B3 Adipic acid production: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
France	14 232	142	67	15.7%	-75	-53%	-14 165	-100%	T2	PS
Germany	18 077	213	251	58.6%	38	18%	-17 826	-99%	T3	PS
Italy	4 402	59	110	25.7%	51	85%	-4 292	-97%	T2	D,PS
Poland	358	NO	NO	-	-	-	-358	-100%	NA	NA
Romania	552	NO	NO	-	-	-	-552	-100%	NA	NA
United Kingdom	19 935	NO	NO	-	-	-	-19 935	-100%	NA	NA
EU-28	**57 555**	**414**	**428**	**100%**	**14**	**3%**	**-57 126**	**-99%**	**-**	**-**
United Kingdom (KP)	19 935	NO	NO	-	-	-	-19 935	-100%	NA	NA
EU-28 + ISL	**57 555**	**414**	**428**	**100%**	**14**	**3%**	**-57 126**	**-99%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.19 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic acid production for 1990 to 2015. Adipic acid production is used as activity data but the information is confidential in France and Germany. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.004 t/t for 2015. In 2015 all emissions are estimated with higher Tier methods.

Table 4.19 2B3 Adipic acid production: methods, activity data, emission factors for N_2O emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 N2O emissions (kt)	2015 Activity data Description	2015 Activity data (kt)	2015 Implied emission factor (t/t)	2015 N2O emissions (kt)
France	T2	PS	Adipic Acid Production	C	C	14 232	Adipic Acid Production	C	C	67
Germany	T3	PS	Adipic Acid Production	C	C	18 077	Adipic Acid Production	C	C	251
Italy	T2	D,PS	Adipic Acid Production	49	0.30	4 402	Adipic Acid Production	86	0.004	110
Poland	NA	NA	Adipic Acid Production	4	0.30	358	Adipic Acid Production	NO	NO	NO
Romania	NA	NA	Adipic Acid Production	6	0.30	552	Adipic Acid Production	NO	NO	NO
United Kingdom	NA	NA	Adipic Acid Production	C	C	19 935	Adipic Acid Production	NO	NO	NO
EU-28				**NE**	**NE**	**57 555**		**NE**	**NE**	**428**
United Kingdom (KP)	NA	NA	Adipic Acid Production	C	C	19 935	Adipic Acid Production	NO	NO	NO
EU-28+ISL				**NE**	**NE**	**57 555**		**NE**	**NE**	**428**

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 1990-2015 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 2015. Between 1990 and 2015, CO_2 emissions from this source increased by4%. Belgium, United Kingdom, 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

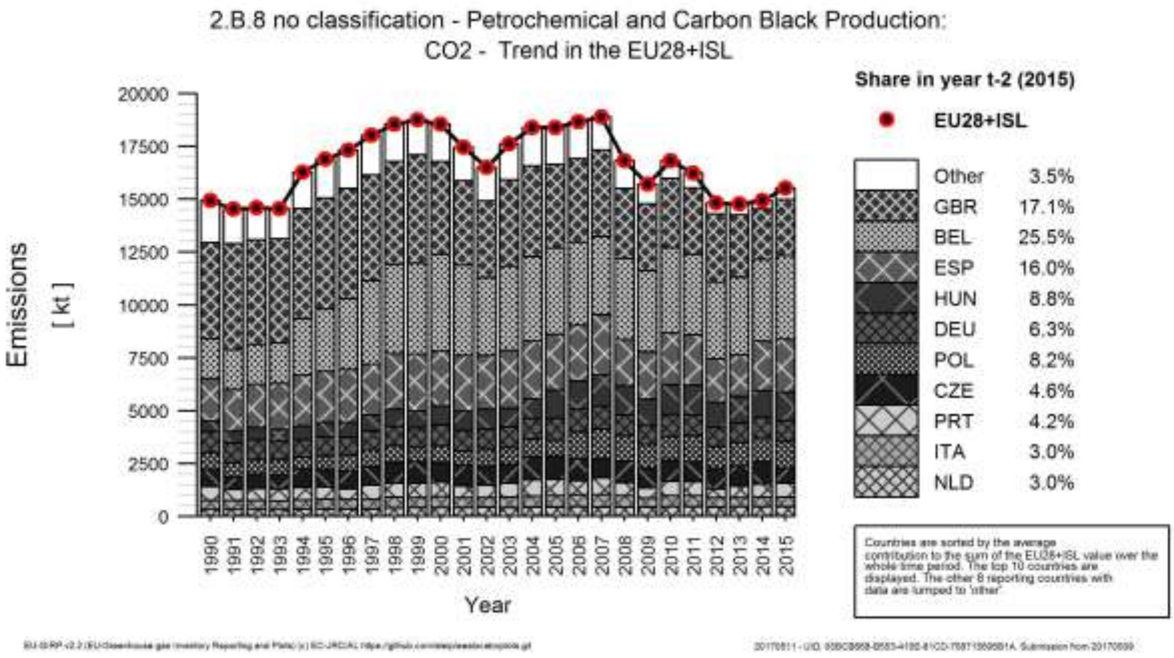


Table 4.20 2B8 Petrochemical and carbon black production CO_2

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Belgium	1 882	3 845	3 957	25.5%	112	3%	2 075	110%
Bulgaria	346	NO	NO	-	-	-	-346	-100%
Croatia	220	0	0	0.0%	0	0%	-220	-100%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	792	1 081	715	4.6%	-366	-34%	-77	-10%
Denmark	NO	NO	NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO,NA	NA,NO	NA,NO	-	-	-	-	-
France	371	168	212	1.4%	44	26%	-159	-43%
Germany	974	975	973	6.3%	-2	0%	-1	0%
Greece	29	NA,NO	NO,NA	-	-	-	-29	-100%
Hungary	504	1 267	1 366	8.8%	99	8%	861	171%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	422	453	462	3.0%	9	2%	40	10%
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	24	NO	NO	-	-	-	-24	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	336	457	458	3.0%	1	0%	123	37%
Poland	806	1 098	1 271	8.2%	172	16%	464	58%
Portugal	662	613	650	4.2%	37	6%	-12	-2%
Romania	574	4	NO	-	-4	-100%	-574	-100%
Slovakia	429	251	332	2.1%	81	32%	-97	-23%
Slovenia	16	NO	NO	-	-	-	-16	-100%
Spain	2 019	2 356	2 481	16.0%	125	5%	462	23%
Sweden	NO,NA,IE	NA,NO,IE	NO,IE,NA	-	-	-	-	-
United Kingdom	4 534	2 378	2 655	17.1%	277	12%	-1 879	-41%
EU-28	**14 940**	**14 947**	**15 532**	**100%**	**585**	**4%**	**592**	**4%**
Iceland	NO	NO,IE	NO,IE	-	-	-	-	-
United Kingdom (KP)	4 534	2 378	2 655	17.1%	277	12%	-1 879	-41%
EU-28 + ISL	**14 940**	**14 947**	**15 532**	**100%**	**585**	**4%**	**592**	**4%**

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 9.0 Mt of CO_2e in 2015 or 0.2% of total EU 28+ISL (without LULUCF) emissions in 2015. Between 1990 and 2015, CO_2 emissions from this source increased by 54% (Table 4.21 and Table 4.22) while CH_4 and N_2O emissions both decreased by about 50%. This category contains a wide range of emissions and sources as shown in Table 4.21.

Table 4.21 2B10 Other: CO_2, CH_4 and N_2O emissions for 1990 and 2015

Member State	2.B.10 Other	CO₂ emissions [kt]	CH4 emissions [kt CO2 equivalents]	N2O emissions [kt CO2 equivalents]	Total emissions [kt CO2 equivalents]	CO2 emissions [kt]	CH4 emissions [kt CO2 equivalents]	N2O emissions [kt CO2 equivalents]	Total emissions [kt CO2 equivalents]
		1990	1990	1990	1990	2015	2015	2015	2015
AUT	10. Other (please specify)	138.56	7.30	NA	145.86	142.78	7.12	NA	149.90
	CO2 from Nitric Acid Production	0.41	NA	NA	0.41	0.40	NA	NA	0.40
	Other chemical bulk production	138.15	7.30	NA	145.44	142.38	7.12	NA	149.50
BEL	10. Other (please specify)	285.15		8.94	294.09	1814.49	6.91	17.32	1838.72
	Other non-specified	285.15		8.94	294.09	1814.49	6.91	17.32	1838.72
BGR	10. Other (please specify)								
CYP	10. Other (please specify)								
CZE	10. Other (please specify)	IE	NO	NO		222.81	NO	NO	222.81
	Other non energy use in chemical industry	IE	NO	NO		206.97	NO	NO	206.97
	Non selective catalytic reduction	IE	NO	NO		15.83	NO	NO	15.83
DEU	10. Other (please specify)	NA	NA	IE		NA	NA	IE	
	Other	NA	NA	IE		NA	NA	IE	
DNM	10. Other (please specify)	0.85	NA	NA	0.85	1.56	NA	NA	1.56
	Production of catalysts	0.85	NA	NA	0.85	1.56	NA	NA	1.56
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	NO	NO	177.28	916.24	NO	NO	916.24
	Phosphoric Acid Production	24.54	NO	NO	24.54	40.16	NO	NO	40.16
	Hydrogen Production	116.22	NO	NO	116.22	785.84	NO	NO	785.84
	Limestone and Dolomite Use	36.52	NO	NO	36.52	90.25	NO	NO	90.25
	Chemicals Production	NO	NO	NO		NO	NO	NO	
FRK	10. Other (please specify)	4398.73	76.81	527.72	5003.26	4820.37	48.27	285.62	5154.26
GBR	10. Other (please specify)	NO	185.65	2.06	187.71	NO	53.53	1.37	54.90
	Chemical industry - other	NO	185.65	2.06	187.71	NO	53.53	1.37	54.90
GRC	10. Other (please specify)	NA,NO	NA	NA		254.53	NA	NA	254.53
	Sulfuric acid	NA	NA	NA		NA	NA	NA	
	Hydrogen production	NO	NA	NA		254.53	NA	NA	254.53
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)								
ITA	10. Other (please specify)	NA	NA	NA		NA	NA	NA	
	other (indirect emissions)	NA	NA	NA		NA	NA	NA	
	Soda Ash (CO emissions only)	NA	NA	NA		NA	NA	NA	
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)	0.17	NA	NA	0.17	0.07	NA	NA	0.07
	Carbide use	0.17	NA	NA	0.17	0.07	NA	NA	0.07
NLD	10. Other (please specify)	583.27	NO	NO	583.27	278.00	NO	NO	278.00
	Other process emissions	583.27	NO	NO	583.27	278.00	NO	NO	278.00
POL	10. Other (please specify)	NO	NO	NO		NO	NO	NO	
PRT	10. Other (please specify)	NO	NO	NO		NO	NO	NO	
	2.B.10.b Ammonium Sulphate	NO	NO	NO		NO	NO	NO	
	2.B.10.c Explosives	NO	NO	NO		NO	NO	NO	
	2.B.10.d Solvent use in plastic products manufa	NO	NO	NO		NO	NO	NO	
	2.B.10.a Sulphuric Acid	NO	NO	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	0.05	0.06	117.10	365.29	0.16	0.20	365.65
	Hydrogen Production	116.99	0.05	0.06	117.10	365.29	0.16	0.20	365.65
SVN	10. Other (please specify)	NO	NO	NO		NO	NO	NO	
SWE	10. Other (please specify)	114.14	0.70	20.71	135.55	148.66	C	5.01	153.67
	Pharmaceutical industry	NA	NE	14.90	14.90	NA	NE	4.17	4.17
	Other non-specified	NE	NE	NE		NE	NE	NE	
	Other organic chemical products	50.39	0.63	NA	51.02	61.30	C	NA	61.30
	Base chemicals for plastic industry	NE	NE	3.54	3.54	NE	NE	NE	
	Other inorganic chemical products	63.75	0.07	2.27	66.09	87.36	0.07	0.84	88.28
	Sulphuric acid production	NE	NA	NA		NE	NA	NA	
ISL	10. Other (please specify)	0.36	NA	46.49	46.85	NO	NO	NO	
	Silicium production	0.36	NA	NA	0.36	NO	NO	NO	
	Fertilizer production	NA	NA	46.49	46.49	NO	NO	NO	

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.21 provides an overview of change between 1990 and 2015 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 4.22 2B10 Other: CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	139	143	143	1.6%	0	0%	4	3%
Belgium	285	1 690	1 814	20.2%	124	7%	1 529	536%
Bulgaria	-	-	-	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	IE	220	223	2.5%	3	1%	223	∞
Denmark	1	1	2	0.0%	0	6%	1	83%
Estonia	NO	NO	NO	-	-	-	-	-
Finland	177	777	916	10.2%	139	18%	739	417%
France	4 399	5 031	4 820	53.8%	-211	-4%	422	10%
Germany	NA	NA	NA	-	-	-	-	-
Greece	NA,NO	328	255	2.8%	-74	-22%	255	∞
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	0.2	0.1	0.1	0.0%	0	0%	0	-58%
Netherlands	583	301	278	3.1%	-23	-8%	-305	-52%
Poland	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	117	353	365	4.1%	12	3%	248	212%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	114	144	149	1.7%	4	3%	35	30%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-28	**5 815**	**8 989**	**8 965**	**100%**	**-24**	**0%**	**3 150**	**54%**
Iceland	0.4	NO	NO	-	-	-	0	-100%
United Kingdom (KP)	NO	NO	NO	-	-	-	-	-
EU-28 + ISL	**5 815**	**8 989**	**8 965**	**100%**	**-24**	**0%**	**3 149**	**54%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.23 2B10 Other: N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NA	NA	NA	-	-	-	-	-
Belgium	9	16	17	5.6%	2	11%	8	94%
Bulgaria	-	-	-	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	NA	NA	NA	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	528	187	286	92.3%	98	53%	-242	-46%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NA	NA	NA	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	0.1	0.2	0.2	0.1%	0	3%	0	219%
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	21	10	5	1.6%	-5	-52%	-16	-76%
United Kingdom	2	1	1	0.4%	0	13%	-1	-33%
EU-28	**559**	**215**	**310**	**100%**	**95**	**44%**	**-250**	**-45%**
Iceland	46.5	NO	NO	-	-	-	-46	-100%
United Kingdom (KP)	2	1	1	0.4%	0	13%	-1	-33%
EU-28 + ISL	**606**	**215**	**310**	**100%**	**95**	**44%**	**-296**	**-49%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.24 provides an overview of all sources reported under 2B10 Other Chemical Industry for the year 2015 and for all gases. The largest contributors to the total emissions are France, Belgiumand Finland.

Table 4.24 2B10 Other: Overview of sources reported under this source category for 2015

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
		2015	2015	2015	2015	2015
Austria	10. Other (please specify), CO2 from Nitric Acid Production, Other chemical bulk production	143	0	NA	150	2%
Belgium	10. Other (please specify), Other non-specified	1814	0	0	1839	20%
Bulgaria	10. Other (please specify)				-	-
Croatia	10. Other (please specify)	NO	NO	NO	-	-
Cyprus	10. Other (please specify)				-	-
Czech Republic	10. Other (please specify), Other non energy use in chemical industry, Non selective catalytic reduction	223	NO	NO	223	2%
Denmark	10. Other (please specify), Production of catalysts	2	NA	NA	2	0.02%
Estonia	10. Other (please specify)	NO	NO	NO	-	-
Finland	10. Other (please specify), Phosphoric Acid Production, Hydrogen Production, Limestone and Dolomite Use, Chemicals Production	916	NO	NO	916	10%
France	10. Other (please specify)	4820	2	1	5154	55%
Germany	10. Other (please specify), Other	NA	NA	IE	-	-
Greece	10. Other (please specify), Sulfuric acid, Hydrogen production	255	NA	NA	255	3%
Hungary	10. Other (please specify)	NO	NO	NO	-	-
Ireland	10. Other (please specify)				-	-
Italy	10. Other (please specify), other (indirect emissions), Soda Ash (CO emissions only)	NA	NA	NA	-	-
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)	0	NA	NA	0	0%
Netherlands	10. Other (please specify), Other process emissions	278	NO	NO	278	3%
Poland	10. Other (please specify)	NO	NO	NO	-	-
Portugal	10. Other (please specify), 2.B.10.b Ammonium Sulphate, 2.B.10.c Explosives, 2.B.10.d Solvent use in plastic products manufacturing, 2.B.10.a Sulphuric Acid	NO	NO	NO	-	-
Romania	10. Other (please specify), Other - non-specified	NO	NO	NO	-	-
Slovakia	10. Other (please specify), Hydrogen Production	365	0	0	366	4%
Slovenia	10. Other (please specify)	NO	NO	NO	-	-
Spain	10. Other (please specify), Other No-Specify	NA	NA	NA	-	-
Sweden	10. Other (please specify), Pharmaceutical industry, Other non-specified, Other organic chemical products, Base chemicals for plastic industry, Other inorganic chemical products, Sulphuric acid production	149	C	0	154	2%
United Kingdom	10. Other (please specify), Chemical industry - other	NO	2	0	55	1%
EU 28 - Total		**8965**	**5**	**1**	**9390**	**100%**
Island	10. Other (please specify), Silicium production, Fertilizer production	NO	NO	NO	-	-
EU 28+ISL - Total		**8965**	**5**	**1**	**9390**	**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 for comparison. Table **4.25** 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 2015.

Table 4.25 Emissions from the non-key categories: 2B4, 2B5, 2B6 and 2B7.

Member State	Category	Emissions in kt CO2 (or CO2 equiv.)			Share of category in 2015	Change 2014-2015		Change 1990-2015	
		1990	2014	2015		kt CO2e	%	kt CO2e	%
Austria	2B5 Carbide production CO2	38	47	53	25%	6	13%	15	40%
Belgium	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	358	677	585	25%	91	-14%	228	64%
Bulgaria	2B5 Carbide production CO2	80	8	6	3%	3	-33%	74	-93%
	2B7 Soda ash production CO2	349	599	574	27%	25	-4%	225	65%
Czech Republic	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	75	75	75	3%	0	0%	0	0%
France	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	2573	141	272	12%	131	93%	2301	-89%
	2B5 Carbide production CO2	159	20	21	10%	1	5%	138	-87%
	2B7 Soda ash production CO2	400	341	321	15%	20	-6%	79	-20%
Germany	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	222	NA,NO,IE	NA,NO,IE	-	-	-	222	-100%
	2B5 Carbide production CO2	443	4	7	3%	3	67%	436	-98%
	2B7 Soda ash production CO2	667	474	456	21%	18	-4%	211	-32%
Italy	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	11	NO	NO	-	-	-	11	-100%
	2B5 Carbide production CO2	26	5	5	2%	0	-6%	22	-83%
	2B6 Titanium dioxide production CO2	53	38	36	13%	2	-5%	16	-31%
	2B7 Soda ash production CO2	183	206	255	12%	49	24%	72	40%
Netherlands	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	740	874	902	39%	28	3%	162	22%
	2B7 Soda ash production CO2	64	NO	NO	-	-	-	64	-100%
Poland	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	137	237	233	10%	4	-2%	95	69%
	2B5 Carbide production CO2	651	NO	NO	-	-	-	651	-100%
Romania	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	110	NO	NO	-	-	-	110	-100%
	2B5 Carbide production CO2	224	1	6	3%	5	786%	218	-97%
	2B7 Soda ash production CO2	87	58	70	3%	12	21%	18	-20%
Slovakia	2B5 Carbide production CO2	NO	86	48	23%	37	-43%	48	∞
	2B5 Carbide production CO2	NO	86	48	23%	37	-43%	48	∞
	2B6 Titanium dioxide production CO2	NO	NO	NO	-	-	-	-	-
Spain	2B4 Caprolactam, glyoxal and glyoxylic acid production, N2O as CO2 equivalent	125	248	254	11%	5	2%	128	103%
	2B5 Carbide production CO2	76	58	56	26%	2	-4%	20	-27%
	2B6 Titanium dioxide production CO2	NA	NA	NA	-	-	-	-	-
	2B7 Soda ash production CO2	270	307	307	14%	1	0%	36	13%
Sweden	2B5 Carbide production CO2	12	11	11	5%	0	-1%	1	-10%
United Kingdom	2B6 Titanium dioxide production CO2	105	165	197	70%	32	19%	93	89%
	2B7 Soda ash production CO2	232	158	141	7%	17	-11%	91	-39%
Total		**8468**	**4923**	**4938**		**15**	**0.3%**	**-3531**	**-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.

Note that in this chapter, EU trends do not always include Sweden for confidentiality reasons and also to preserve time series consistency for the EU. Consequently, the EU CRF tables at sub-category level and data shown on the same level in the NIR are not always consistent. Note that at sector level and at national totals level the EU NIR and the EU CRF tables are fully consistent.

Table 4.26 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2015, CO_2 emissions from 2C Metal Production decreased by approx. 33%. The absolute decrease of CO_2 emissions was largest in Germany, Romania and Belgium.

Table 4.26 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	HFC emissions in 1990 (kt CO2 equivalents)	HFC emissions in 2015 (kt CO2 equivalents)	PFC emissions in 1990 (kt CO2 equivalents)	PFC emissions in 2015 (kt CO2 equivalents)
Austria	8 177	10 772	6 787	10 770	-	-	1 149	NO
Belgium	10 342	3 805	10 328	3 790	-	-	-	-
Bulgaria	1 629	224	1 603	224	-	-	-	-
Croatia	1 583	14	339	14	NO	NO	1 240	NO
Cyprus	0	0	NO	NO	-	-	-	-
Czech Republic	9 662	6 896	9 647	6 883	NO	NO	NO	NO
Denmark	60	0	30	0	-	-	NO	NO
Estonia	0	0	NO	NO	NO	NO	NO	NO
Finland	1 976	2 186	1 976	2 186	NO	-	NO	-
France	9 083	4 125	4 733	4 024	NO,NA	NO,NA	3 567	62
Germany	28 188	18 047	25 080	17 854	NO	48	2 889	95
Greece	1 203	1 210	1 012	1 143	NO	NO	190	66
Hungary	3 699	1 171	3 316	1 166	NO	NO	376	NO
Ireland	26	0	26	NO	NO	NO	NO	NO
Italy	6 421	1 611	4 378	1 563	NO	10	1 975	NO
Latvia	70	1	70	1	NO	NO	NO	NO
Lithuania	17	2	17	2	NO	NO	NO	NO
Luxembourg	985	123	985	123	NO	NO	NO	NO
Malta	0	0	NO	NO	NO	NO	NO	NO
Netherlands	5 312	952	2 675	945	NO	NO	2 638	7
Poland	5 931	2 611	5 767	2 592	NA	NA	142	NA,NO
Portugal	114	111	109	95	NO,NA	NO	NO,NA	NO
Romania	14 218	4 106	11 388	4 094	NO	NO	2 808	7
Slovakia	4 901	4 554	4 586	4 544	NO	NO	315	9
Slovenia	551	208	343	193	-	-	208	16
Spain	4 594	4 292	3 404	4 184	NA,NO	NO,NA	1 164	86
Sweden	3 895	2 766	3 284	2 712	NO	NO	569	34
United Kingdom	9 399	4 512	7 404	4 392	NO	2	1 553	11
EU-28	**132 035**	**74 298**	**109 284**	**73 494**	**0**	**60**	**20 783**	**392**
Iceland	843	1 806	348	1 701	NO	NO	495	104
United Kingdom (KP)	9 399	4 512	7 404	4 392	NO	2	1 553	11
EU-28 + ISL	**132 878**	**76 104**	**109 632**	**75 195**	**0**	**60**	**21 277**	**496**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 4.12: 2C Metal Industry CO_2 – Trend in EU-28

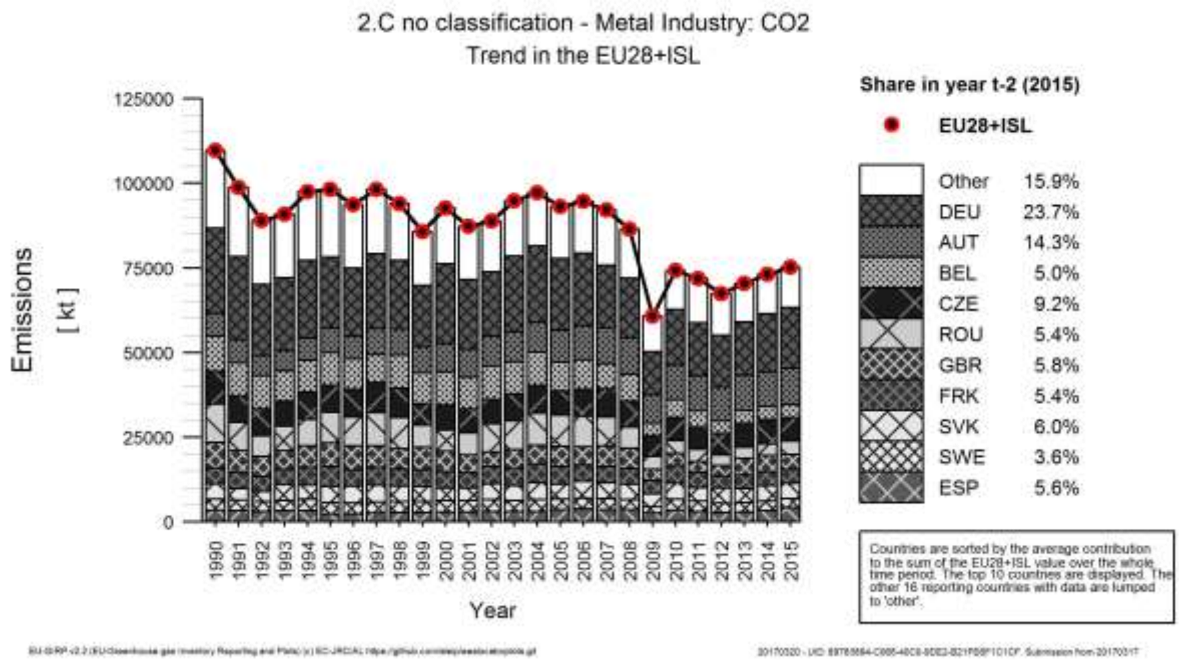


Table **4.26** provides information on the contribution of Member States to EU recalculations of CO_2 emissions from 2C Metal Production for 1990 and 2015, including main explanations.

Table 4.27: 2C Metal Production: Contribution of MS to EU recalculations in CO_2 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 and percent of sector total)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	58	0.6	Revised energy balance (input to blast furnaces).
Belgium	0	0.0	2	0.1	Udated emission data from one company.
Bulgaria	190	13.4	209	518.7	Lead production was previously reported in the Energy sector.
Croatia	0	0.0	1	2.4	CO_2 emission from limestone and dolomite use in steel production was recalculated.
Cyprus	0	0.0	0	0.0	
Czech Republic	-6	-0.1	613	9.3	Updated activity data for lead production available, updated emission factor.
Denmark	0	0.0	0	0.0	
Estonia	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	Correction of errors.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
France	620	15.1	759	22.4	Update of CO_2 emissions elated to the use of carbonaceous materials in electric steelworks. Correction of activity data in zinc production. Update of CO_2 emissions from silicium and ferro-silicium production (bottom up). Update of CO_2 emissions in cast iron foundries.
Germany	6	0.0	86	0.5	Update of statistical data.
Greece	0	0.0	0	0.0	
Hungary	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	500	12.9	231	16.5	CO_2 process emissions from zinc production have been added.
Latvia	17	32.5	0	-12.8	CO_2 emissions from 2C1 were recalculated in all time series according to 2006 IPCC Guidelines taking into account all input and output process materials (coke, limestone, dolomite, carbon electrodes and quicklime). Also the amount of limestone, dolomite and produced non-marketed lime (quicklime) used for steel production processes were allocated from 2A2 to 2C1.
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	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Romania	17	0.1	0	0.0	The emission factor for aluminium production was updated for the years before 2002.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	7	0.2	65	2.0	Oxidation factor=1 implemented (IPCC 2006) for estimates based on carbon balance from fuel used as reductants.
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	-1	0.0	Minor revision to dolomite consumption data.
EU28	1 350	1.3	2 023	2.9	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Iceland	1	0.4	3	0.2	Emissions from a new secondary steel plant were included (not included in the 2016 submission). Correction of mistakes/omissions in 2C2. :
EU28+ISL	1 352	1.2	2 026	2.9	

Table **4.28** provides information on the contribution of Member States to EU recalculations of PFC emissions from 2C Metal Production for 1990 and 2014 and main explanations for the largest recalculations in absolute terms.

Table 4.28: 2C Metal Production: Contribution of MS to EU recalculations in PFC for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent of sector total)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium					
Bulgaria					
Croatia	0	0.0	0	0.0	
Cyprus					
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	1	1.6	Application of bottom-up approach for PFC emissions from a research site (from 2014 onwards).
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	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Netherlands	0	0.0	0	0.0	
Poland	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Romania	353	14.4	0	0.0	The emission factor for aluminium production was updated for the years before 2002.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	135	31.1	1	1.1	Emissions of PFCs were recalculated using the slope factors from IPCC 2006.
United Kingdom	0	0.0	0	0.0	
EU28	488	2.4	2	0.5	
Iceland	0	0.0	0	0.0	
EU28+ISL	488	2.3	2	0.4	

Table **4.29** provides information on the contribution of Member States to EU recalculations of SF_6 emissions from 2C Metal Production for 1990 and 2014 and main explanations for the largest recalculations in absolute terms.

Table 4.29: 2C Metal Production: Contribution of MS to EU recalculations in SF_6 for 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent of sector total)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.00	-0.000005	-0.00003	Plant-specific data was updated.
Belgium					
Bulgaria					
Croatia	0	0.00	0	0.00	
Cyprus					
Czech Republic	0	0.00	0	0.00	
Denmark	0	0.00	0	0.00	
Estonia	0	0.00	0	0.00	
Finland	0	0.00	0	0.00	
France	-0.00001	-0.000001	-0.000004	-0.000008	No reason given (recalculation below level of significance).
Germany	0	0.00	0	0.00	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Greece	0	0.00	0	0.00	
Hungary	0	0.00	0	0.00	
Ireland	0	0.00	0	0.00	
Italy	0	0.00	0	0.00	
Latvia	0	0.00	0	0.00	
Lithuania	0	0.00	0	0.00	
Luxembourg	0	0.00	0	0.00	
Malta	0	0.00	0	0.00	
Netherlands	0	0.00	0	0.00	
Poland	0	0.00	0.000004	0.0001	No reason given (recalculations below level of significance).
Portugal	0	0.00	0	0.00	
Romania	0	0.00	0	0.00	
Slovakia	0	0.00	0	0.00	
Slovenia					
Spain	0	0.00	0	0.00	
Sweden	0	0.00	0.000002	0.00001	No reason given (recalculations below level of significance).
United Kingdom	0	0.00	0	0.00	
EU28	-0.00001	-0.000001	-0.000003	-0.000001	
Iceland	0	0.00	0	0.00	
EU28+ISL	-0.00001	-0.000001	-0.000003	-0.000001	

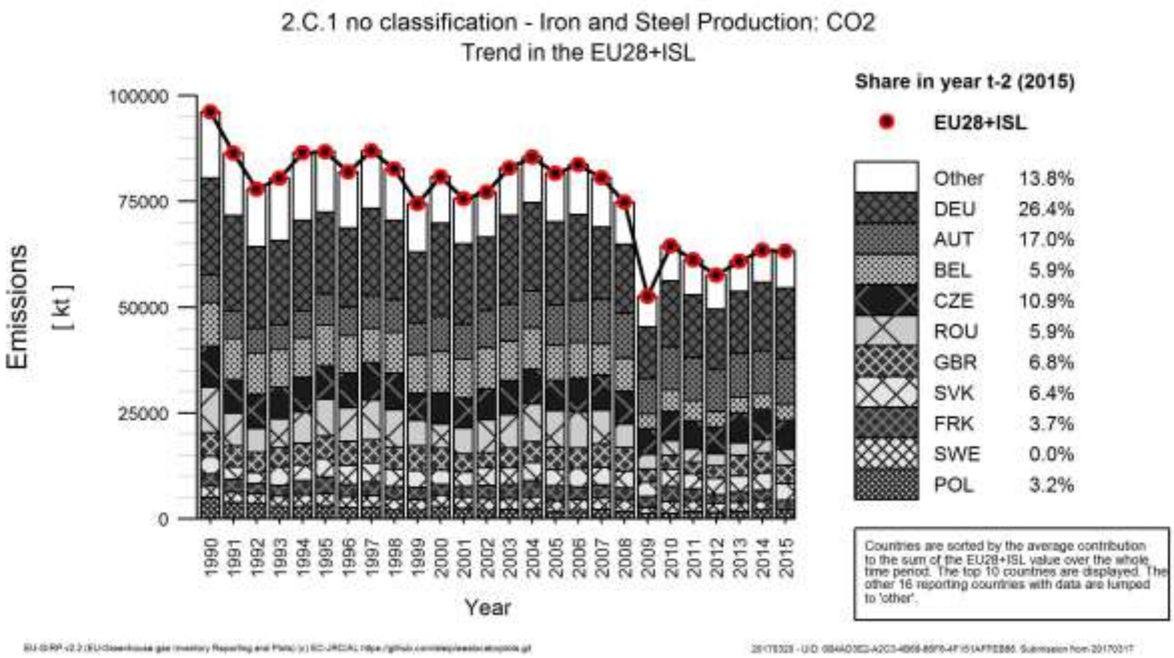
4.2.3.1 2C1 Iron and steel production

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 **4.31**.

CO_2 emissions from 2C1 Iron and Steel Production amounted to approx. 1.47% of total GHG emissions (without LULUCF) in 2015. Germany accounts for 26% of these emissions in the EU-28. Romania had the largest decrease in absolute terms between 1990 and 2015 while increases were encountered in Austria, Spain and Finland and (on a small scale) Slovenia.

The overall emission trend between 1990 and 2015 roughly follows the trend of emissions from Germany that fluctuates due to varying production figures. Between 1990 and 2015, overall CO_2 emissions from iron and steel production decreased by 34% (Table 4.30). Between 2014 and 2015 emissions decreased by 0.24%.

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 **4.30**).

Table 4.30 2C1 Iron and Steel Production: 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2	%	kt CO2	%		
Austria	6 610	7 393	10 210	10 740	17.0%	530	5%	4 130	62%	T1,T3	CS,PS
Belgium	10 278	9 538	3 796	3 706	5.9%	-90	-2%	-6 572	-64%	CS,T3	PS
Bulgaria	1 283	3 096	40	37	0.1%	-3	-7%	-1 246	-97%	T2	CS
Croatia	46	4	29	14	0.0%	-15	-52%	-32	-70%	T2	CS
Cyprus	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	9 643	7 931	7 183	6 873	10.9%	-310	-4%	-2 770	-29%	CS,T2	D,PS
Denmark	30	39	NO	NO	-	-	-	-30	-100%	NA	NA
Estonia	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1 967	2 067	2 032	2 163	3.4%	131	6%	196	10%	CS,T3	CS
France	2 918	3 984	2 445	2 311	3.7%	-135	-6%	-607	-21%	T2	CS
Germany	22 810	19 270	16 001	16 731	26.5%	730	5%	-6 079	-27%	T2	CS
Greece	105	96	70	61	0.1%	-9	-13%	-44	-42%	CS	PS
Hungary	3 153	2 605	904	1 166	1.8%	262	29%	-1 987	-63%	T3	PS
Ireland	26	25	NO	NO	-	-	-	-26	-100%	NA	NA
Italy	3 124	2 897	1 391	1 327	2.1%	-64	-5%	-1 797	-58%	T2	CR,CS,PS
Latvia	70	45	0	1	0.0%	1	11358%	-69	-99%	T2	D,PS
Lithuania	17	5	3	2	0.0%	-1	-22%	-15	-88%	T2	D
Luxembourg	985	465	102	123	0.2%	20	20%	-862	-88%	CS,T2	CS
Malta	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2 266	1 595	956	905	1.4%	-51	-5%	-1 361	-60%	T2	CS
Poland	5 073	3 020	2 074	2 033	3.2%	-41	-2%	-3 041	-60%	T2,T3	CS
Portugal	109	127	62	95	0.2%	33	54%	-14	-13%	T2	PS
Romania	10 781	8 636	3 038	3 759	5.9%	721	24%	-7 022	-65%	T3	CS
Slovakia	4 168	4 323	4 051	4 028	6.4%	-23	-1%	-140	-3%	T2,T3	PS
Slovenia	44	29	53	53	0.1%	0	1%	10	22%	T2	PS
Spain	2 435	1 190	1 960	2 807	4.4%	847	43%	372	15%	T2	CS,PS
Sweden	2 632	2 884	2 210	C	NA	NA	NA	NA	NA	T2,T3	PS
Untited Kingdom	5 595	5 391	4 795	4 319	6.8%	-476	-10%	-1 275	-23%	T2	CS
EU-28	**93 535**	**83 770**	**61 195**	**63 254**	**100%**	**2 059**	**3%**	**-30 280**	**-32%**	**-**	**-**
Iceland	NO	NO,NA	1	0	0.0%	0	-59%	0	∞	T1	D
United Kingdom (KP)	5 595	5 391	4 795	4 319	6.8%	-476	-10%	-1 275	-23%	T2	CS
EU-28 + ISL	**93 535**	**83 770**	**61 196**	**63 255**	**100%**	**2 059**	**3%**	**-30 280**	**-32%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

For this category, it is not useful to give an average IEF across the Member States because of their varying emission allocation (the split between process and combustion related emissions for pig iron production, which is an important sub-category). Activity data, implied implied emission factors and CO_2 emissions for the various Member States and sub-categories are provided in Table **4.31**.

Table4.14 2C1 Iron and Steel Production: Implied emission factors

1990					2015				
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**			10740
	Steel	3921	1.68	6591		Steel	7020	1.52	10703
	Pig Iron	3444	NO,IE	IE		Pig Iron	5795	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			37
	Electric Furnace Steel	370	0.05	20		Electric Furnace Steel	667	0.06	37
Belgium	**Iron and steel production**			10278	Belgium	**Iron and steel production**			3706
	Steel	11570	0.75	8689		Steel	7336	0.50	3644
	Pig Iron	9415	NA,IE	IE		Pig Iron	4247	IE,NA	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	13075	0.12	1589		Sinter	4585	0.01	56
	Pellet	-	-	IE		Pellet	NO	NO	NO
	Other			IE		Other			6
	Use of electrodes	NA	NO,IE	IE		Use of electrodes	1582	0.00	6
Bulgaria	**Iron and steel production**			1283	Bulgaria	**Iron and steel production**			37
	Steel	2180	0.59	1283		Steel	564	0.07	37
	Pig Iron	1143	NO,IE	IE		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	C	NO,IE	IE		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			-		Other			-
Croatia	**Iron and steel production**			46	Croatia	**Iron and steel production**			14
	Steel	171	0.27	46		Steel	149	0.09	14
	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			-

1990					2015				
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)		
Czech Republic	**Iron and steel production**			9643	Czech Republic	**Iron and steel production**			6873
	Steel	8190	IE,NA	IE		Steel	5256	NA,IE	IE
	Pig Iron	6106	IE,NA	IE		Pig Iron	4047	NA,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	8469	IE,NA	IE		Sinter	5553	NA,IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			9643		Other			6873
	Use of limestone and dolomite	891	0.52	462		Use of limestone and dolomite	948	0.85	801
	Metallurgical coke	7125	1.29	9180		Metallurgical coke	2332	2.60	6071
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
Finland	**Iron and steel production**			1967	Finland	**Iron and steel production**			2163
	Steel	2861	0.69	1967		Steel	3939	0.55	2163
	Pig Iron	NO	NO,IE	IE		Pig Iron	NO	NO,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NA	IE,NO	IE		Sinter	NA	NO,IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
	Other non-specified	487	NO	NO		Other non-specified	876	NO	NO
France	**Iron and steel production**			2918	France	**Iron and steel production**			2311
	Steel	19073	0.09	1643		Steel	15086	0.08	1142
	Pig Iron	14088	0.09	1234		Pig Iron	9688	0.11	1112
	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			41		Other			57

1990					2015				
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)		
Germany	**Iron and steel production**			22810	Germany	**Iron and steel production**			16731
	Steel	42193	0.54	22810		Steel	42676	0.39	16731
	Pig Iron	32263	NO,IE	IE		Pig Iron	28393	NO,IE	IE
	Direct reduced iron	C	IE	IE		Direct reduced iron	C	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**			61
	Steel	999	0.10	105		Steel	910	0.07	61
	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**			1166
	Steel	2963	0.12	346		Steel	1675	0.12	194
	Pig Iron	1697	1.65	2427		Pig Iron	1247	1.62	700
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	72	5.28	380		Sinter	46	5.91	272
	Pellet	IE	IE	IE		Pellet	IE	IE	IE
	Other			NO		Other			NO
Iceland	**Iron and steel production**			NO	Iceland	**Iron and steel production**			0
	Steel	NO	NO	NO		Steel	4	0.08	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			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**			1327
	Steel	25467	0.05	1346		Steel	22018	0.04	879
	Pig Iron	11852	0.15	1778		Pig Iron	5051	0.09	448
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	13577	NO,IE	IE		Sinter	6322	NO,IE	IE
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

1990					2015				
Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (kt)	Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (kt)
	Description	(kt)				Description	(kt)		
Latvia	**Iron and steel production**			70	**Latvia**	**Iron and steel production**			1
	Steel	550	0.13	70		Steel	12	0.08	1
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO
Lithuania	**Iron and steel production**			17	**Lithuania**	**Iron and steel production**			2
	Steel	NO	NO	NO		Steel	NO	NO	NO
	Pig Iron	NO	NO	NO		Pig Iron	NO	NO	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			17		Other			2
	Cast Iron	106	0.16	17		Cast Iron	2	0.84	2
Luxem-bourg	**Iron and steel production**			985	**Luxem-bourg**	**Iron and steel production**			123
	Steel	3506	0.12	404		Steel	2126	0.06	123
	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
Nether-lands	**Iron and steel production**			2266	**Nether-lands**	**Iron and steel production**			905
	Steel	5162	0.01	43		Steel	7071	0.00	16
	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			889
	Other non-specified	NA	NA	2223		Other non-specified	NA	NA	889

1990					2015				
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)		
Poland	**Iron and steel production**			5073	Poland	**Iron and steel production**			2033
	Steel	IE	IE	IE		Steel	IE	IE	IE
	Pig Iron	8657	0.13	1157		Pig Iron	5621	0.12	679
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	11779	0.07	841		Sinter	7430	0.05	357
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			3075		Other			997
	Basic Oxygen Furnace Steel	7207	0.13	929		Basic Oxygen Furnace Steel	5359	0.15	789
	Electric Furnace Steel	2309	0.04	2060		Electric Furnace Steel	3978	0.05	208
	Open-hearth Steel	3945	0.52	85		Open-hearth Steel	NO	NA,NO	NO
Portugal	**Iron and steel production**			109	Portugal	**Iron and steel production**			95
	Steel	621	0.07	41		Steel	2016	0.05	95
	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
Romania	**Iron and steel production**			10781	Romania	**Iron and steel production**			3759
	Steel	9959	1.08	10781		Steel	3481	1.08	3759
	Pig Iron	5916	NO,IE	IE		Pig Iron	1983	NO,IE	IE
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	11357	NO,IE	IE		Sinter	2662	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**			4028
	Steel	3562	1.17	4150		Steel	4311	0.93	4019
	Pig Iron	17	NO,IE	IE		Pig Iron	34	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			9
	EAF production of steel	311	0.06	18		EAF production of steel	315	0.03	9
Slovenia	**Iron and steel production**			44	Slovenia	**Iron and steel production**			53
	Steel	632	0.07	44		Steel	632	0.08	53
	Pig Iron	NO	NO,NA	NO		Pig Iron	NO	NO,NA	NO
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	NO	NO	NO		Sinter	NO	NO	NO
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

1990					2015				
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)		
Spain	**Iron and steel production**			2435	**Spain**	**Iron and steel production**			2807
	Steel	13163	0.07	979		Steel	14978	0.05	709
	Pig Iron	C	-	246		Pig Iron	C	-	335
	Direct reduced iron	IE	IE,NA	IE		Direct reduced iron	IE	IE,NA	IE
	Sinter	C	-	538		Sinter	C	-	224
	Pellet	IE	IE,NA	IE		Pellet	IE	IE,NA	IE
	Other			672		Other			1539
	Flaring in iron and steel production	C		672		Flaring in iron and steel production	C		1539
Sweden	**Iron and steel production**			2632	**Sweden**	**Iron and steel production**			C
	Steel	1755	0.09	156		Steel	1701	0.10	173
	Pig Iron	2736	0.77	2094		Pig Iron	2867	0.59	1690
	Direct reduced iron	109	1.19	129		Direct reduced iron	C	-	C
	Sinter	1058	0.20	212		Sinter	-	-	NO
	Pellet	9919	0.00	41		Pellet	C	-	C
	Other			NO		Other			NO
United Kingdom	**Iron and steel production**			5595	**United Kingdom**	**Iron and steel production**			4319
	Steel	17485	0.01	224		Steel	10819	0.02	211
	Pig Iron	12463	0.15	1837		Pig Iron	8774	0.21	1842
	Direct reduced iron	NO	NO	NO		Direct reduced iron	NO	NO	NO
	Sinter	C	C	3534		Sinter	C	C	2265
	Pellet	NO	NO	NO		Pellet	NO	NO	NO
	Other			NO		Other			NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

It can be seen from the table that several Member States use IE for some categores. This can be explained by the fact that they make use of carbon balances and several processes occur within the same industrial site, which makes differentiation into the various subcategories difficult. For example, several countries include emissions from the production of pig iron (which occurs at integrated iron and steel production sites) under "steel production".

According to the 2006 IPCC guidelines, all emissions from iron and steel production should be reported under category 2.C.1, irrespective of their role as reducing agent or fuel.

However, e. g. some Member States report emissions from blast furnace gas and from converter gas under 1A2a instead of 2C1 because this can be interpreted as emissions from energy supply.

Thus, for an overview of total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for this combined category are given in Table 4.31.

Table 4.31 CO_2 Emissions (2015) 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 2015	Share 2C1
	1A2a	2C1	Combined		
Austria	1 449	10 740	12 189	7%	88%
Belgium	1 149	3 706	4 855	3%	76%
Bulgaria	116	37	153	0%	24%
Croatia	52	14	65	0%	21%
Cyprus	NO,IE	NO	-	-	-
Czech Republic	1 928	6 873	8 801	5%	78%
Denmark	89	NO	89	0%	-
Estonia	NO	NO	-	-	-
Finland	2 319	2 163	4 482	3%	48%
France	12 815	2 311	15 125	9%	15%
Germany	38 576	16 731	55 307	34%	30%
Greece	65	61	126	0%	49%
Hungary	174	1 166	1 340	1%	87%
Ireland	2	NO	2	0%	-
Italy	9 209	1 327	10 535	6%	13%
Latvia	22	1	23	0%	4%
Lithuania	NO	2	2	0%	100%
Luxembourg	278	123	401	0%	31%
Malta	IE	NO	-	-	-
Netherlands	3 720	905	4 625	3%	20%
Poland	5 169	2 033	7 202	4%	28%
Portugal	134	95	229	0%	42%
Romania	1 423	3 759	5 183	3%	73%
Slovakia	2 867	4 028	6 895	4%	58%
Slovenia	193	53	246	0%	22%
Spain	5 680	2 807	8 487	5%	33%
Sweden	1 585	C	1 585	1%	-
United Kingdom	13 220	4 319	17 540	11%	25%
EU-28	**100 649**	**63 254**	**163 903**	**100%**	**39%**
Iceland	1	0	1	0%	27%
United Kingdom (KP)	13 220	4 319	17 540	11%	25%
EU-28 + ISL	**102 235**	**63 255**	**165 490**	**101%**	**38%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

EU trends in this table do not include Sweden for confidentiality reasons and to preserve time series consistency for the EU. This also explains the differences between the numbers in this table and the CRF.

It can be seen that the ratio of emissions under 2C1 and combined emissions (see column "Share 2C1" in Table **4.31**) 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. 30 % of emissions are reported under 2C1. This category comprises process-related CO_2 emissions (including emissions from carbonate use). However, emissions from energy-related use of top gas and converter gas are reported under the respective sub-categories of sector 1.

- United Kingdom: Major share of emissions (75 %) is reported under 1A2a. Emissions from sintering (coke breeze and carbonates), from flared blast furnace gas and from electric and ladle arc furnances are reported under 2C1.
- France: Major share of emissions (85 %) is reported under 1A2a. Emissions from sinter production are reported under 1A2a.
- Austria: 88 % 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 (87 %) 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: 78 % of emissions are reported under category 2C1. It also includes emissions from limestone and dolomite use.
- Spain: Major share of emissions (67 %) is reported under 1A2a, including emissions from coke production.
- Poland: 72 % 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 4.32 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 2015. Between 1990 and 2015, PFC emissions from this source decreased by 98 %. In 2015, Germany contributed the highest share among the EU-28+ISL, amounting to 19 % of overall emissions, followed by Spain (17 %) and Greece (13 %) Of the 11 countries reporting PFC emissions under this category in 2015, seven use plant or country-specifc emission factors.

Table 4.32 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		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	-	-	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	-	-	-	-	-	-	-	NA	NA
Finland	NO	-	-	-	-	-	-	-	NA	NA
France	3 567	81	62	12.5%	-19	-23%	-3 505	-98%	T2,T3	CS,PS
Germany	2 889	83	95	19.2%	12	15%	-2 794	-97%	T3	CS
Greece	190	80	66	13.3%	-14	-17%	-124	-65%	T3	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	-	-	-	-	-	-	-	NA	NA
Luxembourg	-	-	-	-	-	-	-	-	NA	NA
Malta	-	-	-	-	-	-	-	-	NA	NA
Netherlands	2 638	0	7	1.3%	6	11935%	-2 631	-100%	T2	CS
Poland	142	NO	NO	-	-	-	-142	-100%	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	2 808	6	7	1.3%	0	3%	-2 802	-100%	T2	D,PS
Slovakia	315	11	9	1.7%	-3	-24%	-306	-97%	T2	PS
Slovenia	208	15	16	3.2%	1	3%	-192	-92%	T3	CS,D
Spain	1 164	62	86	17.4%	24	39%	-1 078	-93%	T2	D
Sweden	569	81	34	6.9%	-47	-58%	-535	-94%	-	-
United Kingdom	1 553	43	11	2.3%	-31	-74%	-1 542	-99%	T2	PS
EU-28	**20 783**	**461**	**392**	**79%**	**-70**	**-15%**	**-20 391**	**-98%**	**-**	**-**
Iceland	495	99	104	20.9%	5	5%	-391	-79%	T2	D
United Kingdom (KP)	1 553	43	11	2.3%	-31	-74%	-1 542	-99%	T2	PS
EU-28 + ISL	**21 277**	**560**	**496**	**100%**	**-65**	**-12%**	**-20 782**	**-98%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

All Member States reduced their emissions from this source between 1990 and 2015. 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 2015 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).

In the review of the 2014 inventory submission of the European Union, the ERT recommended 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. This information is provided below. Additional information can be found in the individual NIRs (Greece: page 217, Netherlands: page 145, Sweden: page 253). An overview of methods can also be found in Annex III to this year's inventory submission.

Greece: The estimation of emissions from aluminium production is performed in close collaboration with the sole plant operating in Greece and since 2013 ETS verified reports are also provided to the inventory team. Carbon dioxide emissions from primary aluminium production are calculated using a highly detailed methodology, tracking the carbon content throughout the process. The methodology is based on the 2006 IPCC Tier 3 method, with small interventions that increase the certainty of the estimations. The equations are described in Greece's NIR.

Data are provided by the plant for years 2005-2012. Since detailed data for the previous years are not available, emissions of years 1990-2004 have been recalculated using the Overlap method in line with the IPCC GPG. It should be noted that the production methodology applied is Centre Worked Prebake with Feed Point System (PFPB methodology). Data since 2013 are provided by the verified ETS reports.

Aluminium production data are directly provided by the plant and are considered confidential. However, publicly available data from the US Geological Survey, the UN Commodity Statistics Database and the Greek Mining Enterprises Association are also used for QA/QC reasons. According to the recommendation made by the previous ERTs, Greece is reporting aluminium production based on these data, although the estimations are based on the more detailed and accurate production quantities provided directly by the plant. It should be mentioned that the reported values are the ones provided by the US Geological Survey, since they cover the whole of the time-series.

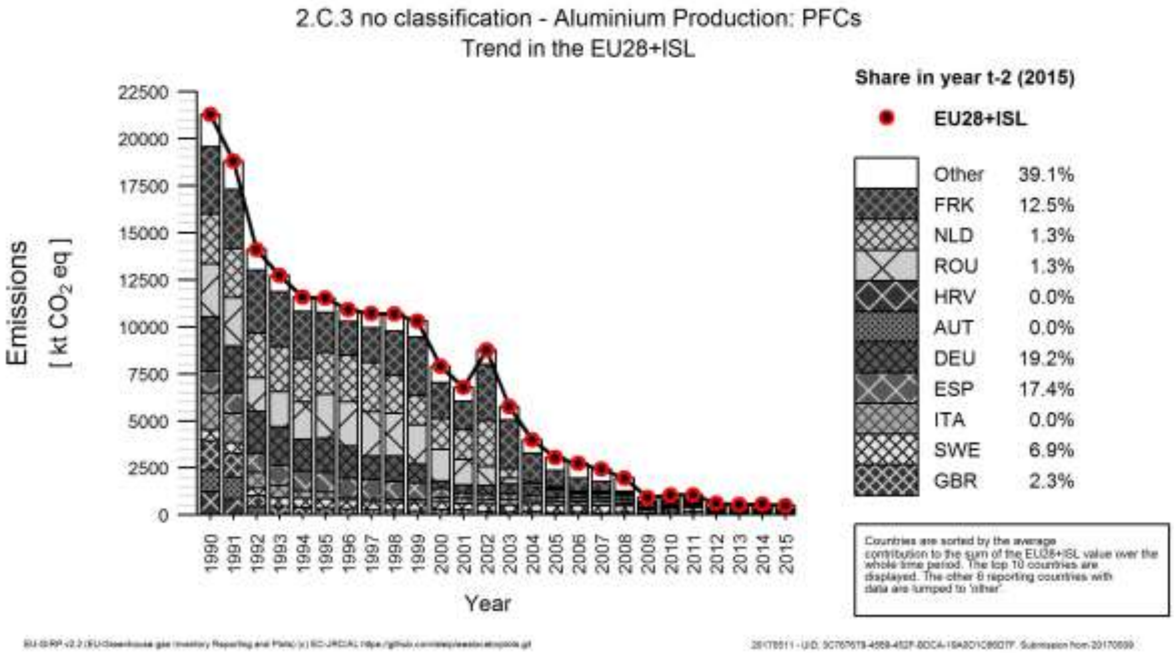
PFC emissions estimates are based on anode effect performance by calculating the anode effect overvoltage statistic (Overvoltage method) and are provided directly to the inventory team by the sole plant operating in Greece. This methodology concerns measurements and recordings that are being performed concerning the parameters of the equation used for the CF4 emission's calculation, namely the overvoltage and the aluminium production process current efficiency. The EF is estimated based on Eq. 3.11 of Chapter 3/GPG (EF=Over-Voltage Coefficient*AEO/CE). The Over-Voltage Coefficient value used by the plant is 1.16 (the updated default one of 2006 IPCC Guidelines), while the Anode Effect Overvoltage (AEO) and Current Efficiency (CE) are measured for each series of electrolytic cells (there are three series). The C2F6 emissions are then calculated by using the following formula: C2F6 = 0.1•CF4.

The Netherlands: Estimations of the PFC emissions from primary aluminium production reported by these two facilities are based on the IPCC Tier 2 method for the complete period 1990–2015. Emission factors are plant-specific and confidential and are based on measured data.

Sweden: The two different processes for aluminium production, prebaked (CWPB) and Söderberg (VSS), have substantially different emission factors for PFCs. Estimates of emissions are based on the number of ovens and the number and duration of anode effects. This activity data is considered to be of good quality.

Activity data used for the PFC emission calculations, anode effects in min/oven day and production statistics, were provided by the company, and specified for the prebaked and Söderberg processes. The activity data and emissions can be found on page 253 of Sweden's NIR 2017.

Figure 4.15 2C3 Aluminium Production: PFC emissions



4.2.3.1 2D3 Other non-energy products from fuels and solvent use

This chapter provides information on greenhouse gas emissions from non-energy producs from fuel and solvent use. Solvents are chemical compounds that are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes. After application (or other procedures of solvent use) most of these substances are released into air.

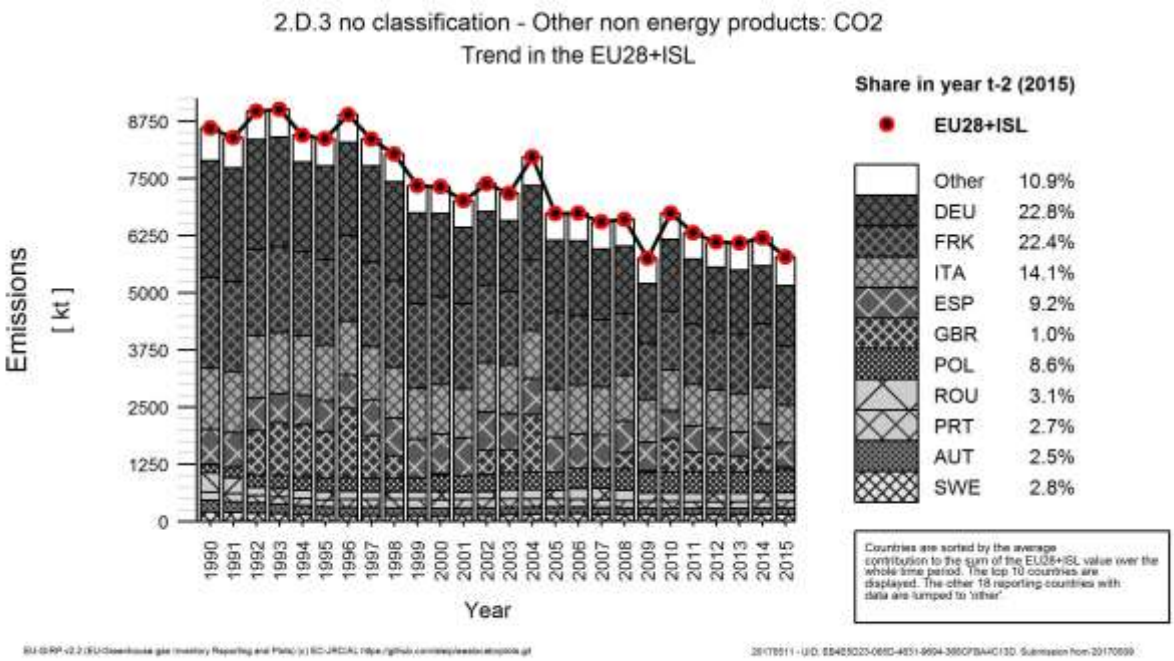
CO_2 emissions from this sector amounted to approximately 0.13% of total GHG emissions (without LULUCF) in 2015. Germany and France together account for 45% of all emissions in the EU-28. Emissions from this sector decreased by 34% since 1990, with the biggest decrease in absolute terms in Germany and France. Emissions decreased in all countries, except Ireland and Luxembourg, where emissions increased since 1990. The peak in 2004 is due to an increase of emissions in the United Kingdom.

Table 4.33 2D3 Other non-energy products from fuels and solvent use: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	252	141	142	2.5%	1	0%	-110	-44%
Belgium	NO,NE,NA	19	22	0.4%	2	13%	22	∞
Bulgaria	83	75	75	1.3%	0	0%	-8	-9%
Croatia	94	41	41	0.7%	1	2%	-53	-56%
Cyprus	6	5	6	0.1%	1	19%	0	-5%
Czech Republic	NO,NA	17	18	0.3%	1	6%	18	∞
Denmark	94	65	68	1.2%	3	5%	-26	-27%
Estonia	21	16	17	0.3%	0	2%	-4	-20%
Finland	NO	6	7	0.1%	1	15%	7	∞
France	1 988	1 378	1 296	22.4%	-82	-6%	-692	-35%
Germany	2 552	1 272	1 317	22.8%	45	4%	-1 235	-48%
Greece	NO,NA	1	1	0.0%	0	23%	1	∞
Hungary	120	89	95	1.6%	6	7%	-26	-21%
Ireland	72	78	83	1.4%	4	5%	10	15%
Italy	1 329	791	815	14.1%	24	3%	-514	-39%
Latvia	24	24	24	0.4%	0	0%	-1	-2%
Lithuania	65	33	35	0.6%	3	8%	-30	-46%
Luxembourg	15	22	23	0.4%	1	4%	8	51%
Malta	0	0	0	0.0%	0	0%	0	-89%
Netherlands	NO	22	22	0.4%	0	0%	22	∞
Poland	186	478	497	8.6%	19	4%	311	167%
Portugal	173	150	157	2.7%	7	5%	-16	-9%
Romania	421	182	178	3.1%	-4	-2%	-243	-58%
Slovakia	111	92	94	1.6%	2	3%	-17	-15%
Slovenia	NO,NA	2	2	0.0%	0	24%	2	∞
Spain	769	529	534	9.2%	5	1%	-235	-31%
Sweden	217	159	159	2.8%	0	0%	-58	-27%
United Kingdom	NE,NO	506	58	1.0%	-448	-89%	58	∞
EU-28	**8 595**	**6 192**	**5 785**	**100%**	**-406**	**-7%**	**-2 810**	**-33%**
Iceland	NA	NO,NA	NO,NA	-	-	-	-	-
United Kingdom (KP)	NE,NO	506	58	1.0%	-448	-89%	58	∞
EU-28 + ISL	**8 595**	**6 192**	**5 786**	**100%**	**-406**	**-7%**	**-2 810**	**-33%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 4.16 2D3 Other non-energy products from fuels and solvent use: CO_2 emissions



For this category, it is not useful to give an average EF across the Member States because of the different methods used, and because of the fact that this category is split into many subcategories with varying EFs.

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).

The source category 2F Product uses as substitutes for ODS includes three key categories:

Table 4.34: Key categories for sector 2F (Table excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
2 F 1 Refrigeration and Air conditioning: no classification (HFCs)	3	96636	T	0	L
2 F 2 Foam Blowing Agents: no classification (HFCs)	0	2915	T	0	0
2 F 4 Aerosols: no classification (HFCs)	3	5504	T	0	0

For 2.F Product uses as substitutes for ODS, table 1 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.4.35 2F Product uses as substitutes for ODS in 1990 and 2015: Member States' and EU-28+ISL total GHG emissions from this category and their split into HFC and PFC emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	HFC emissions in 1990 (kt CO2 equivalents)	HFC emissions in 2015 (kt CO2 equivalents)	PFC emissions in 1990 (kt CO2 equivalents)	PFC emissions in 2015 (kt CO2 equivalents)
Austria	0	1 660	NO	1 660	NO	NO,IE
Belgium	0	2 787	NO	2 785	NO	2
Bulgaria	0	1 152	NO	1 152	NO	0
Croatia	0	420	NO	420	NO	0
Cyprus	0	359	NO,NE	359	-	-
Czech Republic	0	3 457	NO	3 455	NO	2
Denmark	0	639	NO	634	NO	5
Estonia	0	223	NO	223	NO	-
Finland	0	1 549	0	1 544	NO	4
France	0	19 048	NO,IE	19 048	-	-
Germany	0	11 050	NA,NO,IE	11 041	NA,IE	8
Greece	0	5 956	NO	5 903	NO	54
Hungary	0	2 268	NO	2 267	NO	1
Ireland	1	1 073	1	1 073	NO	NO
Italy	0	12 243	NO	12 243	-	-
Latvia	0	227	NO,NE	227	NO	NO
Lithuania	0	478	NO	478	NO	NO
Luxembourg	0	65	0	65	-	-
Malta	0	247	NO,NE,IE	247	NO	NO
Netherlands	0	2 187	NO,IE,NA	2 187	NO	NO
Poland	0	8 962	NO	8 949	NO	13
Portugal	0	2 693	NO,NA	2 679	NA	14
Romania	0	1 637	0	1 637	NO	NO
Slovakia	0	735	NO	735	NO	NO
Slovenia	0	346	NO	346	NO	NO
Spain	0	9 167	NO	9 165	NO	2
Sweden	5	775	5	773	NO	2
United Kingdom	0	15 814	NO,NA,IE	15 814	NO	NO
EU-28	**5**	**107 216**	**5**	**107 109**	**0**	**107**
Iceland	0	207	0	207	NO	0
United Kingdom (KP)	0	15 933	NO,NA,IE	15 933	NO	NO
EU-28 + ISL	**6**	**107 542**	**6**	**107 435**	**0**	**107**

Abbreviations explained in the Chapter 'Units and abbreviations'.

F-gas emissions from 2.F Product uses as substitutes for ODS account for 2.5 % of total EU-28+ISL GHG emissions (without LULUCF) in 2015. HFC emissions in 2015 were about 18 000 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.4.36 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 90% 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 about 5% and 2.F.2 Foam blowing agents ca. 2.8 %, respectively.

Table.4.36 2F Product uses as substitutes for ODS: Member States' sub-categories of HFC emissions for 2015 (kt CO_2 equivalents)

Member State	**2.F Product uses as substitutes for ODS**	2.F.1 Refrigeration and air conditioning	2.F.2 Foam blowing agents	2.F.3 Fire protection	2.F.4 Aerosols	2.F.5 Solvents	2.F.6 Other applications
Austria	**1 660**	1 604	17	13	26	NO	-
Belgium	**2 785**	2 620	76	13	76	-	-
Bulgaria	**1 152**	1 112	23	6	11	-	-
Croatia	**420**	404	NO	5	12	-	-
Cyprus	**359**	345	2	4	9	-	-
Czech Republic	**3 455**	3 422	3	23	7	1	-
Denmark	**634**	591	26	-	17	-	-
Estonia	**223**	215	2	3	3		0
Finland	**1 544**	1 488	6	NA,NO,IE	51	0	0
France	**19 048**	16 564	261	105	1 937	181	NO,IE
Germany	**11 041**	9 752	640	36	613	IE	-
Greece	**5 903**	5 618	192	47	45	-	-
Hungary	**2 267**	2 084	130	8	45	NO	NO
Ireland	**1 073**	910	NO	32	131	NO	NO
Italy	**12 243**	11 161	647	250	185	-	-
Latvia	**227**	218	4	0	5	-	-
Lithuania	**478**	454	16	2	6	NO	0
Luxembourg	**65**	61	1	-	2	-	-
Malta	**247**	241	1	3	2	NO	NO
Netherlands	**2 187**	2 041	IE,NA	-	NO	-	146
Poland	**8 949**	8 443	301	79	126	0	-
Portugal	**2 679**	2 599	42	32	7		-
Romania	**1 637**	1 599	0	4	34	NO	NO
Slovakia	**735**	702	2	21	10	NO	-
Slovenia	**346**	338	2	1	5		-
Spain	**9 165**	7 745	91	995	334	NO	NO
Sweden	**773**	709	30	1	33	-	-
United Kingdom	**15 814**	13 285	400	264	1 761	51	52
EU-28	**107 109**	**96 325**	**2 913**	**1 946**	**5 493**	**234**	**198**
United Kingdom (KP)	**15 933**	13 390	402	267	1 771	51	52
Iceland	**207**	206	-		1		-
EU-28 + ISL	**107 435**	**96 636**	**2 915**	**1 949**	**5 504**	**234**	**198**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table **4.37** to Table.4.40 show the contribution of each MS to EU-28+ISL HFC emissions from 2.F by subcategories (2F1, 2F2, 2F3 2F4, 2F5, 2F6).

Table 4.37 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 2015	Change 2014-2015		Change 1990-2015		Change 1995-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	38	1 586	1 604	1.7%	18	1%	1 604	∞	1 566	4165%	-	-
Belgium	NO	103	2 675	2 620	2.7%	-55	-2%	2 620	∞	2 517	2440%	NA	NA
Bulgaria	NO	3	1 049	1 112	1.2%	62	6%	1 112	∞	1 108	33301%	NO,T2	D,NO
Croatia	NO	29	400	404	0.4%	4	1%	404	∞	374	1283%	T1a,T2	D
Cyprus	NO,NE	2	345	345	0.4%	0	0%	345	∞	343	21136%	NA	NA
Czech Republic	NO	0	3 195	3 422	3.5%	227	7%	3 422	∞	3 422	1131353%	T2	CS
Denmark	NO	42	642	591	0.6%	-51	-8%	591	∞	549	1310%	T2	D
Estonia	NO	10	209	215	0.2%	6	3%	215	∞	205	2059%	T2	CS
Finland	0	24	1 622	1 488	1.5%	-134	-8%	1 488	10912751%	1 464	6091%	T2	NA
France	NO	545	16 771	16 564	17.1%	-207	-1%	16 564	∞	16 019	2942%	T2	CS
Germany	NA	584	9 674	9 752	10.1%	78	1%	9 752	∞	9 169	1571%	T2	CS,D
Greece	NO	42	5 480	5 618	5.8%	138	3%	5 618	∞	5 576	13165%	IE,T2	D,IE
Hungary	NO	26	1 585	2 084	2.2%	498	31%	2 084	∞	2 058	7832%	T2	D
Ireland	NO	76	989	910	0.9%	-79	-8%	910	∞	834	1104%	NA	NA
Italy	NO	265	10 853	11 161	11.5%	308	3%	11 161	∞	10 896	4116%	T2	CS,D
Latvia	NE	2	200	218	0.2%	18	9%	218	∞	216	10281%	T2	CS,D,OTH
Lithuania	NO	5	427	454	0.5%	27	6%	454	∞	449	8370%	T2	CS,D,PS
Luxembourg	0	3	62	61	0.1%	0	-1%	61	85686700%	58	1767%	T2	CS,M,PS
Malta	NO,IE	0.0	224.3	241.1	0.2%	17	7%	241	∞	241	12790102%	NA	NA
Netherlands	NO	73	2 037	2 041	2.1%	5	0%	2 041	∞	1 968	2706%	T2	CS
Poland	NO	117	8 375	8 443	8.7%	68	1%	8 443	∞	8 326	7105%	T2	D
Portugal	NO,NA	18	2 458	2 599	2.7%	141	6%	2 599	∞	2 581	14534%	IE,NO	IE,NO
Romania	NO	2	1 337	1 599	1.7%	261	20%	1 599	∞	1 597	88437%	T2	D
Slovakia	NO	11.2	623.4	702.4	0.7%	79	13%	702	∞	691	6158%	T2	CS
Slovenia	NO	5	321	338	0.3%	17	5%	338	∞	333	6125%	T1,T2	CS,D
Spain	NO	NO	14 192	7 745	8.0%	-6 448	-45%	7 745	∞	7 745	∞	T2	D
Sweden	3	141	744	709	0.7%	-35	-5%	706	22257%	568	401%	NA	CS
United Kingdom	NO	528	13 290	13 285	13.7%	-5	0%	13 285	∞	12 757	2415%	T3	CS
EU-28	**3**	**2 695**	**101 366**	**96 325**	**100%**	**-5 041**	**-5%**	**96 322**	**3023240%**	**93 631**	**3475%**	**-**	**-**
Iceland	NO	10	181	206	0.2%	25	14%	206	∞	197	2069%	-	-
United Kingdom (KP)	NO	531	13 396	13 390	13.9%	-6	0%	13 390	∞	12 859	2421%	T3	CS
EU-28 + ISL	**3**	**2 707**	**101 653**	**96 636**	**100%**	**-5 017**	**-5%**	**96 633**	**3032988%**	**93 929**	**3470%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2015, HFC emissions from 2F1 were about 36 times higher than in 1995 (Table 2 and figures 1-4).

France, Germany, Italy, Spain and the UK are responsible for 61 % of total EU-28+ISL emissions from this source. Between 2014 and 2015 EU-28+ISL emissions decreased by 5%. The largest decrease of HFC emissions from 2F1 between these years was in Spain (45%). Largest increasing emissions compared to the previous year were reported by Czech Republic (7%), Hungary (31%), Latvia (9%), Romania (20%) and Slovakia (13%).

Figure 4.17: 2F1 Refrigeration and Air conditioning: EU-28+ISL HFC emissions

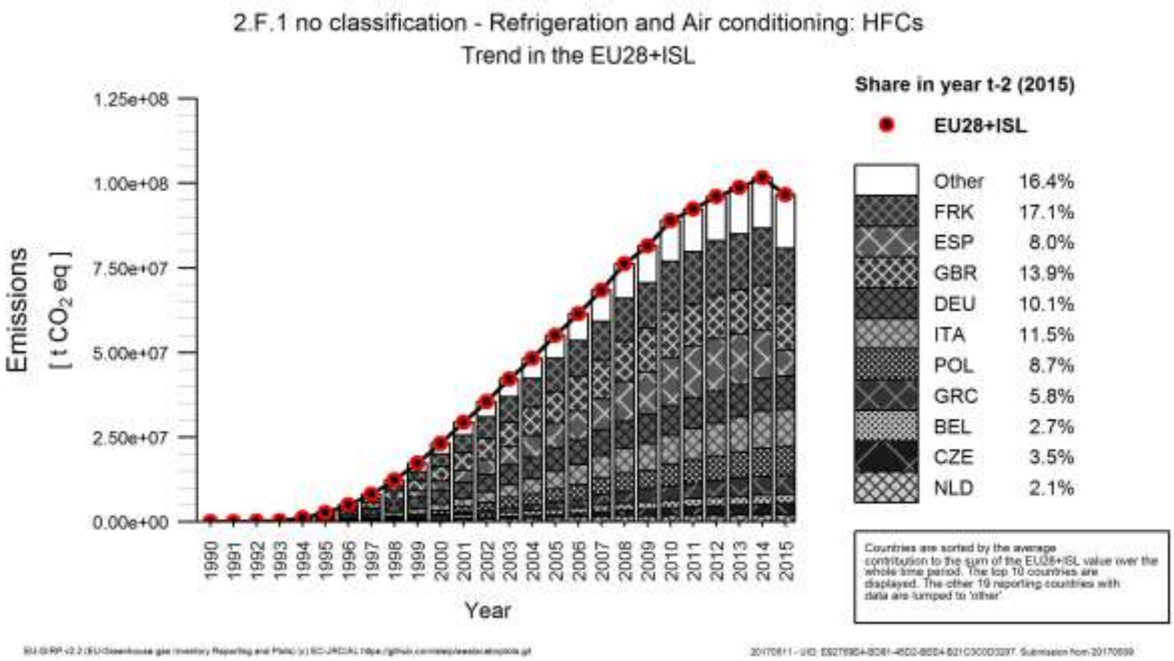
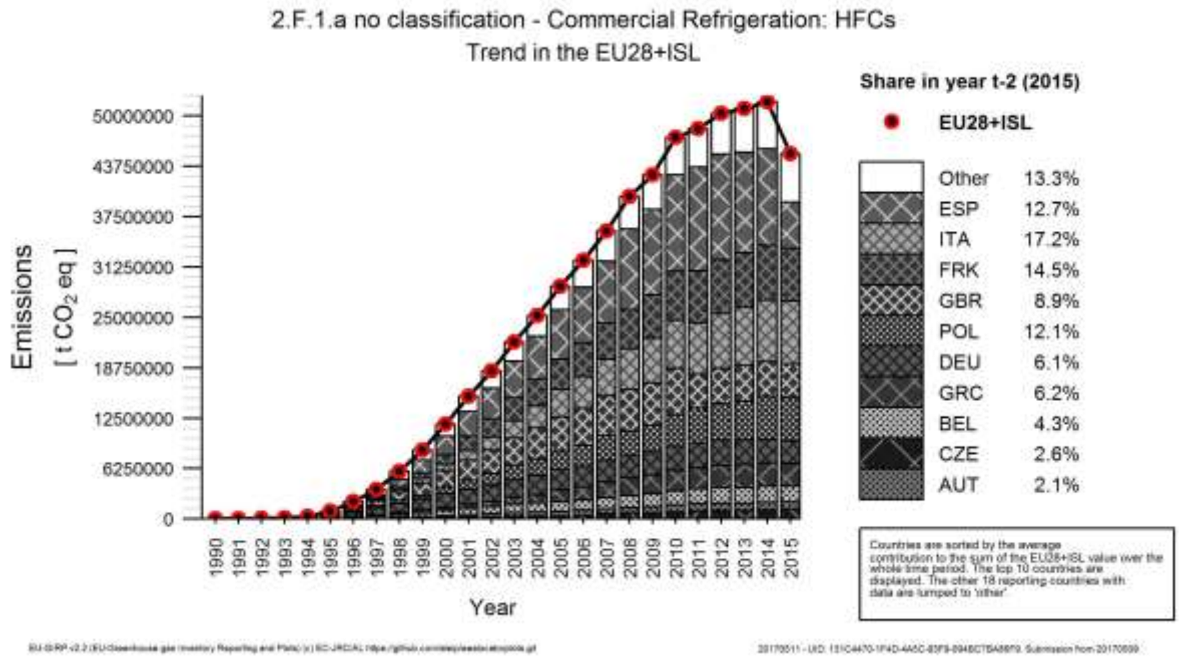


Figure 4.17 shows a clear decrease of emissions in sector 2.F.1 mainly caused by lower emissions reported from Spain. This could be observed in more detail in the following figure X.

Major developments in category 2.F.1 are driven by the subcategories 2.F1a Commercial refrigeration, 2.F.1e Mobile air conditioning and 2.F.1f Stationary air conditioning. Emission plots for these three prominent subcategories are provided in the following graphs. Please note that 2.F.1a often includes emissions from all types of stationary refrigeration equipment in Member States.

Figure 4.18: 2F1a Commercial refrigeration: EU-28+ISL HFC emissions



This figure reveals that emissions from commercial refrigeration in Spain decreased by half. Emissions reported by other countries remain relatively stable or even increased slightly.

Figure 4.19: 2F1e Mobile air conditioning: EU-28+ISL HFC emissions

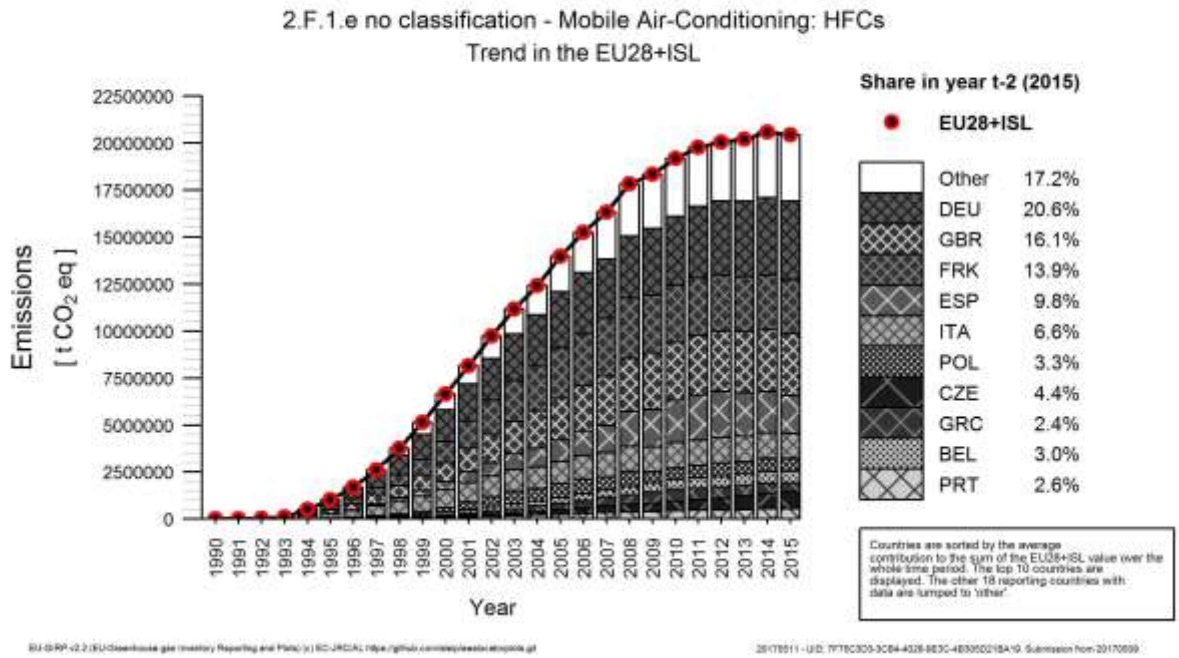


Figure 3 illustrates that emissions from mobile Air-Conditioning were rather stable in their overall quantity and share. The introduction of low-GWP refrigerants in new vehicle models has not yet resulted in a decrease of emissions for this subcategory.

Figure 4.20: Figure 2 2F1f Stationary air conditioning: EU-28+ISL HFC emissions

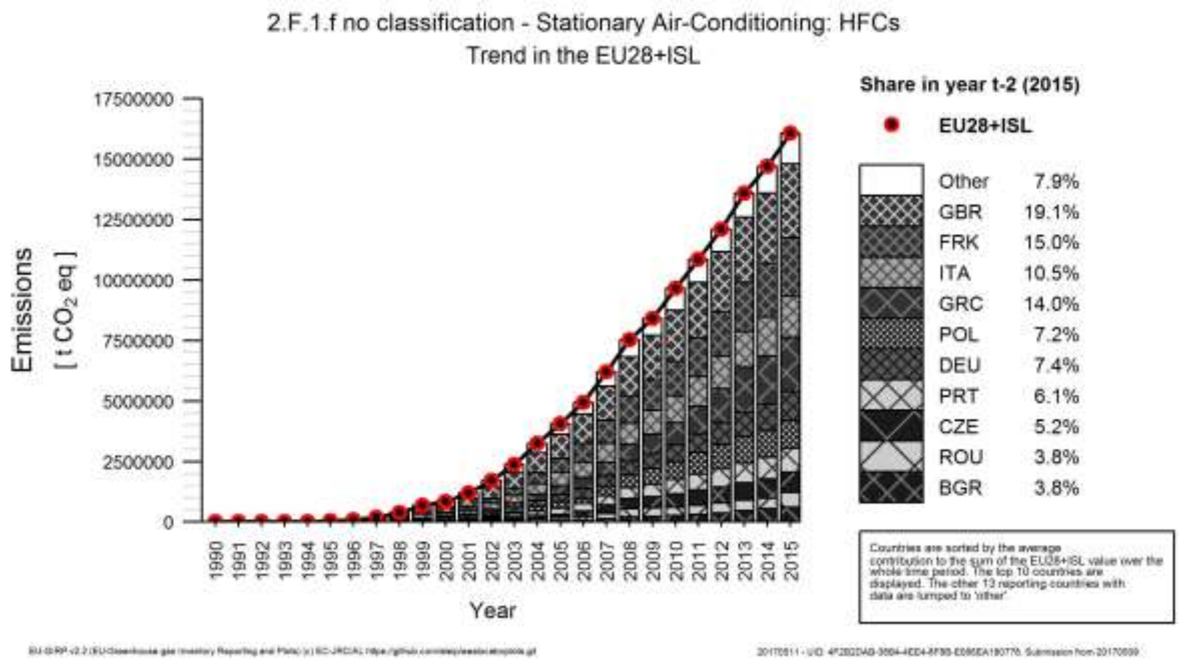


Figure 4 shows a consistent trend for sector 2.F.1.f with increasing emissions.

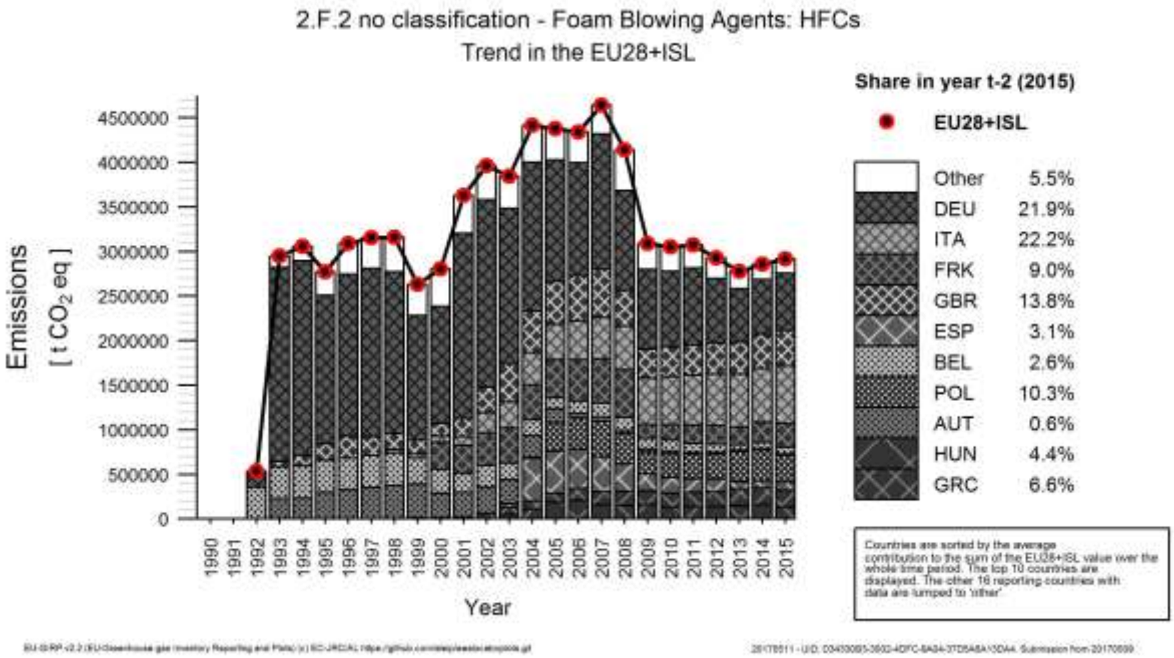
Table 4.38 2F2 Foam Blowing: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFCs emissions in kt CO2 equiv.				Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Change 1995-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	301	17	17	0.6%	0	-1%	17	∞	-284	-94%	NA	NA
Belgium	NO	357	66	76	2.6%	10	15%	76	∞	-281	-79%	NA	NA
Bulgaria	NO	NO	20	23	0.8%	3	13%	23	∞	23	∞	NO,T2	D,NO
Croatia	NO	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Cyprus	NE,NO	NO,NE	2	2	0.1%	0	0%	2	∞	2	∞	-	-
Czech Republic	NO	0	3	3	0.1%	0	-3%	3	∞	3	17880%	T1	D
Denmark	NO	200	40	26	0.9%	-14	-34%	26	∞	-173	-87%	T2	D
Estonia	NO	18	2	2	0.1%	0	-4%	2	∞	-16	-88%	T2	CS
Finland	NO	1	9	6	0.2%	-3	-36%	6	∞	5	994%	T2	D
France	NO	NO	227	261	9.0%	34	15%	261	∞	261	∞	T2	CS,D
Germany	NO,IE	1 666	617	640	21.9%	23	4%	640	∞	-1 026	-62%	T2	CS
Greece	NO	NO	190	192	6.6%	2	1%	192	∞	192	∞	T2	D
Hungary	NO	NO	157	130	4.4%	-27	-17%	130	∞	130	∞	CS	CS
Ireland	NO	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Italy	NO	NO	606	647	22.2%	41	7%	647	∞	647	∞	-	-
Latvia	NO	0	1	4	0.2%	3	356%	4	∞	4	994%	T1a	D
Lithuania	NO	NO	14	16	0.5%	2	12%	16	∞	16	∞	T2	D
Luxembourg	NO	13	1	1	0.0%	0	7%	1	∞	-12	-89%	T1	CS
Malta	NO,NE	NO,NE	1.6	1.0	0.0%	-1	-37%	1	∞	1	∞	T1	D
Netherlands	IE,NA	IE,NA	IE,NA	IE,NA	-	-	-	-	-	-	-	T2	CS
Poland	NO	NO	344	301	10.3%	-43	-12%	301	∞	301	∞	T2	D
Portugal	NA	1	41	42	1.4%	1	2%	42	∞	41	5420%	NO	NO
Romania	NO	NO	0	0	0.0%	0	-86%	0	∞	0	∞	T2	D
Slovakia	NO	NO	2.2	2.0	0.1%	0	-10%	2	∞	2	∞	T2	D
Slovenia	NO	30	2	2	0.1%	0	-4%	2	∞	-28	-94%	T2	CS,D
Spain	NO	NO	83	91	3.1%	8	10%	91	∞	91	∞	T2	D
Sweden	NO	NO	33	30	1.0%	-3	-10%	30	∞	30	∞	-	PS
United Kingdom	NO	184	379	400	13.7%	22	6%	400	∞	217	118%	T2	CS
EU-28	**0**	**2 770**	**2 857**	**2 913**	**100%**	**56**	**2%**	**2 913**	**100%**	**143**	**5%**	**-**	**-**
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	-
United Kingdom (KP)	NO	184	380	402	13.8%	22	6%	402	∞	218	118%	T2	CS
EU-28 + ISL	**0**	**2 771**	**2 859**	**2 915**	**100%**	**56**	**2%**	**2 915**	**100%**	**145**	**5%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2015 HFC emissions from 2F2 (Table 4 and Figure 5) increased by 3 % compared to 2014 – and increased by 7% 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 (22%), Italy (22%), Poland (12%) and UK (14%), those four countries account for 69% of the share in EU-28+ISL emissions in this sector.

Figure 4.21: 2F2 Foam Blowing Agents: EU-28+ISL HFC emissions



This *Figure 4.21* displays that emissions from sector 2.F.2 varied noticeable till 2008 but are rather stable since then.

Table4.39 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 2015	Change 2014-2015		Change 1990-2015		Change 1995-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	13	13	0.7%	0	0%	13	∞	13	∞	-	-
Belgium	NO	1	12	13	0.7%	1	6%	13	∞	13	2177%	-	-
Bulgaria	NO	NO	6	6	0.3%	1	13%	6	∞	6	∞	T2	D
Croatia	NO	0	4	5	0.2%	0	5%	5	∞	5	3540%	T2	D
Cyprus	NE,NO	0	4	4	0.2%	0	0%	4	∞	4	47562%	-	-
Czech Republic	NO	NO	21	23	1.2%	2	9%	23	∞	23	∞	D	D
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-
Estonia	NO	NO	3	3	0.1%	0	-3%	3	∞	3	∞	T2	CS
Finland	NO	NO	NA,NO,IE	NA,NO,IE	-	-	-	-	-	-	-	NA	NA
France	NO	5	121	105	5.4%	-15	-13%	105	∞	101	2190%	T1	CS
Germany	NO	NO	43	36	1.9%	-6	-15%	36	∞	36	∞	CS	CS,D
Greece	NO	NO	43	47	2.4%	4	9%	47	∞	47	∞	CS	D
Hungary	NO	NO	8	8	0.4%	0	-2%	8	∞	8	∞	T1	D
Ireland	NO	NO	32	32	1.7%	0	0%	32	∞	32	∞	-	-
Italy	NO	NO	238	250	12.8%	12	5%	250	∞	250	∞	T2	CS
Latvia	NE	NE	0	0	0.0%	0	-90%	0	∞	0	∞	T2	D
Lithuania	NO	NO	2	2	0.1%	0	1%	2	∞	2	∞	T1b	D
Luxembourg	-	-	-	-	-	-	-	-	-	-	-	-	-
Malta	NE	NE	2.7	2.7	0.1%	0	0%	3	∞	3	∞	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-	T2	CS
Poland	NO	NO	71	79	4.0%	8	11%	79	∞	79	∞	T2	D
Portugal	NA	NO	29	32	1.6%	2	8%	32	∞	32	∞	NO	NO
Romania	NO	NO	4	4	0.2%	0	0%	4	∞	4	∞	T2	D
Slovakia	NO	2.1	19.0	20.5	1.1%	2	8%	21	∞	18	881%	T1a	CS
Slovenia	NO	NO	1	1	0.1%	0	1%	1	∞	1	∞	T2	CS,D
Spain	NO	3	1 022	995	51.0%	-28	-3%	995	∞	991	29890%	T1a	CS,D
Sweden	NO	NO	1	1	0.0%	0	-20%	1	∞	1	∞	T1a	CS
United Kingdom	NO	1	255	264	13.6%	9	3%	264	∞	263	27239%	T2	CS
EU-28	**0**	**12**	**1 956**	**1 946**	**100%**	**-10**	**-1%**	**1 946**	**100%**	**1 935**	**16548%**	**-**	**-**
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	-
United Kingdom (KP)	NO	1	258	267	13.7%	9	3%	267	∞	266	27360%	T2	CS
EU-28 + ISL	**0**	**12**	**1 959**	**1 949**	**100%**	**-10**	**-1%**	**1 949**	**100%**	**1 937**	**16562%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2015, HFC emissions from 2F3 (Table4.39) did hardly change compared to 2014 – 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. In the Netherlands, emissions from this subcategory are included in other reported data

The biggest contributors to this sector are Spain (51%), UK (14%), and Italy (13%), those three countries account for 78% of the share in EU-28+ISL emissions in this sector. Largest decreases of emissions from this subcategory compared to 2014 have been reported by France (-13%), Germany (-15%), Latvia (-90%), Spain (-3%) and Sweden (-20%).

Figure 4.22: 2F3 Fire Protection, EU28+ISL: HFC emissions

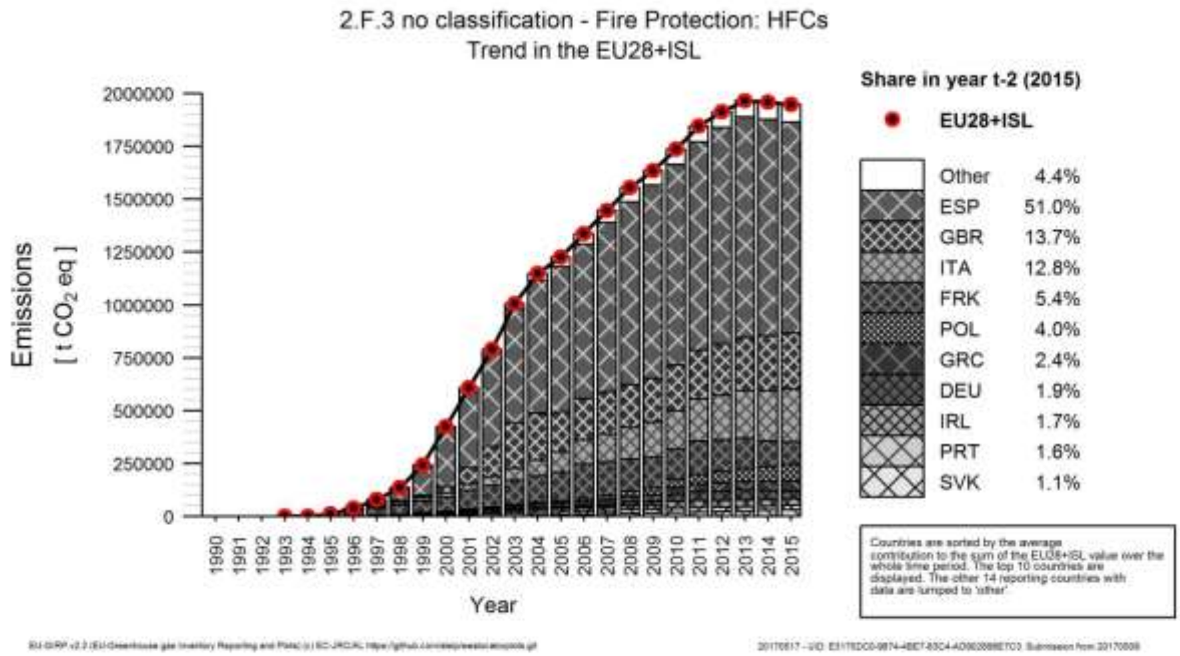


Figure 4.22 illustrates that emissions from fire protection are decreasing slowly since 2013.

Table.4.40 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 2015	Change 2014-2015		Change 1990-2015		Change 1995-2015		Method applied	Emission factor
	1990	1995	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	4	26	26	0.5%	1	2%	26	∞	22	484%	-	-
Belgium	NO	41	79	76	1.4%	-3	-4%	76	∞	34	83%	-	-
Bulgaria	NO	NO	10	11	0.2%	2	19%	11	∞	11	∞	T2	D
Croatia	NO	NO	10	12	0.2%	2	21%	12	∞	12	∞	T2	D
Cyprus	NO	0	9	9	0.2%	0	0%	9	∞	9	88006%	-	-
Czech Republic	NO	NO	8	7	0.1%	-1	-18%	7	∞	7	∞	D	D
Denmark	NO	NO	18	17	0.3%	-1	-6%	17	∞	17	∞	T2	D
Estonia	NO	0	3	3	0.1%	0	-1%	3	∞	3	6448%	T2	CS
Finland	NO	2	67	51	0.9%	-16	-24%	51	∞	49	2407%	T2	D
France	NO	623	1 880	1 937	35.2%	57	3%	1 937	∞	1 314	211%	T2	CS,PS
Germany	NO,IE	342	552	613	11.1%	61	11%	613	∞	271	79%	CS,T2	CS
Greece	NO	0	46	45	0.8%	0	0%	45	∞	45	141895%	T2	D
Hungary	NO	12	58	45	0.8%	-12	-21%	45	∞	34	287%	T2	CS,D
Ireland	1	25	130	131	2.4%	0	0%	130	20288%	106	416%	-	-
Italy	NO	NO	213	185	3.4%	-28	-13%	185	∞	185	∞	T2	CS
Latvia	NO,NE	NO,NE	5	5	0.1%	0	2%	5	∞	5	∞	T1a	D
Lithuania	NO	1	6	6	0.1%	0	-4%	6	∞	5	598%	T1a	D
Luxembourg	NO	2	2	2	0.0%	0	1%	2	∞	1	42%	T1,T2	CS
Malta	NO,NE	NO,NE	1.8	1.8	0.0%	0	0%	2	∞	2	∞	T1	NA
Netherlands	NO	NO	NO	NO	-	-	-	-	-	-	-	NA	NA
Poland	NO	18	125	126	2.3%	0	0%	126	∞	108	618%	T1a,T1b,T2	D
Portugal	NA	17	7	7	0.1%	0	2%	7	∞	-10	-59%	NO	NO
Romania	0	1	31	34	0.6%	3	8%	34	18635%	33	4612%	T2	D
Slovakia	NO	NO	9.2	10.0	0.2%	1	8%	10	∞	10	∞	T1a	D
Slovenia	NO	NO	5	5	0.1%	0	0%	5	∞	5	∞	T1	D
Spain	NO	2	379	334	6.1%	-44	-12%	334	∞	332	13905%	T2	D
Sweden	1	7	32	33	0.6%	1	2%	32	2217%	26	354%	-	D
United Kingdom	IE,NO	660	1 811	1 761	32.0%	-50	-3%	1 761	∞	1 102	167%	T2	CS
EU-28	**2**	**1 757**	**5 521**	**5 493**	**100%**	**-29**	**-1%**	**5 491**	**243673%**	**3 736**	**213%**	**-**	**-**
Iceland	0.3	1	1	1	0.0%	0	-2%	1	155%	0	22%	-	-
United Kingdom (KP)	IE,NO	663	1 821	1 771	32.2%	-50	-3%	1 771	∞	1 108	167%	T2	CS
EU-28 + ISL	**3**	**1 761**	**5 533**	**5 504**	**100%**	**-29**	**-1%**	**5 501**	**211738%**	**3 743**	**213%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2015, HFC emissions from 2F4 reached more than 3 times the level of emissions from this subcategory in 1995 (Table 6 and Figure 6 **4**). France, Germany, Spain and UK are responsible for 85% of total EU-28+ISL emissions from this source. Between 2014 and 2015 EU-28+ISL emissions hardly changed. A significant relative decrease between these years was reported by Czech Republic (-18%), Finland (-24%), Hungary (-21%) and Italy (-13%) and Spain (-12%); the biggest increase was reported by Bulgaria (19%) and Croatia (21%) (Table.4.40). It should be noted that emissions from this subcategory have been relatively stable despite the growing number of patients in need of MDI treatment in most EU Member States.

Figure 6 4 2F4 Aerosols/Metered Dose Inhalers: EU-28+ISL HFC emissions

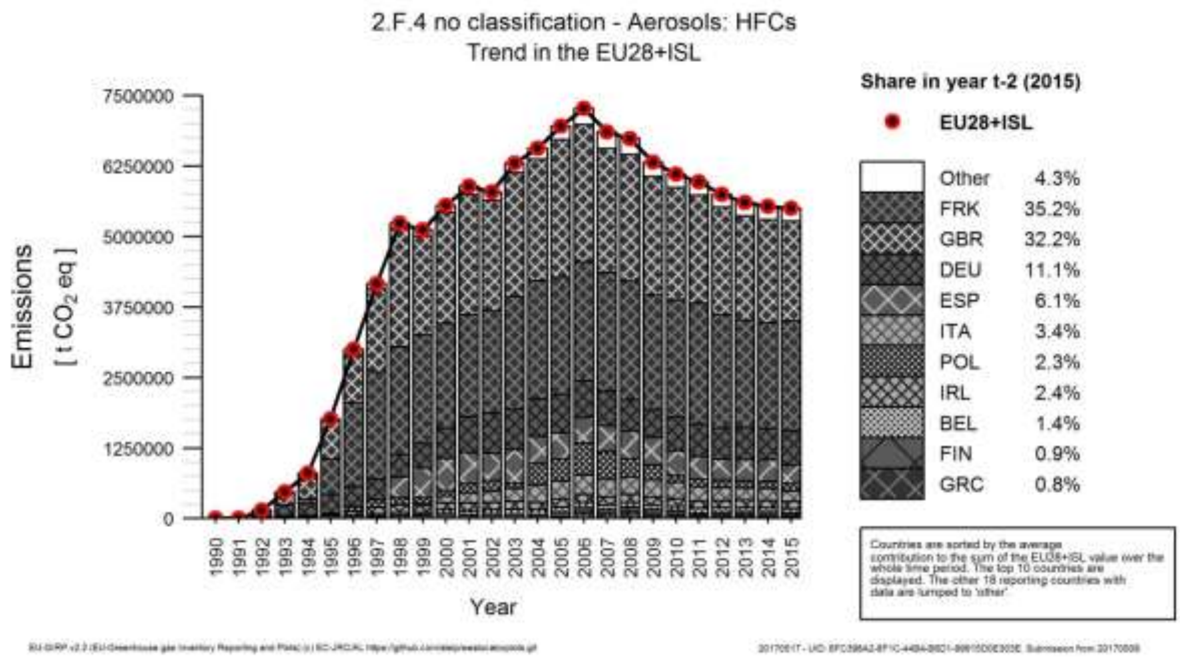


Figure 6 underlines the development of previous years. Emissions from sector 2.F.4 are decreasing since their peak in 2006.

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.4.41 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 2015 and main explanations for the largest recalculations in absolute terms.

Table.4.41 2F Product uses as substitutes for ODS: Contribution of MS to EU recalculations in HFC for 1990 and 2015 (difference between latest submission and previous submission in kt of CO_2 equivalents and percent)

	1990		2015		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	For Mobile Air Conditioning updated information on the amount of air conditioning in buses was added for the year 2014. For Stationary Air Conditioning updated statistical information on the amount of heat pumps sold in the year 2014. The Timeline changed for Aerosols due to a correction of an error in the calculation sheet.
Belgium	0	0.0	23	0.8	The following recalculations have occurred for the period 1995-2015:

	1990		2015		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					- Under Commercial refrigeration (2F1a), there has been a minute increase in emissions of the category "RAC & heat pumps" for the years 1996-2015, after adding a small source. - Under Mobile air-conditioning (2F1e), an adjustment of historically reported values was done for trucks air-conditioning, by including road tractors and correcting an error in the calculation of the total stock of HFC-134a in trucks. - The higher recharging and emissions of Trucks aircos has led to a reduction in the emissions of refrigeration installations – under Commercial refrigeration (2F1a) –, as overall refrigerant deliveries did not change. - Under Foam blowing agents (2F2a), the data for foam emissions in 2014 were revised. - Under Other aerosols (2F4b), for technical aerosols, there was an adjustment of manufacturing and fugitive emissions for the year 2013-2015 because of new information.
Bulgaria	0	0.0	67	6.6	A technical error has occurred in the F-gases quantities in refrigeration and air-conditioning, These quantities are replaced in three of the reports by RIEW. Mobile air conditioning (2.F.1.e): Recalculation due to the inclusion of the production of cars in Bulgaria and change the data source of the cars' statistics. Stationary air conditioning (2.F.1.f) Recalculation due to the update of the data with the new study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases, Germany 2011. Fire extinguishing: Revision of data as companies, included in a list from National Fire Safety and Protection of Population Service" which have fire extinguishing installations were reviewed.
Croatia	0	0.0	-169	-29.0	Technical correction
Cyprus	0	-100.0	39	12.3	The HFCs emissions from category 2.F.1 Refrigeration and air conditioning in 1995, were recalculated by using the annual per capita emissions average value of three countries (Spain, Italy and Greece) (2.48 kg CO_2 eq/capita), instead of average value of four countries (Malta, Spain, Italy and Greece) (9.94 kg CO_2 eq/capita). During the in-country review, it was identified that Malta was excluded from the calculations of emissions from 2F4. Therefore emissions have been recalculated to include Malta in the estimation of the per-capita emissions used for the estimation of emissions.
Czech Republic	0	0.0	399	14.1	Category 2.F.1 has undergone recalculation due to implementation of a new calculation model. The calculation model allows division of the input data into the sub applications. Division is based on expert judgement. After implementation of the calculation model, the following changes are occurring: Based on the new calculation model HFC-134a is reported under category F.1.b Domestic Refrigeration instead of unspecified mix of HFCs and PFCs. Under category F.1.c Domestic Refrigeration: HFC-32, HFC-125, HFC-134a and HFC-143a are reported instead of unspecified mix of HFCs and PFCs. Under category F.1.d Transport Refrigeration: HFC-32, HFC-125, HFC-134a and HFC-143a are reported instead of unspecified mix of HFCs and PFCs. Under category F.1.f Stationary air-conditioning: HFC-32, HFC-125, HFC-134a and HFC-143a are reported instead of unspecified mix of HFCs and PFCs. From category 2.F.1.a Commercial refrigeration, HFC-245fa was relocated to category 2.F.5 Solvents.
Denmark	0	0.0	0	0.0	Detailed information on the amount of HFCs used for refilling of mobile A/C has been available and applied for the years 2009 - 2011, and therefore, a new approach has been implemented in the calculation of emissions from these years onward. HFCs for mobile A/C are only used for

	1990		2015		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					refilling, and therefore the amount used for mobile A/C is assumed to be the same as the amount emitted during use.
Estonia	0	0.0	1	0.5	Recalculations in 2.F.1 related to emissions from work machinery. Activity data and emissions have been recalculated for years 2010–2014, because some of the wheel tractors were not accounted previously in these years.
Finland	0	0.0	-44	-2.5	Several recalculations were done in the category 2.F.1 for the 2017 submission. The recalculations were related to corrections of errors in the calculation model revealed by the project described in more detail Section 4.7.2.4 and corrections and additions of historical activity data. Corrections of errors in the calculation model and corrections and additions to historical activity data additions to historical activity data took place.
France	0	0.0	44	0.2	Several changes in sector 2.F.1: Commercial refrigeration: Slight correction of the penetration rate of R-404A in 2014 following information from industry professionals (AFCE). Domestic refrigeration: The change in HFC-134a emissions in 2014 is due to the correction on the recovery rate for 2014. Industrial refrigeration: The large increase in industrial refrigeration emissions of HFC-32, HFC-125, HFC-134a and HFC-143a over the entire period is caused by the reallocation of chiller emissions. This also affects the emissions of Air conditioning. Mobile air conditioning: Correction of an error in the calculation of tramway emissions. Additionally, for HFC-134a, the average load of HFC-134a was corrected in vehicles. Several changes in sector 2.F.2 Addition of two industrial sites consuming HFCs in their manufacturing process of polyurethane foam. This recalculation affects the emissions and consumption of HFC-365mfc and HFC-227ea. Slight changes in activities and emissions of HFC-134a and HFC-152a from an XPS production site in 2014. Changes in sector 2.F.3 Slight change in the amount of HFC filled in new equipment for 2014 due to correction of an error. Several changes in sector 2.F.4 Correction of emissions of pharmaceutical and technical aerosols.
Germany	0	0.0	212	2.0	Inclusion of new statistical data, updated share information on certain refrigerants and information on the introduction of sustainable refrigerants into the model.
Greece	0	0.0	0	0.0	In the current submission minor recalculations have been performed in 2F1 subcategory (2007-2013) due to updated recycling data.
Hungary	0	0.0	380	26.6	Sector 2.F.1: Taking into account the mentioned lack of data for 2014, interpolation has been applied for this year instead of the method of the last submission. In the last submission, extrapolation was applied using the trend of annual sales data available by HCSO as surrogate data. Sector 2.F.2: Several findings of the review (EU MS support Project) have been implemented resulting recalculation in 2014 submission.

	1990		2015		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					Sector 2.F.3: In 2016 data on the number of MDI products sold have been made available, so the activity data has been changed and Tier 2a method, the user-based approach was applied for this category. Data was available between 2006 and 2015, so before this period surrogate method was applied to complete time series. The used value was the number of asthma and CODP cases for this period.
Ireland	0	0.0	0	0.0	Updated company data for 2014 were received for sector 2.E.1, which resulted in a decrease of 17.15 kt CO_2e (45.8%) in 2014.
Italy	0	0.0	-50	-0.4	Sector 2.E.: New data have been made available so that total F-gases emissions for the sector have increased from 236.5% in 1995 to 60.5% in 2000. Sector 2.F.1: Recalculation has occurred, because disposal emissions have been estimated. MDI emissions have been revised because of new available information on import and export data and the application of the Equation 7.6 of the 2006 IPCC Guidelines. Sector 2.G.: Minor recalculations occur due to an update of data refer to SF_6 refilled.
Latvia	0	0.0	-6	-3.0	HFC-134a emissions from 2.F.1.b Domestic refrigeration were recalculated from 2011-2014 due to updated percentage of households using refrigerators and freezers 2010-2015 according to results of the CSB housholds surwey in 2015. HFCs emissions from 2.F.1.e Mobile Air-Conditioning were recalculated 1995-2014 due to revision of average percentage of vehicles equipped with air conditioning systems by vehicle type and technology according to Lithuania`s NIR 2016 .
Lithuania	0	0.0	0	0.0	No recalculations for this submission.
Luxembourg	0	0.0	1	1.6	Regarding refrigerated transport of 2F1, the entire time series has been revised. In the previous approach, only newly registered refrigerated vehicles were considered for the yearly estimations of emissions. As such, emissions corresponding to the total amount of refrigerants in operating systems were incorrect. To comply with the 2006 IPCC Guidelines, emission estimates have been revised for the entire time series, and are now taking into account emissions from the entire fleet of refrigerated vehicles. Furthermore, regarding 2F1 - Stationary refrigeration and air conditioning, the completeness of the database has been revised for the year 2014; as such the emission data has been updated accordingly. 2F2 Foam blowing: The PU spray emissions (HFC 134a, HFC 152a) and the extruded polystyrene (XPS) emissions (HFC 134a) are estimated using the reported quantities used per habitant and year in Belgium, which have been update. The data for Luxembourg for the years 2009-2014 has been revised accordingly. 2F4 Aerosols/Metered dose inhalers: data for 2013 and 2014 were incorrect and have been replaced by correct values.
Malta	0	0.0	-3	-1.3	No NIR provided
Netherlands	0	0.0	11	0.5	As a result of the review conducted by the European Commission the HFC emissions from Stationary refrigeration (2F1) have been recalculated with a leakage percentage of 5.8% for the period 1994-2014. This percentage is the leakage percentage of the HFC part of thestock from “Annual leak rates from surveys (Baedts et al., 2001)”. Furthermore the following changes were made: - an error in Stationary refrigeration(2F1) in 2014 was detected and corrected;

	1990		2015		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					- because more detailed information of Mobile air-conditioning (2F1) became available, the HFC emissions have been changed for a number of years.
Poland	0	0.0	249	2.9	Activity data for estimating HFCs emission from 2.F.1 Refrigeration and air conditioning were revised to reflect new data obtained from the market.
Portugal	0	0.0	784	44.8	2F1 has been revised completely.
Romania	0	0.0	0	0.0	Recalculations of the HFC emissions have been made for the 2011-2014 year. Recalculations were made as a result of due to the changes in activity data for those years (CRF Category 2.F.1.b) and for 2014 year (CRF Category 2.F.1.c)
Slovakia	0	0.0	108	19.7	Significant recalculations were made in 2F1, NIR chapter 4.12.7: The recalculation of operational emissions considered the possibility of no servicing of equipment few years before its decommissioning. The recalculation of disposal emissions and recovery has been made, as well. The detailed data about recovery in recycling factories have been obtained. Another recalculation of operational emissions in 2.F.1.b domestic refrigeration has been made where the assumption that domestic refrigeration units are not serviced is applied since this submission. The change in emissions in 2.F was nearly 17% increase. Recalculation of the subcategories 2.F.1.a – 2.F.1.f was performed. The recalculation of operational emissions was based on the assumption that equipment that are planned to be decommissioning are not serviced for several years before the decommissioning. The operational emissions from those equipment are not covered by database Leaklog and also by top-down approach. Therefore we assumed that the operational emissions from those equipment decrease the bank of chemical and were added to the emissions reported by Leaklog. Another source of recalculation was gathering of new, complete, data about recovery of the ODS gases. These data are also covered by database Leaklog since 2014. There is available amount of gas that is recovered, reused and destroyed in recycling factories. In the 2017 submission the error in the allocating of the new imported fillings was corrected. New fillings that were filled in Slovakia in 2014 and 2015 were reallocated from the 2.F.1.b category domestic refrigeration into 2.F.1.a category commercial refrigeration. The amount of reallocated gas HFC-134a was below 0.02t (0.03 Gg CO_2 eq.).
Slovenia	0	0.0	5	1.6	Emissions of F-gasses have been recalculated for the period 1995-2014 due to the improved data on transport refrigerators and some other updated values from the database.
Spain	0	0.0	-1 219	-7.2	Emissions of the refrigeration and air subcategory have been recalculated based on the new information available in 2014 on gases and mixtures.
Sweden	0	0.0	3	0.4	Updated data from F-gases database
United Kingdom	0	0.0	-463	-2.8	Minor revisions to UK foams model following consultation with industry and access to new data. Revisions to GDP data used to estimate UK data from EU-wide statistics. Also minor revisions to stock and decommissioning assumptions. Revised recent time series due to access to new data on non-MDI aerosols from the UK trade association, BAMA. Revisions to GDP data used to estimate UK data from EU-wide statistics.
EU28	0	-2.6	402	0.4	

	1990		2015		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Iceland	0	100.0	19	11.5	Various errors in activity data calculations and CRF upload file.
EU28+ISL	0	3.6	392	0.4	

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 8 shows that all Member States report GHG emissions in 2G Other product manufacture and use for the year 2015. 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 all Member States except the Netherlands?.

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.4.42 2G Other: Overview of sources reported under this source category for 2015

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	265			265	4.1%
BEL	Electrical equipment (SF6); Soundproof windows (SF6); Other (C6F14)		NO	89			89	1.4%
BGR	Electrical equipment (SF6)			18			18	0.3%
HRV	Electrical equipment (SF6)	NO	NO	5	NO	NO	5	0.1%
CYP	Electrical equipment (SF6)			0.15			0.1	0.0%
CZE	Electrical equipment (SF6); Soundproof windows (SF6)			74			74	1.1%
DNM	Electrical equipment (SF6); Soundproof windows (SF6); Other (SF6)			103			103	1.6%
EST	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	2	NO	NO	2	0.0%
FIN	Electrical equipment (SF6)	NO	NO	11	NO	NO	11	0.2%
FRK	Electrical equipment (SF6); Accelerators (SF6); Other (SF6, Unspecified mix of PFCs)	1	397	479	NA	NA	876	13.4%
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 => partly Notation Key C), C10F18 => Notation Key C); 4. Other (HFC-134a, HFC-245fa, HFC-365mfc)	10	NA,IE	3419			3429	52.5%
GRC	Electrical equipment (SF6)		NO	5			5	0.1%
HUN	Electrical equipment (SF6)	NO	NO	112	NO	NO	112	1.7%
IRL	Electrical equipment (SF6); Soundproof windows (SF6); Adiabatic properties: shoes and tyres (SF6); Other (SF6)	NO	NO	23	NO	NO	23	0.4%
ITA	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	383	NO	NO	383	5.9%
LVA	Electrical equipment (SF6)	NO	NO	10	NO	NO	10	0.2%
LTU	Electrical equipment (SF6); Accelerators (SF6)	NO	NO	1	NO	NO	1	0.0%
LUX	Electrical equipment (SF6); Soundproof windows (SF6), Other (HFC-43-10mee)	2		9			11	0.2%
MLT	Electrical equipment (SF6), Other (SF6, C3F8)		0.000001	0.19			0.2	0.003%
NLD	Other (SF6)			139			139	2.1%
POL	Electrical equipment (SF6)	NA	NA	73	NA	NA	73	1.1%
PRT	Electrical equipment (SF6)	NO	NO	26	NO	NO	26	0.4%
ROU	Electrical equipment (SF6)	NO	NO	52	NO	NO	52	0.8%
SVK	Electrical equipment (SF6)	NO	NO	14	NO	NO	14	0.2%
SVN	Electrical equipment (SF6)	NO	NO	15	NO	NO	15	0.2%
ESP	Electrical equipment (SF6); Accelerators (SF6), Other (SF6)	NO,NA	NO,NA	222	NO,NA	NO,NA	222	3.4%
SWE	Electrical equipment (SF6); Soundproof windows (SF6)		NO	35			35	0.5%
GBE	Electrical equipment (SF6); Military applications (SF6); Accelerators (SF6); Other (CF4, C2F6, C3F8, c-C4F8, SF6)		155	378			533	8%
EU-28	**TOTAL**	**12**	**552**	**5962**	**-**	**-**	**6 526.1**	
GBR	Electrical equipment (SF6); Military applications (SF6); Accelerators (SF6); Other (CF4, C2F6, C3F8, c-C4F8, SF6)		155	378			533	8.2%
ISL	Electrical equipment (SF6)		NO	2			2	0.0%
EU-28+ISL	**TOTAL**	**12**	**552**	**5964**	**-**	**-**	**6 527.6**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 4.23 and Table 4.43 summarize 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 (58% of SF_6 emissions from EU-28+ISL in 2015). Major manufacturers of SF_6 containing switchgear are located in Germany.

Table 4.43: 2G Other: Member States' contributions to SF_6 emissions

Member State	SF6 emissions in kt CO2 equiv.				Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Change 1995-2015	
	1990	1995	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	132	268	266	265	4.4%	-1	0%	134	102%	-3	-1%
Belgium	88	134	92	89	1.5%	-3	-3%	1	1%	-46	-34%
Bulgaria	4	5	17	18	0.3%	2	9%	15	398%	14	276%
Croatia	10	11	7	5	0.1%	-2	-23%	-5	-50%	-6	-53%
Cyprus	0	0	0	0	0.0%	0	0%	0	476%	0	155%
Czech Republic	84	88	78	74	1.2%	-3	-4%	-10	-12%	-14	-16%
Denmark	13	68	132	103	1.7%	-29	-22%	90	707%	35	51%
Estonia	NO	3	2	2	0.0%	0	7%	2	∞	-1	-27%
Finland	45	27	11	11	0.2%	0	0%	-34	-76%	-16	-59%
France	1 252	1 482	433	479	8.0%	46	11%	-773	-62%	-1 003	-68%
Germany	4 050	6 072	3 227	3 419	57.3%	192	6%	-631	-16%	-2 653	-44%
Greece	3	3	5	5	0.1%	0	3%	2	73%	2	48%
Hungary	11	52	109	112	1.9%	3	3%	101	927%	60	115%
Ireland	33	38	22	23	0.4%	1	3%	-10	-31%	-15	-40%
Italy	294	550	318	383	6.4%	65	20%	89	30%	-167	-30%
Latvia	NO	0	9	10	0.2%	2	18%	10	∞	10	5737%
Lithuania	NO	0	1	1	0.0%	0	-35%	1	∞	1	1655%
Luxembourg	1	1	8	9	0.1%	0	5%	8	914%	7	539%
Malta	0.0	1.4	0.6	0.2	0.0%	0	-68%	0	1680%	-1	-87%
Netherlands	207	261	135	139	2.3%	4	3%	-68	-33%	-122	-47%
Poland	NA,NO	13	49	73	1.2%	24	50%	73	∞	60	481%
Portugal	NO,NA	14	26	26	0.4%	0	2%	26	∞	12	88%
Romania	0	1	52	52	0.9%	0	1%	52	10905%	51	5255%
Slovakia	0.1	10.2	14.2	14.3	0.2%	0	1%	14	24423%	4	41%
Slovenia	10	12	15	15	0.2%	0	-2%	5	50%	3	22%
Spain	64	101	210	222	3.7%	12	6%	158	249%	121	120%
Sweden	79	108	29	35	0.6%	5	18%	-44	-56%	-73	-68%
United Kingdom	892	877	374	378	6.3%	4	1%	-514	-58%	-499	-57%
EU-28	**7 270**	**10 202**	**5 640**	**5 962**	**100%**	**322**	**6%**	**-1 308**	**-18%**	**-4 240**	**-42%**
Iceland	1.1	1	2	2	0.0%	-1	-31%	0	40%	0	23%
United Kingdom (KP)	892	877	374	378	6.3%	4	1%	-514	-58%	-499	-57%
EU-28 + ISL	**7 271**	**10 204**	**5 642**	**5 964**	**100%**	**322**	**6%**	**-1 307**	**-18%**	**-4 240**	**-42%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 4.23: Other Product Manufacture and Use: SF_6 Trend in the EU28+ISL

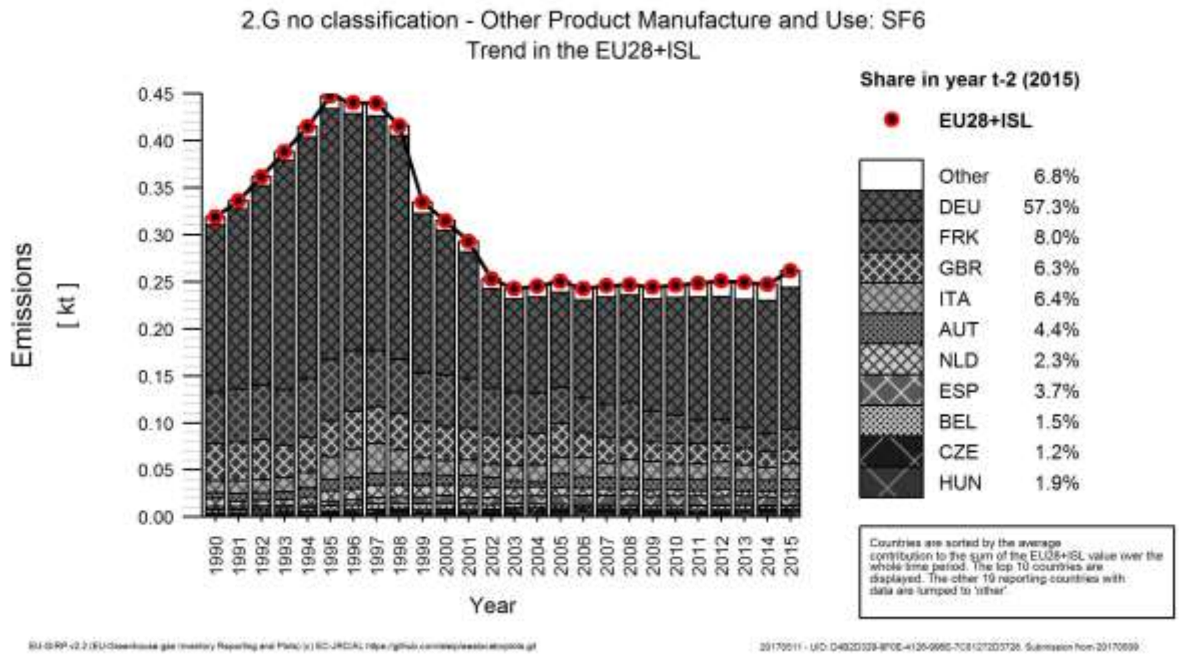


Figure 4.23 shows a stable trend for emissions from SF_6 in sector 2.G. In 2015 a minor increase took place due to larger emissions from Italy.

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.

4.3.1 Gap filling of Activity data

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. Some 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 75% 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. Note that due to large resource needs the CRF includes gap filled activity data only for 2015 and for the EU key categories where the criteria above apply. In 2017 the following categories have been gap-filled:

- Clinker production in 2A1
- Lime production in 2A2
- Glass production in 2A3
- Ammonia production in 2B1

The method for gap filling includes four steps:

1. Emissions have been aggregated for those MS that are using the same activity data and that are reporting activity data and emissions (i.e. not using notation keys for either activity data or emissions. Usually the geographical coverage of these MS is smaller than EU-28.
2. These emissions have been divided by the aggregated activity data of those MS in order to derive an IEF for those MS.
3. This IEF has been multiplied by the emissions of the EU-28 in order to derive a gap-filled estimate for activity data for EU-28.

Table 4.44 shows the details for the gap filling of activity data for the four categories in particular the geographical coverage of MS used as a basis for calculating the IEF.

Table 4.44: Documentation of gap filling of activity data

		2015			
Category	**Geographical coverage**	**Activity data**		**IEF (t/t)**	**Emissions (kt)**
		Description	**(kt)**		
2A1	EU-28 + ISL	Clinker production	139247	0.53	74369
	EU-28 + ISL	Clinker production	139247	0.53	74369
2A2	EU-28	Lime Production	27284	0.71	19313
	EU-28	Lime Production	27284	0.71	19313
2A3	EU-28	Glass Production	34150	0.12	4197
	EU-28 excl FI, LV & SK	Glass Production	34033	0.12	4182
2B1	EU-28	Ammonia Production	40189	0.60	24143
	EU-28 excl BG, NL & RO	Ammonia Production	30693	0.60	18438

Uncertainty estimates

Table 4.45 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 2A the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-28 see Chapter 1.6.

