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Annual European Community greenhouse gas inventory 1990–2003 and inventory report 2005

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Executive summary

ES.1 Background information on greenhouse gas inventories and climate change

The European Community (EC), as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories within the area covered by its Member States. This year the scope of the report has been extended to the new Member States due to the enlargement of the EC.

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

The EC GHG inventory is compiled on the basis of the inventories of the EC Member States for EU-15 or EU-25. It is the direct sum of the national inventories. Only for the EU-15 reference approach for CO_2 from fossil fuels of the developed by the Intergovernmental Panel on Climate Change (IPCC) Eurostat energy data is used. The main institutions involved in the compilation of the EC GHG inventory are the Member States, the European Commission (DG ENV), the European Environment Agency (EEA) and its European Topic Centre on Air and Climate Change (ETC/ACC), Eurostat, and the Joint Research Centre (JRC).

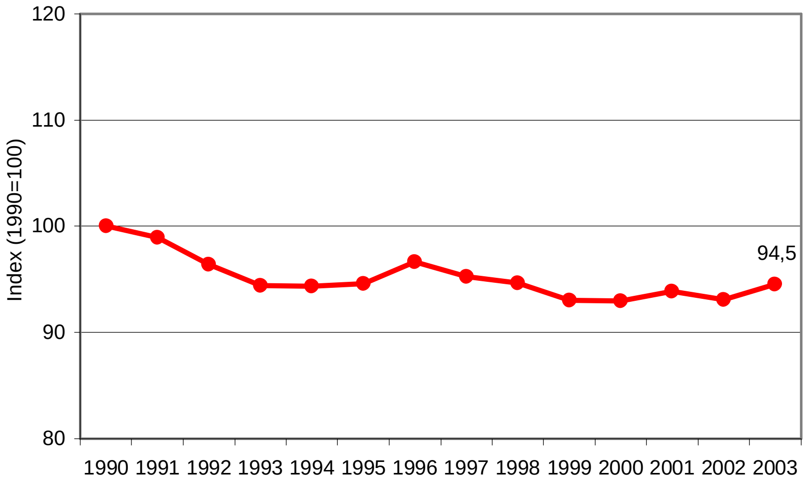
The process of compilation of the EC GHG inventory is as follows: Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG Environment. Then, the EEA's ETC/ACC, Eurostat and JRC perform initial checks on the submitted data. On 28 February, the draft EC GHG inventory and inventory report are circulated to Member States for reviewing and commenting. Member States check their national data and information used in the EC inventory report, send updates, if necessary, and review the EC inventory report itself by 15 March. The final EC GHG inventory and inventory report are prepared by the ETC/ACC by 15 April for submission by the European Commission to the UNFCCC Secretariat.

ES.2 Summary of emission- and removal-related trends

Total GHG emissions without LUCF in the EU-25 decreased by 5.5 % between 1990 and 2003 (Figure ES.1). Emissions increased by 1.5 % between 2002 and 2003.

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

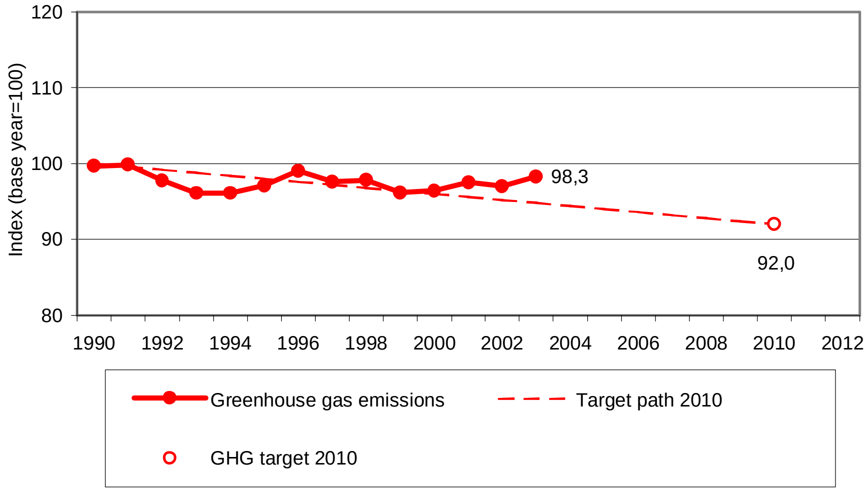
Figure ES.1 EU-25 GHG emissions 1990–2003 compared with target for 2008–12 (excl. LUCF)



Total GHG emissions without LUCF in the EU-15 were 1.7 % below the base year in 2003. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12, from base year levels. Assuming a linear target path from 1990 to 2010, total EU-15 GHG emissions were 3.5 index points above this target path in 2003 (Figure ES.2).

Compared to 2002, EU-15 GHG emissions increased in 2003 by 1.3 % or 53 million tonnes. The increases mainly occurred from energy industries (+24 million tonnes or 2.1%), mainly due to growing thermal power production and a 5 % increase of coal consumption in thermal power stations. The increase in thermal power production was driven by a combination of higher electricity consumption and an almost stable supply of electricity from hydro and nuclear power. In addition, greenhouse gas emissions from households and the services sector increased considerably (+18 million tonnes or +2.8 %), partly due to colder weather in the first quarter of 2003.

Figure ES.2 EU-15 GHG emissions 1990–2003 compared with target for 2008–2012 (excl. LUCF)



Notes: The linear target path is not intended as an approximation of past and future emission trends. It provides a measure of how close the EU-15 emissions in 2003 are to a linear path of emissions reductions from 1990 to the Kyoto target for 2008–12, assuming that only domestic measures will be used. Therefore, it does not deliver a measure of (possible) compliance of the EU-15 with its GHG targets in 2008–12, but aims at evaluating overall EU-15 GHG emissions in 2003. The unit is index points with base year emissions being 100.

GHG emission data for the EU-15 as a whole do not include emissions and removals from LUCF. In addition, no adjustments for temperature variations or electricity trade are considered.

For the fluorinated gases the EU-15 base year is the sum of Member States base years. Thirteen Member States have indicated to select 1995 as the base year under the Kyoto Protocol, Finland and France have indicated to use 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France.

The index on the y axis refers to the base year (1995 for fluorinated gases for all Member States except Finland and France, 1990 for fluorinated gases for Finland and France and for all other gases). This means that the value for 1990 needs not to be exactly 100.

Table ES.1 gives an overview of the main trends in EU-25 GHG emissions and removals for 1990–2003. The most important GHG by far is CO_2, accounting for 82 % of total EU-25 emissions in 2003. In 2003, EU-25 CO_2 emissions without LUCF were 4 064 Tg, which was 1.6 % below 1990 levels. Compared to 2002, CO_2 emissions increased by 2.1 %.

Table ES.1 Overview of EU-25 GHG emissions and removals from 1990 to 2003 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO_2 emissions/removals	3.818	3.748	3.645	3.567	3.561	3.571	3.657	3.597	3.619	3.542	3.562	3.606	3.560	3.669
CO_2 emissions (without LUCF)	4.128	4.106	3.998	3.921	3.917	3.925	4.028	3.963	3.967	3.921	3.931	4.005	3.982	4.064
CH_4	554	537	525	513	504	501	490	479	471	456	443	425	415	407
N_2O	474	460	447	431	439	441	448	448	424	407	408	402	391	389
HFCs	27	27	29	30	34	40	45	52	53	47	46	47	49	53
PFCs	17	16	13	12	11	11	11	10	9	8	7	7	6	6
SF_6	11	11	12	13	14	15	15	14	12	10	10	9	10	10
Total (with net CO_2 emissions/removals)	**4.902**	**4.798**	**4.670**	**4.566**	**4.563**	**4.579**	**4.666**	**4.600**	**4.589**	**4.471**	**4.477**	**4.496**	**4.432**	**4.533**
Total (without CO2 from LUCF)	**5.212**	**5.157**	**5.023**	**4.920**	**4.919**	**4.933**	**5.038**	**4.965**	**4.936**	**4.850**	**4.846**	**4.895**	**4.854**	**4.928**
Total (without LUCF)	**5.212**	**5.156**	**5.023**	**4.919**	**4.917**	**4.931**	**5.036**	**4.964**	**4.935**	**4.849**	**4.844**	**4.894**	**4.852**	**4.925**

Table ES.2 gives an overview of the main trends in the EU-15 GHG emissions and removals for 1990–2003. Also in the EU-15 the most important GHG by is CO_2, also accounting for 82 % of total EU-15 emissions in 2003. In 2003, EU-15 CO_2 emissions without LUCF were 3 447 Tg, which was 3.4 % above 1990 levels. Compared to 2002, CO_2 emissions increased by 1.8 %. The main reason for increases between 1990 and 2003 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions in energy-related emissions from manufacturing industries.

Table ES.2 Overview of EU-15 GHG emissions and removals from 1990 to 2003 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO_2 emissions/removals	3.111	3.111	3.088	3.023	2.970	2.964	3.004	3.063	3.008	3.053	3.010	3.044	3.086	3.058	3.138
CO_2 emissions (without LUCF)	3.335	3.335	3.359	3.285	3.232	3.230	3.267	3.343	3.288	3.331	3.304	3.328	3.394	3.388	3.447
CH_4	441	441	432	426	419	410	408	402	392	383	372	361	351	342	334
N_2O	408	408	403	396	383	391	392	398	399	376	352	352	344	336	336
HFCs	41	27	27	29	30	34	40	45	51	53	46	44	44	46	50
PFCs	12	16	14	12	10	10	9	9	8	8	7	6	6	6	6
SF_6	15	10	11	12	12	13	15	15	13	12	10	10	9	10	9
Total (with net CO_2 emissions/removals)	**4.029**	**4.015**	**3.976**	**3.897**	**3.825**	**3.823**	**3.868**	**3.932**	**3.872**	**3.884**	**3.797**	**3.817**	**3.839**	**3.798**	**3.873**
Total (without CO2 from LUCF)	**4.253**	**4.238**	**4.246**	**4.159**	**4.087**	**4.089**	**4.131**	**4.212**	**4.151**	**4.162**	**4.092**	**4.101**	**4.148**	**4.127**	**4.182**
Total (without LUCF)	**4.252**	**4.238**	**4.246**	**4.159**	**4.087**	**4.088**	**4.129**	**4.211**	**4.150**	**4.160**	**4.091**	**4.100**	**4.146**	**4.126**	**4.180**

The increase of CO_2 emissions was compensated by decreases in CH_4 and N_2O in the same period: CH_4 decreased by 108 Tg (CO_2 equivalents) (–24 %) and N_2O by 73 Tg (CO_2 equivalents) (-18 %). The main reasons for declining CH_4 emissions were reductions in solid waste disposal on land, the decline of coal-mining, and falling cattle population. The main reason for large N_2O emission cuts were reduction measures in the adipic acid production. Fluorinated gas emissions are subject to two opposing trends. While HFCs from consumption of halocarbons showed large increases between 1990 and 2002 (mainly due to the replacement of ozone-depleting substances), HFC emissions from production of halocarbons decreased substantially.

ES.3 Overview of source and sink emission estimates and trends

Table ES.3 gives an overview of EU-25 GHG emissions in the main source categories for 1990–2003. The most important sector by far is ‘Energy’ accounting for 80 % of total EU-25 emissions in 2003. The second largest sector is ‘Agriculture’ (10 %), followed by Industrial processes’ (6 %).

Table ES.3 Overview of EU-25 GHG emissions in the main source and sink categories 1990 to 2003 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	4.123	4.113	4.003	3.931	3.910	3.914	4.023	3.948	3.944	3.894	3.895	3.970	3.946	4.015
2. Industrial Processes	351	331	321	311	332	344	345	354	333	300	303	299	293	305
3. Solvent and Other Product Use	12	11	11	11	10	11	11	11	11	11	11	10	10	10
4. Agriculture	547	524	509	493	494	494	496	497	493	496	491	483	476	468
5. Land-Use Change and Forestry	-310	-358	-353	-354	-354	-351	-370	-364	-346	-378	-365	-398	-421	-392
6. Waste	178	176	177	173	171	167	160	154	154	148	143	131	126	125
7. Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table ES.4 gives an overview of EU-15 GHG emissions in the seven sectors for 1990–2003. The emissions from the largest sector 'Energy', with an 81 % share of the total emissions, increased by 83 Tg CO_2 equivalents (2.5 %). This increase was offset by decreases in all other source categories: emissions from 'Industrial processes' decreased by 48 Tg CO_2 equivalents (– 15 %), emissions from 'Agriculture' by 47 Tg CO_2 equivalents (– 10 %), emissions from 'Waste' by 44 Tg CO_2 equivalents (– 31 %) and emissions from 'Solvent and other product use' by 1 Tg CO_2 equivalents (– 10 %).

Table ES.4 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2003 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	3.310	3.310	3.344	3.273	3.221	3.203	3.235	3.316	3.253	3.292	3.264	3.280	3.347	3.339	3.393
2. Industrial Processes	328	313	301	292	283	302	313	315	320	298	265	266	259	258	265
3. Solvent and Other Product Use	10	10	10	10	10	10	10	10	10	10	10	10	9	9	9
4. Agriculture	462	462	449	442	433	436	437	440	442	440	437	435	426	420	414
5. Land-Use Change and Forestry	-223	-223	-270	-262	-262	-265	-261	-278	-278	-276	-294	-283	-307	-329	-307
6. Waste	141	141	142	141	140	137	133	130	124	120	114	109	104	99	97
7. Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Tables ES.5 and ES.6 give an overview of Member States' contributions to the EC GHG emissions for 1990–2003. Member States show large variations in GHG emission trends.

Table ES.5 Overview of Member States' contributions to EC GHG emissions excluding LUCF from 1990 to 2003 in CO_2 equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	79	83	76	76	77	80	83	83	83	80	81	85	86	92
Belgium	146	149	147	146	151	152	157	148	153	146	148	147	145	148
Cyprus	6	6	7	7	7	7	8	8	8	8	9	8	9	9
Czech Republic	192	178	164	158	152	153	155	159	149	140	148	148	143	147
Denmark	69	80	74	76	80	77	90	80	76	73	68	70	69	74
Estonia	43	41	30	23	24	22	23	24	21	20	20	19	20	21
Finland	70	69	67	68	74	71	77	76	73	72	70	76	77	86
France	568	593	585	559	555	563	578	572	584	566	560	564	554	557
Germany	1.244	1.191	1.142	1.126	1.108	1.103	1.121	1.084	1.057	1.021	1.017	1.028	1.015	1.018
Greece	109	109	110	110	113	114	118	123	128	127	132	134	134	138
Hungary	104	96	86	85	85	84	86	84	85	84	81	84	81	83
Ireland	54	55	56	56	57	58	60	63	65	67	69	71	69	68
Italy	511	513	509	505	496	528	519	525	535	544	551	556	555	570
Latvia	25	24	19	16	15	12	12	12	11	10	10	11	11	11
Lithuania	51	45	42	38	35	31	28	24	22	21	21	20	20	17
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11	11
Malta	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Netherlands	212	216	215	221	221	224	233	225	227	215	214	216	213	215
Poland	460	438	440	430	440	417	437	427	404	402	386	383	370	384
Portugal	59	61	65	64	65	70	67	70	75	83	80	81	86	81
Slovakia	72	63	59	55	52	53	54	54	52	51	48	53	52	52
Slovenia	19	18	18	18	18	19	20	20	20	19	19	20	20	20
Spain	284	290	299	287	303	315	307	328	337	365	380	379	399	402
Sweden	72	72	72	72	75	73	77	73	73	70	67	68	69	71
United Kingdom	748	752	729	710	700	691	714	691	686	652	652	663	644	651
EU25	**5.212**	**5.156**	**5.023**	**4.919**	**4.917**	**4.931**	**5.036**	**4.964**	**4.935**	**4.849**	**4.844**	**4.894**	**4.852**	**4.925**
EU15	**4.238**	**4.246**	**4.159**	**4.087**	**4.088**	**4.129**	**4.211**	**4.150**	**4.160**	**4.091**	**4.100**	**4.146**	**4.126**	**4.180**

Note: For some countries the data provided in this table is based on gap filling (see Chapter 1.8.2 for details.).

The overall EC GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom, accounting for about one third of total EU-25 GHG emissions. These two Member States achieved total GHG emission reductions of 323 million tonnes compared to 1990 ([2]).

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

([2]) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 340 million tonnes on the basis of the 2005 inventory in order to meet the Kyoto target.

Italy and France are the third and fourth largest emitters with a shares of 12 % and 11 % respectively. Italy's GHG emissions were 12% above 1990 levels in 2003. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 2 % below 1990 levels in 2003. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport increased considerably between 1990 and 2003.

Spain and Poland are the fifth and sixth largest emitters in the EU-25 each accounting for about 8 % of total EU-25 GHG emissions. Spain increased emissions by 42 % between 1990 and 2003 (+41 % since the base year). This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 16 % between 1990 and 2003[3] (-32 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

Table ES.6 shows that 12 Member States (including Cyprus and Malta, which do not have a Kyoto target) were above base year levels in 2003, 13 Member States were below. The percentage changes of GHG emissions from the base year to 2003 range from – 66 % (Lithuania) to + 41 % (Spain).

Table ES.6 Greenhouse gas emissions in CO_2 equivalents (excl. LUCF) and Kyoto Protocol targets for 2008–2012

MEMBER STATE	Base year 1) (million tonnes)	2003 (million tonnes)	Change 2002–2003 (%)	Change base year–2003 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78,5	91,6	5,9%	16,6%	-13,0%
Belgium	146,8	147,7	1,6%	0,6%	-7,5%
Cyprus	6,0	9,2	5,3%	52,8%	-
Czech Republic	192,1	145,4	1,8%	-24,3%	-8,0%
Denmark	69,6	74,0	7,3%	6,3%	-21,0%
Estonia	43,5	21,4	9,7%	-50,8%	-8,0%
Finland	70,4	85,5	10,8%	21,5%	0,0%
France	568,0	557,2	0,7%	-1,9%	0,0%
Germany	1248,3	1017,5	0,2%	-18,5%	-21,0%
Greece	111,7	137,6	3,1%	23,2%	25,0%
Hungary	122,2	83,2	3,0%	-31,9%	-6,0%
Ireland	54,0	67,6	-2,6%	25,2%	13,0%
Italy	510,3	569,8	2,7%	11,6%	-6,5%
Latvia	25,4	10,5	-0,9%	-58,5%	-8,0%
Lithuania	50,9	17,2	-12,1%	-66,2%	-8,0%
Luxembourg	12,7	11,3	4,3%	-11,5%	-28,0%
Malta 2)	2,2	2,9	-0,5%	29,1%	-
Netherlands	213,1	214,8	0,6%	0,8%	-6,0%
Poland 2)	565,3	384,0	3,7%	-32,1%	-6,0%
Portugal	59,4	81,2	-5,3%	36,7%	27,0%
Slovakia	72,0	51,7	-1,3%	-28,2%	-8,0%
Slovenia	20,2	19,8	-1,2%	-1,9%	-8,0%
Spain	286,1	402,3	0,9%	40,6%	15,0%
Sweden	72,3	70,6	1,5%	-2,4%	4,0%
United Kingdom	751,4	651,1	1,1%	-13,3%	-12,5%
EU-15	**4252,5**	**4179,6**	**1,3%**	**-1,7%**	**-8,0%**

([1]) The base year for CO_2, CH_4 and N_2O is 1990; for the fluorinated gases 13 Member States have chosen to select 1995 as the base year, whereas Finland and France have chosen 1990. As the EC inventory is the sum of Member States' inventories, the EC base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France.

[3] Note that for Poland data for 2003 have been estimated by gap filling because Poland did not provide GHG emission estimates before the data deadline of this report (see Chapter 1.8.2.).

([2]) Malta and Poland did not provide GHG emission estimates for 2003, therefore the data provided in this table is based on gap filling (see Chapter 1.8.2.).

Note: Malta and Cyprus do not have Kyoto targets.

ES.4 Information on indirect greenhouse gas emissions for EU-15

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 ES.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990–2003. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 68 %) followed by CO (– 48 %) NMVOC (– 38 %) and NO_x (– 31 %).

Table ES.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2003 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	Gg													
NO_x	13.390	13.145	12.832	12.243	11.881	11.599	11.316	10.836	10.593	10.259	9.913	9.686	9.420	9.273
CO	50.457	48.605	46.522	44.276	41.983	40.325	38.766	36.854	35.303	33.246	30.618	29.199	27.263	26.481
NMVOC	15.556	14.865	14.451	13.774	13.436	13.085	12.519	12.322	11.808	11.346	10.643	10.244	9.782	9.594
SO_2	16.527	14.977	13.825	12.563	11.347	10.229	8.852	8.047	7.519	6.753	6.093	5.875	5.669	5.234

1 Introduction to the EC greenhouse gas inventory

This report is the annual submission of the European Community (EC) to the United Nations Framework Convention on Climate Change (UNFCCC). It presents the greenhouse gas (GHG) inventory of the EC, the process and the methods used for the compilation of the EC inventory as well as GHG inventory data of the individual EC Member States for 1990 to 2003. The GHG inventory data of the Member States are the basis of the EC GHG inventory. The data published in this report are also the basis of the progress evaluation report of the European Commission, required under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

This report aims to present transparent information on the process and methods of compiling the EC GHG inventory. It addresses the relevant aspects at EC level, but does not describe particular sectoral methodologies of the Member States' GHG inventories. Detailed information on methodologies used by the Member States is available in the national inventory reports of the Member States, which are included in Annex 13. Note that all Member States' submissions (CRF tables and inventory reports), which are included in Annex 13 and made available at the EEA website, are considered to be part of the EC submission. 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 EC greenhouse gas inventory has been compiled under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([4]).The emissions compiled in the EC GHG inventory are the sum of the respective emissions in the respective 15 or 25 national inventories, except for the IPCC reference approach for CO_2 from fossil fuels. Since the data are revised and updated for all years, they replace EC data previously published, in particular, in the 2004 submission by the European Commission to the UNFCCC Secretariat of the *Annual European Community greenhouse gas inventory 1990–2002 and inventory report 2004* (EEA, 2004a) and in the report entitled *Analysis of greenhouse gas emission trends and projections in Europe 2004* (EEA, 2004b).

As on 1 May 2004 ten new Member States have joint the European Community, this inventory report for the first time includes data for the EU-15 and for the EU-25 Member States. The EU-15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. The ten new Member States are Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Most chapters and annexes of this report refer to EU-15 only, i.e. chapters 3-10 and annexes 1-12. Chapters 1 and 2 and also annexes 12 and 13 refer to the EU-25 where relevant (for more detail see Section 1.8.5). This means that all the detailed information provided in previous reports for the EU-15 is also available in this report. In addition, basic information on data availability, QA/QC, uncertainty estimates, completeness and emission trends are provided for the EU-25.

1.1 Background information on greenhouse gas inventories and climate change

The annual EC GHG inventory is required for two purposes.

Firstly, the EC, 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.

([4]) OJ L 49, 19.2.2004, p. 1.

Secondly, under the monitoring mechanism, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the EC's commitments under the UNFCCC and the Kyoto Protocol. 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 EC inventory is the basis for the evaluation of actual progress.

The legal basis of the compilation of the EC inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([5]). The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol; (3) implement the UNFCCC and the Kyoto Protocol as regards national programmes, greenhouse gas inventories, national systems and registries of the Community and its Member States, and the relevant procedures under the Kyoto Protocol; (4) ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the Community and its Member States to the UNFCCC Secretariat.

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

- their anthropogenic emissions of greenhouse gases listed in Annex A to the Kyoto Protocol (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride SF_6)) during the year before last (X – 2);
- provisional data on their emissions of carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and volatile organic compounds (VOCs) during the year before last (year X – 2), together with final data for the year three-years previous (year X – 3);
- their anthropogenic greenhouse gas emissions by sources and removals of carbon dioxide by sinks resulting from land-use, land-use change and forestry during the year before last (year X – 2);
- information with regard to the accounting of emissions and removals from land-use, land-use change and forestry, in accordance with Article 3(3) and, where a Member State decides to make use of it, Article 3(4) of the Kyoto Protocol, and the relevant decisions thereunder, for the years between 1990 and the year before last (year X – 2);
- any changes to the information referred to in points (1) to (4) relating to the years between 1990 and the year three-years previous (year X – 3);
- the elements of the national inventory report necessary for the preparation of the Community greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

The reporting requirements for the Member States under Council Decision No 280/2004/EC are elaborated in the Commission Decision laying down rules implementing Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([6]). According to the Council decision and the Commission decision the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EC and its Member States use the 'UNFCCC guidelines on reporting and review' (Document FCCC/CP/2002/8), and prepare inventory information in the common reporting format (CRF) and the 'national inventory report' that contains background information.

In accordance with UNFCCC guidelines, the EC and its Member States use the IPCC *Good practice guidance and uncertainty management in national greenhouse gas inventories* (IPCC, 2000), which is

([5]) OJ L 49, 19.2.2004, p. 1.
([6]) This Commission Decision was adopted on 14 February 2005 and will be published in the Official Journal of the European Community soon.

consistent with the *Revised 1996 IPCC guidelines for national greenhouse gas inventories* (IPCC, 1997). The use of IPCC (2000) by countries is expected to lead to higher quality inventories and more reliable estimates of the magnitude of absolute and trend uncertainties in reported GHG inventories.

1.2 A description of the institutional arrangements for inventory preparation

Figure 1.1 shows the inventory system of the European Community. The DG Environment of the European Commission is responsible for preparing the inventory of the European Community (EC) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Community ([7]). DG Environment 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 and Climate Change (ETC/ACC) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) ([8]).

Figure 1.1 Inventory system of the European Community

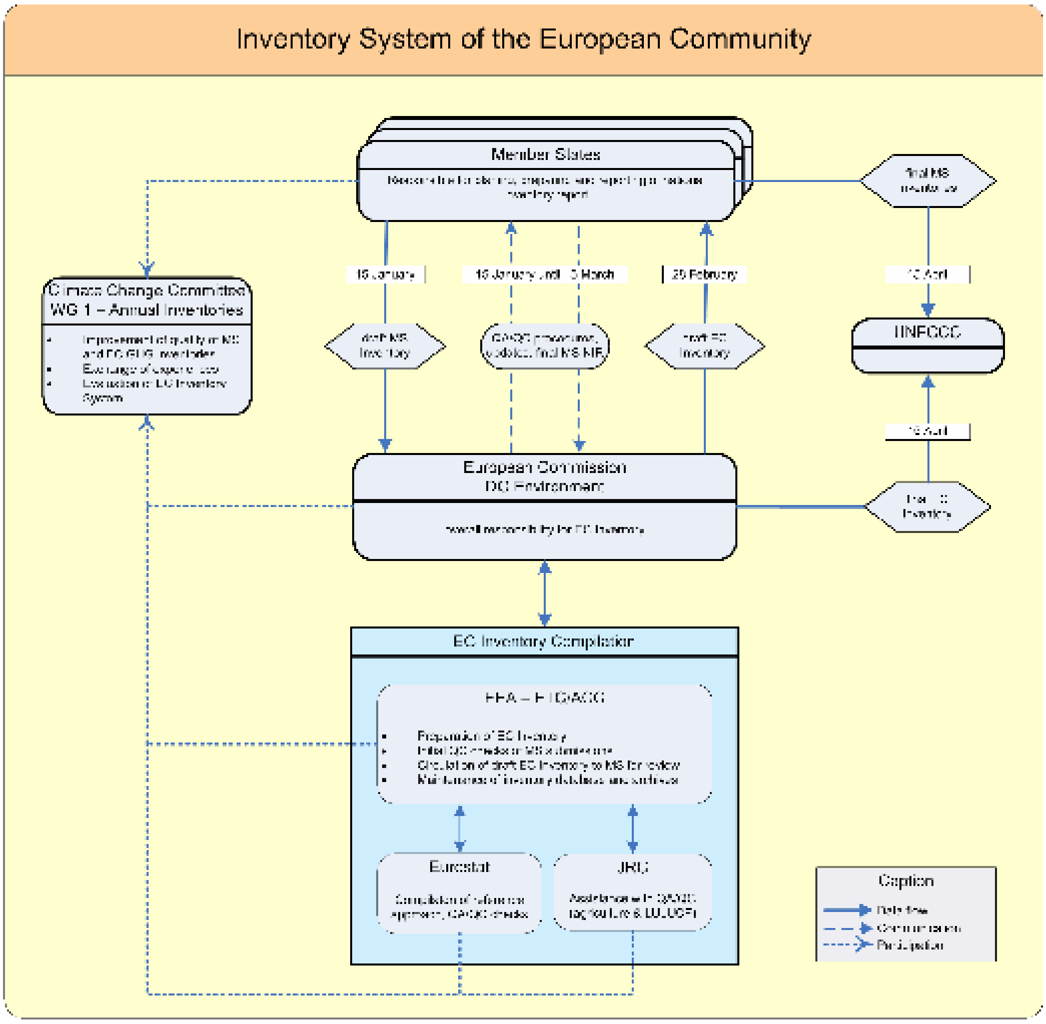


Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EC inventory.

([7]) A draft Staff Working Paper laying down the Community Inventory System will be adopted soon. This paper will specify in more detail the responsibilities of the institutions involved in the preparation of the EC inventory, the preparation of the EC inventory, identification of key categories, estimation of uncertainties, recalculations, response to the UNFCCC review process and QA/QC of the EC inventory report.

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

Table 1.1 List of institutions and experts responsible for the compilation of Member States' inventories and for the preparation of the EC inventory

Member State/EU institution	Contact address
Austria	Manfred Ritter Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Belgium	Peter Wittoeck Federal Department of the Environment Pachecolaan 19 PB 5, B-1010 Brussels
Cyprus	Christos Malikkides Head, Industrial Pollution Control Section, Department of Labour Inspection Ministry of Labour and Social Insurance 12, Apellis Street, 1493 Nicosia
Czech Republic	Pavel Fott Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Denmark	Jytte Boll Illerup Danish National Environmental Research Institute PO Box 358, DK-4000 Roskilde
Finland	Outi Berghäll Ministry of the Environment PO Box 35, FIN-00023 Government Jouko Petäjä Finnish Environment Institute PB 140, FIN-00251 Helsinki Kari Grönfors Statistics Finland PB 6A, FIN-00022 Statistics
France	Ministère de l'Ecologie et du Développement Durable (MEDD) 20 avenue de Ségur, F-75007 Paris Jean-Pierre Fontelle Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 7 Cité Paradis, F-75010 Paris
Estonia	Jaan-Mati Punning Institute of Ecology at TPU Kevade 2, Tallinn 10137
Germany	Michael Strogies Federal Environmental Agency Bismarckplatz 1, D-14193 Berlin
Greece	Dimitra Koutendaki Institute of Environmental Research and Sustainable Development Athens, Greece
Hungary	László Gáspár National Directorate for Environment, Nature and Water Márvány u. 1/c, H-1012 Budapest
Ireland	Michael McGettigan, Paul Duffy Environmental Protection Agency Richview, Clonskeagh Road, Dublin 14, Ireland
Italy	M. Contaldi, R. de Lauretis, D. Romano National Environment Protection Agency (ANPA) Via Vitaliano Brancati 48, I-00144 Rome
Latvia	Agita Gancone, Kristīne Zommere Latvian Environment, Geology and Meteorology Agency Straumes Street 2, Jurmala, LV-2015
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
Luxembourg	Frank Thewes Administration de l'Environment, Division Air-Bruit 16 rue Eugène Ruppert, L-2453 Luxembourg
Malta	Sharon.Micallef Malta Environment Planning Authority P.O. Box 200, Marsa GPO 01, Malta
Netherlands	Jos Olivier RIVM P.O. Box 1, 3720 BA Bilthoven
Poland	Krzysztof Olendrzynski Institute of Environmental Protection, National Emission Centre Kolektorska 4, 01-692 Warszawa
Portugal	Teresa Costa Pereira Direccao-Geral do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Slovakia	Ministry of Environment SR, Department of Air Protection, director Ing. Lubomir ZIAK namestie L. Stura 1, 812 35 Bratislava
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SI-1000 Ljubljana
Spain	Ángleles Cristóbal

Member State/EU institution	Contact address
	Ministerio de Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Per Rosenqvist Ministry of the Environment, S-103 33 Stockholm Sandra Pettersson Swedish Environmental Protection Agency Blekholmsterassen 36, S-106 48 Stockholm
United Kingdom	JD Watterson National Environmental Technology Centre AEA Technology, Culham, Abingdon, Oxon, OX14 3ED
European Commission	Lars Mueller European Commission, DG Environment Rue de la Loi 200, B-1049 Brussels, Belgium
European Environment Agency (EEA)	Andre Jol, Andreas Barkman European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air and Climate Change (ETC/ACC)	Bernd Gugele, Elisabeth Rigler, Manfred Ritter European Topic Centre on Air and Climate Change Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Nikolaos Roubanis Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
Joint Research Centre (JRC)	Frank Raes, Giorgio Matteucci, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA), Italy

1.2.1 The Member States

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

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

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

1.2.2 The European Commission, Directorate-General for the Environment

The European Commission's DG Environment in consultation with the Member States has the overall responsibility for the EC inventory. Member States are required to submit their national inventories and inventory reports under Council Decision No 280/2004/EC to the European Commission, DG Environment; and the European Commission, DG Environment itself submits the inventory and inventory report of the EC to the UNFCCC Secretariat. In the actual compilation of the EC inventory and inventory report, the Euopean Commission, DG Environment is assisted by the EEA including its ETC/ACC and by Eurostat and the JRC.

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

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

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

1.2.3 The European Environment Agency

The European Environment Agency assists the Commission in the compilation of the annual EC inventory through the work of the ETC/ACC. The activities of the ETC/ACC include:

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

The tasks of the EEA and the ETC/ACC are facilitated by the European environmental information and observation network (Eionet), which consists of the EEA as central node (supported by European topic centres) and national institutions in the EEA member countries that supply and/or analyse national data on the environment (see http://eionet.eea.eu.int/). The Member States are encouraged to use the central data repository under the Eionet for making available their GHG submissions to the European Commission and the ETC/ACC (see http://cdr.eionet.eu.int/).

1.2.4 The European Topic Centre on Air and Climate Change

The European Topic Centre on Air and Climate Change (ETC/ACC) was established by a contract between the lead organisation National Institute of Public Health and the Environment — RIVM (the Netherlands) and EEA in March 2001. The ETC/ACC involves 13 organisations and institutions in eight European countries. The technical annex for the 2005 work plan for the ETC/ACC and an implementation plan specify the specific tasks of the ETC/ACC partner organisations with regard to the preparation of the EC inventory. Umweltbundesamt Austria is the task leader for the compilation of the EC annual inventory in the ETC/ACC, including all tasks mentioned above.

The ETC/ACC provides software tools for Member States to compile national GHG inventories and to convert their national inventory from Corinair-SNAP source category codes into the required CRF source categories. The main software tools are CollectER, for compiling and updating national emission inventories, and ReportER, for reporting the emissions in the required format, e.g. CRF. In addition, separate software tools are available to prepare estimates of emissions from agriculture and road transport. These tools are being used by several Member States. The ETC/ACC adapts the tools regularly to the latest changes in reporting requirements. The tools are available at http://etc-acc.eionet.eu.int/.

1.2.5 Eurostat

Based on Eurostat energy balance data, Eurostat compiles annually by 31 March estimates of the EC CO_2 emissions from fossil fuels using the IPCC reference approach. Eurostat compares these estimates with national estimates of CO_2 emissions from fossil fuels prepared by Member States and provides information summarising and explaining these differences. In order to improve the consistency of Member State and Eurostat energy data, a project on harmonisation of energy balances has started between Eurostat and national statistical offices. In addition, Eurostat is leading an EC project aimed at improving estimates of GHG emissions from international aviation.

1.2.6 Joint Research Centre

The Joint Research Centre assists in the improvement of methodologies for the land-use, land-use change and forestry (LULUCF) sector. It does so (1) by inter-comparing methodologies used by the Member States for estimating emissions and removals with a focus on LULUCF and (2) by providing EC-wide estimates with various models/methods for emissions and removals with a focus on LULUCF. For this reason, methods using inverse modelling for CH_4 emissions are currently under development. In addition, the JRC is leading a project for improving the methodologies used for estimating GHG emissions from agriculture with a focus on the N_2O emissions of agriculture soils, the source contributing most to the overall uncertainty of the EC inventory.

1.3 A description of the process of inventory preparation

The annual process of compilation of the EC inventory is summarised in Table 1.2. The Member States should submit their annual GHG inventory by 15 January each year to the European Commission's DG Environment. Then, the ETC/ACC, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACC transfers the nationally submitted data from the spreadsheet format of the common reporting format (CRF) tables into spreadsheets. From these spreadsheets the data is transferred into the EC CRF tables and into the ETC/ACC database.

Table 1.2 Annual process of submission and review of Member States inventories and compilation of the EC 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 3(1) of Decision 280/2004/EC as elaborated in Articles 2 to7 in particular: • Greenhouse gas emissions by sources and removals by sinks, for the year n –2 • And updated time series 1990- year n – 3, depending on recalculations; • Core elements of the NIR Steps taken to improve estimates in areas that were previously adjusted under Article 5.2 of the Kyoto Protocol (for reporting under the Kyoto Protocol)
2. 'Initial check' of Member States' submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	As soon as possible after receipt of Member State data, at the latest by 1 April	Initial checks and consistency checks (by EEA). Comparison of energy data provided by Member States on the basis of the IPCC Reference Approach with Eurostat energy data (by Eurostat and Member States) and check of Member States' agriculture and land use, land-use change and forestry (LULUCF) inventories by DG JRC (in consultation with Member States).
3. Compilation of draft EC inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft EC inventory (by EEA), based on Member States' inventories and additional information where needed.
4. Circulation of draft EC inventory	Commission (DG Environment) assisted by the EEA	28 February	Circulation of the draft EC inventory on 28 February to Member States. Member States check data.
5. Submission of updated or additional inventory data and complete national inventory reports by Member States	Member States	15 March	Updated or additional inventory data submitted by Member States (to remove inconsistencies or fill gaps) and complete final

Element	Who	When	What
			national inventory reports.
6. Estimates for data missing from a national inventory	Commission (DG Environment) assisted by EEA	31 March	The Commission prepares estimates for missing data by 31 March of the reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
7. Comments from Member States regarding the Commission estimates for missing data	Member States	8 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
8. Final annual EC inventory (incl. Community inventory report)	Commission (DG Environment) assisted by EEA	15 April	Submission to UNFCCC of the final annual EC inventory. This inventory will also be used to evaluate progress as part of the monitoring mechanism.
9. Circulation of initial check results of the EC submission to Member States	Commission (DG Environment) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EC submission as soon as possible after their receipt to those Member States, which are affected by the initial checks.
10. Response of relevant Member States to initial check results of the EC submission	Member States	Within one week from receipt of the findings	The Member States, for which the initial check indicated problems or inconsistencies provide their responses to the initial check to the Commission.
11. Any resubmissions by Member States in response to the UNFCCC initial checks	Member States	For each Member State, same as under the UNFCCC initial checks phase Under the Kyoto Protocol: the resubmission should be provided to the Commission within five weeks of the submission due date.	Member States provide to the Commission the resubmissions which they submit to the UNFCCC Secretariat in response to the UNFCCC initial checks. The Member States should clearly specify which parts have been revised in order to facilitate the use for the EC resubmission. As the EC resubmission also has to comply with the deadlines specified in the guidelines under Article 8 of the Kyoto Protocol, the resubmission has to be sent to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, provided that the resubmission correct data or information that is used for the compilation of the EC inventory.
12. Submission of any other resubmission after the initial check phase	Member States	When additional resubmissions occur	Member States provide to the Commission any other resubmission (CRF or national inventory report) which they provide to the UNFCCC Secretariat after the initial check phase.

On 28 February, the draft EC 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 EC inventory report and send updates, if necessary, and review the EC inventory report by 15 March. This procedure should assure the timely submission of the EC GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EC submission to the UNFCCC Secretariat is consistent with the Member State UNFCCC submissions.

The final EC GHG inventory and inventory report is prepared by the ETC/ACC by 15 April for submission to the UNFCCC Secretariat. In late April the inventory and the inventory report are published on the EEA website (http://www.eea.eu.int) and the data are made available through the EEA data warehouse (http://dataservice.eea.eu.int/dataservice). In addition, the EC inventory report is published by the EEA as a printed report, with a CD-ROM including the data. Within five weeks after 15 April, Member States should provide to the Commission any resubmission in response to the UNFCCC initial checks which affects the EC inventory, in order to guarantee that the EC resubmission to the UNFCCC Secretariat is consistent with the Member States' resubmissions.

1.4 General description of methodologies and data sources used

The EC 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/2002/8), to the extent possible ([9]). In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the IPCC *Good practice guidance and uncertainty management in national greenhouse gas inventories,* where appropriate and feasible ([9]). In addition, for the compilation of the EC GHG inventory, Council Decision No 280/2004/EC and the Commission Decision thereunder have been used.

The EC GHG gas inventory is compiled on the basis of the inventories of the 15 or 25 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 or 25 Member States. This is also valid for the base year estimate of the EU-15 GHG inventory. Currently, 13 Member States have indicated to chose 1995 as the base year for fluorinated gases while Finland and France have indicated to chose 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France. The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key source analysis (Section 1.5) is separately performed at EU-15 level ([10]).

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 EC GHG inventory data. The EC believes that it is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidelines to use different methodologies for one source category across the EC especially if this helps to reduce uncertainty and improve consistency of the emissions data provided that each methodology is consistent with the IPCC good practice guidelines.

In general, no separate methodological information is provided at EC level except summaries of methodologies used by Member States. However, for some sectors quality improvement projects have been started with the aim of further improving estimates at Member State level. These sectors include energy background data, emissions from international bunkers, emissions and removals from LUCF, and emissions from agriculture. In Spring 2005 a workshop for improving methods related to GHG inventories and projections will be organised for the waste sector.

The EU-15 CRF Table Summary 3 in Annex 2 provides information on methodologies and emission factors used by the Member States. These tables have been compiled on the basis of the information provided by the Member States in their CRF Table Summary 3. In addition, information on methods, activity data and emission factors was used which was provided by the Member States in accordance with Annex I of the Commission Decision under Council Decision 280/2004/EC. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EC key source. Annex 13 includes the CRF Table Summary 3 for those Member States that submitted these tables in 2004. Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 13. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 13 and made available at the EEA website, are considered to be part of the EC submission.

Differences between EU-15 submissions and Member States' submissions in 2005

Due to the reporting required in Category 5 of CRF Table Summary 1.A., inconsistencies occur between the EU-15 CRF submission 2005 and the sum of the EU-15 Member States' submissions in 2005. Footnote 5 of CRF Table Summary 1.A. requires Parties to report net emissions (emissions minus removals) from LUCF in each subcategory 5 and in the total sum of Category 5. Only a single number should be placed in either the CO_2 emissions or CO_2 removals column, as appropriate. Thirteen Member States reported net removals from LUCF for 2002, two Member States (Portugal and the Netherlands) reported net CO_2 emissions. At EU-15 level, CO_2 removals were larger than CO_2 emissions. Therefore, net removals were reported that resulted from adding the net removals of the 13

([9]) At the moment, the EC is not able to provide some of the information required in the guidelines, such as specific sectoral background data tables. For more details on these issues see Sections 1.7 and 1.8.5.

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

Member States and deducting the net emissions of Portugal and he Netherlands. This means that total CO_2 emissions at EU-15 level do not include net emissions from LUCF of Portugal and the Netherlands. (In turn, net emissions from LUCF of Portugal and the Netherlands reduce net removals of the EU-15.) The sum of CO_2 emissions of the national submissions to the UNFCCC Secretariat includes net emissions of Portugal and the Netherlands and therefore is higher. In turn, the sum of CO_2 removals in the national submissions to the UNFCCC is also higher.

Internal consistency of the EU-15 CRF tables

The EU-15 CRF tables include some internal inconsistencies (i.e. the sum of sub-categories is not equal to the category total) in those categories where Member States have difficulties in allocating emissions to the sub-categories. This refers mainly to the source categories 1.A.2, 1.A.5, 2.F). Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain sub-category. At Member State level, the use of the notation keys makes transparent the reason for not providing emission estimates. However, at EU-15 level, the sub-category emission value is the sum of Member States emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, Annexes 4-11 of this report include the CRF tables 1.A, 1, 2(I), 2(II), 3, 4, 5, 6 for each EU-15 Member State. In addition, some inconsistencies between CRF tables are due to missing data from Luxembourg for some tables (e.g. CRF tables 1.C, 2(II)).

1.5. Description of key source categories

A key source analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000). A key source 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 source analysis at EU-15 level, every Member State provides a national key source analysis which is independent from the assessment at EU-15 level. The EU-15 key source analysis is not intended to replace the key source analysis by Member States. The key source analysis at EU-15 level is carried out to identify those source categories for which overviews of Member States’ methodologies, emission factors, quality estimates and emission trends are provided in this report. In addition, the EU-15 key source analysis helps identiying those categories that should receive special attention with regard to QA/QC at EC level. The Member States use their key source analysis for improving the quality of emission estimates at Member State level.

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

- Starting point for the key source identification for this report were the CRF sectoral report tables, i.e. CRF Tables 1, 2(I), 3, 4, 6 of the EU-15 GHG inventory. All source categories where GHG emissions occur were listed, at the most disaggregated level available at EU-15 level and split by gas. Then a few aggregations were made in particular for those source categories where several Member States have difficulties in allocating emissions to the subcategories (e.g. source categories 1.A.2, 2.E, 2.F).

- A level assessment was carried out for all years between the base year and 2003 and a trend assessment was performed for the base year to 2003. The detailed results of the key source analysis are included in Annex 1 (the grey shaded source categories are identified as key sources).

- This procedure resulted in the identification of 42 key source categories for the EU-15. The EU-15 key sources are listed in Table 1.3 and ranked according to their level contribution to total EU-15 GHG emissions in 2003. They cover 97.1 % of total EU-15 GHG emissions in 2003.

In Chapters 3 to 9 for each key source overview tables are presented which include the Member States' contributions to the EU-15 key source in terms of level and trend.

Table 1.3 EU-15 GHG source categories identified as key sources (emissions in Gg of CO_2 equivalents)

Source category gas	Base year	2003	Absolute change	% change	Level assessment	Cumulative total
1 A 1 a Public Electricity and Heat Production (CO_2)	950.461	1.010.508	60.048	6%	24,2%	24,2%
1 A 3 b Road Transportation (CO_2)	638.574	790.731	152.157	24%	18,9%	43,1%
1 A 2 Manufacturing Industries and Construction (CO_2)	645.923	576.424	-69.499	-11%	13,8%	56,9%
1 A 4 b Residential (CO_2)	405.465	425.033	19.568	5%	10,2%	67,1%
1 A 4 a Commercial/Institutional (CO_2)	162.704	160.818	-1.886	-1%	3,8%	70,9%
1 A 1 b Petroleum refining (CO_2)	105.781	118.555	12.774	12%	2,8%	73,7%
4 A 1 Cattle (CH_4)	124.648	109.814	-14.833	-12%	2,6%	76,4%
4 D 1 Direct Soil Emissions (N_2O)	112.793	100.402	-12.392	-11%	2,4%	78,8%
2 A 1 Cement Production (CO_2)	79.823	81.631	1.808	2%	2,0%	80,7%
4 D 3 Indirect Emissions (N_2O)	76.918	66.213	-10.705	-14%	1,6%	82,3%
6 A 1 Managed Waste disposal on Land (CH_4)	99.564	63.693	-35.871	-36%	1,5%	83,8%
1 A 4 c Agriculture/Forestry/Fisheries (CO_2)	71.585	61.602	-9.983	-14%	1,5%	85,3%
1 A 1 c Manufacture of Solid fuels and Other Energy Industries (CO_2)	95.456	60.857	-34.599	-36%	1,5%	86,8%
2 F Consumption of Halocarbons and Sulphur Hexafluoride (HFC)	5.495	41.075	35.580	648%	1,0%	87,8%
4 B 8 Swine (CH_4)	28.714	30.066	1.351	5%	0,7%	88,5%
2 B 2 Nitric Acid Production (N_2O)	37.002	29.000	-8.002	-22%	0,7%	89,2%
4 B 1 Cattle (CH_4)	33.655	28.982	-4.673	-14%	0,7%	89,9%
4 D 2 Animal Production (N_2O)	30.780	28.566	-2.214	-7%	0,7%	90,5%
1 A 3 b Road Transportation (N_2O)	9.440	23.606	14.165	150%	0,6%	91,1%
1 A 3 a Civil Aviation (CO_2)	17.532	22.576	5.045	29%	0,5%	91,6%
1 B 2 b Natural gas (CH_4)	25.910	21.747	-4.163	-16%	0,5%	92,2%
1 A 3 d Navigation (CO_2)	19.028	20.332	1.304	7%	0,5%	92,7%
2 C 1 Iron and Steel Production (CO_2)	19.859	17.985	-1.874	-9%	0,4%	93,1%
2 A 2 Lime Production (CO_2)	16.878	17.510	632	4%	0,4%	93,5%
4 B 12 Solid Storage and Dry Lot (N_2O)	19.023	17.438	-1.585	-8%	0,4%	93,9%
1 B 1 a Coal Mining (CH_4)	50.477	15.058	-35.419	-70%	0,4%	94,3%
2 B 3 Adipic Acid Production (N_2O)	63.326	14.917	-48.409	-76%	0,4%	94,6%
4 A 3 Sheep (CH_4)	16.054	14.665	-1.389	-9%	0,4%	95,0%
1 A 1 a Public Electricity and Heat Production (N_2O)	11.157	13.351	2.194	20%	0,3%	95,3%
2 B 1 Ammonia Production (CO_2)	14.392	12.416	-1.976	-14%	0,3%	95,6%
2 E Production of Halocarbons and Sulphur Hexafluoride (HFC)	35.907	9.254	-26.652	-74%	0,2%	95,8%
1 A 5 Other (CO_2)	20.847	7.913	-12.934	-62%	0,2%	96,0%
6 A 2 Unmanaged Waste Disposal Sites (CH_4)	11369	7.215	-4.155	-37%	0,2%	96,2%
1 A 4 b Residential (CH_4)	9.546	7.101	-2.445	-26%	0,2%	96,4%
2 F Consumption of Halocarbons and Sulphur Hexafluoride (SF_6)	10.301	5.930	-4.371	-42%	0,1%	96,5%
6 B 2 Domestic and Commercial Wastewater (CH_4)	8.230	5.605	-2.625	-32%	0,1%	96,6%
1 A 3 c Railways (CO_2)	8.316	4.985	-3.331	-40%	0,1%	96,8%
2 C 3 Aluminium production (PFC)	7.335	3.403	-3.932	-54%	0,1%	96,8%
2 C 4 SF6 Used in Aluminium and Magnesium Foundries (SF_6)	2.208	3.035	827	37%	0,1%	96,9%
6 C Waste Incineration (CO_2)	5.177	3.016	-2.160	-42%	0,1%	97,0%
1 A 3 b Road Transportation (CH_4)	4.576	2.359	-2.217	-48%	0,1%	97,0%
2 B 5 Other (N_2O)	4.400	1.534	-2.866	-65%	0,0%	97,1%

1.6 Information on the quality assurance and quality control plan

The EC GHG inventory is based on the annual inventories of the EC Member States. Therefore, the quality of the EC inventory depends on the quality of the Member States' inventories, the quality assurance and quality control (QA/QC) procedures of the Member States and the quality of the compilation process of the EC inventory. Most EC Member States and also the European Community as a whole are currently implementing QA/QC procedures in order to comply with the IPCC good practice guidance.

1.6.1 Quality assurance and quality control of the European Community inventory

In October 2004, the QA/QC programme for the inventory of the European Community was adopted in the Climate Change Committee. The EC QA/QC programme describes the quality objectives and the inventory quality assurance and quality control plan for the EC GHG inventory including responsibilities and the time schedule for the performance of the QA/QC procedures: Definitions of quality assurance, quality control and related terms used are those provided in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for

National Systems under the Kyoto Protocol. The EC QA/QC programme will be reviewed annually and modified or updated as appropriate.

The European Commission (Directorate General for Environment) is responsible for coordinating QA/QC activities for the EC 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 EC inventory.

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

- to provide an EC inventory of greenhouse gas emissions and removals consistent with the sum of Member States' inventories of greenhouse gas emissions and removals,
- to establish appropriate QA/QC procedures at EC level in order to comply with requirements under the UNFCCC and the Kyoto Protocol,
- 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 EC GHG inventory complies with the UNFCCC inventory principles of transparency, completeness, consistency, comparability, accuracy and timeliness.

In the QA/QC plan quality control procedures before and during the compliation of the EC GHG inventory are listed. In addition, QA procedures, procedures for documentation and archiving, the time schedules for QA/QC procedures and the provisions related to the inventory improvement plan are included.

Based on the EC QA/QC programme a draft QA/QC manual was developed which includes all the specific details of the QA/QC peocedures (in particular checklists and forms). Table 1.5 shows that in 2005 QA/QC activities are performed at three levels. Firstly, a range of checks ensures consistency and completeness of Member States data (initial checks). Secondly, a range of checks ensures that data are compiled correctly from data submitted by Member States to the European Commission (checks during preparation of the EC inventory). Thirdly a number of sector-specific QA/QC procedures are carried out. In addition, procedures for documentation and archiving are outlined in Table 1.5: all material related to the inventory preparation, including the QA/QC checks, is archived electronically by the ETC/ACC; some material is also archived in paper copy.

The initial checks include two elements; checking the completeness of the Member States CRF tables and checking the consistency of Member States GHG data. The completeness checks of Member States' submissions are carried out by the ETC/ACC by using a similar status report form as used by the UNFCCC Secretariat. The completed status reports are made available to Member States (through the Eionet and the circulation on 28 February); then Member States can check the status reports and update information, if needed. The status reports of the Member States' submissions are included in Annex 3 of this report.

The consistency checks of Member States data primarily aim at identifying main problems in time series or sub-category sums. For the time series check the algorithms of the UNFCCC secretariat are used. In addition, the ETC/ACC identifies problems by comparison with the previous year's inventory submission of the Member States and checks the availability of the CRF tables needed for the compilation of the EC inventory. The results of these checks are documented in the consistency and completeness report and are made available to the Member States, in order to obtain, if needed, revised emission estimates or additional information.

The initial checks listed in Table 1.5 are performed for EU-15 Member State submissions. For the new Member States limited initial checks are performed; they basically include the completion of the status reports and the performance of checks 1f) and 2 for the consistency and completeness report.

After the initial checks of the emission data, the ETC/ACC transfers the national data from the CRF tables into spreadsheets and into the ETC/ACC database on emissions of GHG and air pollutants. The version of the data received by ETC/ACC are numbered, in order to be traced back to their source. The ETC/ACC database is a relational database (MS Access) and maintained and managed by Umweltbundesamt Austria. A number of further checks are carried out during the compilation of the EC inventory and before submitting the final EC GHG inventory and inventory report (see Table 1.4).

Table 1.4 QA/QC activities related to the EC inventory for the 2004 submission

Quality control activity	Check report/area	Checks
Initial checks of the Member States submissions	Status report	Complete status report form for each Member State's submission
	Consistency and completeness report ([1])	1. UNFCCC data import checking routines in relation to completeness and consistency to check MS submissions. In relation to consistency these procedures analyse and document deviations of time series by certain thresholds and deviations of time series against previous submissions:
		a) Check deviations in time series with UNFCCC algorithms
		b) Check implied emission factors across the time series (focus on 18 largest key sources covering 90 % of EC GHG emissions)
		c) Check time series against previous submissions (document deviations +/- 5%)
		d) compare implied emission factors with implied emission factors of other MS for the 3 largest recalculations in absolute terms and for recalculations of more than 1 million tonnes and document large deviations
		e) Check if previous year values have been used in latest submission
		f) Check consistency between Table 1.A and Table 10
		g) Check consistency between sectoral tables and Table 1.A
		2. Check of correctness of summing of sub-categories in Table 1.A and in sectoral tables
		3. Check of completeness of information in those CRF tables that are necessary for the compilation of the EC inventory
		4. Check completeness to determine if gap filling is required:
		a) Are all gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NOx, NMVOC, SO_2) for all years available?
		b) Are estimates for all EC key sources available which cover 95% of EC GHG emissions?
		5. Check of consistency between NIR and CRF in those parts that are necessary for the compilation of the EC inventory report
		6. Check whether methodological and data changes resulting in recalculations of MS data are documented appropriately in the CRF (refer to 3 largest recalculations in absolute terms and recalculations of more than 1 million tonnes)
		7. Check if Tier 1 uncertainty estimates are available. For which years? Are Excel sheets available?
		8. Document any further findings and procedures applied.
Checks during the preparation of the EC inventory	Preparation report (CRF and inventory report)	1. Check that all initial submissions and all updates of inventory data received until 15 March from Member States are correctly accounted for in the EC inventory and correctly documented and catalogued
		2. Check for errors associated with data input from Member States' CRF files to the EC inventory database and with data transfer and aggregation during intermediate stages of inventory compilation
		3. Ensure that gap filling, where applicable, has been undertaken in accordance with the methods set down in the Implementing Provisions
		4. Check calculations in aggregating Member States' inventory data for all source and sink categories and gases at EC level
		5. Check whether emissions and removals estimates are correctly aggregated from lower reporting levels to higher reporting levels when preparing sum-maries at EC level
		6. Check whether Member States' submissions use the same type of input data (e.g. energy consumption, animal population data) and report the same units for activity data which is aggregated at EU level in sectoral background data tables
		7. Check whether units and conversion factors are correctly used at EC level and that they are consistent with those in Member States' inventories.
		8. Check whether the number of significant digits or decimal places for common parameters, conversion factors, emission factors, or activity data is consistent across source categories; total emissions should also be reported consistently (in terms of significant digits or decimal places) across source categories
		9. Check whether uncertainties in emissions and removals are estimated correctly at EC level in accordance with agreed procedures under the UNFCCC and the Kyoto Protocol and that they are documented correctly

Quality control activity	Check report/area	Checks
		10. Check if estimates of emissions and removals are reported at EC level for all relevant source and sink categories of the 1996 Revised IPCC Guidelines and for all years from the appropriate base year to the current inventory
		11. Check that any findings from the initial checks of the EC inventory prepared by the UNFCCC secretariat, which are relevant for Member States, are forwarded to these Member States; check that all relevant re-submissions provided by Member States are included in the EC resubmission.
		12. Check that recalculations conducted by Member States are documented including changes in methodology, data or other reasons provided as justification for recalculation (refer to 3 largest recalculations in absolute terms and recalculations of more than 1 million tonnes).
		13. Compare trend in activity data to relevant international statistics, where available, or to other sources of national statistics, where available.
		14. Check of correct calculations of summing of Member States inventory data for all source categories and gases and document findings.
		15. Check the inventory report (layout, consistency, tables and figures, references, general format).
	Data file integrity	1. Confirm that the appropriate data processing steps and data relationships are correctly represented in the database.
		2. Ensure that data fields are properly labelled and have the correct design specifications.
		3. Ensure that adequate documentation of database, model structure and operation are archived.
		4. Create pull down menus that limit permissible entries or, where possible, automatically enter data.
		5. Use cell protection so that fixed data cannot accidentally be changed.
		6. Check whether the same electronic data file (whether obtained electronically or transcribed) is used for different source categories that use identical data.
		7. Build in computerized checks to highlight possible problems.
Documentation and archiving	Procedures documentation and archiving	When the annual inventory is finalised, the annual documentation file becomes part of the archives. At that time, it should be complete, and should contain:
		1. An electronic and paper copy of the list of the full content of the documentation file for that year.
		2. paper and electronic copies of each of the draft and final EC Inventory report, paper and electronic copies of the draft and final CRF tables.
		3. electronic copies of all the final, linked source category spreadsheets for the inventory estimates (including all spreadsheets that feed the emission spreadsheets), as well as any important printouts
		4. for the inventory overall and for individual source categories, the documentation should contain adequate explanation of the linkages among the spreadsheets and the Inventory document
		5. All information and data received in the project file from each Member State.
		6. All additional materials received and included in the project file.
		7. Copies of all checklist, reports, and forms that were completed as part of QA/QC procedures.
		Adequate backup routines should be in place for all electronic data.
	Checks documentation and archiving	1. Check whether all inventory data, supporting data, and inventory records are archived and stored appropriately in the database
		2. Specify, for the EC inventory, the exact data source of summary data in each MS submission (e.g. are data taken from Table 1.A or Table 10).
		3. Check whether known data gaps that result in incomplete source category emission estimates are documented.
		4. Check whether all recalculations resulting from MS recalculations are documented appropriately in CRF and NIR
		5. Check whether internal documentation is consistent and complete, e.g. check that spreadsheets and references are consistently documented and procedures are consistently applied.
		6. Check whether bibliographical data references are properly cited and catalogued in the internal documentation.
Sector-specific QA/QC	Energy	1. Check that all formulas are correct.
		2. Compare trend of latest EUROSTAT reference approach with previous Eurostat reference approach, identify reasons for differences and document findings.
		3. Compare trend of EUROSTAT reference approach with latest MS reference approach, identify reasons for differences and document findings.

Quality control activity	Check report/area	Checks
		4. Compare trend of EUROSTAT reference approach with latest EC GHG inventory sectoral approach, identify reasons for differences and document findings.
		5. Check that any further findings and procedures applied are documented.
	Agriculture	1. General check of background tables agriculture (4.A, 4.B(a), 4.B(b), 4.C, 4.D) for completeness and correctness 2. Comparison of consistency between activity data across background tables 4.A, 4.B(a), and 4.B(b) 3. Check on the calculation of emissions for categories 4.A, 4.B and 4.D 4. Comparison of calculated emissions in sector 4 with the numbers submitted in 2003 5. Checks on the consistency of total amount of nitrogen produced by livestock, distributed over the animal waste management systems, and used for documented purposes. 6. Check on the calculation of nitrogen used for estimating indirect emissions from atmospheric deposition.
	LUCF	1. General checks of CRF Tables 5 and 5.A to 5.E for completeness and correctness. 2. Comparison of Table 5 or 5.A against those submitted in 2003 to check for inconsistency. 3. Analysis of reported forest type, methods used, completeness and quality assigned to the inventory by Member States. 4. Calculation of Member States' contributions to EC net emissions in LUCF Category 5.A and ratio of emissions/removals for each Member State. 5. Comparing data as reported in the NIR and the CRF tables. 6. Comparing data in the "old" and the "new" CRF tables, including checks for consistency and recalculation. 7. Provision of additional information on other QA/QC activities related to Sector 5.A.

([1]) The consistency and completeness reports were sent to the Member States on 28 February and are available from the EEA on request.

Sector-specific QA/QC activities to improve the quality of the EC inventory are performed by Eurostat together with ETC/ACC in the energy sector (see also Sections 3.4 and 3.7) and by the JRC in the sectors agriculture and LUCF (see also Sections 6.4 and 7.3).

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

Finally, also the detailed analysis of GHG emission trends of the EC and each EC Member State after the submission of the EC inventory to the UNFCCC also contributes to improving the quality of the EC GHG inventory. This analysis is carried out in the annual EC GHG trend and projections report (see EEA, 2004b); the report identifies sectoral indicators, for socioeconomic driving forces of greenhouse gas emissions, by using data from Eurostat or from Member States' detailed inventories. In addition, it compares and analyses Member States' emission trends in the EC key sources and provides main explanations, either socioeconomic developments or policies and measures, for these trends in some Member States.

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

As the EC GHG inventory is based on the annual inventories of the EC Member States, the quality of the EC inventory depends on the quality of the Member States' inventories and their QA/QC procedures. The following Table 1.5 gives an overview of QA/QC procedures in place at Member State level. The information is taken from the Member State national inventory reports 2004 and 2005.

Table 1.5 Overview of quality assurance and quality control procedures in place at Member State level (NIR descriptions)

Member State	Description of the national QA/QC activities	Source
Austria	A quality management system (QMS) has been designed to contribute to the objectives of good practice guidance, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates. After having been fully implemented during the development of the UNFCCC submission 2004, the accreditation of the Department for Air Emissions as inspection body is scheduled to take place in autumn 2005. The QMS was drawn up to meet requirements of the International Standard ISO/IEC 17020:1998 General Criteria for the operation of various types of bodies performing inspections. The international Standard ISO 17020 has replaced the European Standard EN 45004. During the year 2004 QA/QC activities were focused on transparent documentation, adaptation of SOPs (standard operation procedures) to be more practical and user-friendly. SOPs comply with both IPCC-GPG and ISO 17020 requirements. QC procedures follow the recommendations of IPCC-GPG Chapter 8 on quality assurance and quality control. Priority is given to key sources. For all sources, fundamental checks such as completeness of estimates, time series consistencies, data transcription and documentation are checked. For key sources, activity data, emission factors, emissions and uncertainty analysis are assessed using the Tier 1 checklist. In addition, where applicable Tier 2 QC procedures are employed. Special attention is given to documentation, archiving and reporting as outlined in Section 8.10 of IPCC-GPG. One of the core activities was the re-design of the key management process 'Corrective and preventive actions'. An efficient process was established to gain transparency when collecting and analysing findings by UNFCCC review experts or any other discrepancies found during inventory compilation.	NIR 2005, p. 30
Belgium	The working group on 'emissions' of the Coordination Committee for International Environmental Policy (CCIEP) has conducted internal quality insurance and quality control work by continuously exchanging information about methodologies used and estimated results. Feedback is given and extra controls are made by the responsible person for compiling the Belgian GHG emission inventory. Following the IPCC GPG, QC procedures (Tier 1) will be implemented to check the inventory on selected sets of data and processes. In a first approach, the key sources categories will be checked over their input data, their parameters and their calculations. With this in mind, several meetings have been conducted since January 2003 with the three regions to identify for each sector on which level the good practice guidance (e.g. uncertainty analysis, QA/QC, etc.) has to be implemented and to devise a work programme until the next submission. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002. The purpose of these audits is to analyse the difficulties encountered while compiling the regional and national emission inventories in order to improve the quality and completeness of the Belgian national emission inventory. In the beginning of 2004, a study started in Flanders to calculate uncertainties (Tier 1 and Tier 2 level) and to guide in the implementation of a quality syste (QA/QC plan) of the emission inventory of greenhouse gases. The quality system set up in Flanders is completely based on ISO 9001:2000. A complete development of the system (among others further description in detail of all the procedures involved) as well as a first internal review will become operational in the course of 2005, full implementation for all sectors and on the most detailed level is expected in the course of 2006. The results of this Flemish study will be taken into account to set up a comparable system in the 2 other regions in Belgium.	NIR 2005, p. 12
Cyprus	—	-
Czech Republic	The Czech Republic has not implemented a general QA/QC or verification plan. Nevertheless, several checks have been formalized. In general terms, these include: a stepwise procedure in the preparation of the final national inventory, including recalculation to ensure time series consistency, checking of data and relevant information collected by co-operating institutions, QC of emission estimates through comparison with corresponding figures calculated earlier and consistency check for subsequent years.	NIR 2004, p. 17
Denmark	In the preparation of Denmark's annual emission inventory several quality control (QC) procedures have been carried out already and the QA/QC plan will improve this activity in the future. The Danish Tier 1 QC includes: • a check of time series of the CRF and SNAP source categories as they are found in the Corinair databases. Considerable trends and changes are checked and explained; • a comparison to inventory of the previous year on the level of the categories of the CRF as well as on SNAP source categories. Any major changes are checked, verified, etc.; • total emissions when aggregated to CRF source categories are compared to totals based on SNAP source categories (control of data transfer); • a manual log table has been introduced into the emission databases to collect information about recalculations. Apart from the UNFCCC's in-depth-reviews, quality assurance (QA) with independent review s of the inventories has been carried out for energy and transport. In 2005 priority sources listings will be used to secure implementation of the full quality scheme on the most relevant sources. Verification in relation to other countries is undertaken for priority sources during the first part of the year 2005.	NIR 2005, p. 26
Estonia	—-	NIR 2004
Finland	A quality management system is currently being developed as an integrated part of national system and annual inventroy process. The principles and elements of the quality management system are congruent both with international agreements and guidelines concerning greenhouse gas inventories and with the ISO 9001:2000 standard. ISO 9001-certification is under consideration. As a national entity, Statistics Finland bears the responsibility and has the resources for the co-ordination of the quality management measures for the partners of the Finnish national system and for the quality managemnt of the greenhouse gas inventory at the national level. A quality manual of the national greenhouse gas inventory system including guidelines, annual plans, templates, descriptions of methodologies and work processes and checklists of QA/QC procedures is in preparation and will be in place by the end of 2005.Only rather general quality objectives were set in the situation of transitional arrangements of the national inventory system until the end of 2004. More specific quality objectives will be set in 2005. Tier 1 QC procedures are performed in several stages during the compilation of the CRF-report. QA procedures at the national inventory level are under development and not yet fully implemented. The verification of the emission estimates for the year 2003 is scheduled for the first quarter of 2005.	NIR 2005, p. 21

Member State	Description of the national QA/QC activities	Source
France	CITEPA, responsible for the compilation of the inventory, is currently implementing a quality management system according to ISO 9001: 2000 with the objective of being certified during 2004. This system will fulfil the requirements defined in the IPCC GPG.	NIR 2004, p. 29
Germany	A QA/QC plan was defined in a research project (FKZ: 202 42 266) and an initial version is now available in NIR 2004 (Section 1.6 and Appendix (Anhang) 6). By the time of completion of NIR 2005, the QA/QC plan could not be finished. It will consist of the following elements: • annual review of implementation of QA/QC activities in data collection and reporting (both Tier 1 and Tier 2); • annual planning of milestones in data collection and reporting; • organisational matrix showing the responsibilities in the QA/QC plan and improvement plan. Each QA/QC plan will be valid for one year. Since November 2003 the quality of the source-specific data has been checked by national experts with the help of a checklist also containing the results of the review report of the UNFCCC.	NIR 2005, p. 32
Greece	A QA/QC plan based on the ISO 9001:2000 standard has been developed since the previous inventory submission. The processes cover the QA/QC system management, QC directly related to the estimation of emissions, QA, archiving, uncertainty estimation and inventory improvement. The objectives of the QA/QC plan are the compliance with IPCC/UNFCCC guidelines, the continuous improvement of GHG emissions/removels estimates and timeliness of submission of necessary information. The implementation of the plan started in April 2004 and the first internal review was carried out in June based on the documentation of the system. QA/QC activities since April 2004, were focused on the improvement of the archiving of information and the development of a long term improvement plan, as was also suggested by the in-country review (ICR) of the Greek GHG inventory, carried out last September. Both activities are still in progress.	NIR 2005, p. 15
Hungary	The expert groups of the Hungarian inventory agency do not have any quality assurance accreditation. However, certain checks were performed to ensure the preparation of an inventory of appropriate quality (e.g. multiple-checking of certain data, controlling of results by comparing time series).	NIR 2005, p. 15
Ireland	Ireland has not yet developed formal quality assurance and quality control (QA/QC) systems on the scale recommended by the IPCC good practice guidance. In particular, a system for review of annual inventories that could be regarded as the basis for quality assurance has not been set up. Such a system would require the timely and coordinated participation of several competent institutions on a routine basis following inventory preparation. A worthwhile review would shorten the already limited time available for annual inventory compilation and reporting and it would demand significant operational and management resources. The establishment of review procedures in accordance with the UNFCCC guidelines is well recognised as a key element in the improvement of inventories overall but formal arrangements in this regard are likely to be deferred for a few more years. The inventory preparation process employed in Ireland does incorporate a number of activities that may be regarded as fundamental elements of quality control.	NIR 2005, p. 8
Italy	A proper QA/QC plan has not been applied even though verification and controls are made by means of different procedures. The national atmospheric emissions inventory and the Italian greenhouse gas inventory are compiled and maintained by the National Environmental Protection Agency which is the inventory agency responsible for data submission. All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors as well as methodologies are referenced to their data sources, while all information and documentation are held at the agency so as to be consulted whenever needed. Data entries are checked several times during the compilation of the inventory; special attention is paid to sources which show significant changes from a year to another or new sources. Final checks involve a consistency check on the whole time series. When revisions of the estimation methodologies are applied, emissions for all previous years are recalculated as a matter of course. A specific procedure undertaken for the inventory improvement regards the establishment of national expert panels (specifically, in road transport, forests and energy production sectors) involving, on a voluntary basis, different institutions, local agencies and industrial associations which cooperate for activity data and emission factors accuracy. Development of other expert panels in the agriculture and waste sectors are planned to start in 2004. Quality control activities, except for usual control activities related to the compilation of the inventory, derive also from drawbacks due to the communication of data to different institutions and/or at local level. The preparation of environmental reports where data are needed at different aggregation levels or refer to different contexts such as environmental and economic accountings (e.g. the Eurostat NAMEA project) is another tool of control. International reviews and pilot project activities also contribute to improve the inventory and individuate errors.	NIR 2003, p. 8
Latvia	Uncertainties and quality assurance and quality control (QA/QC) according to the IPCC GPG were not evaluated because of lack of financial and human resources. It is the nearest future job. Compilers of inventory assessed inventory quality on their own view and it was showed in the CRF Table 7 for all years. Generally for quality assurance and control it was taken into account how many activity data were available, how many were covered in emission calculation regarding methodology as well as how many assumptions and experts view were used.	NIR 2005, p.15
Lithuania	Lithuania has not yet developed a QA/QC system.	NIR 2005, p. 26
Luxembourg	—	-
Malta	—	-
Netherlands	In 2001, a programme was started to adapt the monitoring of greenhouse gases in the Netherlands and to transform it into a national system, as described under Article 5 of the Kyoto Protocol. The first phase of the QA/QC improvement project (finished in 2002) included an assessment of the present situation as compared to the UNFCCC/IPCC requirements. The second phase, to be finalised in 2005, involves the description of relevant processes and procedures, including adaptation where needed, of the QA/QC procedures. As part of this process a QA/QC programme that complies with the National System requirements is being developed and implemented. This is to be finalised in 2005. (For the NIR 2005 a brief QAQC plan has been used, based on the draft QA/QC programme). The third phase, implemented in parallel, comprises the formal and legal arrangements, needed for the structural embedding of the	NIR 2005, p. 1-19

Member State	Description of the national QA/QC activities	Source
	protocols. This is done by the Ministry and is to be finalised in 2005. The full QA/QC system will be in operation by the end of 2005 as part of the National System. For the CRF/NIR 2005 a brief QA/QC plan has been used, based on a draft for the more detailed QA/QC programme.	
Poland	Poland has not yet implemented a formal QA/QC procedure, including verification plan, for the national emission inventory. However, several checks are routinely carried out to eliminate possible errors. The calculated emissions figures for a given year, are compared to the respective figures from previous years (time series), and outliers are scrutinized in more detail or in other words an extended QA/QC is carried out for doubtful figures. The first draft of the inventory in form of IPCC tables and draft CRF, is usually produced 12-14 months after the end of the given year depending primarily on the availability of required activity data. During the following several weeks, extensive checks are done in form of consultations with data providers. The consultations cover both correctness of data and their proper interpretation. Wherever possible various different datasets are used for comparison purposes. Here the most important institutional sources include: Central Statistical Office, Agency for Energy Market, and a number of collaborating individual experts and institutions. After the checking period is completed, the final CRF is prepared together with the accompanying report.	NIR 2004, p. 12
Portugal	No formal quality assurance and quality control (QA/QC) procedures have been established so far for the national inventory that are in accordance with the IPCC GPG. In particular, a system of review procedures by personnel not directly involved in the inventory preparation that could be regarded as quality assurance has not been set up. However the inventory compilation process already includes a number of technical activities that can be considered as fundamental elements of quality control. Activities such as: accuracy checks on data acquired and estimated, the use of well documented emission estimation methodologies and emission factors, and adequate information archiving and reporting with a proper back-up scheme, can be regarded as quality-control procedures. These procedures assure calculation and reporting error detection and retrace former estimates enabling a degree of confidence in the final results. During the recent development of the Portuguese national plan on greenhouse gas emissions (PNAC) and the plan for emission ceiling (PTEN) extensive interaction has occurred with the team responsible for those plans, with institutional organisms (Ministry of Agriculture, DGF, INR, DGE) and also economic sectors' representatives (electricity sector, cement, paper pulp, chemical industry, glass industry and ceramics), where these have been given an opportunity to be briefly informed of basic methodologies, activity data and emission factors, and some of their comments were used to improve the quality of the inventory.	NIR 2003, p. 7
Slovakia	The emission estimates elaborated for individual sectors by external consultants are controlled and recalculated at the Department of Air Quality of the Slovak Hydrometeorological Institute. Activity data for major sources are compared with national statistics and with previous year's submitted data. Energy balance from energy statistics is compared with summary fuel consumption reported by sources. Fuel consumption in transport sector based on fuels sold is compared with the model results. External reviewers (from the Czech Republic) are regularly invited to comment the inventory results. Control procedures are continuously developed and built in to the National Emission System. Structural changes of the current national inventory system, in accordance with the new air protection act (transposition of EU air pollution legislation), is an ongoing process. Harmonisation of all pollutant inventories and ISO9001 are introduced. In accordance with these requirements the inventory results for the year N are completed by 31 December (N+1) and the inventory results of the basic pollutants for the year N are completed by 15 January (N+2) draft and 15 April (N+2) final version..	NIR 2005, p. 12
Slovenia	Slovenia prepared a QA/QC plan in February 2005.	Direct communication
Spain	No information was provided on QA/QC procedures	NIR 2005
Sweden	The Swedish Environmental Protection Agency is responsible for the QA/QC plan for the inventory. The current system complies with the Tier 1 procedures outlined in the IPCC Good Practise Guidance. The system is being developed as an integral part of the national system according to article 5.1 of the Kyoto Protocol and will be fully implemented during 2005. Parts of the quality system are already implemented and were used during the compilation of this submission. The QA/QC plan consists of quality procedures and checklists specified for each reporting CRF-code (or group of codes). The plan is updated annually listing all quality control steps that must be undertaken during inventory work (Tier 1 and where appropriate Tier 2). The QA/QC plan also consists of a corrective action list, a recalculation list and documented procedures for handling and responding to UNFCCCs review of the Swedish inventory.	NIR 2005, p. 14
United Kingdom	The national atmospheric emissions inventory and the UK greenhouse gas inventory are compiled and maintained by the National Environmental Technology Centre of AEA Technology plc. Whilst significant parts of the inventory (i.e. agriculture, land use change and forestry) are compiled by other agencies and contractors, Netcen is responsible for coordinating QA/QC activities. The system has developed over the years. A new online database system was adopted for the 1997 inventory in 1998, and since then, developments have proceeded to build QA/QC procedures into the online system. The database consists essentially of a table of activity data and a table of emission factors for the NAEI base source categories. These are then multiplied together to produce emissions according to the IPCC and Corinair formats to be generated. The inventory has been subject to ISO 9000 since 1994 (it is now subject to BS EN ISO 9001:2000) and is audited by Lloyds and the AEA Technology internal QA auditors. The NAEI has been audited favourably by Lloyds on three occasions in the last six years. The emphasis of these audits was on authorisation of personnel to work on inventories, document control, data tracking and spreadsheet checking, and project management. As part of the inventory management structure there is a nominated officer responsible for the QA/QC system — the QA/QC coordinator. The National Environmental Technology Centre is currently accredited to BS EN ISO 9001:2000, and was last audited in May 2003 by Lloyds. UK DEFRA is the process of implementing an EU Decision No 280/2004/EC on a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol which will require them and their contractors to establish a series of more formal memoranda of understanding for all the major data providers and will include specific criteria for QA/QC. The system incorporates the following activities, which are carried out each year as the inventory is compiled: documentation, database, checking, recalculation, uncertainties (Tier 1 and Tier 2) and archiving.	NIR 2004, p. 12

The following Table 1.6 gives an overview of QA/QC procedures in place at Member State level on the basis of information collected for the ‘Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems’ which was held in September 2004 in Copenhagen. It shows that a number of QA/QC procedures are already in place in the EC Member States. Generally, the implementation of QA/QC procedures is more advanced in the EU-15 than in the new Member States.

Table 1.6 Overview of quality assurance and quality control procedures in place at Member State level

Activity	Austria	Belgium	Czech Republic	Denmark	Finland
QA/QC coordinator designated	yes	No	No	Yes	Yes
Quality objectives established	integrated in QMS (improvement plan), not as an extra document	Partial	No		Yes
QA/QC plan in place	yes	Partial	No	No	In preparation
QC procedures in place	yes	Informal	Preparing	Partial	Partial
Tier 1	yes		Preparing	Partial	Partial
All key sources checked?	yes	No	No	Partial	No (under development)
Checklists used?	yes	No	No	Yes	Partial
Electronic/ automated checks used?	yes	No (manual)	No	Yes	Partial
Tier 2	partial	No	No	Partial	Partial
Emission data	yes (where possible)	No	No	Partial	Partial
Sectors/gas	mainly energy, recalculations	No	No	Energy / CO_2	Energy / CO_2 Industrial processes / F-gases
QC checks of country-specific emission factors?	yes (where possible)	No	No	Partial / Energy	Yes (under development)
Activity data	yes (where possible)	No	Partial by Czech Statistical Office		Partial
Sectors	mainly transport, f-gases, solvents	No	No		Energy, Industrial processes (under development), F-gases
Uncertainty estimates	for all KS, for some non-KS	Yes	No		Yes
QC in outside agencies?	partial	Partial	No		Yes (under development)
QA procedures in place	partial	No	No	Partial	Partial (under development)
Expert peer reviews	no	No	No (apart from UNFCCC review)	Stationary combustion	Partial (F-gases: Yes)
Audits	yes (2^{nd} party)	Yes	No	No	Yes (voluntary in-country review, voluntary adjustment)
Verification of emissions	partial	No	Partial	No	No
Sectors/gas	transport, f-gases, solvents (verification of activity data)		F-gases, data from Custom Office and F-gas users		No
Comparisons with other inventories	no		Partial, CO_2 emissions database REZZO1 and data for NAP		Partial
QA/QC manual in place	yes	No	No	No	In preparation
Quality management system in place	EN45004 (accreditation application has been made)	No	CHMI adaptation of ISO 9000		QMS in preparation (ISO 9001 -certification under consideration)

Activity	France	Germany	Greece	Italy	Netherlands
QA/QC coordinator designated	Yes	Sept 2004	yes	Yes (official arrangements in preparation)	'Yes' (official arrangements still under preparation)
Quality objectives established	Integrated in QMS and elaborated by a national committee led by french ministry in charge of environment	Yes	yes	Yes	Partially, further elaboration for next NIR
QA/QC plan in place	Yes	Sept 2004	partial	In preparation	Yes, further detailing and upgrading for next NIR Improvement programme in progress.
QC procedures in place	Yes		yes	Yes	Yes. Upgrading to be finalized in 2005
Tier 1	Yes	2005	yes	Yes	
All key sources checked?	Yes	2005	yes	Yes	Yes (new protocols)
Checklists used?	Yes	2005	yes	Yes	Yes
Electronic/ automated checks used?	Yes	2005	No (manually)	Yes	Yes (consistency, completeness)
Tier 2	Partial	Partial (review findings)	no	Partial	Partial
Emission data	yes (where possible)	Partial (review findings)	no	Yes	Partial
Sectors/gas	Mainly energy and manufacturing industry sectors	Partial (review findings)	no	All, mainly cases where methodological and data changes result in recalculation	Energy / CO_2 and CH_4 Agriculture/CH_4 and N2O Industrial Processes/ N_2O and F-gas Waste / CH_4
QC checks of country-specific emission factors?	Yes (where possible)	Partial (review findings)	partial	Yes	Yes
Activity data	yes (where possible)	Partial (review findings)	no	Yes	Partial
Sectors	Mainly energy and manufacturing industry sectors	Partial (review findings)	no	Energy, industry, solvent use, agriculture, waste, LUCF	Energy, industry, agriculture, waste
Uncertainty estimates	Yes	Partial	yes (Tier 1 methodology)	No	Partial
QC in outside agencies?	Partial	Planned	no	Partial	Upgrade ongoing
QA procedures in place	Partial	No	yes	No	
Expert peer reviews	By a national committee led by french ministry in charge of environment and by sectors experts	Yes	No (apart from UNFCCC review)	No	Yes
Audits	No	Yes	no	No	Under consideration
Verification of emissions	Partial	Partial	no	Yes	Planned, if data available
Sectors/gas	Mainly energy and transports (verification of activity data/ CO_2)	CO_2	no	Yes	Agriculture/CH_4 Energy/CO_2
Comparisons with other inventories	No	Partial	no	Yes	Planned
QA/QC manual in place	Yes	Sept 2004	yes	No	Update in preparation
Quality management system in place	ISO 9001 (AFAQ n° 22708)	Country specific, Sept 2004	ISO 9001:2000	No	Changes/update in preparation as result of organisational changes in PER

Activity	Poland	Portugal	Slovak Republic	Slovenia	Spain	Sweden	UK
QA/QC coordinator designated	No	No	No	No	No	No	Yes
Quality objectives established	No	According to IPCC guidelines	No	Yes	Being discussed, not formally adopted	Yes	Yes
QA/QC plan in place	No	In implementation	No	Yes	In preparation	No	Yes
QC procedures in place	Partial	Partial	Partial	Partial	Partial		Yes
Tier 1	Yes	Partial	Partial	Yes	Partial	Yes	Yes
All key sources checked?	No	Partial	No	Yes	Yes	Yes	Yes
Checklists used?	No	No (in implementation)	No	No	Existing checklists to be extended	Yes	Yes
Electronic/ automated checks used?	Calculation checks, analyzing data trend (flagging suspected data)	No (in implementation)	No	No	Most automated, some manual	Yes	Yes
Tier 2	No	Partial	No	Partial	Limited implementation	Partial	Partial
Emission data	No	Partial	No	Partial	Order of magnitude checks, time series outliers checks	Partial	
Sectors/gas	No	Industry/CO_2	No	Energy / CO_2		Partial	
QC checks of country-specific emission factors?	Based on national studies	Partial	Yes	Yes		Partial	
Activity data	No	Partial	Partial, Statistical Office	Partial	Limited implementation	Partial	
Sectors	No	Agriculture	Energy	Energy / industrial processes		Partial	
Uncertainty estimates	At progress for 2002 GHG inventory	Qualitative	Yes	No	No	Yes	Yes
QC in outside agencies?	Partial	No	Partial	No	Being checked	Yes	Currently verifying
QA procedures in place	No	Yes	No	No	Limited implementation	Partial	Yes
Expert peer reviews	No	Yes	No	No		Partial	Yes
Audits	No	No	No	No		No	Yes
Verification of emissions	Partial		Partial	No	No	No	partial
Sectors/gas	-----		F-gases, energy	-			CH_4, N_2O, HFCs
Comparisons with other inventories	Comparing to inventories of countries with similar characteristics of fuels use, economy or population		Yes	-			No
QA/QC manual in place	No	In implementation	No	Yes	No	Almost	Yes
Quality management system in place	No	In implementation in the Institute for Environment	No	ISO 9001	No	ISO 14001	ISO 9001

1.6.3 Further improvement of the QA/QC procedures

In September 2004 a 'Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems' was organised. The Workshop facilitated the exchange of experience of Member States in the implementation of Quality Control (QC) and -Assurance (QA) procedures and the implementation of the National Inventory System. The workshop brought together experts from 17 Member States, the European Commission (DG ENV, JRC), EEA, ETC/ACC and an observer from the UNFCCC secretariat.

The Workshop's most important recommendations for the further implementation of the QA/QC procedures and the national systems are as follows:

General recommendations:

- Member States are encouraged to use consistent definitions for terms used in relation to national systems and QA/QC. The definitions are based on those used in the IPCC GPG and the UNFCCC guidelines for national systems (Decision 20/CP.7).
- In developing a national QA/QC system, Member States could use the EC QA/QC programme and the QA/QC procedures listed in the summary table in Annex 1 of this workshop report as a starting point.
- Member States are encouraged to make available any information related to their national system in addition to the NIR for other Member States via the Circa website of the Climate Change Committee.
- Member States should supply the Commission with a list of websites concerning their NIR and related background information to be distributed in WG I as soon as this information is available.
- WG I should continue to discuss data quality objectives for national inventories.
- Member States should take into account recommendations made by UNFCCC reviews of the inventory.

Recommendations concerning the national system:

- In developing their national systems, Member States should ensure that the single national entity is provided with resources and a legal basis to fulfil all the requirements outlined by the UNFCCC, the Kyoto Protocol and decision 280/2004/EC (Monitoring Decision). Member States should implement national systems as soon as possible.
- WG I should periodically evaluate the implementation and functioning of national inventory systems. Another workshop on this issue could be held after having gained first experiences.
- Member States and the EC should use national systems to promote synergies between activities under the UNFCCC and other international conventions (e.g. CLRTAP) with respect to consistent reporting of air emission and GHG inventories.
- Member States should consider the implementation of written agreements with outside agencies concerning data availability and QA/QC procedures.
- Member States and the EC could consider implementing a Quality Management System as outlined in international standards.

Recommendations concerning quality assurance

- Member States and the EC are encouraged to compare emission estimates with other independently compiled estimates and analyse and explain significant discrepancies.
- Member States are encouraged to conduct cross country /peer / public reviews.

Recommendations concerning quality control

- Member States and the EC shall provide detailed information on their QA/QC system in their national inventory report as part of the documentation requirements. Parties should supply a summary of implemented QA/QC procedures and key findings.
- Member States should supply national emission factors including uncertainty estimates, net calorific values (NCV) and detailed information upon applicability to the IPCC emission factor database.

For more details of the workshop see the workshop report available on the website of the ETA/ACC: http://air-climate.eionet.eu.int/docs/meetings/040902_GHG_MM_QAQC_WS/meeting040902.html

In May 2004, a 'Workshop on emissions of greenhouse gases from aviation and navigation' was held in Copenhagen. The aim of this workshop was to improve the inventories of GHG emissions from aviation and navigation with special attention to the disaggregation between domestic and international bunker fuels. The workshop brought together national experts from statistical institutes or other organisations that are responsible for energy balances and/or aviation and navigation transport statistics, the national experts responsible for annual GHG inventories and the experts from international organisations that are performing relevant projects (for more details see Section 3.7).

A further workshop is being planned for Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop are: (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 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 will provide an opportunity to discuss potential methodological changes and improvements of the draft 2006 IPCC inventory guidelines. The workshop is targeted at experts who have direct experience in compiling and analysing GHG emission projections and inventories from the waste sector.

Apart from the activities mentioned in this chapter further sector specific QA/QC procedures are mentioned in Chapters 3 to 9.

1.7 Uncertainty evaluation

By 15 April Tier 1 uncertainty analyses were available from 13 EU-15 Member States. These Member States cover about 95 % of total EU-15 GHG emissions in 2003. Table 1.7 shows the availability of Table 6.1 of the Tier 1 uncertainty analysis. For four Member States Tier 1 uncertainty analyses were available for 2003, for eight Member States the latest year available was 2002, for Belgium it is 2001. Most Member States cover all source categories in their uncertainty estimates.

Table 1.7: Availability of Table 6.1 of the Tier 1 uncertainty analysis as of 15 April 2005

Member State	Year	Coverage	Member State	Year	Coverage
Austria	2003	96%	Ireland	2003	100%
Belgium	2001	99%	Italy	2002	100%
Denmark	2002	92%	Netherlands	2002	100%
Finland	2002	97%	Spain	2002	100%
France	2002	100%	Sweden	2003	100%
Germany	2003	100%	United Kingdom	2002	100%
Greece	2002	100%			

The EU-15 Tier 1 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates of the Member States. Uncertainties were estimated for six sectors 'Stationary fuel combustion', 'Transport', 'Fugitive emissions', Industrial processes', 'Agriculture' 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 calcualted 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. Table 1.8 shows the main results of the uncertainty analysis for the EU-15. The lowest uncertainty estimates are for stationary fuel combustion (1 %) and transport (3 %), the highest estimates are for agriculture (41 % - 74 %). For agriculture a range of uncertainties is provided depending on the assumption on N_2O emissions from soils. The lower bound assumes that all MS uncertainty estimates of N_2O from agricultural soils are uncorrelated, the upper bound assumes that all uncertainty estimates are correlated. Overall uncertainty estimates of all EU-15 GHG emissions is calcualted to be between 4 % and 8 %. More detailed uncertainty estimates for the source categories are provided in Chapters 3-8.

