Krajowy Ośrodek Bilansowania i Zarządzania Emisjami

POLAND'S NATIONAL INVENTORY REPORT 2013

Greenhouse Gas Inventory
for 1988-2011

Submission under
the UN Framework Convention on Climate Change
and its Kyoto Protocol

Warszawa, May 2013

IOŚ-PIB
INSTYTUT OCHRONY ŚRODOWISKA – PAŃSTWOWY INSTYTUT BADAWCZY
INSTITUTE OF ENVIRONMENTAL PROTECTION – NATIONAL RESEARCH INSTITUTE
00-548 Warszawa, ul. Krucza 5/11d
www.ios.edu.pl
NIP 525-000-73-07
REGON 001240700

Krajowy Ośrodek Bilansowania i Zarządzania Emisjami
00-805 Warszawa, ul. Chmielna 132/134
(22) 56 96 506 (22) 56 96 500
kobize@kobize.pl **www.kobize.pl**

Poland's National Inventory Report 2013

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Submission under the UN Framework Convention on Climate Change and its Kyoto Protocol

Reporting entity:

National Centre for Emission Management (KOBiZE)
at the Institute of Environmental Protection – National Research Institute

Warszawa
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The Authors Team:

Katarzyna Bebkiewicz
Bogusław Dębski
Przemysław Jędrysiak
Monika Kanafa
Iwona Kargulewicz
Anna Olecka
Janusz Rutkowski
Małgorzata Sędziwa
Jacek Skośkiewicz
Damian Zasina
Marcin Żaczek

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EXECUTIVE SUMMARY

ES.1. Background information on greenhouse gas inventories, climate change and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

ES.1.1. Background information on climate change

Poland has been the signatory to the United Nations Framework Convention on Climate Change (UNFCCC) since 1994 and to its Kyoto Protocol since 2002 thus joining the international efforts aiming at combat climate change. One of the main obligations resulting from ratification of the Kyoto Protocol by Poland is to reduce the greenhouse gas emissions by 6% in 2008-2012 in relation to the base year which was chosen as 1988 according to Article 4.6 of the UNFCCC and Decision 9/CP.2. For gases like: HFCs, PFCs and SF_6 the year 1995 was established as the base one.

ES.1.2. Background information on greenhouse gas inventories in Poland

The Polish greenhouse gas inventory is compiled on an annual basis and submitted in the required by the UNFCCC deadline. The underlying National Inventory Report (NIR), submitted in 2013, presents the results of the greenhouse gases (GHGs) inventory in Poland for 2011 as well as for the whole preceding period since 1988.

The Polish inventory covers the following GHGs:

- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons - HFCs (HFC-23, HFC-32, HFC-43-10mee, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-227ea),
- perfluorocarbons - PFCs (perfluoromethane - CF_4, perfluoroethane - C_2F_6, perfluorobutane - C_4F_{10}) and
- sulphur hexafluoride (SF_6).

Information on emissions of the following GHG precursors is also reported: carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2) where data are in line with the current submission under UNECE CLRTAP as well as under NEC directive.

The national inventory and accompanying tables of Common Reporting Format (CRF) have been prepared in accordance with the UNFCCC reporting guidelines on annual inventories (FCCC/SBSTA/2006/9). Methodologies used to calculate emissions and sinks of GHGs are in accordance with methods recommended in publications of Intergovernmental Panel on Climate Change - IPCC, namely *Revised 1996 Guidelines for National Greenhouse Gas Inventories*, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *Good Practice Guidance for Land Use, Land use Change and Forestry*. According to these guidelines country specific methods have been used where appropriate giving more accurate emission data.

The unit responsible for compiling the GHG inventory is the National Centre for Emissions Management (KOBiZE) in the Institute of Environmental Protection National Research Institute, supervised by the Ministry of Environment.

ES.1.3. Background information on supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

Poland, as the Party to the Kyoto Protocol, is required to present additional information in the National Inventory Report since 2010. This information relates to the activities in frames of Article 3.3 of the Kyoto Protocol and selected by Poland additional activities under Article 3.4 (Forest Management), information on accounting of Kyoto units, national inventory system, national registry and on minimization of adverse impacts in accordance with Article 3.14.

Poland's assigned amount units (AAU) for 2008–2012 have been calculated based on GHG emissions for 1988 estimated in 2006 and revised in course of the review of Initial report of Poland under the Kyoto Protocol performed in 2007 [IRR 2007]. The fixed GHG inventory in 1988 amounted to 563 442.774 Gg CO_2 eq., so the Poland's AAU is:

563 442.774 Gg CO_2 eq. * 94% * 5 = **2 648 181.038 Gg CO_2 eq.**

The national Commitment Period Reserve (CPR), which is the minimum quantity of Kyoto Protocol units in the national registry in the first commitment period in 2008−2012, has been estimated on the basis of the reviewed and approved by ERT inventory for 2010, which amounted to 402 409.367 Gg CO_2 eq., multiplied by 5 years:

402 409.367 Gg CO_2 eq. * 5 = **2 012 046.833 Gg CO_2 eq.**

Detail additional information required by the Kyoto Protocol is presented in Part II of the NIR.

ES.2. Summary of national emission and removal related trends, and emission and removals from KP−LULUCF activities

ES.2.1. GHG inventory

The GHG emissions in the base year 1988 and the year 2011, expressed as CO_2 equivalents, are presented in table ES.1. In 2011 the total national emission of GHG was 399.39 million tonnes of CO_2 eq., excluding GHG emissions and removals from category 5 (*Land use, land use change and forestry* – LULUCF). Compared to the base year (1988), the 2011 emissions have decreased by 29.1%.

Table ES.1. National emissions of greenhouse gases for the base year 1988 and 2011 [Gg CO_2 eq.]

Pollutant	Base year	2011	2011/base year [%]
	Emission in CO_2 eq. [Gg]	Emission in CO_2 eq. [Gg]	
CO_2 (with LULUCF)	436 209.10	306 138.93	70.18
CO_2 (without LULUCF)	469 143.82	330 309.43	70.41
CH_4 (with LULUCF)	53 672.51	37 787.07	70.40
CH_4 (without LULUCF)	53 665.03	35 537.91	66.22
N_2O (with LULUCF)	40 334.29	27 249.62	67.56
N_2O (without LULUCF)	40 333.53	27 240.63	67.54
HFCs	26.44	6 210.80	23488.97
PFCs	250.18	49.88	19.94
SF_6	23.77	40.90	172.10
TOTAL net emission (with LULUCF)	530 466.09	377 477.20	71.16
TOTAL without LULUCF	563 442.77	399 389.55	70.88

*data presented as the base year relates to emissions in 1988 established for accounting the Kyoto Protocol reduction target

Trend of aggregated greenhouse gases emissions follows the trend of emissions CO_2 alone which is the primary greenhouse gas emitted in Poland. The GHGs trend for period between 1988 and 1990 indicates dramatic decrease triggered by significant economical changes, especially in heavy industry, related to political transformation from centralized to market economy. This drop in emissions continued up to 1993 and then emissions started to rise with a peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. The succeeding years characterize slow decline in emissions up to 2002, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. Since 2008 stabilisation in emissions has been noted with distinct decrease in 2008 related to world economic slow-down (tables ES.2, ES.3 and figure ES.1).

Table ES.2. National emissions of greenhouse gases for 1988–2011 according to gases

GHG	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
CO_2 (with LULUCF)	461 277.49	437 704.75	353 746.11	350 479.75	350 467.76	350 058.44	348 211.13	350 447.29	362 655.03	353 757.57	325 835.63	315 323.80
CO_2 (without LULUCF)	469 073.95	449 431.81	372 288.35	370 479.67	361 097.07	361 410.39	357 130.66	358 302.29	371 682.59	362 466.34	335 326.82	326 065.72
CH_4 (with LULUCF)	55 062.55	54 417.43	49 362.87	47 862.47	45 801.77	45 365.80	45 657.31	45 613.49	45 685.96	46 011.73	44 661.45	44 528.69
CH_4 (without LULUCF)	52 872.47	52 222.97	47 166.41	45 686.82	43 418.00	43 156.35	43 445.64	43 410.47	43 445.54	43 805.65	42 469.64	42 314.05
N_2O (with LULUCF)	40 088.78	42 102.69	37 453.55	30 967.64	28 805.22	28 981.07	29 351.55	30 390.65	30 089.71	30 292.72	30 314.33	29 386.34
N_2O (without LULUCF)	40 071.30	42 085.69	37 437.00	30 956.80	28 748.17	28 965.36	29 335.75	30 378.30	30 070.45	30 281.46	30 306.87	29 368.29
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	189.90	292.49	415.91	505.30	724.26
PFCs	127.55	127.77	122.88	122.40	116.61	125.47	132.33	148.96	139.45	149.56	150.87	145.27
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	13.91	30.53	24.95	24.02	25.09	24.64
TOTAL (with LULUCF)	**556 556.37**	**534 352.64**	**440 685.41**	**429 432.26**	**425 191.36**	**424 530.79**	**423 366.23**	**426 820.82**	**438 887.58**	**430 651.51**	**401 492.67**	**390 133.00**
TOTAL (without LULUCF)	**562 145.27**	**543 868.23**	**457 014.65**	**447 245.69**	**433 379.85**	**433 657.57**	**430 058.30**	**432 460.44**	**445 655.46**	**437 142.93**	**408 784.60**	**398 642.23**

* emissions for 1988 estimated for entire series up to 2011 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table ES.2. (cont.) National emissions of greenhouse gases for 1988–2011 according to gases

GHG	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
CO_2 (with LULUCF)	305 018.53	298 552.68	286 198.95	297 553.04	297 590.37	294 146.08	304 269.83	308 549.37	300 308.23	284 431.97	305 309.21	306 138.93
CO_2 (without LULUCF)	315 539.64	312 083.43	300 519.43	312 481.07	316 204.78	318 019.54	331 550.47	332 612.82	326 847.15	311 773.19	332 573.75	330 309.43
CH_4 (with LULUCF)	41 567.84	40 927.07	39 900.64	40 344.32	40 092.68	40 547.64	40 953.95	40 243.46	39 355.20	38 189.86	38 682.41	37 787.07
CH_4 (without LULUCF)	39 361.03	38 742.34	37 701.27	38 056.54	37 885.74	38 325.61	38 723.15	38 023.22	37 127.90	35 959.16	36 448.45	35 537.91
N_2O (with LULUCF)	29 193.09	29 337.84	28 407.77	28 590.99	28 897.62	29 287.76	30 497.23	31 402.22	30 960.80	27 313.07	26 868.99	27 249.62
N_2O (without LULUCF)	29 176.30	29 328.65	28 392.43	28 558.89	28 883.07	29 271.96	30 483.24	31 392.31	30 950.55	27 302.49	26 860.62	27 240.63
HFCs	1 127.78	1 717.39	2 221.21	2 723.42	3 482.23	4 424.87	5 053.80	5 641.57	5 114.06	5 453.34	5 694.34	6 210.80
PFCs	151.88	168.74	177.61	172.31	175.86	160.65	166.08	158.41	139.85	59.24	56.13	49.88
SF_6	24.18	23.96	24.41	21.72	23.44	28.09	34.80	32.66	34.46	39.42	37.07	40.90
TOTAL (with LULUCF)	**377 083.30**	**370 727.68**	**356 930.59**	**369 405.80**	**370 262.20**	**368 595.09**	**380 975.69**	**386 027.69**	**375 912.60**	**355 486.89**	**376 648.14**	**377 477.20**
TOTAL (without LULUCF)	**385 380.81**	**382 064.51**	**369 036.35**	**382 013.94**	**386 655.12**	**390 230.71**	**406 011.53**	**407 860.99**	**400 213.95**	**380 586.83**	**401 670.35**	**399 389.55**

Table ES.3. National emissions of greenhouse gases for 1988–2011 according to IPCC categories

IPCC sector	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
1. Energy	470 203.27	449 799.19	374 069.28	374 593.98	365 079.44	367 091.25	360 725.59	361 867.95	376 982.71	366 724.67	338 916.54	330 890.23
2. Industrial Processes	29 787.98	28 925.03	22 024.98	19 055.26	18 217.13	18 206.60	20 704.02	21 941.52	20 851.44	21 459.27	19 757.68	18 901.07
3. Solvent and Other Product Use	1 006.46	946.14	629.23	608.22	558.57	519.36	521.05	524.81	550.00	548.63	552.44	547.19
4. Agriculture	50 763.84	53 587.52	49 655.35	42 040.69	38 499.62	36 704.72	36 981.38	37 077.84	36 064.97	36 917.34	37 675.34	36 227.97
5. Land-Use, Land-Use Change and Forestry	-5 588.89	-9 515.59	-16 329.24	-17 813.43	-8 188.49	-9 126.78	-6 692.07	-5 639.62	-6 767.88	-6 491.43	-7 291.93	-8 509.23
6. Waste	10 383.71	10 610.35	10 635.81	10 947.54	11 025.08	11 135.64	11 126.25	11 048.33	11 206.35	11 493.03	11 882.60	12 075.77
TOTAL net emission (with LULUCF)	**556 556.37**	**534 352.64**	**440 685.41**	**429 432.26**	**425 191.36**	**424 530.79**	**423 366.23**	**426 820.82**	**438 887.58**	**430 651.51**	**401 492.67**	**390 133.00**

* emissions for 1988 estimated for entire series up to 2011 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table ES.3. (cont.) National emissions of greenhouse gases for 1988–2011 according to IPCC categories

IPCC sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
1. Energy	317 797.83	316 438.61	305 226.87	316 161.75	319 373.26	317 294.89	328 976.85	327 676.32	321 468.59	310 717.64	330 275.36	325 205.95
2. Industrial Processes	21 457.87	20 104.70	18 370.47	21 265.20	22 920.91	27 934.13	30 417.41	32 732.38	31 569.96	23 641.43	25 950.46	28 719.88
3. Solvent and Other Product Use	627.89	631.77	661.01	645.02	677.09	687.75	761.46	721.65	797.18	751.41	779.40	788.67
4. Agriculture	34 462.84	34 139.19	34 037.24	33 439.96	33 275.37	33 787.05	35 349.87	36 169.59	36 166.32	35 209.61	34 560.56	34 929.80
5. Land-Use, Land-Use Change and Forestry	-8 297.52	-11 336.83	-12 105.77	-12 608.14	-16 392.92	-21 635.62	-25 035.84	-21 833.30	-24 301.36	-25 099.94	-25 022.21	-21 912.35
6. Waste	11 034.38	10 750.24	10 740.77	10 502.01	10 408.49	10 526.90	10 505.94	10 561.06	10 211.91	10 266.73	10 104.57	9 745.25
TOTAL net emission (with LULUCF)	**377 083.30**	**370 727.68**	**356 930.59**	**369 405.80**	**370 262.20**	**368 595.09**	**380 975.69**	**386 027.69**	**375 912.60**	**355 486.89**	**376 648.14**	**377 477.20**

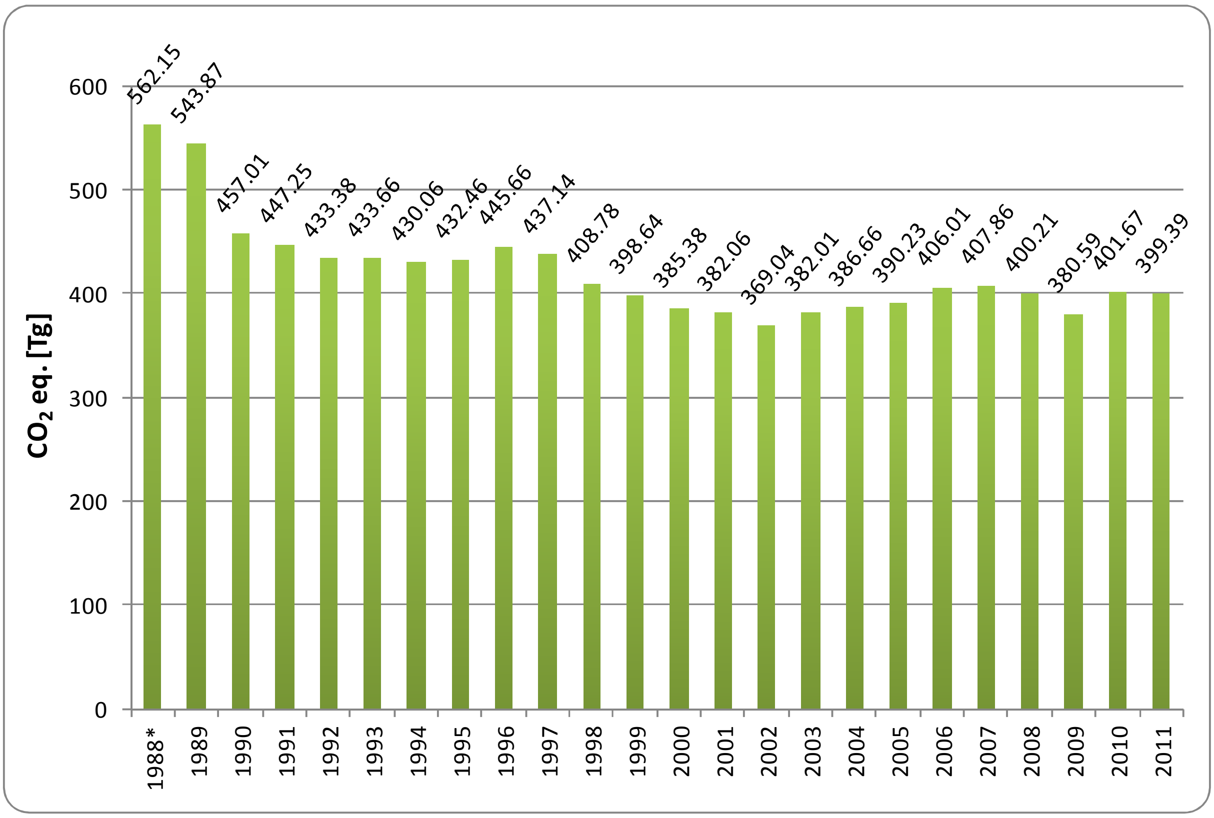

Figure ES.1. Trend of aggregated GHGs emissions excluding category 5 for 1988–2011

* emissions for 1988 estimated for entire series up to 2011 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

ES.2.2. KP-LULUCF activities

The emissions and removals balance of greenhouse gases for the period 2008-2011, to related activities of land use, land use change and forestry (LULUCF) under Article 3.3 and 3.4 of the Kyoto Protocol are presented in Table ES.4. For activities related to afforestation/reforestation and forest management estimated balance is negative, what means the activity is considered as a net CO_2 sink.

Table ES.4. The emissions and removals balance of greenhouse gases for the period 2008-2011, to related activities of land use, land use change and forestry (LULUCF) [Gg CO_2 eq.]

Kyoto Protokol	Activity	2008	2009	2010	2011
-10 238,49	Afforestation/ reforestation	-5 158.57	-5 515.64	-5 819.83	-6 192.16
	Deforestation	258.02	268,07	229,03	235,67
Art. 3.4	Forest management	-27 408.87	-28 168.61	-28 043.34	-25 232.72
	Cropland management	*NA*	*NA*	*NA*	*NA*
	Grazing land management	*NA*	*NA*	*NA*	*NA*
	Revegetation	*NA*	*NA*	*NA*	*NA*

ES.3. Overview of source and sink category emission estimates and trends, including KP-LULUCF activities

ES.3.1. GHG inventory

Carbon dioxide emissions

The CO_2 emissions (excluding category 5) in 2011 were estimated as 330.31 million tonnes. This is 29.6% lower than in the base year. CO_2 emission (excluding category 5) accounted for 82.7% of total GHG emissions in Poland in 2011. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission by 92.2% in 2011. The shares of the main subcategories were as follows: *Energy industries* – 52.6%, *Manufacture Industries and Construction* – 9.4%, *Transport* – 14.5% and *Other Sectors* – 15.7%. *Industrial Processes* contributed to the total CO_2 emission by 6.4% in 2011. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 removal in LULUCF sector in 2011, was calculated to be approximately 24.2 million tonnes. It means that app. 7.3% of the total CO_2 emissions are offset by CO_2 uptake by forests.

Methane emissions

The CH_4 emission (excluding category 5) amounted to 1 692.28 Gg in 2011 i.e. 35.54 million tonnes of CO_2 equivalents. Compared to the base year, the emission in 2011 was lower by 33.8%. The contribution of CH_4 to the national total GHG emission was 8.9% in 2011. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed 32.9%, 34.1% and 23.6% to the national methane emission in 2011, respectively. The emission from the first mentioned sector was covered by emission from Underground Mines (20.2% of total CH_4 emission) and Oil and Natural Gas system (12.7% of total CH_4 emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 26.1% of total CH_4 emission in 2011. Waste disposal sites contributed to 20.5% of the methane emission from total CH_4 emission and Wastewater Handling contributed to 3.1% of total CH_4 emission.

Nitrous oxide emissions

The nitrous oxide emissions (excluding category 5) in 2011 were 87.87 Gg i.e. 27.24 million tonnes of CO_2 equivalents. The emission was app. 32.5% lower than the respective figure for the base year. The contribution of N_2O to the national total GHG emission was 6.8% in 2011. The main N_2O emission sources and its shares in total N_2O emission in 2011 are as follow: *Agricultural Soils* – 65.0%*, Manure Management* – 18.8%, *Chemical Industry* – 3.9% and *Fuel Combustion* – 7.7%.

Emissions of industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2011 was 6 301.58 Gg CO_2 eq. what accounts for 1.6% of total GHG emissions share in 2011. Industrial gases emissions were about 1997.8% higher comparing to the base year (table ES.2). This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. Share of HFCs, PFCs and SF_6 in total 2011 emissions was respectively as follows: 1.56%, 0.01% and 0.010%.

ES.3.2. KP-LULUCF activities

Estimated emissions and removals of greenhouse gases for the period 2008-2011, associated with the LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol are presented in Table S.4. in Section E.S.2.2.

Considering the afforestation activity, associated CO2 sink increased by 12% comparing to 2008. The emissions associated with deforestation in comparison to 2008 decreased by 8.7%. The size of net absorption for forest management activity for the year 2011 is approximately 8 % lower than in 2008. Decreasing area subject to the activity “forest management” and increasing volume of harvested timber, drive mainly the final estimates. Volume of harvested timber in 2011 in comparison to 2008, increased by 8.5% from 34.273 million m3 to the level of 37.180 million m3.

ES.4. Trends of indirect greenhouse gases and SO_2

Emissions of all GHG precursors diminished significantly since 1990. In case of SO_2 emissions, which amounted to 910.0 Gg in 2011, the decrease was noted by about 70% between 1990 and 2011 what was caused by the decline of the heavy industry in the late 1980s and early 1990s. In late 1990s the emissions declined because of the diminished share of coal and lignite among fuels used for power and heat generation. Additionally flue gases desulphurisation had the impact for SO_2 emissions decrease. Emissions of NO_x in 2011 amounted 850.7 Gg and decreased by more than 30% between 1990 and 2011. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s as well as the lower share of hard coal and lignite in fuel used in 1990s. Increasing emissions from road transport cause comparatively lower total emission reductions than in case of SO_2. CO emissions in 2011 amounted to 2915.8 Gg and dropped by more than 60% between 1990 - 2011 triggered by the same reasons as for SO_2 and NO_x. Emissions of NMVOC were about 652.0 Gg in 2011 and decreased by 20% between 1990 and 2011.

PART I:
ANNUAL INVENTORY SUBMISSION

1. INTRODUCTION

1.1. Background information on greenhouse gas inventories, climate change and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1.1.1. Background information on climate change

Poland has been the signatory to the United Nations Framework Convention on Climate Change (UNFCCC) since 1994 and to its Kyoto Protocol since 2002 thus joining the international efforts aiming at combat climate change. One of the main obligations resulting from ratification of the Kyoto Protocol by Poland is to reduce the greenhouse gas emissions by 6% in 2008-2012 in relation to the base year which was chosen as 1988 according to Article 4.6 of the UNFCCC and Decision 9/CP.2. For gases like: HFCs, PFCs and SF_6 the year 1995 was established as the base one.

The basic evidence for fulfilling obligations resulting from the Convention and its Protocol is annual inventory of greenhouse gases of anthropogenic origin made by Parties to the Convention. The report has been prepared following the provisions of the decision 18/CP.8 and 14/CP.11, updating the „Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting Guidelines on Annual Inventories" (document FCCC/SBSTA/2006/9). This report contains also supplementary information related to Article 7.1 in accordance to decision 15/CMP.1.

Underlying report has been elaborated for fulfilling Poland's obligations under United Nations Framework Convention on Climate Change (UNFCCC) signed in New York on 9 May 1992 and its Kyoto Protocol signed in Kyoto on 11 December 1997 of which Poland is the Party, as well as for the needs of Decision 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

1.1.2. Background information on greenhouse gas inventories

The Polish greenhouse gas inventory is compiled on an annual basis and submitted in the required by the UNFCCC deadline. The underlying National Inventory Report (NIR), submitted in 2013, presents the results of the greenhouse gases (GHGs) inventory in Poland for 2011 as well as for the whole preceding period since 1988.

The Polish inventory covers the following greenhouse gases:
- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons – HFCs (HFC-23, HFC-32, HFC-43-10mee, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-227ea),
- perfluorocarbons – PFCs (perfluoromethane - CF_4, perfluoroethane - C_2F_6, perfluorobutane - C_4F_{10}) and
- sulphur hexafluoride (SF_6).

Information on emissions of the following GHG precursors is also reported: carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2)

where data are in line with the current submission under UNECE CLRTAP as well as under NEC directive.

The national inventory and accompanying tables of Common Reporting Format (CRF) have been prepared in accordance with the UNFCCC reporting guidelines on annual inventories (FCCC/SBSTA/2006/9). Methodologies used to calculate emissions and sinks of GHGs are in accordance with methods recommended in publications of Intergovernmental Panel on Climate Change - IPCC, namely: *Revised 1996 Guidelines for National Greenhouse Gas Inventories*, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* as well as *Good Practice Guidance for Land Use, Land use Change and Forestry*. According to these guidelines country specific methods have been used where appropriate giving more accurate emission data.

The unit responsible for compiling the GHG inventory is the National Centre for Emissions Management (KOBiZE) in the Institute of Environmental Protection National Research Institute supervised by the Minister of Environment.

1.1.3. Background information on supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

Poland, as the Party to the Kyoto Protocol, is required to present additional information in the National Inventory Report since 2010. This information relates to the activities in frames of Article 3.3 of the Kyoto Protocol and selected by Poland additional activities under Article 3.4 (Forest Management), information on accounting of Kyoto units, national inventory system, national registry and on minimization of adverse impacts in accordance with Article 3.14.

Poland's assigned amount units (AAU) for 2008–2012 were calculated based on GHG emissions for 1988 estimated in 2006 and revised in course of the review of Initial report of Poland under the Kyoto Protocol performed in 2007 [IRR 2007]. The fixed GHG inventory in 1988 amounted to 563 442.774 Gg CO_2 eq., so the Poland's AAU is:

563 442.774 Gg CO_2 eq. * 94% * 5 = **2 648 181.038 Gg CO_2 eq.**

The national Commitment Period Reserve (CPR), which is the minimum quantity of Kyoto Protocol units in the national registry in the first commitment period in 2008−2012, has been estimated on the basis of the reviewed and approved by ERT inventory for 2010, which amounted to 402 409.367 Gg CO_2 eq., multiplied by 5 years:

402 409.367 Gg CO_2 eq. * 5 = **2 012 046.833 Gg CO_2 eq.**

This value of CPR is still valid and placed at the registry account of Poland. Any new data on CPR which could be calculated based on the currently presented GHG emissions estimations for 2011 for Poland cannot be introduced into the Union registry due to technical problems. For more information see Chapter 12.5.

Detail additional information required by the Kyoto Protocol is presented in Part II of the NIR.

1.2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

The ***Act on the system to manage the emissions of greenhouse gases and other substances*** (*Journal of Laws No 130 item 1070)* established a legal base to manage national emission cap for greenhouse gases or other substances in a way that should ensure that Poland complies with EU and international commitments and will allow for cost-effective reductions of pollutant emission. The area of work specified in the act, carried out by the National Centre for Emissions Management (Krajowy Ośrodek Bilansowania i Zarządzania Emisjami – KOBiZE), include:

- carry out tasks associated with functioning of the national system to balance and forecast emissions, including managing a national database on greenhouse gas emissions and other substances,
- elaborate methodologies to estimate emissions for individual types of installations or activities and methodologies to estimate emission factors per unit of produced good, fuel used or raw material applied,
- elaborate emission reports and forecasts (projections) for air pollutants,
- manage the national registry for Kyoto Protocol units,
- manage the list of JI projects in Poland for which the letters of endorsement or approval have been issued,
- administration of Emission Trading Scheme.

The Minister responsible for issues related to the environment supervises the carrying out of tasks by KOBiZE.

The emission calculation, choices of activity data, emission factors and methodology are performed by Emission Balancing and Reporting Unit (ZBIRE) in the National Centre for Emissions Management. The national Centre is collaborating with a number of individual experts as well as institutions when compiling inventories. Among the latter are: Central Statistical Office (GUS), Agency of Energy Market (ARE), Institute of Ecology of Industrial Areas in Katowice (IETU), Motor Transport Institute (ITS) as well as Office for Forest Planning and Management (BULGiL). These institutions are mainly involved in providing activity data for inventory estimates. The experts of the National Centre have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This verified data is included in GHG inventory for some IPCC subcategories (e.g. in some subsectors in industrial processes).

Prior to submission the elaborated inventories undergo internal process for the official consideration and approval. The responsibility for approval GHG inventories lies on the Minister of Environment.

1.3. Inventory preparation

The GHG emission estimates are based on methodologies elaborated by the Intergovernmental Panel on Climate Change (IPCC) and recommended by the UNFCCC, while emissions of indirect gases according to methodology elaborated by UNECE/EMEP. Wherever necessary and possible, domestic methodologies and emission factors have been developed to reflect country specific conditions. The most important features of the inventory preparation and archiving can be briefly summarized in the following way:

- activity data are mostly taken from official public statistics (GUS, EUROSTAT) or, when required data are not directly available, (commissioned) research reports or expert estimates are used instead,

- emission factors for the main emission categories are mostly taken from reports on domestic research; IPCC default data are used in cases where the emission factors are highly uncertain (e.g. CH_4 and N_2O emission from stationary combustion), or when particular source category contribution to national total is insignificant,
- All activity data, emission factors and resulting emission data are stored at ZBIRE's database in the KOBIZE, which is constantly updated and extended to meet the ever changing requirements for emission reporting, with respect to UNFCCC and LTRAP as well as their protocols.

1.4. Brief general description of methodologies and data sources used

The GHG emissions and removals inventory presented in this report follow the recommended IPCC Guidelines for national inventories [IPCC 1997, 2000, 2003, 2006]. According to these guidelines country specific methods have been used where appropriate giving more accurate emission data especially in case of key categories. For categories where emissions do not occur or are not estimated the abbreviations NO and NE were used in tables. More detail description of methodologies used in Polish GHG inventory is given in sections 3–8.

It should be mentioned that terms emission „sector" and „category" (as well as subsector and subcategory) used in his report, are used interchangeably and refer to source categories in the IPCC guidelines.

The non-CO_2 GHG emissions from fuel combustion (1.A. category) were estimated based on fuel consumption estimates and respective emission factors. Data on fuel consumption for stationary sources with disaggregation into fuel type and source category come from fuel balances elaborated by Central Statistical Office and reported to Eurostat.

One of the steps of emission inventorying from the 1.A. *Energy* category is preparation of energy budgets for main fuels (energy carriers). These budgets are prepared based on the national energy balances published by Central Statistical Office and Agency of Energy Market. The tables of the national energy balance include detailed information on the ins and outs of all the energy carriers used in Poland, as well as information on their conversions to other energy carriers and on their direct consumption. The data for international bunker are also assessed.

The example of evaluation of hard coal consumption is given in table 1.1. The examples of the fuel budgets for: lignite, natural gas, coke-oven gas and blast furnace gas are presented in Annex 4.

Table 1.1. Hard coal consumption

National fuel balance	Hard coal - Eurostat	
	10^3 Mg	TJ
In	91 403	2 174 217
From national sources	76 448	1 809 132
1) Indigenous production	75 668	1 791 485
2) Transformation output or return	780	17 647
3) Stock decrease	0	0
Import	14 955	365 085
Out	91 403	2 174 217
National consumption	79 363	1 863 946
1) Transformation input	61 487	1 419 544
a) input for secondary fuel production	12 418	366 592
b) fuel combustion	49 069	1 052 952
2) Direct consumption	17 876	444 402
Non-energy use	74	1 683
Combusted directly	17 802	442 719
Combusted in Poland	66 871	1 495 671
Stock increase	869	20 558
Export	7 007	196 233
Losses and statistical differences	4 164	93 480
Net calorific value	MJ/kg	22.37

The data on quantity of coal combusted in whole country in a given year (tab. 1.1) is used for calculation of the average net calorific value of this fuel. This calculated net calorific value provides then the basis for the estimation of country specific CO_2 emission factor based on empirical formula that apply the relationship between net calorific value and elemental carbon content in fuel (see chapter 3.1.1). This factor can be used for estimation of the potential CO_2 emission from coal combustion. The amount of fuel combusted in given year, calculated in fuel budget, can be compared with total consumption of this fuel in all sectors. It is one of the ways of verifying of sectoral approach.

Basic information on activity data regarding IPCC categories, are usually published in various Eurostat databases and GUS statistical yearbooks. The activity data that are not available in GUS publications have been worked out by experts based on studies commissioned by the Ministry of Environment specifically for the GHG emission inventory purposes.

Eurostat database containing domestic data transferred by GUS is the main source of activity data for *Energy* sector (Annex 4). The data on fuel consumption in *Road Transportation* subcategory was also taken from Eurostat database and next disaggregated on individual vehicle types based on methodology developed in the Motor Transport Institute.

1.5. Brief description of key categories

The source/sink categories in all sectors are identified to be *key categories* on the basis of their contribution to the total level and/or trend uncertainty in accordance with IPCC Good Practice Guidance [IPCC 2000]. The complete tables with level and trend assessments are given in Annex 1.

1.6. Information on the QA/QC plan including verification and treatment of confidentiality issues where relevant

For further improvement of QA/QC procedures the *Programme for Quality Assurance and Quality Control for annual greenhouse gas inventory* [QA/QC 2012] has been updated this year. The QA/QC programme has been elaborated in line with the *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories* (2000) to assure high quality of the Polish annual greenhouse gas inventory. The QA/QC programme contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures. For more detailed information see Annex 5.

Based on recommendations of the *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories* the following elements of the Quality Assurance and Quality Control system has been addressed:

- Inventory agency responsible for coordinating QA/QC activities,
- QA/QC plan,
- General QC procedures (*Tier 1* method),
- Source category-specific QC procedures (*Tier 2*),
- QA review procedures,
- Reporting, documentation and archiving procedures.

The unit directly responsible for GHG inventory preparation, as well as for co-ordination and implementation of QA/QC procedures within inventory, is the National Centre for Emissions Management (KOBIZE) in the Institute of Environmental Protection National Research Institute (IOŚ PIB) established based on Act of 17 July 2009 on the System to Manage the Emissions of Greenhouse Gases and Other Substances (*Journal of laws* Nr 130 item 1070on 18 August 2009). The Minister responsible for the environment shall supervise the performance of responsibilities by KOBiZE.