Table 4.45 Sector 2 Industrial processes: Uncertainty estimates for the EU-28

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A Mineral Industry	CO_2	148 016	106 004	-28%	3%	0.007%
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	60 097	50 565	-16%	9%	0.0%
2.B Chemical Industry	CH_4	1 371	1 229	-10%	33%	0.0%
2.B Chemical Industry	N_2O	116 272	7 138	-94%	11%	0.2%
2.B Chemical Industry	HFC	29 016	2 477	-91%	21%	0.1%
2.B Chemical Industry	PFC	4 428	1 981	-55%	44%	0.1%
2.B Chemical Industry	mix of HFC	0	0		0%	0.0%
2.B Chemical Industry	SF_6	1 891	97	-95%	0%	0.2%
2.B Chemical Industry	NF3	0	0		0%	0.0%
2.C Metal Industry	CO_2	111 216	69 718	-37%	3%	0.01%
2.C Metal Industry	CH_4	272	134	-51%	13%	0.05%
2.C Metal Industry	N_2O	34	26	-23%	81%	0.27%
2.C Metal Industry	HFC	4 446	67	-98%	30%	0.5%
2.C Metal Industry	PFC	13 974	299	-98%	12%	0.1%
2.C Metal Industry	mix of HFC	0	0		0%	0.0%
2.C Metal Industry	SF_6	1 655	165	-90%	15%	0.1%
2.C Metal Industry	NF3	0	0		0%	0.0%
2.D Non-energy products from fuels and solve	CO_2	13 219	9 046	-32%	34%	0.1%
2.D Non-energy products from fuels and solve	CH_4	5	2	-56%	94%	0.6%
2.D Non-energy products from fuels and solve	N_2O	5	5	-6%	76%	0.1%
2.E Electronics industry	CO_2	0	0		0%	
2.E Electronics industry	CH_4	0	0		0%	
2.E Electronics industry	N_2O	0	0		0%	
2.E Electronics industry	HFC	57	52	-9%	39%	0.4%
2.E Electronics industry	PFC	551	521	-6%	21%	0.1%
2.E Electronics industry	mix of HFC	0	0		0%	0.0%
2.E Electronics industry	SF_6	200	137	-32%	19%	0.8%
2.E Electronics industry	NF3	99	68	-31%	18%	0.1%
2.F Product uses as substitutes for ODS	CO_2	0	1 143		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	1 958	85 524	4268%	43%	7.1%
2.F Product uses as substitutes for ODS	PFC	1	68	6237%	151%	89.9%
2.F Product uses as substitutes for ODS	mix of HFC	0	0		0%	0.0%
2.F Product uses as substitutes for ODS	SF_6	0	0		0%	0.0%
2.F Product uses as substitutes for ODS	NF3	0	0		0%	0.0%
2.G Other product manufacture and use	CO_2	139	149	7%	19%	0.1%
2.G Other product manufacture and use	CH_4	64	82	30%	29%	0.1%
2.G Other product manufacture and use	N_2O	4 911	2 973	-39%	43%	0.1%
2.G Other product manufacture and use	HFC	49	129	164%	95%	1.9%
2.G Other product manufacture and use	PFC	401	588	47%	31%	0.1%
2.G Other product manufacture and use	mix of HFC	0	0		0%	0.00%
2.G Other product manufacture and use	SF6	3 187	2 039	-36%	24%	0.09%
2.G Other product manufacture and use	NF3	0	0		0%	0.00%
2.H Other	CO2	98	61	-38%	18%	0.06%
2.H Other	CH4	0	0		0%	
2.H Other	N2O	64	82	29%	21%	0.1%
2.H Other	HFC	0	3	31110%	18%	56.2%
2.H Other	PFC	0	2	961%	50%	4.8%
2.H Other	mix of HFC	0	0		0%	0.0%
2.H Other	SF6	7	27	257%	59%	1.5%
2.H Other	NF3	0	0		0%	0.0%
2 (where no subsector data were submitted)	*all*	0	0		0%	0.0%
Total - 2	**all**	**517 735**	**342 609**	-34%	**11.0%**	**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. In 2016 a comprehensive ESD review was performed followed by an annual ESD review in 2017..

4.5 Sector Specific Recalculations

Table 4.46 shows that in the industrial processes sector the largest recalculations in absolute terms were made for N_2O and HFCs in 1990 and 2014.

Table 4.46 Recalculations of total GHG emissions and recalculations from industrial processes and product use for 1990 and 2014 by gas (kt CO_2 equivalents) and percent of sector total)

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	14 507	0.3%	-5 960	-0.8%	-3 392	-0.8%	0	0.0%	501	1.9%	84	0.8%	135	2.4%	0	0.0%
Industrial Processes and Product Use	2 351	0.7%	23	1.3%	114	0.1%	0	0.0%	501	1.9%	84	0.8%	135	2.4%	0	0.0%
2014																
Total emissions and removals	2 360	0.1%	5 458	1.2%	-4 686	-1.8%	492	0.4%	16	0.5%	-5	-0.1%	68	45.0%	0	0.0%
Industrial Processes and Product Use	3 585	1.5%	-487	-22.2%	27	0.2%	492	0.4%	16	0.5%	-5	-0.1%	68	45.0%	0	0.0%

Table 4.47 provides an overview of Member States' contributions to EU-28+ISL recalculations.

Table 4.47 Sector 2 Industrial processes: Contribution of Member States to EU-28+ISL recalculations for 1990 and 2014 by gas (difference between latest submission and previous submission kt of CO_2 equivalents)

	1990								2014							
	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	0	0	0	0	0	0	NA	NO,NA	58	0	-1	0	0	0	NA	0
Belgium	0	0	18	NA,NO	0	0	NA,NO	NA,NO	-107	0	-3	23	0	0	NA,NO	0
Bulgaria	-155	8	0	NO	NO	0	NO	NO	303	0	14	67	0	1	NO	NO
Croatia	0	0	0	NO	0	0	NO	NO	2	0	-16	-169	0	0	NO	NO
Cyprus	-42	NE,NA, NO	0	0		0			0	NE,NA, NO	0	39		0		
Czech Republic	-6	0	0	NO	NO	-1	NE,NO	NO	608	-499	0	399	-2	-1	NE,NO	0
Denmark	2	0	-1	NO,NA	NO,NA	0	NO,NA	NO,NA	0	0	0	0	0	0	NO,NA	NO,NA
Estonia	4	NO	0	NO	NO	NO	NO	NO	0	NO	0	1	NO	0	NO	NO
Finland	-4	0	0	0	0	0	NO	NO	-2	0	0	-44	0	0	NO	NO
France	5 422	2	2	0	12	0	NO,NA	0	5 126	2	2	45	12	19	NO,NA	0
Germany	6	9	27	0	0	84	135	0	174	2	14	212	0	0	68	0
Greece	0	0	0	0	0	0	NA,NO	NA,NO	-136	0	0	0	0	0	NA,NO	NA,NO
Hungary	120	0	0	NO	0	0	NO	NO	31	0	0	380	-1	4	NO	NO
Ireland	72	NO	0	0	0	0	NO	NO	77	NO	0	-3	-5	-9	NO	0
Italy	140	0	0	0	0	0	NO,NE,NA	NA,NO	14	-2	0	-50	0	2	NO,NE,NA	0
Latvia	-4	0	2	NO,NA, NE	NO,NA	NA,NO	NO,NA	NO,NA	-8	0	1	-6	NA,NO	0	NA,NO	NA,NO
Lithuania	3	0	0	NO	NO	NO	NO	NO	-23	NO	0	0	NO	0	NO	0
Luxembourg	-8	NO	0	0	NO	0	NO	NO	10	NO	-24	1	NO	0	NO	NO
Malta	0	NO,NA	0	NO,NE,I E,NA	NO,NA	0	NA,NO	NA,NO	0	NA,NO	0	-3	0	0	NA,NO	NA,NO
Netherlands	-116	-7	0	0	0	0	NO	NO,IE	-114	-5	27	11	0	0	NO	NO,IE
Poland	-2 423	0	1	NA,NO	0	NA,NO	NA,NO	NA,NO	-2 235	0	12	329	0	0	NA,NO	NA,NO
Portugal	219	11	0	NO,NA	NO,NA	NO,NA	NO,NA	NO	581	15	4	784	13	-30	NO	NO
Romania	-45	0	0	0	353	0	NO	NO	7	0	0	0	0	0	NO	NO
Slovakia	-1	0	0	NO	0	0	NO	NO	26	0	0	108	0	0	NO	NO
Slovenia	-15	0	0	NO	0	0	NO	NO	3	NA,NO	0	5	0	-1	NO	NO
Spain	-545	1	42	0	0	0	NA,NO	NA,NO	-344	2	1	-1 219	-2	3	NA,NO	NA,NO
Sweden	1	0	0	0	135	0	NA	NA	0	0	9	3	1	-2	NA	NA
United Kingdom	-279	-1	22	0	0	0	NO,NE	0	-473	-1	-15	-441	0	8	NO	0
EU28	2 347	23	114	0	501	84	135	0	3 581	-487	27	480	16	-5	68	0
Iceland	5	0	0	0	0	0		NO,NA	6	0	0	19	0	0		NO
EU28+ISL	2 351	23	114	0	501	84	135	0	3 585	-487	27	492	16	-5	68	0

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[17].

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 links direct payments to respecting a number of statutory management requirements and to maintain all agricultural land in good agricultural and environmental conditions (EC 2003)[18].

- "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.
- The obligation to maintaining land in good agricultural and environmental conditions (GAECs) and maintaining permanent pasture at level at 1.5.2004. Definitions of GAEC are specified at national or regional level and should warrant appropriate soil protection, ensure a minimum level of maintenance of soil organic matter and soil structure and avoid the deterioration of habitats.

In 2013, the Council of the EU Agriculture Ministers adopted four Basic Regulations for a reformed CAP following a CAP Health Check[19] in 2008 and a Commission Communication on the CAP towards 2020[20] in

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[17] http://ec.europa.eu/agriculture/envir/index_en.htm

[18] http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32003R1782

[19] http://ec.europa.eu/agriculture/healthcheck/index_en.htm

[20] https://ec.europa.eu/agriculture/cap-post-2013_en

2011. The four legislative texts that regulate the post-2013 CAP are (i) Rural Development: Regulation 1305/2013[21]; (ii) "Horizontal" issues such as funding and controls: Regulation 1306/2013[22]; (iii) Direct payments for farmers: Regulation 1307/2013[23]; (iv) Market measures: Regulation 1308/2013[24].

With the adoption of the 2013 CAP reform, the environment concerns received an enhanced focus being materialised by explicitly linking the agricultural support to “agricultural practices beneficial to the climate and environment” (so called 'CAP greening'). Agro-environmental indicators have been identified as useful tools to perform this task, especially since they allow for the assessment of territorial impacts. The monitoring and evaluation of CAP performance is carried out through indicators (EC 2006[25], 2001[26], 2000[27]). Green direct payments account for 30% of EU countries' direct payment budgets. Farmers receiving an area-based payment have to make use of various straightforward, non-contractual practices that benefit the environment and the climate. These require action each year. They include:

- diversifying crops;
- maintaining permanent grassland; and
- dedicating 5% of arable land to ecologically beneficial elements ('ecological focus areas').

Currently, the next reform of the CAP is under discussion enabling agriculture in Europe by its modernisation and simplification to face new challenges, such related to economic prospects and care for the environment including action over climate change and maximise its contribution to the Commission's priorities and to the Sustainable Development Goals[28].

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 (NVZ) 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.

The action programmes need to be implemented by farmers within NVZs on a compulsory basis. These programmes must include measures already included in Codes of Good Agricultural Practice, which become mandatory, and other measures, such as limitation of fertilizer application (mineral and organic),

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21 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:en:PDF

22 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0549:0607:en:PDF

23 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0608:0670:en:PDF

24 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0671:0854:en:PDF

25 EC (2006). Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy. Communication from the Commission to the Council and the European Parliament. COM(2006) 508 final. Commission of the European Communities, Brussels.

26 EC (2001). Statistical Information needed for Indicators to monitor the Integration of Environmental concerns into the Common Agricultural Policy. Communication from the Commission to the Council and the European Parliament. COM(2001) 144 final. Commission of the European Communities.

27 EC (2000). Indicators for the Integration of Environmental Concerns into the Common Agricultural Policy. Commission of the European Communities.

28 https://ec.europa.eu/agriculture/consultations/cap-modernising/2017_en

taking into account crop needs and all nitrogen inputs and soil nitrogen supply, with maximum amount of livestock manure to be applied. Every four years countries are require to report on nitrates concentrations in groundwaters and surface waters; eutrophication of surface waters; assessment of the impact of action programme(s) on water quality and agricultural practices; revision of NVZs and action programme(s); estimation of future trends in water quality.

This has affected emissions in most countries:

- In Belgium, Manure Action Plans (MAP, based on the Nitrate Directive) in Flanders affected NH_3 volatilization from manure application. The first action plan in 1991 regulated the reduced period in which manure can be spread and foresaw low-emission techniques for the application of manure on land. The MAP2bis in 2000 focused 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, which have had a positive effect on the NH_3 and N_2O emissions.
- 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.
- In the Netherlands, manure and fertiliser policy influences livestock numbers. Especially young cattle, pigs and poultry numbers decreased by the introduction of measures like buying up part of the so-called pig and 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 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. The milk quota system ended in 2015.

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, among others:

- the 1999 Gothenburg Protocol under the Convention on Long Range Transboundary Air Pollution (CLRTAP[29]) to 'Abate Acidification, Eutrophication and Ground-level Ozone', revised in 2012 setting national emission reduction commitments to be achieved by 2020 and beyond;
- the National Emission Ceilings Directive (NEC - Directive 2001/81/EC[30]) 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. It has been updated in 2016[31] setting new objectives for EU air policy for 2020 and 2030;
- the Industrial Emission Directive (IED[32][33]), 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 (over 30 kg); more than 750 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).

Another policy affecting GHG emissions, in this case through the application of sewage sludge, is the Urban Wastewater Treatment Directive[34]. In the UK, the input from sewage sludge sharply increased in 2001. This is explained by a step in the UK's estimates of sewage sludge collected around 2001, linked to the Urban Wastewater Treatment Directive, which enforced that all large wastewater treatment plants use secondary treatment. This additional treatment reduces the organic load in the effluent, and to achieve this a higher proportion of the organic load in the wastewater treatment plants as sewage sludge. A similar trend is observed in Ireland, where a significant increase (over double) in the quantity of sewage sludge applied to agricultural land took place around 1998 as a result of its diversion away from disposal at solid waste disposal sites.

Legislation related with animal health may also affect emissions through changes in specific parameters. That is the case of Spain, where the methane conversion factor (Ym), and therefore the implied emission factor for CH_4 emissions from enteric fermentation from swine decreased in 2006, partly due to the ban of the use of growth-promoting antibiotics in animal feeding. This resulted in a radical change in feeding conditions: raw materials with lowest digestibility were removed and replaced by carbohydrates (mainly cereals). To increase higher digestibility and quality protein supply, the soybean flour 44 was systematically replaced by soybean 47 which has higher protein content. Also, affordable synthetic amino acids and digestive enzymes were systematically introduced. In addition, during the same year, the regulation on additives used in animal feeding was published, thus forcing the withdrawal of products that were being used to date, in order to make the digestion of other diet components easier.

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

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29 http://www.unece.org/env/lrtap/multi_h1.html

30 http://ec.europa.eu/environment/air/pollutants/ceilings.htm

31 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L2284&from=EN

32 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075

33 http://ec.europa.eu/environment/industry/stationary/index.htm

34 http://ec.europa.eu/environment/water/water-urbanwaste/legislation/directive_en.htm

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.

In the case of Croatia, we can observe livestock population drops in 1992 due to the beginning of the Croatian War of Independence in 1991/1992, which significantly influenced animal production for most animal categories. The countries which formed part of the communist block suffered structural changes when they changed regime, mainly due to privatizations. Lithuania shows an important decrease of non-dairy cattle population in 1993-1994, after the collapse of the Soviet Union and the restoration of independence in 1990, when changes in economy and significant reforms occurred. The reform included the re-establishment of private ownership and management in agriculture sector. Legislation defined dismemberment of collective farms, but they did not definitively ensure their replacement by at least equally productive private farms and corporations. The decrease in cattle population occurred also due to high costs in production, product differences in prices and lack of market for meat and milk. Similarly, Bulgaria shows a decline in cattle numbers in 1992-1995, after the communist period, due to the reforms in agricultural holdings, together with a decrease in the quantities of inorganic fertilisers. Poland, in turn, had a significant drop in cattle population since mid-1990s up to 2002 due to intentional limitations of cattle breeding related to weakening demand for beef meat. Further increase in population could be connected with the prospect of inclusion of Poland into the EU planned for 2004 and joining the common agricultural policy, with expectations for stable agricultural production. An increase in population in 2012 was probably triggered by the improved economic situation for the agricultural markets. The economic situation seems to highly influence the use of fertilisers in the EU countries, especially for liming and urea fertilization. In Poland, limestone/dolomite fertiliser use dramatically decreased after 2004 as a result of a cut in their subsidies for farmers. In 2006 limestone use was lower by 40% than in previous year, despite remaining high need of soils. In Lithuania, a sharp increase of N input from application of other organic fertilizers took place in 2013, caused by changes in national circumstances when using financial resources of 2004-2006 EU ISPA/Cohesion funds Lithuania started to improve municipal solid waste management system. Also in Italy, fertiliser use was affected by the economic crisis (2009-2011), which led to a reduction in the application of all synthetic fertilisers, in particular urea. In 2012, a recovery from the sharp decline was recorded. In the same line, Slovenia reports a strong decrease in urea fertilisers in 1991 and 2008 due to the economic crisis and high prices of fertilisers. Similarly, the area used for rice cultivation suffers large changes for both continuous flooded and intermittently flooded rice as a consequences of economic and environmental pressures. For emissions at EU-level, the combination of emissions from rice from different countries and cultivation systems contributes additionally to fluctuations. Emissions from burning of agricultural residues also have fluctuating trends due to the heterogeneity of the emission source: it is a composite emission categories over countries and crops with different shares of residues burned and different shares of agricultural area and, as a consequence, large fluctuations are to be expected.

5.1 Overview of sector

In the year 2015, N_2O, CO_2 and CH_4 emissions from CRF sector 3 Agriculture were 47.6%, 71.8%, and 0.26% of total EU28+ISL CH_4, N_2O, and CO_2 emissions, respectively. Total emissions from agriculture were 438 Mt CO_2-eq with contributions from CH_4, N_2O, and CO_2 of 242 Mt CO_2-eq, 185 Mt CO_2-eq and 10.3 Mt CO_2-eq, respectively.

Thus, CH_4, N_2O, and CO_2 contributed with 5%, 3.8% and 0.21% to total EU28+ISL GHG emissions. They make 55.3%, 42.3% and 2.3% of total agricultural emissions.

Figure 5.1 shows the development of total GHG emissions from agriculture from 549 Mt CO_2-eq in 1990 to 438 Mt CO_2-eq in 2015 and the considerably decrease in EU28+ISL. The decrease was most pronounced for CO_2 with a decrease of 32.5%, followed by CH_4 with a decrease of 21% and N_2O with a decrease of 18.6%. The decrease was most pronounced in the first decade with a total reduction of 15.3% between 1990 and 2000, a further decrease by between 2000 and 2005, while remaining constant since 2005 (change -0.7%).

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 5.3 shows the distribution of agricultural GHG emissions among the different source categories for the year 2015.

Figure 5.1: EU-28 GHG emissions for 1990-2015 from CRF Sector 3: 'Agriculture' in CO_2 equivalents (Mt)

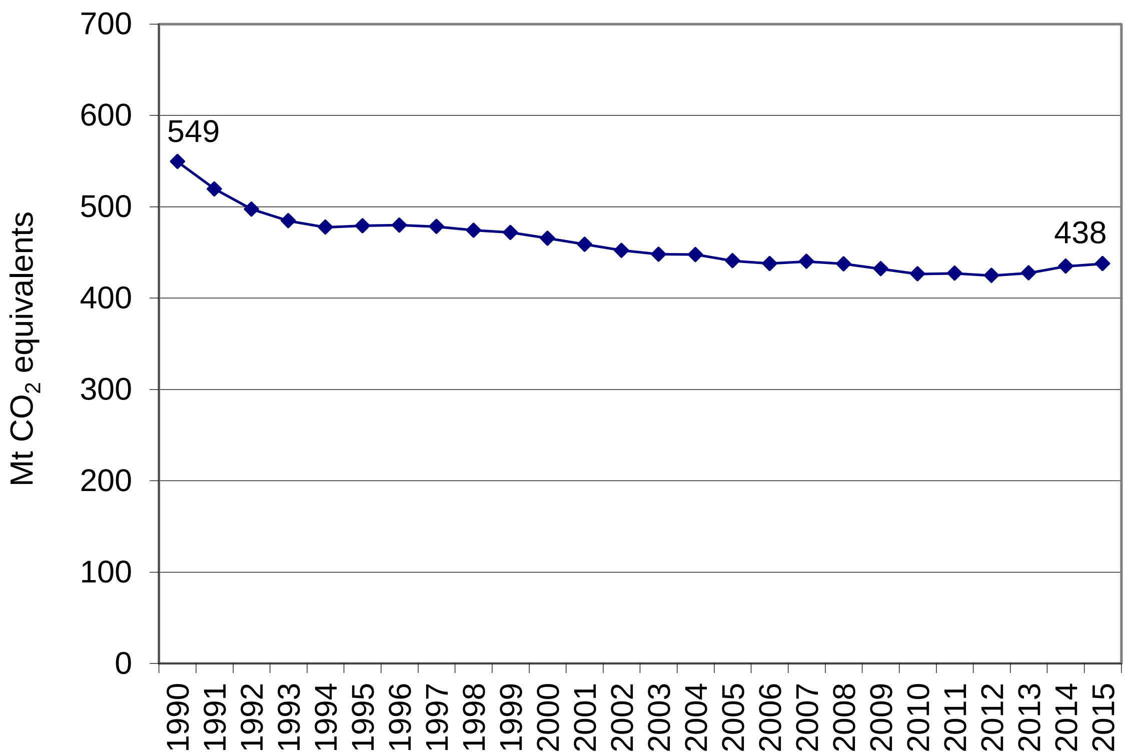


Figure 5.2: Absolute change of GHG emissions by large key source categories 1990-2015 in CO_2 equivalents (Mt) in CRF Sector 3: 'Agriculture'

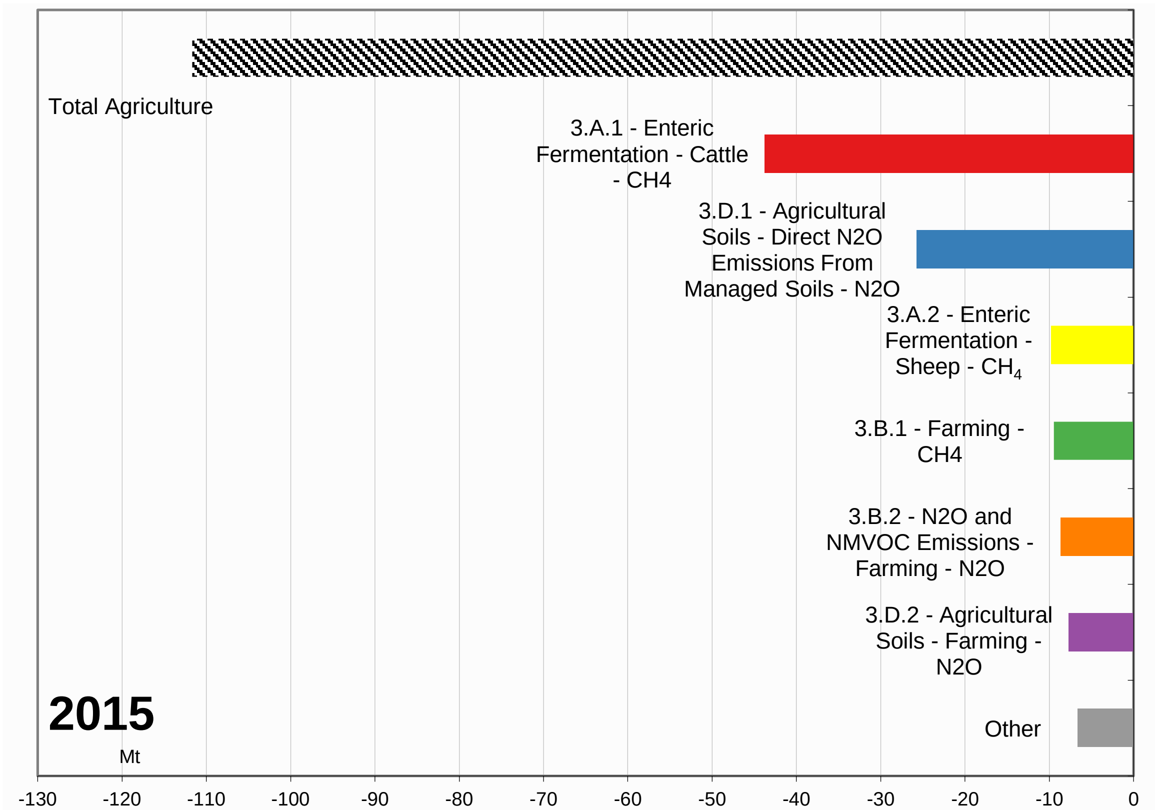
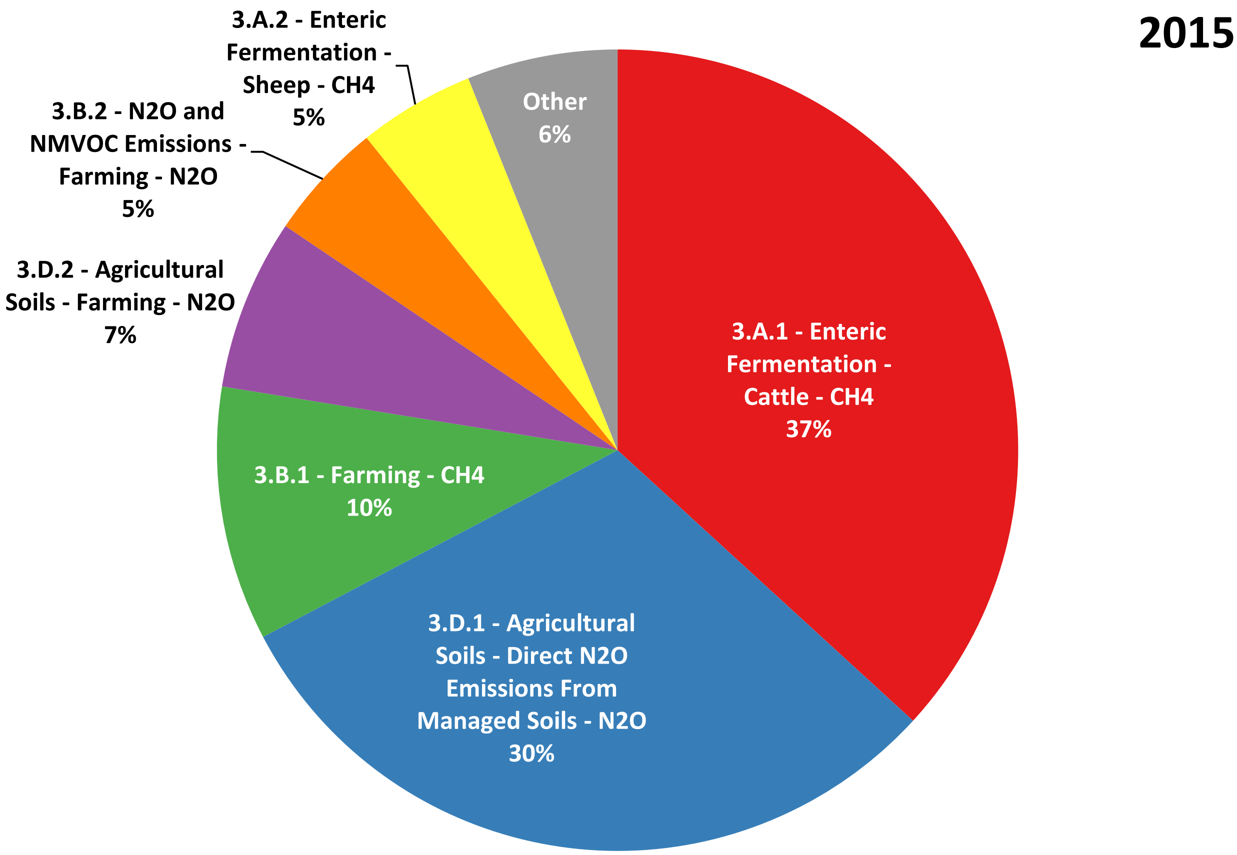


Figure 5.3: Distribution of agricultural GHG emissions among the different source categories for the year 2015



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.

Key source categories considered are:

Table 5.1: Key categories for the EU (Agriculture – sector excerpt)

Source cagegory (gas	Gg CO_2 eq		Level	
	1990	2015	1990	2015
3.A.1.1 Enteric Fermentation: Dairy Cattle (CH_4)	104107	76272	L	L
3.A.1.2 Enteric Fermentation: Non-Dairy Cattle (CH_4)	100710	84776	L	L
3.A.2 Enteric Fermentation: Sheep (CH_4)	30353	20553	L	L
3.B.1.1.1 Manure Management: Dairy Cattle (CH_4)	12850	11405	L	L
3.B.1.1.2 Manure Management: Non-Dairy Cattle (CH_4)	11649	9854	L	L
3.B.1.3 Manure Management: Swine (CH_4)	26317	20743	L	L
3.B.2.5 Manure Management: Indirect N_2O Emissions (N_2O)	10792	8028	L	L
3.D.1.1 Agricultural Soils: Direct N_2O Emissions, Inorganic N Fertilizers (N_2O)	69131	52666	L	L

Source cagegory (gas	Gg CO_2 eq		Level	
	1990	2015	1990	2015
3.D.1.2 Agricultural Soils: Direct N_2O Emissions, Organic N Fertilizers (N_2O)	27092	24166	L	L
3.D.1.3 Agricultural Soils: Urine and Dung Deposited by Grazing Animals (N_2O)	28038	21320	L	L
3.D.2.1 Agricultural Soils: Indirect N_2O Emissions, Atmospheric Deposition (N_2O)	12108	9042	L	L
3.D.2.2 Agricultural Soils: Indirect N_2O Emissions, N-Leaching and Run-off (N_2O)	25799	21181	L	L

Note 1: No method for source category 3.B.2.5 is reported.
Note 2: For source categories 3.D only emissions where countries reported Tier 2 methodology are included.

Other source categories are not contributing to a key source analysis at EU28+ISL level and are therefore not further discussed here. Emissions from source category J – other agriculture emissions are reported only from Germany (digestion of energy crops) and the UK (emissions from liming in oversee territories and crown dependencies).

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.
- Finland: Direct N_2O emissions and deposition from manure management are calculated with a national calculation model (Grönroos et al. 2009); leaching is calculated separately. The model integrates both ammonia and nitrous oxide emissions from manure in each phase of the manure management chain and allows accounting for the effect of possible abatement measures to volatilisation. The amount of N volatilised as NH_3-N and NO-N from MMS is calculated in the model separately from the application to fields (NH_3-N during and after spreading).
- The Netherlands: N-flows from animal production are assessed by the National Emission Model for Ammonia (NEMA). Results include emissions of ammonia (NH_3), nitric oxide (NO), nitrous oxide (N_2O) and nitrogen gas (N2) from stable and storage.
- Slovenia: a mass balance approach which tracks nitrogen throughout the system is used to estimate N_2O emissions, based on EMEP/CORINAIR (2013) methodology. The amount of N which is lost through volatilisation is estimated simultaneously with direct N_2O emissions using EMEP/CORINAIR (2013) methodology. Similar mass-flow approach, based on EMEP/EEA guidelines is followed by Iceland.

5.2.1 Enteric fermentation (CRF Source Category 3.A)

CH_4 emissions in source category *3.A - Enteric Fermentation* are 4% of total EU28+ISL GHG emissions and 38% of total EU28+ISL CH_4 emissions. They make 44% of total agricultural emissions and 79% of total agricultural CH_4 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), 3.A.1.1 (Dairy Cattle) and 3.A.2 (Sheep) as shown in Figure 5.4. Emissions are also reported for 3.A.4 (Other Livestock) and 3.A.3 (Swine). CH_4 emissions from Enteric Fermentation for 'Other Livestock' are reported for the categories Buffalo, Deer, Goats, Horses, Mules and Asses, Poultry, and Other Other Livestock.

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 blue 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 2015.

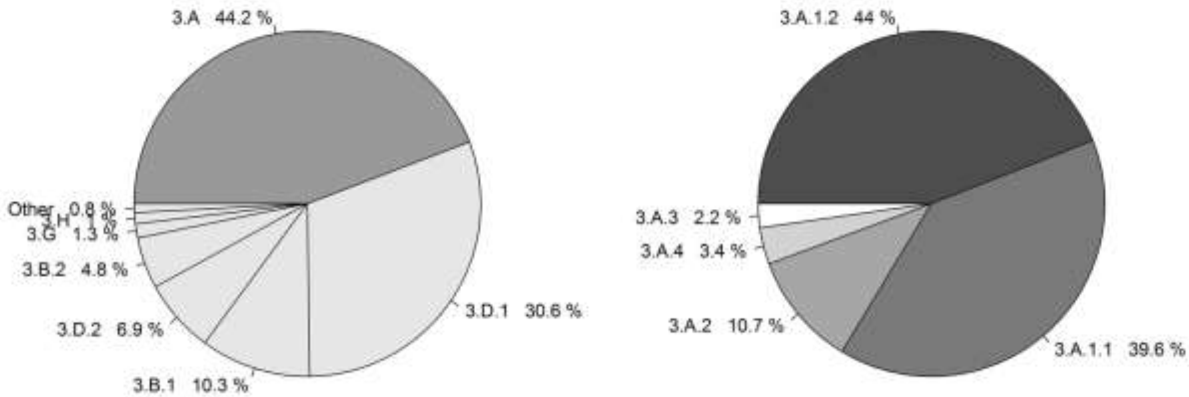
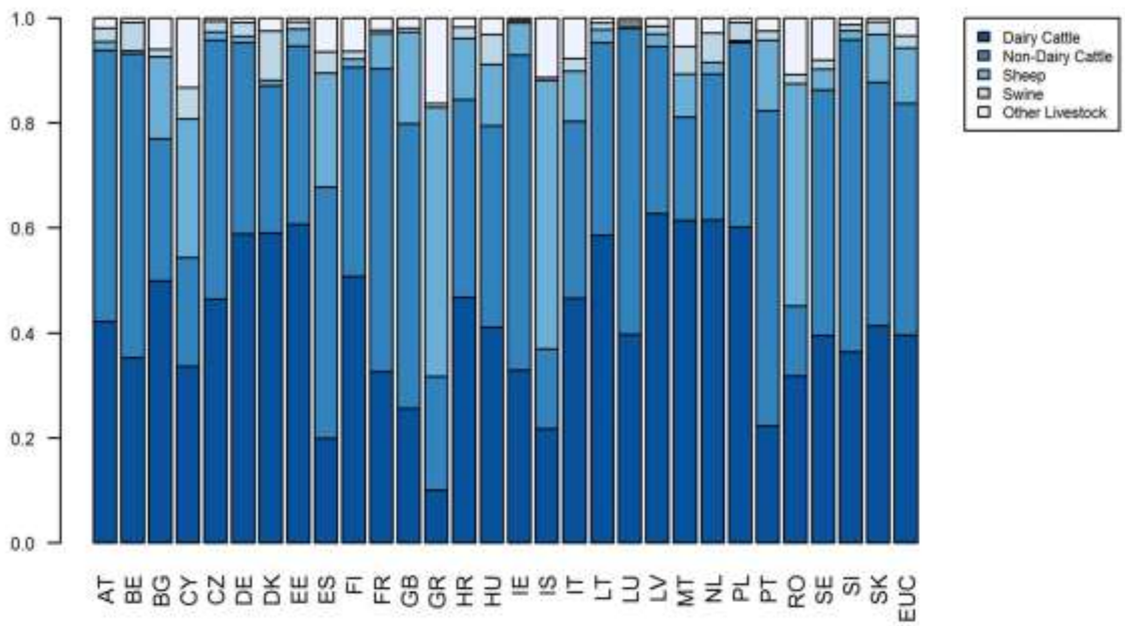


Figure 5.5: Decomposition of emissions in source category 3.A - Enteric Fermentation into its sub-categories by Member State in the year 2015.



Total GHG and CH_4 emissions by Member State from 3.A *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 2015). 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 2015, CH_4 emission in this source category decreased by 22% or 54.5 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (68%) and in Germany in absolute terms (9.9 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 1%.

Table 5.2 3.A - Enteric Fermentation: Member States' contributions to total GHG and CH_4 emissions

Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	4 821	4 131	4 821	4 131
Belgium	5 410	4 583	5 410	4 583
Bulgaria	4 804	1 529	4 804	1 529
Croatia	1 978	1 024	1 978	1 024
Cyprus	197	224	197	224
Czech Republic	5 755	2 896	5 755	2 896
Denmark	4 039	3 667	4 039	3 667
Estonia	1 247	541	1 247	541
Finland	2 423	2 117	2 423	2 117
France	37 613	34 580	37 613	34 580
Germany	34 664	24 782	34 664	24 782
Greece	4 024	3 919	4 024	3 919
Hungary	3 754	2 037	3 754	2 037
Ireland	11 357	10 936	11 357	10 936
Italy	15 491	13 774	15 491	13 774
Latvia	2 222	858	2 222	858
Lithuania	4 282	1 637	4 282	1 637
Luxembourg	434	430	434	430
Malta	38	31	38	31
Netherlands	9 227	8 512	9 227	8 512
Poland	21 554	12 419	21 554	12 419
Portugal	3 521	3 479	3 521	3 479
Romania	18 745	10 682	18 745	10 682
Slovakia	2 584	986	2 584	986
Slovenia	936	933	936	933
Spain	14 294	14 441	14 294	14 441
Sweden	3 288	3 005	3 288	3 005
United Kingdom	28 019	24 073	28 019	24 073
EU-28	**246 721**	**192 227**	**246 721**	**192 227**
Iceland	314	301	314	301
United Kingdom (KP)	28 019	24 073	28 019	24 073
EU-28 + ISL	**247 035**	**192 528**	**247 035**	**192 528**

Total GHG and CH_4 emissions by Member State from *3.A.1 - Cattle 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, CH_4 emission in this source category decreased by 21% or 43.8 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (63%) and in Germany in absolute terms (9.6 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 1%.

Table 5.3 3.A.1 - Cattle: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	4 579	3 881	3 874	2.4%	-8	0%	-706	-15%	T2	CS
Belgium	5 110	4 259	4 272	2.7%	13	0%	-838	-16%	-	-
Bulgaria	2 958	1 202	1 177	0.7%	-26	-2%	-1 781	-60%	T2	CS
Croatia	1 821	819	865	0.5%	46	6%	-956	-52%	T2	CS
Cyprus	101	122	122	0.1%	0	0%	21	20%	T1,T2	CS,D
Czech Republic	5 472	2 694	2 773	1.7%	79	3%	-2 699	-49%	T2	CS
Denmark	3 662	3 240	3 195	2.0%	-45	-1%	-467	-13%	T2	CS,D
Estonia	1 190	530	511	0.3%	-19	-4%	-678	-57%	T2	CS,D
Finland	2 226	1 897	1 919	1.2%	21	1%	-308	-14%	T2	CS
France	33 088	31 050	31 247	19.4%	197	1%	-1 841	-6%	T2,T3	CS
Germany	33 252	23 706	23 624	14.7%	-82	0%	-9 628	-29%	CS,T2,T3	CS,D
Greece	1 184	1 247	1 242	0.8%	-5	0%	58	5%	T2	CS,D
Hungary	2 962	1 567	1 618	1.0%	50	3%	-1 345	-45%	T2	CS
Ireland	10 101	9 877	10 157	6.3%	280	3%	55	1%	CS,T2	CS
Italy	13 164	10 955	11 053	6.9%	98	1%	-2 111	-16%	T2	CS
Latvia	2 118	816	812	0.5%	-4	-1%	-1 306	-62%	T2	CS
Lithuania	4 148	1 558	1 561	1.0%	3	0%	-2 587	-62%	T2	CS
Luxembourg	428	411	421	0.3%	10	3%	-8	-2%	T2	CS
Malta	29	25	25	0.0%	0	-2%	-4	-12%	T2	CS
Netherlands	8 191	7 327	7 603	4.7%	276	4%	-588	-7%	T2,T3	CS
Poland	19 547	11 673	11 834	7.3%	161	1%	-7 712	-39%	T2	CS
Portugal	2 460	2 824	2 864	1.8%	40	1%	404	16%	T2	CS
Romania	10 465	4 741	4 821	3.0%	81	2%	-5 644	-54%	T2	CS
Slovakia	2 328	886	865	0.5%	-22	-2%	-1 463	-63%	T2	CS
Slovenia	904	866	894	0.6%	27	3%	-10	-1%	T2	CS
Spain	8 453	9 537	9 788	6.1%	251	3%	1 335	16%	CS,T2	CS,D
Sweden	2 895	2 611	2 593	1.6%	-17	-1%	-302	-10%	CS	CS
United Kingdom	21 883	19 086	19 208	11.9%	122	1%	-2 675	-12%	T1,T2	CS,D
EU-28	**204 719**	**159 407**	**160 937**	**100%**	**1 530**	**1%**	**-43 782**	**-21%**	**-**	**-**
Iceland	98	103	111	0.1%	8	8%	13	14%	-	-
United Kingdom (KP)	21 883	19 086	19 208	11.9%	122	1%	-2 675	-12%	T1,T2	CS,D
EU-28 + ISL	**204 817**	**159 510**	**161 048**	**100%**	**1 538**	**1%**	**-43 769**	**-21%**	**-**	**-**

Total GHG and CH_4 emissions by Member State from *3.A.2 - Sheep Enteric Fermentation* are shown in Table 5.4 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, CH_4 emission in this source category decreased by 32% or 9.8 Mt CO_2-eq. The decrease was largest in Poland in relative terms (95%) and in Romania in absolute terms (2.1 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 1%.

Table 5.4 3.A.2 - Sheep: Member States' contributions to total GHG and CH_4 emissions

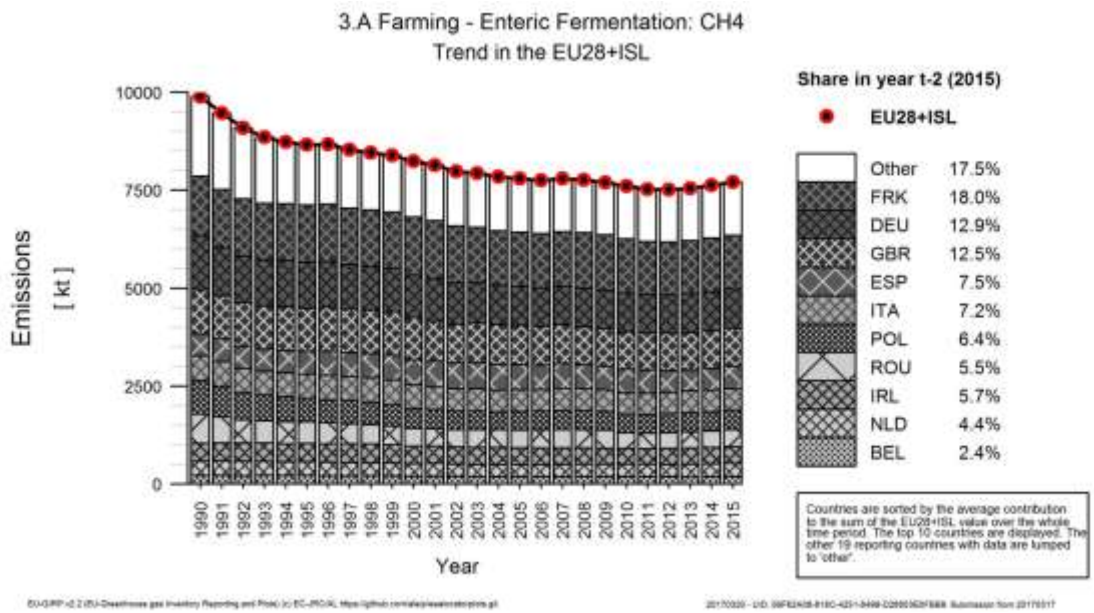
Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	62	70	71	0.3%	1	1%	9	14%	T1	D
Belgium	38	23	24	0.1%	1	5%	-15	-38%	-	-
Bulgaria	1 454	243	239	1.2%	-3	-1%	-1 214	-84%	T2	CS
Croatia	94	119	120	0.6%	1	0%	26	28%	T2	CS
Cyprus	58	59	59	0.3%	1	1%	1	2%	T1	D
Czech Republic	86	45	46	0.2%	1	3%	-40	-46%	T1	D
Denmark	39	37	35	0.2%	-2	-4%	-3	-9%	T2	D
Estonia	32	17	18	0.1%	0	3%	-14	-44%	D,T1	D
Finland	18	29	33	0.2%	4	13%	15	86%	CS	CS
France	3 579	2 361	2 322	11.3%	-39	-2%	-1 257	-35%	T2,T3	CS
Germany	518	301	297	1.4%	-4	-1%	-221	-43%	T1	CS,D
Greece	2 054	2 011	2 009	9.8%	-2	0%	-45	-2%	T2	CS,D
Hungary	392	245	239	1.2%	-6	-2%	-153	-39%	T1	D
Ireland	1 176	694	683	3.3%	-11	-2%	-493	-42%	T1	D
Italy	1 499	1 314	1 331	6.5%	17	1%	-168	-11%	T2	CS
Latvia	33	19	20	0.1%	2	11%	-12	-38%	T1	D
Lithuania	19	34	40	0.2%	6	19%	21	115%	T2	CS
Luxembourg	2	2	2	0.0%	0	8%	1	30%	T2	CS
Malta	4	2	3	0.0%	0	6%	-1	-36%	T2	CS
Netherlands	340	192	189	0.9%	-2	-1%	-151	-44%	T1	D
Poland	832	40	46	0.2%	5	13%	-786	-95%	T1	D
Portugal	794	474	468	2.3%	-6	-1%	-326	-41%	T2	CS
Romania	6 587	4 389	4 526	22.0%	137	3%	-2 061	-31%	T2	CS
Slovakia	154	92	90	0.4%	-2	-3%	-64	-42%	T2	CS
Slovenia	4	17	16	0.1%	-1	-3%	12	298%	T1	D
Spain	4 662	3 006	3 136	15.3%	130	4%	-1 527	-33%	CS,T2	CS,D
Sweden	81	118	119	0.6%	1	1%	38	46%	T1	D
United Kingdom	5 561	4 242	4 219	20.5%	-23	-1%	-1 342	-24%	T1	CS,D
EU-28	**30 171**	**20 192**	**20 399**	**99%**	**207**	**1%**	**-9 773**	**-32%**	**-**	**-**
Iceland	181	158	154	0.8%	-4	-3%	-27	-15%	-	-
United Kingdom (KP)	5 561	4 242	4 219	20.5%	-23	-1%	-1 342	-24%	T1	CS,D
EU-28 + ISL	**30 353**	**20 350**	**20 553**	**100%**	**203**	**1%**	**-9 800**	**-32%**	**-**	**-**

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 22% or 54.5 Mt CO_2-eq in the period 1990 to 2015. 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 82.5% of the total. Emissions decreased in 27 countries and increased in two countries. The three countries with the largest decreases were Germany, Poland and Romania with a total absolute decrease of 27.1 Mt CO_2-eq. Emissions increased in Cyprus and Spain, with a total absolute increase of 175 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 2015



3.A.1 - Cattle - Emissions

Emissions in source category *3.A.1 - Cattle* decreased considerably in EU28+ISL by 21% or 43.8 Mt CO_2-eq in the period 1990 to 2015. The ten countries with the highest emissions accounted together for 83% 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 23 Mt CO_2-eq. The largest increases occurred in Portugal and Spain, with a total absolute increase of 1.7 Mt CO_2-eq.

Emissions in source category *3.A.1 - Dairy Cattle* decreased strongly in EU28+ISL by 27% or 27.8 Mt CO_2-eq in the period 1990 to 2015. 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 in kt accumulated by the different Member States in a specific year. 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 82.8% of the total. Emissions decreased in 25 countries and increased in four countries. The three countries with the largest decreases were Poland, Germany and Romania with a total absolute decrease of 13.7 Mt CO_2-eq. The largest increases occurred in the Netherlands and Ireland, with a total absolute increase of 249 kt CO_2-eq.

Emissions in source category *3.A.1 - Non-Dairy Cattle* decreased considerably in EU28+ISL by 16% or 15.9 Mt CO_2-eq in the period 1990 to 2015. 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 84.6% of the total. Emissions decreased in 21 countries and increased in eight countries. The largest decreases occurred in Germany and Romania with a total absolute decrease of 7.4 Mt CO_2-eq. The largest increases occurred in Portugal and Spain, with a total absolute increase of 2.9 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 that we can see in Figure 5.9 and Figure 5.10.

Cattle population decreased strongly in EU28+ISL by 26% or 31.3 million heads in the period 1990 to 2015. The ten countries with the highest population accounted together for 84.3% of the total. Population decreased in 24 countries and increased in five countries. The largest decreases occurred in Germany and Poland with a total absolute decrease of 10.9 million heads. The largest increases occurred in Portugal and Spain, with a total absolute increase of 1.3 million 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 2015

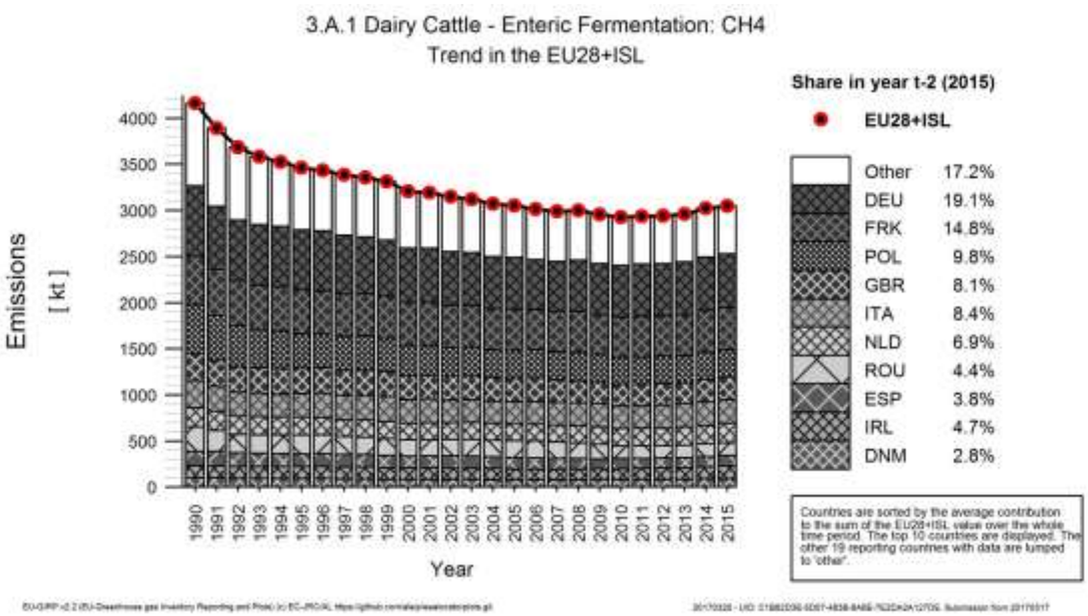


Figure 5.8: 3.A.1 Non-Dairy Cattle: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015

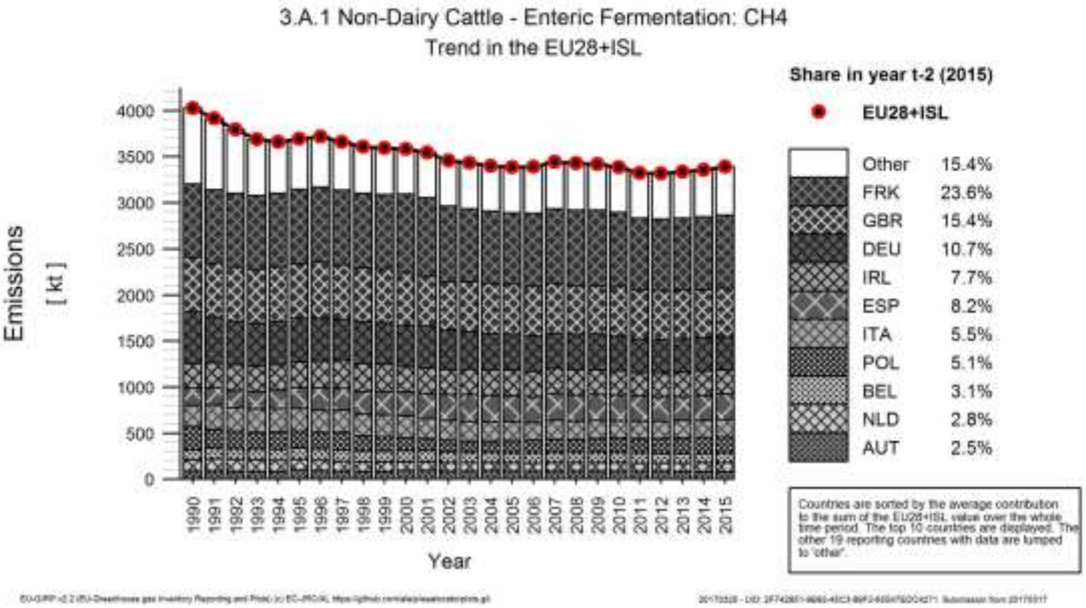


Figure 5.9: 3.A.1 Dairy Cattle: Trend in cattle population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015

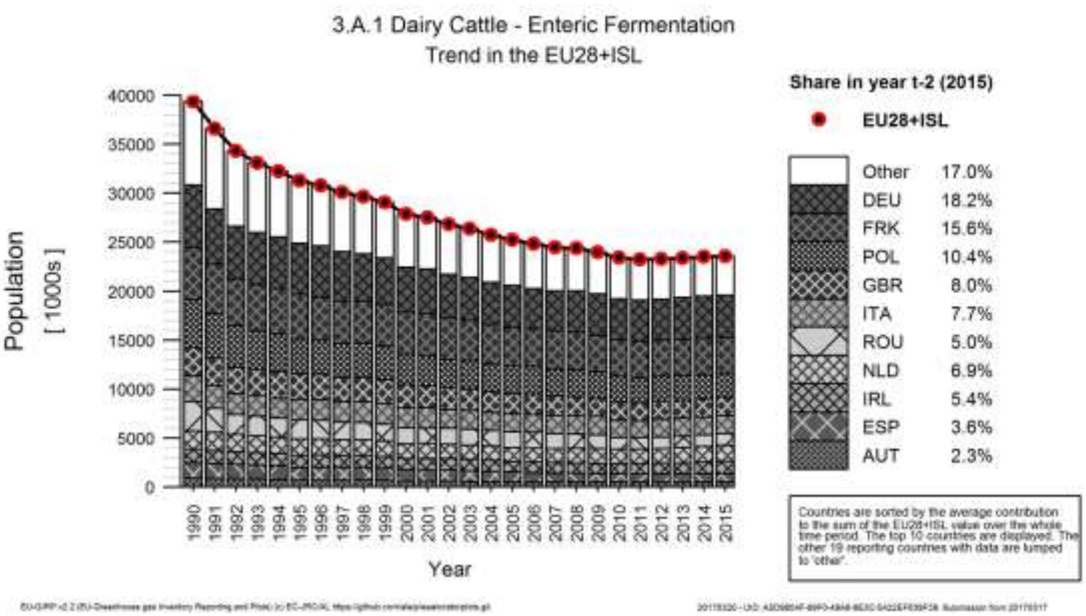
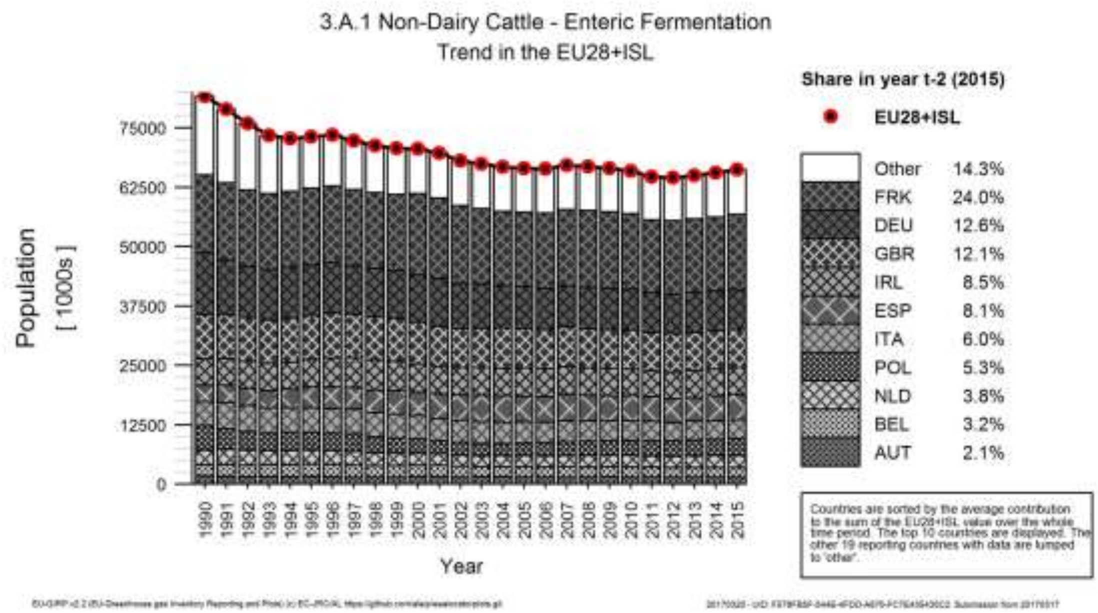


Figure 5.10: 3.A.1 Non-Dairy Cattle: Trend in cattle population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



3.A.2 - Sheep - Emissions

Emissions in source category *3.A.2 - Sheep* decreased strongly in EU28+ISL by 32% or 9.8 Mt CO_2-eq in the period 1990 to 2015. 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 93.6% of the total. Emissions decreased in 21 countries and increased in eight countries. The five countries with the largest decreases were Romania, Spain, the United Kingdom, France and Bulgaria with a total absolute decrease of 7.4 Mt CO_2-eq. The four countries with the largest increases were Finland, Lithuania, Croatia and Sweden, with a total absolute increase of 100 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 47.8 million heads in the period 1990 to 2015. 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 22 countries and increased in seven countries. The three countries with the largest decreases were the United Kingdom, Spain and Bulgaria with a total absolute decrease of 25.7 million heads. The five countries with the largest increases were Austria, Finland, Slovenia, Lithuania and Sweden, with a total absolute increase of 427 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 2015

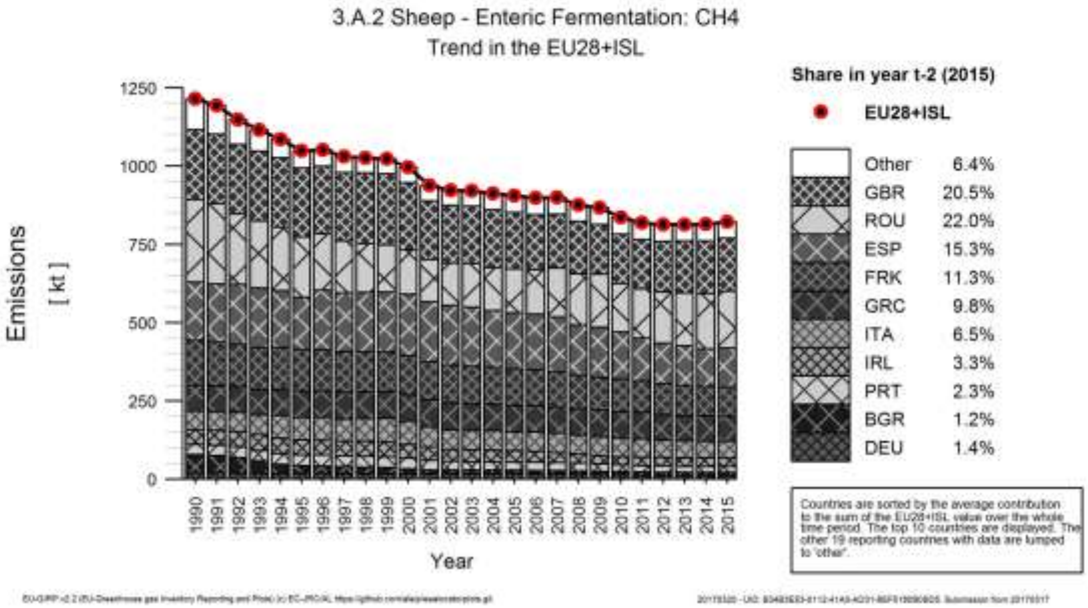
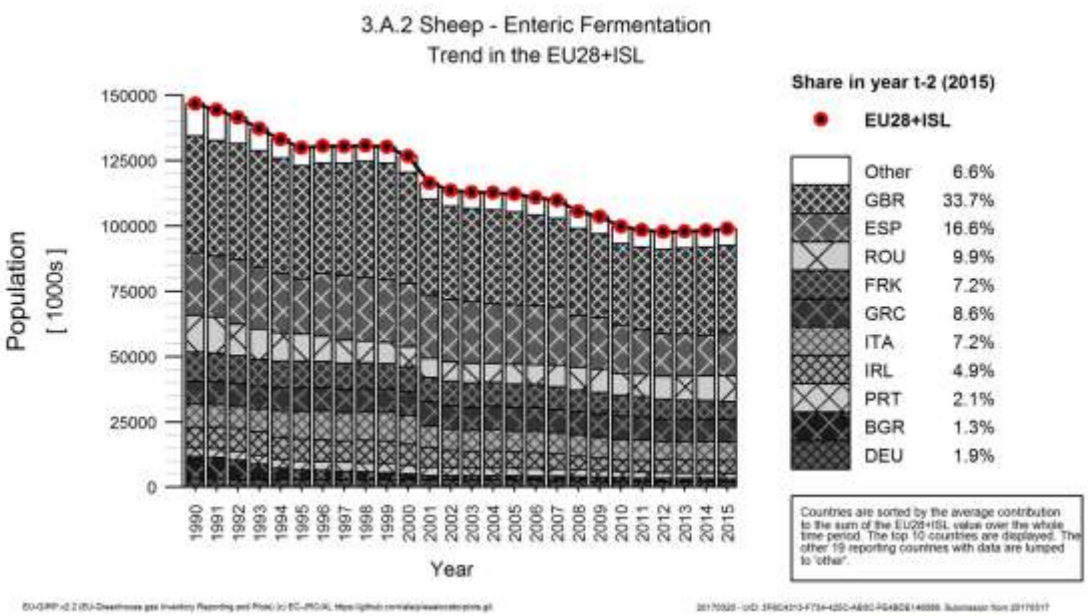


Figure 5.12: 3.A.2: Trend in sheep population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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 moderately between 1990 and 2015 by 5.9% or 4.02 kg/head/year. Table 5.5 shows the implied emission factor for CH_4 emissions in source category *3.A.1 - Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in three countries and increased in 25 countries. Decreases occurred in Croatia, Spain and Ireland with a mean absolute value of 6 kg/head/year. The four countries with the largest increases were Latvia, Finland, Slovakia and Estonia with a mean absolute value of 17 kg/head/year.

Table 5.5 3.A.1 - Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	71	79	|	Ireland	59	59
Belgium	63	67	|	Iceland	52	56
Bulgaria	74	85	|	Italy	68	76
Cyprus	74	83	|	Lithuania	70	84
Czech Republic	62	79	|	Luxembourg	78	84
Germany	68	75	|	Latvia	59	77
Denmark	65	82	|	Malta	55	67
Estonia	63	80	|	Netherlands	67	74
Spain	67	63	|	Poland	82	83
Finland	65	84	|	Portugal	72	74
France	61	64	|	Romania	79	93
United Kingdom	72	77	|	Sweden	67	70
Greece	68	73	|	Slovenia	68	74
Croatia	86	72	|	Slovakia	60	76
Hungary	73	79	|	**EU28+ISL**	**68**	**72**

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 2015 by 22.3% or 23.6 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 5.6 shows the implied emission factor for CH_4 emissions in source category *3.A.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The reported implied emission factor increased in all reporting 29 countries. The four countries with the largest increases were Czech Republic, Slovakia, Estonia and Spain with a mean absolute value of 42 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

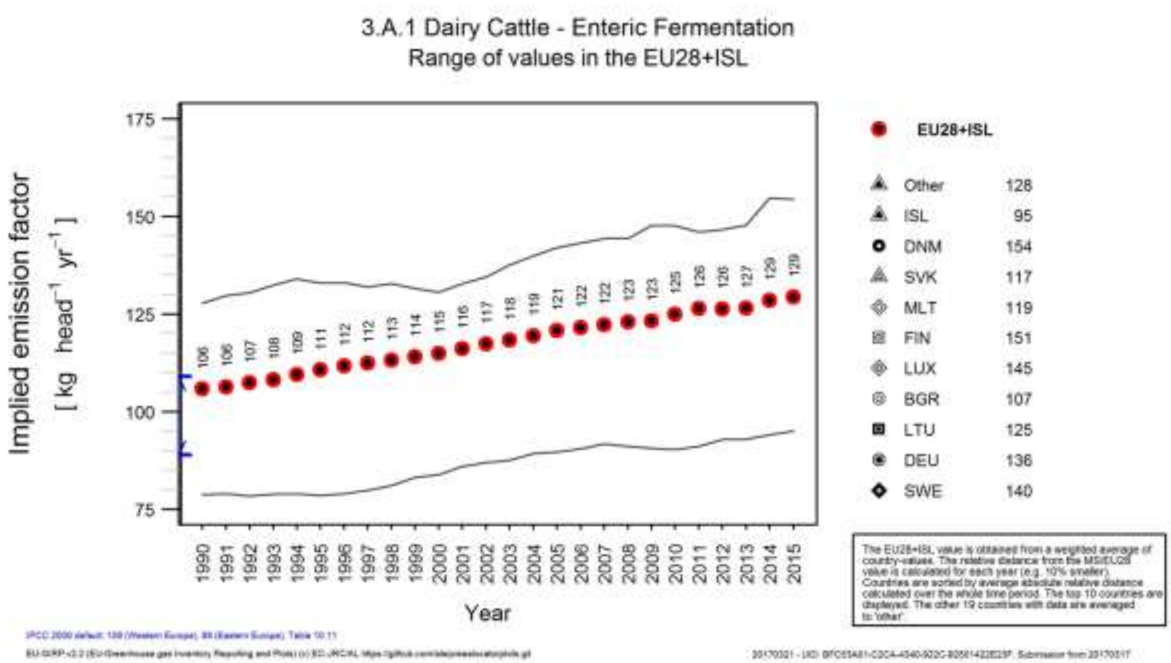


Table 5.6 3.A.1 - Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015	Member State	1990	2015
Austria	105	130	Ireland	101	113
Belgium	112	143	Iceland	79	95
Bulgaria	105	107	Italy	111	140
Cyprus	99	115	Lithuania	101	125
Czech Republic	97	143	Luxembourg	120	145
Germany	120	136	Latvia	103	132
Denmark	128	154	Malta	90	119
Estonia	101	145	Netherlands	110	129
Spain	96	135	Poland	108	122
Finland	112	151	Portugal	97	132
France	99	123	Romania	90	115

Member State	1990	2015		Member State	1990	2015
United Kingdom	102	130	|	Sweden	112	140
Greece	93	118	|	Slovenia	92	120
Croatia	109	110	|	Slovakia	80	117
Hungary	111	133	|	**EU28+ISL**	**106**	**129**

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 strongly between 1990 and 2015 by 25.4% or 62.6 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 5.7 shows the gross energy in source category *3.A.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The reported gross energy increased in all reporting 25 countries. The four countries with the largest increases were Slovakia, Estonia, Spain and Portugal with a mean absolute value of 90 MJ/day.

Figure 5.14: 3.A.1 - Dairy Cattle: Trend in gross energy in the EU28+ISL and range of values reported by countries

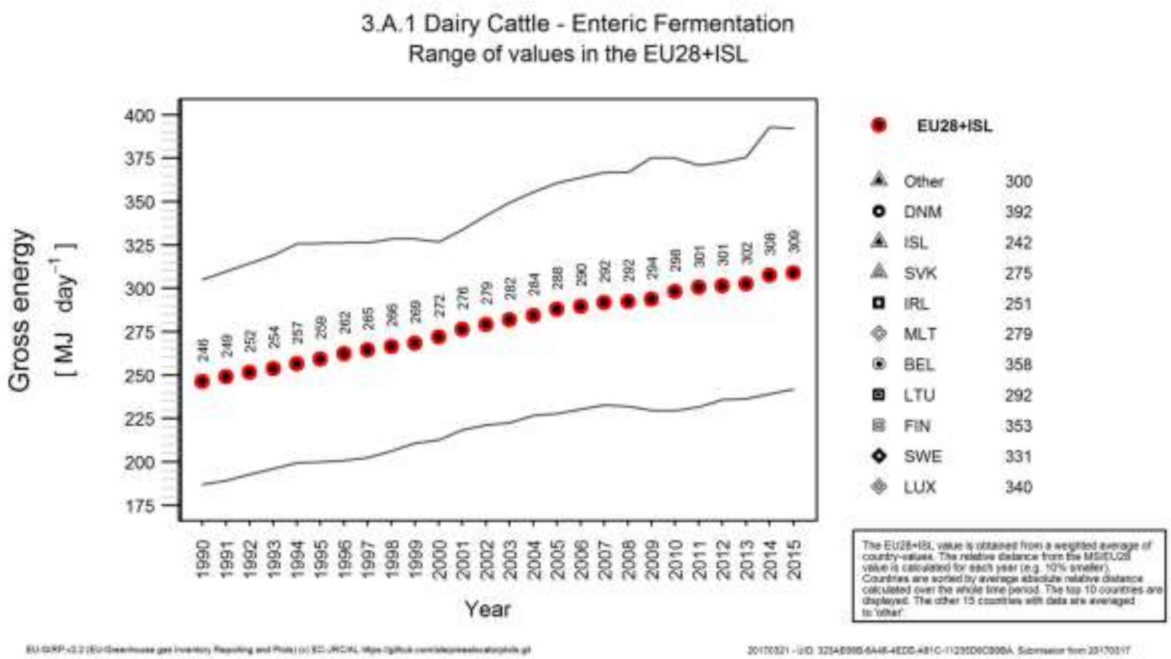


Table 5.7 3.A.1 - Dairy Cattle: Member States' and EU28+ISL gross energy (MJ/day)

Member State	1990	2015		Member State	1990	2015
Austria	247	306	|	Iceland	200	242
Belgium	279	358	|	Italy	261	329
Cyprus	232	270	|	Lithuania	234	292
Germany	260	328	|	Luxembourg	280	340
Denmark	305	392	|	Latvia	242	311

Member State	1990	2015		Member State	1990	2015
Estonia	237	339	|	Malta	210	279
Spain	225	313	|	Poland	254	287
Finland	264	353	|	Portugal	227	309
United Kingdom	236	300	|	Romania	210	271
Greece	217	278	|	Sweden	271	331
Croatia	256	274	|	Slovenia	215	282
Hungary	255	308	|	Slovakia	187	275
Ireland	222	251	|	**EU28+ISL**	**246**	**309**

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 2015 by 69.1% or 7.71 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 5.8 shows the milk yield in source category *3.A.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The reported milk yield increased in all reporting 27 countries. The four countries with the largest increases were Romania, Slovakia, Spain and Croatia 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

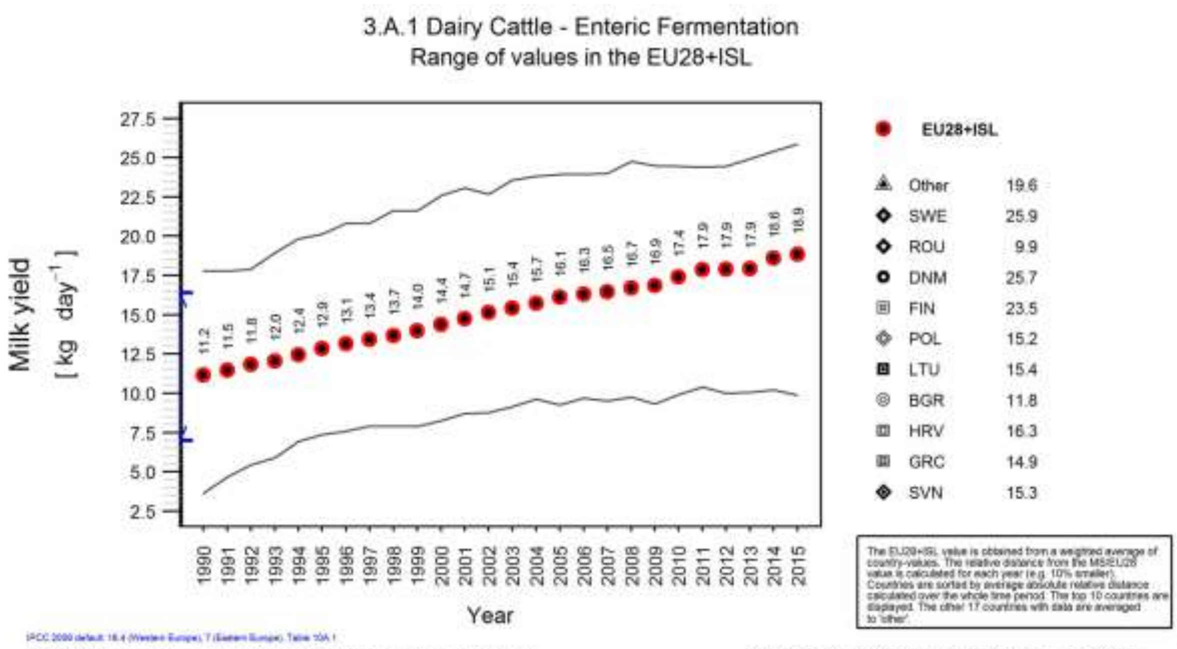


Table 5.8 3.A.1 - Dairy Cattle: Member States' and EU28+ISL milk yield (kg/head/day)

Member State	1990	2015		Member State	1990	2015
Austria	10.4	18.0	|	Ireland	11.5	15.0
Belgium	11.2	21.4	|	Iceland	11.3	16.0
Bulgaria	11.1	11.8	|	Italy	11.5	19.1
Cyprus	12.2	17.1	|	Lithuania	10.2	15.4
Czech Republic	10.7	21.9	|	Luxembourg		
Germany	12.9	20.9	|	Latvia	11.3	19.4
Denmark	16.5	25.7	|	Malta	14.9	17.9
Estonia	11.4	23.1	|	Poland	8.9	15.2
Spain	9.9	21.9	|	Portugal	12.2	22.7
Finland	15.7	23.5	|	Romania	3.6	9.9
France	13.1	19.3	|	Sweden	17.8	25.9
United Kingdom	13.9	21.1	|	Slovenia	7.6	15.3
Greece	7.6	14.9	|	Slovakia	7.0	17.8
Croatia	7.8	16.3	|	**EU28+ISL**	**11.2**	**18.9**
Hungary	13.8	21.1	|			

Note that the Netherlands does not report milk yield in their CRF, but such data are available in their NIR (see also Annex III).

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 2015 by 3.5% or 1.74 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 5.9 shows the implied emission factor for CH_4 emissions in source category *3.A.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in seven countries and increased in 21 countries. The three countries with the largest decreases were Croatia, Ireland and the Netherlands with a mean absolute value of 2 kg/head/year. The largest increases occurred in Finland and Latvia with a mean absolute value of 12 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

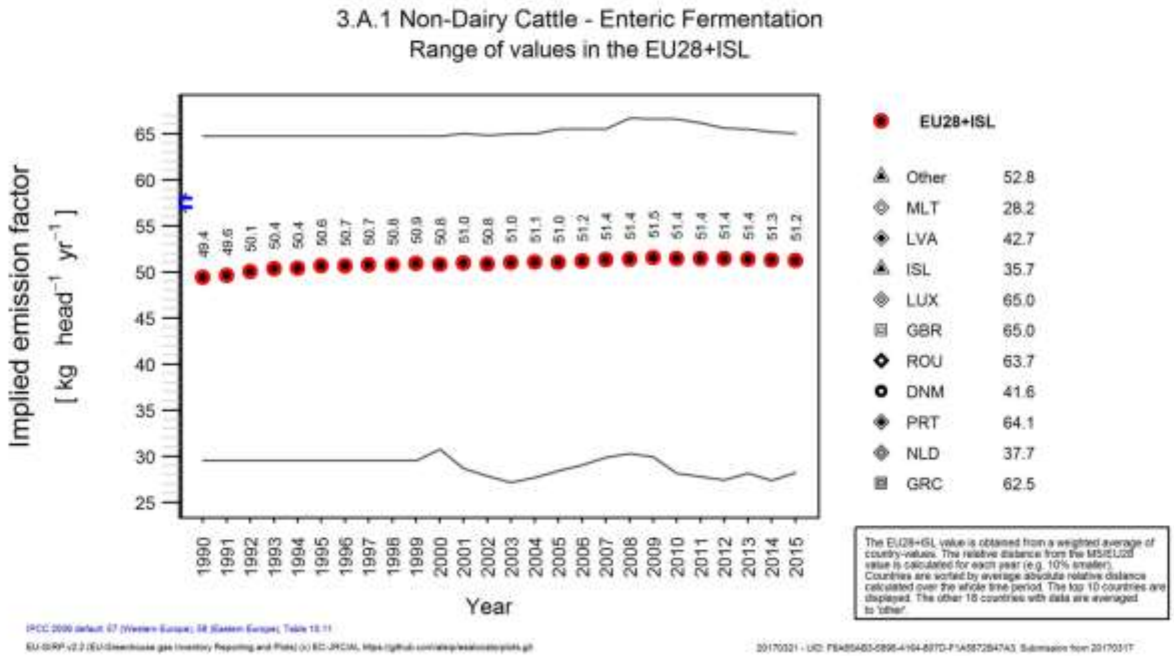


Table 5.9 3.A.1 - Non-Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	52	60	|	Ireland	49	46
Belgium	46	51	|	Iceland	32	36
Bulgaria	55	62	|	Italy	46	47
Cyprus	57	57	|	Lithuania	53	56
Czech Republic	44	55	|	Luxembourg	63	65
Germany	43	43	|	Latvia	33	43
Denmark	34	42	|	Malta	30	28
Estonia	41	44	|	Netherlands	40	38
Spain	53	52	|	Poland	57	56
Finland	39	54	|	Portugal	62	64
France	49	51	|	Romania	65	64
United Kingdom	63	65	|	Sweden	45	49
Greece	57	62	|	Slovenia	50	60
Croatia	54	51	|	Slovakia	53	57
Hungary	53	56	|	**EU28+ISL**	**50**	**52**

3.A.1 - Non-Dairy Cattle - Average gross energy intake

The average gross energy intake, a parameter used for calculating CH_4 emissions in source category *3.A.1 - Non-Dairy Cattle*, increased in EU28+ISL slightly between 1990 and 2015 by 2.5% or 3.08 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 5.10 shows the average gross energy intake in source category *3.A.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. Average gross energy intake decreased in six countries and increased in nineteen countries. It was in 2015 at the level of 1990 in one country. No data were available for Cyprus and the United Kingdom. The three countries with the largest decreases were Malta, Ireland and the Netherlands with a mean absolute value of 4 MJ/head/day. The largest increase occurred in Finland with an absolute value of 34 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

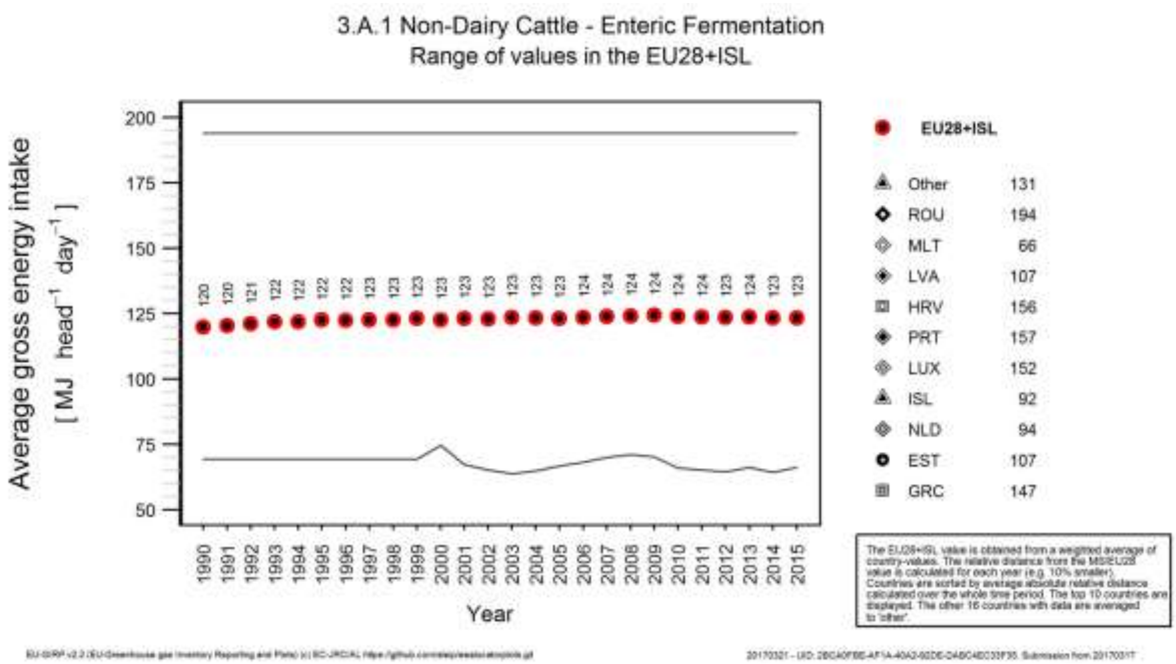


Table 5.10 3.A.1 - Non-Dairy Cattle: Member States' and EU28+ISL average gross energy intake (MJ/head/day)

Member State	1990	2015		Member State	1990	2015
Austria	123	141	|	Iceland	85	92
Belgium	119	131	|	Italy	141	140
Bulgaria	129	146	|	Lithuania	125	128
Czech Republic	104	130	|	Luxembourg	146	152
Germany	103	104	|	Latvia	86	107
Denmark	107	130	|	Malta	69	66
Estonia	99	107	|	Netherlands	98	94
Spain	124	121	|	Poland	133	131
Finland	92	126	|	Portugal	151	157
France	116	120	|	Romania	194	194
Greece	135	147	|	Sweden	129	138
Croatia	155	156	|	Slovenia	111	133
Hungary	134	138	|	Slovakia	125	137

Member State	1990	2015		Member State	1990	2015
Ireland	132	126	|	**EU28+ISL**	**121**	**124**

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 2015 by 0.41% or 0.0343 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 5.11 shows the implied emission factor for CH_4 emissions in source category *3.A.2 - Sheep* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in eleven countries and increased in eleven countries. It was in 2015 at the level of 1990 in seven countries. The three countries with the largest decreases were Slovakia, Portugal and Ireland with a mean absolute value of 1 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

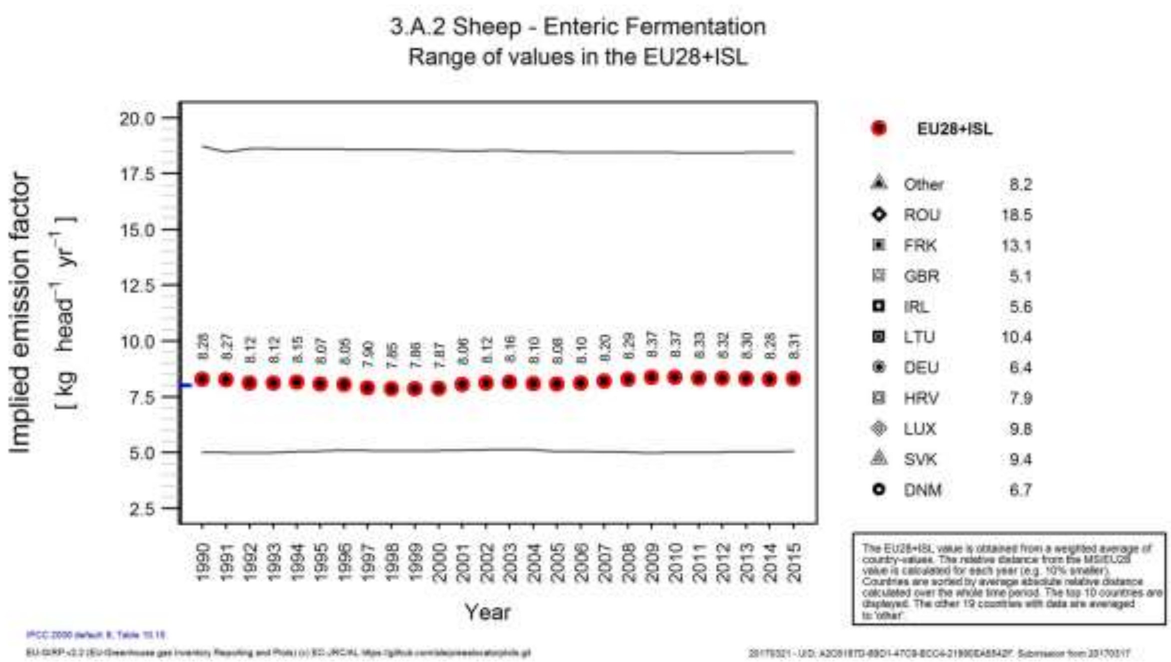


Table 5.11 3.A.2 - Sheep: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	8.0	8.0	|	Ireland	5.9	5.6
Belgium	8.0	8.0	|	Iceland	8.4	8.4
Bulgaria	6.9	7.2	|	Italy	6.9	7.4
Cyprus	8.0	8.0	|	Lithuania	10.3	10.4
Czech Republic	8.0	8.0	|	Luxembourg	9.8	9.8
Germany	6.3	6.4	|	Latvia	8.0	8.0
Denmark	6.7	6.7	|	Malta	9.9	9.9

Member State	1990	2015		Member State	1990	2015
Estonia	8.0	8.0	|	Netherlands	8.0	8.0
Spain	7.8	7.6	|	Poland	8.0	8.0
Finland	6.8	8.4	|	Portugal	9.7	9.1
France	12.6	13.1	|	Romania	18.7	18.5
United Kingdom	5.0	5.1	|	Sweden	8.0	8.0
Greece	9.5	9.5	|	Slovenia	8.0	8.0
Croatia	5.0	7.9	|	Slovakia	10.3	9.4
Hungary	8.0	8.0	|	**EU28+ISL**	**8.3**	**8.3**

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 2015 by 2.2% or 0.537 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 5.12 shows the average gross energy intake in source category *3.A.2 - Sheep* for the years 1990 and 2015 for all Member States and EU28+ISL. Average gross energy intake decreased in seven countries and increased in three countries. It was in 2015 at the level of 1990 in four countries. No data were available for fifteen countries (Austria, Belgium, Cyprus, Czech Republic, Germany, Estonia, Finland, France, the United Kingdom, Croatia, Hungary, Latvia, the Netherlands, Poland and Slovenia). The three countries with the largest decreases were Denmark, Slovakia and Portugal with a mean absolute value of 2 MJ/head/day. Increases occurred in Italy, Bulgaria and Lithuania with a mean absolute value of 1 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

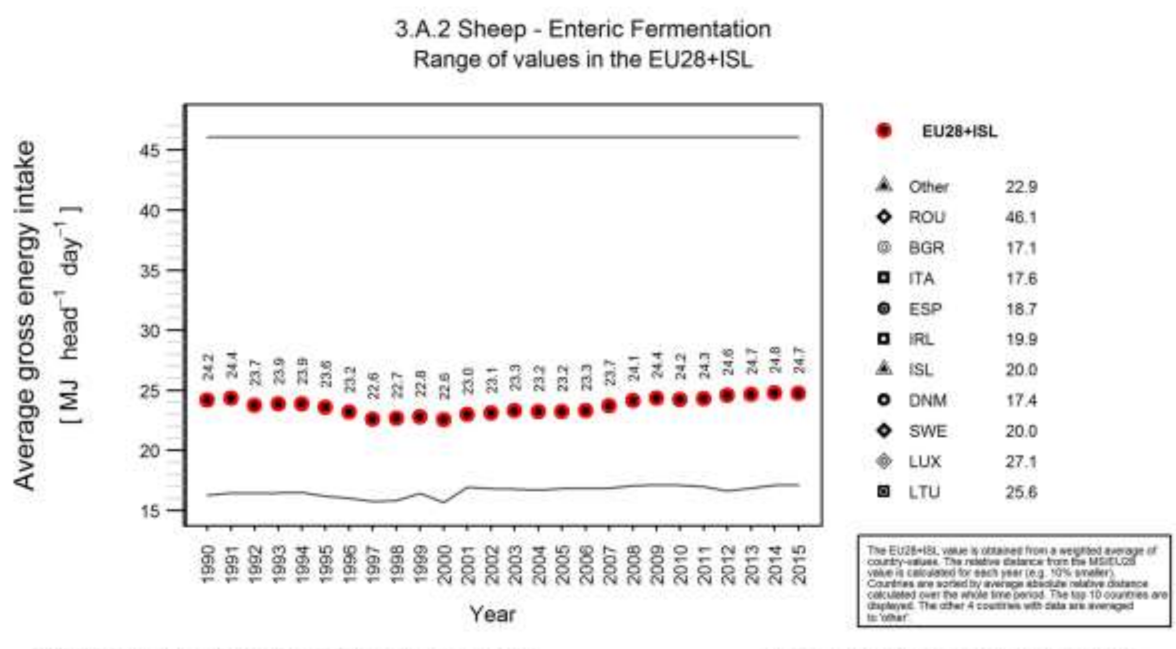


Table 5.12 3.A.2 - Sheep: Member States' and EU28+ISL average gross energy intake (MJ/head/day)

Member State	1990	2015	Member State	1990	2015
Bulgaria	17	17	Luxembourg	27	27
Denmark	20	17	Malta	24	23
Spain	19	19	Portugal	23	22
Greece	23	23	Romania	46	46
Ireland	20	20	Sweden	20	20
Iceland	20	20	Slovakia	25	23
Italy	16	18	**EU28+ISL**	**24**	**25**
Lithuania	26	26			

5.2.2 Manure Management - CH_4 (CRF Source Category 3B1)

CH_4 emissions in source category *3.B.1 - Manure Management* are 0.93% of total EU28+ISL GHG emissions and 8.8% of total EU28+ISL CH_4 emissions. They make 10.3% of total agricultural emissions and 19% of total agricultural CH_4 emissions. The main sub-categories are 3.B.1.3 (Swine), 3.B.1.1.1 (Dairy Cattle) and 3.B.1.1.2 (Non-Dairy Cattle) as shown in Figure 5.20. Emissions are also reported for 3.B.1.4 (Other Livestock and 3.B.1.2 (Sheep). CH_4 emissions from Manure Management for 'Other Livestock' are reported for the categories Buffalo, Deer, Goats, Horses, Mules and Asses, Poultry, and Other Other Livestock. 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 2015.

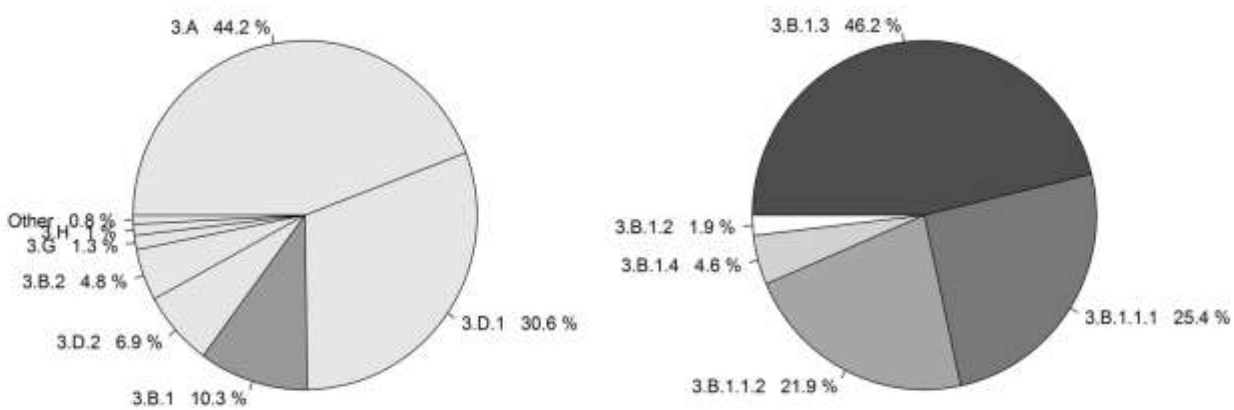
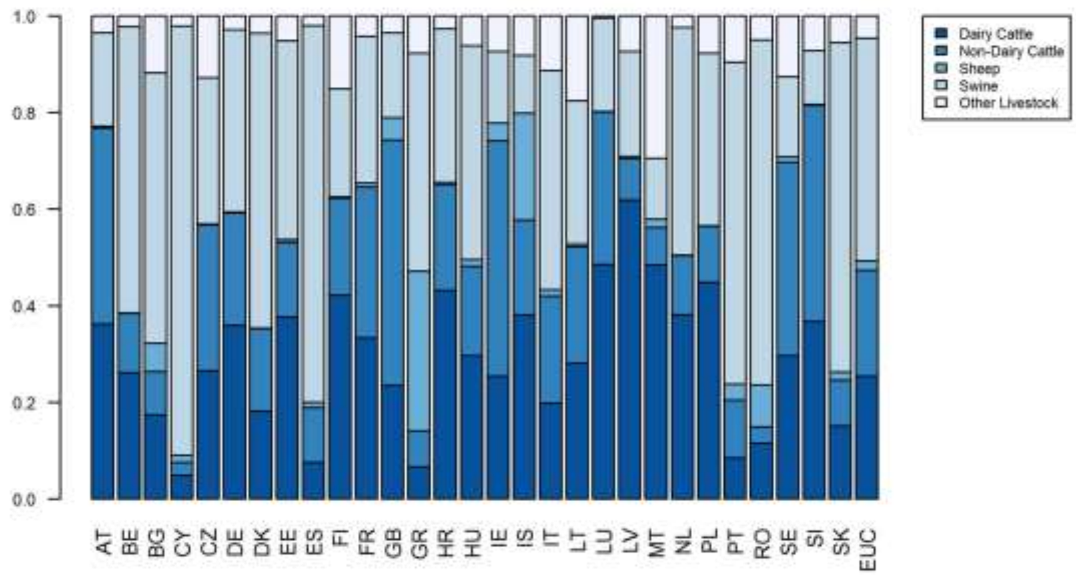


Figure 5.21: Decomposition of emissions in source category 3.B.1 - Manure Management into its sub-categories by Member State in the year 2015.



Total GHG and CH_4 emissions by Member State from 3.B.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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, CH_4 emission in this source category decreased by 17% or 9.4 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (83%) and in Romania in absolute terms (2.9 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 0.9%.

Table 5.13   3.B.1 - Manure Management: Member States' contributions to total GHG and CH_4 emissions

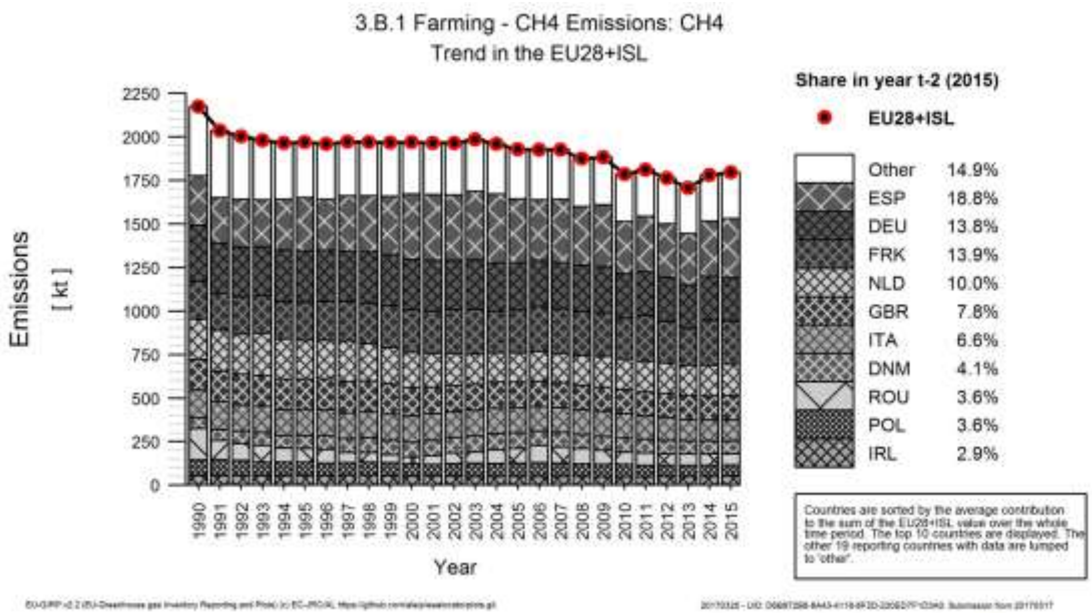
Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	587	438	587	438
Belgium	1 296	1 255	1 296	1 255
Bulgaria	715	119	715	119
Croatia	328	344	328	344
Cyprus	111	137	111	137
Czech Republic	1 752	771	1 752	771
Denmark	1 544	1 854	1 544	1 854
Estonia	147	78	147	78
Finland	370	464	370	464
France	5 392	6 219	5 392	6 219
Germany	8 073	6 201	8 073	6 201
Greece	774	661	774	661
Hungary	1 161	667	1 161	667
Ireland	1 342	1 285	1 342	1 285
Italy	3 934	2 978	3 934	2 978
Latvia	190	101	190	101
Lithuania	622	267	622	267
Luxembourg	52	64	52	64
Malta	5	4	5	4
Netherlands	5 811	4 486	5 811	4 486
Poland	2 274	1 619	2 274	1 619
Portugal	674	591	674	591
Romania	4 506	1 604	4 506	1 604
Slovakia	547	156	547	156
Slovenia	342	248	342	248
Spain	7 062	8 462	7 062	8 462
Sweden	245	256	245	256
United Kingdom	4 445	3 517	4 445	3 517
EU-28	**54 297**	**44 848**	**54 297**	**44 848**
Iceland	51	52	51	52
United Kingdom (KP)	4 445	3 517	4 445	3 517
EU-28 + ISL	**54 348**	**44 900**	**54 348**	**44 900**

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 17% or 9.4 Mt CO_2-eq in the period 1990 to 2015. 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 85.1% of the total. Emissions decreased in twenty countries and increased in nine countries. The three countries with the largest decreases were Romania, Germany and the Netherlands with a total absolute decrease of 6.1 Mt CO_2-eq. The three countries with the largest increases were Denmark, France and Spain, with a total absolute increase of 2.5 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 2015



3.B.1.1 - Cattle - Emissions

CH_4 emissions in source category *3.B.1.1 - Cattle* are 0.44% of total EU28+ISL GHG emissions and 4.2% of total EU28+ISL CH_4 emissions. They make 4.9% of total agricultural emissions and 8.8% of total agricultural CH_4 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 5.14 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, CH_4 emission in this source category decreased by 13% or 3.2 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (64%) and in Germany in absolute terms (1.6 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 0.5%. The ten countries with the highest emissions accounted together for 86.6% of the total. Emissions decreased in seventeen countries and increased in twelve countries. The largest decreases occurred in Germany and Italy with a total absolute decrease of 2.3 Mt CO_2-eq. The largest increases occurred in the Netherlands and France, with a total absolute increase of 1.1 Mt CO_2-eq.

Table 5.14 3.B.1.1 - Cattle: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	424	338	336	1.6%	-1	0%	-88	-21%	T2	CS
Belgium	485	474	482	2.3%	8	2%	-3	-1%	-	-
Bulgaria	87	32	31	0.1%	-1	-3%	-56	-64%	T2	CS
Croatia	209	218	224	1.1%	6	3%	14	7%	T2	CS
Cyprus	10	10	10	0.0%	0	1%	1	8%	T2	D
Czech Republic	892	426	438	2.1%	12	3%	-454	-51%	T1,T2	CS
Denmark	579	660	654	3.1%	-6	-1%	74	13%	CS,T2	CS,D
Estonia	44	43	41	0.2%	-2	-4%	-2	-5%	T2	CS,D
Finland	234	283	289	1.4%	6	2%	55	24%	T2	CS
France	3 357	4 141	4 012	18.9%	-128	-3%	655	20%	T2	CS
Germany	5 250	3 692	3 671	17.3%	-21	-1%	-1 578	-30%	T2	CS
Greece	95	93	93	0.4%	0	0%	-2	-2%	T2	CS,D
Hungary	566	314	321	1.5%	8	2%	-245	-43%	T2	CS
Ireland	1 039	925	953	4.5%	27	3%	-86	-8%	T2	CS
Italy	1 947	1 237	1 250	5.9%	13	1%	-697	-36%	T2	CS
Latvia	111	68	71	0.3%	4	5%	-40	-36%	T2	CS
Lithuania	250	135	139	0.7%	4	3%	-111	-44%	T2	CS
Luxembourg	41	50	51	0.2%	2	3%	10	26%	T2	CS
Malta	2	2	2	0.0%	0	-2%	0	7%	T2	CS
Netherlands	1 823	2 170	2 260	10.6%	90	4%	437	24%	T2	CS
Poland	1 149	904	914	4.3%	11	1%	-235	-20%	T2	CS
Portugal	102	120	121	0.6%	1	1%	19	19%	T2	CS
Romania	602	237	240	1.1%	3	1%	-363	-60%	T2	CS
Slovakia	99	39	38	0.2%	0	-1%	-60	-61%	T2	CS
Slovenia	176	196	202	1.0%	6	3%	27	15%	T2	CS
Spain	1 691	1 544	1 593	7.5%	49	3%	-98	-6%	CS,T2	CS,D
Sweden	156	180	178	0.8%	-2	-1%	22	14%	T2	CS
United Kingdom	3 051	2 587	2 612	12.3%	25	1%	-438	-14%	T2	CS,D
EU-28	**24 471**	**21 118**	**21 229**	**100%**	**111**	**1%**	**-3 242**	**-13%**	**-**	**-**
Iceland	29	28	30	0.1%	2	7%	2	5%	-	-
United Kingdom (KP)	3 051	2 587	2 612	12.3%	25	1%	-438	-14%	T2	CS,D
EU-28 + ISL	**24 499**	**21 146**	**21 259**	**100%**	**113**	**1%**	**-3 240**	**-13%**	**-**	**-**

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 2015

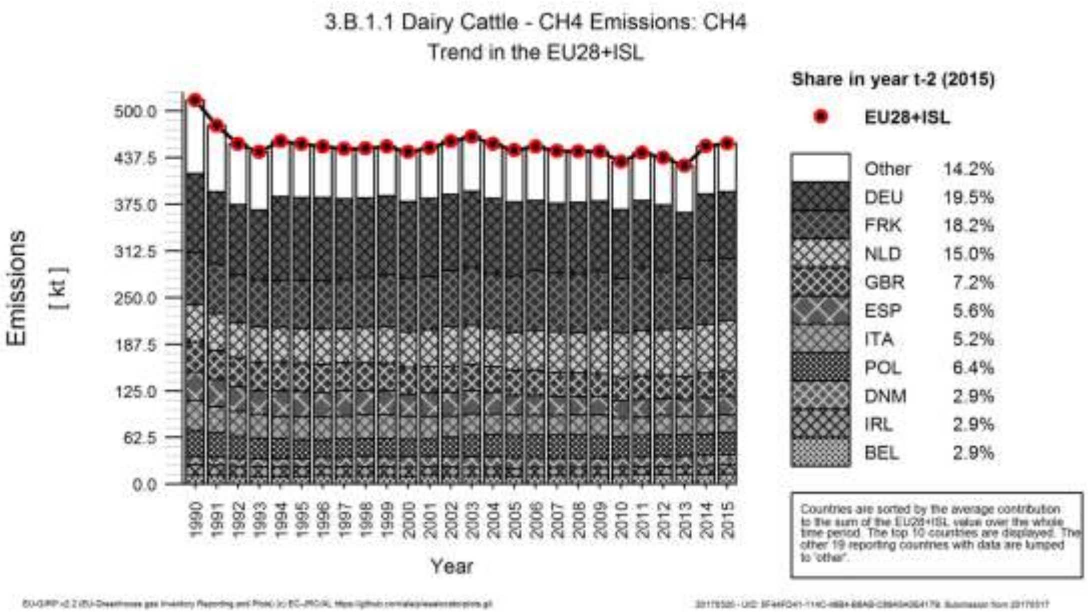
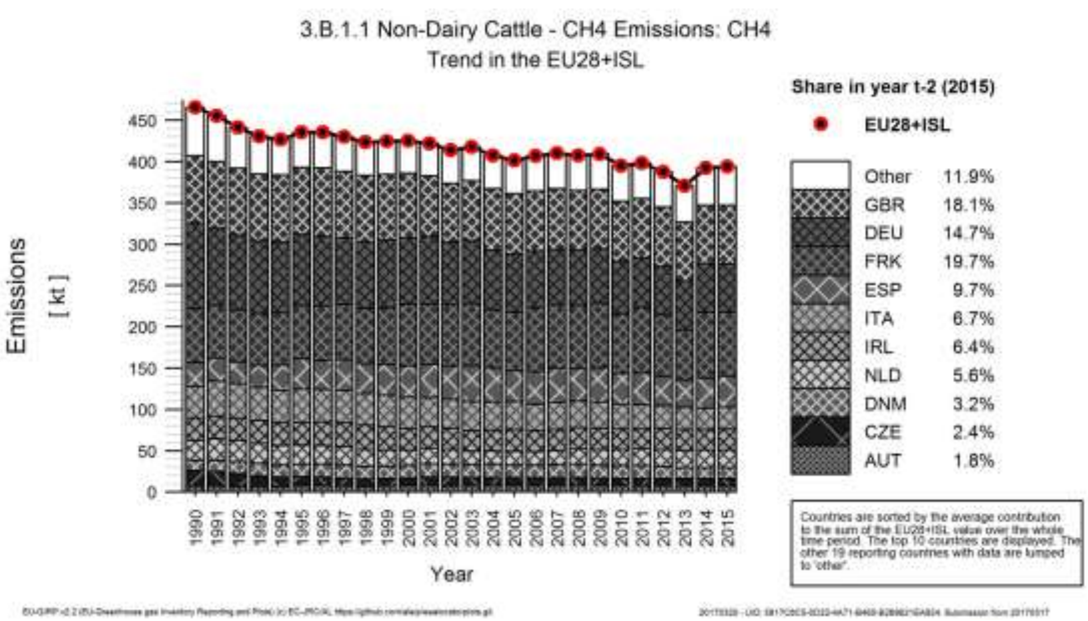


Figure 5.24: 3.B.1.1: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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

CH_4 emissions in source category *3.B.1.3 - Swine* are 0.43% of total EU28+ISL GHG emissions and 4.1% of total EU28+ISL CH_4 emissions. They make 4.7% of total agricultural emissions and 8.6% of total agricultural CH_4 emissions..

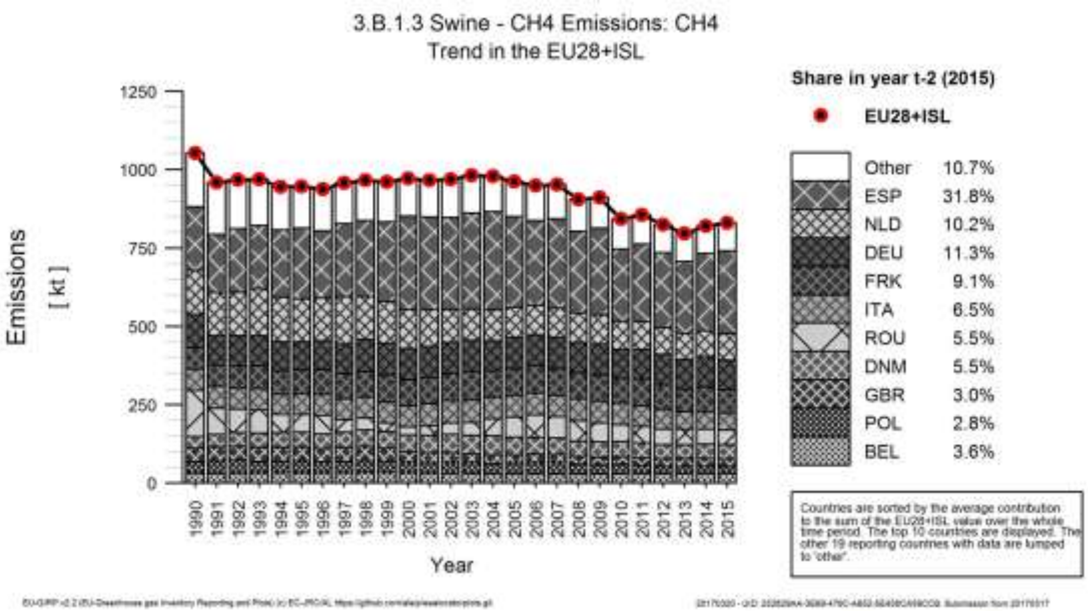
Total GHG and CH_4 emissions by Member State from 3.B.1.3 *Manure Management* are shown in Table 5.15 by Member State plus Iceland, and the total EU-28 and EU-28+ISL for the first and the last year of the inventory (1990 and 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, CH_4 emission in this source category decreased by 21% or 5.6 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (88%) and in Romania in absolute terms (2.5 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 1.1%. 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 89.3% of the total. Emissions decreased in twenty countries and increased in nine countries. The largest decreases occurred in Romania and the Netherlands with a total absolute decrease of 3.9 Mt CO_2-eq. The largest increases occurred in Denmark and Spain, with a total absolute increase of 1.7 Mt CO_2-eq.

Table 5.15 3.B.1.3 - Swine: Member States' contributions to total GHG and CH_4 emissions

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	85	85	0.4%	0	0%	-64	-43%	T1	D
Belgium	793	755	745	3.6%	-10	-1%	-48	-6%	-	-
Bulgaria	543	64	67	0.3%	2	4%	-477	-88%	T2	CS
Croatia	90	96	109	0.5%	13	14%	19	21%	T2	CS
Cyprus	96	117	122	0.6%	5	4%	26	27%	T1	D
Czech Republic	718	243	234	1.1%	-9	-4%	-485	-67%	T1	D
Denmark	920	1 150	1 132	5.5%	-18	-2%	212	23%	CS,T2	CS,D
Estonia	94	38	32	0.2%	-6	-15%	-62	-66%	T2	CS,D
Finland	68	104	104	0.5%	0	0%	37	54%	T2	CS
France	1 696	2 033	1 891	9.1%	-142	-7%	195	11%	T2	CS
Germany	2 685	2 415	2 342	11.3%	-73	-3%	-343	-13%	T2	CS,D
Greece	398	301	298	1.4%	-3	-1%	-100	-25%	T1	D
Hungary	500	290	295	1.4%	6	2%	-204	-41%	T2	CS
Ireland	160	193	190	0.9%	-4	-2%	29	18%	T2	CS,D
Italy	1 705	1 329	1 352	6.5%	23	2%	-353	-21%	T2	CS
Latvia	65	21	22	0.1%	1	7%	-43	-66%	T2	CS
Lithuania	287	83	79	0.4%	-4	-5%	-208	-73%	T2	CS
Luxembourg	11	11	12	0.1%	1	9%	2	14%	T2	CS
Malta	1	1	1	0.0%	0	-8%	-1	-57%	T2	CS,D
Netherlands	3 489	2 072	2 113	10.2%	41	2%	-1 377	-39%	T2	CS
Poland	913	585	579	2.8%	-6	-1%	-334	-37%	T1	CS
Portugal	463	381	394	1.9%	13	3%	-68	-15%	T2	CS
Romania	3 661	1 190	1 146	5.5%	-44	-4%	-2 515	-69%	T2	CS
Slovakia	432	109	106	0.5%	-3	-3%	-326	-75%	T1	0
Slovenia	132	29	28	0.1%	-1	-3%	-105	-79%	T1	D
Spain	5 094	6 140	6 600	31.8%	459	7%	1 506	30%	CS,T2	CS,D
Sweden	59	44	42	0.2%	-1	-3%	-17	-28%	T2	CS
United Kingdom	1 090	627	617	3.0%	-10	-2%	-474	-43%	T2	CS,D
EU-28	**26 312**	**20 506**	**20 737**	**100%**	**231**	**1%**	**-5 576**	**-21%**	**-**	**-**
Iceland	5	6	6	0.0%	1	14%	2	39%	-	-
United Kingdom (KP)	1 090	627	617	3.0%	-10	-2%	-474	-43%	T2	CS,D
EU-28 + ISL	**26 317**	**20 511**	**20 743**	**100%**	**232**	**1%**	**-5 574**	**-21%**	**-**	**-**

Note that some member states are using Tier 1 and default emission factors for 3.B.1.3 category. Although this is a key category for the EU, is not a key category for all member states. For those countries using Tier 1, source category 3.B.1.3 is not a key category.

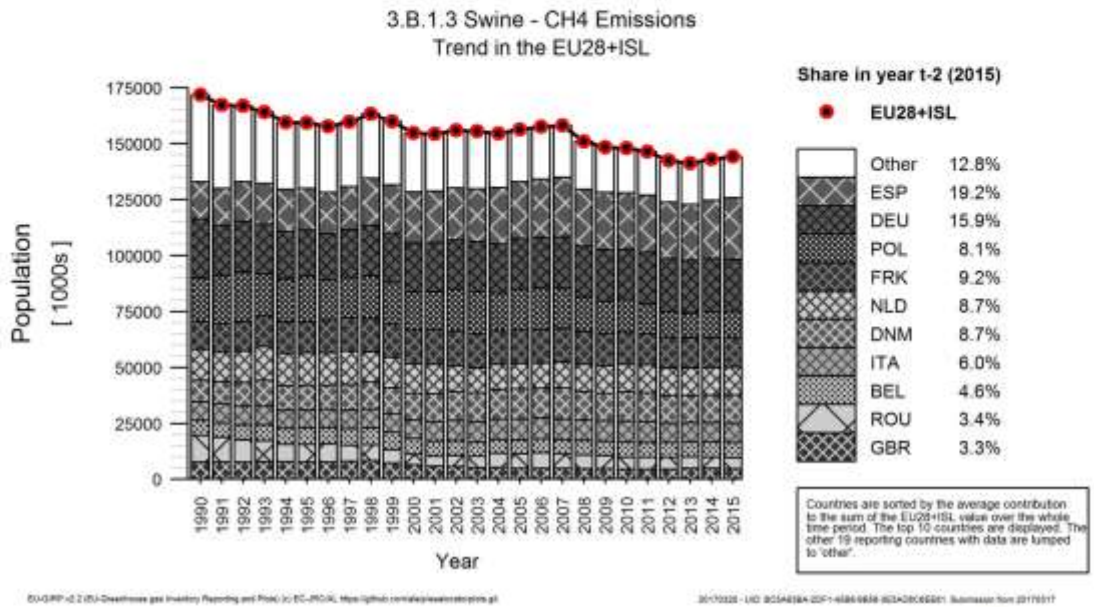
Figure 5.25: 3.B.1.3: Trend in swine emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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 16% or 27.7 million heads in the period 1990 to 2015. 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 87.2% 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 20.5 million heads. The largest increases occurred in Denmark and Spain, with a total absolute increase of 14.3 million 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 2015



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 2015 by 16.9% or 1.37 kg/head/year. Table 5.16 shows the implied emission factor for CH_4 emissions in source category *3.B.1.1 - Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in three countries and increased in 25 countries. Decreases occurred in Spain, Italy and Ireland with a mean absolute value of 2 kg/head/year. The four countries with the largest increases were Estonia, Latvia, Croatia and Finland with a mean absolute value of 6 kg/head/year.