Table 1.8: Tier 1 uncertainty estimates of EU-15 GHG emissions

Source category	Gas	Emissions 2003 [1)]	Emissions for which MS uncertainty estimates are available [2)]	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
Fuel combustion stationary	all	2.463.964	2.403.737	98%	1%
Transport	all	872.311	800.635	92%	3%
Fugitive emissions	all	57.046	61.519	108%	11%
Industrial processes	all	265.030	230.150	87%	6%
Agriculture	all	414.427	403.063	97%	41% - 74%
Waste	all	96.728	87.634	91%	17%
Total	**all**	**4.179.613**	**3.986.738**	**95%**	**4% - 8%**

Table 1.9 gives an overview of information provided by Member States on uncertainty estimates in their national inventory reports 2004 or 2005 and presents summarised results of these estimates. The table includes information from 14 Member States. From the remaining 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 1.9 Overview of uncertainty estimates available from Member States (from Member States' national inventory reports 2003, 2004 and 2005)

Member State	**Austria**		**Belgium**		**Czech Republic**		**Croatia**		**Denmark**		**Finland**	**France**		**Germany**	
Citation	Austrian NIR 2005, p. 25-39		Belgian NIR 2005, p. 13-19		Czech NIR 2004, p. 16-17		Croatian NIR 2005, p. 4-5		Danish NIR 2005 p. 34-36		Finnish NIR 2005 p. 24 A-D)	French NIR 2003 p. 30-31		German NIR 2005, p. 1-33-36, Annex 7	
Method used	Tier 1, Tier 2		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1, Tier 2	Tier 1		Tier 1	
Documentation available in NIR (according to Table 6.1 of GPG)	Partially (Table 7)		Yes (provided as a separate table)		Yes: Table 1.3		Yes: Annex 3 (Table A3-1)		Partially: Table 1.4		Yes: Annex 1 (Table A	Yes: Annex 2 (no reference source information)		Yes: Annex [Anhang] 7 (not according to Table 6.1 of GPG)	
Years and sectors included	Tier 1: base year and 1995 - Key sources Tier 2: 1990, 1997 (from year 1999) – All sectors		2001-All sectors except LULUCF; for Flanders, a complete uncertainty study was conducted both on Tier 1 and Tier 2 level		1990, 2001 - All sources (key sources and "others"		1990, 2001 - All Sectors (except LULUCF)		1990, 2003 - The sources included in the uncertainty estimate cover 99.7% of the total Danish greenhouse gas emission (CO2 eq., without CO2 from LUCF).		1990, 2003 – All secto	1990, 2002 (from year 2004) – All sources (key sources and "others")		1990, 2002 - nearly complete estimation for sources 1A, 2A1, 2A2, 2C1, 2C3, 4A(2002 only), 5A(2002 only)	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	Base year: 2,5% 1995: 2,0%	1990: 2,3% 1997: 2,1	3,6%	-					2,5%		+/- 15% (with LULUCF) +/- 2% (without LULUCF)	-	-	-	-
CH_4	Base year: 19,1% 1995: 20,3%	1990: 48,3% 1997: 47,4%	24,0%	-					20%		+/- 20%	-	-	-	-
N_2O	Base year: 104,3% 1995: 101,2%	1990: 89,6% 1997: 85,9%	91,0%	-					57%		-40 to +100%	-	-	-	-
F-gases	-	-	-	-					129%		-10 to +20%	-	-	-	-
Total	Base year: 4,1% 1995: 5,5%	1990: 9,8% 1997: 8,9%	8,1%	-	7,0%		36,1%		6,8%		+/- 16% (with LULUCF)	22,1	-	-	-
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	-	-	-	-					1,9%		-	-	-	-	-
CH_4	-	-	-	-					9,3%		-	-	-	-	-
N_2O	-	-	-	-					14%		-	-	-	-	-
F-gases	-	-	-	-					54%		-	-	-	-	-
Total	-	-	3,8%	-	2,9%		6,7%		2,1%		+/- 19% (with LULUCF)	3,5	-	-	-

Member State	**Greece**		**Ireland**		**Italy**		**Netherlands**		**Slovakia**		**Spain**		**Sweden**		**United Kingdom**	
Citation	Greek NIR 2005, p. 18-20. Annex IV, Table IV.1		Irish NIR 2005, p. 8-9, 14-15 (Tab. 1.4)		Italian NIR 2004, p. 18, Annex 1		Dutch NIR 2005, p. 1-23 to 1-26, Annex 1.2		Slovakian NIR 2005, p. 12-13; Coverletter 2005 (Data of greenhouse gas emissions): Table on Tier 1 uncertainty calculation and reporting		Spanish NIR 2005, p.46-55		Swedish NIR 2005, p. 16-20		UK NIR 2004 (draft) Annex 7, Table A7.4	
Method used	Tier 1		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1, Tier 2	
Documentation available in NIR (according to Table 6.1 of GPG)	Yes. Annex IV.1		Yes: Table 1.4		Yes (Table A1.2)		Partially (Table 1.4)		Yes: Table on Tier 1 uncertainty calculation and reporting		Yes: Table 5.5.2 and 5.5.3		Partially (Annex 2)		Yes: Annex 7 (no composite table on references included)	
Years and sectors included	1990, 2003 - All sources		1990, 2003 – All sources		1990, 2002 – All sources		1990/95, 2003 – All sources		1990, 2003 - All sources		2001, 2002 (from year 2005) - All sources (key sources and "other emission sources")		2003 (from year 2005) - All sources		1990, 2002 (from year 2004) – All sources	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	3,7% (witout LULUCF) 5% (with LULUCF)	-	1,4	-	-	-	+/-5%	-			-	-	3,5	-	-	2,1
CH_4	34,4%	-	3,5	-	-	-	+/-25%	-			-	-	1,66	-	-	13
N_2O	104,1%	-	11,6	-	-	-	+/-50%	-			-	-	5,99	-	-	231
F-gases	69,9%	-	0,2	-	-	-	HFC+/-50% PFCs +/-50% SF6 +/-50%	-				-	0,31	-	-	HFC 25 PFCs 19 SF6 13
Total	10,8% (without LUCF) 11,5% (with LULUCF)	-	12,2	-	2,5%	-	6%	-	10,0%		2001 +/- 17% 2002 +/- 15.8%	-	6,93	-	17,9	15
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	-	-	2,2	-	-	-	5%	-			-	-	-	-	-	-
CH_4	-	-	2,5	-	-	-	6%	-			-	-	-	-	-	-
N_2O	-	-	7,0	-	-	-	15%	-			-	-	-	-	-	-
F-gases	-	-	0,2	-	-	-	7%	-			-	-	-	-	-	-
Total	8%	-	7,7	-	2,4%	-	4%	-	3,2%		2001 +/-2.65% 2002 +/-3.95%	-	-	-	2	-

1.8 *General assessment of the completeness*

1.8.1 Completeness of Member States' submissions

The EC GHG inventory is compiled on the basis of the inventories of the EC Member States. Therefore, the completeness of the EC inventory depends on the completeness of the Member States' submissions.

Table 1.10 summarises timeliness and completeness of the Member States' submissions on 20 May 2005. It shows that GHG inventories were submitted by 23 Member States. The complete time series was provided by 20 Member States. 18 Member Statres submitted all or almost all tables (i.e. more than 90 %) of the CRF tables for 1990–2003; four Member States at least for 2003. The new LUCF tables are available for ten Member States. The completeness of national submissions with regard to individual CRF tables in the 2004 submission can be found in the status reports in Annex 3. In addition, EU-15 Member State information on the completeness of their emission estimates at source level can be seen from Table 1.11 and Table 1.12 below and in the overview tables in Chapters 3 to 8 which are based on the CRF Table 7 of the Member States.

Table 1.10 Date of latest submission or update, years covered and CRF tables available from Member States by 20 May 2005

MS	Submission dates	Latest data available	Years covered	CRF Tables[1)]	New LUCF tables	Old LUCF tables
Austria	14 Jan 2005	2003	1990-2003	All	1990-2003	
	15 Apr 2005	2003	1990-2003	All	1990-2003	
	20 Apr 2005	2003	1990-2003	All	1990-2003	
Belgium	14 Jan 2005	2003	1990-2003	All	-	
	15 Mar 2005	2003	1990-2003	All	1990-2003	Yes
Cyprus	29 Mar 2005	2003	1990-2003	All	-	Yes
Czech Republic	14 Jan 2005	2003	1990, 1992, 1994-2003	Full CRF only for 2003.	-	Yes
	14 Apr 2005	2003	1990, 1992, 1994-2003	Full CRF only for 1995 and 2003.	-	Yes
Denmark	14 Jan 2005	2003	1990-2003	All	1990-2003	
	15 Mar 2005	2003	1990-2003	All	-	Yes
	15 Apr 2005	2003	1990-2003	All	1990-2003	Yes
Estonia	4 Jan 2005	2003	1990-2003	Full CRF only for 2003.	-	Yes
	15 Apr 2005	2003	1990-2003	All	-	Yes
Finland	14 Jan 2005	2003	1990-2003	All	2003	
	15 Mar 2005	2003	1990-2003	All	1990-2003	Yes
	15 Apr 2005	2003	1990-2003	All	-	Net
France	7 Jan 2005	2003	1990-2003	All	-	Yes
	14 Apr 2005	2003	1990-2003	All	-	Yes
Germany	14 Jan 2005	2003	1990-2003	All	1990-2003	Mapping
Greece	17 Jan 2005	2003	1990-2003	All	1990-2003	
	1 Mar 2005	2003	1990-2003	LUCF	-	Net
	31 Mar 2005	2003	1990-2003	All	-	
Hungary	17 Feb 2005	2003	1990-2003	Full CRF only for 2003.	-	
	17 Mar 2005	2003	1990-2003	Full CRF only for 2003.	-	Yes
	21 Apr 2005	2003	1990-2003	Full CRF only for 2003.	-	Yes
Ireland	17 Jan 2005	2003	1990-2003	All	-	Yes
	12 Apr 2005	2003	1990-2003	All	-	Yes
Italy	17 Mar 2005	2003	1990-2003	LUCF	1990-2003	
	25 Mar 2005	2003	1990-2003	All	-	Net
	7 Apr 2005	2003	1990-2003	All	-	Net
	14 Apr 2005	2003	1990-2003	All	-	Net
	16 May 2005	2003	1990-2003	All	-	Net
Latvia	19 Jan 2005 (earlier to COM)	2003	1990-2003	All	-	
	15 Mar 2005	2003	1990-2003	All	-	Yes
	18 Apr 2005	2003	1990-2003	All	-	Yes
Lithuania	18 Jan 2005	2003	1998, 2001-2003	Full CRF only for 2003.	2003	-

MS	Submission dates	Latest data available	Years covered	CRF Tables[1)]	New LUCF tables	Old LUCF tables
	18 Mar 2005	2003	1998, 2001-2003	Full CRF only for 2003.	-	-
Luxembourg	11 Apr 2005	2003	2003	Limited	-	Yes
Malta						
Netherlands	14 Jan 2005	2003	1990-2003	All	90, 00, 03	
	15 Mar 2005	2003	1990-2003	All	1990-2003	Yes
	14 Apr 2005	2003	1990-2003	All	1990-2003	
Poland						
Portugal	14 Mar 2005	2003	1990-2003	All	-	Yes
Slovakia	19 Jan 2005	2003	1990-2003	Full CRF only for 2003.	-	
	7 Mar 2005	2003	1990-2003	Full CRF only for 2003.	-	Yes
	15 Apr 2005	2003	1990-2003	Full CRF only for 2003.	-	Yes
Slovenia	14 Jan 2005	2003	1990-2003	Full CRF only for 2003.	-	
	15 Mar 2005	2003	1986, 1990-2003	All	-	Yes
	15 Apr 2005	2003	1986, 1990-2003	All	-	Yes
Spain	1 Mar 2005	2003	1990-2003	All	-	Yes
Sweden	14 Jan 2005	2003	1990-2003	All	-	
	15 Mar 2005	2003	1990-2003	All	-	Yes
	14 Apr 2005	2003	1990-2003	All	-	Yes
United Kingdom	21 Jan 2005	2003	1990-2003	All	-	
	22 Feb 2005	2003	1990-2003	LUCF	1990-2003	
	11 Mar 2005	2003	1990-2003	LUCF	1990-2003	
	15 Mar 2005	2003	1990-2003	All	-	Yes
	15 Apr 2005	2003	1990-2003	All	1990-2003	Yes

([1]) All = all or almost all (approx. more than 90 %) of the CRF tables; Limited = Sectoral Report Tables, Table 1A(a), Summary 1.A, Summary 3 (see Annex 3 for more details).

Table 1.11 shows the availability of Member States' national inventory reports or additional inventory information and a short characterisation of the 2005 report. The column 'Report structure 2005' indicates whether the Member States used the UNFCCC structure of national inventory report ([11]).

Table 1.11 National inventory reports or additional information available from Member States as by 25 May 2005

Member State	2005	References	Report structure 2005 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2005 report
Austria	Umweltbundesamt (2005)	Umweltbundesamt 2005. *Austria's national inventory report 2005. Submission under the United Nations Framework Convention on Climate Change,* BE-268. Vienna, 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Belgium	Directorate General Environment (2005)	DG Environment 2005. *Belgium's Greenhouse Gas Inventory (1990-2003). National Inventory Report 2005. Submission to the UNFCCC Secretariat and to the Comission of theEuropean Communities.* Brussels, March 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Cyprus				Greek only
Cezch-Republic	—			[NIR not yet submitted]
Denmark	National Environmental Research Institute (2005)	National Environmental Research Institute 2005. *Denmark´s national inventory report 2005. Submitted under the United Nations Framework Convention*	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, recalculations, key source analysis, QA/QC

([11]) FCCC/CP/2002/8.

Member State	2005	References	Report structure 2005 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2005 report
		on Climate Change, 1990-2003. April 2005		activities, uncertainty evaluation and inventory improvements.
Estonia	Ministry of Environment	Ministry of Environment 2005. *Greenhouse Gas Emissions in Estonia 1990-2003. National Inventory report to the UNFCCC Secretariat.* Tallinn, January 2005	Yes	National inventory report including general information on the inventory, sector and source specific methodological information and data sources, recalculations and key source analysis. No information on Emission trends, QA/QC activities and improvements.
Finland	Statistics Finland (2005)	Statistics Finland 2005. *Greenhouse Gas Emissions in Finland 1990-2003. National Inventory Report to the European Commission.* April 2005.	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source categories, uncertainty evaluation, recalculations and inventory improvements.
France	—			[NIR not yet submitted]
Germany	Umweltbundesamt (2005)	Umweltbundesamt 2005. *Deutsches Treibhausgasinventar 1990-2003. Nationaler Inventarbericht 2005. Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen.* Berlin, January 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty analysis, recalculations and inventory improvements.
Greece	Minstry for the Environment, Physical Planning and Public Work (2005)	Ministry for Environment, Physical Planning and Public Works 2005. *Climate Change Emissions Inventory-National inventory for greenhouse and other gases for the years 1990-2003.* Athens, February 2005	Yes	National inventory report including general information on the inventory, emission trends, QA/QC activities, key source analysis,sector and source specific methodological information and data sources, uncertainty evaluation, recalculations and inventory improvements.
Hungary	National Directorate for Environment, Nature and Water (2005)	National Directorate for Environment, Nature and Water 2005. *National Inventory Report for 2003 and recalculated years (1985-2002) Hungary*. Budapest, February 2005	yes	National inventory report including general information on the inventory, emission trends, recalculations, inventory improvements, uncertainty analysis, QA/QC and key source analysis.
Ireland	Environmental Protection Agency (2005)	Environmental Protection Agency 2005. *Ireland - National Inventory Report 2005, Greenhouse Gas Emissions 1990-2003 Reported to the United nations Framework Convention on Climate Change*. Wexford, January 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Italy	—			[NIR not yet submitted]
Luxembourg	—			[NIR not yet submitted]
Latvia	Latvian Environment, Geology and Meteorology Agency (2005)	Latvian Environment, Geology and Meteorology Agency 2005. *Latvia´s national inventory report for 1990-2002 – submitted under the United Nations Convention on Climate Change*. Jurmala, April 2005.	Yes	National inventory report including general information on the inventory, emission trends, sector and source specific methodological information and data sources, key source analysis, recalculations and inventory improvements. QA/QC activities and uncertainty evaluation are not included.
Lithuania		*National Greenhouse Gas Emission Inventory Report of the Republic of Lithuania (Reported Inventory 2003).* Vilnius, 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source specific methodological information and data sources, QA/QC ativities, key source analysis, uncertainty evaluation and inventory improvements. Recalculations are not included.
Malta	—			[NIR not yet submitted]
Netherlands	Klein Goldewijk,	RIVM 2005. *Greenhouse Gas*	Yes	National inventory report including general

Member State	2005	References	Report structure 2005 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2005 report
	K., Olivier, J.G.J., Peters, J.A.H.W., Coenen, P.W.H.G. and Vreuls H.H.J. (2005)	*Emissions in the Netherlands 1990-2003. National Inventory Report 2005*		information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Poland	—			[NIR not yet submitted]
Portugal	—			[NIR not yet submitted]
Slovakia	Slovak Hydrometeorological Institute 2005	Slovak Hydormeteorological Institute 2005. *Greenhouse Gas Emission Inventory in Slovakia 1990-2003*. Bratislava 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Slovenia	—			[NIR not yet submitted]
Spain	Ministry of the Environment 2005	Ministry of the Environment 2005. *Greenhouse Gas Emissions Inventories Report from Spain 1990-2003 Communication to the European Commission (Decision 2004/280/EC)*. Madrid, February 2005	Yes	National inventory report including general information on the inventory, sector and source specific methodological information and data sources, key source analysis, uncertainty evaluation and recalculations. Not included are QA/QC activities, emission trends, and inventory improvements.
Sweden	Swedish Environmental Protection Agency (2005)	Swedish Environmental Protection Agency 2005. *Sweden's National Inventory Report 2005 – Submitted under the Monitoring Mechanism of Community greenhouse gas emissions.* Stockholm, January 2005	Yes	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
United Kingdom	—			[NIR not yet submitted]

The following tables refer to EU-15 only. Table 1.12 compiles the characterisation of the 2004 NIRs of Member States as well as the findings from the individual review of Member States' inventories conducted by the UNFCCC Secretariat in 2004 and compares those findings with the NIRs submitted in 2005 by Member States. This analysis intends to increase information on completeness of methodological descriptions, underlying data and key parts of the inventory submission by Member States that form the basis of the EC submission.

Table 1.12 Characterisation of Member States' national inventory reports 2004 and changes in 2005

Member State	Characterisation of the report in the 2004 UNFCCC inventory review	Changes to the report in 2005 in response to the review
Austria	**UNFCCC Status report 2004:** The organization of chapters in the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the information required in the annexes is not provided, e.g. tables 6.1 and 6.2 of the IPCC good practice guidance**.** **UNFCCC Review report 2004:** Austria provided a NIR of high quality. The applied methodologies are well documented and a detailed description of the overall system is provided. The NIR conforms with the UNFCCC guidelines and the IPCC good practice guidance. Some small areas for improvement still exist. (FCCC/WEB/IRI/2004/AUT, para 2)	The NIR is still very detailed. In response to the UNFCCC review the report some areas have been further improved.
Belgium	**UNFCCC Status report 2004:** The organization of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, the Executive Summary and some of the recommended sections and annexes (e.g., tables 6.1 and 6.2 of the IPCC good practice guidance) are not provided. **UNFCCC Review report 2004:** The NIR is highly developed and shows some improvements since the last submissions. For a better transparency of the NIR the applied methods need to be described in	Work regarding the completeness and transparency of the inventory is still ongoing. Inconsistencies between the three regions were reduced but work is still ongoing.

Member State	Characterisation of the report in the 2004 UNFCCC inventory review	Changes to the report in 2005 in response to the review
	more detail and the inventory needs to be completed. The split of information according to the three regions also impacts the transparency of the NIR and harmonization is needed. Some inconsistency between CRF tables and the NIR exists. (FCCC/WEB/IRI/2004/BEL, para 2)	
Denmark	**UNFCCC Status report 2004:** The organization of the chapters in the NIR, in general, follows the structure outlined in the revised UNFCCC reporting guidelines adopted by decision 18/CP.8. However, the executive summary is not provided. **UNFCCC Review report 2004:** The NIR is in general conform with the guidelines, except of the LUCF chapter. Since the last submission some improvements took place. Some categories are still not reported. (FCCC/WEB/IRI/2004/DNK, para 2)	The report provides additional categories. Waste water handling, land use and land use change have been reported this time.
Finland	**UNFCCC Status report 2004:** The organization of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the recommended annexes have not been provided. The NIR further provides a web link to a report on the methodologies for calculating the greenhouse gas emissions inventory. **UNFCCC Review report 2004:** The NIR is in general complete and transparent. Some more information and detailed description about complex methodologies and more precise references could still enhance the transparency. The NIR has improved since the last submission. (FCCC/WEB/IRI/2004/FIN, para 2)	More detailed and updated description on methodologies and data sources are provided in the new report.
France	**UNFCCC Status report 2004:** The organization of the NIR, in general, follows the outline of the revised UNFCCC reporting guidelines (decision 18/CP.8). However, the report only provides summary information on the methodologies for all sectors. **UNFCCC Review report 2004:** The NIR follows in general the guidelines, but it does not provide information about methodologies. This information is provided in the OMINEA report. The OMINEA report does not provide the methodologies for all sectors. The ERT recommends including all relevant information in the NIR including the methodologies for all sectors. (FCCC/WEB/IRI/2004/FRA, para 2)	[NIR not yet submitted.]
Germany	**UNFCCC status report 2004:** The organization of the chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines adopted by decision 18/CP.8. **UNFCCC Review report 2004:** Germany provided an appropriate report for the years 1990-2002. To follow the NIR structure as outlined in the guidelines has greatly improved the transparency of the report. There are some gaps regarding the CRFs. Recalculations are still not very transparent. To increase the transparency of the NIR, the ERT recommends that Germany consider making more use of annexes for detailed technical information and providing more straightforward information in the body of the NIR itself. (paras 9-29, FCCC/WEB/IRI/2004/DEU)	The transparency of the report was increased by structuring and shortening the report. Detailed descriptions of methodologies are available in the annexes.
Greece	**UNFCCC status report 2004:** The organization of chapters in the NIR in general follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the recommended annexes are not provided. **UNFCCC review report 2004:** In general Greece provided a complete and transparent inventory. The NIR and CRF tables cover all major sources and sinks with a few exceptions and inconsistencies. A systematic key source analysis should be used to prioritize inventory improvements and development. This should be facilitated by the implementation of the QA/QC plan and the recommendations that will come from the plan. The ERT noted that improvements are needed, particularly in the areas of transparency and documentation of calculation procedures and all elements of the methodologies used. (paras 6-27, FCCC/WEB/IRI/2004/GRC)	Since the last submission a QA/QC plan has been developed. QA/QC activities were focused on the improvement of the archiving of information and the development of a long-term improvement plan but the work still in progress.
Ireland	**UNFCCC status report 2004:** The organization of the NIR does not follow the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). The NIR contains information on key sources, recalculations, QA/QC, trends, completeness and planned improvements. Calculation sheets are provided in appendices to the NIR. **UNFCCC Review report 2004:** NIR, CRF tables and inventory methods are highly developed. Only one inconsistency related to recalculations was found between CRFs and NIR.(para 6) Not all recommendations from the in-country review 2003 have been implemented but this is planned for the future. (para 7)	Ireland recognises the need to deliver annual submissions in close conformity with the UNFCCC Reporting Guidelines on Annual Inventories to facilitate the work of expert review teams in conducting productive and efficient technical reviews of greenhouse gas inventories. Recalculations have been made in response to the recommendation of the 2003 review report.

Member State	Characterisation of the report in the 2004 UNFCCC inventory review	Changes to the report in 2005 in response to the review
	FCCC/WEB/IRI/2004/IRL	
Italy	**UNFCCC Review report 2004:** The NIR conforms with the guidelines and is almost complete and transparent. Some methods need to be described in more detail to enhance transparency and some emissions are not estimated. Italy presents a good diagnosis of the problems in developing a NIR and made effort to address them. (FCCC/WEB/IRI/2004/ITA, para 2)	[NIR not yet submitted]
Luxembourg	**UNFCCC status report 2004:** An NIR has not been submitted. Information on CO_2 emissions from road traffic for the years 1998, 2000 and 2002 is provided in a separate file.	[NIR not yet submitted]
Netherlands	**UNFCCC status report 2004:** The organization of chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). **UNFCCC review report 2004:** The Netherlands provided a complete, carefully documented and highly transparent NIR for the years 1990-2002. The key source assessment is made by subsectors (e.g. energy industry) and not by fuel types as recommended in the IPCC guidelines. Some source categories like the removals from agricultural soils, forest and grassland conversion are not reported. A discussion about planned improvements is already included in the NIR and some further improvements are recommended by the ERT. (paras 9-24, FCCC/WEB/IRI/2004/NLD)	The NIR has been further improved since the last submission. As recommended the IPCC guidelines have been applied.
Portugal	**UNFCCC review report 2004:** In general the NIR is complete, transparent and comprehensive. Compared to the previous NIR there was a significant improvement. Some source categories (e.g. CO_2 emissions from asphalt roofing etc.) are not included in the inventory. Also transparency still needs to be improved in some areas. Portugal does not yet have a formal quality assurance/quality control plan and procedure in place in accordance with the IPCC good practice guidance and has not yet provided quantitative uncertainty estimates. (paras 5-44, FCCC/WEB/IRI/2004/PRT)	[NIR not yet submitted]
Spain	**UNFCCC status report 2004:** The organization of the NIR does not follow the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). The NIR contains information on methodologies used, inventory principles, trends and recalculations, uncertainty analysis and key sources, and discussion of key sources under each IPCC sector including information on activity data and factors used in the calculation of estimates. **UNFCCC Review report 2004:** Efforts have been made to improve the quality of the NIR and the CRFs and the implementation of the IPCC guidelines for the preparation process. The implementation of the IPCC guidelines is not fully completed. The QA/QC system is not in place. (para 7) Areas for improvement have been identified by the partie. The ERT suggests to implement the improvements in the 2005 submission. (para 8). The main outstanding improvement is to provide more detailed information on methodologies.(para 9) FCCC/WEB/IRI/2004/ESP	Recalculations have been made which contributed significantly to an improvement in the accuracy and completeness of the inventories series. IPCC good practice guidelines have been further implemented.
Sweden	**UNFCCC status report 2004:** The organization of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the recommended annexes are not provided (e.g., tables 6.1 and 6.2 of the IPCC good practice guidance). **UNFCCC Review report 2004:** The submitted data covers all years, all gases, sectors and sources/sinks. Some country specific methods are used to report additional sources, e.g. N-fixation in hayfields. The NIR is informative, but more information about applied country-specific methods its key assumption and its advantages would be helpful. Improvements in comparison to the last submission have been made. For the first time quantitative uncertainty estimates have been made. (FCCC/WEB/IRI/2004/SWE, para 2)	Detailed explanations about applied methods are available in the report. Also explanation about country specific methods and why these methods are applied is provided in the report.
United Kingdom	**UNFCCC status report 2004:** The organization of the chapters in the NIR follows the structure outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). **UNFCCC Review report 2004:** The UK inventory is in conformity with the guidelines. Very strong is the methodological implementation in the crosscutting activities. Some gaps in the transparency and consistency occur in the sections of industrial processes and waste. Also the corresponding explanations for the recalculations could be strengthened. In comparison to the last report the transparency in the energy, agricultural and LUCF sector increased. (FCCC/WEB/IRI/2004/GBR, paras 2-3)	[NIR not yet submitted]

Table 1.13 provides an overview regarding incomplete estimation of source categories and completeness of geographical coverage as reported by Member States as far as this information was provided. The table also indicates briefly the reasons why certain source categories were not estimated. Since this overview table reflects the level of completeness of the underlying inventories, it represents an aggregate guide to the completeness of the EC inventory.

Table 1.13 Overview of completeness as reported by Member States in CRF Table 9 and in the 2005 NIR

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Austria	**Completeness by emission sources:** CRF 1.B.2a: CO_2 and CH_4 emissions assumed to be negligible. CRF 2.B.5: CH_4 emissions from carbon black, methanol, ethylene included in the NMVOC estimate. CRF 5: CH_4 and N_2O emissions not estimated due to lack of data. CRF 5.A, 5.B.2.1, 5.C.2.1, 5.D.2.1, 5.E.2.1, 5.F.2.1: no measured data available for C stock change in soils, reassessments planed for near future. Compared to last year's submission, some additional sources have been included in the inventory; **Completeness by geographical coverage:** Complete territory covered.
Belgium	CO_2 emissions from agricultural soils are not estimated. A study is going on at the national level, but will not be finalised before 2005.
Denmark	**Completeness by emission sources:** CRF 2.A.3, 2.A.4: CO_2 emissions included in glass production, improvements planed. CRF 2.A.5, 2.A.6: CO_2 emissions estimates are under development. CRF 4.A: CH_4 emissions from enteric fermentation (poultry and fur farming) not estimated due to lack of default EF, considered of minor importance. CRF 4.D: CH_4 emissions from soils not estimated due to lack of default methodology, considered of minor importance; N_2O emissions not estimated because $Frac_{NCRBF}$ and $Frac_{NCRO}$ unknown. CRF 5.D: CO_2 emissions from cultivation for mineral soils not estimated, on-going survey will prepare estimates. CRF 6.A.1: CO_2 emission from waste disposal not estimated as considered negligible. LULUCF: Denmark is a higly intensive agricultural country. Deforestation was banned 200 years ago and drainage of wetlands has not occurred in the last 20 years as well as field burning was banned 1. january 1990. Due to the demand for land for settlements and infrastructure the agricultural area is decreasing continously. Reestablisment of wetlands is occuring. As a consequence the transistion from one land category to another is resticted and almost unidirectional. The consequenses for the overall emission is assumed to be very little. However, this has not been investigated throughly and hence NE has been used in many places due to lack of data. In future a closer examination of the areas will be made. **Completeness by geographical coverage:** Complete territory covered.
Finland	**Completeness by emission sources:** CRF 1.B.2: Fugitive emissions from oil and natural gas: emissions of CO_2, CH_4 and N_2O are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories. CRF 1: International bunkers/lubricants: emissions of CO_2, CH_4 and N_2O are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories. CRF 2.A, B, D: Emissions from industrial processes: CO_2 emissions from some source categories are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories. CRF 3.A,B,D: No compound specific data of NMVOC emissions available for conversion to CO_2. CRF 4.A: N_2O emissions from enteric fermentation not estimated due to lack of methodology. CRF 4.F: CH_4 and N_2O emissions from field burning of agricultural residues is considered negligible. CRF 6: Wastewater handling not estimated due to lack of default methodology. CRF 6: Other (composting): emissions of CH_4 and N_2O are estimated to be nearly zero (negligible). LULUCF: emissions from land converted to cropland and grassland not available due to lack of are estimates; C stock change in dead organic matter and soils not estimated but will be included in 2006 submission; Methods are under development for CO_2 emissions from wetlands and biomass burning and N_2O emissions from drainage of soils. **Completeness by geographical coverage:** The inventory includes emissions from the autonomic territory of Åland (Ahvenanmaa). Information on the specified emissions for the territory of Åland estimated by the Finnish Environment Institute will be available at the website http://www.environment.fi>state of the environment>air>Finland's GHG emissions by the end of March 2005. **Completeness by temporal coverage:** In general, complete CRF tables are provided for all years. In the energy sector, recent studies on emission factors, more developed estimation models and updated energy data have caused some inconsistencies in the time series. The time series will be recalculated in the future inventories to remove inconsistencies.
France	[No information on completeness has been provided]
Germany	**Completeness by emission sources:** CRF 1.A.3.b: CH_4 emissions from natural gas vehicles not estimated. CRF 2.A: CH_4 and N_2O emissions from mineral products not estimated due to lack of information. CRF 2.A.3, 2.A.4, 2.A.5 and 2.A.6: CO_2 emissions not estimated, but methods are in preparation. CRF 2.C: Metal production: N_2O considered negligible. CRF 4: CH_4 emissions from manure management and enteric fermentation not estimated for goats, mules and asses as German statistics do no provide due not provide the number of animals Further assessment is needed regarding the complete coverage of blast-furnace gas, refinery gas as well as the energy use of CH_4 from coal mines.
Greece	**Completeness by emission sources:** CRF 1.A.3.b: CH_4 and N_2O emissions not estimated due to lack of information

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
	CRF 1.B.: CO_2, CH_4 and N_2O emissions not estimated for Fugitive emissions CRF 1.C.: CH_4 and N_2O emissions not estimated due to no appropriate emision factors CRF 2.A.5, 2.A.6, 2.D.2: Soda ash production and use, sphalt roofing, road-paving, food and drink: CO_2 emissions not estimated due to lack of activity data but considered minor. CRF 2.B.1: Ammonia production: CH_4 emissions not estimated due to lack of activity data. N_2O emissions not estimated due to missing emission factor. CRF 2.B.5: CO_2 and CH_4 emissions not estimated due to lack of activity data. CRF 2.C.2., 2.C.3.: No estimation of CH_4 emissions due to missing emission factors. CRF 3 A,B,C: N_2O emissions not estimated due to lack of data. CRF 4.A.9: CH_4 emissions not estimated, no appropriate emission factor. CRF 4.D: Agricultural soils: CH_4 emissions not estimated due to lack of method. CRF 5: For grassland converted to forest land, forest and croplands converted to grassland, land converted to wetlands, land converted to settlements and land converted to other land not estimated due to lack of activity data, emissions considered negligible. CRF 6.B: CH_4 emissions from sludge treatment not estimated. No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF_6). **Completeness by geographical coverage:** complete territory covered.
Ireland	CRF 2.A.5, 2.A.6, 2.A.7: CO_2 not estimated due to lack of activity data. CRF 2.F.3: HFCs from fires extinguishers not estimate due to lack of data. CRF 4.D.1, 4.D.2, 4.D.3: CH_4 not estimated, awaiting results of major national resarch project CRF 5.B, 5.C, 5.D: CO_2, CH_4 and N_2O not estimated, awaiting results of major national resarch project
Italy	CRF 1.A.2: CO_2 , CH_4 and N_2O emissions for Manufacturing Industries and Construction - Pulp, paper and print, Biomass not estimated, no information available CRF 3: N_2O, no estimation so emissions for other use of N_2O For PFCs no estimation of potentail emissions CRF 5.E.1, 5.E.2.1, 5.E.2.2, 5.E.2.3: no estimates for net carbon stock changes in living biomass and dead organic matters and soils due to insufficient data CRF 6.B: no estimates of N_2O emissions from wastewater handling No estimations for HFCs in the industrial process sector.
Luxembourg	[No information on completeness has been provided]
Netherlands	CRF 1.B.2: Fugitive emissions of CO_2 and CH_4 from several subsource categories not estimated, emissions considered minor. CRF 2.A.5: CO_2 emissions from asphal roofing not estimated, considered minor. CRF 2.A.7: CO_2 and CH_4 emissions from other building materials not estimated, considered minor. CRF 4.A.9: No CH_4 emissions from enteric fermentation for poultry estimated. CRF 5.B and 5.E: CH_4 and N_2O for forest and grassland conversion and other not estimated, consedired to be minor. CRF 6B: N_2O emissions from industrial wastewater and human sewage not estimated. For PFCs and SF_6 not all potential emissions (= total consumption data) are reported at present due to the limited number of companies for which currently consumption figures are available **Completeness by geographical coverage:** The territory of the Netherlands from which emissions are reported is the legal territory; this includes a 12-mile zone from the coastline and inland water bodies. It excludes Aruba and the Netherlands Antil-les, which are self-governing dependencies of the Royal Kingdom of the Netherlands. Emissions from offshore oil and gas production at the Netherlands' part of the continental shelf are included.
Portugal	CFR 2-4A: CO_2 emissions from soda ash production and use International Marine Bunkers, CO_2 emissions from Lubricants, lack of methodology CRF 1: CH_4, fugitive emissions from natural gas/ other leakages are not estimated CRF 2: CH_4 and N_2O from Ammonia production are not estimated because emission factors are not available CRF 3: N_2O, Use of N_2O for anasthesia, fire extinguishers, etc and emissions from HFCs for fire extingiushes and foam blowings and SF_6 emissions from electrical equiment disposal are not available CRF 4: CH_4, Agricultural soils, direct and indirect emissions No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF_6). CFR 5.B, 5.A: CO_2 and N_2O emissions not estimated CRF 5.B to 5.E: CO_2, C stock change in living biomass, only insufficient data available CRF 5.A-5.E: CO_2, Net carbon stock change in dead organic matter and soils, no evaluation of C contents and C stock changes in soils in Portugal
Spain	CRF 5.B: CO_2, CH_4 and N_2O emissions/removals not estimated due to lack of statistical data 5.C, 5.D: CO_2 Emissions/removals not estimated due to lack of statistical data No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF_6).
Sweden	**Energy:** Estimated emissions are complete for most sources. There might still be some problems with in-house generated fuels in the chemical industry, smaller companies in the iron and steel industry and refineries. Fugitive emissions, i.e. venting and flaring of liquid and gaseous fuels, are most likely not complete for smaller companies. CRF 1.B.2: CO_2, CH_4 and N_2O emissions not estimated due to lack of data. **Industrial processes:** For most sources, and particularly for the most important sources, the estimates are in accordance with the requirements concerning completeness as laid out in the GPG. However, some exceptions do exist. These are primarily in sectors with a large number of smaller facilities, with minor emissions. The possible incompleteness from these sectors concerns NMVOC emissions. The completeness is considered to be good for all greenhouse gases, possibly with the exception of CH_4, for a few sources. CRF 2.B.1: Ammonia production: CO_2 and CH_4 emissions not estimated due to lack of data. CRF 2.C.2, 2.C.3, 2.C.5: CH_4 and N_2O emissions not estimated due to lack of data. CRF 2.D.2: Food and drink: CO_2 emissions not estimated due to lack of data. CRF 2.F: Consumption of halocarbons and SF_6: destroyed amounts of HFCs, PFCs and SF_6 not estimated. **Solvent and product use:** For solvent and product use, the assessment of completeness is uncertain. For NMVOC, some specified sectors that are treated and reported separately in the inventory fulfil the requirements of completeness. The completeness of national total estimates of NMVOC from Sector 3 is more difficult to judge,

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
	since Sector 3 comprises many different types of emissions sources. However, the estimates are judged to be of the right order of magnitude. **Agriculture:** All relevant agricultural emissions and sources are reported in the inventory. Reindeer, which are not normally considered as a part of the agricultural sector, have been included in the inventory. The majority of the country's horses do not belong to farms, but are included in the agricultural sector of the inventory. There are, however, some marginal animal groups which are not included, such as turkeys and fur animals (minks, foxes and chinchilla). These groups are very small and there is no methodology developed for estimating GHG emissions. All sales of fertilisers are included, even quantities used in other sectors. N-fixing crops used in lay are included, and sludge used as fertiliser is also included in this submission of the inventory, which means that all anthropogenic inputs to agricultural soils should be covered. **Land use change and forestry:** Carbon from all relevant land use classes except trees in urban areas is reported. The forest and grassland conversions and abandonment of managed lands are very limited and reported as zero. Due to the high variation in carbon concentration in mineral soils and the lack of data on stones and boulders, no reliable estimate of carbon stock changes in mineral soils has so far been made. CRF 5.B: CO_2 emissions from forest and grassland conversion not estimated, very limited area is converted. CRF 5.C: CO_2 emissions from abandonment of managed land not estimated, considered negligible. **Waste:** Completeness of data is considered to be good except on construction and demolition waste, which will be studied further.
United Kingdom	CRF 2.A.5, 2.A.6: Asphalt roofing/road-paving: CO_2 emissions not estimated as no methodology available. CRF 2.B.1: Ammonia production: CH_4 emissions not estimated as manufacturers do not report emission and considered as negligible. CRF 2.C.1: Iron and steel: CH_4 emissions only estimated for EAF and flaring, as no methodology available for other sources. CRF 2.C.2, 2.C.3: Ferroalloys and aluminium production: CH_4 emissions not estimated as no methodology available. CRF 3: CO_2 equivalent of solvent use not included in total, but provided for information. CRF 3.D: Other: Anaesthesia: N_2O emissions not estimated as no activity data available and considered negligible. CRF 5.C: Abandonment of managed lands: CO_2 emissions/removals not estimated as considered as negligible. CRF 6.B.1: Wastewater handling: CH_4 emissions from industrial wastewater not estimated as no activity data available and considered negligible.

Table 1.14 gives a very broad indication of incomplete source categories. However, a large number of the source categories indicated by Member States can be considered as negligible in quantitative terms in relation to the total emissions of the EC inventory. In order to get more specific information on the relevant omissions, the information on completeness was compiled from UNFCCC inventory review reports of Member States (Table 1.15). However, in a number of cases, those reports only provide a list of incomplete source categories without a clarification if these omissions are considered as relevant in quantitative terms. The last column of Table 1.15 indicates if Member States introduced changes to their NIRs regarding the completeness issues addressed during the review in 2004.

Table 1.14 Completeness of Member States' inventories as indicated in UNFCCC review reports and responses in 2005

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
Austria, centralised review 2004	Austria has submitted GHG inventories for the years 1990–2002 using the CRF and a very comprehensive NIR. The geographic coverage is complete and all major sources and sinks are covered. (page 2) **Industrial processes**: Regarding completeness, CO_2 emissions from soda ash production, asphalt roofing, road paving with asphalt and ferroalloys have not been estimated ("NE" is reported). Austria has indicated that CO_2 emissions from asphalt roofing and road paving with asphalt will be estimated for the 2005 submission by also accounting for the carbon content of non-methane volatile organic compound (NMVOC) emissions as CO_2 emissions. (page 6) FCCC/WEB/IRI/2004/AUT	Addition of source categories: *2 C 2 Ferroalloys* (CO_2) has been added to the inventory. Changes in the use of Notation Keys: *2 A 5 Asphalt Roofing* and *2 A 6 Road Paving with Asphalt:* emissions are now reported as "IE", as emissions are already included in the Solvents Sector. *2 A 4 Soda Ash Production and Use:* CO_2 Emissions from Soda Ash Production are now reported as "IE", as coke used in the process is already considered as fuel in the Energy Sector (1 A 2 c Chemical Industries).
Belgium, desk review 2004	Belgium has provided inventory data for the years 1990–2002 and included all the required tables except the sectoral background data tables for the fluorinated gases (F-gases) (tables 2(II)C, E and 2(II)F).In the LUCF sector no estimates have been provided for categories 5.B, 5.C and 5.D, and for a number of sub-sources in some sectors. In the Energy sector, even though the energy data have been recalculated, some gaps where "not estimated" ("NE") is reported still exist, mainly in biomass and other fuel data (categories 1.A.1a and b), and further work on completeness is also necessary in Energy tables 1.B.2 and 1.C (the tables are only partly filled in). In the CRF tables not all the cells contain data or notation keys, leaving	All sectoral tables have been filled in in this submission. CRF-tables are completed with the standard indicators (notation keys), providing information on data gaps, methods applied, emission factors used, completeness and quality. In all regions, the emissions were completely updated for the time series 1990-2002 and provisional emissions are calculated

Member State, type and year of UNFCCC review	**Findings related to completeness from UNFCCC review report**	**Response in 2005 submission**
	unexplained data gaps. **Energy:** All significant emission sources are included in the inventory, but a few sub-sources of CO_2, CH_4 and N_2O under fugitive emissions from the Oil and Natural Gas category and CH_4 and N_2O from marine bunker fuels are still not estimated ("NE" is reported). (page 5) **Waste:** The inventory is practically complete in terms of gases, sources and years covered. CH_4 and N_2O emissions from industrial waste-water handling are not estimated because it is not considered to be a significant source. (page 12) FCCC/WEB/IRI/2004/BEL	for 2001. The completeness of the energy sector has been improved. Biomass and other fuel data in table 1.A.1 are either estimated or flagged as not occurring. CO_2 and CH_4 emissions from Natural gas category and CH_2 emissions from marine bunkers are reported.
Denmark, centralised review 2004	In general the ERT found the Danish inventory to be complete. It covers all years from 1990 to 2002 and all six mandatory GHGs. Some sources are not included, as identified in the CRF (e.g., Waste-water Handling, Limestone and Dolomite Use, Soda Ash Use). In addition, in the LUCF category, emissions from abandonment of managed lands and forest and grassland conversion, and CO_2 emissions and removals from soils are not reported. However, the completeness of the reporting has improved with the inclusion of categories that were previously missing (e.g., Nitric Acid Production). In annex 6 to the NIR Denmark reports GHG emissions data for the Faroe Islands (up to 2001) and Greenland (only CO_2 emissions), but these data are not included in the CRF tables. (page 2) **Agriculture:** The submission is almost complete in terms of gases, sources and time series. The ERT encourages Denmark to complete these tables with the appropriate notation keys. (page 7) **Waste:** The NIR and the CRF tables report estimates only for CH_4 emissions from the source category Solid Waste Disposal on Land, not including estimates for other source categories as required by the UNFCCC reporting guidelines. (page 11) FCCC/WEB/IRI/2004/DNK	This submission includes emission estimates for land use, land use change from 1990 to 2003 in the inventory. The previous inventories included only forestry. Also included for the first time is the methodology leading to estimates of emissions of CH_4 and N_2O for Waste Water handling. Categorie 4 D is fully completed. GHG emission inventories for Faroe Island and Greenland have been included in a separate version of CRFs.
Finland, centralised review 2004	Finland has submitted GHG inventories for the years 1990–2002 using the CRF tables and has provided a comprehensive NIR. The geographical coverage is complete and all major sources and sinks as well as the relevant GHGs and the indirect GHGs are covered. The inventory is sufficiently complete and the missing categories do not suggest any major gaps in coverage. (page 2) **Energy:** - complete (page 4) **Industrial processes:** The CRF includes estimates of most gases and sources of emissions from the Industrial Processes sector. Not included in the inventory are 2.A.3 Limestone and Dolomite Use, 2.A.4 Soda Ash Production and Use, 2.A.5 Asphalt Roofing and 2.A.6 Road Paving with Asphalt. (page 7) **Agriculture:** Information for the most recent years (2000 and beyond) and for some sub-sources (reindeer) is not available and this hinders assessment of the recalculations. The ERT encourages Finland to update this supporting material or include full documentation in the NIR. (page 9) **Waste:** Finland's estimates in this sector are mostly complete. (page 12) FCCC/WEB/IRI/2004/FIN	In this submission correct notation keys have been used. Limestone and Dolomite Use and Soda Ash Production and Use are included in the inventory for the first time. Emissions from the agricultural sector have been reallocated to the LULUCF sector and CH_4 emissions are reported for the subcategories in agriculture.
France, centralised review 2004	France's inventory is by large complete. Potential emissions of HFCs, PFCs and SF_6 are not reported separately. In some tables the additional background information requested is not provided (e.g., tables 4.A, 4.D, 6.A and 6.B). The notation keys are used in a limited way in the tables (e.g., tables 4.E, 4.F and 5.C). (page 2-3) **Energy:** For the Energy sector, complete inventories and CRF tables have been submitted for the years 1990–2002, with the exception of information on the reference approach in tables 1.A(b), 1.A(c) and 1.A(d) for the years 1991–1997 and 2002. (page 5) **Agriculture:** The CRF tables are not filled in completely and notation keys are not always used. (page 10) **LUCF:** As observed in previous review reports, the CRF tables have not been filled in completely. Some inconsistencies still remain between the sectoral report and the sectoral background data tables. The source category Other has not been clearly explained. (page 12) **Waste:** The information contained in CRF table 6.A is not complete in terms of the additional information. The notation key "not applicable" ("NA") has been used for the data on waste incineration, recycling and disposal in the additional information table. (page 14) FCCC/WEB/IRI/2004/FRA	Completeness of CRF tables has been improved. Many background information are available in this submission. The use of notation keys was increased. Table 1.A.b, c,d regarding the reference approach have been completed. In the waste sector CRF tables have been improved by eliminating the notation key NA.

Member State, type and year of UNFCCC review	**Findings related to completeness from UNFCCC review report**	**Response in 2005 submission**
Germany, in-country review 2004	Complete set of CRFs from 1990-2002, but there are some gaps in the CRF. Tables 8(a) and 8(b) (Recalculations) are not reported for all years although it is clear from both the CRF and the NIR that recalculations have been made. Table 9 (Completeness) has not been filled in at all. (page 4) **Energy:** Not included are: CO_2 emissions from fuel combustion activities in the reference approach for the years 2000–2002; disaggregation of emissions in all sub-source categories under 1.A.2 Manufacturing Industries and Construction; feedstocks and non-energy use of fuels for the years 2000–2002; the fraction of feedstocks which is combusted for the whole time series; fugitive emissions of CH_4 from some mining and oil and gas operations, as well as all corresponding releases of CO_2; and recalculations. (page 7) **Industrial processes:** Not included are limestone and dolomite use, soda ash use, asphalt roofing (only AD provided), road paving with asphalt, production of silicon carbide, carbon black, ethylene, dichloroethylene, styrene and methanol, food and drink production and ferroalloys production. In addition, there are some emission sources for which an emissions estimate is given in the CRF but which are not described in the NIR (soda ash production, glass manufacture, and food and drink). (page 13) ***Agriculture:*** *GHG emissions from enteric fermentation and manure management of goats, mules and asses are not reported. The number of horses is actually twice as high as the figure in the official statistics. (page 17)* **Land-Use Change and Forestry:** The 2002 CRF includes only estimates of CO_2 emissions/removals under LUCF. Emissions estimates are not reported for categories 5.B Forest and Grassland Conversion and 5.C Abandonment of Managed Land, but the notation keys "NE" and "NO" are used in the CRF. The estimates for 5.D CO_2 Emissions and Removals from Soils are reported only for cultivation of organic agricultural soils and for liming of agricultural and forest soils. (page 20) **Waste:** The CRF includes estimates of all gases and sources of emissions from the Waste sector except for N_2O in industrial waste-water handling. (page 23) FCCC/WEB/IRI/2004/DEU	The missing CO_2 emissions from fuel combustion activities in the reference approach for the years 2000–2002 are provided in the 2005 submission and table 9 is filled out. Emission from the production of methanol, dichloroethylene and calcium carbide are reported for the first time. Research projects in order to improve the quality of the data are ongoing and results will be available until the next submission. Other issues remain to be adressed.
Greece, in-country review 2004	In general the Greek inventory is complete. It includes an NIR and a complete set of CRF tables, with the exceptions of table 8(b) and 11. A few sources are not included. The ERT also notes the limited use of notation keys in the CRF tables and the use of "0" for "not estimated"("NE"). (page 5) **Energy:** Fugitive emissions are only estimated for CH_4. Greece reports in the CRF that fugitive emissions of CO_2 from Surface mines, CH_4 from Solid fuel transformation, and CO_2 and N_2O from Venting and flaring were not estimated because of lack of AD and/or estimation methodologies. Fugitive emissions of CO_2 from Oil and natural gas were not estimated mainly because of the lack of the AD. (page 10) **Industrial processes:** CO_2 emissions are not estimated from the following subcategories: Limestone and dolomite use; Soda ash production and use; Asphalt roofing; and Road paving with asphalt. CO_2 and CH_4 emissions are reported as "NE" for Ammonia production for the whole period. In the Metal production subcategory, emissions from ferroalloys production are not estimated. Potential emissions for the ozone depleting substances (ODS) substitutes are not calculated because of lack of export/import data. For this last subsector only emissions from refrigeration and air conditioning are reported. (page 14) **Agriculture** – complete (page 18) **Land use change and forestry:** The CRF includes estimates of most gases, sources and sinks from the LUCF sector. Greece has estimated categories 5.A, 5.B and 5.D partially, while estimates for category 5.C have not been made. (page 21) **Waste:** CH_4 Emissions from sludge, N_2O emissions from industrial waste-water treatment and emissions from waste incineration are not estimated. (page 24,) FCCC/WEB/IRI/2004/GRC	General improvement of the use of notation keys. In the Industrial sector CO_2 emissions from Limestone and dolomite use are available in this submission. Other issues still need to be addressed.
Ireland, in-country review 2004	The inventory is in general complete. Compehensive information on the completeness of the inventory is given in the NIR. Some gaps were noted in following sectors: industrial processes, agriculture, LUCF and waste. **Energy:** All significant emission sources and gases are included in the inventory. Emissions from the consumption of aviation gasoline in domestic civil aviation (1.A.3a) are not estimated ("NE" is reported), nor are fugitive CH_4 and CO_2 emissions from natural gas transmission systems	General components of the IPCC good practice guidance have now been adressed in a routine manner. In the agricultural sector CH_4 emissions for swine and poultry have been estimated. Other issues still need to be adressed.

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
	(1.B.2b(ii)). Ireland responded to the draft of this report that with regard to fugitive emissions, only CH_4 emissions from natural gas distribution are a relevant source.(para 22) **Industrial processes:** Emissions are reported for most sources and gases, except for asphalt roofing and road paving with asphalt for which no emissions have been estimated ("NE" is reported), and for N_2O from solvent and other product use. Actual emissions from consumption of HFCs, PFCs and SF_6 have not been provided for the years 1990–1994. Metal production occurred in Ireland only prior to 2001. The only ammonia and nitric acid production plants closed down in June 2002. (para 40) **Agriculture:** CH_4 emissions from manure management from non-cattle livestock species and N_2O emissions from organic soils and the burning of agricultural residues are not estimated because they are not considered significant source categories. Rice cultivation and prescribed burning of savannas do not occur in Ireland.(para 51) **LUCF:** CO_2 emissions/removals are reported for category 5.A Changes in Forest and Other Woody Biomass Stocks. Emissions or removals from land-use change (categories 5.B Forest and Grassland Conversion and 5.C Abandonment of Managed Lands) are not estimated, nor is category 5.D CO_2 Emissions and Removals from Soil, except for emissions from lime application.(para 64) **Waste:** The data in the CRF tables for category 6.A are not consistent with the results presented in the NIR, and it is not clear which of the numbers are the correct ones.(para 74) FCCC/WEB/IRI/2004/IRL	
Italy, centralised review 2004	All years 1990–2002, all gases, all sectors and practically all source/sink categories are covered in the 2004 inventory submission. The following emissions have not been estimated: CH_4 from waste incineration, N_2O from solvents and other product use, and potential emissions of HFCs. Italy reports in the NIR that it plans to estimate and report these emissions in its next submission.(page 2) **Energy:** Italy reports in the NIR that emissions from multilateral operations are not estimated because no AD are available. (page 4) FCCC/WEB/IRI/2004/ITA	CH_4 emissions from waste incineration are reported in the CRF tables. Potential emissions of HFCs have been estimated. Other issues remain to be adressed.
Luxembourg	No 2003 NIR provided	-
Netherlands, in-country review 2004	The Netherlands has provided inventory data for the years 1990–2002 and included all required tables in the CRF. Not all relevant cells in the CRF include a data entry or notation key. The source categories that are not reported include the potentially significant subcategories of CO_2 emissions and removals from agricultural soils, and forest and grassland conversion. (page 4) **Energy:** The CRF tables for 2002 are largely complete. Emissions not fully included are primarily emissions of CO_2 and N_2O from solid and other fuels from Manufacturing Industries and Construction, as well as emissions from the Petroleum Refining subsector. At present, the information provided in table 9 is not complete. (page 7) **Industrial processes:** The source coverage and gases included are substantially complete. Minor sources such as asphalt roofing and road paving with asphalt are shown as "NE". Many of the tables include blank cells where data or a notation key should be entered. (page 15) **Agriculture:** The information provided in the NIR is generally complete and well documented. Explanations for inter-annual changes in the CH_4 IEFs for enteric fermentation, as well as manure management, are not included in the NIR. Indirect N_2O emissions from atmospheric deposition are not estimated. Enteric fermentation emissions from poultry are not estimated, although AD are provided. CH_4 and N_2O from horse manure (category 4.B) are omitted. (page 21) **Land use change and forestry:** The CRF includes estimates for CO_2 sources and sinks from subcategory 5.A only. Estimates for CO_2, N_2O and CH_4 for categories 5.B, 5.C, 5.D and 5.E are not included in the CRF because adequate information is not available. However, emissions/removals in categories 5.B and 5.D may be significant and it is recommended that the Party compile estimates for these sources. (page 24) **Waste:** Not estimated are N_2O and CH_4 emissions from 6.B.2 Waste-water Handling, with the exception of emissions from sludge management in waste-water treatment plants (WWTPs), and AD for the biogenic fraction of waste incinerated under 6.C Waste Incineration. (page 26) FCCC/WEB/IRI/2004/NLD	The submitted data has been improved since the last submission and tries to respond to all issues. Most of the relevant cells are filled out. The lacking sources from last submission are now included in the inventory and the CRF: : CO_2 emissions from solid fuels and from Petrolium refining subsector are estimated. Indirect N_2O emissions from atmospheric deposition (category 4D); CH_4 and N_2O from horse manure (category 4B); Emissions/sinks for *LULUCF subcategories 5A to 5E*, except for the CO_2 sink in category 5A2; CH_4 and N_2O emissions from *industrial* wastewater treatment (6B) and from *large-scale compost production* from organic waste (6D).
Portugal, in-country review 2004	In general the Portuguese inventory is complete. Some source categories are not included in the inventory, the most important being, CO_2 from Asphalt Roofing, N_2O from Solvent and Other Product Use, F-gases from Fire Extinguishers and Semiconductors, potential emissions of F-gases, and CO_2 Emissions and Removals from Soils. . However, the Land-use Change	CRF tables show no response and a NIR 2005 has not yet been provided. Not (yet) adressed.

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
	and Forestry (LUCF) sector does not include emissions and removals from the two autonomous regions of Madeira and the Azores Islands (page 5) **Energy** – complete (page 9) **Industrial processes:** Not included are potential emissions for HFCs, PFCs and SF_6. Actual emissions of PFCs have not been estimated, while only partial estimates of actual emissions of HFCs have been provided for a number of source categories. Emissions have not been estimated for asphalt roofing, fire extinguishers and semiconductors, as well as N_2O emissions from Solvent and Other Product Use. (page 13) **Agriculture:** Not included in the CRF tables is the application of sewage sludge to agricultural soils in category 4.D. (page 16) **Land use change and forestry:** Emissions of CO_2 from land-use conversions (5.B Forest and Grassland Conversion, and 5.C Abandonment of Managed Lands) are not reported. (page 20) **Waste:** Emissions have been estimated in most of the source categories except in 6.B Industrial Waste-water Handling, where emissions from sludge were reported as "not estimated" ("NE"). In addition, CH_4 recovered and flared (both in waste water and in sludge) are reported as "NE". (page 22) FCCC/WEB/IRI/2004/PRT	
Spain, in-country review 2004	The inventory is in general complete. In the 2004 submission the same categories as in the 2003 submission have not been estimated. The ERT recommends to estimate all categories in the 2005 submission that have not been estimated until now.(para 10) The use of notation keys has improved but is still not very correct. (para 11) **Energy:** Emissions from the following sources are not estimated: 1.A.3b Road Transportation (CO_2, CH_4 and N_2O from natural gas), 1.A.5 Other (CO_2, CH_4 and N_2O), 1.B.2.a Oil – Exploration (CO_2 and CH_4) and 1.B.2.b Natural Gas – Exploration (CO_2 and CH_4), 1.B.2.c Venting (CO_2 and CH_4) and 1.B.2.c Flaring – Oil (N_2O). Notation keys are not used all time and it is not sure whether military activities are included in the GHG inventory at all.(para 27) **Industrial processes:** Minor sources have not been estimated: CO_2 emissions from Limestone and Dolomite Use, CO_2 emissions from Asphalt Roofing and from Road Paving with Asphalt, and CH_4 emissions from Ethylene, Dichloroethylene and Styrene production. Estimates of HFC, PFC and SF_6 emissions and time series from Refrigeration and Air Conditioning Equipment are calculated on the basis of an incomplete AD time series. Potential emissions of HFCs, PFCs and SF_6 have not been supplied, mainly because of the current lack of information on imports and exports per gas. CRF table 9 is not filled in. (para 47) **Agriculture:** No additional information is provided in CRF tables 4.A and 4.B(a), and no comparable estimation parameters are provided in the NIR. The ERT recommends Spain to add such parameters in either the CRF or the NIR (where this is more appropriate to the method used). Spain explained that no histosols are cultivated in the country and that therefore the use of the notation key "NO" for this source category is appropriate. (para 58) **LUCF:** Spain reports estimates under category 5.A Changes in Forest and Other Woody Biomass Stocks, but does not report any estimates under categories 5.B Forest and Grassland Conversion, 5.C Abandonment of Managed Lands or 5.D CO_2 Emissions and Removals from Soil (CO_2 emissions from soils are not reported in the Agriculture sector either). Spain indicates in the NIR that this is due to a lack of statistical data. (para 72) **Waste:** Emissions from incineration of industrial waste have not been estimated because of difficulties in obtaining information on this activity. All the CRF tables have been completed for the period 1990–2002. The information provided in the additional information tables and documentation boxes of the CRF is complete for Solid Waste Disposal on Land, but in the case of Wastewater Handling and Waste Incineration the information provided is only partial (para 79).. FCCC/WEB/IRI/2004/ESP	CO_2 emissions from limstone & dolomite use are estimated in this submission. Further issues still need to be adressed.
Sweden, centralised review 2004	All years 1990–2002, all gases, all sectors and practically all source/sink categories are covered in the 2002 inventory. (page 2) FCCC/WEB/IRI/2004/SWE	Submitted data is complete. No special response was required.
United Kingdom, centralised review 2004	The national inventory submitted by the United Kingdom is comprehensive and complete. All major source/sink categories and direct and indirect GHGs are reported, with the exception of N_2O emissions from domestic waste-water treatment. Disaggregation of emissions for some subsectors of manufacturing industries and construction is not reported. The UK has provided inventory data for the years 1990–2002. Minor gaps, where they exist, reflect the limits of disaggregating	N_2O emissions from domestic waste water treatement are reported. No further response was required.

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
	available activity data (AD) to smaller subcategories. (page 2-3) **Energy:** - complete (page 4) **Agriculture:** - complete (page 9) FCCC/WEB/IRI/2004/GBR	

1.8.2 Data gaps and gap-filling

The EC GHG inventory is compiled by using the inventory submissions of the EC Member States. For data gaps in Member States' inventory submissions, the following procedure is applied by the ETC/ACC in accordance with the implementing provisions under Council Decision No 280/2004/EC for missing emission data:

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.

- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' ([12]) 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' ([12]) without application of the conservativeness factor.

Table 1.15 shows that data gaps exist for nine Member States.

Table 1.15 Overview of missing data

Member State	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Cyprus				1990-2003	1990-2003	1990-2003
Czech Republic	1991; 1993	1991; 1993	1991; 1993	1990-94	1990-94	1990-94
Estonia				1990-2003	1990-2003	
Greece						1990-2003
Ireland						1990-94
Lithuania	1991-97; 1999-2000	1991-97; 1999-2000	1991-97; 1999-2000	1990-2000	1990-2003	1990-2003
Luxembourg	Summary 1A for 1991-93 [1]; Tables 1, 1A(a), 2(I), 3, 4, 5, 6 for 1990-97; 1999; 2001	Summary 1A for 1991-1993; Tables 1, 1A(a), 2(I), 3, 4, 5, 6 for 1990-97; 1999; 2001	Summary 1A for 1991-1993; Tables 1, 1A(a), 2(I), 3, 4, 5, 6 for 1990-97; 1999; 2001	1990-97; 1999	1990-97; 1999	1990-97; 1999
Malta	2001-03	2001-03	2001-03	1990-2003	1990-2003	1990-2003
Poland	2003	2003	2003	1990-94; 2003	1990-94; 2003	1990-94; 2003

([1]) Total CO_2 emissions for 1991–93 are available for Luxembourg but without sector and category split.

([12]) As included in FCCC/SBSTA/2003/10/Add.2.

The following overview shows the general approaches used for obtaining estimates for the missing data; these approaches are based on the principles mentioned above:

Estimates at the beginning or at the end of a time series

- **Fuel combustion related GHG emissions (CO_2, CH_4, N_2O of sector 1A):**
  - The percentage change from Eurostat CO_2 emission estimates was used for extrapolation, where available
  - If there were no Eurostat CO_2 emission estimates available, fuel combustion estimates were extrapolated on basis of GDP elasticity of fuel related GHG emissions.
- **Other sectors:**
  - Linear trend extrapolation was used, where no striking dips or jumps in the time series were identified. In general the trend extrapolation was made on basis of the time series 1990-2002. If only a limited number of years were available or a more consistent time series was available for specific years then these years were used for trend extrapolation.
  - Previous year values were used where striking dips or jumps in the time series were identified.

Estimates for years within a time series

- Linear interpolation between the years available was used

Estimates if no time series is available (only relevant for fluorinated gases):

- **HFCs:**
  - Emissions were estimated for 2F1 'Refrigeration and air conditioning equipment' on basis of average per capita emissions of either a set of similar countries (if available) or on basis of one single country (if a set of similar countries was not available). Population data was downloaded from the Eurostat web site in March 2005.
- **PFCs:**
  - It was checked if aluminum production occurs in the relevant countries, which was not the case. For other PFC emissions no estimates were prepared because of lack of data.
- **SF6:**
  - Emissions were estimated for 2F7 'Electrical equipment' on basis of average emissions per electricity consumption of either a set of similar countries (if available) or on basis of one single country (if a set of similar countries was not available). Data on electricity consumption was provided by Eurostat in March 2005.

The following country specific approaches were derived from the general approaches:

Cyprus

HFC

Emissions estimated on basis of average per capita emissions of ES, GR, IT; PT for 2F1 'Refrigeration and air conditioning equipment'

SF_6

Emissions estimated on basis of average emissions per electricity consumption of ES, IT; PT for 2F7 'Electrical equipment'

Czech Republic

CO_2, CH_4, N_2O

Linear interpolation between 1990 and 1992 for 1991 and linear interpolation between 1992 and 1994 for 1993

SF_6

Linear trend extrapolation 1995-2003 for 1990-1994

Estonia

HFC

Emissions estimated on basis of per capita emissions of Latvia for 2F1 'Refrigeration and air conditioning equipment'

Greece

SF_6

Emission estimates calculated on basis of preliminary information for the year 2004 were provided by Greece.

Ireland

HFC, PFC, SF_6

Linear trend extrapolation 1995-2003 for 1990-1994; the extrapolation of the single gases of PFCs for 1990-1994 was made on basis of the shares of these gases in 1995.

Lithuania

CO_2, CH_4, N_2O

Linear interpolation between 1990 and 1998 for 1991-1997 and linear interpolation between 1998 and 2001 for 1999-2000

HFC

Linear trend extrapolation 2001-2003 for 1990-2000

SF_6

Emissions estimated on basis of emissions per electricity consumption of Latvia for 2F7 'Electrical equipment'

Luxembourg:

CH_4, N_2O: totals

Values were estimated by linear interpolation between 1990 and 1994.

CO_2, CH_4, N_2O: sectoral tables

Values for the years 1990-1997, 1999, 2001 were estimated by applying the detailed category split (percentage shares in the sectoral tables) of 1998 (reported by Luxembourg) to the years 1990-1997 and 1999, and the detailed category split (percentage shares in the sectoral tables) of 2000 to the year 2001.

Table 1A(a)

For the estimation of Tables 1A(a) for the years 1990-1997, 1999 and 2001 GHG emissions by fuel groups were estimated on basis of shares in 1998 for 1990-1997 and 1999 and on basis of 2000 for 2001. Then the activity data for 1990-1997 and 1999 was estimated on basis of the implied emission factors of CO2 for 1998 and the activity data for 2001 was estimated on basis of implied emission factors of CO2 for 2000. In addition, for the years 1998, 2000 and 2002 CO2 emissions by fuel for road transport were estimated on basis of average implied emission factors of EU-14.

HFC, PFC, SF_6

For fluorinated gases 1998 emissions were used for 1990-1997 and 1999.

Malta

CO_2, CH_4, N_2O: fuel combustion related

Extrapolation on basis of percentage change of Eurostat CO2 emissions for 2001; for 2002 and 2003 extrapolation on basis of GDP elasticity of GHG emissions

CO_2, CH_4, N_2O: non-fuel combustion related

Linear trend extrapolation 1990-2000; in a few cases previous year values were used.

HFC

Emissions estimated on basis of average per capita emissions of ES, GR, IT; PT for 2F1 'Refrigeration and air conditioning equipment'

SF_6

Emissions estimated on basis of average emissions per electricity consumption of ES, IT; PT for 2F7 'Electrical equipment'

Poland:

General:

Trend extrapolation refers to 1995-2002 because in it was assumed that the time series is more consistent for these years.

CO_2, CH_4, N_2O: fuel combustion related

Extrapolation on basis of percentage change of Eurostat CO2 emissions

CO_2, CH_4, N_2O: non-fuel combustion related

Linear trend extrapolation 1995-2002; in a few cases previous year values were used

HFC, PFC, SF_6

HFC for 2F were extrapolated on basis of total HFCs for 1995-1999; then linear trend extrapolation 1995-2002 for 1990-1994; linear trend extrapolation 1995-2002 for 2003.

PFC

PFC from 2C were extrapolated on basis of total PFCs for 1995-1999; then linear trend extrapolation 1995-2001 for 1990-1994; previous year value for 2003.
PFC from 2F were extrapolated on basis of total PFCs for 1995-1999; then linear trend extrapolation 1995-2000 for 1990-1994

SF_6

Data on CO_2 emissions, GDP, population and electricity consumption was either downloaded from the Eurostat home page or provided by Eurostat in March 2005. Note that all estimates which were derived from the gap filling approaches described above are marked grey in the tables of the next chapter. In addition, they are documented in the relevant annexes: red font refers to gap filling in 2005; blue font refers to gap filling in previous years.

1.8.3 Data basis of the European Community greenhouse gas inventory

The 2005 EC GHG inventory data consist of:

- the GHG submissions of the Member States to the Commission in 2005;
- previous GHG submissions, in cases where Member States did not provide the complete time series for each gas in 2002;
- emission estimates derived from data gap-filling in cases where no data were available for a specific gas and year (used only in few cases).

Table 1.16 shows the sources of GHG emissions data by Member State and type of submission.

Table 1.16 Sources of GHG emissions data for CRF Table Summary 1.A by Member State and type of submission

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Belgium	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Cyprus	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Czech Republic	Inv02	Gap filling	Inv04	Gap filling	Inv03	Inv05	Inv04	Inv04	Inv04	Inv04	Inv04	Inv03	Inv04	Inv05
Denmark	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Estonia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Finland	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
France	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Germany	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Greece	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Hungary	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Inv05
Ireland	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Italy	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Latvia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Lithuania	Inv04	Gap filling	Gap filling	Gap filling	Gap filling	Gap filling	Gap filling	Gap filling	Inv04	Gap filling	Gap filling	Inv04	Inv04	Inv05
Luxembourg	Inv00	Gap filling	Gap filling	Gap filling	Inv97	Inv98	Inv98	Inv00	Inv04	Inv01	Inv04	Inv03	Inv04	Inv05
Malta	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Gap filling	Gap filling	Gap filling
Netherlands	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Poland	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv04	Inv04	Gap filling
Portugal	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Slovakia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Slovenia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Spain	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Sweden	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
UK	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05

([1]) For Cyprus no CRF Tables Summary 1.A are available but only national totals for 1990-2000.

Note: This table indicates the source of GHG emission data and whether data were available for specific years. It does not indicate whether the submission for a year covers all gases, categories or CRF tables. All data sources which are not from 2005 are shaded.

Tables 1.17 to 1.20 show the data basis of the 2004 EC GHG inventory. Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.17 Data basis of CO_2 emissions excluding LUCF (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	61,3	64,8	59,3	59,9	60,2	63,1	66,6	66,5	66,2	64,6	65,5	69,3	71,0	76,2
Belgium	119,0	122,1	120,2	119,1	122,5	123,6	127,7	122,2	127,4	122,0	123,8	123,4	123,0	126,3
Cyprus	4,6	4,7	5,3	5,6	5,6	5,6	5,9	5,9	6,4	6,4	6,7	6,6	6,8	7,2
Czech Republic	164,0	151,9	139,8	135,2	130,6	131,4	132,8	137,4	128,3	121,1	127,9	128,0	123,0	127,1
Denmark	52,9	63,6	57,8	60,1	63,7	60,6	74,0	64,5	60,4	57,5	53,1	54,6	54,3	59,3
Estonia	38,1	35,9	26,1	20,6	21,4	19,3	20,3	20,2	18,3	16,8	16,8	17,1	17,3	19,1
Finland	56,3	55,8	54,5	54,7	61,1	58,1	63,4	62,3	59,5	59,2	57,6	63,2	65,0	73,2
France	396,9	421,5	413,7	393,5	389,0	395,3	409,2	403,1	422,3	411,2	405,0	410,8	403,2	408,2
Germany	1.015,0	976,9	929,5	920,0	905,6	902,2	924,9	893,5	885,2	857,4	860,1	873,9	863,9	865,4
Greece	84,0	83,7	84,7	85,3	87,2	87,3	89,5	94,3	98,9	98,2	104,1	106,3	106,2	110,0
Hungary	72,5	68,7	62,4	63,1	61,8	61,2	62,6	60,8	60,5	60,0	57,8	59,4	57,8	60,5
Ireland	31,8	32,5	33,1	32,7	34,1	34,8	36,0	38,3	40,2	42,1	44,2	46,5	45,8	44,4
Italy	430,6	430,5	429,5	424,4	417,3	446,7	438,9	443,1	453,0	460,3	467,5	472,0	471,4	487,3
Latvia	18,7	17,2	13,3	11,9	11,5	9,0	9,2	8,7	8,1	7,4	6,9	7,4	7,3	7,4
Lithuania	38,9	33,9	31,2	28,4	25,6	22,8	20,0	17,2	15,7	14,9	14,1	13,3	12,7	12,3
Luxembourg	12,0	12,2	12,0	12,3	12,0	9,3	9,4	8,6	7,7	8,4	8,9	9,2	10,2	10,7
Malta	1,9	2,1	2,2	2,2	2,3	2,3	2,3	2,3	2,4	2,5	2,4	2,4	2,5	2,5
Netherlands	158,0	162,9	161,1	165,5	165,5	169,7	177,3	170,2	172,2	166,9	168,9	174,4	173,9	176,9
Poland	380,7	367,0	371,6	363,1	371,6	348,2	372,5	361,6	337,4	329,7	314,8	317,8	308,3	321,3
Portugal	43,6	45,4	49,5	48,1	49,3	53,2	50,3	53,5	58,1	64,8	63,6	64,7	68,8	64,3
Slovakia	59,2	52,1	48,4	45,4	42,4	43,8	44,4	44,7	43,6	42,6	39,5	44,4	43,8	43,1
Slovenia	14,6	13,6	13,5	14,0	13,9	14,8	15,6	16,1	15,8	15,2	15,2	16,3	16,4	16,1
Spain	228,4	235,1	243,2	233,4	244,9	255,5	242,7	262,6	270,8	295,9	308,2	310,5	331,1	331,8
Sweden	56,3	56,7	56,5	56,1	58,7	57,6	61,2	56,8	57,5	54,7	52,4	53,5	54,8	56,0
United Kingdom	588,8	595,4	580,1	566,4	559,1	550,3	572,2	548,4	551,2	541,0	545,3	562,3	545,3	557,5
EU25	**4.128,2**	**4.105,9**	**3.997,9**	**3.920,6**	**3.916,6**	**3.925,3**	**4.028,4**	**3.962,5**	**3.966,9**	**3.920,8**	**3.931,1**	**4.005,1**	**3.982,1**	**4.063,9**
EU15	**3.334,9**	**3.359,1**	**3.284,6**	**3.231,5**	**3.230,1**	**3.267,2**	**3.343,3**	**3.287,9**	**3.330,5**	**3.304,4**	**3.328,3**	**3.394,3**	**3.387,9**	**3.447,4**

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.18 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	9,8	9,8	9,5	9,4	9,3	9,1	9,0	8,7	8,6	8,4	8,1	8,0	7,9	7,8
Belgium	10,8	10,8	10,8	10,6	10,7	10,8	10,6	10,5	10,4	10,1	9,8	9,2	8,8	8,5
Cyprus	0,7	0,7	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,9	0,9	0,9	1,0	1,0
Czech Republic	16,8	15,6	14,4	13,7	13,0	12,9	12,6	12,1	11,4	10,7	10,7	10,5	10,4	10,2
Denmark	5,7	5,8	5,8	6,0	6,0	6,1	6,2	6,1	6,0	6,0	5,9	6,0	6,0	5,9
Estonia	4,4	3,7	3,0	2,4	2,6	2,6	2,7	2,9	2,7	2,5	2,4	2,0	1,9	2,0
Finland	6,4	6,4	6,4	6,4	6,4	6,2	6,1	6,1	5,8	5,7	5,5	5,4	5,2	5,0
France	68,1	68,7	68,3	68,7	70,2	70,9	70,4	66,9	66,6	65,3	64,9	63,7	62,0	60,6
Germany	132,1	121,1	117,4	112,8	108,7	104,9	100,5	97,2	91,9	88,4	82,9	79,3	76,5	75,2
Greece	10,1	10,0	10,2	10,3	10,5	10,6	10,8	10,9	11,2	10,4	10,5	10,1	10,1	10,2
Hungary	11,9	11,5	10,8	10,1	9,9	10,1	10,2	10,1	10,4	10,0	10,1	10,4	9,8	9,5
Ireland	12,0	12,3	12,4	12,5	12,6	12,7	12,9	13,1	13,1	13,0	13,0	12,8	12,8	12,8
Italy	38,3	39,0	37,8	38,0	38,0	38,3	38,2	38,5	38,3	38,5	38,1	37,1	35,9	34,6
Latvia	3,7	3,6	3,1	2,3	2,2	2,4	2,3	2,3	2,3	2,3	2,2	2,2	2,2	1,9
Lithuania	7,9	7,4	6,9	6,4	5,8	5,3	4,8	4,3	3,7	3,5	3,4	3,2	3,6	3,6
Luxembourg	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Malta	0,3	0,3	0,3	0,4	0,3	0,4	0,4	0,3	0,3	0,3	0,4	0,3	0,3	0,3
Netherlands	25,6	25,9	25,4	25,0	24,2	23,8	23,2	22,1	21,3	20,2	19,5	19,0	18,2	17,5
Poland	58,8	54,4	52,0	51,1	51,8	51,6	47,3	47,8	49,0	47,3	45,9	38,8	37,8	37,9
Portugal	10,2	10,6	10,2	10,2	10,4	10,9	10,8	11,0	11,5	11,8	10,8	10,5	10,8	12,1
Slovakia	6,3	5,9	5,5	5,1	5,0	5,2	5,2	5,0	4,7	4,6	4,6	4,4	4,6	4,6
Slovenia	2,4	2,4	2,5	2,4	2,4	2,5	2,4	2,4	2,4	2,4	2,4	2,1	2,1	2,1
Spain	27,8	28,0	28,8	29,1	30,0	30,6	32,0	32,9	34,1	34,4	35,4	36,3	36,7	37,1
Sweden	6,5	6,5	6,6	6,7	6,6	6,5	6,5	6,4	6,2	6,0	5,8	5,8	5,6	5,5
United Kingdom	77,5	76,7	75,6	73,0	66,3	66,0	64,1	61,0	57,6	53,7	49,9	47,0	45,0	40,6
EU25	**554,4**	**536,9**	**524,8**	**513,4**	**504,0**	**501,0**	**490,3**	**479,4**	**470,9**	**456,4**	**443,3**	**425,4**	**415,4**	**406,7**
EU15	**441,5**	**431,9**	**425,9**	**419,2**	**410,4**	**407,9**	**401,9**	**391,7**	**383,2**	**372,3**	**360,7**	**350,7**	**341,9**	**333,7**

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.19 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	5,7	6,1	5,7	5,6	6,0	6,1	5,8	5,9	6,0	5,8	5,8	5,7	5,6	5,5
Belgium	12,2	12,2	11,8	12,2	13,2	13,1	13,5	13,1	13,3	13,1	12,9	12,7	12,2	11,3
Cyprus	0,7	0,7	0,8	0,8	0,8	0,8	0,9	0,9	0,9	0,9	1,0	0,9	1,0	1,0
Czech Republic	11,3	10,2	9,2	8,8	8,3	8,8	9,2	8,8	8,4	8,1	8,2	8,3	8,2	8,2
Denmark	10,7	10,6	10,1	9,9	9,8	9,7	9,4	9,2	9,1	8,8	8,6	8,4	8,0	8,1
Estonia	1,0	1,0	0,8	0,5	0,5	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,3	0,3
Finland	7,6	7,2	6,6	6,7	6,8	7,1	7,1	7,4	7,2	7,1	6,5	6,5	6,6	6,7
France	93,1	92,8	93,7	89,0	91,0	92,5	92,9	94,9	87,7	80,4	80,9	78,5	75,8	74,6
Germany	86,4	82,8	84,2	80,8	81,1	80,9	82,2	79,0	65,8	62,0	62,2	62,5	61,6	63,7
Greece	14,2	13,9	14,0	13,1	13,4	13,1	13,6	13,4	13,3	13,2	13,5	13,2	13,2	13,3
Hungary	18,9	15,2	12,3	12,0	13,2	12,4	13,3	13,2	13,2	13,1	12,6	13,5	12,6	12,4
Ireland	10,0	10,1	10,2	10,2	10,4	10,6	10,8	10,9	11,2	11,4	11,3	10,9	10,2	9,7
Italy	39,9	41,2	40,6	40,9	39,8	41,0	40,8	42,0	41,8	42,9	43,0	43,0	43,0	42,4
Latvia	3,1	2,9	2,2	1,5	1,3	1,1	1,1	1,1	1,1	1,0	1,0	1,1	1,1	1,2
Lithuania	4,1	3,9	3,7	3,5	3,3	3,0	2,8	2,6	2,4	2,9	3,4	3,8	3,3	1,3
Luxembourg	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,1	0,1	0,1	0,1	0,1	0,1
Malta	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Netherlands	21,3	21,7	22,4	23,1	22,3	22,4	22,2	22,0	21,7	20,9	19,9	18,9	18,0	17,3
Poland	19,4	16,1	15,6	15,4	15,6	16,7	16,7	16,7	16,0	23,3	23,9	23,9	22,6	23,0
Portugal	6,1	6,0	5,8	5,6	5,8	6,0	6,2	6,1	6,1	6,4	6,1	6,3	6,4	6,5
Slovakia	6,0	5,2	4,4	3,9	4,0	4,2	4,2	4,3	4,0	3,9	3,8	4,0	3,8	3,9
Slovenia	1,5	1,4	1,5	1,4	1,4	1,4	1,4	1,4	1,5	1,5	1,5	1,5	1,5	1,5
Spain	24,3	23,9	23,1	21,5	23,5	23,1	25,7	25,0	25,7	26,8	28,0	26,8	26,4	27,9
Sweden	8,9	8,7	8,7	8,8	8,9	8,7	8,9	8,8	8,8	8,4	8,3	8,2	8,2	8,2
United Kingdom	67,9	66,0	59,1	55,4	58,6	57,1	59,1	60,8	58,1	45,0	44,9	42,6	41,0	40,4
EU25	**474,5**	**459,8**	**446,5**	**430,8**	**439,3**	**440,6**	**448,4**	**448,3**	**424,1**	**407,3**	**407,5**	**402,0**	**390,8**	**388,5**
EU15	**408,5**	**403,2**	**396,1**	**383,0**	**390,9**	**391,7**	**398,2**	**398,8**	**376,0**	**352,4**	**351,8**	**344,4**	**336,3**	**335,7**

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.20 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	HFC	219	335	387	444	505	555	637	730	813	867	1.019	1.122	1.219	1.308
	PFC	1.079	1.087	463	53	59	69	66	97	45	65	72	82	87	103
	SF_6	503	653	698	794	986	1.139	1.218	1.120	908	684	633	637	641	594
Belgium	HFC	255	255	255	255	255	255	386	526	669	691	759	920	1.148	1.322
	PFC	1.753	1.678	1.830	1.759	2.113	2.335	2.217	1.211	669	348	361	228	108	209
	SF_6	1.663	1.576	1.744	1.677	2.035	2.205	2.120	525	270	120	109	105	94	75
Cyprus	HFC	0	0	0	0	1	2	4	6	10	14	19	25	31	38
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF_6	1	1	1	1	2	2	3	3	3	2	2	2	3	4
Czech Republic	HFC	0	0	0	0	0	2	135	296	382	412	674	1.045	1.092	1.344
	PFC	0	0	0	0	0	0	4	7	9	3	9	14	18	29
	SF_6	113	124	135	146	156	167	183	323	132	111	206	223	212	339
Denmark	HFC	0	0	3	94	135	218	329	324	411	503	605	647	672	695
	PFC	0	0	0	0	0	1	2	4	9	12	18	22	22	19
	SF_6	44	64	89	101	122	107	61	73	59	65	59	30	25	31
Estonia	HFC	0	0	0	0	0	0	1	1	2	3	4	5	6	7
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Finland	HFC	0	0	0	0	7	29	77	168	245	319	502	657	463	652
	PFC	0	0	0	0	0	0	0	0	0	28	22	20	13	15
	SF_6	94	67	37	34	35	69	72	76	53	52	51	55	51	42
France	HFC	3.633	4.195	3.618	2.311	1.536	2.068	3.394	4.246	4.720	5.747	6.857	8.390	9.902	11.412
	PFC	3.458	2.811	2.527	2.328	2.037	1.275	1.303	1.399	1.578	1.830	1.545	1.249	1.609	1.319
	SF_6	2.195	2.220	2.247	2.274	2.301	2.329	2.353	2.267	2.179	1.899	1.858	1.725	1.567	1.585
Germany	HFC	3.510	3.547	3.677	4.950	5.178	6.360	5.768	6.356	6.979	7.280	6.630	8.130	8.247	8.247
	PFC	2.626	2.286	2.068	1.942	1.607	1.759	1.723	1.377	1.481	1.247	790	723	786	786
	SF_6	3.967	4.350	4.876	5.401	5.808	6.633	6.359	6.274	6.038	4.414	4.018	3.325	4.197	4.197
Greece	HFC	935	1.107	908	1.638	2.209	3.369	3.916	4.194	4.670	5.436	4.273	3.873	4.009	4.140
	PFC	258	258	252	153	94	83	72	165	204	132	148	91	88	77
	SF_6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Hungary	HFC	NO	NO	0	0	1	2	2	45	100	252	206	283	279	478
	PFC	271	234	135	146	159	167	159	161	172	189	211	199	203	190
	SF_6	100	105	112	134	143	157	149	160	165	198	178	228	184	195
Ireland	HFC	0	0	0	0	0	21	58	79	104	152	190	231	253	288
	PFC	0	0	5	30	54	75	103	131	62	196	305	297	207	224
	SF_6	113	110	107	103	100	83	101	132	91	63	52	67	71	100
Italy	HFC	351	355	359	355	482	671	450	755	1.181	1.452	2.005	2.759	3.561	4.575
	PFC	1.808	1.423	799	631	355	337	243	252	270	258	346	452	414	494
	SF_6	333	356	358	370	416	601	683	729	605	405	493	795	738	486
Latvia	HFC	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	0	1	2	5	7	9	10	12	13
	PFC	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	0	0	0	0	0	0	0	0	0
	SF_6	0	0	0	0	0	0	0	1	1	1	1	2	3	4
Lithuania	HFC	0	0	0	0	0	0	0	4	8	12	16	14	35	22
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF_6	0	0	0	0	0	0	0	1	1	1	2	3	5	6
Luxembourg	HFC	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	PFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SF_6	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Malta	HFC	0	0	0	0	1	1	2	4	5	8	11	14	17	21
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF_6	0	1	1	1	1	1	2	2	1	1	1	1	2	2
Netherlands	HFC	4.432	3.452	4.447	4.998	6.518	6.011	7.664	8.295	9.348	4.868	3.839	1.492	1.566	1.450
	PFC	2.115	2.095	1.905	1.926	1.853	1.806	2.002	2.177	1.730	1.466	1.521	1.417	1.416	1.396
	SF_6	217	134	143	150	191	301	312	345	329	317	335	357	359	334
Poland	HFC	0	0	0	0	0	22	68	192	224	555	890	1.283	1.257	1.510
	PFC	829	825	821	816	812	820	775	829	810	777	720	881	266	266
	SF_6	2	2	2	2	2	2	1	3	6	17	17	18	18	19
Portugal	HFC	0	0	0	0	0	0	0	1	6	12	24	37	49	62
	PFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SF_6	0	0	0	0	0	5	5	5	5	6	6	7	7	7
Slovakia	HFC	3	3	3	3	3	25	45	70	44	66	78	83	104	134
	PFC	272	267	249	156	132	114	35	33	24	14	12	11	11	21
	SF_6	0	0	0	0	9	10	11	11	12	13	13	13	14	15
Slovenia	HFC	0	0	0	0	0	31	30	38	34	34	45	56	69	83
	PFC	257	303	243	251	282	286	240	194	149	106	106	106	116	119
	SF_6	7	7	7	7	7	25	22	21	21	21	21	21	21	21
Spain	HFC	2.403	2.179	2.763	2.258	3.458	4.645	5.197	6.126	5.809	7.164	8.170	5.284	3.892	4.963
	PFC	883	827	790	831	819	833	797	820	769	704	412	240	264	267
	SF_6	67	73	76	80	88	106	114	135	153	198	225	227	255	296
Sweden	HFC	4	8	11	33	73	129	181	276	311	372	419	441	462	471
	PFC	440	433	336	351	349	391	351	324	309	329	270	267	301	299
	SF_6	107	110	109	98	102	129	111	156	99	101	92	115	103	66
United Kingdom	HFC	11.375	11.854	12.323	13.000	14.010	15.491	16.720	19.181	17.268	10.830	9.081	9.728	10.418	10.699
	PFC	1.394	1.164	571	485	481	457	496	450	441	446	541	438	384	377
	SF_6	1.082	1.130	1.176	1.219	1.235	1.291	1.319	1.275	1.312	1.472	1.852	1.458	1.594	1.559
Total	**HFC**	**27.163**	**27.333**	**28.797**	**30.384**	**34.415**	**39.952**	**45.109**	**51.956**	**53.391**	**47.099**	**46.366**	**46.571**	**48.807**	**53.979**
	PFC	**17.444**	**15.690**	**12.993**	**11.857**	**11.206**	**10.808**	**10.588**	**9.632**	**8.732**	**8.149**	**7.411**	**6.738**	**6.314**	**6.207**
	SF_6	**10.617**	**11.092**	**11.925**	**12.599**	**13.747**	**15.372**	**15.205**	**13.643**	**12.450**	**10.169**	**10.234**	**9.421**	**10.172**	**9.986**

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

1.8.4 Geographical coverage of the European Community inventory

Table 1.21 shows the geographical coverage of the Member States' national inventories. As the EC inventory is the sum of the Member States' inventories, the EC inventory covers the same geographical area as the inventories of the Member States.