According to Article 11 of above mentioned Act the National Centre prepare and submit to the Minister of Environment, 30 days before the deadlines of the provisions of European Union law or international environmental agreements, annual greenhouse gas inventories carried out in accordance with the guidelines of the UNFCCC and the substances listed in the Convention on Long-range Transboundary Air Pollution (UNECE CLRTAP). KOBIZE draws up also sets of information and reports, including those on emissions, for the purpose of public statistics (Art. 3.3.3).

1.7. General uncertainty evaluation, including data on the overall uncertainty for the inventory totals

Uncertainty evaluation made for 2011 is based on calculations and national expert's judgments/ estimations as well as opinions expressed by international experts during the review lead by UNFCCC Secretariat in the years 2007-2012. Calculations include simplified method for sector 5 and for fluorinated industrial gases.

The estimate of emission uncertainty for the year 2011 was made using *Tier 1* approach. The uncertainty ranges varied significantly among various source categories and are presented within sectoral chapters 3-8. More details, including sectoral information on uncertainty ranges, are given in Annex 6.

1.8. General assessment of the completeness

The Polish GHG emission inventory includes calculation of emissions from all relevant sources recommended by the international guidelines. Only CO_2 from *Coal Mining and Handling* (1.B.1.a) is not considered due to the lack of data at this level of aggregation.

2. TRENDS IN GREENHOUSE GAS EMISSIONS

2.1. Description and interpretation of emission trends for aggregated greenhouse gas emissions

For carbon dioxide, net emission is calculated by subtracting from the total CO_2 emission – the emissions and removals from category 5. *Land Use, Land Use Change and Forestry* (LULUCF). According to the IPCC methodology, CO_2 emissions are given with and without contributions from category 5. Also following IPCC, emission of CO_2 from biomass, is not included in the national total.

For non-CO_2 gases, the inventory results can also be presented (table 2.1) in units of CO_2 equivalents by applying values of the so called Global Warming Potentials - GWP. GWP for methane is 21, and for nitrous oxide 310. Carbon dioxide is the main GHG in Poland with the 82.7% (excluding category 5) share in 2011, while the methane contributes with 8.9% (excluding category 5) to the national total. Nitrous oxide contribution is 6.8% (excluding category 5) and all industrial GHG together contribute 1.6%. Percentage share of GHG in national total emissions in 2011 is presented at figure 2.1.

Table 2.1. Greenhouse gas emissions in 2011 in CO_2 eq.

Pollutant	2011	
	Emission in CO_2 eq. [Gg]	Share [%]
CO_2 (with LULUCF)	306 138.93	81.10
CO_2 (without LULUCF)	330 309.43	82.70
CH_4 (with LULUCF)	37 787.07	10.01
CH_4 (without LULUCF)	35 537.91	8.90
N_2O (with LULUCF)	27 249.62	7.22
N_2O (without LULUCF)	27 240.63	6.82
HFCs	6 210.80	1.56
PFCs	49.88	0.01
SF_6	40.90	0.01
TOTAL net emission (with LULUCF)	377 477.20	100.00
TOTAL without LULUCF	399 389.55	100.00

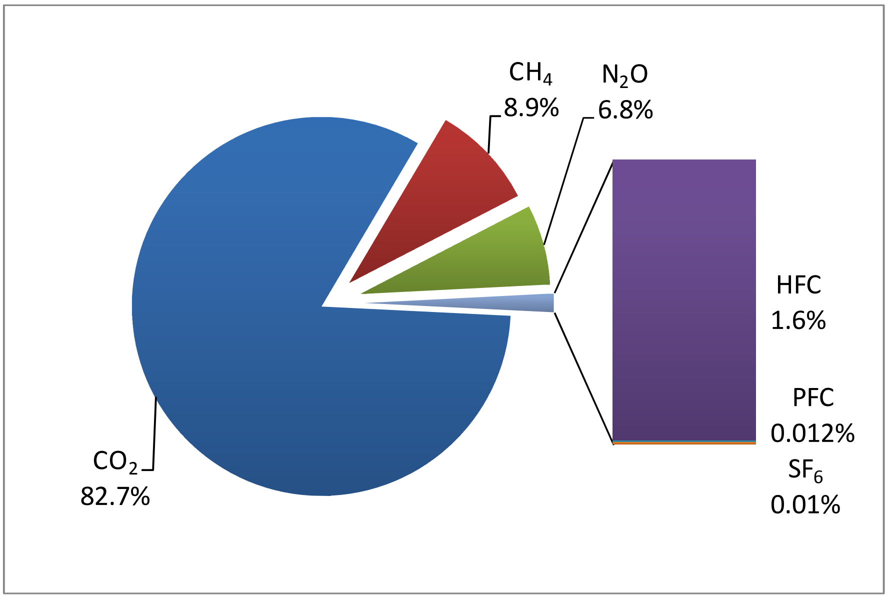

Figure 2.1. Percentage share of greenhouse gases in national total emission in 2011 (excluding category 5)

Emissions of main GHGs in 2011, disaggregated into main source sub-sectors, are given in table 2.2. Respective values for the fluorinated industrial gases are presented in table 2.3. Discussion of these results is given in the following sections.

Table 2.2. Emissions of CO_2, CH_4 and N_2O in 2011 [Gg]

[Gg]	CO_2	CH_4	N_2O
TOTAL without LULUCF	330 309.43	1 692.28	87.87
TOTAL with LULUCF	306 138.93	1 799.38	87.90
1. Energy	308 389.70	700.86	6.77
A. Fuel Combustion	304 568.18	144.66	6.77
1. Energy Industries	173 821.99	4.50	2.76
2. Manufacturing Industries and Construction	31 062.53	3.70	0.52
3. Transport	47 987.70	5.04	1.91
4. Other Sectors	51 695.95	131.41	1.58
5. Other	IE, NO	IE, NO	IE, NO
B. Fugitive Emissions from Fuels	3 821.52	556.20	0.00
1. Solid Fuels	2 097.42	342.04	NA
2. Oil and Natural Gas	1 724.10	214.16	0.00
2. Industrial Processes	21 029.08	14.56	3.49
A. Mineral Products	10 711.41	NA	NA
B. Chemical Industry	3 968.60	12.90	3.43
C. Metal Production	6 006.06	1.66	0.06
D. Other Production	8.20	NE	NE
G. Other	334.81	NO	NO
3. Solvent and Other Product Use	664.67	NE	0.40
4. Agriculture	NE	576.83	73.60
A. Enteric Fermentation	NE	442.22	NE
B. Manure Management	NE	133.77	16.48
D. Agricultural Soils	NE	NA	57.09
F. Field Burning of Agricultural Residues	NE	0.84	0.03
5. Land Use, Land-Use Change and Forestry	-24 170.50	107.10	0.0290
A. Forest Land	-31 019.63	0.59	0.0092
B. Cropland	3 316.34	IE, NO	IE, NO, NA,
C. Grassland	220.88	0.06	0.00089
D. Wetlands	3 145.92	106.45	0.0189
E. Settlements	165.99	NA, NO	NA, NO
F. Other Land	NA, NO	NA, NO	NA, NO
6. Waste	225.98	400.03	3.61
A. Solid Waste Disposal on Land	NA, NO	347.16	NE
B. Wastewater Handling	NE	52.88	3.58
C. Waste Incineration	225.98	NO	0.03

Table 2.3. Emissions of industrial gases: HFCs, PFCs and SF_6 in 2011 [Gg eq. Gg]

2011	HFCs	PFCs	SF_6	Total in eq. CO_2
Total Industrial gases [Gg eq. CO_2]	6 210.80	49.88	40.90	6 301.58
C. Metal Production	NE	37.07	4.35	41.42
3. Aluminium Production	NE	37.07	4.35	41.42
F. Consumption of Halocarbons and SF_6	6 210.80	12.81	36.56	6 260.17
1. Refrigeration and Air Conditioning Equipment	6 044.53	NO	NO	6 044.53
2. Foam Blowing	24.21	NO	NO	24.21
3. Fire Extinguishers	27.27	12.81	NA	40.08
4. Aerosols	110.59	NA	NA	110.59
8. Electrical Equipment	NA	NA	36.56	38.55

As a supplement to the tables 2.2 and 2.3, table 2.4 includes percentage contributions of main source sectors to the national totals in 2011 for CO_2, CH_4 and N_2O.

Trend of aggregated greenhouse gases emissions follows the trend of emissions CO_2 alone which is the primary greenhouse gas emitted in Poland. The GHGs trend for period between 1988 and 1990 indicate dramatic decrease triggered by significant economic changes, especially in heavy industry, related to political transformation from centralized to market economy. This drop in emissions continued up to 1993 and then emissions started to rise with peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. The succeeding years characterize slow decline in emissions up to 2002, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. Since 2008 stabilisation in emissions has been noted with distinct decrease in 2008 related to world economic slow-down (figure 2.2 and tables 2.5 and 2.6).

Table 2.4. Percentage shares of individual source sectors in 2011 emissions

Percentage share of emissions of source sectors in current year without LULUCF	Share [%]		
	CO_2	CH_4	N_2O
TOTAL	100.00	100.00	100.00
1. Energy	93.36	41.41	7.70
A. Fuel Combustion	92.21	8.55	7.70
1. Energy Industries	52.62	0.27	3.14
2. Manufacturing Industries and Construction	9.40	0.22	0.59
3. Transport	14.53	0.30	2.18
4. Other Sectors	15.65	7.77	1.80
5. Other	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1.16	32.87	0.00
1. Solid Fuels	0.63	20.21	0.00
2. Oil and Natural Gas	0.52	12.65	0.00
2. Industrial Processes	6.37	0.86	3.98
A. Mineral Products	3.24	0.00	0.00
B. Chemical Industry	1.20	0.76	3.91
C. Metal Production	1.82	0.10	0.07
D. Other Production	0.00	0.00	0.00
G. Other	0.10	0.00	0.00
3. Solvent and Other Product Use	0.20	0.00	0.46
4. Agriculture	0.00	34.09	83.76
A. Enteric Fermentation	0.00	26.13	0.00
B. Manure Management	0.00	7.90	18.75
D. Agricultural Soils	0.00	0.00	64.97
F. Field Burning of Agricultural Residues	0.00	0.05	0.04
5. Land Use, Land-Use Change and Forestry	-	-	-
A. Forest Land	-	-	-
B. Cropland	-	-	-
C. Grassland	-	-	-
D. Wetlands	-	-	-
E. Settlements	-	-	-
F. Other Land	-	-	-
6. Waste	0.07	23.64	4.11
A. Solid Waste Disposal on Land	0.00	20.51	0.00
B. Wastewater Handling	0.00	3.12	4.07
C. Waste Incineration	0.07	0.00	0.04

Table 2.5. National emissions of greenhouse gases for 1988–2011 according to gases [Gg CO_2 eq.]

GHG	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
CO_2 (with LULUCF)	461 277.49	437 704.75	353 746.11	350 479.75	350 467.76	350 058.44	348 211.13	350 447.29	362 655.03	353 757.57	325 835.63	315 323.80
CO_2 (without LULUCF)	469 073.95	449 431.81	372 288.35	370 479.67	361 097.07	361 410.39	357 130.66	358 302.29	371 682.59	362 466.34	335 326.82	326 065.72
CH_4 (with LULUCF)	55 062.55	54 417.43	49 362.87	47 862.47	45 801.77	45 365.80	45 657.31	45 613.49	45 685.96	46 011.73	44 661.45	44 528.69
CH_4 (without LULUCF)	52 872.47	52 222.97	47 166.41	45 686.82	43 418.00	43 156.35	43 445.64	43 410.47	43 445.54	43 805.65	42 469.64	42 314.05
N_2O (with LULUCF)	40 088.78	42 102.69	37 453.55	30 967.64	28 805.22	28 981.07	29 351.55	30 390.65	30 089.71	30 292.72	30 314.33	29 386.34
N_2O (without LULUCF)	40 071.30	42 085.69	37 437.00	30 956.80	28 748.17	28 965.36	29 335.75	30 378.30	30 070.45	30 281.46	30 306.87	29 368.29
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	189.90	292.49	415.91	505.30	724.26
PFCs	127.55	127.77	122.88	122.40	116.61	125.47	132.33	148.96	139.45	149.56	150.87	145.27
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	13.91	30.53	24.95	24.02	25.09	24.64
TOTAL (with LULUCF)	**556 556.37**	**534 352.64**	**440 685.41**	**429 432.26**	**425 191.36**	**424 530.79**	**423 366.23**	**426 820.82**	**438 887.58**	**430 651.51**	**401 492.67**	**390 133.00**
TOTAL (without LULUCF)	**562 145.27**	**543 868.23**	**457 014.65**	**447 245.69**	**433 379.85**	**433 657.57**	**430 058.30**	**432 460.44**	**445 655.46**	**437 142.93**	**408 784.60**	**398 642.23**

* emissions for 1988 estimated for entire series up to 2011 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table 2.5. (cont.) National emissions of greenhouse gases for 1988–2011 according to gases [Gg CO_2 eq.]

GHG	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
CO_2 (with LULUCF)	305 018.53	298 552.68	286 198.95	297 553.04	297 590.37	294 146.08	304 269.83	308 549.37	300 308.23	284 431.97	305 309.21	306 138.93
CO_2 (without LULUCF)	315 539.64	312 083.43	300 519.43	312 481.07	316 204.78	318 019.54	331 550.47	332 612.82	326 847.15	311 773.19	332 573.75	330 309.43
CH_4 (with LULUCF)	41 567.84	40 927.07	39 900.64	40 344.32	40 092.68	40 547.64	40 953.95	40 243.46	39 355.20	38 189.86	38 682.41	37 787.07
CH_4 (without LULUCF)	39 361.03	38 742.34	37 701.27	38 056.54	37 885.74	38 325.61	38 723.15	38 023.22	37 127.90	35 959.16	36 448.45	35 537.91
N_2O (with LULUCF)	29 193.09	29 337.84	28 407.77	28 590.99	28 897.62	29 287.76	30 497.23	31 402.22	30 960.80	27 313.07	26 868.99	27 249.62
N_2O (without LULUCF)	29 176.30	29 328.65	28 392.43	28 558.89	28 883.07	29 271.96	30 483.24	31 392.31	30 950.55	27 302.49	26 860.62	27 240.63
HFCs	1 127.78	1 717.39	2 221.21	2 723.42	3 482.23	4 424.87	5 053.80	5 641.57	5 114.06	5 453.34	5 694.34	6 210.80
PFCs	151.88	168.74	177.61	172.31	175.86	160.65	166.08	158.41	139.85	59.24	56.13	49.88
SF_6	24.18	23.96	24.41	21.72	23.44	28.09	34.80	32.66	34.46	39.42	37.07	40.90
TOTAL (with LULUCF)	**377 083.30**	**370 727.68**	**356 930.59**	**369 405.80**	**370 262.20**	**368 595.09**	**380 975.69**	**386 027.69**	**375 912.60**	**355 486.89**	**376 648.14**	**377 477.20**
TOTAL (without LULUCF)	**385 380.81**	**382 064.51**	**369 036.35**	**382 013.94**	**386 655.12**	**390 230.71**	**406 011.53**	**407 860.99**	**400 213.95**	**380 586.83**	**401 670.35**	**399 389.55**

Table 2.6. National emissions of greenhouse gases for 1988–2011 according to IPCC categories [Gg CO_2 eq.]

IPCC sector	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
1. Energy	470 203.27	449 799.19	374 069.28	374 593.98	365 079.44	367 091.25	360 725.59	361 867.95	376 982.71	366 724.67	338 916.54	330 890.23
2. Industrial Processes	29 787.98	28 925.03	22 024.98	19 055.26	18 217.13	18 206.60	20 704.02	21 941.52	20 851.44	21 459.27	19 757.68	18 901.07
3. Solvent and Other Product Use	1 006.46	946.14	629.23	608.22	558.57	519.36	521.05	524.81	550.00	548.63	552.44	547.19
4. Agriculture	50 763.84	53 587.52	49 655.35	42 040.69	38 499.62	36 704.72	36 981.38	37 077.84	36 064.97	36 917.34	37 675.34	36 227.97
5. Land-Use, Land-Use Change and Forestry	-5 588.89	-9 515.59	-16 329.24	-17 813.43	-8 188.49	-9 126.78	-6 692.07	-5 639.62	-6 767.88	-6 491.43	-7 291.93	-8 509.23
6. Waste	10 383.71	10 610.35	10 635.81	10 947.54	11 025.08	11 135.64	11 126.25	11 048.33	11 206.35	11 493.03	11 882.60	12 075.77
TOTAL net emission (with LULUCF)	**556 556.37**	**534 352.64**	**440 685.41**	**429 432.26**	**425 191.36**	**424 530.79**	**423 366.23**	**426 820.82**	**438 887.58**	**430 651.51**	**401 492.67**	**390 133.00**

* emissions for 1988 estimated for entire series up to 2011 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table 2.6. (cont.) National emissions of greenhouse gases for 1988–2011 according to IPCC categories

IPCC sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
1. Energy	317 797.83	316 438.61	305 226.87	316 161.75	319 373.26	317 294.89	328 976.85	327 676.32	321 468.59	310 717.64	330 275.36	325 205.95
2. Industrial Processes	21 457.87	20 104.70	18 370.47	21 265.20	22 920.91	27 934.13	30 417.41	32 732.38	31 569.96	23 641.43	25 950.46	28 719.88
3. Solvent and Other Product Use	627.89	631.77	661.01	645.02	677.09	687.75	761.46	721.65	797.18	751.41	779.40	788.67
4. Agriculture	34 462.84	34 139.19	34 037.24	33 439.96	33 275.37	33 787.05	35 349.87	36 169.59	36 166.32	35 209.61	34 560.56	34 929.80
5. Land-Use, Land-Use Change and Forestry	-8 297.52	-11 336.83	-12 105.77	-12 608.14	-16 392.92	-21 635.62	-25 035.84	-21 833.30	-24 301.36	-25 099.94	-25 022.21	-21 912.35
6. Waste	11 034.38	10 750.24	10 740.77	10 502.01	10 408.49	10 526.90	10 505.94	10 561.06	10 211.91	10 266.73	10 104.57	9 745.25
TOTAL net emission (with LULUCF)	**377 083.30**	**370 727.68**	**356 930.59**	**369 405.80**	**370 262.20**	**368 595.09**	**380 975.69**	**386 027.69**	**375 912.60**	**355 486.89**	**376 648.14**	**377 477.20**

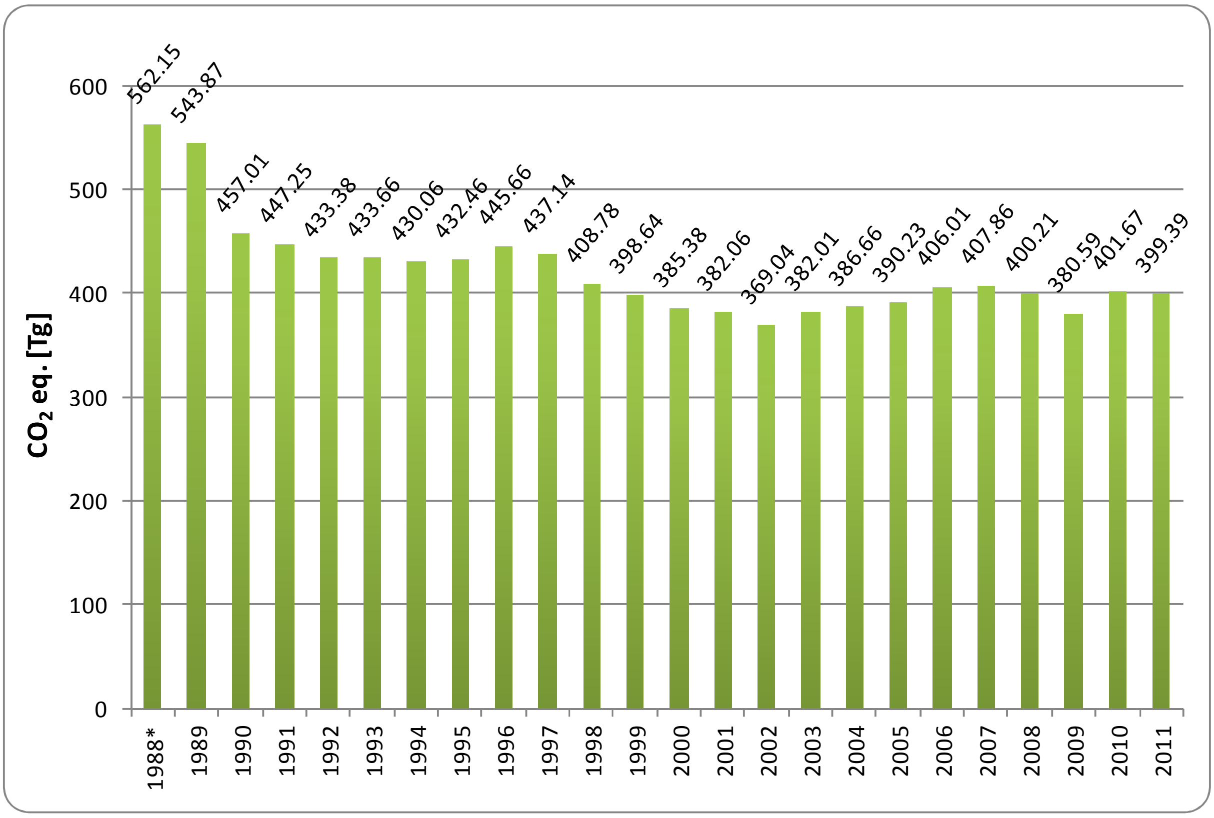

Figure 2.2. Trend of aggregated GHGs emissions (excluding category 5) for 1988–2011

* emissions for 1988 estimated for entire series up to 2011 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

2.2. Description and interpretation of emission trends by gas

Carbon dioxide (CO_2)

In 2011, the CO_2 emissions (without LULUCF) were estimated as 330.31 million tonnes, while when sector 5. LULUCF is included the figure reaches 306.14 million tonnes (table 2.1). CO_2 share in total GHG emissions in 2011 amounted to 82.7%. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission (without LULUCF) by 92.2% in 2011 (fig. 2.3). The shares of the main subcategories in 1.A were as follows: *Energy industries* - 52.6%, *Manufacture Industries and Construction* – 9.4%, *Transport* – 14.5% and *Other Sectors* – 15.7%. Sector 2. *Industrial Processes* contributed to the total CO_2 emission by 6.4% in 2011. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 emission/removal in LULUCF sector in 2011, was calculated to be approximately 24.2 million tonnes. It means that app. 7.3% of the total CO_2 emissions are offset by CO_2 uptake by forests.

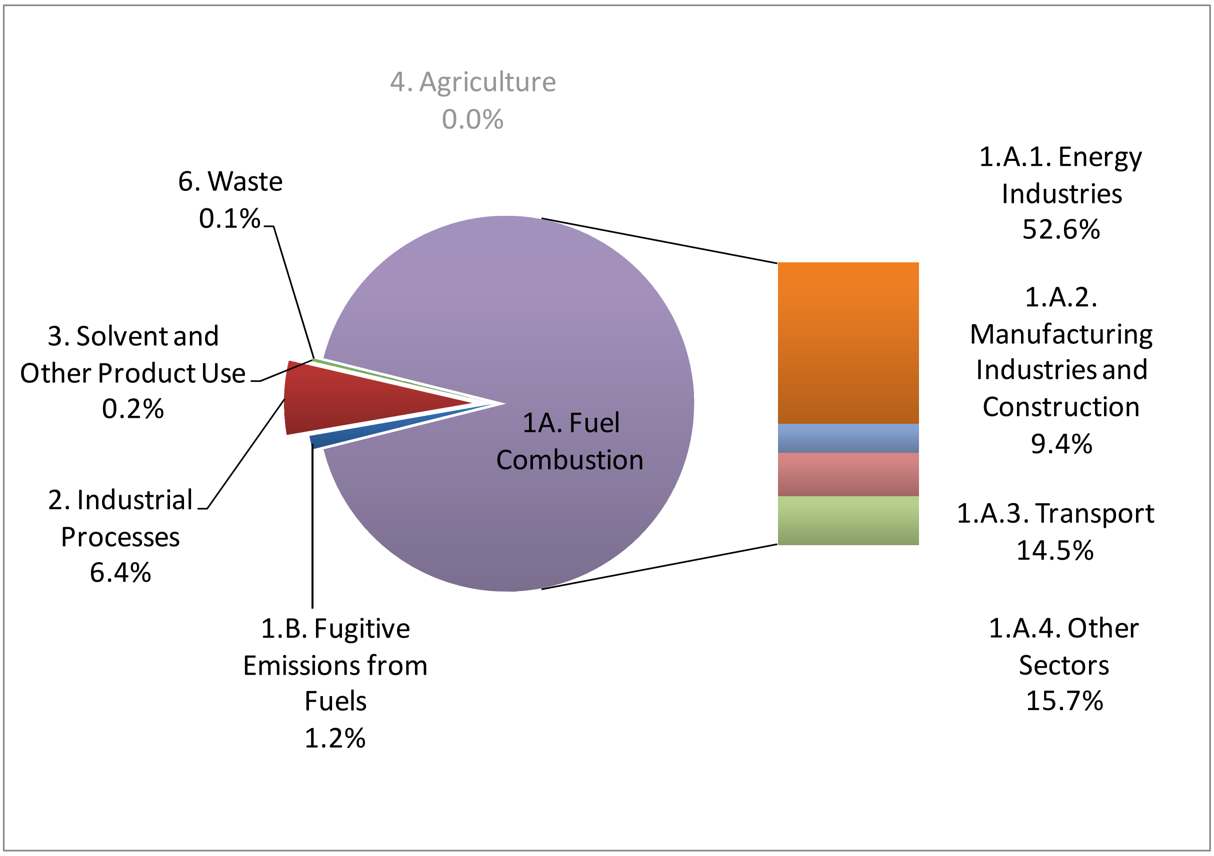

Figure 2.3. Carbon dioxide emission (excluding category 5) in 2011 by sector

Methane (CH_4)

The CH_4 emission (excluding category 5) amounted to 1 692.28 Gg in 2011 i.e. 35.54 million tonnes of CO_2 equivalents (table 2.1). CH_4 share in total GHG emissions in 2011 amounted to 8.9%. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed to 32.9%, 34.1% and 23.6% of the national methane emission in 2011, respectively (fig. 2.4). The emission from the first mentioned sector was covered by emission from *Underground Mines* (app. 20.2% of total CH_4 emission) and *Oil and Natural Gas* system (about 12.7% of total emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 26.1% of total methane emission in 2011. *Disposal sites* contributed to 20.5% of the methane emission and *Wastewater Handling* contributed to 3.1%.

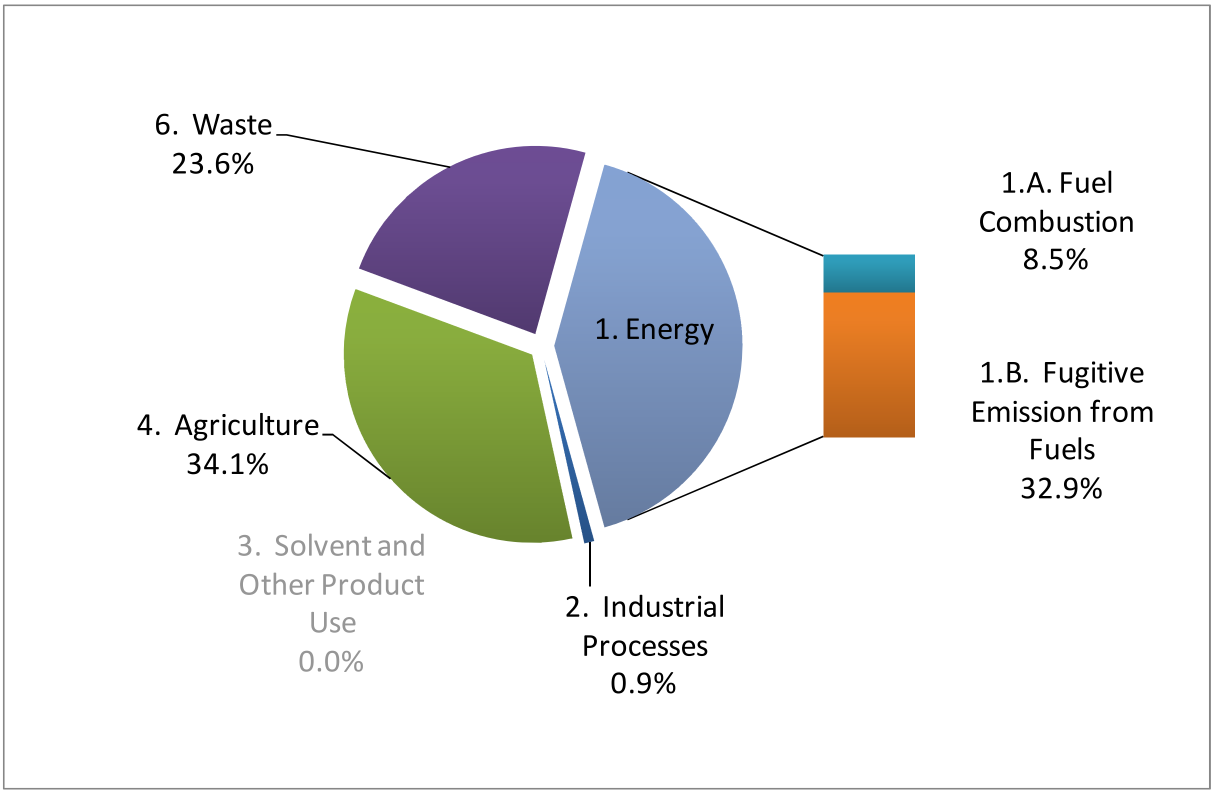

Figure 2.4. Methane emission (excluding category 5) in 2011 by sector

Nitrous oxide (N_2O)

The nitrous oxide emissions (excluding category 5) in 2011 were 87.87 Gg i.e. 27.24 million tonnes of CO_2 equivalents (table 2.2). N_2O share in total GHG emissions in 2011 amounted to 6.8%. The main N_2O emission sources and its shares in total N_2O emission in 2011 are: *Agricultural Soils* – 65.0%, *Manure Management* – 18.8%, *Chemical Industry* – 3.9% and *Fuel Combustion* – 7.7% (fig. 2.5).

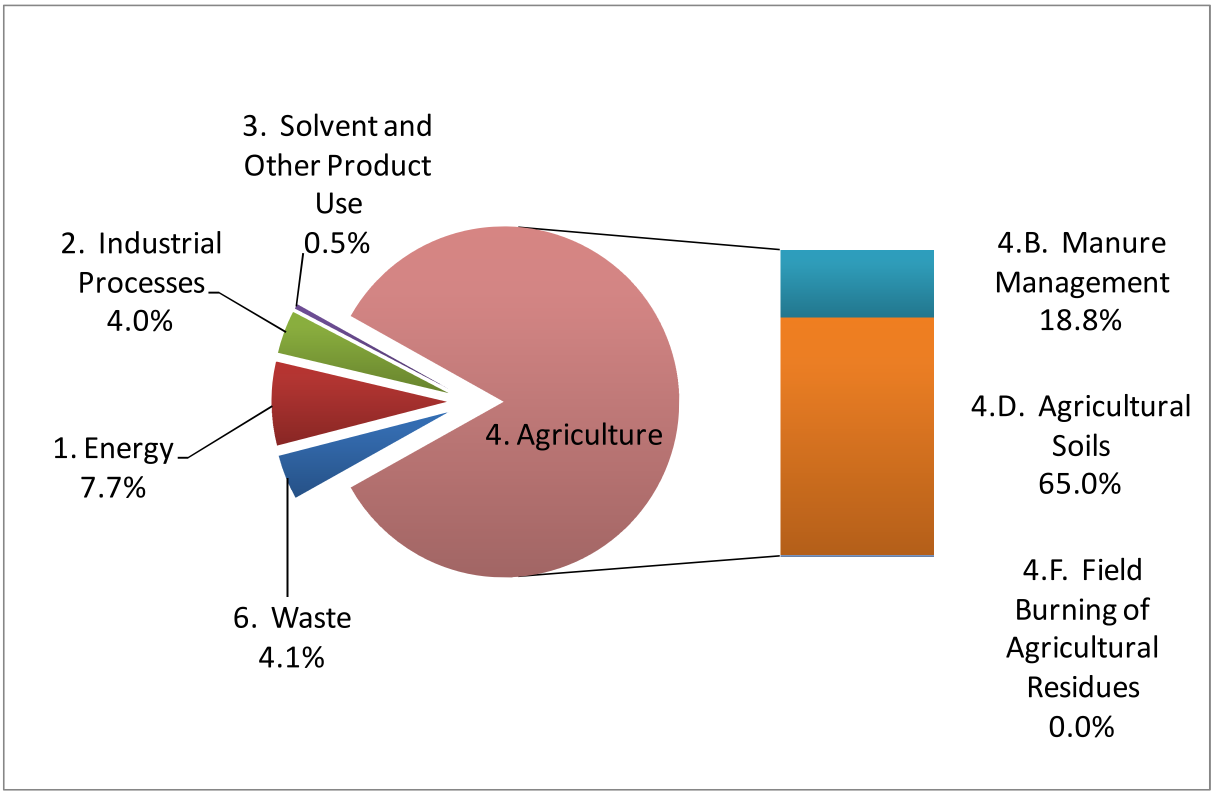

Figure 2.5. Nitrous oxide emission (excluding category 5) in 2011 by sector

Industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2011 was 6 301.58 Gg CO_2 eq. what accounts for 1.6% of total GHG emissions share in 2011. This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. Shares of HFCs, PFCs and SF_6 in total 2011 GHG emissions was respectively as follows: 1.56%, 0.01% and 0.010%.

The total emissions in 2011 according to groups of industrial gases are as follows: HFCs –6.21 million tonnes of CO_2 equivalents, PFCs – 0.05 million tonnes of CO_2 equivalents and SF_6 – 0.04 million tonnes of CO_2 equivalents.

Comparison of GHG emissions to the base year (1988/1995)

Percentage share of individual GHGs to national total in the base year (1988) are presented in Table 2.7 and figure 2.6. The emissions given here for base year are those accepted for the purpose of estimation of Assigned Amount under Kyoto Protocol obligations for 2008–2012 [IRR 2007], which accounted for 563 442.77 Gg CO_2 eq. Compared to 1988, the percentage share of CO_2 (excluding category 5) in 2011 decreased from 83.3% to 82.7%.