Table 5.16 3.B.1.1 - Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	6.6	6.9	|	Ireland	6.1	5.5
Belgium	6.0	7.5	|	Iceland	15.2	15.2
Bulgaria	2.2	2.3	|	Italy	10.0	8.6
Cyprus	7.0	7.0	|	Lithuania	4.2	7.5
Czech Republic	10.2	12.4	|	Luxembourg	7.4	10.2
Germany	10.8	11.6	|	Latvia	3.1	6.8
Denmark	10.4	16.8	|	Malta	4.1	6.1
Estonia	2.3	6.5	|	Netherlands	14.8	21.9

Member State	1990	2015		Member State	1990	2015
Spain	13.3	10.3	|	Poland	4.6	6.1
Finland	6.9	12.6	|	Portugal	3.0	3.1
France	6.2	8.3	|	Romania	4.5	4.6
United Kingdom	10.0	10.5	|	Sweden	3.6	4.8
Greece	5.5	5.5	|	Slovenia	13.2	16.7
Croatia	9.8	18.7	|	Slovakia	2.5	3.3
Hungary	14.0	15.8	|	**EU28+ISL**	**8.1**	**9.4**

3.B.1.1 - Dairy Cattle - Implied emission factor

The implied emission factor for CH_4 emissions in source category *3.B.1.1 - Dairy Cattle* increased in EU28+ISL strongly between 1990 and 2015 by 48.2% or 6.29 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 5.17 shows the implied emission factor for CH_4 emissions in source category *3.B.1.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in four countries and increased in 25 countries. The three countries with the largest decreases were Italy, Bulgaria and Ireland with a mean absolute value of 1 kg/head/year. The four countries with the largest increases were Estonia, Croatia, Latvia and Finland with a mean absolute value of 14 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

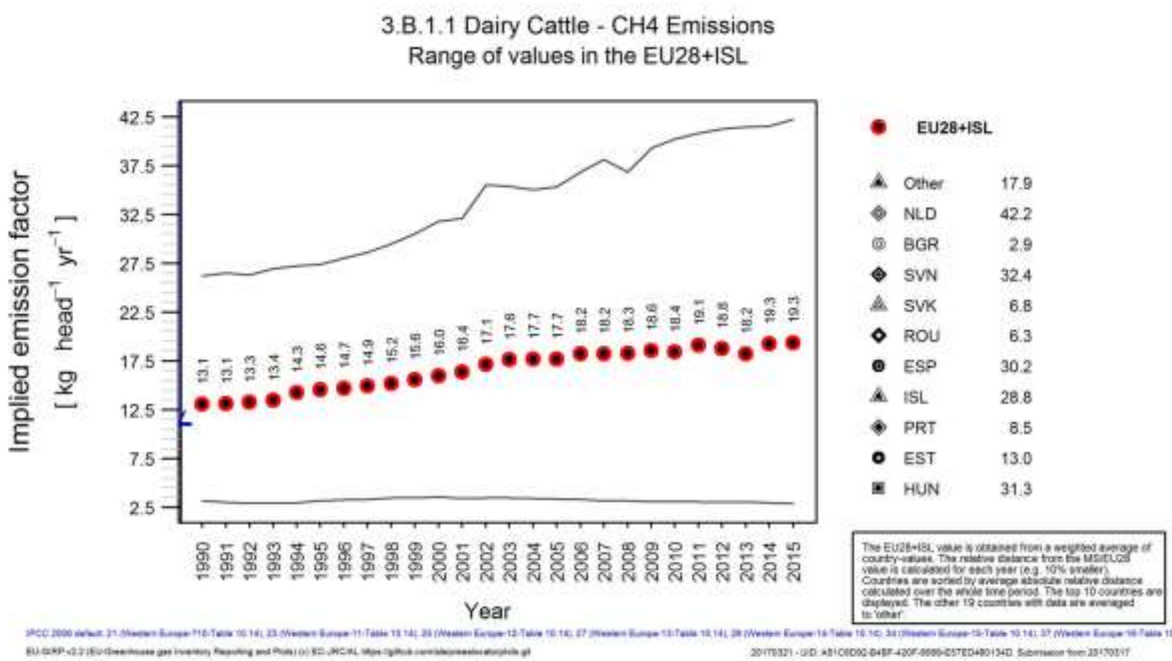


Table 5.17 3.B.1.1 - Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	11.1	11.9	|	Ireland	10.6	10.3
Belgium	14.1	29.1	|	Iceland	24.5	28.8
Bulgaria	3.2	2.9	|	Italy	15.0	12.9
Cyprus	10.6	10.3	|	Lithuania	6.0	9.7
Czech Republic	13.9	21.8	|	Luxembourg	14.5	26.6
Germany	16.7	20.8	|	Latvia	6.4	15.4
Denmark	14.0	24.0	|	Malta	7.6	12.3
Estonia	4.0	13.0	|	Netherlands	26.2	42.2
Spain	23.7	30.2	|	Poland	7.3	11.9
Finland	12.5	27.5	|	Portugal	4.8	8.5
France	13.2	22.6	|	Romania	5.8	6.3
United Kingdom	14.2	17.4	|	Sweden	6.6	9.0
Greece	10.4	13.2	|	Slovenia	21.0	32.4
Croatia	12.2	34.0	|	Slovakia	4.7	6.8
Hungary	24.6	31.3	|	**EU28+ISL**	**13.1**	**19.4**

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 2015 by 4% or 23.7 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 5.18 shows the typical animal mass in source category *3.B.1.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. Typical animal mass decreased in two countries and increased in eleven countries. It was in 2015 at the level of 1990 in fifteen countries. No data were available for the Netherlands. A decrease occurred in France. The largest increase occurred in Finland with an absolute value of 133 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

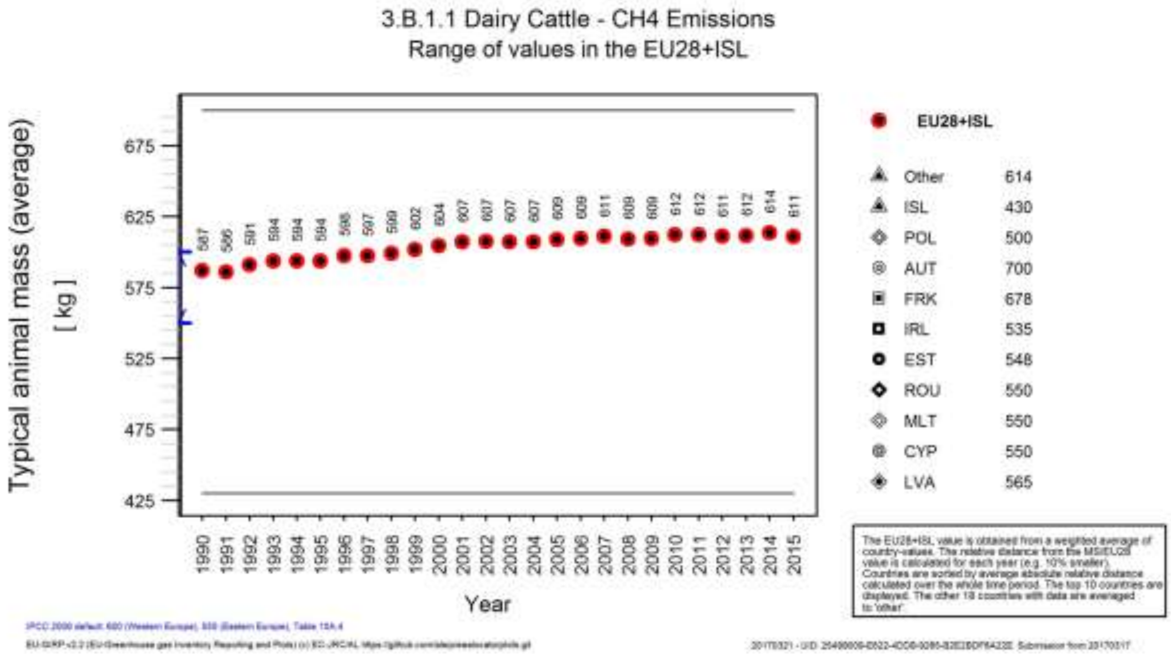


Table 5.18 3.B.1.1 - Dairy Cattle: Member States' and EU28+ISL typical animal mass (kg)

Member State	1990	2015		Member State	1990	2015
Austria	700	700	|	Ireland	535	535
Belgium	600	600	|	Iceland	430	430
Bulgaria	588	588	|	Italy	603	603
Cyprus	550	550	|	Lithuania	575	622
Czech Republic	520	590	|	Luxembourg	650	650
Germany	608	650	|	Latvia	550	565
Denmark	550	580	|	Malta	550	550
Estonia	545	548	|	Poland	500	500
Spain	598	647	|	Portugal	600	600
Finland	520	653	|	Romania	550	550
France	685	678	|	Sweden	650	650
United Kingdom	561	608	|	Slovenia	510	604
Greece	600	600	|	Slovakia	598	598
Croatia	563	563	|	**EU28+ISL**	**587**	**611**
Hungary	633	642	|			

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 2015 by 13.9% or 0.592 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 5.19 shows the VS daily excretion in source category *3.B.1.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The reported vs daily excretion in 2015 was at the level of 1990 in three countries and increased in all reporting other 26 countries. The four countries with the largest increases were Malta, Czech Republic, Slovakia and Estonia 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

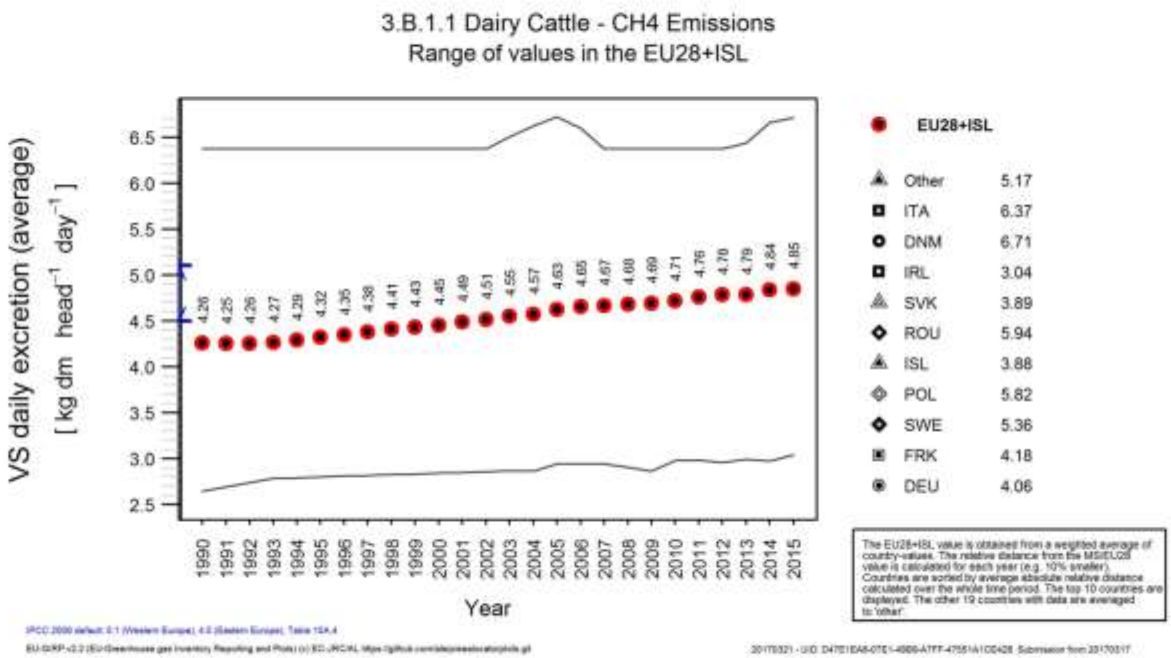


Table 5.19 3.B.1.1 - Dairy Cattle: Member States' and EU28+ISL VS daily excretion (kg dm/head/day)

Member State	1990	2015		Member State	1990	2015
Austria	4.5	4.9	|	Ireland	2.8	3.0
Belgium	4.0	5.1	|	Iceland	3.2	3.9
Bulgaria	4.0	4.1	|	Italy	6.4	6.4
Cyprus	4.5	4.5	|	Lithuania	4.5	5.7
Czech Republic	4.2	6.2	|	Luxembourg	4.8	5.8
Germany	3.5	4.1	|	Latvia	4.7	5.7
Denmark	5.7	6.7	|	Malta	3.3	5.3
Estonia	4.4	6.3	|	Netherlands	3.8	4.7
Spain	3.9	5.3	|	Poland	5.7	5.8
Finland	4.5	6.0	|	Portugal	3.5	4.8

Member State	1990	2015		Member State	1990	2015
France	3.5	4.2	|	Romania	4.6	5.9
United Kingdom	3.5	4.4	|	Sweden	5.1	5.4
Greece	3.7	4.7	|	Slovenia	4.5	5.2
Croatia	4.5	4.5	|	Slovakia	2.6	3.9
Hungary	4.4	5.2	|	**EU28+ISL**	**4.3**	**4.8**

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 2015 by 4% or 0.228 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 5.20 shows the implied emission factor for CH_4 emissions in source category *3.B.1.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in ten countries and increased in eighteen countries. The three countries with the largest decreases were Spain, Romania and Germany with a mean absolute value of 1 kg/head/year. The four countries with the largest increases were Estonia, Lithuania, Sweden and Finland with a mean absolute value of 2 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

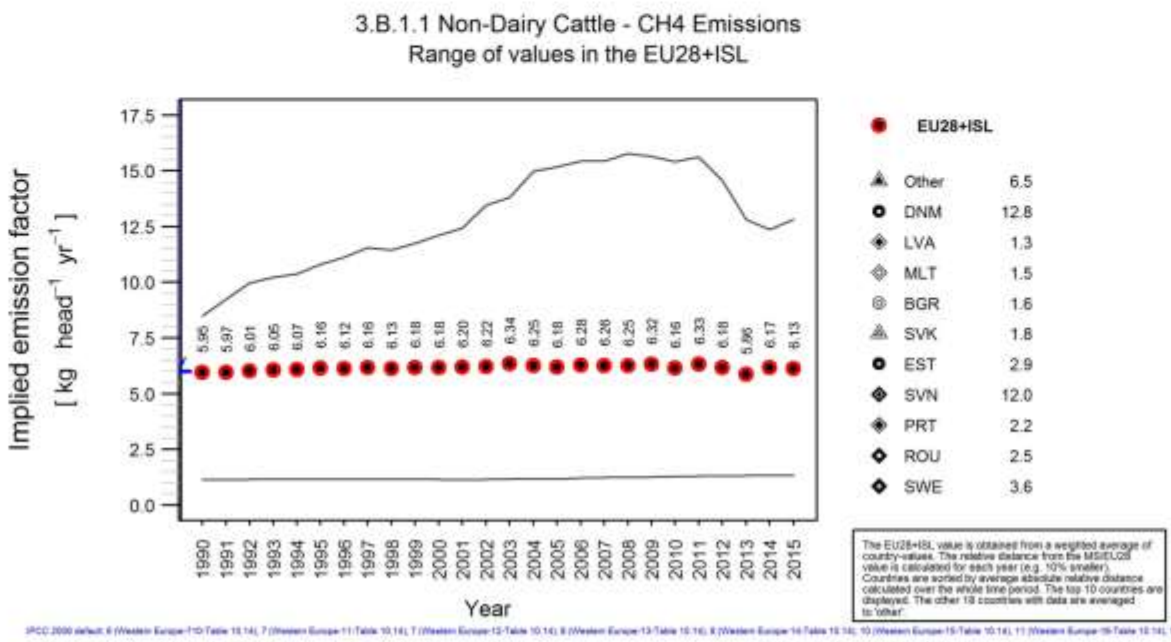


Table 5.20 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	4.1	5.0	|	Ireland	5.0	4.4
Belgium	3.1	2.9	|	Iceland	8.2	8.0
Bulgaria	1.6	1.6	|	Italy	7.5	6.7
Cyprus	4.5	4.4	|	Lithuania	3.2	5.9
Czech Republic	8.2	9.0	|	Luxembourg	4.9	5.3
Germany	7.9	6.9	|	Latvia	1.1	1.3
Denmark	8.5	12.8	|	Malta	1.5	1.5
Estonia	1.3	2.9	|	Netherlands	7.8	8.7
Spain	8.5	7.1	|	Poland	2.0	2.1
Finland	3.7	5.9	|	Portugal	2.2	2.2
France	4.0	4.9	|	Romania	2.9	2.5
United Kingdom	8.7	8.9	|	Sweden	2.1	3.6
Greece	3.3	3.6	|	Slovenia	7.4	12.0
Croatia	6.7	9.9	|	Slovakia	1.8	1.8
Hungary	8.3	8.8	|	**EU28+ISL**	**5.7**	**5.9**

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 2015 by 7.1% or 26.2 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 5.21 shows the typical animal mass in source category *3.B.1.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. Typical animal mass decreased in two countries and increased in 21 countries. It was in 2015 at the level of 1990 in two countries. No data were available for three countries (the United Kingdom, the Netherlands and Sweden). Decreases occurred in Malta and Ireland with a mean absolute value of 15 kg. The largest increases occurred in Finland and Bulgaria with a mean absolute value of 107 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

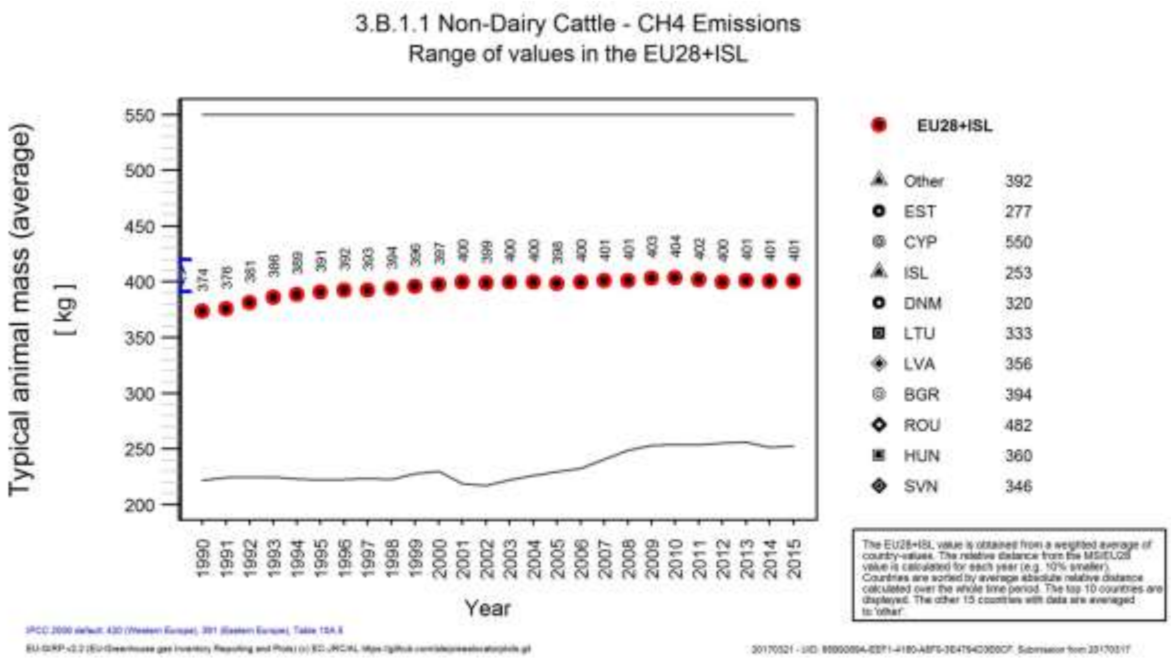


Table 5.21 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28+ISL typical animal mass (kg)

Member State	1990	2015		Member State	1990	2015
Austria	364	419	|	Ireland	362	354
Belgium	381	406	|	Iceland	237	253
Bulgaria	298	394	|	Italy	376	381
Cyprus	550	550	|	Lithuania	325	333
Czech Republic	326	388	|	Luxembourg	405	416
Germany	339	370	|	Latvia	298	356
Denmark	290	320	|	Malta	349	328
Estonia	222	277	|	Poland	311	317
Spain	395	427	|	Portugal	399	418
Finland	278	396	|	Romania	482	482
France	428	434	|	Slovenia	289	346
Greece	375	430	|	Slovakia	331	361
Croatia	331	352	|	**EU28+ISL**	**369**	**395**
Hungary	327	360	|			

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 barely between 1990 and 2015 by 0.5% or 0.0104 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 5.22 shows the VS daily excretion in source category *3.B.1.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. VS daily excretion decreased in six countries and increased in eighteen countries. It was in 2015 at the level of 1990 in four countries. The three countries with the largest decreases were Spain, Ireland and Poland with a mean absolute value of 0.2 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

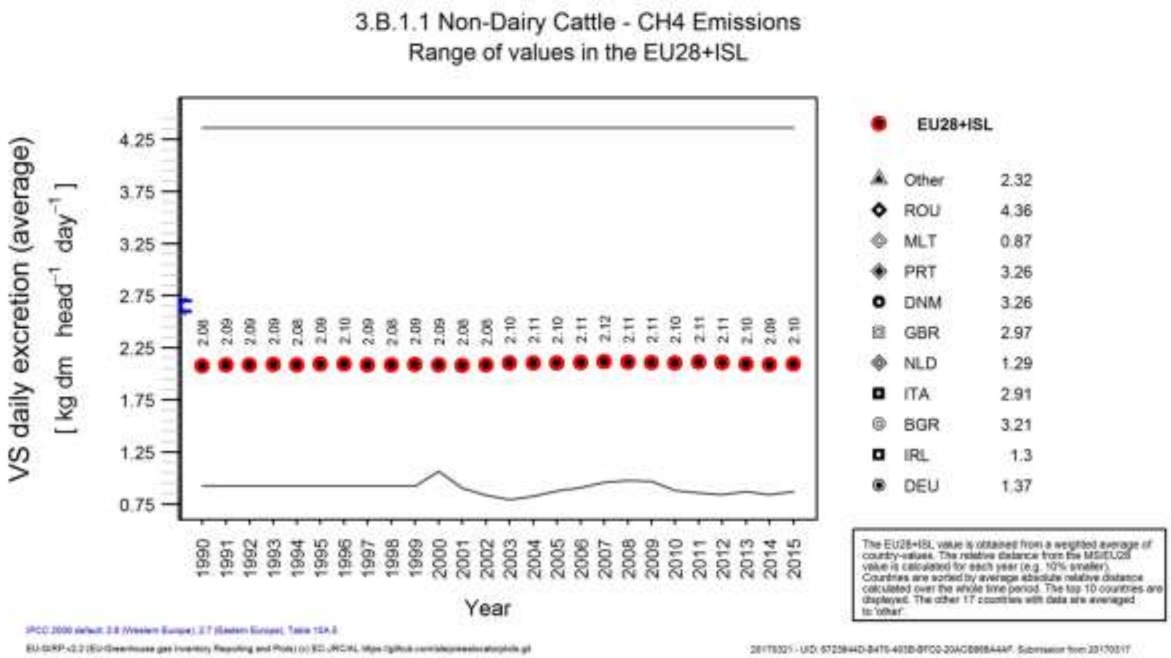


Table 5.22 3.B.1.1 - Non-Dairy Cattle: Member States' and EU28+ISL VS daily excretion (kg dm/head/day)

Member State	1990	2015		Member State	1990	2015
Austria	1.78	2.17	|	Ireland	1.43	1.30
Belgium	1.51	1.62	|	Iceland	0.60	0.60
Bulgaria	2.82	3.21	|	Italy	2.80	2.91
Cyprus	2.70	2.70	|	Lithuania	2.43	2.50
Czech Republic	2.35	2.81	|	Luxembourg	2.48	2.58
Germany	1.37	1.37	|	Latvia	1.68	2.08
Denmark	2.37	3.26	|	Malta	0.92	0.87
Estonia	2.04	2.21	|	Netherlands	1.37	1.29
Spain	2.35	2.06	|	Poland	2.04	1.88
Finland	1.55	2.19	|	Portugal	3.15	3.26
France	1.87	1.91	|	Romania	4.36	4.36
United Kingdom	2.86	2.97	|	Sweden	1.60	1.72

Member State	1990	2015		Member State	1990	2015
Greece	2.62	2.85	|	Slovenia	2.14	2.55
Croatia	2.70	2.70	|	Slovakia	1.86	2.12
Hungary	2.54	2.65	|	**EU28+ISL**	**2.07**	**2.08**

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 2015 by 6% or 0.368 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 5.23 shows the implied emission factor for CH_4 emissions in source category *3.B.1.3 - Swine* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in seventeen countries and increased in ten countries. It was in 2015 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 four countries with the largest increases were Finland, Hungary, Croatia and Latvia with a mean absolute value of 2 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

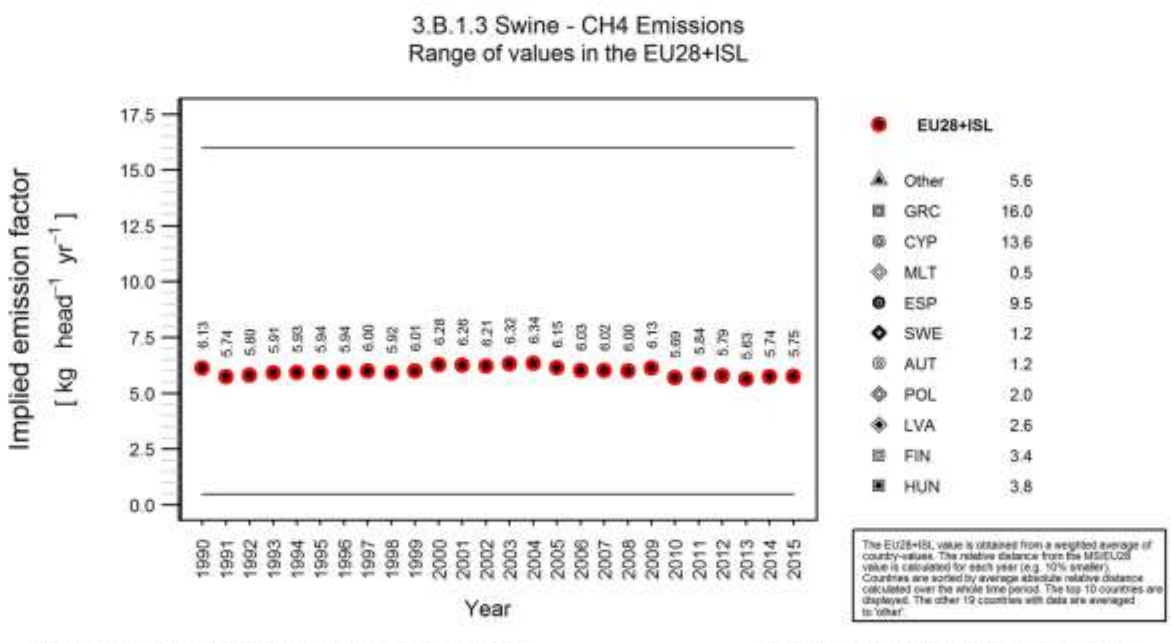


Table 5.23 3.B.1.3 - Swine: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	1.62	1.19	|	Ireland	5.25	5.04
Belgium	4.73	4.47	|	Iceland	6.07	5.88
Bulgaria	5.15	4.62	|	Italy	8.11	6.23
Cyprus	13.85	13.62	|	Lithuania	4.46	4.50

Member State	1990	2015		Member State	1990	2015
Czech Republic	6.00	6.00	|	Luxembourg	5.76	5.20
Germany	4.05	4.08	|	Latvia	1.87	2.63
Denmark	3.87	3.61	|	Malta	0.47	0.47
Estonia	4.37	4.22	|	Netherlands	10.03	6.71
Spain	12.43	9.54	|	Poland	1.88	1.99
Finland	2.02	3.36	|	Portugal	7.30	7.40
France	5.46	5.72	|	Romania	12.20	9.30
United Kingdom	5.78	5.21	|	Sweden	1.05	1.25
Greece	16.00	16.00	|	Slovenia	9.00	4.08
Croatia	4.54	7.43	|	Slovakia	6.86	6.72
Hungary	2.29	3.78	|	**EU28+ISL**	**6.13**	**5.76**

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*, increased in EU28+ISL barely between 1990 and 2015 by 0.39% or 0.319 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 5.24 shows the typical animal mass in source category *3.B.1.3* - *Swine* for the years 1990 and 2015 for all Member States and EU28+ISL. Typical animal mass decreased in twelve countries and increased in six countries. It was in 2015 at the level of 1990 in two countries. No data were available for nine countries (Austria, Cyprus, Finland, the United Kingdom, the Netherlands, Poland, Sweden and Slovenia). The three countries with the largest decreases were Croatia, Latvia and Ireland with a mean absolute value of 9 kg. The three countries with the largest increases were Belgium, Denmark and Estonia with a mean absolute value of 17 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

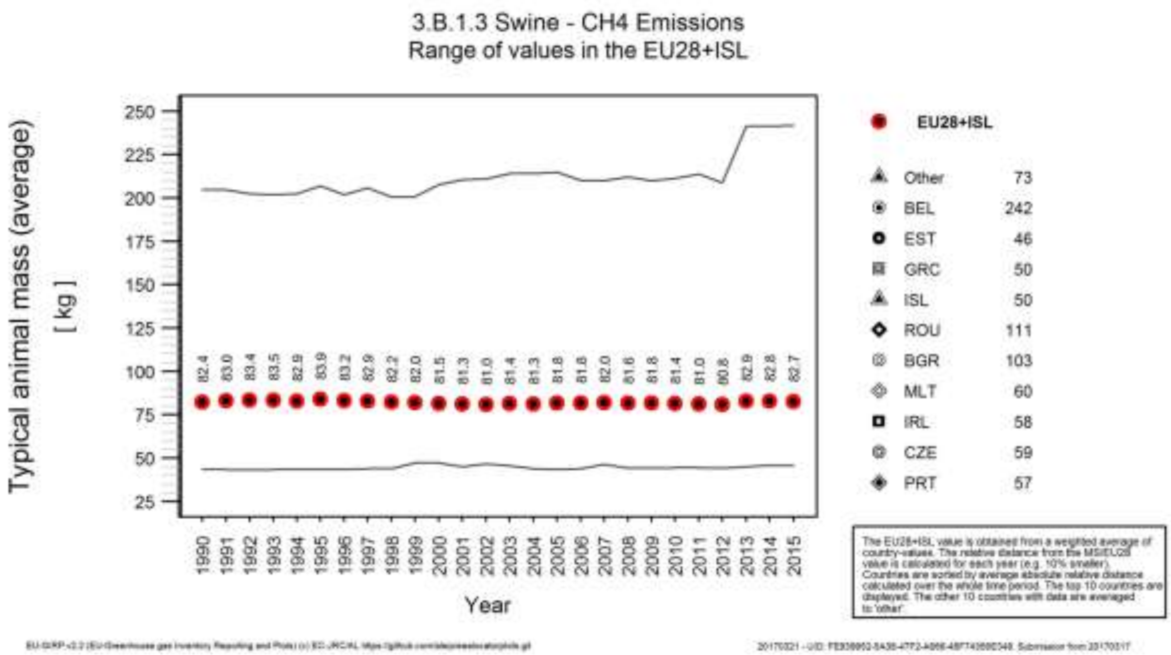


Table 5.24 3.B.1.3 - Swine: Member States' and EU28+ISL typical animal mass (kg)

Member State	1990	2015	Member State	1990	2015
Belgium	205	242	Ireland	63	58
Bulgaria	109	103	Iceland	52	50
Czech Republic	62	59	Italy	79	81
Germany	67	63	Lithuania	65	62
Denmark	98	110	Luxembourg	92	85
Estonia	43	46	Latvia	75	65
Spain	64	62	Malta	59	60
France	64	62	Portugal	62	57
Greece	50	50	Romania	111	111
Croatia	88	76	**EU28+ISL**	**82**	**83**
Hungary	63	64			

3.B.1.3 - Swine - VS daily excretion

The VS daily excretion, a parameter used for calculating CH_4 emissions in source category *3.B.1.3 - Swine*, decreased in EU28+ISL moderately between 1990 and 2015 by 7.3% or 0.0263 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 5.25 shows the VS daily excretion in source category *3.B.1.3 - Swine* for the years 1990 and 2015 for all Member States and EU28+ISL. VS daily excretion decreased in seventeen countries and increased in three countries. It was in 2015 at the level of 1990 in two countries. No data were available for seven countries (Cyprus, Czech Republic, the United Kingdom, Greece, Iceland, Malta and Slovakia). The largest decrease occurred in the Netherlands with an absolute value of 0.2 kg dm/head/day. Increases occurred in Germany, Sweden and Estonia with a mean absolute value of 0.024 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

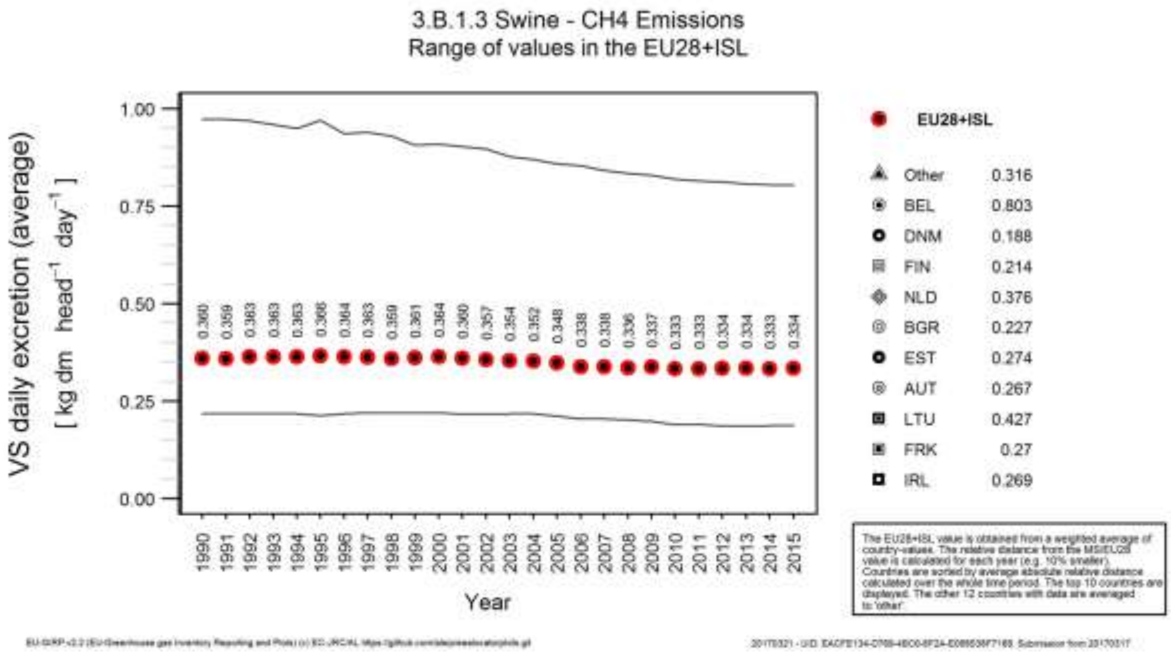


Table 5.25 3.B.1.3 - Swine: Member States' and EU28+ISL VS daily excretion (kg dm/head/day)

Member State	1990	2015	Member State	1990	2015
Austria	0.27	0.27	Italy	0.37	0.34
Belgium	0.97	0.80	Lithuania	0.43	0.43
Bulgaria	0.25	0.23	Luxembourg	0.32	0.31
Germany	0.26	0.30	Latvia	0.40	0.35
Denmark	0.24	0.19	Netherlands	0.57	0.38
Estonia	0.26	0.27	Poland	0.32	0.32
Spain	0.44	0.37	Portugal	0.28	0.26
Finland	0.22	0.21	Romania	0.28	0.28
France	0.28	0.27	Sweden	0.29	0.31
Croatia	0.36	0.34	Slovenia	0.32	0.31
Hungary	0.30	0.30	**EU28+ISL**	**0.36**	**0.33**
Ireland	0.28	0.27			

5.2.3 Manure Management - N_2O (CRF Source Category 3B2)

N_2O the emissions in source category *3.B.2 - Manure Management* are 0.43% of total EU28+ISL GHG emissions and 8.1% of total EU28+ISL N_2O emissions. They make 4.8% of total agricultural emissions and 11% of total agricultural N_2O 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, but substantial emissions are also reported for Swine, and Poultry.

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 2015.3.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.

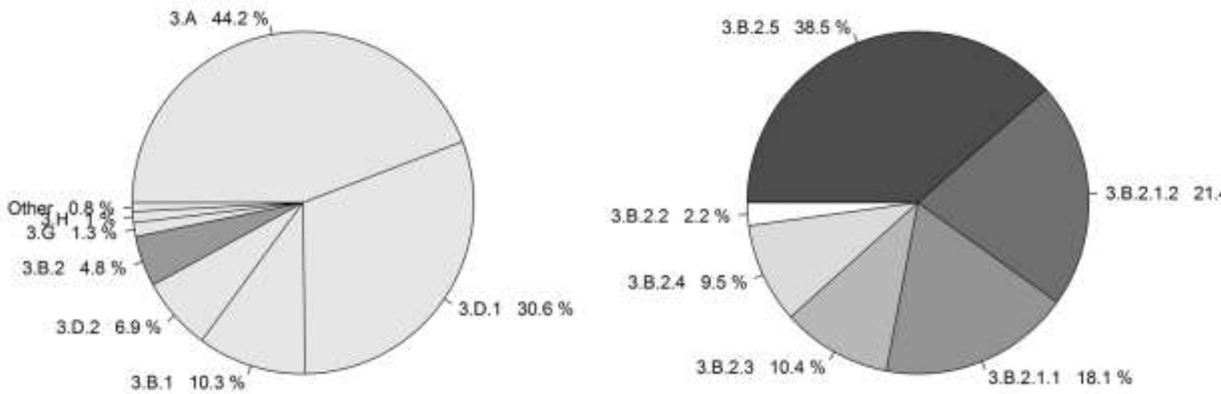


Figure 5.37: Decomposition of emissions in source category 3.B.2 - Manure Management into its sub-categories by Member State in the year 2015.

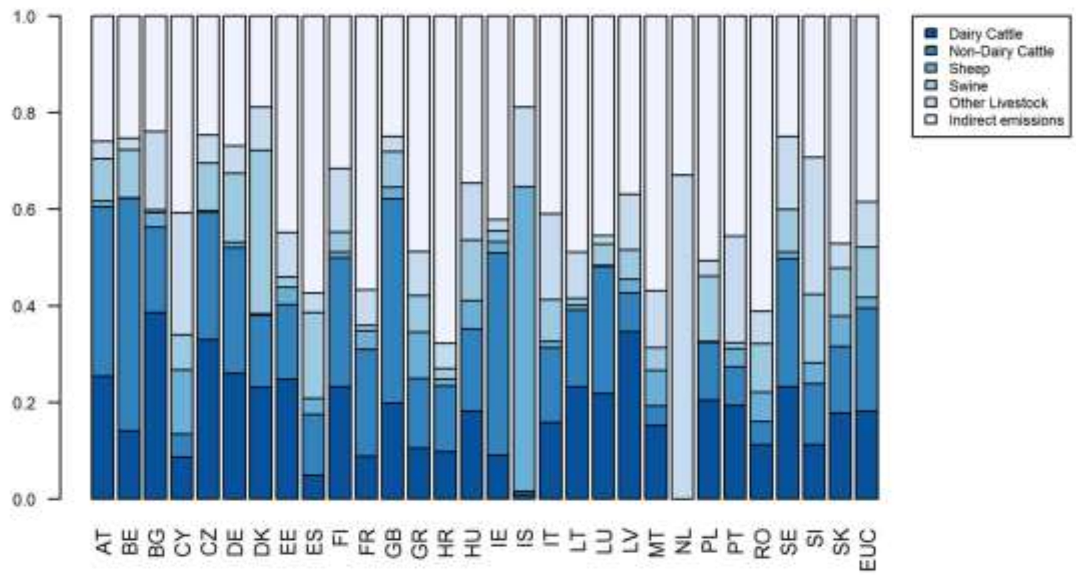
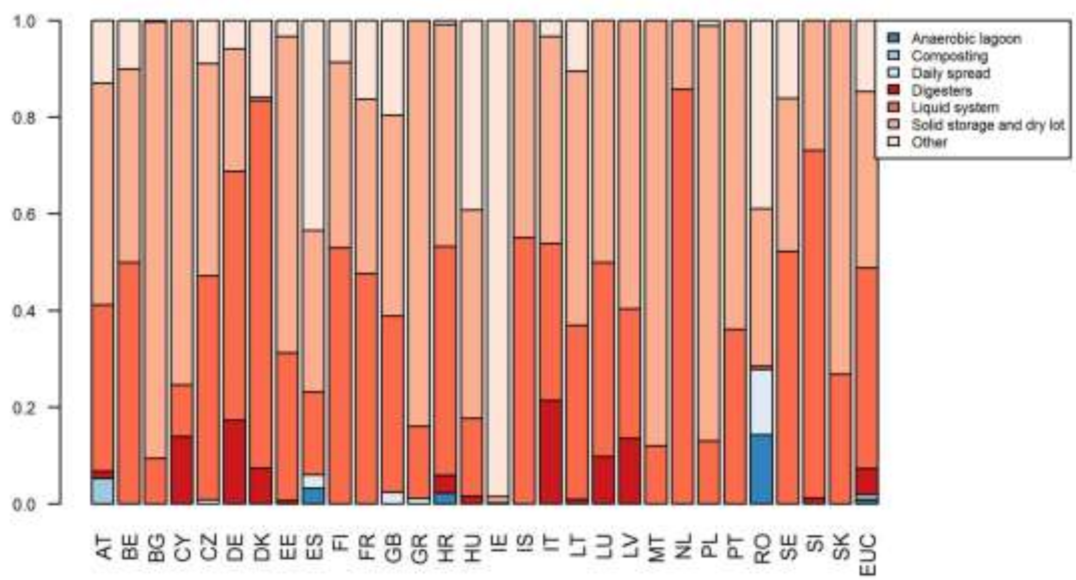


Figure 5.38: Decomposition of manure nitrogen handled in source category 3.B.2 - Manure Management into the different manure management systems by Member State in the year 2015.



Total GHG and N_2O emissions by Member State from 3.B.2 *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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 29% or 8.7 Mt CO_2-eq. The decrease was largest in Latvia in relative terms (69%) and in Czech Republic in absolute terms (1.5 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 0.8%.

Table 5.26 3.B.2 - Manure Management: Member States' contributions to total GHG and N_2O emissions

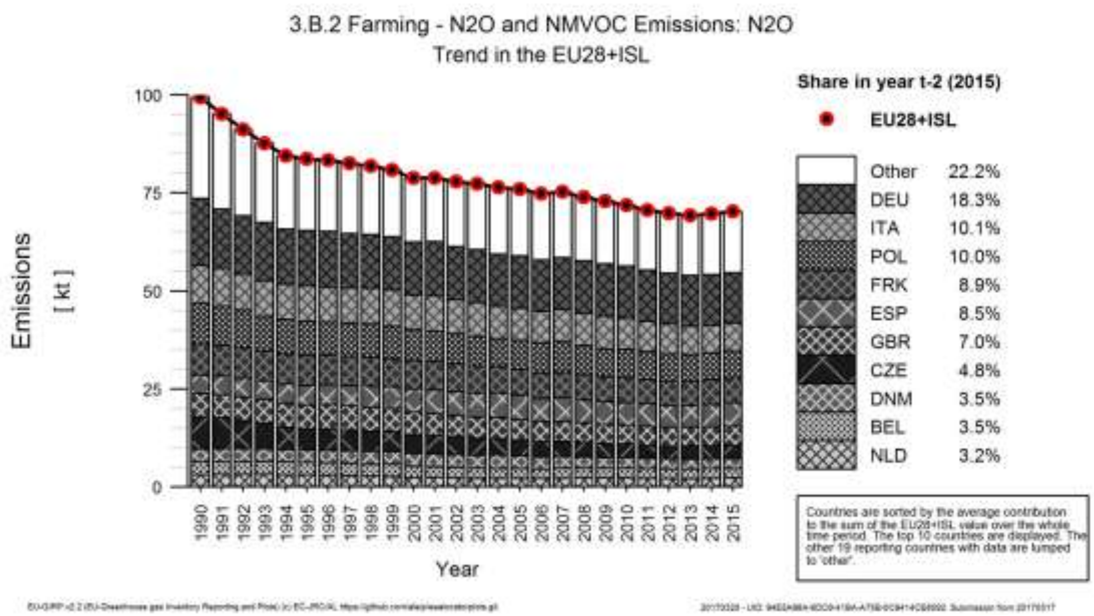
Member State	GHG emissions in 1990 (kt CO2 equivalents)	GHG emissions in 2015 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)
Austria	438	439	438	439
Belgium	972	736	972	736
Bulgaria	1 196	478	1 196	478
Croatia	324	147	324	147
Cyprus	72	64	72	64
Czech Republic	2 459	1 008	2 459	1 008
Denmark	978	732	978	732
Estonia	134	62	134	62
Finland	285	288	285	288
France	2 348	1 859	2 348	1 859
Germany	5 085	3 833	5 085	3 833
Greece	324	310	324	310
Hungary	904	466	904	466
Ireland	480	506	480	506
Italy	2 885	2 109	2 885	2 109
Latvia	307	96	307	96
Lithuania	594	201	594	201
Luxembourg	39	35	39	35
Malta	13	11	13	11
Netherlands	926	674	926	674
Poland	3 096	2 088	3 096	2 088
Portugal	254	193	254	193
Romania	1 204	658	1 204	658
Slovakia	495	171	495	171
Slovenia	152	97	152	97
Spain	1 398	1 782	1 398	1 782
Sweden	362	343	362	343
United Kingdom	1 769	1 469	1 769	1 469
EU-28	**29 497**	**20 854**	**29 497**	**20 854**
Iceland	59	51	59	51
United Kingdom (KP)	1 769	1 469	1 769	1 469
EU-28 + ISL	**29 555**	**20 905**	**29 555**	**20 905**

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 8.7 Mt CO_2-eq in the period 1990 to 2015. 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 77.9% of the total. Emissions decreased in 25 countries and increased in four countries. The three countries with the largest decreases were Czech Republic, Germany and Poland with a total absolute decrease of 3.7 Mt CO_2-eq. The largest increases occurred in Spain, with a total absolute increase of 383 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 2015



3.B.2.1 - Cattle - Emissions

N_2O emissions in source category *3.B.2.1 - Cattle* are 0.17% of total EU28+ISL GHG emissions and 3.2% of total EU28+ISL N_2O emissions. They make 1.9% of total agricultural emissions and 4.5% of total agricultural N_2O 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 5.27 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 34% or 4.3 Mt CO_2-eq. The decrease was largest in Slovakia in relative terms (70%) and in Germany in absolute terms (1 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 0.6%. The ten countries with the highest emissions accounted together for 81.6% of the total. Emissions decreased in 22 countries and increased in six countries. The three countries with the largest decreases were Germany, Czech Republic and Italy with a total absolute decrease of 2.5 Mt CO_2-

eq. The three countries with the largest increases were Finland, Ireland and Spain, with a total absolute increase of 95 kt CO_2-eq.

Table 5.27 3.B.2.1 - Cattle: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	258	266	265	3.2%	0	0%	7	3%
Belgium	651	460	458	5.5%	-1	0%	-193	-30%
Bulgaria	535	276	279	3.4%	2	1%	-257	-48%
Croatia	92	32	34	0.4%	2	7%	-58	-63%
Cyprus	8	9	9	0.1%	0	0%	0	5%
Czech Republic	1 447	583	599	7.2%	15	3%	-848	-59%
Denmark	326	283	278	3.4%	-5	-2%	-48	-15%
Estonia	51	26	25	0.3%	-1	-4%	-27	-52%
Finland	128	142	144	1.7%	1	1%	15	12%
France	875	571	574	6.9%	4	1%	-301	-34%
Germany	3 022	2 003	1 994	24.1%	-9	0%	-1 028	-34%
Greece	79	77	77	0.9%	0	0%	-2	-2%
Hungary	281	158	164	2.0%	6	3%	-117	-42%
Ireland	242	256	258	3.1%	2	1%	15	6%
Italy	1 267	645	660	8.0%	14	2%	-607	-48%
Latvia	121	42	41	0.5%	-1	-2%	-80	-66%
Lithuania	203	78	79	1.0%	1	1%	-124	-61%
Luxembourg	19	17	17	0.2%	0	0%	-2	-13%
Malta	3	2	2	0.0%	0	0%	0	-17%
Netherlands	IE	IE	IE	-	-	-	-	-
Poland	918	678	677	8.2%	-1	0%	-241	-26%
Portugal	62	52	53	0.6%	0	0%	-9	-15%
Romania	214	103	105	1.3%	3	3%	-108	-51%
Slovakia	178	56	54	0.7%	-2	-3%	-124	-70%
Slovenia	37	23	23	0.3%	1	2%	-14	-38%
Spain	248	303	312	3.8%	10	3%	64	26%
Sweden	176	172	171	2.1%	-1	-1%	-5	-3%
United Kingdom	1 101	902	913	11.0%	11	1%	-188	-17%
EU-28	**12 542**	**8 215**	**8 265**	**100%**	**51**	**1%**	**-4 277**	**-34%**
Iceland	1	1	1	0.0%	0	6%	0	11%
United Kingdom (KP)	1 101	902	913	11.0%	11	1%	-188	-17%
EU-28 + ISL	**12 543**	**8 215**	**8 266**	**100%**	**51**	**1%**	**-4 277**	**-34%**

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 2015

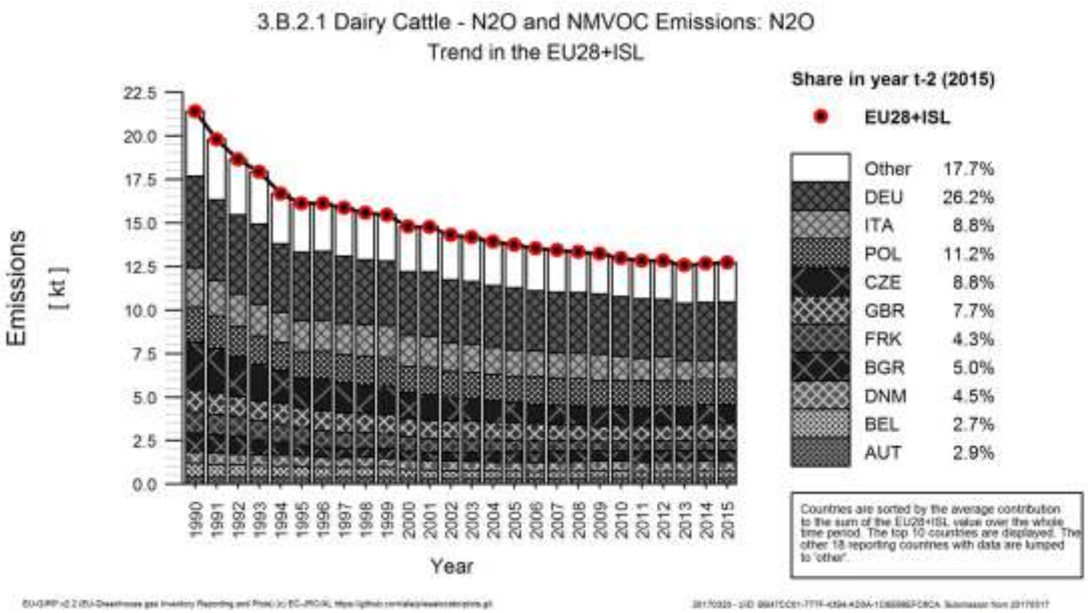
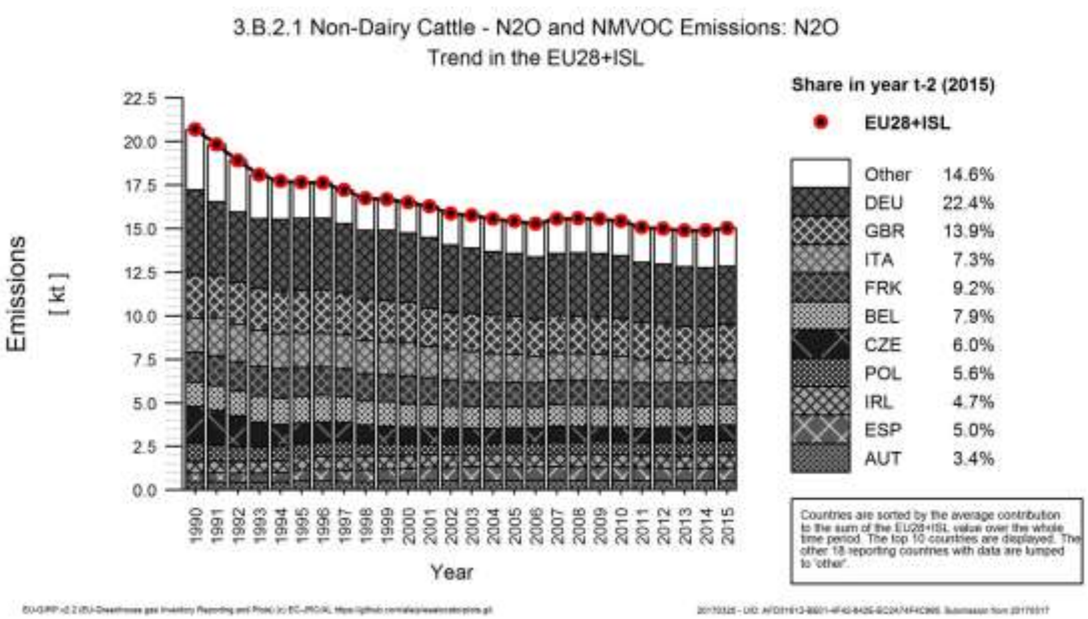


Figure 5.41: 3.B.2.1 - Cattle: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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:

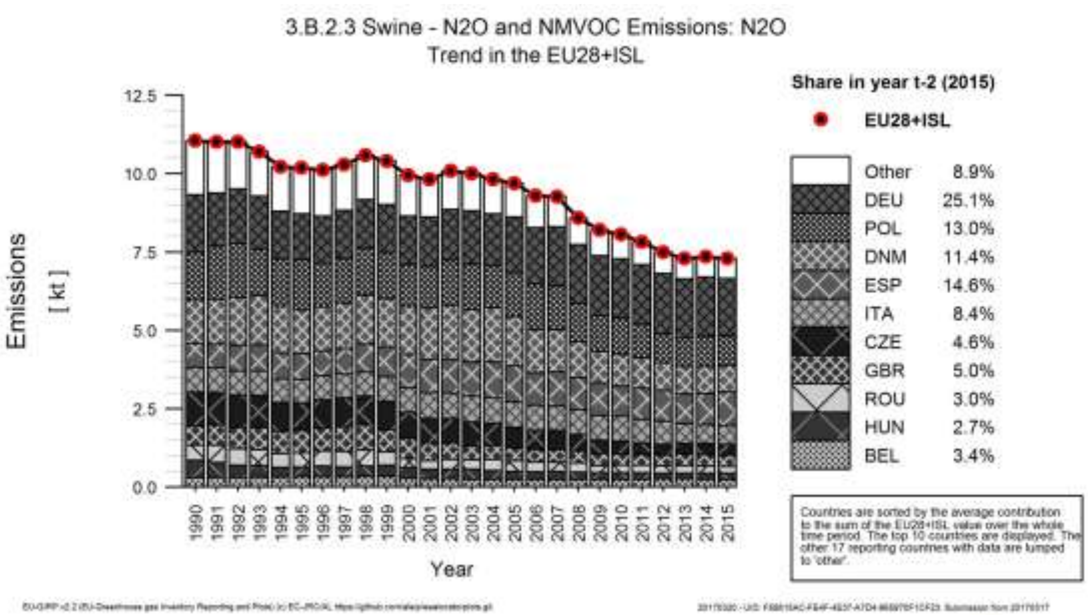
- N-allocation by MMS.

3.B.2.3 - Swine - Emissions

N_2O emissions in source category *3.B.2.3 - Swine* are 0.045% of total EU28+ISL GHG emissions and 0.84% of total EU28+ISL N_2O emissions. They make 0.5% of total agricultural emissions and 1.2% of total agricultural N_2O emissions.. Figure 5.43 shows the trend of emissions indicating the countries contributing most to the EU28+ISL total. The figure represents 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.2.3 *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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 34% or 1.1 Mt CO_2-eq. The decrease was largest in Lithuania in relative terms (97%) and in Czech Republic in absolute terms (225 kt CO_2-eq). From 2014 to 2015 emissions in the current category decreased by 0.8%. The ten countries with the highest emissions accounted together for 91.1% of the total. Emissions decreased in 25 countries and increased in two countries. The three countries with the largest decreases were Czech Republic, Poland and Denmark with a total absolute decrease of 557 kt CO_2-eq. The largest increases occurred in Spain, with a total absolute increase of 89 kt CO_2-eq.

Figure 5.42: 3.B.2.3 - Swine: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



3.B.2.4 - Other Livestock - Emissions

N_2O emissions in source category *3.B.2.4 - Other Livestock* are 0.041% of total EU28+ISL GHG emissions and 0.77% of total EU28+ISL N_2O emissions. They make 0.45% of total agricultural emissions and 1.1% of total agricultural N_2O 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 10% or 232 kt CO_2-eq. The decrease was largest in Croatia in relative terms (64%) and in Bulgaria in absolute terms (121 kt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 2.1%. 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 79.7% of the total. Emissions decreased in fifteen countries and increased in fourteen countries. The three countries with the largest decreases were Bulgaria, Poland and the Netherlands with a total absolute decrease of 291 kt CO_2-eq. The four countries with the largest increases were Denmark, Germany, Spain and Italy, with a total absolute increase of 143 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 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	9	16	16	0.8%	0	2%	7	77%
Belgium	10	17	18	0.9%	1	4%	8	74%
Bulgaria	201	74	80	4.0%	6	8%	-121	-60%
Croatia	21	8	8	0.4%	0	-3%	-13	-64%
Cyprus	17	17	16	0.8%	-1	-7%	-1	-7%
Czech Republic	83	56	59	3.0%	3	5%	-25	-30%
Denmark	46	62	66	3.3%	3	6%	20	44%
Estonia	12	6	6	0.3%	0	2%	-6	-53%
Finland	29	38	38	1.9%	0	0%	9	32%
France	125	137	137	6.9%	0	0%	12	10%
Germany	198	218	218	11.0%	0	0%	21	10%
Greece	30	28	28	1.4%	0	0%	-1	-5%
Hungary	83	55	55	2.8%	0	-1%	-28	-34%
Ireland	10	12	12	0.6%	0	2%	1	14%
Italy	292	372	374	18.9%	2	1%	82	28%
Latvia	22	11	11	0.6%	0	-2%	-11	-50%
Lithuania	16	17	19	1.0%	2	13%	4	22%
Luxembourg	0	1	1	0.0%	0	-1%	0	76%
Malta	1	1	1	0.1%	0	2%	0	1%
Netherlands	533	437	452	22.8%	15	3%	-80	-15%
Poland	157	62	67	3.4%	5	8%	-90	-57%
Portugal	60	44	43	2.1%	-1	-2%	-17	-29%
Romania	67	43	45	2.2%	1	2%	-23	-34%
Slovakia	13	8	9	0.4%	0	4%	-4	-33%
Slovenia	33	26	28	1.4%	2	7%	-5	-17%
Spain	51	72	72	3.6%	-1	-1%	21	40%
Sweden	40	49	52	2.6%	3	5%	12	29%
United Kingdom	45	46	46	2.3%	0	0%	1	2%
EU-28	**2 205**	**1 935**	**1 975**	**100%**	**40**	**2%**	**-230**	**-10%**
Iceland	10	8	8	0.4%	0	4%	-2	-19%
United Kingdom (KP)	45	46	46	2.3%	0	0%	1	2%
EU-28 + ISL	**2 215**	**1 943**	**1 983**	**100%**	**41**	**2%**	**-232**	**-10%**

3.B.2.4.7 - Poultry - Emissions

Largest contribution to other livestock emissions comes from sub-category poultry with 41% of total N_2O emissions. Other animal types with high emissions are 'other' animals in this sub-category with a share of 32% and Horses with a share of 17%. Here only the most important animal type Poultry is discussed.

Emissions in source category *3.B.2.4.7 - Poultry* decreased clearly in EU28+ISL by 14% or 138 kt CO_2-eq in the period 1990 to 2015. Figure 5.45 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 83.3% of the total. Emissions decreased in eighteen countries and increased in ten countries. The largest decreases occurred in Bulgaria and Czech Republic with a total absolute decrease of 137 kt CO_2-eq. The three countries with the largest increases were Sweden, Italy and Germany, with a total absolute increase of 60 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 increased slightly in EU28+ISL by 4% or 65.1 million heads in the period 1990 to 2015. Figure 5.46 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 86.7% of the total. Population decreased in fourteen countries and increased in fifteen countries. The four countries with the largest decreases were Poland, Romania, Hungary and Bulgaria with a total absolute decrease of 149 million heads. The four countries with the largest increases were Spain, the United Kingdom, France and Germany, with a total absolute increase of 192 million heads.

Other activity data related to this emission category are:

- Nitrogen managed on each manure management system

Figure 5.44: 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 2015

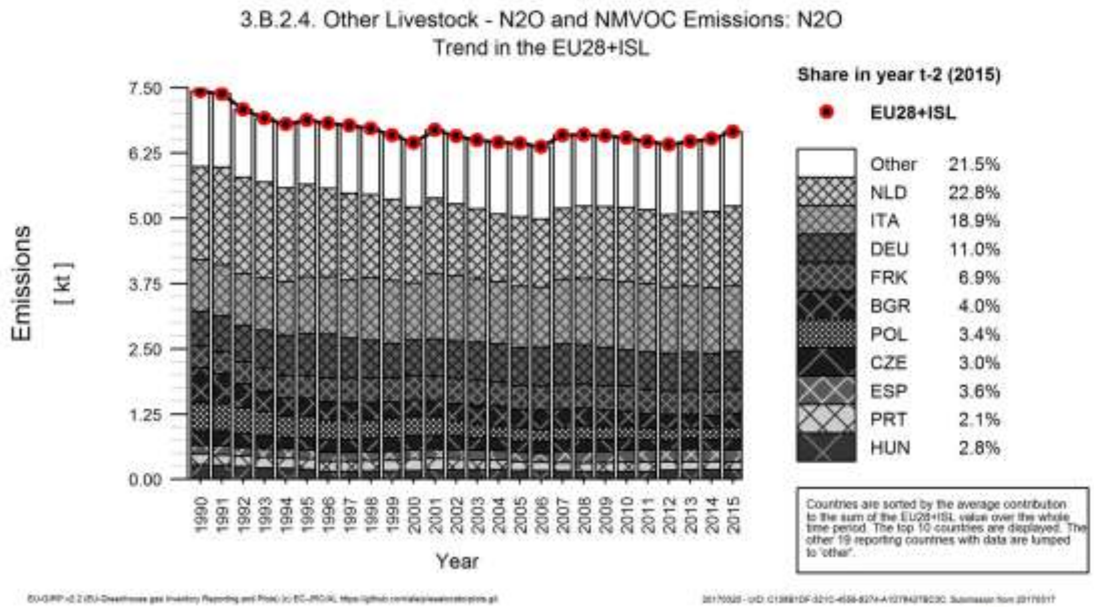


Figure 5.45: 3.B.2.4.7 - Poultry: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015

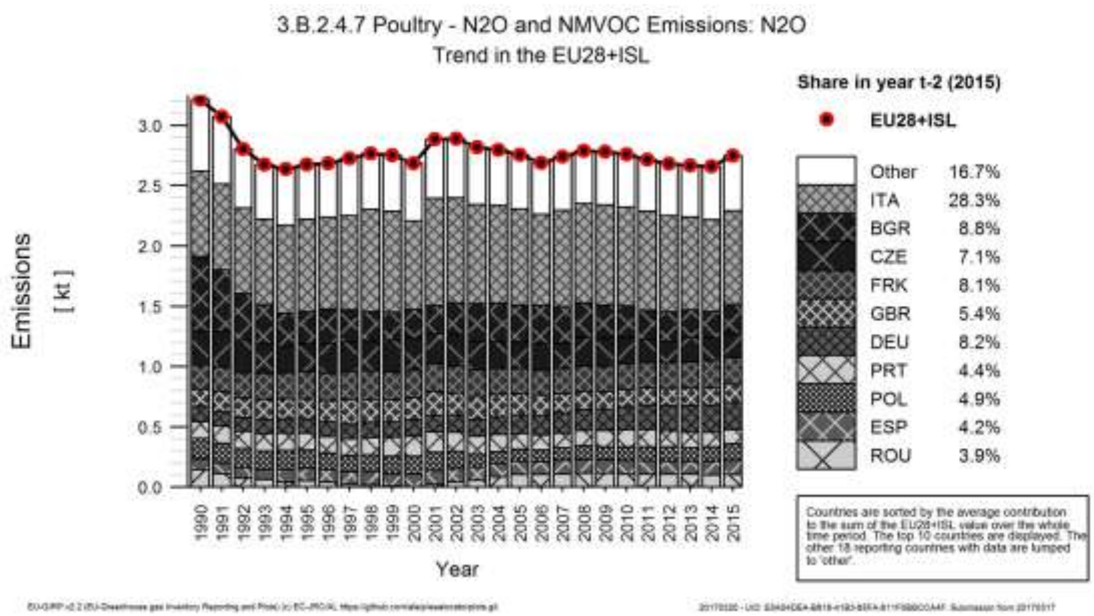
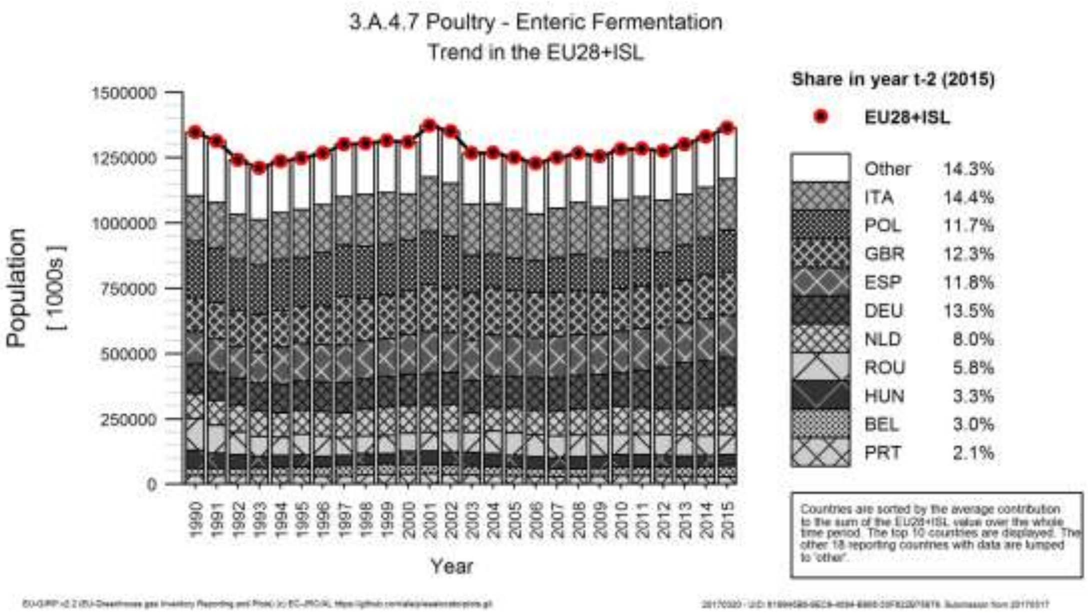


Figure 5.46: 3.A.4.7 - Poultry: Trend in poultry population in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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.2.5 - Manure Management - Indirect Emissions - Emissions

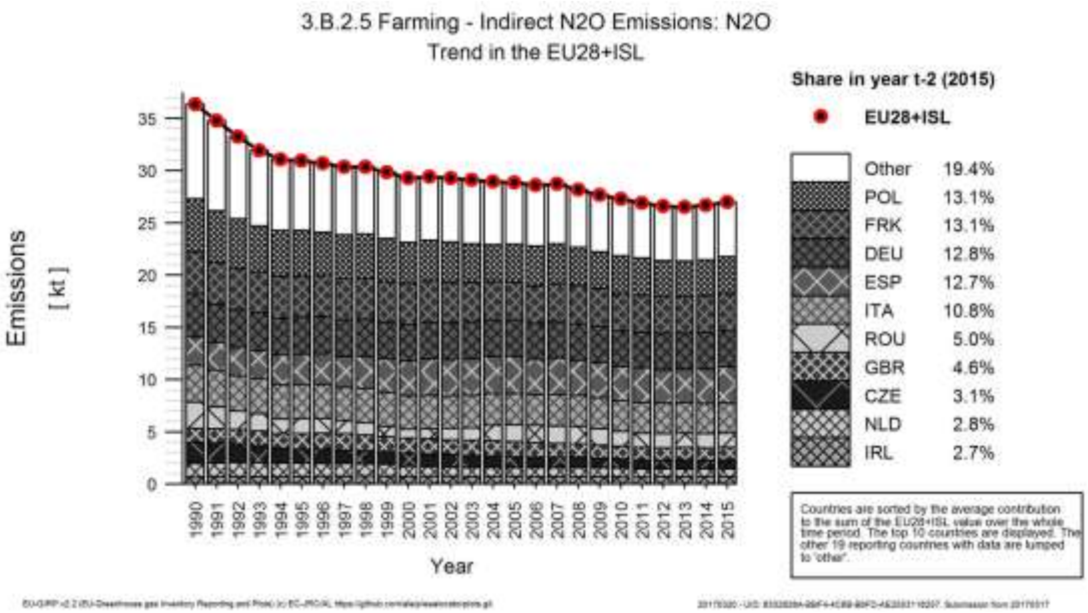
N_2O emissions in source category *3.B.2.5 - Manure Management - Indirect Emissions - Indirect N_2O emissions* are 0.17% of total EU28+ISL GHG emissions and 3.1% of total EU28+ISL N_2O emissions. They make 1.8% of total agricultural emissions and 4.3% of total agricultural N_2O emissions..

Total GHG and N_2O emissions by Member State from 3.B.2.5 *Manure Management - Indirect Emissions* are shown in Table 5.29 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 26% or 2.8 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (72%) and in Poland in absolute terms (454 kt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 1.2%. Figure 5.47 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 80.8% of the total. Emissions decreased in 26 countries and increased in three countries. The three countries with the largest decreases were Poland, Czech Republic and Romania with a total absolute decrease of 1.1 Mt CO_2-eq. The largest increases occurred in Spain, with a total absolute increase of 229 kt CO_2-eq.

Table 5.29 3.B.2.5 - Manure Management - Indirect Emissions: Member States' contributions to total GHG and N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	107	114	114	1.4%	0	0%	7	6%
Belgium	218	188	187	2.3%	-1	-1%	-32	-15%
Bulgaria	353	98	101	1.3%	2	2%	-253	-72%
Croatia	192	92	99	1.2%	8	8%	-92	-48%
Cyprus	30	27	26	0.3%	-1	-4%	-4	-12%
Czech Republic	600	245	249	3.1%	4	1%	-351	-59%
Denmark	197	138	138	1.7%	0	0%	-59	-30%
Estonia	65	30	28	0.3%	-2	-6%	-37	-57%
Finland	99	91	91	1.1%	0	0%	-8	-8%
France	1 194	1 052	1 054	13.1%	3	0%	-140	-12%
Germany	1 243	1 044	1 032	12.9%	-13	-1%	-211	-17%
Greece	154	152	151	1.9%	0	0%	-2	-2%
Hungary	346	159	161	2.0%	3	2%	-184	-53%
Ireland	199	210	213	2.7%	3	1%	15	7%
Italy	1 057	863	865	10.8%	2	0%	-191	-18%
Latvia	120	37	36	0.4%	-1	-4%	-84	-70%
Lithuania	265	98	98	1.2%	1	1%	-166	-63%
Luxembourg	18	16	16	0.2%	0	1%	-2	-10%
Malta	7	6	6	0.1%	0	0%	-1	-14%
Netherlands	394	221	222	2.8%	1	1%	-172	-44%
Poland	1 512	1 032	1 058	13.2%	26	2%	-454	-30%
Portugal	115	88	88	1.1%	0	0%	-27	-24%
Romania	746	397	402	5.0%	6	1%	-343	-46%
Slovakia	221	81	80	1.0%	-1	-1%	-141	-64%
Slovenia	42	28	28	0.4%	0	2%	-14	-33%
Spain	794	974	1 023	12.7%	49	5%	229	29%
Sweden	101	85	85	1.1%	0	0%	-16	-16%
United Kingdom	395	363	366	4.6%	4	1%	-29	-7%
EU-28	**10 782**	**7 926**	**8 018**	**100%**	**92**	**1%**	**-2 764**	**-26%**
Iceland	10	9	10	0.1%	0	3%	-1	-6%
United Kingdom (KP)	395	363	366	4.6%	4	1%	-29	-7%
EU-28 + ISL	**10 792**	**7 936**	**8 028**	**100%**	**92**	**1%**	**-2 764**	**-26%**

Figure 5.47: 3.B.2.5 - Manure Management - Indirect Emissions: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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 2015 by 10.5% or 0.038 kg/head/year. Table 5.30 shows the implied emission factor for N_2O emissions in source category *3.B.2.1 - Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in seven countries and increased in twenty countries. No data were available for the Netherlands. The three countries with the largest decreases were Croatia, Italy and France with a mean absolute value of 0.1 kg/head/year. The four countries with the largest increases were Finland, Bulgaria, Estonia and Austria with a mean absolute value of 0.2 kg/head/year.

Table 5.30 3.B.2.1 - Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015	Member State	1990	2015
Austria	0.335	0.455	Ireland	0.119	0.125
Belgium	0.672	0.602	Iceland	0.031	0.033
Bulgaria	1.127	1.695	Italy	0.548	0.383
Cyprus	0.507	0.494	Lithuania	0.287	0.357
Czech Republic	1.385	1.428	Luxembourg	0.294	0.282
Germany	0.520	0.530	Latvia	0.281	0.329
Denmark	0.488	0.602	Malta	0.461	0.536
Estonia	0.228	0.325	Poland	0.307	0.381
Spain	0.164	0.169	Portugal	0.151	0.115
Finland	0.317	0.527	Romania	0.135	0.171
France	0.136	0.099	Sweden	0.343	0.388
United Kingdom	0.303	0.309	Slovenia	0.23	0.160
Greece	0.381	0.383	Slovakia	0.382	0.395

Member State	1990	2015		Member State	1990	2015
Croatia	0.362	0.241	|	**EU28+ISL**	**0.363**	**0.325**
Hungary	0.582	0.674	|			

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 2015 by 1.5% or 0.00835 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 5.31 shows the implied emission factor for N_2O emissions in source category *3.B.2.1 - Dairy Cattle* for the years 1990 and 2015 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 three countries with the largest decreases were France, Croatia and Italy with a mean absolute value of 0.2 kg/head/year. The four countries with the largest increases were Spain, Finland, Portugal and Austria with a mean absolute value of 0.2 kg/head/year.

Figure 5.48: 3.B.2.1 - Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

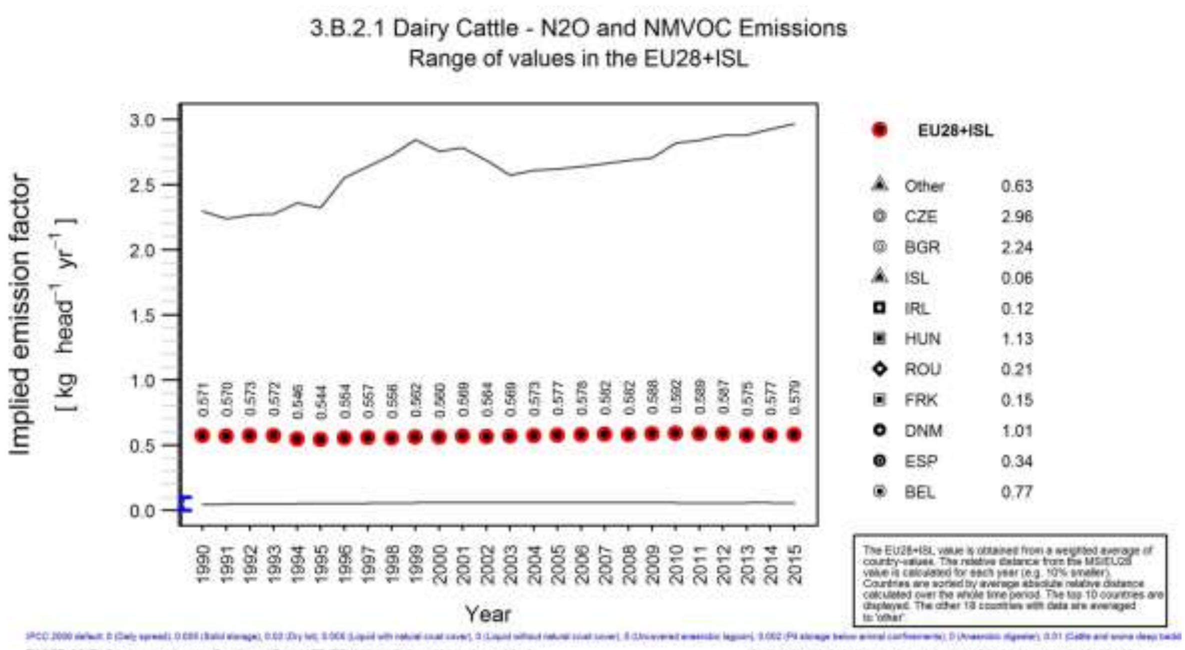


Table 5.31 3.B.2.1 - Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	0.444	0.701	|	Ireland	0.128	0.120
Belgium	0.935	0.772	|	Iceland	0.044	0.056
Bulgaria	1.737	2.245	|	Italy	0.866	0.614
Cyprus	0.759	0.718	|	Lithuania	0.377	0.509
Czech Republic	2.295	2.964	|	Luxembourg	0.503	0.547

Member State	1990	2015	Member State	1990	2015
Germany	0.827	0.778	Latvia	0.596	0.691
Denmark	0.876	1.013	Malta	0.616	0.816
Estonia	0.374	0.567	Poland	0.402	0.585
Spain	0.206	0.342	Portugal	0.330	0.530
Finland	0.484	0.786	Romania	0.169	0.211
France	0.231	0.150	Sweden	0.609	0.789
United Kingdom	0.435	0.516	Slovenia	0.319	0.324
Greece	0.704	0.823	Slovakia	0.728	0.728
Croatia	0.392	0.274	**EU28+ISL**	**0.571**	**0.579**
Hungary	0.883	1.125			

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 considerably between 1990 and 2015 by 19.1% or 18.6 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 5.32 shows the nitrogen excretion rate in source category *3.B.2.1 - Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in one country and increased in 23 countries. It was in 2015 at the level of 1990 in five countries. A decrease occurred in the Netherlands with an absolute value of 18 kg/head/year. The four countries with the largest increases were Spain, Finland, Estonia and Portugal with a mean absolute value of 39 kg/head/year.

Figure 5.49: 3.B.2.1 - Dairy Cattle: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

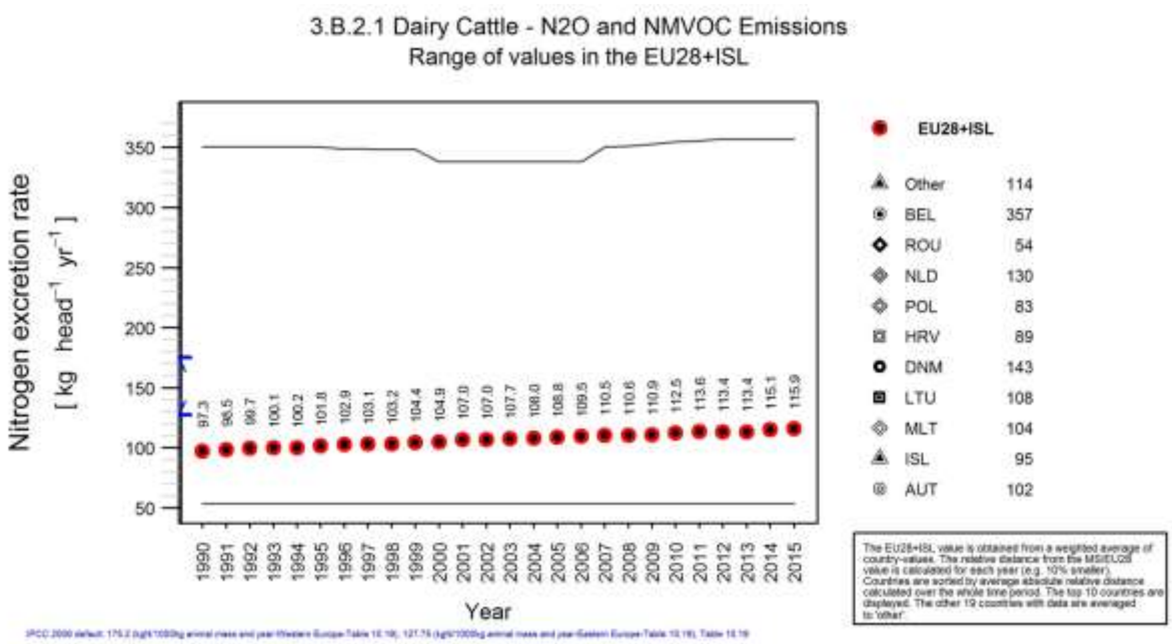


Table 5.32 3.B.2.1 - Dairy Cattle: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	77	102	|	Ireland	96	101
Belgium	350	357	|	Iceland	72	95
Bulgaria	100	100	|	Italy	116	116
Cyprus	96	96	|	Lithuania	80	108
Czech Republic	98	133	|	Luxembourg	85	102
Germany	98	120	|	Latvia	86	109
Denmark	129	143	|	Malta	78	104
Estonia	85	120	|	Netherlands	148	130
Spain	69	115	|	Poland	65	83
Finland	91	133	|	Portugal	86	118
France	102	114	|	Romania	54	54
United Kingdom	97	128	|	Sweden	102	131
Greece	97	114	|	Slovenia	82	111
Croatia	70	89	|	Slovakia	105	105
Hungary	83	109	|	**EU28+ISL**	**97**	**116**

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 2015 by 10.1% or 0.0267 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 5.33 shows the implied emission factor for N_2O emissions in source category *3.B.2.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in thirteen countries and increased in fourteen countries. No data were available for the Netherlands. The three countries with the largest decreases were Portugal, Croatia and Italy with a mean absolute value of 0.1 kg/head/year. The four countries with the largest increases were Finland, Bulgaria, Estonia and Austria with a mean absolute value of 0.2 kg/head/year.

Figure 5.50: 3.B.2.1 - Non-Dairy Cattle: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

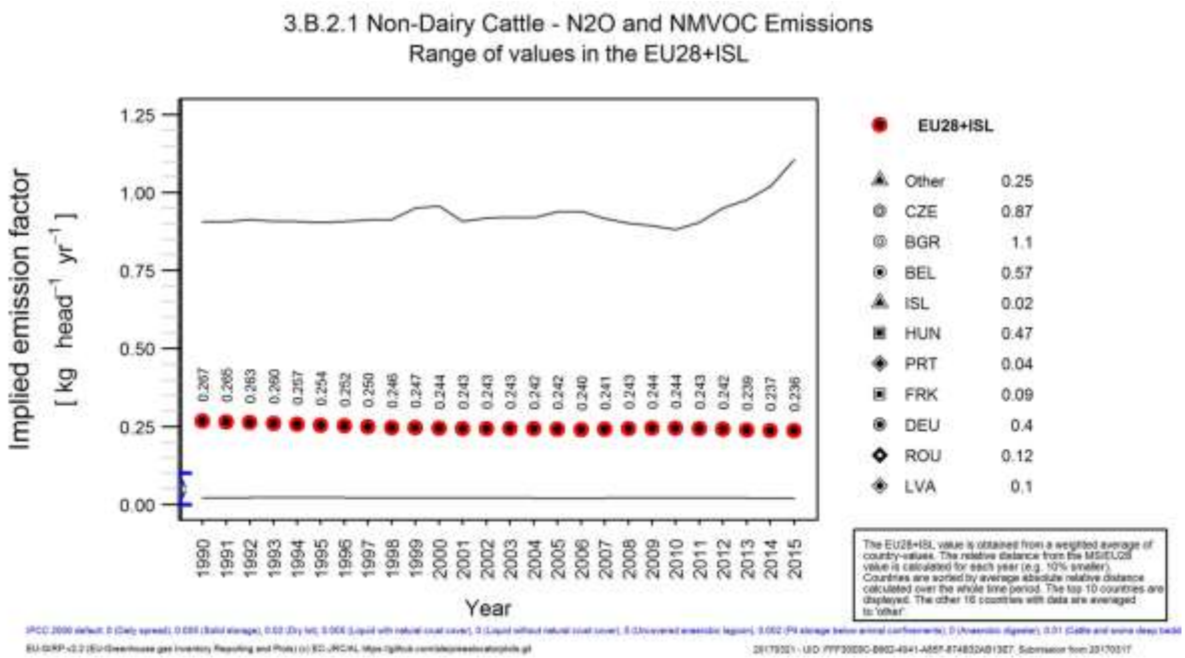


Table 5.33 3.B.2.1 - Non-Dairy Cattle: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	0.277	0.362	|	Ireland	0.117	0.126
Belgium	0.581	0.565	|	Iceland	0.021	0.020
Bulgaria	0.739	1.105	|	Italy	0.384	0.276
Cyprus	0.332	0.315	|	Lithuania	0.237	0.249
Czech Republic	0.907	0.867	|	Luxembourg	0.218	0.201
Germany	0.372	0.402	|	Latvia	0.095	0.100
Denmark	0.292	0.369	|	Malta	0.350	0.329
Estonia	0.143	0.193	|	Poland	0.215	0.240
Spain	0.144	0.141	|	Portugal	0.078	0.040
Finland	0.223	0.409	|	Romania	0.092	0.118
France	0.105	0.088	|	Sweden	0.209	0.268
United Kingdom	0.263	0.260	|	Slovenia	0.17	0.111
Greece	0.241	0.276	|	Slovakia	0.262	0.250
Croatia	0.323	0.222	|	**EU28+ISL**	**0.264**	**0.237**
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 moderately between 1990 and 2015 by 5% or 2.53 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 5.34 shows the nitrogen excretion rate in source category *3.B.2.1 - Non-Dairy Cattle* for the years 1990 and 2015 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in five countries and increased in 21 countries. It was in 2015 at the level of 1990 in two countries. The largest decrease occurred in the Netherlands with an absolute value of 15 kg/head/year. The largest increases occurred in Finland and Latvia with a mean absolute value of 13 kg/head/year.

Figure 5.51: 3.B.2.1 - Non-Dairy Cattle: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

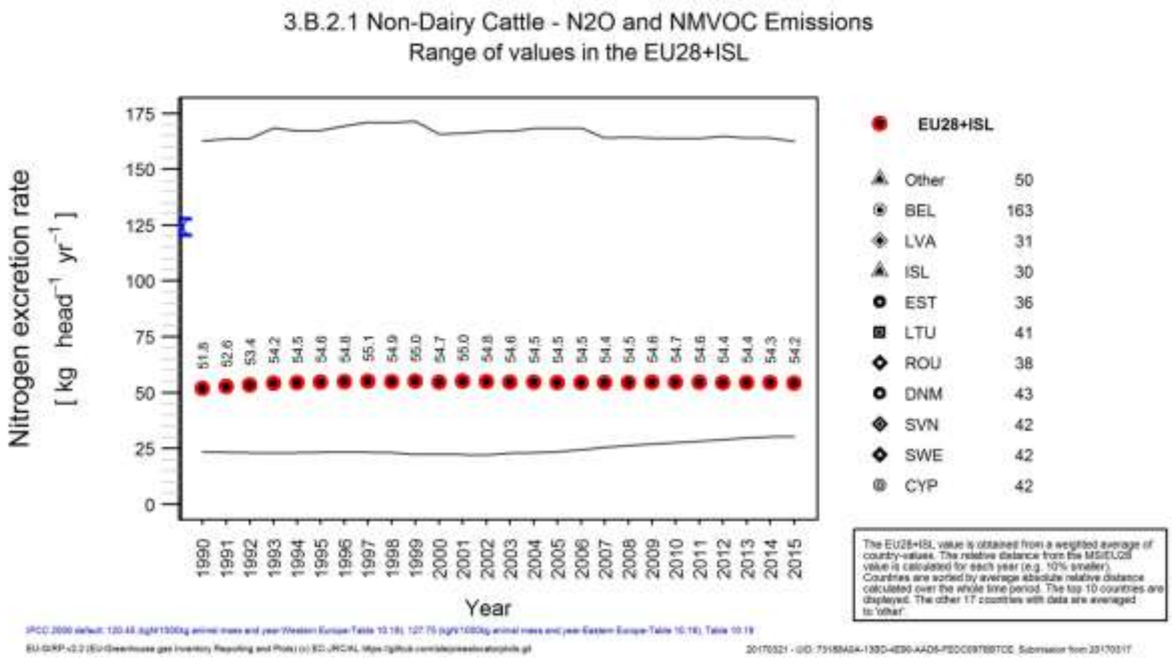


Table 5.34 3.B.2.1 - Non-Dairy Cattle: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2015	Member State	1990	2015
Austria	40	46	Ireland	49	50
Belgium	163	163	Iceland	29	30
Bulgaria	43	49	Italy	50	51
Cyprus	42	42	Lithuania	40	41
Czech Republic	55	67	Luxembourg	45	46
Germany	41	42	Latvia	23	31
Denmark	36	43	Malta	45	42
Estonia	32	36	Netherlands	57	41
Spain	43	42	Poland	33	34
Finland	34	52	Portugal	44	50
France	57	59	Romania	38	38
United Kingdom	53	53	Sweden	39	42
Greece	48	55	Slovakia	42	45
Croatia	55	50	**EU28+ISL**	**51**	**53**

Member State	1990	2015		Member State	1990	2015
Hungary	44	51	|			

3.B.2.3 - Swine - Implied emission factor

The implied emission factor for N_2O emissions in source category *3.B.2.3 - Swine* decreased in EU28+ISL considerably between 1990 and 2015 by 20.7% or 0.0145 kg/head/year. 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 5.35 shows the implied emission factor for N_2O emissions in source category *3.B.2.3 - Swine* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in seventeen countries and increased in ten countries. No data were available for Iceland and the Netherlands. The three countries with the largest decreases were Bulgaria, Estonia and Sweden with a mean absolute value of 0.0088 kg/head/year. The largest increases occurred in Bulgaria and Estonia with a mean absolute value of 0.007 kg/head/year.

Figure 5.52: 3.B.2.3 - Swine: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

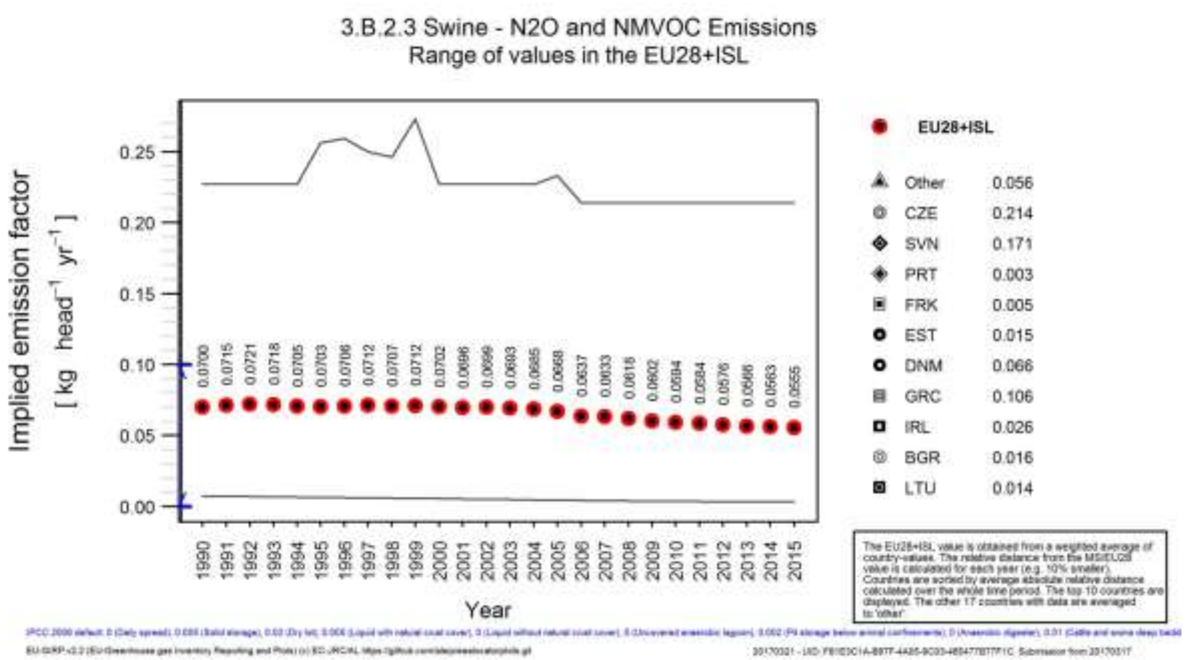


Table 5.35 3.B.2.3 - Swine: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	0.0541	0.0453	|	Hungary	0.0623	0.0626
Belgium	0.0460	0.0369	|	Ireland	0.0277	0.0263
Bulgaria	0.0079	0.0161	|	Italy	0.0944	0.0706
Cyprus	0.0935	0.0438	|	Lithuania	0.1433	0.0137
Czech Republic	0.2271	0.2137	|	Luxembourg	0.0702	0.0552
Germany	0.0695	0.0798	|	Latvia	0.0964	0.0592

Denmark	0.1441	0.0664	Malta	0.0352	0.0362
Estonia	0.0088	0.0146	Poland	0.0784	0.0814
Spain	0.0469	0.0385	Portugal	0.0073	0.0034
Finland	0.0652	0.0318	Romania	0.0402	0.0450
France	0.0124	0.0053	Sweden	0.0626	0.0751
United Kingdom	0.0808	0.0769	Slovenia	0.2212	0.1706
Greece	0.1061	0.1061	Slovakia	0.0881	0.0904
Croatia	0.0715	0.0184	**EU28+ISL**	**0.0700**	**0.0555**

3.B.2.3 - Swine - Nitrogen excretion rate

The nitrogen excretion rate, a parameter used for calculating N_2O emissions in source category *3.B.2.3 - Swine*, decreased in EU28+ISL moderately between 1990 and 2015 by 8.8% or 1.15 kg/head/year. Figure 5.53 shows the trend of the nitrogen excretion rate in EU28+ISL indicating also the range of values used by the countries. Table 5.36 shows the nitrogen excretion rate in source category *3.B.2.3 - Swine* for the years 1990 and 2015 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in nineteen countries and increased in six countries. It was in 2015 at the level of 1990 in two countries. No data were available for the United Kingdom. The largest decreases occurred in Denmark and the Netherlands with a mean absolute value of 3 kg/head/year. The three countries with the largest increases were Sweden, Germany and Estonia with a mean absolute value of 1 kg/head/year. Sweden explains this fact by an update of nitrogen production data for sows and pigs in 2002, due to more intense swine production. The time trend also shows steps because surveys are only done biannually and small percentage differences in the survey have a significant effect on emissions, emission factors differing considerably between the different systems.

Figure 5.53: 3.B.2.3 - Swine: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

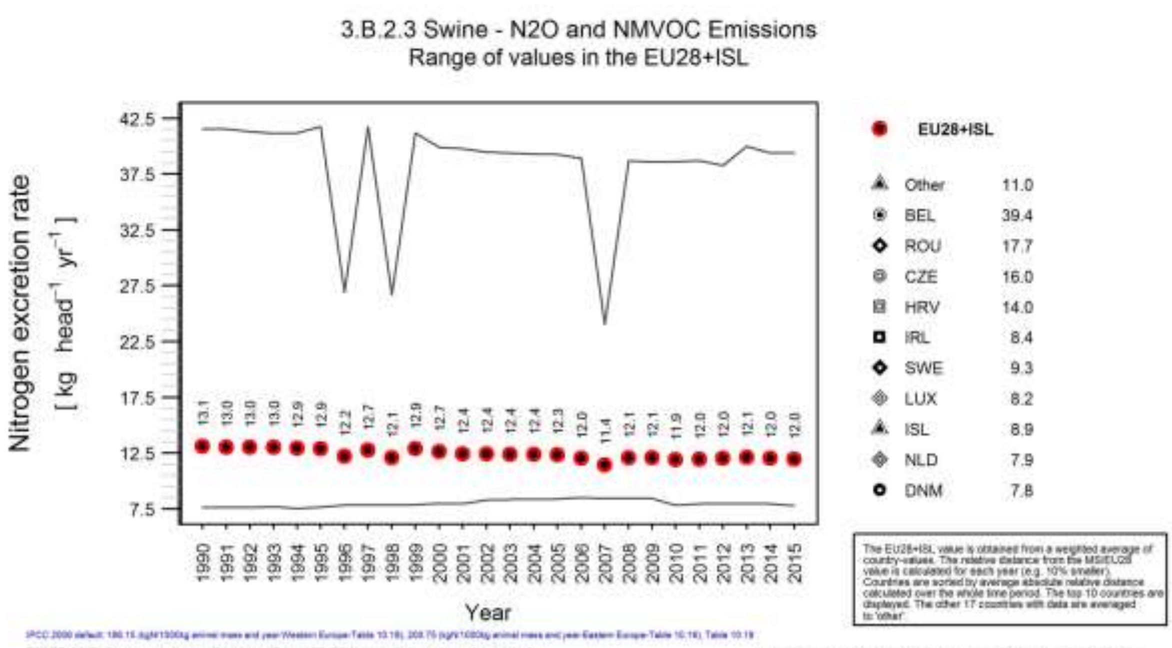


Table 5.36 3.B.2.3 - Swine: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	9.6	9.5	|	Ireland	8.8	8.4
Belgium	41.5	39.4	|	Italy	12.0	12.3
Bulgaria	12.5	11.7	|	Lithuania	12.3	11.9
Cyprus	11.9	11.2	|	Luxembourg	8.9	8.2
Czech Republic	17.0	16.0	|	Latvia	12.3	10.9
Germany	12.1	13.0	|	Malta	11.2	11.5
Denmark	11.9	7.8	|	Netherlands	10.8	7.9
Estonia	8.9	9.4	|	Poland	10.0	10.4
Spain	12.1	9.6	|	Portugal	10.3	9.3
Finland	12.2	12.0	|	Romania	17.7	17.7
France	10.6	9.6	|	Sweden	7.6	9.3
Greece	13.5	13.5	|	Slovakia	10.5	10.7
Croatia	16.9	14.0	|	Slovenia	12.7	12.2
Hungary	9.7	9.5	|	**EU28+ISL**	**13.1**	**12.0**
Iceland	9.2	8.9				

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 considerably between 1990 and 2015 by 17.2% or 0.000363 kg/head/year. Figure 5.54 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.37 shows the implied emission factor for N_2O emissions in source category *3.B.2.4.7 - Poultry* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in seventeen countries and increased in nine countries. It was in 2015 at the level of 1990 in two countries. No data were available for the Netherlands. The largest decreases occurred in Iceland and Finland with a mean absolute value of 0.0071 kg/head/year. The three countries with the largest increases were Luxembourg, Slovenia and Lithuania with a mean absolute value of 0.0011 kg/head/year.

Figure 5.54: 3.B.2.4.7 - Poultry: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

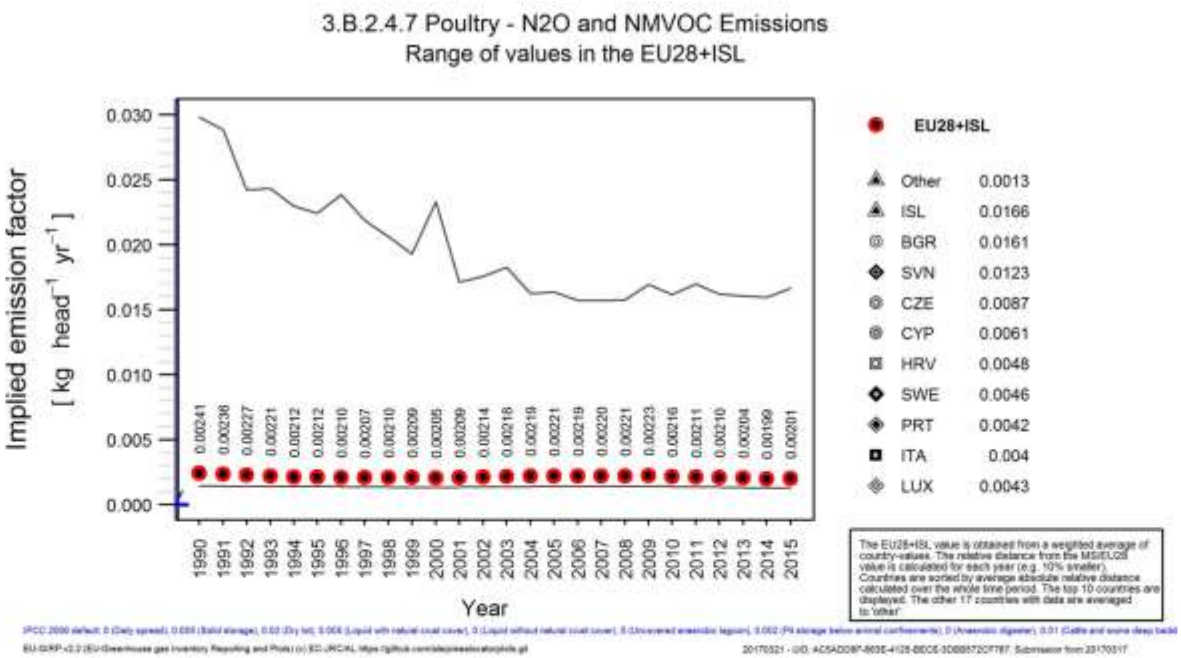


Table 5.37 3.B.2.4.7 - Poultry: Member States' and EU28+ISL implied emission factor (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	0.00092	0.00080	|	Ireland	0.00109	0.00106
Belgium	0.00094	0.00092	|	Iceland	0.02980	0.01664
Bulgaria	0.01585	0.01606	|	Italy	0.00409	0.00396
Cyprus	0.00715	0.00606	|	Lithuania	0.00053	0.00063
Czech Republic	0.00872	0.00872	|	Luxembourg	0.00344	0.00426
Germany	0.00110	0.00123	|	Latvia	0.00342	0.00277
Denmark	0.00112	0.00089	|	Malta	0.00108	0.00107
Estonia	0.00337	0.00326	|	Poland	0.00078	0.00085
Spain	0.00071	0.00072	|	Portugal	0.00435	0.00421
Finland	0.00288	0.00179	|	Romania	0.00119	0.00135
France	0.00074	0.00070	|	Sweden	0.00473	0.00462
United Kingdom	0.00114	0.00089	|	Slovenia	0.00999	0.01233
Greece	0.00085	0.00085	|	Slovakia	0.00231	0.00184
Croatia	0.00507	0.00483	|	**EU28+ISL**	**0.00211**	**0.00175**
Hungary	0.00135	0.00141	|			

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 slightly between 1990 and 2015 by 4.9% or 0.0307 kg/head/year. Figure

5.55 shows the trend of the nitrogen excretion rate in EU28+ISL indicating also the range of values used by the countries. Table 5.38 shows the nitrogen excretion rate in source category *3.B.2.4.7 - Poultry* for the years 1990 and 2015 for all Member States and EU28+ISL. Nitrogen excretion rate decreased in fifteen countries and increased in six countries. It was in 2015 at the level of 1990 in seven countries. No data were available for the Netherlands. The three countries with the largest decreases were the United Kingdom, Denmark and Austria with a mean absolute value of 0.1 kg/head/year. The three countries with the largest increases were Luxembourg, Hungary and Finland with a mean absolute value of 0.1 kg/head/year.

Figure 5.55: 3.B.2.4.7 - Poultry: Trend in nitrogen excretion rate in the EU28+ISL and range of values reported by countries

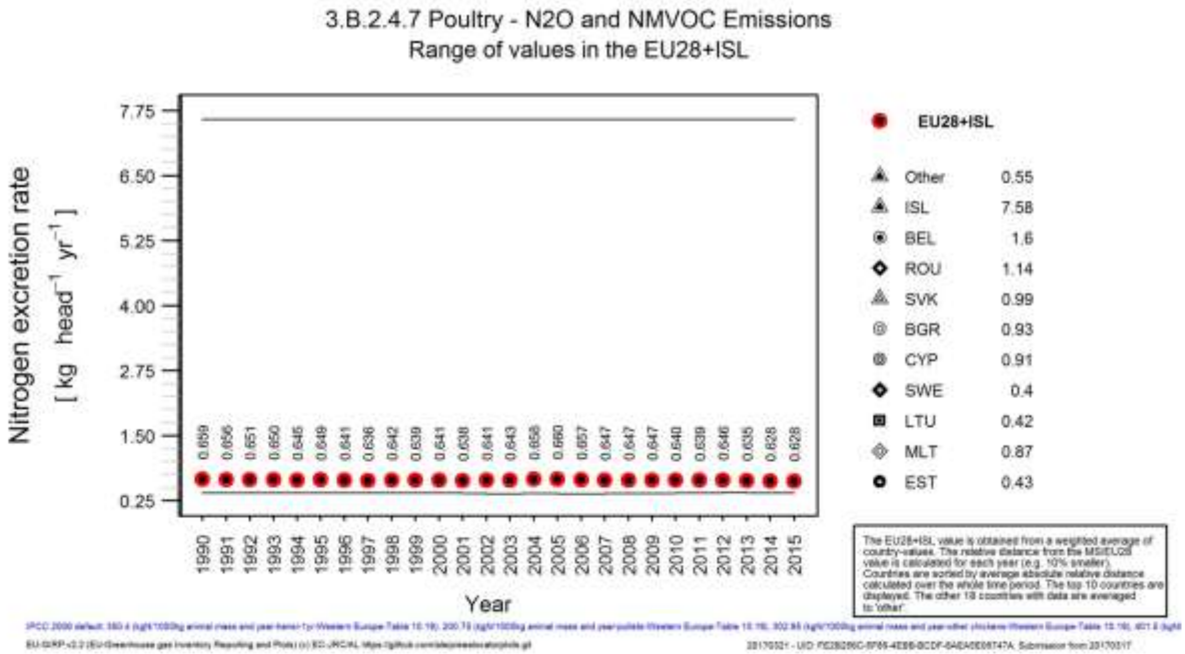


Table 5.38 3.B.2.4.7 - Poultry: Member States' and EU28+ISL nitrogen excretion rate (kg/head/year)

Member State	1990	2015		Member State	1990	2015
Austria	0.59	0.54	|	Ireland	0.60	0.55
Belgium	1.65	1.60	|	Iceland	7.58	7.58
Bulgaria	0.94	0.93	|	Italy	0.52	0.50
Cyprus	0.91	0.91	|	Lithuania	0.39	0.42
Czech Republic	0.60	0.60	|	Luxembourg	0.44	0.54
Germany	0.70	0.69	|	Latvia	0.45	0.45
Denmark	0.63	0.55	|	Malta	0.87	0.87
Estonia	0.44	0.43	|	Poland	0.50	0.48
Spain	0.45	0.45	|	Portugal	0.55	0.55
Finland	0.50	0.56	|	Romania	1.14	1.14
France	0.49	0.48	|	Sweden	0.43	0.40
United Kingdom	0.73	0.58	|	Slovenia	0.47	0.50

Member State	1990	2015		Member State	1990	2015
Greece	0.50	0.50	|	Slovakia	1.05	0.99
Croatia	0.85	0.85	|	**EU28+ISL**	**0.63**	**0.60**
Hungary	0.48	0.56	|			

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 2015 by 0.2% or 3.24e-05 kg N_2O/kg N. Figure 5.56 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.B.2.5 - Indirect N_2O emissions from manure management* - *Indirect N_2O emissions* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in one country and increased in nine countries. It was in 2015 at the level of 1990 in nineteen countries. A decrease occurred in Romania with an absolute value of 1.1e-13 kg N_2O/kg N. The three countries with the largest increases were Iceland, Croatia and Estonia with a mean absolute value of 7.6e-05 kg N_2O/kg N.

Table 5.39 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	2015		Member State	1990	2015
Austria	0.016	0.016	|	Ireland	0.016	0.016
Belgium	0.016	0.016	|	Iceland	0.016	0.016
Bulgaria	0.016	0.016	|	Italy	0.016	0.016
Cyprus	0.016	0.016	|	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	|	Netherlands	0.016	0.016
Spain	0.016	0.016	|	Poland	0.016	0.016
Finland	0.016	0.016	|	Portugal	0.016	0.016
France	0.016	0.016	|	Romania	0.016	0.016
United Kingdom	0.016	0.016	|	Sweden	0.016	0.016
Greece	0.016	0.016	|	Slovenia	0.016	0.016
Croatia	0.025	0.025	|	Slovakia	0.016	0.016
Hungary	0.016	0.016	|	**EU28+ISL**	**0.016**	**0.016**

3.B.2.5 - Indirect N_2O emissions from leaching 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 leaching from manure management* - *Indirect N_2O emissions* increased in EU28+ISL barely between 1990 and 2015 by 0.097% or 1.14e-05 kg N_2O/kg N. Figure 5.56 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.B.2.5 - Indirect N_2O emissions from leaching from* *manure management - Indirect N_2O emissions* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in one country and increased in six countries. It was in 2015 at the level of 1990 in seven countries. No data were available for fifteen countries (Austria, Belgium, Bulgaria, Czech Republic, Germany, Denmark, Croatia, Ireland, Iceland, Luxembourg, Malta, the Netherlands, Sweden, Slovenia and Slovakia). A decrease occurred in Romania with an absolute value of 7.6e-05 kg N_2O/kg N. The three countries with the largest increases were Cyprus, Estonia and Poland with a mean absolute value of 3.1e-05 kg N_2O/kg N.

Figure 5.57: 3.B.2.5 - Indirect N_2O emissions from leaching from manure management: Trend in implied emission factor in the EU28+ISL and range of values reported by countries

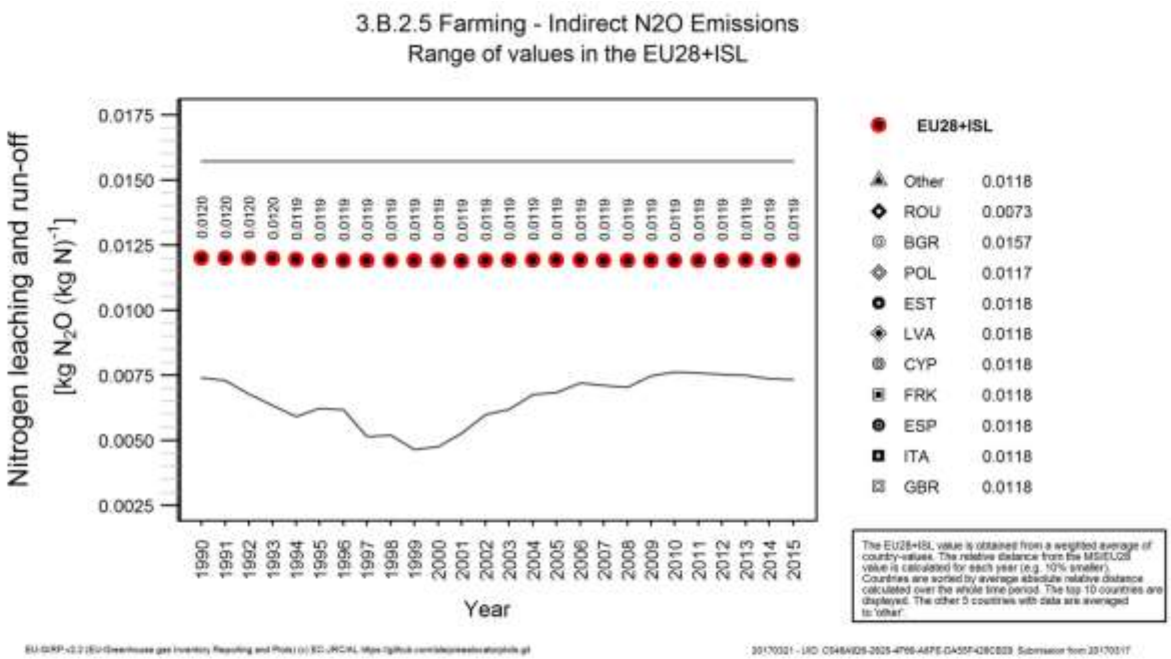


Table 5.40 3.B.2.5 - Indirect N_2O emissions from leaching from manure management: Member States' and EU28+ISL implied emission factor (kg N_2O/kg N)

Member State	1990	2015		Member State	1990	2015
Cyprus	0.0118	0.0118	|	Italy	0.0118	0.0118
Estonia	0.0118	0.0118	|	Lithuania	0.0118	0.0118
Spain	0.0118	0.0118	|	Latvia	0.0118	0.0118
Finland	0.0118	0.0118	|	Poland	0.0117	0.0117
France	0.0118	0.0118	|	Portugal	0.0118	0.0118
United Kingdom	0.0118	0.0118	|	Romania	0.0074	0.0073
Greece	0.0118	0.0118	|	**EU28+ISL**	**0.0117**	**0.0118**
Hungary	0.0118	0.0118	|			

5.2.4 Direct Emissions from Managed Soils - N_2O (CRF Source Category 3D1)

N_2O the emissions in source category *3.D.1 - Direct N_2O Emissions From Managed Soils* for N_2O emissions in source category *3.D.1 - Direct N_2O Emissions From Managed Soils* are 2.8% of total EU28+ISL GHG emissions and 52% of total EU28+ISL N_2O emissions. They make 30.5% of total agricultural emissions and 72% of total agricultural N_2O 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 5.58. Regarding the origin of emissions in the different Member States, Figure 5.59 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 blue correspond to the emitting sub-categories.

Figure 5.58: 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 2015. 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.

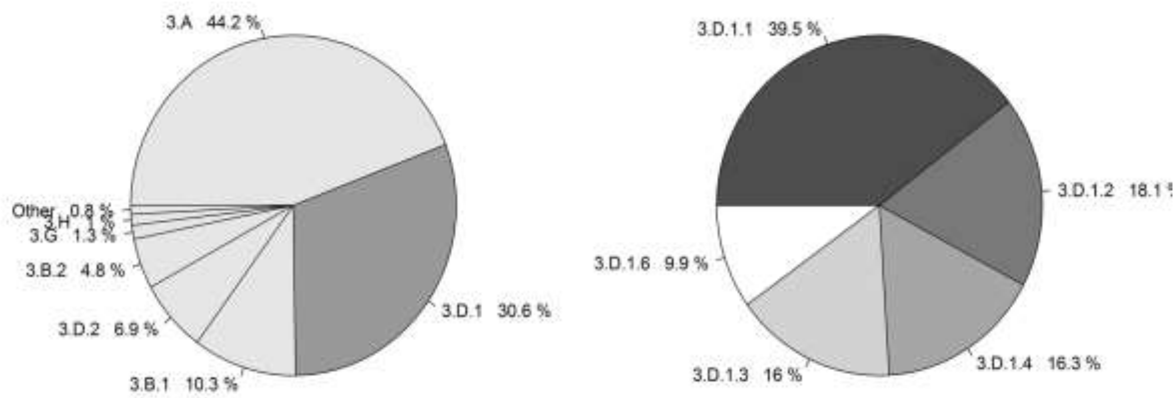
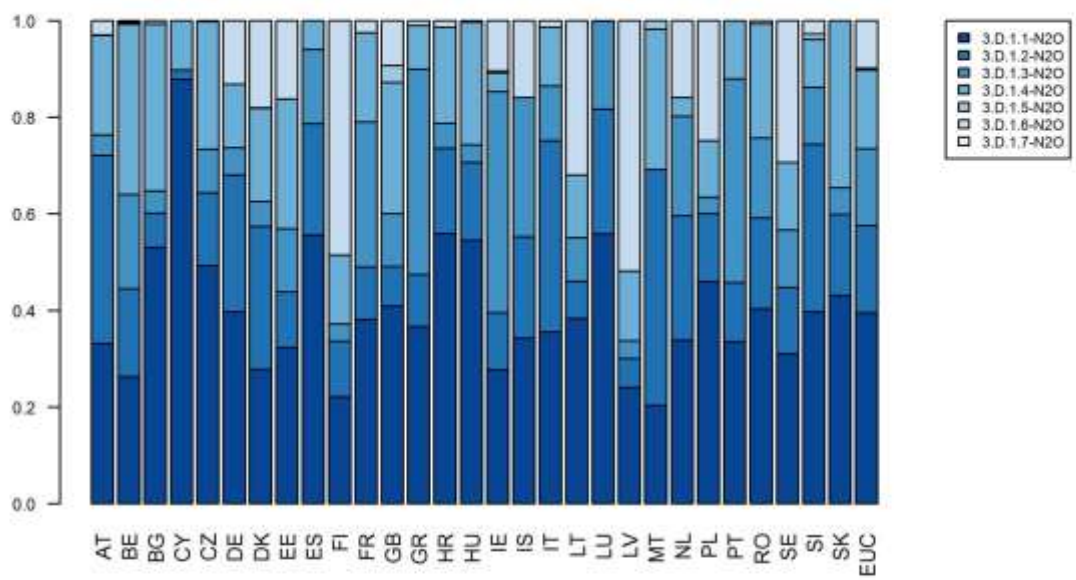


Figure 5.59: Decomposition of emissions in source category 3.D.1 - Direct N_2O Emissions From Managed Soils into its sub-categories by Member State in the year 2015. 3.D.1.1 inorganic N fertilisers, 3.D.1.2 organic N fertilisers, 3.D.1.3 urine and dung deposited by grazing animals, 3.D.1.4 crop residues 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 5.41 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 16% or 25.7 Mt CO_2-eq. The decrease was largest in Romania in relative terms (44%) and in Poland in absolute terms (3.8 Mt CO_2-eq). From 2014 to 2015 emissions in the current category decreased by 0.1%.

Table 5.41 3.D.1 - Direct N_2O Emissions From Managed Soils: Member States' contributions to total GHG and N_2O emissions

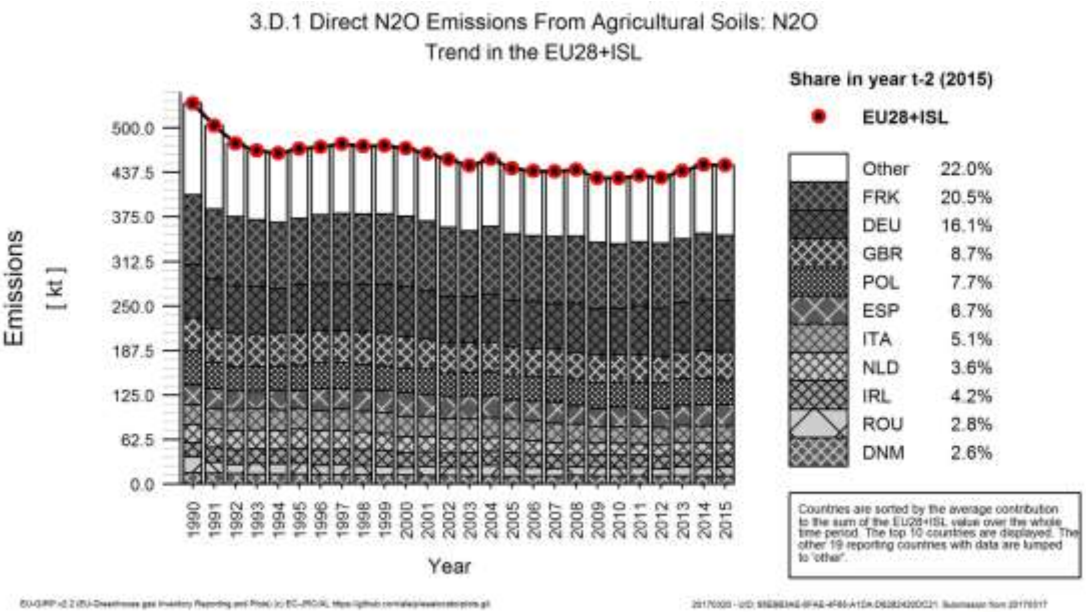
Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	1 884	1 718	1 711	1.3%	-7	0%	-173	-9%	T1	D
Belgium	3 356	2 658	2 567	1.9%	-91	-3%	-789	-24%	NA	NA
Bulgaria	4 039	2 193	2 851	2.1%	658	30%	-1 189	-29%	T1	D
Croatia	1 028	698	735	0.6%	37	5%	-293	-28%	T1	D
Cyprus	129	105	96	0.1%	-9	-8%	-33	-26%	T1	D
Czech Republic	4 210	2 608	2 569	1.9%	-39	-1%	-1 641	-39%	T1,T2	CS,D
Denmark	4 585	3 314	3 317	2.5%	3	0%	-1 269	-28%	CS,D,T1,T2	D
Estonia	894	499	519	0.4%	21	4%	-375	-42%	CS,T1,T2	D
Finland	3 314	3 056	3 038	2.3%	-17	-1%	-275	-8%	T1,T2	CS,D
France	29 048	27 671	27 319	20.5%	-353	-1%	-1 730	-6%	T1,T2	D
Germany	22 427	21 233	21 522	16.1%	289	1%	-905	-4%	T1,T2	CS,D
Greece	3 569	2 350	2 365	1.8%	15	1%	-1 204	-34%	T1	D
Hungary	3 381	3 011	3 082	2.3%	71	2%	-300	-9%	T1	D
Ireland	6 045	5 573	5 596	4.2%	23	0%	-450	-7%	T1	D
Italy	8 335	6 873	6 826	5.1%	-47	-1%	-1 509	-18%	CS,T1	CS,D
Latvia	1 967	1 416	1 480	1.1%	64	4%	-487	-25%	T1	D
Lithuania	2 693	1 990	2 036	1.5%	45	2%	-657	-24%	T1	D
Luxembourg	139	106	107	0.1%	0	0%	-32	-23%	T1	CS,D
Malta	15	15	15	0.0%	0	0%	0	-2%	T1	D
Netherlands	7 519	4 722	4 860	3.6%	139	3%	-2 658	-35%	T1,T1b,T2	CS,D
Poland	14 056	10 933	10 232	7.7%	-701	-6%	-3 824	-27%	T1	CS,D
Portugal	1 807	1 700	1 690	1.3%	-9	-1%	-117	-6%	T1	D
Romania	6 696	3 634	3 734	2.8%	100	3%	-2 961	-44%	T1	D
Slovakia	2 187	1 249	1 247	0.9%	-2	0%	-941	-43%	T1,T2	CS,D
Slovenia	328	334	334	0.3%	1	0%	7	2%	T1	D
Spain	8 348	8 992	8 996	6.7%	4	0%	648	8%	CS,T1a,T1b	D
Sweden	3 157	2 931	2 867	2.1%	-64	-2%	-290	-9%	T1,T2	CS,D
United Kingdom	13 831	11 807	11 553	8.7%	-254	-2%	-2 278	-16%	T1,T1a,T2	CS,D
EU-28	**158 989**	**133 388**	**133 264**	**100%**	**-124**	**0%**	**-25 725**	**-16%**	**-**	**-**
Iceland	171	172	159	0.1%	-13	-7%	-12	-7%	T1b,T2	CS,D
United Kingdom (KP)	13 831	11 807	11 553	8.7%	-254	-2%	-2 278	-16%	T1,T1a,T2	CS,D
EU-28 + ISL	**159 160**	**133 560**	**133 423**	**100%**	**-137**	**0%**	**-25 737**	**-16%**	**-**	**-**

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 25.7 Mt CO_2-eq in the period 1990 to 2015. 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 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 77.9% of the total. Emissions decreased in 27 countries and increased in two countries. The three countries with the largest decreases were Poland, Romania and the Netherlands with a total absolute decrease of 9.4 Mt CO_2-eq. The largest increases occurred in Spain, with a total absolute increase of 648 kt CO_2-eq.

Figure 5.60: 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 2015



The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 23% and 14% below 1990 levels in 2015, 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 considerably in EU28+ISL by 24% or 16.5 Mt CO_2-eq in the period 1990 to 2015. Figure 5.61 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 80.1% of the total. Emissions decreased in 26 countries and increased in three countries. The largest decreases occurred in the United Kingdom and France with a total absolute decrease of 4.6 Mt CO_2-eq. The largest increases occurred in Hungary and Slovenia, with a total absolute increase of 7 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 considerably in EU28+ISL by 23% or 3.3 kt N/year in the period 1990 to 2015. Figure 5.62 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 80.6% of the total. Application of inorganic fertilizers decreased in 26 countries and increased in three countries. The three countries with the largest decreases were the United Kingdom, France and Germany with a total absolute decrease of 1.2 kt N/year. The largest increases occurred in Hungary and Slovenia, with a total absolute increase of 2 kt N/year.

Figure 5.61: 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 2015

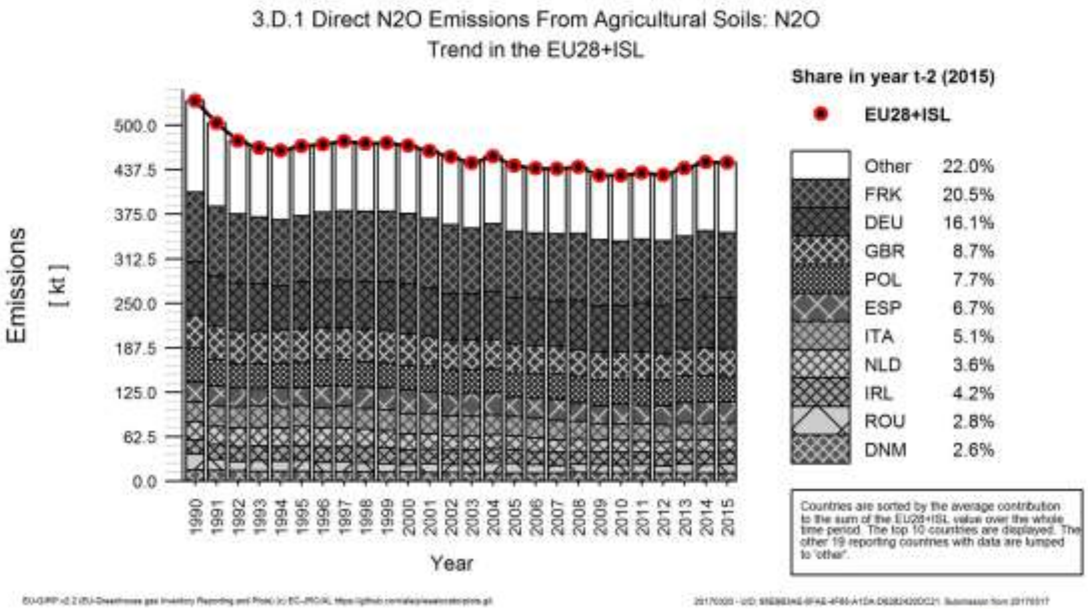
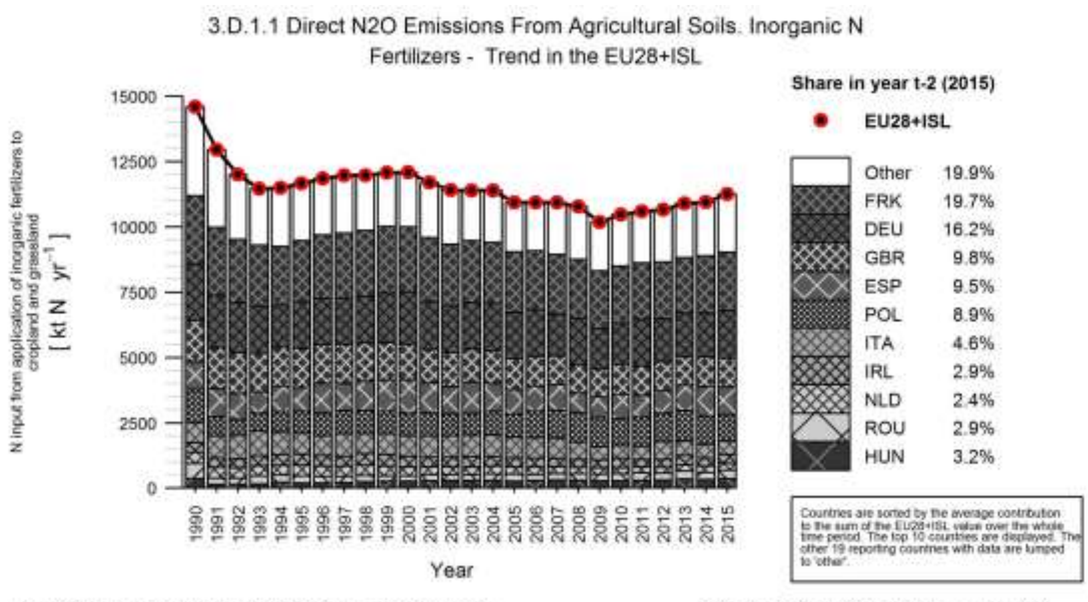


Figure 5.62: 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers: Trend in application of inorganic fertilizers in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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 11% or 2.9 Mt CO_2-eq in the period 1990 to 2015. Figure 5.63 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 82.2% of the total. Emissions decreased in 23 countries and increased in six countries. The three countries with the largest decreases were Romania, Poland and Czech Republic with a total absolute decrease of 2.2 Mt CO_2-eq. The three countries with the largest increases were Spain, the Netherlands and Germany, with a total absolute increase of 1.5 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 878 kt N/year in the period 1990 to 2015. Figure 5.64 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 82.9% of the total. N from applied organic N fertilizers decreased in 24 countries and increased in five countries. The largest decreases occurred in Romania and Poland with a total absolute decrease of 360 kt N/year. The largest increases occurred in Spain and Germany, with a total absolute increase of 227 kt N/year.

Figure 5.63: 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 2015

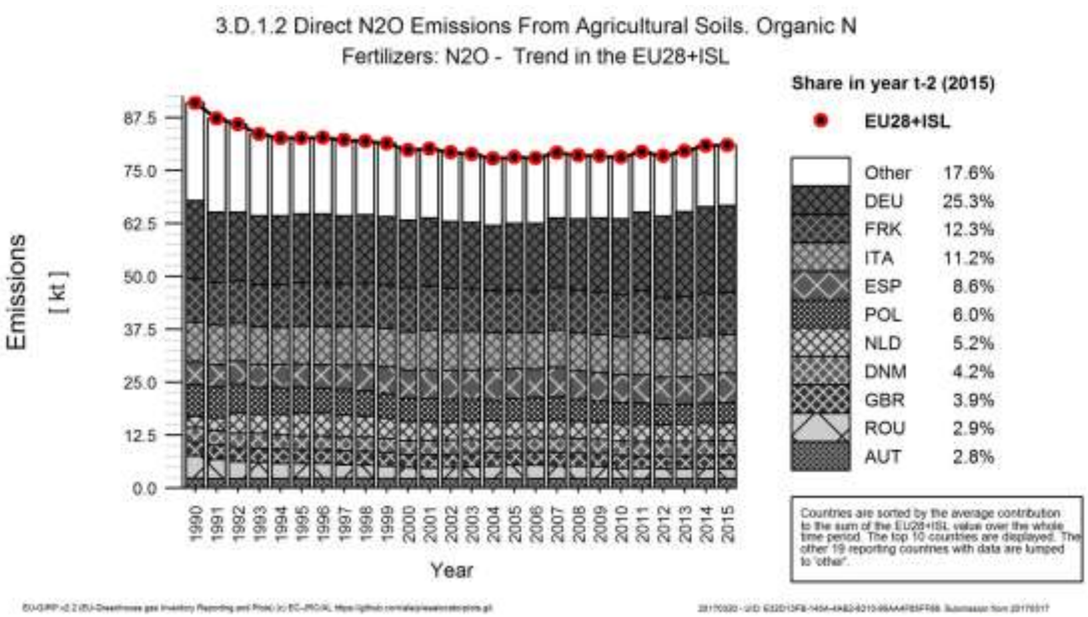
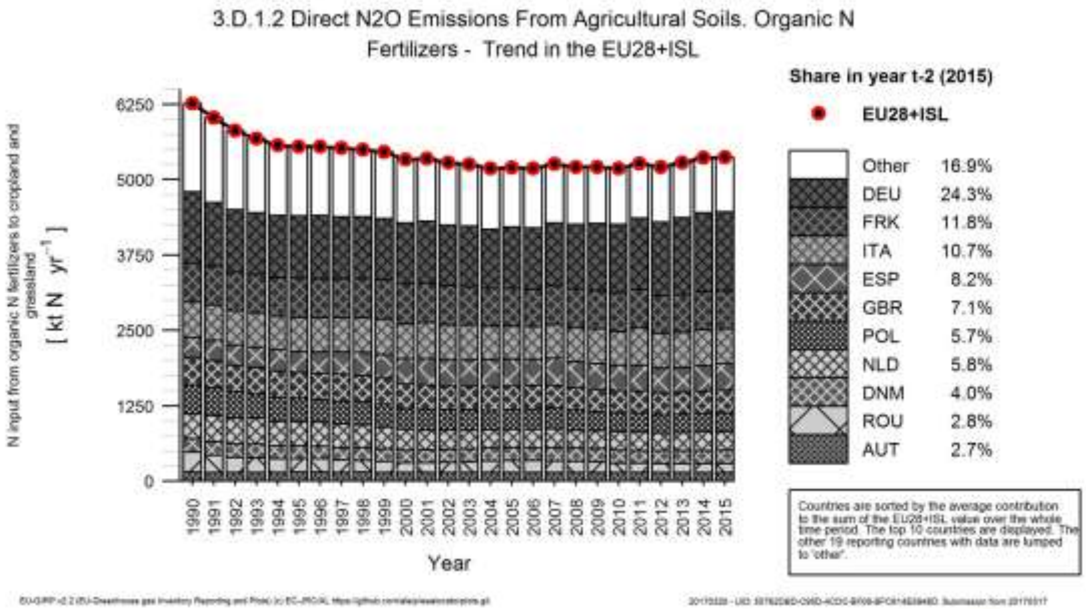


Figure 5.64: 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



3.D.1.3 - Urine and Dung Deposited by Grazing Animals - Emissions

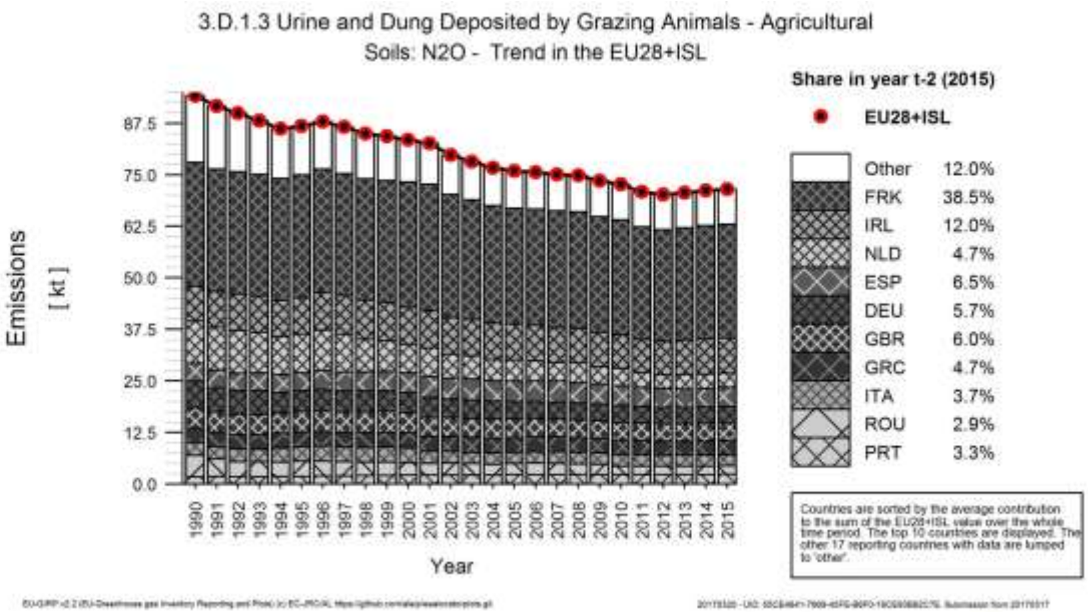
N_2O emissions in source category *3.D.1.3 - Urine and Dung Deposited by Grazing Animals* are 0.44% of total EU28+ISL GHG emissions and 8.3% of total EU28+ISL N_2O emissions. They make 4.9% of total agricultural emissions and 12% of total agricultural N_2O emissions.

Total GHG and N_2O emissions by Member State from 3.D.1.3 *Grazing Animals* 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 24% or 6.7 Mt CO_2-eq. The decrease was largest in Bulgaria in relative terms (77%) and in the Netherlands in absolute terms (2 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 0.5%. 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 grazing animals for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 88% of the total. Emissions decreased in 22 countries and increased in five countries. The three countries with the largest decreases were the Netherlands, Romania and France with a total absolute decrease of 3.6 Mt CO_2-eq. The largest increases occurred in Spain and Portugal, with a total absolute increase of 254 kt CO_2-eq.

Table 5.42 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	149	72	73	0.3%	0	0%	-76	-51%	T1	D
Belgium	711	504	502	2.4%	-2	0%	-209	-29%	-	-
Bulgaria	577	139	133	0.6%	-5	-4%	-444	-77%	T1	D
Croatia	106	37	38	0.2%	1	4%	-68	-64%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	244	223	231	1.1%	9	4%	-12	-5%	T1	D
Denmark	298	183	177	0.8%	-6	-3%	-121	-41%	T1	D
Estonia	170	70	68	0.3%	-2	-3%	-103	-60%	CS,T2	D
Finland	151	109	110	0.5%	1	0%	-42	-28%	T1	D
France	8 926	8 164	8 215	38.5%	51	1%	-711	-8%	T1,T2	D
Germany	1 909	1 206	1 212	5.7%	5	0%	-697	-37%	T1	D
Greece	1 058	1 009	1 008	4.7%	-2	0%	-50	-5%	T1	D
Hungary	193	112	115	0.5%	3	2%	-79	-41%	T1	D
Ireland	2 552	2 538	2 560	12.0%	22	1%	8	0%	T1	D
Italy	934	779	779	3.7%	0	0%	-155	-17%	T1	CS,D
Latvia	150	54	55	0.3%	1	2%	-95	-63%	T1	D
Lithuania	416	183	183	0.9%	0	0%	-234	-56%	T1	D
Luxembourg	19	19	20	0.1%	0	2%	0	2%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 028	1 055	999	4.7%	-55	-5%	-2 029	-67%	T1	D
Poland	1 048	350	350	1.6%	1	0%	-697	-67%	T1	CS,D
Portugal	538	700	712	3.3%	13	2%	174	32%	T1	D
Romania	1 522	613	622	2.9%	9	1%	-900	-59%	T1	D
Slovakia	148	68	68	0.3%	0	0%	-80	-54%	T1	CS
Slovenia	18	39	40	0.2%	1	2%	21	117%	T1	D
Spain	1 308	1 322	1 388	6.5%	67	5%	80	6%	CS,T1a,T1b	D
Sweden	361	344	342	1.6%	-2	-1%	-19	-5%	T1	D
United Kingdom	1 456	1 273	1 275	6.0%	3	0%	-181	-12%	T2	CS
EU-28	**27 990**	**21 165**	**21 274**	**100%**	**109**	**1%**	**-6 716**	**-24%**	**-**	**-**
Iceland	48	46	46	0.2%	0	-1%	-2	-4%	-	-
United Kingdom (KP)	1 456	1 273	1 275	6.0%	3	0%	-181	-12%	T2	CS
EU-28 + ISL	**28 038**	**21 211**	**21 320**	**100%**	**109**	**1%**	**-6 718**	**-24%**	**-**	**-**

Figure 5.65: 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 2015



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 2015 by 1.2% or 0.000125 kg N_2O-N/kg N. Figure 5.66 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.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in three countries and increased in six countries. It was in 2015 at the level of 1990 in twenty countries. Decreases occurred in the United Kingdom, Luxembourg and France with a mean absolute value of 0.00037 kg N_2O-N/kg N. The three countries with the largest increases were Iceland, Belgium and Cyprus with a mean absolute value of 4.5e-06 kg N_2O-N/kg N.