Table 1.21 Geographical coverage of the EC inventory

Member State	Geographical coverage
Austria	Austria
Belgium	Belgium
Cyprus	Cyprus
Czech Republic	Czech Republic
Denmark	Denmark (excluding Greenland and the Faeroe Islands)
Estonia	Estonia
Finland	Finland and Åland Islands
France	France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas territories (New Caledonia, Wallis and Futuna, French Polynesia, Mayotte, Saint-Pierre and Miquelon)
Germany	Germany
Greece	Greece
Hungary	Hungary
Ireland	Ireland
Italy	Italy
Latvia	Latvia
Lithuania	Lithuania
Luxembourg	Luxembourg
Malta	Malta
Netherlands	Netherlands including a 12-mile zone from the coastline and inland water bodies, emissions from offshore oil and gas production at the Netherland's part of the continental shelf, excluded are Aruba and the Netherlands Antilles
Poland	Poland
Portugal	Portugal, Madeira, Azores
Slovakia	Slovakia
Slovenia	Slovenia
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla
Sweden	Sweden
United Kingdom	England, Scotland, Wales, Northern Ireland

1.8.5 Completeness of the European Community submission

National inventory report

This year the EC submission provides GHG emission data for EU-25 and for EU-15. Most chapters and annexes of this report refer to EU-15 only, i.e. Chapters 3-10 and Annexes 1,2,4-11. Chapters 1 and 2 and also Annexes 3, 12 and 13 refer to the EU-25 where relevant. This means that all the detailed information provided in previous reports for the EU-15 is also available in this report. In addition, basic information on data availability, QA/QC, uncertainty estimates, completeness and emission trends are provided for the EU-25. Table 1.22 shows which information is provided for EU-25 and which chapters refer to EU-15 only.

Table 1.22 Coverage of EC national inventory report (EU-25 or EU-15 only)

Chapter/Annex		EU-25	EU-15 only
Chapter 1	**Introduction**		
1.1	Background information	√	
1.2	Institutional arrangements	√	
1.3	Process of inventory preparation	√	
1.4	General description of methods and data sources	√	
1.5	Key source categories		√
1.6	QA/QC	√	
1.7	Uncertainty evaluation	√	
1.8	Completeness	√ (not Tables 1-13-1.15)	Tables I-13-1.15
Chapter 2	**Emission trends**		
2.1	Aggregated GHG emissions	√	
2.2	Emission trends by gas	√	
2.3	Emission trends by sector	√	
2.4	Emission trends by Member States	√	
2.5	Emission trends for indirect GHG and SO_2		√
Chapter 3	**Energy**		Ö
Chapter 4	**Industrial processes**		Ö
Chapter 5	**Solvent use**		Ö
Chapter 6	**Agriculture**		Ö
Chapter 7	**LUCF**		Ö
Chapter 8	**Waste**		Ö

Chapter/Annex		EU-25	EU-15 only
Chapter 9	**Other**		Ö
Chapter 10	**Recalculations and improvements**		Ö
Annex 1	**Key sources**		Ö
Annex 2	**EC CRF tables**		Ö
Annex 3	**Status reports**	Ö	
Annex 4	**CRF tables summary 1.A**		Ö
Annex 5	**CRF tables 1**		Ö
Annex 6	**CRF tables 2(I)**		Ö
Annex 7	**CRF tables 2(II)**		Ö
Annex 8	**CRF tables 3**		Ö
Annex 9	**CRF tables 4**		Ö
Annex 10	**CRF tables 5**		Ö
Annex 11	**CRF tables 6**		Ö
Annex 12	**CRF table 10 for EU-25**	Ö	
Annex 13	**MS CRF and NIR**	Ö	

CRF tables in Annex 2

This year more information is provided in the EU-15 CRF tables. Tables 1.C and Table 2(II) are included for the first time and in some other sectoral background data tables activity data has been included in order to allow the calculation of implied emission factors at EU-15 level. In addition, overview tables have been included in the inventory report including background information on activity data and implied emission factors by EU-15 Member States.

The main reasons for including only a limited number of sectoral background data tables are: (1) limited data availability partly due to confidentiality issues; and (2) the use of different type of activity data by Member States. Latter is due to the fact that the Member States are responsible for calculating emissions. If they use country-specific methods they may also use different types of activity data (e.g. cement or clinker production). At EU-15 level these different types of activity data cannot be simply added up. As at EU-15 level no emissions are calculated directly on the basis of activity data, the documentation of very detailed background data seems to be of lower importance. All the details for the calculation of the emissions are documented in the Member States' CRF tables, as part of their national GHG inventories, which also form part of the EC GHG inventory submission (see Annex 13, which is available at the EEA website http://www.eea.eu.int). However, in order to support the understanding of the emission trends at EU-15 level and in order to enable the calculation of some important implied emission factors, this year the EU-15 provides a selected number of activity data. The focus of these activity data are on the largest EU-15 key sources.

Table 1.23 provides an overview of tables available in Annex 2, an explanation for each table which is not filled in at EU-15 level and activity data provided for the calculation of implied emission factors.

Table 1.23 Inclusion of CRF tables in Annex 2

Table	Included in Annex 2	Comment
Energy		
Table 1	Yes	
Table 1.A (a)	Yes	Includes estimates for Luxembourg for 1990-97, 1999 and 2001
Table 1.A (b)	Yes	
Table 1.A (c)	Yes	
Table 1.A (d)	Yes	
Table 1.B.1	Yes	Refers to EU-15 (does not include Luxembourg)
Table 1.B.2	No	Type of activity data used by the MS varies; overview table for 1B2b included in the NIR
Table 1.C	Yes	Refers to EU-15 (does not include Luxembourg)
Industrial processes		
Table 2(I)	Yes	
Table 2(II)	Yes	Refers to EU-15 (does not include Luxembourg)
Table 2(I). A-G	No	Type of activity data used by the MS varies; overview tables for large key sources included in the NIR
Table 2(II). C,E	No	Type of activity data used by the MS varies; limited data availability; confidentiality issues
Table 2(II). F	No	Limited data availability; confidentiality issues

Table	Included in Annex 2	Comment
Solvent use		
Table 3	Yes	
Table 3. A-D	No	Type of activity data used by the MS varies
Agriculture		
Table 4	Yes	
Table 4. A	Yes	Animal population size and IEF included
Table 4. B(a)	Yes	Animal population size and IEF included
Table 4. B(b)	Yes	Animal population included
Table 4. C	Yes	Activity data and IEF are included
Table 4. D	Yes	Activity data and IEF are included with the exception of crops (because these data vary between MS)
Table 4. E	Yes	
Table 4. F	Yes	Activity data and IEF are included
LUCF		
Table 5	Yes	
Table 5. A	No	Type of activity data used by the MS varies; limited data availability
Table 5. B	No	Type of activity data used by the MS varies; limited data availability
Table 5. C	No	Type of activity data used by the MS varies; limited data availability
Table 5. D	No	Type of activity data used by the MS varies; limited data availability
Table 5. E	No	Type of activity data used by the MS varies; limited data availability
Waste		
Table 6	Yes	
Table 6. A, C	Yes	Annual MSW at the SWDS, DOC degraded, CH_4 recovery and IEF are included
Table 6. B	No	Limited data availability
Summary and other		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	Yes	
Table 9	Yes	
Table 10	Yes	
Table 11	Yes	

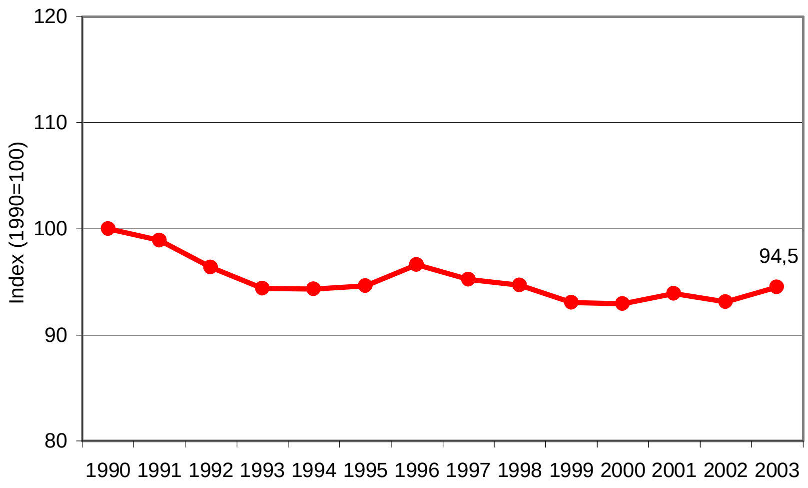
2 European Community greenhouse gas emission trends

This chapter presents the main GHG emission trends in the EC. Firstly, aggregated results are described for EU-25 and EU-15 as regards total GHG emissions and progress towards fulfilling the EC Kyoto target (for EU-15 only). Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EC GHG trends is given. Finally, also the trends of indirect GHGs and SO_2 emissions are also presented for EU-15 only.

2.1 Aggregated greenhouse gas emissions

Total GHG emissions without LUCF in the EU-25 decreased by 5.5 % between 1990 and 2003 (Figure 2.1). Emissions increased by 1.5 % between 2002 and 2003.

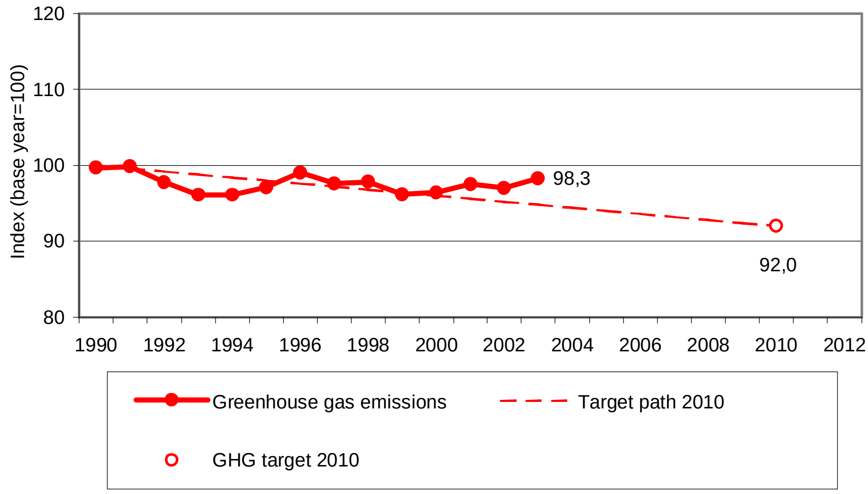
Figure 2.1 EU-25 GHG emissions 1990–2003 compared with target for 2008–12 (excl. LUCF)



Total GHG emissions without LUCF in the EU-15 were 1.7 % below the base year in 2003. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12, from base year levels. Assuming a linear target path from 1990 to 2010, total EU-15 GHG emissions were 3.5 index points above this target path in 2003 (Figure 2.2).

Compared to 2002, EU-15 GHG emissions increased in 2003 by 1.3 % or 53 million tonnes. The increases mainly occurred from energy industries (+24 million tonnes or 2.1%), mainly due to growing thermal power production and a 5 % increase of coal consumption in thermal power stations. The increase in thermal power production was driven by a combination of higher electricity consumption and an almost stable supply of electricity from hydro and nuclear power. In addition, greenhouse gas emissions from households and the services sector increased considerably (+18 million tonnes or +2.8 %), partly due to colder weather in the first quarter of 2003.

Figure 2.2 EU-15 GHG emissions 1990–2003 compared with target for 2008–12 (excl. LUCF)



Notes: The linear target path is not intended as an approximation of past and future emission trends. It provides a measure of how close the EU-15 emissions in 2003 are to a linear path of emissions reductions from 1990 to the Kyoto target for 2008–12, assuming that only domestic measures will be used. Therefore, it does not deliver a measure of (possible) compliance of the EU-15 with its GHG targets in 2008–12, but aims at evaluating overall EU-15 GHG emissions in 2003. The unit is index points with base year emissions being 100.

GHG emission data for the EU-15 as a whole do not include emissions and removals from LUCF. In addition, no adjustments for temperature variations or electricity trade are considered.

For the fluorinated gases the EU-15 base year is the sum of Member States base years. Thirteen Member States have indicated to select 1995 as the base year under the Kyoto Protocol, Finland and France have indicated to use 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France.

The index on the y axis refers to the base year (1995 for fluorinated gases for all Member States except Finland and France, 1990 for fluorinated gases for Finland and France and for all other gases). This means that the value for 1990 needs not to be exactly 100.

2.2 Emission trends by gas

Table 2.1 gives an overview of the main trends in EU-25 GHG emissions and removals for 1990–2003. The most important GHG by far is CO_2, accounting for 82 % of total EU-25 emissions in 2003. In 2003, EU-25 CO_2 emissions without LUCF were 4 064 Tg, which was 1.6 % below 1990 levels. Compared to 2002, CO_2 emissions increased by 2.1 %.

Table 2.1 Overview of EU-25 GHG emissions and removals from 1990 to 2003 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO_2 emissions/removals	3.818	3.748	3.645	3.567	3.561	3.571	3.657	3.597	3.619	3.542	3.562	3.606	3.560	3.669
CO_2 emissions (without LUCF)	4.128	4.106	3.998	3.921	3.917	3.925	4.028	3.963	3.967	3.921	3.931	4.005	3.982	4.064
CH_4	554	537	525	513	504	501	490	479	471	456	443	425	415	407
N_2O	474	460	447	431	439	441	448	448	424	407	408	402	391	389
HFCs	27	27	29	30	34	40	45	52	53	47	46	47	49	53
PFCs	17	16	13	12	11	11	11	10	9	8	7	7	6	6
SF_6	11	11	12	13	14	15	15	14	12	10	10	9	10	10
Total (with net CO_2 emissions/removals)	**4.902**	**4.798**	**4.670**	**4.566**	**4.563**	**4.579**	**4.666**	**4.600**	**4.589**	**4.471**	**4.477**	**4.496**	**4.432**	**4.533**
Total (without CO2 from LUCF)	**5.212**	**5.157**	**5.023**	**4.920**	**4.919**	**4.933**	**5.038**	**4.965**	**4.936**	**4.850**	**4.846**	**4.895**	**4.854**	**4.928**
Total (without LUCF)	**5.212**	**5.156**	**5.023**	**4.919**	**4.917**	**4.931**	**5.036**	**4.964**	**4.935**	**4.849**	**4.844**	**4.894**	**4.852**	**4.925**

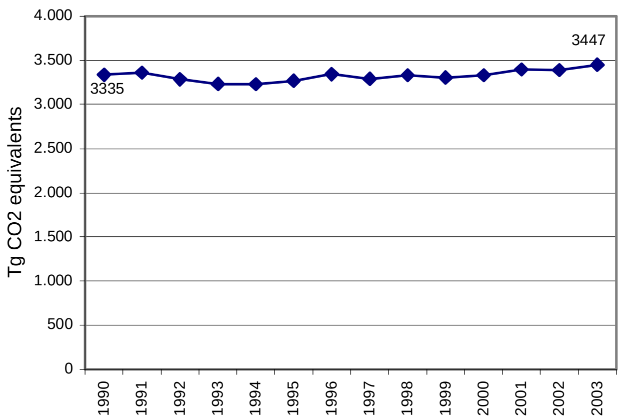
Table 2.2 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2003. Also in the EU-15 the most important GHG by is CO_2, also accounting for 82 % of total EU-15 emissions in 2003. In 2003, EU-15 CO_2 emissions without LUCF were 3 447 Tg, which was 3.4 % above 1990 levels (Figure 2.3). Compared to 2002, CO_2 emissions increased by 1.8 %. The largest four key sources account for 81 % of total CO_2 emissions in 2003. Figure 2.4 shows that the main reason for increases between 1990 and 2003 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions in energy-related emissions from

manufacturing industries and from ‘Other’. The largest reductions of ‘Other’ as shown in Figure 2.4 occurred in 1.A.1.c ‘Manufacture of solid fuels and other energy industries’ and in 1.A.5 ‘Other’.

Table 2.2 Overview of EU-15 GHG emissions and removals from 1990 to 2003 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO_2 emissions/removals	3.111	3.111	3.088	3.023	2.970	2.964	3.004	3.063	3.008	3.053	3.010	3.044	3.086	3.058	3.138
CO_2 emissions (without LUCF)	3.335	3.335	3.359	3.285	3.232	3.230	3.267	3.343	3.288	3.331	3.304	3.328	3.394	3.388	3.447
CH_4	441	441	432	426	419	410	408	402	392	383	372	361	351	342	334
N_2O	408	408	403	396	383	391	392	398	399	376	352	352	344	336	336
HFCs	41	27	27	29	30	34	40	45	51	53	46	44	44	46	50
PFCs	12	16	14	12	10	10	9	9	8	8	7	6	6	6	6
SF_6	15	10	11	12	12	13	15	15	13	12	10	10	9	10	9
Total (with net CO_2 emissions/removals)	**4.029**	**4.015**	**3.976**	**3.897**	**3.825**	**3.823**	**3.868**	**3.932**	**3.872**	**3.884**	**3.797**	**3.817**	**3.839**	**3.798**	**3.873**
Total (without CO2 from LUCF)	**4.253**	**4.238**	**4.246**	**4.159**	**4.087**	**4.089**	**4.131**	**4.212**	**4.151**	**4.162**	**4.092**	**4.101**	**4.148**	**4.127**	**4.182**
Total (without LUCF)	**4.252**	**4.238**	**4.246**	**4.159**	**4.087**	**4.088**	**4.129**	**4.211**	**4.150**	**4.160**	**4.091**	**4.100**	**4.146**	**4.126**	**4.180**

Figure 2.3 CO_2 emissions without LUCF 1990 to 2003 in CO_2 equivalents (Tg) and share of largest key source categories in 2003 for EU-15



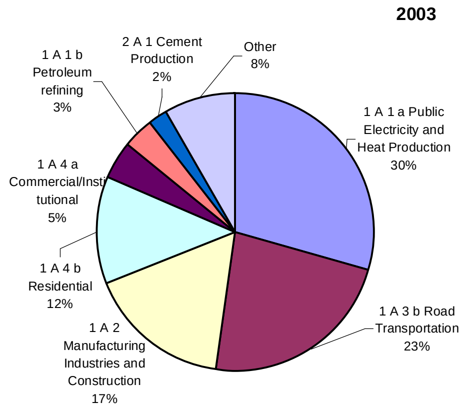
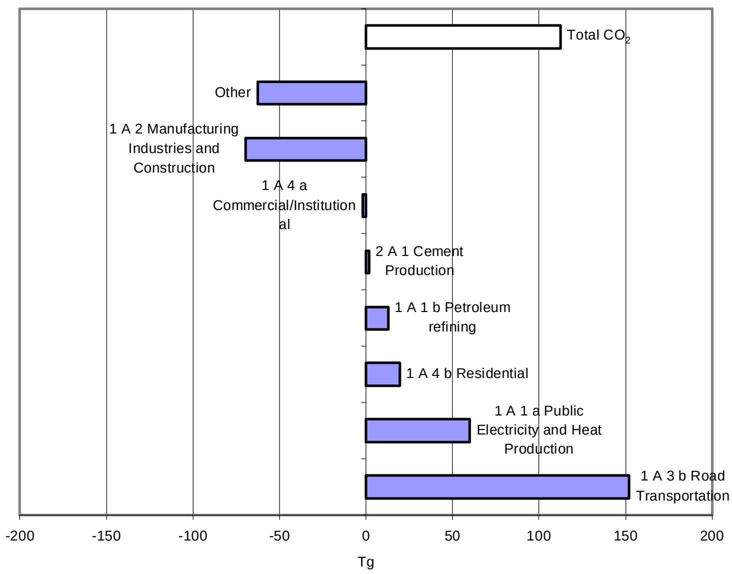
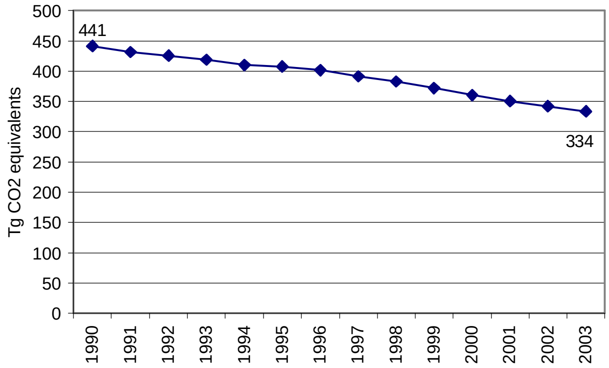


Figure 2.4 Absolute change of CO_2 emissions by large key source categories 1990 to 2003 in CO_2 equivalents (Tg) for EU-15



CH_4 emissions account for 8 % of total EU-15 GHG emissions and decreased by 24 % since 1990 to 334 Tg (CO_2 equivalents) in 2003 (Figure 2.5). The two largest key sources account for slightly more than 50 % of CH_4 emissions in 2003. Figure 2.6 shows that the main reasons for declining CH_4 emissions were reductions in solid waste disposal on land, the decline of coal-mining and falling cattle population.

Figure 2.5 CH_4 emissions 1990 to 2003 in CO_2 equivalents (Tg) and share of largest source categories in 2003 for EU-15



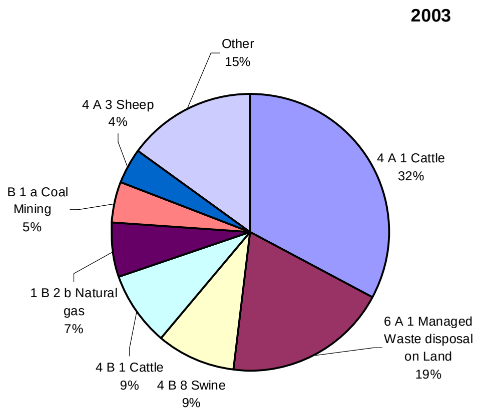
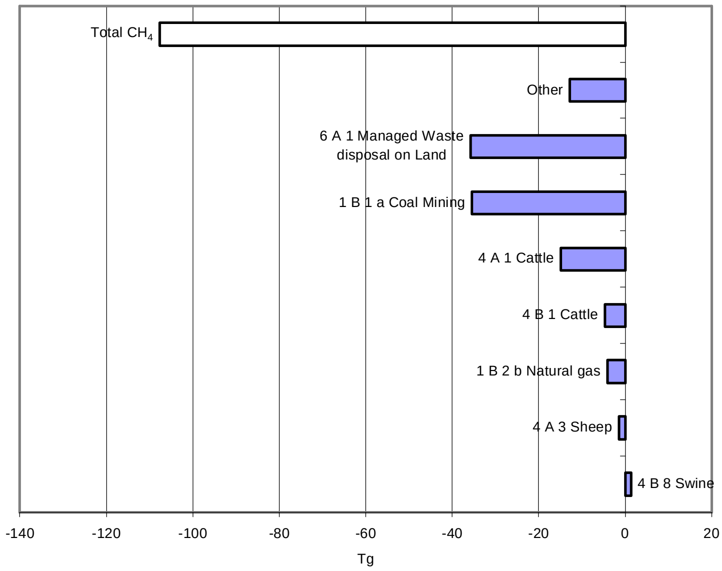


Figure 2.6 Absolute change of CH_4 emissions by large key source categories 1990 to 2003 in CO_2 equivalents (Tg) for EU-15



N_2O emissions are responsible for 8 % of total EU-15 GHG emissions and decreased by 18 % to 336 Tg (CO_2 equivalents) in 2003 (Figure 2.7). The two largest key sources account for about 50 % of N_2O emissions in 2003. Figure 2.8 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Figure 2.7 N_2O emissions 1990 to 2003 in CO_2 equivalents (Tg) and share of largest source categories in 2003 for EU-15

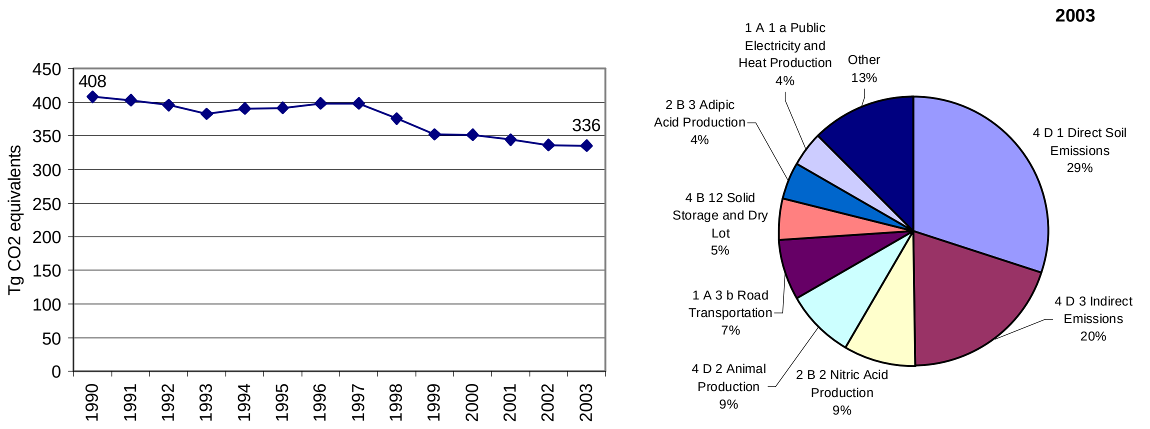
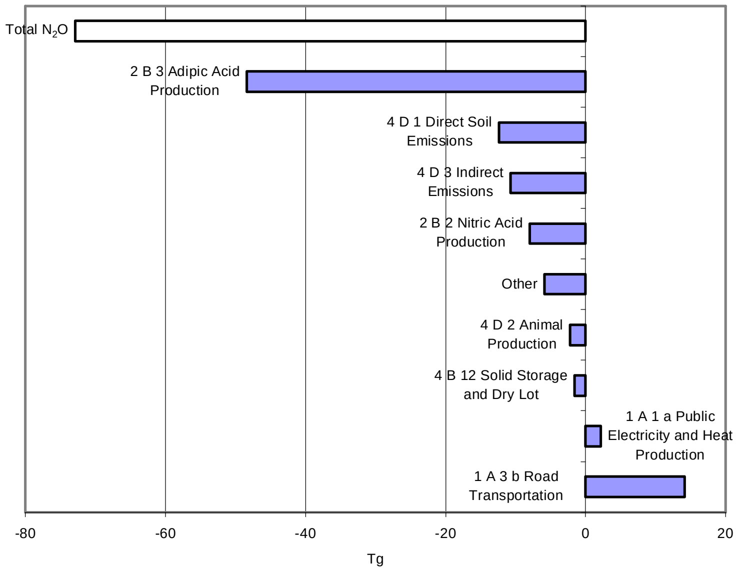


Figure 2.8 Absolute change of N_2O emissions by large key source categories 1990 to 2003 in CO_2 equivalents (Tg) for EU-15



Fluorinated gas emissions account for 1.6 % of total EU-15 GHG emissions. In 2003, emissions were 65 Tg (CO_2 equivalents), which was 22 % above 1990 levels, but 4 % below base year level (Figure 2.9). The two largest key sources account for 77 % of fluorinated gas emissions in 2003. Figure 2.10 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2003. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from production of halocarbons decreased substantially. The decrease started in 1998 and was strongest in 1999.

Figure 2.9 **Fluorinated gas emissions 1990 to 2003 in CO_2 equivalents (Tg) and share of largest source categories in 2003 for EU-15**

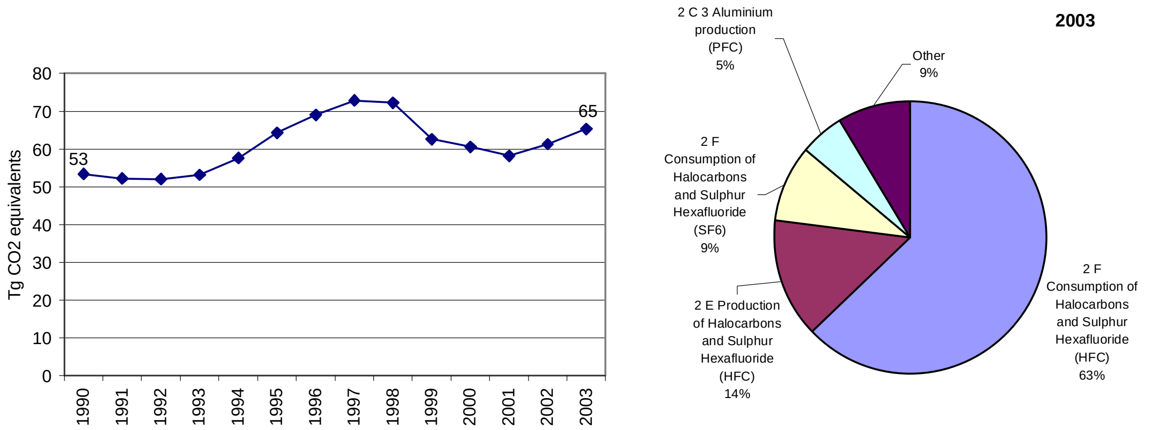
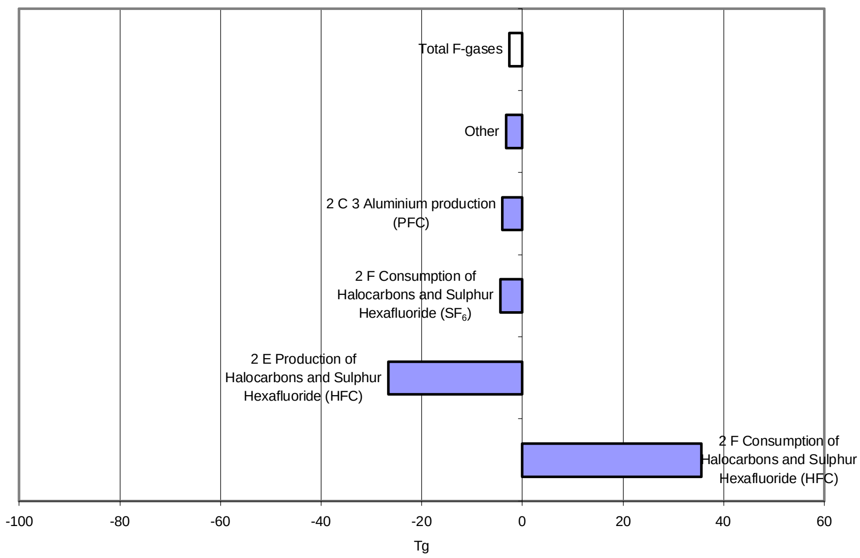


Figure 2.10 **Absolute change of fluorinated gas emissions by large key source categories 1990 to 2003 in CO_2 equivalents (Tg) for EU-15**



2.3 Emission trends by source

Table 2.3 gives an overview of EU-25 GHG emissions in the main source categories for 1990–2003. The most important sector by far is 'Energy' accounting for 82 % of total EU-25 emissions in 2003. The second largest sector is 'Agriculture' (9 %), followed by Industrial processes' (6 %).

Table 2.3 **Overview of EU-25 GHG emissions in the main source and sink categories 1990 to 2003 in CO_2 equivalents (Tg)**

GHG SOURCE AND SINK	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	4.123	4.113	4.003	3.931	3.910	3.914	4.023	3.948	3.944	3.894	3.895	3.970	3.946	4.015
2. Industrial Processes	351	331	321	311	332	344	345	354	333	300	303	299	293	305
3. Solvent and Other Product Use	12	11	11	11	10	11	11	11	11	11	11	10	10	10
4. Agriculture	547	524	509	493	494	494	496	497	493	496	491	483	476	468
5. Land-Use Change and Forestry	-310	-358	-353	-354	-354	-351	-370	-364	-346	-378	-365	-398	-421	-392
6. Waste	178	176	177	173	171	167	160	154	154	148	143	131	126	125
7. Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 2.4 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2003. More detailed trend descriptions are included in Chapters 3 to 9.

Table 2.4 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2003 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	3.310	3.310	3.344	3.273	3.221	3.203	3.235	3.316	3.253	3.292	3.264	3.280	3.347	3.339	3.393
2. Industrial Processes	328	313	301	292	283	302	313	315	320	298	265	266	259	258	265
3. Solvent and Other Product Use	10	10	10	10	10	10	10	10	10	10	10	10	9	9	9
4. Agriculture	462	462	449	442	433	436	437	440	442	440	437	435	426	420	414
5. Land-Use Change and Forestry	-223	-223	-270	-262	-262	-265	-261	-278	-278	-276	-294	-283	-307	-329	-307
6. Waste	141	141	142	141	140	137	133	130	124	120	114	109	104	99	97
7. Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

2.4 Emission trends by Member State

Tables 2.5 and 2.6 give an overview of Member States' contributions to the EC GHG emissions for 1990–2003. Member States show large variations in GHG emission trends.

Table 2.5 Overview of Member States' contributions to EC GHG emissions excluding LUCF from 1990 to 2003 in CO_2 equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	79	83	76	76	77	80	83	83	83	80	81	85	86	92
Belgium	146	149	147	146	151	152	157	148	153	146	148	147	145	148
Cyprus	6	6	7	7	7	7	8	8	8	8	9	8	9	9
Czech Republic	192	178	164	158	152	153	155	159	149	140	148	148	143	147
Denmark	69	80	74	76	80	77	90	80	76	73	68	70	69	74
Estonia	43	41	30	23	24	22	23	24	21	20	20	19	20	21
Finland	70	69	67	68	74	71	77	76	73	72	70	76	77	86
France	568	593	585	559	555	563	578	572	584	566	560	564	554	557
Germany	1.244	1.191	1.142	1.126	1.108	1.103	1.121	1.084	1.057	1.021	1.017	1.028	1.015	1.018
Greece	109	109	110	110	113	114	118	123	128	127	132	134	134	138
Hungary	104	96	86	85	85	84	86	84	85	84	81	84	81	83
Ireland	54	55	56	56	57	58	60	63	65	67	69	71	69	68
Italy	511	513	509	505	496	528	519	525	535	544	551	556	555	570
Latvia	25	24	19	16	15	12	12	12	11	10	10	11	11	11
Lithuania	51	45	42	38	35	31	28	24	22	21	21	20	20	17
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11	11
Malta	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Netherlands	212	216	215	221	221	224	233	225	227	215	214	216	213	215
Poland	460	438	440	430	440	417	437	427	404	402	386	383	370	384
Portugal	59	61	65	64	65	70	67	70	75	83	80	81	86	81
Slovakia	72	63	59	55	52	53	54	54	52	51	48	53	52	52
Slovenia	19	18	18	18	18	19	20	20	20	19	19	20	20	20
Spain	284	290	299	287	303	315	307	328	337	365	380	379	399	402
Sweden	72	72	72	72	75	73	77	73	73	70	67	68	69	71
United Kingdom	748	752	729	710	700	691	714	691	686	652	652	663	644	651
EU25	**5.212**	**5.156**	**5.023**	**4.919**	**4.917**	**4.931**	**5.036**	**4.964**	**4.935**	**4.849**	**4.844**	**4.894**	**4.852**	**4.925**
EU15	**4.238**	**4.246**	**4.159**	**4.087**	**4.088**	**4.129**	**4.211**	**4.150**	**4.160**	**4.091**	**4.100**	**4.146**	**4.126**	**4.180**

Note: For some countries the data provided in this table is based on gap filling (see Chapter 1.8.2 for details.).

The overall EC GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom, accounting for about one third of total EU-25 GHG emissions. These two Member States achieved total GHG emission reductions of 323 million tonnes compared to 1990 ([13]).

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

Italy and France are the third and fourth largest emitters with a shares of 12 % and 11 % respectively. Italy's GHG emissions were 12% above 1990 levels in 2003. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 2 % below 1990 levels in 2003. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport increased considerably between 1990 and 2003.

Spain and Poland are the fifth and sixth largest emitters in the EU-25 each accounting for about 8 % of total EU-25 GHG emissions. Spain increased emissions by 42 % between 1990 and 2003 (+41 % since the base year). This was largely due to emission increases from road transport, electricity and heat

([13]) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 340 million tonnes on the basis of the 2005 inventory in order to meet the Kyoto target.

production, and manufacturing industries. Poland decreased GHG emissions by 16 % between 1990 and 2003[14] (-32 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

Table 2.6 shows that 12 Member States (including Cyprus and Malta, which do not have a Kyoto target) were above base year levels in 2003, 13 Member States were below. The percentage changes of GHG emissions from the base year to 2003 range from – 66 % (Lithuania) to + 53 % (Cyprus).

Table 2.6 Greenhouse gas emissions in CO_2 equivalents (excl. LUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	Base year [1)] (million tonnes)	2003 (million tonnes)	Change 2002–2003 (%)	Change base year–2003 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78,5	91,6	5,9%	16,6%	-13,0%
Belgium	146,8	147,7	1,6%	0,6%	-7,5%
Cyprus	6,0	9,2	5,3%	52,8%	-
Czech Republic	192,1	145,4	1,8%	-24,3%	-8,0%
Denmark	69,6	74,0	7,3%	6,3%	-21,0%
Estonia	43,5	21,4	9,7%	-50,8%	-8,0%
Finland	70,4	85,5	10,8%	21,5%	0,0%
France	568,0	557,2	0,7%	-1,9%	0,0%
Germany	1248,3	1017,5	0,2%	-18,5%	-21,0%
Greece	111,7	137,6	3,1%	23,2%	25,0%
Hungary	122,2	83,2	3,0%	-31,9%	-6,0%
Ireland	54,0	67,6	-2,6%	25,2%	13,0%
Italy	510,3	569,8	2,7%	11,6%	-6,5%
Latvia	25,4	10,5	-0,9%	-58,5%	-8,0%
Lithuania	50,9	17,2	-12,1%	-66,2%	-8,0%
Luxembourg	12,7	11,3	4,3%	-11,5%	-28,0%
Malta [2)]	2,2	2,9	-0,5%	29,1%	-
Netherlands	213,1	214,8	0,6%	0,8%	-6,0%
Poland [2)]	565,3	384,0	3,7%	-32,1%	-6,0%
Portugal	59,4	81,2	-5,3%	36,7%	27,0%
Slovakia	72,0	51,7	-1,3%	-28,2%	-8,0%
Slovenia	20,2	19,8	-1,2%	-1,9%	-8,0%
Spain	286,1	402,3	0,9%	40,6%	15,0%
Sweden	72,3	70,6	1,5%	-2,4%	4,0%
United Kingdom	751,4	651,1	1,1%	-13,3%	-12,5%
EU-15	**4252,5**	**4179,6**	**1,3%**	**-1,7%**	**-8,0%**

([1]) For EU-15 the base year for CO_2, CH_4 and N_2O is 1990; for the fluorinated gases 13 Member States have chosen to select 1995 as the base year, whereas Finland and France have chosen 1990. As the EC inventory is the sum of Member States' inventories, the EC base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France.

([2]) Malta and Poland did not provide GHG emission estimates for 2003, therefore the data provided in this table is based on gap filling (see Chapter 1.8.2.).

Note: Malta and Cyprus do not have Kyoto targets.

[14] Note that for Poland data for 2003 have been estimated by gap filling because Poland did not provide GHG emission estimates before the data deadline of this report (see Chapter 1.8.2.).

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide (EU-15)

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990–2003. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 68 %) followed by CO (– 48 %) NMVOC (– 38 %) and NO_x (– 31 %).

Table 2.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2003 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	Gg													
NO_x	13.390	13.145	12.832	12.243	11.881	11.599	11.316	10.836	10.593	10.259	9.913	9.686	9.420	9.273
CO	50.457	48.605	46.522	44.276	41.983	40.325	38.766	36.854	35.303	33.246	30.618	29.199	27.263	26.481
NMVOC	15.556	14.865	14.451	13.774	13.436	13.085	12.519	12.322	11.808	11.346	10.643	10.244	9.782	9.594
SO_2	16.527	14.977	13.825	12.563	11.347	10.229	8.852	8.047	7.519	6.753	6.093	5.875	5.669	5.234

Table 2.8 shows the NO_x emissions of the EU-15 Member States between 1990–2003. The largest emitters, the United Kingdom, Spain, and Germany made up almost 50 % of total NO_x emissions in 2003. The United Kingdom and Germany reduced their emissions from 1990 levels. This was partly counterbalanced by increases from Spain, Greece, Portugal, Austria and Ireland. All other Member States reduced emissions.

Table 2.8 Overview of EU-15 Member States' contributions to EU-15 NO_x emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	211	221	210	203	195	192	212	199	211	199	204	214	220	229
Belgium	358	362	358	348	354	347	332	326	327	300	308	296	284	278
Denmark	283	332	290	290	290	273	311	265	243	225	208	203	201	209
Finland	294	274	266	267	268	246	250	243	228	222	208	210	210	218
France	1.816	1.895	1.857	1.750	1.706	1.653	1.624	1.558	1.537	1.468	1.394	1.349	1.288	1.237
Germany	2.846	2.611	2.418	2.299	2.130	2.000	1.918	1.823	1.766	1.717	1.634	1.560	1.497	1.428
Greece	300	312	314	314	321	320	325	332	349	337	330	343	341	343
Ireland	116	118	129	117	114	114	118	117	120	117	123	132	121	117
Italy	1.947	2.000	2.019	1.921	1.840	1.808	1.732	1.654	1.553	1.456	1.378	1.367	1.276	1.260
Luxembourg	22	22	22	22	22	20	22	18	19	16	17	17	17	17
Netherlands	560	432	423	407	380	475	455	418	410	414	395	384	373	366
Portugal	260	276	290	281	279	293	283	277	286	297	293	289	296	291
Spain	1.237	1.282	1.315	1.292	1.319	1.342	1.306	1.355	1.365	1.435	1.464	1.448	1.511	1.507
Sweden	315	305	299	284	286	274	262	250	243	232	219	214	208	204
United Kingdom	2.827	2.704	2.621	2.449	2.376	2.240	2.165	2.003	1.935	1.822	1.737	1.660	1.577	1.569
EU15	**13.390**	**13.145**	**12.832**	**12.243**	**11.881**	**11.599**	**11.316**	**10.836**	**10.593**	**10.259**	**9.913**	**9.686**	**9.420**	**9.273**

Table 2.9 shows the CO emissions of the EU-15 Member States between 1990–2003. The largest emitters, France, Italy and Germany that made up 55 % of the total CO emissions in 2003, reduced their emissions from 1990 levels. Also all other Member States reduced emissions.

Table 2.9 Overview of EU-15 Member States' contributions to EU-15 CO emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	1.244	1.255	1.205	1.165	1.106	1.018	1.032	962	923	876	810	804	775	802
Belgium	1.347	1.309	1.286	1.171	1.086	1.058	1.020	973	938	941	927	868	865	742
Denmark	772	814	805	812	781	772	771	718	655	626	615	618	590	593
Finland	702	673	662	651	636	632	623	624	620	611	594	585	575	564
France	10.962	10.852	10.393	9.858	9.176	9.010	8.440	7.996	7.834	7.344	6.770	6.480	6.176	5.968
Germany	11.212	9.528	8.351	7.701	7.080	6.581	6.166	5.994	5.554	5.199	4.913	4.561	4.300	4.153
Greece	1.302	1.312	1.341	1.344	1.340	1.334	1.360	1.361	1.391	1.316	1.364	1.275	1.244	1.200
Ireland	397	391	391	347	326	301	303	308	313	281	275	270	251	235
Italy	7.150	7.451	7.654	7.602	7.380	7.144	6.846	6.602	6.191	5.907	5.225	5.131	4.519	4.430
Luxembourg	172	172	172	172	145	104	102	80	58	49	49	53	48	48
Netherlands	1.127	785	752	708	691	849	832	754	745	721	696	661	628	611
Portugal	1.038	1.152	980	919	870	1.028	874	799	895	812	885	781	814	1.306
Spain	3.538	3.605	3.664	3.441	3.414	3.106	3.198	3.029	3.004	2.752	2.597	2.544	2.427	2.377
Sweden	1.189	1.166	1.146	1.097	1.073	1.058	1.021	938	902	850	794	758	724	694
United Kingdom	8.306	8.140	7.720	7.289	6.878	6.330	6.177	5.716	5.278	4.961	4.106	3.809	3.325	2.757
EU15	**50.457**	**48.605**	**46.522**	**44.276**	**41.983**	**40.325**	**38.766**	**36.854**	**35.303**	**33.246**	**30.618**	**29.199**	**27.263**	**26.481**

Table 2.10 shows the NMVOC emissions of the EU-15 Member States between 1990–2003. The largest emitters France, Germany and Italy that made up 57 % of the total NMVOC emissions in 2003, reduced their emissions from 1990 levels. All Member States except for Greece, Portugal and Spain reduced emissions.

Table 2.10 Overview of EU-15 Member States' contributions to EU-15 NMVOC emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	286	273	245	239	221	221	216	204	191	180	181	185	182	182
Belgium	328	317	314	297	286	270	255	247	238	227	208	200	190	186
Denmark	229	227	222	218	214	201	208	200	173	169	172	140	145	159
Finland	223	209	202	192	188	182	175	170	166	161	155	153	148	144
France	3.691	3.675	3.611	3.478	3.441	3.388	3.152	3.240	3.068	3.100	2.935	2.912	2.781	2.705
Germany	3.534	3.082	2.807	2.581	2.404	2.248	2.110	2.042	1.966	1.842	1.697	1.592	1.494	1.460
Greece	280	288	296	302	308	305	309	308	312	307	299	294	289	288
Ireland	106	107	110	101	103	101	107	111	113	94	85	83	78	74
Italy	2.032	2.093	2.150	2.112	2.050	2.023	1.972	1.909	1.803	1.714	1.544	1.456	1.346	1.311
Luxembourg	19	19	19	19	18	17	17	17	14	12	13	12	11	11
Netherlands	483	278	262	247	243	356	322	290	289	278	259	241	229	225
Portugal	274	288	285	275	281	293	287	286	293	280	279	278	282	316
Spain	1.135	1.177	1.189	1.119	1.142	1.093	1.112	1.126	1.184	1.181	1.162	1.147	1.139	1.146
Sweden	517	496	482	449	429	420	406	376	353	331	320	311	303	301
United Kingdom	2.419	2.336	2.257	2.144	2.108	1.965	1.868	1.796	1.645	1.469	1.334	1.239	1.165	1.087
EU15	**15.556**	**14.865**	**14.451**	**13.774**	**13.436**	**13.085**	**12.519**	**12.322**	**11.808**	**11.346**	**10.643**	**10.244**	**9.782**	**9.594**

Table 2.11 shows the SO_2 emissions of the EU-15 Member States between 1990–2003. The largest emitters, Spain and the United Kingdom, that made up 45 % of the total SO_2 emissions in 2003, reduced their emissions from 1990 levels. All other Member States except for Greece reduced emissions.

Table 2.11 Overview of EU-15 Member States' contributions to EU-15 SO_2 emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	76	71	57	55	49	48	46	42	37	36	33	34	33	34
Belgium	356	361	353	326	283	256	242	221	207	168	165	164	152	127
Denmark	177	236	181	147	145	135	171	99	76	55	28	26	25	31
Finland	241	200	153	133	120	100	104	101	92	86	77	89	87	99
France	1.372	1.500	1.314	1.159	1.102	1.034	1.008	861	874	759	664	602	559	551
Germany	5.324	3.994	3.305	2.943	2.471	1.936	1.337	1.037	834	733	634	641	608	614
Greece	487	525	544	542	513	536	523	518	527	544	493	502	513	545
Ireland	183	180	170	161	175	161	147	166	176	157	131	126	96	76
Italy	1.795	1.677	1.578	1.477	1.388	1.320	1.209	1.133	995	899	753	708	632	506
Luxembourg	15	15	15	15	15	15	15	6	4	4	3	3	2	2
Netherlands	190	108	101	98	87	128	121	102	94	88	73	73	66	65
Portugal	323	313	374	321	299	335	274	294	342	343	307	294	293	201
Spain	2.165	2.166	2.132	1.997	1.946	1.795	1.565	1.748	1.597	1.607	1.488	1.446	1.550	1.352
Sweden	112	111	106	92	91	78	75	69	66	52	49	49	50	51
United Kingdom	3.711	3.521	3.443	3.098	2.663	2.354	2.014	1.653	1.598	1.219	1.194	1.118	1.002	979
EU15	**16.527**	**14.977**	**13.825**	**12.563**	**11.347**	**10.229**	**8.852**	**8.047**	**7.519**	**6.753**	**6.093**	**5.875**	**5.669**	**5.234**

3 Energy (CRF Sector 1)

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

3.1 Overview of sector

CRF Sector 1: 'Energy' contributes 81 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector increased by 2.5 % from 3 310 Tg in 1990 to 3 393 Tg in 2003 (Figure 3.1). In 2003, emissions increased by 1.6 % compared to 2002.

The most important energy-related gas is CO_2 that makes up 79 % of the total EU-15 GHG emissions. CH_4 and N_2O are each responsible for 1 % of the total GHG emissions. The key sources in this sector are as follows.

1.A.1.a: Public electricity and heat production (CO_2)
1.A.1.a: Public electricity and heat production (N_2O)
1.A.1.b: Petroleum-refining (CO_2)
1.A.1.c: Manufacture of solid fuels and other energy industries (CO_2)
1.A.2: Manufacturing industries and construction (CO_2)
1.A.3.a: Civil aviation (CO_2)
1.A.3.b: Road transportation (CH_4)
1.A.3.b: Road transportation (CO_2)
1.A.3.b: Road transportation (N_2O)
1.A.3.c: Railways (CO_2)
1.A.3.d: Navigation (CO_2)
1.A.4.a: Commercial/institutional (CO_2)
1.A.4.b: Residential (CH_4)
1.A.4.b: Residential (CO_2)
1.A.4.c: Agriculture/forestry/fisheries (CO_2)
1.A.5: Other (CO_2)
1.B.1.a: Coal-mining (CH_4)
1.B.2.b: Natural gas (CH_4)

Figure 3.1 shows that the six largest key sources account for about 90 % of emissions in Sector 1.

Figure 3.1 **EU-15 GHG emissions for 1990–2003 from CRF Sector 1: 'Energy' in CO_2 equivalents (Tg) and share of largest key source categories in 2003**

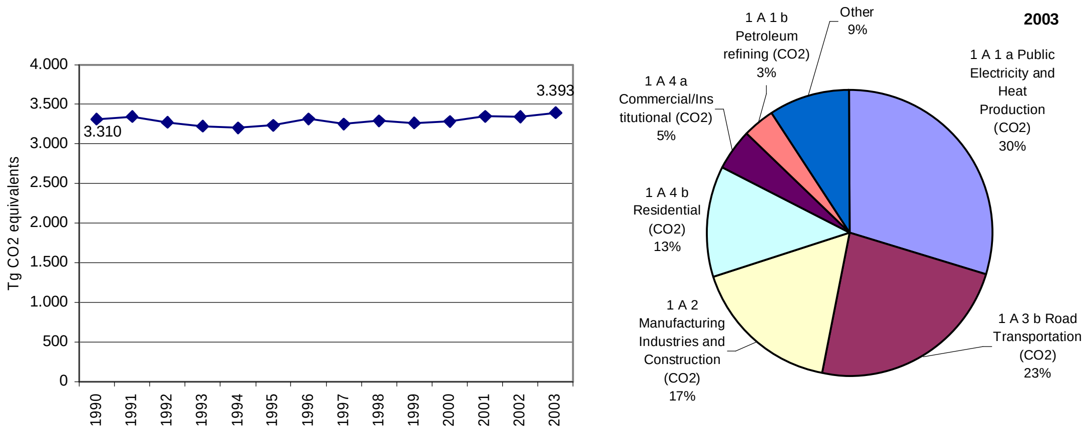
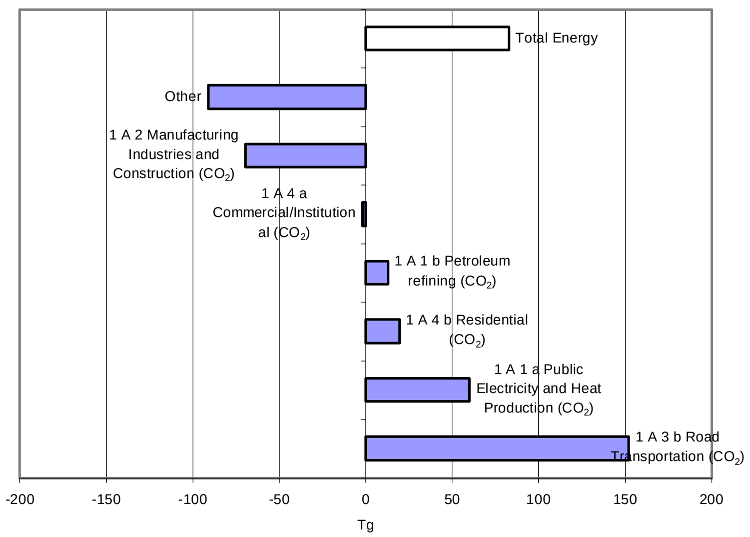


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from manufacturing industries decreased substantially between 1990 and 2003. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries' and from 1.A.5: 'Other' are the main reasons for the large absolute emission reductions from 'Other' in Figure 3.2.

Figure 3.2 **Absolute change of GHG emissions by large key source categories 1990–2003 in CO_2 equivalents (Tg) in CRF Sector 1: 'Energy'**



3.2 Source categories

3.2.1 Energy industries (CRF Source Category 1.A.1)

Table 3.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 1.A.1: 'Energy industries'. CO_2 emissions from energy industries increased by 3.3 % between 1990 and 2003. Most Member States had increases in this source during this time, but the large Member States Germany and the United Kingdom reduced their emissions by 12 % and 10 %, respectively.

This source category includes three key sources: CO_2 from 1.A.1.a: ‘Electricity and heat production’ and CO_2 from 1.A.1.b: ‘Petroleum-refining’, and CO_2 from 1.A.1.c: ‘Manufacture of solid fuels and other energy industries’.

Table 3.1 Member States’ contributions to CO_2 emissions from 1.A.1: ‘Energy industries’ and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	13.622	16.030	C	CS	ALL	H
Belgium	29.907	29.141	CS	CS		
Denmark	26.173	31.402	C	CS	ALL	H
Finland	18.517	36.047	CS (T2)	CS/PS/D	ALL	H
France	68.016	63.802	C	CS	ALL	H
Germany	413.945	362.582	CS	CS	All	H
Greece	43.194	56.100	C	C and CS	ALL	
Ireland	11.057	15.480	T1	PS, CS	Full	H
Italy	134.951	160.883	T3	CS	ALL	H
Luxembourg	1.277	266	C/D	C/D		
Netherlands	51.626	67.347	T2	PS, CS,D	ALL	H
Portugal	15.944	20.009	T2	D+C	All	H
Spain	77.493	105.332	D,C,CS	D.C,PS	ALL	H
Sweden	10.187	12.769	T2/T3 + T1, CS	CS, D	ALL	H
United Kingdom	235.786	212.729	T2	CS	ALL	H
EU15	1.151.697	1.189.920	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL	H

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter ‘Units and abbreviations’.

CO_2 emissions from 1.A.1.a: ‘Electricity and heat production’ is the largest key source in the EU-15 accounting for 24.2 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from electricity and heat production increased by 6 % in the EU-15 (Table 3.2). The emissions from this key source are due to fossil fuel consumption in public electricity and heat plants, which increased by 18 % between 1990 and 2003. Emissions did not increase in line with fuel consumption mainly because of the shift from coal to gas: coal consumption in heat and power plants decreased by 7 % between 1990 and 2003, whereas gas consumption more than tripled.

Between 1990 and 2003, large emission decreases in absolute terms had been achieved by the United Kingdom and Germany, whereas emissions increased considerably in Spain. The most important reason for German CO_2 reductions from electricity and heat production were efficiency improvements in coal-fired power plants. In the United Kingdom, the most important factor for emission reductions was the fuel switch from coal to gas in power production. The fossil fuel consumption in electricity and heat production in Spain increased by 53 % between 1990 and 2003, affecting also emissions from this source.

Table 3.2 Member States' contributions to CO_2 emissions from 1.A.1.a: 'Electricity and heat production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	10.864	10.625	13.292	1,3%	2.667	25%	2.428	22%	C	NS, PS	CS
Belgium	23.465	22.566	23.548	2,3%	981	4%	82	0%	CS	PS, RS	CS, PS
Denmark	24.736	24.060	28.869	2,9%	4.809	20%	4.133	17%	C	NS, PS	CS, C
Finland	16.248	26.149	33.177	3,3%	7.029	27%	16.929	104%	T2(CS)	PS	D, CS, PS
France	48.131	42.271	45.359	4,5%	3.088	7%	-2.772	-6%	C	PS	CS
Germany	334.619	316.865	322.642	31,9%	5.778	2%	-11.976	-4%	CS	NS	CS
Greece	40.632	51.561	52.709	5,2%	1.148	2%	12.077	30%	C	NS	C, CS
Ireland	10.876	15.830	15.109	1,5%	-722	-5%	4.232	39%	T3	NS, PS	PS
Italy	109.678	125.330	128.129	12,7%	2.799	2%	18.452	17%	T3	NS, PS	CS
Luxembourg	1.277	266	266	0,0%	0	0%	-1.011	-79%			
Netherlands	39.759	54.022	54.586	5,4%	565	1%	14.828	37%	CS	NS, Q	PS, CS
Portugal	13.960	21.920	17.512	1,7%	-4.408	-20%	3.552	25%	D	PS	D
Spain	64.341	98.896	91.078	9,0%	-7.818	-8%	26.737	42%	D, CS	Q	D, PS
Sweden	7.622	9.034	9.765	1,0%	731	8%	2.143	28%	T2, T3	PS	CS
United Kingdom	204.251	164.236	174.467	17,3%	10.231	6%	-29.785	-15%	T2	PS, NS	CS
EU15	950.461	983.630	1.010.508	100,0%	26.878	3%	60.048	6%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.1.b: 'Petroleum-refining' is the sixth largest key source in the EU-15 accounting for 2.8 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source increased by 12 % in the EU-15 (Table 3.3).

Between 1990 and 2003, minor emission decreases in absolute terms had been achieved by the United Kingdom and Germany, whereas all other Member States reported increases. Italy had the largest increases in absolute terms.

Table 3.3 Member States' contributions to CO_2 emissions from 1.A.1.b: 'Petroleum-refining'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2.456	2.551	2.526	2,1%	-25	-1%	70	3%	C	NS, PS	PS
Belgium	4.299	4.767	5.156	4,3%	390	8%	857	20%	CS	PS	CS
Denmark	897	971	1.013	0,9%	42	4%	115	13%	C	NS, PS	CS, C
Finland	2.225	2.708	2.782	2,3%	73	3%	557	25%	T2(CS)	PS	D, CS, PS
France	13.239	14.635	13.543	11,4%	-1.092	-7%	305	2%	C	PS	CS
Germany	19.419	19.675	19.373	16,3%	-302	-2%	-46	0%	CS	NS	CS
Greece	2.465	3.449	3.305	2,8%	-144	-4%	840	34%	C	NS	C
Ireland	181	371	372	0,3%	1	0%	191	105%	T3	NS, PS	PS
Italy	16.329	24.551	23.433	19,8%	-1.118	-5%	7.104	44%	T3	NS, PS	CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	11.028	10.874	11.187	9,4%	313	3%	159	1%	CS	NS, Q	PS, CS
Portugal	1.910	2.492	2.497	2,1%	5	0%	587	31%	D	PS	D, CS
Spain	10.907	12.738	12.433	10,5%	-304	-2%	1.526	14%	D, C, CS	Q	D, C, PS
Sweden	2.151	2.752	2.668	2,3%	-84	-3%	517	24%	T2, T3	PS	CS, D
United Kingdom	18.275	19.178	18.266	15,4%	-911	-5%	-9	0%	T2	NS	CS
EU15	105.781	121.711	118.555	100,0%	-3.156	-3%	12.774	12%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries' account for 1.5 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 36 % in the EU-15 (Table 3.4). Between 1990 and 2003, Germany had large emission decreases in absolute and relative terms, whereas absolute emissions increased considerably in the United Kingdom.

Table 3.4 Member States' contributions to CO_2 emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	302	172	212	0,3%	40	24%	-90	-30%	C	NS	CS
Belgium	2.143	424	438	0,7%	14	3%	-1.705	-80%	CS	PS, RS	CS
Denmark	540	1.522	1.520	2,5%	-2	0%	981	182%	C	NS	CS, C
Finland	44	90	89	0,1%	-1	-1%	45	101%	T2(CS)	PS	D, CS, PS
France	6.647	4.786	4.900	8,1%	114	2%	-1.746	-26%	C	AS, PS	CS
Germany	59.907	20.063	20.566	33,8%	502	3%	-39.342	-66%	CS	NS	CS
Greece	97	99	86	0,1%	-13	-13%	-11	-12%	C	NS	C
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	8.945	9.621	9.321	15,3%	-300	-3%	375	4%	T3	NS, PS	CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	839	1.728	1.574	2,6%	-154	-9%	735	88%	CS	NS, Q	PS, CS
Portugal	75	0	0	0,0%	0	-	-75	-100%	D	PS	D
Spain	2.244	1.831	1.821	3,0%	-10	-1%	-423	-19%	D, C, CS	MS, IS, Q	D, C, PS
Sweden	413	325	335	0,6%	10	3%	-78	-19%	T2, T3	PS	CS
United Kingdom	13.260	20.154	19.996	32,9%	-159	-1%	6.736	51%	T2	AS, NS	CS
EU15	95.456	60.815	60.857	100,0%	41	0%	-34.599	-36%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.5 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the N_2O emissions from 1.A.1: 'Energy industries'. N_2O emissions from this source increased by 25 % between 1990 and 2003. Most Member States had increases in this source during this time. In absolute terms, Germany had the only decrease in these emissions. The countries contributing the most to the increasing trend were Spain, the United Kingdom, Greece and Italy.

This source category includes one key source: N_2O from 1.A.1.a: 'Electricity and heat production'.

Table 3.5 Member States' contributions to N_2O emissions from 1.A.1: 'Energy industries' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	47	68	C	CS	ALL	L
Belgium	284	360	C	D		
Denmark	276	328	C	C	ALL	L
Finland	279	548	CS (T2)	CS/PS	ALL	L
France	736	1.055	C	CS	ALL	L
Germany	4.494	3.791	T2	CS	All	M
Greece	1.782	2.244	C	C	ALL	
Ireland	431	548	T1	C	Full	L
Italy	1.683	2.030	T3	D		
Luxembourg	0	0	C/D	C/D		
Netherlands	159	217	T1	D	ALL	L
Portugal	61	96	T2	D+C	All	L
Spain	284	665	D,C	D,C	ALL	L
Sweden	339	443	T2/T3 + T1	CS	ALL	M
United Kingdom	2.333	2.805	T2	CS/D/C	ALL	L
EU15	13.186	15.196	C,CS,D,T1,T2,T3	C,CS,D,PS	ALL	L

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 1.A.1.a: 'Electricity and heat production' account for 0.3 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source increased by 20 % in the EU-15 (Table 3.6). Most Member States had increases in this source during this time. The countries contributing the most to the increasing trend were Spain, Greece, France and the United Kingdom. In absolute terms, Germany had the highest decrease in these emissions.

Table 3.6 Member States' contributions to N_2O emissions from 1.A.1.a: 'Electricity and heat production'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	44	59	65	0,5%	5	9%	21	48%	C	NS, PS	CS
Belgium	79	46	46	0,3%	0	0%	-33	-42%	C	PS, RS	D, C
Denmark	260	247	298	2,2%	52	21%	38	15%	C	NS, PS	CS, C
Finland	259	464	523	3,9%	59	13%	264	102%	T2 (CS)	PS	CS, PS
France	592	883	925	6,9%	42	5%	334	56%	C	PS	CS
Germany	3.651	3.387	3.462	25,9%	75	2%	-189	-5%	T2	NS	CS
Greece	1.688	2.075	2.119	15,9%	43	2%	431	26%	C	NS	C
Ireland	427	604	540	4,0%	-64	-11%	113	27%	T3	NS, PS	C
Italy	1.532	1.755	1.861	13,9%	106	6%	329	21%	T3	NS, PS	D
Luxembourg	0	1	0	0,0%	-1	-100%	0	-			
Netherlands	150	201	205	1,5%	3	2%	54	36%	CS, T1	Q	PS/D
Portugal	52	100	85	0,6%	-14	-15%	34	66%	T2	PS	CS
Spain	197	595	554	4,1%	-41	-7%	356	181%	D, C	Q	D, C
Sweden	303	353	403	3,0%	51	14%	100	33%	T2, T3	PS	CS
United Kingdom	1.922	2.162	2.265	17,0%	103	5%	342	18%	T2	NS	CS, D, C
EU15	11.157	12.932	13.351	100,0%	418	3%	2.194	20%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.2. Manufacturing industries and construction (CRF Source Category 1.A.2)

Table 3.7 and Table 3.8 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO_2 from 1.A.2: 'Manufacturing industries and construction'.

Table 3.7 Member States' contributions to CO_2 emissions from 1.A.2: 'Manufacturing industries and construction' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	12.971	14.163	C	CS	ALL	H
Belgium	32.882	30.361	C	C, CS		
Denmark	5.376	5.404	C	CS	ALL	H
Finland	14.925	13.824	CS (T2)	CS/PS/D	ALL	H
France	83.256	77.634	C	CS	ALL	H
Germany	196.315	129.056	D,CS	D,CS	All	H
Greece	10.491	10.000	C	C	ALL	
Ireland	3.833	4.785	T1	PS, CS	Full	H
Italy	84.969	85.035	T2	CS	ALL	H
Luxembourg	5.258	2.301	C/D	C/D		
Netherlands	32.768	27.056	T2	PS, CS,D	ALL	H
Portugal	9.103	10.722	T2	D+C	All	H
Spain	45.761	67.235	D,C,CS	D.C,PS	ALL	H
Sweden	10.724	11.129	T2/T3 + T1	CS	ALL	H
United Kingdom	97.291	87.720	T2	CS	ALL	H
EU15	645.923	576.424	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.2: 'Manufacturing industries and construction' is the third largest key source in the EU-15 accounting for 14 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from manufacturing industries declined by 11 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which decreased by 4 % between 1990 and 2003. Also in industry a shift from solid fuels to gas took place.

Between 1990 and 2003, Germany shows by far the largest emission reductions in absolute terms. Also France, Belgium, the United Kingdom, Luxembourg and the Netherlands show emission reductions of more than two million tonnes, whereas large emission increases occurred mainly in Spain. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification.

Table 3.8 Member States' contributions to CO_2 emissions from 1.A.2: 'Manufacturing industries and construction'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	12.971	14.395	14.163	2,5%	-231	-2%	1.193	9%	C	NS	CS, PS
Belgium	32.882	30.593	30.361	5,3%	-232	-1%	-2.521	-8%	C	RS	C, CS
Denmark	5.376	5.559	5.404	0,9%	-154	-3%	28	1%	C	NS	CS, C
Finland	14.925	13.196	13.824	2,4%	628	5%	-1.101	-7%	T2 (CS)	PS	D, CS, PS
France	83.256	78.580	77.634	13,5%	-946	-1%	-5.621	-7%	C	NS, AS, PS	CS
Germany	196.315	132.054	129.056	22,4%	-2.998	-2%	-67.259	-34%	D, CS	NS	D, CS
Greece	10.491	10.255	10.000	1,7%	-255	-2%	-491	-5%	C	NS	C
Ireland	3.833	4.892	4.785	0,8%	-107	-2%	952	25%	T1	NS, PS	C
Italy	84.969	79.890	85.035	14,8%	5.144	6%	66	0%	T2	NS	CS
Luxembourg	5.258	2.341	2.301	0,4%	-40	-2%	-2.956	-56%			
Netherlands	32.768	26.662	27.056	4,7%	393	1%	-5.712	-17%	CS, T2	NS, Q	PS, D
Portugal	9.103	11.049	10.722	1,9%	-327	-3%	1.619	18%	D	NS, PS	D, CS
Spain	45.761	63.186	67.235	11,7%	4.049	6%	21.473	47%	D, C, CS	NS, IS, Q	D, C, PS
Sweden	10.724	10.515	11.129	1,9%	614	6%	404	4%	T2, T3	PS	CS
United Kingdom	97.291	83.218	87.720	15,2%	4.501	5%	-9.571	-10%	T2	AS, NS	CS
EU15	645.923	566.385	576.424	100,0%	10.039	2%	-69.499	-11%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.3 Transport (CRF Source Category 1.A.3)

Table 3.9 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO_2 emissions from 1.A.3: 'Transport'. CO_2 emissions from 'Transport' increased by 23 % between 1990 and 2003. Most Member States had increases in this source during this time. The growth was less than 10 % only in Finland, the United Kingdom, Sweden and Germany.

This source category includes four key sources: CO_2 from 1.A.3.a: 'Civil Aviation', 1.A.3.b: 'Road transportation', 1.A.3.c: 'Railways', and 1.A.3.d: 'Navigation'.

Table 3.9 Member States' contributions to CO_2 emissions from 1.A.3: 'Transport' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	12.405	22.692	M, CS	CS	ALL	H
Belgium	19.752	25.297	C,M	C,M		
Denmark	10.441	12.785	M/C	CS	ALL	H
Finland	12.316	13.067	CS (M)	CS	ALL	H
France	119.100	141.384	C /CS /M	C /M /CS	ALL	H
Germany	162.360	170.209	T1,T3,CS	CS	All	H
Greece	15.355	21.230	C, T2a	C, T2a	ALL	
Ireland	5.020	11.393	T1	CS	Full	H
Italy	101.858	126.015	D, T1, T2a, C	CS	ALL	H
Luxembourg	2.724	6.019	C/D	C/D		
Netherlands	26.008	34.157	T2	CS, D	ALL	H
Portugal	10.137	19.583	M	D+C	All	H
Spain	56.513	95.499	D,C	D,C	ALL	H
Sweden	18.352	20.056	T1, T2, CS	CS	ALL	H
United Kingdom	117.209	125.974	T3	CS	ALL	H
EU15	689.550	845.361	C,CS,D,M,T1, T2, T2a, T3	C, CS, D, M, T2a	ALL	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.3.a 'Civil aviation' account for 0.5 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from civil aviation increased by 29 % in the EU-15 (Table 3.10).

The Member States France, Spain and Germany contributed the most to the emissions from this source (66 %). Most Member States increased emissions from civil aviation between 1990 and 2003. The Member States with the highest increases in absolute terms were Germany, Italy and Spain. The countries with the most reductions were Greece and Denmark.

Table 3.10 Member States' contributions to CO_2 emissions from 1.A.3.a: 'Civil aviation'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	32	75	67	0,3%	-8	-11%	35	109%	CS	NS	CS
Belgium	12	15	15	0,1%	0	0%	3	22%	C, M	PS	C
Denmark	243	140	138	0,6%	-2	-2%	-105	-43%	C	NS	C
Finland	320	313	316	1,4%	4	1%	-4	-1%	T2 (M)	NS	CS
France	4.541	5.501	5.186	23,0%	-315	-6%	645	14%	M	NS	M
Germany	2.897	4.205	4.288	19,0%	82	2%	1.390	48%	T1	NS	CS
Greece	1.455	1.218	1.164	5,2%	-54	-4%	-291	-20%	T2a	NS, AS	T2a
Ireland	59	105	103	0,5%	-2	-2%	43	74%	T2a	NS	CS
Italy	1.596	2.677	2.771	12,3%	94	4%	1.175	74%	T1, T2a	NS	CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	41	41	41	0,2%	0	0%	0	0%	CS	NS	CS
Portugal	245	375	394	1,7%	18	5%	149	61%	T2b	NS, AS	D
Spain	4.135	5.091	5.397	23,9%	306	6%	1.262	31%	D, C	NS, IS	C
Sweden	673	601	582	2,6%	-18	-3%	-91	-14%	T1	NS	CS
United Kingdom	1.282	2.074	2.115	9,4%	41	2%	833	65%	T3	NS	CS
EU15	17.532	22.431	22.576	100,0%	146	1%	5.045	29%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.3.b: 'Road transportation' is the second largest key source in the EU-15 accounting for 19 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from road transportation increased by 24 % in the EU-15 (Table 3.11). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 24 % between 1990 and 2003.

The Member States Germany, France and the United Kingdom contributed the most to the emissions from this source (53 %). All Member States increased emissions from road transportation between 1990 and 2003. The Member States with the highest increases in absolute terms were Spain, France and Italy. The country with the lowest increase were Finland and Germany.

Table 3.11 Member States' contributions to CO_2 emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	11.924	20.138	21.883	2,8%	1.745	9%	9.959	84%	M	NS	CS
Belgium	19.270	24.279	24.813	3,1%	534	2%	5.543	29%	C, M, CS	NS	C, CS
Denmark	9.351	11.388	11.864	1,5%	476	4%	2.513	27%	COPERT3	NS	C
Finland	10.800	11.206	11.447	1,4%	241	2%	647	6%	T2 (M)	NS	CS
France	111.403	132.594	132.260	16,7%	-335	0%	20.857	19%	M	NS	M
Germany	150.262	165.898	159.842	20,2%	-6.056	-4%	9.581	6%	T3	NS	CS
Greece	11.873	16.979	18.015	2,3%	1.036	6%	6.142	52%	COPERT3	NS	C
Ireland	4.680	10.833	10.993	1,4%	160	1%	6.313	135%	T1	NS	CS
Italy	93.995	115.119	116.346	14,7%	1.226	1%	22.350	24%	COPERT3	NS, AS	CS
Luxembourg	2.708	5.396	5.993	0,8%	597	11%	3.285	121%			
Netherlands	25.472	32.853	33.433	4,2%	580	2%	7.960	31%	T1	NS	CS
Portugal	9.249	18.831	18.747	2,4%	-84	0%	9.498	103%	D	NS	D
Spain	50.442	83.014	87.135	11,0%	4.120	5%	36.692	73%	COPERT3	NS, IS	CS
Sweden	16.677	18.222	18.414	2,3%	192	1%	1.737	10%	T1	NS	CS
United Kingdom	110.467	119.742	119.548	15,1%	-194	0%	9.080	8%	T3	NS	CS
EU15	638.574	786.493	790.731	100,0%	4.238	1%	152.157	24%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.3.c: 'Railways' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from rail transportation decreased by 40 % in the EU-15 (Table 3.12). The emissions from this key source are due to fossil fuel consumption in rail transport, which decreased by 41 % between 1990 and 2003.

The Member States France, Germany and the United Kingdom contributed the most to the emissions from this source (66 %). Nearly all Member States decreased emissions from rail transportation between 1990 and 2003, only Luxembourg and the Netherlands increased their emissions. The Member States with the highest decreases in absolute terms were Germany and the United Kingdom.

Table 3.12 Member States' contributions to CO_2 emissions from 1.A.3.c: 'Railways'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	174	177	174	3,5%	-2	-1%	0	0%	M	NS	CS
Belgium	202	130	126	2,5%	-4	-3%	-76	-38%	C, M	RS	C
Denmark	297	210	218	4,4%	8	4%	-78	-26%	C	NS	C
Finland	191	134	134	2,7%	0	0%	-58	-30%	T2 (M)	NS	CS
France	1.070	743	703	14,1%	-40	-5%	-367	-34%	C	NS	CS
Germany	2.879	1.675	1.612	32,3%	-64	-4%	-1.268	-44%	T1	NS	CS
Greece	203	129	129	2,6%	0	0%	-74	-37%	C	NS	C
Ireland	147	124	125	2,5%	0	0%	-23	-15%	T1	NS	CS
Italy	441	383	207	4,2%	-175	-46%	-234	-53%	D	NS	CS
Luxembourg	13	21	21	0,4%	0	0%	8	64%			
Netherlands	91	106	103	2,1%	-3	-3%	12	14%	T1	AS	CS
Portugal	173	110	95	1,9%	-15	-14%	-78	-45%	D	NS	D
Spain	415	305	310	6,2%	5	2%	-105	-25%	D, C	Q	C
Sweden	105	70	66	1,3%	-4	-6%	-39	-37%	CS	AS	CS
United Kingdom	1.915	1.065	963	19,3%	-102	-10%	-952	-50%	T2	NS	CS
EU15	8.316	5.382	4.985	100,0%	-397	-7%	-3.331	-40%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.3.d: 'Navigation' account for 0.5 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from navigation increased by 7 % in the EU-15 (Table 3.13). The emissions from this key source are due to fossil fuel consumption in navigation, which increased by 7 % between 1990 and 2003.

Four Member States (Italy, France, Spain and the United Kingdom) contributed the most to the emissions from this source (71 %). Nearly all Member States increased emissions from navigation between 1990 and 2003, only Germany, Ireland, Portugal and the United Kingdom decreased their emissions. The Member States with the highest decreases in absolute terms were Germany and the United Kingdom.

Table 3.13 Member States' contributions to CO_2 emissions from 1.A.3.d: 'Navigation'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	52	80	84	0,4%	5	6%	32	62%	M	NS	CS
Belgium	267	339	343	1,7%	4	1%	76	28%	C, M	RS	C
Denmark	551	581	565	2,8%	-15	-3%	14	3%	C	NS	C
Finland	361	501	519	2,6%	18	4%	158	44%	T2 (M)	NS	CS
France	1.873	2.419	2.565	12,6%	146	6%	691	37%	C	NS	CS
Germany	2.050	738	769	3,8%	32	4%	-1.280	-62%	T1	NS	CS
Greece	1.825	1.937	1.923	9,5%	-14	-1%	98	5%	C	NS	C
Ireland	85	59	61	0,3%	2	3%	-24	-29%	T1	NS	CS
Italy	5.419	6.085	6.148	30,2%	62	1%	729	13%	T1, T2	NS	CS
Luxembourg	4	6	6	0,0%	0	0%	2	46%			
Netherlands	403	580	580	2,9%	0	0%	176	44%	CS	NS, Q	CS
Portugal	470	221	347	1,7%	126	57%	-123	-26%	D	NS	D
Spain	1.500	2.287	2.374	11,7%	87	4%	874	58%	C	AS, IS	C
Sweden	658	669	752	3,7%	83	12%	94	14%	T1	NS	CS
United Kingdom	3.511	1.775	3.297	16,2%	1.522	86%	-214	-6%	T1	NS	CS
EU15	19.028	18.277	20.332	100,0%	2.055	11%	1.304	7%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.3.e: 'Other' account for 0.2 % of total EU-15 GHG emissions in 2003. This source includes mainly pipeline transport and ground activities in airports and harbours. Between 1990 and 2003, CO_2 emissions from 'Other' sources increased by 10 % in the EU-15 (Table 3.14). The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 15 % between 1990 and 2003. A fuel shift occurred from oil to gas.

Two Member States (Germany and France) contributed the most to the emissions from this source (65 %). Several Member States increased emissions from other sources between 1990 and 2003.

Table 3.14 Member States' contributions to CO_2 emissions from 1.A.3.e: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	223	505	484	7,2%	-20	-4%	262	117%	C	NS	CS
Belgium	0	0	0	0,0%	0	-	0	-	C, M	RS	C
Denmark	0	0	0	0,0%	0	-	0	-	NO	NO	NO
Finland	644	656	651	9,7%	-4	-1%	8	1%	T2 (M)	NS	CS
France	213	583	671	10,0%	87	15%	457	214%	C	PS	CS
Germany	4.272	3.717	3.699	54,9%	-19	-1%	-573	-13%	T1	NS	CS
Greece	NO	NO	NO	-	-	-	-	-			
Ireland	48	109	112	1,7%	3	3%	63	131%			
Italy	406	643	543	8,1%	-100	-16%	137	34%	D	NS	CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	NO	NO	NO	-	-	-	-	-	T1	NS, Q	D
Portugal	0	0	0	0,0%	0	-	0	-	NO	NO	NO
Spain	20	283	283	4,2%	0	0%	263	1298%	C	NS	C
Sweden	239	240	242	3,6%	2	1%	4	2%	T1	NS	CS
United Kingdom	34	49	51	0,8%	2	3%	16	48%	M	NS	CS
EU15	6.099	6.785	6.736	100,0%	-49	-1%	637	10%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.15 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 emissions from 1.A.3: 'Transport'. CH_4 emissions from transport decreased by 47 % between 1990 and 2003. Most Member States had decreases in this source during this time.

This source category includes one key source: CH_4 from 1.A.3.b: 'Road transportation'.

Table 3.15 Member States' contributions to CH_4 emissions from 1.A.3: 'Transport' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	61	23	M, T1	CS	ALL	M
Belgium	73	40	C,M	C,M		
Denmark	57	65	M/C	M/C	ALL	M
Finland	103	59	CS (M)	CS/M	ALL	M
France	770	517	C /CS	C /M /CS	ALL	L
Germany	1.334	240	T1,CS	M,CS	All	M
Greece	114	164	C, T2a	C, T2a	ALL	
Ireland	37	49	T1	C	Full	L
Italy	775	615	D, T1, T2a, C	C, CS	ALL	M
Luxembourg	7	9	C/D	C/D		
Netherlands	158	74	CS/T3(road);CS/T1/T2(non-r)	CS (road),D	ALL	M
Portugal	58	53	M	D+C+CS	All	M
Spain	237	194	C	C	ALL	L
Sweden	269	139	T1, T2, CS	CS, C	PART	M
United Kingdom	625	217	T2/T3	D/C	ALL	L
EU15	4.678	2.457	C,CS,D,M,T1, T2, T2a, T3	C,CS,D,M, T2a	ALL,PART	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 1.A.3.b: 'Road transportation' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from 'Road transportation' sources decreased by 48 % in the EU-15 (Table 3.16). Two Member States (Italy and France) contributed the most to the emissions from this source (46 %). Most Member States reduced CH_4 emissions from 'Road transportation' between 1990 and 2003. The Member State with the highest decreases in absolute terms was Germany.

Table 3.16 Member States' contributions to CH_4 emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	61	23	22	0,9%	-1	-6%	-39	-64%	M	NS, Q	CS
Belgium	72	41	39	1,7%	-2	-5%	-33	-45%	C, M	RS	C
Denmark	55	63	62	2,6%	-1	-2%	7	13%	COPERT3	NS	C
Finland	90	50	47	2,0%	-3	-5%	-42	-47%	T3 (M)	NS	CS
France	763	551	511	21,7%	-40	-7%	-252	-33%	M	NS	M
Germany	1.317	269	229	9,7%	-40	-15%	-1.088	-83%	T3	NS	CS, M
Greece	108	156	158	6,7%	3	2%	50	46%	COPERT3	NS	C
Ireland	37	52	49	2,1%	-3	-6%	12	33%	T3	NS	COPERT3
Italy	743	613	579	24,6%	-33	-5%	-164	-22%	COPERT3	NS, AS	CS
Luxembourg	7	9	9	0,4%	0	-1%	2	34%			
Netherlands	157	77	72	3,1%	-5	-6%	-84	-54%	T3	NS, Q	CS
Portugal	56	55	52	2,2%	-4	-7%	-4	-8%	M	NS, AS	C
Spain	234	189	189	8,0%	0	0%	-45	-19%	COPERT3	NS, IS	CS
Sweden	262	144	132	5,6%	-12	-8%	-130	-50%	T2	NS	CS
United Kingdom	614	238	207	8,8%	-31	-13%	-407	-66%	T3	NS	CS
EU15	4.576	2.531	2.359	100,0%	-172	-7%	-2.217	-48%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.17 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the N_2O emissions from 1.A.3: 'Transport'. N_2O emissions from 'Transport' increased by 134 % between 1990 and 2003. All Member States had increases in this source during this time. This source category includes one key source: N_2O from 1.A.3.b: 'Road transportation'.

Table 3.17 Member States' contributions to N_2O emissions from 1.A.3: 'Transport' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	171	281	M, T1	CS	ALL	M
Belgium	356	797	C,M	C,M		
Denmark	147	429	M/C	M/C	ALL	L
Finland	173	529	CS (M)	CS/M	ALL	L
France	1.666	4.346	C /CS	C /M /CS	ALL	L
Germany	3.079	4.237	T1,T2,T3,CS	M,CS	All	M
Greece	175	463	C, T2a	C, T2a	ALL	
Ireland	87	409	T1	C	Full	L
Italy	1.724	3.769	D, T1, T2a, C	C, CS	ALL	M
Luxembourg	12	56	C/D	C/D		
Netherlands	272	472	CS/T3(road);CS/T1(non-r)	CS(road)/D(rest)	ALL	L
Portugal	145	531	M	D+C+CS	All	M
Spain	782	2.412	D,C	D,C	ALL	L
Sweden	324	715	T1, T2, CS	CS, C	ALL	M
United Kingdom	1.337	5.046	T2/T3	D	ALL	L
EU15	10.449	24.492	C, CS, D, M, T1, T2,T2a,T3	C, CS, D, M	ALL	L

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 1.A.3.b: 'Road transportation' account for 0.6 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from 'Road transportation' increased by 150 % in the EU-15 (Table 3.18). The emissions have been increasing through the 1990s as the number of cars equipped with a catalytic converter (with higher emission factors than cars without a catalytic converter) has increased.

Three Member States (the United Kingdom, Germany, Italy and France) contributed the most to the emissions from this source (71 %). All Member States increased N_2O emissions from 'Road transportation' between 1990 and 2003. The Member States with the highest increases in absolute terms were the United Kingdom, France and Italy.

Table 3.18 Member States' contributions to N_2O emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	160	270	268	1,1%	-1	-1%	109	68%	M	NS, Q	CS
Belgium	297	735	739	3,1%	3	0%	442	149%	C, M	RS	C
Denmark	131	394	415	1,8%	21	5%	284	217%	COPERT3	NS	C
Finland	160	481	516	2,2%	35	7%	356	223%	T3 (M)	NS	CS
France	1.592	4.110	4.258	18,0%	147	4%	2.666	167%	M	NS	M
Germany	2.932	4.475	4.093	17,3%	-382	-9%	1.161	40%	T3	NS	CS, M
Greece	123	375	421	1,8%	46	12%	299	243%	COPERT3	NS	C
Ireland	56	369	383	1,6%	14	4%	327	582%	T3	NS	COPERT3
Italy	1.612	3.545	3.670	15,5%	125	4%	2.058	128%	COPERT3	NS, AS	CS
Luxembourg	12	53	53	0,2%	0	-1%	41	345%			
Netherlands	271	482	470	2,0%	-12	-2%	199	74%	T3	NS, Q	CS
Portugal	128	509	518	2,2%	9	2%	391	306%	M	NS, AS	C
Spain	678	2.139	2.298	9,7%	160	7%	1.620	239%	COPERT3	NS, IS	CS
Sweden	261	640	661	2,8%	21	3%	400	153%	T2	NS	CS, C
United Kingdom	1.028	4.669	4.842	20,5%	173	4%	3.814	371%	T3	NS	CS
EU15	9.440	23.246	23.606	100,0%	360	2%	14.165	150%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.4 Other sectors (CRF Source Category 1.A.4)

Table 3.19 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the source 1.A.4: 'Other sectors'. CO_2 emissions from 'Other sectors' increased by 1 % between 1990 and 2003. Most Member States had increases in this source during this time. The relative growth was highest in Greece (78 %).

This source category includes three key sources: CO_2 from 1.A.4.a: 'Commercial/Institutional', CO_2 from 1.A.4.b: 'Residential' and CO_2 from 1.A.4.c: 'Agriculture/forestry/fisheries'.

Table 3.19 Member States' contributions to CO_2 emissions from 1.A.4: 'Other sectors' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	14.392	14.702	C	CS	ALL	H
Belgium	27.232	31.239	C	C		
Denmark	9.129	7.402	C	CS	ALL	H
Finland	6.968	6.031	CS (T2, T1)	CS/D	ALL	H
France	94.417	100.454	C	CS	ALL	H
Germany	204.414	177.792	CS	CS	All	H
Greece	8.026	14.295	C	C	ALL	
Ireland	9.726	10.263	T1	CS	Full	H
Italy	76.262	84.162	T2	CS	ALL	H
Luxembourg	1.277	1.368	C/D	C/D		
Netherlands	37.431	40.151	T2	D, CS	ALL	H
Portugal	4.025	6.595	T2	D+C	All	H
Spain	25.773	35.813	D,C	D,C	ALL	H
Sweden	10.506	6.166	T2/T3 + T1	CS	ALL	H
United Kingdom	110.175	111.020	T2	CS	ALL	H
EU15	639.753	647.453	C,CS,D,T1,T2,T3	C, CS, D	ALL	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.4.a: 'Commercial/institutional' are the fifth largest key source of GHG emissions in the EU-15 and account for 3.9 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from services decreased by 1 % in the EU-15 (Table 3.20). Main factors influencing CO_2 emissions from this key source are (1) outdoor temperature, (2) number and size of offices, (3) building codes, (4) age distribution of the existing building stock, and (5) fuel split for heating and warm water. Fossil fuel consumption in services increased by 8 % between 1990 and 2003, with a fuel shift from coal and oil to gas.

The Member States Germany, France and the United Kingdom contributed the most to the emissions from this source (64 %). The Member States with the highest increases in absolute terms were Spain, Italy and the Netherlands. The Member State with the highest reduction was Germany.

Table 3.20 Member States' contributions to CO_2 emissions from 1.A.4.a: 'Commercial/institutional'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2.214	1.656	1.823	1,1%	167	10%	-391	-18%	C	NS	CS
Belgium	4.278	6.068	6.419	4,0%	351	6%	2.141	50%	C	RS	C
Denmark	1.403	874	854	0,5%	-20	-2%	-549	-39%	C	NS	CS, C
Finland	1.915	1.219	1.314	0,8%	95	8%	-601	-31%	T1, T2	NS, PS	D, CS
France	28.126	27.814	29.745	18,5%	1.931	7%	1.619	6%	C	NS	CS
Germany	61.816	47.431	48.694	30,3%	1.264	3%	-13.121	-21%	CS	NS	CS
Greece	527	1.030	1.131	0,7%	101	10%	604	115%	C	NS	C
Ireland	2.314	2.999	3.044	1,9%	45	1%	730	32%	T1	NS	CS
Italy	15.579	17.326	19.413	12,1%	2.087	12%	3.834	25%	T2	NS	CS
Luxembourg	607	656	646	0,4%	-11	-2%	38	6%			
Netherlands	7.419	10.399	11.405	7,1%	1.006	10%	3.985	54%	CS	NS	CS
Portugal	744	2.804	3.246	2,0%	442	16%	2.503	337%	D	NS	D
Spain	3.783	7.986	7.905	4,9%	-81	-1%	4.122	109%	D, C	IS	D, C
Sweden	2.532	1.227	1.134	0,7%	-93	-8%	-1.398	-55%	T1	NS	CS
United Kingdom	29.447	25.036	24.047	15,0%	-988	-4%	-5.400	-18%	T2	NS	CS
EU15	162.704	154.523	160.818	100,0%	6.295	4%	-1.886	-1%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.4.b: 'Residential' are the fourth largest key source of GHG emissions in the EU-15 and account for 10 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from households increased by 5 % in the EU-15 (Table 3.21). Main factors influencing CO_2 emissions from this key source are (1) outdoor temperature, (2) number and size of dwellings, (3) building codes, (4) age distribution of the existing building stock, and (5) fuel split for heating and warm water. Fossil fuel consumption in households increased by 13 % between 1990 and 2003, with a fuel shift from coal and oil to gas.

Between 1990 and 2003, the largest reduction in absolute terms was reported by Germany reducing emissions by seven million tonnes. Also Denmark and Sweden show emission reductions of more than 1 million tonnes. The United Kingdom had the largest emission increases in absolute terms. One reason for the performance of the Nordic countries seems to be 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.

Table 3.21 Member States' contributions to CO_2 emissions from 1.A.4.b 'Residential'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	10.130	10.234	11.087	2,6%	853	8%	957	9%	C	NS	CS
Belgium	20.224	21.231	22.527	5,3%	1.297	6%	2.304	11%	C	RS	C
Denmark	5.033	4.027	3.971	0,9%	-55	-1%	-1.061	-21%	C	NS	CS, C, D
Finland	3.059	2.675	2.652	0,6%	-23	-1%	-408	-13%	T1	NS	D, CS
France	55.572	57.688	60.821	14,3%	3.133	5%	5.249	9%	C	NS	CS
Germany	129.279	120.090	122.442	28,8%	2.353	2%	-6.837	-5%	CS	NS	CS
Greece	4.684	8.518	10.036	2,4%	1.518	18%	5.352	114%	C	NS	C
Ireland	6.752	6.461	6.382	1,5%	-78	-1%	-370	-5%	T1	NS	CS
Italy	52.337	52.300	56.378	13,3%	4.078	8%	4.041	8%	T2	NS	CS
Luxembourg	609	658	648	0,2%	-11	-2%	39	6%			
Netherlands	19.264	18.663	19.122	4,5%	459	2%	-142	-1%	CS	NS	CS
Portugal	1.621	2.260	2.273	0,5%	13	1%	652	40%	D	NS	D
Spain	12.982	17.381	17.522	4,1%	141	1%	4.541	35%	D, C	IS	D, C
Sweden	6.417	3.695	3.420	0,8%	-275	-7%	-2.997	-47%	T1	NS	CS
United Kingdom	77.502	86.865	85.750	20,2%	-1.115	-1%	8.248	11%	T2	NS	CS
EU15	405.465	412.746	425.033	100,0%	12.287	3%	19.568	5%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.4.c: 'Agriculture/forestry/fisheries' account for 1.5 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from 'Agriculture/forestry/fisheries' decreased by 14 % in the EU-15 (Table 3.22).