Table 2.7. Emissions of greenhouse gases in base year (1988) in CO_2 equivalent

Pollutant	base year 1988	
	Emission in CO_2 eq. [Gg]	Share [%]
CO_2 (with LULUCF)	436 209.10	82.2
CO_2 (without LULUCF)	469 143.82	83.3
CH_4 (with LULUCF)	53 672.51	10.1
CH_4 (without LULUCF)	53 665.03	9.5
N_2O (with LULUCF)	40 334.29	7.6
N_2O (without LULUCF)	40 333.53	7.2
HFCs	26.44	0.0
PFCs	250.18	0.044
SF_6	23.77	0.004
TOTAL net emission (with LULUCF)	530 466.09	100.0
TOTAL without LULUCF	563 442.77	100.0

*the base year for HFCs, PFCs and SF_6 is 1995

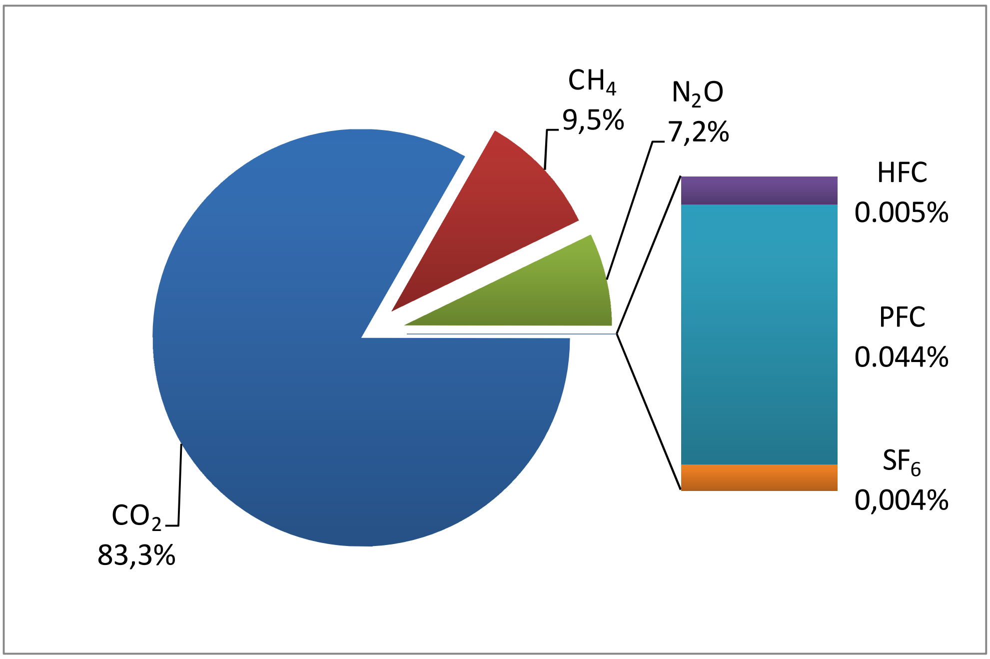

Figure 2.6. Percentage share of national greenhouse gas emissions in base year (1988) excluding emission from sector 5

The data for the GHGs and for the national total GHG emission for 2011 in comparison to the base year are given in table 2.8 and illustrated on figure 2.7 also in relation to the Poland's reduction target under the Kyoto Protocol.

Table 2.8. Greenhouse gas emissions in 2011 with respect to base year 1988/1995*

Pollutant	Base year Emission in CO_2 eq. [Gg]	2011 Emission in CO_2 eq. [Gg]	2011/base year [%]
CO_2 (with LULUCF)	436 209.10	306 138.93	70.18
CO_2 (without LULUCF)	469 143.82	330 309.43	70.41
CH_4 (with LULUCF)	53 672.51	37 787.07	70.40
CH_4 (without LULUCF)	53 665.03	35 537.91	66.22
N_2O (with LULUCF)	40 334.29	27 249.62	67.56
N_2O (without LULUCF)	40 333.53	27 240.63	67.54
HFCs	26.44	6 210.80	23488.97
PFCs	250.18	49.88	19.94
SF_6	23.77	40.90	172.10
TOTAL net emission (with LULUCF)	530 466.09	377 477.20	71.16
TOTAL without LULUCF	563 442.77	399 389.55	70.88

*the base year for HFCs, PFCs and SF_6 is 1995

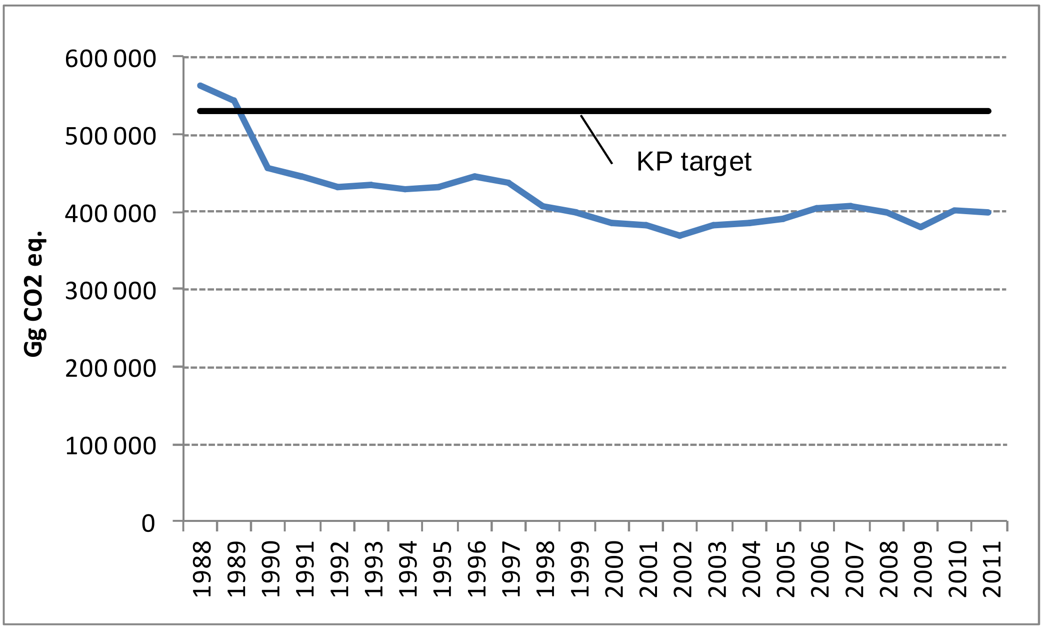

Figure 2.7. Trend of aggregated GHG emissions in 1988-2011 relative to Poland's Kyoto Protocol target

Carbon dioxide

CO_2 emission (excluding category 5) had decreased by app. 29.6% from the base year to 2011. The following changes took place in the structure of fuel use:

- share of solid fuels decreased from 82.1% in base year 1988 to 55.4% in 2011
- share of liquid fuels increased from 11.1% (base year 1988) to 23.9% (2011)
- share of gaseous fuels increased from 6.0% (base year 1988) to 11.8% (2011).

Methane

CH_4 emission (excluding category 5) had decreased by app. 33.8% from the base year to 2011. The reasons for that are as follow:

- the decrease in emission from *Enteric Fermentation* by 40.9%
- the decrease in *Fugitive Emission* by 48.6%
- the increase in emission from *Waste* by 26.2%.

Nitrous oxide

The nitrous oxide emissions (excluding category 5) in 2011 were app. 32.5% lower than the respective figure for the base year. The share in *Manure Management* decreased from 23.1% in the base year 1988 to 18.8% in 2011, in *Agricultural Soils* increased from 55.5% in the base year 1988 to 65.0% in 2011 and in *Chemical Industry* decreased from 12.4% in the base year 1988 to 3.9% in 2011.

Industrial gases: HFCs, PFCs and SF_6

HFCs emissions in 2011 were 234.9 times higher than in base year (1995). This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. PFCs emissions in 2011 were 80.1% lower than in base year (1995). The PFCs emission changes between 2011 and the preceding years depend on the aluminium production levels (main PFC source) and the use of C_4F_{10} in fire extinguishers.

SF_6 emissions in 2011 were about 72.1% higher than in base year (1995). Leakage from electrical equipment during its use and production is the main SF_6 emission.

Large percentage increase of industrial gases emissions, compared to the base year (1995), does not influence significantly the national total GHG emission trend, because all the fluorinated industrial gases together contributed merely app. 1.6% to the national total in 2011.

2.3. Description and interpretation of emission trends by category

Table 2.9 includes emissions of greenhouse gases from all categories for the base year 1988/1995 (fixed for the purpose of accounting the Kyoto Protocol reduction) and for year 2011 according to main categories. In 2011 total GHG emissions accounted for 399.39 million tons CO_2 eq. excluding sector 5. LULUCF. Comparing to the fixed base year emissions in 2011 decreased by 29.1%.

Table 2.9. GHG emissions according to main sectors in base year (1988) and 2011

	Total [Gg eq. CO_2]		(2011-base)/base [%]
	Base year	2011	
TOTAL with LULUCF	530 516.30	377 477.20	-28.8
TOTAL without LULUCF	563 442.77	399 389.55	-29.1
1. Energy	470 309.06	325 205.95	-30.9
2. Industrial Processes	32 832.19	28 719.88	-12.5
3. Solvent and Other Product Use	1 006.46	788.67	-21.6
4. Agriculture	50 893.90	34 929.80	-31.4
5. Land-Use Change and Forestry	-32 926.48	-21 912.35	-33.5
6. Waste	8 401.16	9 745.25	16.0

2.3.1. Energy (IPCC category 1)

The emission of GHGs from *Energy* sector in 2011 was 325.2 million tons of CO_2 equivalent. CO_2 emission share exceeded 94.8% of the total GHG emissions within 1. *Energy* category (table 2.10). The most emission intensive category was 1.A.1. *Fuel combustion activities* related mostly to heavy industry sector, highly energy consuming.

Table 2.10. GHG emissions from sub-sectors in category 1. *Energy* in 2011

GHG emission categories	GHG Emission [Gg CO_2-eq]	% share in the total emission from Energy	% Share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
1. TOTAL ENERGY	325 205.95	100.0	94.8	4.5	0.6
A. Fuel Combustion	309 704.11	95.2	93.7	0.9	0.6
1. Energy Industries	174 770.89	53.7	53.4	0.0	0.3
2. Manufacturing Industries and Construction	31 300.71	9.6	9.6	0.0	0.0
3. Transport	48 687.22	15.0	14.8	0.0	0.2
4. Other Sectors	54 945.28	16.9	15.9	0.8	0.2
5. Other	0.00	0.0	0.0	0.0	0.0
B. Fugitive Emissions from Fuels	15 501.84	4.8	1.2	3.6	0.0
1. Solid Fuels	9 280.28	2.9	0.6	2.2	0.0
2. Oil and Natural Gas	6 221.57	1.9	0.5	1.4	0.0

2.3.2. Industrial Processes and Solvent and Other Product Use (IPCC categories 2 and 3)

Table 2.11 shows detailed information on emissions of CO_2, CH_4, N_2O as well as HFCs, PFCs, SF_6 in 2. *Industrial Processes* sector and in 3. *Solvent and Other Product Use* sector in 2011. CO_2 is dominating among GHGs – it's contribution exceeds 73.2%. The main GHG emission sources in this category were: production processes of cement, nitric acid and ammonia.

The emissions of GHG from 3. *Solvent and Other Product Use* sector includes N_2O emissions from anaesthesia (15.7%) and CO_2 emissions (recalculated from NMVOC) (84.3%).

Table 2.11. The emissions of CO_2, CH_4 and N_2O from sub-sectors in categories: 2. *Industrial Processes* and 3. *Solvents and Other Product Use* in 2011

GHG emission categories	GHG Emission [Gg CO_2-eq]	% share in the total emission from Industrial Processes	% Share in total GHG emission from a given sub-sector			
			CO_2	CH_4	N_2O	HFC, PFC and SF_6
2. TOTAL INDUSTRIAL PROCESSES	28 719.88	100.0	73.2	1.1	3.8	21.9
A. Mineral Products	10 711.41	37.3	37.3	0.0	0.0	
B. Chemical Industry	5 304.12	18.5	13.8	0.9	3.7	
C. Metal Production	6 101.16	21.2	20.9	0.1	0.1	0.1
D. Other Production	8.20	0.0	0.0	0.0	0.0	
F. Consumption of Halocarbons and SF6	6 260.17	21.8				21.8
G. Other	334.81	1.2	1.2	0.0	0.0	
3. TOTAL SOLVENT AND OTHER PRODUCT USE	788.67	100	84.3	0.0	15.7	

2.3.3. Agriculture (IPCC category 4)

The main sources of GHG in category 4. *Agriculture* were: 4.D. *Agricultural Soils,* 4.A. *Enteric Fermentation* and 4.B. *Manure Management* (table 2.12). N_2O emission share was the largest in total GHG emission from 4. *Agriculture* in 2011 and came from both – direct (mineral and organic fertilization) and indirect (volatilization, leaching and runoff from applied synthetic fertilizer and animal manure) N_2O emissions from soils.

Table 2.12. GHG emissions from sub-sectors in category 4. *Agriculture* in 2011

GHG emission categories	GHG Emission [Gg CO_2-eq]	% share in the total emission from Agriculture	% Share in total GHG emission from a given sub-sector	
			CH_4	N_2O
4. TOTAL AGRICULTURE	34 929.80	100.0	34.7	65.3
A. Enteric Fermentation	9 286.65	26.6	26.6	0.0
B. Manure Management	7 917.63	22.7	8.0	14.6
D. Agricultural Soils	17 697.57	50.7	0.0	50.7
F. Field Burning of Agricultural Residues	27.94	0.1	0.1	0.0

2.3.4. Waste (IPCC category 6)

As it can be seen in table 2.13, the emission of CH_4 dominated in this sector in 2011 (almost 86.2%). The main part of GHG emissions came from 6.A. *Solid waste disposal on land* and 6.B. *Wastewater handling*.

Table 2.13. GHG emissions from sub-sectors in category 6. *Waste* in 2011

GHG emission categories	GHG Emission [Gg CO_2-eq]	% share in the total emission from Waste	% Share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
6. TOTAL WASTE	9 745.25	100	2.3	86.2	11.5
A. Solid Waste Disposal on Land	7 290.34	74.8	0.0	74.8	0.0
B. Wastewater Handling	2 218.83	22.8	0.0	11.4	11.4
C. Waste Incineration	236.08	2.4	2.3	0.0	0.1

2.4. Description and interpretation of emission trends for indirect greenhouse gases and SO_2

Emissions of all GHG precursors diminished significantly since 1990. In case of SO_2 emissions, which amounted to 910.0 Gg in 2011, the decrease was noted by about 70% between 1990 and 2011 what was caused by the decline of the heavy industry in the late 1980s and early 1990s. In late 1990s the emissions declined because of the diminished share of coal and lignite among fuels used for power and heat generation. Additionally flue gases desulphurisation had the impact for SO_2 emissions decrease. Emissions of NO_x in 2011 amounted 850.7 Gg and decreased by more than 30% between 1990 and 2011. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s as well as the lower share of hard coal and lignite in fuel used in 1990s. Increasing emissions from road transport cause comparatively lower total emission reductions than in case of SO_2. CO emissions in 2011 amounted to 2915.8 Gg and dropped by more than 60% between 1990 - 2011 triggered by the same reasons as for SO_2 and NO_x. Emissions of NMVOC were about 652.0 Gg in 2011 and decreased by 20% between 1990 and 2011.

Below emission trends of SO_2, NO_x, NMVOC and CO for 2000-2011 are presented for which recalculations were made in 2013.

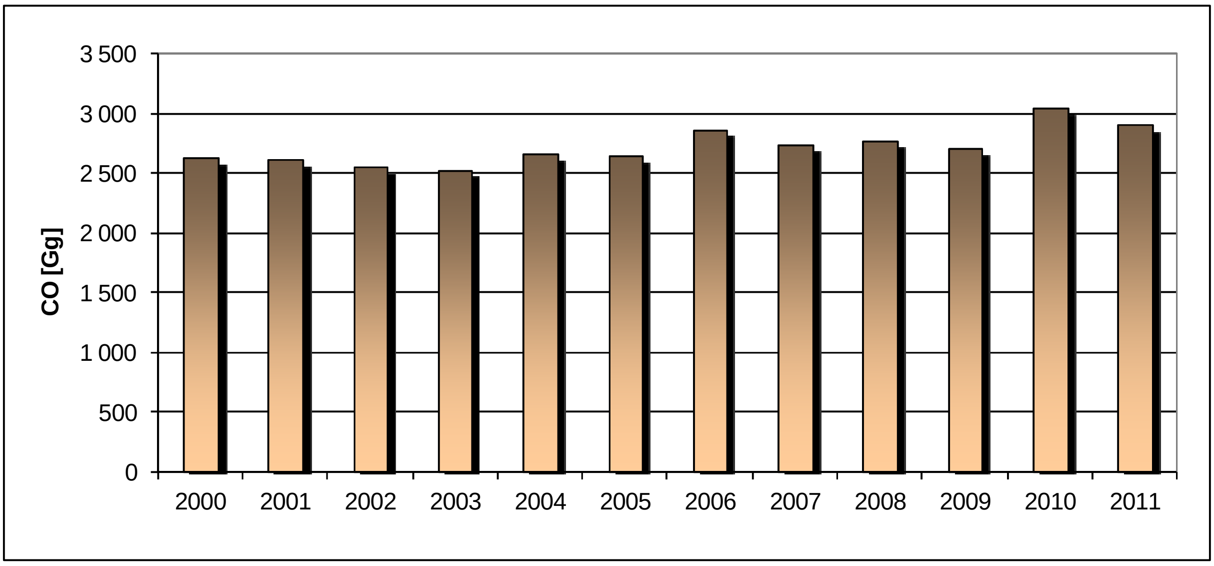

Figure 2.8. Emissions of CO in 2000-2011

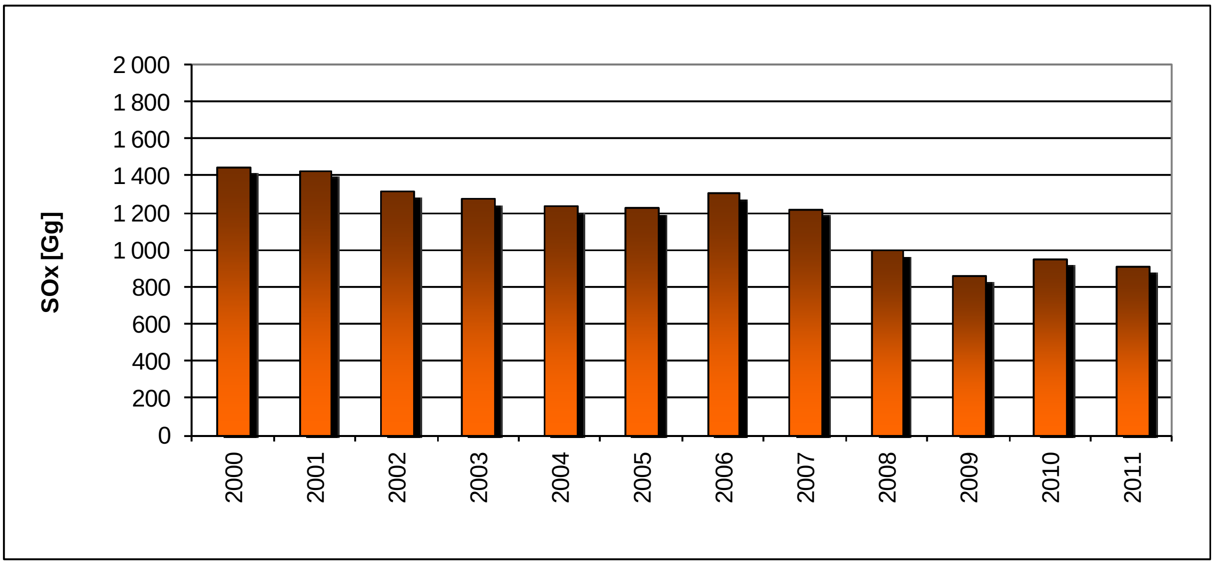

Figure 2.9. Emissions of SO_2 in 2000-2011

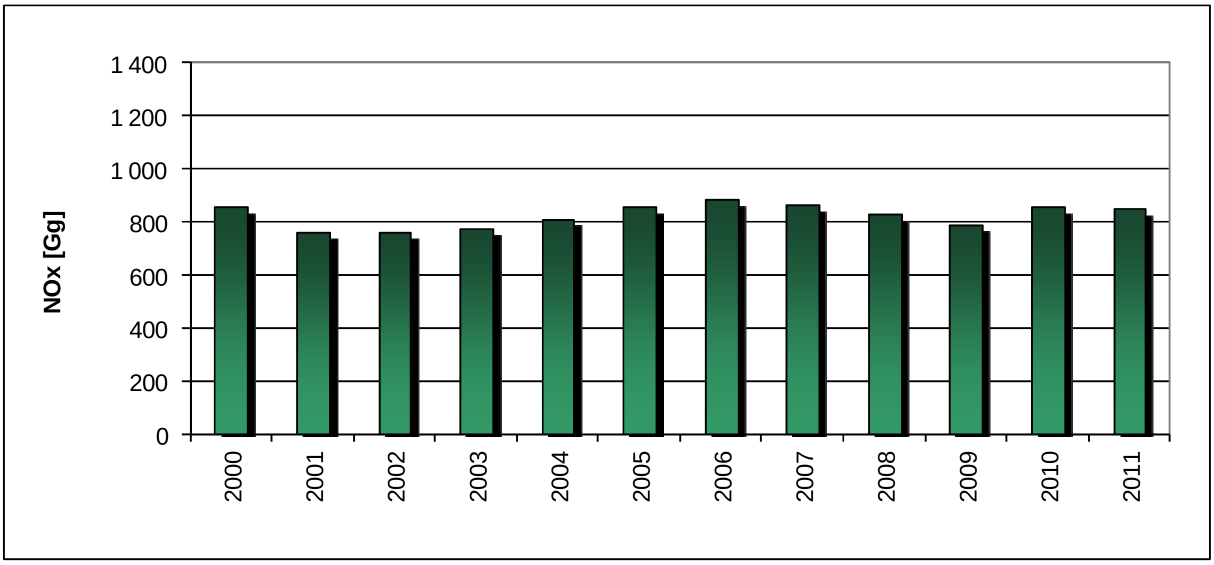

Figure 2.10. Emissions of NO_x in 2000-2011

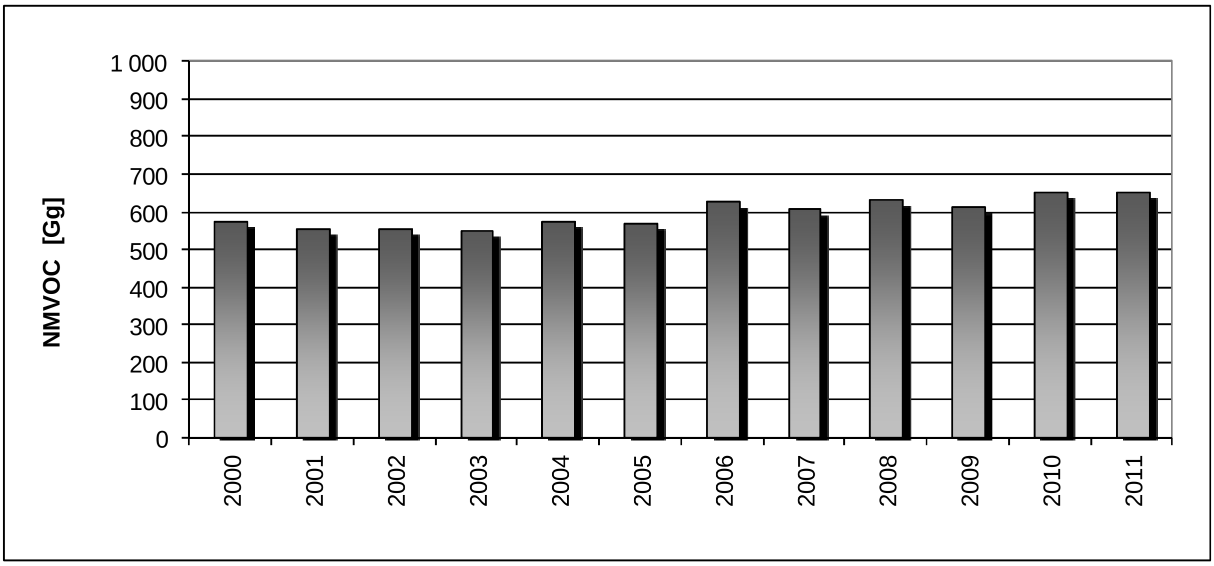

Figure 2.11. Emissions of NMVOC in 2000-2011

2.5. Description and interpretation of emission trends for KP-LULUCF inventory in aggregate and by activity, and by gas

Estimated emissions and removals of greenhouse gases for the period 2008-2011, related to the LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol are presented in Table 2.14.

Table 2.14. The emissions and removals balance of greenhouse gases for the period 2008-2011, to the related activities of land use, land use change and forestry (LULUCF) [Gg.]

Kyoto Protocol	Activity	Gg	2008	2009	2010	2011
Art. 3.3	Afforestation/ reforestation	CO_2 eq.	-4 900.55	-5 247.57	-5 590.80	-5 956.49
		CO_2	-5 159.67	-5 517.33	-5 820.70	-6 193.33
		CH_4	0.04	0.07	0.03	0.05
		N_2O	0.001	0.001	0.001	0.001
	Deforestation	CO_2 eq.	258.02	268.07	229.03	235.67
		CO_2	258.02	268.07	229.03	235.67
		CH_4	NO	NO	NO	NO
		N_2O	NO	NO	NO	NO
Art. 3.4	Forest management	CO_2 eq.	-27 408.87	-28 168.61	-28 043.34	-25 232.72
		CO_2	-27 424.15	-28 191.07	-28 054.41	-25.246.88
		CH_4	0.59	0.87	0.43	0.55
		N_2O	0.01	0.01	0.01	0.01
	Cropland management	*NA*	*NA*	*NA*	*NA*	*NA*
	Grazing land management	*NA*	*NA*	*NA*	*NA*	*NA*
	Revegetation	*NA*	*NA*	*NA*	*NA*	*NA*

Considering the afforestation activity, estimated CO_2 sink increased by 20% comparing to 2008. The emissions associated with deforestation in comparison to 2008 decreased by 8.7%, as a result of lower than in the compared year areas of forest land designated for non-forest purposes. The size of net absorption for forest management for the year 2011 is about 8% lower than in 2008. Decreasing area (subject of activities related to forest management) and increasing volumes of harvested timber, mainly drive the final estimates. Volumes of harvested timber in 2011 in comparison to 2008, increased by 8.5% from 34.273 million m^3 to the level of 37.180 million m^3.

3. ENERGY (CRF SECTOR 1)

3.1. Overview of sector

Following categories from sector 1 have been identified as key sources (excluding LULUCF):

1.A.1, 1.A.2, 1.A.4 Stationary combustion of solid, liquid and gaseous fuels (CO_2 emission), share in total GHG emission 63.2%
1.A.1, 2, 4 - Stationary combustion Other Fuels (CO_2 emission), share in total GHG emission 1.0%
1.A.3.b - Transport Road Transportation (CO_2 emission), share in total GHG emission 11.8%
1.B.1.a - Coal Mining and Handling (CH_4 emission), share in total GHG emission 1.8%
1.B.2.b - Natural Gas (CH_4 emission), share in total GHG emission 1.1%

Share of these categories in total Poland's GHG emissions is 78.9%.

Figure 3.3.1 shows emission trend in *Energy* sector while figure 3.1.2 shows emission trend according to subcategories 1.A. *Fuel combustion* and 1.B. *Fugitive emission*. Emission from subcategory 1.A. *Fuel combustion* is the largest contributor to emissions from sector 1. *Energy* – in 2011 over 95%.

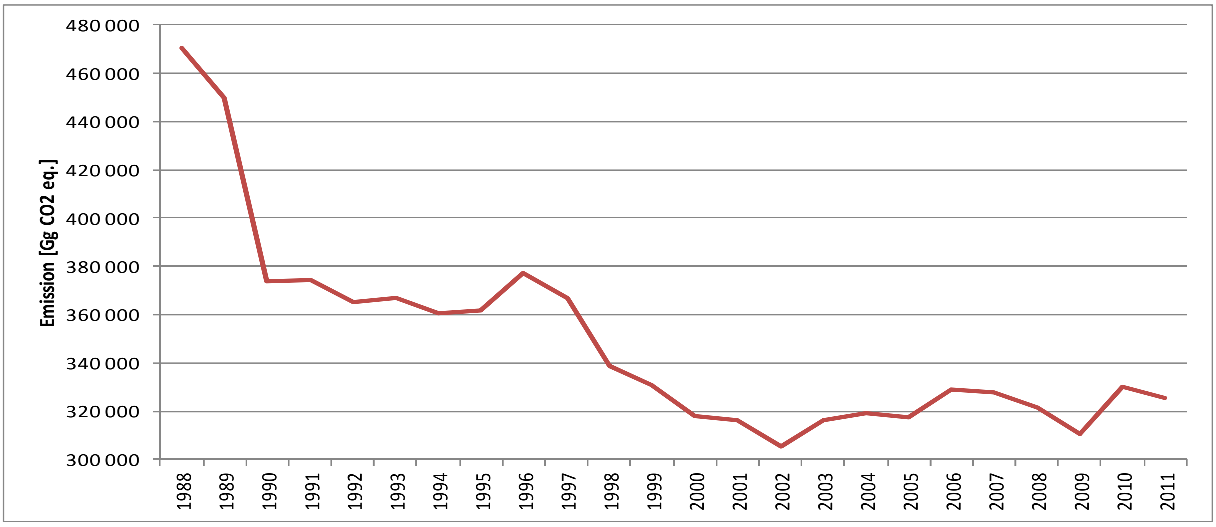

Figure 3.1.1. GHG emission trend in period 1988 – 2011 in sector *Energy*

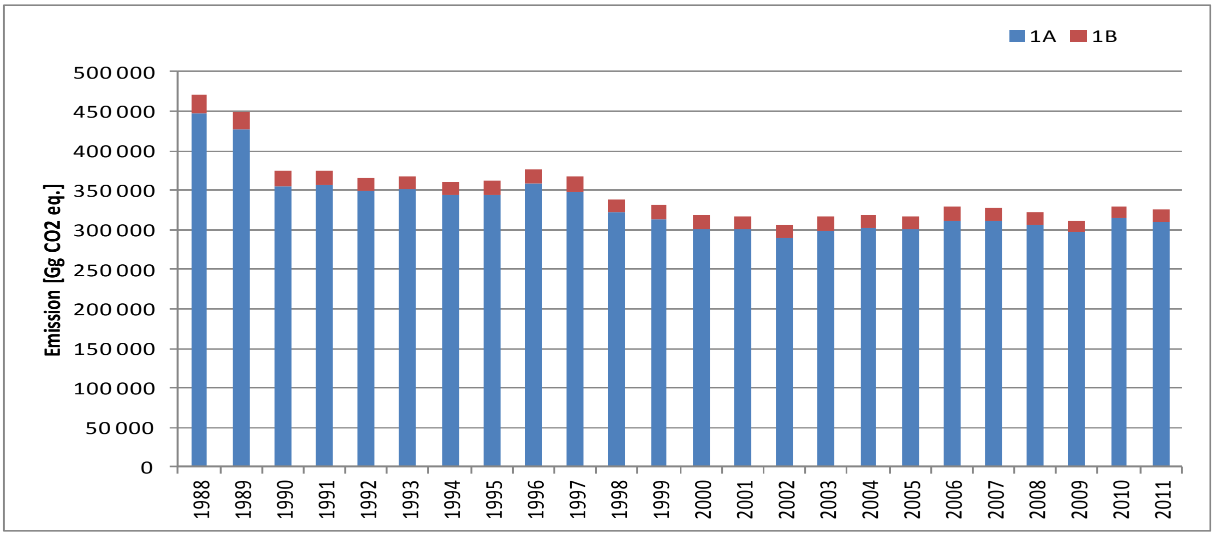

Figure 3.1.2. GHG emission trend in period 1988 - 2011 in subsectors 1.A and 1.B

3.1.1 Fuel combustion (CRF sector 1.A)

Combustion as a source of GHG emission occurs in the following category groups:

1.A.1. *Energy industries*
1.A.2. *Manufacturing industries and construction*
1.A.3. *Transport*
1.A.4. *Other sectors*:
  a. *Commercial/Institutional*
  b. *Residential*
  c. *Agriculture/Forestry/Fishing*

Share of that sector in total GHG emission in 2011 is over 77%. Subsector 1.A.1. *Energy Industries* is by far the largest contributor to emissions from fuel combustion (see figure 3.1.3).

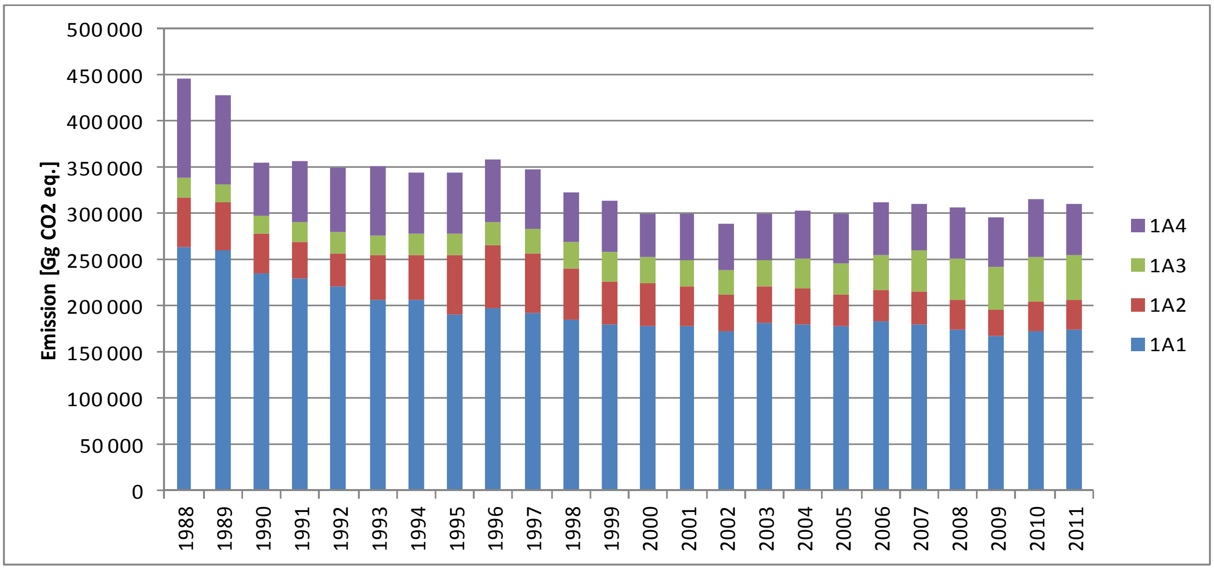

Figure 3.1.3. GHG emissions from fuel combustion in 1988-2010 according to subcategories

Emissions in 1.A.1 *Energy Industries* category are estimated for each detailed sub-categories as follows:

a) 1.A.1.a *Public Electricity and Heat Production*
  – public thermal power plants
  – autoproducing thermal power plants (CHP)
  – heat plants

b) 1.A.1.b *Petroleum Refining*

c) 1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries*
  - coke-oven and gas-works plants
  - mines and patent fuel/briquetting plants
  - other energy industries (oil and gas extraction; own use in Electricity, CHP and heat plants)

Emissions in 1.A.2 *Manufacturing Industries and Construction* category are estimated for each fuel in detailed sub-categories as follows:

a) *Iron and Steel* - 1.A.2.a
b) *Non-Ferrous Metals* - 1.A.2.b
c) *Chemicals* - 1.A.2.c
d) *Pulp, Paper and Print* - 1.A.2.d

e) *Food Processing, Beverages and Tobacco* - 1.A.2.e
f) *Other* - 1.A.2.f:
- construction and other industry branches not included elsewhere

Estimation of emissions in 1.A.3 *Transport* are carried out for each fuel in sub-categories listed below:

a) *Civil Aviation* (1.A.3.a)
b) *Road Transportation* (1.A.3.b)
c) *Railways* (1.A.3.c)
d) *Navigation* (1.A.3.d)
e) *Other Transportation* (1.A.3.e)

Emissions in 1.A.4 *Other Sectors* are estimated for each fuel in detailed sub-categories given below:

a) *Commercial/Institutional* (1.A.4.a)
b) *Residential* (1.A.4.b)
c) *Agriculture/Forestry/Fishing* (1.A.4.c)
- agriculture – stationary sources,
- agriculture – mobile sources: off-road vehicles and other machinery
- fishing.