Figure 5.66: 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

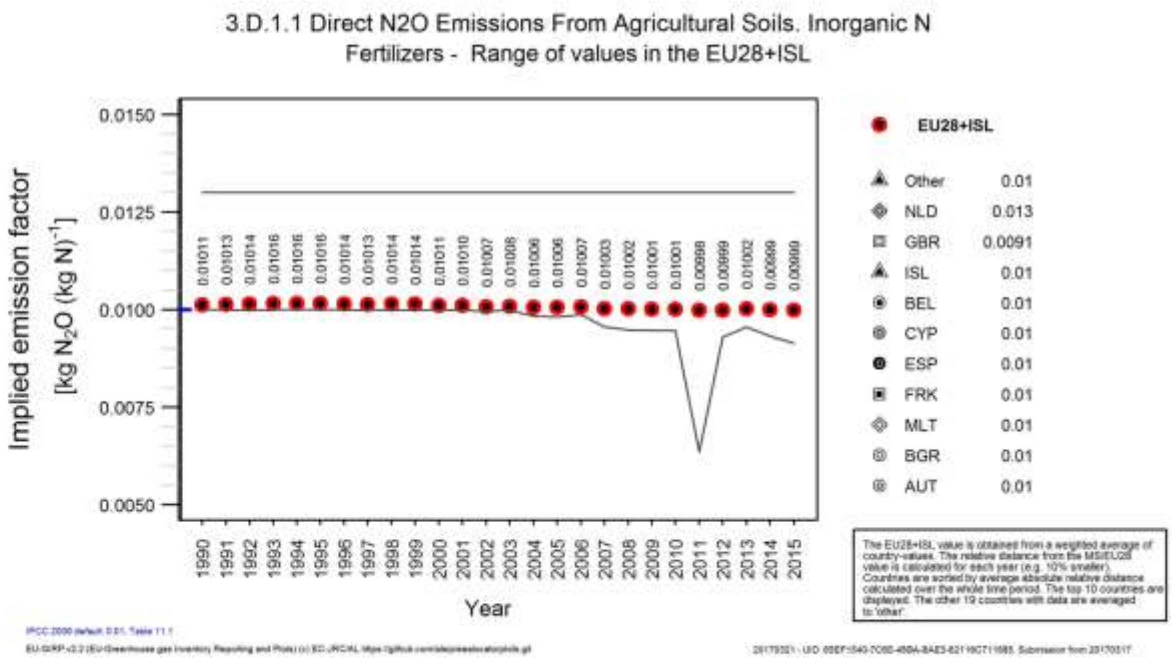


Table 5.43 3.D.1.1 - Direct N_2O Emissions From Inorganic N Fertilizers Inorganic N Fertilizers: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)

Member State	1990	2015		Member State	1990	2015
Austria	0.010	0.0100	|	Ireland	0.010	0.0100
Belgium	0.010	0.0100	|	Iceland	0.010	0.0100
Bulgaria	0.010	0.0100	|	Italy	0.010	0.0100
Cyprus	0.010	0.0100	|	Lithuania	0.010	0.0100
Czech Republic	0.010	0.0100	|	Luxembourg	0.010	0.0100
Germany	0.010	0.0100	|	Latvia	0.010	0.0100
Denmark	0.010	0.0100	|	Malta	0.010	0.0100
Estonia	0.010	0.0100	|	Netherlands	0.013	0.0130
Spain	0.010	0.0100	|	Poland	0.010	0.0100
Finland	0.010	0.0100	|	Portugal	0.010	0.0100
France	0.010	0.0100	|	Romania	0.010	0.0100
United Kingdom	0.010	0.0091	|	Sweden	0.010	0.0100
Greece	0.010	0.0100	|	Slovenia	0.010	0.0100
Croatia	0.010	0.0100	|	Slovakia	0.010	0.0100
Hungary	0.010	0.0100	|	**EU28+ISL**	**0.010**	**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 2015 by 3.8% or 0.000347 kg N_2O-N/kg N. Figure 5.67 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.44 shows the implied emission factor for N_2O emissions in source category *3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in five countries and increased in six countries. It was in 2015 at the level of 1990 in eighteen countries. The three countries with the largest decreases were Iceland, Cyprus and Belgium with a mean absolute value of 1.3e-06 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 5.67: 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

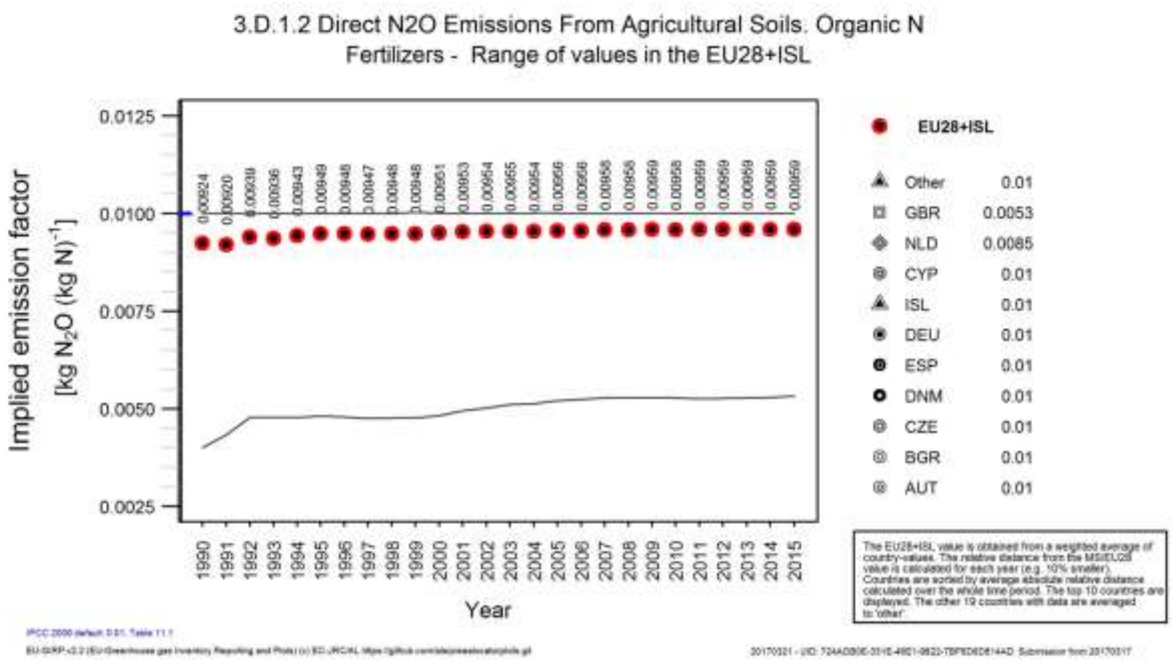


Table 5.44 3.D.1.2 - Direct N_2O Emissions From Organic N Fertilizers Organic N Fertilizers: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)

Member State	1990	2015		Member State	1990	2015
Austria	0.0100	0.0100	|	Ireland	0.0100	0.0100
Belgium	0.0100	0.0100	|	Iceland	0.0100	0.0100
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

Member State	1990	2015		Member State	1990	2015
Estonia	0.0100	0.0100	|	Netherlands	0.0040	0.0085
Spain	0.0100	0.0100	|	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	0.0048	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**	**0.0092**	**0.0096**

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 5.45 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 2015 for all Member States and EU28+ISL. The implied emission factor decreased in thirteen countries and increased in twelve countries. It was in 2015 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, Austria 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 Spain with a mean absolute value of 0.0013 kg N_2O-N/kg N.

Table 5.45 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	2015		Member State	1990	2015
Austria	0.0182	0.0156	|	Ireland	0.0184	0.0189
Belgium	0.0197	0.0195	|	Iceland	0.0110	0.0114
Bulgaria	0.0115	0.0125	|	Italy	0.0112	0.0112
Czech Republic	0.0174	0.0182	|	Lithuania	0.0190	0.0193
Germany	0.0191	0.0190	|	Luxembourg	0.0100	0.0100
Denmark	0.0187	0.0179	|	Latvia	0.0196	0.0191
Estonia	0.0190	0.0186	|	Netherlands	0.0330	0.0330
Spain	0.0133	0.0145	|	Poland	0.0178	0.0191
Finland	0.0179	0.0170	|	Portugal	0.0163	0.0182
France	0.0186	0.0189	|	Romania	0.0174	0.0150
United Kingdom	0.0044	0.0044	|	Sweden	0.0174	0.0169
Greece	0.0104	0.0105	|	Slovenia	0.0185	0.0175
Croatia	0.0140	0.0117	|	Slovakia	0.0168	0.0156
Hungary	0.0138	0.0147	|			

5.2.5 Indirect Emissions from Managed Soils - N_2O (CRF Source Category 3D2)

N_2O the emissions in source category *3.D.2 - Indirect Emissions from Managed Soils* for N_2O emissions in source category *3.D.2 - Indirect Emissions from Managed Soils* are 0.63% of total EU28+ISL GHG emissions and 12% of total EU28+ISL N_2O emissions. They make 6.9% of total agricultural emissions and 16% of total agricultural N_2O 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 5.68. Regarding the origin of emissions in the different Member States, Figure 5.69 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 blue correspond to the emitting sub-categories.

Figure 5.68: 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 2015.

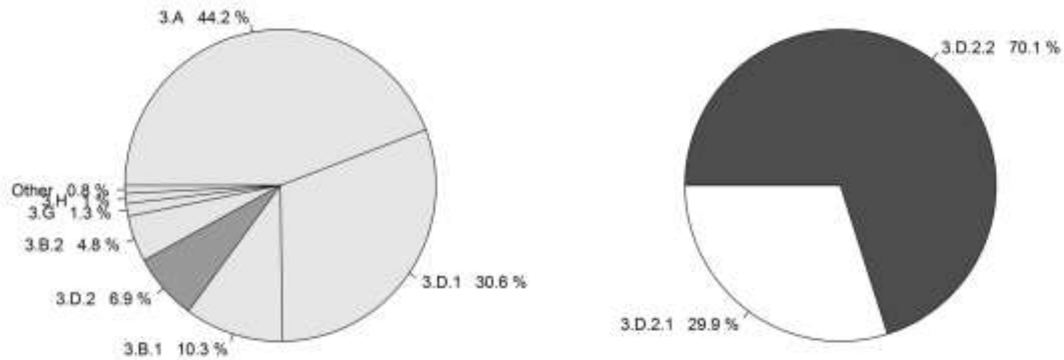
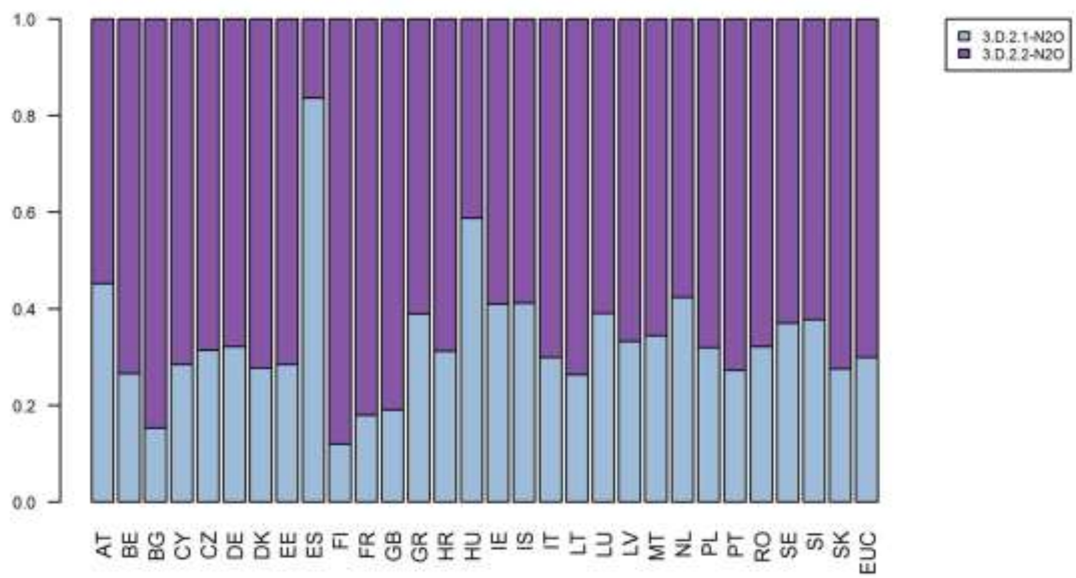


Figure 5.69: Decomposition of emissions in source category 3.D.2 - Indirect Emissions from Managed Soils into its sub-categories by Member State in the year 2015. 3.D.2.1 Atmospheric Deposition and 3.D.2.2 Nitrogen Leaching and Run-off.



Total GHG and N_2O emissions by Member State from 3.D.2 *Indirect Emissions from Managed Soils* are shown in Table 5.46 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 2015). Values are given in kt CO_2-eq. Between 1990 and 2015, N_2O emission in this source category decreased by 20% or 7.7 Mt CO_2-eq. The decrease was largest in the Netherlands in relative terms (63%) and in Poland in absolute terms (1.1 Mt CO_2-eq). From 2014 to 2015 emissions in the current category increased by 0.9%.

Table 5.46 3.D.2 - Indirect Emissions from Managed Soils: Member States' contributions to total GHG and N_2O emissions

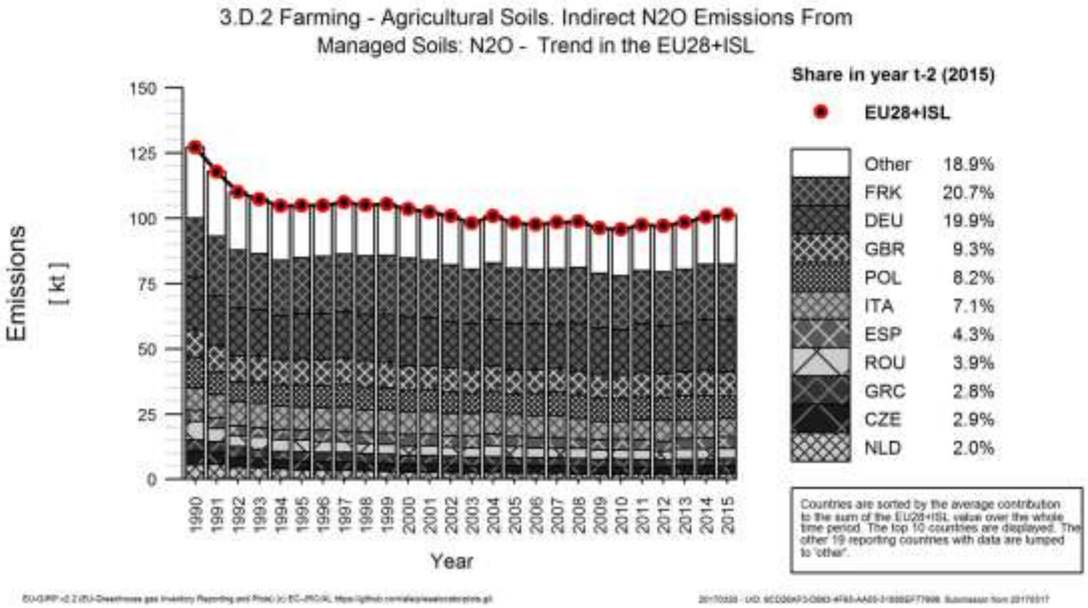
Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	363	339	339	1.1%	1	0%	-24	-7%	T1	D
Belgium	1 052	731	709	2.3%	-21	-3%	-342	-33%	-	-
Bulgaria	1 186	578	750	2.5%	172	30%	-436	-37%	T1	D
Croatia	332	222	235	0.8%	13	6%	-96	-29%	T1	D
Cyprus	20	10	36	0.1%	26	249%	16	83%	T1	D
Czech Republic	1 587	895	889	2.9%	-6	-1%	-698	-44%	T1	D
Denmark	863	509	547	1.8%	39	8%	-315	-37%	T2	D
Estonia	235	122	127	0.4%	5	4%	-108	-46%	D,T1	D
Finland	482	393	389	1.3%	-4	-1%	-94	-19%	T1	D
France	6 700	6 301	6 245	20.7%	-55	-1%	-455	-7%	T1,T2	CS,D
Germany	6 148	5 832	6 005	19.9%	173	3%	-143	-2%	T1	D
Greece	1 242	838	844	2.8%	5	1%	-399	-32%	T1	D
Hungary	311	207	221	0.7%	14	7%	-90	-29%	T1	D
Ireland	521	478	484	1.6%	6	1%	-37	-7%	T1	CS,D
Italy	2 594	2 151	2 134	7.1%	-17	-1%	-459	-18%	T1	CS,D
Latvia	320	167	178	0.6%	11	7%	-142	-45%	T1	D
Lithuania	606	383	396	1.3%	13	3%	-210	-35%	T1	D
Luxembourg	50	39	39	0.1%	0	0%	-10	-21%	T1	D
Malta	5	5	5	0.0%	0	0%	0	-5%	T1	D
Netherlands	1 649	592	609	2.0%	17	3%	-1 040	-63%	T1	D
Poland	3 552	2 681	2 486	8.2%	-194	-7%	-1 066	-30%	T1	D
Portugal	499	422	424	1.4%	2	0%	-75	-15%	T1,T2	CS,D
Romania	2 151	1 120	1 165	3.9%	45	4%	-987	-46%	T1	D
Slovakia	714	382	379	1.3%	-3	-1%	-335	-47%	T1	D
Slovenia	114	111	111	0.4%	1	0%	-2	-2%	T1	D
Spain	1 177	1 290	1 314	4.3%	24	2%	137	12%	CS,T1a,T1b	D
Sweden	385	298	300	1.0%	1	0%	-85	-22%	CS	D
United Kingdom	2 999	2 812	2 813	9.3%	1	0%	-186	-6%	CS,T1	D
EU-28	**37 855**	**29 908**	**30 174**	**100%**	**266**	**1%**	**-7 681**	**-20%**	**-**	**-**
Iceland	52	53	49	0.2%	-4	-8%	-4	-7%	T1b	D
United Kingdom (KP)	2 999	2 812	2 813	9.3%	1	0%	-186	-6%	CS,T1	D
EU-28 + ISL	**37 907**	**29 961**	**30 223**	**100%**	**262**	**1%**	**-7 684**	**-20%**	**-**	**-**

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 20% or 7.7 Mt CO_2-eq in the period 1990 to 2015. Figure 5.70 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 81.5% of the total. Emissions decreased in 27 countries and increased in two countries. The three countries with the largest decreases were Poland, the Netherlands and Romania with a total absolute decrease of 3.1 Mt CO_2-eq. Emissions increased in Cyprus and Spain, with a total absolute increase of 153 kt CO_2-eq.

Figure 5.70: 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 2015



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 25% or 3.1 Mt CO_2-eq in the period 1990 to 2015. Figure 5.71 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 81.4% of the total. Emissions decreased in 26 countries and increased in three countries. The three countries with the largest decreases were the Netherlands, Romania and Poland with a total absolute decrease of 1.5 Mt CO_2-eq. The largest increases occurred in Germany and Spain, with a total absolute increase of 151 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 664 kt N/year in the period 1990 to 2015. Figure 5.72 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 81.3% of the total. Volatilized N from agricultural N inputs decreased in 26 countries and increased in three countries. The three countries with the largest decreases were the Netherlands, Romania and Poland with a total absolute decrease of 326 kt N/year. The largest increases occurred in Germany and Spain, with a total absolute increase of 32 kt N/year.

Figure 5.71: 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 2015

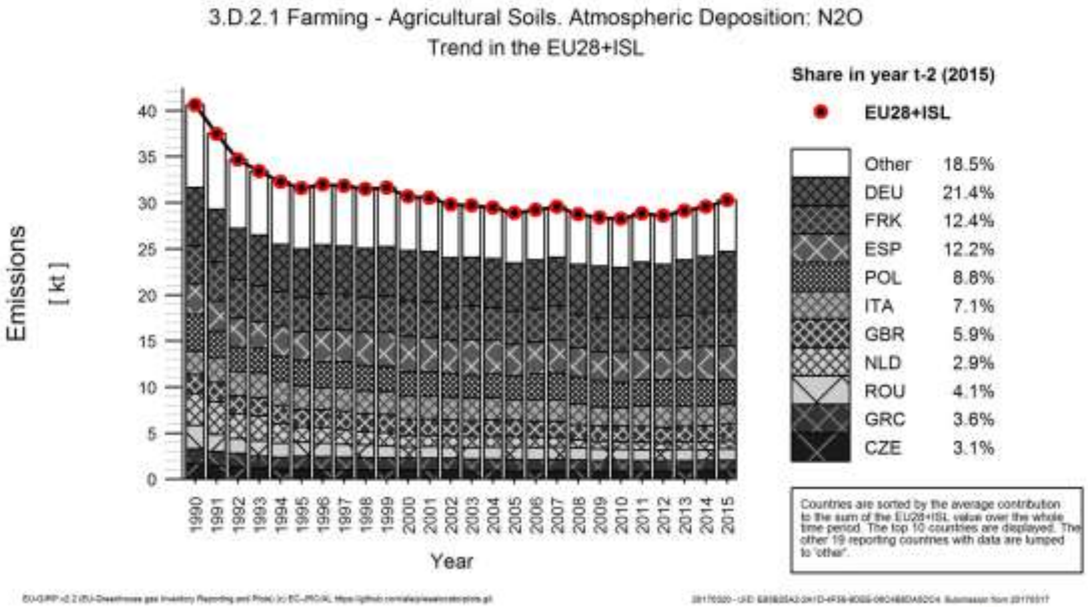
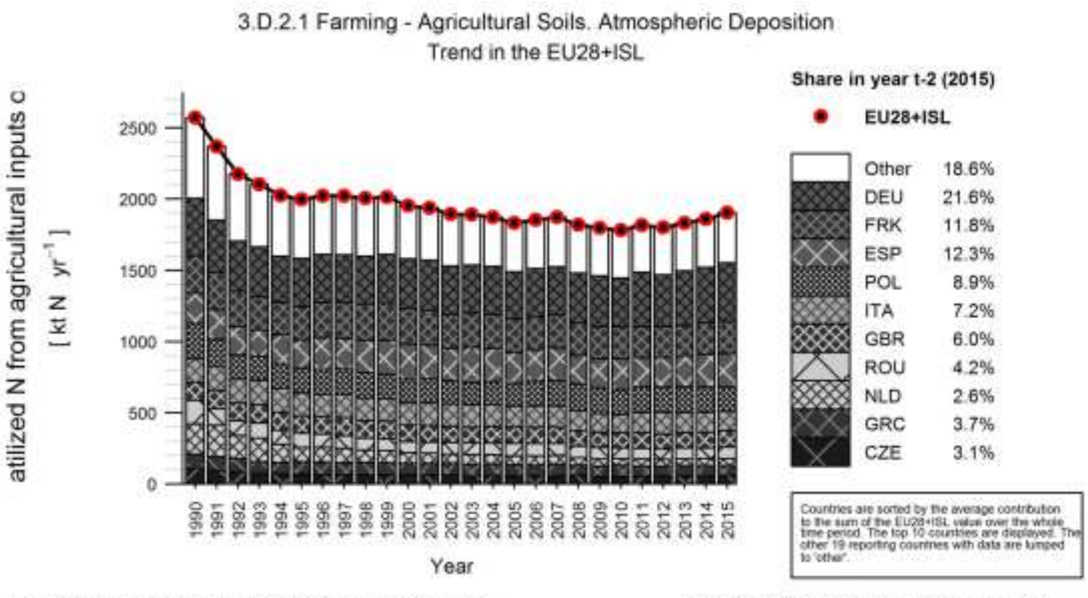


Figure 5.72: 3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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 18% or 4.6 Mt CO_2-eq in the period 1990 to 2015. Figure 5.73 shows the trend of emissions indicating the countries contributing most to EU28+ISL total. The figure represents the trend in N_2O emissions for the different Member States along the inventory period. The ten countries with the highest emissions accounted together for 83.7% of the total. Emissions decreased in 27 countries and increased in two countries. The largest decreases occurred in Poland and Romania with a total absolute decrease of 1.3 Mt CO_2-eq. Emissions increased in Cyprus and Spain, with a total absolute increase of 33 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 18% or 1.4 kt N/year in the period 1990 to 2015. Figure 5.74 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 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 83.5% of the total. N from fertilizers and other agricultural inputs that is lost through leaching and run-off decreased in 27 countries and increased in two countries. The largest decreases occurred in Poland and Romania with a total absolute decrease of 367 kt N/year. N from fertilizers and other agricultural inputs that is lost through leaching and run-off increased in Cyprus and Spain, with a total absolute increase of 9 kt N/year.

Figure 5.73: 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 2015

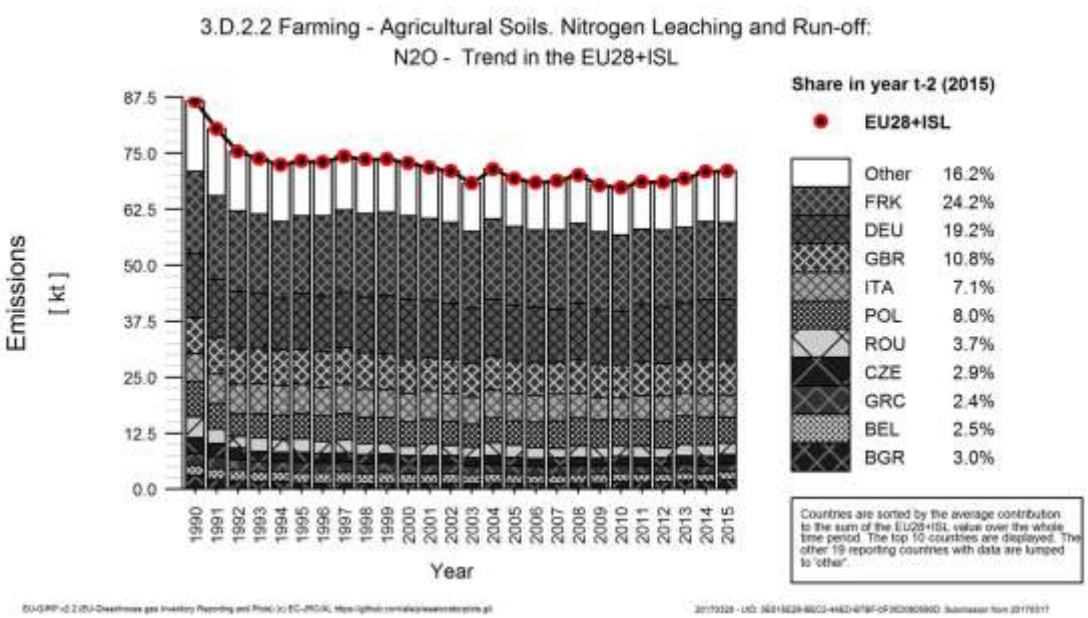
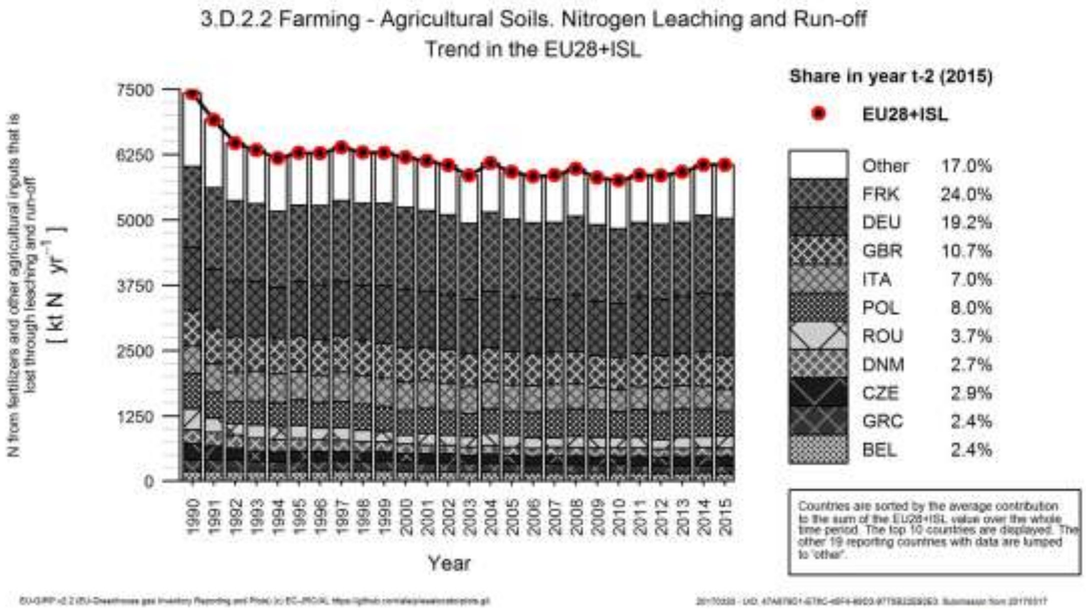


Figure 5.74: 3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off: Trend in emissions in the EU28+ISL and the countries contributing most to EU28+ISL values including their share to EU28+ISL emissions in 2015



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 2015 by 0.66% or 6.65e-05 kg N_2O-N/kg N. Figure 5.75 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.47 shows the implied emission factor for N_2O emissions in source category *3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition* for the years 1990 and 2015 for all Member States and EU28+ISL. The implied emission factor decreased in four countries and increased in six countries. It was in 2015 at the level of 1990 in nineteen countries. The three countries with the largest decreases were Iceland, Luxembourg and Slovenia with a mean absolute value of 3.3e-06 kg N_2O-N/kg N. The three countries with the largest increases were the Netherlands, France and Portugal with a mean absolute value of 0.00045 kg N_2O-N/kg N.

Figure 5.75: 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

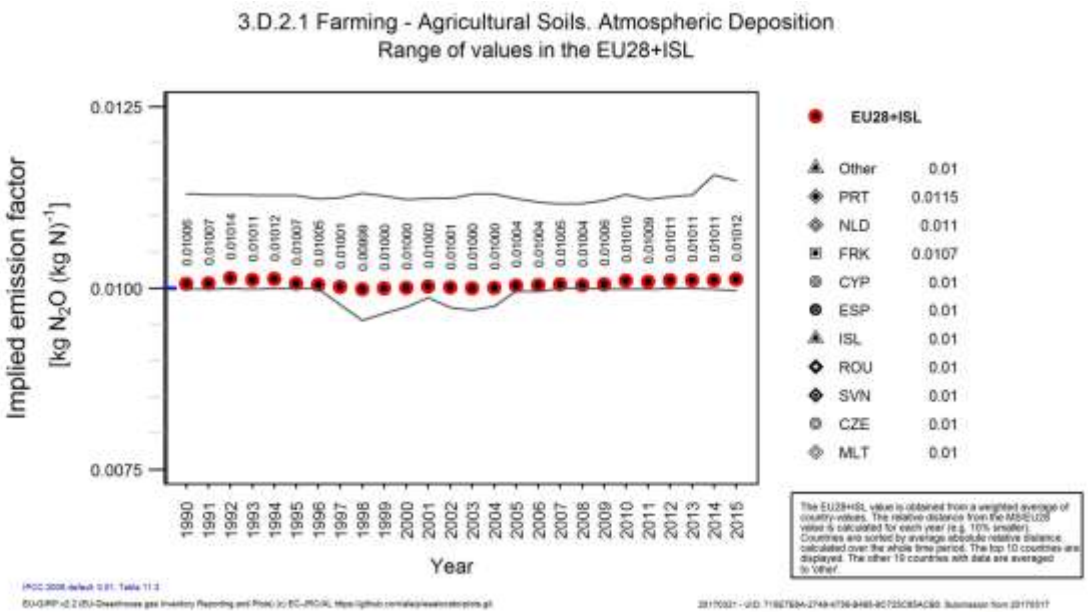


Table 5.47 3.D.2.1 - Indirect N_2O Emissions from Atmospheric Deposition: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)

Member State	1990	2015		Member State	1990	2015
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	0.011	|	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 5.48 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 2015 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 six countries and increased in nine countries. It was in 2015 at the level of 1990 in fourteen countries. The largest decreases occurred in Iceland and Hungary with a mean absolute value of 0.016. The three countries with the largest increases were Germany, Austria and the United Kingdom with a mean absolute value of 0.016.

Table 5.48 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	2015		Member State	1990	2015
Austria	0.041	0.052	|	Ireland	0.028	0.023
Belgium	0.231	0.255	|	Iceland	0.034	0.020
Bulgaria	0.035	0.035	|	Italy	0.087	0.101
Cyprus	0.100	0.100	|	Lithuania	0.063	0.069
Czech Republic	0.100	0.100	|	Luxembourg	0.100	0.100
Germany	0.061	0.091	|	Latvia	0.100	0.100
Denmark	0.059	0.051	|	Malta	0.100	0.100
Estonia	0.100	0.100	|	Netherlands	0.041	0.050
Spain	0.100	0.100	|	Poland	0.100	0.100
Finland	0.016	0.015	|	Portugal	0.063	0.070
France	0.100	0.100	|	Romania	0.100	0.100
United Kingdom	0.026	0.033	|	Sweden	0.026	0.031
Greece	0.100	0.100	|	Slovenia	0.072	0.070
Croatia	0.100	0.100	|	Slovakia	0.100	0.100
Hungary	0.064	0.047	|			

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 5.49 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 2015 for all Member States and EU28+ISL. The fraction of livestock N excretion that volatilises as NH_3 and NO_x decreased in eleven countries and increased in three countries. It was in 2015 at the level of 1990 in fourteen countries. No data were available for Cyprus. The largest decreases occurred in the Netherlands and Denmark with a mean absolute value of 0.1. Increases occurred in Finland, Iceland and Ireland with a mean absolute value of 0.0065.

Table 5.49 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	2015		Member State	1990	2015
Austria	0.176	0.174	|	Ireland	0.078	0.080
Belgium	0.706	0.573	|	Iceland	0.219	0.225
Bulgaria	0.200	0.200	|	Italy	0.231	0.220
Czech Republic	0.200	0.200	|	Lithuania	0.200	0.200
Germany	0.195	0.172	|	Luxembourg	0.200	0.200
Denmark	0.140	0.086	|	Latvia	0.200	0.200
Estonia	0.200	0.200	|	Malta	0.200	0.200
Spain	0.200	0.200	|	Netherlands	0.403	0.173
Finland	0.076	0.088	|	Poland	0.200	0.200
France	0.200	0.200	|	Portugal	0.201	0.168
United Kingdom	0.075	0.072	|	Romania	0.200	0.200
Greece	0.200	0.200	|	Sweden	0.185	0.174
Croatia	0.200	0.200	|	Slovenia	0.389	0.356
Hungary	0.100	0.089	|	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 2015 by 0.63% or 4.66e-05 kg N_2O-N/kg N. Figure 5.76 shows the trend of the implied emission factor in EU28+ISL indicating also the range of values used by the countries. Table 5.50 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 2015 for all Member States and EU28+ISL. The implied emission factor decreased in six countries and increased in three countries. It was in 2015 at the level of 1990 in twenty countries. The three countries with the largest decreases were France, Cyprus and Luxembourg with a mean absolute value of 2.3e-06 kg N_2O-N/kg N. Increases occurred in Denmark, Spain and Iceland with a mean absolute value of 0.00024 kg N_2O-N/kg N.

Figure 5.76: 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

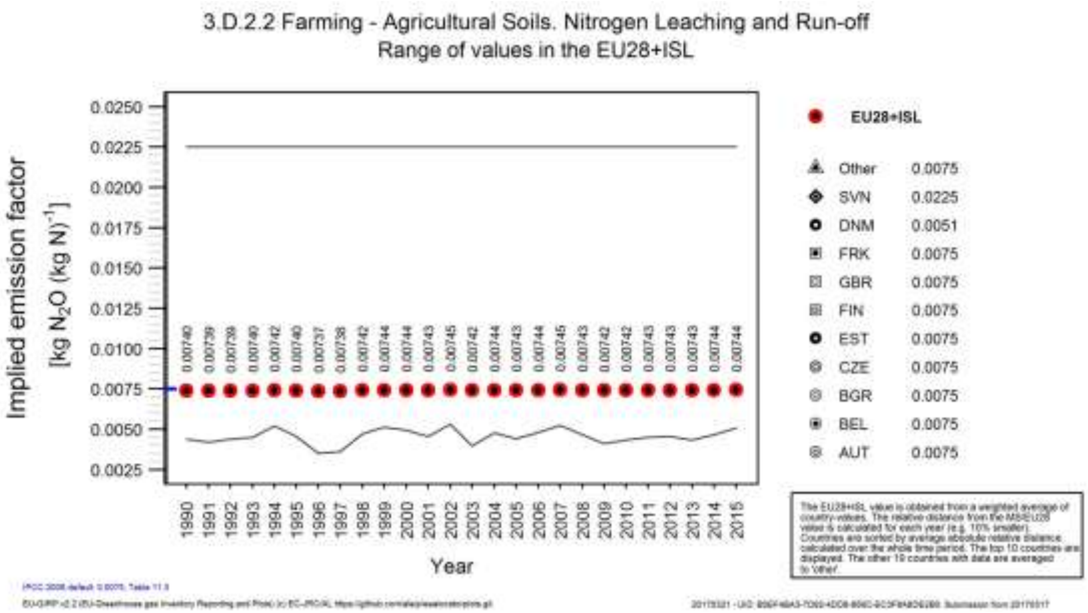


Table 5.50 3.D.2.2 - Indirect N_2O Emissions from Nitrogen leaching and run-off: Member States' and EU28+ISL implied emission factor (kg N_2O-N/kg N)

Member State	1990	2015		Member State	1990	2015
Austria	0.0075	0.0075	|	Ireland	0.0075	0.0075
Belgium	0.0075	0.0075	|	Iceland	0.0075	0.0075
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	0.0051	|	Malta	0.0075	0.0075
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	0.0076	0.0075	|	Romania	0.0075	0.0075
United Kingdom	0.0075	0.0075	|	Sweden	0.0075	0.0075
Greece	0.0075	0.0075	|	Slovenia	0.0225	0.0225
Croatia	0.0075	0.0075	|	Slovakia	0.0075	0.0075
Hungary	0.0075	0.0075	|	**EU28+ISL**	**0.0074**	**0.0074**

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 5.51 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 2015 for all Member States and EU28+ISL. Fraction of N input to managed soils that is lost through leaching and run-off decreased in four countries and increased in two countries. It was in 2015 at the level of 1990 in 22 countries. No data were available for Romania. The largest decrease occurred in Malta with an absolute value of 0.3. Increases occurred in the United Kingdom and Spain with a mean absolute value of 0.013.

Table 5.51 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	2015		Member State	1990	2015
Austria	0.152	0.152	|	Hungary	0.300	0.300
Belgium	0.900	0.900	|	Ireland	0.100	0.100
Bulgaria	0.300	0.300	|	Iceland	0.300	0.300
Cyprus	0.300	0.300	|	Italy	0.300	0.300
Czech Republic	0.300	0.300	|	Lithuania	0.300	0.300
Germany	0.300	0.300	|	Luxembourg	0.300	0.300
Denmark	0.339	0.285	|	Latvia	0.230	0.230
Estonia	0.300	0.300	|	Malta	0.300	
Spain	0.032	0.033	|	Netherlands	0.150	0.130
Finland	0.300	0.300	|	Poland	0.300	0.300
France	0.300	0.300	|	Portugal	0.300	0.300
United Kingdom	0.209	0.234	|	Sweden	0.170	0.134
Greece	0.300	0.300	|	Slovenia	0.300	0.300
Croatia	0.300	0.300	|	Slovakia	0.300	0.300

5.3 Uncertainties

Table 5.52 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 5.52 Sector Agriculture: EU-28 uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	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	244 395	191 811	-22%	11%	0.0%
3.A Enteric Fermentation	N2O	0	0		0%	
3.B Manure Mangement	CO2	0	0		0%	
3.B Manure Mangement	CH4	53 643	44 655	-17%	20%	0.0%
3.B Manure Mangement	N2O	27 720	19 981	-28%	87%	0.1%
3.C Rice Cultivation	CO2	0	0		0%	
3.C Rice Cultivation	CH4	2 448	2 170	-11%	19%	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	197 203	164 103	-17%	120%	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	1 031	676	-34%	53%	0.1%
3.F Field Burning of Agricultural Residues	N2O	362	246	-32%	60%	0.1%
3.G Liming	CO2	10 310	5 686	-45%	23%	0.1%
3.G Liming	CH4	0	0		0%	
3.G Liming	N2O	0	0		0%	
3.H Urea application	CO2	3 309	3 980	20%	17%	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	91	5%	30%	0.3%
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	1 296	37593%	41%	155.0%
3.J Other	N2O	1	245	16243%	98%	158.5%
3 (where no subsector data were submitted)	all	433	427	-1%	0%	0.0%
Total - 3	**all**	**540 946**	**435 365**	**-20%**	**46%**	**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

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.
- 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

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:

- Focusing of the agriculture chapter in the EU-GHG inventory report on key categories and factors and parameters which have a significant relevance for EU total emissions.
- 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[35]. 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[36], *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
- The writing of the agriculture chapter of the EU-GHG inventory report has been highly automated[37]. The process is directly based on the data submitted by the countries and are calculated on the fly and no quantitative data are introduced 'manually'. This allows to provide a report with quantitative information avoiding inconsistencies with the CRF data.

The newly developed system is described in the section QA/QC system in the agriculture sector.

Main improvements since 2016

Since 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 is paid to 'country outlier' and 'time series' checks, as well as to a series of specific checks for the agriculture sector focusing on consistency of the data reported and on the completeness of background data which are important for transparency.

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.

[35] 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.

[36] EU-GIRP: EU-Greenhouse gas Inventory Reporting and Plots, see https://github.com/aleip/eealocatorplots.git

[37] 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/

Further improvements

The following further improvements are foreseen for the next submission:

- Improvement of the key category analysis for the agriculture sector, both with regard to level and to trend key categories.
- 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

Quality checks

Several quality checks are performed in the EU-GIRP[38] software. They are documented in various modules of EU-GIRP and can be examined in the open source repository. The checks include:

- **ERT recommendations**: Country were checked if they had implemented last years' recommendations from the ESD review. From 64 recommendations, 18 were still unresolved and therefore the issue was reopened
- **Check on NEs**[39] and empty cells has been done by extracting all reported 'NE's and the empty cells, respectively, from the data base. The results were compared with the data contained in the file NE_checks_20170125.xlsx provided which also contained a list of empty cells.
- **Notation key abuse**: we identified emission categories where a Member State reported a notation key, while 20 or more Member States reported emission estimates, in order to assess the potential over/underestimations (these also contained in NE checks in the file above).
- **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 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[40] is carried out detecting *seven* cases which can easily be recognised. Other 'mistakes' in units used were detected

[38] EU-GIRP: EU-Greenhouse gas Inventory Reporting and Plots, see https://github.com/aleip/eealocatorplots.git

[39] https://github.com/aleip/eealocatorplots/blob/master/eugirp_checknes.r

[40] https://github.com/aleip/eealocatorplots/blob/master/eugirp_checkunits.r

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[41]. 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[42]. 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
  - *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.

41 https://github.com/aleip/eealocatorplots/blob/master/eugirp_checkoutliers.r

42 See function `ispotentialissue()` in the file https://github.com/aleip/eealocatorplots/blob/master/eugirp_functions.r

- *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[43,44]. 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
  - Check that compares the Manure 'managed' in Pasture Range and Paddock in category 3.B.2 with AD in 3.D.1.3 (Urine and Dung Deposited by Grazing Animals). The sum of FRPR over all animal types should therefore equal the AD in category 3.D.1.3.
  - Comparison of the IEF in 3.D.1.3 (N_2O emissions from Urine and Dung Deposited by Grazing Animals) with default IEFs EF3_RPR_CPP for Cattle - Pigs and Poultry (0.02) and, EF3_RPR_SO for Sheep and other animals (0.01) using the shares $Frac_{RPR\_CPP}$ and $Frac_{RPR\_SO}$ of manure deposited by the two animal groups.
  - Comparison of the fraction of N lost in MMS (via volatilization of NH_3+NO_x) versus total managed manure. According to IPCC Table 50.22 most of the Lost-fractions are between 20% and 45% of N in managed manure and N loss ratios are identified that are higher than 45% or lower than 20%.
  - Comparison of the manure 'managed' and not lost as NH_3+NO_x or leaching in MMS (3B2) with Animal manure applied to soil (3D12a). Manure available for application is obtained from N managed in MMS and not lost ($Frac_{LOSSMS}$) according to Table 50.23 plus any addition of bedding material. The loss fractions in Table 50.23 include also losses of N2 which are not included in the indirect emissions-volatilizations. Therefore FAM is expected to be smaller than N managed in MMS minus N lost as NH_3+NO_x+leaching unless bedding material has been accounted for. In case of crop residues as bedding material care has to be taken to avoid double counting.

- **Recalculation**: Countries were asked for justifications of recalculations of more than 0.05% of national total emissions (excluding LULUCF) for years 1990 and 2015, focusing on key categories.

A large number of issues were identified:

[43] https://github.com/aleip/eealocatorplots/blob/master/agrichecks1ADs.r

[44] https://github.com/aleip/eealocatorplots/blob/master/agrichecks2Nex.r

- 26 completeness issues (related to ‘NE’/’empty’/’notation key abuse’)
- 59 recalculation issues
- 49 country-outlier issues
- 130 time trend issues
- 76 agricheck issues

The status of responses as of March 28, 2017 is given in Table 5.53:

Table 5.53 Status of issues as of March 28, 2017

Check	Resolved	Partially resolved	Unresolved	Not yet responded
Completeness	50%	19%	31%	0%
Outliers	24%	2%	8%	65%
Recalculations	90%	0%	10%	0%
Time series	55%	3%	22%	21%
ESD review	33%	17%	33%	17%

Completeness and recalculation issues had all been responded by March 28, 2017, being the recalculations the type of issues with the highest percentage of resolution. Most of the recalculations required just an explanation and some of them were due to mistakes which have mostly been corrected. The outliers are the type of issues with the highest share of questions still not responded, probably needing more time to justify. For the time series, there are still issues without response, but more than half of the total have already been solved. Regarding the ESD recommendations, one third has already been solved and 17% have not been answered yet although these were the first issues to be asked to countries, probably because many of these issues were related to recommendations of finding better data, which sometimes the countries cannot easily solve.

Calculation of EU background data

EU-wide background data were calculated as weighted averages of the parameters provided by the countries, using activity data (animal numbers in category 3A and 3B and N input in category 3D) as weighting factors[45].

Care is being taken to not include in the calculation erroneous values:

- Data which had been identified as being reported with a different unit than the values reported by other countries (see above) were *converted* into the appropriate unit before calculating EU28+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.

45 https://github.com/aleip/eealocatorplots/blob/master/eugirp_euweightedaverages.r

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.

5.4.4 Workshops and activities to improve the quality of the inventory in agriculture

Workshop on 'Inventories and Projections of Greenhouse Gas Emissions from Agriculture' (2003)

As a first activity to assure the quality of the inventory by Member States, a workshop on "Inventories and Projections of Greenhouse Gas Emissions from Agriculture" was held at the European Environment Agency in February 2003. The workshop focused on the emissions of methane (CH_4) and nitrous oxide (N_2O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH_3). The consideration of ammonia emissions allows the validation of the N_2O emission sources and it further strengthens the link between greenhouse gas and air pollutant emission inventories reported under the UNFCCC, the EC Climate Change Committee, the UNECE Long-Range Transboundary Air Pollution Convention, and the EU national emission ceiling directive. Objectives of the workshop were to compare the Member States methodologies and to identify and explain the main differences. The longer term objective is to further improve the methods used for inventories and projections in the different Member States and to identify how national and common agricultural policies could be integrated in EU-wide emission scenarios.

The workshop report including the Recommendations formulated at the workshop are available here[46]

Survey on agricultural production methods (SAPM 2010)

The Survey on agricultural production methods, abbreviated as SAPM, is a once-only survey carried out in 2010 to collect data at farm level on agri-environmental measures. EU Member States could choose whether to carry out the SAPM as a sample survey or as a census survey. Data were collected on tillage methods, soil conservation, landscape features, animal grazing, animal housing, manure application, manure storage and treatment facilities and irrigation. With reference to irrigation, Member States were asked to provide estimation (possibly by means of models) of the volume of water used for irrigation on the agricultural holding.

The characteristics that were collected are given in the Regulation (EC) No 1166/2008 of the European Parliament and of the Council 19 November 2008 on farm structure surveys[47] and the survey on agricultural production methods and further defined in the Commission Regulation (EC) No 1200/2009 of 30 November 2009 implementing Regulation (EC) No 1166/2008 of the European Parliament and of the Council on farm structure surveys and the survey on agricultural production methods, as regards livestock unit coefficients and definitions of the characteristics[48].

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[46] Leip, A., 2005. N_2O emissions from agriculture. Report on the expert meeting on 'improving the quality for greenhouse gas emission inventories for category 4D', Joint Research Centre, 21-22 October 2004, Ispra. Office for Official Publication of the European Communities, Luxembourg. doi:http://dx.doi.org/10.13140/RG.2.1.4706.7607.

[47] http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32008R1166

[48] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1448050507039&uri=CELEX:32009R1200

A list of characteristics of potential relevance for the quantification of GHG emissions is given in Table 5.54.

Table 5.54 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
		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).

The LiveDate project on Nitrogen Excretion factors

The key indicator 'Gross Nutrient Balance' (GNB) is part of the set of agri-environmental indicators defined in the Commission Communication on the "Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy"[49]. The Eurostat/OECD Methodology and Handbook on Nutrient Budgets has been updated and amended in 2013[50]. Nitrogen excretion coefficients have been identified of a major source of uncertainty for the estimation of the GNB, with high relevance for other reporting obligations, including the nitrate directive, reporting of ammonia emissions under the CLRTAP and the NEC directive, as well (and importantly) for the quantification of N_2O emissions from manure management and agricultural soils. An expert workshop was therefore organized on 28/03/2014 at Eurostat to discuss the possibility to improve the quality of N-excretion data by using a common improved methodology. A recommendation on such a common methodology served 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)[51].

The general objective of the study "Nitrogen and phosphorus excretion coefficients for livestock; Methodological studies in the field of Agro-Environmental Indicators; Lot1" (2012/S 87-142068) is "to bring clarity into the issue of excretion coefficients so that a recommendation on a single, common methodology to calculate N and P excretion coefficients can be identified". The recommendation for a uniform and standard methodology for estimating N and P excretion coefficients must be based on a thorough analysis

49 https://www.eea.europa.eu/policy-documents/development-of-agri-environmental-indicators

50 http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/documents/Nutrient_Budgets_Handbook_%28CPSA_AE_109%29_corrected3.pdf

51 Oenema, O., Sebek, L., Kros, H., Lesschen, J.P., van Krimpen, M., Bikker, P., van Vuuren, A., Velthof, G., 2014. Guidelines for a common methodology to estimate nitrogen and phosphorus excretion coefficients per animal category in eu-28. final report to eurostat, in: Eurostat (Ed.), Methodological studies in the field of Agro-Environmental Indictors. Eurostat, Luxembourg, pp. 1?108.

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:

- *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.*

Regionalisation of the Gross Nutrient Budget with the CAPRI model

The JRC was cooperating with EUROSTAT on a methodology to use the CAPRI model[52] for the regionalisation of the Gross Nutrient Budget (GNB) indicators (nitrogen and phosphorus) that needs to be reported regularly by countries to EUROSTAT and OECD. The GNBs are identified as one of the key agro-environmental indicators. Current reporting occurs at the national level. For policy making, a higher resolution, matching with legislative and environmental boundaries (NVZ, watershed) rather than administrative boundaries (country) is required. The CAPRI model is an economic model for agriculture, which has an environmental accounting model integrated. It has a spatial resolution of NUTS2 and reports, a.o. Nitrogen Balances at this level. The CAPRI model has a down-scaling module integrated which estimates land use shares and environmental indicators at the pixel level (1 km by 1 km). The use of the CAPRI model is motivated in view of the lack of methodology for regionalisation of the GNB and the high costs associated with building up such systems in the countries at one hand, and the thrive to harmonise the conceptual approaches.

The Working Group (WG) on agri-environmental indicators (AEI, February 2012) and the subsequent Standing Committee for Agricultural Statistics (CPSA, May 2012) decided to start a pilot projects on regionalising Gross Nitrogen Balance (GNB) with the CAPRI model. The objective of the pilot project is to evaluate differences between national GNB and the GNB calculated with CAPRI at the country and the NUTS2 scale. Italy, France, Germany and Hungary volunteered for this pilot project. The RegNiBal project (Regionalisation of Nitrogen Balances with the CAPRI Model - Pilot Project) started in February 2013. The overall goal was to use the CAPRI model to provide (operationally) regional GNB data to complement the national Eurostat/OECD GNBs.

Four countries volunteered to share their national GNB estimates with the CAPRI team which were analysed 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[53] included:

A total of 31 'issues' were identified that were related to major discrepancies between the methods and warranted further assessment. At the end of the project, 12 of the identified issues were solved, one was partially solved and 18 could not be solved, but some progress was achieved and concrete recommendations were made for almost all of them. The results and achievements of RegNiBal are summarised in Annex 12.

52 http://www.capri-model.org/

53 Özbek, F.S., Leip, A., Weiss, F., Grassart, L., Hofmeier, M., Kukucka, M., Pallotti, A., Patay, A., Thuen, T., 2015. Regionalisation of Nitrogen Balances with the CAPRI Model (RegNiBal) Pilot project in support of the Eurostat Working Group on Agri-Environmental Indicators. Publications Office of the European Union, Luxembourg. doi: http://dx.doi.org/10.2788/078406.

At the start of the RegNiBal project CAPRI data was generally judged to be more reliable than national data. The situation has changed with the improvements described above; at present, further analysis is needed to see whether CAPRI or national data is ?better? with regard to the remaining unresolved issues.

Overall, N excretion by swine and N removal by grass are considered the most important unresolved issues because of their considerable impact on N-input and N-output. The animal budget analysis for swine of DE and FR shows that CAPRI estimates higher feed intake than the national methodologies. Countries are not always sufficiently accurate in estimating and/or using the average number of animals and N-excretion coefficients in N manure excretion estimations. For the estimates of dry matter yields of grassland, the differentiation of permanent grassland according to the proposal of the GRASSDATE project (Velthof et al 2014)[54] *would likely help (grassland out of production but maintained, unimproved grassland (including 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[55]*). In the CAPRI model, data on animal products and imported feeds are available from statistical sources and are thus more reliable than the data on the N intake of fodder and manure excretion, which would not be required. Generally, the RegNiBal project showed that the CAPRI model could be adequate to provide national (and later regional and spatially explicit) GNBs. However, for the four countries assessed, additional work needs to be carried out to understand residual disagreements in the data.*

Workshop on improving national inventories for agriculture (2014)

Under the WG1 on Annual GHG inventories under the EU Climate Change Committee a workshop on improving GHG inventories in the sector agriculture was organized by the Joint Research Centre as part of the 7th Non-CO_2 Greenhouse Gas Conference (NCGG7), held November 5-7, 2014 Amsterdam, the Netherlands[56]. The workshop was co-organized by CEH in support of the UK greenhouse gas inventory programme.

[54] Velthof, G.L., Lesschen, J.P., Schils, R.L.M., Smit, A., Elbersen, B.S., Hazeu, G.W., Mucher, C.A., Oenema, O., 2014. Grassland areas , production and use. Lot 2. Methodological studies in the field of Agro-Environmental Indicators. Alterra Wageningen UR, Wageningen, The Netherlands.

[55] 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.

[56] http://www.ncgg.info/

The session raised a high interest, contained high quality presentations and allowed scientists, IPCC and FAO representatives and country delegates to discuss about greenhouse accounting methods, their difficulties and challenges to use IPCC guidelines, to select the appropriate tier methods and to design country-specific methodologies which allow reducing uncertainties. From a total attendance of about 200 conference participants and five parallel sessions, this session was temporary attended by almost 100 scientists.

The workshop focused on N_2O emissions from agricultural soils, as they are highly uncertain yet are often estimated with default methodology in lack of country-specific data of sufficient quality. N_2O emissions from agricultural soils are dominating the uncertainty of the total GHG emissions for many countries. The programme included presentations covering the whole range of aspects of N_2O emission estimates: the availability of flux data in Europe and network design strategies (Rene Dechow, Thuenen Institute, DE), use of process-based models in GHG inventories (Steve del Grosso, USDA) to inverse methods to estimated national total N_2O emissions (Rona Thompson, NILU, NO). Further presentation gave national examples on GHG improvements, such as UK (general), NZ (pasture emissions), Thailand (emissions from rice), Norway (emissions from dairy farms) and on the link to IPCC guidelines and the IPCC Emission Factor Database (Kiyoto Tanabe (see below) and 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

Comparison of national inventories with EU-wide calculations with the CAPRI model

An in-depth comparison between GHG emission estimates as calculated with the CAPRI model and national GHG emission inventories had been done in the frame of the GGELS project[57].

57 ftp://mars.jrc.ec.europa.eu/Afoludata/Public/DOCU236/

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[58].

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[59]

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 that generally cover the period 1990-2014. The data base can be consulted at the following link:

http://www.fao.org/faostat/en/#data/GT

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. FAOSTAT emission data are disseminated publicly to facilitate continuous feedback from member countries. Table 5.55 presents total GHG emissions of the agricultural sector by emission source category for the whole EU-28+Iceland and year 2014 (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).

58 ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/leip_weiss2014.ggels_summary.pdf

59 ftp://mars.jrc.ec.europa.eu/Afoludata/Public/363_eughginventory2014/koeble_leip2014.livestockallocation.pdf

Table 5.55 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+ISL, averaged over the years 2000 to 2014, for which reported data from all countries are available in both the FAOSTAT and the UNFCCC data bases are available.

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**	194,573	43.4	197,209	44.4
3.B.1 - CH_4 Emissions from manure management	***CH_4***	*47,029*	*10.5*	*50,841*	*11.4*
3.B.2 - N_2O Emissions from manure management	***N_2O***	*22,080*	*4.9*	*14,301*	*3.2*
3.C - Rice Cultivation	***CH_4***	*2,670*	*0.6*	*5,344*	*1.2*
3.D.1.1 - Direct N_2O Emissions from soils - Inorganic N Fertilizers	**N_2O**	51,811	11.5	51,320	11.6
3.D.1.2 - Direct N_2O Emissions from soils - Organic N Fertilizers	**N_2O**	23,524	5.2	25,011	5.6
3.D.1.3 - Urine and Dung Deposited by Grazing Animals	**N_2O**	22,477	5	22,598	5.1
3.D.1.4 - Crop Residues	**N_2O**	20,709	4.6	15,252	3.4
3.D.1.5 - Mineralization of Soil Organic Matter	**N_2O**	677	0.2	0	0
3.D.1.6 - Cultivation of Organic Soils	**N_2O**	13,182	2.9	23,232	5.2
3.D.2 - Indirect N_2O Emissions from soils	**N_2O**	29,487	6.6	37,288	8.4
3.F – CH_4 from Burning Agricultural Residues	**CH_4**	863	0.2	1,356	0.3
3.F – N_2O from Burning Agricultural Residues	**N_2O**	311	0.1	419	0.1
3.G - Liming	**CO_2**	11,988	2.7	0	0
3.H - Urea Application	**CO_2**	7,277	1.6	0	0
3.I - Other Carbon-containing Fertilizers	**CO_2**	39	0	0	0
Total	**GHGs**	448,699	100	444,173	100

Comparing both databases, we can see that UNFCCC reports higher total emissions than FAOSTAT (448.7 versus 444.2) Mt CO_2-eq yr^{-1}, but that difference is lower and with different sign 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 calculated in FAOSTAT (428.7 versus 444.2) Mt CO_2-eq yr^{-1}. 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 absolute difference corresponds to

- N_2O emissions from category 3.D.1.6 - Cultivation of Organic Soils (-10050 kt CO_2-eq yr^{-1}, with larger emissions reported by FAO), followed by
- indirect N_2O emissions from category 3.D.2 (-7801 kt CO_2-eq yr^{-1}, with larger emissions reported by FAO) and
- N_2O emissions from category 3.B.2 (7779 kt CO_2-eq yr^{-1}, with larger emissions reported by NIR).

These three emission categories represent a significant share of the total agricultural emissions in the NIR and FAO data bases, accounting for 2.9-5.2%, 6.6-8.3% and 3.2-4.9%, respectively.

The largest three differences in relative terms are

- CH_4 emissions from category 3.C - Rice Cultivation (-100.1 %, with larger emissions reported by FAO), followed by
- N_2O emissions from category 3.D.1.6 - Cultivation of Organic Soils (-76.2 %, with larger emissions reported by FAO) and
- CH_4 emissions from category 3.F - Field Burning of Agricultural Residues (-57.1 %, with larger emissions reported by FAO).

The three source categories with the highest absolute and relative differences are N_2O emissions from category 3.D.1.6 - Cultivation of Organic Soils and CH_4 emissions from category 3.C - Rice Cultivation.

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, fertiliser use and cultivated area along the inventory years (1990-2014).

We will employ two types of figures throughout this section. Figure of the type as in Figure 5.84 show the trend of EU28+ISL for both NIR and FAO, similar to the Figures used also in Section 5.2. The upper panel of the figure shows the trend in the data from NIR, and the lower panel shows the trend in the FAO data. The 10 most important countries are plotted explicitly with the pattern used also in the previous sections. The share of AD in the last reported year given next to the legend, and all other countries lumped together into the category 'Other'. This category contains only the 'other' countries with respect to the data base, thus the countries could be different for NIR and FAO.

Figures of the type as in Figure 5.85 show three different perspectives on the comparison of the two data sets, using the average of data for the years 1990-2014: the chart on the left side shows the reported values in absolute units for both NIR and FAO; the chart in the middle shows the relative difference between both data sets, calculated as (FAO-NIR)/NIR. Thus, positive values indicate that the value from FAO are larger than the value from NIR, and negative values indicate that the values from NIR are larger. Large relative differences indicate a problem in data reporting by the countries, but is not necessarily an indication that this has a large impact for the overall total EU emissions. Therefore, the chart on the right side shows the importance of the difference observed in each countries, as compared to the EU28+ISL total: $(FAO_{country}-NIR_{country})/NIR_{EU}$.

Animal populations

Trends of population data in the two data sets and a comparison of average data in the period 1990 to 2014 are shown for dairy cattle (Figure 5.84 and Figure 5.85), non-dairy cattle (Figure 5.86 and Figure 5.87), sheep (Figure 5.88 and Figure 5.89), swine (Figure 5.90 and Figure 5.91) and poultry (Figure 5.92 and Figure 5.93). The trends in the NIR data are discussed in detail in Section 5.2.

Dairy cattle population data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -14.1% and 2%. 11 years showing values that are larger in NIR (on average by 1625.8 thousand heads) and 14 years when FAO data are larger (on average by 231 thousand heads). Comparing all years, NIR is larger by 586 thousand heads or -2.09% of the average value in the EU. The three countries with the largest differences in single years are Romania, Italy and Poland. The largest deviations (FAO minus NIR) are -1048 thousand heads (Romania, 1990), corresponding to 2.7% of total EU dairy cattle population in this year (NIR), -532 thousand heads (Romania, 1991), and -503 thousand heads (Romania, 1993).

Non-dairy cattle population data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -9.1% and 1.5%. 21 years showing values that are larger in NIR (on average by 2099.8 thousand heads) and 4 years when FAO data are larger (on average by 304 thousand heads). Comparing all years, NIR is larger by 1715 thousand heads or -2.46% of the average value in the EU. The three countries with the largest differences in single years are Romania, Germany and France. The largest deviations (FAO minus NIR) are 2354 thousand heads (Germany, 1991), corresponding to 3% of total EU non-dairy cattle population in this year (NIR), 2022 thousand heads (Romania, 1990), and 1610 thousand heads (Romania, 1991).

Sheep population data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -4.1% and 0.3%. 22 years showing values that are larger in NIR (on average by 1937.1 thousand heads) and 3 years when FAO data are larger (on average by 164 thousand heads). Comparing all years, NIR is larger by 1685 thousand heads or -1.42% of the average value in the EU. The three countries with the largest differences in single years are Ireland, Italy and Spain. The largest deviations (FAO minus NIR) are -2995 thousand heads (Ireland, 1998), corresponding to 2.3% of total EU sheep population in this year (NIR), -2988 thousand heads (Ireland, 1999), and -2852 thousand heads (Ireland, 1993).

Swine population data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -7.9% and 4%. 10 years showing values that are larger in NIR (on average by 6242.1 thousand heads) and 15 years when FAO data are larger (on average by 4817 thousand heads). Comparing all years, NIR is smaller by 394 thousand heads or 0.253% of the average value in the EU. The three countries with the largest differences in single years are Germany, Romania and Spain. The largest deviations (FAO minus NIR) are 8636 thousand heads (Germany, 1991), corresponding to 5.2% of total EU swine population in this year (NIR), 7675 thousand heads (Germany, 1990), and 4927 thousand heads (Germany, 1994).

Poultry population data from FAO are smaller than NIR data for all years. Comparing all years, NIR is larger by 223111 thousand heads or -14.2% of the average value in the EU. The three countries with the largest differences in single years are Poland, Italy and France. The largest deviations (FAO minus NIR) are -152751 thousand heads (Poland, 1996), corresponding to 9.7% of total EU poultry population in this year (NIR), -149872 thousand heads (Poland, 2001), and -149026 thousand heads (Poland, 1991).

Figure 5.84: 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.

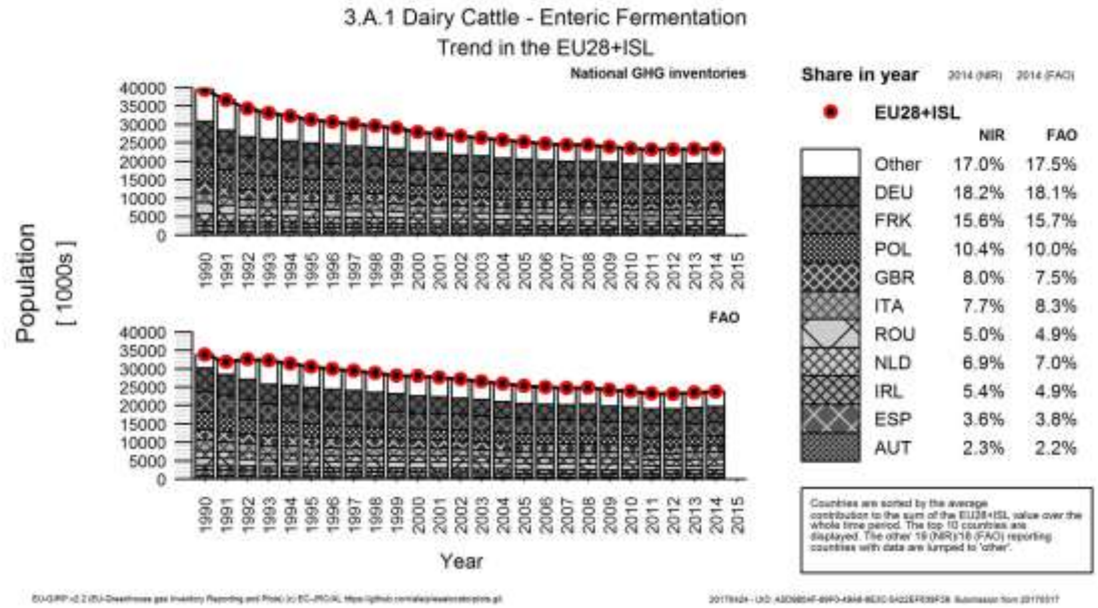


Figure 5.85: 3.A.1: (a) Average Dairy Cattle population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

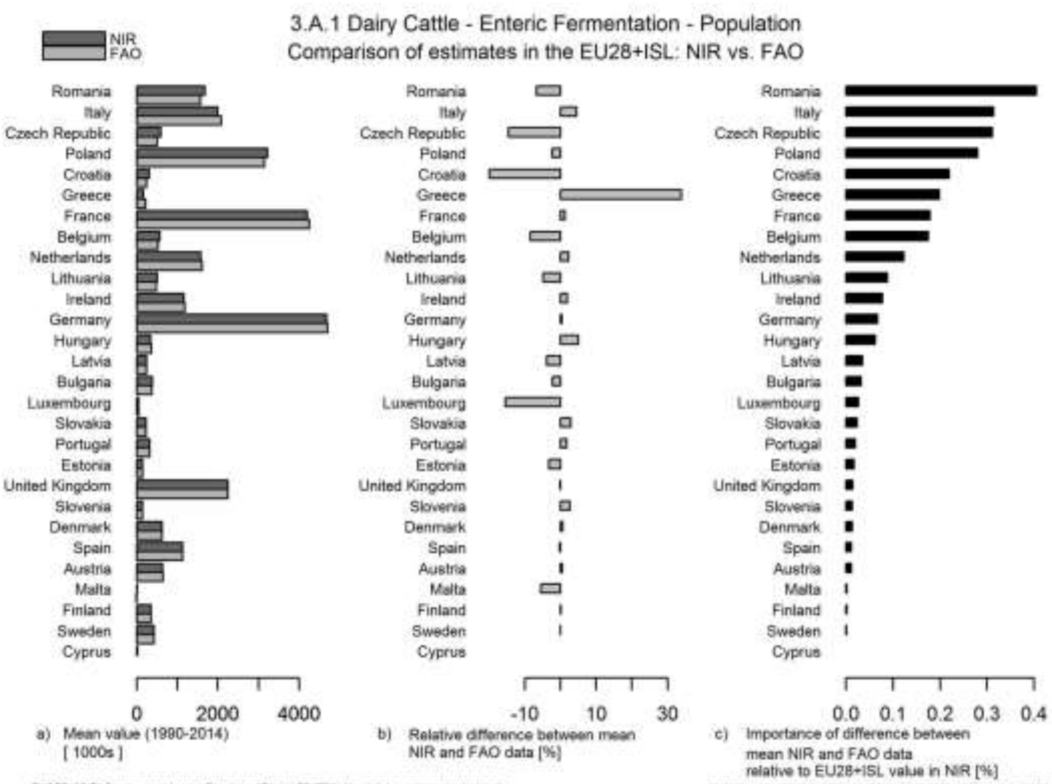


Figure 5.86: 3.A.1: Comparison of non-dairy cattle population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

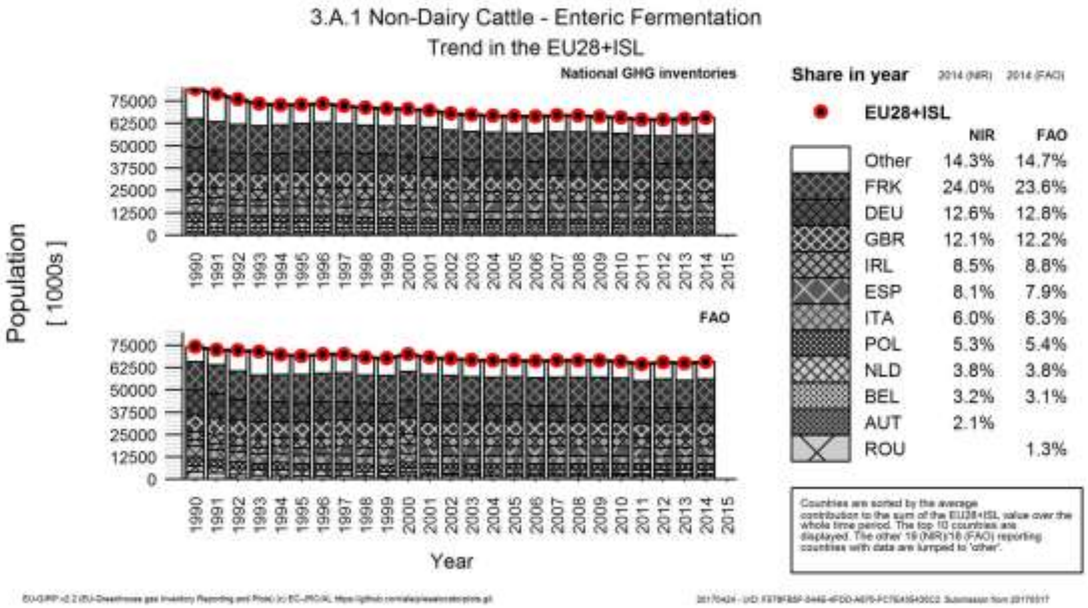


Figure 5.87: 3.A.1: (a) Average Non-Dairy Cattle population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

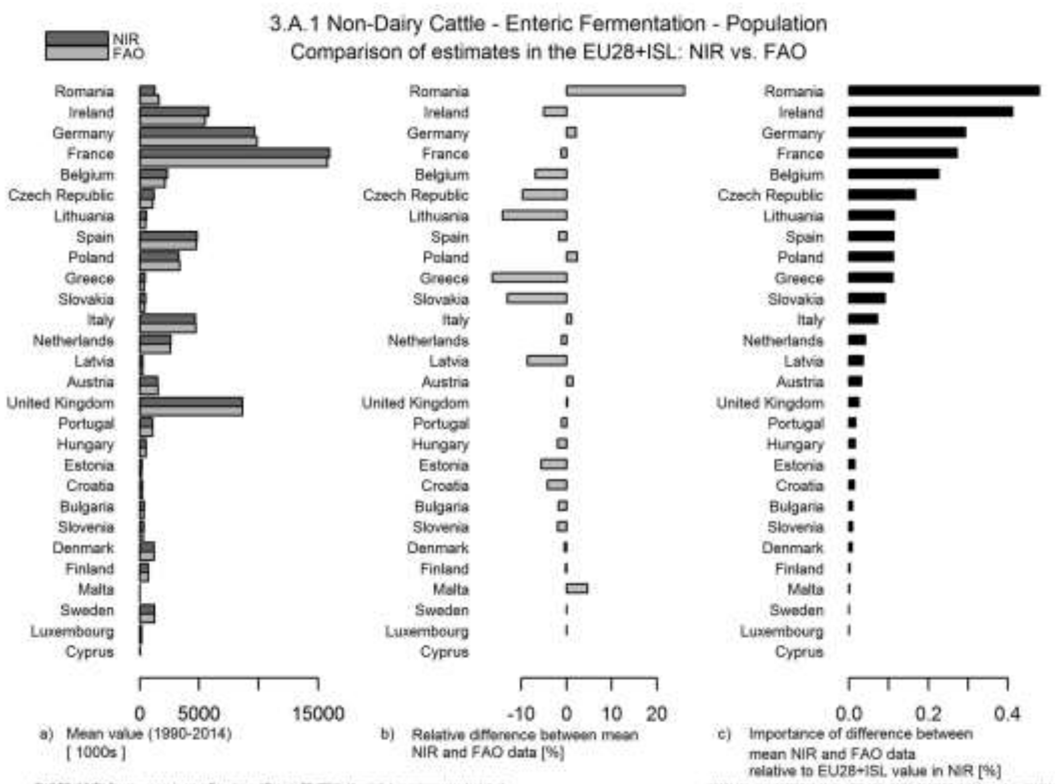


Figure 5.88: 3.A.1: Comparison of sheep population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

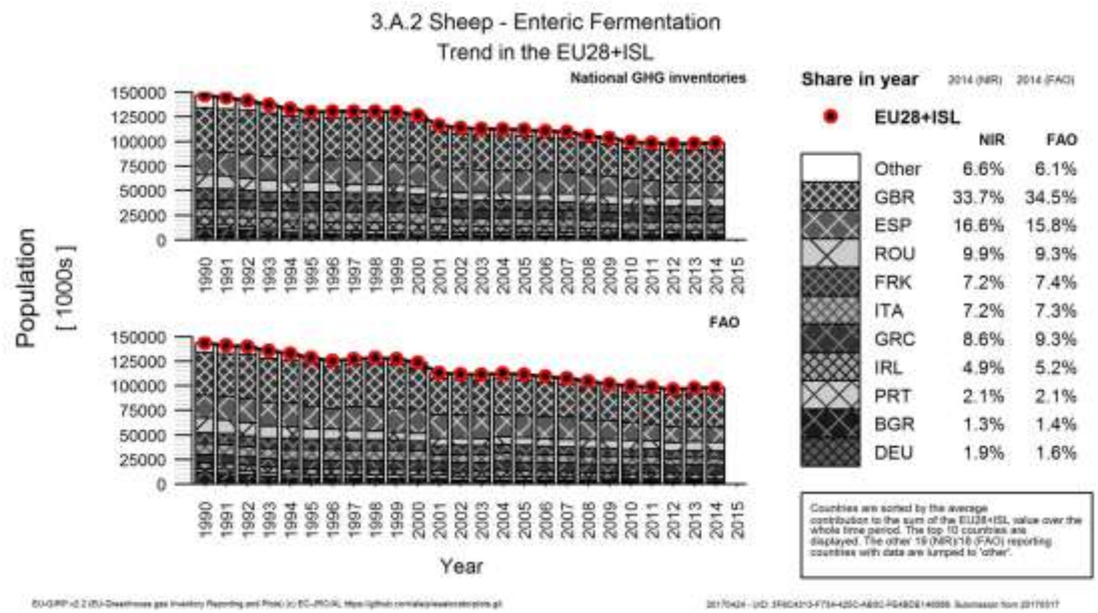


Figure 5.89: 3.A.1: (a) Average Sheep population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

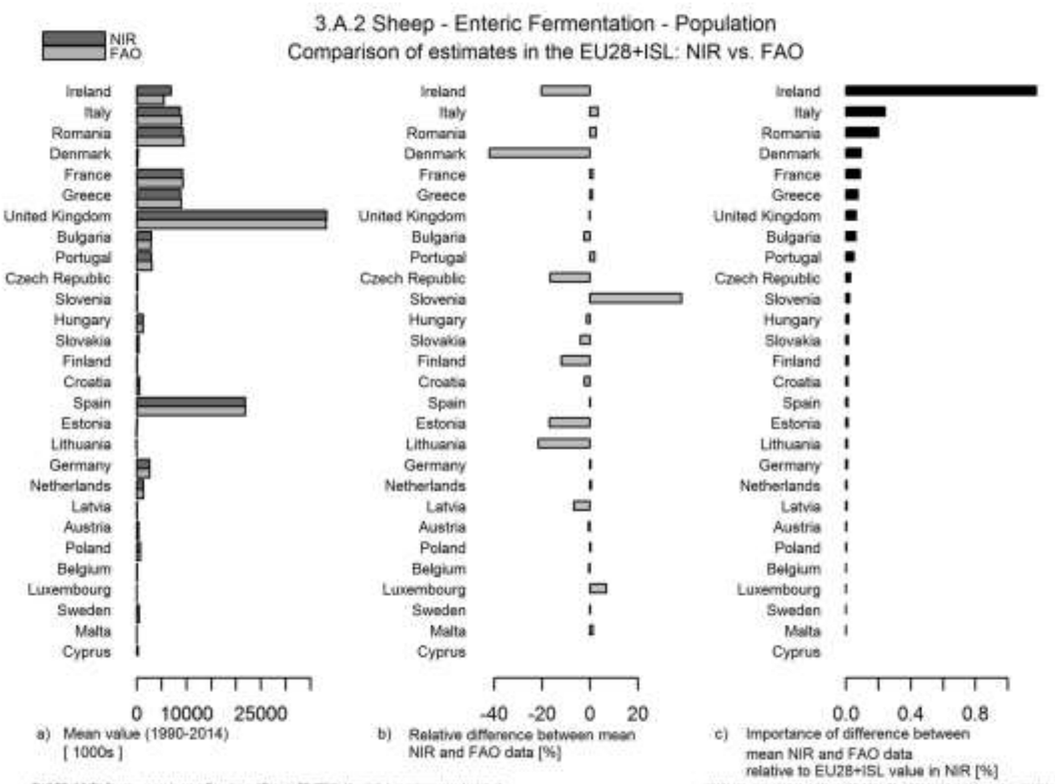


Figure 5.90: 3.A.1: Comparison of swine population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

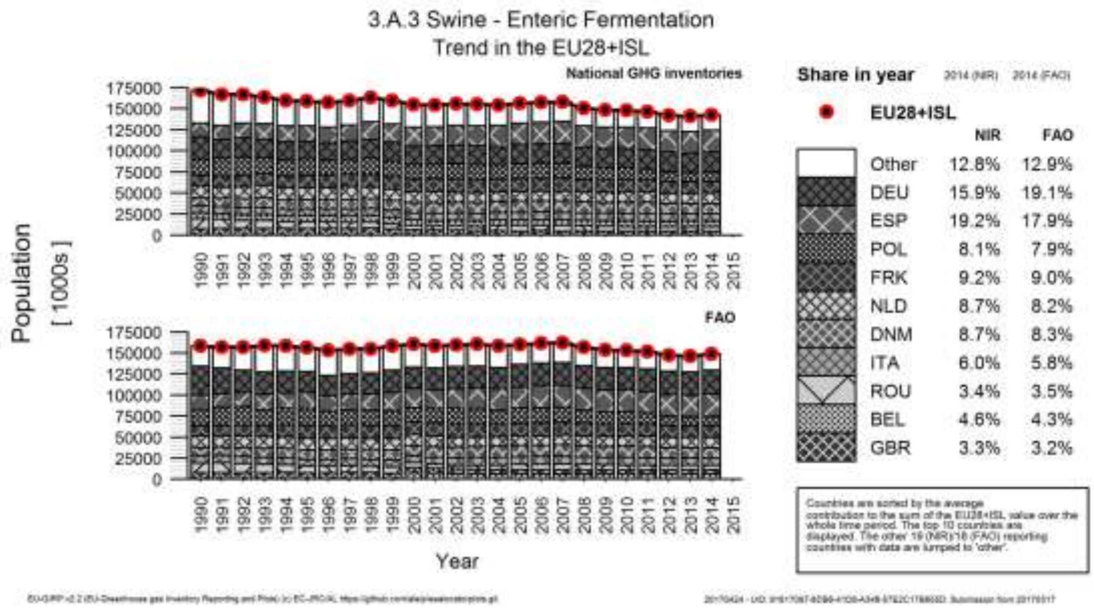


Figure 5.91: 3.A.1: (a) Average Swine population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

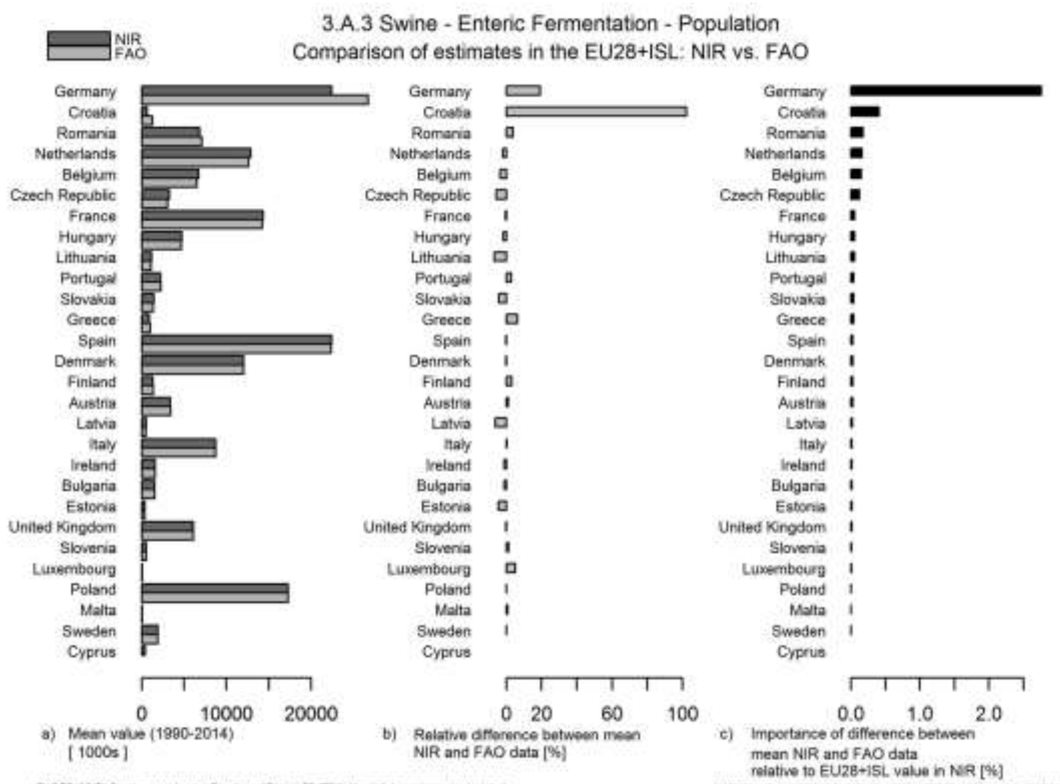


Figure 5.92: 3.A.1: Comparison of poultry population in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

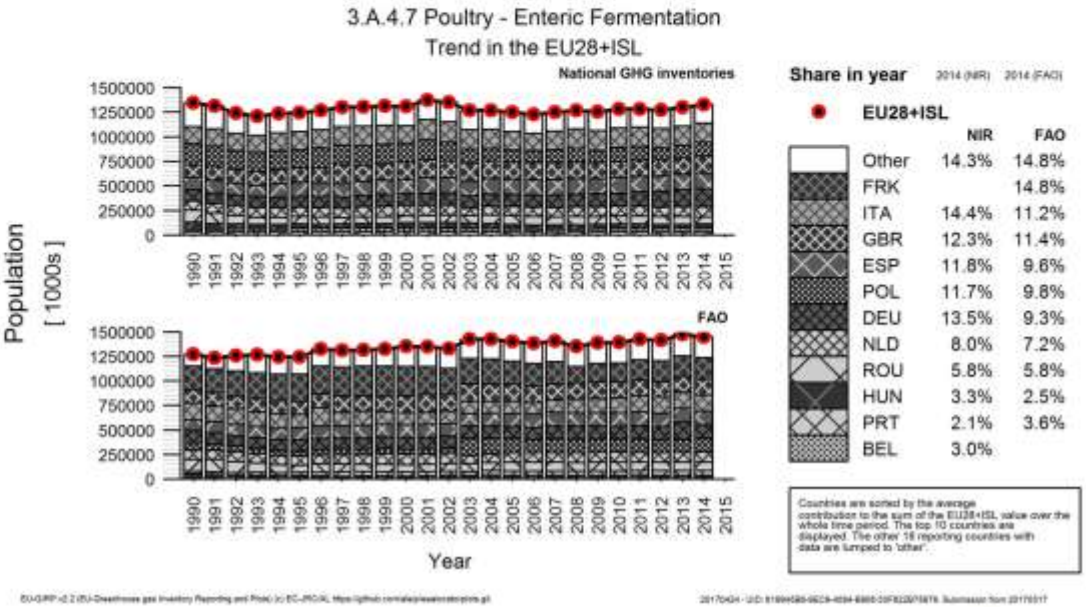
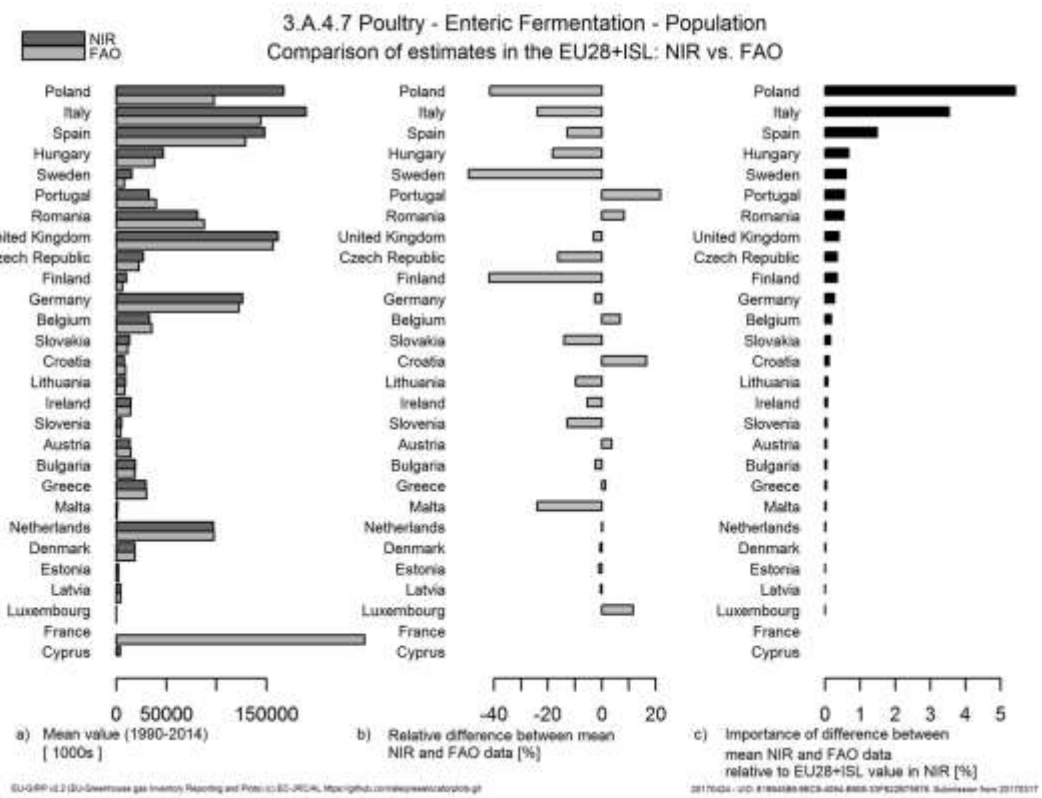


Figure 5.93: 3.A.1: (a) Average Poultry population in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



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 5.94 through Figure 5.103 compare UNFCCC vs. FAOSTAT data related to N excretion rate for the main livestock categories: dairy cattle, non-dairy cattle, sheep, swine and poultry.

Dairy cattle total N excretion data from FAO are smaller than NIR data for all years. Comparing all years, NIR is larger by 683 kt N/year or -24.1% of the average value in the EU. The three countries with the largest differences in single years are the Netherlands, Germany and France. The largest deviations (FAO minus NIR) are -149 kt N/year (Germany, 2014), corresponding to 5.7% of total EU dairy cattle total N excretion in this year (NIR), -142 kt N/year (Germany, 2013), and -141 kt N/year (Germany, 2012).

Non-dairy cattle total N excretion data from FAO are smaller than NIR data for all years. Comparing all years, NIR is larger by 1065 kt N/year or -30.9% of the average value in the EU. The three countries with the largest differences in single years are France, the United Kingdom and Ireland. The largest deviations (FAO minus NIR) are -452 kt N/year (France, 2000), corresponding to 13% of total EU non-dairy cattle total N excretion in this year (NIR), -452 kt N/year (France, 2001), and -426 kt N/year (France, 2002).

Sheep total N excretion data from FAO are smaller than NIR data for all years. Comparing all years, NIR is larger by 722 kt N/year or -73.2% of the average value in the EU. The three countries with the largest differences in single years are France, Italy and the United Kingdom. The largest deviations (FAO minus NIR) are -158 kt N/year (Italy, 2000), corresponding to 15% of total EU sheep total N excretion in this year (NIR), -157 kt N/year (Italy, 1999), and -156 kt N/year (Italy, 1996).

Swine total N excretion data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -10.1% and 13.7%. 9 years showing values that are larger in NIR (on average by 82.9 kt N/year) and 16 years when FAO data are larger (on average by 146 kt N/year). Comparing all years, NIR is smaller by 64 kt N/year or 3.67% of the average value in the EU. The three countries with the largest differences in single years are Germany, Romania and Spain. The largest deviations (FAO minus NIR) are 76 kt N/year (Germany, 1991), corresponding to 3.9% of total EU swine total n excretion in this year (NIR), 69 kt N/year (Germany, 1990), and -62 kt N/year (Romania, 1990).

Poultry total N excretion data from FAO are smaller than NIR data for all years. Comparing all years, NIR is larger by 116 kt N/year or -13.4% of the average value in the EU. The three countries with the largest differences in single years are Poland, Romania and Germany. The largest deviations (FAO minus NIR) are -85 kt N/year (Romania, 1990), corresponding to 9.2% of total EU poultry total N excretion in this year (NIR), -71 kt N/year (Poland, 1994), and -70 kt N/year (Poland, 1991).

Figure 5.94: 3.B.2: Comparison of dairy cattle total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

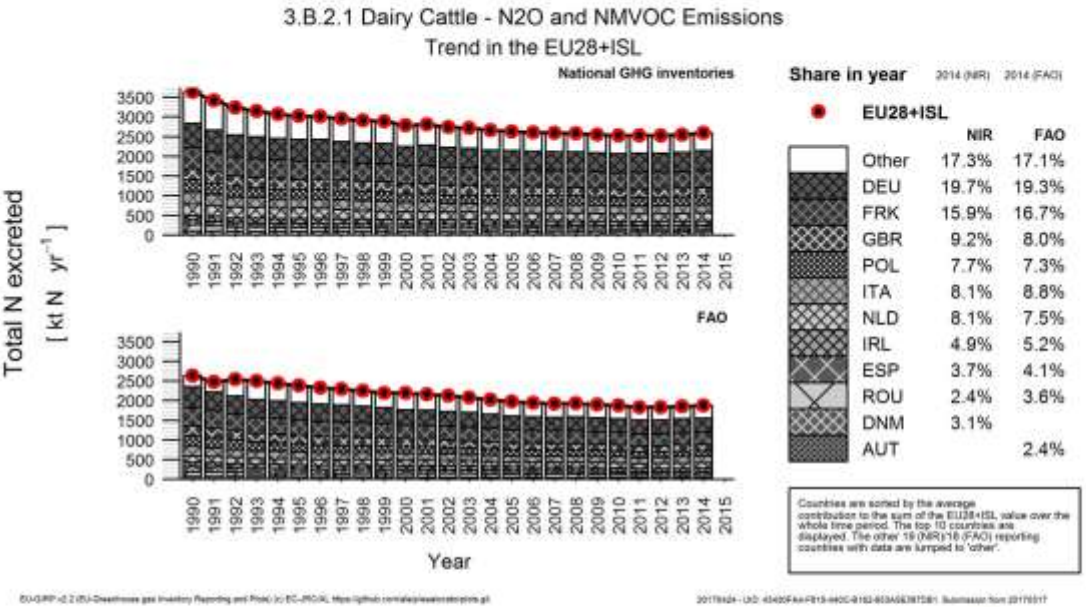


Figure 5.95: 3.B.2: (a) Average Dairy Cattle total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

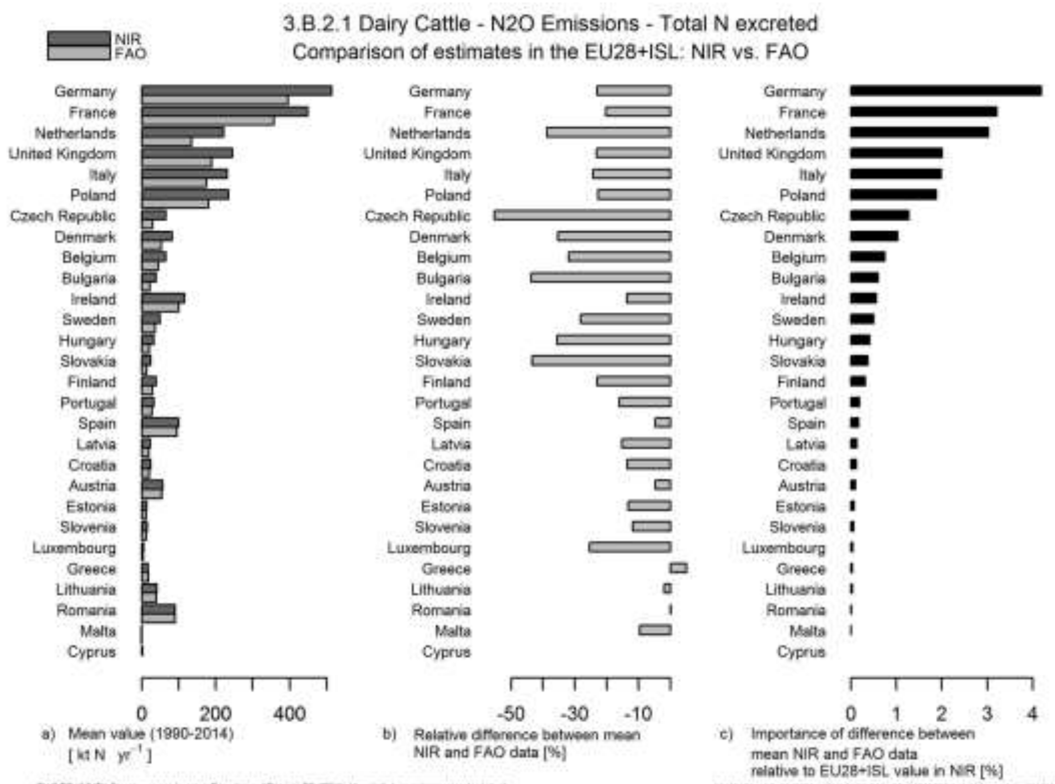


Figure 5.96: 3.B.2: Comparison of non-dairy cattle total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

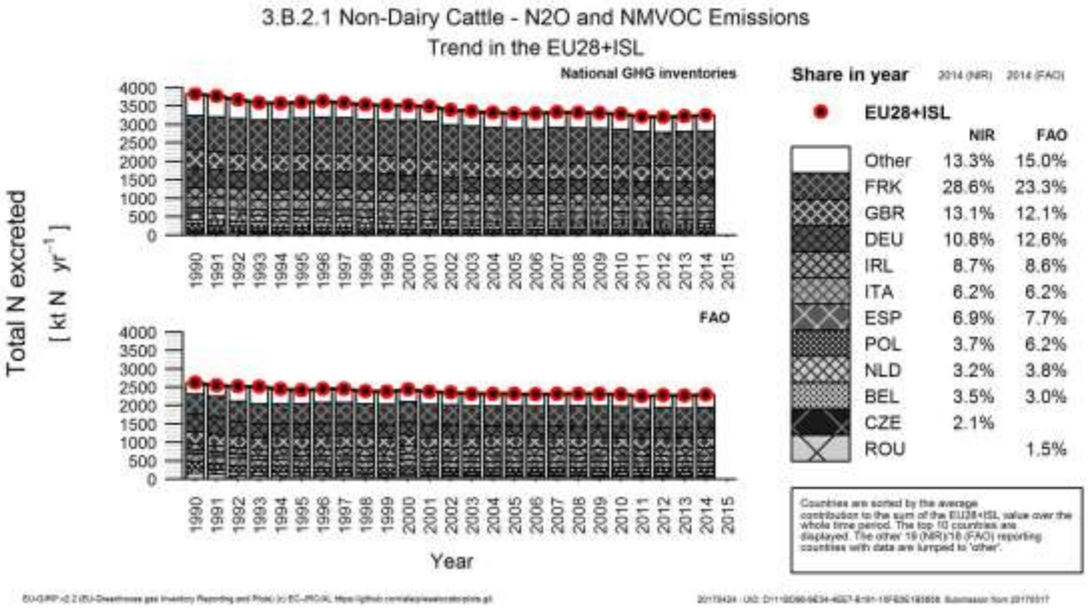


Figure 5.97: 3.B.2: (a) Average Non-Dairy Cattle total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

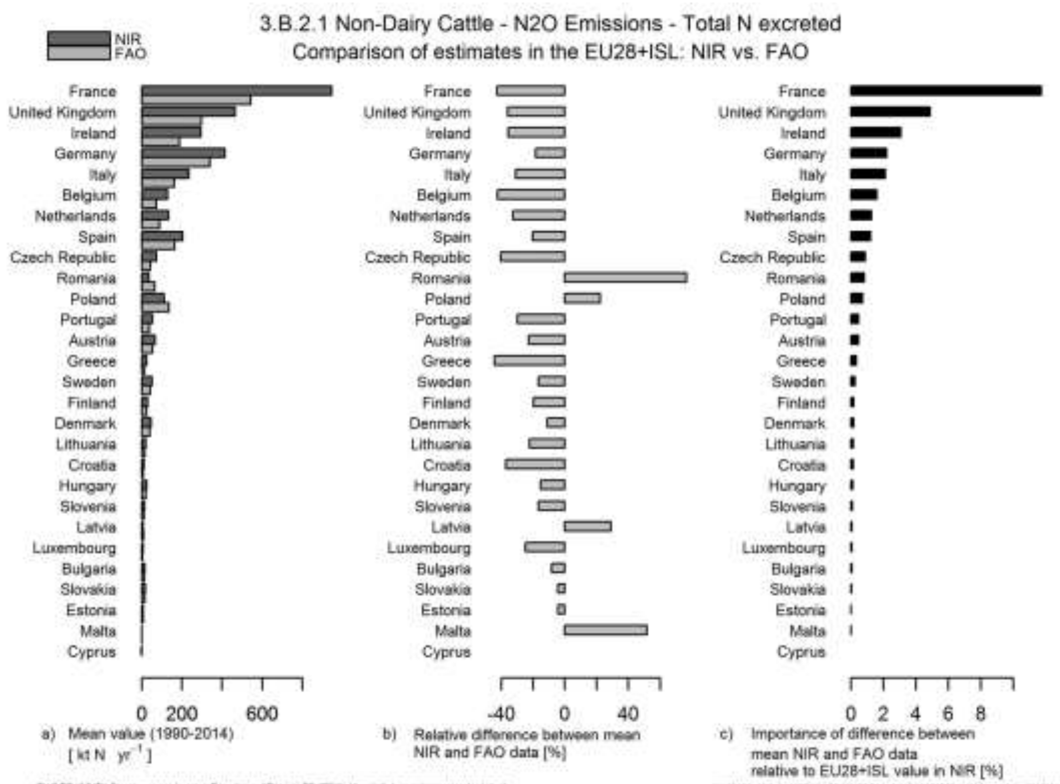


Figure 5.98: 3.B.2: Comparison of sheep total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

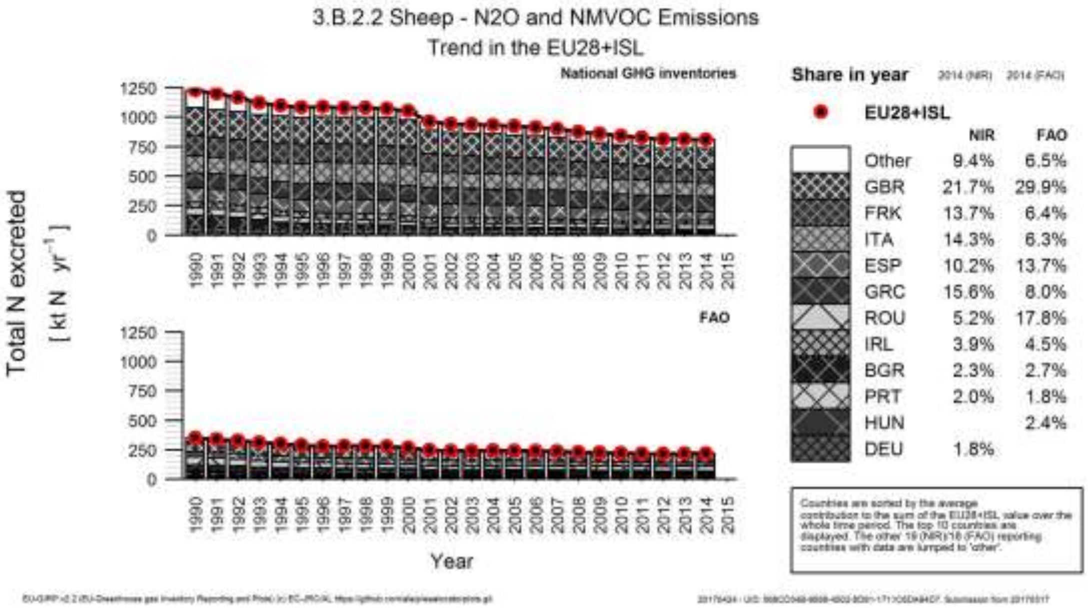


Figure 5.99: 3.B.2: (a) Average Sheep total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

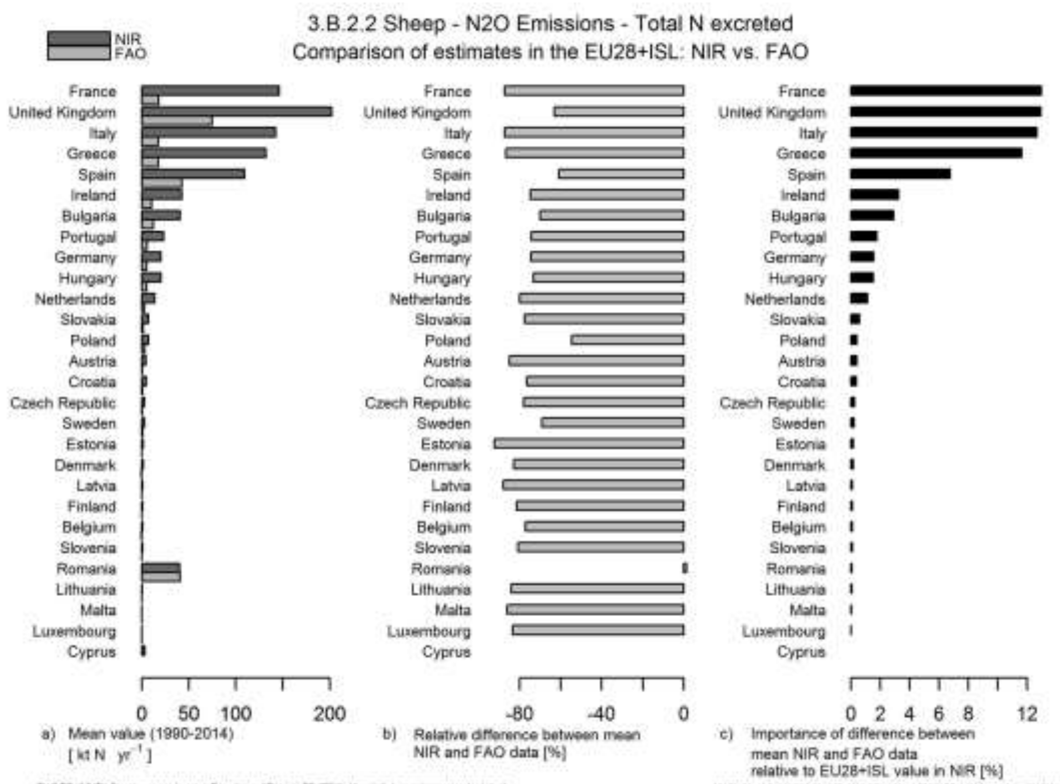


Figure 5.100: 3.B.2: Comparison of swine total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

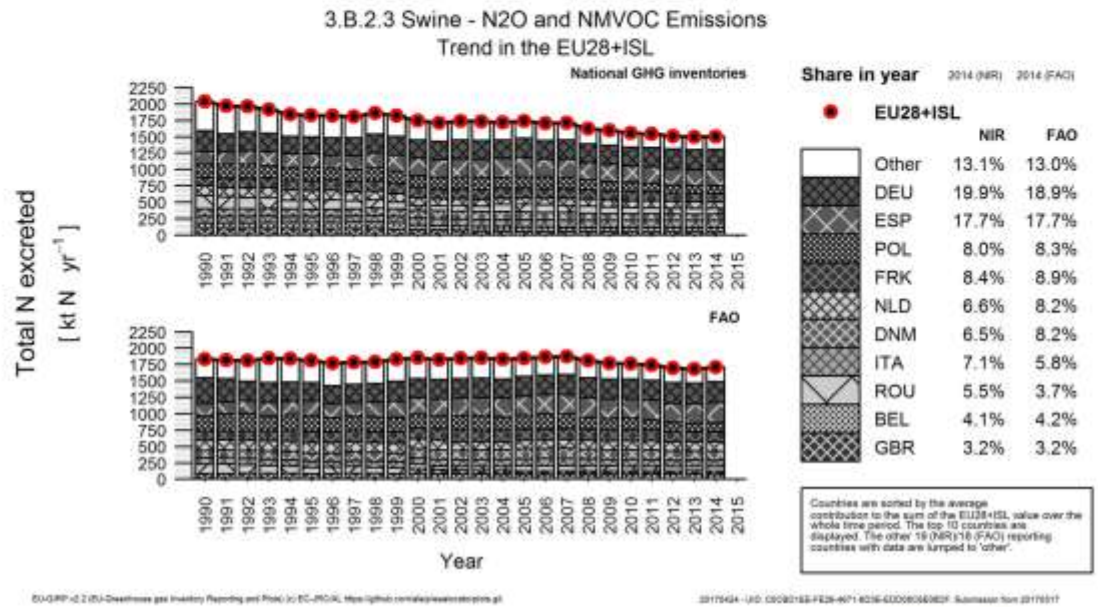


Figure 5.101: 3.B.2: (a) Average Swine total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

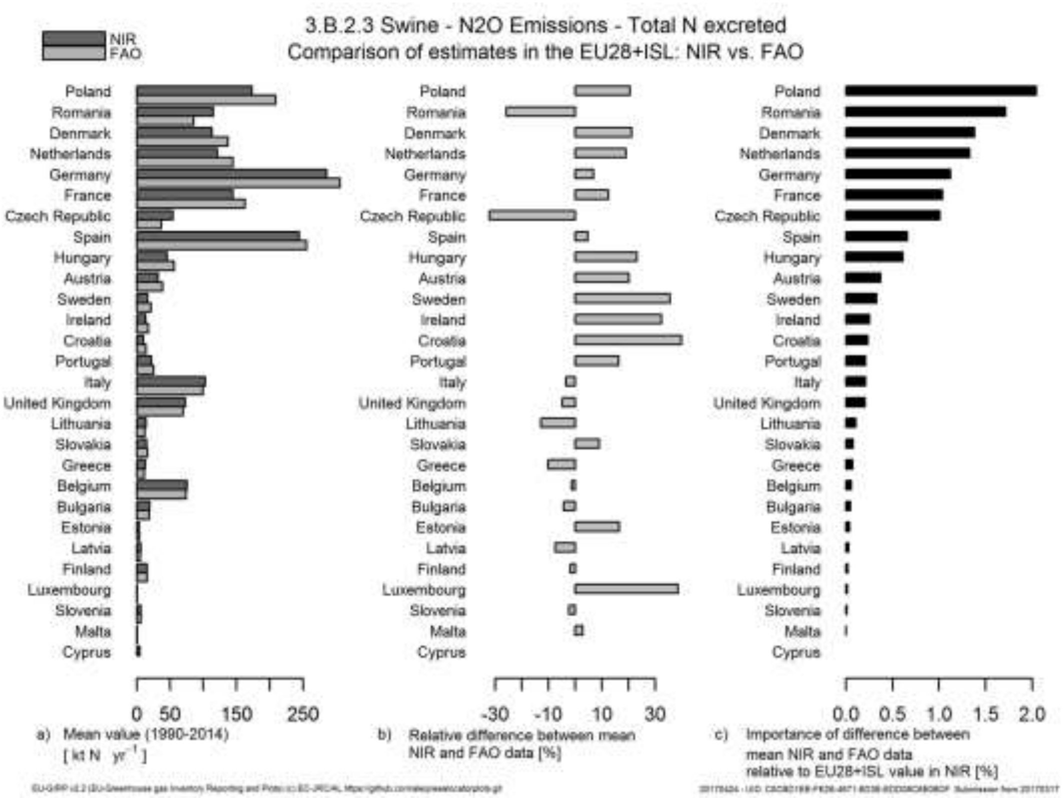


Figure 5.102: 3.B.2: Comparison of poultry total nitrogen excretion in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

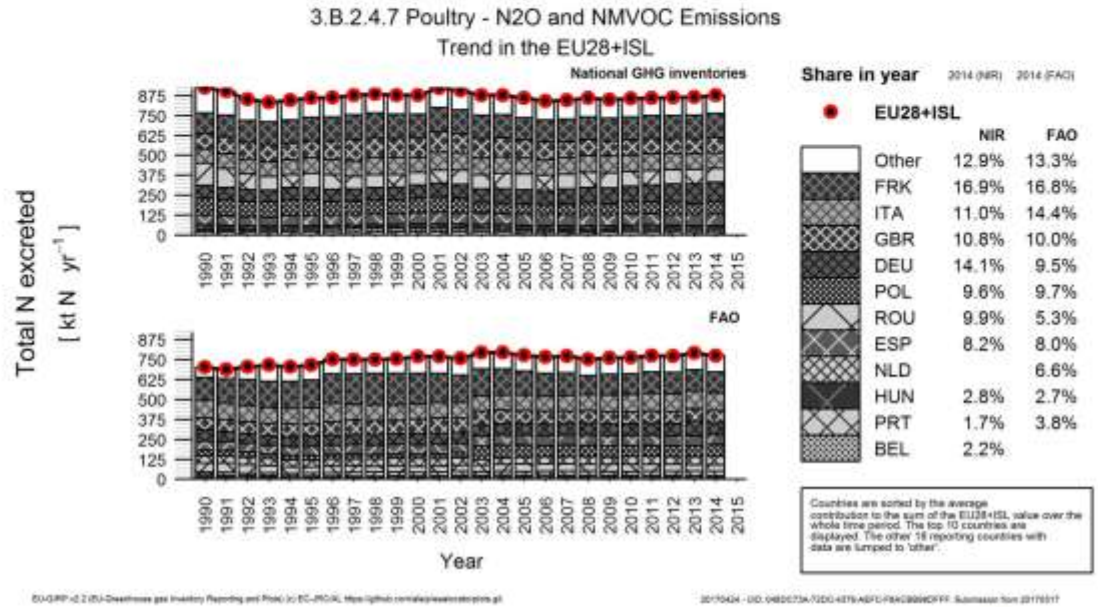
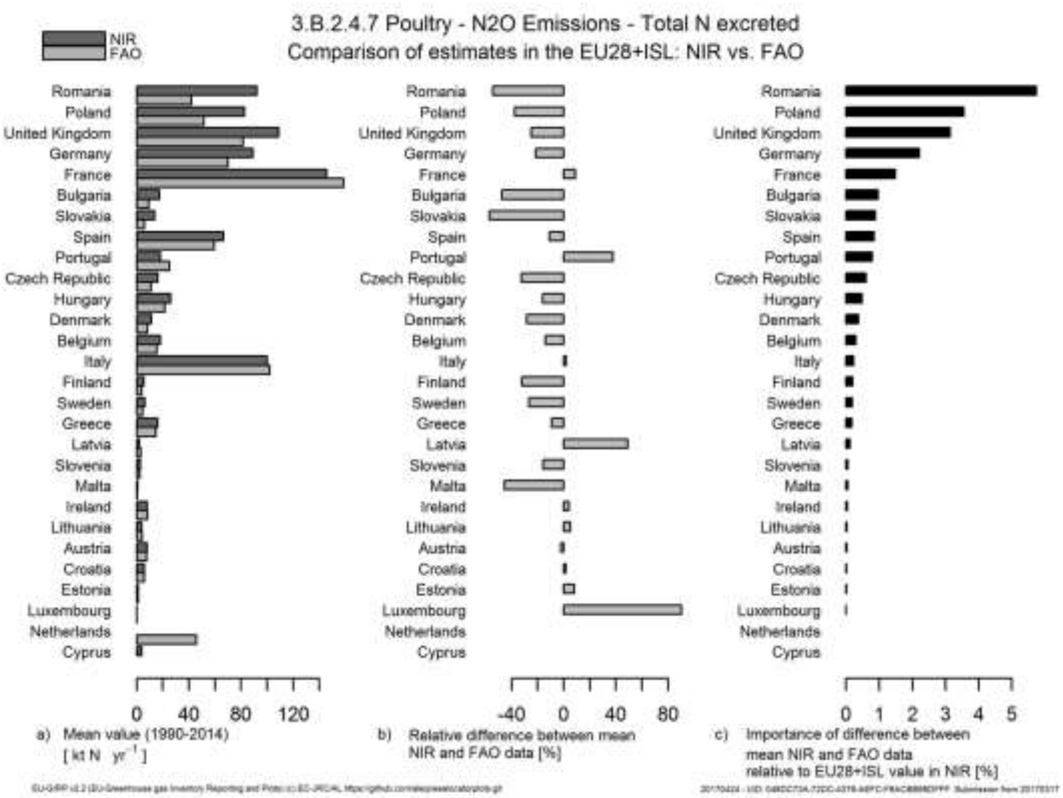


Figure 5.103: 3.B.2: (a) Average Poultry total nitrogen excretion in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



Comparing N excretion from the different livestock categories between the two databases, we can see that, for most of them, FAOSTAT presents lower values, being these differences highest for (sheep (-73.3) the EU28+ISL average). Only for swine, approximately half of the countries are reporting higher values in their NIR than FAOSTAT. Individual differences by country for dairy cattle range from -50 to 5%, with a much more defined decreasing time trend in the NIR data and differences between databases getting smaller along time for the EU28+ISL totals. For most the countries NIR values are larger, being Greece the only country with larger numbers in FAO (5%). Germany holds the highest difference share in absolute values (4% of total EU28+ISL), followed by France and the Netherlands (3.2 and 3.0%, respectively). Similarly, for N excretion from non-dairy cattle most countries present higher values in the NIR, where data is also (but more smoothly) decreasing in time and decreasing differences with FAO, which shows more stable values. Differences in individual countries range from -40 to 50% (Romania) for the average of the time series. Compared to EU28+ISL totals, France is, by far, responsible for the highest share in the total differences FAO-NIR (10% of the total), followed by United Kingdom (4%) and Ireland (3%). Not only differences for the EU totals but also for individual countries are highest for sheep, always bigger in the NIR database and ranging from nearly 0% in Romania to around 80% in many of the countries. Countries with the highest shares of Nex are also the responsible for the highest shares of total EU differences between databases: France, UK, Italy and Greece (15, 15, 14 and 12% of total EU28+ISL differences, respectively). N excretion from swine also shows a decreasing trend in the UNFCCC database, while FAO data is more stable in time. For the individual countries, differences in the average values along the total period range from -30% in the Czech Republic to 40% in Croatia and Luxemburg. Regarding their contribution to total EU28+ISL differences, Poland is in the first place with 2%, followed by Romania (1.8%). The contribution to the total differences is more equally distributed than in previous livestock categories. Regarding poultry, total N excretion for EU28+ISL is slightly increasing in time in FAO database and more irregularly fluctuating according to NIR data, but it is also lower in FAO, both for EU totals and for most of the countries. Individual country differences range from -40% in Romania and Slovakia to 85% in Luxemburg. Regarding country contribution to total EU differences, the biggest share corresponds to Romania with 7%, followed by Poland with 3.5%, and United Kingdom with 3%. Only for non-dairy cattle there is one country clearly dominating the differences in EU28+ISL N excretion, while the other livestock categories do not have one only main contributor.

Rice cultivation

Regarding CH_4 emissions from rice cultivation, the related activity data is the rice cultivated area. Figure 5.104 and Figure 5.105 compare rice area of both databases, UNFCCC inventories and FAOSTAT, first total values for all EU-28 countries together, and then differences between databases by country.

Rice harvested area data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -4.2% and 0.6%. 20 years showing values that are larger in NIR (on average by 0.1 thousand km^2 $year^{-1}$) and 5 years when FAO data are larger (on average by 0.019 thousand km^2 $year^{-1}$). Nevertheless, the data show very similar trends for both datasets. Comparing all years, NIR is larger by 0.056 thousand km^2 $year^{-1}$ or -1.32% of the average value in the EU. The three countries with the largest differences in single years are France, Portugal and Italy. The largest deviations (FAO minus NIR) are -0.1 thousand km^2 $year^{-1}$ (France, 1998), corresponding to 2.4% of total EU rice harvested area in this year (NIR), -0.1 thousand km^2 $year^{-1}$ (France, 1997), and -0.099 thousand km^2 $year^{-1}$ (France, 1995).

Figure 5.104: 3.C: Comparison of rice area in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

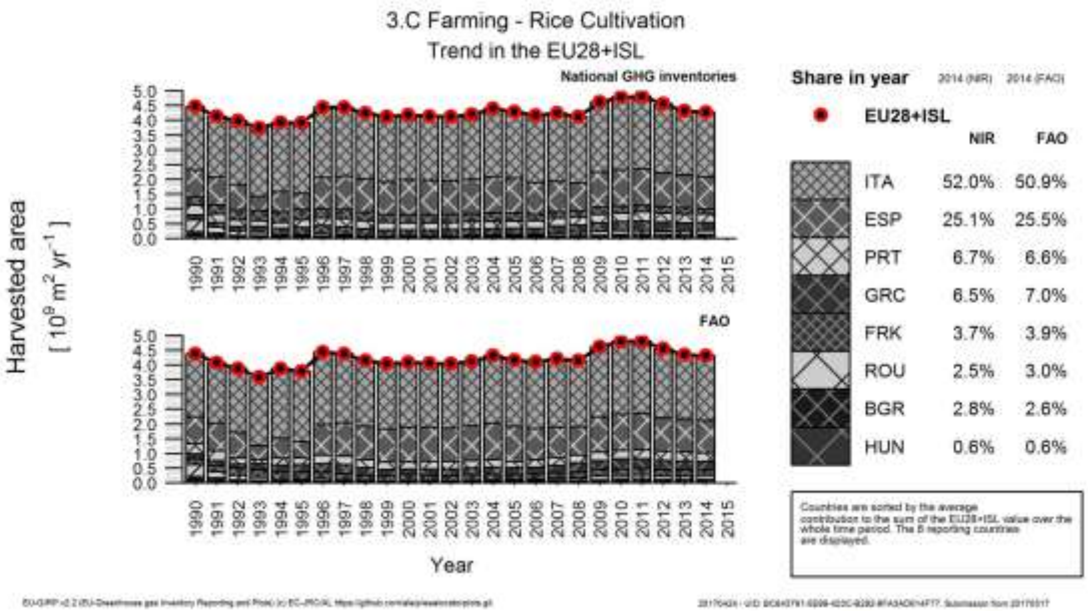
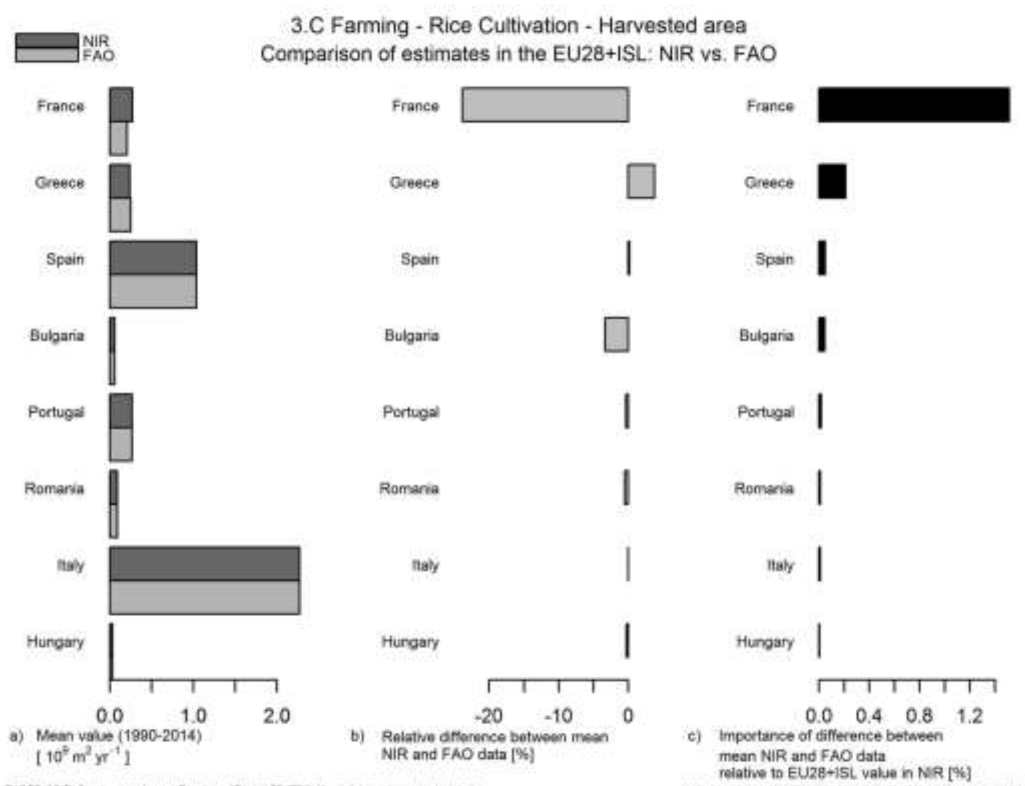


Figure 5.105: 3.C: (a) Average Rice area in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



Cultivation of histosols

Focusing on the area of cultivated organic soils, we can see in Figure 5.106 and Figure 5.107 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.

Area of cultivated organic soils data from FAO are larger than NIR data for all years. Comparing all years, NIR is smaller by 1875164 ha/year or 44.3% of the average value in the EU. The two countries with the largest differences in single years are Poland and Estonia. The largest deviations (FAO minus NIR) are 515455 ha/year (Poland, 2014), corresponding to 13% of total EU area of cultivated organic soils in this year (NIR), 511005 ha/year (Poland, 2013), and 506555 ha/year (Poland, 2012).

Figure 5.106: 3.C: Comparison of histosols area in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

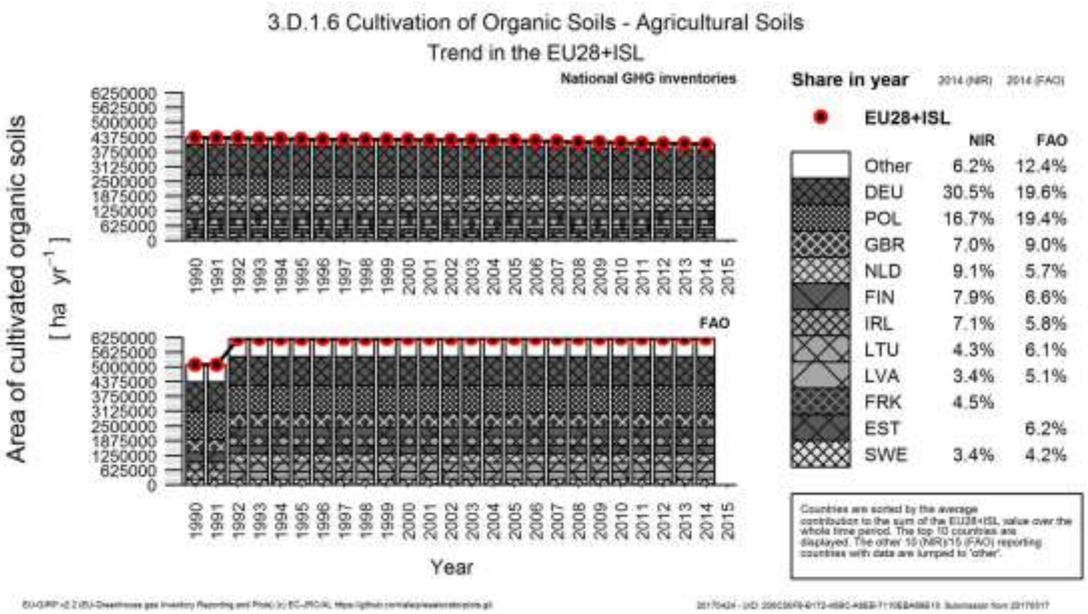
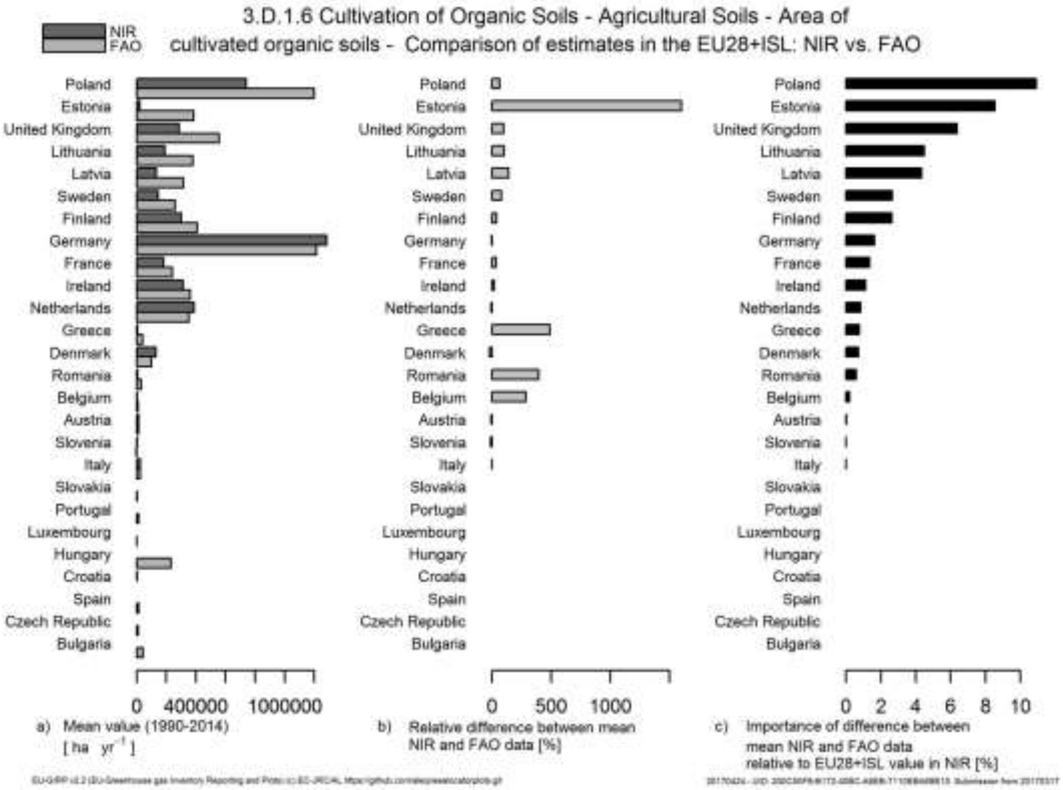


Figure 5.107: 3.C: (a) Average histosols area in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



An in-depth comparison of the area of cultivated organic soils as reported by the FAO, in the NIRs, and 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 5.108. 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'

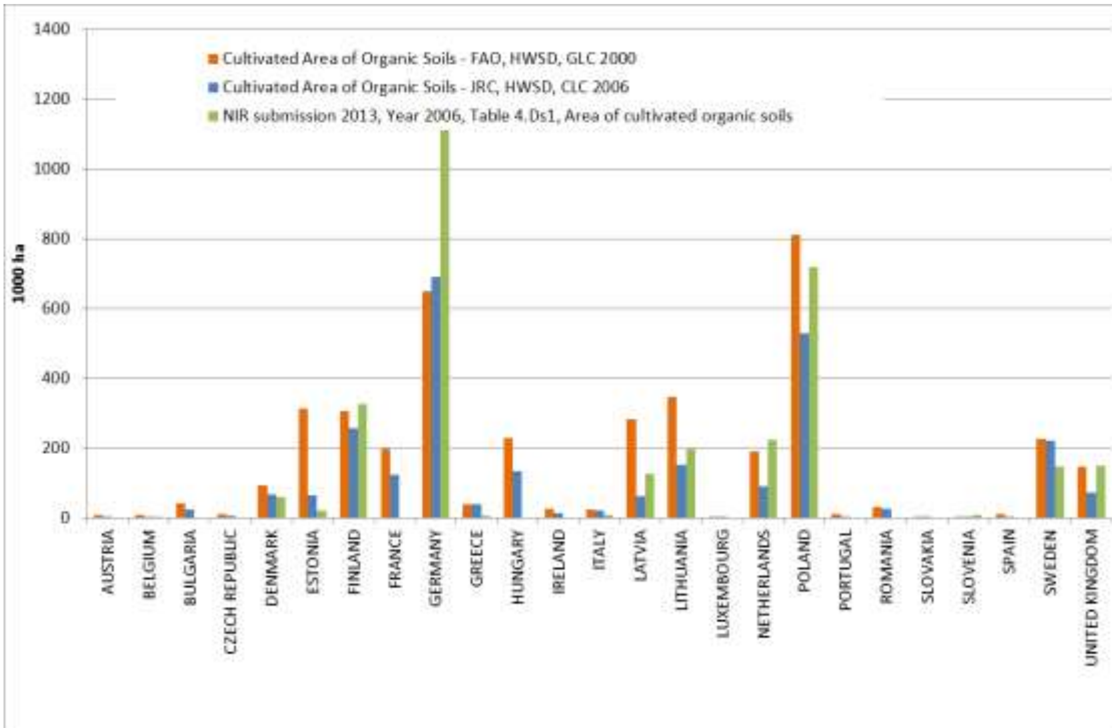
(1) if the topsoil organic carbon content is > 18% or

(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.