Three Member States (Spain, France and the Netherlands) contributed the most to the emissions from this source (49 %). The Member State with the highest increase in absolute terms was Spain, the highest decreases were in Germany, the United Kingdom and the Netherlands. In the Netherlands, this decrease was due to significant energy conservation measures in the greenhouse horticulture which account for approximately 85 % of the primary energy use of the Dutch agricultural sector.

Table 3.22 Member States' contributions to CO_2 emissions from 1.A.4.c: 'Agriculture/forestry/fisheries'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2.048	1.772	1.792	2,9%	19	1%	-256	-13%	C	NS	CS
Belgium	2.730	2.308	2.293	3,7%	-15	-1%	-437	-16%	C	RS	C
Denmark	2.693	2.580	2.577	4,2%	-3	0%	-117	-4%	C	NS	CS, C
Finland	1.994	2.045	2.066	3,4%	20	1%	72	4%	T1, T2	NS	D, CS
France	10.719	10.203	9.888	16,1%	-316	-3%	-831	-8%	C	NS	CS
Germany	13.319	6.732	6.655	10,8%	-77	-1%	-6.664	-50%	CS	NS	CS
Greece	2.815	2.713	3.128	5,1%	415	15%	313	11%	C	NS	C
Ireland	660	836	837	1,4%	0	0%	177	27%	T1	NS	CS
Italy	8.347	8.285	8.372	13,6%	86	1%	25	0%	T2	NS	CS
Luxembourg	61	75	75	0,1%	0	0%	14	23%			
Netherlands	10.747	9.721	9.624	15,6%	-97	-1%	-1.123	-10%	CS	NS, Q	CS
Portugal	1.660	1.327	1.076	1,7%	-252	-19%	-584	-35%	D	NS	D
Spain	9.008	10.381	10.386	16,9%	6	0%	1.378	15%	D, C	NS, IS	D, CS
Sweden	1.557	1.560	1.612	2,6%	53	3%	55	4%	T1	NS	CS
United Kingdom	3.227	2.054	1.223	2,0%	-831	-40%	-2.003	-62%	T2, M	NS	CS
EU15	71.585	62.594	61.602	100,0%	-992	-2%	-9.983	-14%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.23 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 from 1.A.4: 'Other sectors'. CH_4 emissions from 'Other sectors' decreased by 32 % between 1990 and 2003. Most Member States had decreases in this source during this time. The relative growth was highest in Denmark (83 %), the decrease was highest in Germany (74 %).

This source category includes one key source: CH_4 from 1.A.4.a: 'Residential'.

Table 2.23 Member States' contributions to CH_4 emissions from 1.A.4: 'Other sectors' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	397	293	C	CS	ALL	L
Belgium	129	94	C	D		
Denmark	90	165	C	CS/C	ALL	M
Finland	304	324	CS (T2, T1)	CS/PS	ALL	L
France	3.985	3.375	C	CS	ALL	L
Germany	2.559	669	T2	CS	All	M
Greece	214	211	C	C	ALL	
Ireland	89	44	T1	C	Full	L
Italy	310	480	T2	C	ALL	M
Luxembourg	12	7	C/D	C/D		
Netherlands	393	390	T2	CS	ALL	M
Portugal	348	314	T2	D+C	All	L
Spain	820	653	C	C	ALL	L
Sweden	225	243	T2/T3 + T1	CS	ALL	M
United Kingdom	1.468	477	T2	CS/C/D	ALL	L
EU15	11.341	7.740	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL	L

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 1.A.4.b: 'Residential' account for 0.2 % of total GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from households decreased by 26 % in the EU-15. France contributed by 47 % to this source. Between 1990 and 2003, the largest reduction in absolute terms was reported by Germany and France.

Table 3.24 Member States' contributions to CH_4 emissions from 1.A.4.b: 'Residential'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	385	242	260	3,7%	18	7%	-124	-32%	C	NS	CS
Belgium	122	83	86	1,2%	2	3%	-36	-30%	C	RS	D
Denmark	67	97	99	1,4%	2	2%	32	48%	C	NS	CS, C
Finland	240	269	269	3,8%	-1	0%	29	12%	T1	NS	D, CS
France	3.906	3.010	3.308	46,6%	298	10%	-598	-15%	C	NS	CS
Germany	1.200	553	578	8,1%	25	5%	-621	-52%	T2	NS	CS
Greece	205	207	204	2,9%	-3	-2%	-1	-1%	C	NS	C
Ireland	84	44	36	0,5%	-8	-18%	-47	-57%	T1	NS	C
Italy	260	343	369	5,2%	26	8%	109	42%	T2	NS	C
Luxembourg	6	3	3	0,0%	0	1%	-3	-45%			
Netherlands	356	343	346	4,9%	3	1%	-10	-3%	CS	NS, Q	PS, CS
Portugal	344	303	308	4,3%	5	2%	-36	-10%	T2	NS	CS
Spain	775	603	612	8,6%	9	1%	-163	-21%	C	IS	C
Sweden	216	212	234	3,3%	22	10%	18	8%	T1	CS	CS
United Kingdom	1.381	605	389	5,5%	-216	-36%	-992	-72%	T1, T2, M	NS	CS, C
EU15	9.546	6.920	7.101	100,0%	182	3%	-2.445	-26%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.25 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates from 1.A.4: 'Other sectors'. N_2O emissions from 'Other sectors' decreased by 6 % between 1990 and 2003. Most Member States had decreases in this source during this time. The relative growth was highest in Greece (42 %), the decrease was highest in Germany.

This source category includes one key source: N_2O from 1.A.4.b: 'Residential'.

Table 3.25 Member States' contributions to N_2O emissions from 1.A.4: 'Other sectors' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	294	305	C	CS	ALL	L
Belgium	784	847	C	D		
Denmark	110	95	C	C	ALL	L
Finland	114	111	CS (T2, T1)	CS/PS	ALL	L
France	1.287	1.401	C	CS	ALL	L
Germany	1.037	575	T2	CS	All	M
Greece	631	894	C	C	ALL	
Ireland	328	399	T1	C	Full	L
Italy	3.439	3.322	T2	C	ALL	M
Luxembourg	6	0	C/D	C/D		
Netherlands	45	43	T1	D	ALL	L
Portugal	237	176	T2	D+C	All	L
Spain	304	330	D,C	D,C	ALL	L
Sweden	320	283	T2/T3 + T1	CS	PART	M
United Kingdom	599	212	T2	CS/D	ALL	L
EU15	9.534	8.995	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL, PART	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 1.A.4.b: 'Residential' account for 0.1 % of total GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from households decreased by 9 % in the EU-15 (Table 3.26). Italy and France contributed the most to this source (54 %). Between 1990 and 2003, the largest reductions in absolute terms was reported by Germany and Italy. Greece had the largest emission increases in absolute terms.

Table 3.26 Member States' contributions to N_2O emissions from 1.A.4.b: 'Residential'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	138	136	146	2,7%	10	8%	8	6%	C	NS	CS
Belgium	517	508	562	10,5%	54	11%	46	9%	C	RS	NS
Denmark	57	51	50	0,9%	0	-1%	-6	-11%	C	NS	C, CS
Finland	71	74	74	1,4%	0	0%	3	4%	T1	NS	D, CS
France	959	959	1.036	19,4%	77	8%	77	8%	C	NS	CS
Germany	799	385	394	7,4%	9	2%	-405	-51%	T2	NS	CS
Greece	283	422	480	9,0%	58	14%	197	70%	C	NS	C
Ireland	184	200	195	3,7%	-5	-2%	11	6%	T1	NS	C
Italy	2.122	1.772	1.853	34,7%	81	5%	-269	-13%	T2	NS	C
Luxembourg	3	3	0	0,0%	-3	-100%	-3	-100%			
Netherlands	26	23	23	0,4%	0	-2%	-4	-14%	CS	NS	D
Portugal	84	77	78	1,5%	1	1%	-6	-7%	T1	NS	CS
Spain	206	205	204	3,8%	0	0%	-2	-1%	D, C	IS	D, C
Sweden	134	106	110	2,1%	4	4%	-23	-17%	T1	CS	CS
United Kingdom	277	169	131	2,5%	-38	-22%	-146	-53%	T1, T2	NS	CS, D
EU15	5.861	5.091	5.338	100,0%	248	5%	-522	-9%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.5 Other (CRF Source Category 1.A.5)

Table 3.27 provides an overview of Member States' source allocation to Source Category 1.A.5: 'Other'.

Table 3.27 Member States' allocation of sources to 1.A.5: 'Other'

Member State	Source allocation to 1.A.5: 'Other'	Source
Austria	Mobile: Military	CRF Table 1.s.2
Belgium	Mobile: Military aviation	CRF Table 1.s.2
Denmark	Mobile: Emission from military combustion of fuels	CRF Table 1.s.2
Finland	Stationary + Mobile	CRF Table 1.s.2
France	No 'Other' emissions	CRF Table 1.s.2
Germany	Military: stationary and mobile	CRF Table 1.s.2
Greece	No 'Other' emissions	CRF Table 1.s.2
Ireland	No 'Other' emissions	CRF Table 1.s.2
Italy	Mobile	CRF Table 1.s.2
Luxembourg	No 'Other' emissions	CRF Table 1.s.2
Netherlands	Mobile: military fuel	CRF Table 1.s.2
Portugal	No 'Other' emissions	CRF Table 1.s.2
Spain	No 'Other' emissions	CRF Table 1.s.2
Sweden	Mobile: Military use	CRF Table 1.s.2
United Kingdom	Mobile: Military aircraft and naval vessels	CRF Table 1.s.2

Table 3.28 and Table 3.29 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source CO_2 from 1.A.5: 'Other'.

Table 3.28 Member States' contributions to CO_2 emissions from 1.A.5: 'Other' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	35	36	M, CS	CS	ALL	H
Belgium	166	96	C	C		
Denmark	119	92				
Finland	956	1.447	CS (T2, T1)	CS/D	ALL	H
France	0	0	C	CS	NO	
Germany	11.826	2.053	CS	CS	All	H
Greece	NO	NO			NO	
Ireland	NO	NO	NA	NA	NE	NE
Italy	1.041	660	T2	CS	ALL	H
Luxembourg	0	0	C/D	C/D		
Netherlands	566	437	CS/T2	CS	ALL	M
Portugal	8	0	T2	D+C		
Spain	NE	NE	NE		IE	
Sweden	845	299	T1	CS	ALL	H
United Kingdom	5.285	2.793	T2	CS	ALL	M
EU15	20.847	7.913	C,CS,D,M,T1, T2,T3	C, CS, D	ALL, IE, NE	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.A.5: 'Other' account for 0.2 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 62 % in the EU-15. The United Kingdom contributed by 35 % to these emissions. Between 1990 and 2003, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.29 Member States' contributions to CO_2 emissions from 1.A.5: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	35	41	36	0,5%	-5	-12%	1	3%	M	AS	CS
Belgium	166	96	96	1,2%	0	0%	-70	-42%	C	RS	C
Denmark	119	89	92	1,2%	3	4%	-27	-23%	C	NS	C
Finland	956	1.424	1.447	18,3%	23	2%	491	51%	T1, T2	NS	D, CS
France	0	0	0	0,0%	0	-	0	-	C	NS	CS
Germany	11.826	1.963	2.053	25,9%	90	5%	-9.773	-83%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-			
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	1.041	314	660	8,3%	347	111%	-381	-37%	T2	NS	CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	566	499	437	5,5%	-62	-12%	-129	-23%	CS, T2	NS, Q	CS
Portugal	8	0	0	0,0%	0	-	-8	-100%	D	NS	D
Spain	NE	NE	NE	-	-	-	-	-			
Sweden	845	319	299	3,8%	-19	-6%	-546	-65%	T1	NS	CS
United Kingdom	5.285	3.057	2.793	35,3%	-264	-9%	-2.492	-47%	T2	NS, AS	CS
EU15	20.847	7.801	7.913	100,0%	112	1%	-12.934	-62%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

Table 3.30 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO_2 emissions from 1.B.1: 'Fugitive emissions from solid fuels'. CO_2 emissions from 'Fugitive emissions from solid fuels' decreased by 31 % between 1990 and 2003. Most Member States did not report any emissions from this source.

Table 3.30 Member States' contributions to 1.B.1: 'Fugitive CO_2 emissions from solid fuels' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	0	0	NA	NA	NA	NA
Belgium	0	0	NA	NA		
Denmark	0	0	NO	0	NO	
Finland	503	547	CS	CS	ALL	L
France	0	0	C	CS	IE	H
Germany	NE	NE	NE	NE	NE	
Greece	0	0			PART	
Ireland	NO	0	NA	NA	NO	NA
Italy	0	0			NO	
Luxembourg	0	0	C/D	C/D		
Netherlands	403	464	CS/T2	CS	ALL	H
Portugal	9	0	MB	C	All	L
Spain	18	72	CS	PS	ALL	H
Sweden	947	700	T2/T3	CS	PART	H
United Kingdom	861	114	T2/T3	CS	ALL	M
EU15	2.740	1.898	C, CS, D, MB, T2, T3	C, CS, PS	ALL, IE, NE, PART	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1.B.1.b: 'Fugitive CO_2 emissions from solid fuel transformation' account for 0.02 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 49 % in the EU-15 (Table 3.31). Most Member States did not report emissions from this source. Of the two reporting Member States, Spain had emission increases between 1990 and 2003, and the United Kingdom had emission reductions.

Table 3.31 Member States' contributions to a 1.B.1.b: 'Fugitive CO_2 emissions from solid fuel transformation'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	IE	IE	IE	-	-	-	-	-	IE	IE	IE
Belgium	0	NA	NA	-	-	-	-	-	N/A	N/A	N/A
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	0	0	0	0,0%	0	-	0	-			
Germany	NE	NE	NE	-	-	-	-	-			
Greece	NE	NE	NE	-	-	-	-	-			
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	NO	NO	NO	-	-	-	-	-			
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	403	430	464	-	-	-	-	-	CS	NS, Q	CS
Portugal	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Spain	18	14	72	11,1%	58	399%	54	309%	CS	NS, Q	PS
Sweden	NA	NA	NA	-	-	-	-	-	N/A	N/A	N/A
United Kingdom	861	113	114	17,6%	2	2%	-746	-87%	T2, T3	NS, AS	CS
EU15	1.281	557	651	100,0%	93	17%	-630	-49%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.32 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CH_4 emissions from the source 1.B.1: 'Fugitive emissions from solid fuels'. CH_4 emissions from 'Fugitive emissions from solid fuels' decreased by 70 % between 1990 and 2003. In relative terms, Portugal had the highest reductions, while Greece had the highest increases in emissions from this source.

This source category includes one key source: CH_4 from 1.B.1.a: 'Fugitive emissions from coal-mining'.

Table 3.32 Member States' contributions to 1.B.1: 'Fugitive CH_4 emissions from solid fuels' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	11	8	T1	D	ALL	L
Belgium	44	22	C	C		
Denmark	72	93	D	D	ALL	L
Finland	5	6	CS	CS	ALL	L
France	4.331	1.058	C	CS	ALL	M
Germany	25.772	6.891	T2,CS	CS	All	L
Greece	1.095	1.441	T1	D	PART	
Ireland	0	0	NA	NA	NO	NA
Italy	122	95	T1	D, C,CS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	30	23	T1	C	ALL	M
Portugal	66	0	T2	D+C	All	L
Spain	1.789	1.009	C,CS	C,CS	ALL	M
Sweden	0	0	T2/T3	CS	ALL	M
United Kingdom	18.286	4.790	T2	CS	ALL	M
EU15	51.624	15.435	C,CS,D,T1,T2,T3	C, CS, D	ALL, PART	L

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 1.B.1.a: 'Fugitive CH_4 emissions from coal-mining' account for less than 0.4 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 70 % in the EU-15 (Table 3.33). Several Member States did not report emissions from this source. In 2003, the largest share on total emissions from this source had Germany and the United Kingdom (77 %). Both Member States reduced their emissions between 1990 and 2003 substantially due to the decline of coal-mining.

Table 3.33 Member States' contributions to a 1.B.1.a: 'Fugitive CH_4 emissions from coal-mining'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	11	8	8	0,1%	0	0%	-3	-26%	C	NS	C
Belgium	NE	NO	NO	-	-	-	-	-	NO	NO	NO
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	3.569	1.336	912	6,1%	-424	-32%	-2.656	-74%	C	AS	CS
Germany	25.644	7.260	6.871	45,6%	-389	-5%	-18.773	-73%	T2	NS	CS
Greece	1.095	1.487	1.441	9,6%	-46	-3%	346	32%	TS	NS	D
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	55	35	54	0,4%	19	53%	-1	-1%	T1	NS	D, CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Portugal	66	0	0	0,0%	0	-	-66	-100%	T1	NS	D
Spain	1.766	1.000	989	6,6%	-11	-1%	-776	-44%	CS	NS	CS
Sweden	NO	NO	NO	-	-	-	-	-	NO	NO	NO
United Kingdom	18.271	6.331	4.781	31,8%	-1.550	-24%	-13.490	-74%	T1, T2	NS, AS	CS
EU15	50.477	17.459	15.058	100,0%	-2.401	-14%	-35.419	-70%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.7 Fugitive emissions from oil and natural gas (CRF Source Category 1.B.2)

Table 3.34 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO_2 emissions from the source 1.B.2: 'Fugitive emissions from oil and natural gas'. CO_2 emissions from 'Fugitive emissions from oil and natural gas' decreased by 11 % between 1990 and 2003.

This source category includes one key source: CO_2 from 1.B.2.c: 'Venting and flaring'.

Table 3.34 Member States' contributions to 1.B.2: 'Fugitive CO_2 emissions from oil and natural gas' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	102	233	T1, CS	D, CS, PS	PART	L
Belgium	281	286	CS	CS		
Denmark	263	550	C	C	ALL	L
Finland	123	63	CS	PS	PART	M
France	4.306	3.861	C	CS	ALL	H
Germany	IE	IE	IE	IE	IE	
Greece	0	0	0	0	PART	
Ireland	139	59	T1	CS	Full	M
Italy	3.048	2.499	T2	CS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	839	405	CS/T3	CS	ALL	L
Portugal	118	754	MB	C+CS	Part	L
Spain	1.743	1.915	C,CS	C,PS	ALL	H
Sweden	100	80	T1 + T2	CS, D	PART	M
United Kingdom	6.764	5.226	T3	CS	ALL	H
EU15	17.826	15.931	C, CS, MB, T1, T3	C, CS, D, PS	ALL, IE, PART	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Fugitive CO_2 emissions from 1.B.2.c: 'Venting and flaring' account for 0.1 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 18 % in the EU-15 (Table 3.35). The United Kingdom was responsible for 68 % of the emissions from this source. The reductions in the United Kingdom (15 %) contributed mainly to the reduction trend in the EU-15 between 1990 and 2003.

Table 3.35 Member States' contributions to 1.B.2.c: 'CO_2 emissions from venting and flaring'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	0	0	0	0,0%	0	-	0	-	IE	IE	IE
Belgium	84	145	145	2,5%	0	0%	61	73%	CS	PS, AS	CS
Denmark	263	535	550	9,5%	14	3%	286	109%	C	NS, PS	CS
Finland	123	68	63	1,1%	-5	-7%	-60	-49%	CS	PS	PS
France	297	277	314	5,4%	37	13%	17	6%			
Germany	IE	IE	IE	-	-	-	-	-	NE	NE	NE
Greece	0	0	0	0,0%	0	-	0	-			
Ireland	NO	0	0	0,0%	0	-	-	-			
Italy	681	202	206	3,5%	3	2%	-475	-70%	T2	NS	CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	660	271	268	4,6%	-4	-	-392	-	CS, T3	AS	CS
Portugal	49	53	42	0,7%	-11	-21%	-6	-13%	D	PS	CS
Spain	179	218	174	3,0%	-43	-20%	-5	-3%	C, CS	Q	C, PS
Sweden	78	80	78	1,3%	-2	-	0	-	T2	PS	CS, D
United Kingdom	4.677	4.573	3.955	68,3%	-618	-14%	-722	-15%	T2	NS	CS
EU15	7.091	6.424	5.795	100,0%	-629	-10%	-1.296	-18%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.36 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CH_4 emissions from the source 1.B.2: 'Fugitive emissions from oil and natural gas'. CH_4 emissions from 'Fugitive emissions from oil and natural gas' decreased by 22 % between 1990 and 2003.

This source category includes one key source: CH_4 from 1.B.2.b: 'CH_4 emissions from natural gas'.

Table 3.36 Member States' contributions to 1.B.2: 'Fugitive CH_4 emissions from oil and natural gas' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	267	313	T1, CS	CS, D	PART	L
Belgium	517	395	CS	CS		
Denmark	38	84	C	C	ALL	L
Finland	11	62	CS/T1	CS/T1	PART	M
France	2.471	1.882	C	CS	ALL	M
Germany	7.008	7.351	T2,T3,CS	M,CS	All	H,M
Greece	40	212	T1	D	PART	
Ireland	151	79	T1	CS	Full	M
Italy	6.631	4.993	T2, T3	CS	ALL	H
Luxembourg	28	59	C/D	C/D		
Netherlands	2.045	1.039	CS/T3	CS	ALL	M
Portugal	35	286	C+T2	D+C	Part	L
Spain	584	812	C,CS	C,PS	ALL	M
Sweden	0	0	T1 + T2	CS	PART	M
United Kingdom	10.661	6.169	T3	CS	ALL	M
EU15	30.486	23.736	C,CS,D,T1,T2,T3	C, CS, D, M, PS, T1	ALL, PART	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 1.B.2.b 'Fugitive CH_4 emissions from natural gas' account for 0.5 % of total GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from this source decreased by 16 % in the EU-15 (Table 3.37). The United Kingdom, Germany and Italy were responsible for 79 % of the emissions from this source. The decreases in the United Kingdom (– 38 %) contributed largely to the reduction trend in the EU-15 between 1990 and 2003.

Table 3.37 Member States' contributions to a 1.B.2.b: 'CH_4 emissions from natural gas'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	166	211	225	1,0%	14	7%	59	36%
Belgium	514	395	390	1,8%	-6	-1%	-124	-24%
Denmark	6	4	4	0,0%	0	6%	-1	-27%
Finland	4	47	52	0,2%	4	9%	48	1354%
France	2.457	1.888	1.878	8,6%	-10	-1%	-580	-24%
Germany	6.383	7.216	7.214	33,2%	-2	0%	831	13%
Greece	15	163	183	0,8%	20	12%	168	1121%
Ireland	151	82	79	0,4%	-4	-5%	-72	-48%
Italy	6.494	4.874	4.905	22,6%	31	1%	-1.589	-24%
Luxembourg	28	58	59	0,3%	0	1%	31	113%
Netherlands	780	603	596	2,7%	-7	-1%	-184	-24%
Portugal	0	241	244	1,1%	3	1%	244	-
Spain	553	1.053	777	3,6%	-276	-26%	224	40%
Sweden	0	0	0	0,0%	0	-100%	0	-
United Kingdom	8.360	7.110	5.143	23,6%	-1.968	-28%	-3.218	-38%
EU15	25.910	23.948	21.747	100,0%	-2.200	-9%	-4.163	-16%

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.38 shows information on methods applied, activity data, emission factors for CH_4 emissions from 1.B.2:b natural gas for 1990 and 2003. It suggests that at least about 85 % of EU-15 emissions are estimated on basis of higher Tier methods. Activity data and implied emission factors cannot be presented at EU-15 level because Member States use different types of activity data.

Table 3.38 Information on methods applied, activity data, emission factors for 1.B.2.b ‘CH_4 emissions from natural gas’

					1990					2003				
Member State	Method applied	Activity data	Emission factor	GHG source category	Activity data: Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)	Activity data: Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)
Austria	**D**	**AS**	**D**	**Natural Gas**					**7,89**					**10,71**
	Lower tier methodology mainly based on default EF (NIR 2005)			Exploration			0	0,00	IE			0	0,00	IE
				i. Production / Processing	Gas throughput (a)	Mm3 gas	1288	0,00	IE	Gas throughput (a)	Mm3 GAS	2030	0,00	IE
				ii. Transmission	Pipelines length	km	1032	2900,00	2,99	Pipelines length	km	1430	2900,00	4,15
				iii. Other Leakage	Gas consumption	Mm3 gas	6090	803,78	4,90	Gas consumption		8912	735,96	6,56
				at industrial plants and power stations	PJ gas consumed		1500	0,00	NE	PJ gas consumed		789	0,00	NE
				in residential and commercial sectors			0	0,00	NE			0	0,00	NE
Belgium	**CS**	**AS**	**CS**	**Natural Gas**					**24,47**					**18,56**
	Detailed methodology based on length and type of pipelines (NIR 2005)			Exploration			0	NO	NO			0	NO	NO
				i. Production / Processing			0	NE	NE			0	NE	NE
				ii. Transmission	PJ gas consumed		401	5079,35	2,04	PJ gas consumed		614	2687,58	1,65
				iii. Other Leakage	PJ gas consumed		401	55883,89	22,43	Gas consumption	PJ	614	27539,36	16,91
				at industrial plants and power stations			0	0,00	0,00			0	0,00	0,00
				in residential and commercial sectors			0	0,00	0,00			0	0,00	0,00
Denmark	**C**	**NS**	**CS**	**Natural Gas**					**0,27**					**0,19**
	Detailed methodology based on data reported by industry (NIR 2005)			Exploration			IE	0,00	IE			IE	0,00	IE
				i. Production / Processing	Gas produced	10**6 m3	5137	-	IE	Gas produced	10**6 m3	10213	-	IE
				ii. Transmission	Gas transmission	Mm3 gas	2739	88,62	0,24	Gas transmission	Mm3 gas	7275	21,44	0,16
				iii. Other Leakage	Gas distributed	Mm3 gas	1574	14,56	0,02	Gas distributed	Mm3 gas	3420	11,37	0,04
				at industrial plants and power stations	Incl. in transmission		IE	0,00	IE	Incl. in transmission		IE	0,00	IE
				in residential and commercial sectors			NO	0,00	NO			NO	0,00	NO
Finland	**CS, T1**	**CS**	**CS, T1**	**Natural Gas**					**0,17**					**2,47**
	Transmission emission reported by industry partly based on measurements (NIR 2005)			Exploration			0	0,00	NO			NO	NO	NO
				i. Production / Processing			NO	0,00	NO			NO	NO	NO
				ii. Transmission	PJ gas consumed	PJ	92	1855,49	0,17	PJ gas consumed	PJ	171	3345,03	0,57
				iii. Other Leakage	PJ gas distributed via local networks	PJ	5	0,00	NO	PJ gas distributed via local networks	PJ	7	257452,57	1,90
				at industrial plants and power stations			0	0,00	0,00			0	0,00	0,00
				in residential and commercial sectors			0	0,00	0,00			0	0,00	0,00
France	**C**	**PS**	**CS**	**Natural Gas**					**117,01**					**89,41**
				Exploration			0	0,00	0,00			0	0,00	0,00
				i. Production / Processing	PJ Production	PJ	309	1614,89	0,50	PJ Production	PJ	170	612,59	0,10
				ii. Transmission	PJ Consumed	PJ	1055	110440,22	116,51	PJ Consumed	PJ	1646	54256,35	89,31
				iii. Other Leakage			0	0,00	0,00			0	0,00	0,00
				at industrial plants and power stations			0	0,00	0,00			0	0,00	0,00
				in residential and commercial sectors			0	0,00	0,00			0	0,00	0,00
Germany	**T2,T3,CS**	**NS**	**M, CS**	**Natural Gas**					**303,96**					**343,52**
	Detailed methodology based on AD from energy statistics and associations of industries, EF from literature and companies (NIR 2005)			Exploration	Natural gas	TJ	556007	28,76	15,99	Natural gas	TJ	658800	27,00	17,79
				i. Production / Processing	Natural gas from crude oil extraction	TJ	563382	64,40	36,28	Natural gas from crude oil extraction	TJ	665000	62,00	41,23
				ii. Transmission	Total amount of gas consumed	TJ	2292780	9,74	22,32	Total amount of gas consumed	TJ	3224000	9,00	29,02
				iii. Other Leakage	Distribution net	km	246710	789,14	194,69	Distribution net	km	417065	452,07	188,54
				at industrial plants and power stations	Gas consumed	TJ	825669	42,00	34,68	Gas consumed	TJ	1594000	42,00	66,95
				in residential and commercial sectors			NO	NO	NO			NO	NO	NO

Member State	Method applied	Activity data	Emission factor	GHG source category	1990					2003				
					Activity data			Implied emission factor (kg/unit)	CH4 emissions (Gg)	Activity data			Implied emission factor (kg/unit)	CH4 emissions (Gg)
					Description	Unit	Value			Description	Unit	Value		
Greece	**T1**	**NS**	**D**	**Natural Gas**					**0,71**					**8,72**
	Tier 1 methodology and default emission factors are used; activity data is taken from the national energy balance (NIR 2005)			Exploration			NO	NO	NO			NO	NO	NO
				i. Production / Processing	Natural gas production	PJ	6	21000,00	0,12	Natural gas production	PJ	1	21000,00	0,03
				ii. Transmission	Natural gas consumption	PJ	6	IE	IE	Natural gas consumption	PJ	85	IE	IE
				iii. Other Leakage	Natural gas consumption	PJ	6	102500,00	0,59	Natural gas consumption	PJ	85	102500,00	8,70
				at industrial plants and power stations			NE	NE	0,00			NE	NE	0,00
				in residential and commercial sectors			0	0,00	0,00			0	0,00	0,00
Ireland	**CS**	**NS**	**CS**	**Natural Gas**					**7,18**					**3,74**
	Reported emissions are based on data (or CS emission factors respectively) reported by industry (NIR 2005)			Exploration			NO	0,00	NO			NE	0,00	NE
				i. Production / Processing	PJ of Gas produced	PJ	79	14328,25	1,13	PJ of Gas produced	PJ	23	18299,87	0,42
				ii. Transmission			NO	0,00	NO			NE	0,00	NE
				iii. Other Leakage			NO	0,00	NO	PJ of gas consumed	PJ	56	59715,92	3,32
				at industrial plants and power stations	Network Leakage	PJ	24	250870,79	6,05			NO	0,00	NO
				in residential and commercial sectors			NO	0,00	NO			NO	0,00	NO
Italy	**T2**	**NS**	**CS**	**Natural Gas**					**309,24**					**233,57**
				Exploration			0	IE	IE			0	IE	IE
				i. Production / Processing	Mm3 gas produced	Mm3	17296	1398,37	24,19	Mm3 gas produced	Mm3	13996	178,03	2,49
				ii. Transmission	Mm3 gas transported	Mm3	45684	827,60	37,81	Mm3 gas transported	Mm3	76307	305,04	23,28
				iii. Other Leakage	Mm3 gas transported	Mm3	20632	11983,60	247,25	Mm3 gas transported	Mm3	29000	7165,66	207,80
				at industrial plants and power stations			0	0,00	0,00			0	0,00	0,00
				in residential and commercial sectors			0	IE	IE			0	IE	IE
Netherlands	**CS, T3**	**AS**	**CS**	**Natural Gas**					**37,14**					**28,37**
	CS methods comparable with the IPCC Tier 3 method are used for the CH4 estimation from gas production and processing; the Tier 2 method for gas distribution is based on emissions per km pipeline per type of material due to leakages, for which the country-specific emission factors determined for the Western part of Germany were used (NIR 2005)			Exploration	Number of wells drilled/tested	number	79	IE	IE	Number of wells drilled/tested	number	34	IE	IE
				i. Production / Processing	Gas produced	PJ	2292	IE	IE	Gas produced	PJ	2171	IE	IE
				ii. Transmission	Gas transported	PJ	2292	2763,02	6,33	Gas transported	PJ	2437	1473,62	3,59
				iii. Other Leakage	Natural gas distribution network	1000 km	99	312154,33	30,80	Natural gas distribution network	1000 km	118	210646,12	24,78
				at industrial plants and power stations			IE	IE	0,00			IE	IE	0,00
				in residential and commercial sectors			0	NE	NE			0	NE	NE
Portugal	**T1**	**NS**	**D**	**Natural Gas**					**0,00**					**0,00**
				Exploration			NO	0,00				NO	0,00	
				i. Production / Processing			NO	0,00				NO	0,00	
				ii. Transmission	Gas consumed	TJ	NO	0,00	NO	Gas consumed	TJ	NO	0,00	NO
				iii. Other Leakage				0,00					0,00	
				at industrial plants and power stations			NO	0,00	NE			NO	0,00	NE
				in residential and commercial sectors				0,00					0,00	
Spain	**C, CS**	**NS,AS,Q**	**C, CS**	**Natural Gas**					**26,35**					**37,02**
				Exploration			NE	NE	NE			NE	NE	NE
				i. Production / Processing	PJ gas produced (NCV)	PJ	51	70889,00	3,63	PJ gas produced (NCV)		10	70889,00	0,73
				ii. Transmission	PJ gas (NCV)	PJ	207	31791,11	6,57	PJ gas (NCV)		894	11776,17	10,53
				iii. Other Leakage	PJ gas consumed (NCV)	PJ	214	75583,54	16,16	PJ gas consumed (NCV)		905	28473,14	25,76
				at industrial plants and power stations			NE	NE	0,00			NE	NE	0,00
				in residential and commercial sectors			NE	NE	NE			NE	NE	NE
Sweden	**T1**	**NS**	**CS**	**Natural Gas**					**0,00**					**0,00**
				Exploration			NO	0,00	NO			NO	NO	NO
				i. Production / Processing			NO	0,00	NO			NO	NO	NO
				ii. Transmission	Pressure levelling losses	TJ	NO	0,00	NO	Pressure levelling losses	TJ	NO	NO	NO
				iii. Other Leakage			NE	0,00	NE			NE	NE	NE
				at industrial plants and power stations			NO	0,00	NE			NE	NE	NE
				in residential and commercial sectors			NE	0,00	NE			NE	NE	NE
UK	**T2**	**NS**	**CS**	**Natural Gas**					**398,11**					**244,89**
	Emission estimates for offshore gas facilities and for onshore terminals are provided annually by the UK Offshore Operators Association (UKOOA); estimates for onshore gas facilities are based on emissions data reported by process operators (NIR 2004)			Exploration		IE	IE	0,00	IE		IE	IE	0,00	IE
				i. Production / Processing		IE	IE	0,00	IE		IE	IE	0,00	IE
				ii. Transmission		IE	IE	0,00	IE		IE	IE	0,00	IE
				iii. Other Leakage	Gas consumed	PJ	1573	253016,23	398,11	Gas consumed	PJ	3337	73388,66	244,89
				at industrial plants and power stations		NE	NE	0,00	NE		NE	NE	0,00	NE
				in residential and commercial sectors			0	0,00	0,00			0	0,00	0,00

3.3 Methodological issues and uncertainties

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States' contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.39 shows the total EU-15 uncertainty estimates for the sector 'Energy' excluding 1.A.3 'Transport' and 1.B 'Fugitive emissions' 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 uncertainty was estimated for N_2O from 1.A.4.c and the lowest for CO_2 from 'stationary combustion unspecified'. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 3.39: EU-15 uncertainty estimates for the sector 'Energy' excluding 1.A.3 and 1.B

Source category	Gas	Emissions 2003 1)	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	CO_2	1,010,508	578,607	57%	3%
1.A.1.b Petroleum refining	CO_2	118,555	60,893	51%	2%
1.A.1.c Manufacture of solid fuels	CO_2	60,857	21,052	35%	6%
1.A.2 Manufacturing industries and construction	CO_2	576,424	294,680	51%	3%
1.A.4.a Commercial/institutional	CO_2	160,818	55,007	34%	7%
1.A.4.b Residential	CO_2	425,033	297,565	70%	3%
1.A.4.c Agriculture/Forestry/Fisheries	CO_2	61,602	12,480	20%	10%
1.A.5 Other	CO_2	7,913	2,150	27%	13%
1.A stationary combustion unspecified	CO_2		1,041,039		1%
1.A.1.a Public electricity and heat production	CH_4	1,892	227	12%	25%
1.A.1.b Petroleum refining	CH_4	79	9	12%	62%
1.A.1.c Manufacture of solid fuels	CH_4	345	9	3%	38%
1.A.2 Manufacturing industries and construction	CH_4	1,058	227	21%	22%
1.A.4.a Commercial/institutional	CH_4	369	72	20%	84%
1.A.4.b Residential	CH_4	7,101	4,211	59%	21%
1.A.4.c Agriculture/Forestry/Fisheries	CH_4	270	30	11%	84%
1.A.5 Other	CH_4	15	8	57%	40%
1.A stationary combustion unspecified	CH_4		4,747		28%
1.A.1.a Public electricity and heat production	N_2O	13,351	4,349	33%	39%
1.A.1.b Petroleum refining	N_2O	1,068	408	38%	36%
1.A.1.c Manufacture of solid fuels	N_2O	778	262	34%	48%
1.A.2 Manufacturing industries and construction	N_2O	6,816	1,825	27%	56%
1.A.4.a Commercial/institutional	N_2O	1,406	245	17%	215%
1.A.4.b Residential	N_2O	5,338	4,349	81%	42%
1.A.4.c Agriculture/Forestry/Fisheries	N_2O	2,250	228	10%	386%
1.A.5 Other	N_2O	117	29	25%	44%
1.A stationary combustion unspecified	N_2O		19,027		105%
Total	**all**	**2,463,964**	**2,403,737**	**98%**	**1%**

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some countries 2002 data and for Belgium 2001 data

Table 3.40 shows the total EU-15 uncertainty estimates for the sector 1.B 'Fugitive emissions' and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1.B.2 and the lowest for CO_2 from 1.B.2.

Table 3.40: EU-15 uncertainty estimates for the source category 1.B 'Fugitive emissions'

Source category	Gas	Emissions 2003 1)	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid fuels	CO_2	1,898	6,283	331%	58%
1.B.2 Oil and natural gas	CO_2	15,931	14,265	90%	8%
1.B.1 Solid fuels	CH_4	15,435	15,145	98%	29%
1.B.2 Oil and natural gas	CH_4	23,736	25,775	109%	14%
1.B.1 Solid fuels	N_2O	3	3	121%	50%
1.B.2 Oil and natural gas	N_2O	43	47	110%	104%
Total	**all**	**57,046**	**61,519**	**108%**	**11%**

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some countries 2002 data and for Belgium 2001 data

Table 3.41 shows the total EU-15 uncertainty estimates for the sector 1.A.3 'Transport' and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1.A.3.d and the lowest for CO_2 from 1.A.3.b.

Table 3.41: EU-15 uncertainty estimates for the source category 1.A.3 'Transport'

Source category	Gas	Emissions 2003 1)	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO_2	22,576	16,523	73%	24%
1.A.3.b Road transport	CO_2	790,731	735,077	93%	3%
1.A.3.c Railways	CO_2	4,985	1,963	39%	17%
1.A.3.d Navigation	CO_2	20,332	14,587	72%	11%
1.A.3.e Other	CO_2	6,736	8,682	129%	21%
1.A.3.a Civil aviation	CH_4	11	7	62%	66%
1.A.3.b Road transport	CH_4	2,359	1,472	62%	14%
1.A.3.c Railways	CH_4	7	3	39%	36%
1.A.3.d Navigation	CH_4	64	52	82%	40%
1.A.3.e Other	CH_4	16	25	154%	55%
1.A.3.a Civil aviation	N_2O	245	130	53%	145%
1.A.3.b Road transport	N_2O	23,606	21,543	91%	41%
1.A.3.c Railways	N_2O	278	58	21%	71%
1.A.3.d Navigation	N_2O	256	179	70%	152%
1.A.3.e Other	N_2O	107	333	310%	96%
Total	**all**	**872,311**	**800,635**	**92%**	**3%**

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some countries 2002 data and for Belgium 2001 data

3.4 Sector-specific quality assurance and quality control

The main sector-specific QA/QC activity is the project lead by Eurostat on the harmonisation of the energy data used for energy balances and CO_2 inventories. The work programme for this project foresees that Member States perform the following tasks:

- examine the energy data used by the two submissions (CRF to UNFCCC and the European Commission's DG Environment, and joint questionnaires to Eurostat and the IEA) for 1990, 1995 and 2000 and identify and explain the differences;
- establish a procedure at national level that will eliminate discrepancies in the two reporting mechanisms in future; this procedure will be agreed with Eurostat;

- provide the updated energy data in the form of annual questionnaires for the period 1990–2000 ensuring comparable data under the two reporting mechanisms.

By end of 2004, final reports of ten EU-15 Member States were available (Austria, Denmark, France, Germany, Ireland, Italy, Netherlands, Portugal, Sweden and the United Kingdom). Currently a project is ongoing with two objectives: (1) to produce a synthetic report which will include the main findings in the national reports and recapitulate the issues for which divergence of the two reporting procedures existed; (2) carry out a detailed comparative analysis between the available environmental data and Eurostat data for the period 1990-2002 for each Member State.

Following the submission of each Member State's final report, Eurostat will update information in its database and will be in the position to produce CO_2 emission figures based on the energy balances, with minimum deviation from those reported by the Member States and a full understanding of any discrepancies. This will help to improve the quality of the EU-15 GHG inventory for Sector 1: 'Energy'.

In 2003, a workshop on 'Energy balances and energy-related greenhouse gas emission inventories' was organised under Working Group I of the EC Climate Change Committee, and linked to the Eurostat Energy Statistics Committee. The objectives of the workshop were to: (1) share best practice between countries, both statistical institutes and national GHG inventory compilers; (2) strengthen the links between the reporting mechanisms of energy data (Eurostat/IEA) and GHG inventories (UNFCCC/Commission); (3) make recommendations to improve coherency in the data reported under the two reporting mechanisms. More than 60 experts attended the workshop from almost all EU-15 Member States and accession and candidate countries, the European Commission (DG Environment, Eurostat), the EEA and ETC/ACC. Representatives from the IEA, the UNFCCC Secretariat and the European non-energy use research network, attended as observers. The workshop report with the recommendations can be downloaded from the ETC/ACC website: http://air-climate.eionet.eu.int/.

A number of these recommendations were addressed by Eurostat this year, namely timelines of energy data (about 90% of joint energy questionnaires were available by end of February) and the first draft of an EU legal basis on energy statistics was prepared. Issues related to recommendations on the methodology of energy statistics were also addressed in the Energy Statistics Working Group of November 16-17 in Paris co-organised by Eurostat and the IEA. It was agreed that the 2005 joint Eurostat/IEA/UNECE energy statistics questionnaires will have a more detailed fuel breakdown (inclusion of Anthracite, Tars, etc.) which is more in line with the emissions reporting requirements, calorific values for oil products will be included and definitions of bunker fuels will be improved. More information on the outcome of this Working Group can be found at: http://www.iea.org/Textbase/stats/questionnaire/background.asp.

Also the workshop on emissions of greenhouse gases from aviation and navigation organised in May 2004 (see Section 3.7) was a follow-up activity of the workshop on energy balances and energy-related greenhouse gas emissions.

3.5 Sector-specific recalculations

Table 3.42 shows that in the energy sector the largest recalculations in absolute terms were made for CO_2 in 1990 and for N_2O in 2002. However, in relative terms the recalculations of CO_2 emissions in the energy sector were below 1 %.

Table 3.42 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 1: 'Energy' for the years 1990 and 2002 by gas in Gg and percentage

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
Energy	-4.141	-0,1%	-3.914	-3,7%	-3.505	-7,8%	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
Energy	-3.353	-0,1%	-2.542	-4,3%	-3.549	-6,1%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.43 provides an overview of Member States' contributions to EU-15 recalculations. In absolute terms, the Netherlands had the most influence on CO_2 recalculations in the EU-15. For CH_4 it was Germany and for N_2O it was Spain. Explanations for the largest recalculations by Member State are provided in Section 10.1.

Table 3.43 Contribution of Member States to EU-15 recalculations in CRF Sector 1: 'Energy' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2002					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	308	2	-274	NO	NO	NO	605	0	-422	NO	NO	NO
Belgium	1,389	13	10	NO	NO	NO	-2,228	-62	-64	NO	NO	NO
Denmark	16	20	1	NO	NO	NO	78	7	8	NO	NO	NO
Finland	-3,126	61	-352	NO	NO	NO	-2,757	30	-349	NO	NO	NO
France	706	-91	37	NO	NO	NO	-2,723	-86	49	NO	NO	NO
Germany	0	-3,214	-757	NO	NO	NO	-311	-1,776	-137	NO	NO	NO
Greece	591	302	22	NO	NO	NO	76	-2	-100	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	-594	-42	7	NO	NO	NO	1,417	-162	23	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	-8,477	-1,736	0	NO	NO	NO	-7,677	-1,507	55	NO	NO	NO
Portugal	-650	-36	-5	NO	NO	NO	283	-105	-45	NO	NO	NO
Spain	926	5	-1,930	NO	NO	NO	2,614	-37	-2,363	NO	NO	NO
Sweden	147	-148	-236	NO	NO	NO	-183	-81	-223	NO	NO	NO
UK	4,623	949	-28	NO	NO	NO	7,454	1,240	20	NO	NO	NO
EU15	**-4,141**	**-3,914**	**-3,505**	**NO**	**NO**	**NO**	**-3,353**	**-2,542**	**-3,549**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Explanations for recalculations of more than 1000 Gg of CO_2 equivalents are given in table 3.44. Reasons for other recalculations are provided in section 10.1.

Table 3.44: Main reasons for recalculations > 1000 Gg of CO_2 equivalents in CRF sector 1 'Energy'

BE	CO_2	1.A.1: Emission factors/activity data: use of directly reported emissions for large power plants instead of calculations based on activity data and default IPCC emission factors
FI	CO_2	1.B.1: Emission factors: Revised EF based on preliminary results of new measurements Activity data: Improved activity data from surveys Addition/removal/replacement: Emissions from areas previously reported as areas reserved for peat production have been removed due to improved data collection and identified double counting with Agriculture/LULUCF sector (cultivation of organic soils)
FR	CO_2	1.A.1a: Emission factor: Review of CO_2 emission factor for domestic waste incineration with energy recovery; Activity data: updated 1.A.2: Activity data: Energy consumption for manufacturing industries updated 1.A.4: Activity data: Energy consumption for commercial, institutional and residential updated
NL	CO_2	1.A.2; 1.A.3; 1.A.4: Methods: based on energy statistics; Activity data: improved data; Emission factors: improved data
UK	CO_2	1.A.1; 1.A.2, 1.A.4, 1.B.1: see tables 10.1 and 10.2
DE	CH_4	1.B.1a: Activity data: Information is now based on more detailed and exact statistical data by the "Statistic coal industries e.V." from base year onwards
NL	CH_4	1.B.2: Activity data: improved data; Emission factors: improved data

3.6 Comparison between the sectoral approach and the reference approach

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (NewCronos database, May 2005 version). This submission includes the reference approach tables for 1990–2003.

Energy statistics are submitted to Eurostat by Member States on an annual basis with the five joint Eurostat/IEA/UNECE questionnaires on solid fuels, oil, natural gas, electricity and heat, and renewables and wastes. On the basis of this information Eurostat compiles the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EU-15 as a whole.

The Eurostat data for the EU-15 IPCC reference approach includes activity data, net calorific values and carbon emission factors as available in the Eurostat NewCronos database. In the CRF Table 1.A(b) some fuel categories are grouped and average net calorific values are used: 'Orimulsion' is included in 'Residual fuel oil'. 'Natural gas liquids' is included in 'Crude oil'. 'Other kerosene' is included in 'Total kerosene'. 'Anthracite', 'Coking coal' and 'Other bituminous coal' are referred to in the Eurostat NewCronos database as 'Hard coal' and are included in CRF Table 1.A(b) under 'Other bituminous coal'. 'Sub-bitumenous coal' and 'Peat' are included in 'Lignite'. 'Solid biomass', 'Liquid biomass' and 'Gas biomass' is included in 'Total biomass'. For international bunkers, only fuel consumption for international navigation is available in the NewCronos database; data on international aviation is added to the reference approach separately from the joint (Eurostat/IEA/UNECE) oil questionnaire. For the calculation of CO_2 emissions, the IPCC default carbon emission factors adjusted for the non-oxidised fraction are used in the Eurostat database.

The IPCC reference approach method at EU-15 level is a four-step process.

Step 1: For each Member State, annual data on energy production, imports, exports, international bunkers (except international aviation) and stock changes are available in the Eurostat database in fuel specific units (i.e. kt (= 1 000 tonnes)) for solid fuels and petroleum products, TJ for natural gas). The apparent consumption in TJ is calculated for each Member State by using country-specific average net calorific values. These net calorific values are updated annually for solid fuels together with the energy data in the NewCronos database; for petroleum products the net calorific values are kept constant. For groups of fuels average weighted net calorific values are used, which is the case for 'Other bituminous coal' and 'Lignite'.

Step 2: The EU-15 CRF Table 1.A(b) are calculated by adding the relevant Member State activity and emission data, as calculated under Step 1. The net calorific values provided for the EU-15 in CRF Table 1.A(b) are calculated from dividing apparent consumption in TJ by apparent consumption in fuel-specific units for each fuel. Therefore, these net calorific values are 'implied calorific values'; there are no fuel-specific net calorific values at EU-15 level.

Step 3: Fuel consumption from international aviation is included in Tables 1.A(b) from the joint (Eurostat/IEA/UNECE) oil questionnaire, as in the Eurostat NewCronos database data at this level of disaggregation are not available.

Step 4: For the calculations of carbon stored in Tables 1.A(d), Eurostat data on non-energy use of fuels are used, as reported by Member States in the joint questionnaire. For the fraction of carbon stored and carbon emission factors IPCC default values are taken (IPCC, 1997).

Table 3.45 shows the apparent energy consumption from fossil fuel combustion from 1990 to 2003 as provided in Tables 1.A(b). Total fossil fuel energy consumption increased by 10 % between 1990 and 2003. Large increases had gas consumption (+64 %), whereas solid fuel combustion declined by 26 %. Table 3.46 compares EU-15 CO_2 emissions calculated with the IPCC reference approach based on

Eurostat data and the sectoral approach available from Member States. Both, reference and sectoral approach, increase by 4 % between 1990 and 2003; the percentage differences between the two data sets are smaller than 2 %.

Table 3.45: Apparent EU-15 energy consumption (in PJ) according to the reference approach (Eurostat data)

Fuel types	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	21.825	22.442	23.296	22.431	22.739	22.799	23.334	23.257	24.153	23.347	22.852	23.818	23.257	23.413
Solid Fuels	12.643	11.896	11.109	10.268	10.130	9.860	9.781	9.315	9.303	8.628	8.960	9.092	9.110	9.293
Gaseous Fuels	9.354	10.068	10.003	10.588	10.648	11.480	12.780	12.670	13.211	13.782	14.205	14.549	14.636	15.328
Total energy consumption	**43.822**	**44.406**	**44.408**	**43.288**	**43.517**	**44.138**	**45.895**	**45.242**	**46.667**	**45.757**	**46.017**	**47.459**	**47.003**	**48.033**

Table 3.46: IPCC reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO_2 emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Sectoral approach	3.148	3.182	3.112	3.063	3.053	3.085	3.166	3.109	3.150	3.125	3.147	3.216	3.210	3.267
Reference approach	3.129	3.132	3.108	3.013	3.014	3.036	3.144	3.073	3.162	3.073	3.085	3.193	3.175	3.239
Percentage difference	-0,58	-1,56	-0,14	-1,65	-1,27	-1,57	-0,72	-1,15	0,37	-1,67	-1,95	-0,71	-1,09	-0,86

Table 3.47 provides an overview by Member State on differences between the Eurostat and national reference approach for 1990 and 2002/2003, as far as available. The differences can occur due to differences in the basic energy data or due to differences when calculating CO_2 emissions from the basic energy data. The main reasons for diverging energy data are:

- the use of different calorific values (CV) mainly for oil products, BKB (lignite briquettes) and patent fuels. For BKB and patent fuels, Eurostat is using the same CV for all countries which differs from the calorific values used by the Member States;
- small 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).

To explain and resolve these differences Eurostat launched a project for harmonisation of the two (joint questionnaires and CRF) reporting systems of energy data and for revision of reported energy data back to 1990 (see Section 3.4). The main reasons for diverging CO_2 emissions are:

- differences in the treatment of non-energy use of fossil fuels and carbon stored;
- the use of country-specific emission factors. The Eurostat reference approach uses the IPCC default emission factors.

Table 3.47 shows the comparison between Eurostat and national reference approach for CO_2 from fuel combustion. If 1990 is taken, apparent consumption of the two approaches is within 2 % for several Member States (Austria, Denmark, France, Germany, Greece, Italy, Netherlands, Spain and the UK). Differences of more than 5 % can be observed for Belgium, Finland, Ireland, Portugal and Sweden. The differences of CO_2 emissions for 1990 range from – 0.2 % (Austria) to 11.1 % (Greece). A comparison of the differences between 1990 and 2002/2003 shows that for apparent consumption there are six Member States with larger differences in 1990 and seven Member States with larger differences in 2002/2003. As regards CO_2 emissions seven Member States have larger differences in 1990 than in 2002/2003. A comparison of these tables with the tables provided in the 2004 submission shows not much change with regard to 1990, but a better match between the two approaches for the latest year.

Table 3.47 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion (CRF 1.A) ([15])

Austria

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	425.914	28.686	432.880	28.565	1,6%	-0,4%
Solid fossil fuels	169.442	16.326	168.733	15.914	-0,4%	-2,5%
Gaseous fossil fuels	217.047	11.825	219.239	12.238	1,0%	3,5%
Total	**812.403**	**56.837**	**820.853**	**56.716**	**1,0%**	**-0,2%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	550.614	37.403	580.291	38.645	5,4%	3,3%
Solid fossil fuels	165.881	16.031	166.443	15.684	0,3%	-2,2%
Gaseous fossil fuels	316.296	17.423	319.491	17.834	1,0%	2,4%
Total	**1.032.790**	**70.856**	**1.066.225**	**72.163**	**3,2%**	**1,8%**

Belgium

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	692.880	45.246	747.716	49.182	7,9%	8,7%
Solid fossil fuels	408.855	38.484	443.046	41.148	8,4%	6,9%
Gaseous fossil fuels	342.022	18.739	342.955	18.819	0,3%	0,4%
Total	**1.443.757**	**102.469**	**1.533.717**	**109.149**	**6,2%**	**6,5%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	819.551	50.414	962.201	61.702	17,4%	22,4%
Solid fossil fuels	257.111	24.287	260.254	24.159	1,2%	-0,5%
Gaseous fossil fuels	602.983	32.956	604.628	33.097	0,3%	0,4%
Total	**1.679.645**	**107.657**	**1.827.083**	**118.958**	**8,8%**	**10,5%**

Denmark

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	314.962	22.014	317.323	22.344	0,7%	1,5%
Solid fossil fuels	255.386	24.079	254.879	24.129	-0,2%	0,2%
Gaseous fossil fuels	76.099	4.241	76.098	4.269	0,0%	0,7%
Total	**646.447**	**50.334**	**648.300**	**50.742**	**0,3%**	**0,8%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	324.126	23.069	321.099	23.062	-0,9%	0,0%
Solid fossil fuels	237.195	22.362	237.214	22.452	0,0%	0,4%
Gaseous fossil fuels	195.134	10.875	195.133	10.947	0,0%	0,7%
Total	**756.454**	**56.306**	**753.446**	**56.461**	**-0,4%**	**0,3%**

([15]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

Finland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	403.746	26.151	441.576	29.436	9,4%	12,6%
Solid fossil fuels	212.396	20.488	223.400	21.943	5,2%	7,1%
Gaseous fossil fuels	94.646	5.257	91.620	5.121	-3,2%	-2,6%
Total	**710.788**	**51.895**	**756.596**	**56.500**	**6,4%**	**8,9%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	410.699	27.883	396.436	26.474	-3,5%	-5,1%
Solid fossil fuels	344.167	33.115	343.570	33.024	-0,2%	-0,3%
Gaseous fossil fuels	171.004	9.498	171.432	9.536	0,3%	0,4%
Total	**925.870**	**70.495**	**911.438**	**69.034**	**-1,6%**	**-2,1%**

France

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3.523.645	227.303	3.534.399	223.844	0,3%	-1,5%
Solid fossil fuels	824.313	78.009	803.792	74.941	-2,5%	-3,9%
Gaseous fossil fuels	1.089.913	59.276	1.089.913	59.718	0,0%	0,7%
Total	**5.437.871**	**364.588**	**5.428.104**	**358.502**	**-0,2%**	**-1,7%**
2002	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3.640.795	233.211	3.613.632	225.641	-0,7%	-3,2%
Solid fossil fuels	569.483	54.071	529.248	49.523	-7,1%	-8,4%
Gaseous fossil fuels	1.569.394	85.833	1.569.394	86.498	0,0%	0,8%
Total	**5.779.672**	**373.114**	**5.712.274**	**361.662**	**-1,2%**	**-3,1%**

Germany

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	4.997.285	310.913	5.034.262	327.838	0,7%	5,4%
Solid fossil fuels	5.572.479	541.333	5.508.185	566.742	-1,2%	4,7%
Gaseous fossil fuels	2.302.935	126.614	2.302.935	123.971	0,0%	-2,1%
Total	**12.872.699**	**978.860**	**12.845.382**	**1.018.550**	**-0,2%**	**4,1%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	4.955.654	300.103	4.976.400	322.051	0,4%	7,3%
Solid fossil fuels	3.557.007	345.492	3.602.000	353.381	1,3%	2,3%
Gaseous fossil fuels	3.316.297	183.162	3.256.000	177.857	-1,8%	-2,9%
Total	**11.828.958**	**828.757**	**11.834.400**	**853.290**	**0,0%**	**3,0%**

Greece

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	499.503	35.301	512.865	36.302	2,7%	2,8%
Solid fossil fuels	338.766	33.462	337.777	40.141	-0,3%	20,0%
Gaseous fossil fuels	5.764	259	5.783	248	0,3%	-4,0%
Total	**844.032**	**69.022**	**856.426**	**76.692**	**1,5%**	**11,1%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	658.828	46.290	707.910	49.712	7,4%	7,4%
Solid fossil fuels	372.505	36.909	372.071	44.822	-0,1%	21,4%
Gaseous fossil fuels	84.835	4.633	84.835	4.640	0,0%	0,2%
Total	**1.116.167**	**87.832**	**1.164.816**	**99.175**	**4,4%**	**12,9%**

Ireland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	186.241	13.085	165.588	12.323	-11,1%	-5,8%
Solid fossil fuels	150.303	14.478	147.417	14.334	-1,9%	-1,0%
Gaseous fossil fuels	78.417	4.040	78.586	4.318	0,2%	6,9%
Total	**414.961**	**31.603**	**391.591**	**30.975**	**-5,6%**	**-2,0%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	329.627	23.635	314.898	23.208	-4,5%	-1,8%
Solid fossil fuels	105.347	10.106	103.381	10.270	-1,9%	1,6%
Gaseous fossil fuels	153.956	8.580	154.271	8.476	0,2%	-1,2%
Total	**588.930**	**42.322**	**572.550**	**41.954**	**-2,8%**	**-0,9%**

Italy

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3.687.152	245.827	3.755.112	251.788	1,8%	2,4%
Solid fossil fuels	612.156	57.748	614.758	57.389	0,4%	-0,6%
Gaseous fossil fuels	1.632.906	89.716	1.644.135	87.144	0,7%	-2,9%
Total	**5.932.213**	**393.291**	**6.014.005**	**396.321**	**1,4%**	**0,8%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3.568.286	237.650	3.786.846	247.807	6,1%	4,3%
Solid fossil fuels	624.813	59.314	623.076	59.494	-0,3%	0,3%
Gaseous fossil fuels	2.652.467	147.115	2.670.093	145.521	0,7%	-1,1%
Total	**6.845.567**	**444.079**	**7.080.015**	**452.823**	**3,4%**	**2,0%**

Netherlands

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	932.788	51.326	964.000	49.701	3,3%	-3,2%
Solid fossil fuels	384.249	36.081	368.000	34.034	-4,2%	-5,7%
Gaseous fossil fuels	1.289.950	70.140	1.305.000	71.020	1,2%	1,3%
Total	**2.606.987**	**157.547**	**2.637.000**	**154.755**	**1,2%**	**-1,8%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1.063.656	59.506	1.203.000	55.471	13,1%	-6,8%
Solid fossil fuels	365.564	34.467	367.000	34.148	0,4%	-0,9%
Gaseous fossil fuels	1.507.182	82.364	1.508.000	82.614	0,1%	0,3%
Total	**2.936.403**	**176.337**	**3.078.000**	**172.233**	**4,8%**	**-2,3%**

Portugal

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	465.808	29.073	491.139	30.470	5,4%	4,8%
Solid fossil fuels	108.009	10.181	115.571	10.555	7,0%	3,7%
Gaseous fossil fuels	0	0	0	0	-	-
Total	**573.817**	**39.254**	**606.709**	**41.025**	**5,7%**	**4,5%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	605.230	39.164	638.775	41.179	5,5%	5,1%
Solid fossil fuels	137.381	12.949	140.399	12.683	2,2%	-2,1%
Gaseous fossil fuels	110.376	6.152	122.660	6.847	11,1%	11,3%
Total	**852.986**	**58.264**	**901.834**	**60.708**	**5,7%**	**4,2%**

Spain

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1.838.371	119.009	1.869.635	120.077	1,7%	0,9%
Solid fossil fuels	790.770	75.139	795.722	77.451	0,6%	3,1%
Gaseous fossil fuels	208.105	11.310	213.880	11.520	2,8%	1,9%
Total	**2.837.246**	**205.459**	**2.879.237**	**209.048**	**1,5%**	**1,7%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2.719.117	180.680	2.727.987	174.834	0,3%	-3,2%
Solid fossil fuels	844.234	79.723	839.025	80.269	-0,6%	0,7%
Gaseous fossil fuels	894.006	49.463	895.993	49.734	0,2%	0,5%
Total	**4.457.356**	**309.867**	**4.463.004**	**304.837**	**0,1%**	**-1,6%**

Sweden

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	586.804	36.161	628.532	38.906	7,1%	7,6%
Solid fossil fuels	112.065	10.719	121.965	11.161	8,8%	4,1%
Gaseous fossil fuels	21.740	1.212	21.536	1.217	-0,9%	0,4%
Total	**720.609**	**48.092**	**772.032**	**51.283**	**7,1%**	**6,6%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	646.616	41.041	654.334	42.555	1,2%	3,7%
Solid fossil fuels	112.597	10.840	106.267	10.126	-5,6%	-6,6%
Gaseous fossil fuels	33.470	1.865	33.375	1.886	-0,3%	1,1%
Total	**792.683**	**53.747**	**793.975**	**54.566**	**0,2%**	**1,5%**

United Kingdom

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3.207.839	210.668	3.249.999	213.104	1,3%	1,2%
Solid fossil fuels	2.656.489	250.330	2.626.382	241.511	-1,1%	-3,5%
Gaseous fossil fuels	1.976.312	108.696	1.976.478	109.002	0,0%	0,3%
Total	**7.840.640**	**569.694**	**7.852.859**	**563.618**	**0,2%**	**-1,1%**
2003	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2.965.799	189.954	2.989.422	191.804	0,8%	1,0%
Solid fossil fuels	1.594.972	150.520	1.607.096	147.620	0,8%	-1,9%
Gaseous fossil fuels	3.596.149	199.790	3.599.536	204.248	0,1%	2,2%
Total	**8.156.921**	**540.264**	**8.196.055**	**543.672**	**0,5%**	**0,6%**

3.7 International bunker fuels

International bunker emissions of the EC inventory are the sum of the international bunker emissions of the Member States ([16]). A project shared between the Commission (Eurostat and DG Environment), Eurocontrol and EEA has been initiated to improve the quality of the estimates of CO_2 emissions from international aviation. In a first phase of the project, Eurocontrol, the European Organisation for the Safety of Air Navigation and responsible for the coordination of the European air traffic management

([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 EC is neither a country nor a nation, the EC's interpretation of the good practice guidance is that the emission estimate at EC level has to be the sum of Member States estimates for domestic air or marine transport as they are the countries or nations addressed in the definition and decision trees of the IPCC good practice guidance.

system, provided Eurostat with aggregated air traffic data. Several comparisons have been made between energy and emission estimates based on Eurocontrol data on the one hand and data from the energy statistics and GHG inventories on the other hand. The main results of these comparison exercises are:

(1) There are large discrepancies when comparing fuel consumption calculated on the basis of air movement data, with energy statistics. These discrepancies are due to several reasons (a) aircraft carrying fuel reserves - they do not refuel at every landing and take-off (b) the inclusion or exclusion of overseas territories (c) inaccurate coefficients for some older aircraft types (d) ground operations. Discrepancies of up to 20 % were seen as acceptable, but larger differences should be investigated.

(2) A comparison between emissions data provided by Eurostat (calculated on basis of Eurocontrol data) for the years 1996-2001 with data from Member States' GHG inventories revealed that total CO_2 emissions for aviation reported in the 2000 CRF-tables by most Member States are within 10 % of the estimates provided by Eurostat. The share of domestic emissions is usually higher in Member States' estimates, especially as new Member States tend to overestimate the domestic sector.

In May 2004, a 'Workshop on emissions of greenhouse gases from aviation and navigation' was held in Copenhagen. The aim of this workshop was to improve the inventories of GHG emissions from aviation and navigation with special attention to the disaggregation between domestic and international bunker fuels. The workshop brought together the national experts from statistical institutes or other organisations that are responsible for energy balances and/or aviation and navigation transport statistics, the national experts responsible for annual GHG inventories and the experts from international organisations that are performing relevant projects. The workshop report with the recommendations can be downloaded from the ETC/ACC website: http://air-climate.eionet.eu.int/. The most important recommendations of the workshop are as follows.

Legal arrangements

- Member States should consider strengthening their legal arrangements for cooperation on bunkers data collection and emissions calculations.

Emissions estimations methods and data

- Member States should work towards using flight movement data for compiling their inventories. The use of flight movement data usually increases transparency.
- Member States should use at least IPCC Tier 2a method for estimating emissions, especially if the emissions are from a key source. Methodologies based solely on flight movement data such as CORINAIR Detailed Methodology are also recommended.
- Where severe resource constraints exist, Member States could consider using Tier 2 periodically (for example every 3-5 years) and to interpolate based on fuel consumption data.
- It is recommended to add a new methodology to the IPCC Guidelines based solely on flight movement data (for example CORINAIR Detailed Methodology) as a higher tier method, because such methods offer possibilities to compare and verify emissions calculated by the two independent methods (based on fuel consumption and flight movement data).
- Further cooperation between those responsible for compiling energy statistics in Member States and aviation authorities is necessary in order to understand the differences in fuel consumption from different methods.
- Member States should further work on methods for recalculation of time series in cases where flight movement data is not available for all years back to 1990.
- Member States and relevant international organisations should work to improve the quality of marine activity data.
- Member States and relevant marine organisations should further consider how bunker delivery notes required for Annex VI of MARPOL 73/78 could be used for estimating emissions from maritime transportation.

- An important criterion for elaboration of future emission estimation methods is how well these methods are able to reflect the effectiveness of measures regarding the reduction of fuel consumption and CO_2 emissions and other impacts.

Separation of domestic and international emissions and definitions

- Member States should use the definition of 'domestic territory' which is consistent with their instrument of ratification to the UNFCCC and the Kyoto Protocol, for the purposes of splitting domestic and international emissions.
- Domestic and international emissions should be separated based on flight movement data and Member States should aim to apply the definitions used in IPCC guidelines.
- The meeting identified some scope for improving the IPCC definitions mainly related to difficulties in obtaining the information on passenger and freight drop-offs and pick-ups at stops in the same country required in the IPCC good practice guidance.
- IEA's proposal for improved definitions in the joint Eurostat/IEA energy questionnaires should be considered by member countries, by those responsible for compiling and reporting GHG inventories and energy statistics.

Emissions factors

- Further work should be undertaken towards establishing consistent emissions factors for aircraft and engine types across the EU. This work should feed into the IPCC Emissions Factors database.
- The IPCC N_2O emissions factor for non-road diesel engines for Europe of 30 mg/MJ from table 1-49 on page 1.91 of 1996 IPCC Guidelines for national greenhouse gas inventories should be reconsidered.

Quality Assurance/Quality Checking (QA/AC) programmes

- Member States should work towards establishing QA/QC procedures for emissions from aviation and navigation as part of their QA/QC programmes for national inventories.

Eurocontrol data to assist EU Member States

- The majority of Member States would appreciate assistance from Eurocontrol with estimates for emissions from aviation for the purposes of validating their emissions inventories.
- Member States will establish which types of assistance, background information or data, they would like to receive from Eurocontrol, via the Climate Change Committee Working Group 1.
- Methodological approaches based on data collected pre-1996 by Eurocontrol or in different and less comprehensive databases, need to be developed. This is because the problem of establishing a consistent time series for the years 1990-1996 when using Eurocontrol data, remains to be resolved. The database of detailed flight movement data only exists for the years post-1996.

Co-operation within Member States

- Emissions inventory experts should work closely with energy statistics experts, to ensure that the origin of differences in results between emissions estimates related to fuel consumption and to flight movement data are understood and can be explained.

4 Industrial processes (CRF Sector 2)

This chapter starts with an overview on emission trends in CRF Sector 2 ‘Industrial processes’. Then for each EU-15 key source overview tables are presented including the Member States’ contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. The quantitative uncertainty estimates are summarised in a separate section. Finally, the chapter includes a section on recalculations. A section on sector-specific QA/QC is not included as such activities have not yet started in this sector.

4.1 Overview of sector

CRF Sector 2 ‘Industrial processes’ is the third largest sector contributing 6 % to total EU-15 GHG emissions. The most important GHGs from ‘Industrial processes’ are CO_2 (4 % of total GHG emissions), HCFs and N_2O (1 % each). The emissions from this sector decreased by 15 % from 313 Tg in 1990 to 265 Tg in 2003 (Figure 4.1). In 2003, the emissions increased by 2.9 % compared to 2002. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from east European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in HCFC production. The increase in 2003 compared to the previous year is mainly due to emission increases from refrigeration and air conditioning, nitric acid production, cement production and iron and steel production.

The key sources in this sector are:

2.A.1: Cement production (CO_2)
2.A.2: Lime production (CO_2)
2.B.1: Ammonia production (CO_2)
2.B.2: Nitric acid production (N_2O)
2.B.3: Adipic acid production (N_2O)
2.B.5: Other (N_2O)
2.C.1: Iron and steel production (CO_2)
2.C 3: Aluminium production (PFCs)
2.C 4: SF_6 used in aluminium and magnesium foundries (SF_6)
2.E: Production of halocarbons and sulphur hexafluoride (HFCs)
2.F: Consumption of halocarbons and sulphur hexafluoride (HFCs)
2.F: Consumption of halocarbons and sulphur hexafluoride (SF_6)

Figure 4.1 shows that the three largest key sources account for about 57 % of total process-related GHG emissions in the EU-15.

Figure 4.1 **EU-15 GHG emissions for 1990–2003 from CRF Sector 2: 'Industrial processes' in CO_2 equivalents (Tg) and share of largest key source categories in 2003**

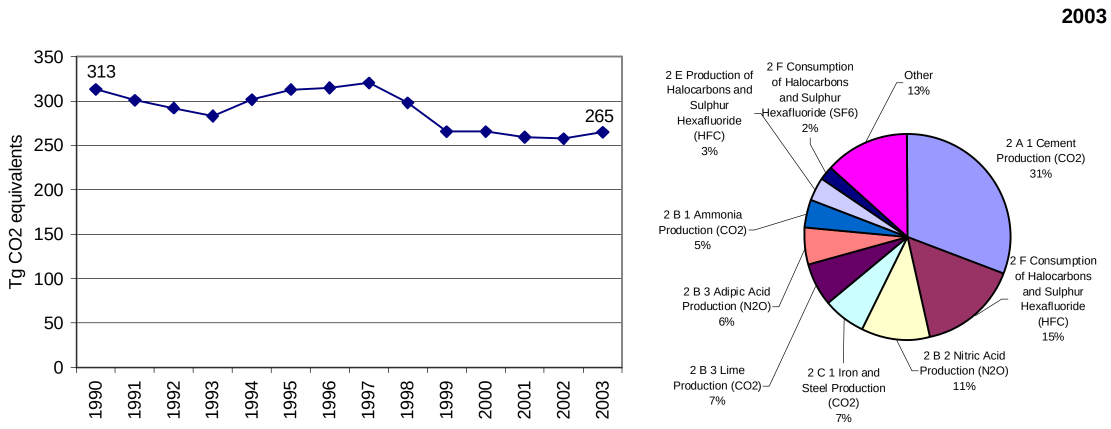
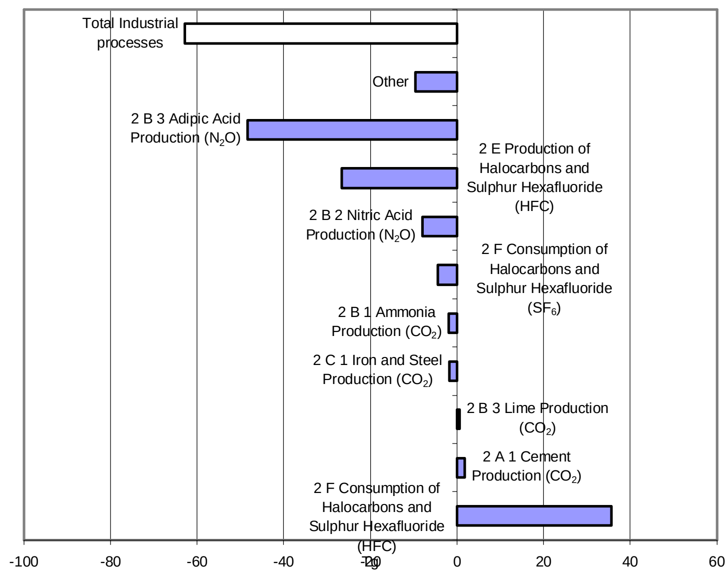


Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France and the UK and in production of halocarbons and SF_6 (HFCs). Large emission increases can be observed of HFCs from consumption of halocarbons and SF_6.

Figure 4.2 **Absolute change of GHG emissions by large key source categories 1990–2003 in CO_2 equivalents (Tg) in CRF Sector 2: 'Industrial processes'**



4.2 Source categories

4.2.1 Mineral products (CRF Source Category 2.A)

Table 4.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 2.A: 'Mineral products'. Between 1990 and 2003, CO_2 emission from 'Mineral products' increased by 3.4 %. The relative decrease was largest in Luxembourg, the relative growth was largest in Ireland.

This source category includes two key sources: CO_2 from 2.A.1:'Cement production' and CO_2 from 2.A.2:'Lime production'.

Table 4.1 Member States' contributions to CO_2 emissions from 2.A: 'Mineral products' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	3.243	3.060	T2	D, CS	ALL	H
Belgium	5.382	5.512	CS	CS		
Denmark	1.037	1.486	CS	CS	ALL	M
Finland	1.286	1.181	T2/D	PS/CS	PART	H
France	14.734	11.993	C	CS	ALL	H
Germany	22.970	20.758	D,CS; NE	D,CS	All	H
Greece	6.330	7.307	T1, T2	D	PART	
Ireland	941	2.360	D	D	Part	M
Italy	21.875	23.483	D, T2	CS, PS	ALL	M
Luxembourg	585	461	C/D	C/D		
Netherlands	1.216	1.349	T2(clincer)/T1/CS/D	PS,CS,D	ALL	M
Portugal	3.375	4.198	D	D+C+CS	All	M
Spain	15.669	20.962	D,T2,CS	D,T2,C,CS	PART	H
Sweden	1.917	1.924	T2, CS, D	CS, D, PS	PART	H
United Kingdom	9.554	7.866	T2	D	PART	H
EU15	110.115	113.901	C, CS, D, T1, T2	C, CS, D, PS, T2	ALL, PART	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.2 provides information on emission trends of the key source CO_2 from 2.A.1: 'Cement production' by Member State. CO_2 emissions from cement production account for 2.0 % of total EU-15 GHG emissions in 2003. In 2003, CO_2 emissions from cement production were 2 % above 1990 levels in the EU-15.

Germany, France and the United Kingdom had large reductions in absolute terms, whereas especially Spain had large increases. Italy is the largest emitter accounting for 21 % of EU-15 emissions, followed by Spain and Germany (20 % and 16 %, respectively). These results should be interpreted with care as different criteria are used by Member States to decide whether particular emissions are allocated to fossil fuel combustion or to the relevant industrial process.

Table 4.2 Member States' contributions to CO_2 emissions from 2.A.1: 'Cement production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2.033	1.736	1.736	2,1%	0	0%	-298	-15%
Belgium	2.824	2.939	2.939	3,6%	0	0%	115	4%
Denmark	882	1.452	1.370	1,7%	-82	-6%	488	55%
Finland	786	517	500	0,6%	-17	-3%	-286	-36%
France	10.948	8.651	8.564	10,5%	-87	-1%	-2.384	-22%
Germany	15.146	12.696	13.373	16,4%	678	5%	-1.772	-12%
Greece	5.778	6.331	6.386	7,8%	55	1%	608	11%
Ireland	750	2.021	2.157	2,6%	136	7%	1.407	188%
Italy	16.084	16.616	17.322	21,2%	706	4%	1.237	8%
Luxembourg	538	460	405	0,5%	-55	-12%	-133	-25%
Netherlands	507	489	434	0,5%	-55	-11%	-73	-14%
Portugal	3.107	3.824	3.538	4,3%	-286	-7%	432	14%
Spain	12.534	15.853	16.371	20,1%	518	3%	3.837	31%
Sweden	1.245	1.253	1.181	1,4%	-73	-6%	-65	-5%
United Kingdom	6.659	5.466	5.356	6,6%	-110	-2%	-1.303	-20%
EU15	79.823	80.304	81.631	100,0%	1.327	2%	1.808	2%

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2.A.1: 'Cement production' for 1990 and 2003. The table shows that most MS report clinker production as activity data. However, even those who report cement production as activity data, base their calculation on raw material composition and not on e.g. default emission factors. The implied

emission factors per tonne of clinker produced vary slightly from 0.5 for the UK to 0.56 for Austria; most MS use country-specific emission factors. The EU-15 IEF (excluding Belgium, Luxembourg and Denmark) is 0.53 t/t of clinker produced. The table also suggests that more than 95 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.3 Information on methods applied, activity data, emission factors for CO_2 emissions from 2.A.1: 'Cement production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2003 Activity data Description	2003 Activity data (kt)	2003 Implied emission factor (t/t)	2003 CO_2 emissions (Gg)
Austria	T2	PS	PS	Detailed methodology based on raw material composition [NIR2005]	Clinker production	3694	0,55	2033	Clinker production	3118	0,56	1736
Belgium	CS	PS	CS	Detailed methodology based on raw material composition [NIR2005]	Cement production	5292	0,53	2824	Cement production	5583	0,53	2939
Denmark	CS/T2	PS	PS	Detailed methodology based on raw material composition (NIR2005)	Cement production	1620	0,54	882	Cement production	2546	0,54	1370
Finland	T2	PS	PS	Detailed methodology based on raw material composition [NIR2005]	Clinker production	1470	0,53	786	Clinker production	940	0,53	500
France	C	AS	PS	Methodology based on national statistics (clinker statistics) and emission factors from industry. [NIR2004]	Clinker production	20854	0,53	10948	Clinker production	16313	0,53	8564
Germany	CS	NS	CS	Methodology based on activity data from associations of industries (clinker production) and a CS EF (which is also obtained from associations of industries based on detailed data, average value for 1999-2001)	Clinker production	28577	0,53	15146	Clinker production	25233	0,53	13373
Greece	T2	NS	CS	Methodology based on activity data and parameters for emission calcualtions collected from industry [NIR2005]	Clinker production	10645	0,54	5778	Clinker production	11755	0,54	6386
Ireland	D	NS, PS	PS	According to the NIR2005 emission calculation is linked to clinker production. However, for the years 1990 to 2000/2001 reported clinker production only presents a rough estimate (due to difficulties in data availability from the only producer), and also the EF used is a rough estimate.	Clinker production	1500	0,50	750	Clinker production	3967	0,54	2157
Italy	T2	NS	CS, PS	Methodology based on activity data from national statistics (clinker production) and the IPCC default EF. [NIR2004]	Clinker production	29786	0,54	16084	Clinker production	32077	0,54	17322
Luxembourg												
Netherlands	CS, T2	Q	PS, CS	Detailed methodology based on masured data [NIR2005]	Clinker production	939	0,54	507	Clinker production	804	0,54	434
Portugal	T2	PS	D	Clinker production is obtained from each plant, IPCC default EF is used [NIR 2004]	Clinker production	6128	0,51	3107	Clinker production	6128	0,51	3107
Spain	CS	AS	CS	Clinker production data and the applied EF are obtained from associations of industries [NIR2005]	Clinker production	23212	0,54	12534	Clinker production	30317	0,54	16371
Sweden	T2	PS	PS	AD (clinker production) is obtained from industry, the default value from the GHG protocol of WRI is used. [NIR2005]	Clinker production	2348	0,53	1245	Clinker production	2235	0,53	1181
UK	T2	AS		AD (clinker production) and CS EF is obtained from industry [NIR2004]	Clinker production	13199	0,50	6659	Clinker production	10616	0,50	5356
EU15					**EU15 w/o BE, LU and DK (about 95%)**	**142.351**	**0,53**	**75.579**		**143.502**	**0,53**	**76.487**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 2.A.2: 'Lime production' account for 0.4 % of total GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source increased by 4 % in the EU-15 (Table 4.4). Germany was responsible for 31 % of the emissions from this source. The decreases in Germany (– 9 %) contributed largely to the reduction trend in the EU-15 between 1990 and 2003.

Table 4.4 Member States' contributions to CO_2 emissions from 2.A.2: 'Lime production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	396	547	547	3,1%	0	0%	150	38%
Belgium	2.156	2.144	2.144	12,2%	0	0%	-12	-1%
Denmark	138	130	102	0,6%	-28	-22%	-35	-26%
Finland	383	439	513	2,9%	74	17%	130	34%
France	2.576	2.445	2.469	14,1%	25	1%	-106	-4%
Germany	5.891	5.299	5.383	30,7%	84	2%	-508	-9%
Greece	445	589	605	3,5%	16	3%	160	36%
Ireland	191	182	202	1,2%	20	11%	11	6%
Italy	1.711	1.941	2.092	11,9%	151	8%	381	22%
Luxembourg	0	0	0	0,0%	0	-	0	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	178	396	417	46,2%	21	5%	239	134%
Spain	1.123	1.513	1.571	9,0%	58	4%	448	40%
Sweden	500	549	564	3,2%	15	3%	64	13%
United Kingdom	1.192	811	901	5,1%	90	11%	-290	-24%
EU15	16.878	16.985	17.510	100,0%	525	3%	632	4%

Table 4.5 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2.A.2: 'Lime production' for 1990 to 2003. The table shows that most MS use lime production as activity data for calculating CO_2 emissions. The EU-15 IEF (excluding Denmark and the UK) is 0.77 t/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.53 for Sweden and 0.8 for Belgium. The reason for the low IEF in Sweden is that also limestone production in pulp and paper and food industries where CO_2 is partly rebound is reported under 'Lime production'. The table also suggests that most MS use default methodologies; about 30 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.5 Information on methods applied, activity data, emission factors for CO_2 emissions from 2.A.2: 'Lime production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990 Activity data: Description	1990 Activity data: (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2003 Activity data: Description	2003 Activity data: (kt)	2003 Implied emission factor (t/t)	2003 CO_2 emissions (Gg)
Austria	CS	PS	PS	Higher tier methodology based on detailed lime composition data [NIR2005]	Lime Production	513	0,77	396	Lime Production	719	0,76	547
Belgium	CS	PS	CS	Higher tier methodology considereing lime composition or raw material composition, respectively.[NIR2005]	Lime Production	2735	0,79	2156	Lime Production	2681	0,80	2144
Denmark	D	NS	D	Lower tier methodology based on lime production data and the IPCC default emission factor [NIR2005]	Production of Lime and Bricks	446	0,31	138	Production of Lime and Bricks	441	0,23	102
Finland	D	PS	PS	Higher tier methodology based on detailed lime composition data [NIR2005]	Lime Production	519	0,74	383	Lime Production	691	0,74	513
France	C	AS	PS	Methodology based on national statistics and emission factors from industry. [NIR2004]	Lime Production	3315	0,78	2576	Lime Production	3200	0,77	2469
Germany	D	NS	D	Lower tier methodology based on lime production data (without consideration of types of lime) and the IPCC default emission factor [NIR2005]	Lime Production	7504	0,79	5891	Lime Production	6857	0,79	5383
Greece	T1	NS	D	Higher tier methodology considering types of lime []NIR2004]	Lime Production	596	0,75	445	Lime Production	811	0,75	605
Ireland	D	NS, PS	PS	Lower tier methodology based on lime production data obtained from industry with out consideration of types of lime and the IPCC default emission facor for quicklime [NIR2005]	Lime production	255	0,75	191	Lime production	273	0,74	202
Italy	D	NS	CS, PS	Only hydraulic lime is considered; AD obtained from NS and information from associations of industry. IPCC default EF are used [NIR2004]	Lime production	2176	0,79	1711	Lime production	2624	0,80	2092
Luxembourg												
Netherlands	NO	NO	NO			NE	NE	NE		NE	NE	NE
Portugal	D	NS, PS	D	Lower tier methodology based on lime production data (without consideration of types of lime) and the IPCC default emission factor [NIR2004]	Lime production	268	0,66	178	Lime production	561	0,74	417
Spain	CS	AS	CS	Higher tier methodology considereing different types of lime and using EF obtained from national association [NIR2004]	Lime production	1475	0,76	1123	Lime production	2050	0,77	1571
Sweden	D	PS	D, CS	Higher tier methodology considereing different types of lime and using default EF [NIR2005]	Lime Production	923	0,54	500	Lime Production	1064	0,53	564
UK	T2	AS		Lower tier methodology using limestone consumption data and not distinguishing between types of lime; stochimetric ratio was used as EF (=default) [NIR2004]	Limestone consumption	2708	0,44	1192	Limestone consumption	2048	0,44	901
EU15					**Average w/o DK and UK (>90%)**	**20.280**	**0,77**	**15.549**		**21.533**	**0,77**	**16.507**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2 Chemical industry (CRF Source Category 2.B)

Table 4.6 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 2.B: 'Chemical industry'. Between 1990 and 2003, CO_2 emission from 'Chemical industry' decreased by 12 %. The relative decrease was largest in Ireland, the relative growth was largest in Portugal.

This source category includes one key source: CO_2 from 2.B.1:'Ammonia production'.

Table 4.6 Member States' contributions to CO_2 emissions from 2.B: 'Chemical industry' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	464	559	PS	PS	ALL	H
Belgium	909	2.024	CS	CS		
Denmark	2	3				
Finland	60	147	CS	PS	NE	NE
France	3.537	2.063	C	CS/ PS	ALL	H
Germany	2.191	2.014	CS	CS	All	H
Greece	0	0	D	D	NE	
Ireland	989	0	D,T1a	D	Part	M
Italy	2.186	1.243	D	C, PS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	3.538	2.935	CS/T2/T1	CS	ALL	M
Portugal	633	1.736	MB+D	D+C	All	M
Spain	673	593	D,C	D,C	ALL	H
Sweden	69	48	D	PS	PART	H
United Kingdom	1.322	1.164	T1	CS	ALL	H
EU15	16.572	14.529	C,CS,D,MB, PS, T1, T1a, T2	C, CS, D, PS	ALL, NE, PART	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 2.B.1: 'Ammonia production' account for 0.3 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 14 % (Table 4.7). The Netherlands, France, Germany, and Portugal are responsible for about two thirds of these emissions in the EU-15. The greatest reductions in absolute terms between 1990 and 2003 had France. The largest growth had Portugal.

Table 4.7 Member States' contributions to CO_2 emissions from 2.B.1: 'Ammonia production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	396	445	494	4,0%	48	11%	98	25%
Belgium	694	1.253	1.247	10,0%	-6	-1%	553	80%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3.357	2.198	2.044	16,5%	-153	-7%	-1.313	-39%
Germany	1.747	1.830	1.998	16,1%	167	9%	250	14%
Greece	IE	IE	IE	-	-	-	-	-
Ireland	989	810	NO	-	-810	-100%	-989	-100%
Italy	1.710	558	680	5,5%	122	22%	-1.030	-60%
Luxembourg	0	0	0	0,0%	0	-	0	-
Netherlands	3.058	2.871	2.686	21,6%	-185	-6%	-372	-12%
Portugal	569	1.528	1.622	13,1%	94	6%	1.053	185%
Spain	550	477	481	3,9%	5	1%	-69	-12%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	1.322	1.233	1.164	9,4%	-69	-6%	-157	-12%
EU15	14.392	13.203	12.416	100,0%	-787	-6%	-1.976	-14%

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.8 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2.B.1: 'Ammonia production' for 1990 to 2003. The table shows that most MS report ammonia production as activity data. The implied emission factors per tonne of ammonia produced vary for 2003 between 0.69 for Germany and 1.45 for France. The EU-15 IEF (excluding Belgium, Greece, Netherlands, Portugal and the UK) is 0.96 t/t of ammonia produced. The decrease of the IEF from 1990 to 2003 is rather due to changing ratios of production of the different countries than to emission reduction measures. The table also suggests that about 75 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.8 Information on methods applied, activity data, emission factors for CO_2 emissions from 2.B.1: 'Ammonia production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2003 Activity data Description	2003 Activity data (kt)	2003 Implied emission factor (t/t)	2003 CO_2 emissions (Gg)
Austria	CS	PS	PS	Estimates based on reported data from industry [NIR2005]	Ammonia production	461	0,86	396	Ammonia production	511	0,97	494
Belgium	CS	PS	CS	Emissions are calculated using natural gas consumption data and the IPCC default EF for natural gas. [NIR2005]	Ammonia production	C	C	694	Ammonia production	C	C	1247
Denmark	NO	NO	NO			NO	0,00	NO		NO	0,00	NO
Finland	NO	NO	NO			NO	0,00	NO		NO	0,00	NO
France	C	AS	PS	Emission data obtained from industry on plant level [NIR2004]	Ammonia production	1928	1,74	3357	Ammonia production	1406	1,45	2044
Germany	CS	NS	CS	Emissions are estimated from ammonia production data (NS) and a CS emission factor. [NIR2005]	Ammonia production	2532	0,69	1747	Ammonia production	2895	0,69	1998
Greece	D	NS	D	Emissions are included in the energy sector [NIR 2005]	Ammonia production	313	IE	IE	Ammonia production	94	IE	IE
Ireland	D	NS, PS	CS, PS	Emissions are calculated using natural gas consumption data and a CS EF for natural gas. [NIR2004] Ammonia production was closed in 2002 [NIR 2005]	Natural Gas Feedstock	430	2,30	989		0	0,00	NO
Italy	D	NS, PS	C, PS		Ammonia production	1455	1,18	1710	Ammonia production	578	1,18	680
Luxembourg												
Netherlands	CS	PS,Q	PS, CS	Emissions are calculated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) and a CS EF based on a 17% fraction of carbon in the gas-feedstock oxidised during the ammonia manufacture, which was calculated from the carbon not contained in the urea produced. [NIR 2005]	Ammonia production	C	C	3058	Ammonia production	C	C	2686
Portugal	D	NS, PS	PS	Emissions are estimated using natural gas consumption data and a PS emission factor. [NIR2004]	Ammonia production	C	0,00	569	Ammonia production	C	0,00	569
Spain	CS	AS	CS		Ammonia production	601	0,91	550	Ammonia production	525	0,92	481
Sweden	NO	NO	NO			374	0,00	0		NO	NO	NO
UK				Estimates based on reported data from industry and natural gas consumption [NIR2004]	Ammonia production: natural gas consumption PJ net	44	29,87	1322	Ammonia production: natural gas consumption PJ net	32	35,87	1164
EU15					**EU15 w/o BE, GR, NL, PT and UK (45% - 60%)**	**7781**	**1,12**	**8749**		**5915**	**0,96**	**5696**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.9 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N_2O from 2.B: 'Chemical industry'. Between 1990 and 2003, N_2O emission from 'Chemical industry' decreased by 57 %. The relative decrease was largest in Ireland, emissions increased in Italy and Portugal.