The amount of CO_2 emissions from fuel combustion in stationary sources were estimated on the level determined as IPCC *Tier 2.* In this case the calculation was based on the following equation:

$$E = \sum (EF_{ab} * A_{ab})$$

where: E - emission
EF - emission factor
A - fuel consumption
a - fuel type, b - sector

The amount of combusted fuel was accepted according to data included in the energy balance submitted by GUS to Eurostat [EUROSTAT].

List of combusted fuels for which GHG emissions were estimated based upon selected or calculated emission factors is as follows:

- liquid fuels: fuel oil, diesel oil, liquid petroleum gas (LPG), crude oil, motor gasoline, jet kerosene, refinery gas, feedstocks, other petroleum products and petroleum coke
- gaseous fuels: natural gas
- solid fuels: hard coal, lignite, coke, hard coal briquettes, lignite briquettes, coke oven gas, blast furnace gas, gas works gas,
- other fuels: industrial wastes, municipal waste (non-biogenic fraction)
- biomass: fuel wood and wood waste, biogas, municipal waste – biogenic fraction.

The emission factors for CO_2 emission estimation for fuel combustion in stationary sources are the following:

- domestic emission factors for hard coal and lignite;

the EFs are based on empirical functions, that link the amount of carbon in fuel with the corresponding net calorific value, the empirical functions are the following:

- for hard coal:

$$C_{hc} = 10(2.4898*NCV + 3.3132)/NCV$$

where:

C_{hc} - emission factor/carbon content for hard coal [kg C/GJ],

NCV - net calorific value of hard coal [MJ/kg] in the given sub-category calculated based upon hard coal combusted expressed in both physical and energy units,

- for lignite:

$$C_{bc} = 10(1.9272*NCV + 9.3856)/NCV$$

where:

C_{bc} - emission factor for lignite [kg C/GJ],

NCV - net calorific value of lignite [MJ/kg] in the given sub-category calculated based upon lignite combusted expressed in both physical and energy units

- default emission factors [IPCC 2006] for biomass and waste (fuel wood and wood waste, biogas, industrial and municipal waste) and gas works gas;

- default emission factors [IPCC 1997] for all other fuels i.e.: natural gas, coke, hard coal briquettes, lignite briquettes, coke oven gas, blast furnace gas, fuel oil, diesel oil, LPG, crude oil, motor gasoline, jet kerosene, refinery gas, feedstocks, other petroleum products and petroleum coke.

The values for fraction of oxidized carbon for the given fuel types were taken from the IPPC guidelines [IPCC 1997].

The following values are used:

- gaseous fuels and derived gases from solid fuels (coke oven gas, blast furnace gas and gas works gas) – 0.995
- liquid fuels – 0.990
- solid fuels – 0.980 (in IPCC guidelines this value is recommended for hard coal; the same values was applied for all other solid fuels (solid in the meaning of solid-state aggregation) due to lack of respective default values)

Emissions of CH_4 and N_2O from fuel combustion in stationary sources are based on fuel quantities submitted by GUS to Eurostat (Eurostat database) and the corresponding emission factors [IPCC 2006].

Trend of fuel use and methodology over the years 1988-2011

Estimation of CO_2 emission from fuel combustion in stationary sources for the years 1988-2011 is based on methodology corresponding to methodology applied for 2011. For the years: 1990-2010 fuel consumptions from the Eurostat database were applied. The Eurostat database does not cover fuel use data for Poland for the years before 1990. Therefore, fuel use data for the period: 1988-1989 were taken from IEA database [IEA]. Amounts of particular fuel consumptions in individual subsectors: 1.A.1, 1.A.2 i 1.A.4 were presented in the tables 1-12 (Annex 2). CO_2 emission factors from fuel combustion in stationary sources for hard coal and lignite are the country specific EFs. These EFs for the entire time series are based on the same empirical functions described above.
The values of CO_2 EFs changed over the years following the changes of the respective net calorific values for hard coal and lignite (Annex 2 -table 13-24). GHG emission factors for other fuels are the IPCC default EFs [IPCC 1997, IPCC 2006]. Values of applied emission factors were tabulated in annex 2 (emission factors of CO_2, CH_4 and N_2O for particular fuel are presented in tables 25-27 of this annex).

The time series of fuel use and GHG emissions for the main subsectors of 1.A *Fuel combustion* are presented below (in the following chapters). Detailed data on particular fuel consumption in the main subcategories of 1.A IPCC category for entire period 1988-2011 and GHG EFs for individual fuels are presented in Annex 2 .

3.1.2. Fugitive emissions (CRF sector 1.B)

The GHG emission sources in fugitive emissions sector cover: fugitive emission from solid fuels (CO_2 and CH_4) and fugitive emission from oil and gas (CO_2, CH_4 and N_2O).

Total emission of GHGs as carbon dioxide equivalent in 1.B subcategory amounted to 15 502 Gg in 2011 and decreased since 1988 by 34%. Table 3.1.4. shows emissions from 1.B.1 and 1.B.2 subcategories, in period 1988-2011.

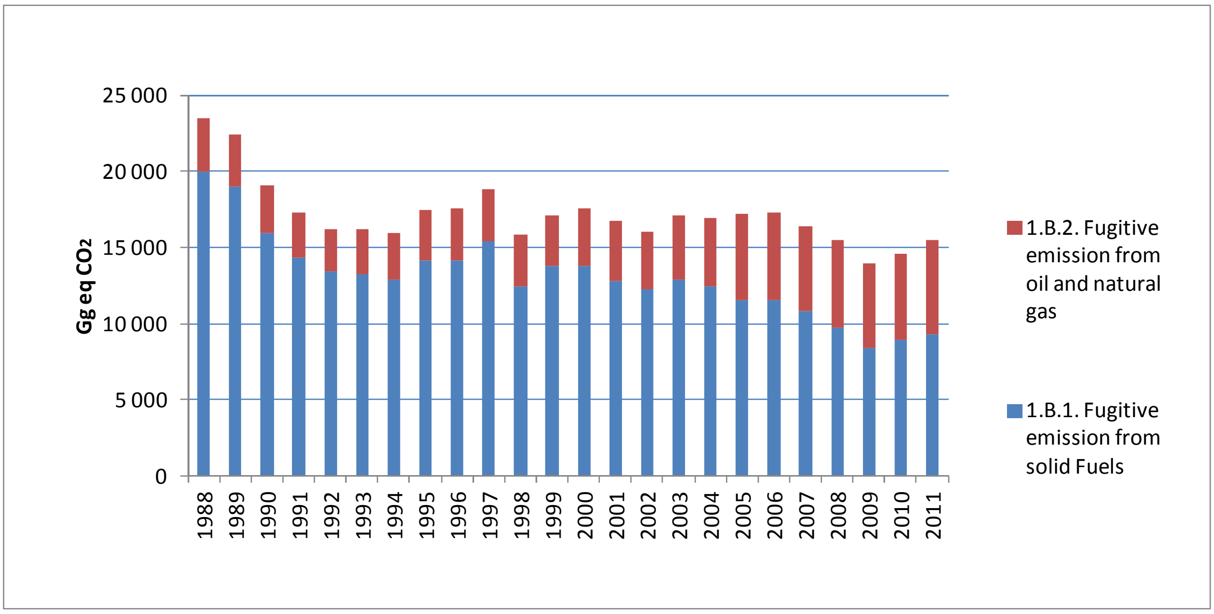

Figure 3.1.4. GHG emissions from 1.B.1 and 1.B.2 subcategories in 1988-2011.

3.2. Fuel combustion (CRF 1.A)

3.2.1. Comparison of the sectoral approach with the reference approach

The Reference Approach is a top-down approach, using a country's energy supply data to calculate the emissions of CO_2 from combustion of mainly fossil fuels. Comparability between the sectoral and reference approaches continues to allow a country to produce a second independent estimate of CO_2 emissions from fuel combustion. It allow to compare the results of these two independent estimates and indicate possible problems with the activity data, net calorific values, carbon content, carbon stored calculation, etc.

The Reference Approach is designed to calculate the emissions of CO_2 from fuel combustion, starting from high level energy supply data. The Reference Approach does not distinguish between different source categories within the energy sector and only estimates total CO_2 emissions from Source category 1.A. *Fuel Combustion*. The IPCC Reference Approach is based on determining carbon dioxide emissions from domestic consumption of fuels (e.g. hard coal and lignite, crude oil, natural gas). Apparent consumption of fuels is calculated as:

Apparent Consumption = Production +Imports – Exports – International Bunkers – Stock Change

Data about production, imports, exports, international bunkers and stock change are based on Eurostat database.

CO_2 emissions were estimated based on adjusted fuel consumption data and default oxidation and emission factors. For hard coal and lignite national emission factors were assumed, for fuels in transport average emission factors were used from subcategories of 1A, and for other fuels default emission factors were applied. Total apparent consumption was corrected by subtracting the amount of carbon which does not lead to fuel combustion emission (carbon which is emitted in another sector of the inventory or is stored in a product manufactured from the fuel). The main sources of such carbon are those used as non-energy products and feedstocks. As the use of energy products for non energy purposes can lead to emissions Poland, following the ERT recommendation, has calculated emission for lubricants and paraffin waxes where respectively 50% and 80% carbon storage are assumed and report them under category 2G *Other*.

Calculating CO_2 emissions with the two approaches can lead to different results. In 2011 the difference between reference and sectoral approaches in CO_2 emissions is equal 4.03%. Comparison of both methods is given in table 3.2.1.

The Reference Approach and the Sectoral Approach often have different results which may be caused by:

- statistical differences - is the difference between energy available for final consumption covering the energy placed at the disposal of final users and final energy consumption covering energy supplied to the final consumer's door for all energy uses;
- distribution loses - losses due to transport or distribution of natural gas;
- differences in NCVs used in reference and sectoral approaches, especially for hard and brown coal, where NCV affects emission factors;
- part of emission from solid fuel use was included in sector Industrial processes (2.C.1: production of sinter, pig iron and steel).

Table 3.2.1. Differences between CO_2 emissions in sectoral and reference approach in period 1988 – 2011

Year	Reference approach [Gg]	Sectoral approach [Gg]	Difference [%]
2011	316 842	304 568	4.03
2010	316 094	310 173	1.91
2009	296 498	291 900	1.58
2008	310 554	301 188	3.11
2007	309 949	306 635	1.08
2006	316 487	306 887	3.13
2005	304 935	295 615	3.15
2004	302 121	298 160	1.33
2003	303 791	294 914	3.01
2002	297 189	285 005	4.27
2001	299 240	295 336	1.32
2000	298 376	296 090	0.77
1999	315 684	308 940	2.18
1998	324 104	318 237	1.84
1997	350 234	342 475	2.27
1996	356 756	353 525	0.91
1995	344 660	338 775	1.74
1994	335 768	339 169	-1.00
1993	356 946	344 787	3.53
1992	359 301	343 751	4.52
1991	368 443	352 365	4.56
1990	371 982	350 669	6.08
1989	430 143	421 212	2.12
1988	452 812	439 952	2.92

3.2.2. International bunker fuels

1990-2011 fuel use data for fuels classified to the international marine bunker were taken from the Eurostat database. For the years 1988-1989, the respective data were taken from the database of the International Energy Agency (IEA).

For the estimation of GHG emissions from bunker fuels, the same IPCC default emission factors were assumed as those used for maritime navigation: for CO_2 and diesel oil 74.10 kg/GJ, for fuel oil 77.60 kg/GJ. The emission factors for CH_4 and N_2O for the two fuels are: 0.007 kg/GJ and 0.002 kg/GJ, respectively. The fuel use data and the corresponding emission estimates of CO_2, CH_4 and N_2O for international marine bunker for the 1988-2011 period are presented in table 3.6.1.

The amounts of fuels for the aviation international bunker were estimated under the assumption that 95% of fuel used for aviation in Poland (expert estimate) is used for international traffic i.e. constitutes the international aviation bunker. For the years 1990-2011 aviation fuel data are those of the Eurostat database, while for the base year and 1989 are those of the IEA database.

For the estimation of GHG emissions from aviation bunker fuels, the same IPCC default emission factors for jet fuel were assumed as those used for emission estimation for domestic aviation: for CO_2 - 3150 g/kg, for CH_4 - 0.0005 kg/GJ and for N_2O - 0.1 g/kg.

The fuel use data and the corresponding emission estimates of CO_2, CH_4 and N_2O for international aviation bunker for the 1988-2011 period are presented in table 3.2.2.

Table 3.2.2. Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2011

AVIATION BUNKER												
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Fuel consumption – jet fuel [Gg]	351.15	352.45	204.25	210.90	228.95	228.00	230.85	248.90	292.60	262.20	266.95	238.45
Fuel consumption – jet fuel [PJ]	15.65	15.71	8.78	9.07	9.84	9.80	9.93	10.70	12.58	11.27	11.48	10.25
Calorific value [MJ/kg]	44.58	44.58	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
CO_2 potential emission factor [g/kg]	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150
CO_2 potential emission factor [kg/GJ]	70.64	70.64	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26
CO_2 potential emission factor [Gg]	1 106	1 110	643	664	721	718	727	784	922	826	841	751
CH_4 emission factor [kg/GJ]	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
CH_4 emission [Gg]	0.008	0.008	0.004	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.005
N_2O emission factor [g/kg]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N_2O emission factor [kg/GJ]	0.0022	0.0022	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
N_2O emission [Gg]	0.035	0.035	0.020	0.021	0.023	0.023	0.023	0.025	0.029	0.026	0.027	0.024
NAVIGATION BUNKER												
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Fuel consumption – diesel oil [PJ]	13.61	10.88	5.96	2.68	3.15	2.43	1.28	1.19	1.75	2.51	2.85	4.39
Fuel consumption - diesel oil [PJ]	8.24	9.37	10.48	3.76	6.76	3.16	4.24	4.60	5.08	6.28	8.08	10.80
CO_2 potential emission - ON [Gg]	1008	806	442	199	234	180	95	88	129	186	211	325
CO_2 potential emission - OP [Gg]	639	727	813	292	525	245	329	357	394	487	627	838
Total CO_2 potential emission [Gg]	1648	1533	1255	491	758	425	424	445	524	674	838	1163
CH_4 emission - ON [Gg]	0.095	0.076	0.042	0.019	0.022	0.017	0.009	0.008	0.012	0.018	0.020	0.031
CH_4 emission - OP [Gg]	0.058	0.066	0.073	0.026	0.047	0.022	0.030	0.032	0.036	0.044	0.057	0.076
Total CH_4 potential emission [Gg]	0.153	0.142	0.115	0.045	0.069	0.039	0.039	0.041	0.048	0.062	0.077	0.106
N_2O emission - ON [Gg]	0.027	0.022	0.012	0.005	0.006	0.005	0.003	0.002	0.003	0.005	0.006	0.009
N_2O emission - OP [Gg]	0.016	0.019	0.021	0.008	0.014	0.006	0.008	0.009	0.010	0.013	0.016	0.022
Total N_2O potential emission [Gg]	0.044	0.040	0.033	0.013	0.020	0.011	0.011	0.012	0.014	0.018	0.022	0.030

Table 3.2.2. (cont.) Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2011

AVIATION BUNKER												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Fuel consumption – jet fuel [Gg]	253.65	249.85	245.10	265.05	260.30	295.45	394.25	410.40	493.05	446.50	470.25	426.55
Fuel consumption – jet fuel [PJ]	10.91	10.74	10.54	11.40	11.19	12.70	16.95	17.65	21.20	19.20	20.22	18.34
Calorific value [MJ/kg]	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
CO_2 potential emission factor [g/kg]	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150
CO_2 potential emission factor [kg/GJ]	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26
CO_2 potential emission factor [Gg]	799	787	772	835	820	931	1 242	1 293	1 553	1 406	1 481	1 344
CH_4 emission factor [kg/GJ]	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
CH_4 emission [Gg]	0.005	0.005	0.005	0.006	0.006	0.006	0.008	0.009	0.011	0.010	0.010	0.009
N_2O emission factor [g/kg]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N_2O emission factor [kg/GJ]	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
N_2O emission [Gg]	0.025	0.025	0.025	0.027	0.026	0.030	0.039	0.041	0.049	0.045	0.047	0.043
NAVIGATION BUNKER												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Fuel consumption – diesel oil [PJ]	1.87	0.94	1.83	1.96	1.66	4.94	3.71	2.13	2.09	2.73	2.30	2.85
Fuel consumption – diesel oil [PJ]	9.92	9.80	9.32	9.80	8.80	8.48	8.56	8.16	9.32	7.60	6.68	4.24
CO_2 potential emission - ON [Gg]	139	69	136	145	123	366	275	158	155	202	170	211
CO_2 potential emission - OP [Gg]	770	760	723	760	683	658	664	633	723	590	518	329
Total CO_2 potential emission [Gg]	909	830	859	906	806	1024	939	791	878	792	689	541
CH_4 emission - ON [Gg]	0.013	0.007	0.013	0.014	0.012	0.035	0.026	0.015	0.015	0.019	0.016	0.020
CH_4 emission - OP [Gg]	0.069	0.069	0.065	0.069	0.062	0.059	0.060	0.057	0.065	0.053	0.047	0.030
Total CH_4 potential emission [Gg]	0.083	0.075	0.078	0.082	0.073	0.094	0.086	0.072	0.080	0.072	0.063	0.050
N_2O emission - ON [Gg]	0.004	0.002	0.004	0.004	0.003	0.010	0.007	0.004	0.004	0.005	0.005	0.006
N_2O emission - OP [Gg]	0.020	0.020	0.019	0.020	0.018	0.017	0.017	0.016	0.019	0.015	0.013	0.008
Total N_2O potential emission [Gg]	0.024	0.021	0.022	0.024	0.021	0.027	0.025	0.021	0.023	0.021	0.018	0.014

3.2.3. Feedstocks and non-energy use of fuels

As the use of energy products for non-energy purposes can lead to emissions Poland, following the ERT recommendation, has calculated emission for lubricants and paraffin waxes where respectively 50% and 80% carbon storage are assumed and report them under category 2G *Other*.

3.2.4. CO_2 capture from flue gases and subsequent CO_2 storage

Not applicable in Poland.

3.2.5. Country-specific issues

Information on country specific fuel structure, important for national emission level and CO_2 emission factors for coal (main fuel in Polish economy), is presented in chapters 3.1.1., 3.2.6-3.2.9 and in annex 2.

3.2.6. Energy Industries (CRF sector 1.A.1.)

3.2.6.1. Source category description

Emissions in 1.A.1 *Energy Industries* category are estimated for each detailed sub-categories as follows:

a) 1.A.1.a *Public Electricity and Heat Production*
– public thermal power plants
– autoproducing thermal power plants (CHP)
– heat plants

b) 1.A.1.b *Petroleum Refining*

c) 1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries*
- coke-oven and gas-works plants
- mines and patent fuel/briquetting plants
- other energy industries (oil and gas extraction; own use in Electricity, CHP and heat plants)

Subsector 1.A.1.a *Public Electricity and Heat Production* is by far the largest contributor to emissions from this category (see figure 3.2.6.1) – almost 95% in 2011.

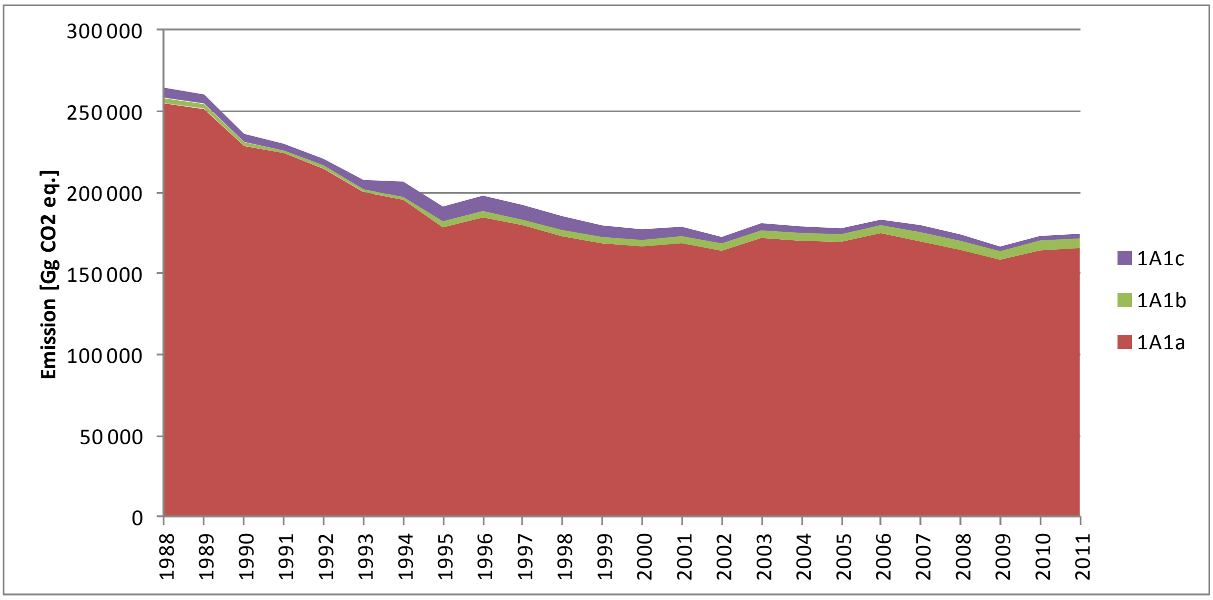

Figure 3.2.6.1. GHG emissions from *Energy Industries* in years 1988-2011 according to subcategories

3.2.6.2. Methodological issues

Methodology of emission estimation in 1.A.1 subcategory corresponds with methodology described for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for subcategories mentioned below are presented in Annex 2.

3.2.6.2.1. Public electricity and heat production (CRF sector 1.A.1.a)

Table 3.2.6.1 presents the structure and amounts of fuel used in the sub-category 1.A.1.a *Public Electricity and Heat Production* for the years 1988-2011.

Table 3.2.6.1. Fuel consumption for the years 1988-2011 in 1.A.1.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	75.465	72.994	66.947	62.620	57.598	56.348	57.221	26.231
Gaseous Fuels	21.274	21.900	21.641	16.329	9.562	3.107	4.094	4.738
Solid Fuels	2445.838	2416.088	2197.783	2169.777	2086.989	1942.858	1890.625	1760.175
Biomass	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878
Other Fuels	16.699	15.129	14.585	14.387	17.289	13.783	14.057	1.447
TOTAL	**2563.017**	**2529.984**	**2306.221**	**2272.027**	**2178.792**	**2022.754**	**1972.873**	**1796.469**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	28.870	28.987	19.318	18.527	15.824	16.909	15.684	14.139
Gaseous Fuels	7.157	7.949	10.768	16.210	21.627	28.242	38.700	45.496
Solid Fuels	1824.673	1776.914	1711.756	1669.246	1646.568	1663.271	1608.461	1687.678
Other Fuels	3.393	3.267	3.809	3.082	3.273	3.369	4.629	2.964
Biomass	2.793	3.381	3.877	3.747	3.904	5.449	5.424	6.642
TOTAL	**1866.886**	**1820.498**	**1749.528**	**1710.812**	**1691.196**	**1717.240**	**1672.898**	**1756.919**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	11.334	9.273	9.110	8.004	8.209	7.658	8.332	7.982
Gaseous Fuels	53.667	57.039	52.808	49.653	51.052	51.828	52.230	57.071
Solid Fuels	1660.617	1658.759	1712.612	1672.643	1609.849	1549.572	1603.600	1602.642
Other Fuels	4.038	5.219	5.205	4.783	5.095	5.463	5.860	6.183
Biomass	10.198	19.320	23.201	27.739	41.289	58.206	69.772	84.333
TOTAL	**1739.854**	**1749.610**	**1802.936**	**1762.822**	**1715.494**	**1672.727**	**1739.794**	**1758.211**

The data in table 3.2.6.1 shows that the use of solid fuels is dominant in 1.A.1.a – mainly hard coal and lignite. In 2011, the use of hard coal was almost 1053 PJ i.e. app. 60% of the entire energy of all fuels used in that sub-sector. Lignite made app. 29% of the energy, accordingly. Despite the significant share of solid fuels (app. 91%) in the total energy related fuel use in 1.A.1.a, a slow decreasing trend can be noticed since the late 1990s (from app. 98% in 1998 till 91% in 2011). At the same time in last decade increased the share of gas as well as the share of biomass. Detailed data concerning individual fuel consumptions in 1.A.1.a subcategory for the entire period 1988-2011 was presented in Annex 2 (tab. 1).

Figure 3.2.6.2 shows CO_2 emission changes over the period 1988-2011. A significant emission decrease took place over the years 1988-1995 followed by a period of emission stabilization.

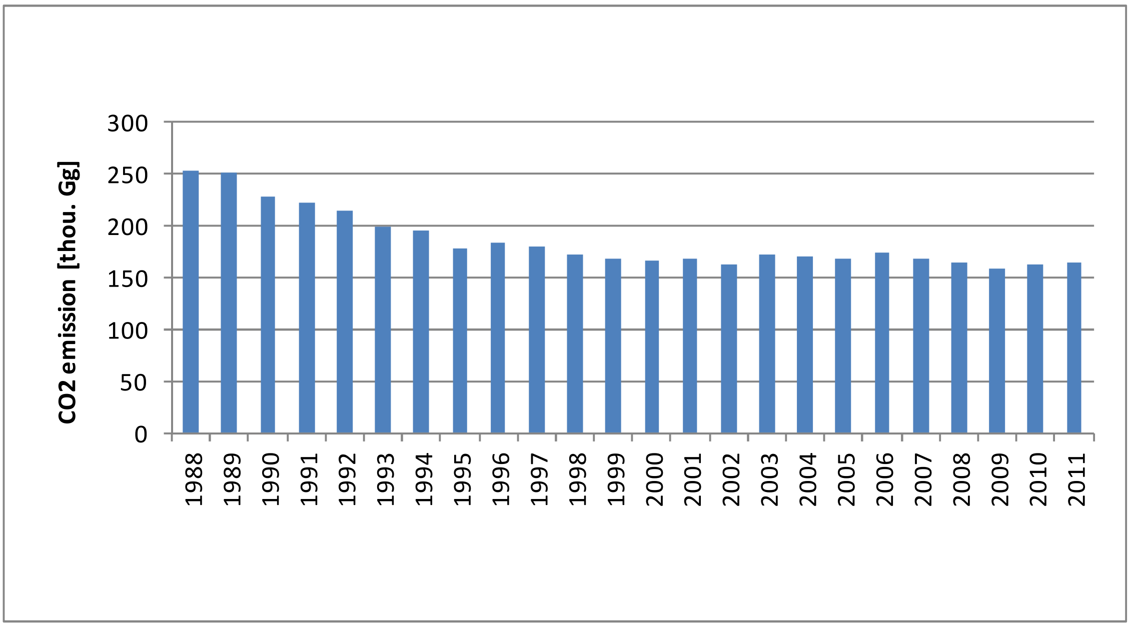

Figure 3.2.6.2. CO_2 emission for 1.A.1.a category in 1988-2011

Figure 3.2.6.3 shows emission trends for CH_4 and N_2O between the base year and 2011. Similarly to CO_2 a significant emission decrease for these gases happened in the period 1988-1995. Since 2002 is noticeable increase of CH_4 emission connected with a growth of biomass consumption. That emission increase is the result of relatively high value of CH_4 EF for solid biomass.

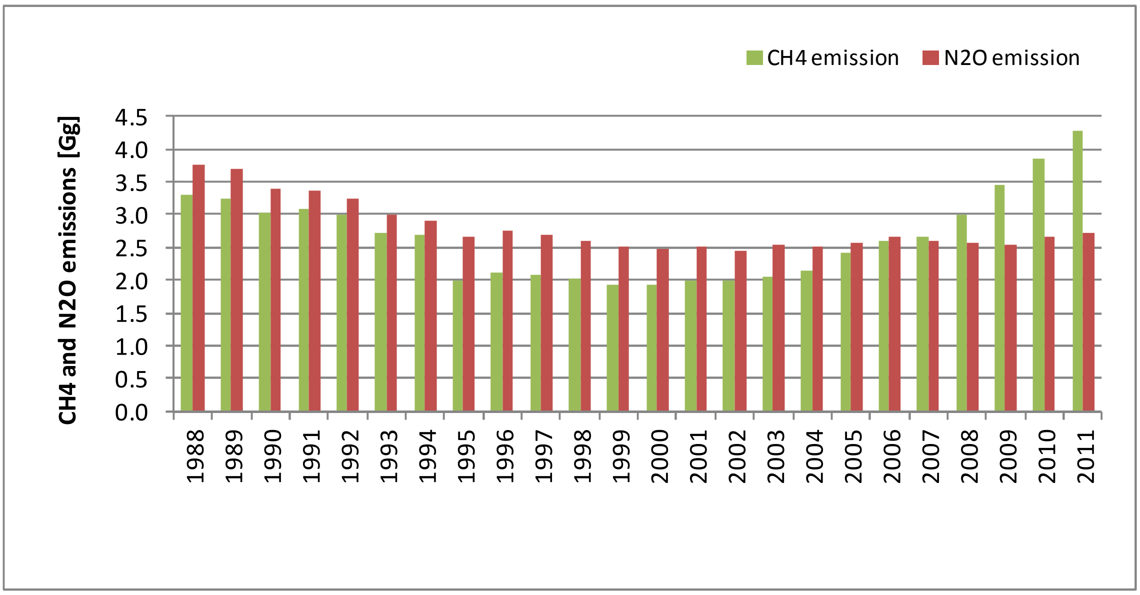

Figure 3.2.6.3. CH_4 and N_2O emissions for 1.A.1.a category in 1988-2011

3.2.6.2.2. Petroleum Refining (CRF sector 1.A.1.b)

Table 3.2.6.2 shows fuel consumption data in sub-category 1.A.1.b *Petroleum Refining* for the years 1988-2011. Detailed data on fuel consumptions in 1.A.1.b subcategory for the entire period 1988-2011 was presented in Annex 2 (table 2).

Table 3.2.6.2. Fuel consumption in 1988-2011 in 1.A.1.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	23.490	22.919	18.958	18.226	24.274	22.185	22.490	44.642
Gaseous Fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562
Solid Fuels	0.142	0.140	0.046	0.119	0.069	0.245	0.068	1.302
Other Fuels	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**33.750**	**32.941**	**25.897**	**20.156**	**26.533**	**24.040**	**24.408**	**49.425**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	50.170	43.736	47.846	43.627	47.032	53.192	53.547	54.260
Gaseous Fuels	1.749	2.529	8.244	10.832	12.110	11.354	10.124	12.770
Solid Fuels	1.451	1.349	0.710	0.637	0.277	0.140	0.023	0.000
Other Fuels	0.350	0.163	0.438	0.310	0.219	0.095	0.253	0.176
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**53.720**	**47.777**	**57.238**	**55.406**	**59.638**	**64.781**	**63.947**	**67.206**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	56.642	54.267	56.324	61.739	62.802	61.339	70.157	62.265
Gaseous Fuels	15.454	14.482	14.900	20.816	18.816	17.381	19.232	27.975
Solid Fuels	0.000	0.000	0.000	0.000	0.000	0.023	0.023	0.073
Other Fuels	0.221	0.285	0.224	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**72.317**	**69.034**	**71.448**	**82.555**	**81.618**	**78.743**	**89.412**	**90.313**

Figure 3.2.6.4 shows CO_2 emission changes in 1988-2011 in sub-category 1.A.1.b.

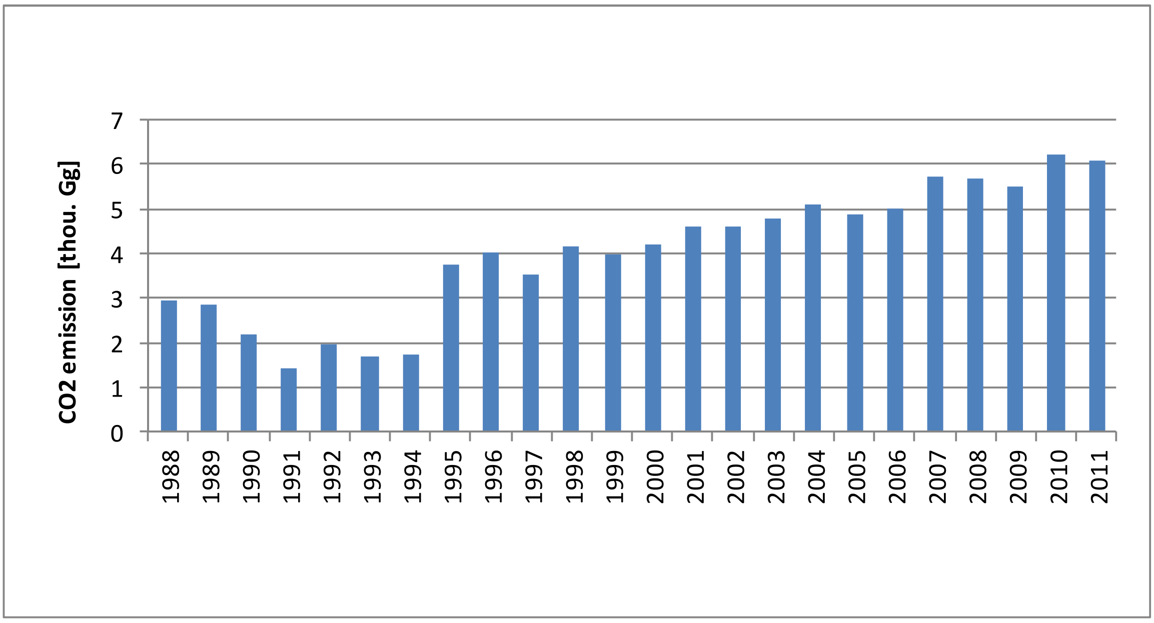

Figure 3.2.6.4. CO_2 emission for 1.A.1.b category in 1988-2011

Figure 3.2.6.5 shows the corresponding CH_4 and N_2O emission in that source sub-category between the base year and 2011.