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 5.108: Area of cultivated organic soils based on two studies and the values given in the National Inventory Reports (2013) for the year 2006



Nitrogen input to agricultural soils

Nitrogen input to agricultural soils is an important factor both direct and indirect N_2O emissions from managed soils. New nitrogen is added with synthetic fertilisers, while other nitrogen sources are recycling nitrogen that comes from livestock and manure management systems, food or other organic waste (compost) or from sewage systems. In the following we compare nitrogen input agricultural soils as mineral fertilisers (Figure 5.109 and Figure 5.110), applied organic fertilisers (Figure 5.111 and Figure 5.112), and crop residues (Figure 5.113 and Figure 5.114).

Nitrogen input from application of inorganic fertilizers to cropland and grassland data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -15.9% and 12.3%. 19 years showing values that are larger in NIR (on average by 503.3 kt N/year) and 6 years when FAO data are larger (on average by 397 kt N/year). Comparing all years, NIR is larger by 287 kt N/year or -2.5% of the average value in the EU. The three countries with the largest differences in single years are Czech Republic, Germany and Poland. The largest deviations (FAO minus NIR) are -603 kt N/year (Poland, 1990), corresponding to 4.1% of total EU nitrogen input from application of inorganic fertilizers to cropland and grassland in this year (NIR), 534 kt N/year (Poland, 2014), and -418 kt N/year (Czech Republic, 1990).

Nitrogen input from organic nitrogen fertilisers to cropland and grassland data from FAO are sometimes smaller and sometimes larger than NIR data. Differences are in the range between -3.3% and 5.8%. 6 years showing values that are larger in NIR (on average by 140.5 kt N/year) and 19 years when FAO data are larger (on average by 156 kt N/year). Comparing all years, NIR is smaller by 85 kt N/year or 1.56% of the average value in the EU. The three countries with the largest differences in single years are France, Germany and Italy. The largest deviations (FAO minus NIR) are -549 kt N/year (Germany, 2014), corresponding to 10% of total EU nitrogen input from organic nitrogen fertilisers to cropland and grassland in this year (NIR), -510 kt N/year (Germany, 2013), and -471 kt N/year (Germany, 2012).

Nitrogen in crop residues returned to soils data from FAO are smaller than NIR data for all years. Comparing all years, NIR is larger by 1207 kt N/year or -27.5% of the average value in the EU. The three countries with the largest differences in single years are France, the United Kingdom and Belgium. The largest deviations (FAO minus NIR) are -467 kt N/year (France, 2007), corresponding to 11% of total EU nitrogen in crop residues returned to soils in this year (NIR), -412 kt N/year (France, 2014), and -389 kt N/year (France, 2008).

Figure 5.109: 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.

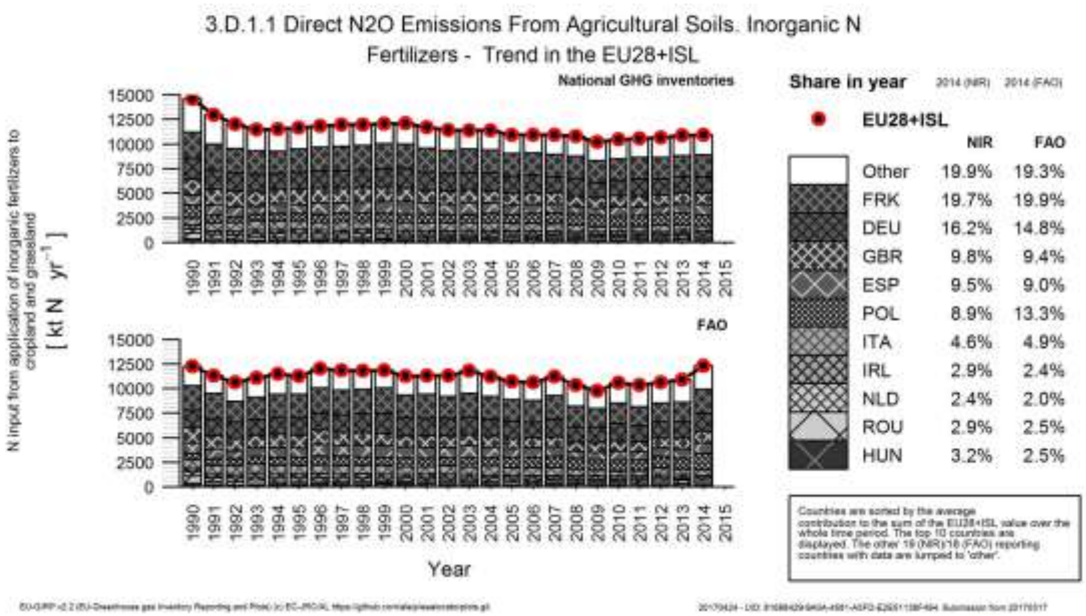


Figure 5.110: 3.D: (a) Average Inorganic N fertilizers N input in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

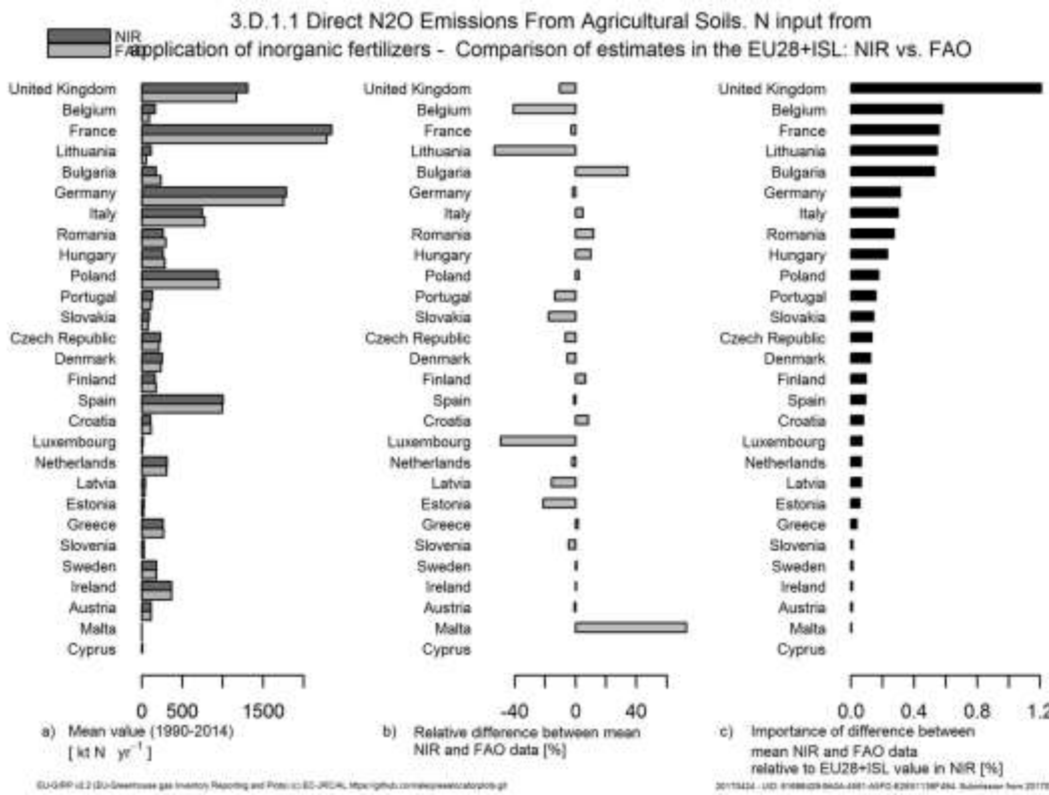


Figure 5.111: 3.D: Comparison of organic n fertilizers N input in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

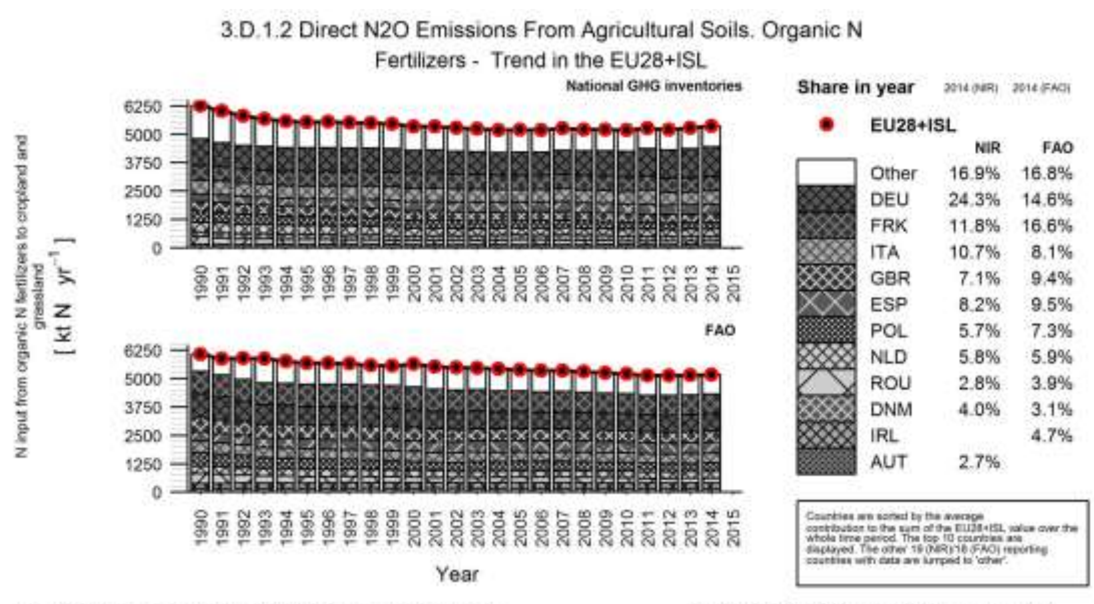


Figure 5.112: 3.D: (a) Average Organic N fertilizers N input in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.

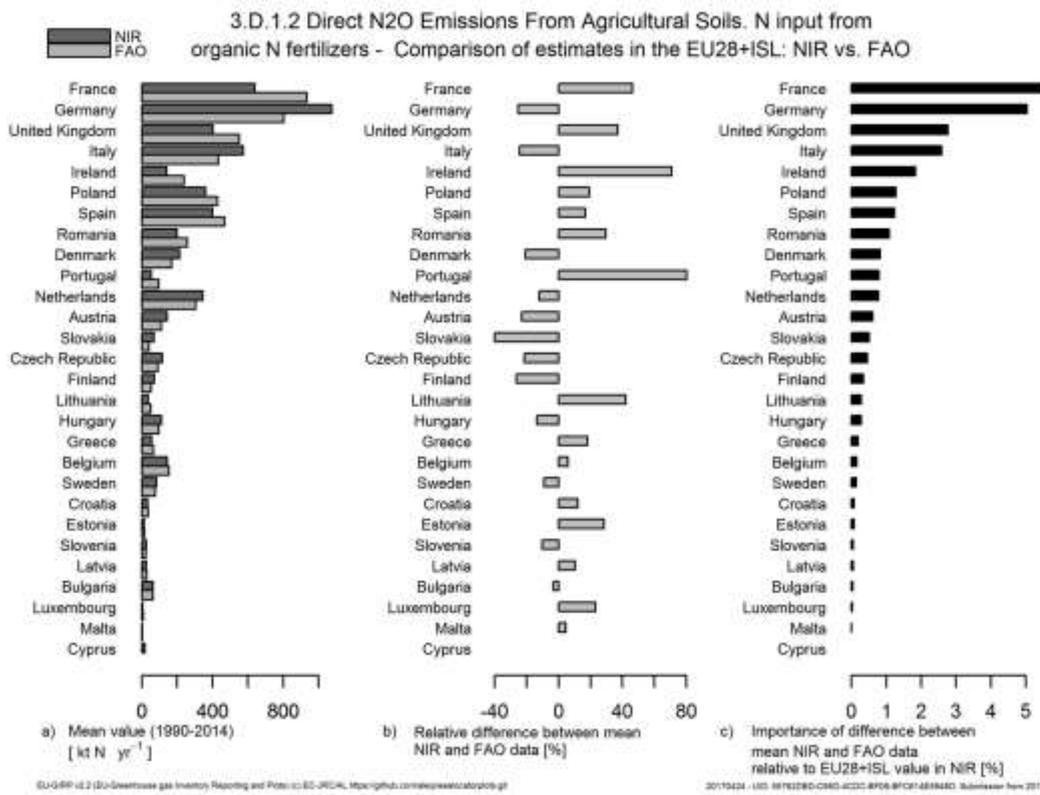


Figure 5.113: 3.D: Comparison of crop residues N input in the EU28+ISL and range of values reported by countries in the UNFCCC and the FAO.

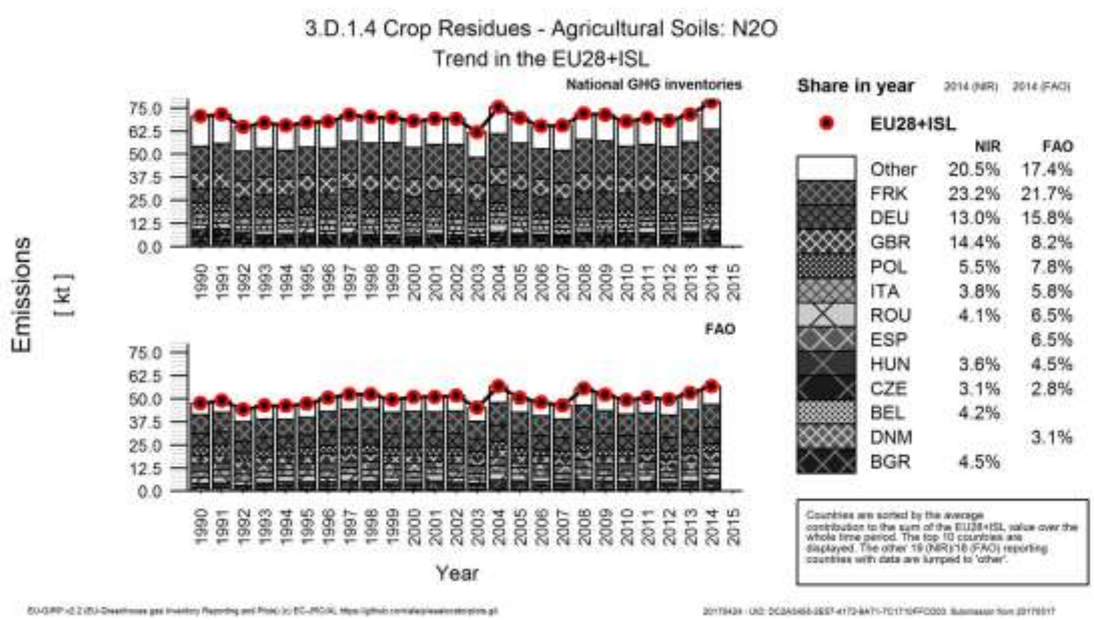
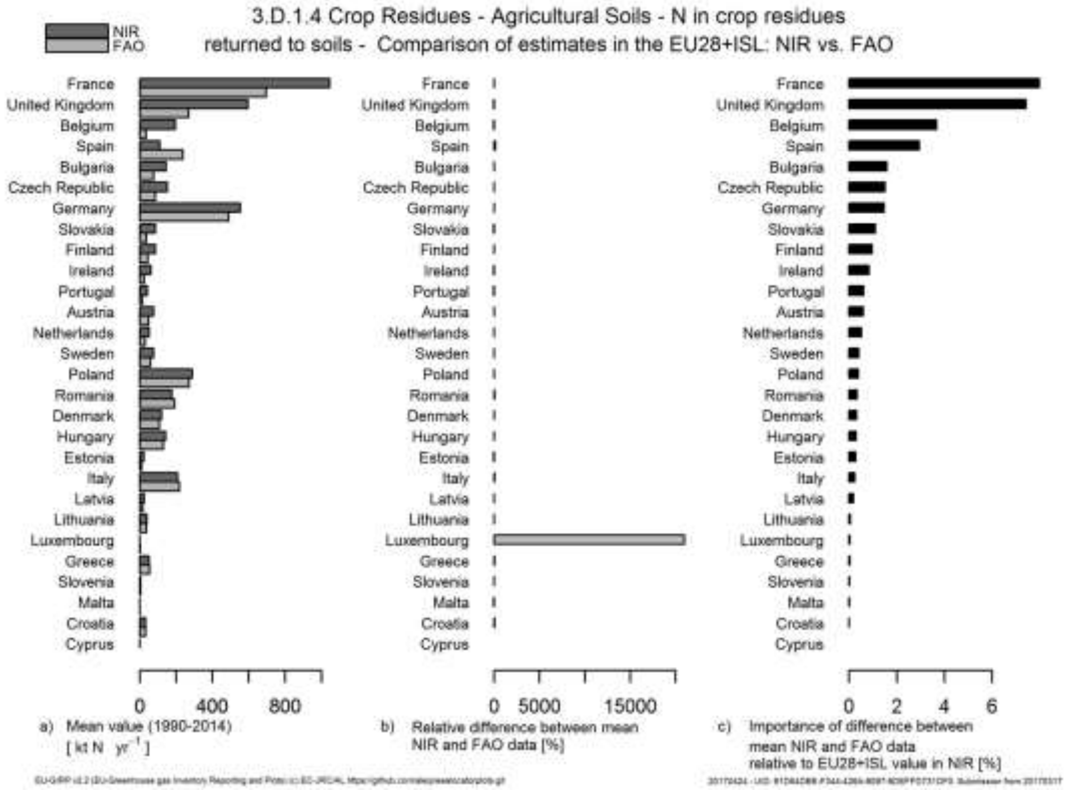


Figure 5.114: 3.D: (a) Average Crop residues N input in the EU28+ISL in the UNFCCC and the FAO, (b) Importance of range of difference in the databases for total EU28+ISL value and (c) Relative difference of mean values by country.



From the three nitrogen sources analysed above, all three present higher total values in the NIR data, but differences are highest in synthetic fertilisers applied. Time trends are quite smooth in the first two cases, with some sudden steps in crop residues applied to soils, which are probably due to climatic reasons and captured by both databases.

Conclusion

Differences in the reported emissions between FAO and UNFCCC databases can be due, as explained before, to diverse activity data or to the methodologies used for the estimation of emissions. If we focus on the emission categories holding the biggest discrepancies between the two databases, different explanations can be found. For category 3.D.1.6 Cultivation of organic soils, we found that FAO reports 76% larger emissions. Activity data is also larger in FAO for all years, but the 44.3% difference in areas does not fully explain deviations in emission estimations. Some additional explanation might be that, although countries use mostly Tier 1 approach, some of them apply country specific emission factors.

Regarding category 3.D.2 Indirect N_2O emissions from soils, where FAO reports 26% higher emissions than NIRs, we find that activity data and direct emissions from the application of inorganic fertilisers, organic fertilisers and urine and dung deposited on pastures are very close in both databases. Therefore, differences in activity data cannot explain the differences in indirect emissions, but these are due to the methodologies used in the estimations. Most countries use Tier 1 approach and default emission factor, but many of them use country specific fractions (especially $Frac_{GASM}$ and $Frac_{GASF}$).

Emissions reported for category 3.B.2 N_2O from manure management are around 35% larger in the NIRs. These can be explained by estimations of total N excretion data, which is smaller in FAO than in NIR for dairy cattle, non-dairy cattle, sheep and poultry for all years (24.1%, 30.9%, 73.2% and 13.4% larger, respectively, as an average of all years for EU total). Only swine shows similar values in the two databases, with numbers which are sometimes higher in the NIRs and sometimes in the FAO database. Many countries use Tier 2 approach, more detailed and using more country specific data than Tier 1 used by FAOSTAT, which can explain differences between databases.

Also emissions in category 3C Rice cultivation were identified as one of the categories with the largest differences in relative terms, in this case showing higher values in FAO. Rice area is not always but mostly higher in NIRs (20 years out of 25), with an average difference of only 1.3% for all years and with a different sign than emission differences. Therefore, rice area data alone cannot explain discrepancies in emissions from rice cultivation. Differences must be due to the consideration of different water regimes (continuously flooded/multiple aeration) and the selection of scaling factors, which are country specific in NIRs but estimated default values in FAOSTAT.

5.5 Sector-specific recalculations, including changes in response of to the review process and impact on emission trend

Table 5.56 to Table 5.59 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 2014 and main explanations for the largest recalculations in absolute terms.

Table 5.56 3A Enteric fermentation: Contribution of MS to EU-28+ISL Recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	**Percent**	**kt CO_2 equiv.**	**Percent**	
Austria	0	0.0	17	0.4	New AD for horses
Belgium	84	1.6	103	2.3	Changed Ym for cattle (from 6 to 6.1), according to country specific estimates (field tests with local conditions).
Bulgaria	331	7.4	76	5.1	Modified DE for cattle categories, corrections of milk units (littres to kg) and fat content of milk. Following ERT recommendation, EF for buffalo has also been recalculated.
Croatia	0	0.0	21	2.2	Emissions for dairy and manure non-dairy cattle recalculated due to error corrections. Also rounding of activity data resulted in small changes for dairy cattle and swine.
Cyprus	-3	-1.3	-10	-4.4	Recalculations that took place have been caused by (a) the change of the daily weight gain, the % fat in milk, (b) the change of fat percentage in milk, (c) correction of the calculations of GE for dairy-cattle and (d) changes in animal population. The recalculations have affected the whole reporting period, i.e. 1990-2015.
Czech Republic	0	0.0	0	0.0	No recalculations

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Denmark	85	2.1	75	2.1	Recalculated values of GE for dairy cattle and change in Ym for heifers, from 6 to 6.5%. The estimation of feed intake changed from FU-system to NorFor system; now DM is calculated based on energy requirement, more precise and optimises diet on each individual farm.
Estonia	-4	-0.3	0	-0.1	The calculations in swine and cattle sub-categories were previously performed on a county level which involved several intermediate calculations which were ultimately aggregated to a country level. Starting from the 2017 submission all the calculations are immediately performed on a country-level using weighed average country-specific activity data which is in line with the IPCC guidelines. The change in calculation approach brought about a re-evaluation of used activity data along with some miscalculation errors detected and corrected in working tables, which lead to recalculations under the Enteric fermentation subsector.
Finland	0	0.0	1	0.1	New, updated or corrected data.
France	1,060	2.9	697	2.1	CH_4 emission factors for enteric fermentatiion were taken from MONDFERENT II newly released study
Germany	12	0.0	11	0.0	Revision of the animal performance calculation with updated animal weight data for cattle and swine.
Greece	7	0.2	-114	-2.8	Updated AD for animal population for 2014 (which was not available yet, thus provisional in last submission).
Hungary	0	0.0	-5	-0.3	Revision of livestock numbers
Ireland	0	0.0	54	0.5	Revised population of replacement heifers reared for both dairy and non-dairy herds (which was not available yet, thus provisional in the last submission).
Italy	-252	-1.6	-112	-0.8	Tier 2 introduced for sheep
Latvia	0	0.0	-11	-1.3	Recalculation is done based of implementation of new country specific values of digestibility (DE, %). Recalculation also is done due to correction of IEF for Deer.
Lithuania	63	1.5	-8	-0.5	In order to increase consistency of used methodologies for calculation of emission from enteric fermentation, the gross energy intake and emission factor of dairy cattle in the period 1990-2014 have been recalculated considering productivity of dairy cattle subcategories. Livestock population were recalculated to annual average population, due to this recalculation average weight of livestock has changed. CH_4 emissions from enteric fermentation by livestock category were recalculated due to recalculated livestock population data.
Luxembourg	0	0.0	3	0.7	NIR states that no recalculations were made

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Malta	12	47.9	-4	-12.4	No information available (no NIR submitted in 2017).
Netherlands	0	0.0	0	0.0	No recalculations
Poland	0	0.0	-38	-0.3	Correction of GE for dairy cattle (new data for % fat in milk)
Portugal	178	5.3	19	0.5	Correlation factor centred in 1998 was withdrawn (UNFCCC review)
Romania	-554	-2.9	580	5.9	The activity data on milk production from National Institute of Statistics was used for the calculation the values on gross energy intake for dairy cattle. The emissions factors has been recalculated for the 1989-2014 period after using milk production.
Slovakia	205	8.6	-33	-3.2	New input data of livestock from the SU SR and new disaggregation of cattle were implemented. In dairy cattle, only high producing cows without suckling cows was allocated. Suckling cows were shifted into non-dairy cattle. Emissions from young sheep and other mature sheep were included for the first time.
Slovenia	0	0.0	0	0.0	Updated value for horse population
Spain	1,476	11.5	2,215	18.9	Important recalculations performed to incorporate (i) corrections applied to the Spanish inventory during the MMR-Step 2 review in 2016, (ii) recommendations proposed in the Step 2 review in 2016 and the UNFCCC review in Sept 2016, (iii) updates to the most recent methodologies, (iv) latest available information at national level regarding agriculture activities, as well as (v) corrections carried out between the submission in January and the March's submission. In general, for the agriculture sector variations for the whole time series between previous and latest editions of the Inventory are due to the set of recalculations performed in activities 3A, 3B, 3D, 3C and 3F, which have caused upward and downward differences with a global upwards result. The upward differences for 3A have been due to the update of the national zootechnical documents for some animal categories (horses and swine), which have risen emissions from horses reduced estimation for mules and asses, keeping with slight fluctuations emissions estimates for white pigs. For cattle, the application of the CH_4 conversion factor of the 2006 IPCC Guide has resulted in an increase of emissions.
Sweden	-341	-9.4	-115	-3.7	New country specific emission factors have been developed for all cattle categories. The emissions factors are developed at the department of animal nutrition and management at the Swedish university of agricultural sciences (Bertilsson, 2016).
United Kingdom	87	0.3	136	0.6	Added country-specific dairy cow milk yield; updated dairy and beef cow live weights; Updated livestock housing periods. Livestock numbers updated for horses

	1990		2014		Main explanations
	kt CO_2 equiv.	**Percent**	**kt CO_2 equiv.**	**Percent**	
EU28	2,446	1.0	3,553	1.9	
Iceland	0	0.0	3	0.9	Revised number of horses and improved CH_4 emissions from poultry
EU28+ISL	2,446	1.0	3,556	1.9	

Table 5.57 3B Manure Management: Contribution of MS to EU-28+ISL Recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	**Percent**	**kt CO_2 equiv.**	**Percent**	
Austria	0	0.0	1	0.3	New AD for horses
Belgium	0	0.0	0	0.0	No recalculations
Bulgaria	-1,334	-65.1	-144	-55.0	Emissions from cattle and swine have been recalculated due to availability of new statistical data for 2015 for the distirbution of manure across management systems. Based on ESD review recommendations, swine manure previously reported in anaerobic lagoons was changed to liquid systems. Correction of emission factor used for the estimation of emissions from buffalo.
Croatia	-25	-7.1	151	86.1	Technical correction for CH_4 emissions from MMS for all animal categories; recalculation of estimates have been performed based on default values and average VS excretion rates from the 2006 IPCC Guidelines for all animal categories and all years.
Cyprus	0	-0.3	-1	-0.5	The changes in the emissions' estimates compared to the previous submission are the following: - T2 methodology has been applied for the estimation of CH_4 emissions from dairy and other cattle. In previous submissions T1 was used. - Changes in horse, mules and asses animal population - Distribution of waste to the waste management systems for market swine and breeding swine for the year 2014 has been revised.
Czech Republic	-20	-1.1	-5	-0.6	During QA/QC procedure a technical error was identified in category Manure Management of cattle and the Gross energy intakes (GE) and then also Emission factors (EF) of Manure Management for cattle were corrected.
Denmark	-267	-14.7	-323	-14.7	Updated MCF for cattle and swine. MCF for sheep, goats and hoses changed to IPCC default values. New estimates for MCF for cattle, based on newly released results of a project to estimate national MCF for manure handled in anaerobic digesters.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Estonia	2	1.1	1	1.1	The calculations in swine and cattle Manure management sub-categories were previously performed on a county level that involved several intermediate calculations which were ultimately aggregated to a country level. Starting from the 2017 submission all the calculations are immediately performed on a country-level using weighed average country-specific activity data in line with the IPCC guidelines. The change in calculation approach brought about a re-evaluation of used activity data along with some miscalculation errors detected and corrected in working tables, which lead to recalculations in CH_4 emissions under the Manure management subsector.
Finland	1	0.4	5	1.2	New, updated or corrected data.
France	359	7.1	504	8.4	Increased CH_4 emissions due to changes in swine categorisation. Additionally, country-specific data were used for the parameter VS for swine, sheep and goats.
Germany	0	0.0	48	0.8	Revision of the animal performance calculation with updated animal weight data for cattle and swine.
Greece	-110	-12.5	-158	-19.2	Updated AD for animal population in 2014.
Hungary	0	0.0	-1	-0.2	Revision of indirect emissions and animal livestock
Ireland	0	0.0	7	0.6	Milk yields for dairy cows were revised. For 2014 the livestock population for heifers and poultry has been updated.
Italy	0	0.0	-130	-4.2	Update of activity data
Latvia	0	0.0	-3	-2.9	Recalculation is done based of implementation of new country specific values of digestibility (DE, %) and updating of manure management systems share (MMS, %) based on latest country specific statistical data and research results.
Lithuania	63	11.2	29	12.2	Recalculations of methane EF for non-dairy cattle, swine, poultry, fur-bearing animals, rabbits and other (nutria) have been made due to new livestock population data.
Luxembourg	0	0.0	1	0.8	NIR states that no recalculations were made
Malta	-10	-65.3	-9	-67.7	No information available (no NIR submitted in 2017).
Netherlands	0	0.0	0	0.0	No recalculations
Poland	0	0.0	-4	-0.2	Correction of GE for dairy cattle (new data for % fat in milk)
Portugal	-714	-51.4	-583	-50.2	Corrections as a result of internal QA/QC procedures
Romania	52	1.2	60	3.8	Data on milk production from the National Institute of Statistics was used for the calculation of gross energy intake and daily volatile solid excreted for dairy cattle. The emission factor has been recalculated for the 1989-2014 period. Recalculations were also made due to errors transcription of the value energy digestibility (DE%) for sheep and goats and for the non-estimation of emissions for rabbits.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Slovakia	-70	-11.3	-34	-17.5	New percentage for liquid and solid AWMS was implemented. Country specific values for average gross energy intake and digestibility were implemented into methodology in sheep and cattle category, which had impact on time series.
Slovenia	0	0.0	0	0.0	Updated value for horse population
Spain	905	14.7	97	1.2	The variations in 3B are due to the change in the methodology estimations previously applied in the Inventory for concatenated manure management systems, which has been replaced by that recommended in the IPCC 2006 GL. This recalculation has resulted in an increase in CH_4 emissions and a decrease in N_2O.
Sweden	-1	-0.3	-3	-1.1	The new activity data is from an updated analysis of the microdata from the survey "Use of fertilisers and animal manure in agriculture between 2005 and 2013 (i.e. the most recent one)". (i) Updated data on MMS distribution including also data for suckler cows, heifers, bulls and steers and calves (ii) The values for amount of nitrogen lost as ammonia from stable ventilation and during storage have been updated. This effect the indirect emissions in CRF 3.B. (iii) The method to estimate average milk yield for the dairy cattle is slightly different. This also resulted in a small effect on the N-excretion values when these rates are estimated based on milk production levels. N excretion rates for all animal categories have been reviewed in collaboration with the agriculture statistics unit at Statistics Sweden.
United Kingdom	11	0.3	16	0.5	Country-specific dairy cow milk yield added; Updated dairy and beef cow live weights; Updated poultry numbers; Updated AWMS; Updated livestock housing periods; Country-specific $Frac_{GASM}$ values. Livestock numbers updated for horses
EU28	-1,158	-2.1	-475	-1.1	
Iceland	0	-0.3	0	-0.3	NIR states that no recalculations were made.
EU28+ISL	-1,158	-2.1	-475	-1.1	

Table 5.58 3B Manure Management: Contribution of MS to EU-28+ISL Recalculations in N_2O for 1990 and 2014 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	6	1.3	New AD for horses

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Belgium	0	0.0	7	0.9	There was a compliation error and will be corrected in next submission. Indirect N_2O emissions from manure management were corrected (wrong atmospheric deposition values for 1990, 2000, 2010 and 2015), while emissions from leaching and runoff do not occur.
Bulgaria	18	1.5	28	6.3	Emissions from cattle and swine recalculated due to statistical data for 2015 for the distribution of manure across management systems. Based on ESD review recommendations, swine manure previously reported in anaerobic lagoons was changed to liquid systems. Indirect N_2O emissions recalculated to include leaching and run-off.
Croatia	0	0.0	0	0.0	Emissions recalculated for dairy and mature cows, sheep, swine categories, horses, mules&asses, poultry and goats due to correction of emission parameter errors and other issues detected during QA procedure.
Cyprus	-1	-1.1	-6	-8.7	The changes in the emissions' estimates compared to the previous submission are the following: - 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 manure management systems did not match the total N excreted by the animals. - Revised calculations have been made for N_2O emissions per technology and N_2O emissions per animal, due to the mistake identified to the conversion of (N_2O-N) emissions to N_2O emissions (44/26 change into 44/28). - Indirect N_2O emissions from leaching and runoff of nitrogen from manure management have been estimated for the first time. - Changes in horse, mules and asses animal population - Distribution of waste to the waste management systems for market swine and breading swine for the year 2014 has been revised.
Czech Republic	-850	-25.7	-322	-24.6	Nex value updated, indirect N_2O emissions from leached nitrogen have been deleted.
Denmark	0	0.0	-2	-0.2	Some changes in the number of animals have been made due to updating of the statistics and this affect both the emission of CH_4 and N_2O.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Estonia	-8	-5.5	-3	-4.0	The calculations in swine and cattle Manure management sub-categories were previously performed on a county level that involved several intermediate calculations which were ultimately aggregated to a country level. Starting from the 2017 submission all the calculations are immediately performed on a country-level using weighed average country-specific activity data which is in line with the IPCC guidelines. The change in calculation approach brought about a reevaluation of used activity data along with some miscalculation errors detected and corrected in working tables, which lead to recalculations in N_2O emissions under the Manure management subsector.
Finland	1	0.4	3	1.1	New, updated or corrected data
France	-513	-17.9	-477	-20.5	New categorisation of swine population. Now leaching during storage is only applied to solid systems and related indirect emissions. Moreover indirect N_2O volatilisation was calculated on the basis of all losses by volatilisation including N2, which has now been removed.
Germany	0	0.0	-9	-0.2	Revision of the animal performance calculation with updated animal weight data for cattle and swine.
Greece	19	6.1	-14	-4.5	Updated AD for animal population in 2014 and modifications, based on TERT 2016 recommendations, of Dairy Cattle Nex.
Hungary	25	2.8	-1	-0.1	Revision of indirect emissions and animal livestock
Ireland	2	0.4	5	1.0	Suckler cows N-excretion is calculated with Tier 2 N method. Milk yields for dairy cows were revised. For 2014 the livestock population for heifers and poultry has been updated.
Italy	22	0.8	-49	-2.3	Update of activity data
Latvia	-16	-5.0	-6	-5.6	Recalculation is done based on implementation of new country specific values of Nex based on national research data and updating of manure management systems share (MMS, %) based on latest country specific statistical data and research results.
Lithuania	56	10.3	28	16.7	Recalculations of direct N_2O emissions due to new N excretion rates, following updated animal numbers in subcategories and recalculated net energy for animal growth. Indirect N_2O emissions have been recalculated due to the new N excretion rates and to the revision of percent of manure nitrogen losses due to run-off and leaching during solid storage of manure (FracLeachMS). N excretion recalculations were motivated by a revised non-dairy cattle herd structure and revised GE for swine and sheep.
Luxembourg	0	0.0	0	0.0	No recalculations were made
Malta	2	16.8	-2	-17.9	No information available (no NIR submitted in 2017).
Netherlands	0	0.0	0	0.0	No recalculations were made

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Poland	-67	-2.1	-44	-2.1	Corrected $Frac_{LEACH}$ in indirect N_2O emissions
Portugal	1	0.4	1	0.4	Corrections as a result of QA/QC procedures
Romania	1	0.1	0	0.1	Recalculations were performed to improve completeness by characterizing for the first time emissions from N losses due to leaching. Also some errors in the calculation on Direct N_2O emissions for poultry were corrected for 1989-2014.
Slovakia	-86	-14.8	-14	-7.6	New value of Nitrogen excretion rate in 2014 was calculated with using new country specific typical animal weight and new disaggregation of all animals´ categories. New subcategories were added: Mature female goats 25.696 kgN/head/year, pregnant goats 22.192 kgN/head/year, other mature goats 10.045 kg N/head/year. Also number of livestock was corrected based on new data provided by the SU SR for time series.
Slovenia	-12	-7.4	-3	-3.2	Updated values of Nex rates, and horse population
Spain	-385	-21.6	-647	-27.7	The variations in 3B are due to the change in the methodology estimations previously applied in the Inventory for concatenated manure management systems, which has been replaced by that recommended in the IPCC 2006 GL. This recalculation has resulted in an increase in CH_4 emissions and a decrease in N_2O.
Sweden	2	0.4	7	2.2	The new activity data is from an updated analysis of the microdata from the survey “Use of fertilisers and animal manure in agriculture between 2005 and 2013 (i.e. the most recent one)”. (i) Updated data on MMS distribution including also data for suckler cows, heifers, bulls and steers and calves (ii) The values for amount of nitrogen lost as ammonia from stable ventilation and during storage have been updated. This effect the indirect emissions in CRF 3.B. (iii) The method to estimate average milk yield for the dairy cattle is slightly different. This also resulted in a small effect on the N-excretion values when these rates are estimated based on milk production levels. N excretion rates for all animal categories have been reviewed in collaboration with the agriculture statistics unit at Statistics Sweden.
United Kingdom	-16	-0.9	-14	-1.0	Country-specific dairy cow milk yield added; updated dairy and beef cow live weights; updated poultry numbers; updated AWMS; Updated livestock housing periods; Country-specific FracGasMS values. Livestock numbers updated for horses
EU28	-1,807	-5.8	-1,529	-6.9	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Iceland	9	17.4	8	19.3	A new nitrogen-flow approach has been implemented, describing all N emissions throughout the agricultural sector and based on EMEP/EEA approach. Indirect emissions of N_2O during manure management are now included in the emissions estimates, increasing emissions in all years.
EU28+ISL	-1,799	-5.7	-1,521	-6.8	

Table 5.59 3D Agricultural Soils: Contribution of MS to EU-28+ISL Recalculations in N_2O for 1990 and 2014 (difference between latest submission and previous submissions in kt CO_2 equivalents and percent)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	85	3.9	86	4.4	Organic soils first time estimated, revised dry matter fractions crops, new AD horses
Belgium	0	0.0	35	1.0	In Flanders, updated number of animals for 2007-2014, new activity data for cropland remaining cropland and a new FracRenewal value for clover and alfalfa has been updated for the entire time series. In Wallonia and Flanders, compost application on agricultural soils has been integrated since 2006 and 1990, respectively.
Bulgaria	122	2.4	33	1.2	Recalculations linked to the recalculaitons in 3B category. Following recommendation of the ESD review 2016 and ERT in 2016, Bulgaria included the emission from 3.D.a.5 Mineralization associated with loss/gain of soil organic matter in the current submission.
Croatia	-107	-7.3	-45	-4.7	Harvested area of crops updated with national sources. Technical correction applied to the coordination between manure excretion (3.B) and manure applied to soils (3.D) data.
Cyprus	-1	-0.7	-5	-4.0	The changes are caused by changes in crop production data by crop and in cultivated area data by crop both taken by Eurostat, and also changes in data sources (Department of Agriculture) regarding the annual amount of synthetic fertiliser N applies to soils.
Czech Republic	305	5.5	320	10.1	EF1 was changed from 1.25 to 1%. $Frac_{REMOVE}$ was updated to zero. Updated activity data of animal manure applied to soils due to recalculations in sector 3B, with an impact on direct and indirect emissions from soils.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Denmark	86	1.6	80	2.1	Recalculation of the area of organic soils due to a new soil map, which has increased emissions. Emissions form mineralisation decreased due to change of the C-TOOL, which is the model to estimate the carbon stock change in soil. Changes in emissions from atmospheric deposition mainly due to change in the EF for NH_3 for inorganic fertiliser and some small changes in emissions from manure management, manure on soil, indirect N_2O from manure management and leaching due to change in normative figures and NH_3 emissions.
Estonia	45	4.1	29	4.8	N_2O emissions from animal manure applied to soils and from urine and dung deposited by grazing animals were revised due to recalculations under the Manure management subcategory and due to corrections in calculations implemented under the crop residues subcategory; data on areas of organic soils cultivated were updated in the framework of the NFI (see chapter LULUCF).
Finland	50	1.3	24	0.7	New, updated or corrected data
France	-936	-2.6	-692	-2.0	Nitrogen balance has been fully revised and EMEP/IPCC methodologies have been coordinated for the calculation of indirect emissions. Instead of using default volatilisation factors from IPCC guidelines, emissions of related gases have been calculated with EMEP methods.
Germany	592	2.1	534	2.0	Several changes in underlying activity data. For submission 2016 the calculation of indirect N_2O emissions from leaching and runoff was not fully in line with IPCC (2006). This was changed for Submission 2017 as required by the Expert Review Team of the In Country Review in September 2016.
Greece	20	0.4	-146	-4.4	Updated emission factor for drained grassland on organic soils. Updated AD and modifications based on TERT 2016 recommendations for Dairy Cattle Nex and Nbedding.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Hungary	-106	-2.8	-46	-1.4	Revision of the nitrogen content of the applied animal manure to soils due to revision of indirect emissions under 3B. New source: compost. Slight changes in 3Da4 and 3Da5. Emissions from atmospheric deposition in 3.B as well as in 3.D were recalculated due to the revision of NOx and NH_3 emissions in the reporting to the UNECE under the LRTAP Convention. Hungary applies the most up-to-date, 2016 EMEP/EEA Emission Inventory Guidebook to calculate the agricultural NH_3 and NOx emissions, which has been introduced in the air pollutant emission inventory since this year. The 2016 EMEP/EEA Emission Inventory Guidebook provides updated methodology and Tier 2 EFs to calculate NH_3 emissions from inorganic N-fertilizers; the IEF for synthetic N-fertilizers changed from 0.066 to 0.038 kg NH_3 (kg N applied)-1). Thus, the methodological change resulted in a significant (11%) decrease in the reported NH_3 emissions compared to the 2016 emissions, which affects the value of $Frac_{GASF}$ in the GHG-inventory. To a lesser extent, some additional methodological changes also contributed to the changes in the value of $Frac_{GASF}$ and $Frac_{GASM}$: • Updated methodology to calculate NOx emissions from sources under 3.D. • The new 2016 EMEP/EEA Guidebook enables to separate NH_3 emissions from animal manure between 3.B and 3.D sectors for those livestock categories for which emissions are reported by Tier 1 methodologies. This resulted in changes in the allocation of nitrogen between 3.B and 3.D. However, emissions from livestock categories having small importance are calculated using Tier 1 in the air pollutant emission inventory. To ensure the consistency between the GHG and the air pollutant inventory NOx and NH_3 emissions from 3.D.2.c Other organic fertilizers applied to soils (compost) have been included in the 2017 submission of the air pollutant inventory. Inclusion of this new source also affects the value of $Frac_{GASM}$.
Ireland	19	0.3	62	1.0	Updated assessment of the nitrogen excreted by non-dairy cows, based on information on feed intake, energy transformations and organic matter excretion from Ireland's Tier 2 model of enteric fermentation from the cattle herd. This information is then used to estimate nitrogen excretion from these based on Equation 10.33 Chapter 10, Volume 4 of the 2006 IPCC Guidelines.
Italy	-369	-3.3	-304	-3.3	Update of activity data of the amount of N-bedding applied to soil

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Latvia	-53	-2.3	-42	-2.6	Recalculations is done based on: 1) implementation of new methodology to determine the share of grazing animals; 2) implementation of country specific value of $Frac_{LEACH-(H)}$ or N losses by leaching/runoff; 3) implementation of updated values of N in sewage sludge, digestate and animal manure applied to soils.
Lithuania	734	28.6	569	31.6	In 3.D.1.2.c Other organic fertilizers applied to soils, recalculation for 2014 due to updated activity data and correction of typing error of dry matter. In 3.D.1.2.b Sewage sludge applied to soils recalculation due to updated activity data and new data on nitrogen concentration in sewage sludge for 2011-2015 period. Due to recalculations made in CRF 3.B.2 Manure management category, emission from 3.D.1.2.a Animal manure applied and 3.D.1.3 Urine and dung deposited by grazing animals were also recalculated. Recalculation of 3.D.1.4 Crop residue category due to: inclusion of silage crops excl. maize, flax, buckwheat, triticale, soya, mixed dry pulses, mixed cereals, other cereals and vegetables categories into estimation of N_2O emission from crop residue; updated data on: dry matter, N content in above-ground residue and N content in below-ground residue parameters according to recent scientific data; as there is a lack of sufficient and reliable scientific data on what amount of N in above-ground residue were removed annually for purposes such as feed, bedding and construction, no removal was assumed ($Frac_{REMOVE}$ 0 kg N); $Frac_{RENEW}$ for perennial grasses, meadows pastures and permanent pastures/meadows were applied. Due to recalculations of Cropland and Grassland organic soils in LULUCF sector, emissions from 3.D.1.6 Cultivation of organic soils were also recalculated. Due to recalculations made in 3.D.1 Direct N_2O emissions from managed soils, recalculations have been made in 3.D.2 Indirect N_2O emissions from managed soils atmospheric deposition and N leaching and run-off from managed soil categories.
Luxembourg	-1	-0.4	-9	-5.7	Error correction
Malta	-9	-30.7	-7	-25.8	No information available
Netherlands	51	0.6	221	4.3	Revised activity data of synthetic N-fertilizer use in 2014. N_2O emissions from below-ground crop residues are included
Poland	375	2.2	153	1.1	Inclusion of N from straw in solid manure applied to soils; N emissions related to F_{SOM} moved to LULUCF

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Portugal	-12	-0.5	-63	-2.9	Update of 2013 and 2014 values of N inorganic fertilizers updated by INE (Direct N_2O emissions, Indirect N_2O emissions). Implementation of tier 2 methodology of EMEP Guidebook 2016 to estimate NH_3 emissions from N inorganic fertilizers, including new emission factors. This recalculation also lead to changes of N_2O indirect emissions from atmospheric deposition on soils of N volatilized as NH_3, as it is explained in MMR-Annex III submitted in 15th January 2017. Other cause for recalculation was the revision of the inorganic fertilizers values of 2013 and 2014 updated by the National Statistical Institute (INE), which affects direct and indirect N_2O emissions from inorganic fertilization application to soils.
Romania	0	0.0	-1	0.0	There have been recalculations to improve completeness by characterizing emissions from N leaching/runoff.
Slovakia	-115	-3.8	17	1.0	The changes in agriculture soils connected with the changes in manure management and correction of EFs in manure applied to soils and atmospheric deposition.
Slovenia	4	0.9	2	0.4	Addition of emissions due to the N mineralization/immobilization associated with loss/gain of soil organic matter
Spain	-3,037	-24.2	-3,397	-24.8	In 3D activity, the slight differences in the upward movement are due to the recalculations in 3D12a and 3D13 due to revisions of the nitrogen of manure applied to the fields and derived from grazing activities calculated in accordance with 3B. For 3D11 activity no new calculations have been made. Indirect 3D emissions have been also revised in accordance to 2016 review recommendations . A specific national $Frac_{LEACH-(H)}$ factor, result of a study of the Spanish Inventory to assess $Frac_{LEACH}$ values according to Table 11.3 of the IPCC 2006 Guidelines, has been applied to these emissions estimates, recalculating them downwards. In activity 3F recalculations have meant an increase in CH_4 and N_2O emissions in the early years of the time series with a strong reduction as from 2000. These recalculations come from the update to IPCC 2006-GL methodologies for the category and a review of the activity data in combination with sector 5C2.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Sweden	-49	-1.4	-57	-1.7	Due to the new ammonia emission model the ammonia emissions from grazing animals and from animal manure applied to soils have been updated. Activity data for sewage sludge applied to soils has been updated for 2014 due to a new reporting to the Sewage sludge directive (86/278/EEC). The emissions from leaching and run-off are recalculated for several years in the time series. This is due to that the estimation method uses total area of agricultural soil as a parameter in the calculations, and that this data changes slightly for every new submission because of the method used by the Swedish national inventory of forests to calculate the area of agricultural soils.
United Kingdom	91	0.5	256	1.8	Updated crop areas; Updated crop production; Updated urea and UAN values; Updated mineralisation data and added direct emissions from cropland management as well as indirect emissions; updated poultry numbers; Country-specific FracGASF, FracGasM and FracLossMS values; Updated AWMS; added country-specific dairy cow milk yield; Updated livestock housing periods. Livestock numbers updated for horses
EU28	-2,219	-1.1	-2,394	-1.4	
Iceland	-142	-38.8	-136	-37.6	Iceland has implemented a nitrogen-flow approach which better describes the N_2O (and other N species) emissions throughout the agriculture sector, based on the UN/ECE 2016 Guidebook, but retains full consistency with the methodologies in the IPCC 2006 Guidelines. The EF used to estimate emissions from soils has been reduced from 0.0125 to 0.01 kg N_2O-N/kg N, in line with the latest information available in the 2006 IPCC Guidelines (Table 11.1). Emission of N_2O are reduced accordingly from the application of synthetic and organic fertilisers and crop residues. 3.D.1.3 Managed soils, grazing animals: In accordance with the IPCC2006 Guidelines, the EF used for grazing Sheep (and selected other animal classes) is 0.01 N_2O-N/kg N. Previously a figure of 0.02 N_2O-N/kg N was used for all animal classes. This has a particularly large impact on emissions of N_2O as sheep are a major source in the agriculture sector. 3.Db2 Indirect emissions, Leaching & run-off: In accordance with the IPCC2006 Guidelines (Table 11.3), the EF used is 0.0075 kg N_2O-N/kg N leached. This is a substantial reduction on the value previously used, 0.025 kg N_2O-N/kg N.
EU28+ISL	-2,360	-1.2	-2,530	-1.5	

6 LULUCF (CRF SECTOR 4)

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. This variety is well recognized as a value in terms of biodiversity and culture, but may represent a challenge when compiling a greenhouse gas (GHG) inventory.

Land use, Land-use change and Forestry (LULUCF) covers anthropogenic greenhouse gas emissions, and CO_2 removals, that result from land management practices. The sign of the impact of these practices on the carbon stock depends of several factors, but it is well know that, while certain patterns prevent the release of the carbon, or enhance the carbon sink, others stimulate the release of the carbon that is naturally stored in the pools.

With more than three-quarters of the European Union (EU) territory covered by forests and agricultural lands, EU‘s environmental and agricultural policies have had for many years a paramount impact on the current European landscape.

In particular, over the last years, the Common Agricultural Policy, and the rural development programs, have stimulated less intensive agricultural practices, and have implemented measurements towards sustainability and enhancement of rural environments. Furthermore, with the aim of protect ecosystems and enhance their services, the EU environmental policy (e.g. Natura 2000 network) has resulted in an increase of the area under conservation regime and it has contributed to preserve the biodiversity and landscapes.

Overall, throughout the reporting period (1990-2015) the resulting trend from these policies is a decrease of the arable lands that is compensated by an increase of forests, and to a lesser extent, by urban areas. This is itself one of the main driver of the final carbon balance in the LULUCF sector. However, of utmost importance is also the fact at the EU level felling accounts for only about two thirds of the net annual wood increment, which explain the significant build-up of biomass over time (i.e. carbon removal) in the forests.

6.1 Overview of the sector

Complying with relevant EU provisions (i.e. Regulation No 525/2013), LULUCF sector of the EU GHG inventory is a compilation of the inventories submitted by individual Member States (MS). Submissions by MS in 2017 are used as the primary source of data and information, unless otherwise specified and referenced in the text.

This chapter provides the general trends of GHG emissions and CO_2 removals from LULUCF at EU level, including information from Iceland. It provides general information on the methods used by individual national inventories, and describes the efforts carried out to harmonize and improve the quality of the inventories. More detailed information can be found in individual national inventory reports (NIR) and common reporting format tables (CRF) submitted by MS and Iceland.

In particular, this chapter includes: an overview of LULUCF sector and overall trends, the contribution of land use changes, the completeness of the sector by individual inventories, 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 or removals and activity data for each land use category, specific methodological information for relevant categories; and an overview of cross-cutting issues including uncertainties, QA/QC procedures, time series consistency, recalculations and verification.

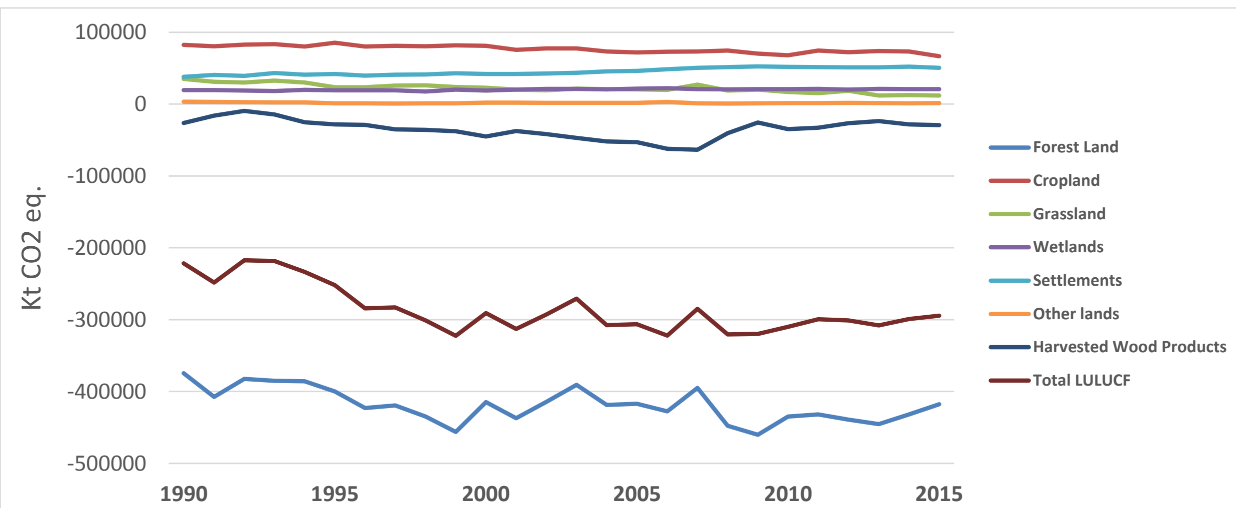
6.1.1 Trends by land use categories

The LULUCF sector within the EU GHG inventory results in a net carbon sink from higher removals by sinks than emissions by sources. In terms of land use categories the only net carbon sinks are represented by Forest land and by Harvested Wood Products. Cropland is the larger source of emissions, and Grasslands, along with the other land use categories, represents a small source of emissions.

In 2015, the LULUCF sector of the EU MS and ISL results in a total net sink of -315.670 kt CO_2, which corresponds to an increase of about 29% as compared to the net carbon sink reported for the year 1990 (Table 6. 2). Harvested Wood Products carbon pool in 2015 is reported as a net carbon sink of about -29.000 kt CO_2eq. Emissions of CH_4 and N_2O offset 4% of total annual carbon 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 and ISL GHG net emissions (+) / removals (-) for 1990–2015, in CO2 eq. (kt).

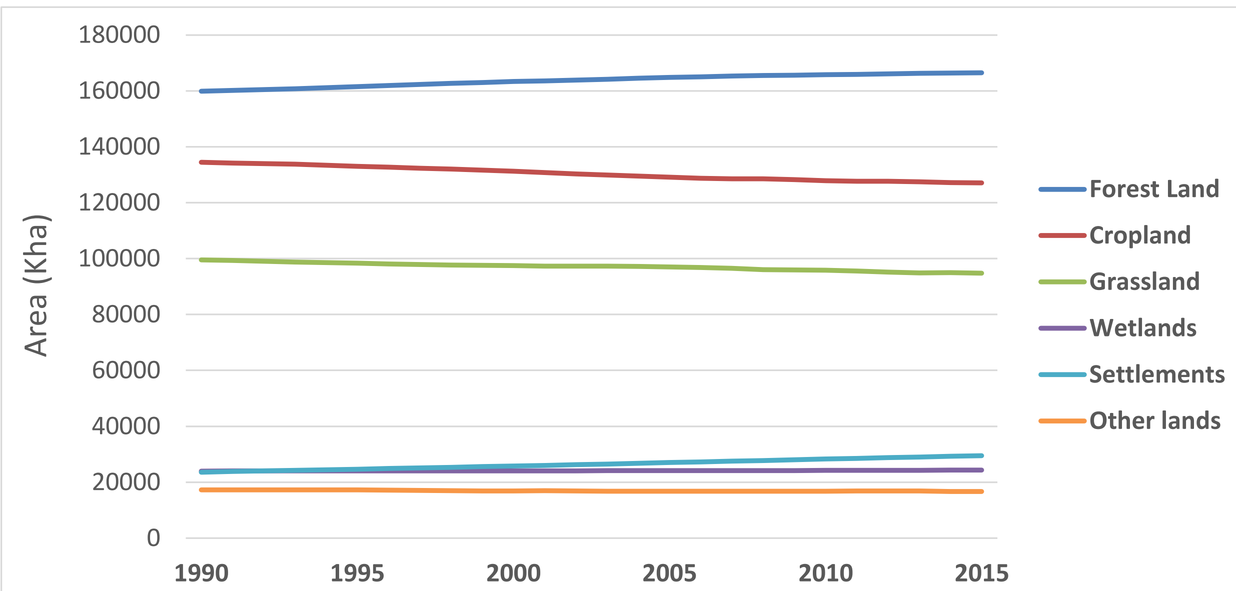


Source: MS and ISL submissions 2017, CRF Table10s1

The overall trend of the LULUCF sector since 1990 is largely affected by the Forest Land category. An increase of the forest carbon sink took place during the 90s mainly due to forest area expansion and to an increase of net forest increment, which has been followed by a slight decline attributable to a general increase in harvest rates. In the late 2000s harvest rate decreased (mainly due to the economic crisis) 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, 2007 and 2009) and wildfires (e.g.1990, 2003, 2005 and 2007) in Mediterranean countries. However, in some specific years the methods implemented by MS to derive carbon stock changes 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 net carbon sink.

The total reported area of the different land use categories in 2015 by EU MS and Iceland is about 459.000 kha. The trend on these categories (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 under each dataset. The changes in areas reported under the land use categories for 2015 as compared to 1990 are: Settlements (+25%), Croplands (-6%), Forest land (+4%), Grassland (-5%), Wetlands (1%). Other lands (-3%).

Figure 6. 2 Total area for each of the land use categories (kha), as reported in EU MS and ISL in 2015.



Although, as already shown, the LULUCF sector results in a net carbon sink at the level of EU and Iceland, the LULUCF sector reported by individual inventories range from a net sources (e.g. Netherlands, Latvia, Ireland, Iceland) to small sinks (e.g. Cyprus, Luxembourg, Estonia) or large sinks (e.g. France, Finland, Sweden) (Table 6. 2).

Compared to 1990, for 2015 individual inventories report, either a significant increase in the carbon sink (e.g. Portugal, Italy) or a substantial reduction (i.e. Austria, Germany), that are driven by the harvested rates.

Table 6. 2 Sector 4 LULUCF: MS' contributions to net CO2 removals in 2015 (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	-12 307	-5 040	-4 980	1.6%	60	1%	7 326	60%
Belgium	-2 799	-2 100	-2 087	0.7%	13	1%	712	25%
Bulgaria	-15 094	-7 211	-6 968	2.2%	243	3%	8 126	54%
Croatia	-6 627	-6 668	-5 092	1.6%	1 576	24%	1 535	23%
Cyprus	-100	-174	-168	0.1%	5	3%	-68	-68%
Czech Republic	-6 626	-7 887	-6 735	2.1%	1 151	15%	-110	-2%
Denmark	4 856	57	4 059	-1.3%	4 002	7027%	-797	-16%
Estonia	-1 737	-1 762	-2 366	0.7%	-604	-34%	-629	-36%
Finland	-15 483	-30 527	-28 177	8.9%	2 350	8%	-12 694	-82%
France	-29 807	-43 063	-39 087	12.4%	3 976	9%	-9 280	-31%
Germany	-33 018	-16 589	-16 301	5.2%	288	2%	16 717	51%
Greece	-2 246	-462	-3 160	1.0%	-2 698	-584%	-914	-41%
Hungary	-2 734	-5 434	-6 583	2.1%	-1 149	-21%	-3 849	-141%
Ireland	5 442	3 986	3 667	-1.2%	-318	-8%	-1 775	-33%
Italy	-5 585	-35 258	-37 063	11.7%	-1 805	-5%	-31 478	-564%
Latvia	-9 667	3 262	296	-0.1%	-2 966	-91%	9 963	103%
Lithuania	-4 038	-7 792	-7 168	2.3%	624	8%	-3 130	-78%
Luxembourg	27	-470	-418	0.1%	52	11%	-445	-1649%
Malta	3	3	3	0.0%	0	8%	0	6%
Netherlands	6 054	6 551	6 581	-2.1%	30	0%	527	9%
Poland	-25 957	-33 289	-29 973	9.5%	3 317	10%	-4 015	-15%
Portugal	888	-10 095	-8 973	2.8%	1 122	11%	-9 862	-1110%
Romania	-20 715	-20 102	-20 102	6.4%	0	0%	612	3%
Slovakia	-9 078	-6 166	-6 474	2.1%	-308	-5%	2 604	29%
Slovenia	-4 508	-5 744	-5 664	1.8%	80	1%	-1 156	-26%
Spain	-25 748	-39 701	-39 264	12.4%	437	1%	-13 516	-52%
Sweden	-38 356	-47 188	-52 512	16.6%	-5 324	-11%	-14 156	-37%
United Kingdom	3 241	-9 015	-8 914	2.8%	101	1%	-12 154	-375%
EU-28	**-251 718**	**-327 877**	**-323 624**	**103%**	**4 253**	**1%**	**-71 906**	**-29%**
Iceland	7 704	8 000	7 954	-2.5%	-46	-1%	249	3%
United Kingdom (KP)	3 223	-9 018	-8 913	2.8%	104	1%	-12 136	-377%
EU-28 + ISL	**-244 032**	**-319 881**	**-315 670**	**100%**	**4 211**	**1%**	**-71 638**	**-29%**

At EU level, in the year 2015 the LULUCF sector offsets 7,1% of the total emissions from other sectors ("Total without LULUCF"), with significant differences among MS (Table 6. 3, column a).

Forest Land category is the most important driver within the LULUCF sector, offsetting itself about 10% of total emissions from other sectors. In 2015 this category resulted, in terms of CO_2 equivalent, a net sink for all the MS with the exception of Denmark (Table 6. 3, 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. 3, column c).

Table 6. 3 Sector 4 LULUCF: Contribution of Sector 4 (column a) and category 4A (column b) to total MS emissions (CO2 eq. 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	-6.1%	-5.5%	1.0%
Belgium	-1.6%	-3.6%	1.0%
Bulgaria	-11.2%	-9.9%	1.5%
Croatia	-21.2%	-23.8%	1.3%
Cyprus	-2.0%	-2.0%	0.0%
Czech Republic	-5.2%	-4.8%	1.5%
Denmark	8.7%	0.5%	-0.1%
Estonia	-13.1%	-13.7%	0.6%
Finland	-46.8%	-61.5%	8.2%
France	-7.8%	-11.6%	12.8%
Germany	-1.6%	-6.4%	13.8%
Greece	-3.3%	-2.3%	0.5%
Hungary	-10.7%	-9.6%	1.4%
Ireland	7.2%	-6.0%	0.9%
Italy	-8.4%	-9.2%	9.6%
Latvia	12.2%	-19.7%	0.5%
Lithuania	-33.4%	-44.1%	2.1%
Luxembourg	-3.9%	-4.7%	0.1%
Malta	0.1%	0.0%	0.0%
Netherlands	3.4%	-1.2%	0.6%
Poland	-7.5%	-7.9%	7.3%
Portugal	-12.3%	-16.0%	2.6%
Romania	-15.7%	-21.9%	6.1%
Slovakia	-15.6%	-12.0%	1.2%
Slovenia	-33.4%	-35.1%	1.4%
Spain	-11.6%	-11.2%	9.0%
Sweden	-94.1%	-86.9%	11.2%
United Kingdom	-1.5%	-3.1%	3.8%
EU 28	**-7.1%**	**-9.7%**	**100%**
Iceland	226.4%	-7.4%	0.1%

Source: MS submissions 2017, CRF Table10s1

6.1.2 Contribution of land use changes

The conversion of lands at the level of EU and ISL for the year 2015 results in a net source of 14.475 kt CO_2 eq. (Table 6. 4). Areas reported under land use changes represent 9% of the total reported land area in EU and ISL. The carbon sink resulting from conversions to Forest Land and Grasslands is balanced by emissions from conversions to Cropland and Settlements.

Table 6. 4 Contribution of land use changes in 2015 for EU +ISL, in terms of area (columns a-b) and net CO2eq. (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 CO2eq.)	d) % of net emissions of the corresponding category[1,2]
4A2. Land converted to Forest Land	8220	5%	-53578	16.7
4B2. Land converted to Cropland	10776	8%	45126	73%
4C2. Land converted to Grassland	13633	14%	-23882	245%
4D2. Land converted to Wetlands	1439	6%	3443	18%
4E2. Land converted to Settlements	6548	22%	43347	92%
4F2. Land converted to Other Land	1243	7%	20	100%
Total land use changes	**41860**	**9%**	**14475**	**28%**

[1] The corresponding category is 4A (Forest land) for 4A2, 4B (Cropland) for 4B2, etc.

[2] The contribution of emissions from land use changes to the total of each category was obtained by considering separately the absolute values of each subcategory, i.e. (abs 4A2)/(abs 4A1+ abs 4A2) x 100.

On average, for the year 2015, from total area under conversion, 33% is reported as converted to Grassland, 26% as converted to Cropland, 20% as converted to Forest land, 16% as converted to Settlements, and 3% as converted to Wetlands and Other lands.

6.1.3 Completeness of the sector

Finally, lack of quantitative estimates often also associates with the absence of land being converted to certain subcategories.

Table 6. 5 shows the current coverage status of reporting in terms of quantitative estimates for each of the land use sub-categories taken from individual inventories in the year 2017.

The three main land uses categories, Forest Land, Cropland and Grassland, including their sub-categories, are mostly complete. 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, or the implementation of the *insignificance* provision in accordance with the Decision 24 CP/19 (e.g. for living biomass under Grassland remaining grassland). Finally, lack of quantitative estimates often also associates with the absence of land being converted to certain subcategories.

Table 6. 5 Sector 4 LULUCF: Coverage of CO2 emissions and removals for each of the LULUCF sub-categories for the year 2015, as derived from individual 2017 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	E	E	R	R		R		E		
Bulgaria	R	R	E	E		R		E		E		R
Croatia	R	R	E	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	R	E	R	R		E	E	E		E
Germany	R	R	E	E	E	R	E	E	E	E		
Greece	R	R	E	E	E	R		E		E		E
Hungary	R	R	R	E	R	R	R	R		E		E
Ireland	R	R	R		E	E	E	E		E		E
Italy	R	R	E		R	R				E		
Latvia	R	R	E	E	E	R	E		R	E		
Lithuania	R	R	R	E		R	E			E		E
Luxembourg	R	R	E	E		R		E		E		E
Malta	R		R	E	R	R				E		E
Netherlands	R	R	E	E	E	E	R	E	E	E		E
Poland	R	R	E	E	E	R	E	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	R	E	R	E	E		R	E		
United Kingdom	R	E	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 net Emissions;
Empty cells = Quantitative estimates were included elsewhere, or no quantitative estimates are provided in line with Tier 1 assumption, the provision of insignificance, because no land use changes took place, or due to the lack of IPCC methods.

Overall, the reporting of Wetlands, Settlements and Other lands categories is associated with lower tiers methods in comparison to the main land use categories. And more specifically, carbon stock changes in “land remaining in the same category” are often assumed in equilibrium for these land use categories, although carbon stock changes are estimated and reported whenever a land use change is identified.

Table 6. 6 shows with more detail the completeness reporting on carbon stock changes by carbon pool and individual inventories for the three most important land use categories as reported in 2017 for the year 2015. Compared to the previous years, several MS have increased the number of carbon pools estimated and reported. As for Table 6. 5, empty cells in Table 6. 5 represent carbon pools which are not reported with quantitative estimates (e.g. based on Tier 1 assumptions or demonstrating the insignificance of the resulting carbon stock changes, because the lack of IPCC methods, of because the absence of organic soil). For specific cases, where empty cells are associated with an incompleteness issue (e.g. Cyprus), information on the ongoing efforts to prepare estimates for the affected pools is included in the individual submissions.

Table 6. 6 Sector 4 LULUCF: Quantitative estimates of carbon stock changes on carbon pools for the most important land use subcategories for the year 2015.

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		R		R	R	R		R		E	E	E	E	E				R	E	E	E	R	
Bulgaria	R	R	E		R	R	E		E		E		E		E						E		R	
Croatia	R				R		R		R		R	E	R		E					E	E		R	
Cyprus	R																							
Czech Rep.	R				R	R	R		R		R		E	E	E				R		R	E	R	
Denmark	R	E		E	E	E	R	E	E		R	E	R	E	E		E			E	E	E	R	E
Estonia	R	R	R	E	R	R	E	E	E		R	E	E	E	E	E	R			E	E	E	R	E
Finland	R		R	E	R		R	E	R		R	E	E	E	E	E	R			E	E		R	E
France	R	E			R	R	R				R		E	E	E		R		E		E	E	R	
Germany	R	E	R	E	R	R	E	E				E	E	E	E	E	R		E	E	E	E	R	E
Greece	R				R				E			E			E		E				E		R	
Hungary	R			E	R	R	R		E		R		E	E	E				R		E	E	R	
Ireland	E	R		E	R	R		E	R		E								R	E	E	E		E
Italy	R	R			R	R	R		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						R		R	
Luxembourg	R				R	R	R		E		R		E	E	E						E	E	R	
Malta	R								R				R		E				R				R	
Netherlands	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	R	R		R		R		E	E	E				R		E	E	E	

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
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						R	E	R	
Slovenia	R	E			R		R		R		E	E	R	E	E						E	E	R	
Spain	R				R	R	R		R		R		R	E	E						E	E	R	
Sweden	R	E	R	E	R	R	E	E	R	R	R	E	E	E	E	E	R	R	E	E	R	E	R	E
UK	R	R	R	R	R	R	E	E	R		E		E	R	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: Quantitative estimates were included elsewhere, or no quantitative estimates are provided in line with Tier 1 assumption (grey cells indicate carbon pools for which the IPCC tier 1 methods assume the net carbon stock changes in equilibrium), the provision of insignificance, or because the pool is not present (i.e. absence of organic sols under certain land use categories).

Source: MS and Iceland submissions 2017, CRF table 4A-4C

6.1.4 Data and methods

This section provides an overview of the information on methods and data used by MS and Iceland 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; a complete description can be found in individual national inventory reports, which are considered also part of this submission.

Given the heterogeneity among MS in terms of ecological and socio-economic conditions, there is not a common definition of land use categories. Methods used to estimate GHG emissions and CO_2 removals from the LULUCF sector also differ 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 they are in accordance with IPCC) is likely to result in more accurate GHG estimates than the implementation of a single EU wide approach.

Table 6. 7 is a summary of relevant information on methodologies applied for each individual carbon pool and for the three main land use categories of the LULUCF sector as included in the GHG inventories 2017.

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 contrast, multiple data sources are often used to derive emissions from “land converted to” which prevents the categorization of the methods under a single Tier. For instance, for estimating carbon stock changes in living biomass from forest land converted to cropland, often, MS implement country-specific values for forest land and default factors for cropland.

Furthermore, because the categorization of methods under a single tier for “land converted to” depends also on the categories involved in the conversion (i.e. different approaches and data sources are often used for forest converted to grassland and for cropland converted to grassland), Table 6. 7 is intended to show only a summary of information on methods and carbon stock changes factors used by individual MS and Iceland.

Finally, because of different underlying methods applied by each MS and Iceland, and due to their own national circumstances, the comparison of absolute levels, or trends, of emissions across them should be done carefully to avoid 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.

Table 6. 7 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 2017 submissions.

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM (1)	SOC Min	SOC Org (2)	LB	DOM	SOC Min	SOC Org (2)	LB (3)	DOM	SOC Min (4)	SOC Org (2)	LB (5)	DOM	SOC Min	SOC Org (2)	LB	DOM	SOC Min (4)	SOC Org (2)	LB	DOM	SOC Min	SOC Org (2)
AT	CS	CS,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	CS	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

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM (1)	SOC Min	SOC Org (2)	LB	DOM	SOC Min	SOC Org (2)	LB (3)	DOM	SOC Min (4)	SOC Org (2)	LB (5)	DOM	SOC Min	SOC Org (2)	LB	DOM	SOC Min (4)	SOC Org (2)	LB	DOM	SOC Min	SOC Org (2)
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 2017, CRF table 4A-4F

(D: default; CS: country-specific; NA: not applicable; NE: not estimated; NO: not occurring). Grey heading means that for these carbon pools IPCC TIER 1 allows to assume no net change in C stock.

"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, 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 2006 IPCC GL 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.

6.1.5 Key categories

The following LULUCF subcategories of the EU GHG inventory were identified to be key categories (Table 6. 1) for the trend (T) and the level assessment (L).

Table 6. 8 Key category analysis for the EU (LULUCF sector excerpt)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
4 A 1 Forest Land: Land Use (CO2)	-357483	-371193	T	L	L
4 A 2 Forest Land: Land Use (CO2)	-25705	-53578	T	L	L
4 B 1 Cropland: Land Use (CO2)	21711	14966	0	L	L
4 B 2 Cropland: Land Use (CO2)	53309	45126	T	L	L
4 C 1 Grassland: Land Use (CO2)	47378	32864	0	L	L
4 C 2 Grassland: Land Use (CO2)	-16148	-23882	T	L	L
4 D 1 Wetlands: Land Use (CO2)	12562	14097	T	L	L
4 E 2 Settlements: Land Use (CO2)	33493	43347	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

Forest land category is the main land use category in the LULUCF sector. It represents about 36% of the total area reported by EU MS and Iceland. According to the information provided in individual 2017 submissions, total forest area increased from 159.938 kha in 1990 to 166.515 kha in 2015, which represents 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 given by the expansion of forests due to decreasing grazing pressure and decreasing agricultural activities, which promoted natural forest expansion, but also due to the promotion of national afforestation programs (including grant-aid).

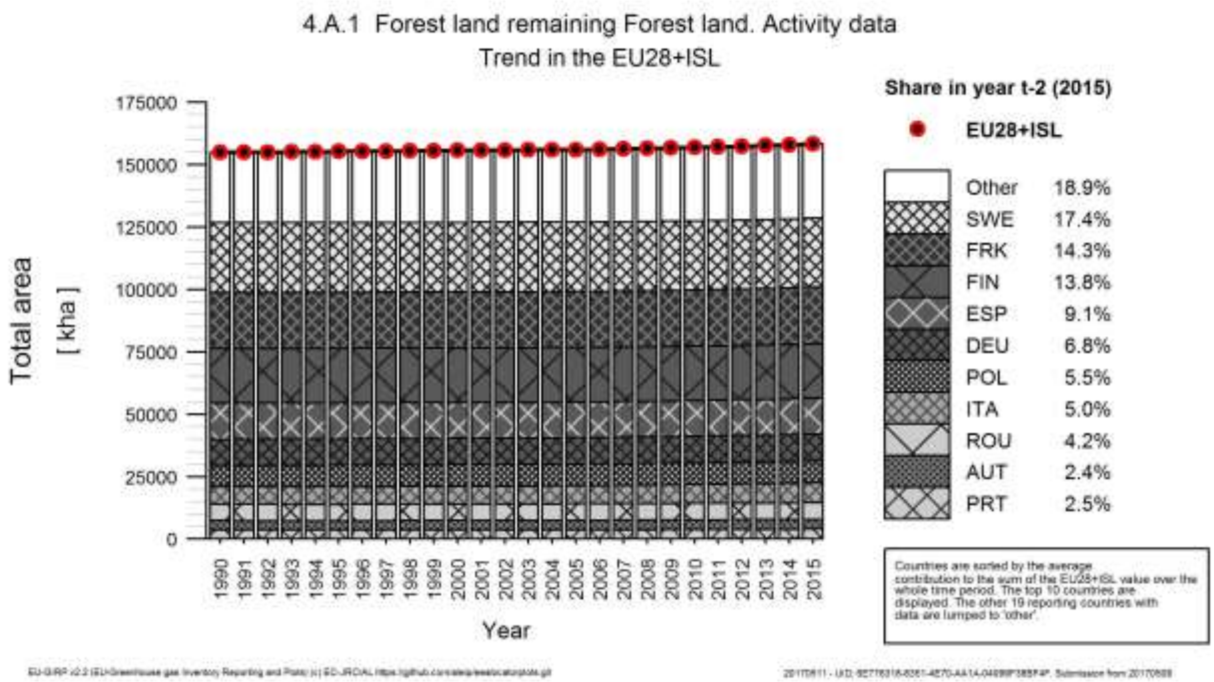
The largest forest area in 2015 is reported by Sweden, France and Finland, which report about 45% of the total forest area at EU level. While deforestation does not appear to be a major issue in Europe, it may be relevant for specific countries; nevertheless, the absolute area under conversion from forest is more than compensated by new planting areas and by natural 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 2015 at the EU level and Iceland slightly increased by 2% as compared with 1990. However, at the level of individuals submissions there are significant differences. For instance, UK reports an increase of about 48% while Netherlands reports a decrease of about 11% respect to the year 1990. The major contributors, in terms of area, for this subcategory at EU level and Iceland 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 and Iceland (kha, 1990-2015)



For the year 2015, the total land area reported under the sub category 4.A1 reached 158.295 Kha out of which about 80% corresponds to the 10 MS with higher contribution.

In terms of GHG emissions the category 4.A1 resulted in a net sink of -371.193 kt CO_2, increasing by 4% as compared in 1990. The major contributors at EU level are Germany, France, Sweden (Table 6. 9).

Table 6. 9 4A1 Forest Land remaining Forest Land: MS and Iceland' contributions to net CO2 emissions (+)/removals (-) (CRF table 4)

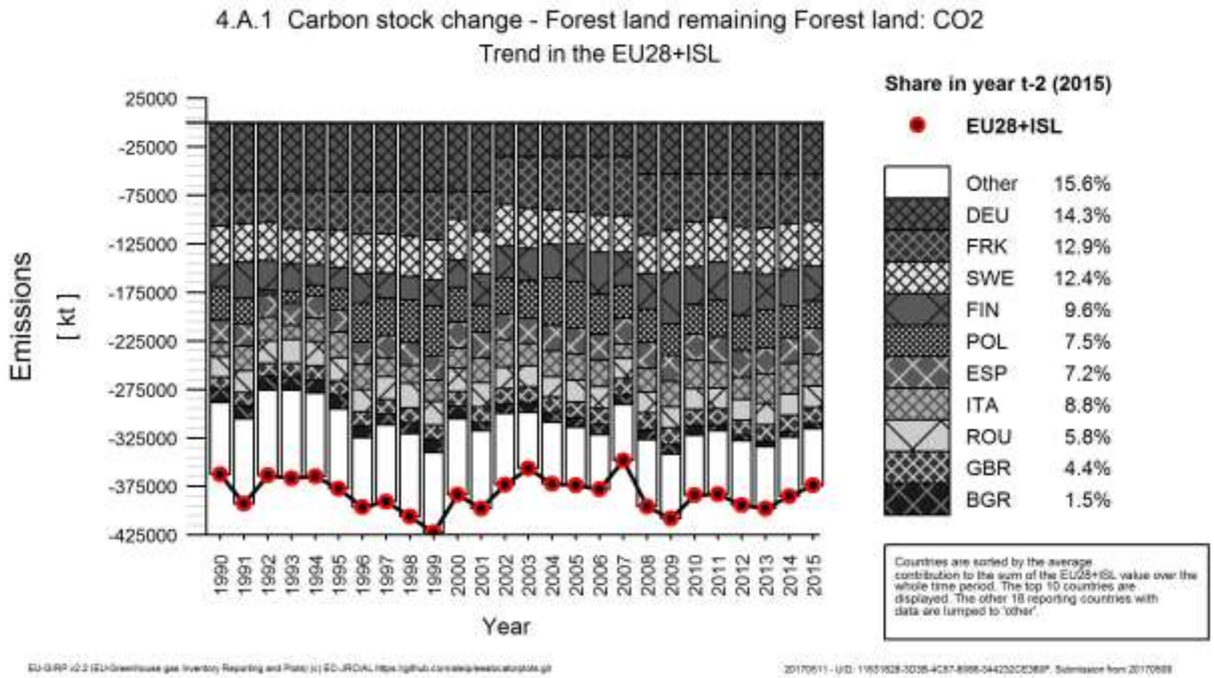
Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	-7 849	-2 580	-2 579	0.7%	1	0%	5 270	67%
Belgium	-2 923	-3 681	-3 676	1.0%	5	0%	-753	-26%
Bulgaria	-13 755	-5 491	-5 352	1.4%	139	3%	8 403	61%
Croatia	-6 695	-6 326	-5 343	1.4%	982	16%	1 352	20%
Cyprus	-100	-174	-168	0.0%	5	3%	-68	-68%
Czech Republic	-4 664	-6 916	-5 650	1.5%	1 266	18%	-986	-21%
Denmark	-554	-4 154	-318	0.1%	3 836	92%	236	43%
Estonia	-2 967	-2 099	-2 389	0.6%	-290	-14%	579	20%
Finland	-22 673	-38 193	-35 767	9.6%	2 426	6%	-13 094	-58%
France	-34 803	-50 466	-47 553	12.8%	2 914	6%	-12 750	-37%
Germany	-70 327	-53 451	-53 534	14.4%	-84	0%	16 793	24%
Greece	-1 139	-2 144	-2 144	0.6%	-1	0%	-1 005	-88%
Hungary	-2 971	-3 254	-3 917	1.1%	-663	-20%	-946	-32%
Ireland	-2 720	27	-135	0.0%	-162	-591%	2 585	95%
Italy	-15 002	-31 751	-33 009	8.9%	-1 258	-4%	-18 007	-120%
Latvia	-15 039	533	-2 589	0.7%	-3 122	-586%	12 450	83%
Lithuania	-7 150	-8 500	-8 151	2.2%	349	4%	-1 002	-14%
Luxembourg	66	-419	-378	0.1%	41	10%	-444	-674%
Malta	0	0	0	0.0%	0	0%	0	0%
Netherlands	-1 949	-1 685	-1 706	0.5%	-21	-1%	244	12%
Poland	-33 947	-31 981	-27 931	7.5%	4 049	13%	6 016	18%
Portugal	-3 603	-9 247	-8 079	2.2%	1 168	13%	-4 476	-124%
Romania	-21 162	-21 607	-21 607	5.8%	0	0%	-446	-2%
Slovakia	-6 088	-4 270	-4 607	1.2%	-337	-8%	1 481	24%
Slovenia	-4 215	-4 567	-4 635	1.2%	-68	-1%	-419	-10%
Spain	-23 102	-26 773	-26 947	7.3%	-174	-1%	-3 845	-17%
Sweden	-39 908	-46 886	-46 463	12.5%	423	1%	-6 555	-16%
United Kingdom	-12 212	-17 169	-16 497	4.4%	672	4%	-4 285	-35%
EU-28	**-357 454**	**-383 224**	**-371 125**	**100%**	**12 099**	**3%**	**-13 671**	**-4%**
Iceland	-16	-33	-32	0.0%	1	3%	-16	-105%
United Kingdom (KP)	-12 226	-17 207	-16 534	4.5%	673	4%	-4 307	-35%
EU-28 + ISL	**-357 483**	**-383 294**	**-371 193**	**100%**	**12 101**	**3%**	**-13 710**	**-4%**

For the year 2015, irrespective of previous years, all 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 Italy. In other cases, for the period 1990-2015, 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 75% of the total sink reported for the year 2015 at the level of EU MS and Iceland (Figure 6. 4).

Figure 6. 4 Trend of emissions (+)/removals (-) in subcategory 4A1 “Forest land remaining Forest Land” in EU MS and Iceland (kt CO_2, 1990-2015)



Inter-annual variations in this subcategory are closely related with natural disturbances that mostly affect direct GHG emissions in forests areas. In this respect, wildfires, in southern European countries, and windstorms, in several European countries, resulted in a significant source of GHG emissions for specific years that can be reflected in the trend at EU level.

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 have a significant share within the overall budget (e.g. Portugal, Spain).

Windstorms (mainly in central Europe) in specific years affected a large amount of forest areas. However, given that the biomass affected by storms is either treated as salvage logging or enters the dead organic matter, emissions peaks due to storms are often not so visible in the GHG inventories. Other type of disturbances generally have a much localized effects and low magnitude. In general, they are difficult to quantify in terms of biomass loss (e.g. insect outbreaks), and therefore they are practically not explicitly mentioned in the individual national inventory reports but reflected in long term in the national forest inventories.

The largest inter-annual variability in GHG estimates that affect the EU trend is 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. 10; Table 6. 11). The consistency of these definitions with the land representation system is ensured within the national inventories 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 (e.g. Global Forest Resources Assessments FRA (FAO)). For forest administrative purposes, lands without tree cover, may be included or not within forest land, thus, additional qualitative criteria complement the forest definitions provided (i.e. treatment of forest roads, nurseries, willow crops, etc.).

Few MS have changed their forest definition since 1990, but recalculations of the whole time series ensured consistency of the time series on activity data. For example, 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).

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 small.

Table 6. 10 Quantitative thresholds used to define forests as selected by individual MS and Iceland

Member State	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	10	5	0.3	-
Czech Republic	30	2	0.05	-
Denmark	10	5	0.5	20
Estonia	30	2	0.5	-

Member State	Crown cover (%)	Height (m)	Area (ha)	Minimal width (m)
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	10
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

Table 6. 11 Additional qualitative criteria used to define forests as selected by individual MS and Iceland.

MS	Forest land definition
Austria	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. Rows of trees (except shelter belts for wind protection) and areas with woody plants in a park structure are not forest land.
Belgium	This category includes all land with woody vegetation consistent with thresholds used to define forest land as described in paragraph 6.1 of the NIR. It also includes systems with vegetation that currently fall below, but are expected to exceed, the threshold of the forest land category.
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

MS	Forest land definition
	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.
Cyprus	Forests include forest roads, cleared tracts, firebreaks and other small open areas within the forest as well as reforested areas or burnt areas or other areas that temporarily have low plant cover due to human intervention or natural causes, but does not include municipal parks and gardens.
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, that are an integrated part of the forest, are also included. Christmas trees are also included.
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	All public and private plantation forests. 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 included and also other plantation as chestnut and cork oak, have been included in forest land.
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.

MS	Forest land definition
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 inputs data both for areas (forest land and conversions to and from forest land) and for the estimation of carbon stock changes in various pools. Nevertheless, this information in some case is 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, Lithuania 5 years).

In the last years, the EU MS have made considerable efforts to adjust their forest inventories to the specific requirements of UNFCCC/KP reporting, but also there were some steps toward a slight harmonization at European scale (e.g. COST E43 Action)[60].

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 requirements 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, MS usually have disaggregated forest land areas in various subdivisions according to available datasets. Breakdown criteria differ across MS, although they are consistent across time series: forest type (e.g. broadleaved/coniferous; evergreen/deciduous; species based classification – beech, oak, pine, spruce, etc.); by climate (e.g. temperate moist or temperate dry,); by soil and site type (e.g. lowland, mountains), administrative or geographical boundaries, and management type (e.g. coppice, high stands).

For Forest land category, definitions of carbon pools are reported by most of the MS (Table 6. 12). 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 wood 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).

[60] http://www.metla.fi/eu/cost/e43

Table 6. 12 Explicit information on forest carbon pools definitions as reported by EU MS and Iceland.

MS	Description
Aboveground biomass	
Austria	All living biomass (DBH > 5cm) above the soil including stem, stump, branches, seeds, bark and foliage (foliage only of evergreen trees). At ARD sites and LUC from and to forests all forest biomass (shrubs, forest understory) with a DBH > 0 cm to 5 cm is also taken under consideration.
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	All living biomass of live roots with a diameter > 2 mm.
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).

MS	Description
Sweden	Biomass of living trees below stump height (1% of tree height) down to a root diameter of 2 mm.
Dead Organic Matter - Dead wood	
Austria	All non-living woody biomass not contained in the litter or soil, standing on the ground, without roots, as they are already considered as part of the litter or soil.
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
Dead Organic Matter – Litter	
Austria	All non-living biomass lying dead in various states of decomposition above the mineral or organic soil.
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 (e.g. 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.

MS	Description
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.
Soil Organic Carbon	
Austria	All organic matter in mineral and organic soils (including peat) to a soil depth of 50 cm (forests, LUC from and to forests) or to a soil depth of 30 cm (all other land uses and LUC).
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 Histosols).
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 30 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.

When assessing inventory completeness, it should be noted 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 the overall 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. 13)

Table 6. 13 Methodologies used by MS and Iceland for estimating carbon stock changes in Living Biomass.

Member State	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

Member State	Estimation method
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 among individual national inventories, upon data availability. Nowadays, 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 data sources. Data collection and data analysis programs are ongoing in most of the MS to further improve the completeness and accuracy of the estimates, primarily of carbon stock changes.

In 2017 GHG inventory submissions, the implied carbon stock change factors reported for the year 2015 for net carbon stock changes in living biomass range from 1.21 to -0.36 T C ha^{-1} among MS and Iceland (Table 6. 14). Generally, low values of IEF are shown by countries 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 countries where planting is the main instrument to ensure forest regrowth.

Table 6. 14 Implied carbon stock change factors for living biomass pool in 4A1 (t C ha-1 year-1) reported in individual GHGI 2017.

Member State	**Net carbon stock change factor in living biomass t C/ha**	
	1990	**2015**
AUT	0.77	0.31
BEL	0.60	0.94
BGR	1.07	0.40
HRV	0.79	0.64
CYP	0.17	0.29
CZE	0.61	0.67
DNM	0.37	1.21
EST	0.27	0.20
FIN	0.34	0.37
FRK	0.45	0.61
DEU	1.43	1.03
GRC	0.10	0.17
HUN	0.47	0.57
IRL	2.14	-0.36
ITA	0.55	1.11
LVA	1.70	0.44
LTU	0.93	1.03
LUX	-0.23	1.13
MLT	0.00	0.00
NLD	1.32	1.15
POL	1.04	0.78
PRT	0.38	0.60
ROU	0.89	0.90
SVK	0.92	0.63
SVN	1.18	1.17
ESP	0.43	0.51
SWE	0.35	0.34
GBR	1.30	1.09
ISL	0.05	0.10

Changes of organic carbon stored in mineral soils and dead organic matter are mostly reported by applying Tier 1 method, which assumes for this land use subcategory that these carbon 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. 6 and Table 6. 7 on completeness).

When they are estimated, MS mainly rely on data collected in the course of the national forest inventories, however, it should be noted that the widespread use of the Tier 1 method is due to the lack of appropriate data (and the high costs associated with systems that would allow a proper collection of data) or to the very high uncertainty of the existing data.

Nevertheless, and increasing number of MS document on the ongoing efforts to estimate emissions and removals from dead organic matter and mineral soils, and more MS as compared with previous submissions report quantitative estimates for these pools on 2017 using country-specific approaches.

When data is available, these are either directly used for estimating carbon stock change by using stock difference or gain-loss methods, or integrated in models. In line with the available datasets in individual countries, carbon stock changes in dead organic matter are often disaggregated between dead wood (DW) and litter (LT). However, some MS include the estimates within soil organic carbon (e.g. Finland).

Finally, particularities are given by France and Luxembourg that report carbon stock changes in dead organic matter only for part of the time-series.

France reports this carbon stock changes since 1999 as a result of the significant inputs that entered into the pool after some windstorms event that affected dramatically the forest area, By other hand,

Luxembourg uses the stock-difference method, which has resulted in a measured increase of dead wood between two consecutive NFI period between 2000 and 2010, for year before and after the Tier 1 assumption of equilibrium was used.

Table 6. 15 Implied carbon stock change factors in DOM carbon pool in 4A1 (t C ha-1 yr-1) reported in individual GHGI 2017.

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	2015	1990	2015
AUT	0.02	0.06	NE,IE	NE,IE
BEL	NO	NO	NO	NO
BGR	0.00	0.03	0.00	0.04
HRV	NO	NO	NO	NO
CYP	NO	NO	NO	NO
CZE	NO	NO	NO	NO
DNM	0.01	-0.02	-0.01	-0.97
EST	0.02	0.01	NO	NO
FIN	IE	IE	IE	IE
FRK	NE	-0.03	NE	NE
DEU	0.04	-0.05	-0.01	-0.01

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	2015	1990	2015
GRC	NA,NO	NO,NA	NA,NO	NO,NA
HUN	NO	NO	NO	NO
IRL	IE	IE	-0.16	0.74
ITA	0.02	0.01	0.03	0.01
LVA	-0.01	0.20	NA	NA
LTU	0.07	0.04	NO	NO
LUX	NO	NO	NO	NO
MLT	0.00	0.00	0.00	0.00
NLD	0.08	0.24	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	0.07	-0.08	-0.08
GBR	IE	IE	0.06	0.04
ISL	NE,IE	NE,IE	NE	NE

Carbon stock changes in mineral soils under forest land remaining forest land for the year 2015 are quantitatively estimated by 11 MS, generally as a small net sink of carbon (with the exception of Austria and Bulgaria) (Table 6. 16).

Most of the MS report absence or insignificant areas of organic soils under this land use subcategory. However, when organic soils are presented, this are reported, in most of the cases, as resulting in a net source of emissions. 12 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.

Finally, in the case of Netherlands, it was justified that forests are not actively drained, but that forest on organic soils are mainly forest with a nature purpose and not a production purpose. Therefore the Netherlands uses notation key NO.

Table 6. 16 Implied carbon stock change factors in mineral and organic soils in 4A1 (t C ha-1 yr-1) reported in individuals GHGI 2017.

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	2015	1990	2015
AUT	-0.19	-0.18	NO	NO
BEL	0.53	0.53	NO	NO
BGR	0.00	-0.06	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	0.14	0.14	-0.19	-0.19
FIN	0.13	0.21	-0.56	-0.27
FRK	NE	NE	NO	NO
DEU	0.41	0.41	-2.10	-2.23
GRC	NA,NO	NO,NA	NA,NO	NO,NA
HUN	NO	NO	-2.60	-2.60
IRL	NO	NO	-0.54	-0.46
ITA	NA,NO	NO,NA	NO	NO
LVA	NA	NA	-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	-0.67	-0.56
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	0.20	-0.37	-0.36
GBR	0.28	0.34	0.14	0.64
ISL	NE	NE	-0.37	-0.37

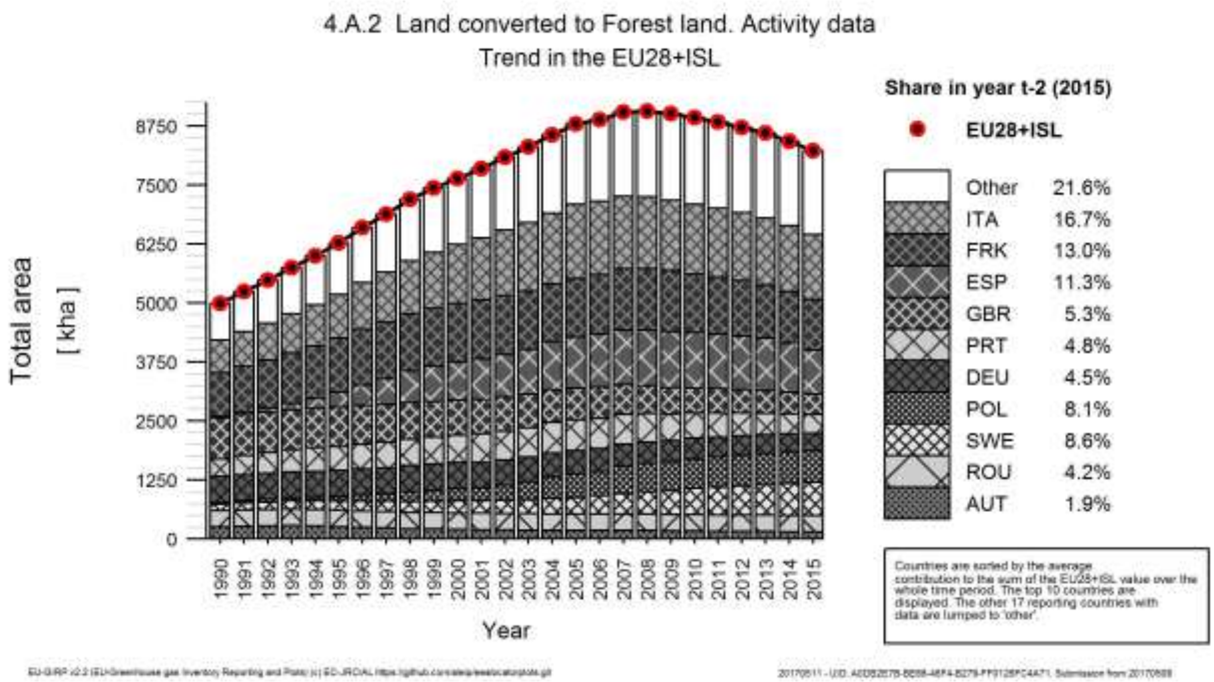
6.2.1.3 Land converted to Forest Land (CRF 4A2)

Overview of Land converted to Forest Land category

In 2015, the area reported under this subcategory represents 5% of the total Forest Land area reported at the level of EU and Iceland. This subcategory has increased by 65% as compared with 1990 (Figure 6. 5), from 4.984 Kha in 1990 to 8.220 Kha in 2017. Most of the new forest areas take place from Grasslands and Cropland areas, and although within the overall category they have a low share in terms of areas, they contribute by 13% to the total carbon sink of the European forest.

For the year 2015, 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 and Iceland (kha, 1990-2015)



This subcategory has been always reported as a net carbon sink at the level of EU and Iceland. For the year 2015, it reaches 53.578 Kt CO_2, which represents an increase of 108% as compared with 1990, and 3% more than in previous year. This trend in emissions is well associated with the trend on areas (Figure 6. 6; Table 6. 17).

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.

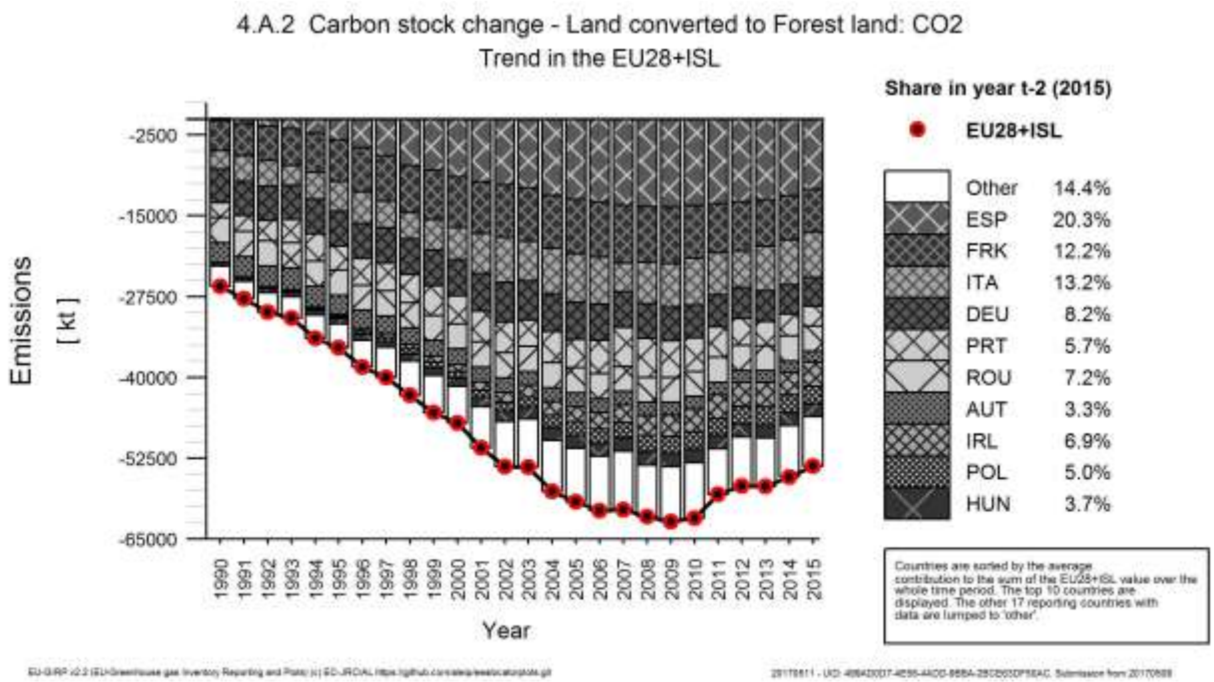
Table 6. 17 4A2 Land converted to Forest Land: MS and Iceland' contributions to net CO2 emissions (+)/removals (-) (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	-3 043	-1 753	-1 747	3.3%	6	0%	1 296	43%
Belgium	-13	-476	-510	1.0%	-34	-7%	-497	-3767%
Bulgaria	-510	-733	-742	1.4%	-9	-1%	-232	-45%
Croatia	-39	-226	-264	0.5%	-38	-17%	-225	-583%
Cyprus	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Czech Republic	-321	-482	-492	0.9%	-9	-2%	-170	-53%
Denmark	-31	131	494	-0.9%	363	278%	524	1698%
Estonia	-10	-85	-87	0.2%	-2	-3%	-77	-803%
Finland	-1	-360	-328	0.6%	32	9%	-327	-31134%
France	-4 615	-6 839	-6 577	12.3%	261	4%	-1 962	-43%
Germany	-5 215	-4 556	-4 393	8.2%	164	4%	822	16%
Greece	NE,NO	-137	-104	0.2%	33	24%	-104	-∞
Hungary	-458	-1 990	-1 964	3.7%	26	1%	-1 505	-328%
Ireland	27	-3 441	-3 686	6.9%	-245	-7%	-3 713	-13622%
Italy	-2 849	-6 966	-7 103	13.3%	-137	-2%	-4 254	-149%
Latvia	-3	-430	-464	0.9%	-34	-8%	-461	-15634%
Lithuania	-1 034	-1 195	-1 181	2.2%	14	1%	-147	-14%
Luxembourg	-306	-117	-101	0.2%	15	13%	204	67%
Malta	NO	NO	NO	-	-	-	-	-
Netherlands	38	-705	-728	1.4%	-23	-3%	-766	-2014%
Poland	-141	-2 736	-2 691	5.0%	45	2%	-2 550	-1807%
Portugal	-2 088	-3 340	-3 003	5.6%	338	10%	-915	-44%
Romania	-3 873	-3 871	-3 871	7.2%	0	0%	2	0%
Slovakia	-2 210	-363	-391	0.7%	-28	-8%	1 819	82%
Slovenia	-271	-1 420	-1 269	2.4%	151	11%	-998	-368%
Spain	-311	-11 860	-10 838	20.2%	1 022	9%	-10 527	-3383%
Sweden	-87	-1 799	-1 783	3.3%	16	1%	-1 696	-1954%
United Kingdom	1 709	653	555	-1.0%	-98	-15%	-1 154	-68%
EU-28	**-25 655**	**-55 097**	**-53 267**	**99%**	**1 830**	**3%**	**-27 612**	**-108%**
Iceland	-27	-259	-309	0.6%	-51	-20%	-283	-1053%
United Kingdom (KP)	1 686	652	554	-1.0%	-98	-15%	-1 132	-67%
EU-28 + ISL	**-25 705**	**-55 357**	**-53 578**	**100%**	**1 779**	**3%**	**-27 873**	**-108%**

As shown in Table 6. 17, in 2017 some MS reported significant changes in this subcategory for the year 2015 as compared with 1990.

For instance Finland, Ireland and Latvia. In the first case, this is due to the net result of summing up under the category 4A.2 emissions and removals from all the lands converted in forest. While in 1990 emissions from drainage organic soils in cropland converted in forests balanced the removals reported under all the other conversions; no drainage of organic soils occur in the last years of the time series and therefore much more large sink was reported. In the case of Ireland, the increase on removals by the post 1990 forest is due to an increase in forests area and productivity as new established forests mature. The slight decrease in the slope of the change in removals from 2007 onward is due to thinning harvests in productive forests at age 17 years old and onwards. Finally, Latvia reports a constant increase of forest area that result in much more sink at the end of the time series as compared with the base year.

Figure 6. 6 Trend of emissions (+)/removals (-) in subcategory 4A2 "Land converted to Forest Land" in EU MS and Iceland (kt CO_2, 1990-2015)



In 2015, about 45% of total carbon sink reported at EU level from subcategory 4A.2 was reported by France, Italy and Spain, while the 10 MS with the larger contribution represent about the 86% of the total sink of the new forest areas.

Methodological issues for Land converted to Forest Land category

Methods used to identify and represent the areas converted to forests, as well as to report GHG emissions and CO_2 removals from these areas, are generally the same as the ones used for the subcategory 4A.1. Nevertheless, difference parameters are involved under each subcategory due to differences on growth patterns, management practices, etc. of these forests. In this sense, and following past recommendations from the ERTs, in the last years Italy improved the methodology to refine the estimates and increase the accuracy under each subcategory.

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 and national registries.

Estimates of GHG emissions and CO_2 removals from this subcategory are usually reported using tier 2 methods involving 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 of emissions depending on whether there is 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 among 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, concerning changes in the carbon stock of soils, there is a high variability among MS on the carbon reference values considered in the estimations. In general, carbon stock changes in soil carbon pool are estimated either at tier 2 or at tier 3 level by using models (e.g. Denmark, UK).

6.2.2 Cropland (CRF 4B)

6.2.2.1 Overview of the Cropland category

Subject to intensive agriculture practices, Cropland category is an important contributor to EU 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 six land use categories.

Based on individual submissions, total Cropland area at the level of EU MS and Iceland covers about 127.000 kha as reported for the year 2015, which represent 28% of total lands, although they show a constant decreasing trend of about 5% as compared with the year 1990.

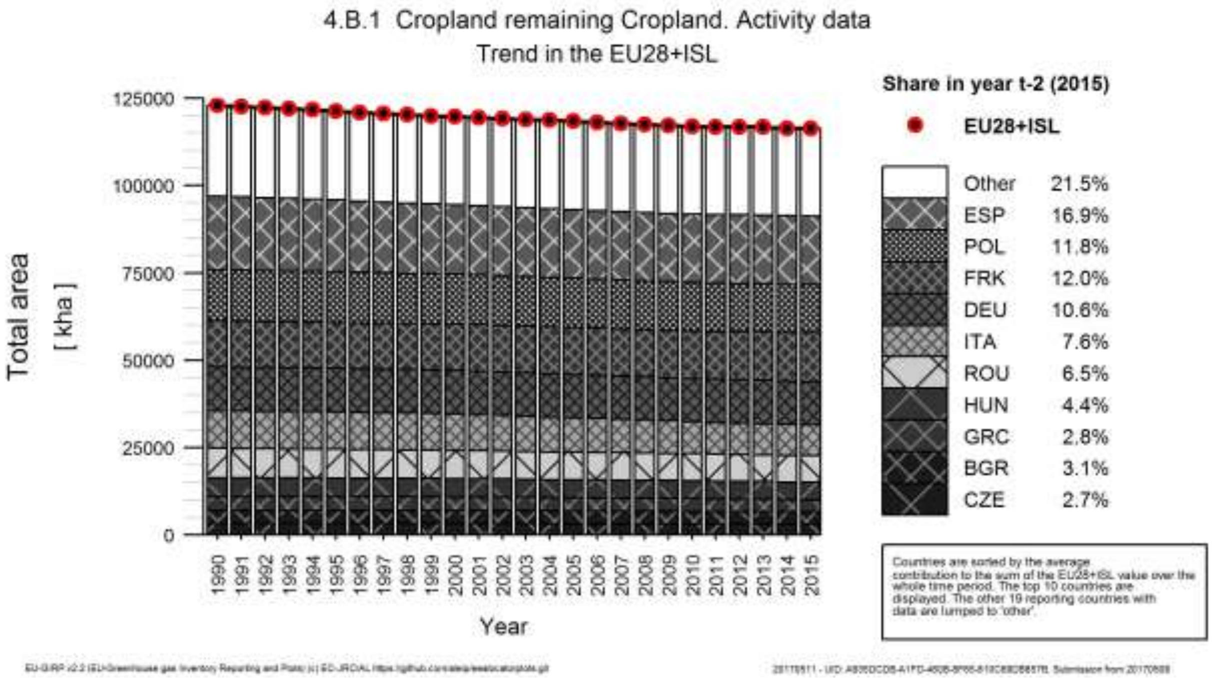
6.2.2.2 Cropland remaining Cropland (CRF 4B1)

Overview of Cropland remaining Cropland category

In line with the overall category, this subcategory has constantly decreased since 1990 (Figure 6. 7). From 122.985 kha in 1990 to 116.341 kha in 2015, which represent a decrease of 5%. With the exception of France, UK, Malta, Slovakia and Iceland, all MS report in 2015 a decrease of Cropland area as compared with 1990.

At the level of the EU MS and Iceland, the overall trend of this subcategory is driven by 10 MS which together contribute to about 80% of the total area, and more specifically, Spain, Poland, France and Germany which represent about half of the area reported under this subcategory.

Figure 6. 7 Trend of activity data in subcategory 4B1 "Cropland remaining Cropland" in EU MS and Iceland (kha, 1990-2015)



In terms of emissions, at the level of EU MS and Iceland, this subcategory has been always reported as a net source. In the year 2015, GHG emissions reach 14.966 kt CO_2 which represents a decrease of 31% as compared to 1990 (Table 6. 18).

This trend is mainly driven by Germany, Sweden and UK which reports the larger emissions 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, France, Romania and Spain which report a substantial net carbon sink in mineral soils and, in some case, 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 intensive 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.

A particular case is Romania, which reports a significant sink in this subcategory because, as explained in its NIR, Cropland areas include lands that are subject to Revegetation activities under the KP. Such areas are reported as tree plantations but they are managed as part of the agricultural land, mainly arable. Tree plantations classified as revegetated areas "behave" as forest plantations with regard to change in each carbon pools therefore they result in a net carbon sink.

Table 6. 18 4B1 Cropland remaining Cropland: MS and Iceland contributions to net CO2 emissions (+)/removals (-) (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	-41	-389	-219	-1.5%	170	44%	-178	-433%
Belgium	213	190	181	1.2%	-9	-5%	-32	-15%
Bulgaria	-702	723	673	4.5%	-51	-7%	1 375	196%
Croatia	165	-6	100	0.7%	106	1738%	-65	-39%
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	-2	-76	-84	-0.6%	-8	-11%	-82	-3596%
Denmark	4 417	3 032	2 655	17.7%	-377	-12%	-1 762	-40%
Estonia	101	57	43	0.3%	-14	-24%	-58	-57%
Finland	4 698	4 428	4 569	30.5%	141	3%	-128	-3%
France	122	-3 604	-3 446	-23.0%	158	4%	-3 568	-2931%
Germany	5 880	7 454	7 553	50.5%	100	1%	1 673	28%
Greece	-808	2 254	287	1.9%	-1 967	-87%	1 094	135%
Hungary	30	-656	-566	-3.8%	90	14%	-596	-2011%
Ireland	26	-9	-53	-0.4%	-45	-524%	-80	-304%
Italy	1 638	2 141	2 157	14.4%	17	1%	519	32%
Latvia	2 754	2 588	2 600	17.4%	11	0%	-154	-6%
Lithuania	273	-67	-79	-0.5%	-12	-17%	-352	-129%
Luxembourg	-1	2	2	0.0%	0	-10%	3	227%
Malta	-1	-1	-1	0.0%	0	2%	0	-53%
Netherlands	1 468	824	794	5.3%	-30	-4%	-674	-46%
Poland	800	366	300	2.0%	-67	-18%	-501	-63%
Portugal	21	-198	-205	-1.4%	-6	-3%	-226	-1077%
Romania	-3 015	-2 907	-2 907	-19.4%	0	0%	109	4%
Slovakia	-955	-877	-910	-6.1%	-33	-4%	46	5%
Slovenia	-251	-185	-181	-1.2%	5	3%	70	28%
Spain	-929	-3 283	-3 346	-22.4%	-64	-2%	-2 417	-260%
Sweden	3 249	3 717	-735	-4.9%	-4 453	-120%	-3 984	-123%
United Kingdom	1 296	4 216	4 233	28.3%	17	0%	2 936	227%
EU-28	**20 444**	**19 733**	**13 413**	**90%**	**-6 320**	**-32%**	**-7 031**	**-34%**
Iceland	1 256	1 562	1 552	10.4%	-10	-1%	296	24%
United Kingdom (KP)	1 307	4 216	4 233	28.3%	17	0%	2 926	224%
EU-28 + ISL	**21 711**	**21 296**	**14 966**	**100%**	**-6 330**	**-30%**	**-6 745**	**-31%**

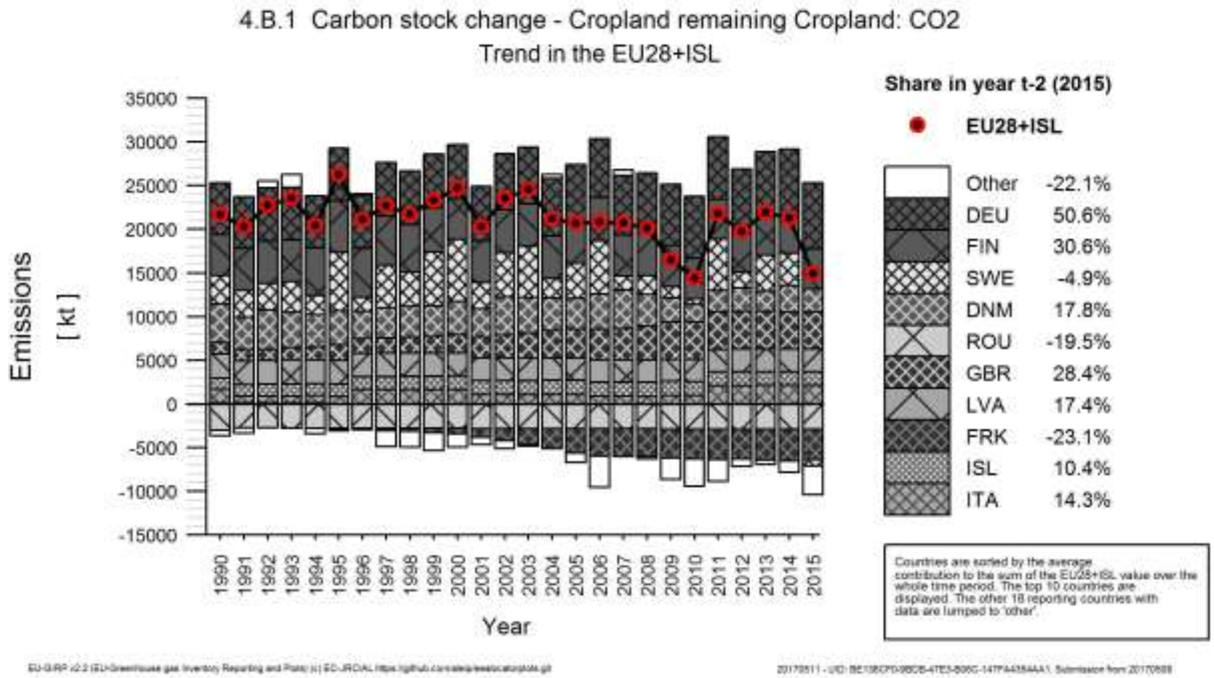
Information above shows that as compared with the year 1990 in 2015 France and Sweden have reported in this submission a significant increase of the sink in Cropland remaining cropland mainly due to an increase in soil organic carbon in mineral soils.

In Sweden, the ICBM-region model used to calculate annual carbon balance of the soil based on national agricultural crop yield, manure statistics, and allometric functions to estimate the annual carbon inputs to soil from crop residues resulted in a large sink in this pool in 2015 as compared with the small source reported for 1990 as a result of the change in management practices.

By other hand, as regards with France, although the same circumstances explain the increase of the sink in mineral soils in the last years as compared with the first years of the time series, here the IPCC approach with country-specific factors was used.

Finally, Bulgaria has shifted from a sink of emissions reported for the year 1990 to a source reported for the year 2015 due to carbon stock changes in living biomass in perennial woody crops. Bulgaria uses the IPCC tier 1 method to report carbon stock changes in this carbon pool, and this resulted in a source of emissions due to a higher loss of biomass in old perennial crops than a sink of carbon in young perennial crops (i.e. less than 30 years)

Figure 6. 8 Trend of emissions (+)/removals (-) in subcategory 4B1 “Cropland remaining Cropland” in EU MS and Iceland (kt CO_2, 1990-2015)



Methodological issues for Cropland remaining Cropland category

Lands included under this subcategory generally are in line with the IPCC definition (Table 6. 19) however, there could be national particularities (e.g. treatment of some woody crops) that result in small differences among MS.

In some cases, because of the absence of annual information on activity data, along with the fact that management practices include crops-rotation cycles and fallow lands; some croplands areas may not be clearly separated from grasslands areas. In these 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 carbon. The final net result is typically associated with an increase or decrease of the intensity in the soils management practices along the time series. By contrary, as reported by all MS, for cropland areas under organic soils, the net result of carbon stock changes associates with a net source of CO_2 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 on the carbon stock in soils at two moments in time. In few cases, carbon stock changes have been estimated by using models (e.g. C-tool by Denmark and ICBM by Sweden).

Table 6. 19 Definitions of lands included by MS and Iceland under the category 4B: Cropland

MS	***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.).

MS	*Definition*
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 m^2 or above in case of berries and 400 m^2 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 m^2. 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).
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, vineyards, 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.

MS	Definition
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 horticultural 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 a country-specific soil organic carbon reference value along with IPCC default values for relative change factors (i.e. for Fmg, Flu, Fi). In some cases, IPCC default relative change factors have been slightly modified to adapt them to national circumstances; but changes rely more on expert judgment than on a statistical analysis or systematic measurements. There is one exception, Austria derived own factors by close comparison with IPCC similar strata.

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. 20 Implied net carbon stock change factor for carbon pools in 4B1 (t C ha-1 yr-1) reported by individual submissions in GHGI 2017.

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	2015	1990	2015	1990	2015	1990	2015
AUT	0.01	-0.03	NO	NO	0.00	0.08	NO	NO
BEL	NO	0.00	NO	NO	-0.04	-0.04	-10.00	-10.00
BGR	0.05	-0.05	NE	NE	0.00	0.00	NO	NO
HRV	-0.01	0.00	NO	NO	0.00	0.00	-10.00	-10.00
CYP	NE	NE	NE	NE	NE	NE	NO	NO
CZE	0.00	0.00	NO	NO	0.00	0.01	NO	NO
DNM	0.01	-0.04	NO	NO	-0.06	0.05	-7.18	-6.55
EST	0.00	0.00	NO	NO	0.09	0.09	-5.00	-5.00
FIN	0.00	0.00	IE	IE	-0.01	0.02	-6.48	-6.59
FRK	0.00	0.00	NE	NE	NE	0.07	NO	NO
DEU	0.00	0.00	NA	NA	NA	NA	-8.10	-8.10
GRC	0.07	0.00	NO	NO	NO	NO	-10.00	-10.00
HUN	0.00	0.00	NO	NO	0.00	0.03	NO	NO
IRL	-0.01	0.02	NO	NO	0.00	0.00	NO	NO

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	2015	1990	2015	1990	2015	1990	2015
ITA	-0.02	-0.04	NO	NO	NO	NO	-10.00	-10.00
LVA	0.00	0.00	0.00	0.00	NA	NA	-7.90	-7.90
LTU	-0.02	0.01	NO	NO	-0.04	0.01	IE	IE
LUX	0.01	-0.01	NO	NO	0.00	0.00	NO	NO
MLT	0.16	0.21	NE	NE	0.05	0.02	NO	NO
NLD	NE	NE	NE	NE	NO	NO	-4.05	-3.97
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	0.02	NO	NO
SVN	0.33	0.32	NA,NO	NA,NO	0.00	0.00	-10.00	-10.00
ESP	0.01	0.02	NE	NE	NO	0.03	NO	NO
SWE	0.00	0.02	0.00	0.00	0.01	0.38	-6.22	-6.22
GBR	0.00	0.01	NO	NO	-0.12	-0.33	-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 or in some cases, NE, in accordance with the Decision 24/CP19, when the insignificant provision was applied. Nevertheless, efforts have been implemented during the last years and are still ongoing to harmonize the use of the notation keys among MS.

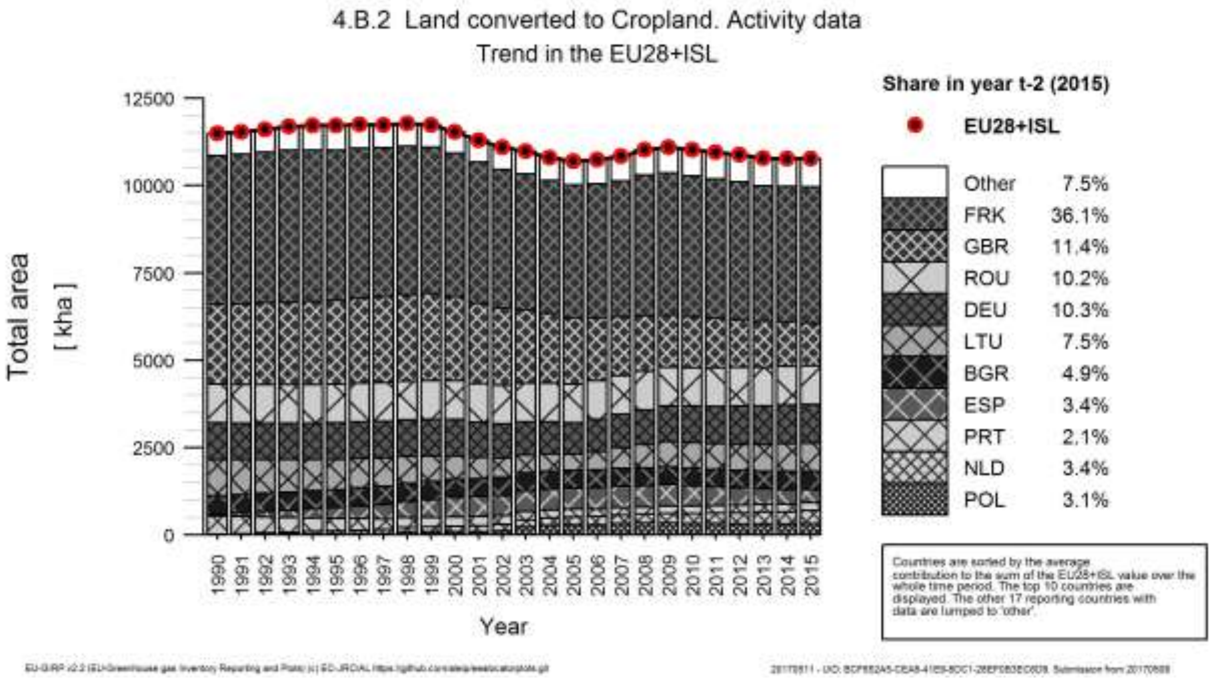
6.2.2.3 Land converted to Cropland (CRF 4B2)

Overview of Land converted to Cropland category

In terms of area, this subcategory represents 8% of the total cropland areas reported at the level of EU and Iceland, however it accounts for 73% of the net CO_2 emissions that are reported under this category. In overall, area reported for the year 2015 decreased by 6% as compared with 1990. From 11.491 kha, reported for the year 1990, to 10.776 Kha in 2015 (Figure 6. 9). Despite of this, contrary to the trend on areas reported under subcategory 4B.1, the decrease was not constant, but undergone a slightly increase in 90s.