This source category includes three key sources: N_2O from 2.B.2:'Nitric acid production', N_2O from 2.B.3: 'Adipic acid production', and N_2O from 2.B.5: 'Other'.

Table 4.9 Member States' contributions to N_2O emissions from 2.B: 'Chemical industry' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	912	883	PS	PS	ALL	H
Belgium	3.934	3.137	CS	CS		
Denmark	1.043	895				
Finland	1.595	1.395	D	PS	ALL	L
France	24.143	9.084	C	CS/ PS	ALL	M
Germany	23.484	10.373	PS, CS	D, PS, CS	part	M
Greece	713	401	D	D	NE	
Ireland	1.035	0	D	CS	Part	L
Italy	6.748	7.061	D	D, PS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	7.570	6.014	CS/T2/T1	PS,D,CS	CS	L
Portugal	567	597	D	D+C	All	M
Spain	2.884	1.965	DC	C,CS	ALL	M
Sweden	829	446	T2, CS	PS	ALL	H
United Kingdom	29.270	3.199	PS	CS	ALL	M
EU15	104.727	45.451	C, CS, D, PS, T1, T2	C, CS, D, PS	ALL, PART	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2.B.2: 'Nitric acid production' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 22 % (Table 4.10). The Netherlands, France, Germany and Belgium are responsible for 66 % of these emissions in the EU-15. Nearly all Member States had reductions from this source between 1990 and 2003. France had the greatest reductions in absolute terms. The largest growth was in Germany.

Table 4.10 Member States' contributions to N_2O emissions from 2.B.2: 'Nitric acid production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	912	807	883	3,0%	76	9%	-29	-3%
Belgium	3.562	3.685	2.922	10,1%	-763	-21%	-640	-18%
Denmark	1.043	774	895	3,1%	121	16%	-148	-14%
Finland	1.595	1.310	1.395	4,8%	85	6%	-200	-13%
France	6.570	4.403	4.600	15,9%	197	4%	-1.971	-30%
Germany	4.673	4.007	6.589	22,7%	2.581	64%	1.915	41%
Greece	713	401	401	1,4%	0	0%	-312	-44%
Ireland	1.035	292	NO	-	-292	-100%	-1.035	-100%
Italy	2.169	585	644	2,2%	59	10%	-1.525	-70%
Luxembourg	0	0	0	0,0%	0	-	0	-
Netherlands	6.330	5.032	5.060	17,4%	28	1%	-1.269	-20%
Portugal	567	590	597	2,1%	7	1%	31	5%
Spain	2.884	1.937	1.965	6,8%	28	1%	-919	-32%
Sweden	814	441	431	1,5%	-10	-2%	-383	-47%
United Kingdom	4.134	2.412	2.618	9,0%	205	9%	-1.516	-37%
EU15	37.002	26.677	29.000	100,0%	2.322	9%	-8.002	-22%

Table 4.11 shows information on methods applied, activity data, emission factors for N_2O emissions from 2.B.2: 'Nitric acid production' for 1990 to 2003. The table shows that almost all MS report nitric acid production as activity data; for some MS this information is confidential. The implied emission factors per tonne of nitric acid produced vary for 2003 between 0.0038 for Italy and 0.0094 for Finland. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0056 t/t of nitric acid produced. The decrease of the IEF is mainly due to changing production ratios in the different MS having different technological standards and close down of older plants in some MS rather than due to introduction of emission

reduction measures. The table also suggests that more than 95 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.11 Information on methods applied, activity data, emission factors for N_2O emissions from 2.B.2: 'Nitric acid production' for 1990 and 2003

					1990				2003			
Member State	Method applied	Activity data	Emission factor	Methodology comment	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	N_2O emissions (Gg)	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	N_2O emissions (Gg)
Austria	CS	CS	PS	Estimates based on reported data from industry [NIR2005]	Nitric acid production	530	0,0056	2,9	Nitric acid production	558	0,0051	2,8
Belgium	CS	PS	CS	Estimates are partly calculated using nitric acid production figures and a french EF and partly reported by industry based on monitroing data [NIR2005]	Nitric acid production	364	0,0316	11,5	Nitric acid production	1716	0,0055	9,4
Denmark	D	PS	PS	Estimates are based on PS activity data using the PS EF for 2002. [NIR2005]	Nitric acid production	450	0,0075	3,4	Nitric acid production	386	0,0075	2,9
Finland	D	PS	PS	Emission factors are plant specific and based on measurements in 1999. [NIR 2005]	Nitric acid production	549	0,0094	5,1	Nitric acid production	477	0,0094	4,5
France	C	AS	PS		Nitric acid production	3200	0,0066	21,2	Nitric acid production	2702	0,0055	14,8
Germany	CS	NS	CS	Activity data taken from national statistics, country-specific emission factor is assumed to be constant [NIR 2005]	Nitric acid production	2741	0,0055	15,1	Nitric acid production	3864	0,0055	21,3
Greece	D	NS	D	Estimates are based on activity data from industry and average IPCC default EF [NIR 2005]	Nitric acid production	511	0,0045	2,3	Nitric acid production	288	0,0045	1,3
Ireland	D	NS, PS	CS, PS	Nitric acid production was closed in 2002	Nitric acid production	339	0,0099	3,3	NO	0	0,0000	NO
Italy	D	NS, PS	D, PS	Emissions are calculated based on nitric acid production and a CS emission factor taken from EPER [NIR2004]	Nitric acid production	1037	0,0068	7,0	Nitric acid production	554	0,0038	2,1
Luxembourg												
Netherlands	CS	Q, NS	PS	Estimates are based on data reported by industry and calculated with Tier 2 method, emission factors are based on plant-specific measured data which are confidential. [NIR 2005]	Nitric acid production	C	C	20,4	Nitric acid production	C	C	16,3
Portugal	D	NS, PS	PS	Estimates are calculated from nitric acid production data using the PS EF from one plant [NIR2004]	Nitric acid production	C	0,0000	1,8	Nitric acid production	C	0,0000	1,9
Spain	CS	AS	CS	Emission factor obtained from national business association [NIR 2005]	Nitric acid production	1329	0,0070	9,3	Nitric acid production	906	0,0070	6,3
Sweden	T2	PS	PS	Estimates are based on activity data and emission factors as reported by industry. [NIR 2005]	Nitric acid production	NO	0,0000	NO	Nitric acid production	258	0,0054	1,4
UK		PS	CS	Estimates are based on PS data as well as calculated using nitric acid production and the average IPCC default value [NIR 2004]	Nitric acid production	2408	0,0055	13,3	Nitric acid production	1625	0,0052	8,4
EU15					**EU15 w/o NL and PT (80%)**	**13.457**	**0,0070**	**94**		**13.334**	**0,0056**	**75**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2.B.3: ‘Adipic acid production’ account for 0.4 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 76 % (Table 4.12). Italy is responsible for 43 % of these emissions in the EU-15 and it had increases in emissions from this source between 1990 and 2003. All other Member States that reported emissions from this source had large emissions reductions between 1990 and 2003 due to reduction measures in adipic acid production.

Table 4.12 Member States’ contributions to N_2O emissions from 2.B.3: ‘Adipic acid production’

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	14.806	3.979	4.140	27,8%	161	4%	-10.666	-72%
Germany	18.805	3.848	3.778	25,3%	-70	-2%	-15.026	-80%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	4.579	6.882	6.417	43,0%	-465	-7%	1.838	40%
Luxembourg	0	0	0	0,0%	0	-	0	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	25.136	656	582	3,9%	-74	-11%	-24.555	-98%
EU15	63.326	15.365	14.917	100,0%	-448	-3%	-48.409	-76%

Table 4.13 shows information on methods applied, activity data, emission factors for N_2O emissions from 2.B.3: ‘Adipic acid production’ for 1990 to 2003. The table shows that in 2003 adipic acid was produced in four MS only. Three MS report adipic acid production as activity data; for Germany this information is confidential. The implied emission factors per tonne of adipic acid produced vary for 2003 between 0.01 for the UK and 0.3 for Italy. The EU-15 IEF (excluding Germany) is 0.12 t/t of adipic acid produced. With the exception of Italy the implied emission factors have been reduced substantially due to emission reduction measures. The table suggests that 100 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.13 Information on methods applied, activity data, emission factors for N_2O emissions from 2.B.3: ‘Adipic acid production’ for 1990 and 2003

					1990				2003			
Member State	Method applied	Activity data	Emission factor	Methodology comment	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)
					Description	(kt)			Description	(kt)		
France	C	PS	PS	Emission data obtained from industry on plant level [NIR 2004]	Adipic acid production	100	0,48	47,8	Adipic acid production	156	0,09	13,4
Germany		PS	PS, D	Estimates are based on PS data as well as calculated using nitric acid production and the IPCC default value for years before mid 90ies [NIR 2005]	Adipic acid production	C	C	60,7	Adipic acid production	C	C	12,2
Italy	D	PS	PS	Emission data obtained from industry on plant level [NIR 2004]	Adipic acid production	49	0,30	14,8	Adipic acid production	69	0,30	20,7
Sweden	NO	NO	NO			55	0,00			NO	NO	NO
UK				Emission data obtained from industry on plant level [NIR 2004]	Adipic acid production	265	0,31	81,1	Adipic acid production	189	0,01	1,9
EU15					**EU15 w/o DE (>70%)**	**470**	**0,44**	**204**		**414**	**0,12**	**48**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

N_2O emissions from 2.B.5: ‘Other’ account for 0.04 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 65 % (Table 4.14). The Netherlands and France are responsible for 85 % of these emissions in the EU-15. Their decreases had the most influence on the reductions in the EU-15.

Table 4.14 Member States' contributions to N_2O emissions from 2.B.5: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	0	0	0	0,0%	0	-	0	-			
Belgium	372	287	215	14,0%	-72	-25%	-157	-42%	CS	PS	CS
Denmark	0	0	0	0,0%	0	-	0	-	NE		
Finland	0	0	0	0,0%	0	-	0	-	NO	NO	NO
France	2.767	646	345	22,5%	-301	-47%	-2.422	-88%	C	PS	PS
Germany	6	6	6	0,4%	0	-	0	-			
Greece	0	0	0	0,0%	0	-	0	-			
Ireland	0	0	0	0,0%	0	-	0	-			
Italy	0	0	0	0,0%	0	-	0	-			
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	1.240	1.240	954	62,2%	-286	-23%	-286	-23%	CS	PS, Q	CS
Portugal	0	0	0	0,0%	0	4%	0	101%	D	NS, PS	CS
Spain	0	0	0	0,0%	0	-	0	-			
Sweden	16	15	15	1,0%	0	2%	-1	-4%	CS	PS	PS
United Kingdom	0	0	0	0,0%	0	-	0	-	NO	NO	NO
EU15	4.400	2.194	1.534	100,0%	-659	-30%	-2.866	-65%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.3 Metal production (CRF Source Category 2.C)

Table 4.15 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 2.C: 'Metal production'. Between 1990 and 2003, CO_2 emission from 'Metal production' decreased by 9 %. The relative decrease was largest in Denmark, the relative growth was largest in Greece.

This source category includes one key source: CO_2 from 2.C.1: 'Iron and steel production'.

Table4.15 Member States' contributions to CO_2 emissions from 2.C: 'Metal production' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	3.725	4.532	C, T2	D, CS, PS	ALL	M
Belgium	1.873	1.908	CS	CS		
Denmark	28	0				
Finland	0	0	NO	NO	IE	IE
France	4.519	3.512	C	CS	ALL	H
Germany	1.012	904	T3,CS	D,CS	All	H
Greece	435	657	T1	D	PART	
Ireland	0	0	NA	NA	NO	NA
Italy	2.205	1.810	D	C, CS	ALL	M
Luxembourg	850	263	C/D	C/D		
Netherlands	2.909	1.968	T2 (carbon inputs)/T1	CS	ALL	M
Portugal	29	26	D	D+C+CS	All	L
Spain	2.785	2.843	D,C	D,C,CS,PS	ALL	H
Sweden	2.266	2.533	T1,T2,CS	CS, PS	ALL	H
United Kingdom	2.304	1.844	T3/T2	CS	ALL	H
EU15	24.939	22.800	C, CS, D, T1, T2, T3	C, CS, D, PS	ALL, IE, PART	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 2.C.1: 'Iron and steel production' account for 0.4 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO_2 emissions from this source decreased by 9 % (Table 4.16). Austria and France are responsible for 51 % of these emissions in the EU-15. France had the largest decreases in absolute terms between 1990 and 2003 while the largest increases were in Austria.

Table 4.16 Member States' contributions to CO_2 emissions from 2.C.1: 'Iron and steel production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3.546	4.618	4.513	25,1%	-105	-2%	967	27%
Belgium	1.873	1.930	1.908	10,6%	-21	-1%	36	2%
Denmark	28	0	0	0,0%	0	-	-28	-100%
Finland	IE	IE	0	-	-	-	-	-
France	4.007	2.644	2.863	15,9%	219	8%	-1.144	-29%
Germany	IE	IE	IE	-	-	-	-	-
Greece	203	443	399	2,2%	-43	-10%	197	97%
Ireland	NE	NO	NO	-	-	-	-	-
Italy	1.346	1.348	1.384	7,7%	36	3%	37	3%
Luxembourg	850	270	263	1,5%	-7	-3%	-588	-69%
Netherlands	2.514	1.409	1.558	8,7%	149	11%	-956	-38%
Portugal	27	21	23	0,1%	3	14%	-3	-12%
Spain	1.835	1.853	1.697	9,4%	-156	-8%	-139	-8%
Sweden	1.776	1.679	2.060	11,5%	381	23%	285	16%
United Kingdom	1.853	643	1.316	7,3%	673	105%	-538	-29%
EU15	19.859	16.856	17.985	100,0%	1.128	7%	-1.874	-9%

Table 4.17 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2.C.1: 'Iron and steel production' for 1990 and 2003. For 2.C.1 'Iron and steel production' it is not useful to give an average IEF for the EU-15 because the allocation of emissions (the split between process and combustion related emissions for pig iron production, which is the most important sub category) is very different in different MS. It ranges from including all emissions in the energy sector (e.g. Finland, Portugal Italy) to reporting all emissions related to carbon input in blast furnaces in the industrial processes sector (e.g. UK, Sweden) or using a split based on country-specific information (e.g. Austria).

Table 4.17 Information on methods applied, activity data, emission factors for CO_2 emissions from 2.C.1: 'Iron and steel production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO2 emissions (Gg)	2003 Activity data Description	2003 Activity data (kt)	2003 Implied emission factor (t/t)	2003 CO2 emissions (Gg)
Austria	**T2**	**NS**	**PS/D**	**Iron and steel production**	**0**	**0,00**	**3546**	**Iron and steel production**	**0**	**0,00**	**4513**
	Total emission data (1A2a/2C1) reported by industry, split on the basis of national study.			Steel production	4291	0,12	503	Steel production	6275	0,11	685
				Iron production	3444	0,88	3043	Iron production	4677	0,82	3828
				Sinter production	4384	0,00	IE	Sinter production	3528	0,00	IE
				Coke production	1725	0,00	IE	Coke production	1	0,00	IE
				Other	0	0,00	0	Other	0	0,00	0
Belgium	**CS**	**PS**	**CS**	**Iron and steel production**	**0**	**0,00**	**1873**	**Iron and steel production**	**0**		**1908**
				Steel	7621	0,12	946	Steel	7700	0,09	675
				Pig iron	9415	0,06	546	Pig iron	7704	0,07	538
				Sinter	13735	0,03	381	Sinter	12676	0,05	686
				Coke	IE	IE	IE	Coke	IE	IE	0
				Other	0	0,00	0	Other	0	0,00	9
				Use of electrodes	15666	0,00	0	Use of electrodes	0	0,00	9
Denmark	**T2**	**PS**	**D**	**Iron and steel production**	**0**	**0,00**	**28**	**Iron and steel production**	**0**	**0,00**	**0**
				Steel	614	0,05	28	Steel	NO	0,00	NO
				Pig Iron	NO	0,00	NO	Pig Iron	NO	0,00	NO
				Sinter	NO	0,00	NO	Sinter	NO	0,00	NO
				Coke	NO	0,00	NO	Coke	NO	0,00	NO
				Other	0	0,00	0	Other	0	0,00	0
Finland	**IE**	**IE**	**IE**	**Iron and steel production**	**0**	**0,00**	**IE**	**Iron and steel production**	**0**	**0,00**	**0**
	The CO_2 emissions from coke and residual fuel oil used in blast furnaces are allocated in metal production in the energy sector CRF 1.A.			Steel	NA	0,00	IE	Steel	NA	IE	IE
				Pig iron	NA	0,00	IE	Pig iron	NA	IE	IE
				Sinter	NA	0,00	IE	Sinter	NA	IE	IE
				Coke	487	0,00	IE	Coke	895	IE	IE
				Other	0	0,00	0	Other	0	0,00	0
France	**C**	**AS, NS**	**CS**	**Iron and steel production**	**0**	**0,00**	**4007**	**Iron and steel production**	**0**	**0,00**	**2863**
				Steel	19073	0,08	1487	Steel	19976	0,08	1566
				Pig iron	228193	0,01	2016	Pig iron	215323	0,00	1038
				Sinter	22000		IE	Sinter	19389		IE
				Coke	0	0,00	NO	Coke	0	0,00	NO
				Other	0	0,00	504	Other	0	0,00	259
				Rolling mills, blast furnast charging	16848	0,03	504	Rolling mills, blast furnast charging	18348	0,01	259
Germany	**T3, CS**	**NS**	**D, CS**	**Iron and steel production**	**NE**	**NE**	**0**	**Iron and steel production**	**NE**	**NE**	**0**
				Steel	43915	NE	NE	Steel	44809	NE	NE
				Pig iron	32263	NE	NE	Pig iron	29481	NE	NE
				Sinter	29869	NE	NE	Sinter	26811	NE	NE
				Coke	NE	NE	NE	Coke	NE	NE	NE
				Other	0	0,00	0	Other	0	0,00	0
				Iron & Steel Foundries	4450	NE	NE	Iron & Steel Foundries	3858	NE	NE
Greece	**T2**	**NS**	**CS**	**Iron and steel production**	**0**	**0,00**	**203**	**Iron and steel production**	**0**	**0,00**	**399**
				Steel production in EAF	999	0,20	203	Steel production in EAF	1701	0,23	399
				Pig iron	NO	NO	NO	Pig iron	NO	NO	NO
				Sinter	NO	NO	NO	Sinter	NO	NO	NO
				Coke	NO	NO	NO	Coke	NO	NO	NO
				Other	0	0,00	0	Other	0	0,00	0

Member State	Method applied	Activity data	Emission factor	1990 Activity data: Description	1990 Activity data: (kt)	1990 Implied emission factor (t/t)	1990 CO2 emissions (Gg)	2003 Activity data: Description	2003 Activity data: (kt)	2003 Implied emission factor (t/t)	2003 CO2 emissions (Gg)
Ireland	**NE, NO**	**NE, NO**	**NE, NO**	**Iron and steel production**	**0**	**0,00**	**NE**	**Iron and steel production**	**0**	**0,00**	**0**
				Steel	0	0,00	NE	Steel	0	0,00	NO
				Pig Iron	0	0,00	NE	Pig Iron	0	0,00	NO
				Sinter	0	0,00	NE	Sinter	0	0,00	NO
				Coke	0	0,00	NE	Coke	0	0,00	NO
				Other	0	0,00	0	Other	0	0,00	0
Italy	**D**	**NS**	**C, CS**	**Iron and steel production**	**0**	**0,00**	**1346**	**Iron and steel production**	**0**	**0,00**	**1384**
	According to the NIR2004, emissions from blast furnaces are included in 1 A 2 (estimated using consumption data of blast furnace gas)			Steel	25467	0,05	1346	Steel	26832	0,05	1384
				Pig Iron	11852	0,00	0	Pig Iron	10123	0,00	0
				Sinter	0	0,00	0	Sinter	0	0,00	0
				Coke	0	0,00	0	Coke	0	0,00	0
				Other	0	0,00	0	Other	0	0,00	0
Netherlands	**CS, T2**	**PS**	**PS, CS**	**Iron and steel production**	**5162**	**0,49**	**2514**	**Iron and steel production**	**6590**	**0,24**	**1558**
	Carbon input (coke) minus output (BFG, BOFgas) are reported as process emissions			Crude steel production	5162	0,01	43	Crude steel production	6590	0,01	55
				Pig iron	0	0,00	0	Pig iron	0	0,00	0
				Sinter	0	NA	NA	Sinter	0	NA	NA
				Coke see 1B1b	IE	IE	IE	Coke see 1B1b	IE	IE	IE
				Other	0	0,00	2471	Other	0	0,00	1503
				Coke a.o. inputs in blastfurnace (- BF and oxygas): carbon input	2298	0,97	2223	Coke a.o. inputs in blastfurnace (- BF and oxygas): carbon input	2689	0,45	1203
				Limestone use: limestone equiv. use	595	0,42	249	Limestone use: limestone equiv. use	718	0,42	300
Portugal	**T2**	**PS**	**D**	**Total steel production**	**316**	**0,08**	**27**	**Total steel production**	**316**	**0,08**	**27**
	According to the NIR2004, emissions from blast furnaces are included in 1 A 2 (estimated using consumption data of blast furnace gas)			Steel	IE	0,00		Steel	IE	0,00	
				Pig Iron	NO	0,00		Pig Iron	NO	0,00	
				Sinter	IE	0,00		Sinter	IE	0,00	
				Coke	IE	0,00		Coke	IE	0,00	
				Other	0	0,00	0	Other	0	0,00	0
Spain	**CS**	**AS, Q**	**CS, PS**	**Iron and steel production**	**0**	**0,00**	**1835**	**Iron and steel production**	**0**	**0,00**	**1697**
				Steel production	13229	0,08	1052	Steel production	15719	0,07	1150
				Pig iron production	5588	0,04	246	Pig iron production	3837	0,07	268
				Sinter production	6947	0,08	538	Sinter production	4999	0,06	278
				Coke production	3211	IE	IE	Coke production	2711	IE	IE
				Other	0	0,00	0	Other	0	0,00	0
Sweden	**CS, T1, T2**	**PS**	**CS, PS**	**Iron and steel production**	**0**	**0,00**	**1776**	**Iron and steel production**	**0**	**0,00**	**2060**
	Consumption of BFG reported as process emissions (including limestone use)			Steel: use of reducing agents	IE	0,00	IE	Steel: use of reducing agents	IE	IE	IE
				Pig iron: use of blast furnace gas, TJ	5142	0,30	1537	Pig iron: use of blast furnace gas, TJ	6008	0,30	1797
				Sinter	IE	0,00	IE	Sinter	IE	IE	IE
				Coke	IE	0,00	IE	Coke	IE	IE	IE
				Other	0	0,00	238	Other	0	0,00	264
				Steel production: coal/anthracite	18	2,89	53	Steel production: coal/anthracite	25	2,92	72
				Steel production: coke	41	3,15	128	Steel production: coke	37	3,15	117
				Steel production: electrodes	9	3,66	32	Steel production: electrodes	4	3,63	15
				Steel production: other	444	0,06	25	Steel production: other	1490	0,04	60
UK	**T2**	**AS**	**CS**	**Iron and steel production**	**0**	**0,00**	**1853**	**Iron and steel production**	**0**	**0,00**	**1316**
	Split follows energy balance final consumption of coke and blast furnace gas (excluding limestone use)			Steel production (EAF)	4546	0,01	60	Steel production (EAF)	2550	0,01	34
				Pig iron production (BF)	12463	0,00	0	Pig iron production (BF)	10229	0,00	0
				Sinter	NA	0,00	NA	Sinter	NA	0,00	NA
				Coke consumed in blast furnaces	5180	0,00	0	Coke consumed in blast furnaces	4246	0,00	0
				Other	0	0,00	1793	Other	0	0,00	1282
				Steel production (OC)	13169	0,00	0	Steel production (OC)	10630	0,00	0
				Pig iron production (ISW)	12463	0,00	0	Pig iron production (ISW)	10188	0,00	0
				Blast furnace gas flared (PJ)	7	273,87	1793	Blast furnace gas flared (PJ)	5	257,35	1282

Table 4.18, Table 4.19 and Table 4.20 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source PFCs from 2.C: 'Metal production'.

Table 4.18 Member States' contributions to PFC emissions from 2.C: 'Metal production' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	1.050	0	NA	NA	NA	NA
Belgium	0	0				
Denmark	0	0				
Finland	0	0	NO	NO	NO	NO
France	2.290	739	C/ T2	PS	ALL	H
Germany	2.486	431	T3	CS	All	H
Greece	258	77	PS	PS	ALL	
Ireland	0	0	NA	NA	NO	NA
Italy	1.673	277	T1, T2	PS	ALL	M
Luxembourg	0	0				
Netherlands	2.097	1.204	CS/T2	M, PS		
Portugal	0	0			NO	
Spain	883	190	T2	T2	ALL	H
Sweden	440	282	T2	PS	ALL	H
United Kingdom	1.327	203	T2/PS	CS	ALL	M
EU15	12.504	3.403	C,CS,PS,T1,T2,T3	C, CS, PS, T3a	ALL	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

PFC emissions from 2.C.3 'Aluminium production' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, PFC emissions from this source decreased by 73 %. The Netherlands and France are responsible for 57 % of these emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2003. Germany had the largest decreases in absolute terms.

Table 4.19 Member States' contributions to PFC emissions from 2.C:3 'Aluminium production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1.050	NO	NO	-	-	-	-1.050	-100%
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	2.290	973	739	21,7%	-234	-24%	-1.551	-68%
Germany	2.486	431	431	12,7%	0	0%	-2.055	-83%
Greece	258	88	77	2,3%	-11	-12%	-180	-70%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1.673	199	277	8,1%	78	39%	-1.397	-83%
Luxembourg	0	0	0	0,0%	-	-	0	-
Netherlands	2.097	1.249	1.204	35,4%	-45	-4%	-893	-43%
Portugal	NO	NO	NO	-	-	-	-	-
Spain	883	199	190	5,6%	-9	-4%	-693	-78%
Sweden	440	283	282	8,3%	-1	0%	-158	-36%
United Kingdom	1.327	209	203	6,0%	-6	-3%	-1.123	-85%
EU15	12.504	3.631	3.403	100,0%	-227	-6%	-9.101	-73%

Table 4.20 shows information on methods applied, activity data, emission factors for PFC emissions from 2.C. 'Metal production' for 1990 to 2003. The table shows that in 2003 aluminium production was reported by most MS as activity data; for some MS this information is confidential. The implied emission factors for CF_4 per tonne of aluminium produced vary for 2003 between 0.001 kg/t for the Netherlands and 0.37 kg/t for Sweden. The EU-15 IEF (average of Sweden, Netherlands, Italy and France) is 0.33 kg/t. The decrease of the IEF from 1990 to 2003 is mainly due to emission reduction

measures that have been implemented. The table suggests that more 100 % of EU-15 emissions are estimated with higher Tier methods. The implied emission factors for C_2F_6 per tonne of aluminium produced vary for 2003 between 0.0001 kg/t for the Netherlands and 0.04 kg/t for Sweden. The EU-15 IEF (average of Sweden, Netherlands, Italy and France) is 0.03 kg/t. The table suggests that for 2003 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions.

Table 4.20 Information on methods applied, activity data, emission factors for PFC emissions from 2.C. 'Metal production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	Gas	1990				2003			
						Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
						Description	(t)			Description	(t)		
Austria	C	NS	PS	Data is obtained from industry (methodology is equivalent to IPCC T2)	CF_4	Aluminium production	88021	1,56	137	Aluminium production	NO		
					C_2F_6	Aluminium production	88021	0,19	17	Aluminium production	NO		
France	C	NS	PS	Data is obtained from industry (methodology is equivalent to IPCC T2)	CF_4	Aluminium production	325900	0,95	309	Aluminium production	444852	0,22	100
					C_2F_6	Aluminium production	325900	0,09	31	Aluminium production	444852	0,02	10
Germany	T3	NS	CS	A CS EF is derived from PS data for 1996 and 2001; [NIR2005]	CF_4	Anode effects	NE	NE	NE	Anode effects	654502	0,0001	58
					C_2F_6	Anode effects	NE	NE	NE	Anode effects	654502	0,00	6
Greece	T3b	PS	PS	Estimates are provided by industry based on measurements according to the PESHINEY methodology [NIR 2005]	CF_4	Aluminium production	C	C	35	Aluminium production	C	C	10
					C_2F_6	Aluminium production	C	C	3	Aluminium production	C	C	1
Italy	T1, T2	PS	PS	For 1990-1999 default Efs have been used, for the years after PS was used. [NIR 2004]	CF_4	Aluminium production	231800	0,86	198	Aluminium production	191663	0,19	36
					C_2F_6	Aluminium production	231800	0,18	42	Aluminium production	191663	0,02	5
Netherlands	T2, T3	PS	PS	Data is obtained from industry using Tier 2 methodology and emission factors based on measured data [NIR 2005]	CF_4	Aluminium production	272122	0,00	281	Aluminium production	282999	0,001	162
					C_2F_6	Aluminium production	272122	0,00	29	Aluminium production	282999	0,0001	16
Spain	T2	Q	PS	Activity data and paramters for estimating emissions have been obtained by industry [NIR 2005]	CF_4	Aluminium production	C	C	122	Aluminium production	C	C	26
					C_2F_6	Aluminium production	C	C	10	Aluminium production	C	C	2
Sweden	T2	PS	PS	Plant specific data is used to estimate emissions, for years before 1995 IEFs were used to calculate emission or expert judgement was used [NIR 2005]	CF_4	Aluminium production	96300	0,61	59	Aluminium production	101231	0,37	38
					C_2F_6	Aluminium production	96300	0,07	7	Aluminium production	101231	0,04	4
UK	T2	PS	CS	Estimates are based on actual emissions data provided by industry using Tier 2 methodology [NIR 2005]	$CF_4 + C_2F_6$	Aluminium production	289796	0,68	196	Aluminium production	342748	0,09	30
						Aluminium production	IE	0,00	IE	Aluminium production	IE	0,00	IE
EU15				**Avarage SE/NL/IT/FR (about 75% of emissions)**	**CF_4**		**926122**	**0,91**	**846**		**1020745**	**0,33**	**335**
				Avarage SE/NL/IT/FR	**C_2F_6**		**926122**	**0,12**	**109**		**1020745**	**0,03**	**35**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2.E)

Table 4.21, Table 4.22 and Table 4.23 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source HFCs from 2.E: 'Production of halocarbons and SF_6'.

Table 4.21 Member States' contributions to HFC emissions from 2.E: 'Production of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	NO	NO	NA	NA	NO	NO
Belgium	0	0				
Denmark	0	0	NO		NO	
Finland	0	0	NO	NO	NO	NO
France	3.605	364	CS	CS/ PS	ALL	M
Germany	3.510	1.212	T1	CS		H
Greece	935	3.195	T1	D	ALL	
Ireland	0	0	NA	NA	NO	NA
Italy	351	23	CS	PS	ALL	M
Luxembourg	0	0				
Netherlands	4.432	560	CS/T2	PS	ALL	M
Portugal	0	0			NE	
Spain	2.403	1.710	D,T2,CS	D,T2,PS	ALL	H
Sweden	NO	NO	NO	NO	NO	
United Kingdom	11.374	2.191	T2/PS	CS	ALL	M
EU15	26.610	9.254	CS, D, PS, T1, T2	C, CS, D, PS, T2	ALL, NE	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2.E: 'Production of halocarbons and SF_6' account for 0.2 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, HFC emissions from this source decreased by 65 %. Greece and the United Kingdom are responsible for 58 % of these emissions in the EU-15. Greece was the only Member State with emission increases from this source between 1990 and 2003.

Table 4.22 Member States' contributions to HFC emissions from 2.E: 'Production of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3.605	509	364	3,9%	-146	-29%	-3.241	-90%
Germany	3.510	1.212	1.212	13,1%	0	0%	-2.298	-65%
Greece	935	3.195	3.195	34,5%	0	0%	2.260	242%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	351	21	23	0,2%	2	8%	-328	-94%
Luxembourg	0	0	0	0,0%	-	-	0	-
Netherlands	4.432	782	560	6,1%	-222	-28%	-3.872	-87%
Portugal	NO	NO	NO	-	-	-	-	-
Spain	2.403	1.171	1.710	18,5%	539	46%	-693	-29%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	11.374	2.292	2.191	23,7%	-101	-4%	-9.183	-81%
EU15	26.610	9.182	9.254	100,0%	73	1%	-17.355	-65%

Table 4.23 shows information on methods applied, activity data, emission factors for HFC emissions from 2.E. 'Production of halocarbons and SF_6' for 1990 tand 2003. For Production of Halocarbons it is not possible to give an average IEF for the EU-15 because for most countries activity data is confidential. Exept for Greece, all reported emissions are estimated with higher Tier methods.

Table 4.23 Information on methods applied, activity data, emission factors for HFC emissions from 2.E. 'Production of halocarbons and SF_6' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment		Gas	1990 Activity data Description	1990 Activity data (t)	1990 Implied emission factor (kg/t)	1990 Emissions (t)	2003 Activity data Description	2003 Activity data (t)	2003 Implied emission factor (kg/t)	2003 Emissions (t)
France	C	PS	PS	Emissions reported by industry [NIR2004]	By-product emissions	HFC-23	HCFC-22 production	C	0,00	140,1	HCFC-22 production	C	0,00	20,8
	C	PS	PS		Fugitive emissions	HFC-125	HFC production	C	0,00	8,8	HFC production	C	0,00	8,8
					Fugitive emissions	HFC-134a	HFC production	C	0,00	8,8	HFC production	C	0,00	10,4
					Fugitive emissions	HFC-143a	HFC production	C	0,00	508,0	HFC production	C	0,00	21,1
					Fugitive emissions	HFC-152a	HFC production	C	0,00	0,0	HFC production	C	0,00	0,0
					Fugitive emissions	HFC-365mfc	HFC production	C	0,00	0,0	HFC production	C	0,00	2,3
Germany	T1		CS	Emission data are reported by industry [NIR2005]	By-product emissions	HFC-23	HCFC-22 production	NE	NE	NE	HCFC-22 production	30000	0,0033	100,0
					Fugitive emissions	HFC-227ea	Destillation	NE	NE	NE	Destillation	C	C	C
					Fugitive emissions	HFC-23	Production	NE	NA	NA	Production	C	NA	NA
					Fugitive emissions	HFC-134a	Production	NE	NE	NE	Production	C	C	C
Greece	T1	PS	D	Emission estimates based on production statistics and and a reference emission factor [NIR 2005]	By-product emissions	HFC-23	HCFC-22 production	C	C	79,9	HCFC-22 production	C	C	273,0
					Fugitive emissions	0	NO	NO	NO	NO	NO	NO	NO	NO
Italy	CS	PS	PS	Emissions reported by industry [NIR2004]	By-product emissions	HFC-23	HCFC-22 production	0	0,00	30,0	HCFC-22 production	0	0,00	0,0
	CS	PS	PS		Fugitive emissions			0	0,00	0,0		0	0,00	0,0
Netherlands	CS/T2	Q	PS	For estimating HFC-23 emissions from HCFC-22 manufacture Tier 2 method is used [NIR 2005]	By-product emissions	HFC-23	HCFC-22 production	C	C	378,8	HCFC-22 production	C	C	39,4
					Fugitive emissions	HFCs		0	NO	NO		0	NO	NO
Spain	D, T2, CS	Q	D, T2, PS	Emissions are estimated using a combined T1/T2 approach [NIR 2005]	By-product emissions	HFC-23	HCFC-22 production	7619	0,03	205,4	HCFC-22 production	C	C	134,4
					Fugitive emissions	HFC-143a		0	0,00	0,0	Production of HFC-143a	C	C	18,6
					Fugitive emissions	HFC-227ea		0	0,00	0,0	Production of HFC-227ea	C	C	6,3
					Fugitive emissions	HFC-32		0	0,00	0,0	Production of HFC-32	C	C	0,7
					Fugitive emissions	HFC-23		0	0,00	0,0	Production of HFC-32	C	C	4,1
UK	T2	PS	CS	HFC emissions from HCFC-22 production are estimated from reported data from the manufacturers [NIR 2004]	By-product emissions	HFC-23	HCFC-22 production	IE	0,00	IE	HCFC-22 production	IE	0,00	IE
					Other	All HFCs	HFC production	24375	39,91	972,8	HFC production	33538	7,13	239,1
					Fugitive emissions	All HFCs	IE	IE	0,00	IE	IE	IE	0,00	IE

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.5 *Consumption of halocarbons and SF_6 (CRF Source Category 2.F)*

Table 4.24, Table 4.25 and Table 4.26 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source HFCs from 2.F: 'Consumption of halocarbons and SF_6'.

Table 4.24 Member States' contributions to HFC emissions from 2.F: 'Consumption of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied 1)	EF 1)	Estimate 2)	Quality 2)
Austria	219	1.308	CS	CS	ALL	M
Belgium	255	1.322				
Denmark	0	695	M/CS	CS	ALL	M
Finland	0	652	T2, T1a & T1b	D	ALL	H
France	28	11.048	CS/ T2/ M	CS	ALL	M
Germany	NE	7.035	M,T2	CS,D,M	All	H
Greece	0	945	T2a	D	PART	
Ireland	0	288	T2	D, CS	Full	M
Italy	0	4.553	T2a, CS	D, CS, PS	ALL	M
Luxembourg	43	43	C/D	C/D		
Netherlands	0	890	CS/T2	CS, D	ALL	M
Portugal	0	62	D	D+CS	Part	L
Spain	0	3.253	D,T2,CS	D,T2,PS	ALL	L
Sweden	4	471	T2	CS, D, PS	ALL	M
United Kingdom	2	8.508	T2	D/CS	ALL	H
EU15	550	41.075	C,CS,D,M,T1a,T1b,T2,T2a	C, CS, D, M, PS, T2	ALL, PART	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2.F: 'Consumption of halocarbons and SF_6' account for 1.0 % of total EU-15 GHG emissions in 2003. HFC emissions in 2003 were 74 times higher than in 1990. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). France, the UK and Italy had the most significant absolute increases from this source between 1990 and 2003.

Table 4.25 Member States' contributions to HFC emissions from 2.F: 'Consumption of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	219	1.219	1.308	3,2%	89	7%	1.089	497%	CS	Q	CS
Belgium	255	1.148	1.322	3,2%	174	15%	1.067	418%	T2, CS	AS, PS	CS
Denmark	0	672	695	1,7%	23	3%	695	-	T2	AS, Q	CS
Finland	0	463	652	1,6%	189	41%	652	3683899%	T1a, T1b, T2	Q	D
France	28	9.393	11.048	26,9%	1.655	18%	11.021	39855%	C, M, T2	NS, AS, PS, Q	CS, D, PS
Germany	NE	7.035	7.035	17,1%	0	0%	-	-	M, T2		CS, D, M
Greece	0	814	945	2,3%	131	16%	945	-	T2a	Q	D
Ireland	0	253	288	0,7%	35	14%	288	-	T2	PS, NS	D, CS
Italy	0	3.539	4.553	11,1%	1.013	29%	4.553	-	T2a, CS	AS, PS	CS, D, PS
Luxembourg	43	43	43	0,1%	0	0%	0	0%			
Netherlands	0	784	890	2,2%	106	13%	890	-	CS, T2	Q	CS
Portugal	0	49	62	0,2%	13	27%	62	-	T2a	NS, AS	D
Spain	0	2.722	3.253	7,9%	531	20%	3.253	-	D, T2, CS	AS, Q	D, T2, PS
Sweden	4	462	471	1,1%	9	2%	467	12138%	T2	CS, PS, NS	CS, D, PS
UK	2	8.127	8.508	20,7%	382	5%	8.507	511507%	T2	AS, Q	D, CS
EU15	550	36.724	41.075	100,0%	4.351	12%	40.524	7362%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.26 shows the sub-categories of HFC emissions from 2.F. 'Consumption of halocarbons and SF_6' by Member State [more analysis added after 15 March]. It shows that 'Refrigeration and air conditioning equipment' is by far the largest sub-category accounting for 72 % ofHFC emissions in source category 2.F. 'Aerosols/metered dose inhalers' and foam blowing account for 13 % and 9 % respectively. Note that sub-categories in this source do not fully add up to category totals because of confidentiality reasons for Germany.

Table 4.26 Member States' sub-categories of HFC emissions from 2.F: 'Consumption of halocarbons and SF_6' for 2003 (Gg CO_2 equivalents)

Member State	**Consumption of Halocarbons and SF_6**	Refrigeration and Air Conditioning Equipment	Foam Blowing	Fire Extinguishers	Aerosols/ Metered Dose Inhalers	Solvents	Semiconductor Manufacture	Electrical Equipment	Other (please specify)
Austria	**1.308**	463	815	26	NO	NO	4	NO	NO
Belgium	**1.322**	1.054	108	39	121	0	0	NO	0
Denmark	**695**	557	129	0	10	0	0	0	0
Finland	**652**	561	24	0	0	0	0	NO	67
France	**11.048**	8.551	649	100	1.516	219	13	0	0
Germany	**7.035**	4.875	1.492	6	648	C	C	NO	NO
Greece	**945**	945	0	0	0	0	0	NE	0
Ireland	**288**	236	12	12	25	0	4	0	0
Italy	**4.553**	4.263	58	38	186	0	9	0	0
Luxembourg	**43**	34	6	0	3	0	0	0	0
Netherlands	**890**	775	0	0	115	0	0	NO	0
Portugal	**62**	40	22	0	0	0	0	0	0
Spain	**3.253**	1.970	0	1.121	162	0	0	0	0
Sweden	**471**	340	97	6	28	0	0	NA	NA
United Kingdom	**8.508**	4.952	406	356	2.669	21	NO	NO	104
EU15	**41.075**	29.615	3.817	1.704	5.483	241	30	0	171

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.27 and Table 4.28 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key sources from 2.F: 'Consumption of halocarbons and SF_6'.

Table 4.27 Member States' contributions to SF_6 emissions from 2.F: 'Consumption of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	249	594	CS	CS	ALL	M
Belgium	103	75				
Denmark	13	31	M/CS	CS	ALL	M
Finland	94	42	T2, T1a & T1b	D	ALL	H
France	1.060	846	CS/ T2	CS	ALL	M
Germany	3.728	2.564	M,CS,T1,T2	D,CS	All	H
Greece	3	3				
Ireland	113	100	T2	D, CS	Full	M
Italy	213	350	T3c, CS	CS, PS	ALL	M
Luxembourg	4	4	C/D	C/D		
Netherlands	217	334	T2	PS,CS,D	PART	L
Portugal	0	7	D	CS	All	M
Spain	67	296	CS,T2	CS,T2	ALL	M
Sweden	83	31	T2, CS	CS, D, PS	ALL	M
United Kingdom	604	651	T2	CS	ALL	H
EU15	6.553	5.930	C,CS,D,M,T1, T1a,T1b,T2,T3c	C, CS, D, PS, T2	ALL, PART	H

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

SF_6 emissions from 2.F: 'Consumption of halocarbons and SF_6' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, SF_6 emissions from this source decreased by 10 %. Germany and France are responsible for 58 % of total EU-15 emissions from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2003.

Table 4. 28 Member States' contributions to SF_6 emissions from 2.F: 'Consumption of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	249	633	594	10,0%	-40	-6%	344	138%	CS	Q	CS
Belgium	103	94	75	1,3%	-19	-20%	-28	-27%	T2, CS	AS, PS	CS
Denmark	13	25	31	0,5%	6	25%	18	134%	T2	AS, Q	CS
Finland	94	51	42	0,7%	-10	-19%	-53	-56%	T1a, T1b, T2	Q	D
France	1.060	828	846	14,3%	18	2%	-214	-20%	C, T2	AS	CS
Germany	3.728	2.564	2.564	43,2%	0	0%	-1.164	-31%	M, CS, T1, T2		D, CS
Greece	3	3	3	0,1%	0	0%	0	0%			
Ireland	113	71	100	1,7%	29	41%	-13	-11%	T2	PS, NS	D, CS
Italy	213	338	350	5,9%	12	4%	137	64%	CS, T3c	PS, AS	PS, CS
Luxembourg	4	4	4	0,1%	0	0%	0	0%			
Netherlands	217	359	334	5,6%	-24	-7%	117	54%	T2	AS	CS
Portugal	0	7	7	0,1%	0	7%	7	-	T2a	PS	PS
Spain	67	255	296	5,0%	41	16%	229	341%	CS, T2	AS, Q	CS, T2
Sweden	83	35	31	0,5%	-4	-11%	-52	-62%	T2, CS	CS	CS, D, PS
United Kingdom	604	662	651	11,0%	-11	-2%	47	8%	T2	AS, Q	CS
EU15	6.553	5.929	5.930	100,0%	0	0%	-624	-10%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.3 Methodological issues and uncertainties

The previous section presented for each EU-15 key source in CRF Sector 2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.29 shows the total EU-15 uncertainty estimates for the sector 'Industrial processes' and the uncertainty estimates for the relevant gases of each source category. The highest uncertainty was estimated for CH_4 from 2.B and the lowest for CO_2 from 2.A.1. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.29: EU-15 uncertainty estimates for the sector 'Industrial processes'

Source category	Gas	Emissions 2003 [1)]	Emissions for which MS uncertainty estimates are available [2)]	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
2.A.1 Cement production	CO_2	81,631	79,120	97%	4%
2.A.2 Lime production	CO_2	17,510	13,796	79%	13%
2.A.3 Limestone and dolomite use	CO_2	8,017	6,098	76%	5%
2.A.4 Soda ash production and use	CO_2	2,160	736	34%	12%
2.A.7 Other	CO_2	4,571	2,105	46%	15%
2.B Chemical industry	CO_2	14,529	7,517	52%	7%
2.C Metal production	CO_2	22,800	12,917	57%	8%
2.G Other	CO_2	715	3,865	540%	11%
2.B Chemical industry	CH_4	803	456	57%	134%
2.C Metal production	CH_4	123	162	132%	37%
2.G Other	CH_4	45	54	120%	45%
2.B Chemical industry	N_2O	45,451	44,944	99%	20%
2.E Production of halocarbons and SF_6	HFC	9,254	5,116	55%	49%
2.F Consumption of halocarbons and SF_6	HFC	41,075	39,986	97%	26%
2.C Metal production	PFC	3,403	3,398	100%	9%
2.F Consumption of halocarbons and SF_6	PFC	1,903	1,029	54%	41%
2.C Metal production	SF_6	3,035	3,986	131%	33%
2.F Consumption of halocarbons and SF_6	SF_6	5,930	4,867	82%	60%
Total	**all**	**265,030**	**230,150**	**87%**	**6%**

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some countries 2002 data and for Belgium 2001 data

4.4 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

4.5 Sector-specific recalculations

Table 4.30 shows that in the industrial processes sector the largest recalculations in absolute terms were made for CO_2. Largest recalculations in relative terms were made for CH_4.

Table 4.30 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 2: 'Industrial processes', for 1990 and 2002 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
Industrial Processes	7.452	5,1%	498	90,4%	1.897	1,8%	200	0,7%	-276	-1,7%	125	1,2%
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
Industrial Processes	11.393	8,2%	514	122,6%	1.103	2,5%	-3.682	-7,4%	279	5,2%	406	4,4%

Table 4.31 provides an overview of Member States' contributions to EU-15 recalculations. The Netherlands had the most influence on the CO_2 recalculations, Germany on CH_4 recalculations and the Netherlands on N_2O recalculations. For HFCs, Italy made the largest contribution to recalculations in 2002, for PFCs the Netherlands contributed the most and for SF_6 it was Germany.

Table 4.31 Contribution of Member States to EU-15 recalculations in CRF Sector 2: 'Industrial processes' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2002					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	55	1	0	215	116	-15	718	-1	0	186	62	-36
Belgium	-126	0	0	0	0	0	-298	0	-227	-357	0	0
Denmark	16	0	0	0	0	0	6	0	0	0	0	3
Finland	171	0	0	0	0	0	266	0	0	0	0	0
France	232	-51	0	5	0	0	254	-46	1	-41	-5	0
Germany	-541	332	6	0	-70	72	71	356	780	0	0	416
Greece	-921	0	0	0	0	3	363	0	-165	10	0	3
Ireland	0	0	0	-21	-75	30	0	0	0	0	0	0
Italy	111	-13	938	0	0	0	1,023	-59	1	-3,545	0	-22
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	6,462	228	954	0	-301	0	4,792	262	714	-6	216	15
Portugal	134	0	0	0	0	0	1,120	0	0	0	0	0
Spain	2,587	1	0	0	55	11	2,957	2	-8	-4	7	16
Sweden	240	0	0	0	0	24	211	0	0	76	0	10
UK	-969	-1	0	0	0	0	-90	0	8	0	0	0
EU15	**7,452**	**498**	**1,897**	**200**	**-276**	**125**	**11,393**	**514**	**1,103**	**-3,682**	**279**	**406**

Explanations for most recalculations of more than 1000 Gg of CO_2 equivalents are given in table 4.32. Reasons for other recalculations are provided in section 10.1.

Table 4.32: Main reasons for the most important recalculations in CRF sector 2 'Industrial processes'

NL	CO_2	2.B, 2.C: Method: now partly based on NEU from energy statistics; Activity data: improved data; Emission factors: improved data
ES	CO_2	2.A: see tables 10.1 and 10.2
IT	HFCs	2.F: Emission factor for 2002 has been corrected

5 Solvent and other product use (CRF Sector 3)

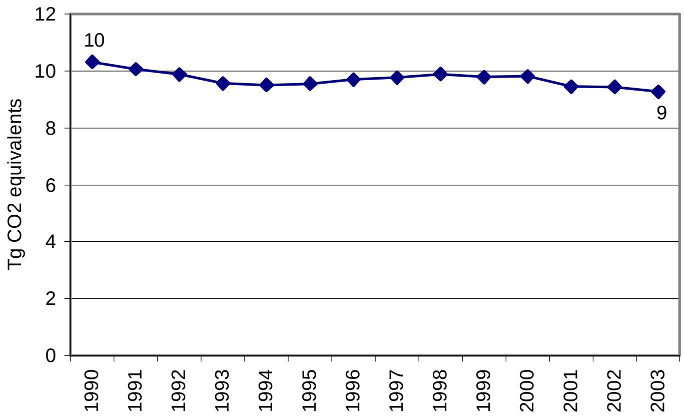
This chapter provides two short sections on emission trends and on recalculations in CRF Sector 3 'Solvent and other product use'. No section on methodological issues and uncertainty is included in this chapter because the sector does not contain an EU-15 key source ([17]). Neither is included a section on sector-specific QA/QC as no such activities are performed in this sector.

5.1 Overview of sector

CRF Sector 3 'Solvent and other product use' contributes 0.2 % to the total EU-15 GHG emissions. The most important GHG from 'Solvent and other product use' is CO_2 (0.13 % of the total GHG emissions). The emissions from this sector decreased by 10 % from 10 Tg to 9 Tg in 2003 (Figure 5.1). In 2003, the emissions decreased by 1.7 % compared to 2002.

This sector does not contain any key source. The Member States Italy, Germany, Spain are responsible for 62 % of the total emissions in this sector (Table 5.1).

Figure 5.1 EU-15 GHG emissions for 1990–2003 from CRF Sector 3: 'Solvent and other product use' in CO_2 equivalents (Tg)



([17]) In this report, overview tables on methodologies and on uncertainties are only presented for the EC key sources as identified in Section 1.5 due to time restrictions (see Section 1.8.5). For information on sector-specific methods used by the Member States see Member States' submissions.

Table 5.1 Member States' contributions to greenhouse gas emissions from CRF Sector 3: 'Solvent and other product use'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	515	426	426	4,6%	0	0%	-89	-17%
Belgium	253	253	253	2,7%	0	0%	0	0%
Denmark	317	151	206	2,2%	54	36%	-111	-35%
Finland	62	44	40	0,4%	-4	-9%	-22	-36%
France	1.934	1.537	1.428	15,4%	-109	-7%	-505	-26%
Germany	1.922	1.922	1.922	20,7%	0	0%	0	0%
Greece	170	155	156	1,7%	1	0%	-14	-8%
Ireland	92	109	111	1,2%	2	1%	19	21%
Italy	2.544	2.250	2.180	23,5%	-70	-3%	-363	-14%
Luxembourg	12	9	9	0,1%	0	0%	-2	-21%
Netherlands	541	249	250	2,7%	2	1%	-291	-54%
Portugal	220	312	318	3,4%	6	2%	98	45%
Spain	1.329	1.716	1.672	18,0%	-44	-3%	343	26%
Sweden	411	303	305	3,3%	3	1%	-105	-26%
United Kingdom	0	0	0	0,0%	0	-	0	-
EU15	10.321	9.437	9.277	100,0%	-160	-2%	-1.043	-10%

5.2 Methodological issues and uncertainties

This sector does not contain any key source; therefore, no additional overview information on methodologies and qualitative uncertainty estimates is provided.

5.3 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

5.4 Sector-specific recalculations

Table 5.2 shows that in the solvent sector only minor recalculations were made (in particular in absolute terms). In relative terms, the highest recalculation was made for N_2O.

Table 5.2 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 3, 'Solvent and other product use', for 1990 and 2002 by gas (Gg and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
Solvent and other product use	511	8,8%	0	0,0%	796	24,7%	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
Solvent and other product use	283	5,6%	0	0,0%	909	28,5%	NO	NO	NO	NO	NO	NO

Table 5.3 provides an overview of Member States' contributions to EU-15 recalculations. The Netherlands contributed the most to CO_2 and Italy to N_2O recalculations.

Table5.3 Contribution of Member States to EU-15 recalculations in CRF Sector 3: 'Solvent and other product use' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2002					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Belgium	NE	0	0	NO	NO	NO	NE	0	-2	NO	NO	NO
Denmark	193	0	0	NO	NO	NO	39	0	0	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	-3	0	0	NO	NO	NO	-24	0	0	NO	NO	NO
Germany	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
Greece	-6	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	14	0	796	NO	NO	NO	96	0	913	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	316	0	0	NO	NO	NO	160	0	-2	NO	NO	NO
Portugal	-3	0	0	NO	NO	NO	-1	0	0	NO	NO	NO
Spain	-1	0	0	NO	NO	NO	23	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	-10	0	0	NO	NO	NO
UK	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
EU15	**511**	**0**	**796**	**NO**	**NO**	**NO**	**283**	**0**	**909**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6 Agriculture (CRF Sector 4)

This chapter starts with an overview on emission trends in CRF Sector 4 'Agriculture'. Then for each EU-15 key source overview tables are presented including the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness, and qualitative uncertainty estimates. The chapter also provides information on quantitative uncertainty estimates, sector-specific QA/QC, and recalculations.

6.1 Overview of the sector

CRF Sector 4 'Agriculture' contributes 10 % to total EU-15 GHG emissions, making it the second largest sector after 'Energy'. The most important GHGs from 'Agriculture' are N_2O and CH_4 (both 5 % of the total GHG emissions). The emissions from this sector decreased by 10 % from 462 Tg in 1990 to 414 Tg in 2003 (Figure 6.1). In 2003, the emissions decreased by 1.3 % compared to 2002. The key sources in this sector are:

4.A.1: Cattle (CH_4)
4.A.3: Sheep (CH_4)
4.B.1: Cattle (CH_4)
4.B.12: Solid storage and dry lot (N_2O)
4.B.8: Swine (CH_4)
4.D.1: Direct soil emissions (N_2O)
4.D.2: Animal production (N_2O)
4.D.3: Indirect emissions (N_2O)

Figure 6.1 shows that the three largest key sources account for about 67 % of agricultural GHG emissions of the EU-15.

Figure 6.1 EU-15 GHG emissions for 1990–2003 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg) and share of largest key source categories in 2003

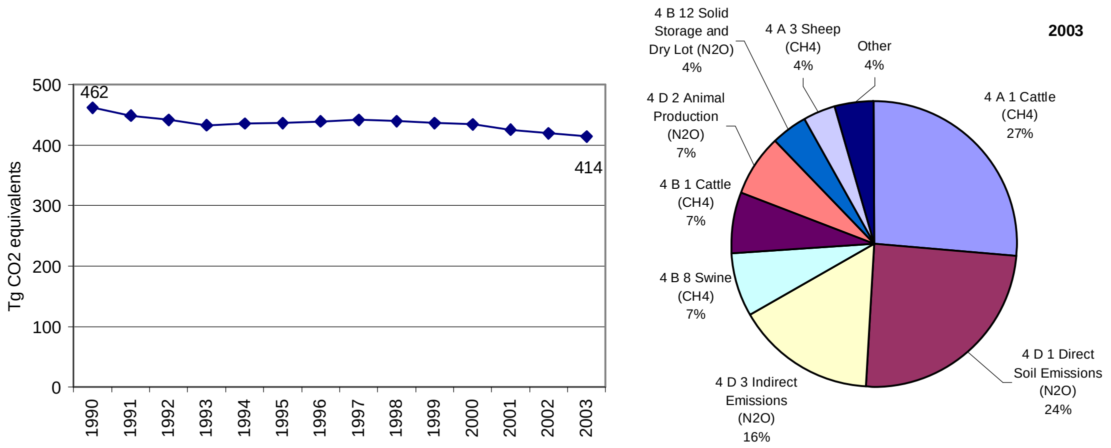
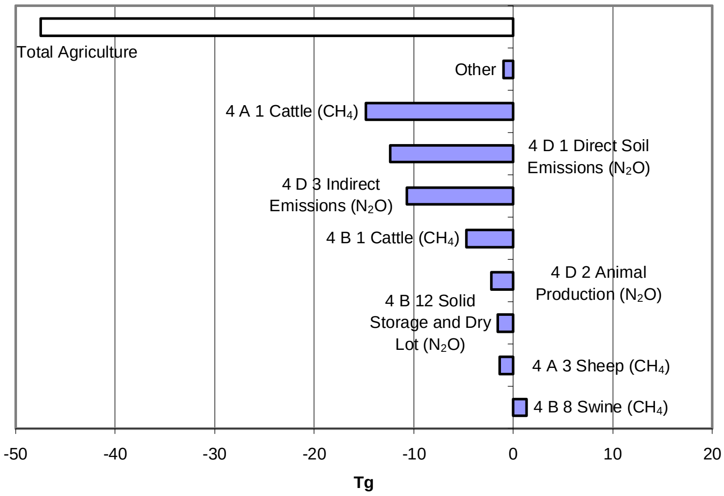


Figure 6.2 shows that large reductions occurred in the largest key sources CH_4 from 4.A.1: 'Cattle' and N_2O from 4.D.1: 'Direct soil emissions'. The main reasons for this are declining cattle numbers and decreasing use of fertiliser and manure in most Member States.

Figure 6.2 **Absolute change of GHG emissions by large key source categories 1990–2003 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture'**



6.2 Source categories

6.2.1 Enteric fermentation (CRF Source Category 4.A)

Table 6.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 from 4.A: 'Enteric fermentation'. Between 1990 and 2003, CH_4 emission from 'Enteric fermentation' decreased by 11 %. The relative decrease was largest in Germany, the relative increase was largest in Spain.

This source category includes two key sources: CH_4 from 4.A.1: 'Cattle' and CH_4 from 4.A.3: 'Sheep'.

Table 6.1 **Member States' contributions to CH_4 emissions from 4.A: 'Enteric fermentation' and information on methods applied and quality of these emission estimates**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	3.573	3.094	T1, T2	D, CS	ALL	M
Belgium	4.494	4.017	M	CS		
Denmark	3.110	2.734	T1/T2	CS	ALL	H
Finland	1.868	1.537	T1/T2	CS/D	ALL	M
France	30.890	28.308	C	CS	ALL	M
Germany	34.294	25.173	T1, CS, C, D	T1, CS, C, D	All	H
Greece	2.861	2.882	T1, T2	D, CS	ALL	
Ireland	9.180	9.294	D	CS, D	Full	M
Italy	12.341	10.933	T1, T2	D, CS	ALL	H
Luxembourg	346	317	C/D	C/D		
Netherlands	7.322	6.062	cattle CS/T2; rest: T1	cattle: CS/T2; rest: CS/D	ALL	M
Portugal	2.594	2.493	T1	D+CS	All	M
Spain	12.651	14.917	T1,T2,CS	T1,T2	ALL	M
Sweden	3.027	2.817	T1 + CS	D + CS	ALL	H
United Kingdom	18.173	16.170	T2	D/CS	ALL	M
EU15	146.724	130.748	C, CS, D, M, T1, T2	C, CS, D, T1, T2	ALL	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from cattle is the largest single source of CH_4 emissions in the EU-15 accounting for 2.6 % of total GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from enteric fermentation from cattle declined by 12 % in the EU-15 (Table 6.2). In 2003, the emissions were 2 % lower compared to 2002. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 15 % below 1990 levels in 2003. The Member States with most emissions from this source were France and Germany (45 %). All Member States except Ireland and Spain reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2003.

Table 6.2 Member States' contributions to CH_4 emissions from 4.A.1: 'Cattle'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3.372	2.922	2.888	2,6%	-34	-1%	-485	-14%	T2	NS	CS
Belgium	4.301	3.892	3.828	3,5%	-65	-2%	-473	-11%	M	NS	CS
Denmark	2.794	2.412	2.331	2,1%	-81	-3%	-463	-17%	T2	NS	CS
Finland	1.745	1.444	1.417	1,3%	-27	-2%	-328	-19%	T2	NS, AS	CS
France	28.382	26.746	26.111	23,8%	-635	-2%	-2.271	-8%	C	NS	CS
Germany	32.593	24.304	23.702	21,6%	-602	-2%	-8.891	-27%	T1,CS,C,D	NS	CS, C, D
Greece	866	815	811	0,7%	-4	0%	-55	-6%	T1	NS	D
Ireland	8.020	8.398	8.205	7,5%	-193	-2%	186	2%	T1	NS	CS, D
Italy	10.227	9.551	8.789	8,0%	-762	-8%	-1.437	-14%	T2	NS	D, CS
Luxembourg	341	311	311	0,3%	0	0%	-30	-9%			
Netherlands	6.561	5.495	5.418	4,9%	-77	-1%	-1.143	-17%	T2	NS	CS
Portugal	1.820	1.774	1.769	1,6%	-5	0%	-52	-3%	T1	NS	D
Spain	7.411	9.268	9.442	8,6%	174	2%	2.031	27%	T2, CS	NS	D
Sweden	2.729	2.570	2.525	2,3%	-46	-2%	-205	-7%	CS	NS	CS
United Kingdom	13.484	12.135	12.267	11,2%	132	1%	-1.217	-9%	T2	NS, RS	D, CS
EU15	124.648	112.037	109.814	100,0%	-2.222	-2%	-14.833	-12%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from sheep is the seventh largest single source of CH_4 emissions in the EU-15 and accounts for 0.4 % of total GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from enteric fermentation of sheep declined by 9 % in the EU-15 (Table 6.3). In 2003, the emissions were 1 % lower compared to 2002. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 12 % below 1990 levels in 2003. The Member States with most emissions from this source were Spain and the United Kingdom (54 %). 9 Member States reduced CH_4 emissions from enteric fermentation of sheep, 6 states did not.

Table 6.3 Member States' contributions to CH_4 emissions from 4.A.3: 'Sheep'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	52	51	55	0,4%	4	7%	3	5%	T1	NS	D
Belgium	28	21	21	0,1%	0	0%	-7	-25%	M	NS	CS
Denmark	33	27	30	0,2%	3	13%	-3	-10%	T2	NS	CS
Finland	17	16	17	0,1%	0	3%	-1	-5%	T1	NS	D
France	1.923	1.573	1.560	10,6%	-13	-1%	-363	-19%	C	NS	D
Germany	544	457	443	3,0%	-14	-3%	-101	-19%	T1,CS,C,D	NS	CS, C, D
Greece	1.345	1.405	1.411	9,6%	5	0%	65	5%	T2	NS	D
Ireland	1.103	1.042	1.004	6,8%	-38	-4%	-98	-9%	T1	NS	CS, D
Italy	1.468	1.367	1.336	9,1%	-31	-2%	-132	-9%	T1	NS	D, CS
Luxembourg	1	2	1	0,0%	0	-4%	0	2%			
Netherlands	286	199	199	1,4%	0	0%	-87	-30%	T1	NS	D
Portugal	565	575	572	3,9%	-3	-1%	7	1%	T1	NS	D
Spain	4.267	4.336	4.326	29,5%	-10	0%	59	1%	T2, CS	NS	D
Sweden	68	72	75	0,5%	4	5%	7	10%	T1	NS	D
United Kingdom	4.354	3.619	3.616	24,7%	-3	0%	-738	-17%	T2	NS, RS	D, CS
EU15	16.054	14.762	14.665	100,0%	-97	-1%	-1.389	-9%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.2 Manure management (CRF Source Category 4.B)

Table 6.4 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 from 4.B: 'Manure management'. Between 1990 and 2003, CH_4 emission from 'Manure management' decreased by 5 %. The relative decrease was largest in the Netherlands, the relative increase was largest in Spain.

This source category includes two key sources: CH_4 from 4.B.1: 'Cattle' and CH_4 from 4.B.8: 'Swine'.

Table 6.4 Member States' contributions to CH_4 emissions from 4.B: 'Manure management' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied 1)	EF 1)	Estimate 2)	Quality 2)
Austria	1.021	885	T1, T2	D, CS	ALL	M
Belgium	2.565	2.445	M	CS		
Denmark	743	972	T2	CS	ALL	M
Finland	215	222	T2	CS/D	ALL	M
France	13.794	13.107	C/ T1	D/ CS	ALL	M
Germany	27.098	23.109	C, D, T1	C,D	All	H
Greece	497	487	T1	D	ALL	
Ireland	1.261	1.350	D	CS, D	Full	M
Italy	4.026	3.821	T1, T2	D, CS	ALL	H
Luxembourg	24	22	C/D	C/D		
Netherlands	2.969	2.423	CS/T2	CS	ALL	L
Portugal	1.558	1.388	T2	D (CS)	All	M
Spain	6.221	8.667	T1,T2,CS	T1,T2	ALL	M
Sweden	361	459	T1 + CS	D + CS	ALL	H
United Kingdom	2.923	2.610	T2	D/CS	ALL	M
EU15	65.275	61.967	C, CS, D, M, T1, T2	C,CS,D,T1,T2	ALL	M

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4.B.1: 'Cattle' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from this source decreased by 14 % (Table 6.5). Germany and France are responsible for 68 % of the total EU-15 emissions from this source. All Member States except Ireland, Spain and Sweden had reductions between 1990 and 2003. In absolute and relative terms, Germany had the most significant decreases from this source.

Table 6.5 Member States' contributions to CH_4 emissions from 4.B.1: 'Cattle'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	547	455	450	1,6%	-5	-1%	-98	-18%	T2	NS	CS
Belgium	1.128	971	945	3,3%	-26	-3%	-183	-16%	M	NS	CS
Denmark	282	262	267	0,9%	6	2%	-15	-5%	T2	NS	CS
Finland	101	94	92	0,3%	-2	-2%	-9	-9%	T2	NS, AS	CS
France	8.781	8.001	7.832	27,0%	-169	-2%	-949	-11%	C, T1	NS	D, CS
Germany	14.609	11.948	11.730	40,5%	-217	-2%	-2.878	-20%	C, D, T1	NS	C, D
Greece	202	190	189	0,7%	-1	0%	-13	-6%	T1	NS	D
Ireland	1.115	1.153	1.125	3,9%	-28	-2%	11	1%	T1	NS	D, CS
Italy	2.217	2.054	1.855	6,4%	-199	-10%	-362	-16%	T2	NS	D, CS
Luxembourg	23	21	21	0,1%	0	0%	-2	-10%			
Netherlands	1.573	1.463	1.432	4,9%	-31	-2%	-141	-9%	CS, T2	NS	CS
Portugal	58	57	57	0,2%	0	0%	0	-1%	T2	NS	CS
Spain	670	765	776	2,7%	11	1%	106	16%	T2, CS	NS	D
Sweden	236	285	300	1,0%	15	5%	65	27%	T2	NS	D
United Kingdom	2.114	1.901	1.909	6,6%	8	0%	-204	-10%	T2	NS, RS	D, CS
EU15	33.655	29.620	28.982	100,0%	-638	-2%	-4.673	-14%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4.B.8: 'Swine' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from this source increased by 5 % (Table 6.6). Germany and Spain are responsible for 62 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source while Germany had the largest reductions.

Table 6.6 Member States' contributions to CH_4 emissions from 4.B.8: 'Swine'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	403	410	1,4%	7	2%	-37	-8%	T2	NS	CS
Belgium	1.315	1.423	1.380	4,6%	-43	-3%	65	5%	M	NS	CS
Denmark	448	692	692	2,3%	0	0%	244	54%	T2	NS	CS
Finland	81	93	97	0,3%	4	5%	16	20%	T2	NS	CS
France	4.252	4.548	4.491	14,9%	-56	-1%	239	6%	C, T1	NS	D, CS
Germany	12.262	10.937	11.139	37,0%	203	2%	-1.123	-9%	C, D, T1	NS	C, D
Greece	146	142	142	0,5%	0	0%	-4	-3%	T1	NS	D
Ireland	124	199	198	0,7%	0	0%	75	60%	T1	NS	D, CS
Italy	1.413	1.386	1.484	4,9%	98	7%	71	5%	T2	NS	D, CS
Luxembourg	1	1	1	0,0%	0	-6%	0	-5%			
Netherlands	1.141	960	918	3,1%	-42	-4%	-223	-20%	CS, T2	NS	CS
Portugal	1.441	1.283	1.266	4,2%	-17	-1%	-174	-12%			
Spain	5.076	7.356	7.406	24,6%	50	1%	2.330	46%	T2, CS	NS	D
Sweden	90	119	122	0,4%	3	3%	32	36%	T2	NS	D
United Kingdom	476	352	318	1,1%	-34	-10%	-158	-33%	T2	NS, RS	D, CS
EU15	28.714	29.893	30.066	100,0%	172	1%	1.351	5%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.7 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N_2O from 4.B: 'Manure management'. Between 1990 and 2003, N_2O emission from 'Manure management' decreased by 12 %. The relative decrease was largest in Germany and Sweden, the relative increase was largest in Portugal.

This source category includes one key source: N_2O from 4.B.12: 'Solid storage.

Table 6.7 Member States' contributions to N_2O emissions from 4.B: 'Manure management' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	786	704			ALL	M
Belgium	975	890	D	D		
Denmark	685	560			ALL	M
Finland	623	462	D	D/CS	ALL	L
France	6.899	6.299	C/ T1	D/ CS	ALL	M
Germany	4.475	2.926	C,CS	D	All	H
Greece	301	283	D	D		
Ireland	627	660	D	CS, D	Full	M
Italy	3.829	3.972	D	D, CS	ALL	H
Luxembourg	0	0	C/D	C/D		
Netherlands	670	598	CS/T2	D	ALL	L
Portugal	943	1.032	T2	D (CS)	All	M
Spain	1.632	1.607	D,CS	D	ALL	M
Sweden	799	560	T1 + T2	D + CS	ALL	M
United Kingdom	1.514	1.320	T1	D/CS	ALL	M
EU15	24.756	21.873	C,CS,D,T1,T2	C, CS, D	ALL	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4.B.12: 'Solid storage and dry lot' account for 0.4 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 8 % (Table 6.8). Italy and France are responsible for 55 % of the total EU-15 emissions from this source. In absolute terms, France had the most significant decrease from this source while Portugal had the largest increases. In relative terms, Sweden had the largest decrease from 1990-2003.

Table 6.8 Member States' contributions to N_2O emissions from 4.B.12: 'Solid storage and dry lot'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	738	662	658	3,8%	-4	-1%	-80	-11%	T1, T2	NS	D, CS
Belgium	909	858	821	4,7%	-37	-4%	-88	-10%	D	NS	D
Denmark	590	506	480	2,8%	-26	-5%	-110	-19%	T1	NS	D
Finland	612	457	450	2,6%	-6	-1%	-162	-26%	D	AS, Q	D
France	6.664	6.211	6.067	34,8%	-144	-2%	-597	-9%	C, T1	NS	D, CS
Germany	IE	IE	IE	-	-	-	-	-			
Greece	282	263	262	1,5%	-1	-1%	-20	-7%	D	NS	D
Ireland	578	620	608	3,5%	-12	-2%	29	5%	T1	NS	D, CS
Italy	3.688	3.789	3.572	20,5%	-217	-6%	-117	-3%	D	NS	D, CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	493	605	465	2,7%	-140	-23%	-28	-6%	CS	NS	CS
Portugal	915	1.009	1.007	5,8%	-2	0%	93	10%	D	NS	D, CS
Spain	1.564	1.539	1.516	8,7%	-22	-1%	-48	-3%	D, CS	NS	D
Sweden	709	475	435	2,5%	-40	-8%	-274	-39%	T1	NS	D
United Kingdom	1.280	1.112	1.096	6,3%	-16	-1%	-184	-14%	T1	NS, RS	D, CS
EU15	19.023	18.106	17.438	100,0%	-669	-4%	-1.585	-8%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4.B.13: 'Other' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 26 % (Table 6.9). Germany is responsible for 83 % of the total EU-15 emissions from this source. Germany had the most significant decreases from this source both in absolute and relative terms.

Table 6.9 Member States' contributions to N_2O emissions from 4.B.13: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	26	24	25	0,7%	1	4%	-1	-4%	T1	NS	D
Belgium	3	11	9	0,3%	-2	-15%	6	214%	D	NS	D
Denmark	0	0	0	0,0%	0	-	0	-	NO	NO	NO
Finland	0	0	0	0,0%	0	-	0	-	D	AS, Q	D
France	0	0	0	0,0%	0	-	0	-	C, T1	NS	D, CS
Germany	4.475	2.971	2.926	82,9%	-45	-1%	-1.548	-35%			
Greece	13	14	14	0,4%	0	1%	1	10%	D	NS	D
Ireland	0	0	0	0,0%	0	-	0	-	T1	NS	CS, D
Italy	0	262	275	7,8%	14	5%	275	-			
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	0	0	0	0,0%	0	-	0	-	CS	NS	CS
Portugal	0	0	0	0,0%	0	-	0	-	D	NS	D, CS
Spain	3	2	2	0,1%	0	-5%	-1	-31%	D, CS	NS	D
Sweden	74	94	103	2,9%	8	9%	29	40%	T1	NS	D
United Kingdom	175	174	174	4,9%	0	0%	-1	-1%	T1	NS, RS	D, CS
EU15	4.768	3.552	3.528	100,0%	-23	-1%	-1.240	-26%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.3 Agricultural soils (CRF Source Category 4.D)

Table 6.10 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N_2O from 4.D: 'Agricultural soils'. N_2O emissions from 4.D: 'Agricultural soils' decreased by 11 % between 1990 and 2003. Most EU-15 Member States decreased emissions.

This source category includes three key sources: N_2O from 4.D.1:'Direct soil emissions', N_2O from 4.D.2:' Animal production', and N_2O from 4.D.3: 'Indirect emissions'.

Table 6.10 Member States' contributions to N_2O emissions from 4.D: 'Agricultural soils' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	3.067	2.656	T1	D	ALL	M
Belgium	4.405	3.877	D	CS		
Denmark	8.308	5.632	CS/M	CS/M	ALL	M
Finland	4.221	3.200	D	D/CS	ALL	L
France	56.051	50.149	C/ T1	D/ CS	ALL	L
Germany	43.876	36.753	C,CS	C,D	All	H
Greece	9.749	8.214	T1a, T1b	D	ALL	
Ireland	7.294	7.443	D	CS, D	Full	M
Italy	18.866	18.444	D	D, CS	ALL	H
Luxembourg	146	0	C/D	C/D		
Netherlands	10.878	8.761	CS/T1b(Direct and indirect)	CS (indirect), D (direct)	ALL	L
Portugal	3.515	3.170	D	D	All	M
Spain	16.264	18.519	D,CS	D,CS	ALL	L
Sweden	5.395	4.889	D, C	CS	ALL	M
United Kingdom	30.410	25.749	T1a/T1b	D	ALL	L
EU15	222.445	197.455	C,CS,D,M,T1, T1a,T1b,T2	C, CS, D, M	ALL	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.11 provides information on emission trends of the key source from 4.D.1: 'Direct soil emissions' by Member State. Direct N_2O emissions from agricultural soils is the largest source category of N_2O emissions and accounts for 2.4 % of total EU-15 GHG emissions in 2003. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2003, emissions declined by 11 % in the EU-15, compared to 2002 they decreased by 1 %. The Member States with most emissions from this source were France and Germany. All Member States except Ireland, Spain and the Netherlands reduced N_2O emissions from agricultural soils.

The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 16 % and 6 % respectively below 1990 levels in 2003. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001).

Table 6.11 Member States' contributions to N_2O emissions from 4.D.1: 'Direct soil emissions'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1.649	1.534	1.414	1,4%	-120	-8%	-235	-14%	T1a, T1b	NS	D
Belgium	2.343	2.176	2.130	2,1%	-46	-2%	-212	-9%	D	NS	CS
Denmark	4.180	2.967	2.892	2,9%	-75	-3%	-1.289	-31%	D, CS	NS	D
Finland	3.369	2.567	2.522	2,5%	-45	-2%	-846	-25%	T1a	NS, AS	D
France	26.459	23.796	23.336	23,2%	-460	-2%	-3.123	-12%	C, T1	NS	D, CS
Germany	27.645	23.720	23.686	23,6%	-33	0%	-3.959	-14%	C, CS	NS	C, D
Greece	2.760	1.803	1.751	1,7%	-53	-3%	-1.009	-37%	T1a, T1b	NS	D
Ireland	3.083	3.217	3.159	3,1%	-58	-2%	76	2%	T1a	NS	D
Italy	9.122	8.984	8.771	8,7%	-212	-2%	-350	-4%	D	NS	D, CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	4.604	4.923	4.817	4,8%	-105	-2%	214	5%	T2	NS	CS
Portugal	1.565	1.361	1.358	1,4%	-2	0%	-206	-13%	T1b	NS	D, CS
Spain	8.523	8.391	9.433	9,4%	1.042	12%	910	11%	D, CS	NS	D
Sweden	3.227	2.889	2.897	2,9%	8	0%	-331	-10%	C, D	NS	CS, T1
United Kingdom	14.265	12.689	12.235	12,2%	-454	-4%	-2.030	-14%	T1a, T1b	NS, RS	D
EU15	112.793	101.016	100.402	100,0%	-614	-1%	-12.392	-11%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4.D.2: 'Animal production' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 7 % (Table 6.12). France, the United Kingdom, Spain and Greece are responsible for 67 % of the total EU-15 emissions from this source. France had the greatest reduction in absolute terms while Spain had the largest increases.

Table 6.12 Member States' contributions to N_2O emissions from 4.D.2: 'Animal production'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	207	212	216	0,8%	4	2%	9	4%	T1a, T1b	NS	D
Belgium	941	859	848	3,0%	-12	-1%	-93	-10%	D	NS	CS
Denmark	312	300	292	1,0%	-8	-3%	-20	-6%	D, CS	NS	D
Finland	108	84	82	0,3%	-2	-2%	-26	-24%	D	AS, Q	D
France	8.539	7.853	7.659	26,8%	-195	-2%	-880	-10%	C, T1	NS	D, CS
Germany	2.519	1.964	1.910	6,7%	-53	-3%	-609	-24%	C, CS	NS	C, D
Greece	3.383	3.532	3.547	12,4%	15	0%	164	5%	D	NS	D
Ireland	2.780	2.883	2.813	9,8%	-70	-2%	33	1%	T1a	NS	D
Italy	1.867	1.743	1.682	5,9%	-61	-3%	-185	-10%	D	NS	D, CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	1.299	688	691	2,4%	3	0%	-608	-47%		NS	
Portugal	580	553	551	1,9%	-2	0%	-30	-5%	T1a	NS	D, CS
Spain	2.794	3.278	3.371	11,8%	93	3%	577	21%	D, CS	NS	D
Sweden	228	304	305	1,1%	1	0%	77	34%	D	NS	CS, T1
United Kingdom	5.223	4.603	4.600	16,1%	-3	0%	-623	-12%	T1a, T1b	NS, RS	D
EU15	30.780	28.856	28.566	100,0%	-290	-1%	-2.214	-7%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4.D.3: 'Indirect emissions' account for 1.6 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source decreased by 14 % (Table 6.13). France, Germany, Italy and the United Kingdom are responsible for 69 % of the total EU-15 emissions from this source. Each of these Member States had large absolute reductions between 1990 and 2003.

Table 6.13 Member States' contributions to N_2O emissions from 4.D.3: 'Indirect emissions'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1.204	1.075	1.016	1,5%	-59	-5%	-188	-16%	T1a	NS	D
Belgium	1.121	998	898	1,4%	-101	-10%	-223	-20%	D	NS, AS	CS
Denmark	3.787	2.438	2.378	3,6%	-59	-2%	-1.409	-37%	CS, M	NS	D
Finland	735	600	592	0,9%	-8	-1%	-143	-19%	D, T1b	NS, AS	D
France	20.363	18.756	18.064	27,3%	-692	-4%	-2.299	-11%	C, T1	NS	D, CS
Germany	13.712	11.156	11.156	16,8%	0	0%	-2.555	-19%	C, CS	NS	C, D
Greece	3.606	2.945	2.917	4,4%	-28	-1%	-689	-19%	T1a	NS	D
Ireland	1.431	1.495	1.471	2,2%	-24	-2%	40	3%	T1a	NS	D
Italy	7.878	8.128	7.991	12,1%	-137	-2%	113	1%	D	NS	D, CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	4.976	3.326	3.252	4,9%	-74	-2%	-1.724	-35%	T1a, T1b	NS, M	D
Portugal	1.370	1.263	1.260	1,9%	-2	0%	-109	-8%	D	NS	D, CS
Spain	4.836	5.194	5.533	8,4%	340	7%	697	14%	D, CS	NS	D
Sweden	1.148	947	938	1,4%	-9	-1%	-211	-18%	C	NS	T1
United Kingdom	10.754	8.965	8.747	13,2%	-219	-2%	-2.007	-19%	T1a, T1b	NS, RS	D
EU15	76.918	67.286	66.213	100,0%	-1.073	-2%	-10.705	-14%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4.D.4: 'Other' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N_2O emissions from this source increased by 26 % (Table 6.14). Sweden and France are responsible for 81 % of the total EU-15 emissions from this source. Between 1990 and 2003, Sweden had the largest absolute reductions from this source, while the French emissions increased.

Table 6.14 Member States' contributions to N_2O emissions from 4.D.4: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	7	9	9	0,4%	0	0%	2	26%	T1b	NS	D
Belgium	0	0	0	0,0%	0	0%	0	1%	D	NS	CS
Denmark	28	70	70	3,1%	0	0%	42	151%	D, CS	NS	D
Finland	9	3	3	0,1%	0	3%	-6	-65%	D	NS, AS	D
France	691	1.080	1.091	48,0%	11	1%	400	58%	C, T1	NS	D, CS
Germany	0	0	0	0,0%	0	-	0	-	C, CS	NS	C, D
Greece	0	0	0	0,0%	0	-	0	-			
Ireland	0	0	0	0,0%	0	-	0	-	T1a	NS	D
Italy	0	0	0	0,0%	0	-	0	-			
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	0	0	0	0,0%	0	-	0	-			
Portugal	0	0	0	0,0%	0	-	0	-	NO	NO	NO
Spain	111	172	182	8,0%	10	6%	71	64%	D, CS	NS	D, CS
Sweden	792	757	750	33,0%	-7	-1%	-42	-5%	D, C	NS	CS, T1
United Kingdom	169	162	168	7,4%	6	3%	-1	-1%	T1a, T1b	NS, RS	D
EU15	1.808	2.255	2.274	100,0%	19	1%	466	26%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.3 Methodological issues and uncertainties

All Member States consider their greenhouse gas inventories in the agricultural sector for complete for those categories that are reported to occur in the countries. For categories 4.A, 4.B (both methane and nitrous oxide) and 4.D (nitrous oxide) emissions in all relevant sub-categories are considered (CRF Tables 7s2). CH_4 emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain. There were no changes in the evaluation of the completeness of Member States agricultural inventory since 2002; no information is available for Belgium, Greece and Luxembourg.

There were also no changes in Member State's evaluation of the quality of the inventory in the agricultural sector since the submission in 2004. Table 6.15 shows the quality of the emission estimates for the categories 4.A through 4.D. Only Germany and Italy are considering the emission estimates of all categories as high quality; in most cases the emission estimates have been evaluated as medium quality. Generally, a lower quality is assumed for N_2O emission estimates, with five countries evaluating the estimate in category 4.D as being of low quality.

In the following section an overview is given for the central data required to assess the EU-15 inventory for agriculture. Detailed information will be given for the categories 'enteric fermentation', 'manure management' (both CH_4 and N_2O), 'rice cultivation' and 'agricultural soils'. Each section contains the following information:

- an overview of the source category (composition, changes since 1990 etc.)
- a table with the most important information taken from the national inventory reports on the methodologies and emission factors used
- a table with essential activity data by Member States
- a table with the implied emission factors by Member States for the most important sub-categories
- a table with information aggregated at EU-15 level with activity data, emissions, and implied emission factors for the most important sub-categories. This table compares also the situation between 2003 and 1990.

Table 6.15: Quality of the emission estimates in Member State's inventory for the sector agriculture

Member State	4A. Enteric Fermentation	4B(a). Manure Management CH4	4B(b). Manure Management N2O	4C. Rice Cultivation	4D. Agricultural soils
Austria	M	M	M	NO	M
Belgium					
Denmark	H	M	M		M
Finland	M	M	L	NO	L
France	M	M	M	L	L
Germany	H	H	H		H
Greece					
Ireland	M	M	M	NA	M
Italy	H	H	H	H	H
Luxembourg					
Netherlands	M	L	L		L
Portugal	M	M	M	M	M
Spain	M	M	M	M	L
Sw eden	H	H	M		M
United Kingdom	M	M	M		L

Information on source: CRF Tables7s2 for 2003, submitted in 2005
Abbreviations explained in the Chapter 'Units and abbreviations'.

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.16. For several countries, N_2O emissions from agricultural soils are by far dominating the uncertainty of the national inventory (uncertainty from 0.7% to 20.9% of total national emissions of Austria and France, respectively, with the corresponding overall uncertainties of 5.5% and 22.1% for Austria and France, respectively); whereby some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N_2O. For example, the uncertainty of direct N_2O emissions is estimated in the Greece inventory of being 5.1% of the national total versus 1.2% uncertainty of the indirect emissions. On the other hands, the Netherlands estimate an uncertainty of 1.3% and 3.1% for direct and indirect N_2O emissions from agricultural soils, respectively. CH_4 emissions from enteric fermentation are less uncertain (0.3% to 2.8% of total national GHG emissions) and manure management contributes with usually less than 1.5% to uncertainty. This last sector represents only in Spain an important source of uncertainty (4.4% of total emissions with the uncertainty of category 4.D being 8.0% and 11.8% for direct and indirect emissions, respectively, and a overall uncertainty of 15.8%).

Table 6.16: Member States's uncertainty estimates using Tier 1 methodology for agriculture.

Member State	Year analysed	Total uncertainty of GHG inventory	Enteric ferm. (4A)	Manure Man. (4B)	Manure Man. (4B)	Agricultural soils (4D)				Source
			CH4	CH4	N2O	total N2O	direct N2O	indirect N2O	animal prod. N2O	
		% of total emissions	uncertainties expressed as % of total GHG emissions							
Austria	2003	5,5	0,3 [1]	0,7	0,6	0,7 [2]				NIR 2005 [3] p. 35 ff
Belgium	2003	8,1	1,2			7,2				NIR 2005 p. 13 ff; direct comm.
Denmark	2003	6,8	0,5	1,3	0,8	1,6				NIR 2005 Tier 1, p. 155; annex p. 186
Finland	2003	15,9	0,7	0,1	0,6		8,8	2,9		NIR 2005 Tier 1; p. 178 ff
Finland	2003	[4]	0,4	0,0	0,3		5,3	1,8		NIR 2005 Tier 2; p. 174 ff
France	2002	22,1	2,3	1,4	0,3	20,9				NIR 2004 Tier 1; p. 32
Germany										
Greece	2003	10,8	0,6	0,2	0,2		5,1	1,2	2,9	NIR 2005 Tier 1, Annex IV, p. 214f
Ireland	2003	12,2	2,8 [5]	1,2	1,0	11,5				NIR 2005 Tier 1; p. 14 f
Italy	2001	2,5	0,7	0,4	0,8		0,5	0,7	0,4	NIR 2003 Tier 1; p. 81 ff
Luxembourg										
Portugal										
Spain	2002	15,8	0,8	4,4	0,8		8,0	11,8	0,9	NIR 2005 Tier 1; p. 54 f
Sweden	2003	6,9	1,2	0,3	0,4	5,9				NIR 2005 Tier 1 p. 202f
The Netherlands	2003	6,0	0,5 [6]		0,3		1,3	3,1		NIR 2005 Tier 1, p. A-8
United Kingdom	2002	17,9 [7]	0,5	0,1	0,9	17,6 [8]				NIR 2004 Tier 1. A7-305 ff

1) Relative uncertainties: Cattle: ±8%; Horses: ±10%; Swine: ±42%; Sheep, Goats: ±62%
2) Relative uncertainty: 24%
3) Uncertainty of total inventory given in NIR; sectoral uncertainties calculated from relative uncertainties and emission data.
4) Range 14 … 15
5) Dairy: 0.7%; Non-dairy: 2.6%; Other livestock: 0.8%
6) Cattle:0.5%, other livestock:0.1%
7) Total uncertainty resulting from Tier 2: analysis: 15%
8) For Tier 2 calculation: lognormal distribution with 97.5 per-centile 100 times the 2.5 percentile.

6.3.1 Enteric fermentation (CRF Source Category 4.A)

CH_4 emissions in the source category Enteric Fermentation stem for ten Member States to over 85 % from the sub-category “Cattle”. Substantial emissions from the sub-category “Sheep” (11%-49%% of emissions in category 4.A.) are reported by Greece, Spain, Portugal, the United Kingdom, Italy and Ireland. Emissions accounting for more than 5% of the emissions in this category are further reported by Greece for the sub-category “Goats” (21%) and Denmark and the Netherlands for the sub-category “Swine” (11% and 6%, respectively).

Accordingly, higher tier methodologies and country-specific methodologies are used for the estimation of CH_4 emissions from cattle. About three quarters of the EU-15 CH_4 emissions from 4.A.3 and at least 80% of CH_4 emissions from 4.A.1 were estimated by the use of higher tier methods. Table 6.17 gives an overview of the methodologies and emission factors used for calculation of CH_4 emissions from enteric fermentation. Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2003 are given in Table 6.18. An overview of the implied emission factors and the methane conversion factors as far as reported by the Member States, are give in Table 6.19.

Regarding animal numbers, some major changes occurred since 1990. In all countries, the numbers of cattle are considerably reduced, on the average by 26 % for dairy cattle and 7 % for non-dairy cattle (Table 6.19). An increase in the number of cattle has only been observed in the category of non-dairy cattle in Sweden (5 %), Ireland (12 %), and Spain (60 %). In Luxembourg, the dairy cattle population decreased by 31%, the population of non-dairy cattle (including suckling cows) decreased by 6%.