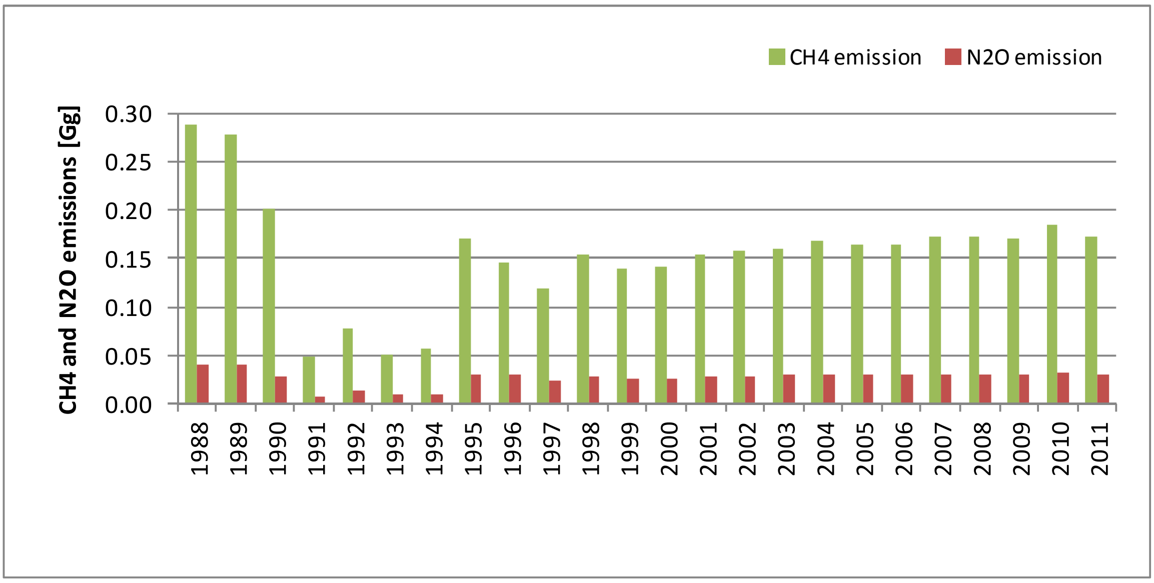

Figure 3.2.6.5. CH_4 and N_2O emissions for 1.A.1.b category in 1988-2011

3.2.6.2.3. Manufacture of Solid Fuels and Other Energy Industries (CRF sector 1.A.1.c)

Table 3.2.6.3 shows the fuel use data in the sub-category 1.A.1.c over the period: 1988-2011. Particular fuel consumptions in 1.A.1.c subcategory for the entire period 1988-2011 were tabulated in Annex 2 (table 3).

Table 3.2.6.3. Fuel consumption in 1988-2011 in 1.A.1.c subcategory [PJ]

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Liquid Fuels	2.592	2.218	2.094	2.393	2.561	5.013	4.213	4.262
Gaseous Fuels	13.736	15.364	12.371	12.432	14.665	12.354	17.401	14.850
Solid Fuels	70.465	66.330	58.694	49.264	47.124	61.209	102.119	98.936
Other Fuels	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004
TOTAL	**86.857**	**83.914**	**73.165**	**64.089**	**64.354**	**78.895**	**123.979**	**118.236**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	3.697	3.145	2.993	2.247	2.196	1.701	1.722	1.643
Gaseous Fuels	23.269	21.155	17.779	19.458	19.491	12.987	12.515	9.741
Solid Fuels	97.648	95.587	89.087	76.060	68.738	66.258	49.936	56.477
Other Fuels	0.158	0.138	0.151	0.155	0.014	0.008	0.005	0.013
Biomass	0.014	0.031	0.026	0.027	0.037	0.052	0.047	0.026
TOTAL	**124.786**	**120.056**	**110.036**	**97.947**	**90.476**	**81.006**	**64.225**	**67.900**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	1.435	1.681	1.404	1.482	1.403	1.577	1.739	2.165
Gaseous Fuels	11.190	10.106	10.363	9.681	9.239	8.858	10.321	9.949
Solid Fuels	50.943	45.376	46.205	58.785	54.457	36.427	42.000	38.376
Other Fuels	0.000	0.000	0.029	0.042	0.051	0.015	0.016	0.022
Biomass	0.020	0.014	0.026	0.085	0.037	0.137	0.349	0.162
TOTAL	**63.588**	**57.177**	**58.027**	**70.075**	**65.187**	**47.014**	**54.425**	**50.674**

The emission trends of CO_2, CH_4 and N_2O in the 1988-2011 period are shown in figures 3.2.6.6 and 3.2.6.7.

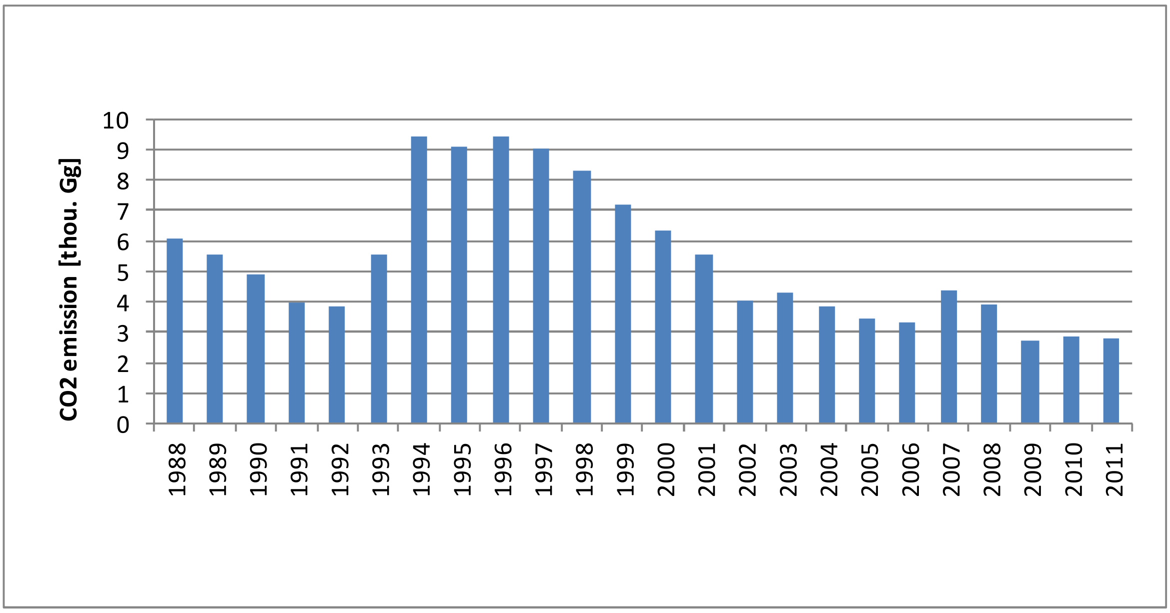

Figure 3.2.6.6. CO_2 emission for 1.A.1.c category in 1988-2011

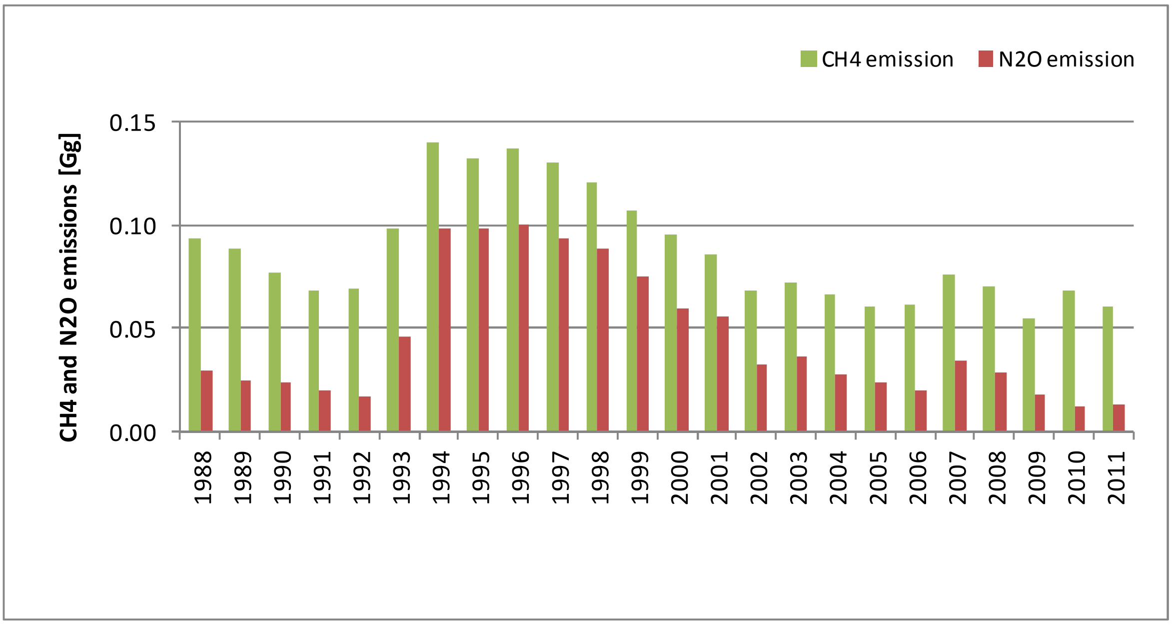

Figure 3.2.6.7. CH_4 and N_2O emissions for 1.A.1.c category in 1988-2011

3.2.6.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2011 for IPCC sector *1.Energy* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6.

Recalculation of data for years 1988-2010 ensured consistency for whole time-series.

2011	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
1. Energy	**308 389.70**	**700.86**	**6.77**	2.2%	23.9%	22.7%
A. Fuel Combustion	**304 568.18**	**144.66**	**6.77**	2.2%	12.0%	22.7%
1. Energy Industries	173 821.99	4.50	2.76	3.4%	16.2%	11.2%
2. Manufacturing Industries and Construction	31 062.53	3.70	0.52	2.4%	11.7%	14.6%
3. Transport	47 987.70	5.04	1.91	5.8%	10.4%	75.0%
4. Other Sectors	51 695.95	131.41	1.58	2.9%	13.2%	28.0%
5. Other	0.00	0.00	0.00	0.0%	0.0%	0.0%
B. Fugitive Emissions from Fuels	**3821.52**	**556.20**	**0.00**	8.5%	30.0%	0.0%
1. Solid Fuels	2097.42	342.04	0.00	15.0%	48.6%	0.0%
2. Oil and Natural Gas	1724.10	214.16	0.00	4.6%	5.3%	100.1%

3.2.6.4. Source-specific QA/QC and verification

Activity data used in the GHG inventory concerning energy sector come from Eurostat Database which is fed by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. Activity data applied in GHG inventory are regularly checked and updated if necessary according to adjustments made in Eurostat Database.

One of the elements of quality control of activity data correction is fuel balances prepared for the purpose of national GHG inventories (see Annex 4). For the main fuels (i.e. coal, lignite) calorific values are analysed for avoiding significant errors. Close cooperation is developed between inventory experts and institutions responsible for energy data. Any doubtful fuel consumption values are systematically verified - it is often required to obtain additional confirmation of data by installations/entities submitting the energy questionnaire. Energy data are also validated by Central Statistical Office's Energy Statistics published on an annual basis.

Natural verification of data in an energy sector is comparison of sectoral and reference approaches within the GHG inventory.

Calculations in energy sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

3.2.6.5. Source-specific recalculations

- activity data on fuel consumption for years 1990-2010 were updated due to changes made in EUROSTAT database;
- for the entire reporting period CO_2 EF for combustion of non-biogenic fraction of municipal waste was corrected following the IPCC 2006 Guidelines [IPCC 2006], where EF= 91.70 kg CO_2/GJ.

3.2.6.6. Source-specific planned improvements

- further developing of cooperation with institutions responsible for compilation of Polish energy balances in order to explain and verify time-trends of activity data in 1.A category
- analysis of the possibility of country specific EF elaboration for the significant fuels in Polish fuel structure

3.2.7. Manufacturing Industries and Construction (CRF sector 1.A.2)

3.2.7.1. Source category description

Emissions in 1.A.2 *Manufacturing Industries and Construction* category are estimated for each fuel in detailed sub-categories as follows:

a) *Iron and Steel* - 1.A.2.a
b) *Non-Ferrous Metals* - 1.A.2.b
c) *Chemicals* - 1.A.2.c
d) *Pulp, Paper and Print* - 1.A.2.d
e) *Food Processing, Beverages and Tobacco* - 1.A.2.e
f) *Other* - 1.A.2.f (construction and other industry branches not included elsewhere)

Subsector 1.A.2.f *Other* is the largest contributor to emissions from this category (see figure 3.2.7.1) – over 38% in 2011. Subcategory 1.A.2.c *Chemicals* ranked second place in this respect (its share in total emission from 1.A.2 - almost 26%).

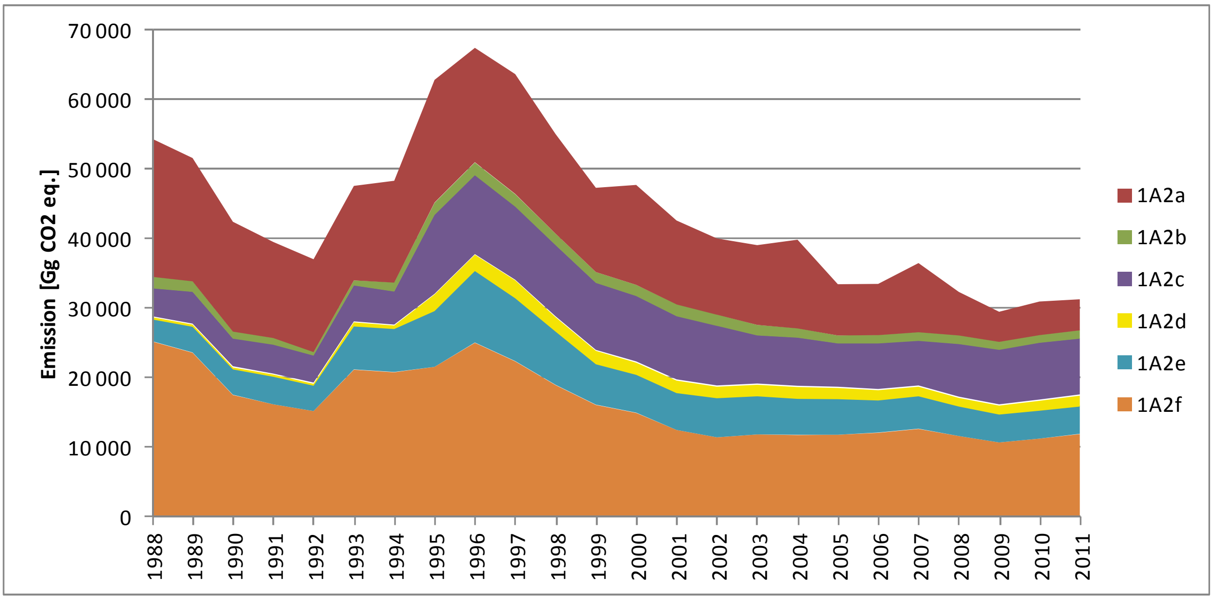

Figure 3.2.7.1. Emissions from *Manufacturing Industries and Construction* category in years 1988-2011 according to subcategories

3.2.7.2. Methodological issues

Methodology of emission estimation in 1.A.2 subcategory corresponds with methodology described for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for subcategories listed below are presented in Annex 2.

3.2.7.2.1. Iron and Steel (CRF sector 1.A.2.a)

Table 3.3.7.1 shows the fuel use data in the sub-category 1.A.2.a *Iron and Steel* for the period: 1988-2011. As you can see in the table solid fuels is the dominant fuel type in that sub-category. Detailed data on fuel consumptions in 1.A.2.a subcategory for the entire period 1988-2011 was presented in Annex 2 (table 4).

Table 3.3.7.1. Fuel consumption in 1988-2011 in 1.A.2.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	18.338	15.604	11.170	7.928	5.450	4.621	3.514	2.850
Gaseous Fuels	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239
Solid Fuels	95.245	85.329	76.291	74.910	78.732	85.847	95.337	117.227
Other Fuels	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005
TOTAL	**190.249**	**167.610**	**144.391**	**123.568**	**117.247**	**120.318**	**128.109**	**147.262**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.898	5.965	1.941	2.187	1.821	0.994	0.358	0.312
Gaseous Fuels	25.898	28.278	23.993	21.440	22.024	18.329	15.463	14.827
Solid Fuels	111.998	112.778	98.921	81.238	93.252	79.627	72.741	76.550
Other Fuels	0.498	0.000	0.000	0.008	0.000	0.277	0.706	1.195
Biomass	0.006	0.004	0.006	0.004	0.003	0.006	0.003	0.004
TOTAL	**140.298**	**147.025**	**124.861**	**104.877**	**117.100**	**99.233**	**89.271**	**92.888**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	0.266	0.085	0.128	0.085	0.131	0.131	0.131	0.131
Gaseous Fuels	19.969	17.091	20.301	21.281	19.758	15.864	16.403	16.542
Solid Fuels	82.644	40.879	36.235	49.282	25.726	21.688	23.621	20.675
Other Fuels	1.654	0.965	1.015	1.313	0.993	0.474	0.187	0.203
Biomass	0.004	0.002	0.001	0.001	0.001	0.001	0.000	0.000
TOTAL	**104.537**	**59.022**	**57.680**	**71.962**	**46.609**	**38.159**	**40.342**	**37.551**

Significant drop in fuel consumption in the period 2005-2011 is the result of subtraction of amount of fuel used in iron and steel industry, which were included in 2.C *Metal Production* category. The values (in PJ) of particular fuel amounts which were excluded from 1.A.2.a and moved to 2.C.1 are presented below:

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	1.330	4.839	4.509	3.843	2.234	2.094	3.433
Natural gas	3.369	0.707	1.443	0.643	0.733	0.519	0.692
Coke	47.568	53.282	51.697	46.713	25.993	27.888	36.552
Coke oven gas	4.242	4.832	6.461	5.717	0.609	4.205	5.100
Blast furnace gas	0.238	0.208	0.230	0.117	0.072	0.000	0.085

Emissions from these fuels were included also in emissions in sector 2.C.1.

Figure 3.3.7.2 shows CO_2 emissions in the 1988-2011 period.

Emissions of CH_4 and N_2O in the same time period are shown in figure 3.3.7.3. Emission trends for all three gases follow closely the trends in fuel use.

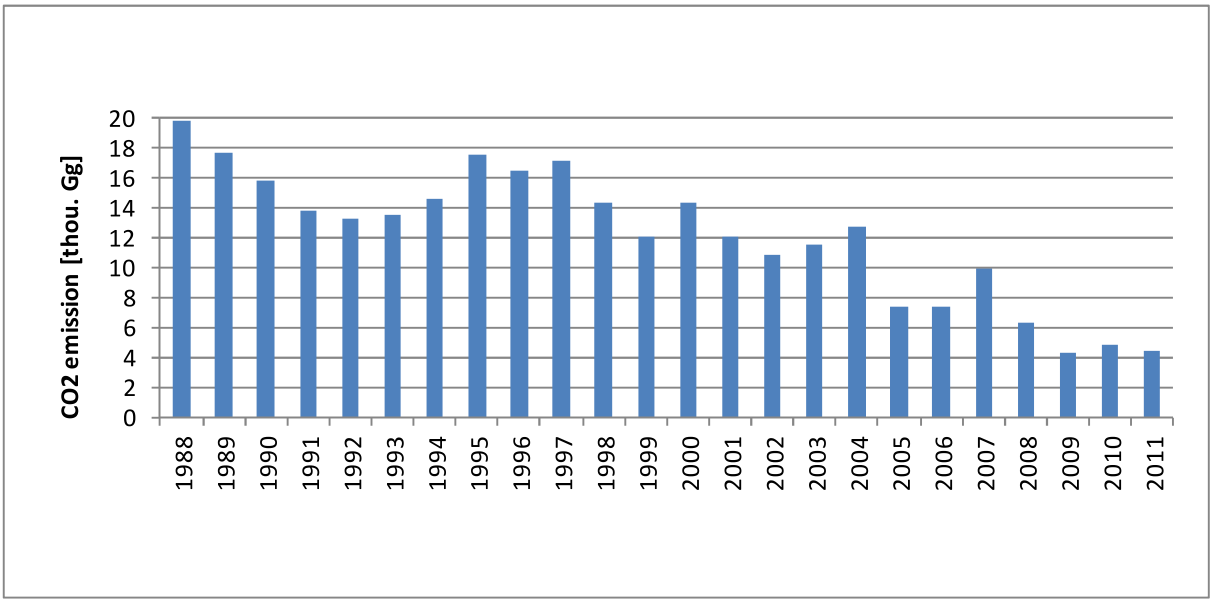

Figure 3.3.7.2. CO_2 emission for 1.A.2.a category in 1988-2011

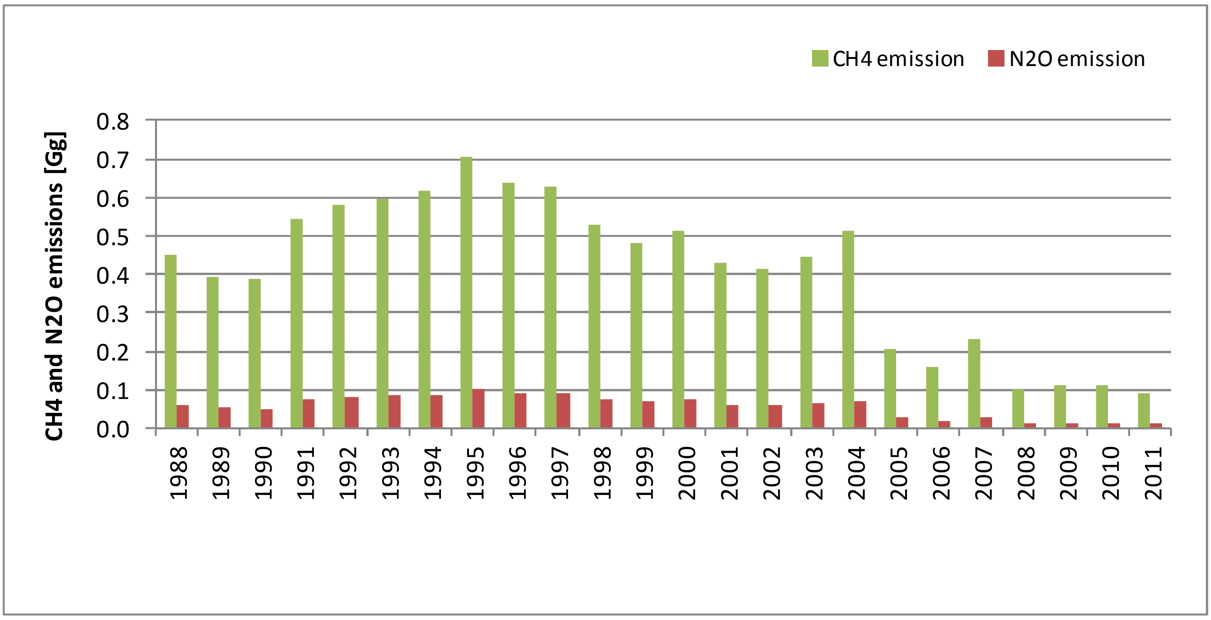

Figure 3.3.7.3. CH_4 and N_2O emissions for 1.A.2.a category in 1988-2011

3.2.7.2.2. Non-Ferrous Metals (CRF sector 1.A.2.b)

The data on fuel type use in the sub-category 1.A.2.b *Non-Ferrous Metals* over the 1988-2011 period are presented in table 3.3.7.2. More detailed data concerning fuel consumptions was tabulated in Annex 2 (table 5).

Table 3.3.7.2. Fuel consumption in 1988-2011 in 1.A.2.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	0.686	0.807	0.803	0.843	0.928	0.845	0.928	0.890
Gaseous Fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447
Solid Fuels	12.001	10.832	6.908	5.965	3.316	4.752	8.184	10.499
Other Fuels	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
TOTAL	**19.195**	**17.827**	**12.749**	**11.924**	**5.971**	**8.072**	**15.257**	**18.986**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	0.939	0.896	0.776	0.730	0.862	0.782	0.616	0.494
Gaseous Fuels	5.108	5.424	5.639	5.660	5.814	5.700	5.589	5.868
Solid Fuels	10.897	10.491	9.715	9.045	9.179	9.946	8.716	8.043
Other Fuels	2.411	2.361	2.164	2.070	2.268	2.551	2.739	2.539
Biomass	0.149	0.042	0.026	0.010	0.011	0.005	0.001	0.000
TOTAL	**19.504**	**19.214**	**18.320**	**17.515**	**18.134**	**18.984**	**17.661**	**16.944**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	0.656	0.616	0.616	0.376	0.376	0.376	0.379	0.336
Gaseous Fuels	6.405	6.468	6.884	6.743	6.542	5.852	6.048	6.674
Solid Fuels	7.049	5.838	6.066	7.030	6.641	6.270	6.042	6.502
Other Fuels	1.800	1.003	1.004	0.982	1.252	1.119	0.994	0.987
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**15.910**	**13.925**	**14.570**	**15.131**	**14.811**	**13.617**	**13.463**	**14.499**

Emissions of the main greenhouse gases in 1.A.2.b between the base year and 2011 are shown in figures 3.3.7.4 and 3.3.7.5.

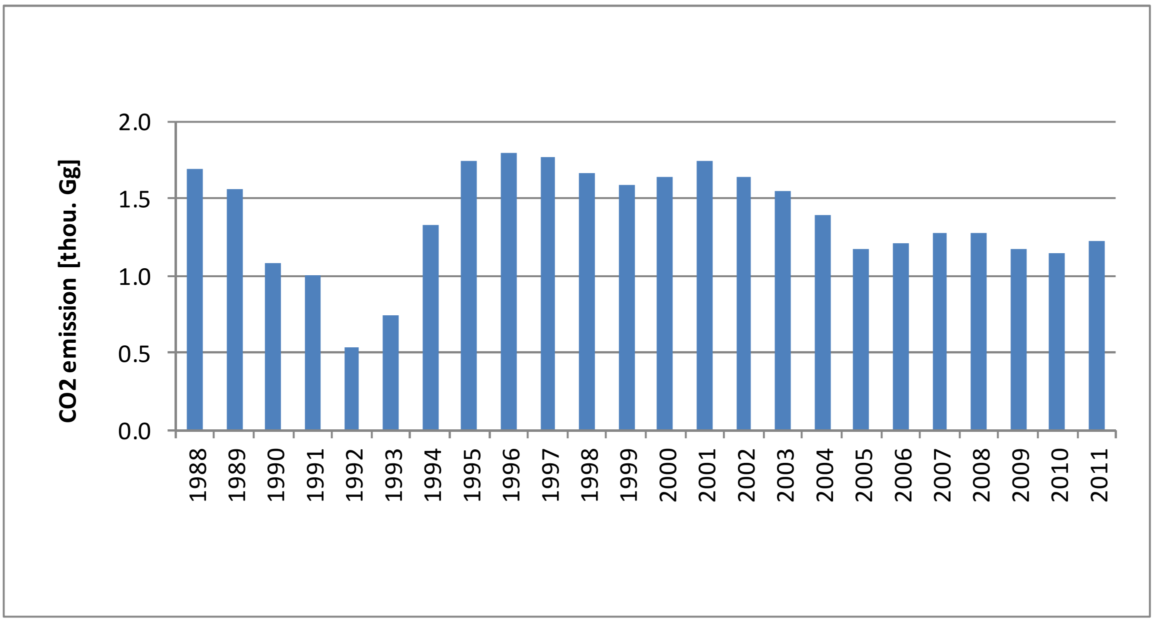

Figure 3.3.7.4. CO_2 emission for 1.A.2.b category in 1988-2011

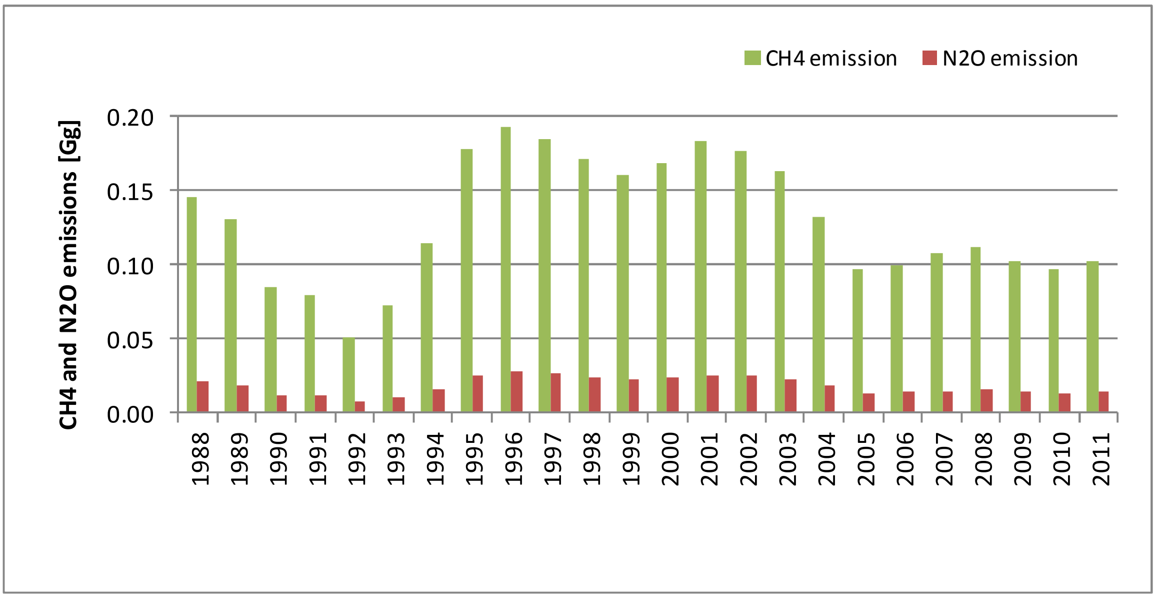

Figure 3.3.7.5. CH_4 and N_2O emissions for 1.A.2.b category in 1988-2011

3.2.7.2.3. Chemicals (CRF sector 1.A.2.c)

Detailed data on fuel consumptions in 1.A.2.c subcategory for the entire period 1988-2011 was presented in Annex 2 (table 6).
The data on fuel type use in the sub-category 1.A.2.c *Chemicals* over the 1988-2011 period are presented in table 3.3.7.3.

Table 3.3.7.3. Fuel consumption in 1988-2011 in 1.A.2.c subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	11.054	9.414	4.096	6.197	8.972	7.748	4.522	10.939
Gaseous Fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356
Solid Fuels	12.407	14.986	10.896	9.352	7.009	16.738	10.312	74.948
Other Fuels	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007
TOTAL	**42.469**	**45.949**	**37.111**	**38.514**	**37.462**	**52.567**	**41.967**	**113.796**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	19.913	23.130	41.005	39.166	38.337	33.155	32.921	33.453
Gaseous Fuels	6.191	11.024	9.408	9.041	9.464	8.481	7.199	6.457
Solid Fuels	75.455	65.909	57.138	52.423	50.205	50.353	47.486	30.175
Other Fuels	17.374	14.356	9.593	9.808	10.332	10.968	10.093	9.914
Biomass	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.153
TOTAL	**118.933**	**114.419**	**117.145**	**110.438**	**108.338**	**102.957**	**97.700**	**80.152**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	33.621	25.975	29.342	29.779	23.461	26.705	22.087	20.370
Gaseous Fuels	7.498	8.104	9.053	8.771	8.037	9.762	12.043	14.220
Solid Fuels	31.215	32.175	31.194	31.381	47.902	45.428	51.160	51.229
Other Fuels	8.749	6.901	7.851	6.875	7.233	8.575	8.137	7.371
Biomass	0.102	0.165	0.000	0.121	0.000	0.058	0.058	0.053
TOTAL	**81.185**	**73.320**	**77.440**	**76.927**	**86.633**	**90.528**	**93.485**	**93.243**

Figure 3.3.7.6 shows CO_2 emissions in the sub-category 1.A.2.c in the 1988-2011 period. Emissions of CH_4 and N_2O, in turn, are shown in figure 3.3.7.7.

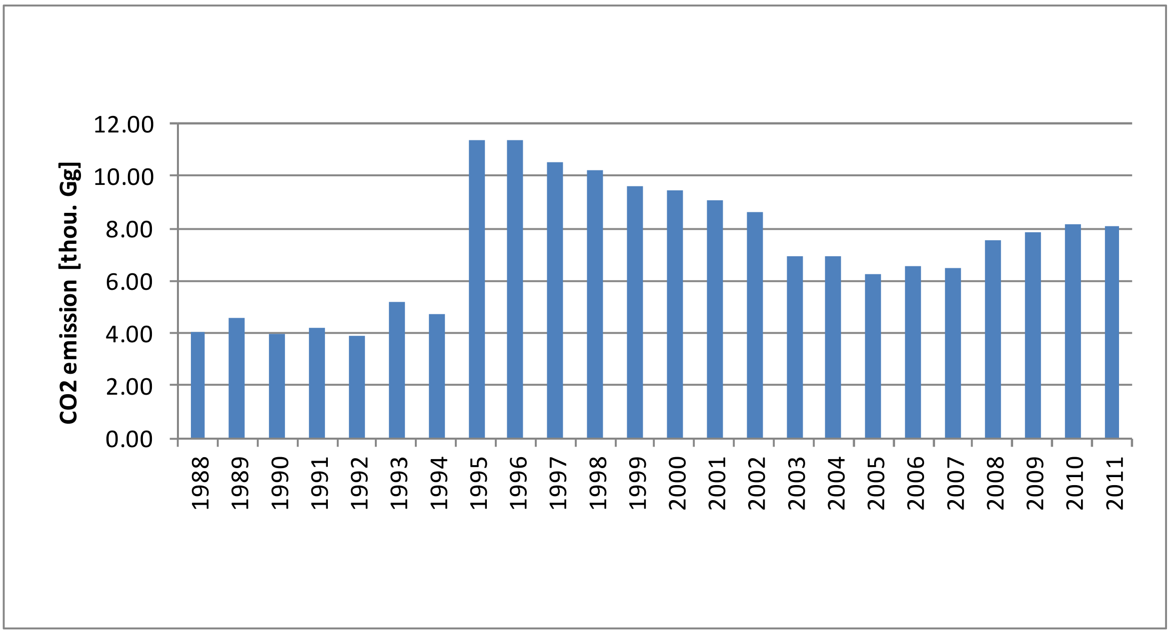

Figure 3.3.7.6. CO_2 emission for 1.A.2.c category in 1988-2011

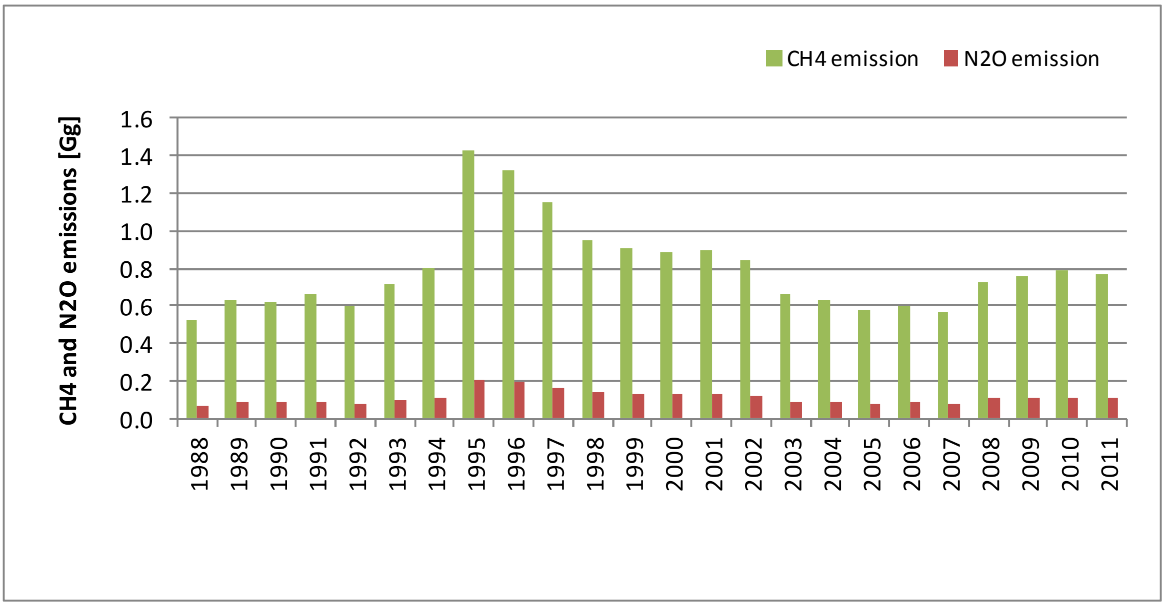

Figure 3.3.7.7. CH_4 and N_2O emissions for 1.A.2.c category in 1988-2011

3.2.7.2.4. Pulp, Paper and Print (CRF sector 1.A.2.d)

The data on fuel type use in the sub-category 1.A.2.d *Pulp, Paper and Print* over the 1988-2011 period are presented in table 3.3.7.4. Characteristic for that sub-sector is relatively large share of biomass in the total fuel use. Detailed data on fuel consumptions in 1.A.2.d subcategory was presented in Annex 2 (table 7).