Main conversions of lands to Cropland take place from areas of Grassland and Forest land. At the level of EU MS and Iceland the trend is mainly driven by France, UK, Romania and Germany which report more than 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 4B2 "Land converted to Cropland" in EU MS and Iceland (kha, 1990-2015)



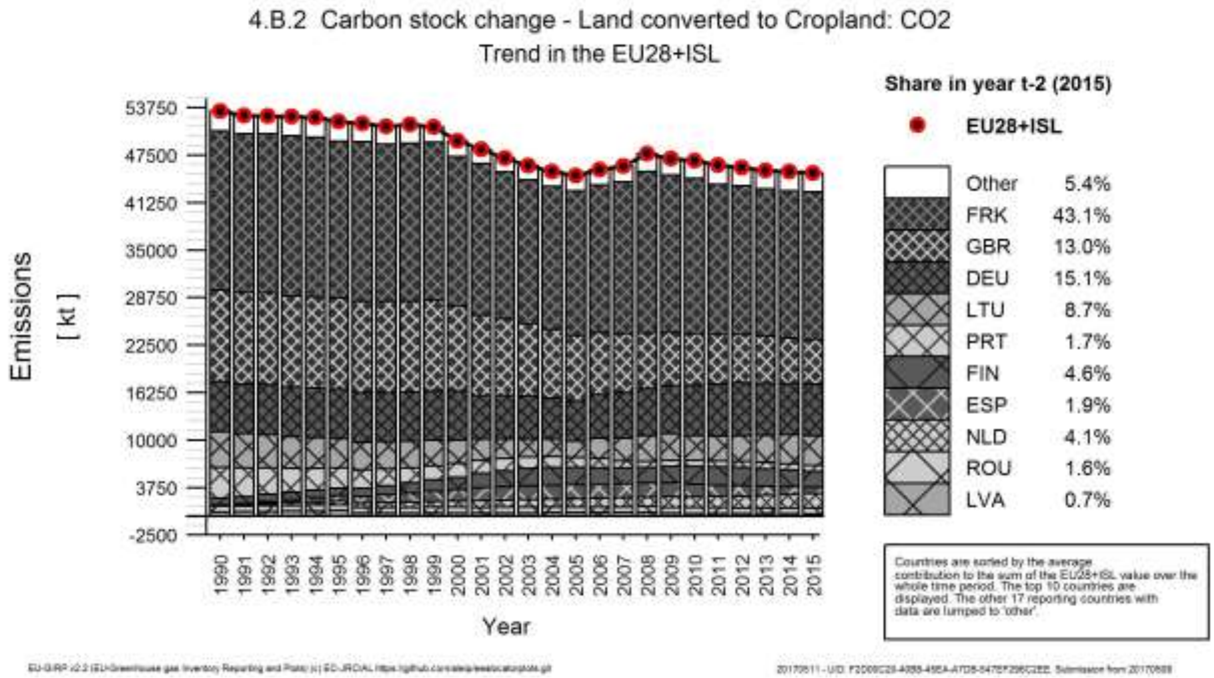
In term of emissions, in the year 2015, this subcategory is reported as a net source that reaches 45.126 Kt CO_2. This represent a decrease of 15% as compared to 1990 (Table 6. 21). The major driver of the trend is France that reports about 40 % of the total emissions in this subcategory; followed by UK and Germany (Figure 6. 10)

Nevertheless, some individual inventories report this subcategory as a small carbon sink as a result of removals from the living biomass carbon pool when Grassland or Other lands are converted to Cropland (i.e. woody vegetation). With some exceptions, all the other carbon pools have been reported as a net source of emissions.

Table 6. 21 4B2 Land converted to Cropland: MS and Iceland' contributions to net CO2 emissions (+)/ removals (-) (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	189	179	186	0.4%	7	4%	-3	-2%
Belgium	39	926	994	2.2%	67	7%	955	2460%
Bulgaria	37	413	264	0.6%	-150	-36%	227	617%
Croatia	25	8	22	0.0%	14	163%	-3	-12%
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	114	88	84	0.2%	-4	-5%	-30	-26%
Denmark	-6	-29	-58	-0.1%	-29	-99%	-52	-923%
Estonia	NO	77	77	0.2%	0	0%	77	∞
Finland	894	2 230	2 096	4.6%	-134	-6%	1 202	134%
France	20 901	19 352	19 462	43.1%	110	1%	-1 439	-7%
Germany	6 556	6 681	6 795	15.1%	114	2%	239	4%
Greece	0	1	0	0.0%	0	-49%	0	386%
Hungary	129	281	283	0.6%	3	1%	154	119%
Ireland	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Italy	534	66	NO	-	-66	-100%	-534	-100%
Latvia	545	312	297	0.7%	-14	-5%	-247	-45%
Lithuania	4 714	3 875	3 928	8.7%	54	1%	-785	-17%
Luxembourg	75	36	36	0.1%	0	1%	-38	-51%
Malta	4	3	3	0.0%	0	7%	0	-13%
Netherlands	169	1 781	1 873	4.1%	91	5%	1 703	1005%
Poland	226	63	63	0.1%	0	0%	-163	-72%
Portugal	4 048	794	780	1.7%	-14	-2%	-3 268	-81%
Romania	744	744	744	1.6%	0	0%	0	0%
Slovakia	466	74	79	0.2%	5	7%	-387	-83%
Slovenia	166	22	24	0.1%	2	10%	-142	-86%
Spain	-43	997	856	1.9%	-140	-14%	899	2109%
Sweden	33	286	298	0.7%	11	4%	264	795%
United Kingdom	12 113	5 976	5 813	12.9%	-163	-3%	-6 300	-52%
EU-28	**52 673**	**45 235**	**45 000**	**100%**	**-235**	**-1%**	**-7 673**	**-15%**
Iceland	635	91	91	0.2%	0	0%	-544	-86%
United Kingdom (KP)	12 114	6 008	5 848	13.0%	-160	-3%	-6 266	-52%
EU-28 + ISL	**53 309**	**45 358**	**45 126**	**100%**	**-232**	**-1%**	**-8 183**	**-15%**

Figure 6. 10 Trend of emissions (+)/ removals (-) in subcategory 4B2 “Land converted to Cropland” in EU MS and Iceland (kt CO2, 1990-2015)



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 being estimated. 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 oxidized.

Usually it is assumed that the carbon stored in living biomass and dead organic matter is lost in the year of the conversion, while for soil organic carbon in mineral soils, following IPPC methodology, MS apply a 20 years transition period before the carbon stock of the soils converted to Cropland reach and equilibrium.

6.2.3 Grassland (CRF 4C)

6.2.3.1 Overview of Grassland category (CRF 4C)

Under this category is 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 a net source of emissions that are below the emissions from Settlements (i.e. conversions of lands to Settlements) and far from the emissions reported under Cropland.

Based on individual submissions, total Grassland area at the level of EU MS and Iceland covers 94.755 Kha in 2015.This represents 21% of the total reported areas. However, as for Cropland, these areas have constantly decreased since 1990 reaching a decrease of 5% in 2015.

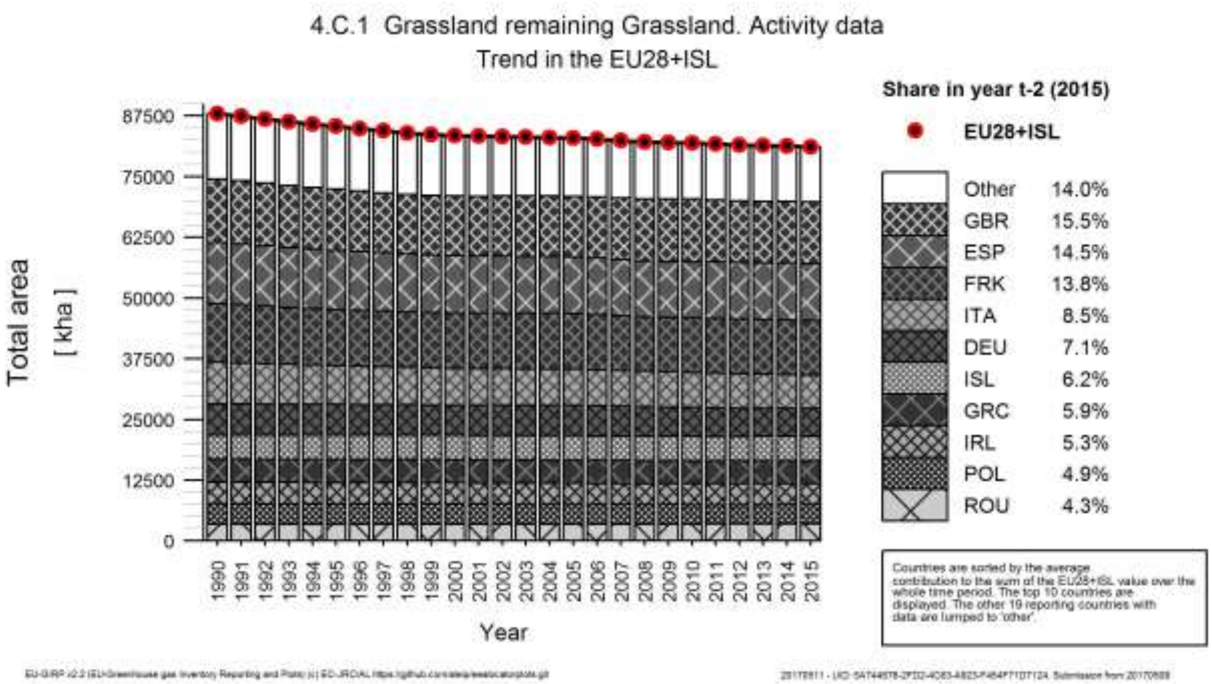
6.2.3.2 Grassland remaining Grassland (CRF 4C1)

Overview of Grassland remaining Grassland category

In 2015, total area reported under this subcategory reaches 81.122 Kha at the level of EU and Iceland. Following the general trend of these lands, this subcategory has also constantly decrease since 1990, and in 2015 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 more than 85 % of the total area reported under this subcategory.

Figure 6. 11 Trend of activity data in subcategory 4C1 "Grassland remaining Grassland" in EU MS and Iceland (kha, 1990-2015)



In terms of emissions, this subcategory has always resulted in a net source. In 2015, emissions reported at EU level reaches 32.864 Kt CO_2, which represents a decrease of 31% as compared with the year 1990 (Table 6. 22).

Nevertheless, individual MS have reported this subcategory either as a net source or as a net sink of emissions. As in the case of Cropland areas, the net result of carbon stock changes in Grassland areas depends on one hand on whether these areas are subject to agricultural activities, and if so, on the presence or absences of significant woody biomass and the intensity and variation of management practices across the years of the time series.

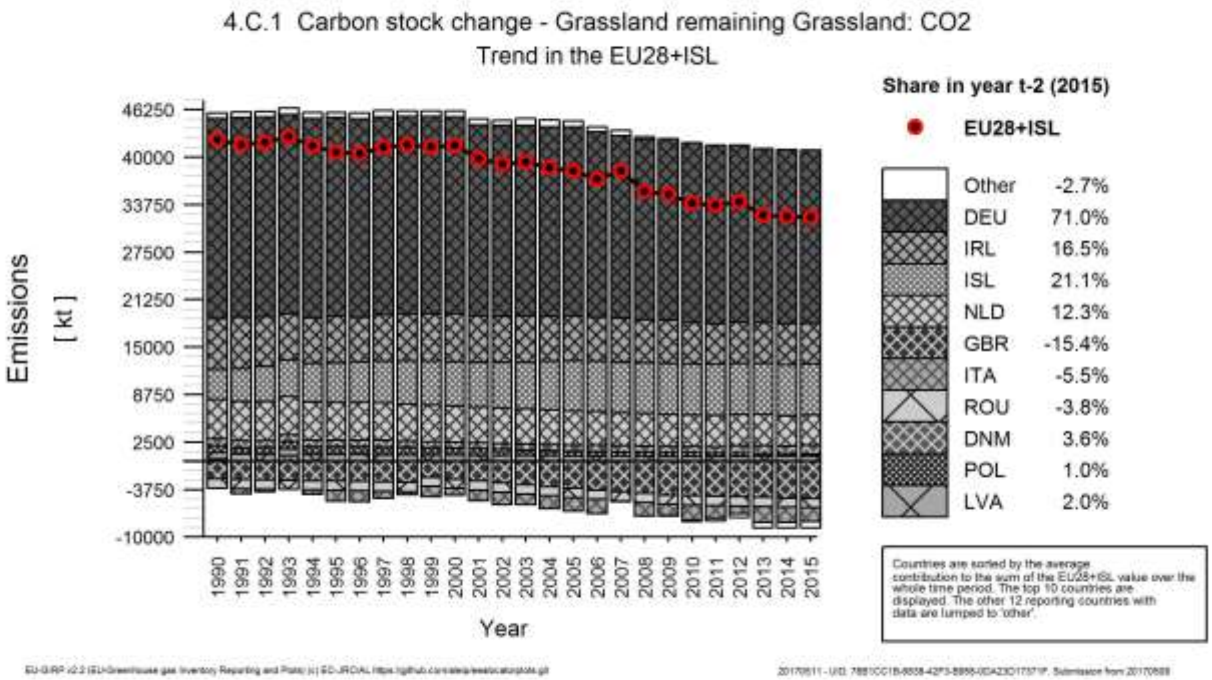
Table 6. 22 4C1 Grassland remaining Grassland: MS and Iceland' contributions to net CO2 emissions (+)/removals (-) (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	294	296	296	0.9%	0	0%	2	1%
Belgium	-421	-363	-357	-1.1%	6	2%	64	15%
Bulgaria	NO,NE	NO,NE	NO,NE	-	-	-	-	-
Croatia	2	2	2	0.0%	0	0%	0	0%
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	0	-274	-276	-0.8%	-2	-1%	-276	-100%
Denmark	903	961	1 141	3.5%	180	19%	238	26%
Estonia	59	52	51	0.2%	-1	-2%	-8	-13%
Finland	683	405	417	1.3%	11	3%	-266	-39%
France	208	-428	-519	-1.6%	-91	-21%	-727	-350%
Germany	26 368	22 851	22 790	69.3%	-61	0%	-3 578	-14%
Greece	0	0	0	0.0%	0	-65%	0	-73%
Hungary	51	-2	-6	0.0%	-3	-136%	-56	-111%
Ireland	6 666	5 404	5 310	16.2%	-94	-2%	-1 357	-20%
Italy	5 249	-787	-1 053	-3.2%	-266	-34%	-6 302	-120%
Latvia	901	632	635	1.9%	4	1%	-266	-29%
Lithuania	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	-2	0	0	0.0%	0	17%	1	84%
Netherlands	5 196	4 016	3 961	12.1%	-55	-1%	-1 235	-24%
Poland	979	375	332	1.0%	-43	-11%	-646	-66%
Portugal	NO	-330	-369	-1.1%	-39	-12%	-369	-∞
Romania	-1 222	-1 222	-1 222	-3.7%	0	0%	0	0%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NO,NA	-	-	-	-	-
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Sweden	-140	-91	-99	-0.3%	-8	-9%	41	29%
United Kingdom	-2 342	-4 858	-4 932	-15.0%	-74	-2%	-2 590	-111%
EU-28	**43 432**	**26 640**	**26 102**	**79%**	**-538**	**-2%**	**-17 330**	**-40%**
Iceland	3 945	6 743	6 762	20.6%	18	0%	2 817	71%
United Kingdom (KP)	-2 342	-4 858	-4 932	-15.0%	-74	-2%	-2 590	-111%
EU-28 + ISL	**47 378**	**33 383**	**32 864**	**100%**	**-519**	**-2%**	**-14 514**	**-31%**

The EU trend in emissions from this subcategory is well affected by Germany, Ireland, Iceland and Netherlands (Figure 6. 12). While for some of them, the overall share grassland remaining grassland areas is not significant at EU level, all of them report important areas of grasslands managed in organic soils that generate a large amount of emissions.

By contrary some others 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 significant net sink from mineral soils.

Figure 6. 12 Trend of emissions (+)/removals (-) in subcategory 4C1 "Grassland remaining Grassland" in EU MS and Iceland (1990-2015)



Methodological issues for Grassland remaining Grassland category

Despite different eco-regions and management approaches existing among the countries, definitions provided by MS and Iceland of Grassland areas show good match with the IPCC land use definition (Table 6. 23). 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, these pools are generally reported as a net sink that is associated with the presence of woody biomass on grassland 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 not provided quantitative estimates. 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. 24).

Table 6. 23 Definitions of lands included by MS and Iceland under the category 4C: Grasslands

MS	***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 areas of extensive grass, ditches associated with agricultural land, areas of bioenergy plants and abandoned arable land. In this context, abandoned arable land refers to fields that are no longer used for agricultural production and where natural reforestation is possible or is already taking place.
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 fulfil 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.

MS	Definition
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. This corresponds to natural grazing land. 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. 24 Implied net carbon stock change factors for carbon pools in 4C1 (t C ha-1 yr-1) reported by individual submissions in GHGI 2017.

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	2015	1990	2015	1990	2015	1990	2015
AUT	NO	NO	NO	NO	0.00	0.00	-6.40	-6.40
BEL	NO	NO	NO	NO	0.16	0.20	-2.50	-2.50
BGR	NE	NE	NE	NE	NE	NE	NO	NO
HRV	NO	NO	NO	NO	NO	NO	-2.50	-2.50
CYP	NE	NE	NE	NE	NE	NE	NO	NO
CZE	NO	NO	NO	NO	0.00	0.09	NO	NO
DNM	-0.07	-1.75	NO	NO	NO	NO	-6.79	-6.76
EST	NO	0.00	NO	NO	NO	NO	-0.36	-0.34
FIN	0.37	0.37	NE	NE	NA	NA	-3.50	-3.50

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	2015	1990	2015	1990	2015	1990	2015
FRK	-0.01	0.02	NE	NE	0.00	0.00	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	-3.86
ITA	-0.01	0.07	0.00	0.00	NA,NO	NO,NA	-2.50	-2.50
LVA	0.01	0.02	0.00	0.00	NA	NA	-6.10	-6.10
LTU	NO	NO	NO	NO	NO	NO	IE	IE
LUX	NO	NO	NO	NO	NO	NO	NO	NO
MLT	0.00	NO	NO,NE	NO,NE	0.03	0.01	NO	NO
NLD	NE	NE	NE	NE	NO	0.00	-4.56	-4.62
POL	NO	NO	NO	NO	-0.05	-0.01	-0.25	-0.25
PRT	NO	NO	NO	NO	NO	0.22	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	0.09	0.24	0.27	-0.26	-0.17	-1.34	-1.81
GBR	0.01	0.00	NO	NO	0.04	0.12	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)

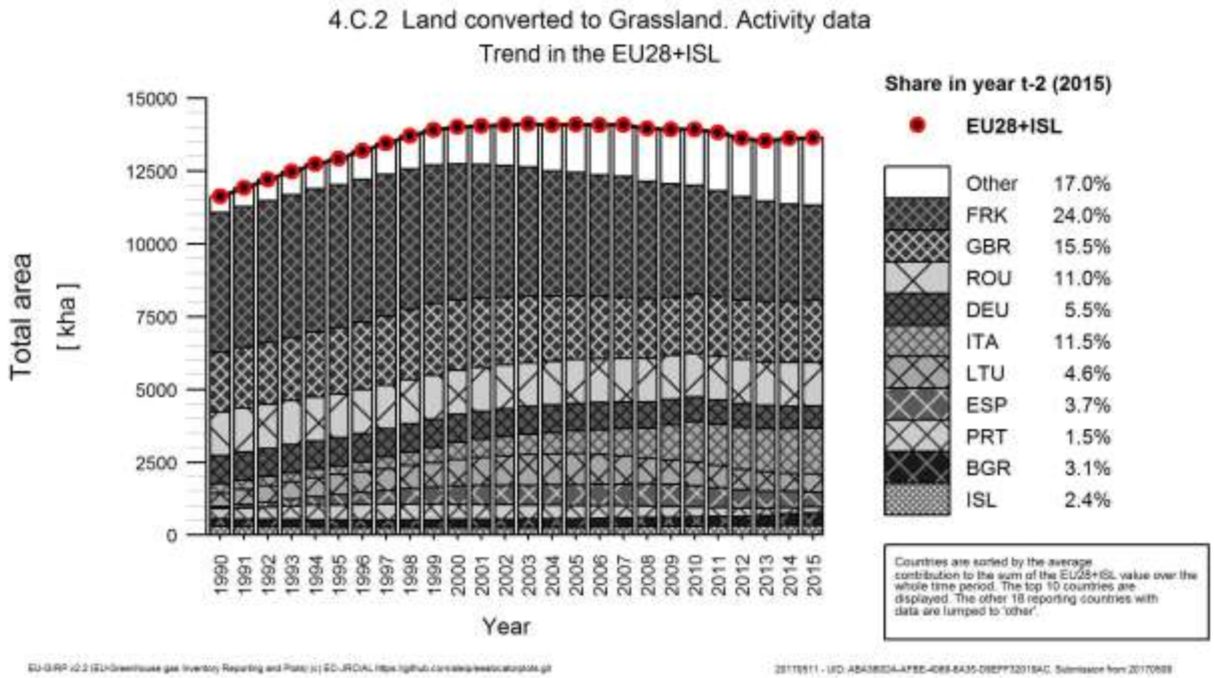
Overview of Land converted to Grassland category

In terms of area, this subcategory represents 14% of the total grassland areas reported at the level of EU MS and Iceland, however the carbon sink reported under this category offsets about 70% of the emissions resulting from grassland remaining grassland.

The area reported under this subcategory for the year 2015 reaches 13.633 Kha which represents an increase of 17% as compared with 1990 (Figure 6. 13). Main conversions to grassland areas take place on original cropland areas and, to a lesser extent, on forests land.

The main drivers of the EU trend on 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 and Iceland (kha, 1990-2015)



In term of emissions, for the year 2015, lands in conversion to Grassland represent at the level of EU and Iceland a total net sink of - 23.882 kt CO_2 that results in an increase of about 48% compared to the year 1990 (Table 6. 25).

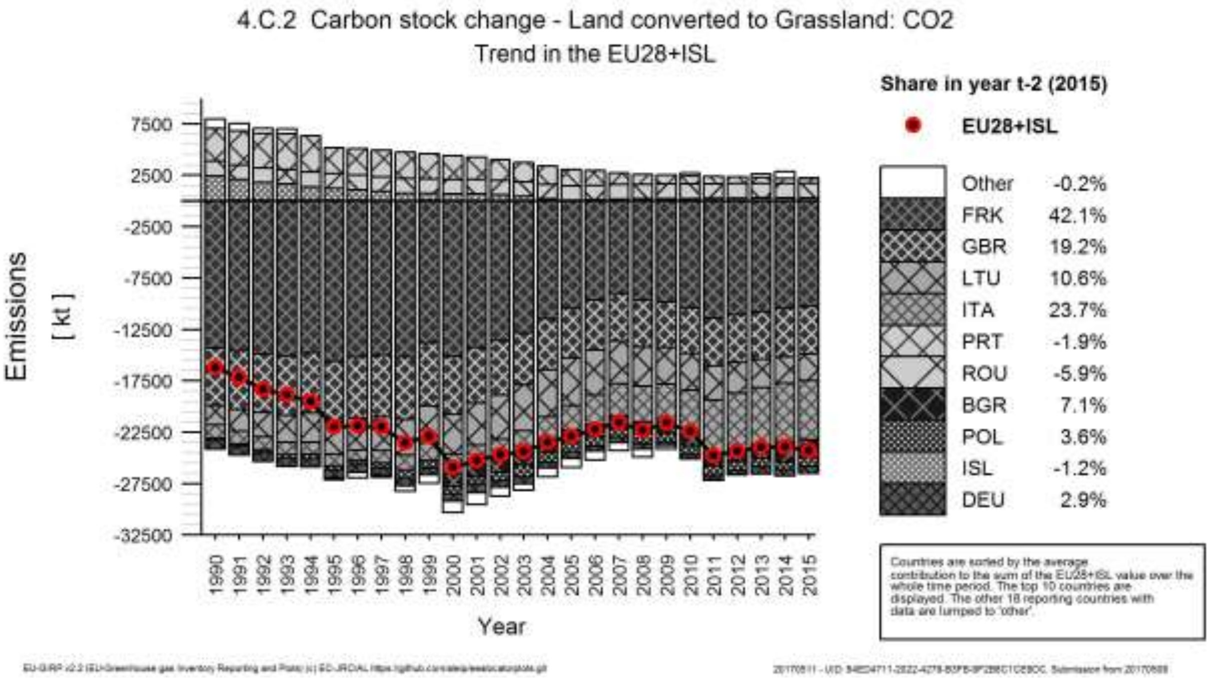
The trend in GHG emissions for this subcategory is driven by France, UK, Italy and Lithuania that report a significant carbon sink on mineral soils a result of the conversion of croplands areas to grassland. By contrary, final net emissions from this subcategory, as it has been reported for several MS (e.g. Romania and Spain), are associated with emissions from the conversion of Forest land, and to a lesser extent, from woody crops, to Grassland.

Table 6. 25 4C2 Land converted to Grassland: MS and Iceland' contributions to the net CO2 emissions (+)/removals (-) (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	333	62	78	-0.3%	16	26%	-255	-77%
Belgium	77	-23	-62	0.3%	-40	-175%	-140	-180%
Bulgaria	27	-1 920	-1 730	7.2%	190	10%	-1 757	-6595%
Croatia	-79	-44	-81	0.3%	-37	-83%	-2	-3%
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	-145	-295	-274	1.1%	21	7%	-129	-89%
Denmark	15	168	208	-0.9%	40	24%	194	1325%
Estonia	1	-45	-14	0.1%	32	70%	-15	-1226%
Finland	179	258	265	-1.1%	7	3%	86	48%
France	-14 316	-10 458	-10 229	42.8%	229	2%	4 087	29%
Germany	-825	-618	-698	2.9%	-80	-13%	127	15%
Greece	0	-623	-1 382	5.8%	-759	-122%	-1 382	-4140244%
Hungary	-36	-259	-195	0.8%	64	25%	-159	-445%
Ireland	3	38	38	-0.2%	1	2%	36	1309%
Italy	-1 275	-5 740	-5 740	24.0%	0	0%	-4 466	-350%
Latvia	0	-356	-334	1.4%	22	6%	-334	-15161423%
Lithuania	-1 877	-2 570	-2 576	10.8%	-6	0%	-699	-37%
Luxembourg	32	-46	-47	0.2%	-1	-1%	-79	-248%
Malta	-3	-1	0	0.0%	0	16%	3	85%
Netherlands	287	431	460	-1.9%	28	7%	172	60%
Poland	-266	-742	-877	3.7%	-134	-18%	-611	-230%
Portugal	3 228	483	472	-2.0%	-11	-2%	-2 756	-85%
Romania	1 423	1 423	1 423	-6.0%	0	0%	0	0%
Slovakia	-202	-185	-191	0.8%	-6	-3%	11	6%
Slovenia	-276	110	124	-0.5%	14	13%	401	145%
Spain	233	1 224	1 418	-5.9%	194	16%	1 185	509%
Sweden	498	323	160	-0.7%	-163	-51%	-338	-68%
United Kingdom	-5 579	-4 450	-4 364	18.3%	86	2%	1 215	22%
EU-28	**-18 541**	**-23 854**	**-24 148**	**101%**	**-293**	**-1%**	**-5 606**	**-30%**
Iceland	2 400	296	290	-1.2%	-6	-2%	-2 110	-88%
United Kingdom (KP)	-5 586	-4 475	-4 388	18.4%	86	2%	1 197	21%
EU-28 + ISL	**-16 148**	**-23 583**	**-23 882**	**100%**	**-299**	**-1%**	**-7 734**	**-48%**

Major changes in the time series of emissions from Land converted to Grassland have been reported by Greece and Latvia as driven by the activity data. Specifically by the abandonment of cropland areas that resulted in an increase of grassland areas and consequently in a larger carbon sink reported in mineral soils at the end of the time series as compared with the base year.

Figure 6. 14 Trend of emissions (+)/removals (-) in subcategory 4C2 "Land converted to Grassland" in EU MS and Iceland (kt CO2, 1990-2015)



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 being estimated. For instance, while some MS only consider a gross quantity of carbon loss from the conversion of forest lands to grassland, some other provide a net estimate on this carbon pool.

Usually, it is assumed that the carbon stored in living biomass and dead organic matter is lost in the year of the conversion, while for soil organic carbon in mineral soils, following IPPC methodology, MS apply a 20 years transition period before the carbon stock of the soils converted to Grassland reach and equilibrium.

6.2.4 Wetlands, Settlements and Other land (CRF Tables 4D, 4E, 4F)

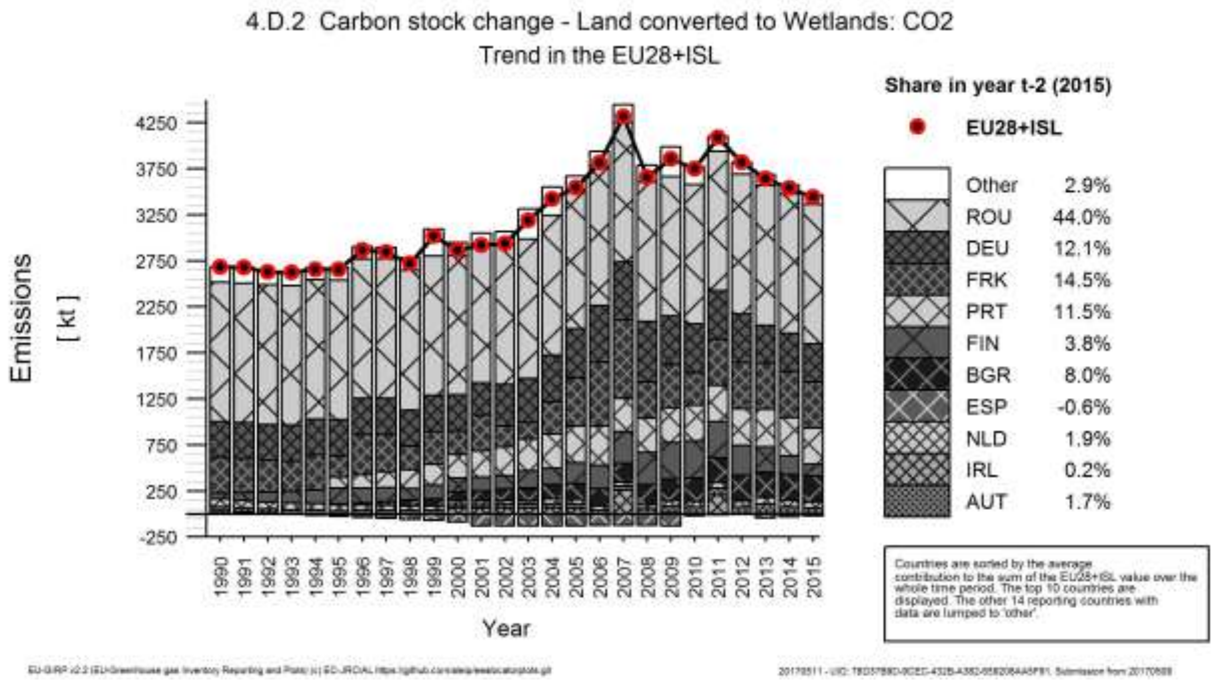
6.2.4.1 Wetlands (CRF 4D)

In terms of area, this category reaches at the level of EU and Iceland 24.302 Kha, which represents 5% of the total reported areas. The trend is strongly dominated by Sweden and Finland which, equal than all the other inventories, 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 6% of the wetlands area but 18% of the final net emissions reported within the category. However, these areas that are dominated, in overall, by Romania and France, have increased by 73%, as compared with 1990, as a result of new areas reported by Sweden in the second half of the time series.

In terms of emissions, Wetlands remaining Wetlands reaches for the year 2015 about 14.000 Kt CO_2. Both subcategories, 4D1 and 4D2, have been in overall reported as a net source of emissions, however, in some instances, they have been also reported as a net carbon sink.

Under this category, MS include different lands that not always are subject to management activities (



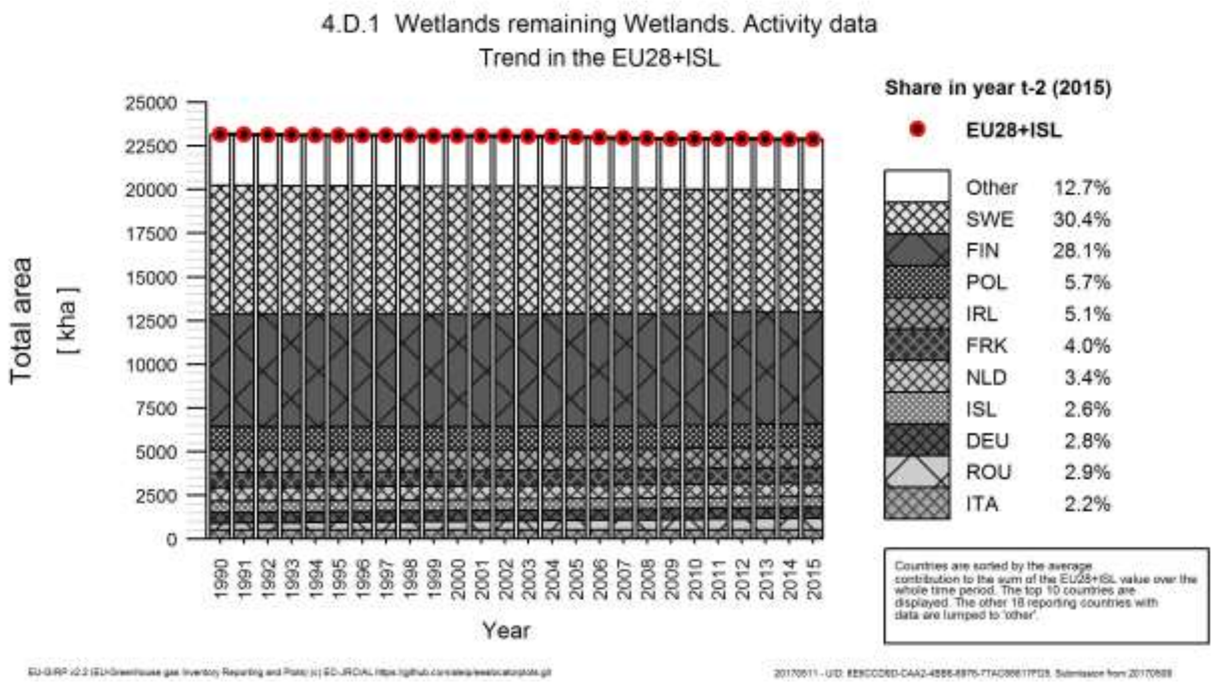
The graphs above show a significant increase of wetlands areas in Sweden that are not linked to any carbon stock changes. This fact is due to that new wetlands areas are the result of the conversion from Other lands (i.e. no carbon stocks are present in these areas) to Other wetlands (i.e. mires and areas saturated by fresh water)

Table 6. 26). This explain why countries with the largest share on areas at the level of EU and Iceland 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 drivers of the trend.

By contrary, Iceland under 4D1, report a significant amount of GHG removals as a result of intact mires.

Figure 6. 15 Trend of activity data and emissions (+)/removals (-) in subcategory 4D1 "Wetlands remaining Wetlands" in EU MS and Iceland (kha, Kt CO2, 1990-2015)



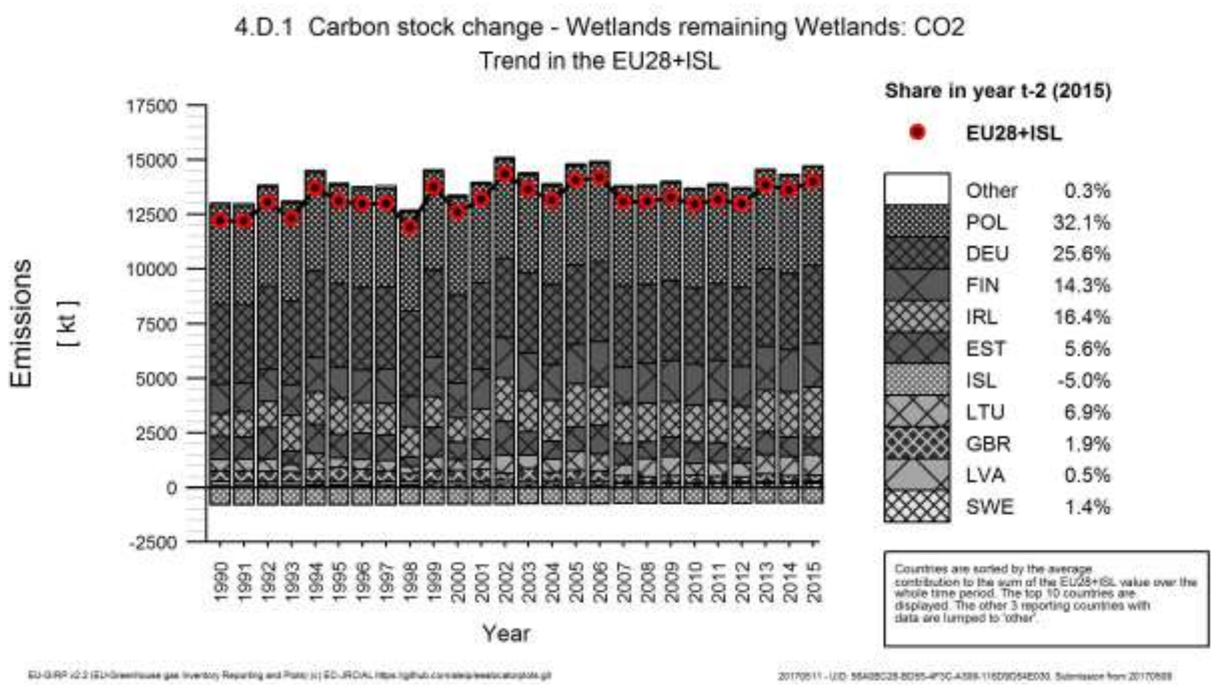
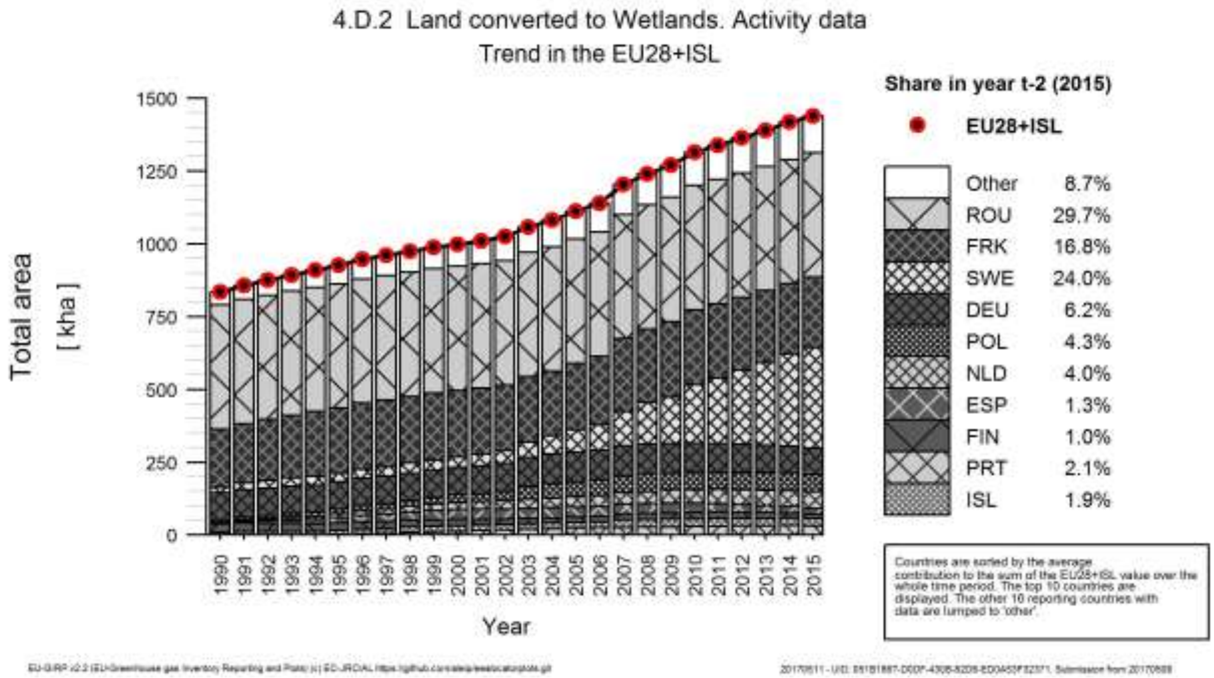
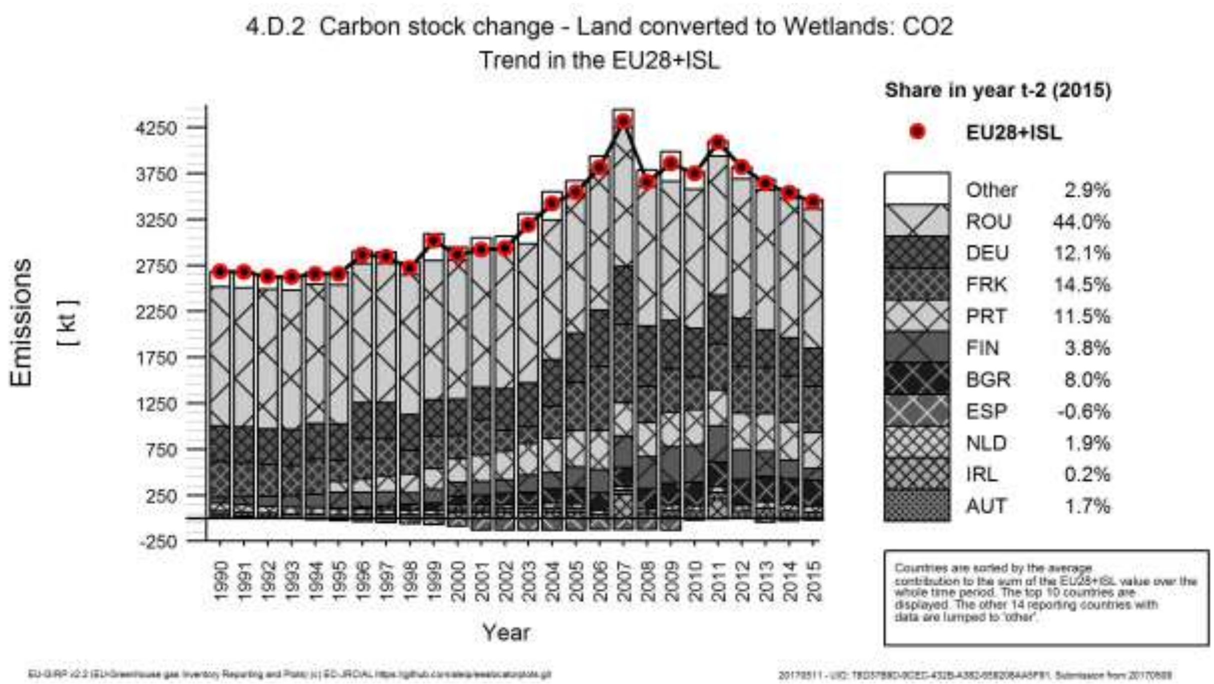


Figure 6. 16 Trend of activity data and emissions (+) / removals (-) in subcategory 4D2 "Lands converted to Wetlands" in EU MS and Iceland (kha, Kt CO2, 1990-2015)





The graphs above show a significant increase of wetlands areas in Sweden that are not linked to any carbon stock changes. This fact is due to that new wetlands areas are the result of the conversion from Other lands (i.e. no carbon stocks are present in these areas) to Other wetlands (i.e. mires and areas saturated by fresh water)

Table 6. 26 Definitions of lands included by MS and Iceland under the category 4D: Wetlands

MS	***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 fulfil 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, have been included in this category (MAMB, 1992). Reservoirs or water bodies regulated by human activities have not been considered.
Latvia	Wetlands category includes all inland water bodies (rivers, ponds, and 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.

MS	Definition
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.), harbours, temporarily flooded areas, bogs, channels and piers.
Slovakia	The wetlands include artificial reservoirs and dam lakes, natural lakes, rivers and swamps.
Slovenia	Wetlands are defined as land that are temporarily or permanently saturated by water. Wetlands include lands, such as fens, marshes, bogs and reeds and is not under agricultural use. Inland water bodies (major rivers, lakes and water reservoirs) are also part of Wetlands. Although there are small areas of raised bogs, all Wetlands are assumed managed.
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 reservoirs and peat extraction sites currently registered for commercial extraction where extraction activity is visible on recent aerial/satellite photographs or by field visits. The areas of inland water exceeding 1km2 are included also in this category.
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 MS and Iceland, 29.480 kha, and 6% of the total reported areas. For the 2015, reported Settlements areas have increased by 25 % 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 from Grasslands.

In terms of emissions this land use category is reported as a net source of emissions that reaches, in 2015, 47.004 Kt CO_2. Out of this, 92% are due to emissions resulting from Land converted to Settlement, which although in term of areas it represent only 22% of the total category, it results in significant emissions when forest lands are converted to urban areas.

Definitions of lands included under this category vary across individual inventories (Table 6. 27).

Table 6. 27 Definitions of lands included by MS and Iceland under the category 4E: Settlements

MS	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.

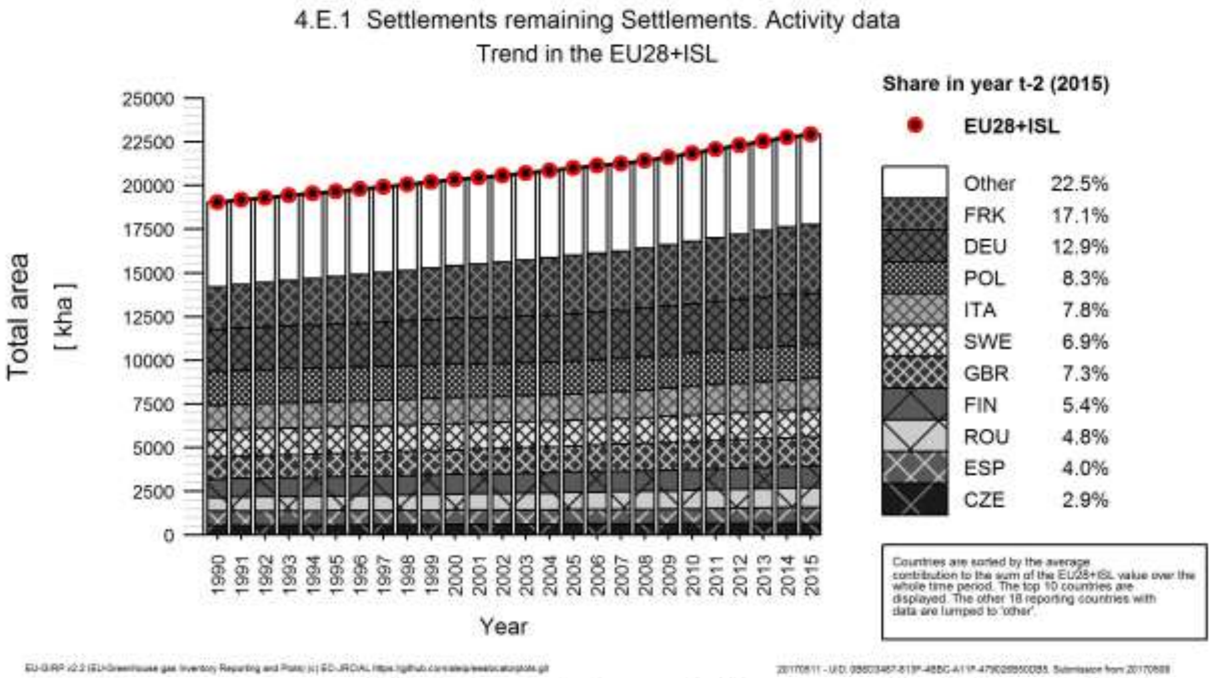
MS	*Definition*
Belgium	All developed land, including transportation infrastructure and human settlements of any size (i.e. including road sides) unless they are already included under other categories.
Bulgaria	The Settlements refer to all classes of urban formation. These are areas that are functionally 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 build-up 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 rifle ranges, 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	Includes all artificial territories, including cities and villages, industry, roads and railway, ports and airports.
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,

MS	Definition
	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 for reporting carbon stock changes in these areas, most of the countries have used the Tier 1 assumption of equilibrium under the subcategory 4E1 for reporting carbon stock changes. Therefore, notation key NO is included in the CRF tables. Nevertheless, few MS have reported this subcategory as a net source of emissions. For instance, Germany, France and Netherlands that have reported emissions as a result of disturbed organic soils in these areas, or UK from disturbed mineral soils.

By contrary, Sweden, Latvia, Poland and Slovenia have reported the subcategory 4E1 as a net sink of carbon due to carbon removals from living biomass on green urban areas (Figure 6. 17; Figure 6. 18)

Figure 6. 17 Trend of activity data and emissions (+)/removals (-) in subcategory 4E1 "Settlements remaining Settlements" in EU MS and Iceland (kha, kt CO2 1990-2015)



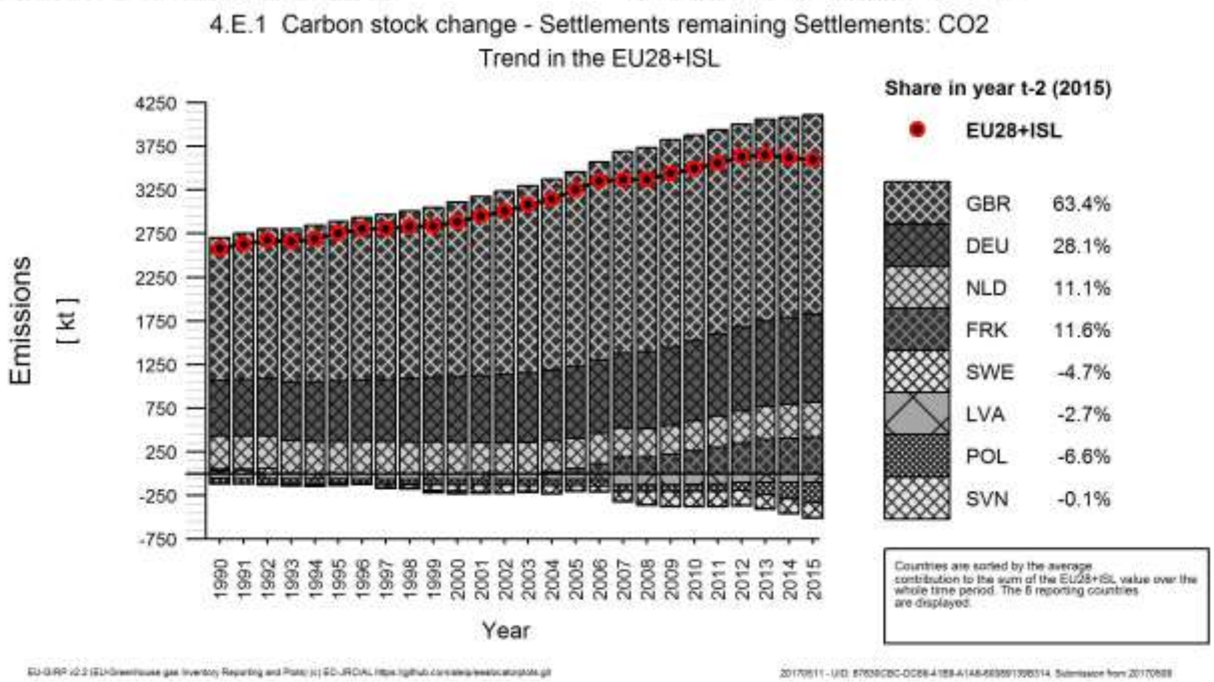
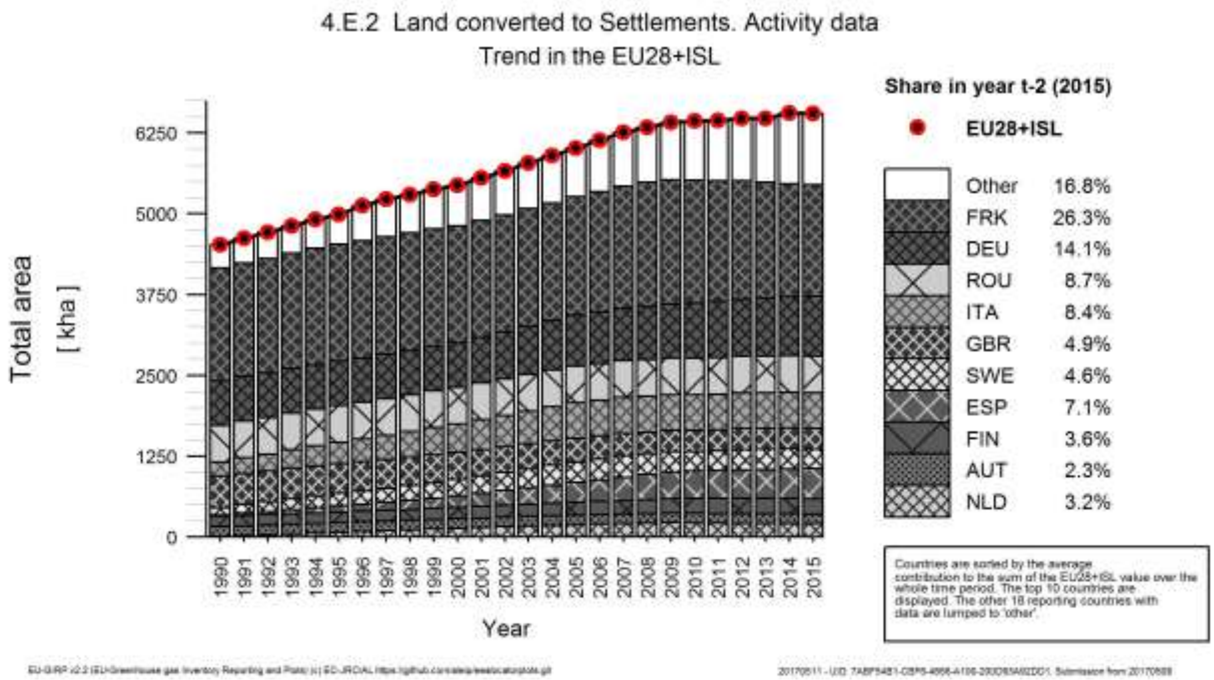
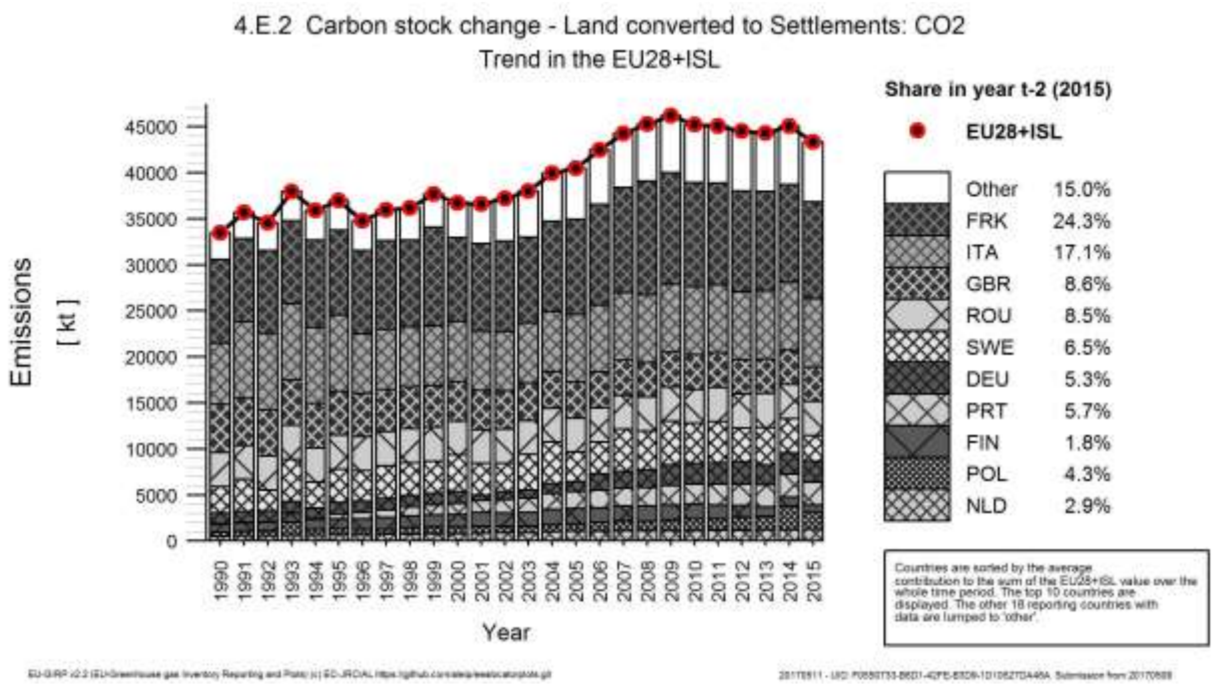


Figure 6. 18 Trend of activity data and emissions (+)/removals (-) in subcategory 4E2 "Land converted to Settlements" in EU MS and Iceland (kha, kt CO2 1990-2015)





As regards, with the subcategory 4E2, annual emissions from Land converted to Settlements have increased by 29% since 1990 (Table 6. 28). For the year 2015 this subcategory was reported as a net source of emissions reaching 43.347 kt CO_2.

The most significant emissions are due to disturbed mineral soils and loss of carbon from living biomass in Forest land being converted to urban areas (France, Italy, Romania and UK). In fact, the conversion of forests in 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.

In these conversions, carbon pools are not uniformly disturbed over the whole area. For instance, usually only part of the converted area is sealed, trees or upper soils layer is removed and, carbon stored in dead organic matter and soil organic matter diminish significantly. To address this issue, carbon stock changes associated with these deforestation events are reported using country-specific data and approaches.

Table 6. 28 4E2 Land converted to Settlements: MS and Iceland' contributions to the net CO2 emissions (+)/removals (-) (CRF table 4)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	577	406	376	0.9%	-29	-7%	-201	-35%
Belgium	210	1 024	1 053	2.4%	29	3%	844	403%
Bulgaria	469	648	777	1.8%	129	20%	308	66%
Croatia	209	577	593	1.4%	16	3%	384	184%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	85	128	88	0.2%	-39	-31%	3	4%
Denmark	13	48	67	0.2%	19	38%	54	421%
Estonia	NO	235	214	0.5%	-21	-9%	214	∞
Finland	870	956	776	1.8%	-180	-19%	-94	-11%
France	9 099	10 601	10 528	24.3%	-73	-1%	1 429	16%
Germany	1 174	2 302	2 291	5.3%	-12	-1%	1 117	95%
Greece	6	11	13	0.0%	1	12%	7	108%
Hungary	110	221	208	0.5%	-13	-6%	98	89%
Ireland	19	28	33	0.1%	4	16%	14	73%
Italy	6 640	7 405	7 418	17.1%	13	0%	778	12%
Latvia	168	1 013	1 035	2.4%	21	2%	866	515%
Lithuania	NO	373	382	0.9%	9	3%	382	∞
Luxembourg	145	68	65	0.1%	-3	-5%	-80	-55%
Malta	4	1	1	0.0%	0	-10%	-3	-74%
Netherlands	510	1 233	1 250	2.9%	18	1%	741	145%
Poland	436	2 566	1 883	4.3%	-682	-27%	1 447	332%
Portugal	30	2 504	2 458	5.7%	-46	-2%	2 427	7961%
Romania	3 700	3 700	3 700	8.5%	0	0%	0	0%
Slovakia	96	81	84	0.2%	4	4%	-12	-12%
Slovenia	394	369	360	0.8%	-9	-2%	-34	-9%
Spain	383	1 134	1 147	2.6%	13	1%	764	199%
Sweden	2 894	3 716	2 801	6.5%	-915	-25%	-93	-3%
United Kingdom	5 225	3 715	3 713	8.6%	-3	0%	-1 512	-29%
EU-28	**33 466**	**45 062**	**43 313**	**100%**	**-1 748**	**-4%**	**9 848**	**29%**
Iceland	13	5	5	0.0%	0	2%	-8	-63%
United Kingdom (KP)	5 239	3 744	3 741	8.6%	-3	0%	-1 498	-29%
EU-28 + ISL	**33 493**	**45 095**	**43 347**	**100%**	**-1 748**	**-4%**	**9 853**	**29%**

Major changes in the time series in Land converted to Settlements have been reported by Spain and Portugal, but not only, driven by the activity data. Specifically, by the increase in Settlements areas that has associated and increase of emissions due to the loss of carbon stock the land under transitions to settlement.

For reporting carbon stock changes in dead organic matter, it is generally assumed that the entire carbon stock in this pool is instantaneously oxidized in the moment of conversion from Forest land to Settlements. It is also assumed that there is no dead wood and litter on Settlements. Emissions are estimated based on per area average carbon stock of these carbon pools determined either at national or regional scale or specific to each deforestation site.

For reporting soils organic matter different assumptions have been implemented by MS, generally based on expert judgment or, occasionally, from some scientific studies. For instance, in Sweden carbon stock in Settlements is estimated as the weighted average of carbon stocks in two strata: unsealed and sealed. Unsealed area is usually considered to cover 40-60% of national settlements 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%).

6.2.4.3 Other land (CRF 4F)

The land use category Other land reached for the year 2015 at the level of the EU and Iceland 16.650 Kha, which represents about 4% of the total reported areas. This land use category has been reported rather constant across the years of the time series as a result of the balance among the decrease in the subcategory 4F1 and the increase in the subcategory 4F2 (Figure 6. 19).

Main areas under the category 4F1 are reported by Sweden and Island, while new areas under Other lands in the subcategory 4F2 are mainly reported by Portugal, France and Bulgaria but without a common pattern on the lands that are converted to Other land. Nevertheless, inter-annual variation on emissions reported at EU level are due to Portugal, Bulgaria and Ireland.

In the case of Portugal, emissions/removals are dominated by the trend on activity data. Cropland and Grassland are the main categories being converted to Other Land, however the forest land category plays also an important role at the beginning of the time series. Consequently, this category is reported as a net source of emissions for the year 1990, 1991 and 1992 due to the loss of carbon in living biomass and then as a net sink of carbon, which increase until 2009 and then decrease, following the trend in agricultural areas. The net sink is the result of abandonment of agricultural areas that resulted in net carbon accumulation in soils under Other Land.

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 areas.

Finally, Bulgaria applies the difference of the area among all land-use categories and the whole area of the country to "Other land" category in order to avoid double accounting or omission of areas. Due to the land representation system, the year 2000 represents a change in the land use change matrix. Starting from that year, Bulgaria reports a leap on activity data and associated emissions of "Land converted to Other Land" that is reflected in the EU trend.

Definitions implemented to report Other land are close amongst MS and match in overall IPCC general description (Table 6. 29). 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 of hierarchy and it includes all the areas that were not identified under any other land use category.

Furthermore, Portugal included under this category shrubland areas. This country specific definition, although different than the one provided by IPCC is consistently applied across the time series. Portugal provided in its NIR specific information on this land use category and on the methods used to estimate carbon stock changes in these areas. Although Portugal plans to move shrubland areas under the land use category Grassland, as an interim solution, in 2017 carbon stock changes from Other land remaining Other land were included in grassland converted to Other land in order to ensure the completeness of the inventory.

Table 6. 29 Definitions of lands included by MS and Iceland under the category 4F: Other lands

MS	***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	Other land category represents a difference between the total area of Croatia and sum of all other land use categories.
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 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 fulfil 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	Residual when all other land use area have been determinate.
Italy	Other Land includes comprises any area not included in another categories. It is included to match overall consistency of country land area.
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.

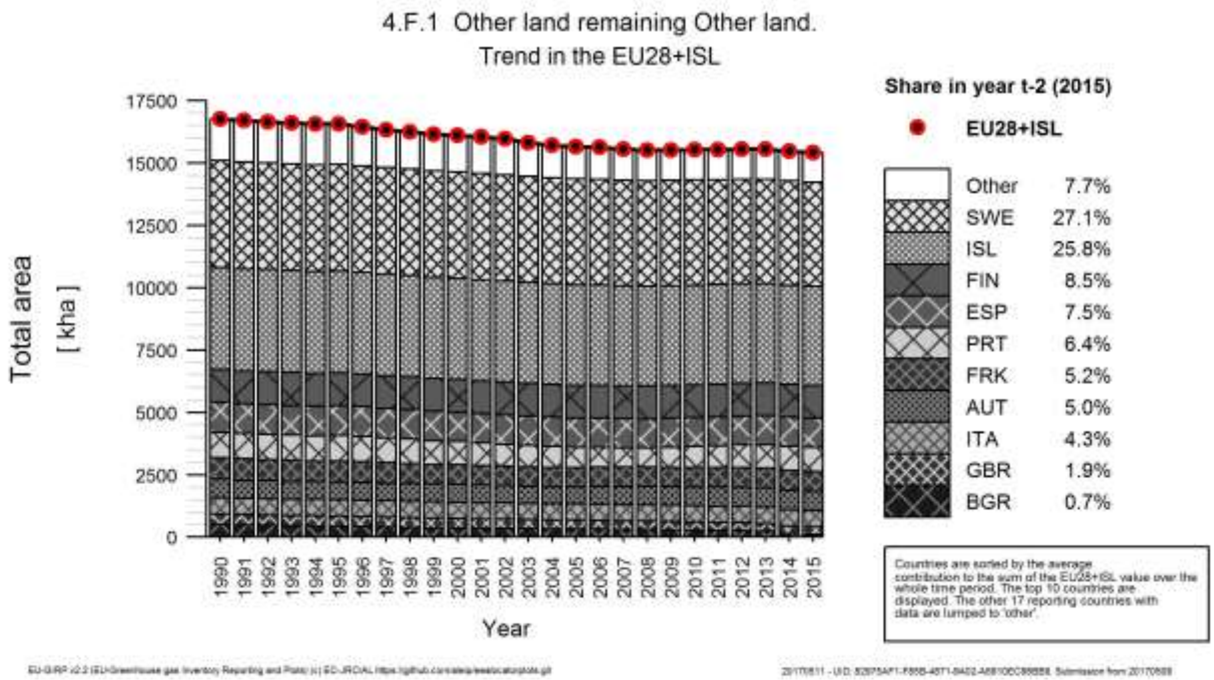
MS	Definition
Netherlands	Surfaces of bare soil which are not included in any other category like: bare sands and the earliest stages of succession from sand in the coastal areas (beaches, dunes and sandy roads) or uncultivated land alongside rivers. It does not include bare areas that emerge from shrinking and expanding water surfaces (which are included in wetlands).
Poland	Other Land includes comprises any area not included in another categories. It is included to match overall consistency of country land area.
Portugal	Shrubland - includes all lands covered in woody vegetation that do not meet the forest or permanent crop definitions and Other land - includes all lands that do not meet the previous definitions, such as lands covered in rocks, sand dunes, etc.
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	For pre-1980 Other Land is the sum of the bare rock, sand/shingle, inland water and coastal water land. For Post-1980, Other Land contains the 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 2015, 20 kt CO_2.

Specifically, emissions are the result of the loss of carbon storage in the living biomass and, in the soils, of the lands that are converted to Other land. However, some MS have reported a net sink from mineral soils.

Finally, as explained aboved, a particular case is Portugal that reports all the carbon pools as a net sink under these conversions due to the woody biomass that is presented in this category according with its own national definition.

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 and Iceland (kha, kt CO2 1990-2015)



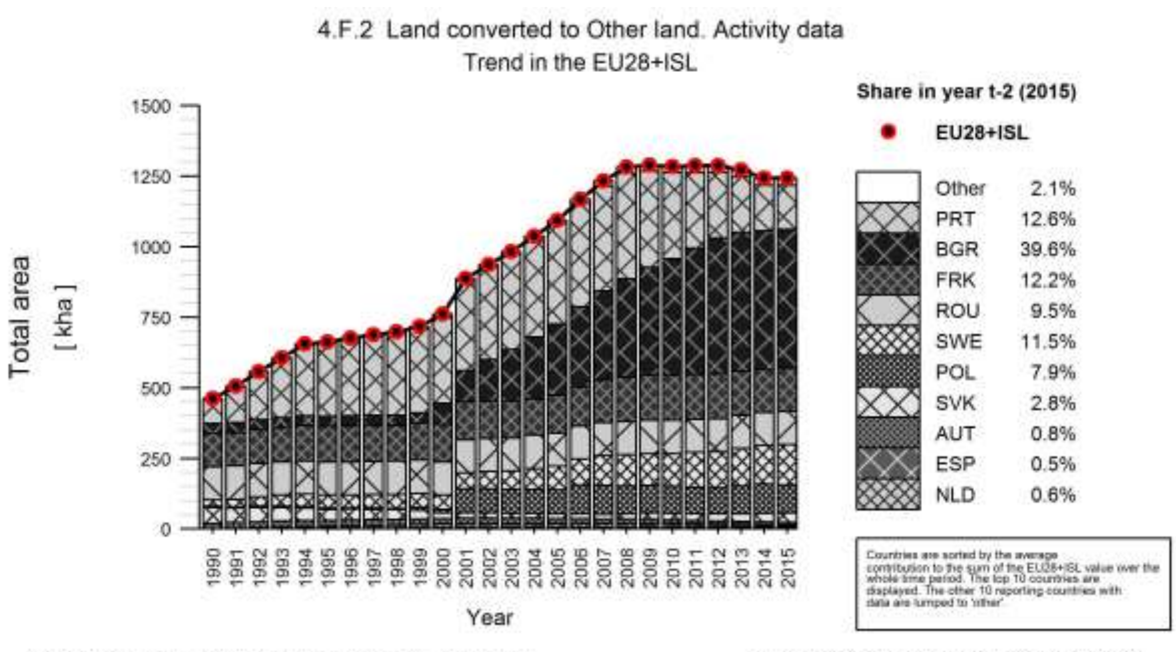
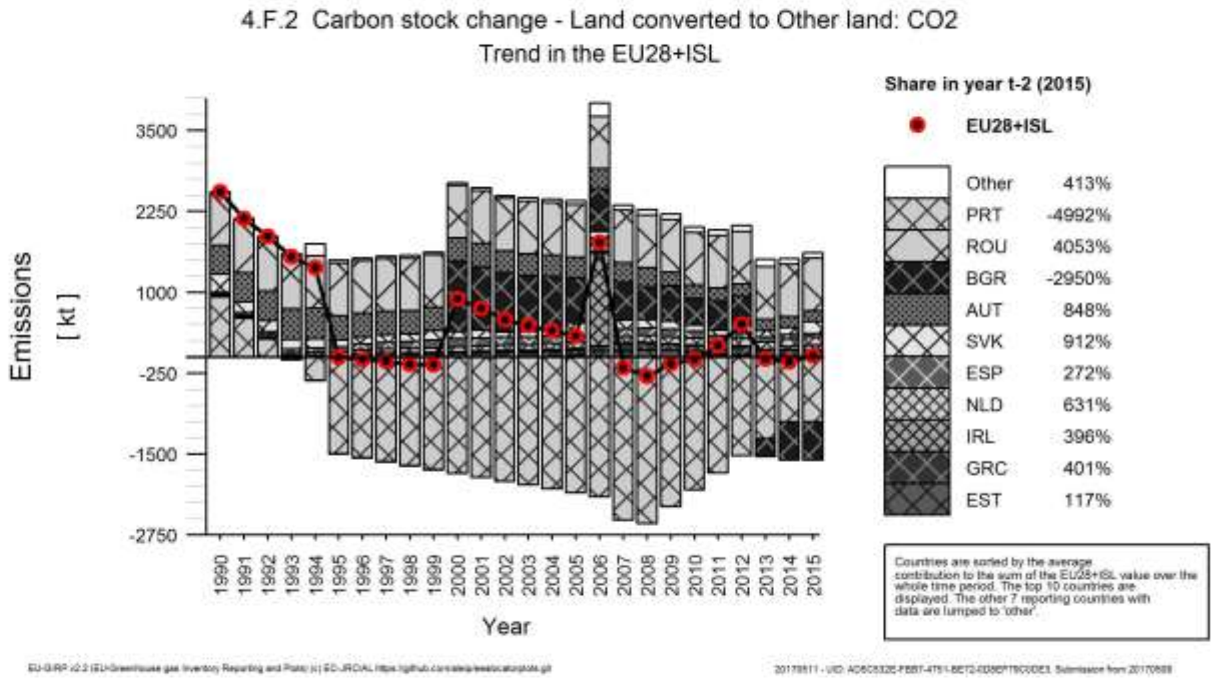


Figure 6. 20 Trend of emissions (+)/removals (-) in subcategory 4F2 "Land converted to Other lands" in EU MS and Iceland (kt CO2, 1990-2015)



6.2.5 Other source of emissions: Tables 4(I)-4(V)

6.2.5.1 Direct nitrous oxide (N2O) 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. 30).

Exceptions are given by Finland, Sweden, and the UK, which report N_2O emissions under this source category due to forest fertilization. Sweden reports more than half of the total emissions at the EU level from nitrogen fertilization as a result of nitrogen inputs occasionally applied to increase the wood production in older forests stands. And, Finland reports 30% of the remaining emissions as a result of forest growth fertilizations and, to a lesser extent, forest vitality fertilizations.

By contrary, Ireland reports N_2O emissions resulting from the addition of organic fertilizers in Settlements areas.

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] are mainly used to derive N_2O emissions from nitrogen inputs to managed soils.

N_2O emissions from nitrogen inputs to managed soils for the year 2015 reaches 39 kt CO_2 equivalent, which represents about 51% less than in 1990.

Table 6. 30 Direct nitrous oxide (N2O) emissions from nitrogen (N) inputs to managed soils (kt CO2 eq.))

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	IE,NO	IE,NO	NO,IE	-	-	-	-	-
Denmark	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Estonia	NA,NO	NA,NO	NO,NA	-	-	-	-	-
Finland	21	13	13	32.2%	-1	-7%	-8	-39%
France	NO	NO	NO	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	IE,NA,NO	NA,NO,IE	NO,IE,NA	-	-	-	-	-
Ireland	NO,IE	0	0	1.2%	0	6%	0	∞
Italy	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NA,NO	NO	NO	-	-	-	-	-
Netherlands	NO,NE,IE	NO,NE,IE	NO,NE,IE	-	-	-	-	-
Poland	NO,IE,NA	NO,IE,NA	NO,IE,NA	-	-	-	-	-
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	16	23	60.2%	8	47%	-26	-52%
United Kingdom	10	4	2	6.3%	-2	-44%	-7	-75%
EU-28	**80**	**34**	**39**	**100%**	**5**	**14%**	**-41**	**-51%**
Iceland	0	0	0	0.1%	0	0%	0	267%
United Kingdom (KP)	10	4	2	6.3%	-2	-44%	-7	-75%
EU-28 + ISL	**80**	**34**	**39**	**100%**	**5**	**14%**	**-41**	**-51%**

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), CO_2, CH_4 and N_2O emissions and removals from drainage and rewetting and other management of organic and mineral soils areas are reported. However, part of these emissions are already covered under other sectors, so countries shall 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 are often already included in CRF tables 4.A to 4.F).

For the year 2015, total emissions from this source category reaches 13.618 kt CO_2 equivalent (Table 6. 31; Table 6. 32; and Table 6. 33). These are reported mainly by UK, Finland, Sweden and Iceland.

Table 6. 31 CO2 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (kt CO2 eq.))

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Belgium	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Estonia	IE,NA,NO	NA,NO,IE	NO,IE,NA	-	-	-	-	-
Finland	NO,IE,NA	NO,IE,NA	NO,IE,NA	-	-	-	-	-
France	NE	NE	NE	-	-	-	-	-
Germany	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Hungary	786	211	223	4.9%	12	6%	-563	-72%
Ireland	477	413	411	9.1%	-2	0%	-66	-14%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	1 017	922	926	20.5%	4	0%	-91	-9%
Lithuania	770	785	784	17.4%	0	0%	14	2%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	O,NE,IE,NA	O,NE,IE,NA	O,NE,IE,NA	-	-	-	-	-
Poland	NA	NA	NA	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	IE,NA,NO	NA,NO,IE	NO,IE,NA	-	-	-	-	-
United Kingdom	1 879	1 879	1 879	41.6%	0	0%	0	0%
EU-28	**4 930**	**4 209**	**4 224**	**94%**	**14**	**0%**	**-706**	**-14%**
Iceland	285	291	291	6.4%	0	0%	6	2%
United Kingdom (KP)	1 879	1 879	1 879	41.6%	0	0%	0	0%
EU-28 + ISL	**5 215**	**4 500**	**4 515**	**100%**	**14**	**0%**	**-700**	**-13%**

Table 6. 32 N2O Emissions and removals from drainage and rewetting and other management of organic and mineral soils (kt CO2 eq.)

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	27	24	24	0.6%	0	0%	-3	-10%
Estonia	1	1	1	0.0%	0	0%	0	-11%
Finland	1 219	1 214	1 213	31.6%	-1	0%	-6	-1%
France	NE	NE	NE	-	-	-	-	-
Germany	235	304	308	8.0%	4	1%	73	31%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	0	1	1	0.0%	0	0%	1	788%
Ireland	92	172	174	4.5%	3	2%	82	89%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	571	641	640	16.7%	-1	0%	69	12%
Lithuania	39	40	41	1.1%	0	1%	1	3%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	O,NE,IE,NA	O,NE,IE,NA	O,NE,IE,NA	-	-	-	-	-
Poland	NA	NA	NA	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	27	27	27	0.7%	0	0%	0	0%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	1 035	1 261	1 274	33.2%	13	1%	239	23%
United Kingdom	53	57	57	1.5%	0	0%	4	7%
EU-28	**3 300**	**3 742**	**3 760**	**98%**	**18**	**0%**	**460**	**14%**
Iceland	67	81	81	2.1%	0	0%	14	21%
United Kingdom (KP)	53	57	57	1.5%	0	0%	4	7%
EU-28 + ISL	**3 367**	**3 823**	**3 841**	**100%**	**19**	**0%**	**475**	**14%**

Table 6. 33 CH4 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (kt CO2 eq.)

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	24	24	24	0.5%	0	0%	0	0%
Belgium	NO,NA	NO,NA	NO,NA	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Denmark	18	57	60	1.1%	3	5%	42	230%
Estonia	0	0	0	0.0%	0	0%	0	-11%
Finland	1 534	920	920	17.5%	0	0%	-614	-40%
France	NE	NE	NE	-	-	-	-	-
Germany	845	823	821	15.6%	-2	0%	-24	-3%
Greece	NO	NO	NO	-	-	-	-	-
Hungary	NA,NO	NA,NO	NO,NA	-	-	-	-	-
Ireland	118	322	339	6.4%	17	5%	221	188%
Italy	NO	NO	NO	-	-	-	-	-
Latvia	280	359	359	6.8%	0	0%	80	28%
Lithuania	NO,NE	NE,NO	NE,NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	),NE,IE,NA	),NE,IE,NA	),NE,IE,NA	-	-	-	-	-
Poland	NA	NA	NA	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	460	498	500	9.5%	2	0%	40	9%
United Kingdom	NO,NE,NA	NO,NE,NA	NO,NE,NA	-	-	-	-	-
EU-28	**3 279**	**3 004**	**3 024**	**57%**	**20**	**1%**	**-255**	**-8%**
Iceland	2 362	2 241	2 239	42.5%	-3	0%	-124	-5%
United Kingdom (KP)	NO,NE,NA	NO,NE,NA	NO,NE,NA	-	-	-	-	-
EU-28 + ISL	**5 641**	**5 245**	**5 262**	**100%**	**17**	**0%**	**-379**	**-7%**

6.2.5.3 Direct nitrous oxide (N2O) 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. This implies a significant increase of the completeness for this source of emissions as compared with previous year.

For the year 2015, net emission from this source category reached 8.720 kt CO_2 equivalent, which represent an increase of 12% as compared to 1990. Significant emissions under this category are reported by France, Romania, UK and Poland (Table 6. 34) and in most of the cases they were estimated using IPCC methodologies and default emissions factors.

Table 6. 34 Direct nitrous oxide (N2O) 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 (kt CO2eq.)

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	129	117	119	1.4%	2	1%	-10	-8%
Belgium	8	170	181	2.1%	11	6%	173	2256%
Bulgaria	67	72	72	0.8%	0	0%	5	8%
Croatia	36	76	76	0.9%	1	1%	41	113%
Cyprus	NE,NO	NE,NO	NO,NE	-	-	-	-	-
Czech Republic	9	5	5	0.1%	0	-1%	-4	-44%
Denmark	0	6	10	0.1%	5	82%	10	5722%
Estonia	NE,NO	5	5	0.1%	0	0%	5	∞
Finland	29	38	37	0.4%	-1	-2%	8	29%
France	1 854	1 737	1 748	20.0%	11	1%	-105	-6%
Germany	482	443	445	5.1%	1	0%	-38	-8%
Greece	1	8	8	0.1%	0	-3%	7	1361%
Hungary	24	41	39	0.5%	-2	-4%	15	62%
Ireland	18	95	96	1.1%	1	1%	77	421%
Italy	551	523	518	5.9%	-5	-1%	-33	-6%
Latvia	2	58	63	0.7%	5	9%	62	4124%
Lithuania	393	335	339	3.9%	4	1%	-54	-14%
Luxembourg	17	11	11	0.1%	-1	-5%	-6	-37%
Malta	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Netherlands	6	123	129	1.5%	6	5%	124	2195%
Poland	173	1 082	1 089	12.5%	7	1%	916	529%
Portugal	507	341	333	3.8%	-9	-3%	-175	-34%
Romania	1 305	1 816	1 816	20.8%	0	0%	511	39%
Slovakia	75	16	18	0.2%	1	8%	-57	-77%
Slovenia	42	30	29	0.3%	-1	-4%	-13	-31%
Spain	17	174	162	1.9%	-12	-7%	145	849%
Sweden	99	202	196	2.2%	-6	-3%	97	99%
United Kingdom	1 942	1 196	1 169	13.4%	-27	-2%	-773	-40%
EU-28	**7 784**	**8 721**	**8 713**	**100%**	**-8**	**0%**	**928**	**12%**
Iceland	0	0	0	0.0%	0	0%	0	497%
United Kingdom (KP)	1 943	1 204	1 177	13.5%	-27	-2%	-766	-39%
EU-28 + ISL	**7 785**	**8 728**	**8 720**	**100%**	**-8**	**0%**	**935**	**12%**

6.2.5.4 Indirect nitrous oxide (N2O) 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 were reported also under the Agriculture sector.

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, a number of the MS have reported in the CRF table 4(IV) the notation key IE (i.e. included elsewhere).

Nevertheless, the reporting of these emissions has also undergone a significant increase in this year submission following recommendations provided during the EU QA/QC checks.

For the year 2015, indirect N_2O emissions reported under LULUCF reach 489 kt CO_2 equivalent (Table 6. 35). These emissions are mainly reported by Germany, UK and Lithuania. To a lesser extent, others MS have provided for first time also minor quantities of indirect N2O emissions.

Table 6. 35 Indirect nitrous oxide (N2O) emissions from managed soils (kt CO2 eq.)

Member State	N20 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014 - 2015		Change 1990 - 2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	15	13	13	3%	0	1%	-1.1	-8%
Belgium	IE	IE	IE	-	-	-	-	-
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	IE	IE	IE	-	-	-	-	-
Cyprus	NE	NE	NE	-	-	-	-	-
Czech Republic	2	1	1	0.2%	0	-1%	-0.9	-44%
Denmark	IE	IE	IE	-	-	-	-	-
Estonia	NO	0	0	0%	0	0%	-	-
Finland	2	3	3	0.6%	0	-3%	0.7	33%
France	NO	NO	NO	-	-	-	-	-
Germany	109	100	100	20%	0	0%	-8	-8%
Greece	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Hungary	IE	IE	IE	-	-	-	-	-
Ireland	IE	IE	IE	-	-	-	-	-
Italy	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Latvia	0	3	3	0.6%	0	-1%	2.8	1762%
Lithuania	88	75	76	16%	1	1%	-12	-14%
Luxembourg	4	3	2	1%	0	-5%	-1	-37%
Malta	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Poland	IE	IE	IE	-	-	-	-	-
Portugal	22	9	12	2%	3	34%	-11	-48%
Romania	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Slovakia	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Slovenia	10	7	7	1%	0	-5%	-3.0	-32%
Spain	0.4	4	4	0.8%	0	-7%	4	849%
Sweden	8	3	4	0.8%	1	42%	-4	-51%
United Kingdom	440	271	264	54%	-7	-2%	-176	-40%
EU-28	**700**	**491**	**489**	**100%**	**-2**	**0%**	**-211**	**-30%**
Iceland	IE	IE	IE	-	-	-	-	-
United Kingdom (KP)	440	271	264	54%	-7	-2%	-176	-40%
EU-28 + ISL	**700**	**491**	**489**	**100%**	**-4**	**-1%**	**-421**	**-60%**

6.2.5.5 CO2, CH4 & N2O emissions from Biomass Burning (CRF Table 4(V))

This source category covers CO2, and non-CO2 emissions from biomass burning as a result of wildfires and controlled burning, on land use category.

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 CO2 emissions. In addition, MS have also used the notation keys NO or NA when no wildfires or controlled burning do not take place under certain categories or NE for those land use categories for which the IPCC does not provide methods. For instance, for reporting emissions from biomass burning in Settlement (e.g. Estonia).

In general, controlled burning on managed lands is not a common practice in the EU MS and Iceland, with few exceptions for confined areas (.e.g. Finland, Sweden, and UK in forest lands and, Spain and UK in grasslands). In addition, northern countries report negligible emissions from biomass burning (i.e. controlled burning and wildfires).

Methodologies used to report CO2 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 also used for estimation of CH4 and N2O emissions resulting from fires.

Overall, emissions from biomass burning decreased in 2015 compared to 1990 (Table 6. 36, Table 6. 37 and Table 6. 38) although increased compared with previous year. Nevertheless, their trends and variability 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. 36 CO2 emissions from Biomass Burning (in kt CO2)

Member State	CO2 emissions in kt			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2	%	kt CO2	%
Austria	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Belgium	5	NO	NO	-	-	-	-5	-100%
Bulgaria	32	29	171	4.4%	142	494%	138	427%
Croatia	9	3	115	2.9%	112	3771%	106	1181%
Cyprus	1	3	1	0.0%	-2	-65%	1	101%
Czech Republic	1 076	673	751	19.2%	78	12%	-325	-30%
Denmark	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Estonia	IE,NE,NO	NE,NO,IE	NO,NE,IE	-	-	-	-	-
Finland	4	9	2	0.0%	-7	-82%	-2	-60%
France	1 741	417	632	16.1%	215	51%	-1 109	-64%
Germany	NO,IE	NO,IE	NO,IE	-	-	-	-	-
Greece	145	3	13	0.3%	10	295%	-132	-91%
Hungary	IE,NA,NO	NA,NO,IE	NO,IE,NA	-	-	-	-	-
Ireland	440	241	135	3.4%	-107	-44%	-306	-69%
Italy	5 052	1 196	739	18.9%	-457	-38%	-4 313	-85%
Latvia	218	68	70	1.8%	2	3%	-148	-68%
Lithuania	4	6	2	0.0%	-4	-69%	-3	-60%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NO,NE	NE,NO	NE,NO	-	-	-	-	-
Netherlands	4	5	5	0.1%	0	1%	1	27%
Poland	107	31	23	0.6%	-7	-23%	-83	-78%
Portugal	2 040	134	728	18.6%	594	443%	-1 312	-64%
Romania	4	10	10	0.3%	0	0%	6	168%
Slovakia	7	6	11	0.3%	5	84%	4	52%
Slovenia	21	1	3	0.1%	2	265%	-18	-84%
Spain	26	84	171	4.4%	87	104%	145	552%
Sweden	IE,NA,NO	NA,NO,IE	NO,IE,NA	-	-	-	-	-
United Kingdom	100	358	332	8.5%	-26	-7%	232	233%
EU-28	**11 035**	**3 277**	**3 912**	**100%**	**636**	**19%**	**-7 123**	**-65%**
Iceland	NE,NA	NE,NA,NO	NO,NE,NA	-	-	-	-	-
United Kingdom (KP)	100	358	332	8.5%	-26	-7%	232	233%
EU-28 + ISL	**11 035**	**3 277**	**3 912**	**100%**	**636**	**19%**	**-7 123**	**-65%**

Table 6. 37   CH4 emissions from Biomass Burning (in kt CO2 eq.)

Member State	CH4 emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0.5	0.1	0.3	0.0%	0	148%	0	-31%
Belgium	1	NO	NO	-	-	-	-1	-100%
Bulgaria	2	2	13	0.7%	11	494%	10	427%
Croatia	1.2	0.3	14.0	0.8%	14	4244%	13	1035%
Cyprus	0.0	0.2	0.1	0.0%	0	-65%	0	104%
Czech Republic	117	73	82	4.7%	8	12%	-35	-30%
Denmark	0.7	0.0	0.0	0.0%	0	-28%	-1	-95%
Estonia	0.3	0.0	0.0	0.0%	0	-93%	0	-99%
Finland	5	1	0	0.0%	-1	-70%	-4	-91%
France	947	850	890	50.6%	39	5%	-58	-6%
Germany	7	1	3	0.2%	2	342%	-4	-57%
Greece	62	9	11	0.6%	1	15%	-51	-83%
Hungary	23	17	18	1.0%	1	4%	-5	-21%
Ireland	109	57	32	1.8%	-25	-44%	-77	-71%
Italy	1 518	336	288	16.4%	-48	-14%	-1 229	-81%
Latvia	24	17	13	0.8%	-3	-19%	-11	-44%
Lithuania	3	3	1	0.1%	-1	-49%	-1	-50%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0.2	0.3	0.3	0.0%	0	1%	0	34%
Poland	44	35	34	1.9%	-1	-3%	-10	-23%
Portugal	364	41	141	8.0%	100	244%	-223	-61%
Romania	0.4	1.1	1.1	0.1%	0	0%	1	168%
Slovakia	7	17	17	1.0%	0	-2%	9	126%
Slovenia	1.6	0.1	0.2	0.0%	0	265%	-1	-84%
Spain	308	74	170	9.7%	96	130%	-138	-45%
Sweden	2	30	2	0.1%	-29	-94%	0	-18%
United Kingdom	17	32	26	1.5%	-6	-19%	10	59%
EU-28	**3 565**	**1 599**	**1 757**	**100%**	**158**	**10%**	**-1 807**	**-51%**
Iceland	NE,NA	0.0	0.2	0.0%	0	364%	0	∞
United Kingdom (KP)	17	32	26	1.5%	-6	-19%	10	59%
EU-28 + ISL	**3 565**	**1 600**	**1 758**	**100%**	**158**	**10%**	**-1 807**	**-51%**

Table 6. 38 N2O emissions from Biomass Burning (in kt CO2 eq.)

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015	
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%
Austria	0.3	0.1	0.2	0.0%	0	148%	0	-31%
Belgium	5	NO	NO	-	-	-	-5	-100%
Bulgaria	2	1	8	1.2%	7	494%	7	427%
Croatia	0.9	0.2	9.9	1.4%	10	4334%	9	1052%
Cyprus	0.0	0.2	0.1	0.0%	0	-63%	0	116%
Czech Republic	10	6	7	0.9%	1	12%	-3	-30%
Denmark	0.4	0.0	0.0	0.0%	0	-21%	0	-92%
Estonia	0.0	0.0	0.0	0.0%	0	-92%	0	-99%
Finland	0.5	0.2	0.0	0.0%	0	-71%	0	-90%
France	527	393	419	58.2%	25	6%	-108	-21%
Germany	4	0.4	2	0.3%	2	342%	-3	-57%
Greece	5	1	1	0.1%	0	15%	-4	-83%
Hungary	15	13	12	1.7%	-1	-9%	-3	-19%
Ireland	18	9	5	0.7%	-4	-44%	-13	-72%
Italy	261	62	38	5.3%	-23	-38%	-223	-85%
Latvia	3	3	2	0.3%	-1	-27%	-1	-35%
Lithuania	3	3	1	0.2%	-1	-49%	-1	-50%
Luxembourg	NO	NO	NO	-	-	-	-	-
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0.2	0.2	0.2	0.0%	0	1%	0	30%
Poland	10	4	5	0.7%	1	39%	-5	-50%
Portugal	60	7	23	3.2%	16	244%	-37	-61%
Romania	0.1	0.4	0.4	0.1%	0	0%	0	168%
Slovakia	5	11	11	1.5%	0	-2%	6	126%
Slovenia	1.0	0.0	0.2	0.0%	0	265%	-1	-84%
Spain	279	73	156	21.7%	83	114%	-123	-44%
Sweden	0.2	2.5	0.1	0.0%	-2	-94%	0	-18%
United Kingdom	15	23	18	2.5%	-5	-23%	3	23%
EU-28	**1 224**	**613**	**720**	**100%**	**107**	**17%**	**-504**	**-41%**
Iceland	NE,NA	0.0	0.2	0.0%	0	364%	0	∞
United Kingdom (KP)	15	23	18	2.5%	-5	-23%	3	23%
EU-28 + ISL	**1 224**	**613**	**720**	**100%**	**107**	**17%**	**-503**	**-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 the 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 the level of EU MS and Iceland a net carbon sink of about -29.130 kt CO_2 in 2015 (Table 6. 39). Most of the countries reported this carbon pool as a net sink, however six MS estimated that HWP is a net source of emissions for the year 2015.

The largest contributors of the carbon sink are Poland, Sweden, Finland and Germany, while largest emissions are reported by Romania.

In line with the recommendations provided during the EU QA/QC checks, and the information contained in the improvement plans of individual submissions, more MS have provided quantitative estimates for this carbon pool in this year submission. For instance, Iceland and mainly Poland, which have significantly contributed to an increase in the sink reported for this carbon pool as compared with previous year.

The methods and data sources for estimating carbon stock changes from this carbon pool are consistent with methodologies provided by 2006 IPCC GL.

Contrary to information provided in previous submissions, and after the correction of some identified mistakes, with the exception of Romania, individual inventories implemented the IPCC Approach B (i.e. production approach) to provide estimates on HWP consistently with the reporting of the carbon pool under the KP reporting. Nevertheless, and despite efforts implemented during the QA/QC procedures Malta has misallocated the information on HWP provided in the CRF table Table4.Gs1. in the 2017 submission.

As regards with Romania, in order to avoid the potential double-counting that could be introduced at the EU level when different approaches (i.e. A and B) are used across MS for reporting HWP; Romania has informed to be working for the implementation of Approach B for future submissions.

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 all the MS according with information included in individual inventories.

In addition, some MS have stated that carbon stock changes in this carbon pool are insignificant or that the pool as considered under the Approach B does not exist (e.g. Luxembourg, Malta).

By other hand, Cyprus has informed that emissions from HWP are in preparation while, Belgium that currently report only HWP from 200 onwards informed during the QA/QC check that efforts are ongoing to increase the accuracy and consistency of the reporting of this carbon pool.

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. 39 Information on HWP as taken from EU MS and Iceland submissions for the year 2015.

Member State	Net CO2 emissions (+) /removals (-) kt CO2	GHG source and sink categories		Approach A	Approach B	Approach C
Austria	**-1599.20**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Belgium	**301.11**	1. Solid wood	x		X	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Bulgaria	**-544.01**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Croatia	**-126.19**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Cyprus	**NE**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Czech Republic	**-164.15**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Denmark	**-171.46**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Estonia	**-1080.21**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	x			
Finland	**-2333.01**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
France	**-1747.11**	1. Solid wood	NO		x	
		2. Paper and paperboard	NO			
		3. Other (please specify)	x			
Germany	**-2123.51**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Greece	**91.20**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Hungary	**-648.20**	1. Solid wood	x		x	
		2. Paper and paperboard	x			

Member State	Net CO2 emissions (+) /removals (-) kt CO2	GHG source and sink categories		Approach A	Approach B	Approach C
		3. Other (please specify)	NA			
Ireland	-731.46	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Italia	266.96	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Latvia	-1788.02	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Lithuania	-1289.53	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			x
		2. Paper and paperboard	NO			
		3. Other (please specify)	NO			
Netherlands	88.38	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)				
Poland	-5340.55	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Portugal	-424.23	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	-721.44	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			
Slovenia	-129.04	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Spain	-1589.35	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NO			

Member State	Net CO2 emissions (+) /removals (-) kt CO2	GHG source and sink categories		Approach A	Approach B	Approach C
Sweden	**-6716.63**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
United Kingdom	**-1922.04**	1. Solid wood	x		x	
		2. Paper and paperboard	x			
		3. Other (please specify)	NA			
Iceland	**0.22**	1. Solid wood	x		x	
		2. Paper and paperboard	NE			
		3. Other (please specify)	NE			

6.2.7 Emissions from organic soils in the EU GHG inventory

At the level of the EU MS and Iceland, organic soils reported under the three main land use categories cover about 18.282 kha that are mainly located in northern countries.

Total CO_2 emissions from organic soils areas reported under these land use categories in 2015, reach 97.123 kt CO_2 which represents about 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.

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, 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, CO2 emissions and average implied C stock change factors in the EU MS and Iceland reported for the year 2015 for organic soils.

Land use subcategory	Area (Kha)	ICECF (tC/ha)	CO2 emissions (Kt CO2)
4A1	11895	[-2.60; 0.64]	17449
4A2	652		1839
4B1	1506	[-10.00; -1.00]	26877
4B2	255		6025
4C1	3629	[-6.76; 0.25]	42417
4C2	345		3508

6.3 Uncertainties

For the year 2015, LULUCF uncertainty was estimated in 41.0% for the uncertainty of the level and 19.8 % for the uncertainty of the trend. (Table 6. 41)

For more information on the uncertainty analysis please refer to chapter 1.6.

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 2015	Emission trends 1990-2015	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
4.A Forest Land	CO2	-338 004	-392 158	16%	25%	0.1%
4.A Forest Land	CH4	1 995	1 383	-31%	87%	0.1%
4.A Forest Land	N2O	2 744	2 678	-2%	85%	0.1%
4.B Cropland	CO2	71 491	58 731	-18%	57%	0.1%
4.B Cropland	CH4	673	687	2%	87%	0.1%
4.B Cropland	N2O	4 103	3 511	-14%	110%	0.1%
4.C Grasland	CO2	15 036	-1 038	-107%	2385%	0.7%
4.C Grasland	CH4	1 525	825	-46%	158%	0.4%
4.C Grasland	N2O	497	297	-40%	113%	0.5%
4.D Wetlands	CO2	15 727	16 089	2%	35%	0.1%
4.D Wetlands	CH4	82	89	8%	252%	0.1%
4.D Wetlands	N2O	70	68	-3%	194%	0.1%
4.E Settlements	CO2	35 406	43 506	23%	35%	0.1%
4.E Settlements	CH4	79	105	34%	117%	0.3%
4.E Settlements	N2O	1 682	2 887	72%	57%	0.1%
4.F Other Land	CO2	1 583	1 471	-7%	245%	3.2%
4.F Other Land	CH4	0	0		0%	
4.F Other Land	N2O	521	1 096	110%	31%	0.3%
4.G Harvested wood products	CO2	-27 725	-26 037	-6%	34%	0.2%
4.G Harvested wood products	CH4	0	-1 063		102%	
4.G Harvested wood products	N2O	0	16		73%	
4.H Other	CO2	0	79		30%	
4.H Other	CH4	0	221		100%	
4.H Other	N2O	107	145	36%	8%	0.1%
4.I	CO2	0	0		0%	0.0%
4.I	CH4	0	0		0%	0.0%
4.I	N2O	21	13	-39%	203%	0.8%
4.II	CO2	406	435	7%	54%	0.0%
4.II	CH4	1 552	980	-37%	113%	0.5%
4.II	N2O	1 279	1 272	-1%	111%	0.0%
4.III	CO2	0	0		0%	0.0%
4.III	CH4	0	0		0%	0.0%
4.III	N2O	135	150	11%	747%	4.9%
4.IV	CO2	0	0		0%	0.0%
4.IV	CH4	0	0		0%	0.0%
4.IV	N2O	10	10	-4%	135%	0.7%
4.V	CO2	20	93	364%	39%	1.1%
4.V	CH4	14	29	101%	18%	0.3%
4.V	N2O	7	19	190%	35%	0.8%
4 (werhe no subsector data were submitted)	*all*	*725*	*860*	19%	*67%*	*53%*
Total - 4	**all**	**-208 240**	**-282 549**	**36%**	**38.1%**	**18.6%**

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 and Iceland 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[61]. 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

[61] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0525

country area and be consistent with related KP information), as well as trends and outliers in emissions and areas (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 resolve 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 mainly 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 2017 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 total land reported under UNFCCC varies by less than 1% from the official geographical area, so the risks that some significant emissions have not been counted is very small.

6.4.2 Quality Assurance and Quality control

Information submitted under the LULUCF sector by EU MS and Iceland are under double QA/QC systems: one at the country level, and another one, carried out in the context of the EU GHG Monitoring Mechanism Regulation, performed at EU level by the Joint Research Centre of the European Commission in collaboration with MS and Iceland.

At the EU level, the first and main activity is the annual checking of early versions of national GHG inventories that are submitted in January. The checks focus on completeness, accuracy, and transparency and they are intended to identify and resolve calculation errors and time-series consistency issues. QA/QC procedures are implemented by interacting with national experts to get clarifications and to plan possible improvements. During the analysis of the 2017 submissions, around 215 findings (i.e. potential issues) were communicated to the MS and Iceland on, for instance, the 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, outliers in IEFs values for all categories, and lack of transparency for specific national circumstances that affected the EU trend.

Specifically, completeness and consistency checks are applied to time-series of estimates reported under Convention and under KP. The following list represent a summary of some examples of the checks that are implemented, but it does not intend to represent an exhaustive list:

1. Completeness check: the use of the any 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 UNFCCC information
    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;
    d. Consistency among areas reported under the KP and UNFCCC.
3. Checks of the time-series of emissions factors (for each land subcategory and subdivision, and each carbon pool)
    a. Comparison of IEF with IPCC default factors;
    b. Discontinuities in IEFs along the time series;
    c. Comparison of IEF among MS, taking into consideration of eco-regions, soil type and method used for each country, 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 LULUCF 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 and UNFCCC tables
    a. Area reported under activity tables matches NIR-2;
    b. NIR-2 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 category, data reported in CRF table 4.1 is identical to data reported in the background tables. <u>To note</u>: Following a draft recommendation from the 2016 ERT (ARR not available at the time of writing this document), Estonia is not reporting unmanaged wetlands under "other wetlands" in the CRF table 4.D however those areas are included in CRF 4.1. This lead to an inconsistency among the information of these tables that is directly affecting LULUCF sector of the EU GHG inventory.
    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 Iceland, 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[62].
- 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, 26-27 April 2017 Stresa (Italy), Italy
  - JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 02-03 May 2016 Stresa (Italy), Italy.
  - JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 26-27 May 2015 Arona (NO), Italy.
  - JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 05-07 May 2014, Arona (NO), Italy.
  - II JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 04-06 November 2013, Arona (NO), Italy.

[62] http://forest.jrc.ec.europa.eu/effis/

- JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 27 February-1 March 2013, Ispra (VA), Italy.
- "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in Brussels, November 21, 2011.
- "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in Brussels, November 9-10, 2010.
- Technical workshop on projections of GHG emissions and removals in the LULUCF sector, Ispra (VA), Italy. 27-28 January 2010.
- Technical workshop on LULUCF reporting issues under the Kyoto Protocol, Ispra (VA), Italy. November 13-14, 2008.
- "Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol" Ispra (VA), Italy. 27-29 November 2006).
- "Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector". Ispra (VA), Italy. September 22-23, 2005.

For further information on these workshops, and additional activities see: http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/.

6.4.3 Verification

Relatively little information on verification is typically included in national 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[63], Pilli et al. 2016[64],[65]), to estimate carbon stock changes in all forest carbon pools for 26 MS (all countries except Malta and Cyprus). Overall, at EU-level, the results from CBM were very close to the sum of MS' GHG inventories (a difference of only 3% for the average sink 2000-2015 in the category "forest land remaining forest land"). However, for few MS the differences were larger and deserve further investigations. 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 national GHG inventories with CBM results will be carried out in coming years. Another exercise on comparison was implemented by the EU JRC for biomass burning data[66], carrying out a comparison of the data reported by some MS with the data provided by the European Forest Fire Information system.

[63] 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.

[64] Pilli, R., Grassi, G., Kurz, W., Abad Viñas, R., Guerrero Hue, 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 vol. 11 no. 1 p. 5. doi: 10.1186/s13021-016-0047-8

[65] Pilli, R., Grassi, G., Kurz, W., Moris, J., Abad Viñas, R. (2016) Modelling forest carbon stock changes as affected by harvest and natural disturbances. II. EU-level analysis Carbon Balance and Management vol. 11 no. 1 p. 20. doi:10.1186/s13021-016-0059-4

[66] 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.

Besides that, a comprehensive analysis of MS submissions have been also carried out in 2015[67]. In this context, some inconsistencies were found that were communicated to concerned 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.

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. 47provide 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 2014 and main explanations for the largest recalculations in absolute terms.

[67] 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

Table 6. 42 4A Forest Land: Contribution of MS to EU-28+ISL Recalculations in CO2 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO2 equivalents and percent)

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Austria	38	0.3	23	0.5	update of soil EF in SL, correction of small calculation error
Belgium	8	0.3	49	1.2	update of areas in the three regions, recalculation of deadwood and litter CSC
Bulgaria	116	0.8	4 245	40.5	update of C stock in the living biomass for the period 2010 – 2015 due to new data from NFI for the 2015 year, update the methods of estmation the changes in dead wood, litter and soils C pools, update of some coeficents (D and Root to shoot ratioo) according to the new data for 2015 from NFI
Croatia	4	0.1	-3	0.0	changes in LUC matrix
Cyprus	513	83.6	478	73.4	update of salvage logging data
Czech Republic	-20	-0.4	-8	-0.1	updated carbon fraction applicable to biomass burning under wildfires based on species-specific representation in forest was applied
Denmark	-320	-121.1	-236	-6.2	christmas trees on agricultural land have been moved back to forest land
Estonia	6 295	67.9	-920	-72.8	soil emission factors were updated for remaining Forest land
Finland	158	0.7	-8 851	-29.8	new, updated or corrected data. New method
France	1 050	2.6	13 025	18.5	Les gains de biomasse sont modifiés du fait de la prise en campagne des nouvelles campagnes de l'IGN qui réduisent fortement l'accroissement comparée à l'extrapolation précédente. Mise à jour des émissions liées aux incendies dans les DOM Les pertes de biomassse sont modifiés sur toute la série du fait de la modification des stocks de référence pour les défrichements ce qui modifie la valeur de prélèvement en forêt restant forêt. Les modifications sont aussi dues à la prise en compte de la mortalité des nouvelles campagnes IGN. Mise à jour de la méthodologie pour l'estimation des flux de carbone des sols grâce aux résultats du RMQS par zone pédo climatique.
Germany	-3	0.0	-2	0.0	Corrected emission factors for the biomass
Greece	0	0.0	-13	-0.6	reconstruction of the land use, land-use change matrices for the period 1990 – 2015, use of the most updated emission factors for the estimation of CSC in living biomass, recalculations of CO2 and non-CO2 emissions from wildfires
Hungary	-231	-7.2	-770	-17.2	most of the changes are due to adding carbon stock changes of the litter pool in the L-FL sectors that were not reported previously; some minor changes are due to correcting calculation errors
Ireland	0	0.0	0	0.0	
Italy	2 948	14.2	-4 681	-13.8	update of activity data
Latvia	-380	-2.6	188	299.2	recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soils as well as new biomass expansion factors and carbon content in wood were implemented in the calculations
Lithuania	0	0.0	543	5.5	recalculation were done in forest land remaining forest land subcategory since interpolation-extrapolation tool for annual growing stock volume change estimation was applied for National forest inventory data for the period 2001 - 2015. Following the implementation of the tool, not only volume of living trees, but also dead organic matter was recalculated
Luxembourg	-1	-0.2	0	0.0	

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Malta	2	100.0	2	100.0	
Netherlands	-22	-1.1	296	11.0	new data and/or methodological changes
Poland	-67	-0.2	-123	-0.4	updated historical soil distribution data
Portugal	129	2.2	802	6.0	harvesting for 2013 and 2014 was revised
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	-291	-6.9	1 429	19.3	emissions were recalculated due to consideration of relatively high variation in EF for some periods recognized during the 2016 revision.
Spain	-154	-0.7	-4 310	-12.6	methodological review (forest fires emissions), activity data (afforestation/reforestation and forest fires areas) updating and carbon content (DW and LB) updating in FL.
Sweden	-260	-0.7	-785	-1.6	update of area estimates, Update of sub sample data of inventory leads to deviation between submissions
United Kingdom	5 255	33.3	815	4.7	incorporation of new forestry data and new model for soil and litter carbon stock change
EU28	14 469	3.6	856	0.2	
Iceland	3	6.5	6	2.0	the improvement in data as well as development in the methodology applied
EU28+ISL	14 472	3.6	862	0.2	

Table 6. 43 4B Cropland: Contribution of MS to EU-28+ISL Recalculations in CO2 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO2 equivalents and percent)

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Austria	33	28.8	37	15.0	revision of AD, correction of calculation error
Belgium	-41	-13.9	1 298	713.1	update of areas in the three regions, soil organic C stock change were corrected
Bulgaria	8	1.2	292	34.5	revision of activity data
Croatia	-49	-20.6	-4	-61.8	changes in LUC matrix
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	updated methodology
Denmark	-1 141	-20.5	-877	-22.6	recalculation of CSC in soil, inclusion of abandoned organic soils
Estonia	11	12.2	-10	-7.0	updated activity data
Finland	499	9.8	-295	-4.2	new data obtained, error corrected, new CSCs reported, new method
France	-496	-2.3	-3 705	-19.0	modification méthodologique pour la prise en compte de la biomasse des cultures (vergers, vignes) Mise à jour des stocks de référence pour les défrichements. Modification méthodologique avec ajout des flux de carbone des sols sur les cultures restant cultures (Tier 1 du GIEC)
Germany	-33	-0.3	-67	-0.5	Corrected data sources and methods for the calculation of Biomass in this land use category
Greece	100	11.1	2 571	811.9	updated AD
Hungary	-3	-1.6	1	0.3	changes are mainly due to correcting errors in the land use change matrix
Ireland	31	697.5	-7	-461.6	refined assessment of cropland areas using Ireland's Land Parcel Information system dataset
Italy	0	0.0	-1 009	-31.4	update of activity data

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Latvia	5	0.1	133	4.8	recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soils as well as new biomass expansion factors and carbon content in wood were implemented in the calculations
Lithuania	-45	-0.9	-39	-1.0	recalculations were done due to the misinterpretation of organic soil share in total cropland area, which previously led to overestimation of emissions from drainage of organic soils
Luxembourg	-4	-4.8	10	37.7	AD for land use changes between cropland and grassland were revised
Malta	4	464.1	3	266.0	
Netherlands	0	0.0	3	0.1	new data and/or methodological changes
Poland	0	0.0	0	0.0	
Portugal	-267	-6.2	-7	-1.1	correction in C stock levels for biomass and litter from shrubland
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	-232	-157.0	-237	-325.1	the carbon stock value in orchards and vineyards was reconsidered and gains occurred after 2 years onward were also estimated and reported in Land converted to perennial Cropland
Spain	-14	-1.4	-2 259	-8 457.4	activity data (afforestation/reforestation area and CL transitions) updating and carbon content (DW) updating in FL
Sweden	-72	-2.1	-103	-2.5	update of area estimates, Update of sub sample data of inventory leads to deviation between submissions
United Kingdom	-24	-0.2	66	0.6	incorporation of new crop area data
EU28	-2 843	-3.7	-6 007	-8.4	
Iceland	0	0.0	0	0.0	
EU28+ISL	-2 843	-3.6	-6 006	-8.2	

Table 6. 44 4C Grassland: Contribution of MS to EU-28+ISL Recalculations in CO2 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO2 equivalents and percent)

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Austria	303	93.5	310	641.8	revision of AD
Belgium	-389	-850.4	239	38.3	update of areas in the three regions, soil organic C stock change were corrected
Bulgaria	-18	-40.8	142	6.9	revision of AD
Croatia	44	36.3	14	25.5	rounding the number of decimal places
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	112	13.8	-145	-11.4	recalculated due to the new guidelines
Estonia	81	380.7	15	183.1	the grassland organic soil emission factor from Sweden was updated, soil emission factors were updated
Finland	16	1.9	51	8.4	new data, new method, new emissions estimated
France	2 548	15.3	-406	-3.9	Modification méthodologique pour la prise en compte de la biomasse des prairies (bosquets, haies) Mise à jour des stocks de référence pour les défrichements. Mise à jour de la méthodologie pour l'estimation des flux de

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
					carbone des sols grâce aux résultats du RMQS par zone pédo climatique. Modification méthodologique avec ajout des flux de carbone des sols sur les prairies restant prairies (Tier 1 du GIEC)
Germany	6	0.0	2	0.0	Corrected data sources and methods for the calculation of Biomass in this land use category
Greece	0	0.0	228	26.8	updated AD and inclusion of direct N20 emissions
Hungary	0	0.0	-1	-0.5	correction of CSC data in soils in FL converted to GL and the formula
Ireland	0	0.0	-18	-0.3	revision of the areas of grassland associated with biomass burning
Italy	20	0.5	84	1.3	update of activity data
Latvia	-1	-0.1	-137	-33.2	recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sector, updated activity data of organic soils as well as new biomass expansion factors and carbon content in wood were implemented in the calculations
Lithuania	178	9.1	234	8.7	recalculation of grassland category were done due to the misinterpretation of organic soil share in total land converted to grassland area (cropland converted to grassland), which affected not only emissions from drainage of organic soils, but also removals in mineral soils after conversion. In addition to this, emissions from drainage of organic soils in grassland were recalculated due to the error in calculation formula, since not all organic soils in grassland are drained in Lithuania as it was calculated previously
Luxembourg	-17	-35.5	-14	-43.7	AD for land use changes between cropland and grassland were revised
Malta	-5	100.0	-1	100.0	
Netherlands	0	0.0	14	0.3	new data and/or methodological changes
Poland	0	0.0	32	8.0	updated historical soil distribution data
Portugal	-108	-3.2	-11	-6.6	correction in C stock levels for biomass and litter from shrubland
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	253	47.8	-9	-7.3	emissions were recalculated due to inclusion of new data on biomass growth obtained from SORS as well as biomass growth after conversion to perennial grassland, which improved EFs
Spain	232	16 126.5	-174	-12.4	methodological review (transition periods), activity data updating (afforestation/reforestation and fires areas) and carbon content (DW) updating in FL
Sweden	680	211.1	236	6 477.0	update of area estimates, Update of sub sample data of inventory leads to deviation between submissions
United Kingdom	-981	-14.5	151	1.6	revision to various categories of emissions. Changes include inclusion of more detailed deforestation area data, following UNFCCC review recommendation and a new methodology for calculating biomass carbon stock change from hedges as a result of grassland management
EU28	2 911	12.9	802	31.3	
Iceland	3	0.0	8	0.1	revision of areas for natural birch shrubland 1990-2014 of drained organic soils and mineral soils
EU28+ISL	2 914	10.0	813	8.4	

Table 6. 45 4D Wetlands: Contribution of MS to EU-28+ISL Recalculations in CO2 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO2 equivalents and percent)

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	-1	-4.2	3	21.1	update of areas in the three regions
Bulgaria	0	0.0	0	-0.1	not provided in the NIR
Croatia	43	100.6	-7	-57.0	rounding the number of decimal places
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	0.0	3	7.1	recalculation of the organic area has been made according to the GIS analysis of the organic soils, recalculated due to the new guidelines
Estonia	6	0.5	-29	-3.1	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	2	0.1	35	1.7	new data, new method, new CSC reported
France	2 108	122.4	2 539	124.4	Mise à jour de la méthode pour la prise en compte des flux sur les terres impliquant les zones humides, car la méthode précédente basée sur un stock de carbone fixe et très élevé donnait des résultat peu cohérents. Désormais les flux sont le plus souvent supposés inexistants car il n'est pas possible de caractériser les zones humides avec précision.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Hungary	0	0.0	1	0.5	changes are mainly due to correcting errors in the land use change matrix
Ireland	-370	-20.3	-408	-14.9	revision in emissions and areas associated with the extraction of peat for both power generation and horticultural use
Italy	0	0.0	0	0.0	
Latvia	-2	-0.2	-4	-0.4	recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors, updated activity data of organic soils as well as new biomass expansion factors and carbon content in wood were implemented in the calculations
Lithuania	0	0.0	0	0.0	
Luxembourg	1	8.1	0	2.2	AD for land use changes between forestland and wetland were revised
Malta	0	0.0	0	0.0	
Netherlands	0	0.3	2	3.6	new data and/or methodological changes
Poland	-16	-0.3	-167	-3.6	correction of estimates made due to new input data in area of peat extration and in the amount of extrated peat biomass
Portugal	0	0.0	-1	-0.3	correction in C stock levels for biomass and litter from shrubland
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	-1	-51.3	-4	-13.5	updated Efs
Spain	0	0.0	-29	-1 105.2	methodological review (transition periods) and carbon content (DW) updating in FL
Sweden	-154	-68.7	-210	-52.9	update of calculations for Horticultural peat
United Kingdom	0	0.0	-111	-29.2	revisions to peat extraction area estimates following review of satellite imagery
EU28	1 573	9.6	1 620	9.2	
Iceland	5	0.7	5	0.8	the revision in areas of intact mires for the years 1990-2014

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
EU28+ISL	1 578	10.1	1 625	9.5	

Table 6. 46 4E Settlements: Contribution of MS to EU-28+ISL Recalculations in CO2 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO2 equivalents and percent)

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Austria	188	48.2	186	84.8	new EF for soil in SL, revision of AD
Belgium	-22	-9.3	481	88.7	update of areas in the three regions
Bulgaria	-230	-32.9	-285	-30.5	update estimates for living biomass
Croatia	12	5.9	-68	-10.5	changes in LUC matrix
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	
Denmark	0	1.1	4	8.9	recalculation of the changes in the default C stock in agricultural soils
Estonia	-1	-100.0	-90	-27.7	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	-73	-7.7	-261	-21.5	new data, new method.
France	-1 142	-11.1	-514	-4.5	Mise à jour de la méthodologie pour l'estimation des flux de carbone des sols grâce aux résultats du RMQS par zone pédo climatique. Prise en compte des stocks de carbone de la biomasse sur les terres artificielles avec arbres Mise à jour des stocks de carbone de référence pour les zones urbanisées sur la base de recherches bibliographiques
Germany	-1	-0.1	-3	-0.1	Corrected data sources and methods for the calculation of Biomass in this land use category
Greece	0	0.0	0	0.0	inclusion of direct N20 emissions
Hungary	-5	-4.5	2	0.7	changes are mainly due to correcting errors in the land use change matrix
Ireland	-55	-74.3	-32	-52.8	revised estimates of CO2 from organic soils for forest land converted to settlements
Italy	-2	0.0	-2 143	-22.4	update of activity data
Latvia	0	0.2	60	7.0	recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors, updated activity data of organic soils as well as new biomass expansion factors and carbon content in wood were implemented in the calculations
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	-3	-4.8	error correction in the calculation of gains and losses of biomass
Malta	4	100.0	1	100.0	
Netherlands	0	0.0	10	0.6	new data and/or methodological changes
Poland	47	14.2	543	29.6	additional estimates of CSC in categories 4.E.2.2 and 4.2.3
Portugal	0	0.0	-4	-0.2	correction in C stock levels for biomass and litter from shrubland
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	-5	-1.3	-11	-2.9	updated Efs
Spain	-10	-2.5	-6	-0.5	carbon content (DW) updating in FL

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Sweden	-10	-0.3	530	17.5	update of area estimates, Update of sub sample data of inventory leads to deviation between submissions
United Kingdom	-17	-0.2	179	3.0	various revisions to figures for deforestation following UNFCCC review recommendation to include more detailed forest area data
EU28	-1 333	-3.6	-1 389	-2.8	
Iceland	0	0.0	0	0.0	
EU28+ISL	-1 333	-3.6	-1 381	-2.8	

Table 6. 47 4F Other land: Contribution of MS to EU-28+ISL Recalculations in CO2 for 1990 and 2014 (difference between latest submission and previous submissions in kt CO2 equivalents and percent)

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Bulgaria	0	0.0	-266	-82.0	improvements in land area representation – new transition between categories has been considered, correction of technical errors related to area representation, update of the some coeficients, implementation of the new methodology of estimation (tier 2 method) in FL
Croatia	0	0.0	0	0.0	
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	1	3.5	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	
France	0	0.0	0	0.0	
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	-0.1	no recalculation
Malta	1	100.0	1	100.0	NIR not provided
Netherlands	0	0.4	1	0.6	new data and/or methodological changes
Poland	0	0.0	0	0.0	
Portugal	60	6.9	-53	-5.6	correction in C stock levels for biomass and litter from shrubland
Romania	0	0.0	0	0.0	NA
Slovakia	0	0.0	0	0.0	
Slovenia	-1	-6.1	-2	-8.9	updated Efs
Spain	2	7.3	-1	-0.8	methodological review (transition periods)
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	0	-100.0	no recalculations

	1990		2014		Main explanations
	kt CO2 equiv.	Percent	kt CO2 equiv.	Percent	
EU28	62	2.5	-156	-63.4	
Iceland	0	0.0	0	0.0	
EU28+ISL	62	2.5	-156	-63.4	

7 WASTE (CRF SECTOR 5)

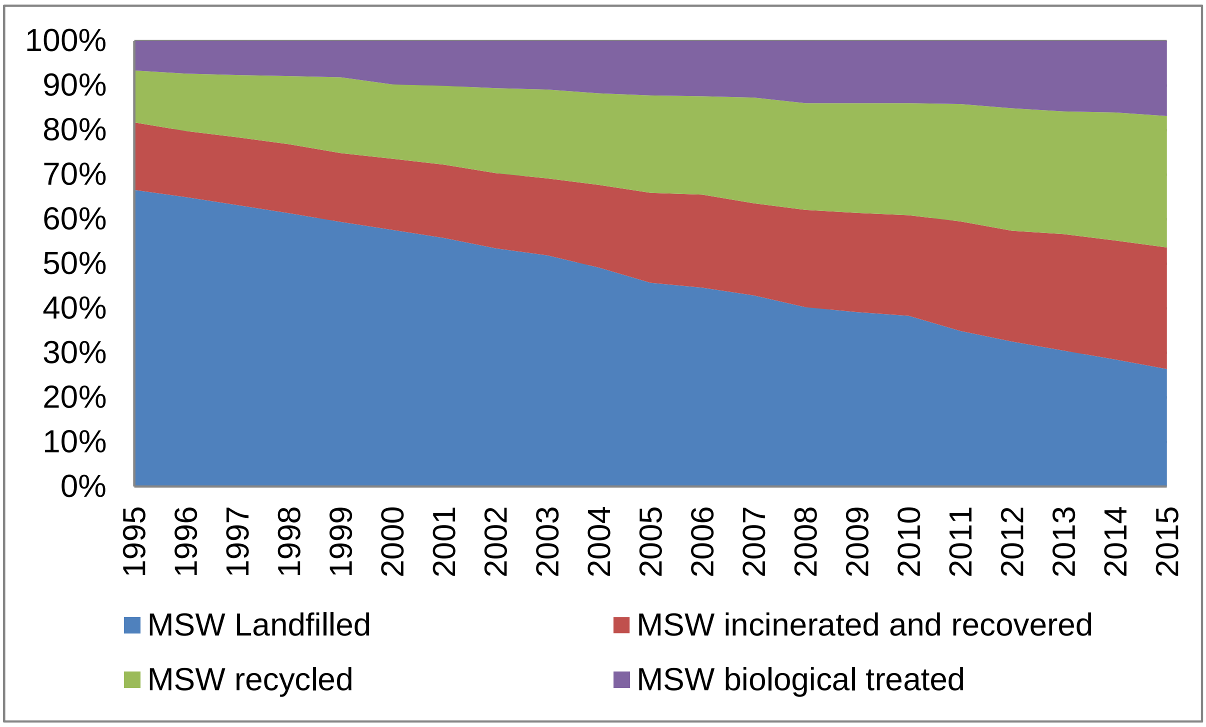
GHG emissions in the waste sector are generated from the treatment and disposal of liquid and solid waste. According to the IPCC 2006 Guidelines emission estimates in the waste sector need to be carried out for four subcategories:

- 5.A Solid waste disposal
- 5.B Biological treatment of solid waste
- 5.C Incineration and open burning of waste
- 5.D Wastewater treatment and discharge.

Of the above, the first three categories mainly refer to possible routes for treatment and disposal of solid. 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 7.1 shows the share of the waste treatments over the time series 1995 to 2015 based on activity data for municipal waste. 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 municipal 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 treatment reported to Eurostat is broken down to five treatment types (recovery, incineration with energy recovery, other incineration, disposal on land and biological treatment) and in waste categories. Eurostat data shown in the figures below include only information for municipal waste treatment, while in the GHG inventory also industrial waste, sludge and hazardous waste are reported by some Member States under the categories solid waste disposal, biological treatment and waste incineration. However the Eurostat data is used to show the overall trend of waste treatment in the European Union.

Between 1995 and 2015 the amount of municipal waste landfilled is continuously decreasing in the EU Member States and Iceland and other waste treatment methods like recycling or biological treatment of waste are applied more. 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 2015 the share of waste landfilled decreased to 26 % of total waste treated while incineration including energy recovery increased to 27 %, recycling increased to 29 % and biological treatment of waste makes up 17 % of total MSW solid waste treated in 2015.

Figure 7.1   Sector 5 Waste: Development of municipal waste treatment in the EU-28+ISL

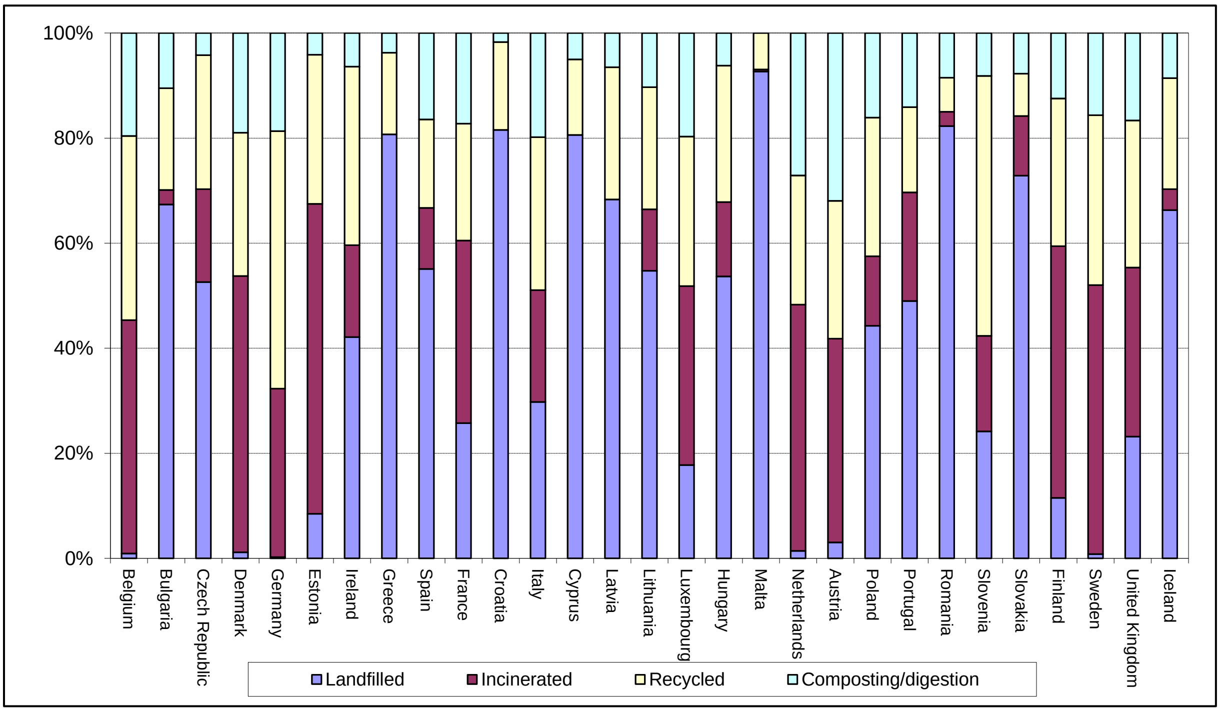


Note: Missing 2013, 2014 and 2015 data for Ireland and Greece has been gap filled by using 2012 value, Portugal and Iceland has been gap filled by using 2014 value
Source: EUROSTAT 2017, own calculation

Many Member States experienced a reduction of waste landfilled and an increase of recycling, composting and landfill gas recovery. These trends have already started before the Landfill Directive 1999/31/EC and the Directive on packaging waste 94/62/EC and 2008/98/EC, but are further supported by these directives.