A similar situation is given for sheep populations with an EU-15 wide decrease by 12 %. The picture is a little bit different for the categories Goats and Swine, as some countries have encountered a significant increase of the populations, for example the goat population in Belgium in 2003 increased by 200 %

respective to the population in 1990; in the Netherlands this figure amounts to 351 %. The swine population was increasing especially in Denmark (36 %), Spain (48 %) and Ireland (60 %). Poultry numbers were increasing in almost all countries moderately with an average increase of 7 % between 1990 and 2003; only Austria reported CH_4 emissions from enteric fermentation of poultry.

Characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States. However, a few differences can be found in the numbers, which can be explained in the following way:

- In the United Kingdom, dairy cattle include also dairy heifers for the calculation of CH_4 emissions from manure management, which is different than the assumptions made in Table4.A;
- As Table4.B(b) does not offer to report animal numbers for goats, these are included in the category 'sheep' in the Danish inventory, while being reported separately in tables 4.A and 4.B(a);
- Young swine are included in Table 4.A for Austria only, which explains the lower number reported for emissions from manure management;
- CH_4 emissions from enteric fermentation is considered to be lower for young animals in the Flemish inventory. In order to use the same emission factors as for the adult animals, the population of young animals is corrected by a factor of 0.4 for sheep younger than 1 year, 0.6 for horses younger than 6 months, and 0.5 for all ponies. Swine with a weight less than 20 kg are not counted for CH_4 emissions from enteric fermentation.
- The Belgian (Flemish region) N_2O emission inventory for poultry includes more animal categories such as ostriches for which no CH_4 emission factor is known and therefore a larger poultry population is reported in Table4.B(b).

Table 6.17: Member State's background information for the calculation of CH_4 emissions in category 4A

Member State	Comments
Austria NIR 2005, p. 197-207	Cattle: Tier 2. Other animal categories: Tier 1. Tier 2 is based on Tier 1 with national EFs for different sub-categories. For the emissions from poultry the IPCC Tier 2 method with Swiss EFs (Gross Energy Intake, MCF) was used, assuming very similar conditions to Austrian conditions. In 1993, Austria changed the animal counting system with a subsequent shift from the number of "Young swine" to "Fattening pigs". The age class split for swine categories of the years 1990-1992 was adjusted using the split from 1993. Cattle: country-specific values for the Gross Energy Intake for dairy and non-dairy cattle based on typical diets and milk yields between 3000 and 8000 kg per cow and year. Emissions from organic and conventional farming practices have been calculated separately. Swine: a flat emission factor of 1.5 kg/head/year.
Belgium NIR 2005, p. 61; CRF Table4.A for 2003	Tier 1 methodology using IPCC default factors except if country specific data are available. Further harmonisation of the EFs between the regions is foreseen. The EFs presented are a weighted average of the regional EFs. Flanders formerly used the IPCC-emission factors from 1994. In this submission, emission factors from the IPCC guidelines 1996 have been used for the entire time series in Flanders. The IPCC emission factor for swine will be used in Wallonia in the next submission.
Denmark DK NIR 2005, p. 138 ff	All animal categories: Tier 2. Feeding data based on Danish norm figures. Changes in fodder conditions and stable systems are accounted for in each year. MCF for non-dairy cattle: 4% for rearing of bull calves, 6% other. Emissions calculated in the framework of the DIEMA model, which include about 30 different livestock categories (by animal type, weight and age classes), which are further sub-divided according to stable types (about 100 combinations). Emissions are calculated for each sub-category and aggregated to IPCC categories.
Finland NIR 2005, p. 104-109	Cattle: Tier 2. Other animal categories: Tier 1. Reindeer: emissions are calculated on basis of Finnish literature. The EFs are very preliminary and needs to be developed further. Additional information: animal weight, daily weight gain, milk production for dairy and suckling cow, digestible energy of forage and length of pasture season national.
France NIR 2004, p. 77 CRF Table4.D for 2003	Diary cattle: country-specific method based on national expert data (emission factors), other animals: Tier 1
Germany NIR 2005, p. 6-5 Daemmgen et al., 2004	Dairy cattle: national methodology; other cattle (key source category) and all other animals: Tier 1. The calculation of the EF for dairy cattle is based on a regression approach based on milk production, animal weight (derived from milk production data), and animal feed. The latter (grass/grass silage or maize/maize silage) is derived from the regional agricultural model RAUMIS. The emission factors used for other cattle (IPCC default for Western Europe; default values from the CORINAIR guidebook: EMEP, 2003) reflect the general situation in Germany.

Greece NIR 2005, p. 105	Sheep (half of CH_4 emissions from enteric fermentation): Tier 2. All animal categories: Tier 1.
Ireland NIR 2005, p. 51	All animal categories: Tier 1. It has not been possible to acquire and apply the full range of input data necessary for Tier 2 EFs. Nevertheless, the suitability of the default EFs for cattle has been assessed and changes that are considered justifiable for Irish conditions have been made. Investigations indicated that the value of 100 kg CH_4/head/year value was generally appropriate for dairy cattle in Ireland, where the feed is largely based on grass and silage. For other cattle a weighted EF of 50 kg CH_4/head/year was adopted in 2000 during the preparation of Ireland's Climate Change Strategy (determined by Irish agricultural experts in accordance to Tier 2, but not documented for the Irish inventory agency).
Italy CRF Table4.A for 2003	The Tier 2 approach has been followed.
Luxembourg	
Netherlands NIR 2005, p.6-3	Cattle: emission factor from country-specific Tier 2 analysis. The emission factors are calculated every year for several subcategories of dairy and non-dairy cattle, respectively. Other animal categories: Tier 1. Sheep and goats: the same EF is used because sheep and goats roughly consume per animal the equal amount of dry matter.
Portugal NIR 2004, p. 231-232 CRF Table4.A for 2003	All animal categories: Tier 1 level. For the emission factor for rabbit, the default EF for horse has been downscaled to the average weight of a rabbit according to the scaling equation in IPCC GPG.
Spain NIR 2005, p. 127	Cattle and sheep: Tier 2. Other animal categories: Tier 1. If Tier 1 was used, the default emission factor for developed countries was reduced by 20% for young animals. If Tier 2 was used, some of the activity data required are not available in Spain and national methodologies have been used for their calculation (usually based on disaggregation by breeds, and their characteristics, within the different animal species). Disaggregation in animal types is finer than in IPCC and based on statistics published by MAPA.
Sweden NIR 2005, p. 136, 152-153	Significant cattle subgroups: national emission factor (Tier 1). Reindeer: according to Tier 2 methodology using a Finnish value of gross energy requirements. Other animal categories: Tier 1. The national methodology for dairy cows, beef cows and other cattle is based on feed energy requirements expressed as metabolisable energy (initial steps similar to Tier 2). The calculations have been revised recently. For other cattle groups, the conclusion is to use a common emission factor for this group, 50 kg CH_4/head and year. For dairy cows the calculation is performed for a lactation period of 305 days and a non-lactating period of 60 days.).
United Kingdom NIR 2004, p. 79	Dairy cattle: Tier 2, varying from year to year. Beef and other cattle: Tier 2, not varying. Lambs and deer: Tier 2. Other animals: Tier 1. For dairy cattle, the animal weight assumed to increase 1% $year^{-1}$. The calculation is based on the population on the 'dairy breeding herd' rather than 'dairy cattle in milk' because the latter definition includes 'cows in calf but not in milk'. The enteric emission factors for beef cattle were almost identical to the IPCC Tier I default so the default was used in the estimates. The emission factor for lambs is assumed to be 40 % of that for adult sheep.

Table 6.18: Animal population [1000 heads] in 2003

Member State	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	558	1494	325	55	1578	13027
Belgium	787	2052	146	26	6526	31401
Denmark	596	1128	83	12	12949	17796
Finland	334	667	98	7	1375	10354
France	4156	15757	9283	1389	10237	284542
Germany	4363	9248	2638	NE	19534	122056
Greece	217	376	9083	5744	964	31756
Ireland	1152	5510	5979	8	1750	12683
Italy	1901	4730	7952	961	9111	196511
Luxembourg[2)]	41	149	9		84	79
Netherlands	2661	1098	1185	274	11169	74896
Portugal	335	1057	3406	520	2296	43381
Spain	1115	5537	23498	3162	25208	153234
Sweden	403	1204	448	5	1902	16402
United Kingdom	2192	8325	35846	88	5047	175414
EU-15	20811	58333	99981	12251	109731	1183533

1) Information source: CRF Table 4A for 2003, submitted in 2005
2) Information source: background information submitted by Luxembourg

Table 6.19: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH4/head/yr) [1)]					CH4 conversion (%) [1)]				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	105	53	8.0	5.0	1.5	6.0	6.0	NE	NE	NE
Belgium	105	48	8.2	9.0	1.5	NE	NE	NE	NE	NE
Denmark	118	36	17.2	13.2	1.1	6.0	4,00 / 6,00	6.0	5.0	0.6
Finland	117	43	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
France	103	52	8.0	5.0	1.5	NA	NA	NA	NA	NA
Germany	103	73	8.0	NE	2.0	NE	NE	NE	NE	NE
Greece	81	56	7.4	5.0	1.5	NA	NA	5.1	NA	NA
Ireland	100	50	8.0	5.0	1.5					
Italy	100	48	8.0	5.0	1.5	5.2	4.4			
Luxembourg										
Netherlands	83	33	8.0	8.0	1.5	NE	NE	NE	NE	NE
Portugal	100	48	8.0	5.0	1.5	NE	NE	NE	NE	NE
Spain	110	59	8.8	4.9	1.3	0.1	0.1	0.1	NA	NA
Sweden	129	57	8.0	5.0	1.6	6.7	7.0	6.0	5.0	0.6
United Kingdom	104	43	4.8	5.0	1.5	6.0	6.0	NE	NE	NE

NA: Not Applicable - NE: Not Estimated
1) Information source: CRF Table 4B(a) for 2003, submitted in 2005

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 81 kg CH_4 $head^{-1}$ yr^{-1} (Greece) and 129 kg CH_4 $head^{-1}$ yr^{-1} (Sweden) for dairy cattle, and 33 kg CH_4 $head^{-1}$ yr^{-1} (The Netherlands) and 73 CH_4 $head^{-1}$ yr^{-1} (Germany) for non-dairy cattle. The difference could partly be explained with a different classification scheme for cattle and partly by the different level of intensity for dairy production.

At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 93 kg CH_4 $head^{-1}$ yr^{-1} to 102 kg CH_4 $head^{-1}$ yr^{-1} while at the same time the animal number of dairy cattle decreased by 26 %, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by 16 %.

Note however, that the increase of the implied emission factor of 10 % is due to changes reported in eleven countries only, as the other do not use time varying emission factors; for those countries, the increase of methane emission for each dairy cow amounts to 13 %. The implied emission factors for non-dairy cattle, not being linked to the increasing milk yield, was estimated to be more stable over time and increased in nine countries by 4 % (from 49 kg CH_4 $head^{-1}$ yr^{-1} to 51 kg CH_4 $head^{-1}$ yr^{-1}) and remained stable at EU-15 level. The only country where the IEF for cattle (in the sub-category of non-dairy cattle) decreased (by 6 % and 3 %) between 1990 and 2003 are the Netherlands and Spain respectively.

For sheep, the implied emission factors changed since 1990 in three countries (Belgium, Spain, and UK) by –2 %, 3 %, and 3 %, respectively. Note that the IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH_4 $head^{-1}$ yr^{-1} and 13.2 kg CH_4 $head^{-1}$ yr^{-1} considerably higher than the IPCC default values and the numbers used in other Member States.

Table 6.20: Total CH_4 emissions and implied Emission Factor at EU-15 level for the years 1990 and 2003

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
	1990				
Total Emissions of CH4 [Gg CH4]	2607	3312	764	63	163
Total Population [1000 heads]	28163	62500	113113	12722	106326
Implied Emission Factor [kg CH4 / head / year]	93	53	7	5	2

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
	2003				
Total Emissions of CH4 [Gg CH4]	2118	3112	698	62	164
Total Population [1000 heads]	20811	58333	99956	12251	109694
Implied Emission Factor [kg CH4 / head / year]	102	53	7	5	2

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
	2003 value in percent of 1990				
Total Emissions of CH4 [Gg CH4]	81%	94%	91%	98%	101%
Total Population [1000 heads]	74%	93%	88%	96%	103%
Implied Emission Factor [kg CH4 / head / year]	110%	101%	103%	101%	98%

Source of information: CRF Table4s1 and 4.A for 1990 and 2003. Additional background information for Luxembourg.

6.3.2 Manure Management (CH_4) (CRF source category 4.B(a))

Table 6.24 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (47 % and 49 %, respectively). For cattle, the contributions of dairy and non-dairy cattle are also at the same level (24% and 23%, respectively). The highest contribution of cattle to CH_4 emissions from manure management are observed in Ireland with 83 % of total emissions, the lowest in Portugal, where cattle contribute with only 5 %. This is compensated with the emissions from swine manure with 90 % of the total CH_4 from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 11% and 4.5% of total CH_4 from manure managementemissions, respectively. Greece has also the highest contribution of poultry to CH_4 emissions from manure management with 16 %.

An overview of the methodologies and emission factors used in Member State’s inventory is given in Table 6.21. About one quarter of the EU-15 CH_4 emissions from 4.B.1 and about 40 % of the CH_4 emissions from 4.B.8 were estimated by the use of higher tier methodologies. Table 6.22 summarizes the produced manure over the animal wastes management systems ‘liquid systems’, ‘solid storage and dry lot’ and ‘pasture, range and paddock’ for the animal categories dairy and non-dairy cattle and swine. The table shows, that in all countries more manure is managed in liquid systems for swine than for cattle, whereby in Italy and Ireland 100 % of the swine manure is managed in liquid systems. Only in the UK more manure is managed in solid than in liquid systems. In the category cattle, generally more manure is managed in liquid systems for dairy cattle than for non-dairy cattle with the exception of Austria and France.

Substantial changes in the allocation of manure to manure management systems are reported for Sweden, Germany, Finland, and Denmark, however, with different signs of the direction of the changes. In Denmark for dairy cattle, there was a shift from manure managed in solid systems to liquid systems, which increased from 70% of the total manure in 1990 to 76 % in 2003. This was compensated by a reduction in the percentage of manure managed in solid storage systems while the proportion of manure from dairy cattle excreted on pasture, range and paddock remained constant at 15 %. The situation was different for non-dairy cattle, where the proportion of the liquid systems decreased from 37% to 23 % of the manure with a corresponding increase of the use of solid system (from 36 % to 40 %) and an increase in the fraction of manure excreted in pasture, range and paddock (from 28 % to 37 %).

In contrary, liquid systems were more frequently used to manage manure from dairy cattle in Sweden (from 24 % in 1990 to 49 %) and Germany (from 66 % to 83 %) with a corresponding decrease of the importance of solid storage systems. The trend for non-dairy cattle goes into the other direction in Sweden with a decreasing portion of manure managed in liquid systems (21 % in 1990 and 15 % in 2003) and increasing use of solid storage systems. In Sweden, the fraction of manure on pasture, range and paddock increased for both dairy (from 17 % to 21 %) and non-dairy cattle (from 31 % to 45 %).

In Finland, the largest shifts in manure management systems was observed for swine, where over 90 % are managed in liquid systems in 2003, while in 1990 more than half of the manure was managed in solid storage systems. The same trend occurred in Sweden where 74 % of manure from swine are stored in liquid systems in 2003, compared to 44 % in 1990. In Germany, liquid systems were already the major manure management system for swine in 1990 (85 %) in the importance increased during the last 13 years up to 91 %.

Table 6.21: Member State's background information for the calculation of CH_4 emissions in category 4B (CH_4)

Member State	Comments
Austria NIR 2005, p. 208-213	Tier 2: cattle and swine. Other animals: Tier 1. Manure management systems for dairy cattle, suckling cows and cattle 1-2 years in "summer situation" and "winter situation". In summer, 14.1 of Austrian dairy cows and suckling cows are on alpine pastures 24 hours/day. 43.6% are on pasture for 4 hours/day; rest not on pasture. This results in 21.3% pasture/range/paddoch during summer. VS country-specific as a function of manure production (based on milk yield) and feed diet with country-specific feed rations under organic and conventional management. No change in feed intake for non-dairy cattle occurred and a constant VS excretion rate was used. VS excretion for swine country-specific constant value
Belgium NIR 2005, p. 61-62	Flanders: Tier 2 method with country-specific data. In the calculation, a 'integrator' is used to account for the fact that the weight of the cattle of the whole lifetime is not the same as the slaughter weight, and integrates therefore between the weight at birth and the slaughter weight. Wallonia: EFs for each animal category by Sinterem taking into account type and volume of manure produced during time spent in stables, density, carbon content, and carbon volatilization ratio. The parameters come from studies conducted in Wallonia or France.
Denmark NIR 2005, p. 141 ff	All animal types: Tier 2; disaggregation as for category 4A with estimates based on national data for feed consumption and standards for ash content and digestibililty. MCF for liquid systems national (10%). Reduction of CH_4 emissions in biogas plants included in the inventory.
Finland NIR 2005, p. 109-116	Tier 2 for all animal categories. EF both national and default. Cattle national: digestible energy, fraction of animal's manure managed annually in each AWMS, average milk production and animal weight. For MCF, a default value of 10% (IPCC 1997) has been used instead of 39% (IPCC 2000) due to Finland's climatic conditions.
France NIR 2004, p. 78 CRF Table4.B(a) for 2003	Tier 1. AWMS distribution national. Milk heifers are counted with non-dairy cattle. But heifers more than 2 years old (40% of the total heifer livestock) are considered as dairy cattle.

Germany NIR 2005, p. 6-16	As detailed data for the application of the Tier 2 methodology are missing, emissions are estimated using the "simple" CORINAIR (EMEP, 2003) methodology. The emission factors represent the general situation in Germany. Calculations are done at the district level.
Greece NIR 2005, p. 109	Tier 1. AWMS distribution estimated on the basis of IPCC and country-specific values and kept constant.
Ireland	Tier 2 with IPCC default values for B0, Vs, and MCF, while accounting for conditions that would be representative for Ireland. Only emissions from cattle and swine are relevant.
Italy	
Luxembourg	
Netherlands NIR 2005, p. 6-6	Tier 2 methodology for all animal categories distinguishing three manure management systems: liquid manure, solid manure and pasture. Country-specific EFs expressed in kg CH_4 per kg of manure and are base on volatile solids and maximum methane producing capacity for all AWMS and additionally on storage temperature and storage period for liquid manure systems.
Portugal NIR 2004, p. 236-242	Tier 2
Spain NIR 2005, p. 128-129	Tier 2 for beef and pork herds, Tier 1 for other animal categories using smooth temperature functions for the MCF and EF (modification accepted by IPCC). Management systems: own expert calculation.
Sweden NIR 2005, p. 136, 144-145	Cattle and Swine: Tier 2; all other animal groups: Tier 1. Default values for MCF and B0i factors except for MCF for liquid manure, where the value of 10% is adopted as national value. This is considered to be a more appropriate value for Swedish conditions, firstly because of Sweden's cold climate, and secondly because of the fact that the slurry containers usually have a surface cover. Since dairy cows often are stabled during the night, the data on stable period for this animal category is combined with an assumption that 45% (Swedish Board of Agriculture, 1995) of its manure was produced in the stable (assumption made in STANK model)
United Kingdom NIR 2004, p . 92	Dairy cattle: Tier 2. Other animals: Tier 1. IPCC default with the exception of lambs (40% of adult sheep) and deer. For dairy cattle, the calculations are based on the population of the 'dairy breeding herd' rather than 'dairy cattle in milk' used in earlier inventories.

Table 6.22: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2003

Member State	Dairy Cattle - Allocation of AWMS (%) [1]			Non-Dairy Cattle - Allocation of AWMS (%) [1]			Swine - Allocation of AWMS (%) [1]		
	Liquid system[2]	Solid storage and dry lot	Pasture range paddock	Liquid system[2]	Solid storage and dry lot	Pasture range paddock	Liquid system[2]	Solid storage and dry lot	Pasture range paddock
Austria	19	70	11	24	66	10	71	29	
Belgium									
Denmark	76	9	15	23	40	37	91	8	1
Finland	25	47	28	23	51	25	57	43	
France	11	42	47	19	29	51	84	16	0
Germany	83	17		54	46		91	9	
Greece									
Ireland	30	12	58	17	18	65	100		
Italy	33	58	10	35	60	5	100		
Luxembourg									
Netherlands									
Portugal	35	35	30		60	40	98	1	1
Spain									
Sweden	49	29	21	15	25	45	74	23	
United Kingdom	31	10	46	6	21	51	31	55	7

NA: Not Applicable - NE: Not Estimated. The portion lacking for 100% are reported as daily spread (only UK) and 'other'.
1) Information source: CRF Table 4B(a) for 2003, submitted in 2005
2) Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes only in Ireland with 2% of the manure managed.

The implied emission factors for CH_4 emissions from manure management vary substantially among the Member States, as shown in Table 6.23. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers more than one order of magnitude, which is more than the range proposed in the IPCC Guidelines for different climate regions (for dairy cattle in Western Europe, for example, an emission factor of 14 kg CH_4 head^{-1} y^{-1} is proposed for cool climate regions and a factor of 81 kg CH_4 head^{-1} y^{-1} of warm climate regions), but less than the ratio of the methane conversion factors of liquid (39 % - 72 %) and solid (1 % - 2 %) manure. The ratio of the highest and the smallest IEF used by the Member States is 30 for dairy cattle, and 12 for non-dairy cattle and 13, 11 and 11 for sheep, goats and swine. Thus, it is not surprising that the highest implied emission factor for dairy cattle is found for Germany, which manages 83% of the manure in liquid systems, and a much lower IEF is reported by Austria, where only 19% of the manure are managed in liquid systems.

Also, the trend in the implied emission factors does not correspond to climate regions. By far the highest IEF for dairy cattle is used in the German inventory (85.6 kg CH_4 head^{-1} y^{-1}), followed by the UK, The Netherlands, Belgium, and Italy (25.5 to 20.0 kg CH_4 head^{-1} y^{-1}). IEFs between 10 and 20 kg CH_4 head^{-1} y^{-1} are reported by most countries and an implied emission factor smaller than 10 kg CH_4 head^{-1} y^{-1} is used only by Finland (8.5) and Portugal (2.9). The ranking of the countries for their IEFs of non-dairy cattle and swine are different; they have in common only that the highest IEF is used in Germany.

Note that, for dairy cattle for example, most countries are allocating 100 % of the population to the cool climate region, with Italy, Potugal and Spain allocating a part of the population into the temperate region (89%, 49%, and 72%, respectively) and only Greece allocating 100 % of the animals to the temperate climate region . France assumes 98 % of the dairy cattle in the temperate and 2 % of the cattle in the warm climate region. Looking at another animal type, as for example swine, the distribution across the climate regions is somewhat different. In Italy, the a higher proportion of the swine population lives in the cool climate region (95%), while in Portugal and Spain, the portion of animals living in the cool climate region is smaller than for dairy (and non-dairy) cattle with 21% and 38%, respectively. In France, the same allocation across the climate regions for swine is assumed as for dairy cattle. For the categories dairy cattle, non-dairy cattle and swine, only in few cases did the allocation of animal population to climate regions change since 1990, this is most distinctly for Belgium, which assigned 100% of the animal population to the temperate climate region in 1990 and 100% to the cool climate region in 2003. In Spain, the swine population shifted from a majority living in the cool climate region (53%) in 1990 to the temperate climate region (62%) in 2003.

Table 6.23: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory

Member State	Implied EF (kg CH4/head/yr) [1]				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	19,1	7,2	0,2	0,1	12,4
Belgium	21,7	13,6	1,4	1,4	10,1
Denmark	18,0	1,8	0,3	0,3	2,5
Finland	8,5	2,3	0,2	0,1	3,4
France	18,5	18,8	0,3	0,2	20,9
Germany	85,6	20,0	0,2	NE	27,2
Greece	19,0	13,0	0,3	0,2	7,0
Ireland	15,9	6,4			5,4
Italy	20,0	10,6	0,2	0,1	7,8
Luxembourg					
Netherlands	24,0	3,8	0,2	0,3	3,9
Portugal	2,9	1,7	0,2	0,1	26,3
Spain	14,3	3,8	0,2	0,2	14,0
Sweden	17,8	5,9	0,2	0,1	3,0
United Kingdom	25,5	4,2	0,1	0,1	3,0

NA: Not Applicable - NE: Not Estimated
1) Information source: CRF Table 4B(a) for 2003, submitted in 2005

Table 6.24: Total CH_4 emissions from manure management and implied Emission Factor at EU-15 level

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Horses	Sw ine	Poultry
	1990						
Total Emissions of CH4 [Gg CH4]	796	806	20	2	5	1367	107
Total Population [1000 heads]	28110	62559	113191	12433	2335	105375	1109492
Implied Emission Factor [kg CH4 / head / year]	28	13	0.2	0.2	2	13	0.1

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Horses	Sw ine	Poultry
	2003						
Total Emissions of CH4 [Gg CH4]	697	684	18	2	6	1432	107
Total Population [1000 heads]	20811	58184	99981	12251	2698	109731	1183533
Implied Emission Factor [kg CH4 / head / year]	33	12	0.2	0.2	2	13	0.1

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Horses	Sw ine	Poultry
	2003 value in percent of 1990						
Total Emissions of CH4 [Gg CH4]	88%	85%	92%	101%	120%	105%	100%
Total Population [1000 heads]	74%	93%	88%	99%	116%	104%	107%
Implied Emission Factor [kg CH4 / head / year]	118%	91%	104%	102%	103%	101%	93%

Source of information: CRF Table4s1 and 4.A for 1990 and 2003. Additional background information for Luxembourg.

At the EU-15 level, CH_4 emissions from manure management have decreased for most animal types (cattle, sheep, swine, and poultry), and have increased for goats (combined effect of a small increase in the goat population and in the implied emission factor used) and horse (increase of the animal number by 16%). The emissions from poultry decreased slightly despite the falling animal numbers due to higher emission factors used for the 2003 inventory. The opposite applies for dairy cattle, where a large decrease in the animal population (-22%) is compensated partly by enhanced manure production (15%).

6.3.3 Manure Management (N_2O) (CRF source category 4.B(b))

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems; the percentage of emissions from solid storage systems thus varies between 78% in Sweden and 99% in Portugal. Note that in the German inventory N_2O emissions from manure management is estimated according the mass-flow approach using IPCC Tier 1 methodologies (an overview of the methodologies and emission factors used in all Member States is given in Table 6.25), but report N_2O emissions from manure management under the sub-category “other” and do not report implied emission factors or emissions separated for liquid and solid manure storage systems. About 10 % of the EU-15 N_2O emissions from 4.B.12 were estimated by the use of higher tier methods.

Generally, GHG emissions (in CO_2-equivalents) from manure management are predominantly CH_4 rather than N_2O emissions. This is seen most significantly in the German inventory, where 7.9 times as much is emitted as CH_4 compared to N_2O, followed by Spain (ratio 5.3). Values close or smaller to unity are found for Finland (0.5), Sweden (0.8), Austria (1.3), and Portugal (1.4). Table 6.27 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value. Thus, the differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.26.

These numbers are based on the used nitrogen excretion rate per head and year, where a range by a factor of ca. 2.5 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range between 55.8 kg N $head^{-1}$ y^{-1} for Austria and 129.5 kg N $head^{-1}$ y^{-1} for Denmark (factor 2.3). The largest range is found for sheep with values between 5.2 kg N $head^{-1}$ y^{-1} (Sweden) and 21.2 kg N $head^{-1}$ y^{-1} (Denmark). The range for non-dairy cattle is the narrowest one with values ranging between 29.6 kg N $head^{-1}$ y^{-1} and 57.9 kg N $head^{-1}$ y^{-1} for Austria and France, respectively.

Emissions of N_2O, amount of nitrogen excreted and implied emission factors for anaerobic lagoons, liquid systems, and solid storage and dry lot, are reported for EU-15 in Table 6.28. Since 1990, the total amount of nitrogen excreted and managed in liquid or solid storage systems has been reduced by 5 % for EU-15. Parallel to this development did the amount of nitrogen excreted on pasture, range and paddock decrease by 5 %. However, there are large differences in the development between the Member States. In Belgium, for example, only 42 % of the amount of nitrogen were excreted in 2003 on pasture, range and paddock compared to 1990 (while total manure production decreased by 7 %). On the other site, nitrogen excretion on pasture, range and paddock increased in Sweden by 24 % while total manure excretion dropped by 2 %.

The amount of manure managed in liquid systems decreased from 1990 to 2003 from 2010 Gg N to 1894 Gg N (6 %). Significant increase of the amount of nitrogen managed in liquid systems occurred in Ireland (9 %) and Sweden (40 %).

Table 6.25: Member State’s background information for the calculation of N_2O emissions in category 4B(b)

Member State	Comments
Austria NIR 2005, p. 209	Tier 1. For cattle and swine: country-specific EFs. N excretion from dairy cattle based on milk yield; N excretion from non-dairy cattle national. N excretion of cattle < 1 year: from revised German inventory, cattle > 2 year: from Swiss inventory. N excretion from swine: national.
Belgium NIR 2005, p. 63-65	Nitrogen excreted by each animal category is estimated through local production factors. In Wallonia, the methane emissions from the manure applied during grazing are reported under agricultural soils (category 4.D). It will be checked if these emissions should not rather be included in the manure management category.
Denmark NIR 2005, p. 143 ff	Country-specific calculation of nitrogen excretion figures in the framework of the DIEMA model complex. IPCC default factors. Reduction of N_2O emission in biogas plant included in the inventory.
Finland NIR 2005, p. 109-116	IPCC - default factors
France NIR 2004, p. 78 CRF Table4.B(b) for 2003	Tier 1. AWMS distribution is based on country specific data. For nitrogen excretion: heifers more than 2 years old are considered as dairy cattle but this livestock is counted with Non-dairy cattle.

Germany Daemmgen et al., 2004 NIR 2005, p. 6-16	Emissions of nitrogen compounds from manure management is done with the mass-flow (EMEP, 2003), using IPCC methodologies (Tier 1) for N_2O and NO emission estimates, which are no key sources. The distribution over manure management systems takes into consideration all relevant housing systems occurring in Germany and is based on the length of the grazing period, the average time per day spent grazing and in milking **yards.** All calculations are done on the district level using the agricultural model RAUMIS. N-excretion factors are calculated on the basis of milk productivity for dairy cattle and national data for other animals. Values for the content of total ammoniacal nitrogen (TAN) were estimated for cattle, swine, sheep, horses, and poultry.
Greece	
Ireland NIR 2005, p. 52	Proportion of manure nitrogen assigned to each applicable AWMS and nitrogen excretion rates for cattle: national. N-excretion rates for sheep, swine and poultry: IPCC default. The same values are used for all years.
Italy	
Luxembourg	
Netherlands NIR 2005, p. 6-6	IPCC default factors for liquid and solid manure management systems. Activity data are collected at Tier 2 level for cattle and swine.
Portugal NIR 2004, p. 244-248	
Spain NIR 2005, p. 132	IPCC methodology using Nex fraction of the "Near East & Mediterranean" climate region and applying age-related correction factors.
Sweden	IPCC methodology
United Kingdom NIR 2004, p. 93-95	IPCC methodology. It is assumed that 20% of the total N emitted by livestock volatilises as NO_x and NH_3 - Nex factors used in the AWMS estimates are 20% less than total nitrogen excreted.

Source: CRF Tables.4B(B) for 2003, submitted in 2005

Table 6.26: Total nitrogen excretion by Animal Waste Management System [Gg N] - 2003

Member State	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Total
Austria		41		68	22	10	141
Belgium		122	52	84	43	4	304
Denmark		191		50	32		273
Finland		22		40	17		78
France		476		623	802		1901
Germany		7		3	2		12
Greece		14	1	27	364	6	411
Ireland	9	98		62	289		459
Italy		258		367	173	28	825
Luxembourg							
Netherlands		316		55			371
Portugal	40	18		94	60		212
Spain		182	113	156	433	1	884
Sweden		47		45	43	11	145
United Kingdom		104	106	112	470	93	885
EU-15	49	1896	272	1785	2748	152	6902

NA: Not Applicable - NE: Not Estimated

1) Information source: CRF Table 4B(b) for 2003, submitted in 2005

Table 6.27: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory

Member State	Implied EF (kg N2O-N / kg N) [1)]		
	Anaerobic lagoon	Liquid system	Solid storage and dry lot
Austria		0.100%	2.00%
Belgium	NO	0.100%	2.00%
Denmark		0.09%	1.96%
Finland	NO	0.104%	2.34%
France		0.100%	2.00%
Germany	NO	IE	IE
Greece		0.100%	2.00%
Ireland	0.10%	0.100%	2.00%
Italy	NO	0.100%	2.00%
Luxembourg			
Netherlands	NO	0.087%	1.73%
Portugal	0.09%	0.087%	2.20%
Spain[2]	NO	0.100%	2.00%
Sweden	NO	0.100%	2.00%
United Kingdom		0.098%	2.01%

NA: Not Applicable - NE: Not Estimated
1) Information source: CRF Table 4B(b) for 2003, submitted in 2005

As all countries are using IPCC default values for the IEF or values that are close to it, these numbers apply also for the EU-15 N_2O inventory for manure management. Also, no changes occurred in the IEFs used since 1990, the decreases in N_2O emissions of 9 % and 7 % for liquid and solid manure storage systems are solely due to decreases in nitrogen excretion by the same fraction. The slight difference in the numbers presented in Table 6.29 for the reduction of N_2O emissions from and N excretion into liquid management systems are due to a slight decrease of the implied emission factor used in Denmark from 0.10 % in 1990 to 0.09 % in 2003.

Table 6.28: Total N_2O emissions, Nitrogen excreted and implied Emission Factor for category 4B(b) at EU-15 level

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N2O [Gg N2O-N]	0,08	3,0	61,4
Total Nitrogen excreted [Gg N]	49	2010	1968
Implied Emission Factor [kg N2O-N / kg N]	0,10%	0,10%	1,98%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2003		
Total Emissions of N2O [Gg N2O-N]	0,07	2,9	56,3
Total Nitrogen excreted [Gg N]	44	1894	1795
Implied Emission Factor [kg N2O-N / kg N]	0,10%	0,10%	1,99%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2003 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	90%	94%	92%
Total Nitrogen excreted [Gg N]	91%	94%	91%
Implied Emission Factor [kg N2O-N / kg N]	100%	100%	101%

The figure for the EC-total animal numbers exclude Luxembourg, as no background information are available. The contribution of Luxembourg to total EC emissions in sector 4.A equals 0.35% for dairy cattle and 0.24% for non-dairy cattle.

6.3.4 *Rice Cultivation (CH_4) (CRF source category 4.C)*

Rice cultivation is occurring in five EU-15 countries: France, Greece, Italy, Portugal, and Spain. Italy is by far the largest producer of rice in Europe, with 2187 km^2 of rice cultivation, followed by Spain with an area of 1170 km^2. The other three countries have rice producing areas around 200 km^2, as shown in Table 6.29 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aeration. All countries but Italy are reporting rice production under a continuously flooding regime, while in Italy the practice of multiple aeration is predominant. In Italy rice paddies are flooded with 15-25 cm of water usually from April-May to August. During this field submersion time two or three water drainage periods, 2 to 4 days each, can happen in 85% of rice paddies, a clearly uninterrupted submersion in 13-14% and about one month delayed submersion in 1-2% (IT NIR 2003).

The trend in rice growing areas in these countries is divers: while in Italy, the area cultivated with rice fluctuated since 1990, its level was in 2003 was 2 % larger than in 1990. The harvested area in Spain increased from 1990 to 2003 by 28 %, but around 1993-1995 rice production was only half of the area in 1990; also Greece increased its rice production since 1990 by 37%. The trend was opposite in France with peaks in rice production during 1993-1995 and about the same level in 1990 and 2003. Finally, Portugal saw a decline in rice production, amounting to 24% since 1990.

A summary of the implied emission factors used by these countries is given in Table 6.30. France and Greece are using IPCC default emission factors presented in the IPCC Good Practice Guidance. This value is the arithmetic mean of the seasonally integrated emission factors presented in Table 4-13 of the IPCC Guidelines. In this Table, a value from Schuetz et al (1989) is also presented (36 g m^{-2}, range 17-54 g m^{-2}, representing a seasonally averaged emission factor). In Italy, as reference factor 33 g m^{-2} CH_4 per year has been selected (Schuetz et al., 1989) [18], which are based on averaged CH_4 flux measurements over 3 years during the growing period only, carried out in continuously flooded rice paddies in the Po valley, without org. matter amendment or mineral fertilisation (Tani, 2000) [19]. The value has been adapted to 39.6 g m^{-2} CH_4 per year to take into account the post-harvest emissions (Tani, 2000). This value has been multiplied with the factor of 1.5 to account for the assumed emissions of rice fields that are amended with organic matter (factor of two) representing about 50% of the area cultivated. A scaling factor of 25% and 50% has then been applied to estimate the emissions from single and multiple aeration management regimes (IT NIR 2003). No changes in implied emission factors occurred since 1990. Spain uses a seasonal emission factor of 12 g m^{-2}, which has been obtained from Table 4-9 of the IPCC *Guidelines* reporting a study carried out in Spain (Seiler et al., 1984); the value used by Portugal in 1990 and 2003 are the above-mentioned value of 36 g m^{-2} measured by Schuetz et al. (1989) and 29.6 g m^{-2}, respectively.

At EU-15 level, the implied emission factors amounts to 22.4 g m^{-2} in 2003 for continuous flooded rice fields, which represents a decrease in the implied emission factor by 11% since 1990 (see Table 6.31), which can be explained by the higher contribution of Spain. Note that the implied emission factors for intermittently flooded field are stemming from the Italian inventory only. Here it is smaller than the emissions from continuously flooded fields, at the EU-15 level and with the given choices of emission factors by the different countries, however, the average emission from continuous flooded fields appears to be only half of those from single-aerated rice fields.

[18] Schütz, H., Seiler, W. , and Conrad, R.: Processes involved in formation and emission of methane in rice paddies, Biogeochem., 7, 33-53, 1989.

[19] Tani, A.: Methane emissions from rice paddies: review, assessment and perspectives for Italian lands, Technical Report carried out for APAT, 2000.

Table 6.29: Harvested Area Rice in the Member States in 2003 and 1990

Member State	Harvested area in 2003 [10^9 m^2]		
2003	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.23		
Greece	0.23	NO	NO
Italy	0.31	0.02	1.86
Portugal	0.34	NO	NO
Spain	1.16	NO	NO
Member State	Harvested area in 1990 [10^9 m^2]		
1990	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.24		
Greece	0.16	NO	NO
Italy	0.30	0.02	1.83
Portugal	0.34	NO	NO
Spain	0.90	NO	NO

NA: Not Applicable - NE: Not Estimated

1) Information source: CRF Table 4C for 2003 and 1990, submitted in 2005

Table 6.30: Implied Emission factors for CH_4 emissions from rice cultivation used in Member State's inventory

Member State	Implied EF (g CH4 · m^{-2}) 1)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.0		
Greece	20.0	NO	NO
Italy	59.4	44.6	29.7
Portugal	36.0		
Spain	12.0	NO	NO

NA: Not Applicable - NE: Not Estimated - NO: Not Occurring

1) Information source: CRF Table 4B(a) for 2003, submitted in 2005

Table 6.31: Total CH_4 emissions, area harvested and implied Emission Factor for category 4.C at EU-15 level

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	49.0	1.0	54.4
Total Area harvested [10^9 m^2 y^{-1}]	1.9	0.0	1.8
Implied Emission Factor [g CH4 / m^2]	25.2	44.6	29.7

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2003		
Total Emissions of CH4 [Gg CH4]	48.8	1.0	55.2
Total Area harvested [10^9 m^2 y^{-1}]	2.2	0.0	1.9
Implied Emission Factor [g CH4 / m^2]	22.4	44.6	29.7

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2003 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	100%	102%	102%
Total Area harvested [10^9 m^2 y^{-1}]	112%	102%	102%
Implied Emission Factor [g CH4 / m^2]	89%	100%	100%

6.3.5 Agricultural soils (CRF Source Category 4.D)

As described above, N_2O emissions from agricultural soils belong to the most uncertain source categories of national GHG inventories. For direct N_2O emissions, the highest uncertainty is attributed to the emission factor, which ranges between 24% Austria and 400% Greece relative uncertainty (expressed in 2•standard_deviation). For indirect emissions, both the activity data and the emission factors are considered equally uncertain, which stems from the fact that a most uncertain parameter, the fraction of nitrogen leached, must be applied to determine the activity data. Thus, uncertainties of indirect N_2O emissions are estimated as up to 100% and 900% (Spain) for the activity data and emission factor, respectively. Compared to these values, the sub-category of animal production is less uncertain, with a maximum uncertainty estimated by Greece and Spain (112%).

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see Table 6.33). For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N_2O inventory with the CORINAIR NH_3 inventory or using simulation models. A more specific discussion of emission factors and parameters (see Table 6.34) used is presented below.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.32. About 80 % of the EU-15 N_2O emissions from 4.D.3 were estimated by the use of higher tier methodologies, whereas less than 10 % were estimated by the use of higher tier methods from 4.D.1 and only about 1 % from 4.D.2.

Table 6.32: Member State's background information for the calculation of N_2O emissions in category 4D

Member State	Comments
Austria NIR 2005, p. 218-231	Link between ammonia and nitrous oxide inventories. Direct emissions: mineral fertilizers and urea application; manure application; nitrogen fixation and crop residues using default EF. Crop residues: national values for crop to residue ratios Nitrogen fixation: national values for N fixation legumes and clover-hey Indirect due to volatilisation: FracGASF 23% for mineral fertilizers and 15.3% for urea fertilizers (CORINAIR) Leaching and run-off: FracGASM is calculated as Nlosses/Nextotal, considering nitrogen excreted during grazing, NH_3 losses during housing and manure storage and N_2O emissions during manure management and upon application on land are according to CORINAIR (see Austria's Informative Report 2004 under the UNECE CLRTAP) resulting (for 2003) in 20% loss. Sewage sludge: N content 3.9% dry matter.
Belgium NIR 2005, p. 60-64	Direct emissions: daily spread, mineral and organic fertilisers, crop residues using IPCC default EF. Nitrogen content in the non-N-fixing crops and fraction of crop residues removed as crop has been changed from the IPCC default values to crop-specific values. Grazing animals: based on number of days in pasture, N excretion, and volatilisation. Default IPCC EF. Indirect emissions: leaching and runoff and atmospheric deposition. FracGASF 2.3% in Wallonia (recommended by IIASA for different fertiliser types); 4.3% in Flanders (weighted average for NH_3 and NO volatilisation). Leaching and run-off estimated on the basis on N from grazing animals, fertilisers, crop residues, sludge and atmospheric deposition. National FracLEACH 17%, default IPCC EF.
Denmark NIR 2005, p. 145 ff	N_2O emissions are closely related to the N balance calculated in the framework of the DIEMA modelling complex. EFs are IPCC default Synthetic fertiliser: Ca. 1-2% of the fertiliser is applied on parks, golf courses and private gardens. Manure: Amount of N applied = N-excretion in stables minus the emissions of ammonia in stables, storage, and in relation to application of manure, is obtained from ammonia emission inventory Nitrogen-fixing crops: Tier 1b. Emissions from clover-grass are included (contribution in 2003: 63%). Estimates of amount of N fixed model-based (DIAS) Crop residues: cereals: aboveground residues are straw+stubble+husks. Straw is given in the census and amounts used for feeding, bedding, and fuel are subtracted. Straw for feeding and bedding are subtracted as they are later returned to the soil with the manure. Cultivation of histosols: a constant fraction of 10% of the organic soil cultivation is assumed to be in rotation Indirect due to volatilisation: NH_3 from fertilizer, crops, NH_3-t
Finland NIR 2005, p. 116-123	Sources included: direct emissions from synthetic fertilisers, animal manure applied to soils, crop residue, N-fixing crops, sewage sludge, cultivation of organic soils. indirect emissions from nitrogen volatilisation and nitrogen leaching from synthetic fertiliser, manure and sewage sludge applied to soils. Emissions from nitrogen excreted to pasture range and paddocks. Default emission factors. National values for FracGASF (0.006), FracGASM (0.31), and FracLEACH (0.15). Some national values for crop residue to crop product ratio, dry matter fraction, and nitrogen fraction in crop residues. Correction for volatilisation for synthetic fertiliser and manure applied. Indirect emissions due to volatilisation calculated from volatilised synthetic fertiliser and total manure and sewage sludge.
France CRF Table4.D for 2003	Country-specific.
Germany NIR 2005, p. 6-23 - 6-30	N_2O and NO emissions are calculated using default emission factors for N_2O (0.0125 kg kg^{-1} N) and emission factors for NO (0.007 kg kg^{-1} N) and N2 (0.1 kg kg^{-1} N). Sub-categories included: Synthetic fertiliser, manure, N-fixing crops, crop residues, organic soils, grazing animals, and indirect emissions following volatilisation of N-compounds and leaching and run-off. Emissions from the application of sewage sludge are not included. N-fixing crops: national data on the amount of nitrogen fixed per hectare, disaggregated for leguminous crops (250 kg ha^{-1} N), clover and clover/grass and clover/alfalfa (200 kg ha^{-1} N), and alfalfa (300 kg ha^{-1} N). Crop residues: national data for nitrogen content in crop residues in kg ha^{-1} N. Grazing animals: N input calculated with the mass-flow approach with default factors for N_2O, NH_3, and NO emissions (IPCC, EMEP)
Greece NIR 2005, p. 112-115	All source categories considered with IPCC default methodologies. Crop residues: Tier 1b using default factors. Fraction burned in fields assumed to be 10% (IPCC GPG)
Ireland NIR 2005, p. 53-55	All sources for direct N_2O emissions are considered except application of sewage sludge (not quantified) and cultivation of organic soils (is taken as negligible). N-fixing crops and crop residues: Tier 1b with default IPCC input parameter Grazing animals: default EF Indirect due to volatilisation: Volatilisation of NH_3 from synthetic fertiliser and animal wastes taken from NH_3 inventory (CORINAIR emission factors, based on quantitative information, manure management practices and synthetic fertiliser types). NO_x emissions are assumed to be negligible. Indirect due to leaching and run-off: national value for FracLEACH (10%), based on estimates of the nitrogen loads in Irish rivers under the OSPAR convention suggesting that 10% of all applied nitrogen in Ireland is lost through leaching.
Italy	Crop residues: all burned crop residues are considered: residues from cereal production reported in cat 4.D, residues removed, collected and burnt on open fields (olives and vineyard residues) in sector 6 (response to centralised review of 2004 submission)
Luxembourg	
Netherlands NIR 2005, p. 6-9 f	Country-specific activity data on N input to soil and NH_3 volatilisation during grazing, manure management and manure application. Most of these data are estimated on a Tier 2 level (or higher). Country-specific EFs for direct N_2O emissions and emissions from animal production. Synthetic fertiliser: distinction between organic and inorganic soils and between ammonium phosphate/sulphate and other synthetic fertiliser. Manure: distinction between organic and inorganic soils and between manure application methods. Histosols, crop residues, and N-fixing crops: Tier 2 Indirect due to volatilisation: Tier 1, country-specific data on ammonia volatilisation Nitrogen leaching and run-off: Tier 1

Portugal NIR 2004, p. 249-266	Manure: only manure managed in solid systems, from all animal species, are assumed to be applied on soils. Therefore the equation introduces a 'fraction of manure-nitrogen used as fertilizer'. The equation splits also the volatilisation fraction into 'volatilisation during housing and storage' and 'volatilisation upon application' (calculated using CORINAIR methodology). FracGASM in Table4.D corresponds to the volatilisation upon application. Crop residues: includes annual crops, permanent crops, carob production. Tier 1b methodology with mostly IPCC default and some national parameters. Indirect due to volatilisation: considered volatilised of NH_3+NO_x from housing, storage, and excretion of manure during grazing, and application of manure and synthetic fertiliser. Nitrogen leaching and run-off: quantity of nitrogen volatilised as NH_3+NO_x subtracted before applying FracLEACH. No estimation of emissions from histosols and sewage sludge, which are considered minor.
Spain NIR 2005, p. 130-131	Crop residues: national methodology Grazing animals: N contained in manure calculated as described for cat. 4B(b) Indirect due to volatilisation: FracGASF is the value of NH_3 and NO_x calculated in the inventory Nitrogen leaching and run-off: FracLEACH of 15% used
Sweden NIR 2005, p. 137-143, 154-155	Synthetic fertilizer: correction for FracGASF - statistics on sold fertiliser. The fertiliser sales values are however a bit higher than the estimated use of fertilisers (e.g horticulture). National EF (Klemedtsson, 2001) of 0.8%. Manure: correction for FracGASM; Grazing period considered in the equation FracGASM estimated by Statistics Sweden and Swedish EPA. The estimates are model-based and take into account many factors that influence gas emissions. National EF (Klemedtsson, 2001) of 2.5%. Sewage sludge: included in inventory with FracGASM of 30%; differentiation between direct and indirect emissions of N_2O. Nitrogen fixing crops: national value for N-fixation (fraction of yield: 0.047) Lay land (N-fixing crops): based the amount of leguminous crops in lay land (Nfixing factor) by county, calculated by a model NPK-FLO Crop residues: IPCC GPG methodology with national values for the fraction of crop residue to crop product and nitrogen content in crop residues. Background emissions: also for mineral soils (national EF=0.5 kg N_2O-N/ha), for organic soils default EF Grazing animals: Nitrogen lost as ammonia is excluded; in consistency to the calculation of indirect emissions. Default EF except cattle: weighted EF of 1.8% (manure on permanent grassland (20%) and temporary grassland or fertilised arable land (80%)) Indirect due to volatilisation: FracGASF based on Corinair methodology; FracGASM national; FracGASG included: fraction of manure from grazing animals emitted as ammonia. Nitrogen leaching and run-off: SOILNDB model, which is part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). By using national data on crops, yields, soil, amount of used fertilisers and/or manure and spreading time, the leaching is estimated for 22 regions. These regions are based on similarities in agricultural production. LEACHFACTOR is estimated as 27 kg N/ha for 1990-1997 and 23 kg N/ha since 1999. 1998 interpolated. Implied FracLEACH depends on sum of nitrogen in fertiliser
United Kingdom NIR 2004, p. 94-96	All categories considered, IPCC default factors. Nitrogen-fixing crops: includes contribution from improved grass (4 kg N/ha/year)

Table 6.33: Activity data for the calculation of N_2O emissions from agricultural soils

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off	Other 1 1)	Other 2 1)	Other 3 1)
	Direct						Indirect		Other		
Austria	97	92	20	23	NO	22	32	71	2		
Belgium	151	135	22	3502	25200	87	52	53	0		
Denmark	197	182	32	53	18440	30	78	164	8	4	
Finland	159	43	1	26	293000	17	29	37	1		
France 2)	2051	866	5244	46587	NO	786	601	1244	NA	32	NA
Germany	1788	909	0	NA	1413326	196	495	718	NO		
Greece	220	38	24	4378	6665	364	107	197			
Ireland	359	140	0	19		289	94	83			
Italy	745	395	4177	17288	9000	173	403	495			
Luxembourg											
Netherlands	291	309	5	35	231000	93	110	743			
Portugal	110	82	56	4508	NO	57	56	81			
Spain	1100	290	54	106	NO	346	359	311	13	17	
Sw eden	180	68	116	11470	240000	39	39	61	1	2	1
United Kingdom	1125	391	801	2.23E+10	39200	470	338	583	28		
EU-15	8573	3940	-	-	2275831	2968	2793	4841			

Information source: CRF Table 4.D 2003 submitted in 2005

1) Other: AT(1):Sewage sludge (N from sewage sludge spreading (kg N/yr)) - BE(1):0(Sludge spreading) - DK(1):Industrial waste used as fertilizer((kg N/yr)) - DK(2):Sewage sludge used as fertilizer((kg N/yr)) - FI(1):Sludge spreading(Nitrogen input from sewage sludge applied to soils (kg N/yr)) - FR(1):Overseas territories(0) - FR(2):Sewage sludge spreading (Nitrogen input from sludge applied to soils (kg N/yr)) - FR(3):Cultures

without fertilizers(0) - DE(1):0(0) - ES(1):Municipal Solid Wastes Compost (Nitrogen input from Municipal Solid Wastes Compost applied to soils (kg N/yr)) - ES(2):Domestic Waste Water Sludges (Nitrogen input from Domestic Waste Water Sludges applied to soils (kg N/yr)) - SE(1):Sewage sludge (Use of Sewage sludge (kg N/yr)) - SE(2):Cultivation of mineral soils (Area of cultivated mineral soils (ha)) - SE(3):N-fixation in hayfields (Area or hayfields etc with clover (ha)) - UK(1):Improved Grass(N fixed by improved grassland (kg N/yr))

2) Input of animal wastes reported in Table4.D for France erroneously amount to 999 Gg N. This value has been corrected here. Also, the amount of nitrogen input to pasture, range and paddock in the French inventory excludes the quantity produced in overseas territories, which are included in Table4.B(b)

Table 6.34: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off	Other a [1)]	Other b [1)]	Other c [1)]
	Direct						Indirect		Other		
Austria	1.25%	1.25%	1.25%	1.25%		2.0%	1.00%	2.50%	1.25%		
Belgium	1.25%	1.25%	0.075%	0.019%	5.0	2.0%	1.02%	2.50%	1.25%		
Denmark	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%	1.25%	1.25%	
Finland	1.25%	1.40%	1.25%	1.25%	7.7	1.0%	1.00%	2.50%	1.27%		
France	1.25%	1.25%	0.075%	0.013%		2.0%	0.4%	2.51%		1.98%	
Germany	1.25%	1.25%	2.9		8.0	2.0%	1.00%	2.50%	NO		
Greece	1.25%	1.25%	0.054%	0.007%	8.0	2.0%	1.00%	2.50%			
Ireland	1.25%	1.25%	1.250%	1.250%		2.0%	1.00%	2.50%			
Italy	1.25%	1.25%	0.052%	0.009%	8.0	2.0%	1.00%	2.50%			
Luxembourg											
Netherlands	1.00%	1.78%	1.0%	1.0%	4.7	1.5%	1.00%	0.75%			
Portugal	1.25%	1.25%	0.106%	0.008%		2.0%	1.00%	2.50%			
Spain	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%	1.25%	1.25%	
Sweden	0.79%	2.50%	0.059%	0.007%	8.0	1.6%	1.00%	2.50%	1.17%	0.5	0.4
United Kingdom[2)]	1.25%	1.25%	0.075%	0.024%	8.0	2.0%	1.00%	2.50%	1.25%		

Information on source: CRF Table 4.D 2003 submitted in 2005

2) The Emission Factor used by UK for crop residues has been multiplied by 1000000 to obtain a value which can be displayed

Direct emissions from application of fertiliser. Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands, Sweden and Portugal. Lower N_2O emission rates resulting from the application of nitrogen with inorganic fertilisers and higher N_2O emission rates when applying organic fertilisers are used by Sweden and the Netherlands. Portugal uses lower than the default emission factors for both fertilizer categories. The Swedish EF of 0.8 % is based on a study on N_2O emissions in Sweden and other countries of northern Europe and in Canada[20], supported by a study in Norway suggesting a lower emission factor for emitted fertiliser N than the IPCC default value[21] (SE NIR 2003). The Netherlands distinguish also between mineral fertiliser application on mineral soils and on organic soils, with the EFs being twice as high for the application on organic soils; for the application of manure, differentiation is made between surface spreading and incorporation of the fertiliser. As more nitrogen is locally available if the fertiliser is incorporated into the soil, this application system is assumed to result in higher emissions of N_2O in mineral soils. For organic soils, the same, higher, EF is applied for both application systems (NL NIR 2005). N_2O emissions from the application of organic fertilizer is calculated in the German inventory by applying a mass-flow approach. Emissions are related to the "total ammoniacal nitrogen" (TAN) in animal wastes and the flow of TAN through the production systems is followed by considering the fate of NH_3, N_2O, NO, and N_2O (DE NIR 2005). In Denmark, emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture), which is used to cover both emissions of ammonia, particulate matter and greenhouse gases. Particularly, there is a direct link between the ammonia and N_2O emission inventories (DK NIR 2005). In the Austrian inventory the fraction FracGASM relates to N excreted by livestock and not to the excreted nitrogen left for spreading, as in the inventory submitted in 2004. Also the amount of mineral fertiliser applied is calculated now as the average of two subsequent years in the

[20] Kasimir Klemedtsson 2001. Methodology for estimating the emissions of nitrous oxide from agriculture. Swedish Environmental protection Agency. Report 5170

[21] Laegreid and Aastveit, 2002. Nitrous oxide emissions from field-applied fertilizers. Danish Institute of Agricultural Sciences, Plant Production no. 81 October 2002.

Austrian GHG inventory, and does not correspond to the amount sold in one calendar year (AT NIR 2005).

Direct emissions from crop residues and nitrogen-fixing crops. The values reported in the columns "N-fixing crops" and "Crop residue" are not directly comparable, since the emission factor can be applied either on the amount of dry biomass (pulses and soybeans or other crops, respectively) or on the amount of N input by N-fixing crops or by crop residues. Five Member States are relating the implied emission factor to the amount of nitrogen recycled in crop residues or introduced by nitrogen-fixing crops (Austria, Denmark, Finland, The Netherlands, and Spain). All of them except of the Netherlands use the IPCC default emission factor of 1.25% to estimate N_2O emissions. The Netherlands, which reports in this inventory for the first time N_2O emissions from crop residues as a separate source category, used an EF of 1.0% kg N_2O-N (kg N)$^{-1}$. Eight countries (Belgium, France, Greece, Ireland, Italy, Portugal, Sweden, and the UK) are relating N_2O emissions to the production of dry biomass. The implied emission factors vary between 0.052% kg N_2O-N kg (dry biomass)$^{-1}$ to 0.106% kg N_2O-N kg (dry biomass)$^{-1}$ for nitrogen fixing crops and 0.007% kg N_2O-N kg (dry biomass)$^{-1}$ to 0.024% kg N_2O-N kg (dry biomass)$^{-1}$ for emissions from crop residues[22].

In the German inventory, N_2O emissions from nitrogen fixing crops are reported as an average emission per hectare (2.9) of cultivated crop based on mean nitrogen input factors of 200 kg N ha^{-1} (grass/clover, clover/alfalfa mixtures) and 250 kg N ha^{-1} (alfalfa, leguminous crops) and an emission factor of 1.25% (Daemmgen, 2004[23]). No implied emission factor for N_2O emissions from crop residues are reported in the German inventory.

Direct emissions from the cultivation of histosols. N_2O emissions from the cultivation of histosols are reported as not occurring in Austria, France, and Spain, and as not estimated in Portugal. Also, no emissions from the cultivation of histosols are reported by Ireland, because tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the middle and western part of the country. Consequently, nitrogen inputs due to the cultivation of organic soils have been taken as negligible (IE NIR 2005). The cultivation of histosols represents the biggest share of emissions from agricultural soils in the Swedish (19 %) and Finnish (34 %) inventory and a substantial source for N_2O emissions in Germany (15 % - as large as emission from application of manure) and the Netherlands (6 %), where emissions from histosols are for the first time reported as a separate source category. The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used in most countries. Only Belgium and the Netherlands use 5 kg N_2O-N ha^{-1} and 4.7 kg N_2O-N ha^{-1}, respectively.

On absolute terms, the estimated emissions of N_2O from the cultivation of histosols are largest for Germany (17.8 Gg N_2O), followed by Finland (3.6 Gg N_2O) and Sweden (3.0 Gg N_2O).

Direct emissions from animal production. All countries are reporting N_2O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2% N_2O-N per kg N excreted and year, except of the emission inventories of the Netherlands and Sweden, which use an EF of 1.5% and 1.6%, respectively, and the inventory of Finland using and EF of 1.3%.

Indirect emissions. Almost all Member States report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH_3 and NO_x volatilised and nitrate leached to the groundwater using the default IPCC emission factors. France uses a smaller emission factor for N_2O from volatilised NH_3+NO_x (0.4%) and the Netherlands use a smaller emission factor for N_2O from nitrogen leached or run-off (0.75%).

22 Not considering the emission factor from UK, which is not comparable

23 Ulrich Dämmgen (Hrsg.) (2004). Nationaler Inventarbericht 2004 – Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen – Teilbericht für die Quellengruppe Landwirtschaft. Lanbauforschung Völkenrode FAL Agricultural Research, Sonderheft 260.

Country-specific methodologies, however, are used by most Member States for the calculation of nitrogen volatilisation and nitrate leaching, with only 5 and 3 Member States using the IPCC default values for the volatilisation fractions of mineral and organic fertilizer (FracGASF and FracGASM), respectively, and 6 countries are using the default IPCC values for the leaching fraction (FracLEACH). Belgium does not report the fractions used, and the Netherlands reports the fractions as NE. No N_2O emissions from agricultural soils are estimated by Luxembourg.

While volatilisation of NH_3 and NO_x from the application of mineral fertiliser is considered by all Member States to be lower as the IPCC default values (range of national factors 0.6% to 8.0%), most of the Member States with country-specific volatilisation rates for organic fertiliser are estimating larger losses of NH_3 + NO_x than proposed by the IPCC (range 16% to 36%). The country-specific methodology for the estimation of NH_3 volatilization is in some cases based on the NH_3 inventory using the CORINAIR methodology thus differentiating between different kinds of synthetic fertilisers. Also, model-based estimations for the fraction of nitrogen volatilised from applied animal wastes have been used. An NH_3 model used in Denmark estimates decreasing levels of NH_3 volatilisation in Denmark for the period 1990-2001 with an average volatilisation rate of 28 % (DK NIR 2003). The German inventory includes indirect emissions from volatilizaton of NH_3 and NO_x due to the production of N-fixing crops (DE NIR 2004).

The fraction of nitrogen lost by leaching ranges from 10% to 34% with most national values being smaller than the IPCC default value. They are in some cases based on a nitrogen-leaching model (e.g., Denmark, Sweden) and in some cases based on national studies (e.g., Finland, Ireland). The UK estimate of N_2O emissions via leaching includes a correction to avoid double counting N_2O emitted from mineral fertilizer use (UK NIR 2004).

N_2O emissions from other sources. Six countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in three cases the IPCC default factor for direct N_2O emissions, an equivalent number of Member States used a different value.

Table 6.35: Relevant parameters for the calculation of N_2O emissions from agricultural soils

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAS	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0,31%		3,1%	20%	16%	30%	0,5%	1,5%	34%
Belgium									
Denmark	NO	NO	2,2%	22%	12%	34%	NE	NE	26%
Finland	NE		0,6%	31%	22%	15%	0,8%	4,2%	43%
France	NA	NA	10%	20%	28%	30%	CS	CS	CS
Germany			5,7%	29%	15%	30%	NA	NA	NA
Greece	10%		10%	20%	88%	30%			
Ireland			3,9%	17%	63%	10%	as GPG	as GPG	as GPG
Italy	10%		10%	31%	25%	30%	3,0%	1,5%	45%
Luxembourg									
Netherlands	NO	NO	NE	NE	NE	NE	NE	NE	NE
Portugal	6%		6%	16%	27%	30%	1,3%	2,2%	72%
Spain	NA		7,3%	36%	NA	15%	NA	NA	NA
Sweden	NO	NO	1,1%	33%	29%	21%	1,0%	2,0%	20%
United Kingdom			10%	20%	52%	30%	3,0%	1,5%	45%

Information on source: CRF Table 4.D 2003 submitted in 2005

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.35). This was most significant for indirect emissions from volatilisation of NH_3+NO_x (-24%), followed by indirect emissions from leaching and run-off (-15%) and application of synthetic fertiliser (-16%). In the latter two cases, the reduction of emissions can be explained by a reduction of nitrogen input, as the implied emission factor was not changing during the reporting period. For indirect emissions from volatilization, the decrease in the nitrogen input was further accentuated by a reduced implied emission factor of 0.87% in 2003 versus 0.99% in 1990. Here, the decrease is due solely to France, which used for the 1990 inventory the default emission factor of 1%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 6%, caused by a doubling of the implied emission factor for this source in the Netherlands during 1990 to 2003.

Table 6.36: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor at EU-15 level in 2003 and 1990 and changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N2O [Gg N2O-N]	197	84	28	99	50	198
Total Nitrogen input [Gg N]	10200	4332	2365329	3204	3193	5793
Implied Emission Factor [kg N2O-N / kg N]	1.23%	1.24%	0.00%	1.97%	0.99%	2.18%

2003	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N2O [Gg N2O-N]	166	84	27	92	38	170
Total Nitrogen input [Gg N]	8573	4073	2275831	2968	2793	4841
Implied Emission Factor [kg N2O-N / kg N]	1.23%	1.31%	0.00%	1.98%	0.87%	2.23%

2003 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N2O	84%	100%	96%	93%	77%	86%
Total Nitrogen input	84%	94%	96%	93%	87%	84%
Implied Emission Factor	100%	106%	99%	100%	87%	103%

Source of information: Tables 4.D for 1990 and 2003, submitted in 2005

6.3.6 Agricultural soils (CH_4) (CRF source category 4.D)

For 2003, CH_4 fluxes have been calculated in three countries (Table 6.36). The methodologies are summarized in Table 6.37.

Table 6.37: CH_4 Emission from agricultural soils

Member States	D. Agricultural Soils (1)	1. Direct Soil Emissions	2. Animal Production	3. Indirect Emissions	4. Other (please specify)
Austria	0.43	NA	NA	NA	0.43
Belgium	4.90	4.73	0.17	NE	
Denmark		NE	IE	NE	
Finland		NE	IE	NE	
France					
Germany	-30.2	IE	NO	NO	-30.17
Greece		NE	NE	NE	
Ireland					
Italy		NO	NO	NO	
Luxembourg					
Netherlands		NO	IE	NO	
Portugal		NE	IE	NE	
Spain					
Sweden	IE	NA	IE	NA	NA
United Kingdom		NE	NE	NE	

NA: Not Applicable - NE: Not Estimated - NO: Not Occurring - IE: Implied Elsewhere

Information on source: CRF Table 4.D 2003 submitted 2005

Table 6.38: Member State's background information for the calculation of CH_4 emissions in category 4.D

Member State	
Austria NIR 2005, p. 218-231	Based on average carbon content of sewage sludge (300 kg / ton), from which 52% are volatilized, and 5% thereof as CH_4.
Belgium NIR 2005, p. 60-64	CH_4 fluxes: Flanders: two sources (wetland and surface waters) and one sink (consumption by forest soils, agricultural soils, and grasslands). The same emission (of 2000) has been used for the entire time-series. In the future efforts will be done to obtain more accurate data for the complete time-series.
Germany NIR 2005, p. 6-23 - 6-30	Emissions of CH_4 fluxes from agricultural soils are calculated on the basis of Boeckx and Van Cleemput (2001) with an uptake of CH_4 in grassland soils of 2.5 kg ha^{-1} a^{-1} CH_4 and in arable soils of 1.5 kg ha^{-1} a^{-1} CH_4

6.3.7 EU-15 uncertainty estimates

Table 6.39 shows the total EU-15 uncertainty estimates for the sector 'Agriculture' and the uncertainty estimates for the relevant gases of each source category. The highest uncertainty was estimated for N_2O from 4.D and the lowest for CH_4 from 4.A. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 6.39: EU-15 uncertainty estimates for the sector 'agriculture'

Source category	Gas	Emissions 2003 1)	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
4.A Enteric fermentation	CH_4	130,748	129,813	99%	12%
4.B Manure management	CH_4	61,967	60,642	98%	17%
4.C Rice cultivation	CH_4	2,205	1,657	75%	38%
4.D Agricultural soils	CH_4	-521	-530	102%	127%
4.F Field burning	CH_4	107	42	39%	54%
4.B Manure management	N_2O	21,873	17,056	78%	93%
4.D Agricultural soils	N_2O	197,455	194,370	98%	84% - 195%
4.F Field burning	N_2O	369	15	4%	54%
Total Agriculture	**all**	**414,427**	**403,063**	**97%**	**41% - 74%**

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some countries 2002 data and for Belgium 2001 data

6.4 Sector-specific quality assurance and quality control

As a first activity of a project on the comparison of methods used by Member States for emission calculations and emissions projections, lead by JRC, 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.

Regarding the quality of national greenhouse gas inventories for the agricultural sector, the participants of the workshop expressed concern in the areas of the consistent assessment of the nitrogen balance in agricultural livestock production systems (source category 4.B), the quality of CH_4 emission estimates from enteric fermentation (source category 4.A), and the comprehensive treatment of greenhouse gas emissions from agricultural soils (source category 4.D). The workshop recommended, amongst other, to continue the exchange of experience between countries, to coordinate the input of MS into the revision of the IPCC Guidelines, and to involve European research projects. It was decided to focus on category 4D due to its dominant role in the total uncertainty of European GHG inventories.

Therefore, an expert meeting of the working group on "improving the quality for greenhouse gas emission inventories for category 4.D" was held in October 2004 at the Joint Research Center in Ispra, Italy with the participation of experts from 14 countries and six international organizations / projects.

The objectives of the workshop were:

- To assess the current state of reporting of emissions from agricultural soils;
- To highlight gaps in the availability of data;
- To report on national activities for the generation of national emission factors and other parameters;
- To discuss the link between different source categories in agriculture and with the inventory for ammonia emissions;
- To discuss the use of Tier 3 approaches (process-based models);
- To make recommendations to improve comparability, transparency and completeness of reporting of N_2O emissions from agricultural soils.

The workshop's participants formulated general recommendations for the improvement of the quality of greenhouse gas emission inventories for category 4.D as well as a series of specific recommendations, directed both at European Member States in order to improve GHG inventories under the current Guidelines and suggestions beyond the current guidelines addressing the IPCC process for revision of the Guidelines. The recommendations of the workshop, the minutes, the Ppresentations and additional information can be found in the internet at:
http://carbodat.ei.jrc.it/ccu/pweb/leip/home/ExpertMeetingCat4D/index.htm.

6.5 Sector-specific recalculations

Table 6.40 shows that in the agriculture sector the largest recalculations in absolute terms were made for N_2O in years 1990 and 2002, in relative terms, largest recalculations were made for CO_2. Also CH_4 emissions were recalculated in both years.

Table 6.40 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 4: 'Agriculture', for 1990 and 2002 by gas (Gg and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
Agriculture	-3.208	-100,0%	-8.322	-3,7%	17.157	7,4%	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
Agriculture	-2.057	-100,0%	-5.646	-2,8%	11.140	5,3%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 6.41 provides an overview of Member States' contributions to EU-15 recalculations. Germany was mainly responsible for the CH_4 emission recalculations. For N_2O Germany had the largest recalculations, but France, Greece (for 1990) and the Netherlands also had large recalculations.

Table 6.41 Contribution of Member States to EU-15 recalculations in CRF Sector 4: 'Agriculture' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2002					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	10	3	NO	NO	NO	0	19	132	NO	NO	NO
Belgium	0	-11	-918	NO	NO	NO	0	-100	-304	NO	NO	NO
Denmark	0	10	9	NO	NO	NO	0	10	-7	NO	NO	NO
Finland	-3,208	16	21	NO	NO	NO	-2,057	17	68	NO	NO	NO
France	0	-1,101	3,568	NO	NO	NO	0	-787	3,052	NO	NO	NO
Germany	IE	-6,613	5,766	NO	NO	NO	IE	-5,377	5,157	NO	NO	NO
Greece	0	-176	3,239	NO	NO	NO	0	-129	-525	NO	NO	NO
Ireland	IE	0	424	NO	NO	NO	IE	0	449	NO	NO	NO
Italy	0	297	-48	NO	NO	NO	0	603	-122	NO	NO	NO
Luxembourg	-	0	0	NO	NO	NO	-	0	0	NO	NO	NO
Netherlands	0	-321	4,759	NO	NO	NO	0	508	2,874	NO	NO	NO
Portugal	0	-79	288	NO	NO	NO	0	-63	329	NO	NO	NO
Spain	0	0	-12	NO	NO	NO	0	-23	37	NO	NO	NO
Sweden	IE	0	0	NO	NO	NO	0	0	0	NO	NO	NO
UK	0	-355	57	NO	NO	NO	0	-324	0	NO	NO	NO
EU15	**-3,208**	**-8,322**	**17,157**	**NO**	**NO**	**NO**	**-2,057**	**-5,646**	**11,140**	**NO**	**NO**	**NO**

NO: not occurring; IE: included elsewhere

Explainations for recalculations of more than 1000 Gg of CO_2 equivalents are given in table 6.42. Explainations for most recalculations are provided in section 10.1.

Table 6.42: Main reasons for recalculations > 1000 Gg of CO_2 equivalents in CRF sector 4 'Agriculture'

FI	CO_2	4.D: Removal: CO_2 emissions are included under cropland and grassland in LULUCF sector
FR	CH_4, N_2O	4.B: Method: distribution of manure management systems previously used have been modified according to French data
DE	CH_4	4.B.1(Other Cattle), 3,6,8: Activity data: figures 2002/2003 have been updated due to new information of animals in Hamburg, Bremen, Berlin 4.B.1(Dairy cows): Activity data: total recalculation from 1990 until 2002 4.B.1: Emission factors have been recalculated from 1990 until 2003 due to wrong factors for pasture range and paddock
DE	N_2O	4.D: see tables 10.1 and 10.2
GR	N_2O	4.D (1990): Activity data: Updated data on fertilizers consumption; Addition/removal/replacement: Cultivation of Histosols
NL	N_2O	4.D: Now includes indirect emissions; Methods: new; Activity data: improved data; Emission factors: improved data; Addition (2002): direct emissions from Histosols and crop residue

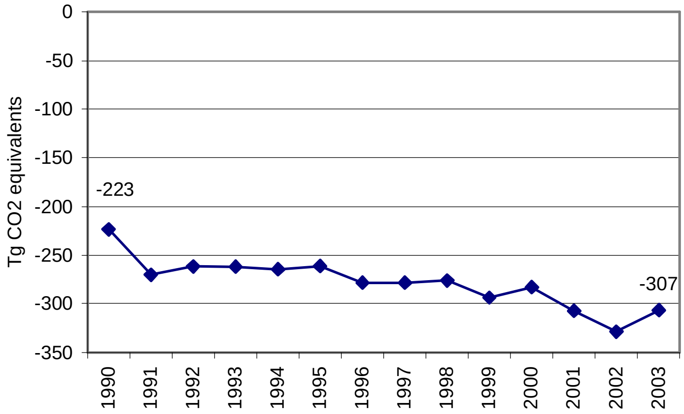
7 LUCF (CRF Sector 5)

This chapter starts with an overview on emission removal trends in CRF Sector 5 'LUCF'. Sections on methodological issues and uncertainty, sector-specific QA/QC and on recalculations are also provided.

7.1 Overview of sector

CRF Sector 5 'LUCF' is both a source and a sink of GHG emissions. In 2003, net GHG emissions from LUCF (emissions minus removals) were -307 Tg in the EU-15 (Figure 7.1). They decreased by 37 % from 1990 to 2003 and increased by 4 % from 2002 to 2003. Net GHG emissions from LUCF have been below 1990 levels for the past decade.

Figure 7.1 EU-15 net GHG emissions (emissions minus removals) for 1990–2003 from CRF Sector 5: 'LUCF' in CO_2 equivalents (Tg)



Sector 5 is an overall sink of greenhouse gases for all Member States except the Netherlands and Portugal (Table 7.1). Italy, Germany and France account for the largest removals in absolute terms; large changes between 1990 and 2003 occurred in Spain. Italy and France. The United Kingdom and Denmark turned from net emissions in 1990 to net removals in 2003.

Table 7.1 Member States' contributions to net GHG emissions from CRF Sector 5: 'Land use change and forestry'

Member State	Greenhouse gas emissions/removals (Gg CO_2 equivalents)			Change 2002-2003		Change 1990-2003	
	1990	2002	2003	(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	-9.013	-11.311	-12.773	-1.462	13%	-3.759	42%
Belgium	-3.103	-3.980	-3.359	621	-16%	-256	8%
Denmark	158	-1.476	-1.204	271	-18%	-1.363	-861%
Finland	-22.749	-15.475	-17.782	-2.307	15%	4.967	-22%
France	-33.137	-54.531	-52.574	1.957	-4%	-19.437	59%
Germany	-73.250	-76.704	-77.050	-345	0%	-3.800	5%
Greece	-3.193	-5.456	-5.529	-72	1%	-2.335	73%
Ireland	-407	-978	-981	-3	0%	-574	141%
Italy	-60.726	-95.746	-81.828	13.917	-15%	-21.102	35%
Luxembourg	-273	-273	-273	0	0%	0	0%
Netherlands	2.894	2.759	2.761	2	0%	-134	-5%
Portugal	6.058	-1.208	7.076	8.284	-686%	1.018	17%
Spain	-9.033	-36.395	-40.118	-3.723	10%	-31.085	344%
Sweden	-20.292	-26.541	-21.499	5.042	-19%	-1.207	6%
United Kingdom	2.662	-1.470	-1.522	-51	3%	-4.183	-157%
EU15	-223.404	-328.787	-306.658	22.129	-7%	-83.254	37%

Overall, for the EU-15, the Sector 5 removes 7 % of the total emissions (without LUCF). The equivalent shares of the Member States range from – 0.2 % (United Kingdom) to –30.5 % (Sweden) (Table 7.2, column a). In the Netherlands and Portugal, the sector gives a contribution to the total emissions respectively by 8.7 % and 1.3 %.

Table 7.2 Contribution of Sector 5 (a) and Category 5.A (b) to total emissions (without LUCF) and Member States contribution to EU-15 Sector 5.A(c)

Member State	Sector 5 over total emission excluding LUCF (a) (%)	Category 5.A over total emissions (b) (%)	Member States contribution to EU-15 total for Sector 5.A (c) (%)
Austria	-13,9%	-13,9%	3,7%
Belgium ([1])	-2,3%	-2,3%	1,0%
Denmark	-1,6%	-4,8%	1,0%
Finland	-20,8%	-25,0%	6,2%
France	-9,4%	-11,8%	19,1%
Germany	-7,6%	-7,7%	22,7%
Greece	-4,0%	-4,0%	1,6%
Ireland	-1,5%	-2,0%	0,4%
Italy	-14,4%	-14,0%	23,3%
Luxembourg	-2,4%	-2,6%	0,1%
Netherlands	1,3%	-1,1%	0,7%
Portugal	8,7%	6,6%	-1,5%
Spain	-10,0%	-10,0%	11,7%
Sweden	-30,5%	-35,8%	7,3%
United Kingdom	-0,2%	-1,5%	2,8%
EU15	-7,3%	-8,2%	100,0%

([1]) Data only from Wallonia which represents 80 % of the forest area of Belgium.

Source: 1: Member States' submissions 2005, CRF Table 5, 5.A and Summary 2.

If only Category 5.A: 'Changes in forests and other wooded land', the largest contributor to Sector 5 inventories and the only one reported by all Member States, is examined (Table 7.2, column b), it is possible to see that the category is a net remover of GHG for all Member States except for Portugal (range 1.5–35.8 %,) and for EU-15 as a total (– 8.2 %). When analysing Category 5.A, it should be considered that the proportion of total land area covered by forests is different in the various Member States, ranging from 8–9 % (Ireland and Netherlands) up to 67 % (Finland and Sweden). EU-15 as a whole has 42 % of its land covered by forests (FAO).

7.2 Methodological issues and uncertainties

As in other sectors, this section of the report is based on data and information from the EU-15 Member States. Therefore, information below is often detailed by countries. It is also important to note that a lot of developments have taken place in the EU-15 countries since the last inventory submission. The improvements include:

- extended use of the new Good Practice Guidance for LULUCF (IPCC 2003)
- more complete category coverage
- estimation of emissions from important pools like soils
- use of improved activity data
- use of improved emission factors
- developments in uncertainty estimation
- improved reporting on methodology.

Due to these improvements, data were recalculated and better estimated in several Member States. The improvements and the current inventory methods are described in the following section, which is followed by an analysis of sources or uncertainties, while recalculations are analysed in Section 7.4.

7.2.1 Methodological issues

Pursuant to relevant regulations, emissions and removals from LUCF of the EU-15 are the sum of Member States' emissions and removals as reported either in the "new" or in the "old" CRF tables[24]. Table 7.3 demonstrates current coverage of emission and removal estimation in the various subcategories. Because of their predominance in both emission levels and reporting frequency, only the methodology for subcategory A and D is detailed below. However, some details for the other categories, and advancements in other respects (including reporting in the new CRF tables) will be discussed in later sections, too.

Table 7.3 Summary of Reporting Categories 5.A through 5.E of the "old" CRF tables by EU-15 Member State

Member State	Reporting category				
	5.A	5.B	5.C	5.D	5.E
Austria	X* (x)	X* (x)			
Belgium	X (x)				(x)
Denmark	X (x)			X (no)	
Finland	X* (x)				
France	X (x)	X (x)	X (x)	X (x)	
Germany	X* (x)			X* (x)	
Greece				X (no)	
Ireland	X (x)			X (x)	
Italy	(x)		(x)	(x)	(x)
Luxembourg	X (x)				
Netherlands	X (x)	X (no)	X (no)	X (no)	X (no)
Portugal	(x)				
Spain	(x)				(x)
Sweden	X (x)			X (x)	
United Kingdom	X (x)	X (x)		X (x)	X (x)

Note: X means that the category is estimated; status in the previous year submission is given in brackets. * means that the data is not submitted by the MS in the "old" tables, rather, in the "new" ones.

Due to the built-in flexibility of the Guidance and the varying conditions within the various countries, different methodologies were used with regard to data collection methods, definitions and conversion factors. Table 7.4 provides a summary of some methodological issues related to reporting of greenhouse gas emissions and removals (limited to CO_2 in current CRFs under Category 5.A). It can be seen from the tables (and also from the fact that some countries developed their estimates in the "new" CRF tables, see Section 7.3.1) that countries made an increased effort to apply the new GPG for LULUCF.

[24] The term "new" refers to CRF tables prepared based on document UNFCCC/SBSTA/2004/8, and "old" refers to CRF tables that have been in use for the last years. Note that all MS, except for Germany, submitted data in the old CRF tables, and data in the new CRF tables of Germany were converted to the old tables when calculating the EU estimates.

Table 7.4 Summary of methodological issues for Reporting Category 5.A by EU-15 Member State

Member State	Method (1)	Emission factors (2)	Estimate completeness (3)	Quality (4)
Austria	T3 (D)	CS (CS)	Partly (Partly)	High (High)
Belgium	D (D)	CS (CS)	NE (Partly)	NE (NE)
Denmark	CS/T2/D (NE; D)	D/CS (NE; CS)	Partially (NE)	NE (NE)
Finland	T3 (CS)	CS (CS)	Partially (All)	Medium (Medium)
France	CS (CS)	CS (CS)	All (All)	Low (Low)
Germany	CS (CS)	CS (CS)	All (All)	Medium (Medium)
Greece	D,CS,T1,T2 (D)	CS, D (D)	Partly (Partly)	NE (NE)
Ireland	CS (CS)	CS (CS)	All (All)	Medium (Medium)
Italy	T1, T2 (D, CS)	D, CS (D, CS)	All (Partly)	High (High)
Luxembourg	(C/D)	(C/D)	(NE)	(NE)
Netherlands	T2, CS (T1)	CS (CS)	All (All)	Medium (Medium)
Portugal	D (D)	D+CS (D+CS)	Partly (Partly)	Medium (Medium)
Spain	CS (CS)	CS (CS)	All (All)	Medium (Medium)
Sweden	T2 (T2, CS)	CS (T2, CS)	All (All)	High (High)
United Kingdom	CS (M)	CS (M)	All (All)	Medium (Medium)

Note: Methodology and emission factors codes: D: default IPCC; CS: country-specific; T1, T2: Tier 1, Tier 2; NE: not estimated; M: model.
Forest type code: TF: temperate forest; (P): plantations; BF: boreal forest; TrF: tropical forest; others: other types, generally under temperate.
Information in brackets indicates the status of the previous year submission

Sources: columns (1) and (2): CRF Table Summary 3, sheet 2; columns (3) and (4): CRF Table 7, sheet 2 (IPCC Table 8A), and the NIR. If no information in these sources is provided, than either information from the "new" CRF tables (Sheet Summary3) or the previous years' information is used.

As it can be seen from Table 7.4, most Member States (10 out of 15) are using country-specific or even higher tier approaches, and even more countries use country specific emission factors. This is needed due to the variety of forest types occurring within the EU-15 (boreal, temperate, mediterranean, and also tropical) in order to achieve the accuracy as required by IPCC (2003). For Member States that indicate to use IPCC default methods under column 1, the underlying data sources are in many cases based on national surveys and statistics that can be considered as country-specific.

Eight Member States evaluate their reporting for Category 5.A as complete, four Member States as partly complete, while only three Member States do not provide an evaluation of completeness. The Member States which consider their 5.A inventories to be complete represent 88 % of the net EU-15 5.A emissions (see Table 7.2, column c) so the EU-15 inventory in this category can be considered as complete.

However, it should be mentioned that Member States are calculating their biomass stocks by considering different components which are additional to tree stems and main branches, such as leaf, roots, dead wood and, in some case, understory vegetation. Although these components are considered by appropriate expansion factors, it should be mentioned that differences are present also in these factors.

The evaluation of quality requires more detailed analysis by country. The quality of the reporting under 5.A is considered high by Austria, Italy and Sweden (Table 7.5, column 4), medium by the majority of Member States (7) and low by France. Belgium, Denmark, Greece and Luxembourg do not provide an evaluation of the quality of their 5.A inventory. Taking into consideration that Member States which contribute to approximately 77 % of the total net EU-15 5.A emissions (see Table 7.2, column c) assessed the quality of their inventories to be from high to medium, hence medium can be then considered as a conservative estimation of the quality of the aggregated EU-15 5.A inventory.

An overview of definitions, data sources and methodologies used by the Member States to produce 5.A inventories is presented in Table 7.5 to 7.6. The data provide a good overview of methodologies and approaches for the Member States.

Table 7.5(a) Overview of methodology used by the Member States: forest definitions

MS	Definition		
	NFI Forest	**forests and other woody biomass (old tables)**	**forest land (new tables)**
Austria	All areas covered by woody plants if these criteria are met: a) minimum area 0.05 ha and b) minimum width >= 10 m and c) minimum crown coverage of 30%. Below only marginal lands (mountain, not relevant), row of trees (except wind belts), nurseries. Afforestation/Reforestation become 'forest' when 30 % is reached (tree/ha reported).		Forest reserves: area assessed, volume estimated (1990, not reported). Areas taken out of production (growing).
Belgium	All areas covered by woody plants if these criteria are met: a) minimum area 0.5 and 0.3 ha, b) minimum width >= 25 and 9 m, c) minimum crown coverage of 20% and 10%, and d) minimum height 3 m for Flanders and the Wallonia Region, respectively	same definition is applied as in NFI	same definition is applied as in NFI
Denmark	The forest is to be or should be planted with tree-species which can develop on the location into high trees with stems, that would say at least, to the height of 6 m; the area should be more than 0.5 ha and wider than 20 m (at least on average)	Areas taken out of production.	
Finland	Forestry land is grouped into three classes according to site productivity: *forest land* , where the potential annual increment is at least 1.0 m3/ha; *scrub land* (*unproductive forest land*), is mainly exposed bedrock and scree or mires, where the potential annual increment is below 1.0 m3/ha but over 0.1 m3/ha; *waste land* , unless naturally treeless, producesless than 0.1 m3/ha	includes forest and other wooded land FAO definition	includes forest and other wooded land FAO definition
France	Either: mesaured trees (diameter > 7.5 cm) have a crown cover percentage at least 10% or there are more than 500 stems per ha that are viable trees (seedlings, plants or shoots, vigorous, well shaped and regularly distributed. Minimum area: 5 acres (2.02 ha) (0.05), minimum average width 15 m. definition by IFN 2004.		
Germany	Forest within the meaning of the FFI is any area of ground covered by forest vegetation, irrespective of the information in the cadastral survey or similar records. The term 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. Areas with forest cover in open pasture land or in built-up areas of under 1000 m², coppices under 10 m wide and the cultivation of Christmas trees and ornamental brushwood as well as parkland attached to country houses are not forest within the meaning of the FFI. Watercourses up to 5 m wide do n		same definition is applied as in NFI
Greece	includes: (a) areas larger than 0.5 ha or strips more than 30 m wide with tree crown cover (stand density) of more than 10% of the area, or areas with 250 trees of reproductive age per hectare, able to produce wood or other products or services and are not used for any other land-use (b) areas where trees are removed to below 10% of stand density and are not given for other land-use (c) reforested areas and (d) scrublands (areas covered by broadleaved evergreens).		includes forest and other wooded land FAO definition
Ireland	All areas covered by woody plants if these criteria are met: a) minimum area 0.5 ha and b) minimum width >= 40 m and c) minimum crown coverage of 30% (20) and d) minimum height 2 m e) minimum potential production of 2 -4 m3/ha/yr	only forest land	only forest land

Table 7.5(b) Overview of methodology used by the Member States: forest definitions

MS	Definition		
	NFI Forest	**forests and other woody biomass (old tables)**	**forest land (new tables)**
Italy	Forest area: a territory with one or more of the following characteristics: -) purpose to wood or non-wood goods production currently regarded as forestal; -) contain tree or bush stands with direct or indirect function of protection; -) contain spontaneous tree or bush stands with naturalist, scenic or recreation function. Included are also areas temporarily without a stand because cutting or exceptional occurence. Not included: city parks, gardens, botanical gardens and other areas with only aesthetic function. Likewise not considered: forest nurseries, fruit cultivation of walnut and filbert, manna ash stands, carob tree stands and every fruit tree stands. Excluded are also the tree rows and scattered trees in agricultural territory and along the roads. the minimum size is 2000 m2, the minimum width is 20 m and the minimum crown coverage is 20%.		includes forest and other wooded land FAO definition
Luxembourg	All areas covered by woody plants if these criteria are met: a) minimum area 0.5 ha and b) minimum crown coverage of 10% and c) minimum height 5 m		
Netherlands	Land with tree crown cover (or equivalent stocking level) of more than 20% and area of more than 0.5 ha. Trees should be able to reach a minimum height of 5 m at maturity in situ. Furthermore, a forest must have a minimum average width of 30 m.	forest land and non-forest trees: forest, trees outside forests and dead wood	forest land and non-forest trees and heather
Portugal	Area greater than 0.2 ha and more than 15 m wide. Includes exploitable forest grounds temporarily deprived of vegetation, and grounds related to forestry (forest roads, nurseries, etc).		
Spain	Minimum area 0,25 ha, minimum crown cover 5% and minimum width 20 m		
Sweden	Forest land is defined as land suitable for forest production, not used for other purposes, and with an average production higher than (or equal to) 1 m3 per hectare and year during a period of 100 years. The minimum area is 0.25 ha.	About 94% of the reported carbon uptake increment originates from trees on Forest land. The remaining parts originate from trees on all other land use classes (Mire, Rock surface, Sub-alpine coniferous woodland, Grazing land, Arable land, Other area) except trees from High mountains in the northwest of Sweden, protected areas (Nature reserves and Military wasteland), and Urban and Industrial land	
United Kingdom	the minimum woodland area to be considered as forest area is 2 (0.1) ha. In general the minimum width for a woodland is 50 (16) m. Areas of scattered trees with distinct crowns constitute of woodland if the canopy covers more than 20% of the ground.	only forest lands that show an increment in carbon stocks	

Table 7.6 Overview of methodology used by the Member States: data sources

MS	Data sources			
	forest area	increment	harvest	other loss
Austria	NFI	Applying allometric relationships at two NFI dates results in increment data by difference	NFI, Austrian record of felled wood and Austrian wood balance.	NFI
Belgium	regional forest inventories	regional forest inventories	regional forest inventories and model	
Denmark	Currently: Forestry census	Currently: Forestry census	Drain data from thinning statistics and harvesting.	not
Finland	NFI	measured annually in NFI. Difference in volume of the tallied trees between five years (average sink).Trees with diameter < 2.5 cm, not inventoried may account for 1–2 % of the increment. measured in representative plots	NFI, MTT Agrifood Research Finnland, published literature	NFI
France				
Germany	NFI	NFI	NFI	NFI
Greece	NFI	NFI	national statistics	fire and illegal logging
Ireland	Forest Inventory and Planning System (FIPS)	Irish yield models (Hamilton et al, 1971 and Forest and Wildlife Service, 2000)	Coillte records (Coillte, 2001) compiled through the company's timber sales reporting system.	not
Italy	NFI	Growth rate based on a dynamic model starting from NFI in 1985.	Harvesting data: national statistics ISTAT.	by fire derived by burned forest surface statistics of CFS
Luxembourg				
Netherlands	national statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling), land use maps	national statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling), land use maps	national statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling)	national statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling)
Portugal				
Spain				
Sweden	NFI. Land use conversions can potentially be traced by permanent sample plots.	Increment obtained as five-year average data from NFI	National Board of Forests (using comsumption studies and expert judgement)	National Board of Forests (using comsumption studies and expert judgement)
United Kingdom	Planting rate from Forestry Commission.	net removals: growth, biomass in new plantations, timber.	net removals: growth, biomass in new plantations, timber.	not

Table 7.7(a) Overview of methodology used by the Member States: methodological issues

MS	growing stock definition in NFI	fraction of biomass included in "living biomass"	Annual values	Conversion and Expansion Factors, Biomass Function	Uncertainties
Austria	starting from ground: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 5 cm	above and belowground woody biomass	Increment 'indices' to weight average increment, calculated from 1200 spruce cores. Average of five years from NFI. No projection of increment (need for relevant recalculation).	Working on stratification of BEFs (age and diameter). Coarse root included	Uncertainties analysis provided for forest biomass changes
Belgium	wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 7 cm	above and belowground woody biomass	models	average values of neighbouring countries	not estimated
Denmark	starting from stump: wood volume of the stem over bark until 5 cm of diameter of all trees with diameter at brest height >= 5 cm	above and belowground woody biomass	From averages of increment reported by forest owners.	BEF changed compared to 1999 communication. BEF based on literature from studies in similar conditions (Germany, Belgium). Stem, no branches, no stump. Starting diameter is 5 cm.	not estimated
Finland	starting from stump: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at brest height > 0 cm	above and belowground woody biomass	Average of previous NFI period.	Tendency to work with Biomass functions. Study on BEF ready by 2004–05, including below ground. National conversion factors (currently site and age independent, but will use age and site dependent values later)	not estimated (but work is under way)
France	starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 7 cm				
Germany	starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 7 cm	above and belowground biomass	linear interpolation	CS wood density for stem and branches by species; CS tree-level species and age specific volume expansion factor; stand-level D (but verified) root-shoot ratio	relative standard errors are given for total biomass, but for volume stock, conversion and expansion factors
Greece	starting from stump: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 10 cm	above and belowground biomass	Average of previous NFI	IPCC default	not estimated
Ireland	starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 7 cm	above and belowground woody biomass	periodic current annual increment by Irish yield models (Hamilton et al, 1971 and Forest and Wildlife Service, 2000)	BEF value was reviewed by COFORD and was revised to a weighted value of 1.64 for all tree species in 2003 (corresponding 2.0 for the young tree category and 1.4 for the mature tree category).	not estimated

Table 7.7(b) Overview of methodology used by the Member States: methodological issues

MS	growing stock definition in NFI	fraction of biomass included in "living biomass"	Annual values	Conversion and Expansion Factors, Biomass Function	Uncertainties
Italy	starting from stump: wood volume of the stem over bark until 3 cm of diameter of all trees with diameter at brest height >= 3 cm	above and belowground woody biomass	From functions based on NFI and volume development.	national BEF's by ISAFA	
Luxembourg					
Netherlands	starting from ground: wood volume of the stem over bark until 5 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 5 cm	above and belowground woody biomass	national statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling)	national aspecific value	not estimated
Portugal	starting from stump: wood volume of the stem over bark until 7.5 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 7.5 cm				
Spain	starting from ground: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 5 cm				
Sweden	starting from stump: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at brest height > 0 cm	above and belowground woody biomass, needles	Annual data from the NFI. The harvest figures are based on consumption studies performed by the National Board of Forestry. Land use conversions can potentially be traced by permanent sample plots	Expansion factors for the conversion of estimates of volume to biomass are based on standing stock data. The biomass per fraction (stem including bark, branches and needles, stump and root system) is estimated by applying Marklunds biomass functions to sample trees of the NFI. The corresponding volume is estimated by functions from Näslund (growth is estimated by functions from Svensson). The developed expansion factors are applied to both estimates of volume growth and harvested volume	not estimated
United Kingdom	starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at brest height >= 7 cm	above and belowground woody biomass, leaves	Modelled values.	Model with allocation.	uncertainty analysis includes more sources than in last year

7.2.2 *Source and extent of uncertainties*

The above section shows that, to estimate LUCF emissions and removals, EU-15 Member States use different methodologies, in accordance with the IPCC guidelines and the new GPG for LULUCF. Due to lack of data for many elements of the entire estimation procedure, however, it is only possible to give an overview of the sources of uncertainty for the EU-15 LUCF inventory in a few countries. For Category 5.A in particular, Germany estimated a relative standard deviation of 8.2% and 12.8% for the old and new "Bundesländer", respectively, for 1993, and 7.7% and 10.1% for 2002.