Table 3.3.7.4. Fuel consumption in 1988-2011 in 1.A.2.d subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	1.380	1.300	1.369	1.331	1.409	1.692	1.531	2.620
Gaseous Fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232
Solid Fuels	1.976	2.192	1.811	2.043	1.640	4.841	4.123	22.605
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437
TOTAL	**3.811**	**3.858**	**3.282**	**3.435**	**3.075**	**8.179**	**7.514**	**40.894**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.682	2.112	2.612	2.221	2.180	2.041	2.032	2.203
Gaseous Fuels	0.455	1.096	0.563	1.007	1.211	1.445	1.461	2.094
Solid Fuels	22.495	24.122	19.022	17.528	15.725	15.593	14.346	14.107
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.011	0.106	0.109
Biomass	16.243	16.472	16.476	15.545	15.938	15.138	16.622	17.950
TOTAL	**40.875**	**43.802**	**38.673**	**36.301**	**35.054**	**34.228**	**34.567**	**36.463**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	2.241	2.027	2.115	2.330	1.984	1.990	1.988	1.985
Gaseous Fuels	2.657	2.288	2.976	4.087	4.822	4.834	5.030	4.585
Solid Fuels	13.826	13.459	11.621	9.481	7.879	8.515	9.979	11.096
Other Fuels	0.150	0.125	0.123	0.118	0.137	0.155	0.158	0.169
Biomass	18.957	18.611	19.379	18.644	19.729	19.189	19.166	18.755
TOTAL	**37.831**	**36.510**	**36.214**	**34.660**	**34.551**	**34.683**	**36.321**	**36.590**

Figures 3.3.7.8 and 3.3.7.9 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.d in the period: 1988-2011.

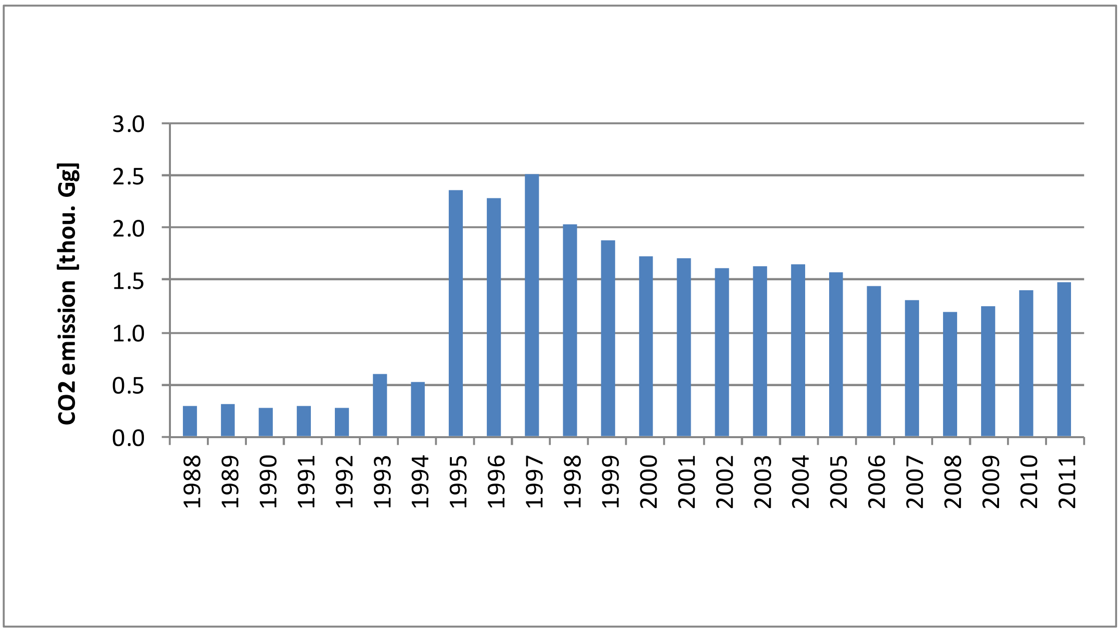

Figure 3.3.7.8. CO_2 emission for 1.A.2.d category in 1988-2011

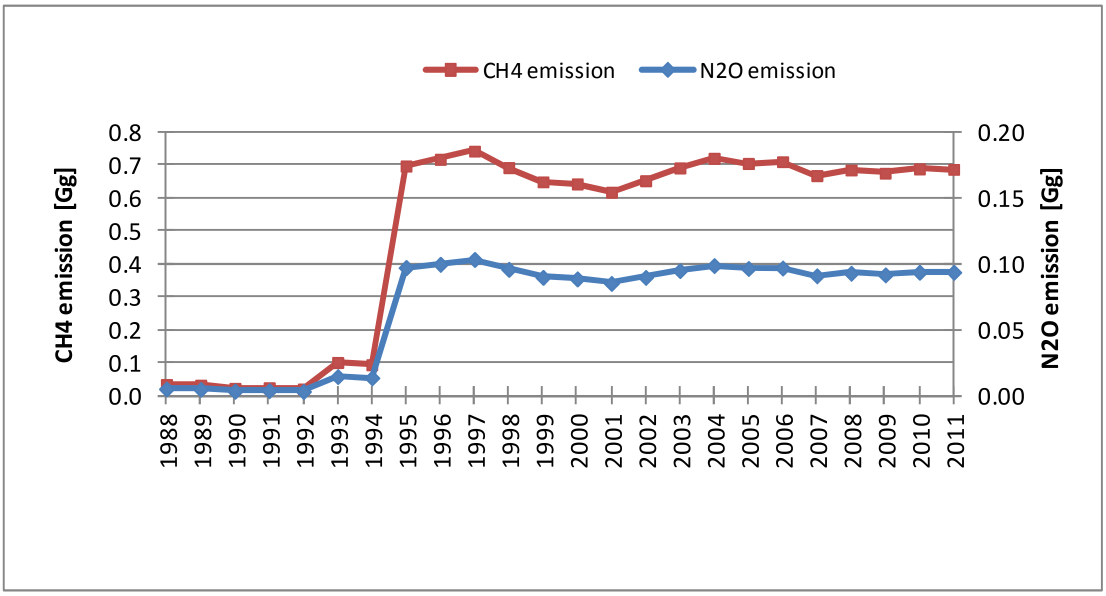

Figure 3.3.7.9. CH_4 and N_2O emissions for 1.A.2.d category in 1988-2011

3.2.7.2.5. Food Processing, Beverages and Tobacco (CRF sector 1.A.2.e)

The data on fuel type use in the sub-category 1.A.2.e *Food Processing, Beverages and Tobacco* over the 1988-2011 period are presented in table 3.3.7.5. Detailed data on fuel consumption was tabulated in Annex 2 (table 8).

Table 3.3.7.5. Fuel consumption in 1988-2011 in 1.A.2.e subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	4.468	3.524	3.053	2.636	2.393	4.695	5.209	7.415
Gaseous Fuels	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839
Solid Fuels	29.279	35.542	35.469	39.034	35.518	59.569	56.912	75.938
Other Fuels	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082
TOTAL	**35.829**	**41.084**	**40.583**	**43.749**	**40.353**	**67.589**	**69.360**	**87.274**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	8.570	7.863	9.857	10.196	10.627	10.837	11.290	11.324
Gaseous Fuels	15.051	12.927	10.694	9.255	10.494	11.363	12.490	15.075
Solid Fuels	92.385	81.307	67.057	48.274	43.637	41.557	43.534	40.545
Other Fuels	0.000	0.000	0.000	0.000	0.001	0.014	0.000	0.000
Biomass	0.094	0.075	0.104	0.089	0.112	0.104	0.097	0.386
TOTAL	**116.100**	**102.172**	**87.712**	**67.814**	**64.871**	**63.875**	**67.411**	**67.330**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	10.978	9.998	8.633	7.771	7.529	5.560	4.966	4.485
Gaseous Fuels	16.164	17.456	18.623	20.614	20.725	20.950	21.610	22.128
Solid Fuels	37.450	36.955	31.793	32.094	27.433	26.469	26.533	26.155
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.447	0.282	0.311	0.248	0.459	0.301	0.542	0.679
TOTAL	**65.039**	**64.691**	**59.360**	**60.727**	**56.146**	**53.280**	**53.651**	**53.447**

Figures 3.3.7.10 and 3.3.7.11 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.e in the period: 1988-2011.

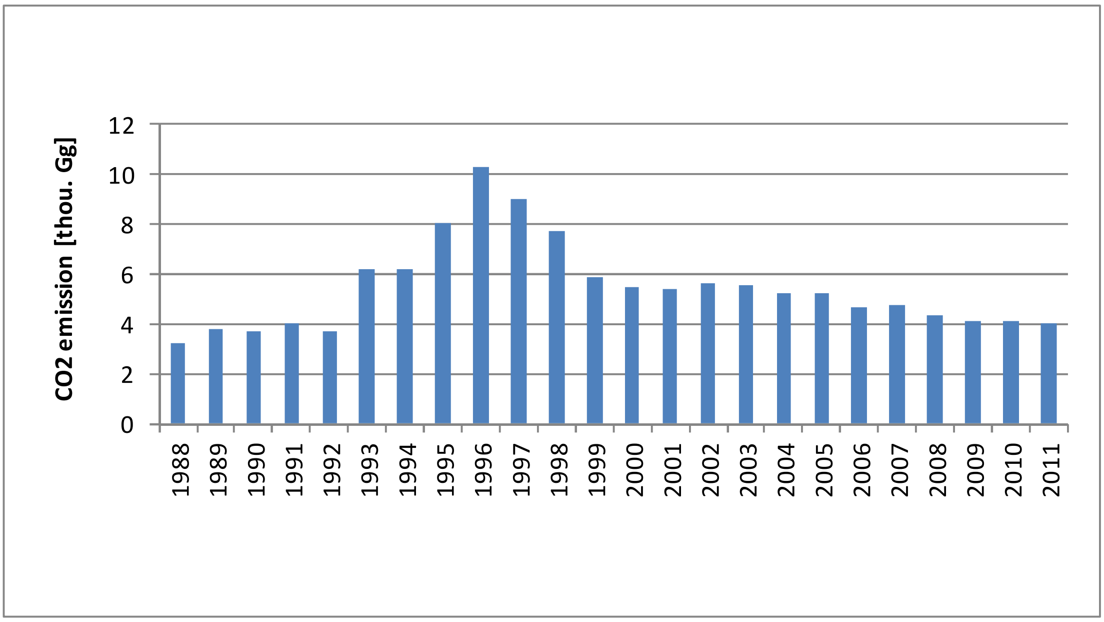

Figure 3.3.7.10. CO_2 emission for 1.A.2.e category in 1988-2011

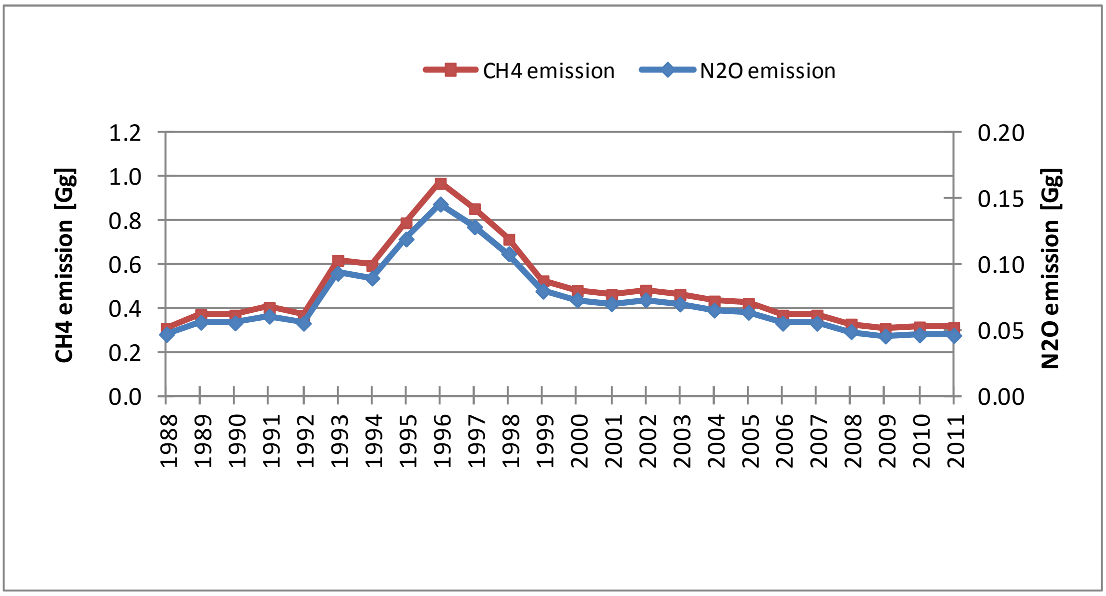

Figure 3.3.7.11. CH_4 and N_2O emissions for 1.A.2.e category in 1988-2011

3.2.7.2.6. Other (1.A.2.f)

The data on fuel type use in stationary sources in the sub-category 1.A.2.f *Other* over the 1988-2011 period are presented in table 3.3.7.6. Detailed data concerning total fuel consumption in 1.A.2.f subcategory was tabulated in Annex 2 (table 9).

Table 3.3.7.6. Fuel consumption in 1988-2011 in stationary sources of 1.A.2.f subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	29.047	27.157	18.847	15.593	15.112	16.945	17.021	22.417
Gaseous Fuels	52.767	50.455	40.219	34.460	36.058	39.907	38.844	40.694
Solid Fuels	210.393	196.143	146.240	137.806	126.085	183.863	178.462	180.009
Other Fuels	0.464	0.504	0.090	0.035	0.401	0.548	1.738	2.491
Biomass	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.980
TOTAL	**302.785**	**283.728**	**212.377**	**193.867**	**182.733**	**246.291**	**239.479**	**250.591**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	28.331	30.567	28.979	24.990	22.447	21.343	22.295	26.974
Gaseous Fuels	40.860	41.717	44.737	40.269	46.522	50.177	52.506	56.740
Solid Fuels	211.248	183.833	145.860	122.290	107.114	81.408	68.100	62.974
Other Fuels	2.819	1.180	2.300	2.045	2.624	2.337	2.595	3.987
Biomass	6.530	8.200	8.239	8.606	10.111	10.991	12.592	11.999
TOTAL	**289.788**	**265.497**	**230.115**	**198.200**	**188.818**	**166.256**	**158.088**	**162.674**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	26.232	29.189	24.049	18.654	17.854	18.583	17.583	16.290
Gaseous Fuels	60.829	62.287	65.056	66.426	66.574	64.617	68.129	68.610
Solid Fuels	62.044	56.016	55.060	67.470	56.190	41.717	44.341	50.205
Other Fuels	3.504	5.130	10.460	8.683	8.938	13.527	15.051	16.816
Biomass	12.445	12.028	11.169	13.036	14.001	14.067	17.882	21.122
TOTAL	**165.054**	**164.650**	**165.794**	**174.269**	**163.557**	**152.511**	**162.986**	**173.043**

Figures 3.3.7.12 and 3.3.7.13 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.f in the period: 1988-2011.

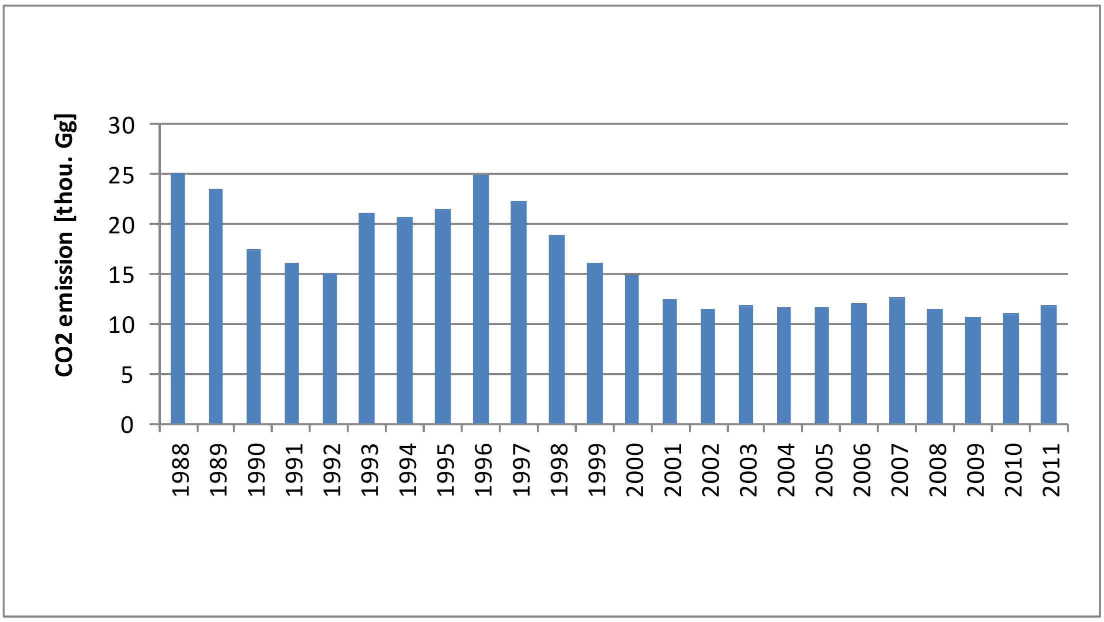

Figure 3.3.7.12. CO_2 emission from stationary sources in 1.A.2.f category in 1988-2011

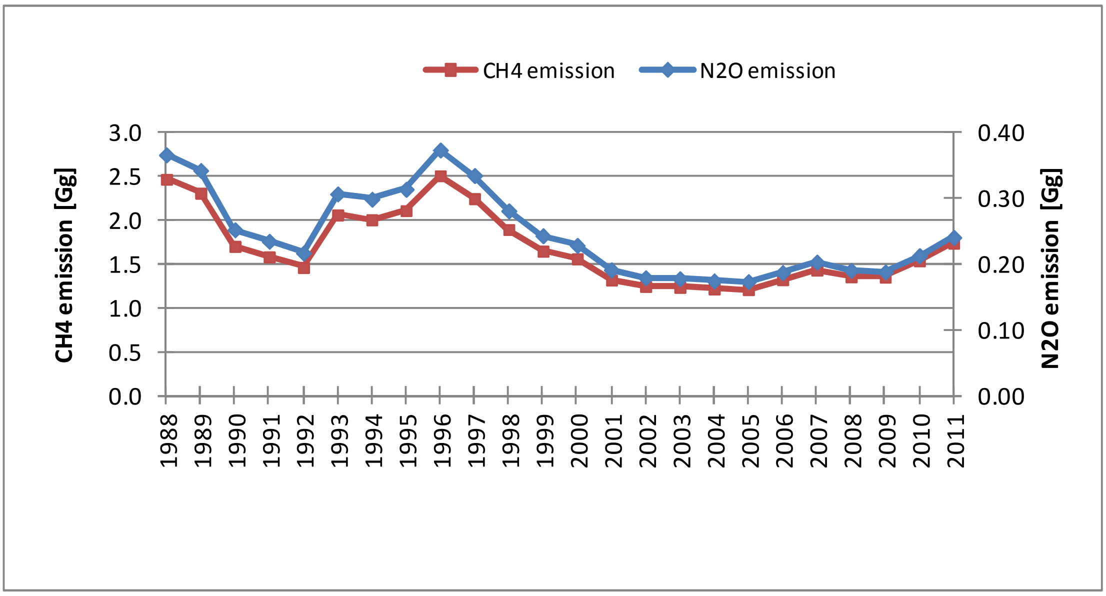

Figure 3.3.7.13. CH_4 and N_2O emissions from stationary sources in 1.A.2.f category in 1988-2011

3.2.7.3. Uncertainties and time-series consistency

See chapter 3.2.6.3.

3.2.7.4. Source-specific QA/QC and verification

See chapter 3.2.6.4.

3.2.7.5. Source-specific recalculations

- activity data on fuel consumption for years 1990-2010 were updated due to changes made in EUROSTAT database;
- for the entire reporting period CO_2 EF for combustion of non-biogenic fraction of municipal waste was corrected following the IPCC 2006 Guidelines [IPCC 2006], where EF= 91.70 kg CO_2/GJ;
- for the period 1988-2010 consumptions of diesel oil assigned to off-road vehicles and other machinery in industry and construction sub-sectors, reported as a separated part of 1.A.2.f IPCC, were deleted; according to methodology currently applied for inventory preparation, diesel oil consumed for mentioned purpose is included in particular subsectors of 1.A.2 IPCC category (i.e. in particular branches of industry), where fuel is used; because of AD correction the GHG emission values in 1.A.2.f were adjusted as well.

3.2.7.6. Source-specific planned improvements

- further developing of cooperation with institutions responsible for compilation of Polish energy balances in order to explain and verify time-trends of activity data in 1.A category
- analysis of the possibility of country specific EF elaboration for the significant fuels in Polish fuel structure

3.2.8. Transport (CRF sector 1.A.3)

3.2.8.1. Source category description

Estimation of emissions in 1.A.3 *Transport* are carried out for each fuel in sub-categories listed below:

a) *Civil Aviation* (1.A.3.a)
b*) Road Transportation* (1.A.3.b)
c) *Railways* (1.A.3.c)
d) *Navigation* (1.A.3.d)
e) *Other Transportation* (1.A.3.e)

Share of that sector in total GHG emission in 2011 is about 12%. Road transport is by far the largest contributor to transport emissions (see figure 3.2.8.1) - in year 2011 about 98%.

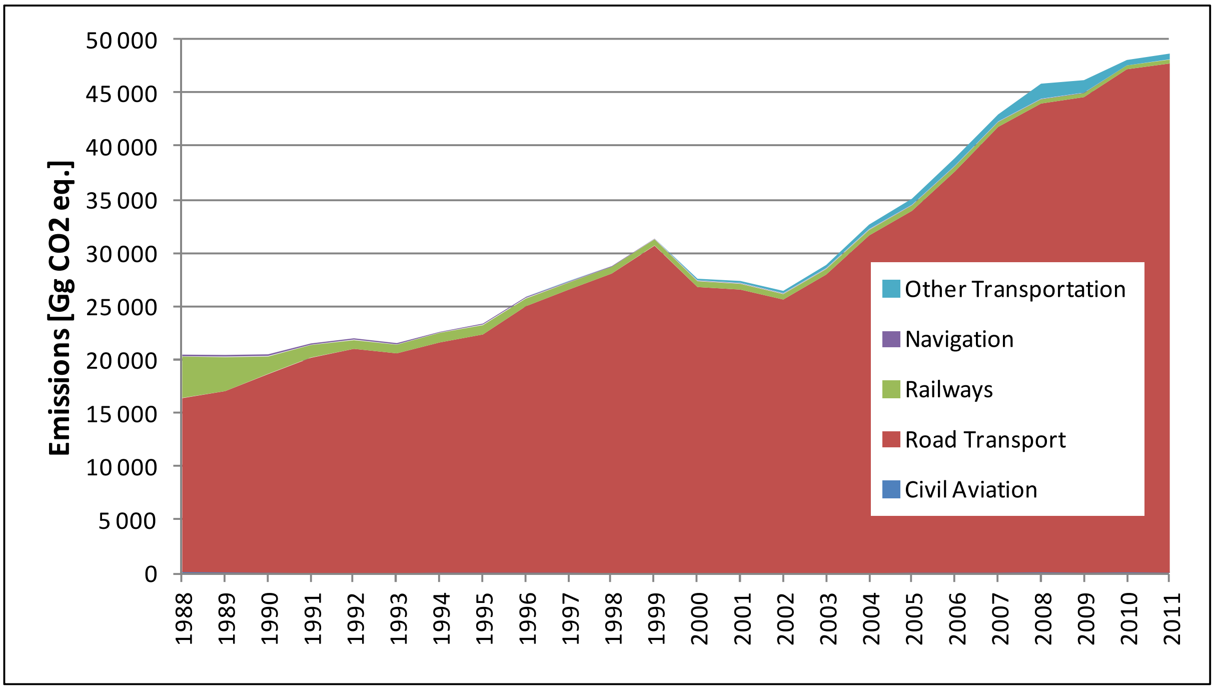

Figure 3.2.8.1. Emissions from transport in years 1988-2011

3.2.8.2. Methodological issues

The methodology used for estimation of GHG emissions in the national inventory for mobile sources for the entire time series 1988-2011 is factor based – data on fuel used are multiplied by the corresponding emission factors. Domestic emission factors for mobile sources include: CO_2 emission factors for road transport which are taken from annual reports of Motor Transport Institute and CO_2 emission factors for hard coal combustion in railway transport (concerns the period till 1998) – here the EF is calculated based upon an empirical function described above for stationary sources (chapter 3.1.1).

CO_2 emission factors for road transport have been elaborated by the Motor Transport Institute based on research, analysis and literature. The values of EFs may differ from year to year compared to values in table 3.2.8.1 which is caused by different issues explained below.

ITS published CO_2 EFs in g/kg units which must be converted into kg/GJ to be used in inventory calculation. To conversion NCVs are used, which may differ from year to year and that is why CO_2 EFs are not constant for period 1988-2011. Since 1996 NCV comes from "Energy Statistic" published by Central Statistical Office (GUS) these are standard calorific values and are mostly constant (it fluctuate only ±0,01MJ/kg and from 2004 all NCV are constant). Before 1996 Poland use real calorific value based on statistical data of fuel consumption given in TJ and Gg units.

Moreover, CO_2 EFs depend on carbon content in fuel. There is visible change between years 1995 and 1996 for CO_2 EF for gasoline. The change in IEF for gasoline in 1996 was caused by introducing the new EFs based on the newer country study applying, among others, analysis of gasoline content. EFs used before 1996 were based on study completed in early 1990-ties. The EFs were derived based on C content in different fuel types as well as on the data containing information on vehicle park and mobility. The specific car models were analyzed for elaboration of EFs.

IEF contain information on different EFs derived for various engine types, including two-stroke ones. In 1990-ties large change in vehicles number and structure was observed. The share of two-stroke engines extremely dropped in 1990-ties.

The other issue is that characteristics of gasoline used in Poland changed over time. The regular petrol (leaded) was used in 1980-ties and early 1990-ties like: regular petrol 86, 94, 98. Presently only lead-free petrol 95 and 98 is sold/used. For instance consumption of regular petrol 86 drop from 526.8 Gg in 1991 to 88.1 Gg in 1994 and was withdrawn from production in 1994 following decreasing demand.

All other emission factors for mobile sources were taken from IPCC guidelines and have constant values over the entire time series 1988-2011. The values of the EFs in 2011 are those in table 3.2.8.1. Exception is N_2O emission factor from gasoline for passenger cars with catalyst, which is based on COPERT IV (following recommendation made by ERT).

Table 3.2.8.1. Emission factors [kg/GJ] for transport types (means) in 2011

Type of transport	Category code	EF CO_2	EF CH_4	EF N_2O
1.A.3.a.ii International Aviation - bunker	PL	73.26	0.0005	0.0023
1.A.3.a.ii Civil Aviation. Domestic	PL	73.26	0.0005	0.0023
	BL	72.10	0.0600	0.0009
1.A.3.b.i Passenger Cars without catalysts	α.BS	70.75	0.03	0.002
	α.LG	63.11	0.02	0.0002
	α.ON	73.16	0.002	0.004
	β.BS	70.75	0.02	0.001
1.A.3.b. Passenger Cars with catalysts	γ.BS	70.31	0.007	0.003
	γ.LG	63.11	0.02	0.0002
	γ.ON	73.16	0.002	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t without catalysts	α.BS	70.75	0.02	0.001
	α.LG	63.11	0.03	0.0002
	α.ON	73.16	0.001	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t with catalysts	γ.BS	70.31	0.02	0.001
	γ.LG	63.11	0.01	0.0002
	γ.ON	73.16	0.001	0.004
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. without catalysts	α.ON	73.16	0.006	0.003
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. with catalysts	γ.ON	73.16	0.006	0.003
1.A.3.b.iii Buses	α.ON	73.16	0.0039	0.0013
	γ.ON	73.16	0.0039	0.0013
1.A.3.b.iv Motorcycles	BS	70.75	0.1	0.001
1.A.3.b.iv Mopeds	BS	70.75	0.1	0.001
1.A.3.b.vi Tractors	ON	73.16	0.004	0.0039
1.A.3.b - different types of vehicles	biodiesel	70.80	0.003	0.0006
1.A.3.b - different types of vehicles	bioethanol	70.80	0.003	0.0006
1.A.3.c. Railways	ON	75.00	0.005	0.0006
1.A.3.d.ii Domestic Navigation - inland	ON	73.00	0.004	0.030
1.A.3.d.ii Domestic Navigation - marine	ON	74.10	0.007	0.002
	OP	77.60	0.007	0.002
1.A.3.d.i Domestic Navigation - bunker	ON	74.10	0.007	0.002
	OP	77.60	0.007	0.002
1.A.4.c.iii Fishery	ON	74.10	0.007	0.002
	OP	77.60	0.007	0.002
1.A.4.c.ii Agriculture - Off-Road Vehicles	ON	73.00	0.004	0.0039
1.A.4.c.ii Agriculture - Machines	ON	73.00	0.004	0.030
1.A.2.f.ii Off-Road Vehicles in Industry, Other	ON	73.00	0.004	0.030
1.A.3.e.ii Other Off-Road Transport	BS	71.00	0.120	0.002
	LG	63.10	0.062	0.0002
	ON	73.00	0.004	0.0300

Abbreviation explanations to table:
catalyst - catalytic converter; BS - motor gasoline; ON - diesel oil; LG – liquid gas; OP - fuel oil; PL - jet fuel; BL - aviation gasoline; α – 4-stroke, old generation; β - 2-stroke, old generation; γ – new generation (Euro).

For the source category 1.A.3 and for other mobile sources the following data sources were used to estimate the fuel use:

- Eurostat database – use of fuels (according to Energy Market Agency fuel used is equal to fuel sold) in the following sub-categories: 1.A.3.a – *Civil Aviation*, 1.A.3.b. -*Road Transportation*, 1.A.3.c – *Railways*, in part of the sub-category 1.A.3.d – *Navigation – i.e. inland water navigation*, in part of the sub-category 1.A.4.c – vehicles and machinery in agriculture, use of fuels included in the international maritime bunker,
- report of the Motor Transport Institute [ITS 2011],
- GUS G-03 reports – selected aggregated data from the energy balance statistics [GUS 2012e] – used for estimation of fuel use for part of the sub-category 1.A.3.d – *Navigation* - for maritime shipping,
- Statistical Yearbook [GUS 2012] – data on fishing used for fuel use estimation in the sub-category 1.A.4.c. iii – Fishing,
- report [ITS 2001] – data used for fuel use estimation in the sub-category 1.A.4.c. iii – Fishing.

3.2.8.2.1. Civil Aviation (CRF sector 1.A.3.a)

Emissions from aviation come from the combustion of jet fuel and aviation gasoline. Data on fuel use in domestic aviation are shown in figure 3.2.8.2.

When assessing the amount of fuel used for civil aviation, it was assumed that 5% of the jet fuel and the entire amount of aviation kerosene in the national aviation transport statistics is used in domestic aviation.

According to the initial estimations based on EUROCONTROL data on fuel use share of jet kerosene used for domestic aviation in Poland is very similar to the value assumed by PL (5%). Table below contain Eurocontrol data for fuel consumption [TJ].

Fuel consumption	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Domestic	566	680	757	698	750	822	812	750	850
International	7 647	8 348	10 063	12 552	16 409	19 922	22 705	20 612	22 078
Total	8 214	9 028	10 820	13 250	17 159	20 743	23 516	21 361	22 928
% Domestic share	**7**	**8**	**7**	**5**	**4**	**4**	**3**	**4**	**4**

Further efforts are undertaken to develop method to split domestic and international aviation. Poland has already contacted with ULC (The Civil Aviation Authority of the Republic of Poland) to collect relevant data.

Figures 3.2.8.3 and 3.2.8.4 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.a in the period 1988-2011.