The share of the single municipal waste treatment routes differs significantly among Member States in 2015 (compare Figure 7.2). The waste management practices and policies which determine the fraction of municipal solid waste (MSW) disposed to solid waste disposal sites (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 municipal waste on SWDS is the predominant (>70%) municipal waste disposal route in Greece, Croatia, Cyprus, Malta Romania and Slovakia with correspondingly fewer quantities of waste incinerated, recycled or biological treated. In Belgium, Denmark, Germany, Estonia, the Netherlands, Austria and Sweden, 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 7.2 : Waste management practices in the EU-28+ISL (shares) in 2015



Note: In comparison to Inventory data Eurostat data only contains municipal solid waste and does not contain industrial waste and sludge
Source: EUROSTAT 2017, own calculations,

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 3.2 % to total GHG emissions without LULUCF in 2015. Total emissions from waste decreased by 42 % from 240 Mt in 1990 to 138 Mt in 2015 (Figure 7.3). In 2015, emissions decreased by 3.5 % compared to 2014.

Figure 7.3 Sector 5 Waste: EU-28+ISL GHG emissions, 1990-2015

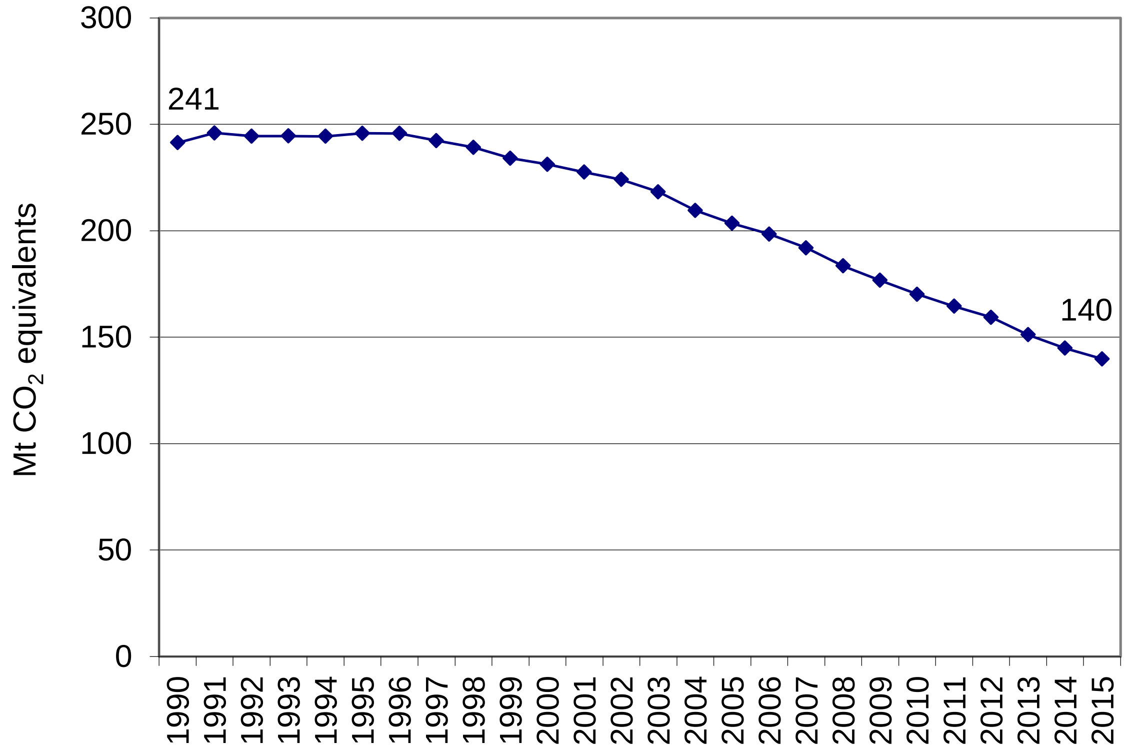
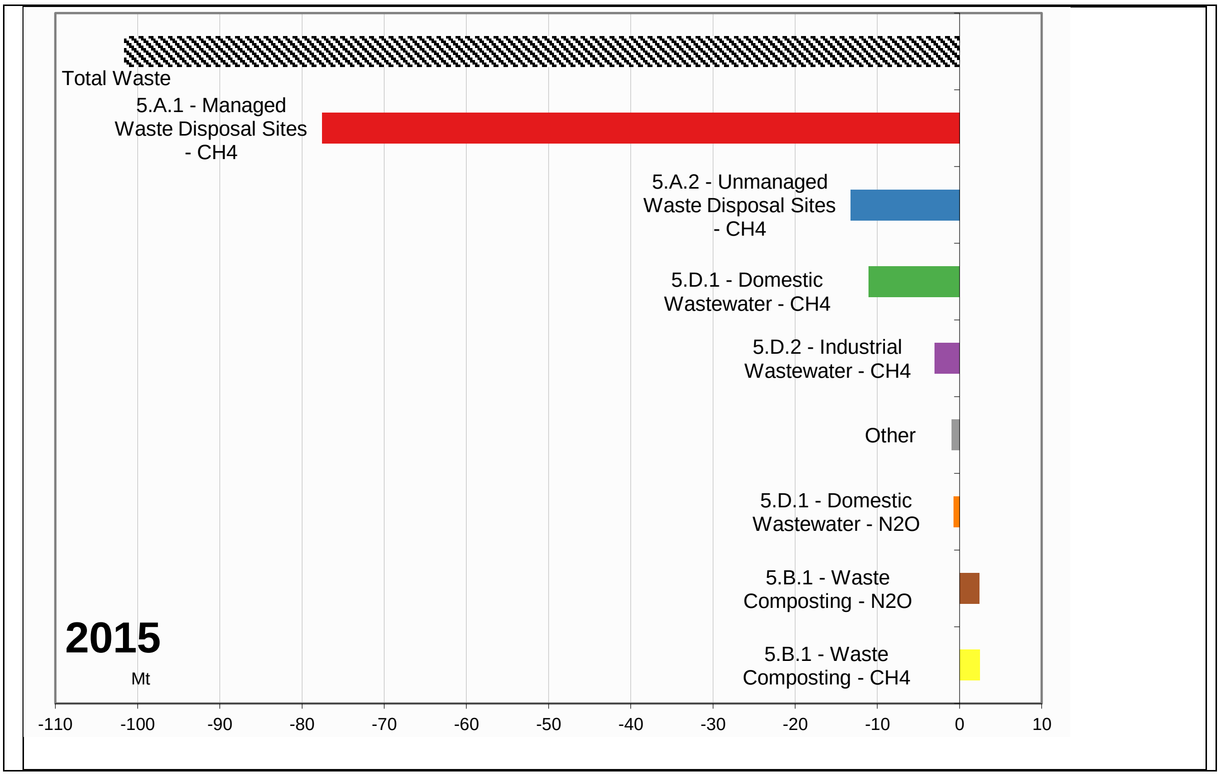
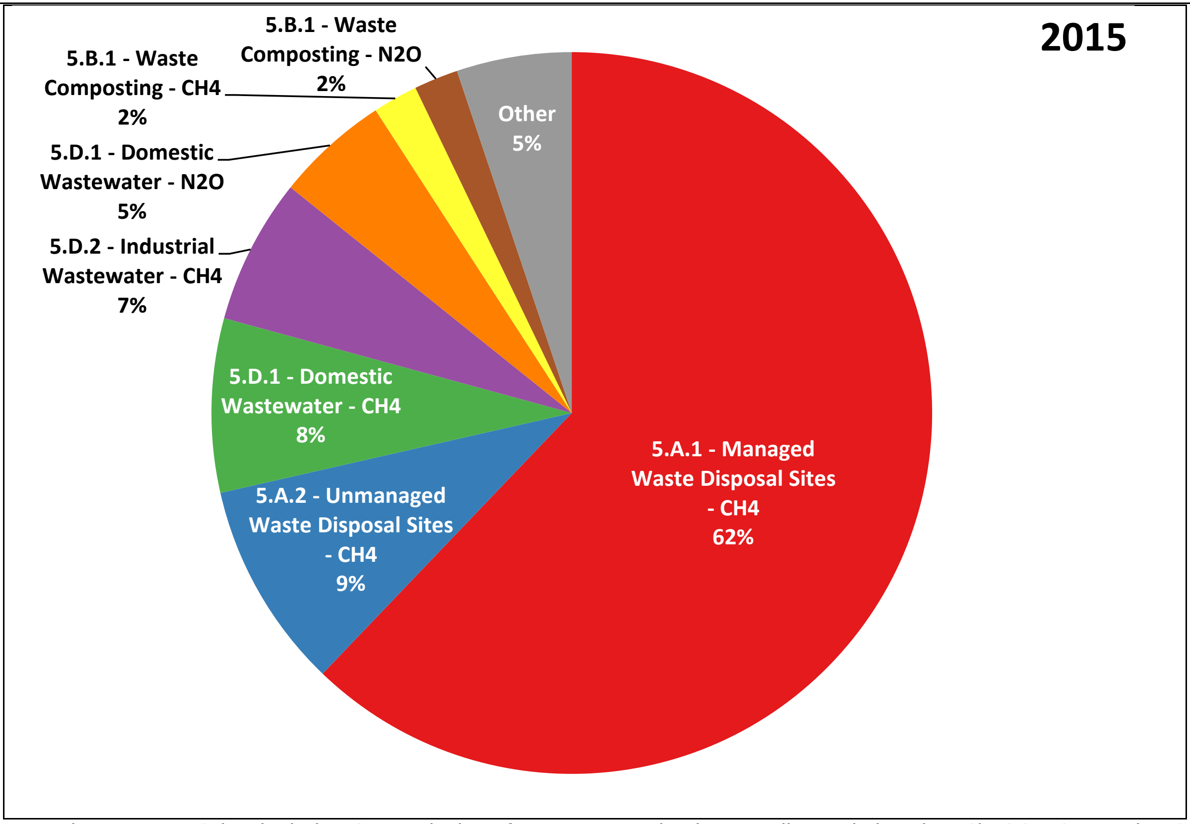


Figure 7.4 shows that CH_4 emissions from 5A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 62 % of waste-related GHG emissions in the EU-28+ISL in 2015.

Figure 7.4 Sector 5 Waste: Absolute change of GHG emissions (in CO_2 equivalents) by large key source categories, 1990–2015, and share of largest key source categories in 2015





Note: The category Other includes CH_4 emissions from uncategorized waste disposal sites (5.A.3), CO_2, CH_4 and N_2O emissions from waste incineration and open burning of waste (5.C), N_2O emissions from industrial wastewater treatment and emissions reported under 5.E. other, also CH_4 and N_2O from 5B2 Anaerobic digestion at biogas facilities and CH_4 and N_2O for 5D3 other wastewater treatment and discharge, all other categories in the waste sector are contributing to a EU key source

Source: MS submission 2017

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. Source categories considered in detail are:

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2015		1990	2015
5 A 1 Managed Waste Disposal Sites: Waste (CH_4)	164444	86875	T	L	L
5 A 2 Unmanaged Waste Disposal Sites: Waste (CH_4)	26251	12990	T	L	L
5 B 1 Waste Composting: Waste (CH_4)	361	2820	T	0	0
5 B 1 Waste Composting: Waste (N_2O)	329	2771	T	0	0
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (CH_4)	21907	10884	T	L	L
5 D 1 Wastewater Treatment and Discharge: Domestic Wastewater (N_2O)	7825	7115	0	0	L
5 D 2 Wastewater Treatment and Discharge: Industrial Wastewater (CH_4)	12108	9107	0	L	L

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.

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 2.0 % and 0.3 % to total GHG emissions in 2015, 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 Estonia (1990-1993) and Poland (1990-2015) report emissions from this category. As this is no EU key category no further information on 5A3 is included in the following chapters.

The EU-28+ISL report CH_4 emissions from managed solid waste landfills in source category 5A1 or 5A2. The methane recovery that takes place in those managed or unmanaged 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, mainly no CH_4-recovery is taken place. Only Ireland (1996-1998) and Latvia (2002-2015) report CH_4 recovery from unmanaged landfills for a few years in the time series.

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 48 % between 1990 and 2015 in the EU-28+ISL. Sixteen EU-28 Member States reduced their emissions from this source, while Croatia, Cyprus, the Czech Republic, France, Greece, Hungary, Latvia, Malta, Portugal, Romania, Slovakia, Spain and Iceland did not. In these Member States waste disposal changed from unmanaged to managed landfills during the time period 1990 and 2015 which leads to increasing CH_4 emissions from managed landfills.

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 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	3 644	1 294	3 644	1 294
Belgium	3 053	934	3 053	934
Bulgaria	4 945	3 135	4 945	3 135
Croatia	349	1 254	349	1 254
Cyprus	258	458	258	458
Czech Republic	1 979	3 385	1 979	3 385
Denmark	1 536	655	1 536	655
Estonia	214	187	214	187
Finland	4 328	1 766	4 328	1 766
France	12 144	12 553	12 144	12 553
Germany	34 250	8 950	34 250	8 950
Greece	2 243	3 157	2 243	3 157
Hungary	2 675	3 059	2 675	3 059
Ireland	1 318	741	1 318	741
Italy	18 158	14 113	18 158	14 113
Latvia	283	387	283	387
Lithuania	1 029	802	1 029	802
Luxembourg	96	53	96	53
Malta	41	136	41	136
Netherlands	13 679	2 945	13 679	2 945
Poland	11 164	9 112	11 164	9 112
Portugal	2 728	3 709	2 728	3 709
Romania	1 372	3 520	1 372	3 520
Slovakia	611	961	611	961
Slovenia	433	340	433	340
Spain	5 474	9 837	5 474	9 837
Sweden	3 422	991	3 422	991
United Kingdom	60 203	12 111	60 203	12 111
EU-28	**191 630**	**100 547**	**191 630**	**100 547**
Iceland	142	182	142	182
United Kingdom (KP)	60 434	12 299	60 434	12 299
EU-28 + ISL	**192 003**	**100 918**	**192 003**	**100 918**

Note: The first two column show total emissions from 5A reported in kt CO_2 eq.. The last two columns show CH_4 emissions in kt CO_2 eq.. As only CH_4 emissions are reported under 5.A the figures in the columns are identical 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

2.0 % of total EU-28+ISL GHG emissions. Between 1990 and 2015, CH_4 emissions from managed landfills declined by 48 % in the EU-28+ISL.

Twelve EU-28 Member States reduced their emissions from this source during that period, Croatia, the Czech Republic, France, Greece, Hungary, Italy, Portugal, Spain and Iceland did not. Bulgaria, Cyprus, Estonia, Ireland, Latvia, Malta, Romania and Slovakia did not report CH_4 emissions from managed landfills in 1990. In 2015, CH_4 emissions from managed landfills decreased by 5.4 % compared to 2014.

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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	3 644	1 382	1 294	1.5%	-88	-6%	-2 350	-64%	T2	CS,D
Belgium	3 053	1 064	934	1.1%	-130	-12%	-2 119	-69%	T2	D
Bulgaria	NO	950	1 002	1.2%	53	6%	1 002	∞	T2	CS,D
Croatia	17	921	1 056	1.2%	135	15%	1 039	6019%	T2	CS
Cyprus	NO	53	61	0.1%	8	15%	61	∞	T2	D
Czech Republic	1 979	3 331	3 385	3.9%	54	2%	1 406	71%	T1	CS,D
Denmark	1 536	691	655	0.8%	-36	-5%	-881	-57%	CS,T2	CS,D
Estonia	NO	201	187	0.2%	-14	-7%	187	∞	T2	D
Finland	4 328	1 825	1 766	2.0%	-59	-3%	-2 561	-59%	T2	CS,D
France	12 144	13 391	12 553	14.4%	-837	-6%	409	3%	T2	CS,D
Germany	34 250	9 550	8 950	10.3%	-600	-6%	-25 300	-74%	T2	CS
Greece	80	1 476	1 524	1.8%	48	3%	1 444	1805%	T2	CS,D
Hungary	2 675	3 141	3 059	3.5%	-82	-3%	384	14%	T2	D
Ireland	NO	648	741	0.9%	93	14%	741	∞	T2	CS,D
Italy	11 974	13 449	12 637	14.5%	-812	-6%	663	6%	T2	CS
Latvia	NO	267	269	0.3%	2	1%	269	∞	T2	D
Lithuania	879	773	724	0.8%	-49	-6%	-155	-18%	T2	D
Luxembourg	96	56	53	0.1%	-3	-5%	-43	-44%	T1	D
Malta	NO	107	123	0.1%	17	15%	123	∞	T2	PS
Netherlands	13 679	3 146	2 945	3.4%	-201	-6%	-10 734	-78%	T2	CS
Poland	4 760	5 267	5 303	6.1%	36	1%	543	11%	T2	CS,D
Portugal	722	2 797	2 838	3.3%	41	1%	2 116	293%	T2	CS,D
Romania	NO	1 285	1 374	1.6%	89	7%	1 374	∞	T2	CS,D
Slovakia	NO	554	579	0.7%	25	5%	579	∞	T2	CS,D
Slovenia	433	330	340	0.4%	10	3%	-93	-21%	T2	CS,D
Spain	4 324	9 149	9 075	10.4%	-74	-1%	4 752	110%	T2	CS,D
Sweden	3 422	1 080	991	1.1%	-89	-8%	-2 431	-71%	T2	CS,D
United Kingdom	60 203	13 653	12 111	13.9%	-1 543	-11%	-48 093	-80%	T2	CS
EU-28	**164 198**	**90 538**	**86 531**	**100%**	**-4 007**	**-4%**	**-77 667**	**-47%**	**-**	**-**
Iceland	16	157	155	0.2%	-2	-1%	140	900%	T2	CS,D
United Kingdom (KP)	60 434	13 849	12 299	14.2%	-1 550	-11%	-48 135	-80%	T2	CS
EU-28 + ISL	**164 444**	**90 890**	**86 875**	**100%**	**-4 015**	**-4%**	**-77 569**	**-47%**	**-**	**-**

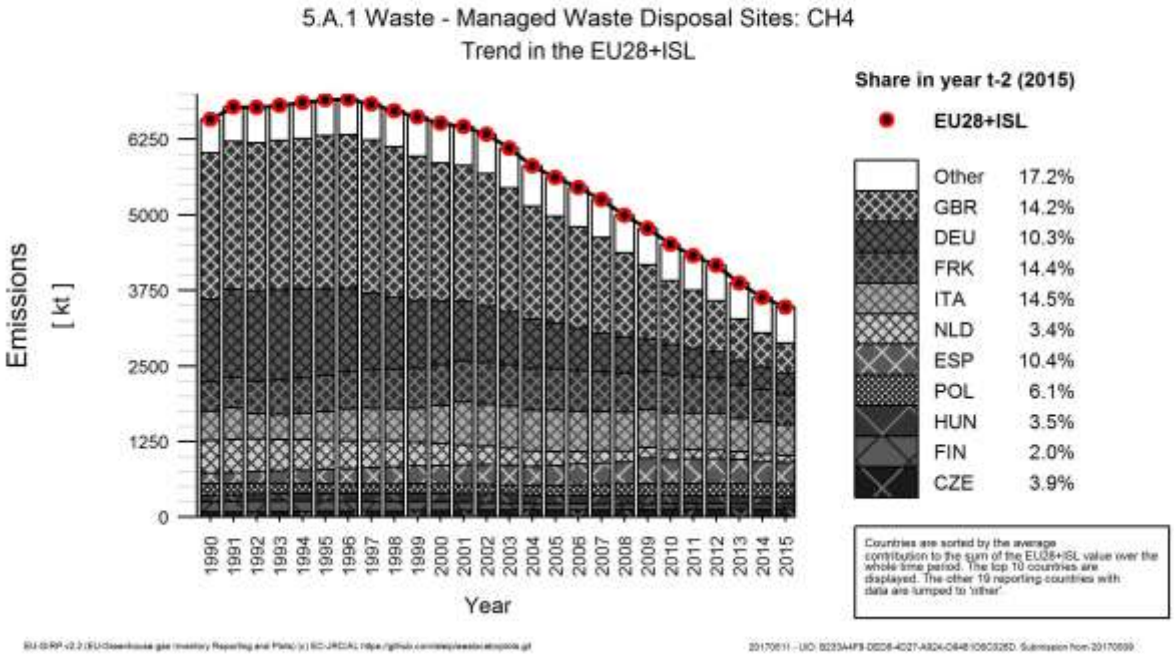
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trends in Emissions and Activity Data

CH_4 emissions from solid waste disposal on managed land decreased considerably between 1990 and 2015 by 48 %. *Figure 7.5* shows the trend of emissions indicating the countries contributing most to EU-28 total.

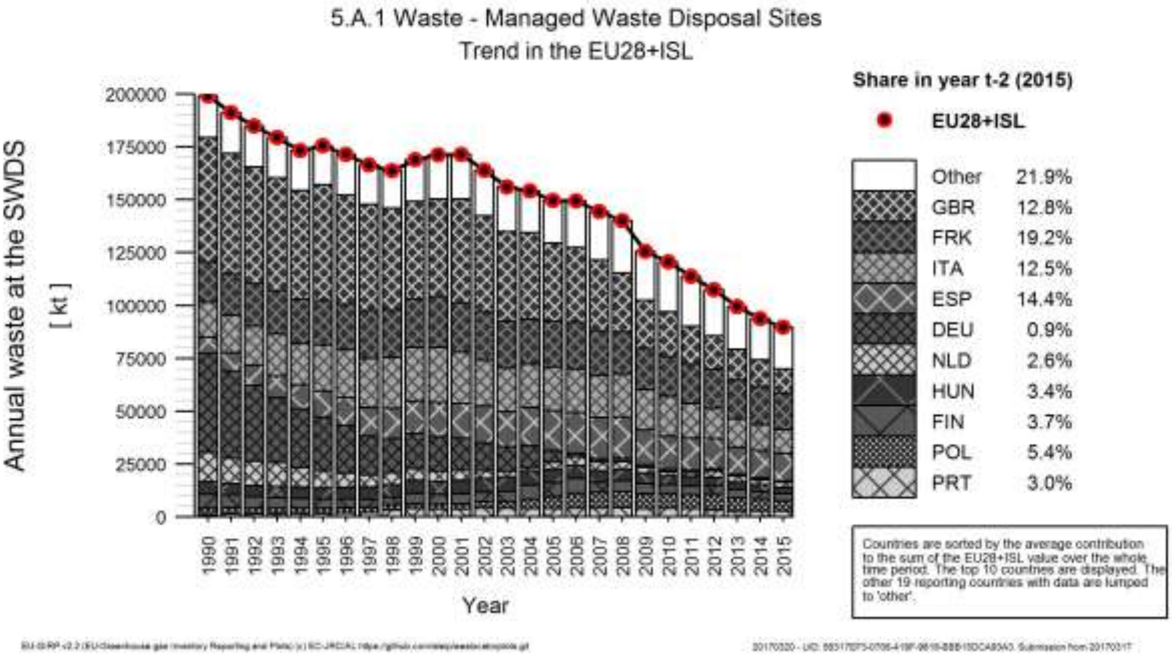
The Member States with highest emissions from this source in 2015 were France, the United Kingdom, Spain, Italy and Germany. These MS account for 65 % of EU-28+ISL CH_4 emissions from 5A1 in 2015. The largest reductions in absolute terms between 1990 and 2015 were reported by the United Kingdom and Germany. 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 7.5 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 2017 the yearly total municipal waste disposal on managed landfills declined by 55 % between 1990 and 2015 (see *Figure 7.6*). 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+ISL since 1990 (see Figure 7.7).

Figure 7.6 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 (Greece, 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 10.5 % to EU-28 emissions in 2015, 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. Due to fluctuations in the amount of CH_4 recovery, CH_4 emissions show a fluctuating trend from 2009 onwards. CH_4 recovery and flaring of CH_4 has already been practiced in earlier years of the time series 1990-2015. The highest amounts of CH_4 recovery are found in 2014 and 2015 leading to a decline of CH_4 emissions again. In 2015 CH_4 emissions from solid waste disposal decreased by 1 % compared to 2014.

Portugal, contributing with 3.3 % to EU-28 emissions in 2015, 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. Between 2014 and 2015 CH_4 emissions from 5.A.1 increased by 1 % again, which was caused by a decline in CH_4 recovery in 2015.

France, contributing with 14.6 % to EU-28 emissions in 2015, increased its emissions from managed solid waste disposal sites steadily until 2003; followed by a declining trend 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 the highest amount of CH_4 recovery can be found in 2015, which leads to a decrease in CH_4 emissions by 6 % between 2014 and 2015.

The **United Kingdom** has also a high share of CH_4 emissions from managed landfills among Member States with 14.3 % in 2015. 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 14.7 % to EU-28+ISL emissions in 2015, 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.

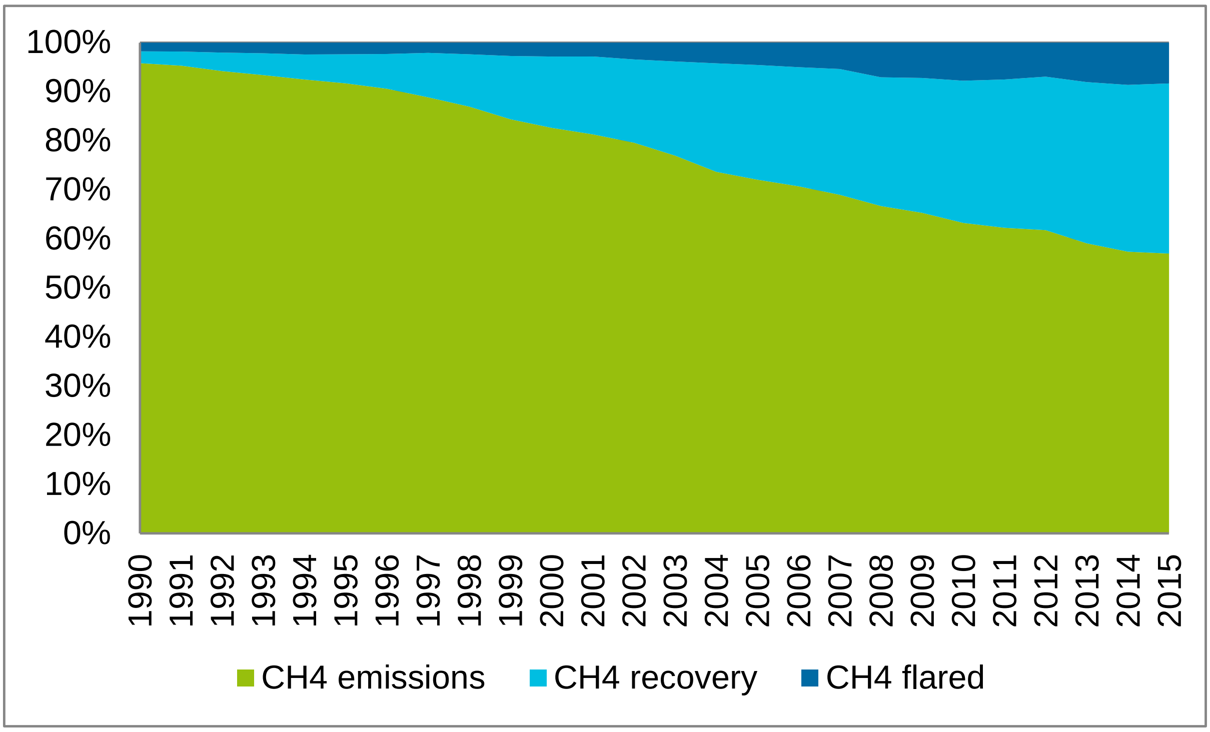
Germany, contributing with 10.4 % to EU-28 emissions in 2015, managed to reduce CH_4 emissions steadily until now from 1993 onwards. The amount of waste disposed on landfills shows a strong decrease from 1990 onwards, while in parallel CH_4 recovery increased. The highest share of CH_4 recovery could be found in 2002 and declined thereafter due to a decreasing amount of waste landfilled.

Methane recovery and flaring

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 and flaring of CH_4.

CH_4 recovery and flaring of CH_4 in EU-28+ISL increased from 4 % of total CH_4 generated in managed landfills in 1990 to 43 % of generated CH_4 from managed SWDS (only 5A1) in 2015. Methane recovery is further promoted by the Landfill Directive, and monitoring programs are 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 2014, CH_4 recovery and CH_4 flaring decreased by 3 % in 2015. This is caused by reduced amounts of waste landfilled and the ban of organic material in the landfilled waste.

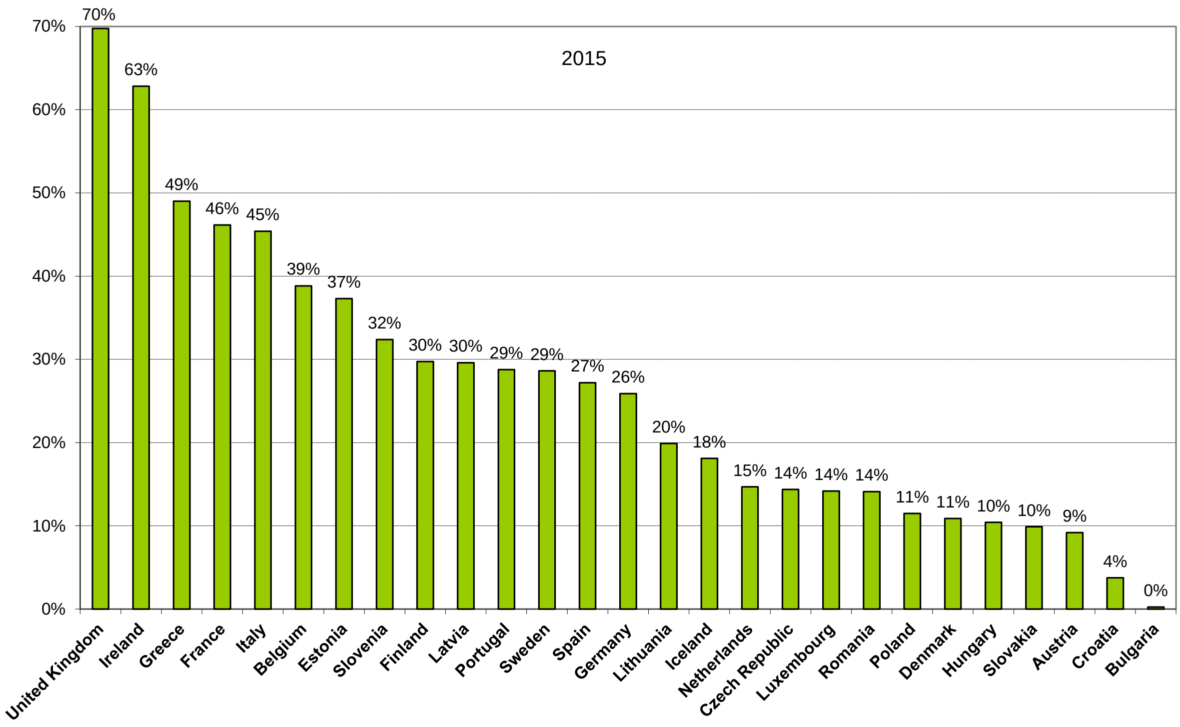
Figure 7.7 5A1 Managed Solid Waste Disposal: Development of the share of methane recovery, methane flared and CH_4 emissions on total CH_4 produced in managed landfills in the EU 28+ISL



Source: CRF 2017, Table 5A

The recovered CH_4 is the amount of CH_4 that is captured for energy use and is a country-specific value which has significant influence on the emission level. Additionally the amount of CH_4 flared is considered. The percentage of CH_4 recovered and flared, in Figure 7.8, varies among the Member States between 0.2 % in Bulgaria and 70 % in the United Kingdom and depends - amongst other - on the share of solid waste disposal sites where recovery installations exist. Cyprus and Malta do not report any data under 5.A CH_4 recovery and flaring in 2015. For 2011 - 2014 Malta reported a small amount of CH_4 flared.

Figure 7.8 5A1 Managed Solid Waste Disposal: Methane recovery rates for 2015



CH_4 recovery and flarding in % = CH_4 recovery in Gg + CH_4 flared 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 2017 Table 5A

Compared to 2014 the methane recovery and flaring in 2015 increased for eleven Member States.. In fifteen Member States the amount of CH_4 recovered and flared decreased in comparison to 2015.

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 emission trends over time. According to Table 7.2 the Czech Republic and Luxembourg apply a Tier 1 method to estimate CH_4 emissions from solid waste disposal on managed landfills. Giving the IPCC 2006 Guidelines for National Greenhouse Gas Inventories, 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 are 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. A few examples: 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 became a more important waste treatment mehthod 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 0.3 % of total EU-28+ISL GHG emissions in 2015. Between 1990 and 2015, CH_4 emissions from this source decreased by 50 % (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 Cyprus and Romania showed an increase of CH_4 emissions from unmanaged landfills. In Cyprus CH_4 emissions from unmanaged landfills still slightly increased between 2014 and 2015 due to an increasing amount of solid waste disposal on unmanaged landfills until 2009. Between 2009 and 2015 the amount of solid waste disposed on unmanaged landfills decreased by 44 %. In Romania CH_4 emissions from unmanaged waste disposal sites increased until 2010, but showed a decreasing trend from 2010 onwards. Between 2010 and 2015 the CH_4 emissions decreased by 15 %.

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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Bulgaria	4 945	2 298	2 133	16.4%	-166	-7%	-2 812	-57%	T2	CS,D
Croatia	331	258	198	1.5%	-60	-23%	-133	-40%	T2	CS
Cyprus	258	397	398	3.1%	0	0%	139	54%	T2	D
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	1 686	1 633	12.6%	-53	-3%	-530	-25%	T2	CS,D
Hungary	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	1 318	IE	IE	-	-	-	-1 318	-100%	NA	NA
Italy	6 184	1 552	1 476	11.4%	-76	-5%	-4 708	-76%	T2	CS
Latvia	283	147	119	0.9%	-29	-19%	-164	-58%	T2	CS,D
Lithuania	150	87	78	0.6%	-8	-10%	-71	-48%	T2	D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	41	23	13	0.1%	-10	-43%	-28	-69%	M	M
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	5 311	2 978	2 756	21.2%	-223	-7%	-2 556	-48%	T2	CS,D
Portugal	2 007	934	871	6.7%	-63	-7%	-1 136	-57%	-	-
Romania	1 372	2 230	2 146	16.5%	-84	-4%	774	56%	T2	CS,D
Slovakia	611	398	382	2.9%	-16	-4%	-230	-38%	T2	CS,D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	1 150	804	762	5.9%	-42	-5%	-388	-34%	T2	CS,D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**26 125**	**13 793**	**12 963**	**100%**	**-830**	**-6%**	**-13 162**	**-50%**	**-**	**-**
Iceland	127	29	27	0.2%	-1	-5%	-99	-78%	T2	CS,D
United Kingdom (KP)	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28 + ISL	**26 251**	**13 822**	**12 990**	**100%**	**-832**	**-6%**	**-13 261**	**-51%**	**-**	**-**

Note: The notation key included in column "method applied" for Ireland, Portugal and Malta is not correct. According to the MS NIR Ireland, Portugal and Malta apply a Tier 2 method to calculate CH_4 emissions from waste disposal on unmanaged landfills. For Malta this information is based on the 2016 submission, as there is no NIR from the 2017 submission available yet.
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 2015 by 50 %. *Figure 7.9* 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 7.10*) 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 (Hungary, Ireland). Bulgaria, Greece, Italy, Poland and Romania are responsible for about 78 % of the total EU-28+ISL emissions from unmanaged waste disposal sites. Italy and Poland show large absolute reductions between 1990 and 2015. In these two countries, waste is not disposed on unmanaged landfill sites any more (in Italy since 2000, in Poland since 2012).

Figure 7.9 5A2 Waste disposal on unmanaged landfills: CH_4 emissions (Trend in relevant MS)

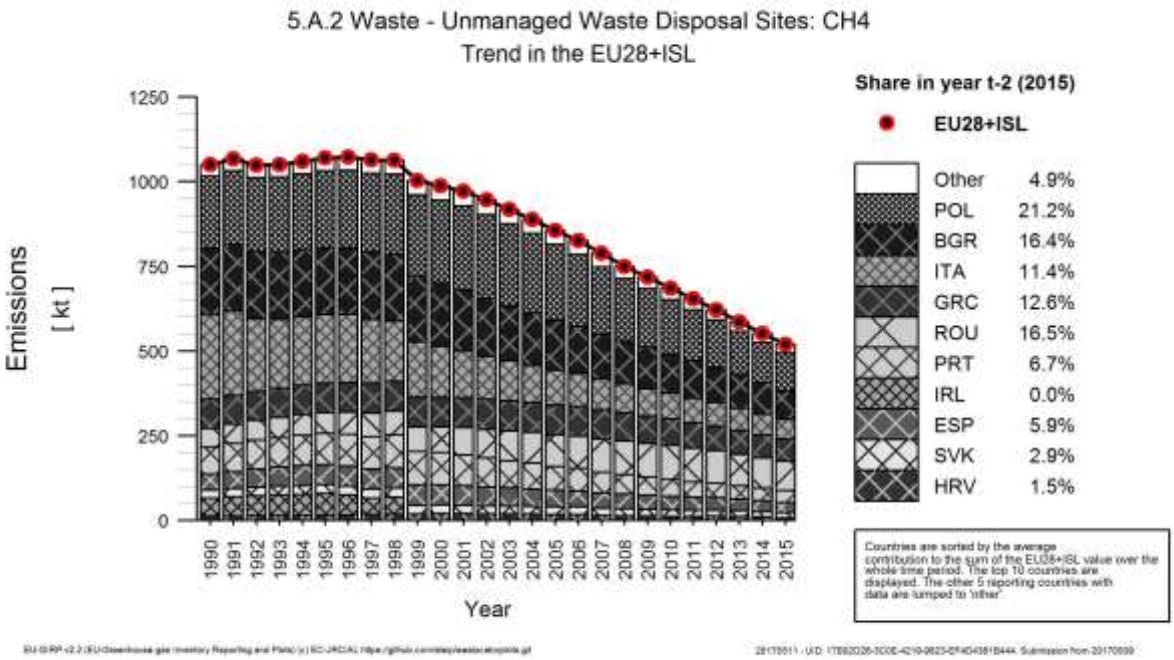
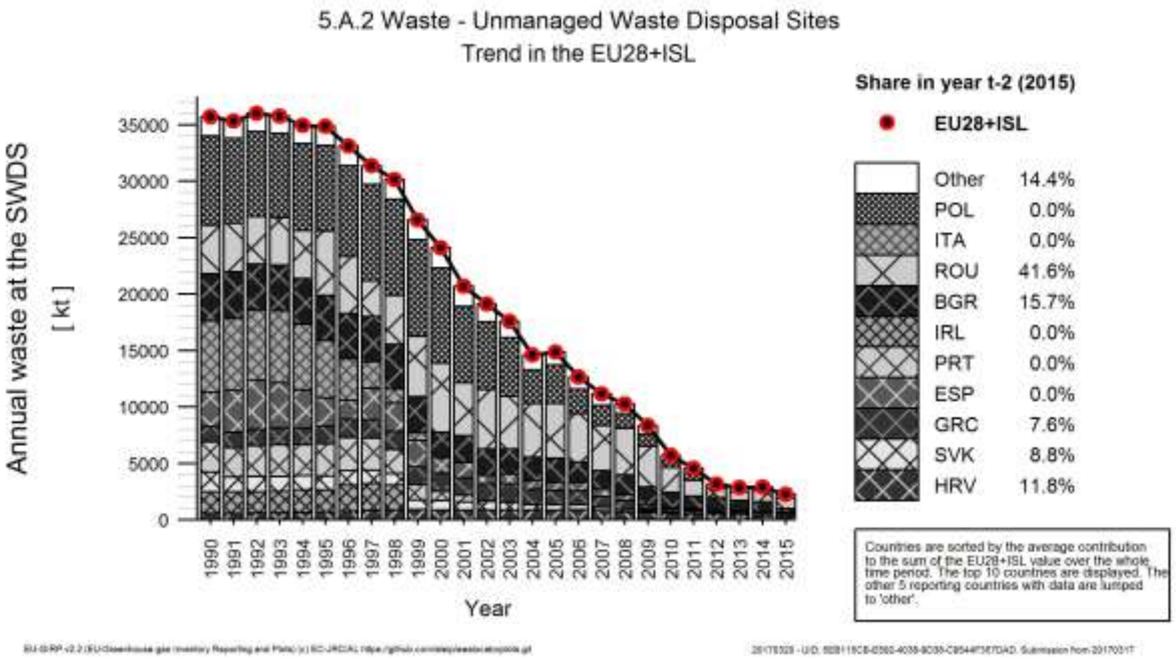


Figure 7.10 shows the relevant trends for the amount of waste disposed on unmanaged landfills, where the highest reductions in waste disposal between 1990 and 2015 are found for Italy and Poland. In Bulgaria, Croatia, Cyprus, Greece, Iceland, Lithuania, Romania and Slovakia solid waste disposal on unmanaged landfills is still practiced, but the amount of waste disposed is considerably decreasing since 1995. While in the year 1995 almost 35.7 Mt have been disposed on unmanaged landfills only 2.3 Mt were disposed in 2015. However, emissions are still produced from the waste disposed in the past.

Figure 7.10 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 2015 (Bulgaria, Croatia, Cyprus, Greece, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Spain). Only seven of these Member States (Bulgaria, Croatia, Cyprus, 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 unmanaged landfills is 0.8, while shallow unmanaged 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 unmanaged 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 2015

Member State	MCF
Bulgaria	0.8
Croatia	0.8
Czech Republic	0.6
Cyprus	0.4
France	0.4
Greece	0.8
Iceland	0.2
Italy	0.6
Latvia	0.7
Lithuania	0.4
Poland	0.8
Portugal	0.6
Romania	0.7
Slovakia	0.4
Spain	0.6

Source: CRF Table 5.A 2017

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 2014 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 2014 for the sector 5.A in absolute terms are Spain, Ireland, Italy, Poland and France.

Table 7.5: 5A Solid Waste Disposal on Land: Contribution of member states to EU recalculations in CH_4 emissions for 1990 and 2014 (difference between latest submission and previous submission)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	-236	-6.1	-22	-1.6	Implementation of technical correction of the ESD 2016 review (historical DOC Residual Waste)
Belgium	0	0.0	0	0.0	
Bulgaria	1 381	38.8	146	4.7	Recalculations were performed due to recommendations after ERT in country review in November 2016. They include: • concerning waste components in country specific morphology - separation of paper/paperboard from textile; including of rubber and leather and sludge in morphology; using a default DOC values for each waste component to

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					derive DOC for bulk waste for managed disposal sites for the period 2002-2015. • for unmanaged disposal sites for the period 1950-2001 for DOC calculations country used a default morphology and default DOC values for each waste component to derive DOC of bulk waste • For estimation of CH_4 emissions from Solid waste disposal for methane generation rate (k), country used a default k value = 0.09 for bulk waste for managed and unmanaged disposal sites. • For calculation of CH_4 emissions from 5.A.2 Unmanaged solid waste disposal sites, country used oxidation factor value OX=0.
Croatia	0	0.0	-11	-0.9	Data on amount of CH_4 flared was recalculated
Cyprus	7	2.9	1	0.1	The emissions from this source have been recalculated due to the following changes: a) change in the solid waste production data for the years 2010 - 2014, 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	0	0.0	Updated activity data available.
Denmark	-238	-13.4	-134	-16.3	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 2010-2015. Furthermore, during the in-country review, the country specific DOCi value for sludge was changed from 0.57 to 0.15 (IPCC, 2006) and the me-thane content of the LFG was changes from 0.41 to the default IPCC value of 0.5 (IPCC, 2006)
Estonia	0	-0.1	-17	-8.0	Updated activity data.
Finland	0	0.0	2	0.1	Corrected and more accurate activity data
France	-591	-4.6	-913	-6.4	In the previous submission, due to an error (double counting of construction waste stored in ISDND accompanied by the attribution of a DOC relating to municipal waste), the total quantities taken into account were overestimated.
Germany	725	2.2	350	3.8	Update of dispose waste quantity for the year 2014. In the earlier versions of the NIR, a national value was used for the share of CH_4 in landfill gas (F) of 49% based on official statistical data. In the review process of the NIR this approach was criticized and the use of the IPCC default value of 50% recommended. For this reason, a 50% methane content was calculated. In the Excel calculation tool for the calculation of the methane emissions, transmission errors were corrected (Methane concentration in landfill gas, DOC for mechanically biologically treated wastes).
Greece	-1	0.0	-20	-0.6	Updated AD.
Hungary	-223	-7.7	-208	-6.2	Soil and stones have been removed from demolition waste + revised GDP data affected backward extrapolation of disposed waste
Ireland	-78	-5.6	-611	-48.5	In 2016 a comprehensive review of national greenhouse gas inventory data was undertaken pursuant to Article 19(1) of Regulation (EU) No 525/2013. This review identified that the use of DOCf values of 0.6 and 0.75 for some landfills was not in line with the IPCC guidelines. As a result the Ireland now utilizes the default value of 0.5 for DOCf. Furthermore given the limitations of the application of the IPCC FOD model on an individual landfill or group of landfills basis, Ireland now utilises on one model which is based on weighted information based on individual landfill characteristics. The application of this new approach to emission estimates has resulted in recalculations for the full timeseries. For the period of the timeseries (1999-2014) where landfills are classified as managed waste disposal sites, the revisions discussed have resulted in an average annual reduction in emissions of 27.0

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
					per cent with up to 60 per cent reduction in emissions in some years.
Italy	0	0.0	1 514	11.2	Recalculations in the sector are due the methane generation rate constant, to an update in k-values following the suggestion of ESD review (EU, 2016).
Latvia	-110	-27.9	-115	-21.7	Recalculated for all-time series. Changes in activity data and calculation methodology
Lithuania	0	0.0	26	3.1	Flaring of landfill gas emissions were evaluated in this submission for the first time, and the amount of flared methane was subtracted from the amount calculated using FOD model. In addition, MSW fraction remaining after manual sorting was added to the total amount of landfilled waste.
Luxembourg	16	19.8	27	94.1	Updated AD and methodology
Malta	25	150.0	-12	-8.3	No NIR/information available.
Netherlands	-620	-4.3	0	0.0	New figures for solid waste disposal are used.
Poland	477	4.5	855	10.0	Update of MSW morphology and fraction of methane in landfill gas
Portugal	0	0.0	30	0.8	The slight recalculation (<1% difference in 2014) refers to a revision of the percentage of CH_4 in biogas for the period 2012-2014.
Romania	0	0.0	129	3.8	The amount of MSW deposited in managed and unmanaged SWDS in 2010-2014 periods was updated based on recalculations made by Waste directorate of NEPA. The amounts of CH_4 recovery were updated for 2011-2014 period due to an error of reporting data.
Slovakia	-58	-8.7	-96	-9.1	Emissions from waste disposal (5.A) were recalculated due to requirement to improve estimation of emissions from non-MSW waste. We used this opportunity and fully reviewed the model for non-MSW, including new approach to modelling of AD on disposed sewage sludge.
Slovenia	0	0.0	3	0.8	Improved data on screening analyzes
Spain	-583	-9.6	-3 114	-23.8	IPCC 2006 implemented and new AD from focal point
Sweden	0	0.0	-14	-1.2	Emissions of methane from CRF 5.A Solid waste disposal the year 2014, has been recalculated due to availability of new activity data from recently published reports on amounts of landfilled waste. Emissions of methane regarding the year 2013 has been recalculated due to interpolation of activity data.
United Kingdom	-2 415	-3.8	195	1.4	Improvements in data for commercial and industrial waste sent to landfill in the UK, and a revision of decay rates to align more consistently with IPCC defaults. This leads to small decrease in emissions in the Base Year and slightly higher emissions in later years.
EU28	-2522	-1.3	-2016	-1.9	
Iceland	0	0.0	-47	-20.1	Error in previous submission. Methane recovery was not included in the IPCC Waste Model file for 2014.
EU28+ISL	-2522	-1.3	-2063	-1.9	

7.2.2 Biological treatment of solid waste (CRF Source Category 5B)

Source category 5B Biological treatment of solid waste includes the key sources CH_4 and N_2O from 5B1 Composting. Besides composting the source category 5B includes the subcategory 5B2 anaerobic digestion and also emissions from mechanical-biological treatment according to the IPCC 2006 Guidelines. The whole sector 5.B contributes only 0.2 % to EU+ISL total GHG emissions without LULUCF in 2015. Decomposition of biomass during biological treatment is much faster than on landfills and the CH_4 and N_2O emissions are estimated on an annual basis without the need for long time series as in the case of landfills. Whereas for composting the decomposition of the organic waste fraction takes place under aerobic conditions, under anaerobic digestion the decomposition takes place without oxygen. Further information on emission trends and methodologies is only provided for source category composting 5B1, as anaerobic digestion 5B2 is no EU key source.

Table 7.6 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 2015.

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 2015 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	36	175	23	94	13	81
Belgium	7	64	4	39	3	25
Bulgaria	NO	53	NO	22	NO	31
Croatia	NO	11	NO,NE,IE	4	NO,NE,IE	6
Cyprus	NO	8	NO	3	NO	4
Czech Republic	NO	679	NE,IE	45	NE,IE	634
Denmark	50	301	12	113	38	188
Estonia	1	26	0	11	1	15
Finland	44	113	18	44	26	69
France	134	573	88	331	46	242
Germany	41	1 103	16	326	25	777
Greece	NO	21	NO	9	NO	13
Hungary	9	133	4	34	5	99
Ireland	NO	19	NO	8	NO	11
Italy	25	643	20	521	5	122
Latvia	41	44	17	18	24	26
Lithuania	7	43	3	15	4	28
Luxembourg	NO	29	NA,NO	8	NO,IE	21
Malta	NO	1	NO	NA,NO	NO	1
Netherlands	20	151	7	77	14	74
Poland	8	315	3	131	5	184
Portugal	9	37	4	14	5	23
Romania	NO	58	NO	24	NO	34
Slovakia	111	195	46	81	65	114
Slovenia	NO	12	NO	5	NO	7
Spain	132	631	55	248	77	383
Sweden	12	116	5	30	7	86
United Kingdom	10	1 700	4	652	6	1 048
EU-28	**697**	**7 254**	**329**	**2 910**	**367**	**4 345**
Iceland	NO	4	NA	2	NA	2
United Kingdom (KP)	10	1 705	4	654	6	1 050
EU-28 + ISL	**697**	**7 263**	**329**	**2 913**	**367**	**4 349**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.2.1 Waste Composting (CRF Source Category 5B1)

Emission and Trends

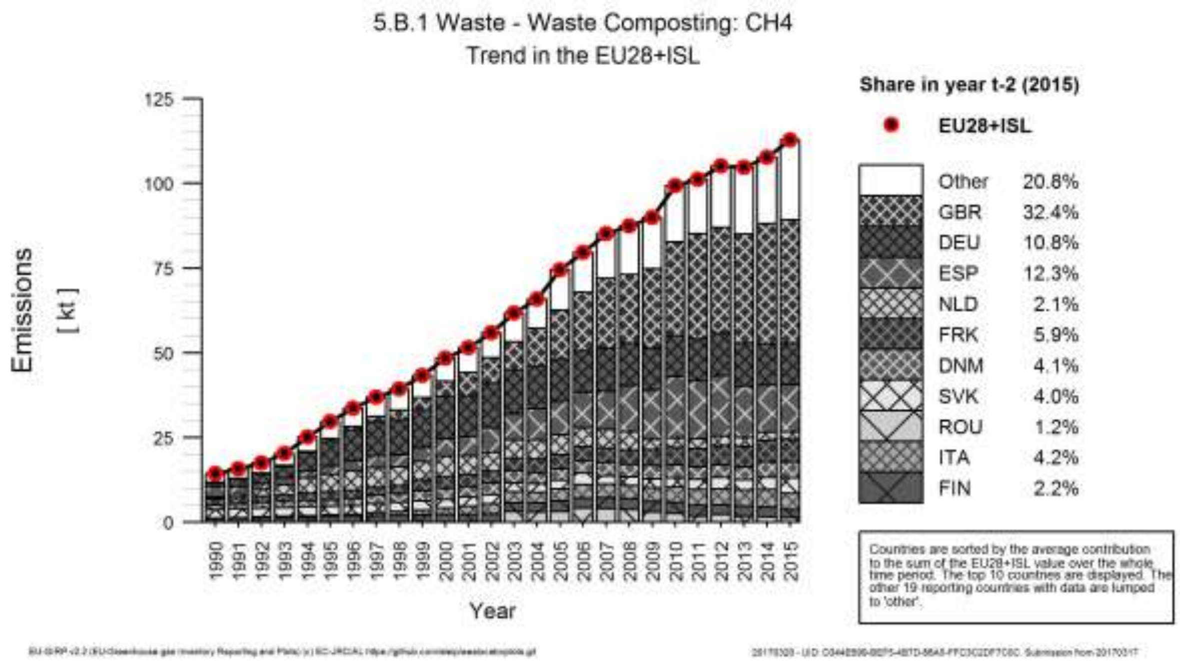
CH_4 emissions from 5B1 Composting account for 0.07 % of total EU-28+ISL GHG emissions in 2015. Between 1990 and 2015, CH_4 emissions from this source increased considerably from 361 kt CO_2 equivalents to 2818 kt CO_2 equivalents in 2015 (Table 7.7). Only Malta does not report emissions from composting. All Member States that practice composting feature an increasing emission trend from 1990 onwards. Nevertheless between 2014 and 2015 eight Member States experienced a decrease in CH_4 emissions from composting. In Finland, Italy, the Netherlands and Sweden the decreasing amount of waste composted is due to an increasing amount of waste that is anaerobic digested. Total CH_4 emissions from composting increased by 4.6 % between 2014 and 2015.

Table 7.7: 5B1 Waste Composting: 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	13	57	58	2.0%	0	0%	45	342%	T2	CS
Belgium	3	24	25	0.9%	1	6%	23	879%	T1	CS
Bulgaria	NO	6	31	1.1%	25	430%	31	∞	T1	D
Croatia	IE,NE	3	6	0.2%	3	115%	6	∞	T1	D
Cyprus	NO	3	4	0.2%	1	48%	4	∞	T1	D
Czech Republic	NE	51	62	2.2%	11	22%	62	∞	T1	D
Denmark	35	117	116	4.1%	0	0%	82	236%	CS,T1	CS,OTH
Estonia	1	13	15	0.5%	2	17%	14	2114%	T1	D
Finland	26	71	61	2.2%	-10	-14%	36	140%	T1	D
France	44	157	167	5.9%	9	6%	123	282%	T2	CS
Germany	25	304	304	10.8%	0	0%	279	1099%	T2	CS
Greece	NO	16	13	0.4%	-3	-21%	13	∞	D	D
Hungary	5	48	48	1.7%	0	0%	43	858%	T1	D
Ireland	NO	11	11	0.4%	0	0%	11	∞	T1	D
Italy	5	132	118	4.2%	-13	-10%	114	2467%	D	CS
Latvia	24	22	26	0.9%	3	15%	2	8%	D	D
Lithuania	4	20	21	0.7%	0	0%	16	408%	T1	D
Luxembourg	NO	12	12	0.4%	0	-1%	12	∞	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	14	61	58	2.1%	-2	-4%	45	327%	T2	CS
Poland	5	129	184	6.5%	54	42%	179	3653%	T1	D
Portugal	5	18	19	0.7%	1	7%	14	279%	T1	D
Romania	NO	39	34	1.2%	-5	-14%	34	∞	T1	D
Slovakia	65	87	114	4.0%	26	30%	49	75%	T1	D
Slovenia	NO	7	7	0.3%	0	3%	7	∞	T1	D
Spain	77	347	347	12.3%	0	0%	270	352%	T1	D
Sweden	7	47	42	1.5%	-5	-11%	35	490%	NO,T1	D,NO
United Kingdom	5	887	912	32.3%	25	3%	907	16538%	T1	D
EU-28	**361**	**2 690**	**2 815**	**100%**	**125**	**5%**	**2 454**	**680%**	**-**	**-**
Iceland	NA	2	2	0.1%	0	6%	2	∞	T2	CS,D
United Kingdom (KP)	5	890	915	32.4%	25	3%	909	16584%	T1	D
EU-28 + ISL	**361**	**2 695**	**2 820**	**100%**	**125**	**5%**	**2 459**	**681%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 7.11 5B1 Waste Composting: CH_4 emissions (Trend in relevant MS)



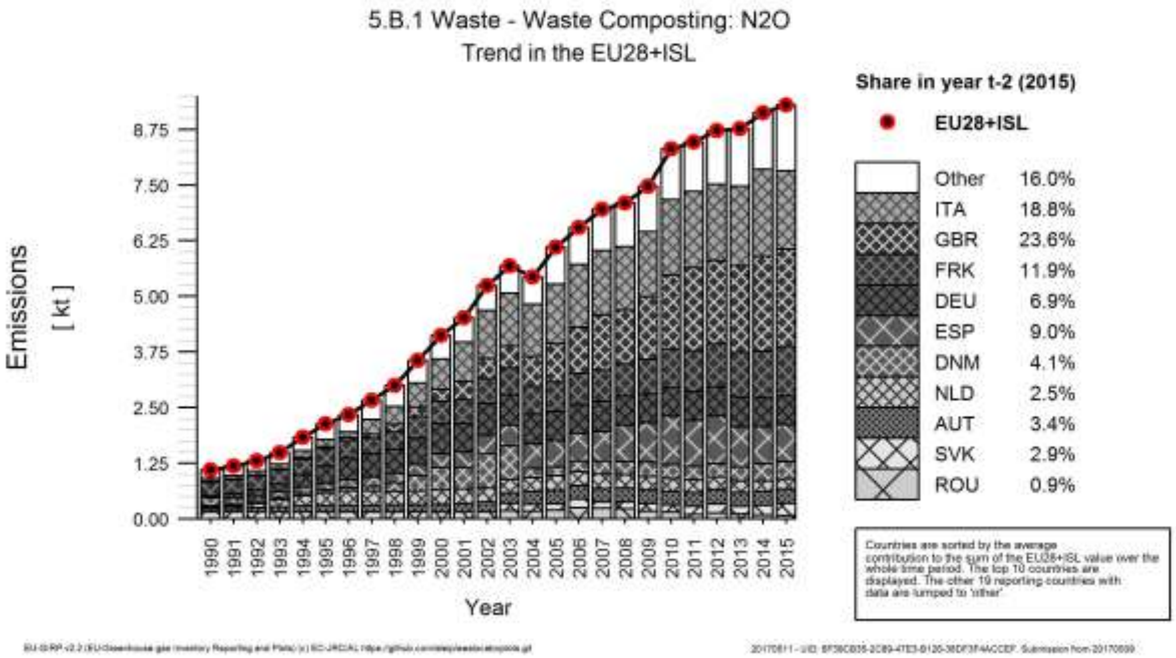
N_2O emissions from 5B1 Composting account for 0.06 % of total EU-28+ISL GHG emissions in 2015. Between 1990 and 2015, N_2O emissions from this source increased considerably from 329 kt CO_2 equivalents to 2770 kt CO_2 equivalents in 2015 (Table 7.8). Between 2014 and 2015 total N_2O in EU 28+ISL emissions increased by 1.9 %.

Table 7.8: 5B1 Waste Composting: Member States'+ ISL 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	23	94	94	3.4%	1	1%	71	314%	T2	CS
Belgium	4	37	39	1.4%	2	6%	35	879%	T1	CS
Bulgaria	NO	4	22	0.8%	18	430%	22	∞	T1	D
Croatia	IE,NE	2	4	0.2%	2	115%	4	∞	T1	D
Cyprus	NO	2	3	0.1%	1	48%	3	∞	T1	D
Czech Republic	NE	36	45	1.6%	8	22%	45	∞	T1	D
Denmark	12	113	113	4.1%	0	0%	101	837%	CS,T1	CS,OTH
Estonia	0	9	11	0.4%	2	17%	10	2114%	T1	D
Finland	18	51	44	1.6%	-7	-14%	26	140%	T1	D
France	88	313	331	11.9%	18	6%	243	276%	T2	CS
Germany	16	191	191	6.9%	0	0%	176	1099%	T2	CS
Greece	NO	11	9	0.3%	-2	-21%	9	∞	D	D
Hungary	4	34	34	1.2%	0	0%	31	858%	T1	D
Ireland	NO	8	8	0.3%	0	0%	8	∞	T1	D
Italy	20	580	521	18.8%	-58	-10%	501	2467%	D	D
Latvia	17	17	18	0.7%	2	10%	1	8%	D	D
Lithuania	3	15	15	0.5%	0	0%	12	408%	T1	D
Luxembourg	NO	9	8	0.3%	0	-1%	8	∞	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	7	72	69	2.5%	-3	-4%	63	965%	T2	CS
Poland	3	92	131	4.7%	39	42%	128	3653%	T1	D
Portugal	4	13	14	0.5%	1	7%	10	279%	T1	D
Romania	NO	28	24	0.9%	-4	-14%	24	∞	T1	D
Slovakia	46	62	81	2.9%	19	30%	35	75%	T1	D
Slovenia	NO	5	5	0.2%	0	3%	5	∞	T1	D
Spain	55	248	248	9.0%	0	0%	193	352%	T1	D
Sweden	5	33	30	1.1%	-4	-11%	25	490%	NO,T1	D,NO
United Kingdom	4	634	652	23.5%	18	3%	648	16538%	T1	D
EU-28	**329**	**2 716**	**2 767**	**100%**	**52**	**2%**	**2 438**	**740%**	**-**	**-**
Iceland	NA	2	2	0.1%	0	6%	2	∞	T1	D
United Kingdom (KP)	4	636	654	23.6%	18	3%	650	16584%	T1	D
EU-28 + ISL	**329**	**2 719**	**2 771**	**100%**	**52**	**2%**	**2 441**	**741%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 7.12 5B1 Waste Composting: N_2O emissions (Trend in relevant MS)



Methodological information

According to the IPCC 2006 Guidelines CH_4 and N_2O emissions from composting are estimated by using the quantity of organic waste processed by composting and the respective emission factor. The application of a Tier 2 method requires the use of a country specific emission factor based on representative measurements. The IPCC default emission factor for CH_4 emissions from composting is 10 g CH_4/kg waste treated on a dry weight basis and 4 g CH_4/kg based on a wet weight basis. The range of this emission factor is very high and varies between 0.08 and 20 g CH_4/kg waste treated. Most Member States apply the default EF for CH_4 emissions based on a wet weight basis, while Hungary, Lithuania, Sweden and the United Kingdom use activity data in kt dry matter in the CRF tables (see Table 7.9). Only Austria, Belgium, Denmark, France, Germany, Italy, and the Netherlands apply country specific EFs. For Finland and Luxembourg the EF reported in the CRF Table 5.B. and summarized in Table 7.9 and Table 7.10 are higher than for the other MS as they include composting of sludge, which is mainly reported on a dry weight basis. In most cases country specific EFs are much lower than the IPCC default EF. The use of country specific EFs for CH_4 emissions from composting shows that CH_4 emissions are lower than the IPCC default EF if the facility is well operating.

Table 7.9 5B1 Composting: EFs applied by Member States in 2015 in g CH_4/kg waste treated

Member States	EF CH4 emissions	Member States	EF CH4 emissions
Austria	1,82	Italy	1,63
Belgium	0,75	Latvia	4,00
Bulgaria	4,00	Lithuania	10,00
Croatia	4,00	Luxembourg	5,14
Cyprus	4,00	Malta	NO
Czech Republic	4,00	Netherlands	0,81
Denmark	3,82	Poland	4,00
Estonia	4,00	Portugal	4,00
Finland	6,02	Romania	4,00
France	0,78	Slovakia	4,00
Germany	1,40	Slovenia	4,00
Greece	4,00	Spain	4,00
Hungary	10,00	Sweden	11,43
Iceland	4,00	United Kingdom	10,01
Ireland	4,00		

Source: CRF Table 5.B 2017

The IPCC default emission factor for N_2O emissions from composting is 0.6 g N_2O/kg waste treated on a dry weight basis and 0.24 g N_2O/kg based on a wet weight basis. The range of this emission factor is very high and is between 0.2 and 1.6 g N_2O/kg for dry waste treated and 0.06 and 0.6 g N_2O/kg for wet waste. Most Member States apply the default EF for calculating N_2O emissions from composting.

Table 7.10 5B1 Composting: EFs applied by Member States in 2015 in g N_2O/kg waste treated

Member States	EF N2O emissions	Member States	EF N2O emissions
Austria	0,25	Italy	0,60
Belgium	0,10	Latvia	0,24
Bulgaria	0,24	Lithuania	0,60
Croatia	0,24	Luxembourg	0,31
Cyprus	0,24	Malta	NO
Czech Republic	0,24	Netherlands	0,08
Denmark	0,31	Poland	0,24
Estonia	0,24	Portugal	0,24
Finland	0,36	Romania	0,24
France	0,13	Slovakia	0,24
Germany	0,07	Slovenia	0,24
Greece	0,24	Spain	0,24
Hungary	0,60	Sweden	0,69
Iceland	0,30	United Kingdom	0,60
Ireland	0,24		

Source: CRF Table 5.B 2017

Further methodological information for all Member States is provided in the Annex of this submission.

7.2.2.2 Recalculations (CRF Source Category 5B)

Table 7.11 and Table 7.12 provide information on the contribution of Member States to EU recalculations in N_2O and CH_4 from 5B Biological treatment of solid waste for 1990 and 2014 and main explanations (if available in Member States' inventories) for the largest recalculations in absolute terms.

Table 7.11: 5B Biological treatment: Contribution of Member States to EU recalculations in N_2O for 1990 and 2014 (difference between latest submission and previous submission)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	-1	-2.0	In the Flanders region there was a very small adjustment of the activity data (amounts of waste composted) for 2013 and 2014.
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	0.0	
Cyprus	0	0.0	-3	-54.4	(a) Revised data for the years 2010 - 2014. (b) The emission factor for N_2O emissions is assumed 0.24 g/kg as proposed in the corrigendum of the 2006 guidelines dated July 2015, compared to 0.3 g/kg in previous submissions.
Czech Republic	0	0.0	0	0.0	
Denmark	0	-2.2	-10	-8.1	The N_2O emission factor for composting of organic waste was updated from 0.30 to 0.24 kg N_2O / Mg wet weight organic waste (IPCC, 2006). Further-more, minor technical errors in the calculation methodology was corrected.

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Estonia	0	0.0	-1	-12.2	Updated activity data.
Finland	-1	-6.6	-4	-6.9	Corrected and more accurate activity data
France	34	63.6	-180	-36.5	Composting: Correction of an anomaly on the consideration of the moisture content for the estimation of the EF. However, in the method used, the moisture content depends on the type of waste (green waste, biowaste, sludge) and the composition of the composted waste depends on the time. Consequently, the impact of the correction varies over the time series.
Germany	0	0.0	15	4.8	The activity data for the current reporting year must be estimated as the official waste statistics has one year's delay. Regular recalculations are therefore necessary for the previous year.
Greece	0	0.0	-7	-36.6	Updated AD and N_2O EF.
Hungary	0	0.0	1	2.1	Revised activity data (composted sludge)
Ireland	0	0.0	-4	-32.1	The emission factor for N_2O was corrected from 0.3g N_2O/kg to 0.24g N_2O/kg as provided in the July 2015 correction of relevant chapter in the IPCC 2006 Guidelines.
Italy	3	20.0	97	20.0	Update of EF for compost production
Latvia	0	0.0	1	4.5	Changes for EF in IPCC methodology (*9: Corrected chapter(s) as of July 2015.)
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	5	115.0	Updated AD and methodology
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	-4	-4.5	Final data for 2014
Poland	0	0.0	0	0.0	
Portugal	-1	-20.0	-3	-20.0	No recalculations have been made since latest 2016 submission (UNFCCC Review resubmission made in November 2016), when EFs have been updated accordingly to the 2015 corrigenda of the IPCC 2006 GL.
Romania	0	0.0	-3	-9.4	N_2O emissions were recalculated for 2014 year taking into account the final data associated to the amount of composted waste.
Slovakia	-12	-20.0	-16	-20.0	Emissions from biological treatment (5.B) were recalculated due to requirement to apply new emission factor for N_2O according to the corrigendum of IPCC guidelines from July 2015.
Slovenia	0	0.0	0	0.0	
Spain	-14	-20.0	-91	-26.9	EF IPCC 2006 implemented
Sweden	-1	-20.0	-11	-25.5	Recalculation of methane emissions from anaerobic digestion at biogas facilities and nitrous oxide emissions from composting has been made, due to the new default emission factors provided in Table 4.1 in 2006 Guidelines (according to the changes in 9th Corrigenda for the 2006 IPCC Guidelines, July 2015).
United Kingdom	0	0.0	119	22.9	Revision to estimate for mechanical/biological treatment to reflect change in IPCC Guidelines
EU28	8	2.6	-100	-3.4	
Iceland	0	0.0	0	0.0	
EU28+ISL	8	2.6	-100	-3.4	

Table 7.12: 5B Biological treatment: Contribution of Member States to EU recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submission)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	-1	-2.0	In the Flanders region there was a very small adjustment of the activity data (amounts of waste composted) for 2013 and 2014.
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	-1	-23.3	CH_4 emission from anaerobic digestion of organic waste in biogas facilities not included in this category
Cyprus	0	0.0	-4	-54.4	Revised data for the years 2010 - 2014.
Czech Republic	0	0.0	-5	-0.8	updated methodology
Denmark	0	0.0	-4	-2.1	Minor technical errors in the calculation methodology was corrected. In the period 2010-2014 the changes are more significant due to im-proved data on composting received by the DEPA.
Estonia	0	0.0	-2	-12.2	Updated activity data.
Finland	0	0.0	3	3.6	Corrected and more accurate activity data
France	17	59.9	-41	-15.9	Composting: Correction of an anomaly on the consideration of the moisture content for the estimation of the EF. However, in the method used, the moisture content depends on the type of waste (green waste, biowaste, sludge) and the composition of the composted waste depends on the time. Consequently, the impact of the correction varies over the time series.
Germany	0	0.0	65	9.1	The activity data for the current reporting year must be estimated as the official waste statistics has one year's delay. Regular recalculations are therefore necessary for the previous year.
Greece	0	0.0	-4	-20.7	Updated AD and N_2O EF.
Hungary	0	0.0	1	1.0	Revised activity data (composted sludge)
Ireland	0	0.0	-2	-15.1	Revised composting activity data
Italy	2	113.9	71	112.9	According to the review process compost production emission factor have been updated
Latvia	0	0.0	0	0.0	
Lithuania	0	0.0	7	35.5	Methane emissions due to leakages from anaerobic digestion plants were estimated for the first time
Luxembourg	0	0.0	15	271.7	updated AD and methodology ; fugitive CH_4 emissions from unintentional leakages and process disturbances of anaerobic digesters are added
Malta	0	0.0	0	0.0	
Netherlands	0	0.0	-2	-2.0	Final data for 2014
Poland	0	0.0	0	0.0	
Portugal	0	0.0	-2	-6.1	No recalculations have been made since latest 2016 submission (UNFCCC Review resubmission made in November 2016), when EFs have been updated accordingly to the 2015 corrigenda of the IPCC 2006 GL.
Romania	0	0.0	-4	-9.4	CH_4 emissions were recalculated for 2014 year taking into account the final data associated to the amount of composted waste.
Slovakia	0	0.0	0	0.0	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Slovenia	0	0.0	0	0.0	
Spain	0	0.0	-35	-8.4	Final data for 2014 included.
Sweden	0	0.0	-3	-4.1	Due to revised AD on composted waste, methane emissions from composting was recalculated for the year 2014.
United Kingdom	0	2.0	232	30.4	Updates in activity data for anaerobic digestion and composting for 2014 and other recent years.
EU28	20	5.7	285	7.4	
Iceland	0	0.0	0	0.0	
EU28+ISL	20	5.7	285	7.4	

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 7.13 gives an overview of greenhouse gas emissions from waste incineration and open burning by Member State. Total emissions from 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 2015. Total emissions decreased by 34 % between 1990 and 2015. Most Member States decreased their emissions from waste incineration without energy recovery and open burning between 1990 and 2015, except for Czech Republic, Greece, Hungary, Lithuania, Malta, Poland, Portugal, Romania, Slovenia and Sweden. The United Kingdom, France, Italy and Spain feature the largest decreases in absolute terms.

Table 7.13 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	28	2	28	2	0	0	0	0
Belgium	302	292	299	292	3	0	0	0
Bulgaria	21	11	20	10	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	135	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	NE,NO,IE	NO,NE,IE	NE,NO,IE	NO,NE,IE	NE,NO,IE
France	2 321	1 601	2 209	1 526	92	47	20	28
Germany	0	0	NO	NO	NA,NO	NA,NO	NA,NO	NA,NO
Greece	0	10	0	9	0	1	0	0
Hungary	122	197	121	194	1	2	0	0
Ireland	92	40	91	40	1	0	1	0
Italy	594	191	507	111	37	21	50	58
Latvia	4	2	1	0	3	2	NA,NO	NA,NO
Lithuania	3	6	3	6	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	NO,IE,NA	NO,IE	NO,IE,NA	NO,IE	NO,IE,NA	NO,IE
Poland	358	542	350	488	7	55	NO,NA	0
Portugal	8	23	7	22	1	1	0	0
Romania	0	7	NO	6	NO,NE	1	NE,NO	0
Slovakia	75	13	67	7	6	5	2	1
Slovenia	2	27	2	27	0	0	0	0
Spain	805	650	113	NO,IE	365	348	327	302
Sweden	45	61	44	56	1	5	0	0
United Kingdom	1 512	329	1 345	270	30	50	137	9
EU-28	**6 321**	**4 141**	**5 232**	**3 200**	**550**	**542**	**539**	**399**
Iceland	15	9	7	9	2	0	6	0
United Kingdom (KP)	1 524	341	1 357	282	30	50	137	9
EU-28 + ISL	**6 348**	**4 162**	**5 251**	**3 220**	**552**	**542**	**545**	**400**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.2.3.1 Recalculations (CRF Source Category 5C)

Table 7.14 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 2014 and main explanations (if available in Member States' inventories) for the largest recalculations in absolute terms.

Table 7.14: 5C Waste incineration: Contribution of Member States to EU recalculations in CO_2 equiv. for 1990 and 2014 (difference between latest submission and previous submission)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	1	3.8	0	1.1	Change of combustion efficiency from 95 to 100%
Belgium	0	0.0	0	0.0	
Bulgaria	0	0.0	0	0.0	
Croatia	0	0.0	0	-0.1	Data on incineration of clinical waste was recalculated
Cyprus	0	0.0	0	0.0	
Czech Republic	0	0.0	0	0.0	

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Denmark	0	0.0	0	0.0	
Estonia	0	0.0	0	-1.7	Updated activity data.
Finland	0	0.0	0	0.0	
France	0	0.0	90	5.2	Incineration of sludge (5C1.1b) The EF for CH_4 from the 2006 Guidelines has been taken into account. Incineration of non-hazardous waste (5C1.2a) Developments since 2011 are due to the change in the composition of waste incinerated from 2010 (following publication of the industrial waste statistics 2012) and the updating of the quantities stored in 2012 (ITOM 2012 published) and in 2014 (ITOM 2014 Provisional).
Germany	0	0.0	0	0.0	
Greece	0	0.0	7	234.7	Updated AD.
Hungary	0	0.0	-1	-0.4	Revised activity data
Ireland	0	0.0	3	9.0	Revised activity data
Italy	0	0.0	-117	-51.1	Update of activity data
Latvia	0	-29.1	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	0	0.0	11	2.2	Correction of composition of incinerated municipal waste.
Portugal	0	0.0	0	-0.2	Update and correction of a compilation error related to clinical waste activity data since 2008.
Romania	0	0.0	0	0.7	CO_2 emissions were recalculated for 2014 year taking into account the final data associated to the amount of incinerated waste.
Slovakia	7	11.1	1	11.2	Emissions from incineration of waste without energy recovery (5.C) were recalculated due to requirement to apply oxidation factor 1. The previously used OF 0.9 based on was not accepted by the ERT because we could not provide documentation for this change of default value 1.
Slovenia	1	49.1	6	47.3	Implementation of methodology from 2006 IPCC GL
Spain	-191	-62.8	0	0.0	
Sweden	0	0.0	0	0.0	
United Kingdom	0	0.0	-15	-5.0	Minor revision to waste incineration activity data.
EU28	-183	-3.4	-14	-0.4	
Iceland	-4	-35.3	-1	-15.1	Major revisions to activity data and implemented T1 approach following IPCC 2006 GL
EU28+ISL	-187	-3.4	-15	-0.4	

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 environments[68]. According to the key category analysis CH_4 and N_2O emissions from 5D1 Domestic wastewater and CH_4 emissions from 5D2 Industrial wastewater are an EU key source and analysed in more detail in the following chapter. N_2O emissions from industrial wastewater are not contributing to an EU key source and are therefore not further analysed in this 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 7.15 shows total GHG, CH_4 and N_2O emissions by Member State from 5D Wastewater Handling. Between 1990 and 2015, total emissions from wastewater handling decreased by 35% in EU-28+ISL. All Member States except for Denmark, France, Ireland and Iceland decreased their emissions from wastewater treatment and discharge between 1990 and 2015. Due to the implementation of new wastewater treatment technologies CH_4 emission decreased considerably by 41 % between 1990 and 2015, while N_2O emissions decreased moderately by 11 %.

[68] In most countries, indirect N_2O emissions from disposal of wastewater effluents are the major source of N_2O emissions from wastewater handling, whereas direct N_2O emissions from wastewater treatment plants are small or not relevant.

Table 7.15 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 2015 (kt CO2 equivalents)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (kt CO2 equivalents)
Austria	217	184	96	161	121	23
Belgium	961	301	126	99	835	202
Bulgaria	3 041	1 000	198	143	2 843	857
Croatia	305	289	67	82	238	207
Cyprus	127	49	12	16	114	33
Czech Republic	1 124	1 058	234	197	890	861
Denmark	157	172	61	63	96	109
Estonia	151	89	39	30	113	59
Finland	300	254	79	81	221	173
France	2 256	2 649	722	457	1 534	2 192
Germany	3 664	1 079	958	452	2 705	627
Greece	2 620	1 299	279	327	2 341	972
Hungary	1 086	450	148	77	938	373
Ireland	157	173	96	120	61	54
Italy	4 488	3 840	1 266	1 349	3 222	2 492
Latvia	351	254	29	19	322	235
Lithuania	538	192	67	45	471	147
Luxembourg	16	11	9	7	7	4
Malta	27	8	10	6	17	2
Netherlands	481	282	172	71	309	211
Poland	4 501	1 589	723	760	3 778	829
Portugal	2 616	2 612	217	254	2 399	2 358
Romania	3 652	2 259	505	515	3 146	1 744
Slovakia	596	356	130	49	466	307
Slovenia	210	141	50	49	159	92
Spain	3 370	2 351	863	960	2 507	1 391
Sweden	261	234	226	206	35	28
United Kingdom	4 964	4 071	765	676	4 199	3 395
EU-28	**42 237**	**27 245**	**8 147**	**7 272**	**34 090**	**19 974**
Iceland	8	11	6	6	2	6
United Kingdom (KP)	5 004	4 123	784	700	4 221	3 423
EU-28 + ISL	**42 285**	**27 309**	**8 172**	**7 301**	**34 113**	**20 008**

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 2015. Between 1990 and 2015, CH_4 emissions decreased by 51 %. Key drivers for the large emission reduction are the introduction of wastewater treatment technologies and an increase of CH_4 recovery and flaring (see ***Figure 7.14***). In 2015, CH_4 emissions decreased by 2 % in comparison to 2014.

Table 7.16 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	121	23	23	0.2%	0	1%	-98	-81%	T2	CS,D
Belgium	835	207	202	1.9%	-5	-2%	-633	-76%	CR,T1	CR,D
Bulgaria	591	586	638	5.9%	53	9%	47	8%	T2	D
Croatia	141	111	110	1.0%	-1	-1%	-31	-22%	T1	D
Cyprus	90	15	7	0.1%	-8	-56%	-84	-93%	T1	D
Czech Republic	527	444	446	4.1%	2	1%	-81	-15%	T1	CS,D
Denmark	96	109	109	1.0%	0	0%	14	14%	CS	CS
Estonia	113	50	49	0.5%	-1	-1%	-63	-56%	T1	D
Finland	194	149	147	1.4%	-1	-1%	-47	-24%	CS,T2	CS,D
France	1 444	2 083	2 089	19.2%	6	0%	645	45%	T1	D
Germany	2 696	595	584	5.4%	-11	-2%	-2 112	-78%	CS,D	CS,D
Greece	1 520	162	163	1.5%	0	0%	-1 358	-89%	D	D
Hungary	803	354	346	3.2%	-8	-2%	-457	-57%	T1	D
Ireland	61	53	54	0.5%	1	2%	-8	-12%	T1,T2	CS,D
Italy	1 702	1 114	1 084	10.0%	-31	-3%	-619	-36%	T1	D
Latvia	185	111	99	0.9%	-12	-11%	-86	-46%	D	CS
Lithuania	471	163	147	1.3%	-17	-10%	-324	-69%	T1	D
Luxembourg	7	4	4	0.0%	0	-9%	-4	-52%	T1	CS
Malta	17	1	2	0.0%	1	83%	-15	-86%	D	CS
Netherlands	203	182	185	1.7%	3	1%	-19	-9%	T2	CS,D
Poland	3 152	719	581	5.3%	-139	-19%	-2 571	-82%	T1	CS,D
Portugal	1 258	855	854	7.8%	-1	0%	-403	-32%	T2	CS,D
Romania	2 768	1 573	1 548	14.2%	-25	-2%	-1 221	-44%	D	D
Slovakia	437	305	302	2.8%	-3	-1%	-135	-31%	CS,T2	D
Slovenia	152	89	90	0.8%	0	0%	-62	-41%	T1	CS,D
Spain	788	239	239	2.2%	0	0%	-549	-70%	T1,T2	D
Sweden	31	23	23	0.2%	0	1%	-8	-26%	T2	CS
United Kingdom	1 479	745	727	6.7%	-18	-2%	-752	-51%	CS	CS
EU-28	**21 883**	**11 065**	**10 850**	**100%**	**-214**	**-2%**	**-11 033**	**-50%**	**-**	**-**
Iceland	2	5	6	0.1%	0	5%	4	175%	T1	CS,D
United Kingdom (KP)	1 500	773	755	6.9%	-18	-2%	-746	-50%	CS	CS
EU-28 + ISL	**21 907**	**11 098**	**10 884**	**100%**	**-214**	**-2%**	**-11 023**	**-50%**	**-**	**-**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from domestic wastewater treatment and discharge decreased moderately between 1990 and 2015 by 9 %. ***Figure 7.15*** shows the trend of emissions indicating the countries contributing most to EU-28+ISL total.

Table 7.17 5D1 Domestic and commercial wastewater: Member States' contributions to N_2O emissions

Member State	N2O emissions in kt CO2 equiv.			Share in EU-28+ISL emissions in 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	96	160	161	2.3%	2	1%	65	68%	CS	CS,D
Belgium	126	99	99	1.4%	0	0%	-28	-22%	D	D
Bulgaria	198	144	143	2.0%	-1	-1%	-56	-28%	T1	D
Croatia	67	83	82	1.2%	-1	-1%	15	23%	T1	D
Cyprus	12	16	16	0.2%	0	0%	4	34%	T1	D
Czech Republic	234	197	197	2.8%	1	0%	-37	-16%	T1	CS,D
Denmark	61	61	63	0.9%	2	3%	1	2%	CS	CS
Estonia	39	30	30	0.4%	0	0%	-9	-22%	T1	D
Finland	58	67	69	1.0%	2	4%	11	18%	CS,T1	D
France	681	421	423	5.9%	2	0%	-258	-38%	T1	D
Germany	927	420	427	6.0%	7	2%	-499	-54%	CS,D	CS,D
Greece	274	320	321	4.5%	1	0%	47	17%	D	CS
Hungary	148	80	77	1.1%	-4	-4%	-71	-48%	CS	D
Ireland	96	119	120	1.7%	1	1%	24	25%	T1	D
Italy	1 198	1 298	1 298	18.2%	0	0%	100	8%	T1	D
Latvia	27	19	19	0.3%	0	-1%	-8	-29%	D	D
Lithuania	67	45	45	0.6%	0	-1%	-22	-33%	T1	D
Luxembourg	9	8	7	0.1%	-1	-7%	-2	-20%	T1	D
Malta	10	5	6	0.1%	1	18%	-4	-43%	D	D
Netherlands	23	24	25	0.3%	0	2%	2	8%	T1	D
Poland	723	760	760	10.7%	0	0%	37	5%	T1	D
Portugal	217	255	254	3.6%	-1	0%	37	17%	T2	CS,D
Romania	505	517	515	7.2%	-2	0%	10	2%	D	D
Slovakia	119	49	47	0.7%	-2	-4%	-72	-60%	CS,T2	D
Slovenia	50	49	49	0.7%	0	0%	-1	-2%	T1	D
Spain	863	960	960	13.5%	0	0%	97	11%	D	D
Sweden	208	196	196	2.8%	0	0%	-11	-5%	T1	CS,D
United Kingdom	765	684	676	9.5%	-7	-1%	-89	-12%	T1	D
EU-28	**7 800**	**7 087**	**7 086**	**100%**	**-2**	**0%**	**-715**	**-9%**	**-**	**-**
Iceland	6	6	6	0.1%	0	0%	0	0%	T1	D
United Kingdom (KP)	784	707	700	9.8%	-7	-1%	-84	-11%	T1	D
EU-28 + ISL	**7 825**	**7 117**	**7 115**	**100%**	**-2**	**0%**	**-710**	**-9%**	**-**	**-**

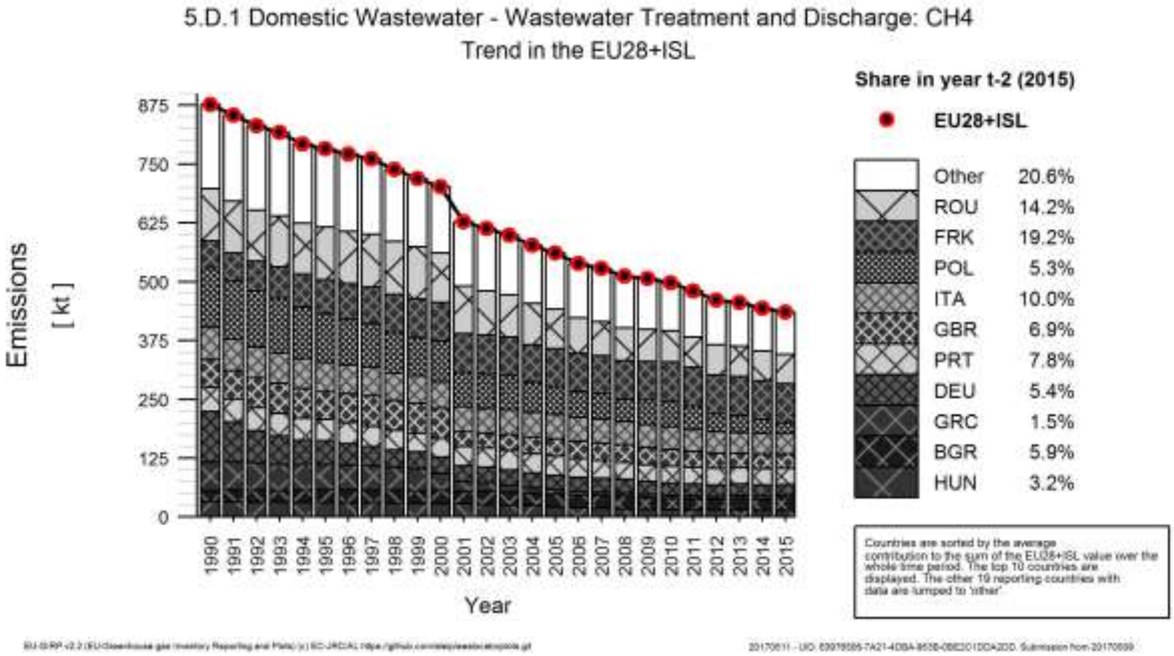
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trends in Emissions and Activity Data for CH_4 emissions from domestic wastewater

CH_4 emissions from domestic wastewater treatment and discharge decreased considerably between 1990 and 2015 by 51 %. Figure 7.13 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 22 % of EU-28+ISL emissions from source 5D1 in 2015, whereas France shows significant emission increases (Table 7.16). France is responsible for 20 %, Italy for 10 % and Romania for 15 % of EU-28+ISL emissions from this source in 2015. Although France increased its emissions between 1990 and 2015, 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.

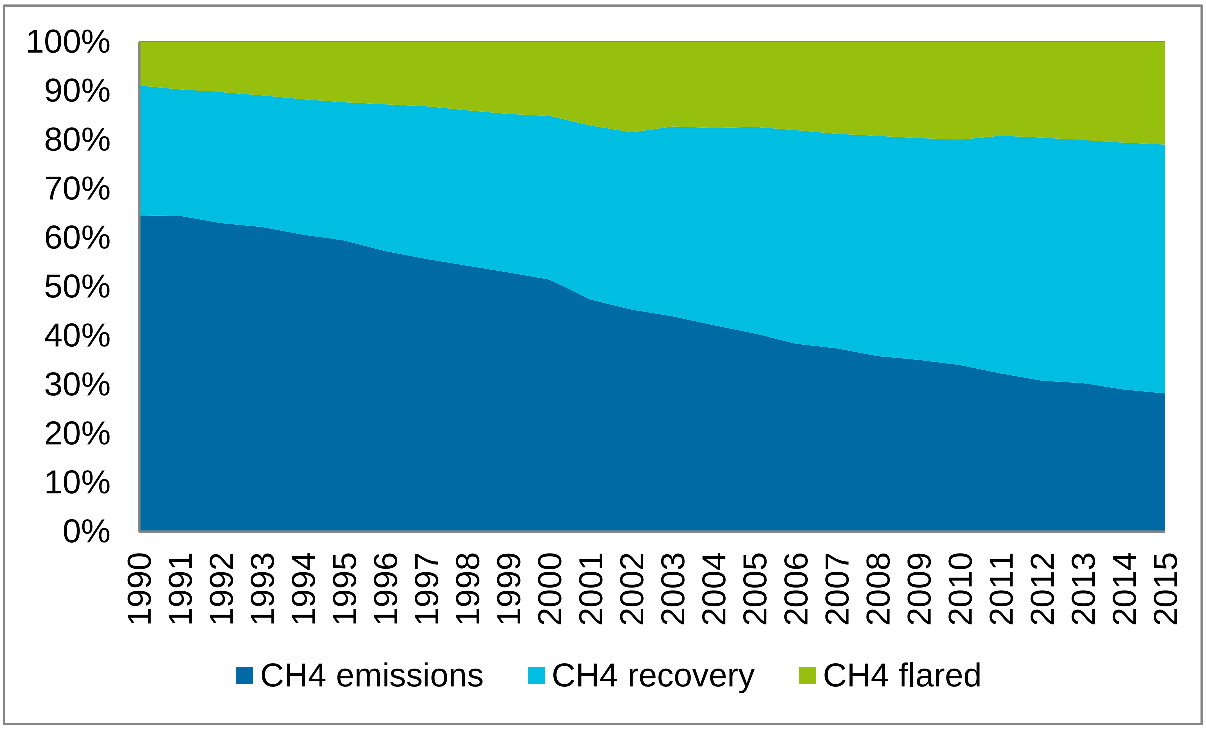
Figure 7.13 5D1 Domestic wastewater: CH_4 emissions (Trend in relevant MS)



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 7.14***)
- Improvements of wastewater disposal routes
- Amount of sludge removed

Figure 7.14 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 2017, Table 5D

In 2015 21% of the CH_4-emissions generated by Domestic Wastewater Handling were flared and 51% was recovered for energy purposes.

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.

France's 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 2015. Wastewater treatment in collective systems increased slightly from 79 % in 1990 to 81 % in 2015. Furthermore France applies CH_4 recovery for generated CH_4 from wastewater since 1990. CH_4 recovery peaks in 2014 and remains constant in 2015.

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 67 % of the total wastewater has been treated appropriate, 16 % remained untreated and 16 % of total wastewater received only insufficient treatment in 2015. Between 2000 and 2015 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 (-89 %) 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

Italian CH_4 emissions from domestic wastewater handling 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 2015 about 82 % of population is served by wastewater treatment plants.

CH_4 emissions from domestic wastewater handling in **Poland** decreased continuously throughout the time series. The share of rural population using latrines for domestic wastewater storage decreased from 96 % in 1990 to 60 % in 2015 and the share of urban populations using septic tanks decreased from 19 % to 9 % in the same period. Instead the treatment pathway using high nutrient removal increased for rural population from 0 % to 19 % and from 0 % for urban population to 82 % between 1990 and 2015.

Methodological information for CH_4 emissions from domestic wastewater

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 7.14***), 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.

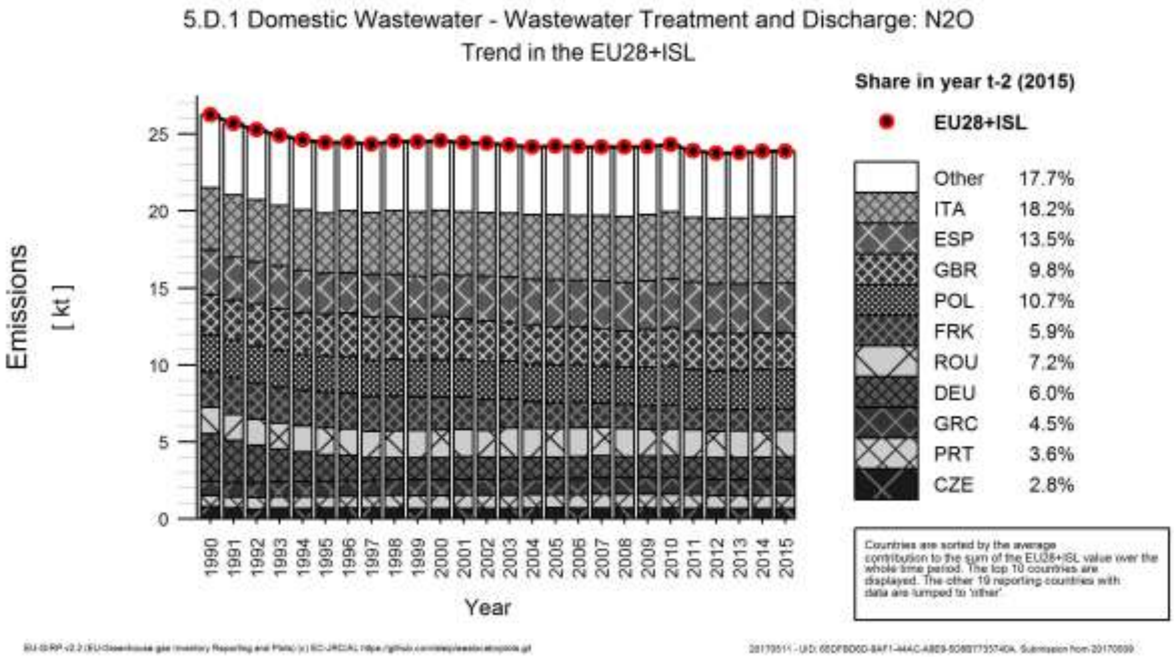
Further methodological information for all Member States is provided in the Annex of this submission.

Trends in Emissions and Activity Data for N_2O emissions

According to the key category analysis N_2O emissions from domestic wastewater treatment are an EU key source. Between 1990 and 2015 N_2O emissions from domestic wastewater and discharge decreased only moderately by 9 %. ***Figure 7.15*** shows the trend of emissions indicating the countries contributing most to EU-28+ISL total.

Member States with large population have a high share of EU-28+ISL N_2O emissions from this source in general. In 2015 Italy is responsible for 18 %, Spain for 14 %, Poland for 10 % of EU-28+ISL N_2O emissions from wastewater treatment (see Table 7.17). Large decreases in absolute terms are reported by Germany and France between 1990 and 2015, as the amount of wastewater treated in advanced centralized wastewater treatment plants increased over the years.

Figure 7.15 5D1 Domestic wastewater: N_2O emissions (Trend in relevant MS)



Methodological information for N_2O emissions from domestic wastewater

Direct emissions of N_2O during processing only occur in countries with predominantly advanced centralized wastewater treatment plants with nitrification and denitrification steps. Indirect emissions come from wastewater treatment effluent discharged into aquatic environments. For direct emissions the quantity of wastewater treated in such facilities needs to be multiplied with a default emission factor. For indirect emissions, it is necessary to estimate the nitrogen in wastewater based on protein intake per person and correction factors to reflect non-consumed proteins and industrial/commercial co-discharged into the sewer system. If sludge is removed, a corresponding quantity of nitrogen needs to be deducted.

For the calculation of N_2O emissions from domestic wastewater no different tier levels are provided in the IPCC 2006 Guidelines and it is good practice to estimate N_2O emissions from domestic wastewater effluent by applying the methodology provided in the 2006 IPCC Guidelines. According to Table 7.17 only Austria, Denmark, Finland, Germany, Hungary, Portugal and Slovakia apply a country specific methodology.

Further methodological information for all Member States is provided in the Annex of this submission.

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 2015. Between 1990 and 2015, CH_4 emissions decreased by 25 %. Key drivers for the development of CH_4 emissions are primarily economic activities and the share of CH_4 flared or recovered. 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 2015, CH_4 emissions increased by 1 % in comparison to 2014 (see Table 7.18).

Table 7.18 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 2015	Change 2014-2015		Change 1990-2015		Method applied	Emission factor
	1990	2014	2015		kt CO2 equiv.	%	kt CO2 equiv.	%		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA
Bulgaria	2 252	321	219	2.4%	-102	-32%	-2 033	-90%	T2	D
Croatia	97	97	97	1.1%	0	0%	0	0%	T2	D
Cyprus	24	26	26	0.3%	0	0%	2	9%	T1	D
Czech Republic	363	397	414	4.5%	18	4%	51	14%	CS,T1	CS,D
Denmark	IE	IE	IE	-	-	-	-	-	NA	NA
Estonia	NO	12	10	0.1%	-2	-17%	10	∞	T1	D
Finland	27	24	26	0.3%	2	7%	-1	-3%	CS,T3	CS,D
France	90	103	103	1.1%	0	0%	13	15%	T1	D
Germany	9	42	43	0.5%	1	2%	34	366%	CS	CS
Greece	821	813	809	8.9%	-4	-1%	-12	-1%	D	D
Hungary	135	27	27	0.3%	0	0%	-108	-80%	T1	D
Ireland	IE	IE	IE	-	-	-	-	-	NA	NA
Italy	1 520	1 386	1 408	15.5%	22	2%	-112	-7%	T1	D
Latvia	137	140	136	1.5%	-5	-3%	-1	-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	0.1%	0	2%	2	32%	T2	CS
Poland	627	259	248	2.7%	-11	-4%	-378	-60%	T1	CS,D
Portugal	1 141	1 435	1 503	16.5%	69	5%	362	32%	T2	CS,D
Romania	378	185	196	2.2%	11	6%	-182	-48%	D	D
Slovakia	29	6	6	0.1%	0	-3%	-24	-81%	CS,T2	D
Slovenia	8	2	2	0.0%	0	7%	-5	-72%	T1	D
Spain	1 719	1 145	1 152	12.6%	6	1%	-567	-33%	T1	D
Sweden	4	5	5	0.1%	0	-2%	1	22%	T2	CS
United Kingdom	2 720	2 541	2 668	29.3%	127	5%	-52	-2%	T1	D
EU-28	**12 108**	**8 975**	**9 107**	**100%**	**132**	**1%**	**-3 001**	**-25%**	**-**	**-**
Iceland	IE	IE	IE	-	-	-	-	-	NA	NA
United Kingdom (KP)	2 720	2 541	2 668	29.3%	127	5%	-52	-2%	T1	D
EU-28 + ISL	**12 108**	**8 975**	**9 107**	**100%**	**132**	**1%**	**-3 001**	**-25%**	**-**	**-**

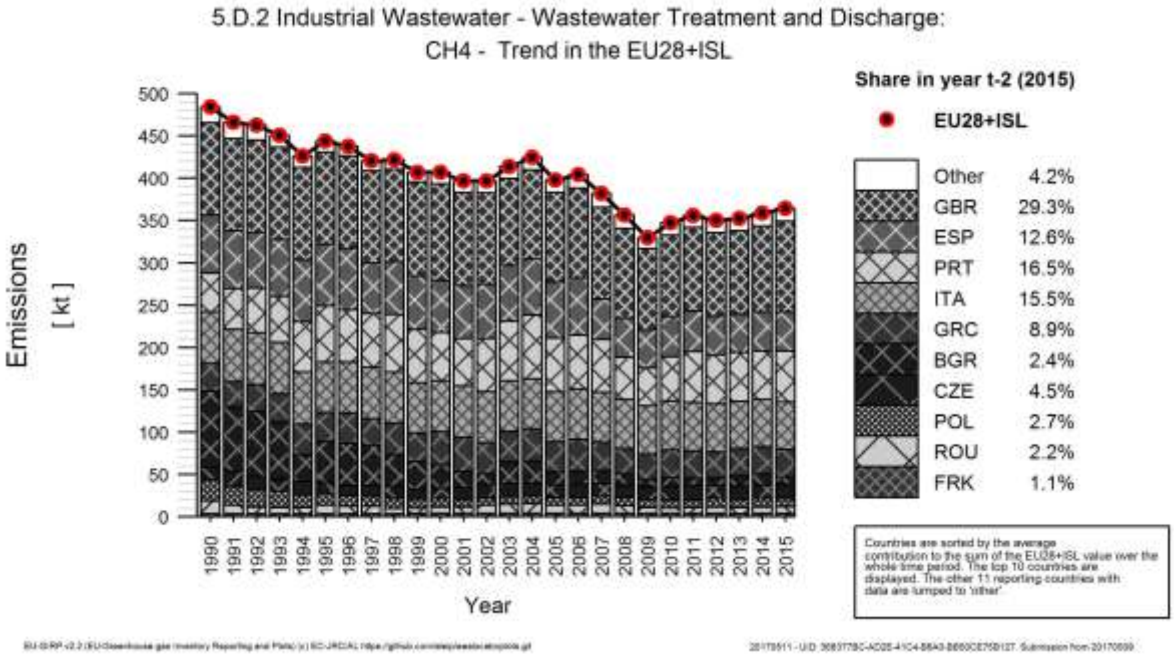
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trends in Emissions and Activity Data

CH_4 emissions from industrial wastewater treatment and discharge decreased between 1990 and 2015 by 25 %. ***Figure 7.16*** 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 Spain and Poland contributing together to 18 % of EU-28+ISL emissions from source 5D2 in 2015, whereas Portugal shows large emission increases between 1990 and 2015 (Table 7.18). The United Kingdom is responsible for 29.3 %, Portugal for 16.5 % and Italy for 15.5 % of EU-28+ISL CH_4 emissions from this source in 2015. The emission trends in this sector are mainly influenced by the strong decrease in Bulgaria, Spain and Poland and increasing emissions in Portugal, while in other relevant countries CH_4 emissions are almost constant or slightly decreased (United Kingdom, Italy, Greece).

Figure 7.16 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, Portugal, Italy, the United Kingdom and Spain.

Bulgaria decreased its CH_4 emissions from industrial wastewater until 2012 and slightly increased in 2013 and 2014, while in 2015 CH_4 emissions decreased again. 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 0.11 Mio in 2015. The increases in 2013 are caused by an increasing amount of industrial wastewater while in 2014 and 2015 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 2015 with lowest emissions in 2010. Between 1990 and 2015 CH_4 emissions slightly decreased by 2 %. Given the high share of UKs CH_4 emissions in EU-28+ISL of 29.3 % 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 by 7 % until 2015 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 32 % until 2015. The industries with the highest organic loads are wood and wood derivatives and the organic chemical industry. Industrial wastewater load from wood and wood derivatives showed an increasing trend until 2007 and fluctuations in the years after. Also wastewater from the organic chemical industry is fluctuating with a strong decline in the years of the economic crisis 2008-2010.

In **Spain**, CH_4 emissions from industrial wastewater decreased by 9 % until 2015 in comparison to 1990. Industries with high organic loads that have on-site wastewater treatment are the oil refining industry and the pulp and paper production industry. Other industries with high organic loads are the food- and drink processing industry and the organic chemical industry. Due to changes in production levels CH_4 emissions from this source are also highly fluctuating throughout the time series in Spain.

CH_4 emissions from industrial wastewater in **Poland** decreased by 60 % between 1990 and 2015, due to a reduction in wastewater production by industries. Main reduction of wastewater production took place in the mining and quarrying industry, the iron and steel industry and in the wood and paper 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, Iceland, 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 and N_2O emissions (CRF Source Category 5D)

Table 7.19: 5D Waste water treatment: Contribution of member states to EU recalculations in CH_4 for 1990 and 2014 (difference between latest submission and previous submission)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	-2	-9.1	Update connection rate to wastewater treatment plans --> effect on connection rate to septic tanks
Belgium	0	0.0	0	0.0	
Bulgaria	-389	-12.0	-70	-7.2	Recalculations of CH_4 emissions from 5.D.1 domestic wastewater are made after ERT in country review in November 2016. Considering recommendations, country separated septic systems to septic and latrines, as for septic systems MCF=0.5 is used in calculations and for latrines MCF=0.1 is used. Recalculations of CH_4 emissions from 5.D.2 industrial wastewater treatment have been made due to change in MCF for treatment system/discharge pathway - waters, discharged into sea, river lakes to 0.05 after ESD recommendations in June 2016.
Croatia	0	0.0	0	0.0	
Cyprus	25	27.6	61	351.8	The emissions from this source have been recalculated due to the change of the % BOD reduction following the TERT's recommendation in trial review and Wastewater disposed in septic tanks is considered as uncollected and 1 is used as a correction factor (compared to 1.25 in previous submissions). Following a recommendation of the ERT during the in-country review of the 2016 submission, the methane correction factor (MCFj) has been changed from 0 which is the default for centralised, aerobic treatment plant to 0.3 which is the default for not well managed, centralised, overloaded aerobic treatment.
Czech Republic	-248	-21.8	109	15.0	Updated methodology in line with IPCC 2006 GLs.
Denmark	0	0.0	0	0.0	
Estonia	0	0.0	0	0.0	
Finland	0	0.0	0	0.2	More accurate and complemented data
France	9	0.6	15	0.7	- Update of the 2014 activity of the quantities of methane sludge and therefore CH_4 emissions from methanisation
Germany	930	52.4	574	909.0	- Updated statistical data for recent years. - Updated data on septic tanks available - Adjustment of MCF to national climate conditions - Update of information on biogas generation from sewage sludge and leakage emissions.
Greece	-1 635	-41.1	-562	-36.6	Updated AD and modifications based on TERT 2016 recommendations for MCF.
Hungary	0	0.0	4	1.1	Minor activity data change affected CH_4 emissions.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-4	-0.1	Minor recalculation is occurred due to update of activity data.
Latvia	-23	-6.6	3	1.3	Update of activity data

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Lithuania	-71	-13.1	-57	-25.7	In the previous submission, maximum CH_4 producing capacity (Bo = 0.6 kg CH_4/kg BOD) was omitted from the formula for calculation of methane emissions from latrines resulting in overestimation of emissions. In addition, new data on population connected to sewerage network provided by the Lithuanian EPA for 2012-2014 were a bit higher than previously used which also influenced the final result.
Luxembourg	0	0.0	0	0.0	
Malta	0	0.0	0	0.0	
Netherlands	3	1.0	5	2.2	Correction of formula to calculate methane from sludge handling
Poland	843	28.7	312	46.8	New fraction of methane in biogas recovered in domestic wastewater treatment plants
Portugal	-561	-18.9	-616	-21.2	Implementation of ESD review technical corrections not covered by the UNFCCC review: 1) Septic tanks treatment for industrial WWT: excluded from 2005 onwards; 2) Re-estimation of MCF for unknown situations based on an average weighted MCF of all known industrial treatment situations. 3) Compilation error: emissions from industrial anaerobic treatment were not included in the reported estimates.
Romania	0	0.0	-4	-0.2	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.
Slovakia	0	0.0	0	0.0	
Slovenia	0	0.0	0	0.0	
Spain	854	51.7	494	55.4	IPCC 2006 implemented in industrial wastewater
Sweden	0	0.0	0	0.0	
United Kingdom	2	0.0	-118	-3.4	Updated sectoral production data used as a basis for estimating industrial wastewater arising.
EU28	-262	-0.8	108	0.5	
Iceland	0	19.0	1	21.4	Revised activity data and simplified method to IPCC T1 due to lack of quality data
EU28+ISL	-262	-0.8	109	0.5	

Table 7.20: 5D Waste water treatment: Contribution of member states to EU recalculations in N_2O for 1990 and 2014 (difference between latest submission and previous submission)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Austria	0	0.0	-2	-1.1	Update connection rate to wastewater treatment plants; data on nitrogen flows available (2014)

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Belgium	-121	-48.9	-171	-63.3	As a result of the 2016 ESD-review the following recalculations were performed: The Flanders Region applied IPCC equations 6.9 and 6.7 to estimate N_2O emissions from wastewater treatment and discharge, where previously the human sewage approach was used (IPCC equation 6.8). The Brussels Region applied the human sewage approach (IPCC equation 6.8) but the resulting N_2O emissions are corrected to take into account the nitrogen abatement rate due to the denitrification process in the wastewater treatment plants.
Bulgaria	0	0.0	-1	-0.8	Recalculations are made for the whole time series due to updated information for protein consumption for some years by Faostat, including 2011, 2012 and 2013. N_2O emissions from sludge spreading are calculated only in Sector Agriculture and are excluded from reporting in the waste sector
Croatia	0	0.0	0	0.0	
Cyprus	0	0.1	0	-0.3	The emissions from this source have been recalculated due to the change of the protein supply quantity.
Czech Republic	0	0.0	-7	-3.6	Updated methodology in line with IPCC 2006 GLs.
Denmark	0	0.0	1	1.2	For Wastewater treatment and discharge recalculations occur only in 2013 and 2014 due to updated activity data causing a minor decrease of -0.3% in 2013 and a minor increase in 2014 of 0.4%.
Estonia	0	0.0	0	0.0	
Finland	0	0.0	4	5.3	More accurate and complemented data
France	-7	-0.9	-7	-1.6	Correction of the value of the parameter Fnon-con (from 1,4 to 1,1) on the DOM-COM.
Germany	-11	-1.2	7	1.7	FAO data for protein consumption has been updated; for the year 2014 updated data on the share of denitrification in wastewater treatment plants became available. Updated statistical data for recent years.
Greece	0	0.0	3	1.0	Updated AD and modifications based on TERT 2016 recommendations for MCF.
Hungary	-112	-43.3	-144	-64.2	Bigger methodological change in N_2O emissions (reevaluation of total N in wastewater, taking into account N-removal in modern WWT plants and consequently revision of nitrogen in the effluent)
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Latvia	2	6.9	2	15.0	Update of activity data
Lithuania	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Malta	2	20.8	-7	-59.6	No NIR/information available.
Netherlands	0	0.0	0	-0.2	Final data for 2014 & minor error corrections
Poland	0	0.0	22	3.0	application of FAO's latest protein consumption data

	1990		2014		Main explanations
	kt CO_2 equiv.	Percent	kt CO_2 equiv.	Percent	
Portugal	-109	-33.4	-148	-36.7	1) Implementation of ESD review technical corrections not covered by the UNFCCC review: N_2O emissions from Ind. WW are now estimated together with domestic WW applying a default factor in eq. 6.8 for FIND-COM (factor for ind. and commercial co-discharged protein) = 1.25 (default); previously, industrial WW estimates were based on an old EF = 0.02 kg N_2O/kg inhab-eq from EMEP/CORINAIR (EEA, 2002). 2) Correction of a calculation error in the previous estimates: instead of subtracting N from wastewater effluent (equation 6.8) we were subtracting the N_2O emissions from sludge removal in equation 6.7 and consequently the emissions were underestimated. (EU QA\QC 2017)
Romania	0	0.0	1	0.2	The N_2O emissions from wastewater treatment and discharged were recalculated for 2014 year taking into account the final data associated to total number of population, data provided by National Institute of Statistics.
Slovakia	-9	-6.4	2	3.8	Emissions from waste water treatment (5.D) were recalculated due to new information on the share of modern waste water treatment plants in Slovakia.
Slovenia	0	0.0	0	0.0	
Spain	130	17.7	2	0.2	The recalculation observed in the N_2O emissions is the result of the correction of some errors added to the absence of the estimation of the emissions from the burning of methane without energy valorization (torches).
Sweden	0	0.0	-2	-1.1	Emissions of nitrous oxide from CRF 5.D.1 Domestic wastewater and CRF 5.D.2 Industrial wastewater have been partly recalculated. The reasons for the recalculations are the availability of new activity data from recently published reports, and correction of some activity data.
United Kingdom	270	52.4	296	72.1	Method improvements to use updated indicators for estimating industrial waste water activity data, and also to apply more representative factors (FNON-CON and FIND-COM) for nitrogen loading of the WW system.
EU28	33	0.4	-148	-2.0	
Iceland	1	15.7	-1	-12.2	Country-specific activity data has been reviewed and simplified due to unreliability. An IPCC 2006 Tier 1 approach is now implemented.
EU28+ISL	30	0.4	-149	-2.0	

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, Estonia, 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 2015 in Germany. Denmark reports CO_2 and CH_4 emissions from accidental fires under 5E “Other”. Estonia reports CH_4 and N_2O emissions from biogas burnt in a flare from municipal and industrial sources under 5.E. Spain reports under the category 5E CH_4 emissions from the collected extended sludge from sewage treatment plants for drying, which can be considered as an integral process of wastewater treatment.

Table 7.21 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 2015 (kt CO2 equivalents)	CO2 emissions in 1990 (kt)	CO2 emissions in 2015 (kt)	N2O emissions in 1990 (kt CO2 equivalents)	N2O emissions in 2015 (kt CO2 equivalents)	CH4 emissions in 1990 (kt CO2 equivalents)	CH4 emissions in 2015 (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	-
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	22	NA	NA	NO	1	NO	21
Finland	0	0	NO	NO	NO	NO	NO	NO
France	0	0	NO	NO	NO	NO	NO	NO
Germany	0	78	NA	NA	NO	74	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	NO	NO	NO	NO	NO	NO
Poland	0	0	NO	NO	NO	NO	NO	NO
Portugal	0	0	NA	NA	NO	0	NO	0
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	NA	NA	44	1
Sweden	0	0	-	-	-	-	-	-
United Kingdom	0	0	NO	NO	NO	NO	NO	NO
EU-28	**63**	**125**	**18**	**21**	**0**	**75**	**46**	**29**
Iceland	0	0	NA	-	NO	-	NO	-
United Kingdom (KP)	0	0	NO	NO	NO	NO	NO	NO
EU-28 + ISL	**63**	**125**	**18**	**21**	**0**	**75**	**46**	**29**

Abbreviations explained in the Chapter 'Units and abbreviations'.

7.3 EU-28 uncertainty estimates

Table 7.22 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 CO_2 from 5C. With regard to the uncertainty on trend CH_4 from 5B 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 1.6.

Table 7.22 Sector 5 -Waste: EU-28uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2015	Emission trends 1990-2015	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
5.A Solid Waste Disposal	CO2	0	0		0%	
5.A Solid Waste Disposal	CH4	192 391	99 034	-49%	29%	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	444	3 957	791%	80%	3.8%
5.B Waste Water Handling	N2O	371	2 660	617%	84%	2.5%
5.C Waste Incineration	CO2	5 227	3 211	-39%	15%	0.1%
5.C Waste Incineration	CH4	212	97	-54%	29%	0.3%
5.C Waste Incineration	N2O	187	194	4%	100%	0.4%
5.D Wastewater treatment and discharge	CO2	0	0		0%	
5.D Wastewater treatment and discharge	CH4	32 339	19 569	-39%	51%	0.1%
5.D Wastewater treatment and discharge	N2O	7 811	7 244	-7%	889%	0.8%
5.E Other	CO2	18	21	21%	300%	0.6%
5.E Other	CH4	3	28	968%	49%	2.7%
5.E Other	N2O	11	75	591%	59%	3.5%
Total - 5	**all**	**239 014**	**136 092**	**-43%**	**52.3%**	**11.9%**

***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

There are several activities for improving the quality of estimating and reporting GHG emissions from waste: Before and during the compilation of the EU GHG inventory, several checks are made of the Member States data in particular for completeness, 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 Source category Gas Emissions 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). In 2015, a few Member States volunteered to be reviewed under step 2 of the ESD trial review for the sector waste. In 2016, again a comprehensive review was carried out for all sectors and all EU Member States with a focus on the years 2005, 2008-2010, 2013 and 2014 in order to track progress of the EU Member States under the EU Effort Sharing Decision. (ESD review 2016)

After the implementation of the new IPCC guidelines in 2015 and the subsequent changes to the sector, chapters had to be re-written in 2016, and certain methodological changes had to be applied, which have been reviewed in the 2016 ESD review.

In March 2016, during the WG1-meeting, a note/paper on wastewater treatment and discharge was discussed with the Member States. This note/paper reflects a number of concerns raised during the ESD 2015 trial review. In connection to the ESD review further capacity building activities between the ESD review team and EU sectoral experts have taken place via webinars and distribution of working papers on the main conclusions from the ESD reviews.

In 2016 and 2017, 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.

In the past several workshops have been conducted. 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.

8 OTHER

Sector Other is not an EU key category (see Annex 1.1) and does not include any emissions in 2017.

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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 NOx 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 NOx 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. Six 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 (48 %) and Denmark (25 %). Eight countries reported indirect N_2O emissions in 2015, with Denmark, the United Kingdom, Romania 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 in 2015

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	NO,IE,NA	-	NO,NE,NA	-
Belgium	NO	-	NO	-
Bulgaria	NO	-	864	8%
Croatia	NA,NO	-	NA,NO	-
Cyprus	NO,NE	-	NO,NE	-
Czech Republic	799	48%	309	3%
Denmark	412	25%	5 219	48%
Estonia	NO,NE,IE	-	NO,NE	-
Finland	52	3%	182	2%
France	NO,IE,NA	-	NO,NE	-
Germany	NA,NO	-	NO,IE	-
Greece	NO,NE	-	NO,NE	-
Hungary	NO,NE	-	NO,NE	-
Ireland	NO,NE,IE	-	NE,NO	-
Italy	NO	-	1 123	10%
Latvia	17	1%	NO,IE,NA	-
Lithuania	NO,NE,IE	-	NE,NO	-
Luxembourg	NO,NE	-	NO,NE	-
Malta	NO,NE	-	NO,NE	-
Netherlands	207	12%	NO,NE	-
Poland	NA	-	NA	-
Portugal	175	11%	NO,NE,NA	-
Romania	NO,NE	-	1 567	15%
Slovakia	NO,NE,IE	-	NO,NE,IE	-
Slovenia	NO,NE	-	NO,NE	-
Spain	NE,IE,NA	-	NE,NA	-
Sweden	NO	-	2	0.02%
United Kingdom	NE,NO	-	1 516	14%
EU-28	**1 662**	**100%**	**10 783**	**100%**
United Kingdom (KP)	NO,NE	-	1 526	14%
Iceland	NO,NE	-	NO,NE	-
EU-28+ISL	**1 662**	**100%**	**10 793**	**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, NOx 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)[69] 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.

[69] 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 2014 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.

Recalculations presented are calculated from MS submissions used for the EU submission in September 2016 and MS submissions received until 15 March 2017, corresponding explanations are taken from MS NIR Annex III or directly from the MS NIRs.

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	
1A1_Energy Industries CO_2	Romania	19 518	38	ETS data were used as activity data in the 1A1a category for some specific fuels. Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A1 categories. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A1 categories.
1A1_Energy Industries CO_2	Spain	1 241	2	Oxidation factor=1 implemented (IPCC 2006)
1A2_Manufacturing Industries and Construction CO_2	France	-3 871	-5	Plusieurs modifications et corrections ont été introduites dans la nouvelle édition de l'inventaire pour le secteur 1A2 pouvant affecter l'année 2014 : - liquid fuels : Mise à jour du bilan de l'énergie et correction d'un biais de calcul introduit temporairement dans le bilan de l'énergie de l'édition 2015 pour palier au transfert des consommations des vapocraqueurs en usages non énergétique dans les statistiques alors qu'ils étaient toujours pris en compte dans les usages énergétiques de l'édition 2015 de l'inventaire. - solid fuels : Mise à jour du bilan de l'énergie et transfert de consommations non énergétiques vers CRF 2C (Production de silicium et ferro-silicium) pour toute la série. - Gaseous fuels : Mise à jour du bilan de l'énergie ; transfert de consommations de gaz naturel vers le non énergétique pour la production de HCN sur toute la série ; corrections mineures des quantités de gaz naturel non énergétique pour les productions d'ammoniac et d'hydrogène. - Other fuels : Transfert des émissions de combustion du fuel gaz des vapocraqueurs du 1A2c vers le 2B10 (mise en cohérence de la méthodologie appliquée avec les lignes directrices du GIEC) ; corrections à la baisse sur les consommations d'autres fuels provenant des données du SEQE (principalement secteurs chimie et autres industries) car ces consommations étaient surestimées (erreur dans les PCI considérés). - Biomasse : Transfert de consommations énergétiques vers du non énergétiques (CRF 2C pour la production de silicium et ferrosilicium) pour toute la série. - FE CO_2 : Mise à jour de quelques facteurs d'émission du CO_2.
1A2_Manufacturing Industries and Construction CO_2	Romania	-23 359	-31	Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A2 categories. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A2 categories. In 1A2a category a double accounting was corrected. It was concluded that quantities of solid fuels reported in the IPPU sector were reported as fuels, too. Further to discussions with the National Institute for Statistics and taking into account the the EU-ETS reports in this category, the corresponding quantities of sub-bituminous coal, coke-oven_coke and anthracite were subtracted from the energy sector, iron &steel category, on the entire time -series.
1A2_Manufacturing Industries and Construction CO_2	Spain	601	1	Update of emission factors and oxidation factors. Update of activity data based on new information

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
1A2_Manufacturing Industries and Construction CO_2	United Kingdom	-825	-1	Numerous revisions to UK energy statistics, with decreases in emission estimates for coal and natural gas and increases in those for LPG as a result. Revisions to UK energy statistics for gas oil, plus revisions to the estimated split of gas oil use between 1A2 off-road vehicles & mobile machinery and other sectors, leading to decreased emissions from gas oil. Re-allocation of emissions from use of waste lubricants as fuel from 2D1 to 1A2. The net result of these many changes is a decrease in emissions.
1A3_Transport CO_2	Italy	-536	-1	Revision of AD for road transport
1A3_Transport CO_2	Lithuania	-1 679	-23	Update of diesel oil consumption from road transportation in 2014; Application of new CO_2 EF for natural gas from pipelines transportation (according to new study); Off-road EF revision and emission allocation by sector
1A4_Other sectors CH_4	Germany	1 055	34	Revision of preliminary energy balance. Change of CO_2-EF for diesel. Revised offroad machinery diesel consumption.
1A4_Other sectors CO_2	Italy	-840	-1	Update of activity data
1A4_Other sectors CO_2	Lithuania	1 304	23	Revision of CO_2 emission factors for natural gas, wood/wood waste and other solid biomass based on study "Update of country specific GHG emission factors for Energy sector" (performed in 2016 by Lithuanian Energy Institute); reallocation of off-road emissions according to 1.A.4 sectors instead 1.A.3.
1B1_Solid Fuels CH_4	Czech Republic	1 203	13	updated activity data available and emission factors, explanation provided in NIR
1B1_Solid Fuels CH_4	Poland	-4 090	-16	implementation new methodology of estimating domestic methane emission from coal mining (1.B.1.a.i Coal mining and handling, Underground mines, Mining activities)
1B2_Oil and natural gas CH_4	Romania	-4 382	-15	Recalculation have been made for the entire period 1989-2014. Recalculations were made as a result of due to the improvements on estimating CH_4 emissions at the AD level (CRF category 1B2a2, 1B2b3), at the EFs level (CRF category 1B2a; 1B2b3, 1B.2c)
2B_Chemical industries CO_2	France	3 378	85	-2B1: correction of CO_2 emission data process and emission data converted into liquefied CO_2 and urea for a site in 2014 - 2B8: Transfer of process emissions from steam crackers to CRF 2B10 - 2B10: Transfer of process emissions and combustion of steam crackers (ethylene / propylene + fuel gas) from CRF 2.B.8.b / 2.B.8.g and 1A2c to CRF 2.B.10 .
2B_Chemical industries CO_2	Poland	-566	-13	CO_2 recovered for fertilizer urea production was deducted in calculation of emission for 2B1 subcategory

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
2B_Chemical industries CO_2	Portugal	562	88	In ammonia production subsector (2B1), We implemented the deduction of the CO_2 used for the urea production. This led to a decrease of 29.7 kt of CO_2 in 1990 and 20.7 kt of CO_2 in 2008 (last year with ammonia production). New CO_2 emissions from ethylene production (2B8b), based on 2006 IPCC Guidelines emission factor. Revision of the vinyl chloride monomer (2B8c) activity data for all the period 1990-2014. Review of the time series of activity data and emission factors for the Carbon Black (2B8f) sector.
2C_Metal industry CO_2	France	620	15	Update of CO_2 emissions elated to the use of carbonaceous materials in electric steelworks. Correction of activity data in zinc production. Update of CO_2 emissions from silicium and ferro-silicium production (bottom up). Update of CO_2 emissions in cast iron foundries.
2D_Non-energy products from fuels and solvent use CO_2	Bulgaria	-699	-81	No information available
2D_Non-energy products from fuels and solvent use CO_2	France	1 487	134	Les émissions indirectes de CO_2 (liées à la conversion des COVNM) étaient prises en compte hors du total national dans l'édition précédente à la ligne « Indirect CO_2 ». Cette année, les émissions sont prises en compte dans le total national (CRF 2D) ce qui entraine la différence constatée. En plus d'un transfert de catégorie de ces émissions, il est à noter que le ratio de conversion COVNM/CO_2 a été revu à la baisse passant de 85% à environ 70%.
2D_Non-energy products from fuels and solvent use CO_2	Poland	-1 908	-82	methodology update according to 2006 IPCC GLs
2D_Non-energy products from fuels and solvent use CO_2	United Kingdom	-665	-55	Re-allocation of waste lubricants used for energy from 2D1 to 1A2. Within 2D1, there have also been downward revisions to estimates of emissions from lubricants from non-road transport sectors in order to improve consistency between the UK inventory and UK energy statistics.
3A_Enteric fermentation CH_4	France	1 060	3	Intégration des facteurs d'émission de CH_4 entérique de MONDFERENT II
3A_Enteric fermentation CH_4	Romania	-554	-3	The activity data on milk production from National Institute of Statistics was used for the calculation the values on gross energy intake for dairy cattle. The emissions factors has been recalculated for the 1989-2014 period after using milk production.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3A_Enteric fermentation CH_4	Spain	1 476	12	Important recalculations performed to incorporate (i) corrections applied to the Spanish inventory during the MMR-Step 2 review in 2016, (ii) recommendations proposed in the Step 2 review in 2016 and the UNFCCC review in Sept 2016, (iii) updates to the most recent methodologies, (iv) latest available information at national level regarding agriculture activities, as well as (v) corrections carried out between the submission in January and the March's submission. In general, for the agriculture sector variations for the whole time series between previous and latest editions of the Inventory are due to the set of recalculations performed in activities 3A, 3B, 3D, 3C and 3F, which have caused upward and downward differences with a global upwards result. The upward differences for 3A have been due to the update of the national zootechnical documents for some animal categories (horses and swine), which have risen emissions from horses reduced estimation for mules and asses, keeping with slight fluctuations emissions estimates for white pigs. For cattle, the application of the CH_4 conversion factor of the 2006 IPCC Guide has resulted in an increase of emissions.
3B_Manure management CH_4	Bulgaria	-1 334	-65	Emissions from cattle and swine have been recalculated due to availability of new statistical data for 2015 for the distirbution of manure across management systems. Based on ESD review recommendations, swine manure previously reported in anaerobic lagoons was changed to liquid systems. Correction of emission factor used for the estimation of emissions from buffalo
3B_Manure management CH_4	Portugal	-714	-51	Corrections as a result of internal QA/QC procedures
3B_Manure management CH_4	Spain	905	15	The variations in 3B are due to the change in the methodology estimations previously applied in the Inventory for concatenated manure management systems, which has been replaced by that recommended in the IPCC 2006 GL. This recalculation has resulted in an increase in CH_4 emissions and a decrease in N_2O.
3B_Manure management N_2O	Czech Republic	-850	-26	Nex value updated, indirect N_2O emissions from leached nitrogen have been deleted
3B_Manure management N_2O	France	-513	-18	New categorisation of swine population. Now leaching during storage is only applied to solid systems and related indirect emissions. Moreover indirect N_2O volatilisation was calculated on the basis of all losses by volatilisation including N2, which has now been removed.
3D_Agricultural soils N_2O	France	-936	-3	Nitrogen balance has been fully revised and EMEP/IPCC methodologies have been coordinated for the calculation of indirect emissions. Instead of using default volatilisation factors from IPCC guidelines, emissions of related gases have been calculated with EMEP methods.
3D_Agricultural soils N_2O	Germany	592	2	several chnages in underlying activity data (see NIR!)