Some countries report quantitative estimates of uncertainty in terms of the percentage standard errors with regard to the data sources used in the 5.A inventories. A recent review (Laitat et al, 2000) provides more detailed data on the national forest inventories of 12 Member States. The following ranges were found:

- 0.2–1.2 % (3–15 % for UK) for forest area (9 Member States);
- 0.54–5.1 % (1–15 % for UK) for wood volume (10 Member States);
- 0.4–0.8 % for volume growth (3 Member States).

Several countries reported developments in uncertainty estimation. However, until further data are not available, it is important to identify factors that contribute to the overall uncertainty. Below is a more detailed analysis that provides additional information on sources and ranges of uncertainty.

Uncertainties linked to forest area definitions

- Errors in forest area estimation are in the order of 1 to 10 %.
- The forest definition differ in Member States with regard to threshold of crown cover, area dimension and/or using a productivity index. However, many definitions are compatible with the one by FAO.
- In some countries, different land-cover data sources provide different estimates of total forest area.

Uncertainties linked to activity data

- More countries use updated forest inventory data than in the previous submissions. In several countries, forest inventories are based on representative sampling, where the uncertainty can be and, indeed, is estimated, and is generally low.
- Harvest statistics are usually less certain, however, their quality is improving, too. Sweden uses periodic averages instead of annual data to decrease large interannual variation due to turbulent markets, which can also decrease the uncertainty for individual years.

Uncertainties linked to national forest inventories (NFI)

- Errors in volume and growth increment estimates in NFI are generally within 1–5 %.
- Volume calculations may start from different diameter thresholds in different countries, ranging from 0 to 7 cm. The overall impact of this on the volume estimation is expected to be minor.
- Volume and yield functions may sometimes be old. However, more and more countries try to base their estimates on field measurements. The use of old models may result in an underestimation of current volume/growth, as is the case in Germany where the latest forest inventory revealed that measured increment was more than double of the one that had been expected using yield tables. Austria, Sweden and [Italy] also updated their forest inventory estimates, including those of forest area.

Uncertainties linked to calculation of stocks increment

- There are different approaches to calculate the stocks increment, from the IPCC defaults (growth-harvest) to difference from consecutive surveys. As an example, Sweden has estimated the standard error of removals (10%) and of harvests (5-25%). Germany estimated the relative standard error or merchantable volume (“Derbholzvorrat”, 1.4-40.0%), depending on species.

- The errors in the estimation of ‘removals’ values obtained with different approaches are: growth-harvest, error: 20 %; differences in state (e.g. two subsequent NFIs), error: 13 %; combined estimation, error: 11 %; Change estimation aided by remote sensing, error: 10 %.
- Reports to the UNFCCC have to be performed annually, even if most of the Category 5.A data are estimated periodically. Different uncertainty is related to the different approaches (e.g. annual values versus simple or moving averages, use of indicators, etc.). There are indications that the use of simple averages or interpolation between sampling years/periods of inventories may lead to significant errors, making it necessary to perform *ex-post* recalculation when new data became available.

Uncertainties linked to harvest/drain statistics

- The uncertainty linked to different statistical sources is potentially higher than the one of forest inventories, but mostly unknown. Problematic areas are: reliability of market statistics, fuelwood, local use and export/import of wood. However, several countries directly measure the amount of wood that is removed from the forest, which is then produces more reliable estimates.
- Not all annual statistics include the effects of major disturbances on forest stocks. If disturbances are occurring between two NFIs, there could be inconsistencies in annual reporting when using interpolated/averaged data.

Uncertainties linked to expansion and conversion factors

- Differences in conversion factor from dry weight to carbon may occur, but they are not really relevant (low variability/error).
- Wood density data are mostly based on literature, sometimes they are quite variable for the same species in different places and should be updated. Germany estimated the relative standard error of wood density (between 8.7 and 27.2, depending on species).
- The uncertainty related to biomass expansion factors (BEF), used to expand wood stem volume/biomass to total volume/biomass, is mostly unknown, but potentially relevant. Use of volume/biomass functions, dependent on diameter and age class may reduce somewhat this uncertainty. Germany reported relative standard error estimates for volume expansion factor by age and species (between 0.9% and 11.3%, depending on species and age), for root estimation factors (between 19.1 and 59.2%, depending on species groups).
- Most of the countries are using only two expansion factors, one for deciduous and one for conifers. Wood density is generally at species level.
- There are some gaps for BEF, at least in some regions. This may increase uncertainty.
- Not all countries include the same biomass components in their expansion factors.

7.3 Sector-specific quality assurance and quality control

Several MS reported increased efforts of QA/QC. In addition to others, countries with extended forest cover (Finland, Germany, Sweden) reported extended procedures, which ensures the good quality of estimates. These procedures include checking both the forest inventory data, as well as the preparation of the GHG inventory. In addition, several steps were taken with respect to data quality at the EU-15 level (see below).

7.3.1 Experiences with the new CRF tables

COP-9 decided in 2003 that new, more detailed, and restructured CRF tables should be used for reporting in the LULUCF sector. Using these tables is not mandatory this year, rather, countries can try the new tables and gain experience with them. Ten EU-15 Member States submitted the new CRF tables in addition to the old ones (Table 7.8). As the new tables require more detailed reporting, efforts were needed to collect and process necessary data. In some countries, the whole GHG inventory system was restructured, which also ensures higher accuracy. In some cases, however, due to lack of proper data (at least for some inventory years), emissions and removals from land converted to other land is reported under land remaining the same land.

Table 7.8 New CRF tables available from EU-15 Member States by pools reported (DOM=dead organic matter)

Country	New CRF submission	Pools reported		
		Biomass	DOM	Soil
Austria	1990-2003	Y	N	N
Belgium	1990-2003	Y	N	N
Denmark	1990-2003	Y	N	N
Finland	1990-2003	Y	N	N
France	1990-2004	Y	N	N
Germany	1990-2003	Y	N	N
Greece	1990-2003	Y	Y	N
Ireland				
Italy	1990-2003	Y	Y	Y
Luxembourg				
Netherlands	1990-2003	Y	Y	Y
Portugal	1990-2003	Y	N	N
Spain				
Sweden				
United	1990-2003	Y	Y	Y

7.3.2 Other relevant QA/QC activities

Under the intergovernmental framework for European cooperation in the field of scientific and technical research (COST), the EC initiated in 2000 the action ‘Contribution of forests and forestry to mitigate greenhouse effects’ (COST E21) with the objective to exchange experience and knowledge and to improve the quality of GHG inventory compilation for forests in Europe. This action completed its work in 2004. Another action (COST E43) was started in 2004 under the same framework: ‘Harmonisation of national forest inventories in Europe: Techniques for common reporting’ also aiming at improving and harmonising the existing national forest resource inventories in Europe and at promoting the use of scientifically sound and validated methods in forest inventory designs, data collection and data analysis. One specific area of work of COST E43, in which 25 European countries participate, is the harmonised estimation procedures for carbon pools and carbon pool changes.

7.4. Sector-specific recalculations

Table 7.9 shows the extent of recalculations in the LUCF sector by gas for the EU-15 for 1990 and 2002.

Table 7.9 Recalculations of total greenhouse gas emissions and recalculations of net greenhouse gas emissions in CRF Sector 5: ‘LUCF’, for 1990 and 2002 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
LUCF (net)	-122.658	121,4%	-189	-51,3%	-228	-63,1%	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
LUCF (net)	-171.106	107,8%	910	1651,1%	-214	-69,2%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 7.10 provides an overview of Member States' contributions to EU-15 recalculations for the years 1990 and 2002. The 2002 data shows that the recalculations increased emissions for some countries (Denmark, Finland and the Netherlands), while for other countries the removals increased (Austria, Germany, Ireland, Italy, UK). The recalculations were done due to the considerable improvements of the estimation methodology in many Member States, as well as new or improved data. In category 5A, new forest inventory data showed larger growth of volume stocks than expected (Austria, Germany). More specifically, recalculation was done due to the following reasons:

- Estimation of new sources (subcategories): Denmark (where emission and removal estimates for soils were included).
- Use of improved activity data: area of recently planted forest (UK), forest growth (Austria, Germany), harvest statistics (Sweden), rates of change of land use (UK), deforestation estimation (UK)
- Use of new or improved emission/removal factors: soil carbon density (UK), net emission due to disturbance of soil for afforestation (UK), , estimation of root biomass by applying default (IPCC) root/shoot ratios (Germany), replacement of the former conservative estimate of 1.3 of the biomass expansion factor by a weighted value of 1.64 (Ireland).

Table 7.10 Contribution of Member States to EU-15 recalculations in CRF Sector 5: 'LUCF' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2002					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	201	0	0	NO	NO	NO	-3.678	0	0	NO	NO	NO
Belgium	-1.210	-106	-237	NO	NO	NO	-2.166	-102	-226	NO	NO	NO
Denmark	2.990	0	0	NO	NO	NO	2.337	0	0	NO	NO	NO
Finland	1.004	16	29	NO	NO	NO	2.512	10	13	NO	NO	NO
France	-1.022	0	0	NO	NO	NO	-229	1.008	0	NO	NO	NO
Germany	-80.765	0	0	NO	NO	NO	-90.611	0	0	NO	NO	NO
Greece	-4.498	-70	-16	NO	NO	NO	-3.564	-5	0	NO	NO	NO
Ireland	-341	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	-37.351	-20	-2	NO	NO	NO	-75.394	6	1	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	4.316	0	0	NO	NO	NO	4.172	0	0	NO	NO	NO
Portugal	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Spain	423	0	0	NO	NO	NO	-1.094	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
UK	-6.405	-9	-2	NO	NO	NO	-3.392	-7	-1	NO	NO	NO
EU15	**-122.658**	**-189**	**-228**	**NO**	**NO**	**NO**	**-171.106**	**910**	**-214**	**NO**	**NO**	**NO**

NO: not occurring

8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6: ‘Waste’. For each EU-15 key source overview tables are presented including the Member States contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness, and qualitative uncertainty estimates. The quanitative uncertainty estimates for this sector and the sector specific QA/QC activities are summarised in separate sections. Finally, the chapter includes information on recalculations.

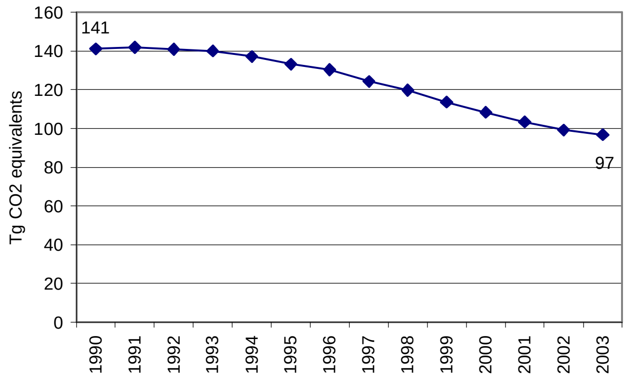
8.1 Overview of sector

CRF Sector 6 ‘Waste’ is the fourth largest sector in the EU-15, contributing 2 % to total GHG emissions. Total emissions from ‘Waste’ have been decreasing by 31 % from 141 Tg in 1990 to 97 Tg in 2003 (Figure 8.1). In 2003, emissions decreased by 2.5% compared to 2002. The key sources in this sector are:

6.A.1: Managed waste disposal on land (CH_4)
6.A.2: Unmanaged waste disposal sites (CH_4)
6.B.2: Domestic and commercial wastewater (CH_4)
6.C: Waste incineration (CO_2)

Figure 8.1 shows that CH_4 emissions from landfills account for about 73 % of waste-related GHG emissions in the EU-15.

Figure 8.1 EU-15 GHG emissions 1990–2003 from CRF Sector 6: ‘Waste’ in CO_2 equivalents (Tg) and share of largest key source categories in 2003



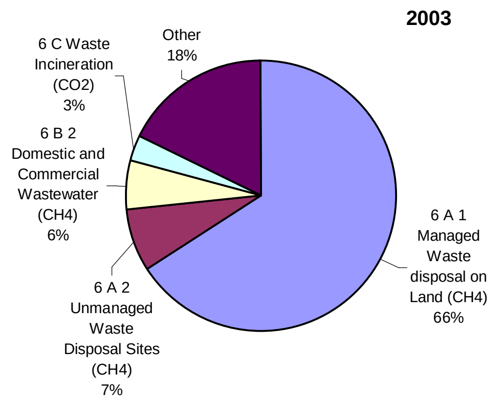
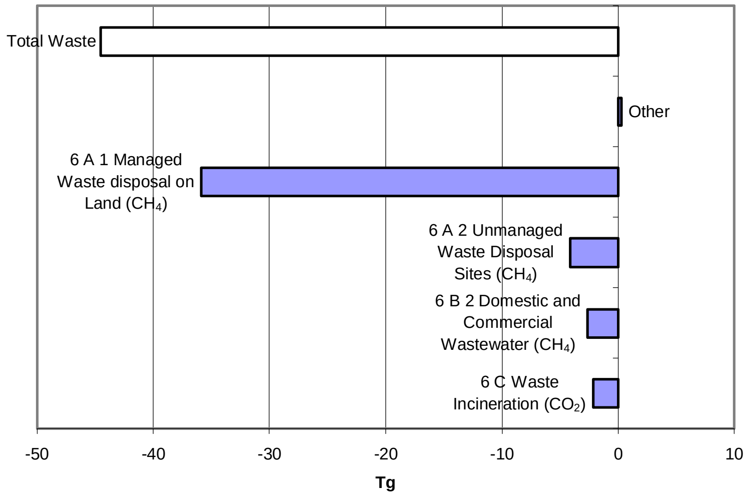


Figure 8.2 shows that CH_4 emissions from ‘Managed waste disposal on land’ had the greatest decrease of all waste-related emissions.

Figure 8.2 **Absolute change of GHG emissions by large key source categories 1990–2003 in CO_2 equivalents (Tg) in CRF Sector 6: 'Waste'**



8.2 Source categories

8.2.1 Solid waste disposal on land (CRF Source Category 6.A)

Table 8.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 from 6.A: 'Solid waste disposal on land'. CH_4 emissions from 'Solid waste disposal on land' decreased by 35 % between 1990 and 2003 in the EU-15. Nearly all EU-15 Member States reduced their emissions from this source.

This source category includes two key sources: CH_4 from 6.A.1: 'Managed waste disposal on land' and CH_4 from 6.A.2: 'Unmanaged waste disposal on land'.

Table 8.1 **Member States' contributions to CH_4 emissions from 6.A: 'Solid waste disposal on land' and information on methods applied and quality of these emission estimates**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1)]	EF [1)]	Estimate [2)]	Quality [2)]
Austria	4.144	2.829	CS	CS	ALL	L
Belgium	2.630	917	M	CS		
Denmark	1.334	1.153	CS/M	CS/M	ALL	M
Finland	3.679	2.497	T2	D/CS		
France	11.209	10.311	CS/ T2	CS	ALL	M
Germany	31.479	11.655	T2	D,CS	T1	M
Greece	2.652	3.915	T1	D	ALL	
Ireland	1.234	1.931	T2	CS, D	Full	M
Italy	10.348	9.690	T2	D, CS	ALL	M
Luxembourg	64	49	C/D	C/D		
Netherlands	12.011	6.775	CS, T2	CS	ALL	M
Portugal	3.892	4.860	T2	D+CS	All	M
Spain	3.456	7.394	T2	T2,CS		
Sweden	2.554	1.740	T2	D + CS	ALL	M
United Kingdom	23.760	8.064	M	CS	ALL	L
EU15	114.445	73.779	C, CS, D, M, T1, T2	C, CS, D, M, T2	ALL	M

([1]) Information source: CRF Summary Table 3 for 2002.
([2]) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.2 provides information on emission trends of the key source CH_4 from 6.A.1 'Managed waste disposal on land' by Member State. CH_4 emissions from managed waste disposal on land account for

1.5 % of total EU-15 GHG emissions. Between 1990 and 2003, CH_4 emissions from managed landfills declined by 36 % in the EU-15. In 2003, CH_4 emissions from landfills decreased by 2 %. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by about 30 % between 1990 and 2003. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilised or flared. The share of CH_4 recovery increased in several EU-15 Member States.

The Member States with most emissions from this source were Germany, Spain, Italy and the UK. Several Member States reduced their emissions between 1990 and 2003. The largest reductions in absolute terms were reported by Germany and the UK. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation of the Member States. The landfill waste directive was adopted in 1999 and requires the Member States to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

Table 8.2 Member States' contributions to CH_4 emissions from 6.A.1:'Managed waste disposal on land'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	4.144	2.883	2.829	4,4%	-54	-2%	-1.315	-32%	CS	PS, Q	CS
Belgium	2.630	1.014	917	1,4%	-97	-10%	-1.713	-65%	M	RS	CS
Denmark	1.334	1.156	1.153	1,8%	-3	0%	-181	-14%	T2	NS, PS	CS
Finland	2.235	1.620	1.518	2,4%	-102	-6%	-717	-32%	T2	PS	D, CS
France	6.332	8.093	7.963	12,5%	-129	-2%	1.631	26%	CS, T2	NS	CS
Germany	31.479	11.922	11.655	18,3%	-267	-2%	-19.824	-63%	T2	NS	CS
Greece	1.088	1.887	2.121	3,3%	235	12%	1.034	95%	T1	NS, Q	D
Ireland	908	1.274	1.481	2,3%	207	16%	572	63%	T2	NS	CS
Italy	7.787	9.751	9.294	14,6%	-457	-5%	1.507	19%	T2	NS	D, CS
Luxembourg	64	48	49	0,1%	0	0%	-16	-25%			
Netherlands	12.011	7.253	6.775	10,6%	-478	-7%	-5.236	-44%	CS, T2	AS	CS
Portugal	549	1.531	1.706	2,7%	175	11%	1.157	211%	T2	NS	D, S
Spain	2.690	6.178	6.429	10,1%	251	4%	3.738	139%	T2	NS	D
Sweden	2.554	1.845	1.740	2,7%	-105	-6%	-814	-32%	T3	NS	D, CS
United Kingdom	23.760	8.820	8.064	12,7%	-756	-9%	-15.696	-66%	M	NS	CS
EU15	99.564	65.275	63.693	100,0%	-1.582	-2%	-35.871	-36%			

CH_4 emissions from 6.A.2: 'Unmanaged waste disposal on land' account for 0.2 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH_4 emissions from this source decreased by 37 % due to a decreasing amount of municipal waste going to unmanaged waste disposal sites (Table 8.3). Not all Member States reported emissions from this source. France and Greece are responsible for 57 % of the total EU-15 emissions. France and Italy had large absolute reductions between 1990 and 2003.

Table 8.3 Member States' contributions to CH_4 emissions from 6.A.2: 'Unmanaged waste disposal on land'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Belgium	0	0	0	0,0%	0	-	0	-	NO	NO	NO
Denmark	NO	NO	NO	-	-	-	-	-	NO		
Finland	NO	NO	NO	-	-	-	-	-	(T2)	(PS)	(D, CS)
France	4.876	2.513	2.347	32,5%	-166	-7%	-2.529	-52%	CS, T2	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Greece	1.564	1.829	1.794	24,9%	-35	-2%	230	15%	T1	NS	D
Ireland	326	427	450	6,2%	23	5%	124	38%	T2	NS	CS
Italy	2.561	515	396	5,5%	-119	-23%	-2.165	-85%	T2	NS	D, CS
Luxembourg	0	0	0	0,0%	0	-	0	-			
Netherlands	NO	NO	NO	-	-	-	-	-	NO		
Portugal	1.291	1.366	1.262	17,5%	-103	-8%	-28	-2%	T2	NS	D, S
Spain	751	1.008	965	13,4%	-43	-4%	214	28%	T2	NS	D
Sweden	NO	NO	NO	-	-	-	-	-	NO		
United Kingdom	0	0	0	0,0%	0	-	0	-	NE	NE	NE
EU15	11.369	7.657	7.215	100,0%	-443	-6%	-4.155	-37%			

8.2.2 Wastewater handling (CRF Source Category 6.B)

Table 8.4 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 from 6.B: 'Wastewater handling'. Between 1990 and 2003, CH_4 emissions from wastewater handling decreased by 24 %. This source category includes one key source: CH_4 from 6.B.2: 'Domestic and commercial wastewater'.

Table 8.4 Member States' contributions to CH_4 emissions from 6.B: 'Wastewater handling' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied 1)	EF 1)	Estimate 2)	Quality 2)
Austria	286	303	C	CS	ALL	L
Belgium	81	77	D	D,CS		
Denmark	200	244	NE		NE	
Finland	153	128	D	D/CS	ALL	M
France	714	1.169	CS/T2	CS	ALL	L
Germany	2.226	112	D	D,CS	T1	L
Greece	2.357	655	T1	D	PART	
Ireland	0	0	NA	NA	NE	NE
Italy	1.340	1.432	D	D	ALL	M
Luxembourg	4	5	C	CS	ALL	L
Netherlands	290	207	CS	CS	ALL	M
Portugal	870	835	D	D+CS	All	M/L
Spain	1.250	2.025	D	D,C,CS	0	
Sweden	0	0	NO	NO	IE	
United Kingdom	701	789	M	CS	PART	L
EU15	10.473	7.981	C,CS,D,M, T1,T2	C, CS, D	ALL,IE,PART	L

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 from 6.B.2: 'Domestic and commercial wastewater' accounts for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2003 emissions decreased by 32 %. Large decreases in absolute terms are reported from Germany and Greece, whereas Spain had large emission increases (Table 8.5).

Table 8.5 Member States' contributions to CH_4 emissions from 6.B.2: 'Domestic and commercial wastewater'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	189	199	200	3,6%	1	0%	11	6%	CS	Q	CS
Belgium	81	78	77	1,4%	0	0%	-4	-4%	D	RS	D, CS
Denmark	200	277	244	4,4%	-33	-12%	44	22%	D, CS	NS	D, CS
Finland	131	109	109	1,9%	-1	-1%	-22	-17%	D	PS	D, CS
France	714	1.163	1.169	20,9%	6	0%	455	64%	CS, T2	NS	CS
Germany	2.226	133	112	2,0%	-21	-16%	-2.114	-95%	D	NS	D, CS
Greece	2.252	655	538	9,6%	-117	-18%	-1.714	-76%	D	NS	D
Ireland	NE	NE	NE	-	-	-	-	-			
Italy	83	170	166	3,0%	-4	-2%	83	100%	D	NS	D
Luxembourg	2	2	2	0,0%	0	-2%	0	22%			
Netherlands	190	180	168	3,0%	-12	-7%	-23	-12%	CS	NS	CS
Portugal	706	623	627	11,2%	4	1%	-79	-11%	D	NS, RS	D, CS
Spain	756	1.348	1.404	25,1%	56	4%	649	86%	D	NS	D, CS
Sweden	IE	IE	IE	-	-	-	-	-	IE	IE	IE
United Kingdom	701	784	789	14,1%	5	1%	88	13%	M		CS
EU15	8.230	5.722	5.605	100,0%	-117	-2%	-2.625	-32%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

8.2.3 Waste incineration (CRF Source Category 6.C)

Table 8.6 and Table 8.7 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 6.C: 'Waste incineration'. This key source accounts for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2003, CO_2 emissions from waste incineration decreased by 42 %; France and the UK had the largest decreases in absolute terms.

Table 8.6 Member States' contributions to CO_2 emissions from 6.C: 'Waste incineration' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2003 (Gg CO_2 equivalents)	Methods applied [1]	EF [1]	Estimate [2]	Quality [2]
Austria	21	11	C	CS	ALL	L
Belgium	339	344	D	PS		
Denmark	0	0	IE			
Finland	IE	0	NO	NO	IE	IE
France	2.300	1.386	C	CS/ PS	ALL	M
Germany	NO	NO	NO	NO	NO	
Greece	0	0			NO	
Ireland	NO	NO	NA	NA	NO	NA
Italy	493	168	D	CS	ALL	M
Luxembourg	19	0	C	CS	ALL	L
Netherlands	IE	IE	IE	0	IE	
Portugal	10	350	D	D+C	All	H
Spain	750	178	C	C,CS		
Sweden	44	121	PS	PS	ALL	H
United Kingdom	1.201	460	T2	CS	PART	L
EU15	5.177	3.016	C,D,PS,T2	C, CS, D, PS	ALL, IE, NE, PART	M

(1) Information source: CRF Summary Table 3 for 2002.
(2) Information source: CRF Table 7 for 2002.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.7 Member States' contributions to CO_2 emissions from 6.C: 'Waste incineration' and information on methods applied and quality of these emission estimates

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	21	11	11	0,4%	0	0%	-9	-46%	C	AS	CS
Belgium	339	335	344	11,4%	8	3%	4	1%	D	PS	PS
Denmark	IE	IE	IE	-	-	-	-	-	IE		
Finland	IE	IE	IE	-	-	-	-	-	IE		
France	2.300	1.424	1.386	45,9%	-38	-3%	-914	-40%	C	NS, PS	CS, PS
Germany	NO	NO	NO	-	-	-	-	-	NO		
Greece	NE	NE	NE	-	-	-	-	-	NO		
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	493	185	168	5,6%	-17	-9%	-326	-66%	D	NS	CS
Luxembourg	19	0	0	0,0%	0	-	-19	-100%			
Netherlands	IE	IE	IE	-	-	-	-	-	IE		
Portugal	10	359	350	11,6%	-9	-2%	340	3372%	D	PS, NS	PS, C, CS
Spain	750	275	178	5,9%	-97	-35%	-573	-76%	C	NS, Q	CS, C
Sweden	44	61	121	26,3%	60	99%	77	176%	PS	PS	PS
United Kingdom	1.201	481	460	15,2%	-21	-4%	-741	-62%	T2	NS, AS	CS
EU15	5.177	3.130	3.016	100,0%	-114	-4%	-2.160	-42%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

8.3 Methodological issues and uncertainties

Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

The following considerations address national methods and circumstances which are available in the Member States' national inventory reports. The focus is laid on the reporting categories 6.A.1 'CH_4 emissions from managed solid waste disposal sites' and 6.A.2 'CH_4 emissions from unmanaged solid waste disposal sites' since they are EU-15 key sources and contribute 1.5 % and 0.2 % of the GHG emissions from the sector 'Waste', respectively. The reporting category 6.B.2 'CH_4 emissions from domestic and commerical wastewater', key source in the EU-15 as well, is also comprehensively analysed. The quality of reporting is assessed to be low in the EU, compare table 8.4 and a comparative analysis of the Member States' methods and country specific values provide a sound basis for reviews. Source categories 6.B.1, 6.C and 6.D are only briefly discussed.

8.3.1 Managed Solid Waste Disposal (CRF Source Category 6.A.1)

CH_4 emissions from managed solid waste disposal are key sources in all Member States. For key sources in the source category, 6.A it is good practice to use the First Order Decay (FOD) method (Tier 2) to calculate the emissions and to display emissions trends over time. All EU-15 Member States apart from Greece and Luxembourg applied – in line with the IPCC Good Practice Guidance – tier 2 methodologies in order to estimate CH_4 emissions from managed solid waste disposal sites (see Table 8.2). While the method used in Luxembourg is not indicated, Greece applied the tier 1 methodology due to the lack of detailed data which are required. Three Member States used a country-specific emission model in accordance with the Tier 2 methodology (Denmark, United Kingdom and Belgium) and four Member States (Sweden, Austria, France and Finland) applied country-specific methods in accordance with the Tier 2 methodology. The remaining Member States applied the tier 2 methodology proposed by the IPCC Good Practice Guidance and the IPCC Guidelines. Eight Member States assume that the estimates have a medium quality in that source category, two Member States indicate a low quality, while five Member States did not report the results of the quality assessment (compare Table 8.1). Table 8.8 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 8.8: Description of national methods used for estimating CH_4 emissions from managed solid waste disposal

Member States	Description of methods
Austria	Country specific method: First the overall amount of generated landfill gas per ton waste was calculated, taking into account the DOC-content of the waste and the average temperature at the landfill. For the calculation the amount of landfill-gas produced in the year of disposal and in the 30 years after disposal is taken into account. To determine the total amount of landfill gas emissions for one year, the amounts generated by waste disposed in the last 31 years are summed up. After subtracting the collected gas and multiplying by the CH_4 constant of landfill gas, the emitted quantity of CH_4 from residual waste was obtained. The country specific approach is based on the methodology described by Tabasaran and Rettenberger.
Belgium	IPCC Tier 2 Method with national model (NIR 2004)
Denmark	Emissions based on a model suited to Danish conditions. The model is based on the IPCC tier 2 approach (NIR 2004).
Finland	Finland used IPCC Tier 2 method as basis. However Equation 5.1 from the GPG (2000) has been slightly modified, so that term MCF (t) has substituted for the term MCF (x) in the calculation of methane generation potential L0(x). Calculation is not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous year also. (NIR 2005)
France	IPCC Tier 2 Method
Germany	IPCC Tier 2 Method
Greece	IPCC Tier 1 Method: According to the IPCC Good Practice Guidance, the Tier 2 methodology should be applied for the estimation of emissions from solid waste disposal on land. However due to the lack of the detailed data required, its application is not yet feasible (NIR 2004).
Ireland	IPCC Tier 2 method
Italy	IPCC Tier 2 method
Luxembourg	Method is described neither in NIR nor in CRF
Netherlands	IPCC Tier 2 Method
Portugal	IPCC Tier 2 method
Spain	IPCC Tier 2 method
Sweden	IPCC Tier 2 methodology with a slightly different time factor and with some estimates on the national gas potentials (NIR 2005). Comparison between the suggested IPCC gas potentials and Swedish estimates show that the IPCC values tend to be higher, but considering the large methodological uncertainties, which is the same in both cases, the difference might be within a reasonable interval.
United Kingdom	Tier 2 method with country specific model. The UK method is based on equation 4 and 5 in the Revised 1996 IPCC guidelines which are compatible with equations 5.1 and 5.2 in the Good Practice Guidance. A slightly different version of equation 5.1 is used, which takes into account the fact that the model uses a finite time interval (one year).

Source: NIR 2005 if available, else NIR 2004.

The Tier 2 FOD method requires data on current, as well as historic, waste quantities, composition and disposal practices for several decades. In the following section a detailed overview of the most important parameters and methodological aspects of the FOD method applied by the Member States are presented. The main factors influencing the quantity of CH_4 produced are the ***amount*** of waste disposed of on land and the *concentration* of biodegradable C in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the Member States are summarized in Table 8.9.

Table 8.9: Data sources used for generating time series of activity data for managed solid waste disposal

Member States	Data sources used for generating time series (6.A.1)
Austria	The quantities of residual waste from 1950 to 1990 were taken from a study [Hackl, Mauschitz; 1999] and from 1990 to 1997 from the current Bundesabfallwirtschaftsplan (Federal Waste Management Plan). However, in both references the amount of waste from administrative facilities of industry is not considered whereas it is included in the Deponiedatenbank, which is used for the activity data from 1998 onwards. Thus to achieve a consistent time series, the share of waste from administrative facilities of industry in the year 1998 was taken and was assumed remained constant over the time series. Activity data for "residual waste" was not available in the years before 1998, the value for 1998 was used for these years (NIR Austria 2004).
Belgium	In Wallonia, the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). It publishes each year the industrial and municipal waste disposed, based on the taxes declaration forms covering 50 solid waste disposal sites of various sizes. Those statistics are available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgement assumptions (NIR 2005). In the Flemish region the quantity of waste disposed originates from the institute responsible for waste management in Flanders (OVAM). There are no solid waste disposal sites in the Brussels Region..
Denmark	The amount of municipal solid waste deposited at solid waste disposal sites is according to official registration performed by the Danish Environmental Protection Agency in the so called ISAG database. In the Flemish region the quantity of waste disposed originates from the institute responsible for waste management in Flanders (OVAM). There are no solid waste disposal sites in the Brussels Region.
Finland	Activity data for the time series is taken from different sources: VAHTI database contains data on the total amounts of waste taken to landfills from 1997 onwards. Corresponding data for the years 1992-1996 were collected to the Landfill Registry of the Finish Environment Institute. The activity data for municipal waste for the year 1990 is based on the estimates of the Advisory Board for Waste Management (1992) for municipal solid waste generation and treatment in Finland in 1989. The disposal data (amount and composition) at the beginning of 1990s for industrial, construction and demolition waste are based on surveys and research by Statistics Finland and the Technical Research Centre of Finland. Estimated data on waste amounts before the year 1990 is based on the report of VTT (Tukhanen 2002) (NIR 2005).
France	The amount of waste on SWDS derives from the surveys called "ITOMA" made by ADEME (NIR 2004). These surveys have been developed since 1985. For years 1960 to 1984, assumptions made by ADEME are used. ADEME is the French agency for environment and energy management.
Germany	The surveys of waste quantities commenced in 1975 on the basis of the Environmental Statistics Act in 1974. Waste quantities for the period from 1970 to 1975 were extrapolated on the basis of population data. The most recent year for which suitable differentiated data is available is 2000. For 2001 and 2002, quantities were assumed to remain constant in comparison to 2000. This data will be recalculated as soon as the relevant specialized series of the Federal Statistical Office become available. For the period 1970 to 1990, there was no standardized basis for waste-production and waste disposal data throughout all of Germany, as this creates a problem with regard to data on waste quantities and landfilled proportions of waste during that period. Data for the former GDR cannot simply be derived from average data of the old German Länder, since marked differences applied: the average per-capita waste production (municipal waste), at about 175 kg/a was considerably lower than that of the Federal Republic of Germany, where the corresponding figure was about 365 kg/a of household waste. From the former GDR's Ministry for nature Conservation, Environmental Protection and Water Resources Management, statistical data on settlement-waste production for the territory of the former GDR is available for four different years in the period leading up to reunification (1983, 1985, 1988, 1989); from this data, in connection with population data, the applicable settlement-waste quantities for the former GDR were derived for the period 1970-1990. For the years 1990 and 1993 and for the period since 1996, differentiated data is available on landfilled quantities of individual fractions of municipal waste. For the years prior to 1990, the landfilled proportions from 1990 were used, with no changes. For the years after 1990 for which data was lacking, data from framing years was interpolated.
Greece	Estimates on solid waste quantities generated are contained in various reports, research programs and studies, but refer to specific points in time rather than to complete time series, while different assumptions are applied in each source for the estimation of generated quantities. Therefore, on the one hand there is a lack of data for some years, while on the other hand the evolution of quantities between years for which official data are available cannot always be considered as reliable. For this reason, a re-estimation of generated quantities of municipal solid wastes for the whole period 1990-2002 was carried out, on the basis of population figures and coherent assumptions regarding generation rates per capita and day, in order to derive complete time series for generated quantities (NIR 2004).
Ireland	The waste material contributing to DOC includes MSW and street cleanings, are given in the National Waste Database reports. The EPA commenced the development of the National Waste Database in the early 1990s. National statistics generated from this database and published on a three-year cycle by EPA are the primary basis for establishing the historical time-series of MSW placed in landfills in Ireland. These publications provide detailed descriptions of the methods employed to compile the waste database. The results of other less comprehensive surveys undertaken in previous years (1987, 1993, 1994) have also been used to some extent in compiling the MSW time-series.
Italy	The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in

Member States	Data sources used for generating time series (6.A.1)
	landfills has been reconstructed on the basis of available data reported in different sources: studies, national legislation and regression models based on population (NIR 2004).
Netherlands	The amount of waste deposited at disposal sites is collected by the Working Group on Waste Registration. A yearly survey (since 1990) is used therefore. The response to this survey is every year 100%. (email communication with national waste expert April 2005).
Portugal	Since 1999 data on MSW is available, including production amounts, final disposal and to a less extent waste composition. For previous years information was available from the Strategic Plan on Municipal Solid Waste which was approved by the Government in 1997. This plan includes data from annual municipal registries and a research study performed by Quercus (1995). The data was based on a survey performed in 1994, which enabled the calculation of per capita generation rates for 1994, based on the amounts of waste collected and the population served by waste collection. Before 1994, data on landfill wastes had to be estimated based on expert judgment for waste generation growth rates. For the period 1960-1980 it was considered a per capita waste generation growth rate of 2,5% per year; for the following years (1980-1994) 3% per year (NIR 2004).
Spain	The data source for characterization and quantification of the waste has been the annual publication entitled "Environment in Spain" from the Ministry of the Environment (NIR 2005).
Sweden	*Household waste and similar*: First national survey by EPA in 1980, similar data in 1985, 1990 and 1994 by Statistics Sweden, since 1994 annual survey on landfilled waste by RVF. For the years in between the surveys, where data are missing, data are imputed. Standard values on fractions of landfilled household waste from 1970 and 1975 available from RVF. *Figures on sludge from households and park and garden waste*: available since 1990. industrial waste: data from 1980s but no indication on biological fraction. Studies on quantities and treatment of biological waste from industry in 1993 and 1996 by EPA. *Landfilled sludge from the pulp industry (important waste fraction):* yearly documented from 1994 with high quality from the Swedish EPA. Previously landfilled sludge from the pulp industry has been documented intermittently.
United Kingdom	The estimates of historical waste disposal and composition data are based on various data sources. Estimates for municipal waste are based on population where data are absent. Until 1994 the waste arising data are based on waste surveys in the UK using actual data. After 1994, data are based on a new study carried out by a UK consultancy. Years between 1995 and 1998 inclusive are extrapolated backwards form the 1999 data and years ahead of 1999 are extrapolated based on a projected scenario of waste disposal.

Source: NIR 2005 if available, else NIR 2004. Luxembourg is not considered as there NIR is not available.

Some Member States explicitly describe the consistency of their time series (compare Table 8.10).

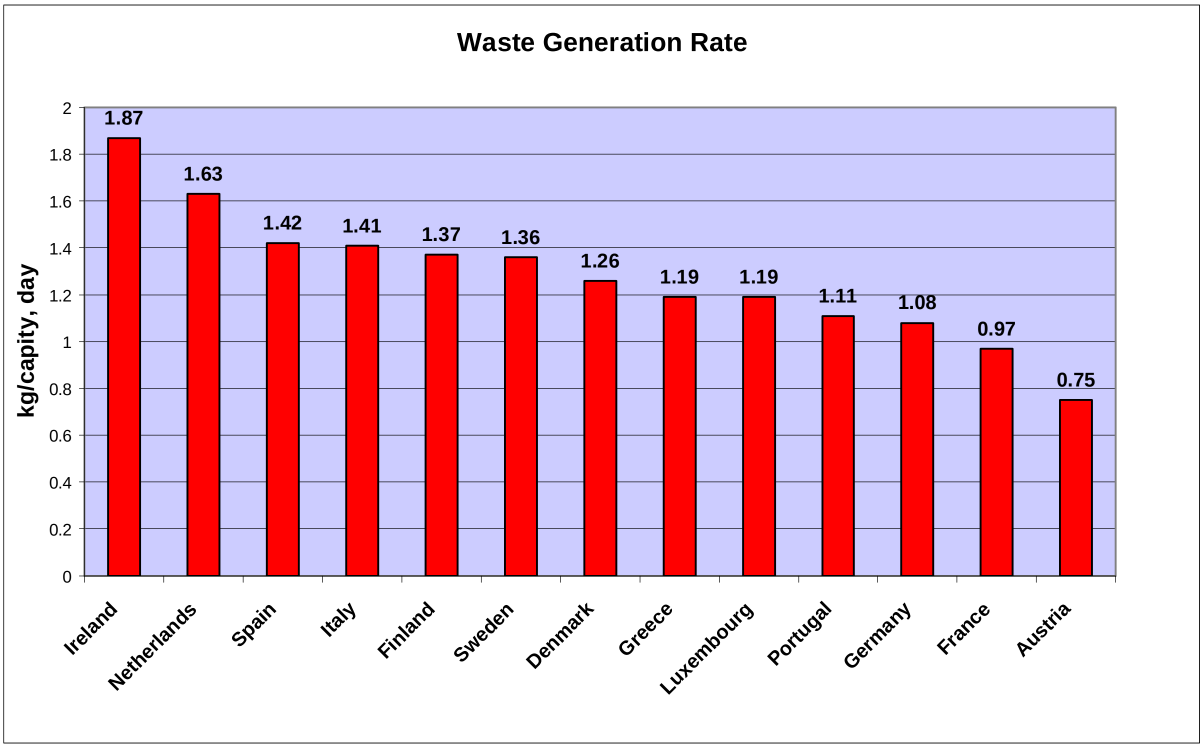
Table 8.10: Consistency of time series of activity data

Member States	Consistency of time series
Austria	no detailed description of time series consistency
Belgium	The time series are expected to be consistent in Belgium.
Denmark	The time series of activity data is consistent in the sense that the source for the data for the whole time-series is the registered amount of waste. A registration has been done since the start of the 1990th in order to measure the effects of action plans. The consistency of the emission factor comes as a result of the same model run for the whole time-series. The time lag in the model is the same for the whole time-series and is within the interval recommended for a first order decay model in the IPCC guidelines (NIR 2005)
Finland	no detailed description of time series consistency
France	Since 1985, ADEME ensures completeness of the surveys by providing adjustments if necessary. Surveys are not available for each year, so interpolations are made, for years 1986-1988, 1990 – 1992, 1994 and 2001. For years 1960 – 1984, consistency between 1984 and 1985 was checked to approve the times series (email communication with national waste expert April 2005).
Germany	Over the log activity-data period involved, thirty years, time series inconsistencies have to be expected. In Germany, such inconsistencies must be expected primarily as a result of German reunification and its fusion of two different economic and statistical systems; furthermore, they must be expected as a result of improvements of laws and statistics for the waste sector (NIR 2005).
Greece	no detailed description of time series consistency
Ireland	The time-series estimates given in the present submission are fully consistent (NIR 2005).
Italy	no detailed description of time series consistency, Time series refer to different official reports; from 1996 it could be considered fully consistent.
Netherlands	The time series of activity data is consistent in the sense that the source for the data is for the whole time-series the same. The amounts of waste deposited is registered by a yearly survey since 1990 with a response of 100%. (email communication with national waste expert April 2005)
Portugal	no detailed description of time series consistency
Spain	no detailed description of time series consistency
Sweden	The times series in the waste sector are calculated consistently, and when statistics are not produced annually, interpolation and extrapolation have been necessary tools for imputation.
United Kingdom	The estimates for all years have been calculated from the LQM model and thus the methodology is consistent throughout the time series. Estimates of waste composition and quantities have been taken from different sources prior to 1995 and after 1995. This has led to some discontinuity between the two sets of estimates (discontinuity in estimated MSW, industrial and commercial waste arising) (NIR 2004).

Source: NIR 2005 if available, else NIR 2004. Luxembourg is not considered as there NIR is not available.

The amount of waste disposed on SWDS depends on the one hand on the total amount of waste generated respectively on the per capita waste generation rate, Figure 8.3 provides an overview.

Figure 8.3: Waste Generation Rate

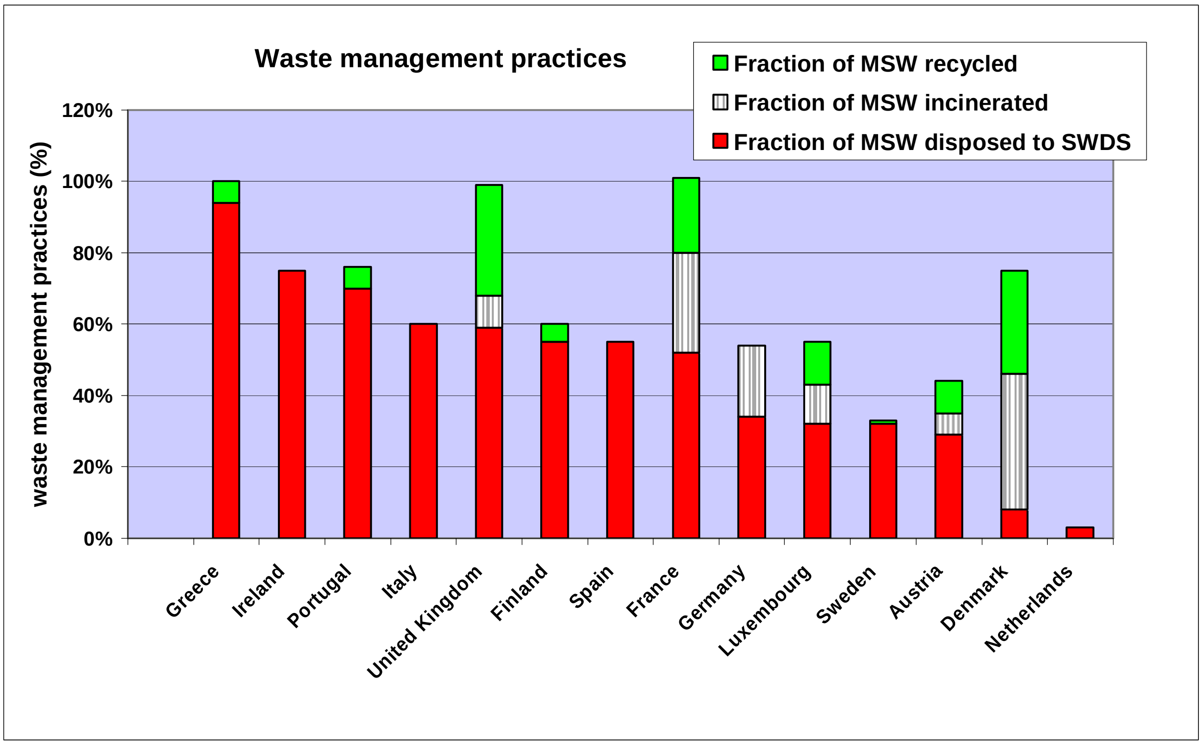


Source: CRF 2005, table 6 A Additional information; NIR 2005 if available, else NIR 2004; Additional information by Luxembourg. For Denmark the waste generation rate is the figure from the NIR, not from the CRF which includes large amounts of industrial waste not relevant for the estimation.

The waste generation rate per capita varies significantly among the Member States. Austria shows the lowest rate of 0.75 kg/capita/day, while Ireland reports the highest waste generation rate of 1.87 kg/capita/day. The average of all the Member States providing a waste generation rate lies at 1.28 kg/capita/day.

On the other hand the amount of waste generated on SWDS is strongly influenced by the waste management practices of the individual Member States: by the share of waste incinerated, recycled and composted, compare Figure 8.4.

Figure 8.4: Fraction of MSW disposed to SWDS, incinerated and recycled



Source: CRF 2005, table 6 A Additional information; NIR 2005 if available, else NIR 2004; Additional information by Luxembourg

The waste management practices and policies which determine the fraction of MSW disposed to SWDS, the fraction of waste incinerated and the fraction of waste recycled differ significantly among the Member States. For example, disposing waste on SWDS is the predominant waste disposal route in Greece and Ireland with correspondingly few quantities of waste incinerated and recycled in these countries (the latter due to considerable public concern over the use of large-scale waste incineration). In Germany, Denmark and the Netherlands it is vice versa. Landfills in Germany remaining in operation may store only waste that conforms to strict categorisation criteria from 2005 onwards. They also must reduce landfill-gas formation from such waste by more than 90% with respect to gas from untreated waste. In the Netherlands, waste policy also has the aim of reducing landfilling by introducing bans for the landfilling of certain categories of waste, e.g. the organic fraction of household waste (in the early 1990s) and by raising the landfill tariff to comply with the incineration of waste.

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. While the first three parameters do not vary strongly among the Member States, more information is provided on the DOC (Figure 8.5 and Table 8.12) as well on waste composition of land filled waste (Table 8.11). The latter parameters are again strongly influenced by waste management practices and policies.

Table 8.11: Waste composition of land filled waste

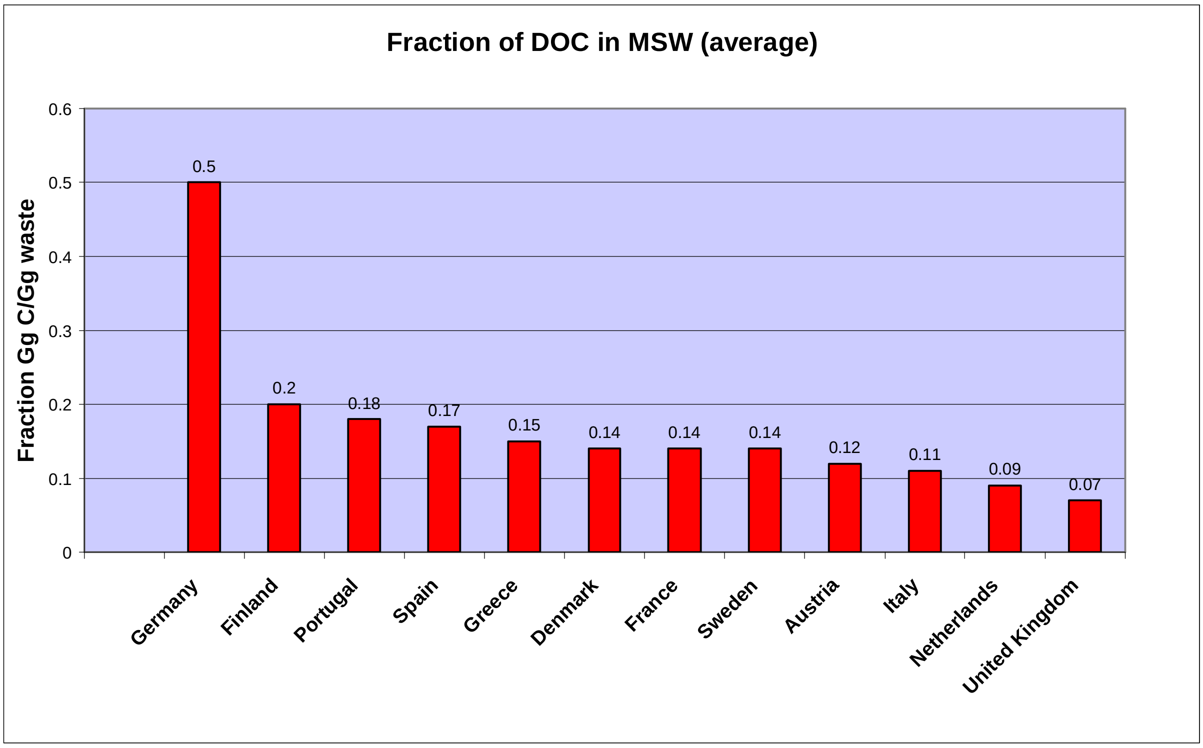
Member States	Composition of landfilled waste
Austria	Landfilled waste is differentiated in "residual waste" and ""non residual waste" (bulk, construction, mixed industrial waste, road sweeping, sewage sludge, rakings, residual matter from waste treatment). The latter is divided into well bio-degradable waste (half-life period 1-20 years and hardy bio-degradable waste (half life period: 20-100 years) (NIR 2004)
Belgium	There is one model for solid waste disposal on land, using specific parameters (DOC,…)for municipal waste and for industrial waste. Hospital Waste is included in municipal waste.
Denmark	The composition of waste has considerable variation. As waste types are taken into consideration: Domestic waste, bulky waste, garden waste, commercial & office waste, industrial waste, Building and construction waste, sludge and ash and slag. As material fraction the following are differentiated: Waste food, cardboard, paper, wet card board and paper, plastics, other combustibles, glass and metal (NIR 2005)

Finland	Solid municipal, industrial, construction and demolition wastes and municipal and industrial sludges are considered as emissions sources. Different DOC are applied (NIR 2005)
France	Composition of landfilled waste is not mentioned explicitly in the NIR 2004. According to the surveys of ADEME for year 2000, landfilled waste is composed of: "green waste" 0.4%, household waste 42.2% (paper 25%, food and garden waste 29%, plastics,11%, glass 13%, other inert 22%), standard industrial waste 29,1%, waste similar to household waste 4.7%, secondary waste and other (inert) 23%. (email communication with national waste expert April 2005).
Germany	Composition of solid waste on landfills: household waste, municipal waste of former GDR, bio-degradable waste from "bio" bins, bulky waste, road sweepings, market waste, garden and park waste, sewage sludge.
Greece	The estimated composition of generated MSW is: Putrescible matter, paper, plastics, metals, glass, rest. However, accurate data on the composition of generated municipal solid waste at national level are not available, as a comprehensive analysis at national scale covering a complete time period has not been accomplished yet. The estimated disposed quantities of solid waste do not include sludge from wastewater treatment plants, as well as other kinds of waste (e.g. clinical waste)(NIR 2004).
Ireland	Waste constituents of MSW that contribute to DOC are organics, paper, textiles and in the category other (fine elements, unclassified materials and wood wastes). Furthermore street cleansings are considered. Explicitly mentioned: completeness with respect to additional sources of organic waste including sludge and industrial waste remains to be addressed (NIR 2005).
Italy	Apart from municipal solid waste, industrial waste which is land filled and sludge from wastewater handling plants have also been considered (NIR 2004). Landfill waste comprises IPCC categories paper and paperboard, food and garden waste, glass, textiles, other (inert and organic).
Luxembourg	The waste amounts indicated by Luxembourg which are incinerated and disposed of on SWDS comprise all types of waste which have been accepted by the installation, comprising municipal, industrial and bulky waste.
Netherlands	Composition of landfilled waste comprises IPCC categories for municipal waste (paper and paperboard, food and garden waste, plastics, glass, textiles and other: Metals, Building wastes and ashes, wood and other) (NIR 2005).
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes (NIR 2004).
Spain	Composition of landfilled waste is not mentioned explicitly in the NIR 2005.
Sweden	Landfilled waste includes household and similar waste, sludge from wastewater handling, park and garden waste, sludge from the pulp industry and other organic industrial wastes.
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading and inert waste. As recommended in the Good Practice Guidance, the estimates of waste disposal quantities include commercial and industrial waste, demolition and construction waste and sewage sludge, as well as municipal waste (NIR 2004). The composition is based on an assumption used in the model, not measured data. (CRF, 2005)

Source: NIR 2005 if available, else NIR (2004).

Fraction of Dissolved Organic Carbon (DOC) in MSW: The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream. Different countries are known to have MSW with widely differing waste compositions. While the average DOC value in MSW are illustrated in Figure 8.4, table 8.13 provides corresponding detailed information on the DOC values extracted from the NIR.

Figure 8.5: Fraction of DOC in MSW



Source: CRF 2003 Table 6A,C Additional information

Table 8.12: Further information on DOC values

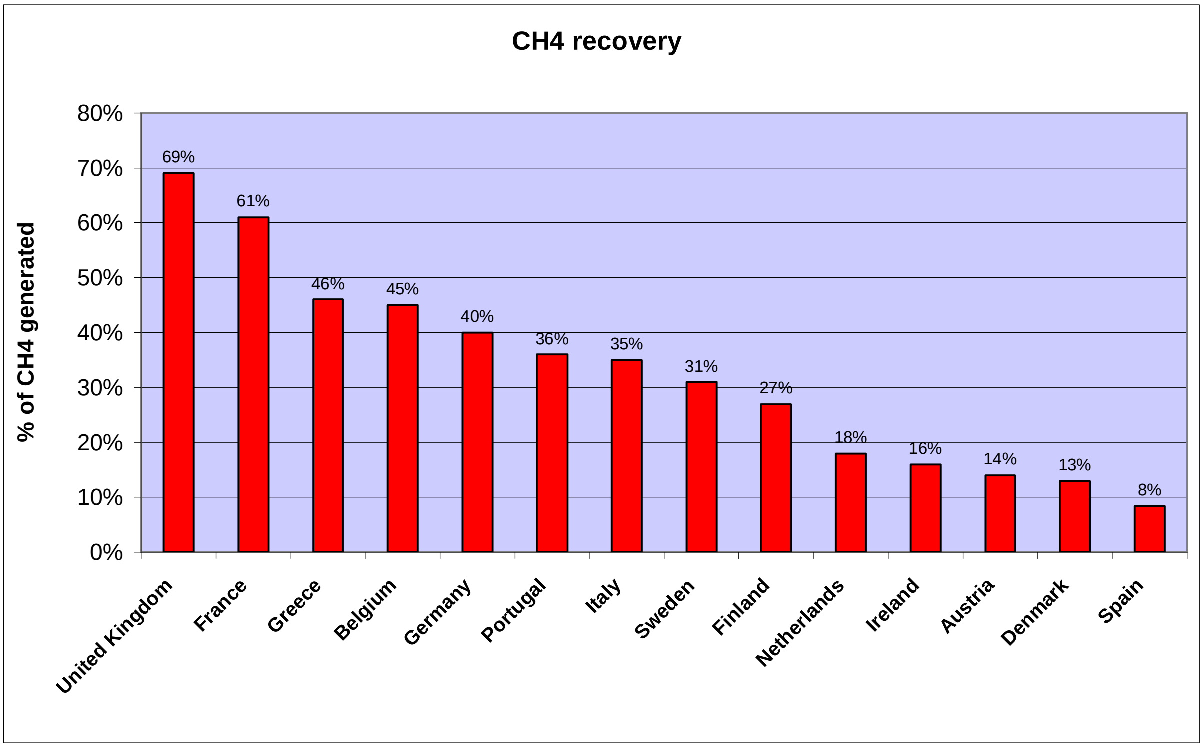
Member States	Further information on DOC values
Austria	Time series of bio-degradable organic carbon content of directly deposited residual waste are indicated for the years 1990 to 2002. In the method for the calculation of emissions from non residual waste DOC values are not applied (NIR 2004)
Belgium	The data are classified according to 12 main categories (119 subcategories), thus allowing an accurate calculation of the amounts of waste and its degradable organic carbon content (IPCC Good Practice Guidance [10] equation 5.4, page 5.9), which are used as an input in the model. Those statistics are available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgement assumptions. The DOC value for municipal waste lies in the default value range from IPCC revised 1996 Guidelines and was chosen according to national expert judgement (NIR 2005)
Denmark	The value is a calculation of a weighted mean DOC value from individual DOC values for waste fractions used in the FOD model. The calculation is on 2003 data and based on values to be found in the NIR2005.
Finland	Time series of DOC values are presented for 1990-2003. DOC fractions of different types of solid municipal waste are based on the IPCC default values and national research data. DOC values of subgroups (Municipal sludge, Industrial sludge, Solid industrial waste, construction and demolition waste and industrial inert waste) are indicated (NIR 2005)
France	country specific data according to the composition of landfilled waste and the DOC for 3 kinds of waste (high DOC 150 kg/ t, medium DOC 75 kg/t, inert DOC 0 kg/t). The result is a DOC of 100 kg/ t. With regard to the IPCC default 210 kg/ t, we choose the middle 140 – 150 kg/t (email communication with national waste expert 2005).
Germany	Both national and IPCC default factors were used for DOC. DOC values are indicated for those fractions for which data on landfilled waste quantities is available via the 1990-2002 time series. While national studies of individual DOC fractions of household waste (paper, glass, textiles, etc) are available, no reliable data on landfilled quantities of these waste fractions is available, and thus DOC values from a more highly aggregated level had to be used. Constant DOC values were assumed for all years, since no data is available for chronological adaptation of DOC values for household waste or bulky waste. Overall, waste-management measures carried out in the 1990s had various, often opposing effects, and experts consider it realistic to assume constancy in the aforementioned terms in the final result (NIR 2005).
Greece	Time series of total amounts of DOC for waste on managed and unmanaged waste disposal sites are provided (NIR 2004) but no further specification how DOC was determined.
Ireland	IPCC DOC default values are used for organics, paper and textiles. Country specific values for street cleansings and the category other are indicated. Available DOC of MSW is estimated from the given composition and appropriate DOC contents (40 % for paper and textiles, 15 % for putrescibles, 25 % for street cleansings and 15 % for other) (CRF 2005)
Italy	DOC contents for each land filled waste typology was identified based on Andreottola and Cossu (1996). In the NIR one DOC value is indicated for the Italian waste composition. There is a difference to the average DOC in the waste according to IPCC, depends on the Italian waste composition (NIR 2004). In particular paper and paperboard DOC value differs from IPCC default figure (CRF 2005)
Netherlands	Time Series of DOC values for solid waste are presented for 1990-2003 (NIR 2005). The DOC values are based on the composition of the different waste streams land filled. The DOC value of 0.09 is the average of all the waste land filled (not only MSW) (email communication with national waste expert April 2005).
Portugal	The estimation of DOC was based on information on the waste composition from annual municipal registries, and also from the Quercus survey (NIR 2004). Figures are presented for IPCC categories A,B, C and D. Furthermore two DOC values for industrial waste are indicated, one for 1960-1999, one for the time after (NIR 2004)
Spain	The variables A, B, C and D that appear in the calculation of the DOC have been derived from specific country data on waste streams disposed of in landfills (NIR 2005). No further specification is provided.
Sweden	IPCC default values for gas potentials are used for the different fractions of household waste and a weighted average is calculated as suggested in the GPG (email communication with national waste expert April 2005).
United Kingdom	DOC was estimated assuming that the DOC arises solely from the cellulose and hemi-cellulose content of waste. The proportion of cellulose and hemi-cellulose in each waste component and the degradability of these fractions was based on a study by Barlaz et al. 1997. Each waste component (paper, food, etc.) was assigned a DOC value based on the cellulose and hemi-cellulose content. The component was then split into four fractions: rapidly degrading, moderately degrading, slowly degrading and inert, each of which was assigned the appropriate degradation rate. For example, paper was assumed to be 25% moderately degrading and 75% slowly degrading. The DOC value for both components was assumed to be equal to the percentage by weight of cellulose and hemi-cellulose multiplied by a factor of 72/162. This was around 22% for household waste (NIR 2004). The DOC degraded is taken to be the DOC content of the waste disposed of in the given year, including construction and demolition waste. It should be noted that this figure is derived from assumptions used in the model, not from measurement (CRF 2005)

Source: CRF 2003 Table 6A,C Additional information; NIR 2005 if available, else NIR (2004). Luxembourg is not considered as their NIR is not available

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills.

Methane recovery: The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered, compare Figure 8.6 varies among the Member States between 8 % in Denmark and 69 % in the United Kingdom and depends on the share of solid waste disposal sites that are able to recover CH_4 (see Table 8.13).

Figure 8.6: Methane recovery



CH_4 recovery in % = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100
Source: CRF 2005 Table 6.A,C

Table 8.13: Furhter information on CH_4 recovery

Member States	No of SWDS recovering CH_4 1) 2)	Total No of SWDS 2)	Data source for methane recovery 2)
Austria	54	Excavated-soil landfills: 225 Demolition-waste landfills: 75 Residual-materials landfills: 29 Mass-waste landfills: 58	No specification
Belgium	12 (Wallonia) 20 (Flanders)		Each year, all the landfills with CH_4 recovery (12 in 2002) are contacted to collect data on the amount and CH_4 content of the biogas recovered (flaring or energy purposes). The CH_4 content is measured by landfill owners as it determines the possible use of the biogas (only "rich" biogas" is used in engines, the rest is flared). Following a 1997 legal decree, a contract with the ISSEP (Scientific Institute for Public Service in Wallonia) also organises a close following of the environmental impacts of the Solid Waste Disposal Sites on Air, Water and Health. Seven main Sites are followed for the time being and the report includes biogas analysis. Details can be found on the DGRNE web site (NIR 2005)
Denmark	26	135	Data for landfill gas plants are according to Energy Statistics from the Danish Energy Agency (NIR 2005).
Finland	26		Finnish Biogas Plant Register (Kuittinen % Huttunen 2004)
France	84%		82% of the solid waste disposal are landfilled on SWDS with biogas capturing (NIR 2004).
Germany		330	Methane recovery is applied for 75% of the waste volume on SWDS (FHG ISI 2003).
Greece	4		Amount of recovered methane is considered to be equal to 0, as no data on the recovered methane from managed disposal sites were available (NIR 2004)
Ireland	5		Annual reports on renewable energy use; top down: the amount of CH_4 captured for energy use is estimated from the reported electricity production in the national energy balance, assuming 35 % conversion efficiency Bottom-up: Estimates on CH_4 utilized and flared from 53 individual landfills that were producing CH_4 in any appreciable quantities in that year. Total emission results quite similar top-down and bottom-up.
Italy	420		Amount of methane recovered is estimated on the basis of a survey (De Poli F., Pasqualini S., 1997. Landfill gas: the Italian situation. ENEA, atti del convegno Sardinia 97), and of the amount of energy recovered in landfills (GRTN, 2004. Dati statistici sugli impianti e la produzione di energia elettrica in Italia nel 2002. Gestore Rete Trasmissione Nazionale (also available at web-site www.grtn.it).

Luxembourg	2		No information provided
Netherlands	51	30 operating, few thousand old sites which still are active	Data based on a yearly survey by the 'Vereniging Afvalbedrijven' (a trade organization for the waste sector).
Portugal	13		In the absence of metering landfill gas recovered data, estimates on recovered CH_4 were done based on: the information of NIR for each waste management system - existence of burners, and the starting year of landfill operation and on an average efficiency for the gas capture (75%) and the gas burners (97%) (NIR 2004).
Spain	9 CRF (2005), 174 NIR (2005)	183	The information on methane recovered is based on specific country data (NIR 2005).
Sweden	72	192	Information on recovered gas (in energy units) is provided by RVF and converted to used quantities by Statistic Sweden (NIR 2005).
United Kingdom	An exact figure is not available (CRF 2005)		The fraction of methane recovered was derived from a survey of statistics on gas use for power generation, and a survey of installed flare capacity, assuming that flares operate at full capacity except for 15 % downtime. In 2002 the estimates were that 24% of generated methane was utilized and 45% was flared. The estimates on generated methane and flaring are not derived from metering data, as recommended by the Guidance as such data were not readily available at the time of the study (NIR 2004).

Source: 1) CRF 2005 Table 6 A,C 2) NIR 2005 if available else NIR 2004

Industrial waste: Data on industrial waste may be difficult to obtain in many countries. DOC default values for industrial waste are not provided by the IPCC. Table 8.14 illustrates how industrial waste is considered in the individual Member States. Five Member States neither mention nor consider industrial waste in the NIR.

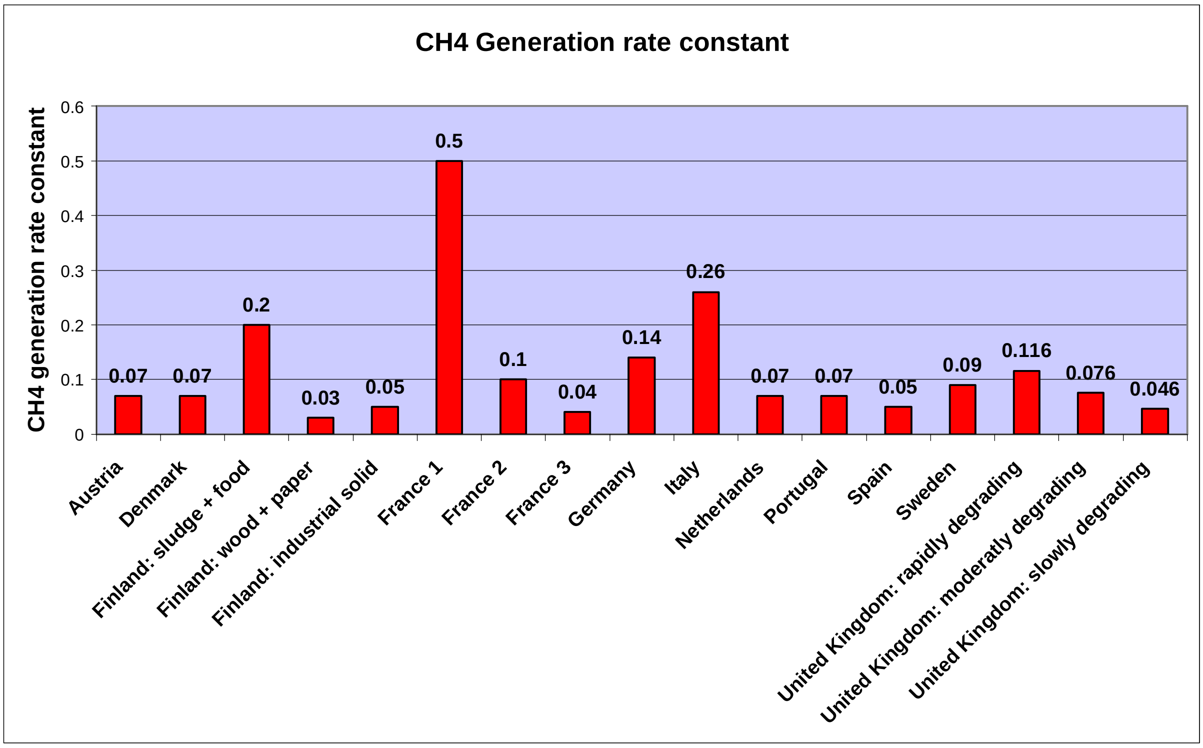
Table 8.14: Methodological issues regarding industrial waste

Member States	**Industrial waste**
Austria	Mixed industrial waste is considered under "non residual waste" but not specified in detail (NIR 2004)
Belgium	A country specific model for industrial waste is applied. The DOC value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCCGood Practice Guidance methodology (equation 5.4, page 5.9). This detailed estimation led to a complete recalculation, as the new estimated DOC were much lower than the default value previously used (NIR 2005).
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in thre emission model (NIR 2005).
Finland	Industrial wastes and sludges are considered beside the solid municipal, construction and demolition wastes and municipal sludges as emission source on solid waste disposal sites. Activity data and DOC of industrial sludge and solid industrial waste are indicated.
France	Industrial waste is neither mentioned nor considered explicitly (NIR 2005)
Germany	Industrial waste is neither mentioned nor considered explicitly (NIR 2005)
Greece	Industrial waste is neither mentioned nor considered explicitly (NIR 2004)
Ireland	The food industry is a significant source of wastewater sludge on SWDS. They remain to be quantified (NIR 2005).
Italy	Industrial waste which is landfilled in SWDS and sludge from wastewater handling plants have also been considered (NIR 2004).
Luxembourg	Industrial waste is neither mentioned nor considered explicitly (NIR 2005)
Netherlands	Industrial waste is neither mentioned nor considered explicitly (NIR 2005)
Portugal	The fermentable part of industrial waste is considered. Time series are based on 1999 data which refer to annual registries relating to industrial unit declarations sent to the regional environment directorates. Historical industrial waste disposal data have been estimated on expert judgment. For the period 1960-199 it was considered a growth rate of 1,5% per year; for the following years (1990-98) 2% per year, data for the years 200 to 2002 are also estimated based on 2% per year growth rate. All industrial waste generated was considered to be disposed in SWDS together with urban waste. However, as there is no available information concerning final industrial waste disposal, it was assumed that all estimated waste produced until 2002 have followed the urban disposal pattern between uncontrolled and controlled SWDS. Except DOC, the same parameters are used for industrial waste as for municipal waste (NIR 2004).
Spain	Industrial waste is neither mentioned nor considered explicitly (NIR 2005).
Sweden	Detailed description how activity data and emissions of relevant industrial waste and sludge are generated.
United Kingdom	The estimates of waste disposal quantities include commercial and industrial waste. For industrial and commercial waste, the data are based on national estimates from a recent study. The data were extrapolated to cover past years based on employment rates in the industries concerned (NIR 2004). In the LQM model, all industrial waste except for blast furnace and steel slag and power station ash is assumed to have some organic content (CRF 2005)

Source: NIR 2005 if available else NIR 2004; CRF 2005 Table 6,C documentation box

Methane generation rate constant: CH_4 is emitted on SWDS over a long period of time rather than instantaneously. The tier 2 FOD model can be used to model landfill gas generation rate curves for individual landfill over time. One important parameter is the methane generation rate constant. It is determined by a large number of factors associated with the composition of waste and the conditions at the site. Rapid rates which are associated with high moisture content and rapidly degradable material can be found for example in Italy and in part of the waste in Finland and France. Figure 8.7 gives an overview of the CH_4 generation rate constants reported by the Member States, while table 8.15 summarizes information on the applied country specific approach.

Figure 8.7: Methane generation rate constant



Source: CRF 2003 Table 6 A,C Additional information. Luxembourg is not considered as there NIR is not available

Table 8.15: Further information on methane generation rate constant

Member States	Information on the half-time respectively the methane generation rate constant
Austria	not applicable in the model
Belgium	no further specification
Denmark	Assumption is that the half-life of the Carbon in the waste is 10 years (NIR 2005).
Finland	Methane generation rate constants are divided into 3 categories: k1= 0.2 sludges and food waste in MSW, k2=0.03 wood waste in MSW and in construction and demolition waste, paper waste containing lignin in MSW, k3=0.05 industrial solid waste and other fractions of MSW than above. Country specific k1 and k2 are according to rapid and slow rate constants in Good Practice Guidance (NIR 2005).
France	no further specification
Germany	A half life of 5 years was assumed. This yields a value of 0.14 for k. The half-life is considerably less than the IPCC default value of 14 years. The small national half-life figure was derived from various literature sources and from information of national experts. The lower half-life could have to do with the composition of land filled waste, as well as with specific technologies for placing waste in landfills, technologies that were specially developed early on in Germany and that are designed to create optimal conditions for decomposition (NIR 2005)
Greece	not applied as Tier 1 method is applied.
Ireland	not applicable
Italy	The maximum methane generation rate constant of 0.26 per year has been assumed due to the high moisture content in Italian landfill sites (Direct communication).
Netherlands	Methane generation rate constant: 0.094 up to and including 1989, decreasing to 0.0693 in 1995 and constant thereafter, this corresponds to half-times of 7.4 and 10 years, respectively. The change in k-values is caused by a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990s (NIR 2005).
Portugal	Two different values were considered for the CH_4 generation rate constant (k), to take into consideration diverse regional circumstances. A higher k value (0.04) was applied for municipalities above Tagus River, reflecting higher moisture conditions, a lower k figure (0.02) was used for the others (NIR 2004). (In the CRF of 2002 generated in 2004 k=0.03 is indicated, therefore there Portugal must have adopted a new methane generation rate constant).
Spain	Methane generation rate constant (k=0.05) have been taken from the IPCC Good Practice Guidance (NIR 2005).
Sweden	National value for half time of 7.5 years (NIR 2005).

United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading and inert waste. These categories each have a separate decay rate. The range from 0.046 (slowly degrading waste) to 0.116 (rapidly degrading waste), they lie within the range quoted in the Good Practice Guidance (NIR 2005)

Source: NIR 2005 if available else NIR 2004; CRF 2003 Table 6 A,C Additional information. Luxembourg is not considered as there NIR is not available

8.3.2 Unmanaged Solid Waste Disposal (CRF Source Category 6.A.2)

CH_4 emissions from unmanaged solid waste disposal were reported in only six Member States in 2003 (France, Greece, Ireland, Italy, Portugal and Spain). All of these Member States apply Tier 2 methods according to the IPCC except Greece which uses the tier 1 methodology (compare Table 8.3). Five of these six Member States (France, Portugal, Spain, Greece and Ireland) still dispose MSW to unmanaged SWDS, compare column 'Annual MSW to unmanaged SWDS' in table 8.16, while in Italy waste disposals from the past still emits (see Table 8.3). The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. According to the Revised 1996 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow, deep or uncategorized. Table 8.17 gives an overview of the MCF applied the relevant Member States.

Table 8.16: Selected parameters for calculating emissions from source category 6.A.2

Member States	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS	MCF CH_4		
			Unmanaged SWDS	deep	shallow
France	X	180.80	0.5	0.00	0.50
Greece	X	1,817.65	0.00	0.60	0.00
Ireland	X	549.79	0.00		0.40
Italy	X	0	0.60	0.00	0.60
Portugal	X	7.36		IE	0.60
Spain	X	189,9440	0.60	0.80	0.40

Source: CRF 2005 table 6 and 6.A

Further country-specific information on unmanaged solid waste disposal is provided in Table 8.17.

Table 8.17: Further information on unmanaged solid waste disposal

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is only if MSWD use compacting or not (email communication with national waste expert April 2005). No further information given in the NIR 2004.
Greece	Out of the existing disposal sites, it is estimated that 25 of them fulfill the criteria set by the IPCC guidelines so as to be considered as 'managed'. The remaining disposal sites is disposed at unmanaged disposal sites. Time series of DOC and MSW quantities disposed on unmanaged SWDS are given for 1990-2002 (NIR 2004).
Ireland	In 1995, 40% of DOC is assigned a MCF of 0.4, on the assumption that 40 percent of MSW is places in unmanaged SWDS of less than 5 m depth: The MSW split between managed and unmanaged sites in 1969 is taken to be the reverse of that adopted for 1995 and appropriate adjustment is made for the intervening years and for the years after 1995 with a gradual increase for managed landfills (NIR 2005).
Italy	The share of waste disposed of into uncontrolled landfills, which was 52.7% in 1975, gradually decreases thanks to the enforcement of new regulations, and it has been assumed equal to 0 in the year 2000, although emissions are released due to the waste disposed in the past years. The unmanaged sites have been considered 50% deep and 50% swallow (NIR 2004). The MCF value for unmanaged landfill results as average of the default IPCC values reported for deep and shallow sites.
Portugal	The share of final disposal destiny (inter alia open dump sites) for the beginning years of the 1960-2002 time series was calculated having as a basis the Quercus survey. Data for recent years refer to data collected from management systems. There have been significant efforts at national level to deactivate and close all uncontrolled dumping sites. This effort was concluded in 2002 when all uncontrolled dumping sites had been closed. Concerning uncontrolled dumping sites, it was considered that there is gas burning when a dumping site has been closed and is associated with a managed landfill having recovery of CH_4. It was assumed that gas burning starts typically 2-3 years after the beginning of the landfill operation. It was assumed that all estimated industrial waste produced until 2002 have followed the urban disposal pattern between uncontrolled and controlled SWDS (NIR 2004).
Spain	In the case of uncontrolled sites, part of the mass is burnt, in order to reduce the volume, and in this case, apart from the biogas emissions from the unburnt MSW fraction, there are also emissions corresponding to the combustion of the fraction burnt. One percent of MSW is dumped onto unmanaged sites. Different MCF values have been applied to uncontrolled landfill sites (0.8 and 0.4) depending on whether they are deep (more than 5 meters) or shallow (less than 5 meters) assuming 50 % of landfills in

	each category. In case of uncontrolled dumping, the estimation of the emissions from the burnt fraction has been effected by multiplying the activity variable by the corresponding emission factors. Of the total waste burnt in uncontrolled dumpsites, it has been assumed that 85 % is of renewable organic origin and 15 % of fossil origin, a ration considered country specific information. Further details are given how the emission factors for the combustion are determined (NIR 2004).

Source: NIR 2005 if available, else NIR 2004.

8.3.3 Waste water handling (CRF Source Category 6.B)

CH_4 Emissions from domestic and commercial waste water handling (6.B.2) are the most significant emission source in category 6.B and key source in the EU. CH_4 emissions from waste water handling are calculated with the help of diverse methods (C,CS,D, M, T1 and T2). The quality of the estimate is low for EU-15, compare (see Table 8.4). Table 8.18 provides an overview of the CH_4 emission sources in wastewater handling which have been identified by the Member States. Furthermore methods applied to determine CH_4 emission from municipal wastewater and sludge handling are described in detail.

Table 8.18: CH_4 emission sources in wastewater handling and methods for determining CH_4 emissions from municipal wastewater and sludge handling

Member States	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Austria	The calculation of CH_4 emissions was taken from a study [STEINLECHNER et al. 1994] . First the amount of generated methane per unit of wastewater is determined for each of the three different types of treatments (mechanical/ biological/ further) separately. These factors were multiplied with the corresponding capacities of the Austrian wastewater treatment plants and then summed up, resulting in total CH_4 emissions for the subsector Commercial and Domestic Wastewater of the year 1993. Emissions from Industrial Wastewater were calculated separately, its wastewater was treated like biological treated wastewater. By dividing the emissions of 1993 by the number of inhabitants of 1993 an implied emission factor for Industrial and Domestic and Commercial Wastewater Treatment was obtained. The main difference between the Austrian and the IPCC method is that the Austrian method calculates emissions using an implied emission factor per inhabitant and not per kg DOC. To calculate emissions therefore the amount of produced biogas was estimated together for industrial and domestic and commercial waste water, based on the amount of organic waste. It was not calculated on the basis of BOD (biochemical oxygen demand) and COD (chemical oxygen demand) (NIR 2005).
Belgium	In this category, two sources of methane emissions are taken into account: the CH_4 emissions from municipal wastewater treatment plants and from sceptic tanks. The methodology for the individual wastewater treatment plant (septic tank) is based on an article (Vasel, 1992) [32], which describes the characteristics and parameters of individual septic tank. In the municipal wastewater treatment plants, the CH_4 and N_2O emissions are estimated by using the methodology described in the EMEP/CORINAIR guidebook [3]. There is a distinction between the emissions from water treatment and sludge treatment.
Denmark	As regards the CRF source category 6 B Waste-water handling, the CH_4 emission is considered of negligible importance due to aerobic wastewater systems.
Finland	A national methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used in estimation of the CH_4 emissions. Emission sources cover municipal and industrial wastewater handling plants and uncollected domestic waste water for CH_4 emissions (NIR 2005). For uncollected domestic wastewaters the Check-method with the default parameters (IPCC Good Practice Guidance) has been used.
France	On the basis of the statistics of the wastewater treatment plants in France, the emissions are calculated according to the IPCC tier 2 method, distinguishing natural lagoons and cesspools (NIR 2004).
Germany	Municipal wastewater treatment in Deutschland uses aerobic procedures (municipal wastewater-treatment facilities, small wastewater-treatment facilities), i.e. it produces no methane emissions, since such emissions occur only under anaerobic conditions. Treatment of human sewage from persons not connected to sewage networks or small wastewater-treatment facilities represents an exception: in cesspools and septic tanks, uncontrolled processes (partly aerobic, partly anaerobic) can occur that lead to methane formation. Organic loads from cesspools and septic tanks are calculated pursuant to the IPCC method, in which the relevant population is multiplied by the average organic load per person;
Greece	CH_4 from waste water handling were estimated according to the default methodologies suggested by IPCC (NIR 2004).
Hungary	Neither appropriate municipal nor industrial wastewater handling data are available for Hungary. Even where they exist, they cannot be considered as comprehensive. For the above reasons, methane emissions from wastewater handling were calculated from basic data available and with emission factors provided in the Revised Guidelines, a bit deviating from the IPCC methodology. Data on municipal and industrial wastewater were collected from the Inspectorate for Environmental Protection, which are based on own measurements and those taken by the producers of wastewater. Information on sludge produced during wastewater treatment and the distribution of decomposing matter between water and sludge is not available at all, therefore it was not calculated (NIR 2005).
Ireland	CH_4 from wastewater handling were not estimated for the CRF 2005.
Italy	In Italy wastewater handling is managed mainly using aerobic treatment plants, where the complete-mix activated sludge process is more frequently designed. It is assumed that domestic and commercial wastewaters are treated 100% aerobically, whereas industrial wastewaters are treated 85% aerobically and 15% anaerobically. Consequently, there are no CH_4 emissions from the treatment of domestic and commercial wastewaters. The stabilization of sludge, both in domestic and industrial wastewater treatment plants, occur in aerobic or anaerobic reactors; whereas anaerobic digestion is used, the reactors are of course covered and provided of gas recovery; therefore, emissions from sludge disposal do not occur (NIR 2004). CH_4 emissions have been estimated from sludge stabilisation occurring in Imhoff tanks (3-5% of total

	sludge anaerobically treated).
Netherlands	Country-specific methodology is used for CH_4 from wastewater handling, which is equivalent to the IPCC Tier 2 method. A full description of the methodology is provided in Oonk et al. (2004). The present Tier 2 methodology complies with the IPCC Good Practice Guidance (IPCC, 2000) (NIR 2005).
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines (IPCC,1997) and GPG (IPCC,2000), which follows three basic steps: 1. Determination of the total amount of organic material originated in each wastewater handling system 2. Estimation of emission factors and 3. Calculation of emissions. In the national inventory all calculations have been done at municipal territorial units. National totals result from the summation of estimates performed for each municipality (NIR 2004).
Spain	For the treatment of waste water in the residential and commercial sectors, the methodology used has been derived from the IPCC Reference Manual and the EMEP/CORINAIR Guidelines. The activity variable taken has been the organic load in terms of tonnes of BOD5. To calculate this variable, the datum used has been the population effectively served by the residential waste water treatment plants. For the degradable organic load, a burden of 21.9 kg BOD5/inhabitant equivalent per year and 0.75 as the fraction for the degradable organic load was taken into account. The emissions on the water and sludge lines are obtained as the product of the activity variable by the methane emission factors, discounting from this result the amount of methane recovered (NIR 2005).
Sweden	CH_4 emissions from wastewater handling do not occur in Sweden.
United Kingdom	The methodology of the UK model differs in some respects from the IPCC default methodology. The main differences are that it considers wastewater and sewage together rather than separately. It also considers domestic, commercial and industrial wastewater together rather than separately. Emissions are based on empirical emission factors derived from the literature expressed in kg CH_4/tonne dry solids rather than the BOD default factors used by IPCC. The model however complies with the IPCC Good Practice Guidance as a national model (IPCC, 2000). Emissions from sewage are calculated by disaggregating the throughput of sewage into 14 different routes. The routes consist of different treatment processes each with its own emission factor. The allocation of sludge to the treatment routes is reported for each year (NIR 2002).

Source: NIR 2005 if available else NIR 2004; CRF 2005 Table 6 B; Luxembourg is not considered as there NIR is not available

CH_4 emissions from industrial wastewater and sludge handling are not key sources but the reporting of these emissions by Member States is very inhomogeneous and seems to be difficult. Emissions from sludge handling are reported only by one Member State (Spain), other Member States either did not estimate the emissions (seven Member States: Belgium, Denmark, France, Greece, Ireland, Portugal, United Kingdom) or reported the emissions elsewhere (four Member States: Austria, Finland, Netherlands and Sweden). Emissions from industrial wastewater handling are reported by seven Member States (Austria, Finland, Greece, Italy, Netherlands, Portugal, Spain), but five Member States indicate either that emissions are not estimated (Belgium, Ireland, United Kingdom), or that emissions are reported elsewhere (Denmark) or that this category is not applicable (Sweden). An overview of methodological issues regarding CH_4 emissions from industrial wastewater and sludge handling is provided in table 8.19.