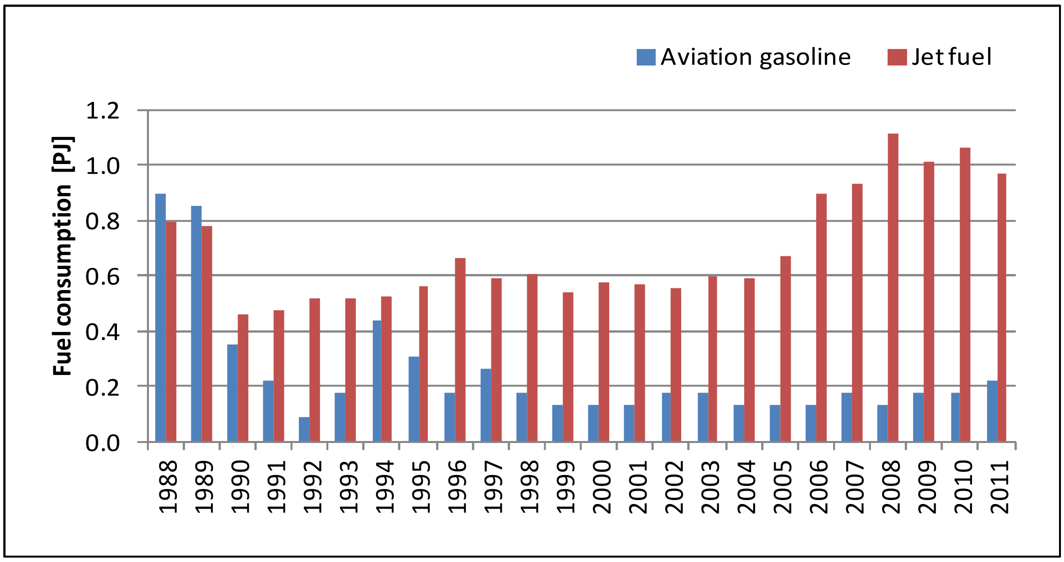

Figure 3.2.8.2. Fuel consumption in 1.A.3.a category for 1988-2011

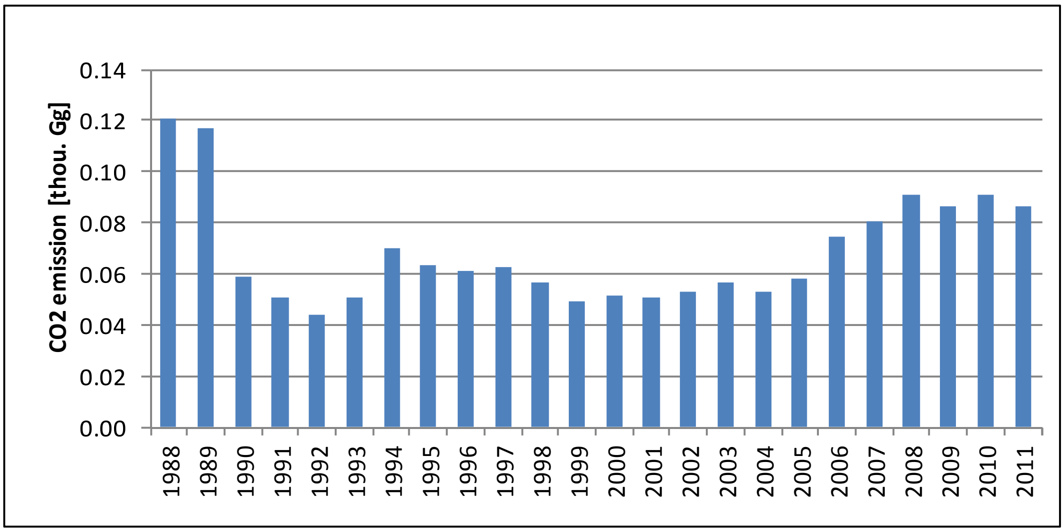

Figure 3.2.8.3. CO_2 emission for 1.A.3.a category in 1988-2011

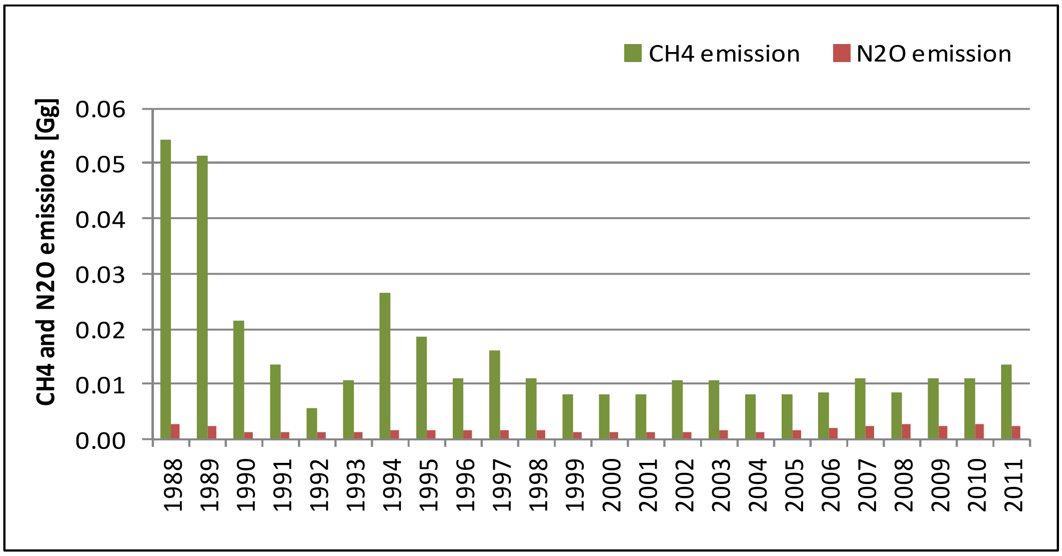

Figure 3.2.8.4. CH_4 and N_2O emissions for 1.A.3.a category in 1988-2011

3.2.8.2.2. Road Transportation (CRF sector 1.A.3.b)

Emission estimates from this category are based on fuel consumed by different vehicle types – including passenger cars, light and heavy duty vehicles, buses, tractors, motorcycles and mopeds. Activity data for years 1990-2011 for calculation are taken from Eurostat database and was disaggregated on individual type of vehicle according to ITS report [ITS 2011].

The amount of vehicles according to categories in 2011 [GUS T 2012] is given in table below.

Table 3.2.8.2. Amount of vehicles according to categories in 2011

Category	Amount [thous. pcs.]
Passenger cars	18 125
Trucks	2 892
Buses	100
Motorcycles	1 069
Tractors	1 613

Consumption of main fuels in road transport (gasoline, diesel oil and LPG) in 1988-2011 period is shown in figure 3.2.8.5.

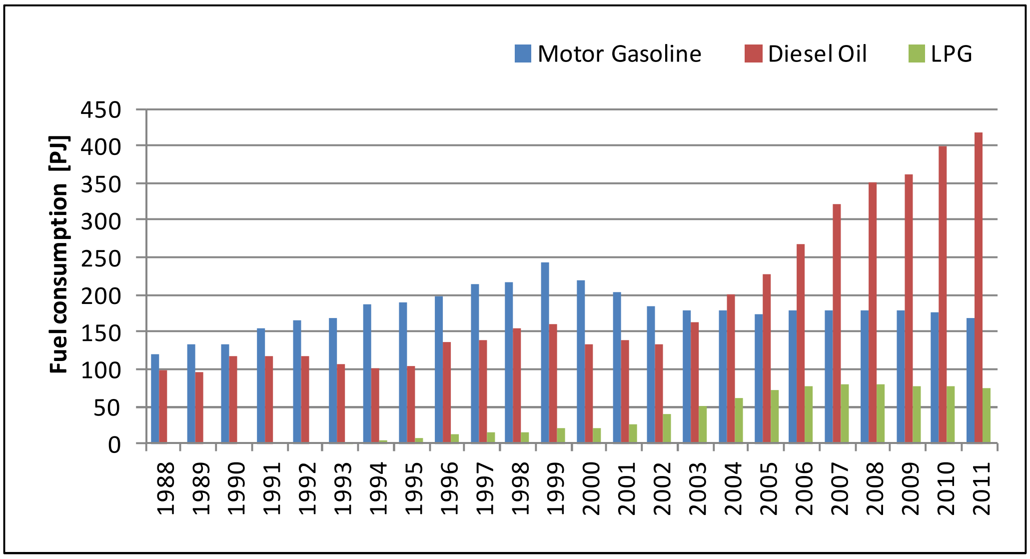

Figure 3.2.8.5. Fuel consumption in 1.A.3.b category for 1988-2011

There is a growing trend of consumption of biofuels in road transport. Amounts of biofuels used in years 2005 - 2011 are given in table 3.1.8.3.

Table 3.4.3. Amounts of biofuels used in years 2005 – 2011 [PJ]

Fuel type	2005	2006	2007	2008	2009	2010	2011
Biodiesel	0.67	1.52	1.06	13.19	19.58	29.22	31.60
Bioethanol	1.58	2.55	3.37	5.29	8.18	7.90	7.48

As the consumption of biofuels in 1.A.3.b is not significant compared to consumption of other fuels, it is not shown in the above figure.

CO_2 emission in 2011 is equal 47 001 Gg. Figure 3.2.8.6 shows CO_2 emissions in sub-category 1.A.3.b in period 1988-2011. Emissions of CH_4 and N_2O in the same sub-category are shown in figure 3.2.8.7.

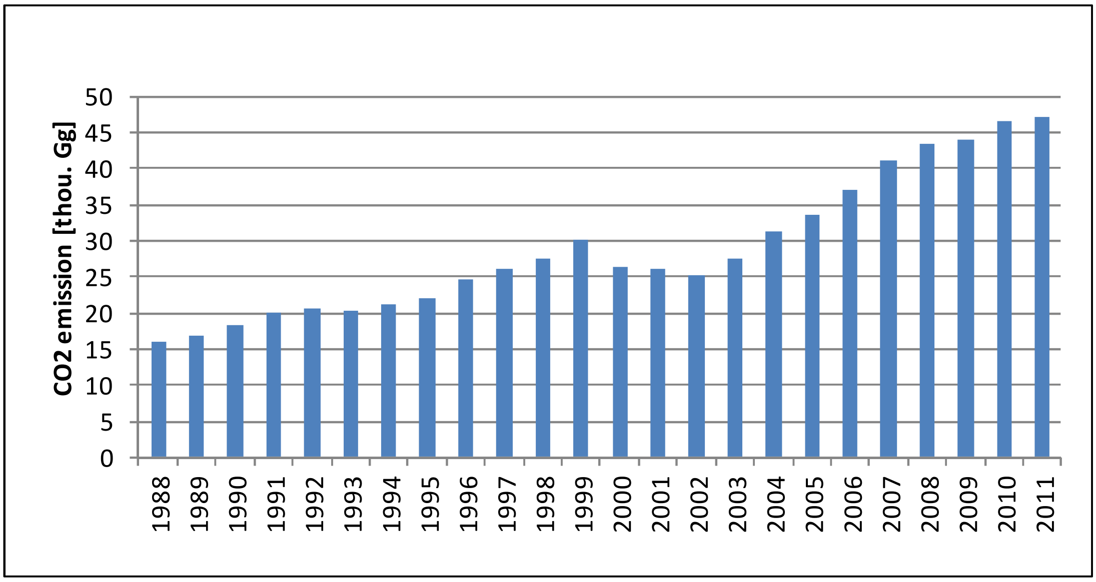

Figure 3.2.8.6. CO_2 emission for 1.A.3.b category in 1988-2011

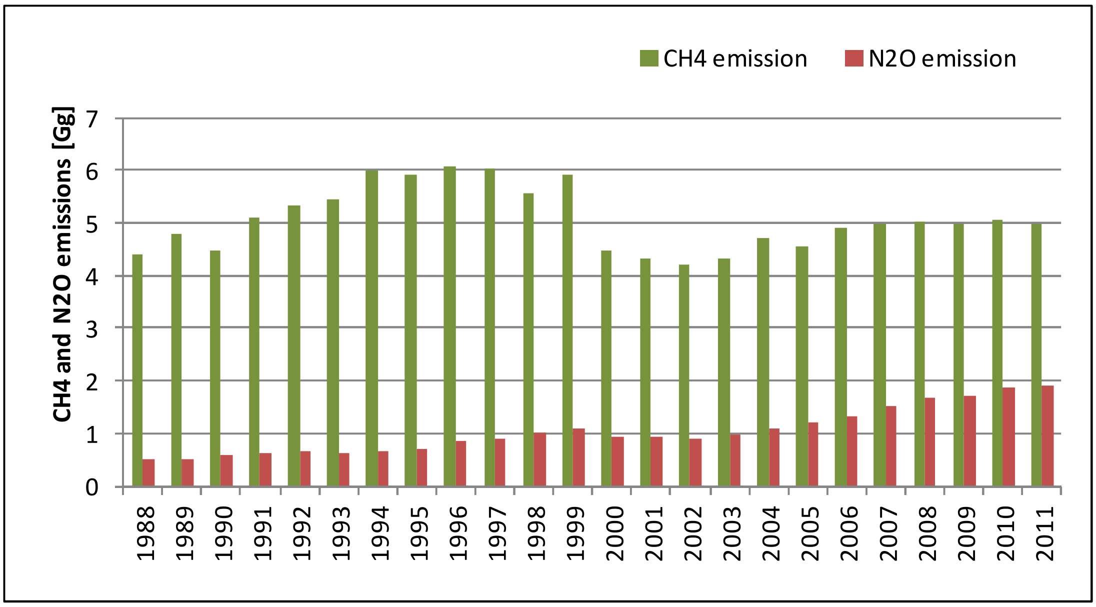

Figure 3.2.8.7. CH_4 and N_2O emissions for 1.A.3.b category in 1988-2011

3.2.8.2.3. Railways (CRF sector1.A.3.c)

Railway locomotives used in Poland are diesel and electric. Up to year 1998 coal was used in steam locomotives. The amounts of fuels used in railway transport in the 1988-2011 period are shown in figure 3.2.8.8.

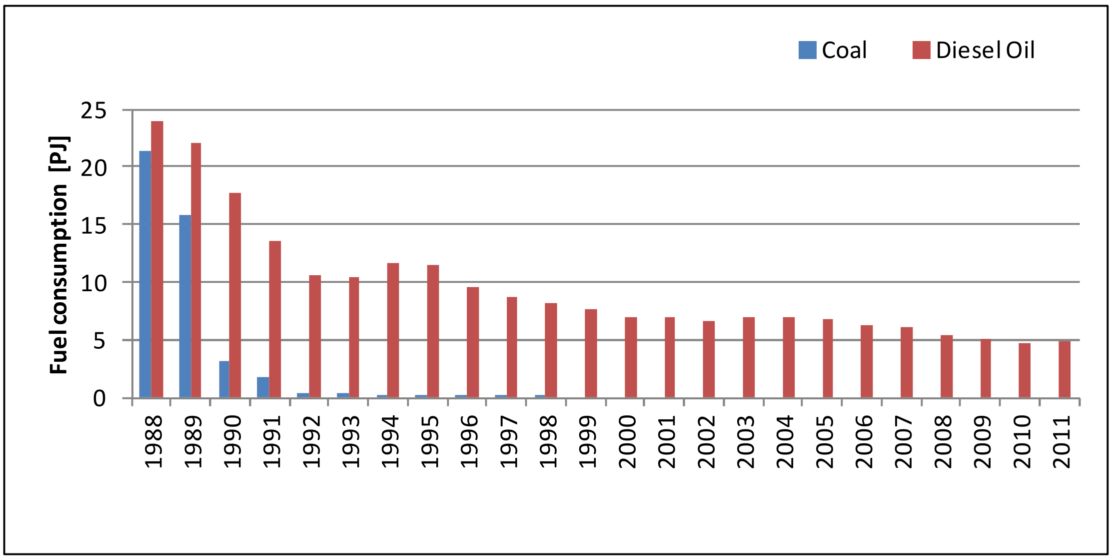

Figure 3.2.8.8. Fuel consumption in 1.A.3.c category for 1988-2011

Figures 3.2.8.9 and 3.2.8.10 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.c for the entire time series beginning in the base year.

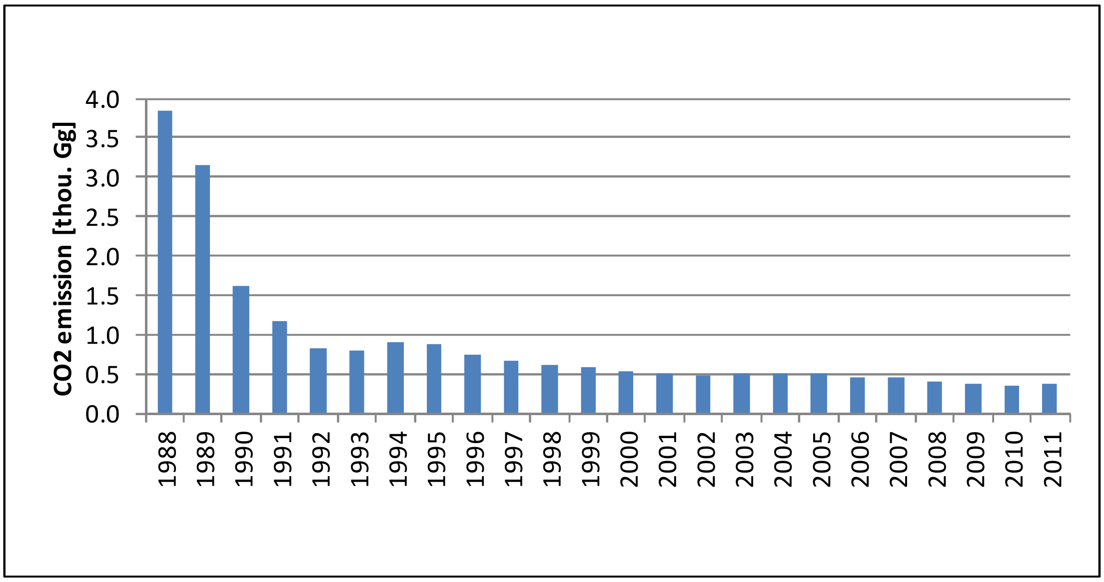

Figure 3.2.8.9. CO_2 emission for 1.A.3.c category in 1988-2011

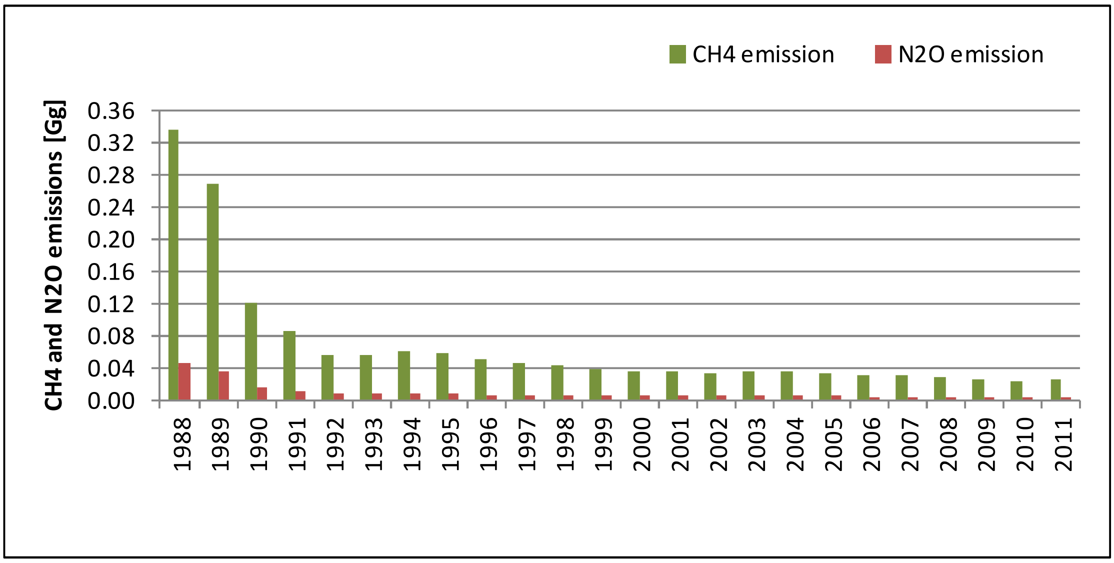

Figure 3.2.8.10. CH_4 and N_2O emissions for 1.A.3.c category in 1988-2011

3.2.8.2.4. Navigation (CRF sector 1.A.3.d)

The structure of fuels used in Navigation has been recalculated based on G-03 questionnaires and statistical data on levels of international vs. domestic shipping activity. As these levels fluctuate an average level of domestic shipping activity was assumed (2% for 1988-1996 and 1% for 1997-2011). The amounts of fuels (diesel and fuel oil) used in both inland water and maritime navigation in the 1988-2011 period are shown in figure 3.2.8.11.

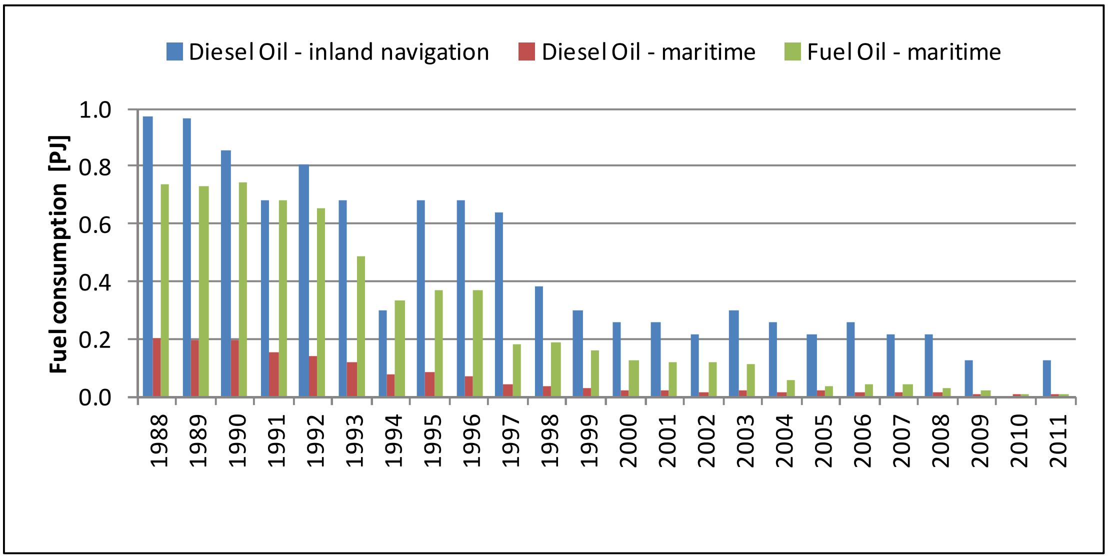

Figure 3.2.8.11. Fuel consumption in 1.A.3.d category for 1988-2011

Figures 3.2.8.12 and 3.2.8.13 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.d for the entire time series 1988-2011.

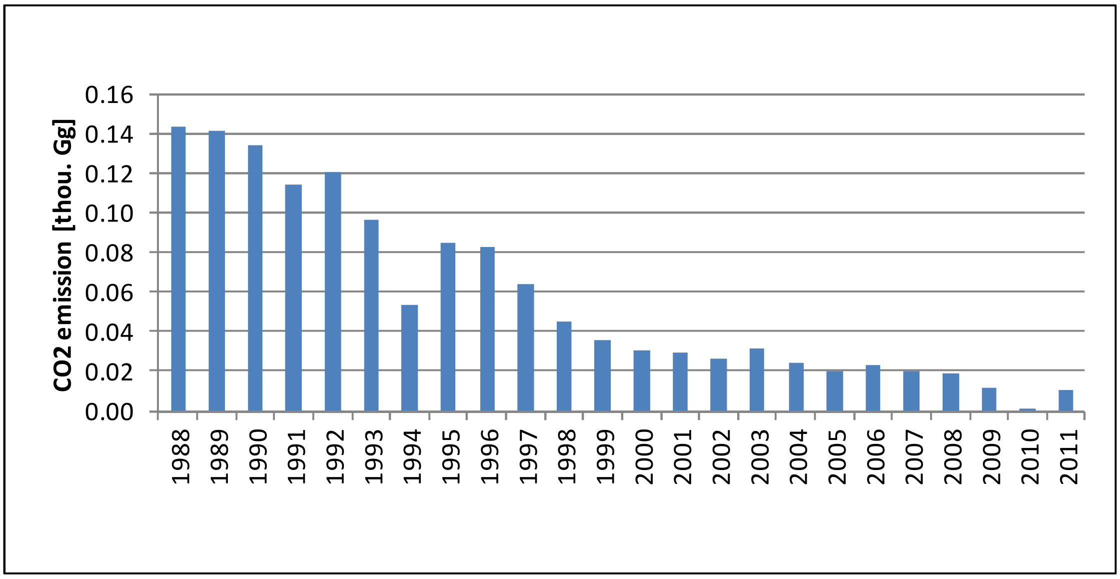

Figure 3.2.8.12. CO_2 emission for 1.A.3.d category in 1988-2011

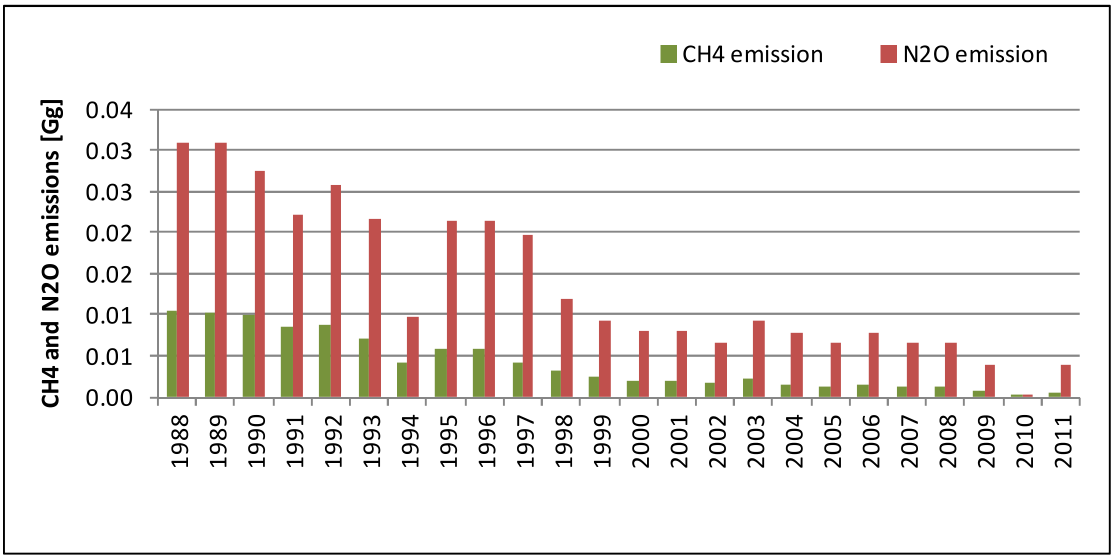

Figure 3.2.8.13. CH_4 and N_2O emissions for 1.A.3.d category in 1988-2011

3.2.8.2.5. Other transportation (CRF sector 1.A.3.e)

Pipeline transport contains combustion related emissions from the operation of pump stations and maintenance of pipelines. For the years where activity data are available (where fuel consumption in pipeline transport was separated in Energy sector), pipeline transport has been transferred from 1.A.1.c to 1.A.3 category. Activity data for natural gas are available since year 1994. From year 2000, when gas pipeline Jamal was completed, the amount of this fuel increased sharply from 21 TJ in 1999 to 2498 TJ in 2000. Activity data for Motor gasoline and Diesel oil were available respectively from year 2001 and 2000.

The amounts of natural gas used in the sub-category 1.A.3.e.i. *Pipelines transport* in the 1988-2011 period are shown in figure 3.2.8.14. Figure 3.2.8.15 shows consumption of motor gasoline and diesel oil. Figures 3.2.8.16 and 3.2.8.17 show respectively emissions of CO_2, CH_4 and N_2O, in the sub-category 1.A.3.e from Pipelines for the entire time series 1988-2011.

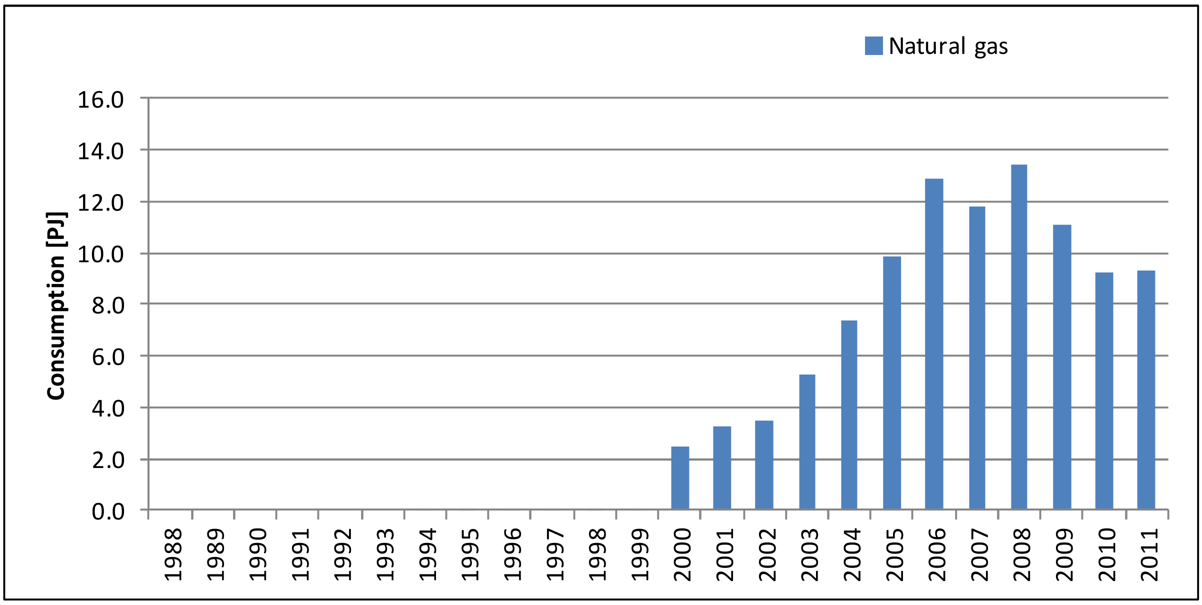

Figure 3.1.8.14. Natural gas consumption in *Pipelines transport* category for 1988-2011

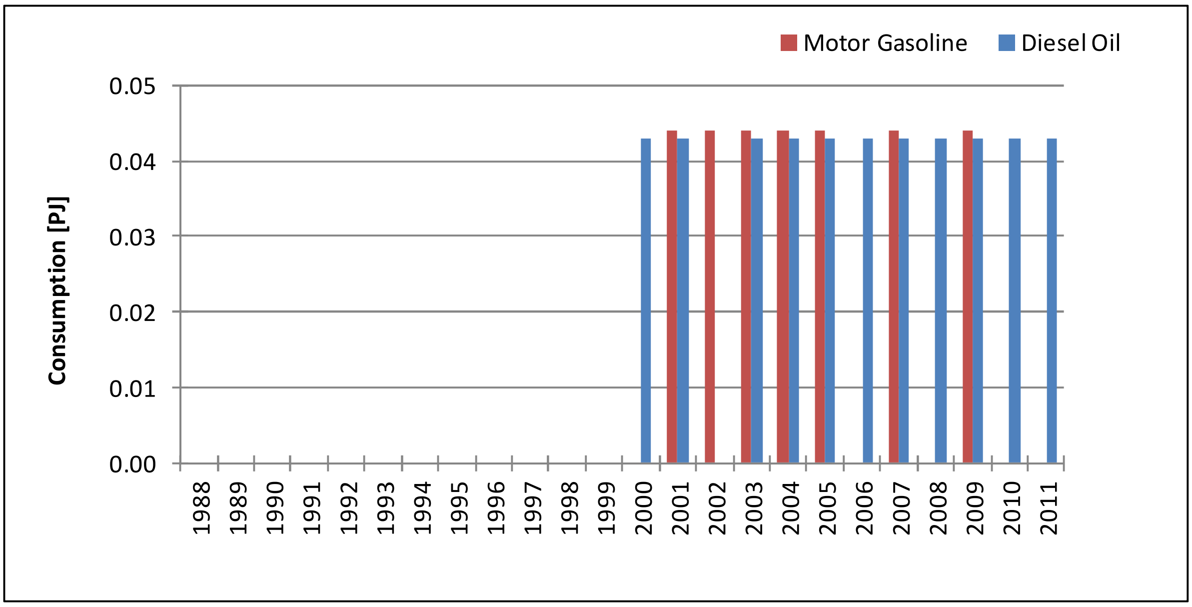

Figure 3.2.8.15. Motor gasoline and diesel oil consumption in *Pipelines transport* category for 1988-2011

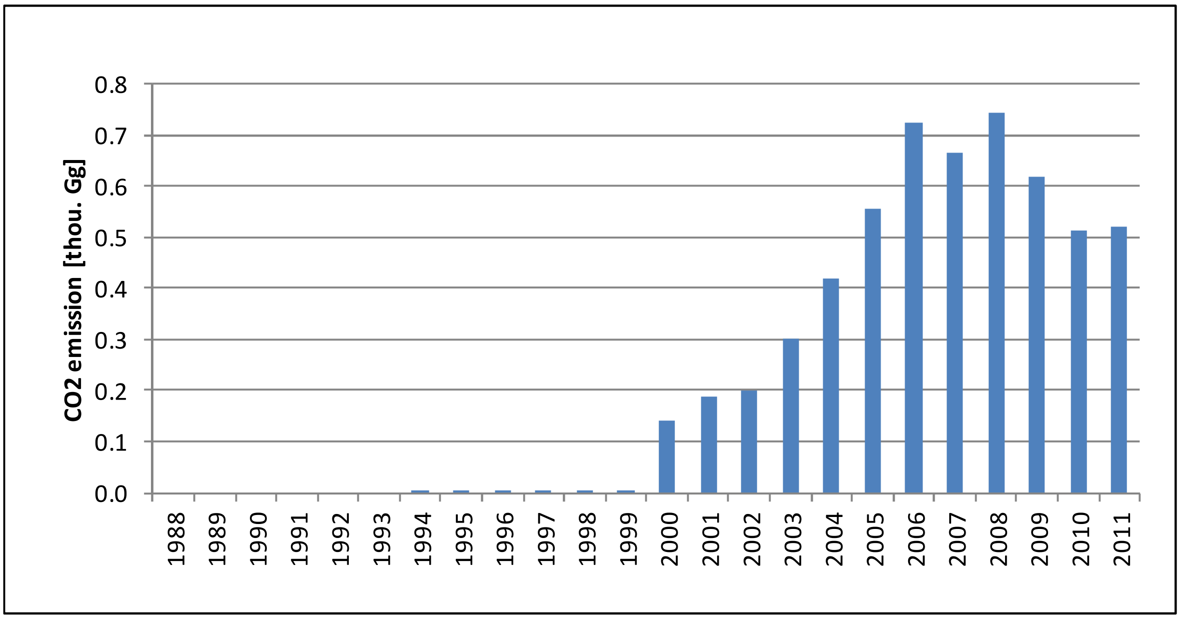

Figure 3.2.8.16. CO_2 emission from Pipelines category in 1988-2011

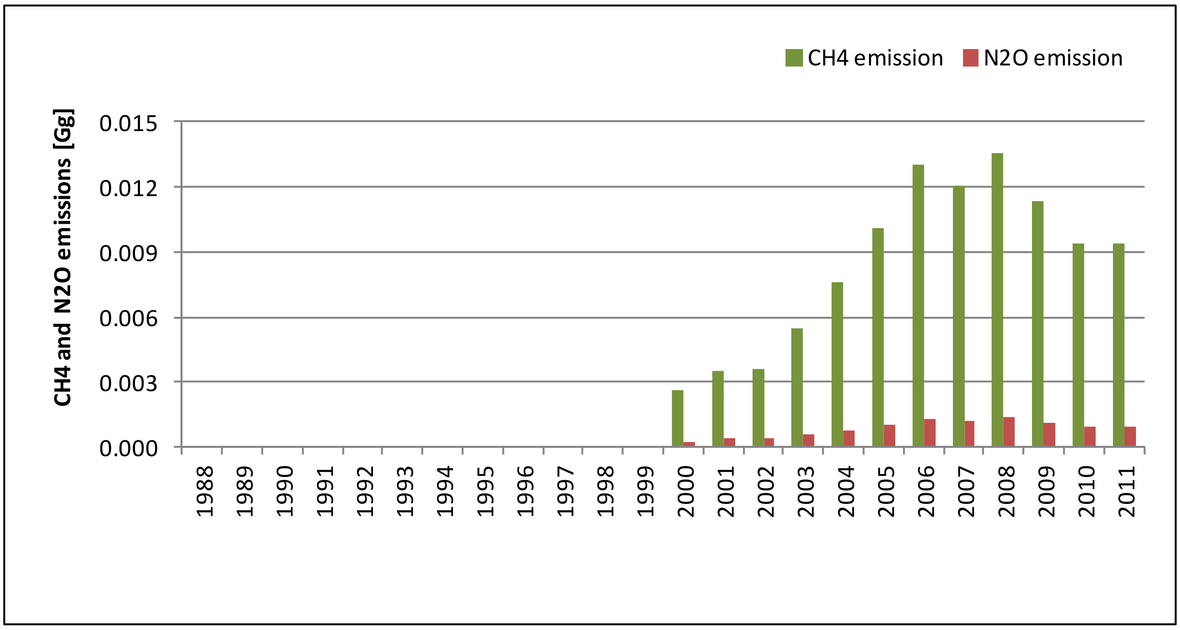

Figure 3.2.17. CH_4 and N_2O emissions from Pipelines category in 1988-2011

3.2.8.2.6. Other mobile sources outside of the source category 1.A.3

Other mobile sources included in the national inventory in sub-categories other than 1.A.3 include:

- machinery and off-road transport in agriculture (sub-category 1.A.4.c.ii) – classified in source category 1.A.4
- fishery (sub-category 1.A.4.c.iii) - classified in source category 1.A.4

The amounts of fuels used in the above listed sub-categories in the 1988-2011 period are presented in table 3.2.8.4. The amounts of corresponding emissions of CO_2, CH_4 and N_2O are shown in tables 3.2.8.5–3.2.8.7.