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	Lithuania	734	29	In 3.D.1.2.c Other organic fertilizers applied to soils recalculation for 2014 was done due to update of activity data and correction of typing error of dry matter. In 3.D.1.2.b Sewage sludge applied to soils recalculation was made due to update activity data and new data on nitrogen concentration in sewage sludge for 2011-2015 period. Due to recalculations made in CRF 3.B.2 Manure management category, emission from 3.D.1.2.a Animal manure applied and 3.D.1.3 Urine and dung deposited by grazing animals were also recalculated. Recalculation of 3.D.1.4 Crop residue category was made due to: inclusion of silage crops excl. maize, flax, buckwheat, triticale, soya, mixed dry pulses, mixed cereals, other cereals and vegetables categories into estimation of N_2O emission from crop residue; updated data on: dry matter, N content in above-ground residue and N content in below-ground residue parameters according to recent scientific data; as there is a lack of sufficient and reliable scientific data on what amount of N in above-ground residue were removed annually for purposes such as feed, bedding and construction, no removal was assumed (FracREMOVE 0 kg N); FracRENEW for perennial grasses, meadows pastures and permanent pastures/meadows were applied. Due to recalculations of Cropland and Grassland organic soils in LULUCF sector, emission from 3.D.1.6 Cultivation of organic soils was recalculated. Due to recalculations made in 3.D.1 Direct N_2O emissions from managed soils category recalculation has been made in 3.D.2 Indirect N_2O emissions from managed soils atmospheric deposition and N leaching and run-off from managed soil categories.
3D_Agricultural soils N_2O	Spain	-3 037	-24	In 3D activity, the slight differences in the upward movement are due to the recalculations in 3D12a and 3D13 due to revisions of the nitrogen of manure applied to the fields and derived from grazing activities calculated in accordance with 3B. For 3D11 activity no new calculations have been made. Indirect 3D emissions have been also revised in accordance to 2016 review recommendations . A specific national FracLEACH-(H) factor, result of a study of the Spanish Inventory to assess FracLEACH values according to Table 11.3 of the IPCC 2006 Guidelines, has been applied to these emissions estimates, recalculating them downwards. In activity 3F recalculations have meant an increase in CH_4 and N_2O emissions in the early years of the time series with a strong reduction as from 2000. These recalculations come from the update to IPCC 2006-GL methodologies for the category and a review of the activity data in combination with sector 5C2.
3G_Liming CO_2	Germany	1 279	90	no information available
4A_Forest land CO_2	Cyprus	513	84	update of salvage logging data
4A_Forest land CO_2	Estonia	6 295	68	Soil emission factors were updated for remaining Forest land.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
4A_Forest land CO_2	France	1 050	3	Les gains de biomasse sont modifiés du fait de la prise en campagne des nouvelles campagnes de l'IGN qui réduisent fortement l'accroissement comparée à l'extrapolation précédente. Mise à jour des émissions liées aux incendies dans les DOM Les pertes de biomassse sont modifiés sur toute la série du fait de la modification des stocks de référence pour les défrichements ce qui modifie la valeur de prélèvement en forêt restant forêt. Les modifications sont aussi dues à la prise en compte de la mortalité des nouvelles campagnes IGN. Mise à jour de la méthodologie pour l'estimation des flux de carbone des sols grâce aux résultats du RMQS par zone pédo climatique.
4A_Forest land CO_2	Italy	2 948	14	Update of activity data
4A_Forest land CO_2	United Kingdom	5 255	33	Incorporation of new forestry data and new model for soil and litter carbon stock change
4B_Cropland CO_2	Denmark	-1 141	-21	recalculation of CSC in soil, inclusion of abandoned organic soils
4C_Grassland CO_2	France	2 548	15	Modification méthodologique pour la prise en compte de la biomasse des prairies (bosquets, haies) Mise à jour des stocks de référence pour les défrichements. Mise à jour de la méthodologie pour l'estimation des flux de carbone des sols grâce aux résultats du RMQS par zone pédo climatique. Modification méthodologique avec ajout des flux de carbone des sols sur les prairies restant prairies (Tier 1 du GIEC)
4C_Grassland CO_2	Sweden	680	211	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
4C_Grassland CO_2	United Kingdom	-981	-14	Revisions to various categories of emissions. Changes include inclusion of more detailed deforestation area data, following UNFCCC review recommendation and a new methodology for calculating biomass carbon stock change from hedges as a result of grassland management.
4D_Wetlands CO_2	France	2 108	122	Mise à jour de la méthode pour la prise en compte des flux sur les terres impliquant les zones humides, car la méthode précédente basée sur un stock de carbone fixe et très élevé donnait des résultat peu cohérents. Désormais les flux sont le plus souvent supposés inexistants car il n'est pas possible de caractériser les zones humides avec précision.
4E_Settlements CO_2	France	-1 142	-11	Mise à jour de la méthodologie pour l'estimation des flux de carbone des sols grâce aux résultats du RMQS par zone pédo climatique. Prise en compte des stocks de carbone de la biomasse sur les terres artificielles avec arbres Mise à jour des stocks de carbone de référence pour les zones urbanisées sur la base de recherches bibliographiques.
4G_Harvested wood products CO_2	Finland	2 748	64	Error correction, updates in data.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
5A_Solid waste disposal on land CH_4	Bulgaria	1 381	39	Recalculations were performed due to recommendations after ERT in country review in November 2016. They include: • concerning waste components in country specific morphology - separation of paper/paperboard from textile; including of rubber and leather and sludge in morphology; using a default DOC values for each waste component to derive DOC for bulk waste for managed disposal sites for the period 2002-2015. • for unmanaged disposal sites for the period 1950-2001 for DOC calculations country used a default morphology and default DOC values for each waste component to derive DOC of bulk waste • For estimation of CH_4 emissions from Solid waste disposal for methane generation rate (k), country used a default k value = 0.09 for bulk waste for managed and unmanaged disposal sites. • For calculation of CH_4 emissions from 5.A.2 Unmanaged solid waste disposal sites, country used oxidation factor value OX=0.
5A_Solid waste disposal on land CH_4	France	-591	-5	In the previous submission, due to an error (double counting of construction waste stored in ISDND accompanied by the attribution of a DOC relating to municipal waste), the total quantities taken into account were overestimated.
5A_Solid waste disposal on land CH_4	Germany	725	2	Update of dispose waste quantity for the year 2014. In the earlier versions of the NIR, a national value was used for the share of CH_4 in landfill gas (F) of 49% based on official statistical data. In the review process of the NIR this approach was criticized and the use of the IPCC default value of 50% recommended. For this reason, a 50% methane content was calculated. In the Excel calculation tool for the calculation of the methane emissions, transmission errors were corrected (Methane concentration in landfill gas, DOC for mechanically biologically treated wastes).
5A_Solid waste disposal on land CH_4	Netherlands	-620	-4	New figures for solid waste disposal are used.
5A_Solid waste disposal on land CH_4	Spain	-583	-10	IPCC 2006 implemented and new AD from focal point
5A_Solid waste disposal on land CH_4	United Kingdom	-2 415	-4	Improvements in data for commercial and industrial waste sent to landfill in the UK, and a revision of decay rates to align more consistently with IPCC defaults. This leads to small decrease in emissions in the Base Year and slightly higher emissions in later years.
5D_Waste water treatment and discharge CH_4	Germany	930	52	- Updated statistical data for recent years. - Updated data on septic tanks available - Adjustment of MCF to national climate conditions - Update of information on biogas generation from sewage sludge and leakage emissions.
5D_Waste water treatment and discharge CH_4	Greece	-1 635	-41	Updated AD and modifications based on TERT 2016 recommendations for MCF.
5D_Waste water treatment and discharge CH_4	Poland	843	29	new fraction of methane in biogas recovered in domestic wastewater treatment plants

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
5D_Waste water treatment and discharge CH_4	Portugal	-561	-19	Implementation of ESD review technical corrections not covered by the UNFCCC review: 1) Septic tanks treatment for industrial WWT: excluded from 2005 onwards; 2) Re-estimation of MCF for unknown situations based on an the average weighted MCF of all known industrial treatment situations. (previously, MCF applied for industrial treatment unknown situations was based on the weighted average of domestic wastewater treatment); 3) Compilation error: emissions from industrial anaerobic treatment were not included in the reported estimates.
5D_Waste water treatment and discharge CH_4	Spain	854	52	IPCC 2006 implemented in industrial wasterwater

Table 10.2 Main recalculations by source category for 2014 and Member States' explanations for recalculations given in the CRF or in the NIR

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	France	650	2	- 1A1a: a correction of the consumption of biomass in 2014 at an electricity production site in Guyana was achieved - The natural gas consumption of an urban heating site was added over several years, including 2014 (completeness of large installations Of combustion). - 1A1c - Processing of solid mineral fuels: update of coke production for the year 2014 following the receipt of the Energies & Matières report from the Professional Federation (A3M), received too late for the 2016 edition
1A1_Energy Industries CO_2	Germany	735	0	1A1a: Due to an error correction in the calculation model for the waste fuels, Recalculations were made in the years 2008 - 2014. In 2014 it was as usual recalculations were taking place after replacing the preliminary data with the final data from the energy balance 1A1b: The adjustment of the emission factor for refinery gas to the current calorific value resulted in recalculations for liquid fuels in the years 2013 and 2014. After the availability of the final energy balance for 2014, the provisional values have been replaced. That led to recalculations for all fuels. 1A1c: An error correction in the raw brown coal caused too small losses in 2011. For the year 2014, the provisional data were replaced by the final results of the Energy balance. Thus, calculations were required for almost all energy carriers
1A1_Energy Industries CO_2	Spain	1 111	1	Oxidation factor=1 implemented (IPCC 2006)
1A2_Manufacturing Industries and Construction CO_2	France	-8 422	-14	Plusieurs modifications et corrections ont été introduites dans la nouvelle édition de l'inventaire pour le secteur 1A2 pouvant affecter l'année 2014 : - liquid fuels : Mise à jour du bilan de l'énergie et correction d'un biais de calcul introduit temporairement dans le bilan de l'énergie de l'édition 2015 pour palier au transfert des consommations des vapocraqueurs en usages non énergétique dans les statistiques alors qu'ils étaient toujours pris en compte dans les usages énergétiques de l'édition 2015 de l'inventaire. - solid fuels : Mise à jour du bilan de l'énergie et transfert de consommations non énergétiques vers CRF 2C (Production de silicium et ferro-silicium) pour toute la série. - Gaseous fuels : Mise à jour du bilan de l'énergie ; transfert de consommations de gaz

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
				naturel vers le non énergétique pour la production de HCN sur toute la série ; corrections mineures des quantités de gaz naturel non énergétique pour les productions d'ammoniac et d'hydrogène. - Other fuels : Transfert des émissions de combustion du fuel gaz des vapocraqueurs du 1A2c vers le 2B10 (mise en cohérence de la méthodologie appliquée avec les lignes directrices du GIEC) ; corrections à la baisse sur les consommations d'autres fuels provenant des données du SEQE (principalement secteurs chimie et autres industries) car ces consommations étaient surestimées (erreur dans les PCI considérés). - Biomasse : Transfert de consommations énergétiques vers du non énergétiques (CRF 2C pour la production de silicium et ferrosilicium) pour toute la série. - FE CO_2 : Mise à jour de quelques facteurs d'émission du CO_2.
1A2_Manufacturing Industries and Construction CO_2	Germany	1 634	1	Revision of preliminary energy balance. Error correction of waste model. Change of CO_2-EF for diesel. Change of NCVs for solid fuels. Revised offroad machinery diesel consumption.
1A2_Manufacturing Industries and Construction CO_2	Romania	-1 426	-10	Country specific CO_2 EFs for the corresponding fuels from 2014 EU ETS reports were used for all 1A2 categories. Net calorific values determined from the 2014 EU-ETS reports were used for the specific fuels in 1A2 categories. In 1A2a category a double accounting was corrected. It was concluded that quantities of solid fuels reported in the IPPU sector were reported as fuels, too. Further to discussions with the National Institute for Statistics and taking into account the the EU-ETS reports in this category, the corresponding quantities of sub-bituminous coal, coke-oven_coke and anthracite were subtracted from the energy sector, iron &steel category, on the entire time -series.
1A2_Manufacturing Industries and Construction CO_2	Spain	-535	-1	Update of emission factors and oxidation factors. Update of activity data based on new information
1A2_Manufacturing Industries and Construction CO_2	United Kingdom	-895	-2	Numerous revisions to UK energy statistics, with decreases in emission estimates for coal and natural gas and increases in those for LPG as a result. Revisions to UK energy statistics for gas oil, plus revisions to the estimated split of gas oil use between 1A2 off-road vehicles & mobile machinery and other sectors, leading to decreased emissions from gas oil. Re-allocation of emissions from use of waste lubricants as fuel from 2D1 to 1A2. The net result of these many changes is a decrease in emissions.
1A3_Transport CO_2	Germany	-1 001	-1	For 1.A.3.b iii, a recalculation occur due to revised subsector-specific consumption data for all years from 2011 onwards.
1A3_Transport CO_2	Greece	-1 030	-6	Recalculations for road transport included a) the substraction of biodiesel consumption from diesel consumption and b) diesel and gasoline consumption based on energy balance data. Domestic aviation emissions were recalculated from 2008 according to EUROCONTROL calculations and nonETS aviation emissions were reallocated to 1A5 category.
1A4_Other sectors CO_2	Czech Republic	944	10	updated activity data available and emission factors, explanation provided in NIR

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
1A4_Other sectors CO_2	France	-1 560	-2	1A4a:-update the balance of energy for oil products and natural gas. -Modification of consumption of district heating for 2014 which have an impact on the consumption of the 1A4a/1A4b. -Addition of the consumptions of biogas since 1994. 1A4b:-update of the energy balance. -Modification of consumption of district heating for 2014 which have an impact on the consumption of the 1A4a/1A4b. 1A4c:-update of the energy balance.
1A4_Other sectors CO_2	Italy	507	1	Update of activity data
1B1_Solid Fuels CH_4	Czech Republic	551	18	updated activity data available and emission factors, explanation provided in NIR
2B_Chemical industries CO_2	Poland	-823	-15	CO_2 recovered for fertilizer urea production was deducted in calculation of emission for 2B1 subcategory
2B_Chemical industries CO_2	Portugal	592	2 790	In ammonia production subsector (2B1), We implemented the deduction of the CO_2 used for the urea production. This led to a decrease of 29.7 kt of CO_2 in 1990 and 20.7 kt of CO_2 in 2008 (last year with ammonia production). New CO_2 emissions from ethylene production (2B8b), based on 2006 IPCC Guidelines emission factor. Revision of the vinyl chloride monomer (2B8c) activity data for all the period 1990-2014. Review of the time series of activity data and emission factors for the Carbon Black (2B8f) sector.
2C_Metal industry CO_2	Czech Republic	613	9	updated activity data available, explanation provided in NIR
2C_Metal industry CO_2	France	759	22	Update of CO_2 emissions elated to the use of carbonaceous materials in electric steelworks. Correction of activity data in zinc production. Update of CO_2 emissions from silicium and ferro-silicium production (bottom up). Update of CO_2 emissions in cast iron foundries.
2D_Non-energy products from fuels and solvent use CO_2	France	687	66	Les émissions indirectes de CO_2 (liées à la conversion des COVNM) étaient prises en compte hors du total national dans l'édition précédente à la ligne « Indirect CO_2 ». Cette année, les émissions sont prises en compte dans le total national (CRF 2D) ce qui entraine la différence constatée. En plus d'un transfert de catégorie de ces émissions, il est à noter que le ratio de conversion COVNM/CO_2 a été revu à la baisse passant de 85% à environ 70%.
2D_Non-energy products from fuels and solvent use CO_2	Poland	-1 571	-69	methodology update according to 2006 IPCC GLs
2F_Product uses as substitute for ODS HFC	Portugal	784	45	2F1 has been revised completely.
2F_Product uses as substitute for ODS HFC	Spain	-1 219	-7	New AD available regarding regenerated F-gases New estimations of sector coverage New AD available from pharmaceutical companies
3A_Enteric fermentation CH_4	France	697	2	CH_4 emission factors for enteric fermentatiion were taken from MONDFERENT II newly released study

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3A_Enteric fermentation CH_4	Romania	580	6	The activity data on milk production from National Institute of Statistics was used for the calculation the values on gross energy intake for dairy cattle. The emissions factors has been recalculated for the 1989-2014 period after using milk production.
3B_Manure management CH_4	France	504	8	Increased CH_4 emissions due to changes in swine categorisation. Additionally, country-specific data were used for the parameter VS for swine, sheep and goats.
3B_Manure management CH_4	Portugal	-583	-50	Corrections as a result of internal QA/QC procedures
3B_Manure management N_2O	Spain	-647	-28	The variations in 3B are due to the change in the methodology estimations previously applied in the Inventory for concatenated manure management systems, which has been replaced by that recommended in the IPCC 2006 GL. This recalculation has resulted in an increase in CH_4 emissions and a decrease in N_2O.
3D_Agricultural soils N_2O	France	-692	-2	Nitrogen balance has been fully revised and EMEP/IPCC methodologies have been coordinated for the calculation of indirect emissions. Instead of using default volatilisation factors from IPCC guidelines, emissions of related gases have been calculated with EMEP methods.
3D_Agricultural soils N_2O	Germany	534	2	several chnages in underlying activity data (see NIR!)
3D_Agricultural soils N_2O	Lithuania	569	32	In 3.D.1.2.c Other organic fertilizers applied to soils recalculation for 2014 was done due to update of activity data and correction of typing error of dry matter. In 3.D.1.2.b Sewage sludge applied to soils recalculation was made due to update activity data and new data on nitrogen concentration in sewage sludge for 2011-2015 period. Due to recalculations made in CRF 3.B.2 Manure management category, emission from 3.D.1.2.a Animal manure applied and 3.D.1.3 Urine and dung deposited by grazing animals were also recalculated. Recalculation of 3.D.1.4 Crop residue category was made due to: inclusion of silage crops excl. maize, flax, buckwheat, triticale, soya, mixed dry pulses, mixed cereals, other cereals and vegetables categories into estimation of N_2O emission from crop residue; updated data on: dry matter, N content in above-ground residue and N content in below-ground residue parameters according to recent scientific data; as there is a lack of sufficient and reliable scientific data on what amount of N in above-ground residue were removed annually for purposes such as feed, bedding and construction, no removal was assumed (FracREMOVE 0 kg N); FracRENEW for perennial grasses, meadows pastures and permanent pastures/meadows were applied. Due to recalculations of Cropland and Grassland organic soils in LULUCF sector, emission from 3.D.1.6 Cultivation of organic soils was recalculated. Due to recalculations made in 3.D.1 Direct N_2O emissions from managed soils category recalculation has been made in 3.D.2 Indirect N_2O emissions from managed soils atmospheric deposition and N leaching and run-off from managed soil categories.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
3D_Agricultural soils N_2O	Spain	-3 397	-25	In 3D activity, the slight differences in the upward movement are due to the recalculations in 3D12a and 3D13 due to revisions of the nitrogen of manure applied to the fields and derived from grazing activities calculated in accordance with 3B. For 3D11 activity no new calculations have been made. Indirect 3D emissions have been also revised in accordance to 2016 review recommendations . A specific national FracLEACH-(H) factor, result of a study of the Spanish Inventory to assess FracLEACH values according to Table 11.3 of the IPCC 2006 Guidelines, has been applied to these emissions estimates, recalculating them downwards. In activity 3F recalculations have meant an increase in CH_4 and N_2O emissions in the early years of the time series with a strong reduction as from 2000. These recalculations come from the update to IPCC 2006-GL methodologies for the category and a review of the activity data in combination with sector 5C2.
4A_Forest land CO_2	Estonia	-920	-73	Soil emission factors were updated for remaining Forest land.
4A_Forest land CO_2	Finland	-8 851	-30	New, updated or corrected data. New method
4A_Forest land CO_2	Hungary	-770	-17	Most of the changes are due to adding carbon stock changes of the litter pool in the L-FL sectors that were not reported previously; some minor changes are due to correcting calculation errors
4A_Forest land CO_2	Italy	-4 681	-14	Update of activity data
4A_Forest land CO_2	Lithuania	543	6	Recalculations were done in forest land remaining forest land subcategory since interpolation-extrapolation tool for annual growing stock volume change estimation was applied for National forest inventory data for the period 2001 - 2015. Following the implementation of the tool, not only volume of living trees, but also dead organic matter was recalculated.
4A_Forest land CO_2	Portugal	802	6	Harvesting for 2013 and 2014 was revised
4A_Forest land CO_2	Slovenia	1 429	19	Emissions was recalculated due to consideration of relatively high variation in EF for some periods recognized during the 2016 revision.
4A_Forest land CO_2	Spain	-4 310	-13	Methodological review (forest fires emissions), activity data (afforestation/reforestation and forest fires areas) updating and carbon content (DW and LB) updating in FL.
4A_Forest land CO_2	Sweden	-785	-2	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
4A_Forest land CO_2	United Kingdom	815	5	Incorporation of new forestry data and new model for soil and litter carbon stock change
4B_Cropland CO_2	Belgium	1 298	713	See chapter 6.3 in NIR
4B_Cropland CO_2	Denmark	-877	-23	recalculation of CSC in soil, inclusion of abandoned organic soils
4B_Cropland CO_2	France	-3 705	-19	Modification méthodologique pour la prise en compte de la biomasse des cultures (vergers, vignes) Mise à jour des stocks de référence pour les défrichements. Modification méthodologique avec ajout des flux de carbone des sols sur les cultures restant cultures (Tier 1 du GIEC)

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
4B_Cropland CO_2	Italy	-1 009	-31	Update of activity data
4B_Cropland CO_2	Spain	-2 259	-8 457	Activity data (afforestation/reforestation area and CL transitions) updating and carbon content (DW) updating in FL.
4E_Settlements CO_2	France	-514	-4	Mise à jour de la méthodologie pour l'estimation des flux de carbone des sols grâce aux résultats du RMQS par zone pédo climatique. Prise en compte des stocks de carbone de la biomasse sur les terres artificielles avec arbres Mise à jour des stocks de carbone de référence pour les zones urbanisées sur la base de recherches bibliographiques.
4E_Settlements CO_2	Italy	-2 143	-22	Update of activity data
4E_Settlements CO_2	Poland	543	30	Additional estimates of CSC in categories 4.E.2.2 and 4.2.3
4E_Settlements CO_2	Sweden	530	18	Update of area estimates, Update of sub sample data of inventory leads to deviation between sumbissions
4G_Harvested wood products CO_2	Finland	1 750	42	Error correction, updates in data.
4G_Harvested wood products CO_2	Poland	-970	-21	Updated annual historical HWP production data based on FAOSTAT. The projected inflow values were used in Equation 2.8.5 of the IPCC 2013 KP Supplement to estimate carbon stocks, as well as gains and losses.
4G_Harvested wood products CO_2	Spain	-957	-441	Activity data updating.
5A_Solid waste disposal on land CH_4	France	-913	-6	In the previous submission, due to an error (double counting of construction waste stored in ISDND accompanied by the attribution of a DOC relating to municipal waste), the total quantities taken into account were overestimated.
5A_Solid waste disposal on land CH_4	Ireland	-611	-49	Revised method following ESD review
5A_Solid waste disposal on land CH_4	Italy	1 514	11	Update of parameters for landfills
5A_Solid waste disposal on land CH_4	Poland	855	10	update of MSW morphology and fraction of methane in landfill gas
5A_Solid waste disposal on land CH_4	Spain	-3 114	-24	IPCC 2006 implemented and new AD from focal point
5D_Waste water treatment and discharge CH_4	Germany	574	909	- Updated statistical data for recent years. - Updated data on septic tanks available - Adjustment of MCF to national climate conditions - Update of information on biogas generation from sewage sludge and leakage emissions.
5D_Waste water treatment and discharge CH_4	Greece	-562	-37	Updated AD and modifications based on TERT 2016 recommendations for MCF.

Category	MS	1990		Main explanations
		kt CO_2 equiv.	Percent	
5D_Waste water treatment and discharge CH_4	Portugal	-616	-21	Implementation of ESD review technical corrections not covered by the UNFCCC review: 1) Septic tanks treatment for industrial WWT: excluded from 2005 onwards; 2) Re-estimation of MCF for unknown situations based on an the average weighted MCF of all known industrial treatment situations. (previously, MCF applied for industrial treatment unknown situations was based on the weighted average of domestic wastewater treatment); 3) Compilation error: emissions from industrial anaerobic treatment were not included in the reported estimates.

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 15 625 kt (-0.3 %). EU-28 + ISL GHG emissions for 2014 increased by 5 177 kt (+0.1 %) 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	2014
Total CO_2 equivalent emissions including LULUCF (absolute in kt)	3 999	1 500	2 908	3 296	-1 113	8 713	5 979	-1 043	2 260
Total CO_2 equivalent emissions including LULUCF (percent)	0.1	0.0	0.1	0.1	0.0	0.2	0.1	0.0	0.1
Total CO_2 equivalent emissions excluding LULUCF (absolute in kt)	-15 625	-16 013	-10 981	-1 343	-1 537	-888	2 342	-2 294	5 177
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0.3	-0.3	-0.2	0.0	0.0	0.0	0.1	-0.1	0.1

Table 10.4 provides an overview of recalculations for the key categories for 1990 and 2014 (see Section 1.5 for information on identification of key categories). The table shows that the largest recalculations in absolute terms were made in the key category CO_2 from 1A2 ‘Manufacturing industries’ for 1990 and 2014.

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 2014. Large recalculations in absolute terms were made in Belgium, Bulgaria, the Czech Republic, Estonia, France, Germany, Greece, Italy, Poland, Portugal, Romania, Spain and the United Kingdom. Recalculations in relative terms of more than 2 % were made in Estonia, Greece, Lithuania, Malta, Portugal, Romania and Iceland.

Table 10.4 Recalculations for the EU-28 and Iceland key source categories 1990 and 2014 (difference between latest submission and previous submission in kt of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2014	
		(kt CO_2 equivalents)	(%)	(kt CO_2 equivalents)	(%)
1.A.1. Energy Industries	CO_2	20890	1.3%	8494	0.7%
1.A.1. Energy Industries	N_2O	-39	-0.5%	-131	-1.7%
1.A.2. Manufacturing Industries	CO_2	-27496	-3.2%	-10705	-2.2%
1.A.3. Transport	CO_2	-2506	-0.3%	2904	0.3%
1.A.3. Transport	CH_4	54	0.8%	5	0.4%
1.A.3. Transport	N_2O	-189	-2.3%	-413	-4.4%
1.A.4. Other Sectors	CO_2	1066	0.1%	1256	0.2%
1.A.4. Other Sectors	CH_4	1327	6.2%	562	3.5%
1.A.5. Other	CO_2	-8	0.0%	371	5.8%
1.B.1. Solid Fuels	CH_4	-2777	-2.8%	4664	19.9%
1.B.2. Oil and Natural Gas	CH_4	-4108	-5.9%	-296	-0.8%
1.B.2. Oil and Natural Gas	CO2	-61	-0.3%	-506	-2.2%
2.A. Mineral Industry	CO_2	-322	-0.2%	87	0.1%
2.B. Chemical Industry	CO_2	3748	7.0%	3060	6.3%
2.B. Chemical Industry	Unspecified mix of HFCs and PFCs	0	0.0%	0	0.0%
2.B. Chemical Industry	N_2O	61	0.1%	-1	0.0%
2.B. Chemical Industry	HFCs	0	0.0%	1	0.2%
2.C. Metal Industry	CO_2	1340	1.2%	2022	2.8%
2.C. Metal Industry	PFC	488	2.3%	2	0.4%
2.D. Non-energy products from fuels and solv	CO_2	-2416	-14.8%	-1582	-13.2%
2.F. Product uses as substitute for ODS	HFC	0	3.6%	494	0.4%
3.A. Enteric Fermentation	CH_4	2446	1.0%	3556	1.9%
3.B. Manure Management	CH_4	-1158	-2.1%	-475	-1.1%
3.B. Manure Management	N_2O	-1799	-5.7%	-1521	-6.8%
3.D. Agricultural Soils	N_2O	-2360	-1.2%	-2530	-1.5%
3.G. Liming	CO_2	1219	11.9%	-170	-2.7%
5.A. Solid Waste Disposal	CH_4	-2522	-1.3%	-2063	-1.9%
5.B. Biological Treatment of Solid Waste	N2O	8	2.6%	-100	-3.4%
5.B. Biological Treatment of Solid Waste	CH_4	20	5.7%	285	7.4%
5.D. Waste Water treatment and discharge	CH_4	-262	-0.8%	109	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 1990–2014 (difference between latest submission and previous submission kt of CO_2 equivalents)

	1990	1995	2000	2005	2010	2011	2012	2013	2014
Austria	-40	2	104	-169	113	70	141	108	49
Belgium	273	328	267	293	-821	-1030	239	5	212
Bulgaria	-388	872	1101	1036	480	518	485	381	308
Croatia	-51	14	82	27	49	155	387	152	150
Cyprus	-16	-24	-13	34	54	36	55	86	29
Czech Republic	-1313	-1060	-1518	-1068	-583	-905	-260	-176	731
Denmark	-315	-326	-302	-358	-385	-388	-319	-458	-368
Estonia	438	282	251	859	1232	698	695	180	22
Finland	-48	-43	-7	29	-277	-328	-14	-82	21
France	1091	-1181	-470	308	-1587	-1127	-3 472	-3 451	-4 463
Germany	4 814	2 333	1894	2 017	2 378	2 212	2 148	1666	4 060
Greece	-1746	-1683	-1360	223	-424	-351	-167	-2 232	-2 050
Hungary	-238	-231	-96	-159	-118	41	34	-153	654
Ireland	15	-19	-176	-340	-543	-563	-499	-559	-431
Italy	-2 003	-2 352	-1616	544	-3 377	-3 648	1424	1583	4 737
Latvia	-115	-102	-98	-90	-159	-169	-162	-164	-163
Lithuania	831	699	861	760	620	697	688	692	730
Luxembourg	-140	-39	-126	-84	-71	-49	-22	6	-15
Malta	382	66	35	20	-80	-97	-91	-52	-52
Netherlands	-766	-665	-536	-91	398	228	147	581	526
Poland	-5 115	-6 331	-1678	1529	3 374	3 148	2 088	2 440	2 932
Portugal	-1060	-1325	-1472	-1992	-904	-513	-563	-389	-162
Romania	-8 548	-3 783	-2 154	-2 796	1844	2 829	1870	3 552	3 906
Slovakia	-44	-138	65	40	17	-209	14	32	20
Slovenia	-22	-40	-34	-25	-16	-15	5	27	28
Spain	1894	2 222	469	1082	-4 039	-3 402	-3 591	-4 574	-4 711
Sweden	-281	-253	-171	-113	-442	-432	-416	-402	-546
United Kingdom	-3 022	-3 130	-4 189	-2 795	1812	1816	1594	-1020	-833
EU-28	**-15 577**	**-15 962**	**-10 943**	**-1 252**	**-1 397**	**-728**	**2 474**	**-2 200**	**5 335**
Iceland	-91	-105	-96	-61	-80	-110	-97	-73	-142
EU-28 + ISL	**-15 625**	**-16 013**	**-10 981**	**-1 343**	**-1 537**	**-888**	**2 342**	**-2 294**	**5 177**

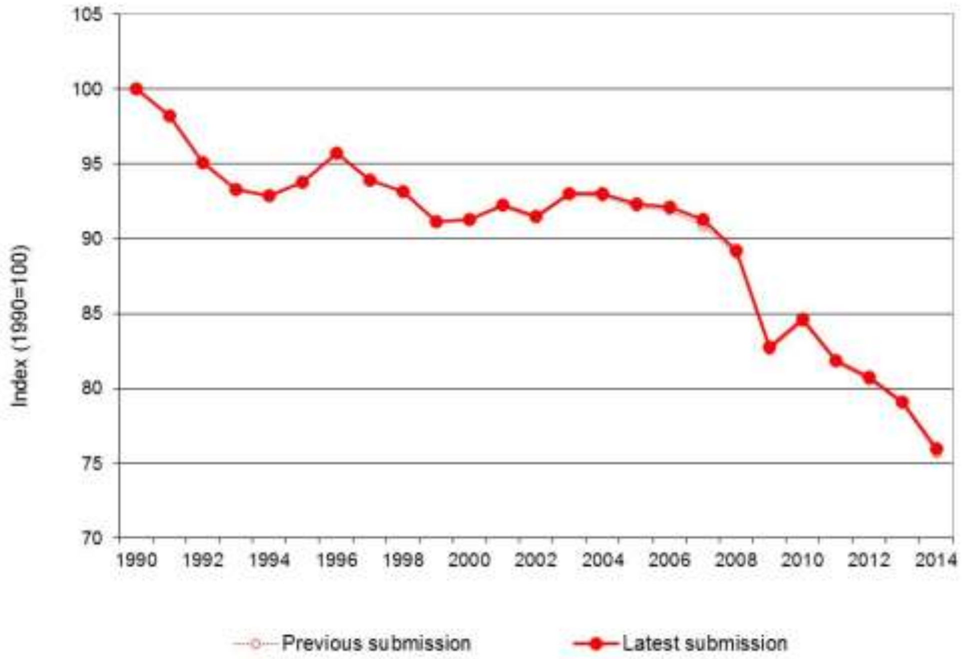
Table 10.6 Contribution of Member States to EU-28 recalculations of total GHG emissions with indirect CO_2 and without LULUCF for 1990–2014 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2010	2011	2012	2013	2014
Austria	-0.1	0.0	0.1	-0.2	0.1	0.1	0.2	0.1	0.1
Belgium	0.2	0.2	0.2	0.2	-0.6	-0.8	0.2	0.0	0.2
Bulgaria	-0.4	12	19	17	0.8	0.8	0.8	0.7	0.5
Croatia	-0.2	0.1	0.3	0.1	0.2	0.6	16	0.6	0.7
Cyprus	-0.3	-0.3	-0.2	0.4	0.6	0.4	0.6	11	0.3
Czech Republic	-0.7	-0.7	-10	-0.7	-0.4	-0.7	-0.2	-0.1	0.6
Denmark	-0.4	-0.4	-0.4	-0.5	-0.6	-0.7	-0.6	-0.8	-0.7
Estonia	11	14	15	4.7	6.2	3.4	3.6	0.8	0.1
Finland	-0.1	-0.1	0.0	0.0	-0.4	-0.5	0.0	-0.1	0.0
France	0.2	-0.2	-0.1	0.1	-0.3	-0.2	-0.7	-0.7	-10
Germany	0.4	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.5
Greece	-17	-15	-11	0.2	-0.4	-0.3	-0.1	-2.1	-2.0
Hungary	-0.3	-0.3	-0.1	-0.2	-0.2	0.1	0.1	-0.3	11
Ireland	0.0	0.0	-0.3	-0.5	-0.9	-10	-0.9	-10	-0.7
Italy	-0.4	-0.4	-0.3	0.1	-0.7	-0.7	0.3	0.4	11
Latvia	-0.4	-0.8	-0.9	-0.8	-13	-15	-14	-14	-14
Lithuania	18	3.2	4.6	3.4	3.1	3.4	3.3	3.6	3.8
Luxembourg	-11	-0.4	-13	-0.6	-0.6	-0.4	-0.2	0.1	-0.1
Malta	19.1	2.6	13	0.7	-2.6	-3.0	-2.7	-18	-18
Netherlands	-0.3	-0.3	-0.2	0.0	0.2	0.1	0.1	0.3	0.3
Poland	-11	-14	-0.4	0.4	0.8	0.8	0.5	0.6	0.8
Portugal	-17	-19	-18	-2.3	-13	-0.7	-0.8	-0.6	-0.3
Romania	-3.4	-2.0	-15	-19	15	2.3	15	3.2	3.5
Slovakia	-0.1	-0.3	0.1	0.1	0.0	-0.5	0.0	0.1	0.0
Slovenia	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.1	0.2
Spain	0.7	0.7	0.1	0.2	-11	-0.9	-10	-14	-14
Sweden	-0.4	-0.3	-0.2	-0.2	-0.7	-0.7	-0.7	-0.7	-10
United Kingdom	-0.4	-0.4	-0.6	-0.4	0.3	0.3	0.3	-0.2	-0.2
EU-28	**-0.3**	**-0.3**	**-0.2**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.1**
Iceland	-2.5	-3.1	-2.4	-16	-17	-2.4	-2.1	-16	-3.1
EU-28 + ISL	**-0.3**	**-0.3**	**-0.2**	**0.0**	**0.0**	**0.0**	**0.1**	**-0.1**	**0.1**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both 1990 and 2014 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 2014 was - 24.4 %. In the latest submission the trend is - 24.1 %.

Figure 10.1: Comparison of EU-28 and Iceland GHG emission trends 1990–2014 (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 / Sector	Category, TACCC	Reference	Recommendation	Status
General	Completeness	ARR 2014	The NIR states that, since 2011, the inventory for all member States has been complete, and therefore no gap filling for emissions has been needed. Nevertheless, some EU member States still report “NE” for several mandatory LULUCF and KP LULUCF categories. therefore, the ERT recommends that the Party continue its efforts to improve the completeness of the reporting of emissions from all mandatory categories in the LULUCF sector, and also encourages the Party to improve the completeness of the reporting of emissions for non-mandatory categories.	The completeness of the EU GHG inventory is assessed every year during the QA/QC checks in order to identify completeness issues reported by the EU MS. When an issue is identified, individual MS are requested to provide explanations on reasons for omitting estimates, and on the efforts that are ongoing to solve the issue. In addition, the EU continues working with its MS in order to increase the accuracy and completeness of their estimates. Every year, during the annual LULUCF workshop organized by the JRC of the EC, several ways on how to implement higher tiers methods and ensure the completeness, with enhanced information on activity data and emissions factors is shared among MS and other Parties. Moreover bilateral support is also provided to some MS with the aim of ensure the completeness of the inventory. As result of the implemented efforts by individuals MS and the EU, in 2017, as compared with the year 2012, the completeness on Living biomass, DOM, soil organic carbon in mineral and in organic soils under Land converted to Cropland has increased respectively by about 4, 13, 9 and 2 MS that have reported these pools for first time during the recent years (see also Table 6.5 for information on completeness of current reporting). Nevertheless, despite of this efforts, in the year 2017 some MS reported the notation key NE under certain mandatory pools categories and the EU will continue devoting efforts to increase the completeness.
General	Consistency	ARR 2014	Work with member States in order to report consistent notation keys that transparently describe the completeness of the overall inventory	Harmonization of notation key use is ongoing process. During the initial checks MS get informed if their use of notation keys differs from the majority of other MS.
General	Transparency, Uncertainty analysis	ARR 2014	Transparently describe any changes in overall uncertainty estimates in the NIR on an annual basis	This has been implemented. Please refer to chapter 1.6.
General	Other	ARR 2014	Provide an update on the progress of implementation of all recommendations in the NIR. In the NIR 2016, table 10.7 EU updated some of the implementation provided by previous ERT.	Table 10.7 now lists the progress of implementation for all 'open' recommendations.
Energy	1. General , Transparency	ARR 2014	Enhance the transparency and consistency in the reporting of recalculations, by working with the member States to achieve the enhancement of the European Union QA/QC system	To check MS recalculations and their explanations is part of the initail checks. For each (sub)sector a tabls is included in the EU NIR showing the recaclculations andcoerresponding explanations as provided by the MS in Annex 3 or directly in their NIR. If explanations are missing the MS is asked during the initial checks to provide the missing information in their next NIR.

NIR chapter / Sector	Category, TACCC	Reference	Recommendation	Status
Energy	1. General , Transparency	ARR 2014	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	The information on methodologies and emission factors is not available from the CRF/XML on fuels level for some sub-categories like 1A1a, 1A1c …. Note that for other categories like 1A1b this information is available on fuel split level. Information on methodologies and emissions factors has been inlcuded in all tables in the NIR where possible.
Energy	International bunkers and multilateral operations, Transparency	ARR 2014	Use most recent results of the collaboration with Eurocontrol to improve the accuracy of emission estimates for the European Union and for the member States, ensuring the consistency in the time series in accordance with the IPCC good practice guidance and report on the results of the collaboration in the NIR	This recommendation is not implemented, as it goes beyond the scope of the EU NIR.
Energy	Feedstocks, Consistency	ARR 2014	Continue with efforts to ensure consistency of the reporting among member States, in particular with regards to the allocation of emissions between the energy and industrial processes sectors	Planned for 2018
IPPU	2.A.1 Cement production – CO2, Transparency	ARR 2014	The ERT noted in the NIR, under the Convention, that Poland does not provide adequate information on AD collection and EF determination. In response to a question raised by the ERT during the review, the European Union stated that Poland had explained that methodological descriptions are available in its own NIRs, and that the submissions of member States are also part of the European Union's submission. The ERT considers that referring to the NIRs of member States does not ensure sufficient transparency within the NIR of the European Union, and therefore recommends that the Party include the relevant information from the Polish NIR in the European Union's NIR.	In response to a question asked during the ESD review with respect to the methodological tier for calculating cement manufacture emissions, it was confirmed that the method used for CO2 estimation from clinker production in Poland was as follows: - 1988-2000 - Tier 1 method with CS EF (the average value from EFs for the years 2001-2004) - 2001-2004 - Tier 2 method with CS EFs based on country case study - 2005 onwards - Tier 2 method based on EU ETS reports. This confirms and elaborates on the information provided in the POL NIR. This has been updated in the Annex III Methodological descriptions for 2A1.
IPPU	2.A.2 Lime production – CO2, Transparency	ARR 2014	Tthe ERT reiterates the recommendation made in previous review reports that the European Union provide more information for Italy about the methods used to estimate emissions from lime production for the entire time series; in particular there should be transparent documentation on whether the method is based on the amount of calcium carbonate from raw material or on the amount of calcium and magnesium oxides in the lime produced for each of the periods. The ERT also recommends that the European Union provide more information for Italy about the underlying drivers for the changes in IEF since 2005 and on how time-series consistency has been maintained.	Further appropriate detail from ITA NIR, section 4.2.2 has been included in the Annex III Methodological descriptions for 2A2.

NIR chapter / Sector	Category, TACCC	Reference	Recommendation	Status
IPPU	2.A.4 Other process uses of carbonates – CO2, Consistency	ARR 2014	The ERT recommends that the European Union include this information for Croatia in the NIR in order to enhance the transparency of the description of methods and also recommends that the European Union work with Croatia to ensure the consistency of the full time series.	Croatia was asked to clarify if the variation in Lime production emissions, emission factors and IEFs in recent years reflects recent changes in production volume and ratio of quicklime and dolomitic lime. Variation in IEFs (since 2011) reflects recent changes in lime production volume and ratio of quicklime and dolomitic lime and the fact that total quicklime production (from factories of lime and sugar refineries) is included in the CRF tables, while emissions only from factories of lime are included in the CRF. [HVR NIR, section 4.2.2.2]
IPPU	2.B.1 Ammonia production – CO2, Transparency	ARR 2014	The ERT recommends that the European Union provide in its NIR adequate and transparent methodology overviews for France and Germany to enable the ERT to make a thorough review of the AD and EFs used in the ammonia production emission estimations of these countries.	More detailed time series information on AD and EFs and methodology is included in the DEU and FRA NIRs
IPPU	2.B.1 Ammonia production – CO2, Comparability	ARR 2014	On the basis of the status report provided by the European Union in table 4.23 of the NIR (on the implementation of previous recommendations), the ERT reiterates the recommendation made in previous review reports that the European Union make efforts to ensure that Greece complete the on-going work to obtain more accurate data on the amount of liquid fuel used as feedstock and the updated AD in the emission estimates.	Greece has made efforts on this matter however the lack of information on the liquid fuels used is because the relevant plant ceased operation in 1999. [GRC NIR, section 4.6]
IPPU	2.C.3 Aluminium production – CO2, PFCs , Transparency	ARR 2014	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.	This information is provided in chapter 4.2.3.2 of the NIR. Additional information can also be found in the individual NIRs of the Member States (Greece: page 217, Netherlands: page 145, Sweden: page 253).
IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs, PFCs and SF6, Transparency	ARR 2014	The ERT recommended the EU to endeavour to provide in the NIR summary overviews of methodologies used to estimate emissions from consumption of halocarbons and SF_6 for key categories based on the relevant methodological descriptions reported in the NIRs of its member States.	Methodology and emission factors are included for 2F1, 2F2, 2F3 and 2F4 (colums in tables, 4,5,6,7). For SF6 emissions several emission sources are included in 2G which would lead to very detailed methodological descriptions which have not been included for this submission.

NIR chapter / Sector	Category, TACCC	Reference	Recommendation	Status
IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs, PFCs and SF6, Transparency	ARR 2014	The ERT reiterates the recommendation made in the 2012 review report that the European Union make the necessary corrections in the use of notation keys to ensure the transparency of its reporting.	No longer relevant in our understanding.
IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs, PFCs and SF6 , Transparency	ARR 2014	There is an inconsistency between EU NIR and Netherlands NIR. In the EU NIR no notation key was used for 2.F.3 of the Netherlands and 2.F.4 reported as NO. However the Netherlands are reporting these emissions under 2.F.6. The ERT recommends the EU to include an explanation in the annual submission on the reporting of the emissions in the processes related to the use of HFCs and SF_6in the Netherlands and enhance the QC procedures to ensure that the information in the European Union's NIR accurately reflects the information in the NIR of member States.	The NIR includes the following statement: "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." This relates in particular to the situation of the Dutch NIR. No further explanations on 2F5 and 2F6 are provided.
IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs, PFCs and SF6, Accuracy	ARR 2014	The country-specific methodology used by Greece is not transparently described in the NIR, in particular, AD and EF used are not presented in the NIR. The ERT recommends the EU to work with Greece in order to implement appropriate country-specific methodologies to estimate HFCs and/or PFCs emissions in accordance with the 2006 IPCC guidelines.	The issue has been highlighted in the past but represents rather a field of action for Greece (in particular data collection, establishment of a robust methodology etc.) than an issue the EU could work on.
Agriculture	3.B Manure management – N2O, Consistency	ARR 2014	TheERT recommended the EU to elaborate an explanation for the increase in nitrogen excretion rate for swine for Sweden in the NIR.	The explanation has been included in the NIR 2017 in section 5.2.2 Manure management N2O, as follows: "Sweden explains this fact by an update of nitrogen production data for sows and pigs in 2002, due to more intense swine production. The time trend also shows steps because surveys are only done biannually and small percentage differences in the survey have a significant effect on emissions, emission factors differing considerably between the different systems"

NIR chapter / Sector	Category, TACCC	Reference	Recommendation	Status
LULUCF	4.A.2 Land converted to forest land – CO2	ARR 2014	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.	The EU made progress with Italy to ensure that the issue raised by the ERT is solved. Italy provided information on this issueto the EU that was also included in the Italy's NIR. In section 6.2.1.3 of the EU NIR a mention to the refinement carried out by Italy to improve the accuracy of the estimates is included. More detailed information on the methods used by Italy to report carbon stock changes from Land converted to Forest land is included as an Annex of the EU NIR and in the Italy's NIR.
LULUCF	4.B.2 Land converted to cropland – CO, Transparency	ARR 2014	The ERT recommends the EU to provide transparent explanations in the annual submission, indicating the key drivers for the changes in the trend and recalculations.	Following the recommendation from the ERT, the EU has included in the NIR more detailed explanations on reasons for the changes in the EU trends and recalculations. An example can be found in section 6.2.1.3. With the inclusion of new graphs on trends for each land use subcategory, the EU progressed in identifying those MS with the highest contribution to the EU trend and to its changes, and more detailed explanations were included in the 2017 EU NIR. In addition, country-specific information on recalculations for the base year and the last year of the time series for which recalculations can be identified are included at the end of chapter 6. The EU will continue improving the transparency by updating each year the descriptions on reasons for changes in the EU trends and the information on recalculations.
LULUCF	4.B.2 Land converted to cropland – CO2 , Completeness	ARR 2014	The previous ERT recommended the EU to work with the member States to improve the completeness of their reporting and use higher-tier methods in order to enhance accuracy. The current ERT notes that the current approach of reporting does not allow to review the completeness by country and pool in this category. Nevertheless, the ERT notes that some member States still do not provide emissions and removals for this activity. The ERT reiterates the recommendation made in the previous reviews reports 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	The completeness of the EU GHG inventory is assessed every year during the QA/QC checks in order to identify completeness issues reported by the EU MS. When an issue is identified, individual MS are requested to provide explanations on reasons for omitting estimates, and on the efforts that are ongoing to solve the issue. In addition, the EU continues working with its MS in order to increase the accuracy and completeness of their estimates. Every year, during the annual LULUCF workshop organized by the JRC of the EC, several ways on how to implement higher tiers methods and ensure the completeness, with enhanced information on activity data and emissions factors is shared among MS and other Parties. As result of the implemented efforts by individuals MS and the EU, in 2017, as compared with the year 2012, the completeness on Living biomass, DOM, soil organic carbon in mineral and in organic soils under Land converted to Cropland has increased respectively by about 4, 13, 9 and 2 MS that have reported these pools for first time during the recent years (see also Table 6.5 for information on completreness of current reporting). Moreover the use of higher tiers methods has also increase among MS, Nevertheless, for subcategories "land converted to" a Tier categorization depends on which land is been converted to therefore it would not possible to provide a single tier method.

NIR chapter / Sector	Category, TACCC	Reference	Recommendation	Status
LULUCF	4.F.2 Land converted to other land – CO2, Transparency	ARR 2014	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.	As recommended by the ERT, the EU has included such information in the NIR. Specifically, this can be found in section 6.2.4.3.
LULUCF	4 (V) Biomass burning – CO2, CH4 and N2O, Transparency	ARR 2014	The ERT recommended the EU to include the reasons for the use of the notation key "NE" when applicable and make efforts to increase the completeness of reporting.	As recommended by the ERT, the EU has included such information in the NIR. Specifically, in section 6.2.5.5 an overview of reasons for the use of notations key, and in particluar the notation key NE, can be found.
KP-LULUCF	General (KP-LULUCF), Adherence to UNFCCC Annex I inventory reporting guidelines	ARR 2014	The ERT recommends that the European Union continue to work with and support member States to improve consistency in the use of notation keys and further improve the transparency of its future submissions.	The EU has progressed and continue working towards the harmonization on the use of notation keys among MS and the provision of transparent information on reasons whenever a notation key was used. During the QA/QC checks, MS were contacted whenever a clear erroneous selection of notation key was identified. Moreover, the harmonization on the use of notation keys has been an issue subject to discussion during the annual technical LULUCF workshops organized by the JRC of the EC. Nevertheless, noting that a full harmonization of the notation keys among MS will requiere more time given the wide range of cases in which they are used, MS are always requested to provide transparent information on the use of notation keys, and such information is used to provide a synthesis of reasons for the use of the notation keys that is included across sections of the EU NIR.
KP-LULUCF	Deforestation – CO, Adherence to UNFCCC Annex I inventory reporting guidelines	ARR 2014	The ERT welcomed the explanation provided on the use of notation keys and recommends that the European Union work with member States so that they use the appropriate notation keys and also recommends that the European Union provide a synthesis in its NIR of the explanations and justifications provided by member States.	As recommended by the ERT, the EU has included such information in the NIR. Specifically, this can be found in section 11.3.2
KP-LULUCF	Forest management – CO_2, Transparency	ARR 2014	The ERT reiterates the recommendation made in the previous review report that the European Union work with its member States to ensure that future reporting on forest management is complete and accurate.	The completeness of the KP-LULUCF sector is checked every year during the initial QA/QC checks. MS are always requested to provide quantitative estimates for carbon stcok changes for each mandatory and voluntarely elected activity, or otherwise to include transparent and verifiable information to demostrate that the omitted carbon pool is not a net source of emissions. A synthesis of this information is provided in the table 11.17 of the EU NIR. Moreover, specifically for the issue raised in ARR 2014, as regards with France; France is implemneting significant improviments to enhance the reporting of forest related activities under the KP-LULUCF. Billateral discussions have been already hold , and it is expected that with these improviments in next submission the potential incompleteness reporting of France under FM will be solved.

NIR chapter / Sector	Category, TACCC	Reference	Recommendation	Status
Waste	5. General, Transparency	ARR 2014	recommends that the European Union continue to work with and support member States to improve consistency in the use of notation keys and further improve the transparency of its future submissions.	This recommendation is not implemented, as it goes beyond the scope of the EU NIR. The EU NIR is not an assessment of MS compliance, nor an assessment of potential problems at MS level.
Waste	5. General , Adherence to UNFCCC Annex I inventory reporting guidelines	ARR 2014	The ERT observed some apparent errors in figure 8.2 of the NIR (page 819): the key category CH4 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 to ensure consistency between the NIR and the CRF tables.	This recommendation is not implemented. AD for the waste sector is quite complex and goes back until 1950 in most Member States. So it is not possibe to include more information in the NIR and also detailed checks of consistency go beyond the scope of the initial checks and should be part of the individual country reviews.
Waste	5.A Solid waste disposal on land – CH4, Transparency	ARR 2014	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.	Clarified. This issue referred to Cyprus that reported CH4 emission frm 5.A.1 and 5.A.2 under 5.A.3 in the 2016 submission. In the 2017 submission Cyprus improved the reporting and reported all CH4 emissions from solid waste disposal under 5.A.1 or 5.A.2. Only a few Member States still report CH4 emissions from 5.A.3 because they have uncategorized landfills. Detailed information on 5.A.3 is still not included in the NIR as this is no EU key category.

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

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 those that elected to account for these activities during the second commitment period (CP2) of the KP.

It is important to note that each MS and Iceland will account for net emissions and removals for each activity under Article 3(3) and (4), if elected, by issuing RMUs or cancelling Kyoto Protocol units based on the corresponding reported emissions and removals from these activities and the specific accounting rules. The EU will neither issue, nor cancel units based on the reported emissions and removals from activities under Article 3(3) and (4).

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 CP2 of the KP, the JRC[70] provided MS with a proposal on the outline for reporting KP-LULUCF supplementary information within the national inventory reports (NIR). Nevertheless, the type and amount of information reported by MS and Iceland slightly differs among inventories. Therefore, note that this chapter does not aim to provide an exhaustive compilation of all supplementary information reported by MS and Iceland, but only an overview of the most important elements on KP-LULUCF. For more detailed information, we suggest the readers to refer to MS and Iceland 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 and Iceland.
- Information related to the land representation approach for KP-LULUCF activities.
- Activity-specific information, (i.e. methodologies for estimating carbon stock changes and other source of GHG emissions, justification for omitting carbon pools, 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 disturbances, information on HWP, methods for the construction of the FMRL, whether MS and Iceland have implemented technical corrections, 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. To achieve this, the consistency of the MS and Iceland national GHG inventories with good practices is checked twice every year, before national GHG inventories are officially

[70] Joint Research Centre of the European Commission

submitted to UNFCCC. One check is in the context of MS' own QA/QC procedures, and a second one in the context of the EU's QA/QC procedures as implemented by the EU JRC experts in the context of the Regulation 525/2013.

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 and Iceland 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 carbon pools and GHG emissions reported by EU MS and Iceland for each mandatory and elected activities.

Carbon stock changes are estimated in most cases for biomass pools, but for dead organic matter and soil organic matter pools notation keys are also used. “NE” is mainly used when the “not a source” provision is applied, while “IE” is mainly used for belowground biomass (being included under aboveground biomass) or for “gain” or “losses” in living biomass when the stock difference method is applied and a net gain or net loss is then reported. In addition, “IE” is also used when carbon stock changes in litter and dead wood are reported together or when dead organic matter and soil organic matter pools are estimated by using models not capable to apportion net carbon stock changes among pools.

Despite the continuous improvements implemented by MS and Iceland in their GHG inventories, when implementing the “not a source” provision, both the EU QA/QC procedures and the UNFCCC expert review teams highlighted the need of providing more transparent information to demonstrate that omitted carbon pools are not a net source of emissions. After such recommendations more detailed information has been provided in individual inventories during the recent years and a synthesis of such information is presented in Table 11.17.

Concerning to other sources of emissions, a full set of quantitative estimates is not yet provided by MS and Iceland, 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, for instance, following IPCC methods, when the source of information does not allow to separate the final destination of the nitrogen fertilizers.

Table 11.2 *Synthesis of carbon 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 2015)*

Member State	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	R	NO	NO	NO	NO
Belgium	R	R	R	R	R	NO	R	NO	NO	NO	R	NO	NO	NO	NO
Bulgaria	R	IE	R	NO	R	NO	R	NO	NO	NO	NO	NO	R	R	R
Croatia	R	R	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	NO	NO	NO
Estonia	R	R	R	R	R	R	R	NO	NE	NE	NO	NO	IE	R	R
Finland	R	R	IE	IE	R	R	IE	R	R	R	R	R	R	R	R
France	R	R	R	R	R	IE	NO	NO	NO	NO	R	NE	R	R	R
Germany	R	R	R	R	R	R	IE	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	NO	NO	NO
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	R	NO	R	R	R	R	NO	NO	NO
United Kingdom	R	IE	R	IE	R	R	R	R	NE	R	R	R	R	R	R
Iceland	R	R	R	NO	R	R	NO	R	R	R	NE	NE	NO	NO	NO
Deforestation															
Austria	R	R	R	R	R	NO	IO	NO	NO	NO	R	NO	NO	NO	NO
Belgium	R	R	R	R	R	NO	R	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	R	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	NO	NO	NO
Estonia	R	R	R	R	R	R	R	NO	NE	NE	NO	NO	NO	NO	NO
Finland	R	R	IE	IE,R	R	R	IO,NO	IE	R	R	R	IE	R	R	R
France	R	R	R	R	R	IE	IO	NO	NO	NO	R	NE	R	R	R
Germany	R	R	R	R	R	R	NO	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	R	NO	NO	NO	NO
Luxemburg	R	R	R	R	R	NO	IO	NO	NO	NO	R	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	R	NO	NO	NO
United Kingdom	R	IE	R	IE	R	IE	IO	NO	NO	NO	R	R	R	R	R
Iceland	R	R	R	NO	R	NO	NO	NO	NO	NO	NE	NE	NO	NO	NO
Forest Management															
Austria	R	R	IE	R	R	NO	R	NO	NO	NO	NO	NO	IE	R	R
Belgium	R	R	NO	NO	R	NO	R	NO	NO	NO	R	NO	NO	NO	NO
Bulgaria	R	IE	R	R	R	NO	R	NO	NO	NO	NO	NO	R	R	R
Croatia	R	R	NO	NO	NO	NO	R	NO	NO	NO	NO	NO	R	R	R
Cyprus	NR	NR	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	NO	NO	NO
Estonia	R	R	R	R	R	R	R	NO	NA	NA	NO	NO	IE	R	R
Finland	R	R	IE	IE	R	R	R	R	R	R	R	R	R	R	R
France	R	R	R	R	R	IE	R	NO	NO	NO	R	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	R	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NO	NO	R	R	R
Iceland	R	R	R	NO,IE	R	R	R	NO	R	R	NE	NE	NA	NA	NA
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	NR	NR	R	R			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	NR	NR	R	R			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	NA		R	NA	NA	NA	NA	NO,NA	NO,NA	NO,NA
Wedlands Drainage and Rewetting															
United Kingdom	NR	NR	NR	NR		NR		NE	NE	NE		NE	NE	NE	NE

Notation keys: R – carbon stock changes or GHG emissions from other sources is reported; NR – the pool *is not reported (mainly under assumption of not a source); NE – removals/emissions are 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 249,500.00 kha, which is approximately 55% of the total area reported under the Convention (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 (2%), while Wetland Drainage and Rewetting and Revegetation cover less than 1%.

With the exception of Finland, France, Latvia, the Netherlands and Romania all GHG inventories reports larger areas under afforestation/reforestation than under deforestation. Consequently, forest area reported under KP increases over time at EU level.

Regardless of specific activities, most of the area under the KP accounting is reported by Spain, Germany, Sweden, France, and Finland. The largest area under AR is reported by Italy, the largest under D is reported by France, and the largest under FM is reported by Sweden.

Table 11.3 Synthesis of total area (kha) reported under KP-LULUCF activities by EU MS and Iceland in GHG inventories 2015, based on NIR-2 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	218.07	74.01	3811.43					4103.51
Belgium	38.89	33.63	675.91					748.44
Bulgaria	263.22	4.49	3622.79					3890.50
Croatia	59.07	4.67	2311.06					2374.80
Cyprus	1.06	0.02	157.08					158.15
Czech Republic	58.00	17.33	2610.40					2685.73
Denmark	103.02	9.99	534.55	2837.88	205.11			3690.55
Estonia	59.38	19.59	2361.32					2440.29
Finland	173.17	391.48	21684.75					22249.40
France	1479.20	1624.34	21517.95					24621.49
Germany	534.14	286.43	10627.12	14646.24	6313.88			32407.80
Greece	34.25	5.21	1234.49					1273.95
Hungary	173.25	12.66	1767.47					1953.38
Ireland	311.13	17.42	449.14	673.33	4277.80			5728.82
Italy	1845.03	51.47	7464.06	8939.12	426.20			18725.89
Latvia	40.94	59.02	3063.04					3162.99
Lithuania	44.59	2.02	2161.36					2207.97
Luxemburg	8.84	5.82	87.31					101.97
Malta	NA	NA,NO	0.07					0.07
Netherlands	67.63	72.98	323.69					464.29
Poland	734.65	17.98	8660.52					9413.15
Portugal	610.13	360.77	3754.81	2338.69	595.85			7660.24
Romania	32.01	365.08	7064.39			104.51		7565.98
Slovakia	42.59	8.50	1977.53					2028.61
Slovenia	NO,NA	27.13	1082.74					1109.87
Spain	1246.49	114.29	14435.44	20164.92				35961.13
Sweden	353.05	296.69	28295.15					28944.88
United Kingdom	655.42	60.70	2810.72	4534.68	15274.57		NE,NA	23336.09
EU	**9187.20**	**3943.70**	**154546.26**	**54134.85**	**27093.41**	**104.51**	**0.00**	**249009.94**
Iceland	45.52	0.06	93.63			277.06		416.27
EU+Iceland	**9232.73**	**3943.76**	**154639.89**	**54134.85**	**27093.41**	**381.57**	**0.00**	**249426.21**

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. It can be noted that information on KC is missing for few MS because, as explained by these MS during the EU QA/QC procedures, remaining open issues in the CRF Reporter used to generate the CRF tables prevented the provision of this information in 2017, as already happened in 2016.

Table 11.4 Synthesis of KP-LULUCF activities being key category as reported by EU MS and Iceland (from table NIR-3) in 2017 submissions. "KC" indicates a key category.

Member State	Art. 3.3 activities		Art. 3.4 activities					Comments
	AR	D	FM	CM	GM	RV	WDR	
Austria	KC	KC	KC					Level, trend
Belgium								KC analysis is not available in the NIR 3
Bulgaria								KC analysis is not available in the NIR 3
Croatia	KC	KC	KC					Level, trend
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, trend
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	KC	KC					Corresponding land category is key under GHG inventory
Germany	KC	KC	KC	KC	KC			Corresponding land category is key under GHG inventory. AR high expected growth.
Greece			KC					Level, trend
Hungary	KC	KC	KC					Removal of the category (does not) exceed the emissions of the smallest category identified as key in the UNFCCC inventory.
Ireland								KC analysis is not available in the NIR 3
Italy	KC	KC	KC	KC	KC			Level, trend
Latvia	KC	KC	KC					Corresponding land category is key under GHG inventory
Lithuania	KC	KC	KC					Corresponding land category is key under GHG inventory
Luxemburg	KC	KC	KC					Corresponding land category is key under GHG inventory
Malta								KC analysis is not available in the NIR 3
Netherlands	KC	KC	KC					Level, trend
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		KC					Corresponding land category is key under GHG inventory
Slovenia		KC	KC					Corresponding land category is key under GHG inventory
Spain	KC	KC	KC	KC				Level, trend
Sweden								KC analysis is not available in the NIR 3
UK	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 CO2 eq.), and accounting quantities for KP-LULUCF activities (KP CRF table "Accounting")

Table 11.5 and Table 11.6 show respectively: (i) net emissions and removals, and (ii) accounted quantities for each MS and Iceland on each of the KP activities, and the sum for total EU and total EU plus Iceland.

The total net accounted amount at EU level, as reported so far for CP2 by EU MS in the accounting tables is: -479,365.64 kt CO2eq. With the addition of Iceland the total net accounting results in a net sink of -480,413.21 kt CO2eq. These numbers should be consider with caution, because a number of technical corrections to FMRL still need to be done.

Emissions from deforestation offset about 71% of removals accounted in afforestation/reforestation. By far, the largest contributors to emissions from deforestation are France and Romania that are responsible of about 45% 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 2013-2014-2015, as reported by EU MS and Iceland. Based on MS CRF accounting tables

Member State	Net emissions (+) and removals (-), kt CO2eq																				
	A. Art 3.3 activities						B. Art. 3.4 activities														
	A.1 AR			A.2 D			B.1 FM			B.2 CM				B.3 GM				B.4 RV			
	2013	**2014**	**2015**	**2013**	**2014**	**2015**	**2013**	**2014**	**2015**	**1990**	**2013**	**2014**	**2015**	**1990**	**2013**	**2014**	**2015**	**1990**	**2013**	**2014**	**2015**
Austria	-2016.19	-2033.65	-2071.45	536.48	524.77	518.33	-3434.18	-3799.58	-3851.11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Belgium	-333.91	-373.07	-412.45	1292.22	1316.69	1341.48	-3329.06	-3364.99	-3371.98	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bulgaria	-1125.41	-1262.00	-1382.47	125.93	59.56	158.69	-5985.43	-6011.73	-5836.85	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Croatia	-204.44	-235.39	-274.20	67.90	37.68	87.16	-7077.00	-6970.12	-5686.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyprus	NE,NO	NE,NO	NO,NE	NE,NO	NE,NO	NO,NE	NE,NO	NE,NO	NO,NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Czech Republic	-492.61	-549.75	-589.37	234.27	231.19	179.73	-6405.31	-6280.87	-5075.56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denmark	22.98	-326.75	-607.62	35.83	116.44	252.76	-2546.19	-3774.13	667.73	4416.19	2297.46	3003.94	2542.28	931.98	1181.58	1091.25	1283.59	NA	NA	NA	NA
Estonia	-147.67	-164.40	-177.80	280.97	210.24	184.61	-2924.46	-3031.13	-3518.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Finland	-166.08	-208.61	-202.53	3602.06	3441.90	3126.14	-56214.41	-54381.39	-49312.94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
France	-9278.99	-9613.26	-9843.11	11189.40	11146.10	11184.66	-57492.46	-52816.49	-48864.80	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Germany	-6230.29	-6451.30	-6688.57	2035.72	2064.05	2094.69	-54415.10	-54900.08	-54853.16	12668.64	14657.92	14452.56	14656.22	25771.82	22365.06	22316.58	22159.34	NA	NA	NA	NA
Greece	-135.85	-146.89	-124.41	47.33	47.28	44.90	-2038.90	-2039.00	-2028.15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hungary	-1234.10	-1070.32	-1218.30	122.09	150.29	217.83	-1534.90	-3181.24	-4343.99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ireland	-3711.44	-3702.66	-3802.49	190.94	223.20	266.20	-435.55	-256.60	-529.69	26.27	36.12	42.82	9.29	7076.42	5883.29	5908.47	5790.13	NA	NA	NA	NA
Italy	-7700.70	-8385.37	-8862.63	2011.72	2022.73	2033.48	-30120.35	-31127.49	-31551.67	-119.52	396.99	336.54	349.69	-5.13	-641.62	-672.23	-705.99	NA	NA	NA	NA
Latvia	-69.29	-73.31	-77.09	1695.64	1727.50	1756.53	-3679.00	474.99	-2534.44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lithuania	-219.84	-252.56	-288.89	213.43	272.93	26.63	-8912.50	-8428.79	-7916.78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Luxemburg	-179.37	-176.28	-173.19	46.90	44.68	42.46	-436.29	-359.70	-306.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Malta	NO	NO	NO	NO	NO	NO	NE,NO	NE,NO	NE,NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Netherlands	-747.53	-802.87	-859.34	1510.89	1543.71	1576.79	-1425.15	-1415.31	-1390.78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Poland	-2844.38	-2818.22	-2851.87	203.67	316.94	301.57	-45448.98	-38107.10	-33993.79	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Portugal	-3434.60	-3606.14	-3392.46	2123.35	2099.96	2075.63	-7468.76	-8992.84	-7898.57	3354.25	346.30	358.11	356.34	1443.65	42.93	22.37	-39.59	NA	NA	NA	NA
Romania	-352.31	-346.17	-346.17	8076.26	8076.26	8076.26	-27459.97	-27479.10	-27479.10	NA	NA	NA	NA	NA	NA	NA	NA	--	-1211.36	-1222.00	-1222.00
Slovakia	-443.07	-441.81	-465.10	43.04	62.80	64.45	-6789.44	-4845.26	-5158.64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Slovenia	NA	NA	NA	492.71	499.07	506.03	-4515.38	-4677.90	-4760.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Spain	-12754.25	-12245.27	-11419.13	569.54	563.01	562.50	-24743.30	-25830.99	-26092.38	-1098.17	642.08	-1808.82	-1996.88	NA	NA	NA	NA	NA	NA	NA	NA
Sweden	-1206.29	-1319.00	-1390.05	3592.94	3157.62	2167.20	-53243.86	-53180.72	-52982.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
United Kingdom	-400.01	-774.72	-1252.83	1339.15	1248.06	1381.58	-19504.76	-19337.00	-18661.79	15224.97	13645.11	13410.77	13292.41	-7487.25	-6376.38	-6428.92	-6492.34	NA	NA	NA	NA
EU	**-55405.64**	**-57379.78**	**-58773.52**	**41680.38**	**41204.65**	**40228.28**	**-437580.68**	**-424114.52**	**-407332.13**	**34472.63**	**32021.98**	**29795.93**	**29209.36**	**27731.49**	**22454.84**	**22237.52**	**21995.14**	**0.00**	**-1211.36**	**-1222.00**	**-1222.00**
Iceland	-180.05	-201.25	-251.36	0.16	0.11	0.22	-79.42	-82.83	-82.24	NA	NA	NA	NA	NA	NA	NA	NA	-347.70	-548.93	-557.51	-569.58
EU+Iceland	**-55585.69**	**-57581.02**	**-59024.88**	**41680.53**	**41204.77**	**40228.51**	**-437660.10**	**-424197.35**	**-407414.37**	**34472.63**	**32021.98**	**29795.93**	**29209.36**	**27731.49**	**22454.84**	**22237.52**	**21995.14**	**-347.70**	**-1760.29**	**-1779.51**	**-1791.58**

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.

*Note that quantitative estimates for WDR have not yet been provided by UK so in order to facilitate the reading such column was not included.

Table 11.6 Accounting quantities for 2013-2020 of KP-LULUCF activities as reported by EU MS and Iceland (Kt CO_2eq), based on 2016 MS and Iceland CRF accounting tables*

Member State	Accounting quantity							
	Article 3.3		Article 3.4					MS accounting amount on LULUCF activities (RMUs)
	AR	D	FM	CM	GM	RV	WDR	
Austria	-6121.29	1579.58	-9005.86					-13547.56
Belgium	-1119.43	3950.39	-2569.03					261.94
Bulgaria	-3769.89	344.18	6600.99					3175.29
Croatia	-714.02	192.74	-3581.08					-4102.36
Cyprus	NE,NO	NE,NO	NO,NE					0.00
Czech Republic	-1631.74	645.19	-3703.73					-4690.28
Denmark	-911.39	405.03	-6631.73	-5404.88	760.47			-11782.50
Estonia	-489.86	675.82	-1251.11					-1065.15
Finland	-577.22	10170.11	-57764.73					-48171.85
France	-28735.37	33520.16	-22328.74					-17543.95
Germany	-19370.15	6194.45	-96914.34	5760.78	-10474.48			-114803.74
Greece	-407.15	139.51	-891.98					-1159.62
Hungary	-3522.72	490.21	-5940.13					-8972.65
Ireland	-11216.59	680.34	616.93	9.42	-3647.39			-13557.28
Italy	-24948.71	6067.93	-26301.50	1441.79	-2004.46			-45744.96
Latvia	-219.69	5179.67	8057.38					13017.36
Lithuania	-761.29	512.99	-8836.06					-9084.35
Luxemburg	-528.85	134.04	-393.51					-788.32
Malta	NO	NO	NO,NE					0.00
Netherlands	-2409.74	4631.40	43.76					2265.41
Poland	-8514.46	822.18	-36150.87					-43843.16
Portugal	-10433.20	6298.95	-13777.77	-9001.98	-4305.23			-31219.24
Romania	-1044.64	24228.77	-25090.40			-3655.36		-5561.63
Slovakia	-1349.98	170.28	-13541.34					-14721.04
Slovenia	NO	1497.81	-4440.49					-2942.68
Spain	-36418.64	1695.04	-7366.68	130.89				-41959.39
Sweden	-3915.34	8917.75	-57203.48					-52201.07
United Kingdom	-2427.56	3968.79	-10001.55	-5326.64	3164.11		NE	-10622.85
EU	**-171558.93**	**123113.32**	**-398367.05**	**-12390.62**	**-16506.99**	**-3655.36**	**0.00**	-479365.64
Iceland	-632.66	0.49	217.51			-632.91		-1047.58
EU + Iceland	**-172191.59**	**123113.80**	**-398149.54**	**-12390.62**	**-16506.99**	**-4288.27**	**0.00**	-480413.21

**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 KP 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 KP 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, because the vast majority of MS reported that the conversions of natural to planted forest do not take place in their territories as all the natural forests are under strict protection (e.g. Czech Republic) or mainly because there are no natural forests.

When definitions are provided, natural forests 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, since 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 “human-induced” AR any expansion of forest areas since 1990 (see following chapters for more details). Most of the MS considered all national pre-1990 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 ensured 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, EU MS and Iceland that have elected voluntary activities under Article 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 and Iceland 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 and Iceland 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 ensures 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 Article 3(4) are not accounted for under Article 3(3) activities. To this regard, the consistency in the time series is checked every year during the QA/QC procedures, looking if: (i) the total area reported in NIR-2 table is constant over time and matches the official country area; and (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 and Iceland to define forest.

11.2.2 Methodology used to develop the land transition matrix

Areas of KP-LULUCF activities have to be consistent with areas of correspondent land categories reported under the Convention. This is an issue subject to annual 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 and Iceland 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, inventory compilers combine also several data sources involving 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 and Iceland is provided in Table 11.8. For more detailed information on data sources and methods applied MS and Iceland their national GHG inventories should be consulted.

Table 11.8 Methodologies for land identification and tracking of lands subject to KP- LULUCF 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		x		CORINE Land Cover Maps
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 and Iceland 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 inventories 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.

According to the availability of data and resources (Table 11.8), the individual inventories rely on various methods and approaches to identify and track lands under Article 3(3) and Article 3(4) of the KP. Generally, the data sources 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, countries have implemented dedicated projects aimed to collect additional information that allow to comply with KP reporting requirements.

Reporting method 1 is based on the use of grid-based assessments, usually with 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 apply reporting 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 taken from 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	1
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 CO2 removal estimates

Methods used for the estimation of emissions and removals related to Article 3(3) and Article 3(4) activities are consistent with those used for reporting carbon stock changes under 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 changes in litter, dead wood, and mineral soils carbon pools was improved considerably in the last years as proven by the reduced number of MS using notation keys for these carbon pools in the current inventory.

In 2017, as explained by Belgium during the QA/QC checks, some internal constrains prevented the full provision of information in the KP tables. Therefore, only quantitative information was provided. Empty cells relate with notation keys that should have been introduced.

The range of the implied carbon stock change 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 and Iceland, 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 inventory compilers. More information is also provided in Table 11.17.

Table 11.10 Implied carbon stock change factors (tC ha^{-1}yr^{-1}) by pool reported under AR activity by EU MS and Iceland (for the year 2015), based on KP CRF tables.

AR						
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
Austria	0.97	0.26	0.85	0.02	0.49	NO,NA
Belgium	1.46	0.29			1.14	
Bulgaria	2.19	NO,IE	0.23	NO,NE	-0.98	NO
Croatia	0.47	0.10	NA,IE	NA,NO	0.73	NA,NO
Cyprus	NE	NE	NE	NE	NE	NO
Czech Republic	1.80	0.36	0.49	0.01	0.11	NO
Denmark	1.35	0.31	0.02	0.00	0.08	-1.30
Estonia	0.84	0.33	0.30	0.02	-0.72	-0.52
Finland	0.63	0.20	IE,NA	IE,NA	0.12	-1.40
France	1.07	0.46	0.16	0.03	0.11	NO,IE
Germany	2.87	0.53	0.47	0.03	-0.24	-2.23
Greece	0.84	0.15	NE,NA	NE,NA	NE,NA	NA
Hungary	1.54	0.39	NE,NA	NE,NA	NE,NA	NO,NA
Ireland	1.92	0.80	0.71	0.22	NA,NO	-0.73
Italy	0.97	0.19	0.01	0.01	0.13	NO,NA
Latvia	0.33	0.08	0.08	0.08	NO,NA	-2.60
Lithuania	1.28	0.30	1.10	NO,NA	-0.60	-2.23
Luxemburg	3.17	0.64	0.50	0.15	0.88	NO
Malta	NO	NO	NO	NO	NO	NO
Netherlands	3.05	0.36	NO	0.12	-0.01	-0.18
Poland	0.80	0.21	NO	NO	0.06	-0.68
Portugal	1.09	0.09	0.05	NO,IE	0.24	NO
Romania	1.86	NO,IE	0.05	NO,IE	1.13	NO,IE
Slovakia	1.08	0.24	0.42	NA,NO	1.24	NA,NO
Slovenia	NO	NO	NO	NO	NO	NO
Spain	1.93	NA,IE	0.07	0.04	0.47	NA,NO
Sweden	0.86	0.28	0.26	0.02	-0.15	-2.21
United Kingdom	1.48	NA,IE	0.03	NA,IE	-0.89	-1.25
Iceland	0.85	0.21	0.14	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 net 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). A particular case introduced by Germany that reported a sink in mineral soils associated with conversions of cropland to grassland (within previously deforested lands), based on country-specific data.

Moreover, some MS use also notation keys under Deforestation. For instance, when carbon stock changes for a certain pool have been already included in the estimation of other carbon pool due to the methodology used to derive carbon stock changes (e.g. below-ground biomass include as part of above-ground biomass or litter estimated along with SOC), as it is the case in the use of “IE” by Finland, Spain, UK, Romania and Croatia. Furthermore, also the notation key “NO” is used in the absence of Deforestation taking place in organic soils. Finally, the notation key NA as a second notation key is a matter of the aggregation implemented by the CRF Reporter that sum up also the notation key “NA” when this refer to ”*Deforested land previously reported under afforestation/reforestation and forest management and subject to natural disturbances”*

Table 11.11 Implied carbon stock change factors (tC ha-1yr-1) by pool reported under D activity in EU MS and Iceland (for the year 2015), based on KP CRF tables.

D						
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
Austria	-0.67	-0.17	-0.53	0.00	-0.49	NO,NA
Belgium	-7.05	-1.41	-0.21	-0.05	-1.93	
Bulgaria	-6.03	NO,IE	-0.71	-0.35	-2.55	NO
Croatia	-0.69	-0.36	NA,IE	NA,IE	-2.70	NA,NO
Cyprus	NE	NE	NE	NE	NE	NO
Czech Republic	-2.05	-0.41	-0.28	-0.06	-0.03	NA,NO
Denmark	-3.00	-0.35	-2.80	-0.27	-0.06	-4.49
Estonia	-0.52	-0.12	-1.05	-0.03	-0.69	-1.62
Finland	-0.53	-0.16	IE,NA	-0.01	-0.39	-5.11
France	-1.01	-0.27	-0.11	-0.04	-0.43	IE
Germany	-0.99	-0.12	-0.51	-0.05	0.13	-5.86
Greece	-0.09	-0.03	-0.02	0.00	-2.04	NO,NA
Hungary	-2.01	-0.50	-0.96	-0.30	-0.84	NO
Ireland	-0.89	-0.20	-0.22	-0.13	-0.37	-1.10
Italy	-3.33	-0.70	-0.21	-0.11	-5.92	NO,NA
Latvia	-3.84	-0.96	-0.94	-0.88	-0.58	-4.42
Lithuania	-1.23	-0.28	-0.47	-0.06	-1.42	-1.42
Luxemburg	-0.64	-0.15	-0.13	-0.04	-0.91	NA,NO
Malta	NO	NO	NO	NO	NO	NO
Netherlands	-3.46	-0.50	-1.55	-0.10	0.00	-2.56
Poland	-2.23	-0.45	0.00	-0.06	-1.83	NO
Portugal	-0.29	-0.04	-0.05	IE	-1.09	NO
Romania	-3.85	IE,NA	-0.33	IE,NA	-1.61	NO,NA
Slovakia	-1.39	-0.44	-0.13	-0.08	-0.03	NA,NO
Slovenia	-2.82	-0.27	-0.30	-0.14	-1.55	NA
Spain	-0.90	NA,IE	-0.06	-0.03	-0.31	NA,NO
Sweden	-0.22	-0.07	-0.84	0.00	-0.72	-1.60
United Kingdom	-2.22	NA,NO,IE	-0.40	NA,NO,IE	-1.73	NA,NO,IE
Iceland	-0.34	-0.08	-0.13	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 carbon pools when reported are estimated to be a net sink of carbon under FM. Organic soils are always reported as a net source whenever drainage took place in 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. Implied carbon stock change factors (tC ha^{-1}yr^{-1}) by pool reported under FM activity in EU MS and Iceland (for the year 2015), 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	NO,NE,IE,NA	0.06	-0.18	NO,NA
Belgium	0.95		NO		0.53	
Bulgaria	0.40	NO,IE	0.04	0.03	-0.06	NO
Croatia	0.54	0.13	NA,NO	NA,NO	NA,NO	NA,NO
Cyprus	NE	NE	NE	NE	NE	NO
Czech Republic	0.50	0.10	NO	NO	NO	NO
Denmark	0.72	0.11	-1.15	-0.02	NO,NA	-1.30
Estonia	0.20	IE,NA	NE,NA	0.01	0.51	-0.05
Finland	0.32	0.06	IE,NA	IE,NA	0.21	-0.27
France	0.43	0.17	0.00	-0.03	0.01	IE
Germany	0.90	0.13	-0.01	-0.05	0.41	-2.23
Greece	0.35	0.12	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NA
Hungary	0.44	0.15	NE,NA	NE,NA	NE,NA	-2.60
Ireland	-0.85	0.49	0.60	0.14	NA,NO	-0.46
Italy	1.00	0.20	0.00	0.00	NO,NE,NA	NO,NA
Latvia	0.39	0.10	NO,NA	0.06	NO,NA	-2.60
Lithuania	0.85	0.20	0.04	0.03	NO,NA	-1.46
Luxemburg	0.78	0.18	0.00	0.00	NO	NO
Malta	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Netherlands	0.87	0.16	NO	0.22	NO	NO
Poland	0.62	0.16	NO,NA	NO,NA	0.11	-0.57
Portugal	0.45	0.17	0.00	NO,IE	-0.01	NO
Romania	0.98	NO,IE,NA	0.00	NO,NA	0.09	-0.68
Slovakia	0.51	0.11	NA,NO	NA,NO	NA,NO	NA,NO
Slovenia	0.95	0.22	NO,NA	0.00	NO,NA	NO,NA
Spain	0.47	NA,NO,IE	0.00	0.00	0.00	NA,NO
Sweden	0.25	0.08	-0.07	0.07	0.20	-0.33
United Kingdom	0.96	NA,NO,IE	0.04	NA,NO,IE	0.38	0.72
Iceland	0.18	0.05	0.01	NO,IE	0.01	-0.49

Table 11.13 Implied carbon stock change factors (tC ha^{-1}yr^{-1}) by pool reported under CM activity in EU MS (for the year 2015), based on MS CRF tables.

CM						
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
Denmark	0.01	-0.03	NO	NO	0.04	-6.27
Germany	0.00	0.00	NA,IE	NA,NO,IE	-0.05	-7.45
Ireland	0.00	IE	NO	NO	0.00	NO
Italy	-0.04	NO,IE	NE	NE	NE	10.00
Portugal	0.01	0.00	0.00	IE	-0.04	NO
Spain	0.02	IE	0.00	NO	0.01	NO
United Kingdom	0.00	NE,IE	NE,NO	NE,NO	-0.66	-5.00

Table 11.14 Implied carbon stock change factors (tC ha^{-1}yr^{-1}) by pool reported under GM activity in EU MS (for the year 2015), based on MS CRF tables.

GM						
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
Denmark	-0.46	-0.24	NO	NO	-0.02	-6.70
Germany	-0.01	0.00	NA,IE	NA,NO,IE	0.09	-6.38
Ireland	0.00	NO,IE	NO	NO	0.01	-3.97
Italy	NO	NO	NE	NE	0.45	NO
Portugal	-0.01	-0.01	0.00	IE	0.07	NO
United Kingdom	0.00	NE,IE	NE,IE	NE,IE	0.13	-0.04

Table 11.15 Implied carbon stock change factors (tC ha^{-1}yr^{-1}) by pool reported under RV activity in EU MS and Iceland (for the year 2015), based on MS CRF tables.

RV						
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
Romania	2.96	IE	0.01	NO	0.24	NO
Iceland	0.06	IE	IE	NO	0.51	NA

Table 11.16 Implied carbon stock change factors (tC ha^{-1}yr^{-1}) by pool reported under WDR activity in EU MS and Iceland (for the year 2015), based on MS CRF tables.

WDR						
Member State	**Above ground Biomass**	**Below ground Biomass**	**Litter**	**Dead wood**	**Min Soils**	**Org Soils**
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 and Iceland, 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 8,000 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 of CH_4 emissions (i.e. associated CO_2 emissions are reported in the background activity table together with carbon stock changes in other carbon 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 individual inventories 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 emissions from 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 a 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 management practice 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 and Iceland were encouraged to follow it (http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/) whenever such provision was applied in order to ensure that no underestimations occur.

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 of the MS and Iceland concerned. Table 11.17 summarized the demonstrations provided by the MS and Iceland when a carbon pool was 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	Carbon 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, LT, SOC	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. By other hand, it is also assumed that, under the conditions of current forestry practices at the country level, forest soils do not represent a net source of CO2
Denmark	FM, CM, GM	DW, LT, SOC	No litter and dead organic matter are reported under CM and GM 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.
Germany	CM, GM	DW, LT	Dead wood and litter do not occur in connection with cropland management and grassland management
Greece	AR, FM	SOC, DW, LT	Based on several studies SOC and DOM increase in AR. For FM, silvicultural 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. Quantitative demonstration is also provided in the NIR
Hungary	AR, FM	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, LT	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, FM	DW, SOC	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, FM	LT, SOC	Justification based on NFI data that shows that the conversion of non-forest to forest always involves a build-up of carbon.
Poland	AR, FM	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, LT	DW reported 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	DW	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 and Iceland 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 stock change from carbon pools.

11.3.4 Information on whether or not indirect and natural CO2 removals have been factored out

Individual inventories 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 length reporting period, the magnitude of these removals is insignificant.

For FM, it is recognized that the issue of factoring out indirect 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 through the FMRL. Indeed, it is expected that the effects of such processes on the emissions and removals occurring during the commitment period approximately cancel out in the accounting when the projected FMRL is compared to the reported FM estimates.

11.3.5 Changes in data and methods since the previous submission (recalculations)

An overview of the reason for recalculations is provided in table 11.18

Table 11.18 Summary of information on changes and methods since the previous submissions (recalculations)

Member State	Overview of reasons for recalculations
Austria	The Af-/reforestation, deforestation time series was revised. The soil C stocks of settlement areas were recalculated (see information in chapter 6.6.4.1.2). Consequently the annual soil C stock changes of af-/deforestation areas from settlement and deforestation areas to settlement changed. Direct and indirect N2O emissions associated with C stock losses in soil of afforestation areas from grassland and deforestation areas to settlement and other land were estimated in submission 2017 for the first time for the whole time series. The HWP production for the year 2014 has been revised by the FAO and therefore the value reported for HWPs at af-/deforestation areas and forest management areas for the year 2014 has changed. In addition, the shares of HWPs produced from wood of the af-/reforestation, deforestation and forest management areas slightly changed due to the correction of a calculation error.
Belgium	---
Bulgaria	Comparing the Submission 2016 the recalculations are as a result of implementation of the 2013 KP Supplement and the 2006 IPCC Guidelines in term of the updated default emission factors and coefficients and updates of country-specific parameters.
Croatia	ARD and FM areas are reported according to results of conducted survey through LULUCF 1 project. Better application of 2006 Guidelines (GWP for N2O and emission factor). Changes in parameters used for previous and this year estimation
Cyprus	---
Czech Republic	This inventory includes changes in activity data in areas, which were further improved for this inventory. Also, new activity data were used for litter and deadwood carbon stock estimates for AR and D activities. Finally, the emission contribution of HWP is newly included. All these changes required recalculation of emission estimates for the entire reporting period and the currently reported estimates are herewith revised compared to those in the previous submission
Denmark	Minor recalculations have been made as updated values from the NFI have become available; also minor changes in the Land Use Matrix have occurred. See more in Chapter 6.3.7.
Estonia	Areas subject to Afforestation/Reforestation, Deforestation and Forest management are updated annually by NFI, new data is integrated to overall activity data. Methodological consistency between the reference level and reporting for forest management during the 2nd commitment period, including the area accounted for the treatment of harvested wood products is secured by implementation of the same methodological approaches for the whole accounting period and recalculation of the whole time series according to a new methodology.
Finland	The areas of Article 3.3 activities and Forest Management were recalculated because new NFI data were available, also new RS data for updating. Errors in data and calculations were also corrected. Biomass removal estimates on deforestation were recalculated due to an improved method based on NFI sample plots. Losses in living biomass under Afforestation/Reforestation are reported separate from gains for the first time in this submission. Also HWP is allocated to AR first time in this submission. The activity data for biomass burning were recalculated from fire statistics. Indirect N2O emissions from N mineralization on deforestation to cropland and grassland are now reported as summed up to the direct emissions from N mineralization.
France	Update of the method for accounting for soil carbon fluxes after occupation changes from estimated carbon stocks by soil-climate zone. Taking into account the latest available results from the national forest inventory, which updates biomass growth and mortality. Improvement of forest fires in overseas territories.
Germany	---
Greece	In the current submission no specific changes have been made with regard to methodologies applied in comparison to the previous submission. In some categories (e.g. biomass burning) the activity data have been corrected for some years or the emission factors used have been updated (e.g. IEFs in areas under AR), while in others correction of previous errors in the reporting of emissions/removals (i.e. HWP) in the CRF tables led to recalculations of GHG estimations.
Hungary	We recalculated the emissions removals from FM land in 2015 mainly due to the fact that FF are now included in FM. This year we completed the methodology by adding the estimation of losses of carbon from pre-conversion biomass on AR land (this only involved a small adjustment of the estimated emissions under AR).
Ireland	Deforestation to settlements: - There was an error in the calculation of emissions of CO2 form organic soils for forest land converted to settlements for the inventory year 2006 to 2014. The error was correct, but had a very small effect on the net emission form this subcategory.
Italy	Concerning the ARD activities under art. 3.3 of the Kyoto Protocol, the main driver for the deviations from the previous sectoral estimates is the update of activity data and from the detection and correction of computation errors. With reference to forest management resulting from the detection and correction of computation errors and from updating of activity data. With reference to cropland management, the 2017 submission results in a decresion of the emissions reported in 2016 submission, due to the update of activity data for 2013 and 2014 A slight deviation of the removals estimated under grazing land management results from the comparison of the 2017 submission and 2016 estimates, due to the update of activity data used in the soil carbon stock changes assessment.
Latvia	Recalculations are done due to implementation of country specific biomass expansion factors and carbon content in wood.
Lithuania	Recalculation of GHG emissions/removals in forests occurred due to the newly applied interpolation-extrapolation tool for annual growing stock volume change estimation between NFI sampling plot re-measurements.
Luxemburg	Since the previous submission the calculation of direct and indirect N2O emissions associated with the loss of soil carbon stock due to land use changes (deforestation) have been refined. Also the current report contains a technical correction of the FMRL.
Malta	---
Netherlands	This year a new approach was implemented for assessing carbon stock changes in newly established forests. Additionally the model used to project carbon stock changes in FL-FL beyond the latest National Forest Inventory (NBI6 in 2013) was recalibrated to better reflect observed mortality patterns (Arets et al., 2017). These changes above in both newly established forests and forests remaining forests will affect emissions and removals in all categories in which carbon stocks in biomass on Forest Land is included, i.e. carbon stock losses from deforestation, emissions from wildfires and HWP. HWP is affected because different calculated amounts of wood will become available from deforestation, which is included in HWP assuming instantaneous oxidation.
Poland	All changes are caused by the change in activity data, for forest and forest management activity. Emission and C stock change factors are not changed at all.
Portugal	Data for HWP was made consistent with the most recent UNECE database. Mistake in C Stock levels for biomass and litter from shrubland detected and corrected. Change in harvest allocation between LF / FF and 3.3AR / 3.4FM. Minor mistake in HWP estimates detected and corrected.
Romania	Recalculations only affect forest management estimates where area subject to forest management increased by 10% following rigorous implementation of forest definition by new land assessment method.
Slovakia	In 2017 submission, FM area has been recalculated and corrected for 2013 – 2014
Slovenia	Considering ERT revision report and recommendations data and methodologies were internally revised and recalculations were made.
Spain	The results of this edition of the Inventory modify those of the series 1990-2014, due to the updating of activity variables and revision of the methodology followed.
Sweden	In the current submission, the living biomass pool and activity areas have been recalculated for the most recent years to improve accuracy and each estimate is now based on 6000 more re-measured sample plots. To avoid an increasing uncertainty of estimates by decreasing number of sample plots Sweden has introduced extrapolation for inventory cycles without a full record of sample plots until 2015. The extrapolation (for the most recent years without a full record due to a five-year inventory cycle) is now based on the trend of five years previous to the inventory. The same method is now used for all reported living biomass in both the KP and the UNFCCC reporting. There are only minor differences in area between submissions (Table 10.8). The differences can be explained by corrections in underlying data (cycle 1985 has been re-measured and some minor corrections) and due to extrapolation of the most recent years.
UK	This is the eighth official submission of Article 3.3 and Article 3.4 estimates, and the third in the second Kyoto Protocol commitment period. There have been major methodological and activity data updates to Afforestation and Forest Management and some smaller activities are reported for the first time. Details of recalculations are given in Table 11.4.
Iceland	The emission/removal factor and the area estimate for the Revegetation activity have been revised since last year's submission. Removals due to AR activities have not been revised.

11.1.1 Improvement status and plan

During this year submission significant improvements have been implemented in order to correct errors and inconsistencies flagged during the internal QA/QC checks, or in order to follow the recommendations provided by the 2016 ERT. However, despite of these improvements, the EU plans to continue devoting efforts to enhance the overall TACCC of the KP chapter.

For instance, during the QA /QC more than 200 findings, potentially affecting the quality of the inventories, were communicated to the MS which resulted in significant increase of the overall quality of the EU inventory, and with a particular focus in the KP submissions, in an increase of its completeness and consistency. Moreover, as regards with the 2016 ERT, based on a provisional main findings list from last year review, all the issues have been addressed, and in most of the cases implemented in the 2017 submission. However, some improvements are still ongoing, with the expectation to be implemented in next year submissions. In particular, the focus will be on:

- To continue enhancing the internal QA/QC checks to ensure the avoidance of inconsistencies between information provided in individuals MS submissions and the EU submission; and internally, between NIR and CRF tables.
- To continue working with MS to ensure the completeness of the inventory, in particular with Cyprus and Malta for the mandatory KP activities, and with UK in order to provide quantitative estimates for the KP activity WDR.
- To continue working with Romania and Cyprus in order to provide a consistent KP information. In particular as regards with the current reporting of HWP by Romania, and with the information included for non-elected activates by Romania and Cyprus.
- To continue supporting MS in the estimation and provision of information on Technical Corrections, and to ensure the consistency between the FMRL and the reporting of the activity FM.
- To continue working with MS towards the harmonization on the use of the notation keys.

11.3.6 Uncertainty estimates

For information on uncertainties please refer to chapter 1.6

11.3.7 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, and improve its comparability. For instance, the consistency among the information submitted under the KP and the Convention is assessed. Also many other checks are implemented to ensure that estimates are prepared by applying methodologies consistent with IPCC methods, and adequate to the significance of the category or carbon pool that is being estimated.

11.3.8 The year of the onset of an activity, if after 2013

This information is implicitly achieved by each individual MS and Iceland, and consequently by the EU inventory, through the provision of the estimates in the NIR-2 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 systems 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 comes 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 (i.e. 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 11.19 shows a synthesis of current information reported by EU MS and Iceland on the direct-human induced origin of AR lands.

Table 11.19 Summary of current information reported by EU MS and Iceland aimed at demonstrating that Afforestation/Reforestation activities are direct human-induced

Member State	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				x	
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 by most MS, so that around 90% of the total area reported under conversion to forest land is assumed as directly human-induced AR. However, some MS adopt some more stringent criteria. For instance, UK does not report under AR the areas of planting that are not state-owned or grant-aided. If not included under AR, natural forest expansion has been reported by individual inventories under FM.

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. Individual inventories 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 11.20.

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.

On the 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 11.20 Information on differentiation between temporary forest cover loss and deforestation provided by MS and Iceland in their GHG inventories.

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 the legal framework.*
Cyprus	*This information is not yet available. The Forest Department is conducting a full inventory of forested areas which should be complete by 2020. This should give us the additional information needed to distinguish between forest disturbance and deforestation. Harvesting is not taking place extensively in Cyprus and no areas are clear-cut of forest as the common practice is the thinning of trees.*
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 reforested 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 Cadaster 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 Cadaster 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.*

Member State	***Short description***
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)*

Member State	*Short description*
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. conversions to settlements, flooding by a recently constructed water reservoir, convention 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 latter 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.*

Member State	***Short description***
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 totally damaged, the legislation on prevention of insect and fungus disturbances binds owners to remove the rest of the damaged trees. After that, the reestablishment work should be started immediately 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 licenses 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

The methodologies adopted by individual inventories ensure 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 GHG inventories.

11.4.4 Information related to the natural disturbances provision under Article 3(3)

In accordance with decision 2/CMP.7; 14 MS and Iceland have stated their intention of excluding emissions resulting from natural disturbances under AR during CP2 (Table 11.21).

In general, MS argued that areas affected by natural disturbances 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, it is also argued that according to current laws it is not allowed to change the use of a disturbed land, but just to implement measures to rehabilitate such forest areas.

The types of disturbance for which MS and Iceland intends to exclude emissions from the accounting of AR activities vary among individual submissions. This fact explains why a value on background level and margin for the EU was not provided. Among other factors, the heterogeneity on the type of disturbances considered among MS makes the information on background level and margin meaningless at EU level, either under AR or FM.

In general, wildfires seem to be the most important natural disturbance that is expected to affect AR areas. However, several MS intend to exclude emissions only from areas affected by windstorms, while some others considered all disturbances types as a safeguard measure, i.e. in case some of these events occur in the future.

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 of natural disturbances.

MS have also provided information to demonstrate no 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, in some cases have been also argued that salvage logging does not occur in lands subjected to forest fires, as all biomass and dead organic matter is immediately oxidized when affected by wildfires. In contrast, some other MS wishing to exclude emissions from windstorms 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 11.21 Synthesis of Information from MS and Iceland that intends to apply the natural disturbance provision under AR activities during CP2, as reported in their NIR

Member States	Approach for the development of the BL and the Margin	BL+Margin	Type of disturbance
Bulgaria	Default method	0.50 kt CO2 eq.	wildfires, extreme weather events – windstorms, wet snowfall, ice, others
Croatia	Default method	5.10 kt CO2 eq.	Wildfires
France	Default method	0.034 kt CO2 eq.	Wildfires, storms, droughts
Greece	Default method	3.82 kt CO2 eq.	Wildfires
Ireland	Default method	70.62 kt CO2	Wildfires
Italy	Default method	1.16 kt CO2 eq.	Wildfires
Luxembourg	Minimum level of historical time series	(zero)	Extreme weather events (storms)
Malta	---	---	---
Netherlands	Default method	0.012 kt CO2 eq.	Wildfires
Portugal	Default method	39.40 t CO2 eq./ha	---
Romania	Default method	0.64 kt CO2 eq.	Wildfires
Spain	Default method	0.155 t CO2 eq./ha	All considered in the 2013 KP supplement
Sweden	Default method	300 kt CO2 eq.	Wildfires, insect attacks and disease infestations, extreme weather events and geological disturbances
United Kingdom	Default method	54 kt CO2 eq.	Wildfires, insect attacks and disease infestations, extreme weather events 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 know the georeferenced location of the areas affected as it is required under the decision 2/CMP.8., (e.g. Ireland). 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)

All MS used the “Production approach” to estimate net emissions and removals from this carbon pool. The methodology corresponds to the IPCC 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 and individual MS GHG inventories.

Some MS have stated that it is not possible to separate HWP originated from AR lands from those originated from FM lands. Therefore, when this is the case, following a conservative approach, all the emissions and removals from this carbon pool have been assigned to FM lands (in line with IPCC KP guidance). Additionally, some other MS have also stated that HWP are never originated from AR lands as the age of the trees does not allow harvesting practices (e.g. Croatia, Latvia). Finally, when carbon stock changes from HWP are reported separated between AR and FM, the default IPCC method (equation 2.8.3 of the 2013 KP Supplement) has been used for this purpose.

Concerning HWP originated from deforestation events, following reporting rules, these have been reported on the basis of instantaneous oxidation, and following a draft recommendation of the 2016 EU ERT (ARR not available at the time of writing this document), most of the MS are currently providing information, when it was relevant, on *“harvest originating from deforestation events*” in table 4(KP-I)C for information purposes, to allow checking transparently the quantities considered as instantaneous oxidation.

On the other hand, following also the EU GHG inventory ERT’s views, MS have also progressively enhanced the transparency of the information by providing more detailed descriptions on the origin of HWP reported under deforested lands. In some instances, the share of HWP originating from D within the total budget of the country is estimated on an area-basis share of lands under D and FM for individual reporting years (e.g. Czech Republic).

Beside this, some MS report, and account, for emissions and removals from HWP originated from trees growing in lands subject to deforestation (e.g. Finland). While, some MS justified that by law HWP cannot be linked to Deforestation (e.g. Greece). Finally, some MS have stated ongoing effort to increase the information on this regard by next submission (e.g. Spain).

Instantaneous oxidation approach has been also 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 GHG inventories.

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.

Since FM, CM, GM, 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 and Iceland 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 forest areas. 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 among data sources has to be done cautiously.

11.5.2.1 Conversion of natural forest to planted forest

The vast majority of inventory compilers 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.

For 2015, only Cyprus (0.9 Kha), Latvia (90.9 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, numbers provided by Romania seem unrealistic, and they could be associated with a misinterpretation of the information that should be provided in that table.This issue will be followed up in next submission.

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 11.22). 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 to refer to individual submissions of information on FMRL, as submitted by the EU, EU MS, and Iceland; or to the individual GHG inventories.

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 coordinated by the JRC in collaboration with the International Institute for Applied System Analysis (IIASA) and the European Forest Institute (EFI). To this purpose, the G4M and EFISCEN models were implemented on the basis of information on forest characteristics (from country sources) and on wood production and prices of land and timber, derived from the 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.

Table 11.22 Synthesis of information related to the construction of the FMRL values as reported by EU MS and Iceland in 2017 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	5823.00	X		
Belgium	-2499	NA		X	
Bulgaria	-7950	23.00		X	
Croatia	-6289	904.83	X		
Cyprus	-157	NA			X
Czech Republic	-4686	NA		X	
Denmark	409	-82.62	X		
Estonia	-2741	NE		X	
Finland	-20466	-13582.00	X		
France	-67410	21795.00		X	
Germany	-22418	NE	X		
Greece	-1830	91.98			X
Hungary	-1000	-40.00		X	
Ireland	-142	-470.85	X		
Italy	-22166	NA		X	
Latvia	-16302	11703.39		X	
Lithuania	-4552	-922.00		X	
Luxemburg	-418	181.68		X	
Malta	-49	NE			X
Netherlands	-1425	NE		X	
Poland	-27133	NA	X		
Portugal	-6830	3302.54	X		
Romania	-15793	-3665.25		X	
Slovakia	-1084	NA		X	
Slovenia	-3171	NE	X		
Spain	-23100	NO		X	
Sweden	-41336	7268.39	X		
UK	-8268	-7566.00	X		
EU	-315322	24765.08			
Iceland	-154	NE	X		
EU+Iceland	-315476	24765.08			

**The FMRL value for EU and EU + Iceland is the value inscribed in the Appendix to the annex to decision 2/CMP.7 for EU27 applying FOD function for HWP, plus the values applying instantaneous oxidation inscribed for: Croatia, Iceland (when relevant), and those MS for which a FMRL value applying FOD function for HWP was not available*

11.5.2.3 Technical Corrections of FMRL

In line with requirements of the Decision 2/CMP.7, most MS have already 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, 17 MS implemented technical corrections to the FMRL value (Table 11.22) in order to ensure such consistency.

Reasons for these inconsistencies and the associated technical corrections vary among inventories (Table 11.23). Overall, they mostly 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.

However, 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/or resources. In some case, it is explicitly indicated that a technical correction is expected to be implemented in the coming years (e.g. the Netherlands, Spain). To this regard, the JRC has always encouraged MS to provide information on methodological consistency of FMRL in the annual GHG inventories, and - to the extent possible - to provide (even preliminarily) quantitative information on the expected magnitude of any possible technical correction.

It is expected that all MS will implement a TC correction, as a minimum, at the time of the accounting (i.e. annual or end of the CP).

Table 11.23 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 the submission of FMRL Croatia implemented several methodological improvement steps in estimating its emissions/removals of FM. Due to these methodological improvements, changes in the FM input data, FM estimates and FM figures of historic years occur. As a consequence of all these methodological changes the FMRL changes from -6,289 kt CO2 net removals to FMRLcorr. – 4,906.20178 kt CO2 net removals without HWP instantaneous oxidation) and to FMRLcorr. – 5,384.16933 kt CO2 net removals with the HWP
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 accurate reference level using the most recently collected data. Had the reference period not been changed, the FMRL would have significantly underestimated the inflow for 2013 and thus caused a significant gap between the reported 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. The results are planned to be available in 2017 and they will be implemented in the 2018 GHG inventory. A number or reason for the reported TC is provided in Page 439 of the NIR.
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.

Member State	Information on the need for TC
	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 construction 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.
Luxembourg	The IPCC KP Supplements require a technical correction of the FMRL if methodological changes result in calculation of the time series, if new historical data become available or if pools are included in current reporting that have not been taken into account in the FMRL. Those conditions are fulfilled as the current FMRL does not use the methodological approach employed in Luxembourg and hence a technical correction of the FMRL was carried out.
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. Following 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.

Member State	Information on the need for TC
	- 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 not relevant 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; 19 MS and Iceland have stated their intention of excluding emissions resulting from natural disturbances that affect areas subject to FM during CP2, (Table 11.24). Nevertheless, so far, emissions from natural disturbances have not been excluded from the accounting of FM activity.

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. In addition, further and specifically related information to MS and Iceland can be found in individual GHG inventories.

Table 11.24 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	Default method	11.34 kt CO2 eq	Wildfires
Bulgaria	Default method	1255 kt CO2 eq	Wildfires, extreme weather events – windstorms, wet snowfall, ice, others
Cyprus	Default method	187.294 kt CO2 eq	Wildfires, extreme weather events – windbreaks, snow breaks and ice breaks
Croatia	Default method	38.25 kt CO2 eq.	Wildfires
Estonia	Default method	275 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	Default method	689 kt CO2 eq.	Wildfires, storm, droughts
Greece	Default method	228.56 kt CO2 eq.	Wildfires
Ireland	Default method	136 kt CO2	Wildfires
Italy	Default method	3380 kt CO2 eq.	Wildfires
Luxembourg	Minimum level of historical time series	(zero)	Extreme weather events
Malta	---	---	---
Netherlands	Default method	4.38 kt CO2 eq.	Wildfires and wind storms
Portugal	Default method	2264.22 kt CO2 eq.	Wildfires
Romania	Default method	127 kt CO2 eq.	Wildfires and windfalls
Spain	Default method	2285.48 kt CO2 eq.	All considered in the 2013 KP supplement
Sweden	Default method	3014.12 kt CO2 eq.	Wildfires, insect attacks and disease infestations, windstorms and geological disturbances
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)

All MS used the "Production approach" to estimate net emissions and removals from this carbon pool, in line with the 2013 KP Supplement. Most MS and Iceland used the default IPCC method (equation 2.8.3 of the 2013 KP Supplement), to allocate the carbon stock changes to specific forest activities under Article 3(3), and Article 3(4).

As regard with harvest from lands not included under forest management or under Article 3(3) activities, only 5 MS have reported quantitative information on CRF table 4(KP-I) C. All the other MS, have explained that HWP are not originating from lands subject to any other activity than ARD, or FM.

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 MS 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, at the latest, by the end of the commitment period as a result of an ongoing programme of research and methodological development.

Definitions implemented by the MS and Iceland 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 Individual GHG inventories, Iceland includes the activity of increasing 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 GHG 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 corresponding to Grassland since usually not the entire area of grassland within 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, cadaster 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 Article 3(3) activities and any elected Article 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 11.1.4.

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 JI 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 2016 for the EU[71] registry is submitted together with this report (Annex 1.13). 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 31.12.2016 as well as information on transfers of the units in 2016 to and from other Parties of the Kyoto Protocol.

The joint assigned amount of the EU, its Member States and Iceland for the second commitment period of the Kyoto Protocol is equal to the percentage inscribed for the Union, its Member States and Iceland in the third column of Annex B to the Kyoto Protocol as replaced by the Doha Amendment (80 %) of its base year emissions multiplied by eight. Council Decision (EU) 2015/1339 sets out the terms of the joint fulfilment agreement as well as the respective emission levels of each Party to that agreement. The Agreement between the EU, its Member States and Iceland, concerning Iceland's participation in the joint fulfilment of commitments by the EU, its Member States and Iceland for the second commitment period of the Kyoto Protocol sets out the terms governing Iceland's participation.[72] The emission levels define the Member States' and Iceland's assigned amounts for the second commitment period. These emission levels have been determined on the basis of the existing Union legislation for the period 2013-2020 under the 'Climate and Energy package'[73]. This assigned amount of the EU is determined in line with the terms of the joint fulfilment agreement, as described in the EU's initial report and will be established upon the completion of the initial review, still ongoing at the moment of this submission..

Summary of information reported in the CP2 SEF tables of the EU registry.

SEF tables for the EU registry are provided in Annex 1.13. Table 12.1 provides an overview of transactions included in Table 2(b) in the EU registry.

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[71] The Community registry was replaced by the Union registry in 2012

[72] OJ L 207, 4.8.2015, p. 17

[73] Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community and Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020, OJ L 140, 5.6. 2009.

Table 12.1 Transactions included in Table 2(b) in the EU registry.

		Additions						Subtractions					
	Total transfers and acquisitions	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**
1	**AT**	NO	NO	NO	75.396	NO	NO	NO	NO	NO	37.698	NO	NO
2	**AU**	NO	NO	NO	386.987	NO	NO	NO	NO	NO	3.573.312	NO	NO
3	**BE**	NO	NO	NO	239.290	NO	NO	NO	NO	NO	7.554	NO	NO
4	**CDM**	NO	NO	NO	6.620	NO	NO	NO	NO	NO	NO	NO	NO
5	**CH**	NO	NO	NO	6.066.604	NO	NO	NO	NO	NO	9.703.077	NO	NO
6	**DE**	NO	NO	NO	1.402.960	NO	NO	NO	NO	NO	218.209	NO	NO
7	**DK**	NO	NO	NO	634.856	NO	NO	NO	NO	NO	NO	NO	NO
8	**ES**	NO	NO	NO	229.375	NO	NO	NO	NO	NO	20.000	NO	NO
9	**FI**	NO	NO	NO	294.692	NO	NO	NO	NO	NO	NO	NO	NO
10	**FR**	NO	NO	NO	1.314.645	NO	NO	NO	NO	NO	300	NO	NO
11	**GB**	NO	NO	NO	13.163.692	NO	NO	NO	NO	NO	2.061.256	NO	NO
12	**IT**	NO	NO	NO	154.464	NO	NO	NO	NO	NO	NO	NO	NO
13	**NL**	NO	NO	NO	9.551.267	NO	NO	NO	NO	NO	648.580	NO	NO
14	**NO**	NO	NO	NO	11.392	NO	NO	NO	NO	NO	49.879	NO	NO
15	**PT**	NO	NO	NO	3.403.623	NO	NO	NO	NO	NO	510	NO	NO
16	**SE**	NO	NO	NO	5.101.906	NO	NO	NO	NO	NO	3.992	NO	NO
17	**Subtotal**	NO	NO	NO	42.037.769	NO	NO	NO	NO	NO	16.324.367	NO	NO

Discrepancies and notifications

With respect to the respective paragraphs of 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 is publicly available on the European Commission website: https://ets-registry.webgate.ec.europa.eu/euregistry/EU/public/reports/publicReports.xhtml

Article 6 project information

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

No ERUs have been issued in the EU Registry in 2016

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

No AAUs have been issued in the EU Registry in 2016

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

No ERUs have been issued in the EU Registry in 2016

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
2016	AT	0	0	0	75.396
2016	AU	0	0	0	386.987
2016	BE	0	0	0	239.290
2016	CDM	0	0	0	6.620
2016	CH	0	0	0	6.066.604
2016	DE	0	0	0	1.402.960
2016	DK	0	0	0	634.856
2016	ES	0	0	0	229.375
2016	FI	0	0	0	294.692
2016	FR	0	0	0	1.314.645
2016	GB	0	0	0	13.163.692
2016	IT	0	0	0	154.464

2016	NL	0	0	0	9.551.267
2016	NO	0	0	0	11.392
2016	PT	0	0	0	3.403.623
2016	SE	0	0	0	5.101.906

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

No RMUs have been issued in the Union registry in 2016

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
2016	AT	0	0	0	37.698
2016	AU	0	0	0	3.573.312
2016	BE	0	0	0	7.554
2016	CH	0	0	0	9.703.077
2016	DE	0	0	0	218.209
2016	ES	0	0	0	20.000

2016	FR	0	0	0	300
2016	GB	0	0	0	2.061.256
2016	NL	0	0	0	648.580
2016	NO	0	0	0	49.879
2016	PT	0	0	0	510
2016	SE	0	0	0	3.992

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
2016	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
2016	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
2016	0	0	0	877355

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
2016	0	0	0	0

Calculation of commitment period reserve (CPR)

For the purposes of the joint fulfilment, the commitment period reserve applies to the EU, its Member States and Iceland individually. The EU commitment period reserve is calculated in the EU's initial report and will be established upon the completion of the initial review, still ongoing at the moment of this submission..

KP-LULUCF accounting

Each EU Member State and Iceland apply Article 3(3) and (4) of the Kyoto Protocol and decisions agreed thereunder individually. Member States account individually for emissions by sources and removals by sinks from Kyoto LULUCF activities and individually decide on accounting modalities and elections where foreseen under the Kyoto Protocol. Any issuance of removal units (RMUs) or cancellation of units resulting from the accounting under Articles 3(3) and (4) would be made to the Member States' and Iceland's Kyoto registries. 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

[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

the following other Directorates General of the European Commission: Eurostat, and the Joint Research Centre (JRC) .

14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

The following changes to the national registry of EU have therefore occurred in 2016.

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	New tables were added to the CSEUR database for the implementation of the CP2 SEF functionality. Versions of the CSEUR released after 6.7.3 (the production version at the time of the last Chapter 14 submission) introduced other 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, including the new tables, 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 6.7.3 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 completed in January 2017 and the test report is provided. 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	The mandatory use of hard tokens for authentication and signature was introduced for registry administrators.
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 6.7.3 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 January 2017 and the test report is provided.

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

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[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/

policy dialogues are also be used to keep third countries fully informed of forthcoming initiatives, and as a means of exchanging information, data and results of preparatory studies with partner countries and other external stakeholders.

The EU's 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) set 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.

On 30 November 2016, the Commission published a proposal for a revised Renewable Energy Directive to ensure that the target of at least 27% renewables in the final energy consumption in the EU by 2030 is met (European Commission 2017b). The revised Renewable Energy Directive strengthens the existing EU criteria for bioenergy sustainability and extends them to cover also biomass and biogas for heat and power. More specifically, the Directive includes the following new requirements (European Commission 2016):

- **The sustainability criteria for biofuels are improved, including by requiring that (new) advanced biofuels emit at least 70% fewer GHG emissions than fossil fuels.**
- **A new sustainability criterion on forest biomass in introduced, in order to ensure that the production of woodfuel continues to be sustainable and that any LULUCF emissions are accounted for (in the country of biomass production).**
- **The EU sustainability criteria are extended to cover solid biomass and biogas used in large heat and power plants (above 20 MW fuel capacity).This means, for instance, that electricity and heat from biomass have to produce at least 80% fewer GHG emission compared to fossil fuels by 2021and 85% less by 2026.**

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

[78] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0296&from=EN

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 **1 February 2017**, the European Commission published its **regular** Renewable Energy Progress Report (European Commission 201**7a**) under the framework of the 2009 Renewable Energy Directive. The report includes information on **the assessment of sustainability of EU** biofuels. The 201**7** report and its accompanying staff working document **(European Commission 2017b) report that the net savings in greenhouse gas emissions resulting from the use of renewable energy in transport of around 35 Mt CO_2-equivalent in 2014. Indirect Land Use Change (ILUC) emissions associated to biofuels consumed in the EU are estimated to be 23 Mt CO_2-equivalent, leaving a net saving of 12 Mt CO_2-equivalent. Recent modelling work of the ILUC impacts of individual biofuel feedstock confirms that ILUC emissions can be much higher for biofuels produced from vegetable oils compared to biofuels produced from starch or sugar. Advanced biofuels from non-food crops have generally very low or no ILUC emissions. In 2014, around 10% of bioethanol and around 26% of biodiesel consumed in the EU was imported.**

The main exporting countries for biodiesel were Malaysia (palm oil), Brazil and the US (Soybean) and for bioethanol Guatemala, Bolivia, Pakistan, Russia, Peru, Ukraine, Canada and Moldova.

Projections for 2020 foresee that the EU biofuel policy could lead to an expansion of 1.8 Mha of cropland in the EU and to 0.6 Mha in the rest of the world, with 0.1 Mha at the expense of forest. Expansion of cropland at global level would occu at the expense of grassland (-1.1 Mha), abandoned land (-0.9 Mha) and other natural vegetation (-0.4 Mha). No significant negative effects from the production of biofuels and bioliquids on biodiversity, water resources, water quality and soil quality were found in the EU. However, indirect land use change can cause biodiversity losses if additional land expansion takes place in sensitive areas, such as forests and highly biodiverse grassland. The EU ethanol consumption had negligible impact on cereal prices given that the EU share in the global ethanol market did not exceed 7%, and the global cereal market is driven mainly by demand for feed. In the future, the strongest biofuel consumption growth is expected in developing countries, while the increased demand for food and feed for a growing and more affluent population is projected to be mostly met through productivity gains, with yield improvements expected to account for about 80% of the increase in crop output. Regarding land use right, the most recent reports on large-scale land deals confirm the finding of the 2015 Commission progress report on renewable energy that only very small share of biofuel projects outside the EU have been developed with the EU market in mind.

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 201**7**) 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), **NTA 8080, Roundtable on Sustainable Palm Oil RED (RSPO 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].

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.

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79 OJ C160, 19.6.2010, p.1

80 https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes

In response to the ICAO outcome and to give further momentum to the global discussions, the European Commission has proposed amending the EU ETS[81] so that only the part of a 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.

In October 2016, the ICAO agreed on a Resolution for a global market-based measure to address CO_2 emissions from international aviation as of 2021. The agreed Resolution sets out the objective and key design elements of the global scheme, as well as a roadmap for the completion of the work on implementing modalities. The Carbon Offsetting and Reduction Scheme for International Aviation, or CORSIA, aims to stabilise CO_2 emissions at 2020 levels by requiring airlines to offset the growth of their emissions after 2020. In light of the progress on the global measure under ICAO, the European Commission has proposed to continue the current approach beyond 2016. This proposal will now be considered by the European Parliament and the Council of the European Union.

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

[81] See Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emissions, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013PC0722

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

In **2016**, the European Commission published **the legislative proposals to implement the 2030 climate and energy framework which sets three key targets for the year 2030:**

- **At least 40% cuts in greenhouse gas emissions by 2030 (from 1990 levels)**
- **At least 27% share for renewable energy**
- **At least 27% improvement in energy efficiency**

To achieve the at least 40% target the EU emissions trading system (ETS) sectors would have to cut emissions by 43% (compared to 2005) – to this end, the ETS is to be reformed and strengthened. The non-ETS sectors would need to cut emissions by 30% (compared to 2005) – this needs to be translated into individual binding targets for Member States. IWhile 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 energy targets, the 2030 framework proposes a new governance framework based on national plans for competitive, secure and sustainable energy.

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.[82]

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[83], 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[84] 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

In July 2015 the Commission made a Proposal for a Regulation setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU[85]. This review of the Energy Labelling Directive aims at further exploiting the potential of energy efficiency especially with regard to the

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[82] 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

[83] 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

[84] http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/com_2015_0337_en.pdf

[85] http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2015/com_2015_0341_en.pdf

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[86]. 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[87]. 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/swd_2015_0139_en.pdf

[87] 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”[88] 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” 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:

[88] Official Journal No C 82, 1.4.2008, p.1

- o Aid to energy from renewable sources
- o Energy efficiency measures, including cogeneration and district heating and district cooling
- o Aid for resource efficiency and in particular aid to waste management
- o Aid to Carbon Capture and Storage (CCS)
- 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[89] after the draft list had been published on 5 May 2014 and applies to free allocation for the first time in 2015. According to the ETS Directive, it will be

[89] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0746&from=EN

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.
- 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)”.[90]

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:

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[90] See http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0264en01.pdf

- 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"[91] in its Economic Brief which aims to shed some light on the true magnitude and allocation of 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)

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[91] http://ec.europa.eu/economy_finance/publications/economic_briefs/2015/pdf/eb40_en.pdf

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).

The portfolio of CSLF-recognized projects, as of October 2016 was 34 active projects and 15 completed projects spread out over five continents. The CSLF Technical Group is currently preparing the 2017 CSLF Technology Roadmap and additional projects were recognized as CSLF projects.

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)[92], 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 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

[92] The Gulf Cooperation Council covers Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

aiming at further developing the activities of the Network and at supporting its sustainability over the mid-term.

In 2016 a background paper on "Areas of potential EU GCC Clean Energy Cooperation" was published (EU-GCC Clean Energy Network II, 2016). An essential element of the project are the five Working Groups that focus on areas of common interest for the stakeholders of the two re gions (EU, GCC):

- **Renewable Energy Sources**
- **Energy Demand Side Management and Energy Efficiency**
- **Clean Natural Gas and Related Technologies**
- **Electricity Interconnections and Market Integration**
- **Carbon Capture and Storage**
- **Climate change policies**

The areas of future cooperation were outlines as

- **Networking and Partnership development**
- **Organisation of experts' events, thematic discussions, seminars, webinars, training sessions and high level conferences**
- **Operation of Working Groups**
- **Dissemination of information**
- **Promotion and facilitation of of joint demonstration and pilot projects.**

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.[93]

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.

- *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

[93] http://www.eib.org/infocentre/publications/all/mediterranean-solar-plan-project-preparation-initiative.htm

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 2010-2015, 28 projects were approved for grant financing of €232 million, representing total lending of approximately €5.4 billion and total investment cost of approximately €6.9 billion.

- ***Carribean Investment Facility***

Like LAIF, CIF is one of the EU's regional blending facilities, which combine EU grants with other public and private sector resources to leverage additional non-grant financing to support investments in infrastructure and to support the private sector. The main purpose of CIF is to support investments in strategic economic infrastructure and private sector development, with a focus on small and medium-sized enterprises (SMEs), as well as to contribute to measures that help Caribbean countries to adapt to and mitigate the impacts of climate change.

The main strategic objectives of CIF are:

• Strengthening investments in strategic economic infrastructure, such as renewable energy, transport, information and communication technologies, and interconnectivity.

• Increasing investments in water and sanitation, climate adaptation and sustainable social infrastructure.

• Supporting investments in SME-development, including SMEs which contribute to the green economy.

CIF resources are made available under the European Development Fund (EDF), the EU's multiannual funding instrument to support countries in the African-Caribbean-Pacific (ACP) group. The EDF earmarked a minimum of €40 million in direct funding for CIF for the period 2012-2015. An additional allocation of €30.2 million was made available from the National Indicative Programme of Guyana in 2013. Since it was officially launched in March 2013, CIF has provided a total contribution of around €68.6 million to finance nine projects with a total investment cost of over €541 million.

- *Global Energy Efficiency and Renewable Energy Fund (GEEREF)*

The European Commission has launched an innovative pilot instrument to involve the private sector. The Global Energy Efficiency and Renewable Energy Fund (GEEREF), launched in 2008, 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.
- **USD 19.6 million investment to the Africa Renewable Energy Fund, managed by Bekeley Energy.**
- **USD 16.6 million investment in the Catalyst Mena Clean Energy Fund, that invests in renewable energy infrastructure for electricity generation and small scale renewable energy and energy efficiency projects across the Middle East and Northern Africa region**
- €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.

The 2015 review of the EU neighbourhood policy, emohazised strong support to give energy cooperation a greater place in the ENP, both as a security measure (energy sovereignty) and as a means to sustainable economic development and to support greater energy independence through support to diversification of energy sources, better cooperation on energy efficiency, and transition to the low carbon economy (European Commission 2015c).

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.

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17 UNITS AND ABBREVIATIONS

t	1 tonne (metric) = 1 megagram (Mg) = 106 g
Mg	1 megagram = 106 g = 1 tonne (t)
Gg	1 gigagram = 109 g = 1 kilotonne (kt)
Tg	1 teragram = 1012 g = 1 megatonne (Mt)
TJ	1 terajoule

AWMS	animal waste management systems
BEF	biomass expansion factor
BKB	lignite briquettes
C	confidential
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	

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**
NA — not applicable	PS — plant-specific	RS — regional statistics	NO — not occurring	
OTH - other				
RA — reference approach			P — partial	
T1 — IPCC Tier 1			Part — partial	
T1a — IPCC Tier 1a				
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				
T2 — IPCC Tier 2				
T3 — IPCC Tier 3				