Table 8.19: CH_4 emissions from industrial wastewater and sludge handling and methods applied

Member States	CH_4 from industrial waste		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	x	IE	Industrial wastewater is managed like biological treatment, so methane emissions of biological treatment (F2) are multiplied by the delivery rate of industrial treatment plants (IWWT). To calculate emissions the amount of produced biogas was estimated together for industrial and domestic and commercial waste water (NIR2005).
Belgium	NE	NE	
Denmark	IE	NE	Data is available for the Danish wastewater treatment systems for centralised municipal WWTPs, where major part of WW is treated. A significant part of Industrial WW is treated at those WWTPs and emissions from this part are covered by the methodology used. For Industry, only data concerning effluents to surface water are available. No data regarding industrial on-site WW treatment processes or final sludge disposal are available at a level that allows for calculation of on-site industrials WW contribution to CH_4 emissions. Although some data is available for a separation of WW Industrial and Domestic and Commercial this separation has not been done in this CRF reporting (CRF 2005).
Finland	x	IE	A national methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used in estimation of the CH_4 emissions. The emissions from industrial wastewater treatment are based on the COD load. Formula is provided in the NIR 2005.
France	0	NE	For industrial wastewater, emissions from treatments on site are not estimated (CRF 2005). Due to the major use of aerobic treatment system CH_4 emissions are very small. So due to the lack of data emissions are not estimated (email communication with national waste expert April 2005).
Germany	NO	0	The composition of industrial wastewater, in contrast to that of household wastewater, varies greatly, by industrial sector. In Germany, the biological stage of industrial wastewater treatment is partly aerobic and partly anaerobic. Anaerobic wastewater treatment is especially useful for industries whose wastewater has

Member States	CH_4 from industrial waste		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			high levels of organic loads. This treatment method has the advantages that it does not require large amounts of oxygen, produces considerably smaller amounts of sludge requiring disposal and generates methane that can be used for energy recovery. As in treatment of municipal wastewater, treatment of industrial wastewater releases no methane emissions into the environment. The procedures used include aerobic treatment and anaerobic purification; gas formed in the latter procedure is either used for energy recovery or is flared off (NIR 2005).
Greece	**x**	**NE**	The methodology for calculating methane emissions from industrial wastewater is similar to the one used for domestic wastewater. In order to estimate the total organic waste produced through anaerobic treatment, the following basic steps were accomplished: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2001. Data on industrial production for 2002 were not available and for this reason production was estimated through linear extrapolation. Calculation of generated wastewater, by using the default factors per industrial sector (m^3 of wastewater/t product) as suggested by the IPCC Good Practice Guidance. Calculation of degradable organic fraction of waste, by using the default factors (kg COD/m^3 wastewater) suggested by the IPCC Good Practice Guidance for each sector / sub-sector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling (NIR 2004).
Ireland	**NE**	**NE**	
Italy	**x**	**NO**	The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective DOC for each major industrial wastewater source. No country specific emission factors of methane per COD are available so the default value of 0.25 kg CH_4/kg DC, suggested in the IPCC GPG had been used for the whole time series. As recommended by the GPG for key source categories, data have been collected for several industrial sectors (food and beverage, paper and pulp, organic chemicals, iron and steel, textile, leather industry). National data have been used in the calculation of the total amount of both COD produced and wastewater output for: pulp & paper sector, beer, wine, milk and sugar sectors. The introduction of leather sector has improved the emission estimation (NIR 2004).
Luxembourg			
Netherlands	**x**	**IE**	CH_4 emission from industrial wastewater refer to anaerobic industrial waste water treatment plants. The major part of the Dutch industry emit in the sewer system which is connected to municipal waste water treatment plants. These emissions are included in the category: Domestic and commercial waste water (CRF 2005).
Portugal	**x**	**NE**	Emissions from industrial wastewater are first rough estimates based on national estimates for industry wastewater organic content, and default emission factors from Corinair Guidebook (CH_4 and N_2O) and national data for domestic wastewater (COVNM). Quantities of industrial wastewater organic charge (in millions of inh. eq.) were multiplied by an emission factor for each pollutant considered (NIR 2004).
Spain	**x**	**x**	For the treatment of industrial waste water, the methodology followed has been derived from the IPCC Reference Manual for the area sources (general statistic information) and the EMEP/CORINAIR Guidebook for the point sources (sectorial questionnaires). The activity variable taken for point sources has been the volume of waste water purified in the oil refineries and paper pulp works, where the information has been obtained through questionnaires, and for area sources it has been the organic load in terms of chemical oxygen demand in water and sludge, with the basic variables coming from the discharge regulation studies carried out by the Directorate General for Hydraulic Works and Water Quality at the Ministry of the Environment for the food sectors in 1994 and chemistry sector in 1996. In order to extend the time series homogeneously for the food and chemistry sectors, the corresponding values from the industrial production index produced by the Spanish National Statistics Institute were used (NIR 2005).
Sweden	**NA**	**IE**	CH_4 emissions from Waste water handling do not occur.
United Kingdom	**NE**	**NE**	Industrial waste is considered together with commercial and domestic wastewater. There is no estimate made of emissions from private wastewater treatment plants operated by companies prior to discharge to the public sewage system or rivers (NIR 2005). They are not estimated but believed to be small (CRF 2005)

Source: NIR 2005 if available else NIR 2004; CRF 2005 Table 6.B

According to the IPCC Good Practice Guidance, the emission factor for determining CH_4 emissions from wastewater and sludge handling is composed of the maximum methane producing potential (B_0) and the methane conversion factor (MCF). There is an IPCC default value available for the maximum methane producing potential which is applied in most of the Member States. In contrast, the MCF has to be determined country specifically and varies strongly among the Member States depending on wastewater and sludge treatment systems used; table 8.20 provides an overview of the MCF applied by the Member States.

Table 8.20: Methane Conversion Factors

Member States	MCF	Specification of MCF	Further information on MCF
Austria	**20°C = 35%** **10°C = 10%**	(67% of a year) (33% of a year)	Apart from temperature sewage provides ideal conditions for methane production: moisture, pH value and nutrient supply. The temperature is too low, this is taken into account by applying a methane conversion factor (MCF). Calculations are made with an average temperature of 20°C for 8 months and 10°C for the rest of the year.
Belgium			
Denmark	**0,4**	Anaerobic treatment of sludge	
Finland-	**0.01**	Collected domestic wastewater	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on country specific knowledge
France	**0.23** **0.35**	"natural" lagoons septic system	Country specific data from experts
Germany	**0.5**	Cesspools and septic tanks	The MCF for cesspools and septic tanks has been estimated on the basis of experience gained other in countries (septic tanks in the U.S., anaerobically treated municipal wastewater in the Czech Republic).
Greece			
Ireland			
Italy			Default IPCC emission factors have been used: g CH_4/g BOD= 0.6 for domestic wastewater and sludge treatment and g CH_4/g COD=0,25 for industrial wastewater.
Netherlands	**0.54** **0.035**	Sludge handling Aerobic waste water treatment	
Portugal	**1** **0.5** **0.1** **0.18** **0.17**	Anaerobic Digestion Imhoff tank Percolation beds Other treatment Average	Average MCF factors for wastewater treatment systems were weighted by the percentage of each type of treatment for each region, and using the MCF values established by expert judgement for each treatment type. MCF evolution over time was estimated considering an annual average variation rate of: -2% for wastewater treatment plants, and +5% for sludge.
Spain	**0.15** **0.3** **0.005** **0.3**	industrial wastewater industrial sludge domestic wastewater domestic wastewater sludge	
Sweden			
United Kingdom			

Source: NIR 2005 if available else NIR 2004

All Member States report N_2O Emission from waste water handling. Different methods are applied (C, CS, D, T1 and T2). The quality of the estimates is considered to be low by eight Member States and medium by three Member States. In table 8.21 the methods for determining N_2O emissions from wastewater handling applied by the Member States are described in detail.

Table 8.21: Methods for determining N_2O emissions from wastewater handling

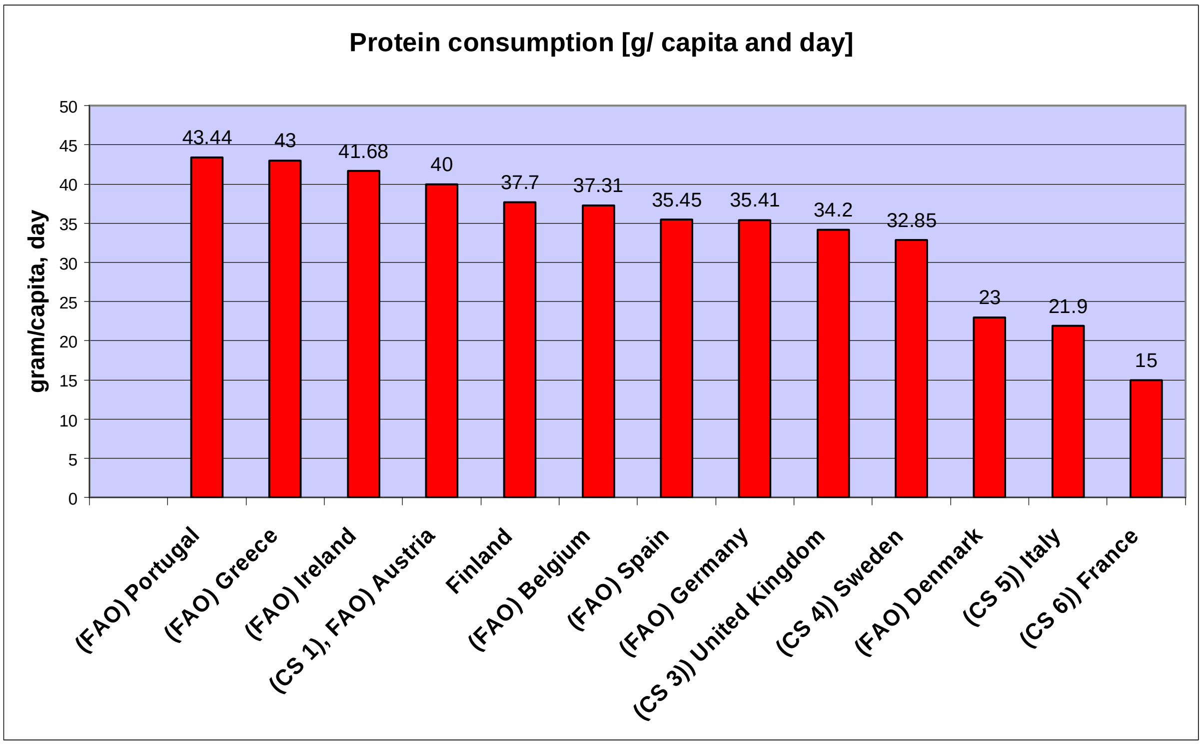
Member States	N_2O Emissions from wastewater 1)		Description of methods used (N_2O)
	Industrial	domestic	
Austria	**X**	**O**	N_2O emissions from domestic, commercial and industrial waste water were calculated in accordance with the IPCC methodology with the assumption that industry introduces additional 30% of the nitrogen from the human metabolism into the wastewater system [ORTHOFER et al., 1995]. According to this study about 75% of the domestic and commercial sewage in Austria is treated in sewage plants. Furthermore it was estimated in this study that about 10% of the nitrogen that enters wastewater treatment plants is denitrificated and that only 1% of the total nitrogen in the denitrification process is emitted as N_2O (NIR 2005).
Belgium	**0**	**X**	In Wallonia and in Brussels, the N_2O emissions are estimated by using the methodology described in the IPCC Guidelines. In Flanders, N_2O emissions are estimated by using the methodology described in the EMEP/CORINAIR guidebook (NIR 2005).
Denmark	**IE**	**X**	Emissions of N_2O was divided into direct and indirect emission contributions, i.e. from the wastewater handling and effluents, respectively. Indirect emissions was divided into contributions from indutrial dischrages, rainwater conditioned effluents, effluents from scattered houses, from mariculture and fish farming and from WWTPs. The method are

Member States	N_2O Emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	domestic	
			described in the Danish NIR 2005.
Finland	**NE**	**NE**	In Finland, the N input from fish farming and from municipal and industrial wastewaters into the waterways is collected into the VAHTI database. For municipal wastewaters the measured values have been considered more reliable than the N in-put according to population data. In addition to the IPCC approach, also nitrogen load from industry and fish farming were taken into account. For uncollected wastewaters the nitrogen load is based on population data. The assessed N_2O emissions cover only the emissions caused by the nitrogen load to waterways. In addition to the emissions caused by nitrogen load of domestic and industrial wastewaters also the emissions caused by the nitrogen load of fish farming have been estimated. N_2O emission calculations are consistent with the IPCC method for discharge of sewage (NIR 2005).
France	**0.91**	**3.22**	N_2O from industrial sites is estimated according to the total N rejected into water (not collected and treated by domestic systems). N_2O from human sewage: Approximatively 40% of total N entering into domestic wastewater handling systems are eliminated (CRF 2005).
Germany	**NE**	**NE**	IPCC Default Method
Greece	**0**	**0**	N_2O from waste water handling were estimated according to the default methodologies suggested by IPCC (NIR 2004).
Ireland	**NE**	**NE**	Emissions of N_2O from human sewage discharges reported under source category 6.B wastewater handling have been made following the IPCC methodology (NIR 2005).
Italy	**X**	**IE**	N_2O emissions from domestic and commercial wastewater are included in human sewage (CRF 2005).
Luxembourg			
Netherlands	**NE**	**X**	Country-specific methodology is used for N_2O emissions from wastewater handling, which is equivalent to the IPCC Tier 2 method. A full description of the methodology is provided in Oonk et al. (2004) (NIR 2005). Since the N_2O emissions from urban waste water handling are a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance (IPCC, 2000) (NIR, 2005). N_2O from industrial wastewater is considered as minor source and no data available (CRF 2005).
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines (IPCC,1997) (NIR 2004).
Spain	**0**	**0**	
Sweden	**X**	**X**	National activity data on nitrogen in discharged wastewater (industry and domestic waste water) is used, in combination with a model estimating nitrogen in human sewage from people not connected to municipal wastewater treatment plants.
United Kingdom	**NE**	**NE**	Nitrous oxide emissions from the treatment of human sewage are based on the IPCC (1997c) default methodology.

1) according to table6 B in CRF 2005; X= emissions are reported;NE= not estimated; IE= included elsewhere
Source: NIR 2005 if available else NIR 2004; CRF 2005 Table 6.B

One important parameter for the determination of N_2O emissions from wastewater handling, the daily per capita protein consumption is country-specific and applied by almost all Member States, an overview of the values in given in Figure 8.8.

Figure 8.8: Protein consumption in kg per capita and day



Source: CRF 2005 Table 6 B; NIR 2005 if available else NIR 2004

CS= Country specific value; FAO= FAO data basis
CS 1) STATISTIK AUSTRIA CS 2) "Food in Spain (La alimentación en España)" from the Spanish Ministry of Agriculture, Fisheries and Food (MAPA)"CS 3) DEFRA, 2002: The National Food Survey, 1990-02 CS 4) National value, National Food Administration. 2002. www.slv.se CS 5) INRAN - Istituto Nazonale di Ricerca per gli Alimenti e la Nutrizione, 1997. CS 6) no further specification of source

8.3.4 Waste Incineration (CRF Source Category 6.C)

Emissions from waste incineration are reported by eight Member States in 2003 (Austria, Belgium, France, Sweden, United Kingdom, Italy, Spain and Portugal). Two of those Member States assume the quality of the estimate to be low (Austria, United Kingdom), two Member States describe the quality as high (Sweden, Portugal) and two as medium (France, Italy). In Table 8.22 an overview of category descriptions and methodological issues is provided.

Table 8.22: Emission reported and methodological issues of CRF category 6.C

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category CO_2 emissions from incineration of corpses and waste oil are included as well as CO_2, CH_4 and N_2O Emissions from municipal waste incineration without energy recovery. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year (NIR 2005).
Belgium	X	N_2O Emissions from domestic waste incineration are calculated using activity data known from the individual companies involved combined with the emission factor of CITEPA. For CO_2 emissions, each region applies its own methodology according to the available activity data. In *Flanders*, only the fraction of organic-synthetic waste is taken into consideration (assuming that organic waste does not give any net CO_2 emissions). For the municipal waste, the institute responsible for waste management in Flanders (OVAM) is given the analysis of the different fractions in the waste. Based on this information, the amount of non-biogenic waste (excluding the inert fraction) is determined. The carbon emission factor is based on data from literature for the different fractions involved. For industrial waste, the amount of biogenic waste is considered to be the same as in municipal waste. The remaining amount is considered to be the non-biogenic part in which no inert fraction is present. For industrial waste, it is more difficult to determine the content of C and therefore the results of a study carried out by the Vito 'Debruyn en Van Rensbergen 'Greenhouse gas emissions from municipal and industrial wastes of October 1994' are used. This study gives a content of C of the industrial waste of 65,5 %. In *Wallonia*, following a legal decree in 2000, the air emissions from waste incineration are measured by ISSEP and the results are validated by a Steering Committee . These results allow a crosscheck with the results of measurements directly transmitted by the incinerators to the environmental administration. There is a distinction between the emission from municipal waste incineration and hospital waste incineration. The CO_2 emissions of

		municipal waste incineration are reported assuming that 68 % of the waste is composed of organic material. This is based on the average garbage composition in Wallonia and the use of IPCC equation on organic content of the various materials. The CO_2 emissions from hospital waste incineration are measured by the Walloon incinerators and are fully reported. Emissions from the incineration of corpses are calculated using the EMEP/CORINAIR emission factors and statistical data on the number of corpses. In *Brussels*, The emission factors for the incineration of hospital and municipal waste and corpses are estimated by measurements in situ in connection with EMEP/CORINAIR emission factors. The emissions of CO_2 form the flaring in the chemical industry are reported in Category 6.C according to IPCC Guidelines.
Denmark		
Finland		
France	X	Carbon dioxide of biogenic origin was excluded from the emission estimates. Only waste incinerators without energy recovery are considered in this category. The incineration of special industrial waste is partially included according to the information available. Furthermore the incineration of utilised greenhouse films is included (NIR 2004)
Germany		
Greece		
Hungary	x	Municipal waste is incinerated at only one plant in Hungary, at Budapest Waste Incineration Plant Co., where energy recovery is taking place as well. The incinerator is currently under renovation so it is operated at a lower capacity. The objective of the reconstruction is to decrease emission of pollutants from the incinerator. Information on waste incinerators and joint incinerators is currently being processed. We estimate incinerated industrial waste at 20 % to 25 % of municipal waste. In calculating N_2O emissions we applied the value of 8.33 kg/t as suggested in Good Practice (NIR 2004).
Ireland		
Italy	x	Existing incinerators in Italy are used for the disposal of municipal waste, together with industrial waste, hospital waste, sewage sludge and waste oil. Emissions from removable residues from agricultural production are included in this IPCC category. They refer mainly to olives and wine residues: the total residues amount and carbon content have been estimated by both IPCC and national factors. In order to improve emission estimations from incinerators, a complete data base of these plants has been built; for each plant a lot of information has been included, among which the year of the construction and possible upgrade, the typology of combustion chamber and gas treatment section, if it is provided of energy recovery (thermal or electric), the type and amount of waste incinerated (municipal, industrial, etc.). Different procedures were used to estimate emission factors, according to the data available for each type of waste. With regard to municipal waste, on the basis of the IPCC Guidelines (IPCC, 1997) and referring to the average content analysis on a national scale a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. On the other hand, CO_2 emissions from the incineration of sewage sludge were not included at all, while all emissions relating to the incineration of hospital and industrial waste were included. Removable residues from agriculture production are estimated for each crop type (cereal, green crop, permanent cultivation) taking in account the amount of crop produced, the ratio of removable residue in the crop, dry matter content of removable residue, the ratio of removable residue burned, the fraction of residues oxidised in burning, the carbon and nitrogen content of the residues. On the basis of these parameters CH_4 and N_2O emissions have been calculated. CO_2 emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC Guidelines (IPCC, 1997) and country-specific values, when available (CESTAAT, 1992; Borgioli, 1981). Emissions from olives and wine residues are more than 65% of the total emissions from removable residues (NIR 2004).
Luxembourg		
Netherlands		The source category waste incineration is included in source category 1A1 '*Energy industries'* since all waste incineration facilities also produce electricity or heat used for energetic purposes and according to the *IPCC Guidelines* (IPCC, 1997), these should be reported under category 1A1a. Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports. The fossil-based and organic CO_2 emissions from *waste incineration* (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fractions of fossil C in total C is assumed, which will yield the CO_2 emissions. The method is described in detail in *Joosen and De Jager (2003)* and in the monitoring protocol (Ruyssenaars, 2005).
Portugal		
Spain	X	The amount of municipal solid waste entering the incineration process in all the incinerators in operation without energy recovery was obtained from the publication "The Environment in Spain". The information of the emission factors has been taken assuming that the control technique used is the one for "control of particles". For SO_2, NO_x, VOC, CO, N_2O and NH_3 the emission factors are taken from EMEP/CORINAIR Guide Book. For CO_2 a factor of 324 kg/ton has been assumed, calculated assuming 36% of fossil origin and 64% of biogenic origin in the waste and considering that the overall factor forCO_2 per ton of waste is 900 kg(fossil + biogenic)/ton.
Sweden		Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6.C. In earlier submissions, CRF 1.A.1a included emissions from combustion of hazardous waste. These emissions are reallocated and now reported under CRF 6.C for better compliance with the 1996 revised IPCC Guidelines. Reported emissions are for the whole time series obtained from the facility's Environmental report or directly from the facility on request. CO_2, SO_2 and NO_x are measured continuously in the fumes at the plant. In 2003 capacity was increased substantially at the plant by taking one new incinerator into operation. The new incinerator incinerates a mixture of MSW, industrial waste and hazardous waste. As a consequence of increased capacity, the emissions in 2003 increased compared to earlier years. Emissions reported are CO_2, NO_x, SO_2 and NMVOC. According to information from the facility, occasional measurements concerning CH_4 and N_2O have been performed. The CH_4 measurement showed very low or non-detectable amounts. CH_4 is therefore reported as NA in the CRF tables. For N_2O the occasional measurements showed levels giving emissions in the approximate order of 0.2 Mg N_2O/year. N_2O is reported as NE in the CRF-tables.

Portugal	X	Until 1999, incineration of solid wastes refers to uncontrolled combustion of industrial solid waste on land and to incineration of hospital hazardous wastes. In 1999, two new incineration units started to operate in an experimental regime. These units are exclusively dedicated to the combustion of MSW which is composed of domestic/commercial waste. The components of fossil origin – plastics, synthetic fibbers and synthetic rubber – are to be accounted in the estimated. The non-biogenic components fractions are considered to be different for MSW, industrial solid waste and clinical waste. In all cases it was assumed incineration occurring without energy recovery. Non CO_2 emissions were estimated as the product of the mass of total waste combusted, and an emission factor for the pollutant emitted per unit mass of waste incinerated (NIR 2005).
United Kingdom	X	Incineration of chemical wastes, clinical wastes, sewage sludge and animal carcasses is included here. There are approximately 70 plant incineration chemical or clinical waste or sewage sludge and approximately 2600 animal carcass incinerators. Animal carcass incinerators are, typically, much smaller than the incinerators used to burn other forms of waste. This source category also includes emissions from crematoria. Emissions are taken from research studies or are estimated on literature based emission factors, IPCC default values, data reported by the Environment Agency's Pollution Inventory.

X = Emissions are reported in source category 6.C
Source: NIR 2005 if available, else NIR 2004.

8.3.5 Waste – Other (CRF Source Category 6.D)

Under CRF source category 6.D eight Member States report emissions. Emissions from composting have been reported by five Member States (Austria, Belgium, Finland, Netherlands and Italy), Portugal indicates emissions from open burning of industrial waste and Spain from domestic and commercial wastewater sludge spreading, compare Table 8.23. Luxembourg does not provide further information from which emissions source the emissions derived in this source category.

Table 8.23: Reported emissions under CRF source category 6.D

Member States	Specification of "other waste"	6 D CO_2	6 D CH_4	6 D N_2O	6 D NO_x
Austria	Compost production	0.00	1.19	0.18	0.00
Belgium	Composting	0.00	15.99	0.00	0.00
Finland	Composting etc.	5.17	0.27	NO	NO
Italy	Compost production	0	0.18	0.00	0.00
Netherlands	Large scale organic waste composting	0.00	3.3	0.1	0.0049
Portugal	Open burning of industrial waste	0.5	0.09	0.65	0.04
Spain	Domestic/Commercial Wastewater sludge spreading		29.35	0.00	0.00
Luxembourg		0.19	0.00	0.00	0.00

Source: CRF 2005 Table 6

In Table 8.24 the source category is described further in detail.

Table 8.24: Description and methodological issues of source category CRF 6.D

Member States	Waste – Other
Austria	Emissions were estimated using a country specific methodology. To estimate the amount of composted waste it was split up into three fractions of composted waste: 1) mechanical biological treated residual waste, 2) bio waste, loppings, bio composting, 3) sewage sludge. CH_4 emissions were calculated by multiplying an emission factor (CH_4 and N_2O) based on national references by the quantity waste (NIR 2005).
Belgium	CH_4 emissions from compost production are estimated in Flanders using regional activity data combined with emission factors of CITEPA.
Finland	No further specification in the NIR 2005.
Italy	Under this source category, CH_4 emissions from compost production have been reported. The amount of waste treated in composting plants has shown a nearly 15-fold increase in Italy from 363,319 in 1990 to 5,361,471 in 2002. Since no methodology is provided by the IPCC for these emissions, literature data (Hogg, 2001) has been used for the emission factor, 0.029 kgCH_4/kg treated waste (NIR 2004).
Netherlands	This source category consists of some CH_4 and negligible N_2O emissions from industrial composting. A country-specific methodology for this source category is used with activity data from *WAR (2004)* and emission factors from *VROM (2002)* (see monitoring protocol, Ruyssenaars, 2005). Emissions from small-scale composting of garden waste and food waste by households are not estimated as this is assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the *IPCC Good Practice Guidance* (IPCC, 2000). (NIR, 2005) The used emission factors are: * 2.4 kg CH_4/ton composted organic waste * 1.1 kg CH_4/ton anaerobic digested organic waste * 0.096 kg N_2O/ton composted organic waste * 0.046 kg N_2O/ton anaerobic digested organic waste * 0.18 kg NO_x/ton anaerobic digested organic waste.
Portugal	No further specifications in the NIR 2004.

Spain	No further specifications in the NIR 2005.

Source: NIR 2005 if available, else NIR 2004.

6.5.1 EU-15 uncertainty estimates

Table 8.25 shows the total EU-15 uncertainty estimates for the sector 'Waste' and the uncertainty estimates for the relevant gases of each source category. The highest uncertainty was estimated for CH_4 from 6.D and the lowest for CH_4 from 6.A. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 8.25: EU-15 uncertainty estimates for the sector 'agriculture'

Source category	Gas	Emissions 2003 1)	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
6.C Waste incineration	CO_2	3.016	2.937	97%	19%
6.A Solid waste disposal on land	CH_4	73.779	70.308	95%	15%
6.B Waste water handling	CH_4	7.981	5.881	74%	42%
6.C Waste incineration	CH_4	539	266	49%	54%
6.D Other	CH_4	986	331	34%	200%
6.B Waste water handling	N_2O	9.224	7.721	84%	127%
6.C Waste incineration	N_2O	358	190	53%	94%
Total Waste	**all**	**96.728**	**87.634**	**91%**	**17%**

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some countries 2002 data and for Belgium 2001 data

8.4 Sector-specific quality assurance and quality control

Under the Climate Change Committee a workshop is being planned for Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop are: (1) to provide an opportunity to learn about the methods used for inventories and projections in the different Member States, to share information, experience and best practice; (2) to compare the parameters chosen in the estimation methodologies across EU-15 Member States; (3) to compare emissions and methods used for GHG inventories with data and methods for EPER; and (4) to strengthen links between assessment of air pollution under the IPPC and emissions under the UNFCCC. In addition, the workshop will provide an opportunity to discuss potential methodological changes or improvements of the draft 2006 IPCC inventory guidelines. The workshop is targeted at experts who have direct experience in compiling and analysing GHG emission projections and inventories from the waste sector.

8.5 Sector-specific recalculations

Table 8.26 shows that in the waste sector large recalculations were made for CH_4 in 1990 and for N_2O in 2002.

Table 8.26 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 6: 'Waste', for 1990 and 2002 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
Waste	-352	-5,2%	2.431	2,0%	1.076	13,4%	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
Waste	-653	-14,3%	-690	-0,8%	435	4,7%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.27 provides an overview of Member States' contributions to EU-15 recalculations. The United Kingdom and Belgium were responsible for the most recalculations for CO_2, Spain, Portugal and Greece for CH_4 and N_2O.

Table 8.27 Contribution of Member States to EU-15 recalculations in CRF Sector 6: 'Waste' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2002					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	411	-5	NO	NO	NO	0	373	177	NO	NO	NO
Belgium	-580	0	160	NO	NO	NO	-1.074	-74	158	NO	NO	NO
Denmark	0	224	88	NO	NO	NO	0	302	58	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	-133	-42	143	NO	NO	NO	-333	181	177	NO	NO	NO
Germany	NE	0	1	NO	NO	NO	NE	0	0	NO	NO	NO
Greece	21	1.261	327	NO	NO	NO	220	-1.177	-369	NO	NO	NO
Ireland	0	76	54	NO	NO	NO	0	0	60	NO	NO	NO
Italy	-52	902	-2	NO	NO	NO	-95	1.121	-8	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	-881	153	389	NO	NO	NO	0	281	235	NO	NO	NO
Portugal	0	1.850	-1	NO	NO	NO	-21	2.633	-7	NO	NO	NO
Spain	141	-2.404	-80	NO	NO	NO	39	-4.363	-41	NO	NO	NO
Sweden	44	0	0	NO	NO	NO	61	29	-6	NO	NO	NO
UK	1.088	1	1	NO	NO	NO	550	2	2	NO	NO	NO
EU15	**-352**	**2.431**	**1.076**	**NO**	**NO**	**NO**	**-653**	**-690**	**435**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated

Explanations for recalculations of more than 1000 Gg of CO_2 equivalents are given in table 8.28. Explanations for most recalculations are provided in section 10.1.

Table 8.28: Main reasons for recalculations > 1000 Gg of CO_2 equivalents in CRF sector 4 'Agriculture'

BE	CO_2	6.C: Method: Adjustment of partition of waste into a biogenic fraction and a non-biogenic fraction was made for Flanders; Removal: Municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)
UK	CO_2	6.A: Methods/Addition/removal: Methodology change to now report CO_2 emissions in sector 6.A.1 from the disposal of wood treated with preservatives derived from benzols and tars
GR	CH_4	6.B: Emission factors: Updated EF according to GPG 6.A: Activity data: Updated data on MSWDS
PT	CH_4	6.A: see tables 10.1 and 10.2
ES	CH_4	6.A: see tables 10.1 and 10.2

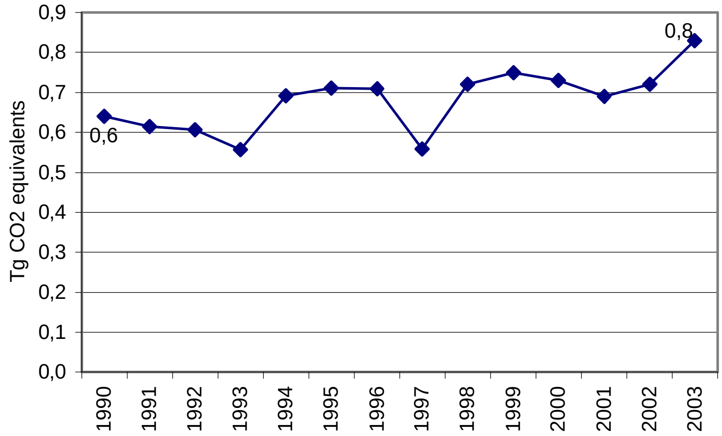
9 Other (CRF Sector 7)

This chapter provides information on emission trends, source allocations of Member States and recalculations in CRF Sector 7: 'Other'. No information on methods, emission factors and uncertainty estimates is included in this chapter because the sector does not contain an EU-15 key source ([25]). Neither is included a section on sector-specific QA/QC as no such activities are performed in this sector.

9.1 Overview of sector

CRF Sector 7 'Other' is the smallest sector contributing 0.02 % to overall EU-15 GHG emissions. CO_2 is the ony gas under 'Other'; emissions from 'Other' have increased since 1990 (+ 30 %). In 2003, the emissions increased by 15 % compared to 2002.

Figure 9.1 EU-15 GHG emissions 1990–2003 from CRF Sector 7: 'Other' in CO_2 equivalents (Tg)



Only Finland reports emissions under 'Other'. The Finnish emissions derive from non-energy use of oil products and natural gas.

9.2 Methodological issues and uncertainties

This report does not include more information on methodological issues because the emissions in this sector are caused by one Member State only.

9.3 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

9.4 Sector-specific recalculations

Table 9.1 shows that in CRF Sector 7: 'Other', recalculations were made mainly for 2002.

([25]) In this report, overview tables on methodologies and on uncertainties are only presented for the EC key sources as identified in Section 1.5 due to time restrictions (see Section 1.8.5). For information on sector-specific methods used by the Member States see Member States' submissions.

Table 9.1 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 7: 'Other', for 1990 and 2002 by gas (Gg and percentage)

1990	**CO_2**		**CH_4**		**N_2O**		**HFCs**		**PFCs**		**SF_6**	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-122.396	-3,8%	-9.539	-2,1%	16.013	4,1%	200	0,7%	-276	-1,7%	125	1,2%
Other	0	0,0%	-43	-100,0%	-1.181	-100,0%	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	-165.492	-5,1%	-7.491	-2,1%	8.640	2,6%	-3.682	-7,4%	279	5,2%	406	4,4%
Other	0	-0,1%	-38	-100,0%	-1.185	-100,0%	NO	NO	NO	NO	NO	NO

NO: not occurring

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Tables 10.1 and 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2002 for each Member State, which provided the relevant information. For each Member State, those three sources have been identified which had the largest recalculations in absolute terms. In addition, all recalculations of more that 1 000 Gg are presented. For more details see the information provided by the Member States' submissions in Annex 13.

Table 10.1 Main recalculations in the Member States for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Austria			
Total emissions excluding LUCF	827		
CO_2 from 1.A.4	577	1.A.4 (stationary): Activity data: Energy statistics was revised by STATISTIK AUSTRIA. Details are provided in the NIR. 1.A.4 (mobile): Activity data were updated by a national transport model.	CRF 1990, Table 8(b)
CH_4 from 6.A	413	6.A.1: Emission factors: as recommended in the Centralized Review 2004 the IPCC default CH_4 oxidation factor (0.1) was applied. 6.A.1: Activity data: disposed waste data have been updated on the basis of information from new reporting obligation of disposal site operators.	CRF 1990, Table 8(b)
CO_2 from 1.A.3	-354	1.A.3b: Emission factors: have been updated using the new handbook of emission factors (version 2.1). The handbook is the result of new measurements. Activity data: have been updated using a national transport model.	CRF 1990, Table 8(b)
Belgium			
Total emissions excluding LUCF	-63		
CO_2 from 1.A.1	1 692	Emission factors/activity data: use of directly reported emissions for large power plants instead of calculations based on activity data and default IPCC emission factors	NIR 2005, p. 77
N_2O from 4.D	-1 235	Activity data: N content in the non-fixing crops has been changed from IPCC default values to cropspecific values	NIR 2005, p. 64
CO_2 from 6.C	-580	Method: Adjustment of partition of waste into a biogenic fraction and a non-biogenic fraction was made for Flanders; Removal: Municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)	NIR 2005, p. 75
Denmark			
Total emissions excluding LUCF	578		
CH_4 from 6.B	200	Emission factors/activity data: Emission estimates for Wastewater handling has been introduced in this submission.	CRF 1990, Table 8(b)
CO_2 from 3	193	A survey based on new methodologies results in new NMVOC emission estimates	CRF 1990, Table 8(b)
N_2O from 6.B	88	Emission factors/activity data: Emission estimates for	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		Wastewater handling has been introduced in this submission.	
Finland			
Total emissions excluding LUCF	-6 417		
CO_2 from 4.D	-3 208	Addition/removal/replacement: CO_2 emissions are included under cropland and grassland in LULUCF sector	CRF 1990, Table 8(b)
CO_2 from 1.B.1	-2 997	Emission factors: Revised EF based on preliminary results of new measurements Activity data: Improved activity data from surveys Addition/removal/replacement: Emissions from areas previously reported as areas reserved for peat production have been removed due to improved data collection and identified double counting with Agriculture/LULUCF sector (cultivation of organic soils)	CRF 1990, Table 8(b)
CO_2 from 1.A.4	-602	Methods: Times series consistency has been improved: changes in recent years (incl. 2003) have been applied to the whole time series Emission factors: Consistent use of EFs throughout the time series has been implemented Activity data: Changes in Energy statistics (allocation) have been applied consistently to the whole time series	CRF 1990, Table 8(b)
France			
Total emissions excluding LUCF	3 273		
N_2O from 4.B	3 824	Method: distribution of manure management systems previously used have been modified according to french data	CRF 1990, Table 8(b)
CH_4 from 4.B	-1 057	Method: distribution of manure management systems previously used have been modified according to french data	CRF 1990, Table 8(b)
CO_2 from 1.A.2	363	No documentation available	
Germany			
Total emissions excluding LUCF	-5 019		
CH_4 from 4.B	-6 613	4.B.1(Other Cattle), 3,6,8: Activity data: figures 2002/ 2003 have been updated due to new information of animals in Hamburg, Bremen, Berlin 4.B.1(Dairy cows): Activity data: total recalculation from 1990 until 2002 4.B.1: Emission factors have been recalculated from 1990 until 2003 due to wrong factors for pasture range and paddock	CRF 1990, Table 8(b)
N_2O from 4.D	5 766	Indirect soil emissions: Activity data: Number of animals (ewes) for the years 1991 - 1993 were recalculated for Mecklenburg-Vorpommern, Thüringen, Sachsen, Sachsen-Anhalt, 1990 - 2003 new information of mineral fertilizers in Bremen, Berlin and Hamburg were considered, recalculation from 1990 until 2003 Method: indirect emissions from atmospheric deposition were calculated by C/ CS (Massflow calculation of emissions of reactive nitrogen according to CORINAIR) Direct soil emissions: Activity data: emissions from the application of nitrogen fertilizers were recalculated from 1990 until 2003 due to recalulated nitrogen fertilizers for Berlin, Bremen, Hamburg Activity data: new figures for 2002/2003 for emissions from agricultural land use area and legumes Activity data: updated estimation of area of organic soils for	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		emissions from cultivated histosols Method for emissions from animal wastes applied to soil: N returned to soil, according to the massflow approach Activity data (emissions from animal wastes applied to soil): Recalculation from 1990 until 2003, number of animals (ewes) for the years 1991 - 1993 were recalculated for Mecklenburg-Vorpommern, Thüringen, Sachsen, Sachsen-Anhalt; 1990 - 2003 new information of mineral fertilizers in Bremen, Berlin and Hamburg were considered	
CH_4 from 1.B.1	-1 827	1.B.1a: Activity data: Information is now based on more detailed and exact statistical data by the "Statistic coal industries e.V." from base year onwards	CRF 1990, Table 8(b)
CH_4 from 1.B.2	-1 456	No documentation available	
Greece			
Total emissions excluding LUCF	4 663		
N_2O from 4.D	3 248	Inclusion of indirect emissions from agricultural soils	NIR 2004
CO_2 from 1.A.4	2 685	Allocation of emissions from agricultural machinery to agriculture (1.A.4.c) instead of transport (1.A.3)	NIR 2004
CO_2 from 1.A.3	-2 684	Allocation of emissions from agricultural machinery to agriculture (1.A.4.c) instead of transport (1.A.3)	NIR 2004
CH_4 from 6.B	1 419	Inclusion of CH_4 emissions from industrial waste water handling	NIR 2004
Ireland		No recalculations for the years 1990–2001.	
Total emissions excluding LUCF	488		
N_2O from 4.D	424	4.D.1: Activity data: The activity data for F_{AM}, the manure nitrogen input to soils, is calculated according to GPG Equation 4.23 where previously it was calculated according to the 1996 IPCC Guidelines	CRF 1990, Table 8(b)
CH_4 from 6.B	76	The activity data for F_{AM}, the manure nitrogen input to soils, is calculated according to GPG Equation 4.23 where previously it was calculated according to the 1996 IPCC Guidelines	CRF 1990, Table 8(b)
N_2O from 6.B	54	Activity data: FAO estimate of protein intake of about 114 g/capita/day annually for the population of Ireland now adopted instead of national value of 60 g/capita/day previously used	CRF 1990, Table 8(b)
Italy			
Total emissions excluding LUCF	2 315		
CO_2 from 1.A.2	-2 877	No documentation available	
CO_2 from 1.A.1	2 140	No documentation available	
N_2O from 2.B	938	No documentation available	
Luxembourg		No recalculations	
Netherlands			
Total emissions excluding LUCF	320		
CO_2 from 1.A.2	-9 424	Methods: based on energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
N_2O from 4.D	4 294	Now includes indirect emissions Methods: new Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO_2 from 2.B	3 538	Method: now partly based on NEU from energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO_2 from 1.A.3	-3 391	Methods: based on energy statistics	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		Activity data: improved data Emission factors: improved data	
CO_2 from 2.C	2 909	Method: now partly based on NEU from energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO_2 from 1.A.4	2 519	Methods: based on energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CH_4 from 1.B.2	- 1 709	Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CH_4 from 4.A	- 1 117	Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
Portugal			
Total emissions excluding LUCF	1 499		
CH_4 from 6.A	1 802	Method: Previously used First Order Decay model - equation 3 IPCC 1996 - was changed to equation 4, which is a derivative of Eq. 3 and allows a better consideration of variances in annual SW disposed into land. Emission factor: to take account of in-country review recommendations, k parameter (methane generation rate) was changed to 0.07. Activity data: Fermentable industrial waste: new data for 2000 and 2002 were used. Municipal waste: updates for 2002 and 2003. According to in-depth review recommendations, new estimates for the composition of municipal wastes were used, which enable the use of different DOC values reflecting the evolution in the composition of solid waste.	CRF 1990, Table 8(b)
CO_2 from 1.A.3	-323	Method: Correction of the duplication of CO_2 emissions estimates from NMVOC evaporative emissions. CO_2 emissions are estimated now solely from fuel consumption.	CRF 1990, Table 8(b)
N_2O from 4.D	292	4.D.1: Activity data: Nitrogen added to soil as synthetic fertilizer and Manure is now reported after ammonia volatilisation and hence the IEF equals the default IPCC. But this action has caused no change in emission estimates 4.D.1: Addition/removal/replacement: Manure in Liquid Systems is now assumed to be applied to soils and contributing to N_2O emissions. 4.D.2: Method: FracLEACH is applied before ammonia volatilisation in accordance with IPCC GP. Formally it was applied after volatilisation 4.D.2: Activity data: Revision of Ammonia volatilisation from synthetic fertilizers after detailed consideration of specific fertilizers (urea, etc)	CRF 1990, Table 8(b)
Spain			
Total emissions excluding LUCF	-699		
CH_4 from 6.A	1 935	Method: The following parameters involved in the calculations of the emissions of methane have been revised: i) the oxidation factor for the methane generated and not recovered (OX), given the value of 0.1 recommended in the IPCC Good Practice Guide for industrialized countries with well monitored landfill sites, instead of the value of 0.05 in the previous edition; ii) the constant rate of methane generation (K) now taken is 0.05 as recommended by the IPCC Good Practice Guide as the default value if no information is available for this, instead of the 0.1 value used in the previous edition. The methane recovered has also been revised, assuming that a maximum of 70% of the methane generated can be achieved; this restriction was not present in the previous edition. The most relevant of the	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		changes indicated in terms of its (downward) repercussion on the emissions is the parameter "k" that implies a change in the mean period of 7 to 13 years for degradation of the waste.	
CO_2 from 1.A.2	1 923	1.A.2a: Emission factor: Furthermore, with the new information available for the PNA, the historical series for 1990-2002 on the characteristics of the siderurgy gases and other fuels used in the sinter, pig-iron and steel from integrated iron and steel plants in he integrated siderurgy and the fuels used in the electric steel plants have been revised, giving as a result a revision of the associated emission factors. 1.A.2a: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on fuel consumption used in sinterisation plants, blast and steel furnaces in the integrated siderurgy as well as in the steel mills of the electric steel plants have been revised. 1.A.2b: Activity data: The recalculations are derived from the changes implied by sub-sections 4.1.2; 4.1.4 and by the adjustment in the energy balance sheet for the final fuel consumption in the industry. 1.A.2c: Activity data: The recalculations are derived from the changes implied by sub-sections 4.1.2; 4.1.4 and by the adjustment in the energy balance sheet for the final fuel consumption in the industry. 1.A.2d: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on fuel consumption used in the paper pulp and paper and cardboard manufacturing plants have been revised, as already indicated in sub-section 4.1.2. Another reason for the recalculations in this sector come from the modifications made in connection with co-generation activities as mentioned above in sub-section 4.1.4. 1.A.2f: Emission factor: For mobile industrial machinery: Revision of the CO_2 emission factor, derived from the estimated content of carbon in the fuel. 1.A.2f: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on fuel consumption used in the lime, glass and glass fibre manufacturing plants have been revised, as have those for the manufacture of glass-frit, ceramic wall and floor tiles and the manufacture of bricks and roof tiles. With respect to mobile industrial machinery the fuel consumption series has been revised, indexing it to the changes in the evolution of the "Building and Civil Engineering Works by Companies" indicator indicated in the Ministry of Public Works Yearbook (the consumption data for the years 1993-1996 have been kept the same as in the previous edition, as a direct estimate of fuel consumption was available for these years, provided by the related professional association ATEMCOP (Spanish Technical Professional Association of Machinery for Public Works and Mining)	CRF 1990, Table 8(b)
CO_2 from 2.A	1 382	2.A.3: Addition/removal: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on the consumption of this kind of raw materials in the following sectors: i) glass manufacture, ii) glass-frit manufacture, iii) manufacture of bricks and roof tiles. The CO_2 emissions from the decarbonation of the limestone and dolomite consumed in the manufacture of magnesite, included in the previous edition of the inventory in category 2.A.7 with the emissions of other types of carbonates consumed in this industry, have now been included here. 2.A.7: Emission factor: The revisions commented in the	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		preceding paragraph have entailed the assignation of differentiated CO_2 emission factors depending on the type of product (porous vs. non-porous). 2.A.7: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on consumption carbonated materials in the manufacture of ceramic wall and floor tiles, has been revised distinguishing between the types of product (porous vs. non-porous) for the estimation of the CO_2 emissions due to decarbonation. 2.A.7: Addition/removal: The CO_2 emissions from only materials other than limestone (calcium carbonate) and dolomite (calcium-magnesium carbonate) consumed in the manufacture of magnesite and in the glass industry have now been included here, whereas in the previous edition of the inventory this category included the emissions from all types of carbonates consumed in these industries except for sodium carbonate, which was placed in its corresponding category 2.A.4.	
CO_2 from 2.C	1 205	2.C.2: Activity data: Revision of ferromanganese and silicon-manganese production data for 1997 to 2000. 2.C.3: Emission factor: Revision of the implicit CO_2 emission factor through the realization at one of the plants of an input/output balance sheet for carbon in the process for manufacturing pre-baked anodes, instead of using a default emission factor. 2.C.3: Method: Revision of the method for estimating the emissions of PFCs in the three existing aluminium production plants, which now become Tier 2, as the Company owning the plants has stopped considering the parameters previously provided for Tier 3b to be representative.	CRF 1990, Table 8(b)
Sweden			
Total emissions excluding LUCF	71		
CO_2 from 2.C	163	2.C.1 (steel): emissions have been reported in CRF 2C1 Other 2.C.1 (blast furnace gas): acitvity data: revision of activity data and emission due to former linkage error 2.C.1 (other-steel production): acitvity data: new activity data has been added	CRF 1990, Table 8(b)
CH_4 from 1.A.3	- 144	Mobile combustion: Methods: Diesel used in stationary combustion have been excluded from total delivered amounts Emission factors: new emission factors for navigation, off-road vehicles and working machinery. Activity data: new activity data for off-road vehicles and working machinery 1.A.3b: Methods: calculations from road traffic have been adjusted	CRF 1990, Table 8(b)
N_2O from 1.A.4	- 104	1.A.4b-c: Mobile combustion: Methods: Diesel used in stationary combustion have been excluded from total delivered amounts Emission factors: new emission factors for navigation, off-road vehicles and working machinery. Activity data: new activity data for off-road vehicles and working machinery	CRF 1990, Table 8(b)
United Kingdom			
Total emissions excluding LUCF	5 367		
CO_2 from 1.A.1	7 697	Method: Method improvement as a result of an on-going task to improve the accuracy of fuel use estimates for the	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		cement industry, the lime industry, and the electricity supply industry. This necessarily affects estimates from other industrial combustion. This is a therefore a re-allocation of emissions. Emission factors: Carbon emission factors for solid, liquid and gaseous fuels have been updated following a review of the CEFs in the UK GHG inventory. 1.A.1c: Method: Method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation.	
CO_2 from 1.A.2	3 153	Emission factors: Carbon emission factors for solid, liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory. 1.A.2a: Method: Method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation. There has been a re-allocation of certain fuels which affects the emissions in 1A2a, 1A2f and 2C1. 1.A.2f: Method: Method of estimating emissions from the use of coke in "other industrial combustion" in sector 1A2f (1990 to 1994 inclusive) improved. 1.A.2f: Method: Method improvement as a result of continuing task to improve the accuracy of fuel use estimates for the cement industry, the lime industry, and the electricity supply industry. This necessarily affects estimates from other industrial combustion. This is a re-allocation of fuel use and therefore emissions. 1.A.2f: Addition/removal: A change has been made to re-allocate the emissions of coke used in the blast furnace of a primary lead zinc smelter from 2C1_Iron&Steel to 1A2f (as this an non-ferrous metals process, not an iron and steel process). 1.A.2f_{ii}: Method: Improvement to model used to estimate emissions from industrial off-road mobile machinery.	CRF 1990, Table 8(b)
CO_2 from 1.B.2	-2 374	1.B.2a_i: Method: Methods of estimating emissions from onshore and offshore oil and gas sectors revised. Has affected the sum of emissions in sectors 1B2ai_Oil_Exploration (Offshore oil and gas - well testing), and, 1B2ciii_Flaring (Offshore oil and gas - flaring) for 1990 to 2000 inclusive.	CRF 1990, Table 8(b)
CO_2 from 1.A.4	- 2 362	Emission factors: Carbon emission factors for solid, liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory. 1.A.4a: Removal: Re-allocation of emissions from coke in 1A4a_Commercial/Institutional to 1A2f other industrial combustion. Only affects 1990 and 1991. 1.A.4b: Addition/removal: Re-allocation of emissions from sector 1B1b_Solid_Fuel_Transformation to sector 1A4b_Residential. Previously, it was assumed that emissions from the combustion of petroleum coke occurred in the fuel transformation sector. In fact, the emissions from the combustion of this fuel occur when small amounts of pet. coke are incorporated into some grades of domestic smokeless fuel produced within the fuel transformation process. This fuel is then burnt by householders. Emissions from the consumption of this petroleum coke are now assigned to the IPCC fuel "Other Bituminous Coal".	CRF 1990, Table 8(b)
CO_2 from 1.B.1	- 2 140	Emission factor: Revision to emission factors for Coke Oven Gas (COG) following a review of the CEFs in the UK GHG inventory.	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CH_4 from 1.B.1	1 083	No explanatory information	
CO_2 from 6.A	1 019	Methods/Addition/removal: Methodology change to now report CO_2 emissions in sector 6A1_Managed_Waste_Disposal_on_Land from the disposal of wood treated with preservatives derived from benzols and tars . This change is a consequence of the revision to the method used to estimate emissions from the manufacture of iron & steel. In previous inventories emissions from the combustion of these compounds was included as part of the emission from coal use in coke ovens - however these compounds are not burnt in this sector. Emissions from the decomposition of these fossil fuel derived preservatives have now been allocated to sector 6A1.	CRF 1990, Table 8(b)

Table 10.2 Main recalculations in the Member States for 2002 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Austria			
Total emissions excluding LUCF	1 813		
CO_2 from 1.A.2	1 891	Stationary: Activity data: Energy statistics is revised for all subcategories by STATISTIK AUSTRIA. Details are provided in the NIR. Mobile: Activity data: Updated by national transport model.	CRF 2002, Table 8(b)
CO_2 from 1.A.1	-1 665	1.A.1a: Emission factors: CO_2 emissions factor for municipal waste is updated according to information from plant operators. 1.A.1a: Activity data: Energy statistics is revised by STATISTIK AUSTRIA. Details are provided in the NIR. Activity data reported due to emission declarations for plants > 50 MWth are completed for the year 2002. 1.A.1b: Method: The methodology is now more transparent and consistent regarding activity data and selection of emission factors. 1.A.1b: Emissions factor: Plant Specific emission factors are used. In the previous submission the CO_2-emissions were reported by the plant operator and disaggregated to fuels from the energy statistics. 1.A.1b: Activity data: 1990 to 2002: Energy statistics is revised by STATISTIK AUSTRIA. 1.A.1c: Activity data: 1990 to 2002: Energy statistics is revised by STATISTIK AUSTRIA. Details are provided in the NIR. 1.A.1c: Removal: Emissions from LPG used in gas works were double counted with gas works gas.	CRF 2002, Table 8(b)
CO_2 from 2.C	573	2.C.1: Method: process specific CO_2 emissions from pig iron production have been recalculated as the underlying activity data used for the calculation (non-energy use of coke) has been updated in the national energy balance 2.C.1: Emission factor: for calculating CO_2 emissions	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		electric arc furnaces now a country specific emission factor is used (previously an emission factor taken from a Swiss publication was applied). 2.C.1: Activity data: Update for 2002 2.C.2: Addition: Addition of CO_2 emissions 2.C.3: Activity data: Activity data used for calculation of CO_2 emissions from Aluminium production has been harmonized	
Belgium			
Total emissions excluding LUCF	-4 634		
CO_2 from 1.A.2	-3 382	1.A.2a: Addition/removal: CO_2 emissions from electric arc furnaces were recalculated and allocated to 1.A.2a. 1.A.2c: Recalculation of non-energy use and related CO_2 emissions 1.A.2f: Activity data: Energy consumption in the quarries is taken into account in 1.A.2f. 1.A.2f: Activity data: Availability of new detailed activity data on the use of biomass fuels in cement kilns from cement plants;	NIR 2005, p. 40
CO_2 from 1.A.1	1 244	Addition: Municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)	NIR 2005, p. 75
CO_2 from 6.C	-1 074	Method: Adjustment of partition of waste into a biogenic fraction and a non-biogenic fraction was made for Flanders; Removal: Municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)	NIR 2005, p. 75
Denmark			
Total emissions excluding LUCF	505		
CH_4 from 6.B	277	Emission factor/Activity data: Emission estimates for Wastewater handling has been introduced in this submission.	CRF 2002, Table 8(b)
N_2O from 6.B	58	Emission factor/Activity data: Emission estimates for Wastewater handling has been introduced in this submission.	CRF 2002, Table 8(b)
CO_2 from 1.A.4	53	Method/Emission factor: In the Submission. in 2004 for invent. 1990-2002 the Coal fuel cat. included Coke and Brown Coal Briquettes. In this Submission. individual CO_2 EFs are applied for these three fuels. The consumption of Coke and BCB is very low and so is the change in CO_2 emission. Emission factor: The CO_2 emission factor for Fish & Rape oil has been changed. However, this is a biomass fuel and the cons. is very low.	CRF 2002, Table 8(b)
Finland			
Total emissions excluding LUCF	-4 782		
CO_2 from 1.B.1	-2 906	Emission factor: Revised EF based on preliminary results of new measurements Activity data: Improved activity data from surveys Removal: Emissions from areas previously reported as areas reserved for peat production have been removed due to improved data collection and identified double counting with Agriculture/LULUCF sector (cultivation of organic soils)	CRF 2002, Table 8(b)
CO_2 from 4.D	-2 057	Removal: CO_2 emissions are included under cropland and grassland in LULUCF sector	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO_2 from 1.A.5	250	Methods: Times series consistency has been improved: changes in recent years (incl. 2003) have been applied to the whole time series Emission factors: Consistent use of EFs throughout the time series has been implemented Activity data: Changes in Energy statistics (allocation) have been applied consistently to the whole time series	CRF 2002, Table 8(b)
France			
Total emissions excluding LUCF	-332		
N_2O from 4.B	3544	Method: Modification of the distribution of manure management system previously used according to French data	CRF 2002, Table 8(b)
CO_2 from 1.A.2	-2 786	Activity data: Energy consumption for manufacturing industries updated	CRF 2002, Table 8(b)
CO_2 from 1.A.1	2276	1.A.1a: Emission factor: Review of CO_2 emission factor for domestic waste incineration with energy recovery 1.A.1a: Activity data: Activity updated	CRF 2002, Table 8(b)
CO_2 from 1.A.4	-2 101	1.A.4a: Activity data: Energy consumption for commercial and institutional updated 1.A.4b: Activity data: Energy consumption for residential updated	CRF 2002, Table 8(b)
Germany			
Total emissions excluding LUCF	-822		
CH_4 from 4.B	3544	Activity data: Total recalculation from 1990 until 2002 4.B.1: Emission factor: Recalculation from 1990 until 2003 (Emission Factor pasture range and paddock was wrong)	CRF 2002, Table 8(b)
CH_4 from 1.B.1	-1 827	Activity data: Information is now based on more detailed and exact statistical data by the "Statistic coal industries e.V." from base year onwards	CRF 2002, Table 8(b)
CH_4 from 4.A	-1 022	Other cattle, pigs, sheep, horses: Activity data: Figures 2002/ 2003 updated, new information of animals in Hamburg, Bremen, Berlin are considered 4.A.1: Dairy cows: Method: county-specific; Emission factor: Recalculation from 1990 until 2002, Activity data: Total recalculation from 1990 until 2002 4.A.1: Other cattle: Method: T1; Activity data: Figures 2002/ 2003 updated, new information of animals in Hamburg, Bremen, Berlin are considered	CRF 2002, Table 8(b)
Greece			
Total emissions excluding LUCF	-1 795		
CH_4 from 6.A	-1 559	Activity data: Updated data on MSWDS	CRF 2002, Table 8(b)
N_2O from 4.D	-519	Activity data: Updated data on cultivated areas, crop production and fertilizers consumption	CRF 2002, Table 8(b)
CO_2 from 2.C	436	Acitvity data: Updated data on steel production	CRF 2002, Table 8(b)
Ireland			
Total emissions excluding LUCF	509		
N_2O from 4.D	449	4.D.1: Activity data: The activity data for F_{AM}, the manure nitrogen input to soils, is calculated according to GPG Equation 4.23 where previously it was calculated according to the 1996 IPCC Guidelines	CRF 2002, Table 8(b)
N_2O from 6.B	60	Activity data: FAO estimate of protein intake of about 114 g/capita/day annually for the population of Ireland now adopted instead of national value of 60 g/capita/day previously used	CRF 2002, Table 8(b)
Italy			
Total emissions excluding	1 185		

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
LUCF			
CO_2 from 1.A.1	6 351	No information	
CO_2 from 1.A.2	-5 053	No information	
HFC from 2.F	-3 541	Emission factor has been corrected	CRF 2002, Table 8(b)
Luxembourg		No recalculations	
Netherlands			
Total emissions excluding LUCF	-304		
CO_2 from 1.A.2	-9 129	Method: Based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO_2 from 2.B	3 126	Method: Now partly based on NEU from energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO_2 from 1.A.1	2 843	Method: Based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO_2 from 1.A.3	-2 670	Method: Based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
N_2O from 4.D	2 319	Method: new Emission factor: improved data Activity data: improved data Addition: Now includes indirect emissions and direct emissions from histosoils and crop residue	CRF 2002, Table 8(b)
CO_2 from 2.C	1 649	Method: Now partly based on NEU from energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO_2 from 1.A.4	1 580	Method: Based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CH_4 from 1.B.2	-1 476	Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO_2 from 1.B.2	-1 231	Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
Portugal			
Total emissions excluding LUCF	4 123		
CH_4 from 6.A	2 592	Method: Previously used First Order Decay model - equation 3 IPCC 1996 - was changed to equation 4, which is a derivative of Eq. 3 and allows a better consideration of variances in annual SW disposed into land. Emission factor: To take account of in-country review recommendations, k parameter (methane generation rate) was changed to 0.07. Activity data: Fermentable industrial waste: new data for 2000 and 2002 were used. Municipal waste: updates for 2002 and 2003. According to in-depth review recommendations, new estimates for the composition of municipal wastes were used, which enable the use of different DOC values reflecting the evolution in the composition of solid waste.	CRF 2002, Table 8(b)
CO_2 from 2.A	1 104	Addition: First time inclusion in the CRF tables of emissions from commercial lime production. Additionally emissions from Lime production in paper pulp industry and in integrated iron and steel production that were formerly reported in source categories: Limestone and Dolomite use (2A3) and Fuel combustion (1A2a) were replaced here.	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		First time estimate of emissions from consumption of limestone in fertilizer industry (production of calcium and magnesium nitrate). Emission factor: Use of CS EF from Glass Production (Carbon Market Allocation Plan (PNALE)) based in plant specific data: consumption of limestone and dolomite	
CO_2 from 1.A.2	1 078	Activity data: Correction of detected errors in fuel consumption (LHV) from coke consumption in the Cement Industry. Use of plant specific LHV for Pet. Coke;	CRF 2002, Table 8(b)
Spain			
Total emissions excluding LUCF	-1 144		
CH_4 from 6.A	3 686	Method: The following parameters involved in the calculations of the emissions of methane have been revised: i) the oxidation factor for the methane generated and not recovered (OX), given the value of 0.1 recommended in the IPCC Good Practice Guide for industrialized countries with well monitored landfill sites, instead of the value of 0.05 in the previous edition; ii) the constant rate of methane generation (K) now taken is 0.05 as recommended by the IPCC Good Practice Guide as the default value if no information is available for this, instead of the 0.1 value used in the previous edition. The methane recovered has also been revised, assuming that a maximum of 70% of the methane generated can be achieved; this restriction was not present in the previous edition. The most relevant of the changes indicated in terms of its (downward) repercussion on the emissions is the parameter "k" that implies a change in the mean period of 7 to 13 years for degradation of the waste.	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO_2 from 2.A	1 908	2.A.2: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on raw materials giving rise to CO_2 emissions due to decarbonation in the production of lime have been revised. 2.A.3: Addition: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on the consumption of this kind of raw materials in the following sectors: i) glass manufacture, ii) glass-frit manufacture, iii) manufacture of bricks and roof tiles. The CO_2 emissions from the decarbonation of the limestone and dolomite consumed in the manufacture of magnesite, included in the previous edition of the inventory in category 2.A.7 with the emissions of other types of carbonates consumed in this industry, have now been included here. 2.A.7: Emission factor: The revisions commented in the preceding paragraph have entailed the assignation of differentiated CO_2 emission factors depending on the type of product (porous vs non-porous). 2.A.7: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on consumption carbonated materials in the manufacture of ceramic wall and floor tiles, has been revised distinguishing between the types of product (porous vs. non-porous) for the estimation of the CO_2 emissions due to decarbonation. 2.A.7: Addition/removal: The CO_2 emissions from only materials other than limestone (calcium carbonate) and dolomite (calcium-magnesium carbonate) consumed in the manufacture of magnesite and in the glass industry have now been included here, whereas in the previous edition of the inventory this category included the emissions from all types of carbonates consumed in these industries except for sodium carbonate, which was placed in its corresponding category 2.A.4.	CRF 2002, Table 8(b)
CO_2 from 1.A.4	1 447	Activity data: For agricultural mobile machinery (tractors), the estimated fuel consumption has been revised, introducing into the calculation a corrective factor to adjust the rated power to the power used, and an additional estimate for consumption during travel off agricultural land. Addition: The motors used in agriculture for irrigation purposes has been added as a distinct activity, as information has become available on the fuel consumption in this activity, as published in the Saving Strategy Report and Energy Efficiency – E4 for the agricultural sector.	CRF 2002, Table 8(b)
CO_2 from 1.A.2	1 283	1.A.2a: Emission factor: Furthermore, with the new information available for the PNA, the historical series for 1990-2002 on the characteristics of the siderurgy gases and other fuels used in the sinter, pig-iron and steel from integrated iron and steel plants in he integrated siderurgy and the fuels used in the electric steel plants have been revised, giving as a result a revision of the associated emission factors. 1.A.2a: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on fuel consumption used in sinterization plants, blast and steel furnaces in the integrated siderurgy as well as in the steel mills of the electric steel plants have been revised. 1.A.2b, c, e: Activity data: The recalculations are derived from the changes implied by sub-sections 4.1.2; 4.1.4 and by the adjustment in the energy balance sheet for the final fuel consumption in the industry. 1.A.2d: On the basis of the new information available for	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		the drafting of the PNA, the historical series for 1990-2002 on fuel consumption used in the paper pulp and paper and cardboard manufacturing plants have been revised, as already indicated in sub-section 4.1.2. Another reason for the recalculations in this sector come from the modifications made in connection with co-generation activities as mentioned above in sub-section 4.1.4. 1.A.2f: Emission factor: For mobile industrial machinery: Revision of the CO_2 emission factor, derived from the estimated content of carbon in the fuel. 1.A.2f: Activity data: On the basis of the new information available for the drafting of the PNA, the historical series for 1990-2002 on fuel consumption used in the lime, glass and glass fibre manufacturing plants have been revised, as have those for the manufacture of glass-frit, ceramic wall and floor tiles and the manufacture of bricks and roof tiles. With respect to mobile industrial machinery the fuel consumption series has been revised, indexing it to the changes in the evolution of the "Building and Civil Engineering Works by Companies" indicator indicated in the Ministry of Public Works Yearbook (the consumption data for the years 1993-1996 have been kept the same as in the previous edition, as a direct estimate of fuel consumption was available for these years, provided by the related professional association ATEMCOP (Spanish Technical Professional Association of Machinery for Public Works and Mining)	
CO_2 from 2.C	1 049	2.C.2: Activity data: Revision of ferromanganese and silicon-manganese production data for 1997 to 2000. 2.C.3: Method: Revision of the method for estimating the emissions of PFCs in the three existing aluminium production plants, which now become Tier 2, as the Company owning the plants has stopped considering the parameters previously provided for Tier 3b to be representative. 2.C.3: Emission factor: Revision of the implicit CO_2 emission factor through the realization at one of the plants of an input/output balance sheet for carbon in the process for manufacturing pre-baked anodes, instead of using a default emission factor.	CRF 2002, Table 8(b)
Sweden			
Total emissions excluding LUCF	-117		
CO_2 from 1.A.3	-224	Method: Ethanol and RME mixed in gasoline and diesel, and diesel used in stationary combustion have been excluded from total delivered amounts of diesel. Emission factor: New emission factors for navigation, off-road vehicles and working machinery. Activity data: New activity data for off-road vehicles and working machinery	CRF 2002, Table 8(b)
CO_2 from 1.A.1	-214	1.A.1a: Removal: Combustion of hazardous waste is reallocated to CRF 6C. 1.A.1b: Activity data: Smaller revisions for the whole time series due to new information about activity data.	CRF 2002, Table 8(b)
CO_2 from 2.C	173	2.C.1 (steel): Removal: Emissions have been reported in CRF 2C1 Other 2.C.1 (other): Activity data: New activity data has been added	CRF 2002, Table 8(b)
United Kingdom			
Total emissions excluding LUCF	8 863		
CO_2 from 1.A.1	9 366	Method: Method improvement as a result of an on-going task to improve the accuracy of fuel use estimates for the cement industry, the lime industry, and the electricity	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		supply industry. This necessarily affects estimates from other industrial combustion. This is a therefore a re-allocation of emissions. Emission factor: Carbon emission factors for solid, liquid and gaseous fuels have been updated following a review of the CEFs in the UK GHG inventory. 1.A.1a: Emission factor: Carbon emission factors for solid, liquid and gaseous fuels have been updated following a review of the CEFs in the UK GHG inventory. 1.A.1a: Activity data: Revision of activity data for MSW and sour gas 1.A.1b: Emission factor: Carbon emission factor changes for Fuel oil, Natural Gas, OPG, Petroleum coke, gas oil and Naphtha. Emission factors updated following a review of CEFs in the UK GHG inventory 1.A.1b: Activity data: Activity data revised for fuel oil, natural gas, OPG, LPG, gas oil, naphtha and petroleum coke 1.A.1ci: Method: Method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation. 1.A.1ci: Emission factor: Update of emissions factors for blast furnace gas, coke oven gas 1.A.1ci: Activity data: Revision to activity data 1.A.1cii: Emission factor: Revision in carbon emission factors for colliery methane, natural gas, OPG following a review of CEFs in the UK GHG 1.A.1cii: Activity data: Revision to activity data	
CO_2 from 1.A.3	1 914	Emission factor: Carbon emission factors for liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory. 1.A.3aii: Method: Major improvement to the method used to estimate GHG emissions from domestic and international aviation - a model based on individual aircraft movements is now used, corresponding to a Tier 3 approach. The split between domestic and international emissions has changed - domestic emissions have declined, with a corresponding increase in emissions allocated to aviation bunkers. 1.A.3aii: Emission factor: Carbon emission factor for aviation spirit revised. 1.A.3aii: Activity data revised 1.A.3b: Method: Model to estimate emissions of GHGs from road transport revised. Improvements to the methodology include more detailed information on traffic speeds on different types of roads and information on the composition of the vehicle fleet. Now includes estimate of GHGs released when lubricating oil is burnt inside car engines. 1.A.3c: Method: Improvement to estimate of emissions from rail transport. Re-allocation of emissions associated with freight, intercity and regional rail movements. 1.A.3dii: Emission factor: Carbon factor for fuel oil and gas oil revised 1.A.3dii: Activity data revised 1.A.3e: Emission factor: Carbon factor revision to gas oil	CRF 2002, Table 8(b)
CO_2 from 1.B.1	-1 891	1.B.1b: Emission factor: Revision to emission factors for Coke Oven Gas (COG) following a review of the CEFs in the UK GHG inventory.	CRF 2002, Table 8(b)
CH_4 from 1.B.1	1 205	1.B.1b: Method: Method of estimating emissions from iron and steel production improved. The new method updates	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation.	
CO_2 from 1.A.4	-1 122	Emission factor: Carbon emission factors for solid, liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory. 1.A.4b: Emission factor: Carbon emission factor revisions following a review of the UK GHG inventory 1.A.4b: Addition/removal: Re-allocation of emissions from sector 1B1b_Solid_Fuel_Transformation to sector 1A4b_Residential. Previously, it was assumed that emissions from the combustion of petroleum coke occurred in the fuel transformation sector. In fact, the emissions from the combustion of this fuel occur when small amounts of petcoke are incorporated into some grades of domestic smokeless fuel produced within the fuel transformation process. This fuel is then burnt by householders. Emissions from the consumption of this petroleum coke are now assigned to the IPCC fuel "Other Bituminous Coal". 1.A.4a: Activity data revised 1.A.4bii: Emission factor: Revision to emission factor for diesel following a review of the UK GHG inventory 1.A.4ci: Emission factor: Revision to emission factors for Natural gas, coal, fuel oil and gas oil following a review of the CEFs in the UK GHG inventory; activity data revised 1.A.4cii: Emission factor: Emission factor revision for gas oil	CRF 2002, Table 8(b)

10.2 Implications for emission levels

Table 10.3 provides the differences in total EU-15 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-15 1990 GHG emissions excluding LUCF have increased in the latest submission compared to the previous submission by 7.201 Gg (+ 0.2 %). EU-15 GHG emissions for 2002 increased 3.070 Gg (+ 0.1 %) due to recalculations.

Table 10.3 Overview of recalculations of EU-15 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total CO_2 equivalent emissions including LUCF (absolute)	-115.873	-215.715	-133.864	-119.881	-135.772	-139.515	-146.646	-132.429	-146.023	-153.223	-156.760	-163.469	-167.340
Total CO_2 equivalent emissions including LUCF (percent)	-2,8%	-5,1%	-3,3%	-3,0%	-3,4%	-3,5%	-3,6%	-3,3%	-3,6%	-3,9%	-3,9%	-4,1%	-4,2%
Total CO_2 equivalent emissions excluding LUCF (absolute)	7.201	7.076	11.050	10.703	8.247	10.262	7.161	18.034	9.561	8.237	9.785	2.573	3.070
Total CO_2 equivalent emissions excluding LUCF (percent)	0,2%	0,2%	0,3%	0,3%	0,2%	0,2%	0,2%	0,4%	0,2%	0,2%	0,2%	0,1%	0,1%

Table 10.4 provides an overview of recalculations for the EU-15 key source categories for 1990 and 2002 (see Section 1.5 for information on identification of EU-15 key sources). The table shows that the largest recalculations in absolute terms were made in the Key Source 1.A.1: 'Energy Industries', (+ 12.117 Gg in 1990 and + 19.973 Gg in 2002).

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 2002. Large recalculations in absolute terms were made in the UK. In relative terms, the highest recalculations were made by Finland.

Table 10.4 Recalculations for the EU-15 key source categories 1990 and 2002 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2002	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1.A.1. Energy Industries	CO_2	12117	1,1%	19973	1,7%
1.A.1. Energy Industries	N_2O	-536	-3,9%	-778	-5,0%
1.A.2. Manufacturing Industries	CO_2	-5985	-0,9%	-16685	-2,9%
1.A.3. Transport	CO_2	-7401	-1,1%	-1862	-0,2%
1.A.3. Transport	CH_4	-122	-2,5%	-71	-2,6%
1.A.3. Transport	N_2O	-882	-7,8%	-667	-2,7%
1.A.4. Other Sectors	CO_2	2756	0,4%	-195	0,0%
1.A.4. Other Sectors	CH_4	-106	-0,9%	-137	-1,8%
1.A.5. Other	CO_2	569	2,8%	778	11,1%
1.B.1. Solid Fuels	CH_4	-556	-1,1%	-586	-3,2%
1.B.2. Oil and Natural Gas	CH_4	-3221	-9,6%	-1546	-5,6%
2.A. Mineral Products	CO_2	941	0,9%	4418	4,1%
2.B. Chemical Industry	CO_2	3138	23,4%	3890	34,1%
2.B. Chemical Industry	N_2O	959	0,9%	403	0,9%
2.C. Metal Production	CO_2	3612	16,9%	3707	20,6%
2.C. Metal Production	PFC	-133	-1,1%	-35	-1,1%
2.C. Metal Production	SF_6	96	4,6%	7	0,2%
2.E. Production of Halocarbons and SF_6	HFC	0	0,0%	-65	-0,7%
2.F. Consumption of Halocarbons and SF_6	HFC	200	57,1%	-3617	-9,0%
2.E. Production of Halocarbons and SF_6	PFC	30	0,5%	-17	-0,3%
2.F. Consumption of Halocarbons and SF_6	SF_6	30	0,5%	-17	-0,3%
4.A. Enteric Fermentation	CH_4	-1834	-1,2%	-1647	-1,2%
4.B. Manure Management	CH_4	-6330	-8,8%	-3889	-5,9%
4.B. Manure Management	N_2O	4418	21,7%	4143	22,5%
4.D. Agricultural Soils	N_2O	12512	6,0%	6761	3,5%
6.A. Solid Waste Disposal on Land	CH_4	1037	0,9%	-1172	-1,5%
6.B. Waste-water Handling	CH_4	1635	18,5%	605	8,1%
6.B. Waste incineration	CO_2	-511	-9,0%	-1427	-31,3%

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5 because the more detailed data was not estimated in the 2003 inventory.

Table 10.5 Contribution of Member States to EU-15 recalculations of total GHG emissions without LUCF for 1990–2002 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	827	493	927	765	565	803	461	706	514	320	443	473	1.813
Belgium	-63	-837	-1.512	-1.386	-1.308	-2.208	-2.602	-1.892	-2.175	-1.862	-1.867	-2.605	-4.634
Denmark	578	520	533	548	33	-255	-246	-400	422	348	506	411	505
Finland	-6.417	-5.484	-4.255	-4.590	-4.511	-4.767	-4.889	-4.726	-5.278	-5.035	-4.888	-4.846	-4.782
France	3.273	3.439	5.561	2.292	3.069	2.832	1.819	3.221	1.693	1.304	2.332	2.076	-332
Germany	-5.019	-5.127	-3.871	-4.758	-389	2.061	2.189	1.576	1.390	1.008	738	450	-822
Greece	4.663	4.260	3.773	3.727	4.127	4.062	3.687	3.349	3.760	3.727	2.675	-1.362	-1.795
Ireland	488	503	520	545	576	598	608	621	641	632	716	723	509
Italy	2.315	1.981	3.053	4.215	3.665	2.993	2.226	1.838	-151	3.244	7.411	1.874	1.185
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	320	-2.012	-2.262	155	-1.230	-468	-1.481	7.052	2.722	2.083	579	-647	-304
Portugal	1.498	1.379	1.608	2.090	2.003	2.250	2.458	2.808	3.221	3.267	2.240	2.884	4.123
Spain	-699	-787	-1.158	-1.580	-1.528	-1.792	-3.207	-2.973	-3.533	-5.189	-4.727	-4.148	-1.144
Sweden	71	69	-109	-80	-194	-341	-20	19	-196	-112	-219	20	-117
UK	5.367	8.679	8.241	8.762	3.369	4.494	6.160	6.836	6.531	4.502	3.845	7.271	8.863
EU15	**7.201**	**7.076**	**11.050**	**10.703**	**8.247**	**10.262**	**7.161**	**18.034**	**9.561**	**8.237**	**9.785**	**2.573**	**3.070**

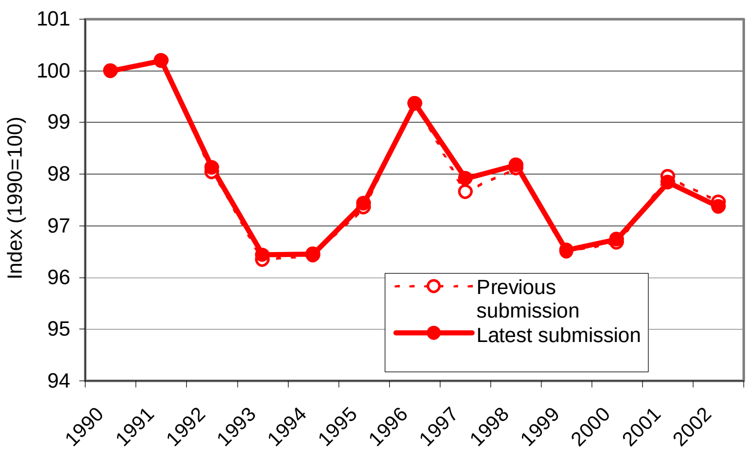
Table 10.6 Contribution of Member States to EU-15 recalculations of total GHG emissions without LUCF for 1990–2002 (difference between latest submission and previous submission in percentage)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	1,1	0,6	1,2	1,0	0,7	1,0	0,6	0,9	0,6	0,4	0,5	0,6	2,1
Belgium	0,0	-0,6	-1,0	-0,9	-0,9	-1,4	-1,6	-1,3	-1,4	-1,3	-1,2	-1,7	-3,1
Denmark	0,8	0,7	0,7	0,7	0,0	-0,3	-0,3	-0,5	0,6	0,5	0,7	0,6	0,7
Finland	-8,4	-7,3	-5,9	-6,3	-5,7	-6,3	-6,0	-5,9	-6,8	-6,5	-6,5	-6,0	-5,8
France	0,6	0,6	1,0	0,4	0,6	0,5	0,3	0,6	0,3	0,2	0,4	0,4	-0,1
Germany	-0,4	-0,4	-0,3	-0,4	0,0	0,2	0,2	0,1	0,1	0,1	0,1	0,0	-0,1
Greece	4,5	4,1	3,6	3,5	3,8	3,7	3,2	2,8	3,0	3,0	2,1	-1,0	-1,3
Ireland	0,9	0,9	0,9	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,7
Italy	0,5	0,4	0,6	0,8	0,7	0,6	0,4	0,4	0,0	0,6	1,4	0,3	0,2
Luxembourg	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Netherlands	0,2	-0,9	-1,0	0,1	-0,6	-0,2	-0,6	3,2	1,2	1,0	0,3	-0,3	-0,1
Portugal	2,6	2,3	2,5	3,4	3,2	3,3	3,8	4,2	4,5	4,1	2,9	3,7	5,1
Spain	-0,2	-0,3	-0,4	-0,5	-0,5	-0,6	-1,0	-0,9	-1,0	-1,4	-1,2	-1,1	-0,3
Sweden	0,1	0,1	-0,2	-0,1	-0,3	-0,5	0,0	0,0	-0,3	-0,2	-0,3	0,0	-0,2
UK	0,7	1,2	1,1	1,3	0,5	0,7	0,9	1,0	1,0	0,7	0,6	1,1	1,4
EU15	**0,2**	**0,2**	**0,3**	**0,3**	**0,2**	**0,2**	**0,2**	**0,4**	**0,2**	**0,2**	**0,2**	**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 the 1990 and 2002 emissions have increased, the emission trend in the EU-15 has hardly changed. In the previous submission the trend of GHG excluding LUCF between 1990 and 2002 was – 2.5 %. In the latest submission this trend has changed to – 2.6 %.

Figure 10.1 Comparison of EU-15 GHG emission trends 1990–2002 (excl. LUCF) 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 EC response to UNFCCC review

The following improvements were made in 2005 in response to UNFCCC reviews:

- More information is provided in the EU-15 CRF tables. Tables 1.C, 2(II), are included for the first time and in several sectoral background data tables (4.A, 4.B, 4.C, 4.D, 4.E, 4.F, 6.A,C) activity data have been included in order to allow the calculation of implied emission factors at EU-15

level. In addition, overview tables have been included in the inventory report including background information on activity data and implied emission factors by EU-15 Member State.
- The EU-15 reference approach is provided for the latest year (2003) for the first time in this submission.
- QA/QC activities have been further extended on the basis of the EC QA/QC programme adopted in October 2004. Also a quantitative Tier 1 uncertainty analysis has been performed on the basis of Member States' Tier 1 uncertainty analysis.
- The transparency of the EC inventory was improved by:
  - providing an analysis of methods used in the sectors 'Industrial processes' and 'Waste';
  - extending the description of methodologies, uncertainty estimates and sector-specific QA/QC for the agriculture and LUCF sector;
  - including overview information at sub-category level on methods used, activity data and emission factors used for the EU-15 key sources.

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EC inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 10.7 provides an overview of Member States' responses to the UNFCCC review ([26]). The table shows that a considerable amount of improvements were made compared with the 2004 submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 10.7 Improvements made by Member States in response to the UNFCCC review

Member State	Improvements in response to UNFCCC review as indicated in the NIR
Austria	**Energy** 1 A 2 Manufacturing Industries and Construction: Sectoral division of natural gas consumption is improved by energy statistics. 1 A 2 a Iron and steel production: Fuel consumption and CO_2 emissions are now corresponding in a more accurate way with pig iron production and process emissions of category 2 C 1 Iron and Steel. 1 A 1 c Manufacture of Solid Fuels and Other Energy Industries: Includes now emissions from oil/gas extraction and compressors for storage and liquidification of natural gas only. **Industrial Processes** 2 F Consumption of Halocarbons and SF_6: emissions from 2001 and 2002 were updated using extrapolation techniques (following recommendations from the ERT) and data from industries, previously the same estimated as for 2000 was used for these years. **Agriculture** Animal Category Other: In Austria animals of category Other which mainly is deer (but not including wild living animals) have been counted from 1993 on. As recommended in the centralized review, in this inventory for the years 1990 to 1992 the animal number of 1993 was used. 4 A, 4 B, 4 D (Non-dairy cattle): The S&A report 2004 noticed high inter-annual variations in the CH_4 and N_2O IEF values between 1992/1993 and 1993/1994. An error regarding activity data of non-dairy cattle for the year 1993 was identified and corrected in this submission. 4 D 3 Atmospheric nitrogen deposition: Following the recommendation of the centralized review (October 2004), in contrast to the last submission also N volatised in housing, storage and pasture was taken into account. Now, in accordance with the IPCC good practice, the value FracGASM relates to N excreted by livestock and not to Nex left for spreading. 4 F Field burning: As recommended in the Centralized Review 2003 the IPCC methodology using default values was applied. CRF-Tables, background data: According to the Centralized Review 2003 emissions from different animal waste management systems (AWMS) are reported under the appropriate AWMS in the CRF. As recommended in the S&A report 2004 in table 4 B (b) notation keys instead of "0" have been used. **Waste** 6 A 1 Managed waste disposal on land: As recommended in the Centralized Review 2004 the IPCC default CH_4 oxidation factor (0.1) was applied. (para 15)
Belgium	**General improvements:** The efficiency of the institutional arrangements for the preparation of the inventory still has been improved. On the technical side, all the sectoral tables have been fulfilled in this submission (in the 2003 submission, some regional sectoral tables were included in the annexes of the NIR). In all regions, the emissions were completely updated for the time series 1990-2002 and provisional emissions are calculated for 2001.
Denmark	For the submissions to UNFCCC April 13, 2004, of inventories 1990-2002 some inconsistencies were pointed out during the consistency phase of the review. The inconsistencies concerned the Industrial Sector

([26]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Improvements in response to UNFCCC review as indicated in the NIR
	and F-gases and their potential emissions and the Agricultural Sector and Livestock data. The inconsistencies did not affect the actual emissions. Denmark used the possibility to correct the inconsistencies and to resubmit the inventories. The resubmission took place May 19, 2004 and was sent in parallel to the Commission, with the explanation that no actual emission was affected by the resubmission. Uncertainty analyses have been improved for this submission. Geographical coverage has also been completed as inventories for Greenland and the Faroe Islands as far as they available have been included in a separate version of CRFs. Further improvements have been made in the different sectors. The review report has not been available when preparing the submission for 2005. All suggestions and comments made by the review teams were considered, but due to the late availability of the review report some improvements are still in progress and will be implemented in the next submission.
Finland	Previously, Finland's inventory submission, besides common reporting format tables (CRF), consisted of a national inventory report (NIR) and a more comprehensive additional methodology report (Greenhouse gas emissions and removals in Finland, Pipatti, 2001). The latest centralized review (16 December 2004) urges Finland to provide more precise references and summaries on the methodologies in the NIR. In the current submissions, this request has been taken into account. Finland has made an effort to include the main content of the methodology report directly in the NIR. This means that the current NIR includes more detailed and updated descriptions on the methodologies and data sources used. The documentation of methodologies will be further improved to the inventory submission of 15 April 2005 to the UNFCCC. A quality management system is currently being developed as an integrated part of the national system and annual inventory process. The latest centralized review (16 December 2004) recommends Finland to focus on the further improvement of QA/QC procedures. Finland has established the national system required in the Kyoto Protocol (Article 5.1). The National Greenhouse Gas Inventory System in Finland will be started on a permanent basis on schedule with the Government resolution; that is, by the end of 2004. In this submission, Finland reports emissions from forestland and cropland by using the new CRF tables. In addition, emissions from the liming of agricultural soils and direct N_2O fertilization on forestland (for the year 2003) are reported with the new CRF tables. The whole LULUCF category reporting is under active development and will be more complete in next submissions. (para 147)
France	[NIR not yet provided]
Germany	Several improvements have been made in this submission. More detailed information about applied methods is available and recalculations in response to the review have been made. Many improvements are planned for the next submission in 2006.
Greece	QA/QC activities since April 2004, were focused on the improvement of the archiving of information and the development of a long term improvement plan as suggested by the in-country review of the Greek GHG inventory. A number of recalculations have been performed since the previous inventory submission in order to improve consistency with UNFCCC reporting guidelines and IPCC guidelines. The recalculations made are driven by the results of the various review process (e.g. UNFCCC technical review of inventories), while prioritisation is based on the key source analysis and the availability of resources.
Ireland	Major research projects on emissions of CH_4 from enteric fermentation and direct N_2O emissions from soils have been completed and a system is being developed for an efficient application of their findings, which includes re-assessment of the values adopted in the past for some of the most important input variables. This re-assessment responds to the inventory review process, which has identified large differences between the Irish values of some variables and IPCC default values or those of other Parties. (Para 56). It has not been possible to fully implement the recommendations for the current reporting cycle but the present NIR mentions some changes and improvements now planned in response to the in-country review report (para 2). Improvements in order to the good practice guidance have been made.
Italy	[NIR not yet provided]
Luxembourg	[NIR not yet provided]
Netherlands	**Response to the issues raised in the UNFCCC reviews is available in chapter 10.4.6** **Inconsistency in time series:** For this submission recalculations for the complete time series were performed for all major sectors, resulting in consistent time series in all sectors. **Missing notation keys and other documentation in CRF tables:** In this submission additional notation keys were included. We also improved the explanation of the NE and IE entries in the documentation boxes of the CRF tables. **Incompleteness of CRF:** Categories 5 B. and 5 D. were not reported in the last submission. These categories are now included in the NIR. **Additional information in the NIR:** An annex with references to other reports 'that should be considered as part of the NIR' was added in this report, which are also publicly available through the internet, as are the NIR and the corresponding CRF files. **Comparison of activity data with international statistics:** Because the recalculation for the fossil fuel related emissions is now completely based on national energy statistics the major part of the above mentioned will be resolved. In the NIR/CRF 2005 the following specific changes were made in the CRF tables (see also *Section 10.4.3*) partly in response to the reviews and partly as a result of the national improvement programme: • CRF tables improved by replacing 0 by notation keys NE, NA, NO, IE, C, where applicable; • Correction of typing/unit errors as observed; • A physical link between the CRF files and the tables of the NIR was further improved to make sure that the data in both are equal.
Portugal	[NIR not yet provided]
Spain	Some recalculations have been made in order to address the recommendations of the in-country review 2003. This largely improved the accuracy and completeness of the inventory series and the emission trends.
Sweden	In response to the UNFCCC review tier 2 source analysis has been implemented and uncertainty estimates have been made. The QA/QC management system has been further developed and several recalculations have been made.
United Kingdom	[NIR not yet provided]

10.4.3 Improvements planned at EC level

Several activities are planned at EC level with a view to improving the EC GHG inventory system:

- The further development of the QA/QC activities in 2005 will include:
  - organisation of a workshop on inventories and projections in the waste sector (see Section 8.4);
  - organisation of an expert meeting on improving the quality of GHG inventories and projections for the LUCF Sector (see Section 7.3);
  - further development of the EC QA/QC programme;
  - preparation of a quality management manual for the EC based on the current draft for use in 2006;
- During the year 2005 further work will be carried out with the aim of improving the quantitative uncertainty estimate for the EU-15 in accordance with the GPG in the 2005 submission.
- The ETC/ACC will adapt the new UNFCCC software for the purposes of the EC inventory in order to further extend the scope of the EC CRF submission.

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Units and abbreviations

t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g
Mg	1 megagram = 10^6 g = 1 tonne (t)
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
Tg	1 teragram = 10^{12} g = 1 megatonne (Mt)
TJ	1 terajoule

AWMS	animal waste management systems
BEF	biomass expansion factor
BKB	lignite briquettes
C	confidential
CCC	Climate Change Committee (established under Council Decision No 280/2004/EC)
CH_4	methane
CO_2	carbon dioxide
COP	conference of the parties
CRF	common reporting format
CV	calorific value
EC	European Community
EEA	European Environment Agency
EF	emission factor
Eionet	European environmental information and observation network
ETC/ACC	European Topic Centre on Air and Climate Change
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
LUCF	land-use change and forestry
LULUCF	land-use, land-use change and forestry
N	nitrogen
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable

NE	not estimated
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
RIVM	National Institute of Public Health and the Environment (The Netherlands)
SF_6	sulphur hexafluoride
UNFCCC	United Nations Framework Convention on Climate Change

Abbreviations in the source category tables in Chapters 3 to 9

Methods applied	**EF: methods applied for determining the emission factor**	**AD: methods applied for determining the activity data**	**Estimate: assessment of completeness**	**Quality: assessment of the uncertainty of the estimates**
C — Corinair	C — Corinair	AS — associations, business organizations	All — full	H — high
CS — country-specific	CS — country-specific	IS — international statistics	F — full	M — medium
COPERT X — Copert Model X = version	D — default	NS — national statistics	Full — full	L — low
D — default	M — model	PS — plant specific data	IE — included elsewhere	
M — model	MB — mass balance	Q — specific questionnaires, surveys	NE — not estimated	
NA — not applicable	PS — plant-specific	RS — regional statistics	NO — not occurring	
RA — reference approach			P — partial	
T1 — IPCC Tier 1			Part — partial	
T1a — IPCC Tier 1a				
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				
T2 — IPCC Tier 2				
T3 — IPCC Tier 3				