Table 3.2.8.4. Fuel consumption [PJ] in 1988-2011 in mobile sources in subcategories other than 1.A.3

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ON-1.A.4.c.ii	50.27	48.72	50.17	48.33	56.80	71.65	77.59	81.70	91.12	106.01	96.46	98.79	109.45	102.03	101.73	102.93	104.84	107.25	79.64	73.20	73.25	70.49	70.70	71.29
ON-1.A.4.c.iii	4.55	4.15	3.43	3.30	3.44	2.82	3.22	3.16	2.60	2.70	1.95	1.96	1.73	1.83	1.79	1.44	1.62	1.38	1.30	1.35	1.30	1.93	1.59	1.64
OP-1.A.4.c.iii	7.54	6.87	5.67	5.46	5.69	4.67	5.33	5.24	4.24	4.41	3.18	3.19	2.83	2.98	2.93	2.36	2.65	2.25	2.13	2.20	2.11	3.14	2.60	2.67

ON - diesel oil, OP - fuel oil

Table 3.2.8.5. CO_2 emission [thous. Gg] in 1988-2011 in mobile sources in subcategories other than 1.A.3

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.A.4.c.ii	3.669	3.556	3.662	3.528	4.146	5.230	5.664	5.964	6.652	7.739	7.041	7.212	7.990	7.448	7.426	7.514	7.653	7.829	5.814	5.344	5.348	5.146	5.161	5.204
1.A.4.c.iii	0.923	0.840	0.694	0.668	0.697	0.571	0.652	0.641	0.522	0.543	0.391	0.393	0.348	0.367	0.360	0.290	0.325	0.277	0.261	0.270	0.260	0.386	0.319	0.329

Table 3.2.8.6. CH_4 emission [Gg] in 1988-2011 in mobile sources in subcategories other than 1.A.3

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.A.4.c.ii	0.201	0.195	0.201	0.193	0.227	0.287	0.310	0.327	0.364	0.424	0.386	0.395	0.438	0.408	0.407	0.412	0.419	0.429	0.319	0.293	0.293	0.282	0.283	0.285
1.A.4.c.iii	0.085	0.077	0.064	0.061	0.064	0.052	0.060	0.059	0.048	0.050	0.036	0.036	0.032	0.034	0.033	0.027	0.030	0.025	0.024	0.025	0.024	0.035	0.029	0.030

Table 3.2.8.7. N_2O emission [Gg] in 1988-2011 in mobile sources in subcategories other than 1.A.3

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.A.4.c.ii	0.327	0.317	0.327	0.315	0.370	0.466	0.505	0.532	0.593	0.690	0.628	0.643	0.713	0.664	0.662	0.670	0.682	0.698	0.518	0.477	0.477	0.459	0.460	0.464
1.A.4.c.iii	0.024	0.022	0.018	0.018	0.018	0.015	0.017	0.017	0.014	0.014	0.010	0.010	0.009	0.010	0.009	0.008	0.009	0.007	0.007	0.007	0.007	0.010	0.008	0.009

3.2.8.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.2.8.4. Source-specific QA/QC and verification

See chapter 3.2.6.4

3.2.8.5. Source-specific recalculations

- Fuel consumption in 1990-2010 was corrected based on updated Eurostat database;
- emission from subcategory 1.A.3.e.i *Off-road transportation* is included in subcategory 1.A.3.b *Road transportation*; In statistics activity data for this subcategory are given together with fuel use from road transport and there is no possibility to separate such data.

3.2.8.6. Source-specific planned improvements

- developing a methodology to split domestic and international aviation bunker fuels;
- improving the methodology of estimating emissions from road transport.

3.2.9. Other sectors (CRF sector 1.A.4)

3.2.9.1. Source category description

Emissions in 1.A.4 *Other Sectors* are estimated for each fuel in detailed sub-categories given below:

a) *Commercial/Institutional* (1.A.4.a)
b) *Residential* (1.A.4.b)
c) *Agriculture/Forestry/Fishing* (1.A.4.c)

- agriculture – stationary sources,
- agriculture – mobile sources: off-road vehicles and other machinery
- fishing.

Subsector 1.A.4.b *Residential* is by far the largest contributor to emissions from this category (see figure 3.2.9.1) – about 63 % in 2011.

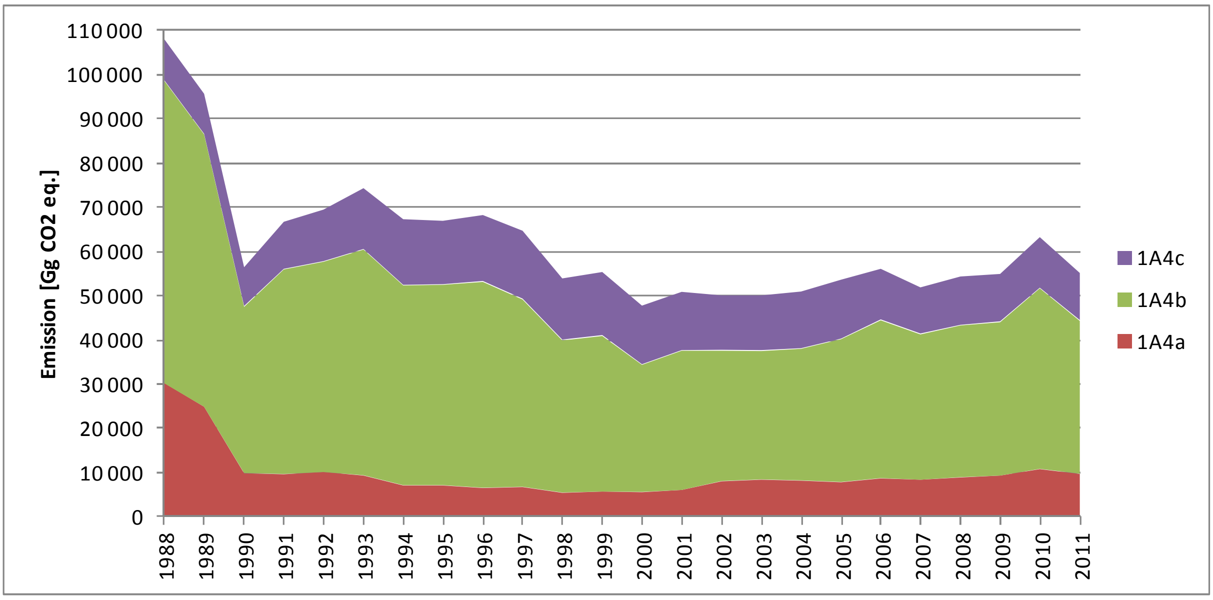

Figure 3.2.9.1. GHG emissions from 1.A.4. *Other sectors* in years 1988-2011 according to subcategories

3.2.9.2. Methodological issues

Methodology of emission estimation in 1.A.4 subcategory corresponds with methodology described for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for subsectors included in 1.A.4 subcategory are presented in Annex 2.

3.2.9.2.1. Other Sectors – Commercial/Institutional (1.A.4.a)

The data on fuel type use in stationary sources in the sub-category 1.A.4.a *Other Sectors – Commercial/Institutional* over the 1988-2011 period are presented in table 3.5.9.1. Detailed data concerning fuel consumption in 1.A.4.a subcategory was tabulated in Annex 2 (table 10).

Table 3.5.9.1. Fuel consumption in 1988-2011 in 1.A.4.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	0.000	0.000	0.000	0.000	0.000	0.000	1.334	0.782
Gaseous Fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260
Solid Fuels	297.022	244.616	91.216	92.072	95.735	86.052	64.046	62.499
Other Fuels	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000
Biomass	0.084	0.123	0.379	0.187	0.206	12.374	11.968	11.983
TOTAL	**312.319**	**257.484**	**105.886**	**103.317**	**107.142**	**110.326**	**87.010**	**88.524**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.762	6.088	7.741	10.293	16.429	21.176	22.675	23.897
Gaseous Fuels	18.771	24.256	32.769	37.697	38.567	49.971	61.001	67.057
Solid Fuels	52.142	48.087	29.851	27.865	22.005	17.283	29.822	29.723
Other Fuels	0.124	0.000	0.003	0.004	0.024	0.091	0.101	0.071
Biomass	10.625	9.627	9.085	9.216	9.211	6.596	6.440	6.466
TOTAL	**83.424**	**88.058**	**79.449**	**85.075**	**86.236**	**95.117**	**120.039**	**127.214**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	21.200	17.721	28.333	27.628	27.168	25.328	30.764	28.571
Gaseous Fuels	69.570	68.410	63.517	65.489	71.250	75.746	83.433	78.138
Solid Fuels	28.433	28.087	32.203	27.900	30.863	33.550	40.119	33.637
Other Fuels	0.002	0.022	0.000	0.000	0.037	0.092	0.019	0.046
Biomass	6.599	6.544	5.113	5.802	5.896	7.946	8.923	8.896
TOTAL	**125.804**	**120.784**	**129.166**	**126.819**	**135.214**	**142.662**	**163.258**	**149.288**

Figures 3.5.9.2 and 3.5.9.3 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.4.a in the period 1988-2011.

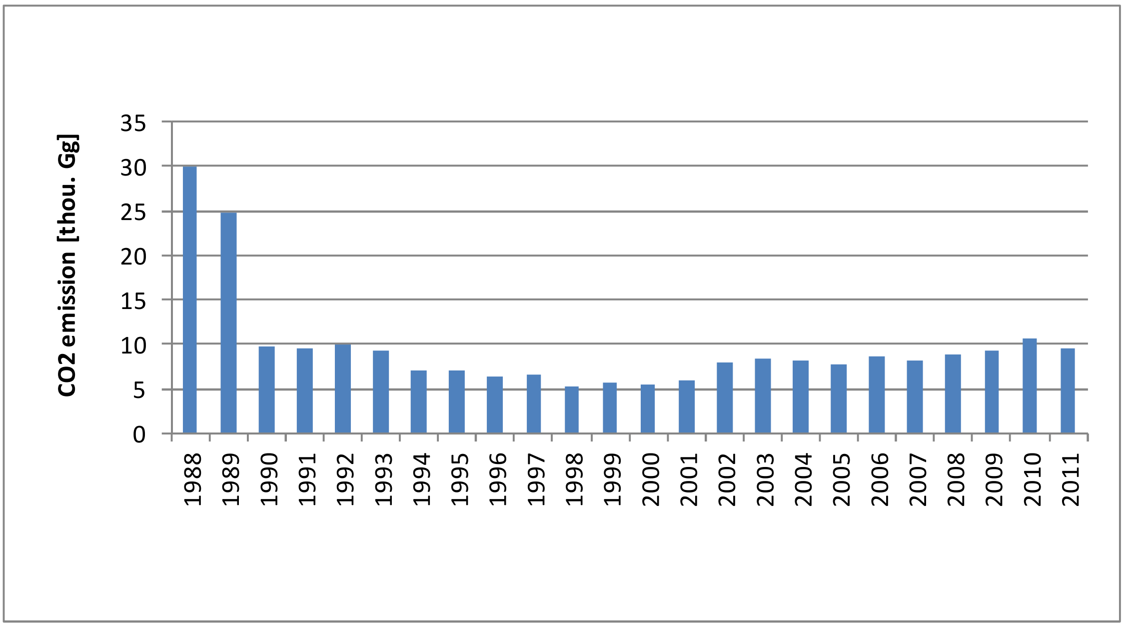

Figure 3.5.9.2. CO_2 emission for 1.A.4.a category in 1988-2011

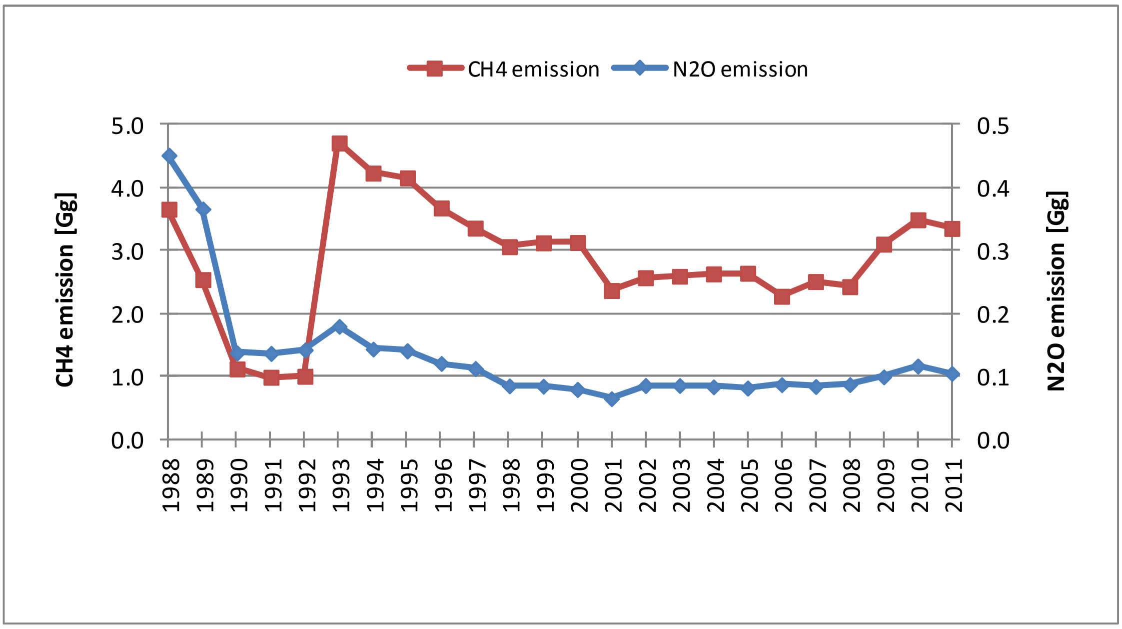

Figure 3.5.9.3. CH_4 and N_2O emissions for 1.A.4.a category in 1988-2011

3.2.9.2.2. Residential (CRF sector 1.A.4.b)

The data on fuel type use in stationary sources in the sub-category 1.A.4.b *Residential* over the 1988-2010 period are presented in table 3.5.2. Detailed information on fuel consumption for 1.A.4.b subcategory are presented in Annex 2 (table 11).

Table 3.5.2. Fuel consumption in 1988-2011 in 1.A.4.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	6.955	7.664	1.702	1.012	1.840	6.072	8.970	12.834
Gaseous Fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559
Solid Fuels	617.865	546.681	307.564	385.686	390.347	413.265	346.089	339.464
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	33.615	32.351	34.335	27.721	33.969	106.000	104.715	105.000
TOTAL	**761.015**	**694.315**	**465.805**	**548.093**	**567.368**	**666.927**	**611.445**	**616.857**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	18.230	24.790	26.920	29.033	37.280	42.000	44.181	48.091
Gaseous Fuels	143.057	150.022	138.268	135.995	127.611	133.737	127.093	127.629
Solid Fuels	358.593	307.562	235.470	243.304	179.025	198.225	181.875	174.738
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	101.000	100.000	100.700	95.000	95.000	104.500	104.500	103.075
TOTAL	**620.880**	**582.374**	**501.358**	**503.332**	**438.916**	**478.462**	**457.649**	**453.533**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	45.220	42.170	39.870	36.496	32.202	28.121	29.313	27.686
Gaseous Fuels	126.376	135.111	138.686	132.622	131.450	134.857	148.427	135.471
Solid Fuels	184.880	208.687	242.209	219.897	238.001	241.865	295.284	240.129
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	103.360	100.700	104.500	102.000	102.500	102.500	112.746	115.000
TOTAL	**459.836**	**486.668**	**525.265**	**491.015**	**504.153**	**507.343**	**585.770**	**518.286**

Figure 3.5.9.4 show emissions of CO_2 in 1.A.4.b in the 1988-2011 period while CH_4 and N_2O, emissions in the same sub-category are shown in figure 3.5.9.5.

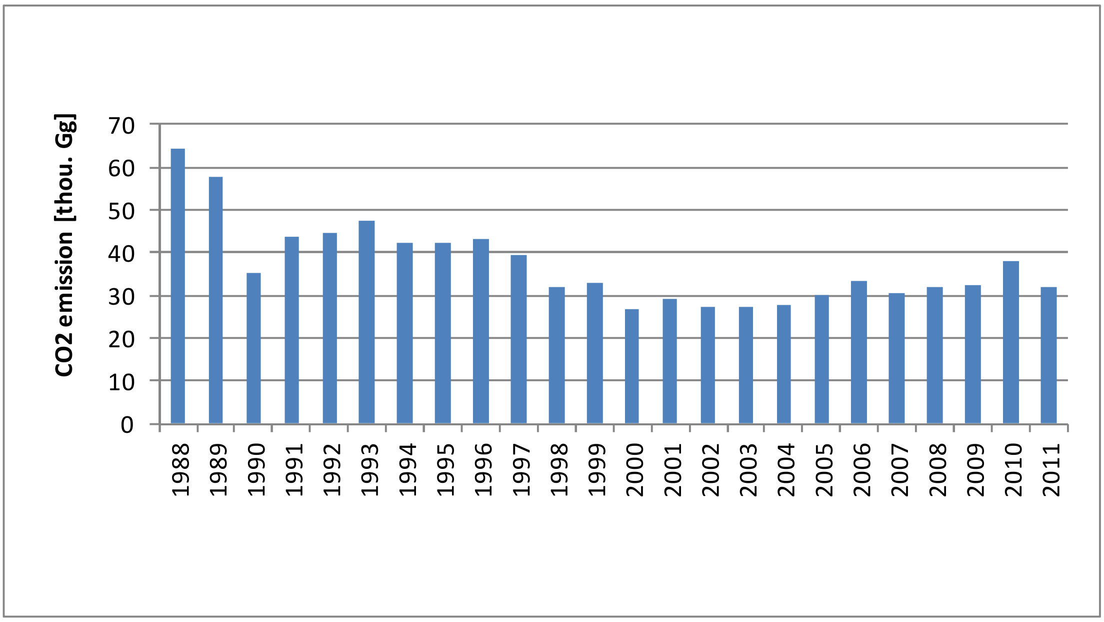

Figure 3.5.9.4. CO_2 emission for 1.A.4.b category in 1988-2011

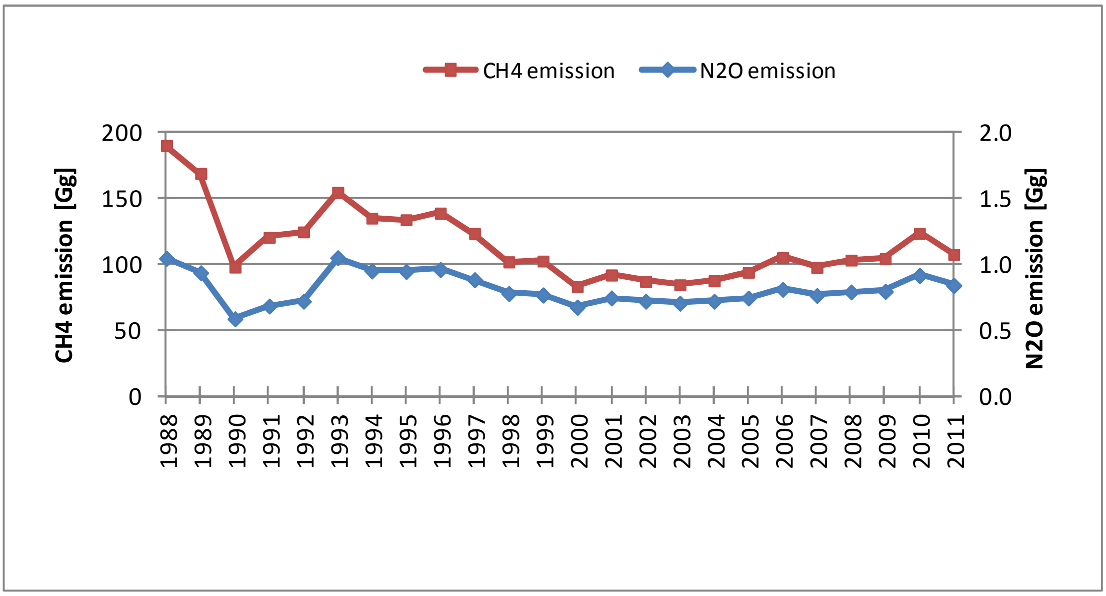

Figure 3.5.9.5. CH_4 and N_2O emissions for 1.A.4.b category in 1988-2011

3.2.9.2.3. Agriculture/Forestry/Fishing – stationary sources (CRF sector 1.A.4.c)

The data on fuel type use in stationary sources in the sub-category 1.A.4.c Agriculture/Forestry/ Fishing over the 1988-2011 period are presented in table 3.5.9.3. Detailed data concerning total fuel consumption in 1.A.4.c subcategory (including fuel consumption related to off-road vehicles and other machinery in agriculture and fuel use in fishing) was tabulated in Annex 2 (table 12).

Table 3.5.9.3. Fuel consumption in stationary sources in 1.A.4.c subcategory for years 1988-2011 [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	2.733	2.613	3.560	2.720	1.440	14.060	18.280	10.510
Gaseous Fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243
Solid Fuels	42.690	42.027	39.465	59.712	64.662	63.946	66.262	64.300
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.039	0.113	0.039	0.278	0.583	20.057	18.367	18.500
TOTAL	**45.969**	**45.198**	**43.512**	**62.985**	**66.740**	**98.195**	**103.121**	**93.553**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	6.250	9.128	8.160	8.410	8.804	8.464	6.904	9.368
Gaseous Fuels	0.428	0.571	0.869	0.476	0.536	0.777	0.914	1.197
Solid Fuels	68.014	58.905	53.170	55.389	37.591	41.917	35.065	34.071
Other Fuels	0.000	0.000	0.000	0.006	0.012	0.011	0.000	0.000
Biomass	17.567	17.000	17.100	17.106	17.113	19.053	19.010	19.017
TOTAL	**92.259**	**85.604**	**79.299**	**81.387**	**64.056**	**70.222**	**61.893**	**63.653**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	9.400	10.684	4.328	3.720	3.926	3.490	3.264	3.670
Gaseous Fuels	1.182	1.084	1.492	1.841	1.900	1.577	1.486	1.531
Solid Fuels	35.838	39.001	46.028	40.728	45.336	44.947	53.242	43.882
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	19.878	19.038	19.977	19.060	19.024	19.030	21.088	23.931
TOTAL	**66.298**	**69.807**	**71.825**	**65.349**	**70.186**	**69.044**	**79.080**	**73.014**

Figures 3.5.9.6 and 3.5.9.7 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.4.c in the period: 1988-2011.

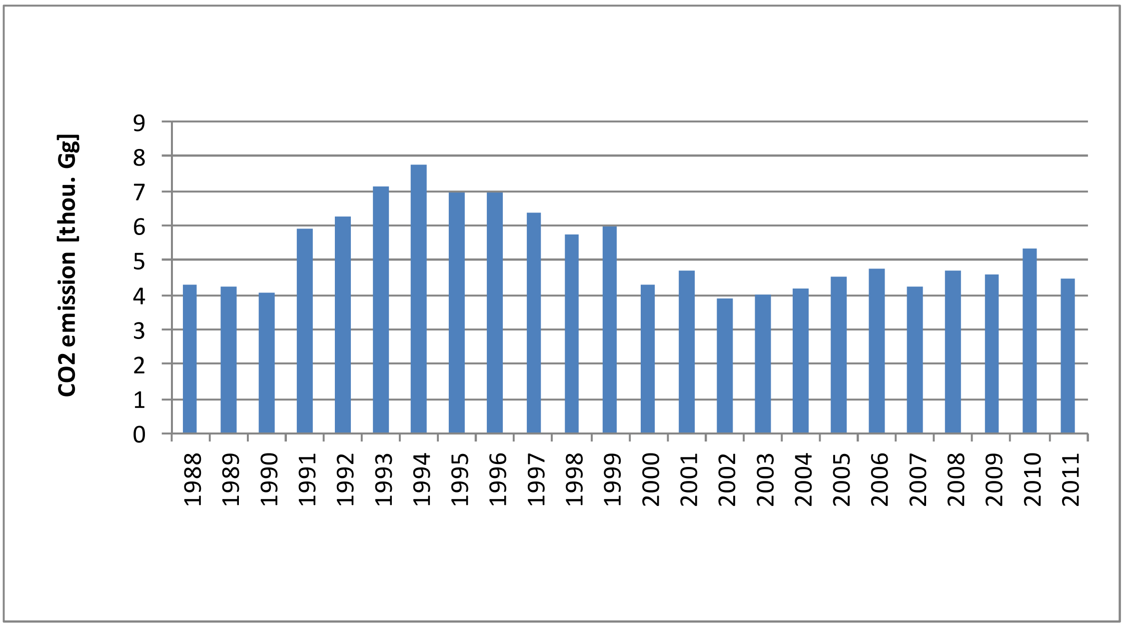

Figure 3.5.9.6. CO_2 emission for stationary sources in 1.A.4.c category in 1988-2011

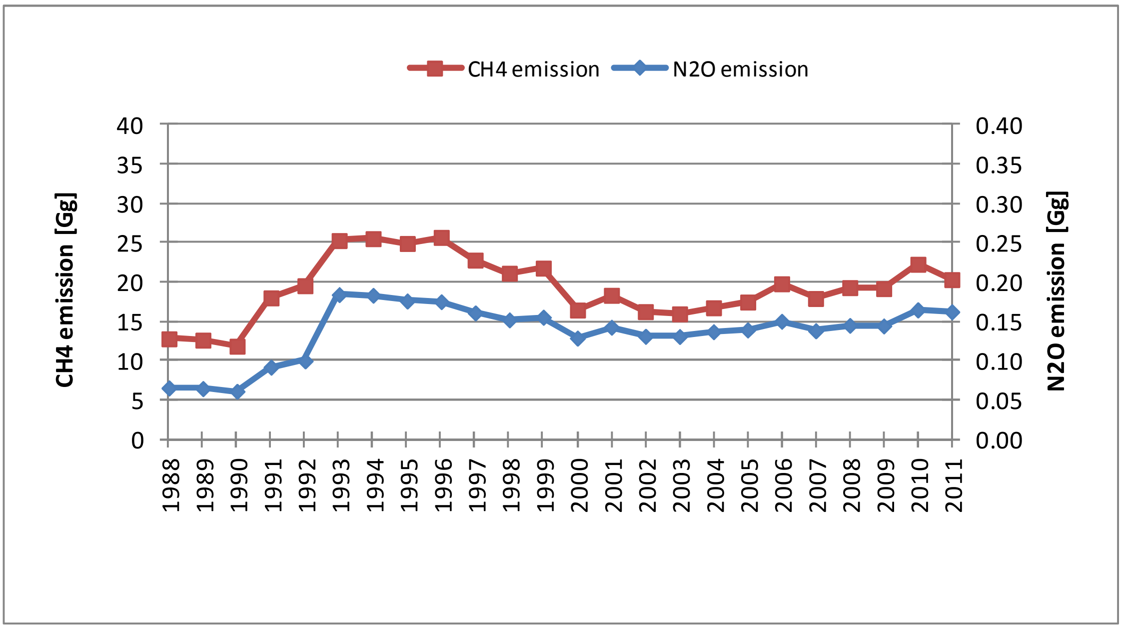

Figure 3.5.9.7. CH_4 and N_2O emissions for stationary sources in 1.A.4.c category in 1988-2011

The mobile sources classified in the sub-category 1.A.4.c (i.e. off-road vehicles and other machinery in agriculture and fishing) are described in chapter 3.2.8.2.6.

3.2.9.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.2.9.4. Source-specific QA/QC and verification

See chapter 3.2.6.4

3.2.9.5. Source-specific recalculations

- activity data on fuel consumption for years 1990-2010 were updated due to changes made in EUROSTAT database;
- for the entire reporting period CO_2 EF for combustion of non-biogenic fraction of municipal waste was corrected following the IPCC 2006 Guidelines [IPCC 2006], where EF= 91.70 kg CO_2/GJ;
- for the years 1990-2010 diesel oil consumed by road tractors used in agriculture (classified into 1.A.3 in Polish GHG inventory) was corrected; previously this consumption was covered by fuel attributed to agriculture sector; presently it was determined, that diesel oil use for mentioned purpose is included in fuel consumption in road transport what caused the increase activity and emission values in 1.A.4.c.ii subsector (oil consumed by road tractors used in agriculture is no longer subtracted from fuels use in agriculture sector – 1.A.4).

3.2.9.6. Source-specific planned improvements

- further developing of cooperation with institutions responsible for compilation of Polish energy balances in order to explain and verify time-trends of activity data in 1.A category;
- analysis of the possibility of country specific EF elaboration for the significant fuels in Polish fuel structure.

3.3. Fugitive emissions (CRF sector 1.B)

3.3.1. Fugitive emission from solid fuels (CRF sector 1.B.1)

3.3.1.1. Source category description

Fugitive emission from solid fuels involves emission from coal mining and handling (CH_4) and emission from coke oven gas subsystem (CO_2 and CH_4).

The biggest share of emission in 1.B category comes from coal mining and handling. The hard coal and lignite extraction are presented at the graph bellow (Figure 3.3.1). The main reason for the decreasing coal extraction since late 1980s was the declining demand for coal and lignite in economy.

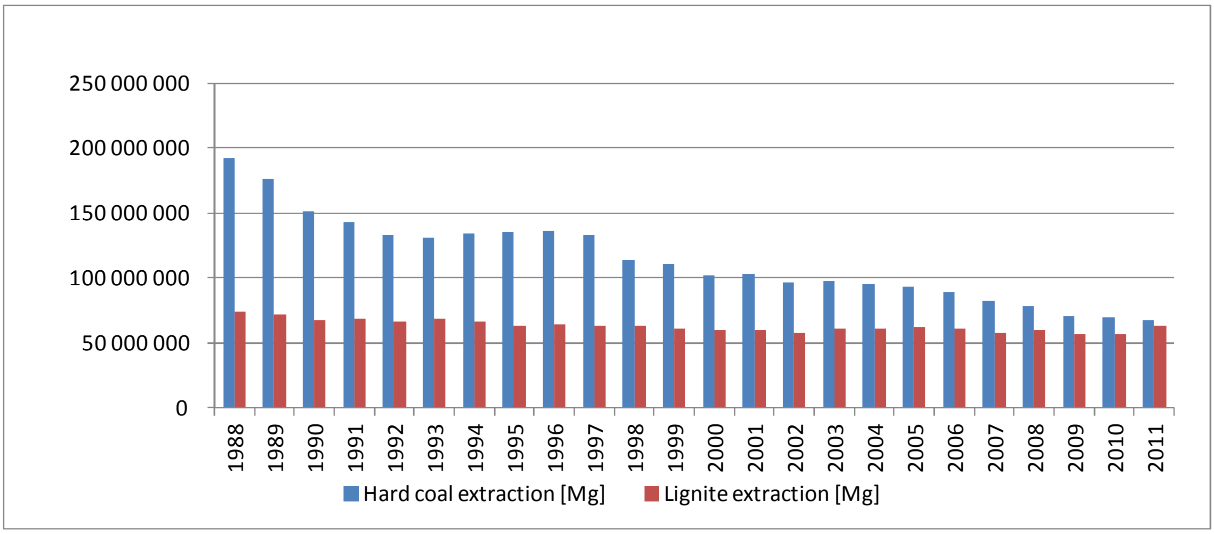

Figure 3.3.1. Hard coal and lignite extraction in 1988-2011.

3.3.1.2. Methodological issues

<u>3.3.1.2.1 Fugitive emissions from fuels – coal mining (CRF sector 1.B.1.a.)</u>

<u>Coal Mining and Handling – underground mines (1.B.1.a.i.)</u>

Two domestic studies [Gawlik et al., 1994, and Gawlik and Grzybek (G&G), 2001] provided estimates of domestic CH_4 emissions in the years 1992 and 1999, respectively. These estimates were made by detailed analysis of mine specific data. Based on these estimates domestic factors were derived for the following emission sources in underground hard coal mines:

- venting systems,
- methane capture systems,
- post-mining processes and
- production waste.

For the year 1999, annual emissions of closed mines were also estimated.

The set of Polish emissions factors used in the national inventory for the above listed emission sources are presented in table 3.8.1. This table includes results from more recent study: [Kwarciński et al. 2005] done in 2005, in which emission factors were estimated for the year 2003 – once again – based on detailed data and measurements. Also an in-depth analysis was carried out and the resulting EFs were compared with those from earlier studies. For the domestic inventory purposes emissions factors were calculated for one tonne of extracted coal. Data on coal extracted (see below) are publicly available e.g. in publications of the Polish Geological Institute [PIG, 2012].

Table 3.3.1. Domestically derived methane emission factors

Emissions sources	1992 data	1999 data	2003 data
	[Gawlik et al. 1994]	[Gawlik & Grzybek 2001]	[Kwarciński et al. 2005]
	Gg CH_4 /Mg extracted coal	Gg CH_4 /Mg extracted coal	Gg CH_4 /Mg extracted coal
venting systems	3.5235	4.1953	3.8868
methane capture systems	0.2912	0.3882	0.6651
post-mining processes	0.8690	0.6642	0.2873
production waste	0.0381	0.0413	0.0194
closed mines		0.0318	

After analysis, a selection of the respective EFs was made for: venting systems, methane capture systems, post-mining processes, production waste and closed mines for each year over the period: 1988-2010 based on the above mentioned three domestic studies. For the years 1988-1991, the 1992 EFs (Gawlik et. al. 1994) were applied. For the years 1993-1998 and 2000-2002, emission factors were calculated by linear interpolation of EFs from [Gawlik et. al. 1994], [Gawlik & Grzybek 2001] and [Kwarciński et al. 2005] following recommendation given in 7.3.2.2 of GPG2000. The estimation of 1999 CH_4 emissions from closed mines were applied to years: 2000-2011.

Table 3.3.2 shows data on hard coal extraction and total methane emissions from coal mines in 1988-2011. The total CH_4 emissions include estimates from: venting systems, methane capture systems, post-mining processes, production waste and closed mines.

Table 3.3.2. Hard coal extraction and total methane emissions from coal mines in 1988-2011

Year	**Hard coal extraction [Gg]**	**CH_4 Emissions [Gg]**
1988	191 624	782.22
1989	175 947	727.29
1990	151 321	622.67
1991	143 131	587.41
1992	132 730	545.70
1993	131 400	545.51
1994	134 078	583.46
1995	135 523	597.74
1996	136 272	608.79
1997	132 576	613.39
1998	113 859	540.60
1999	109 986	554.56
2000	102 081	521.28
2001	102 477	505.99
2002	96 160	469.68
2003	97 274	476.11
2004	95 623	468.09
2005	93 006	455.38
2006	89 342	437.57
2007	82 779	405.69
2008	77 989	382.41

2009	70 500	346.03
2010	69 186	339.66
2011	67 637	332.12

Coal Mining and Handling – surface mines (1.B.1.a.ii.)

Fugitive emission of CH_4 from surface mining was estimated based on the activity data concerning lignite extraction amount from the study published by Polish Geological Institute [PIG. 2012] and country specific emission factor, which was taken from the study [Radwański 1995]. The value of these emission factors are as follow:
- Ventilation emission from coal seam - 0.007 m^3 CH_4 / t of extracted lignite.
- Ventilation emission from surrounding rocks - 0.012 m^3 CH_4 / t of extracted lignite.
The conversion factor applied for recalculation of emitted methane volume to mass of CH_4 is 0.67 kg/m^3.

In table 3.3.3 are shown data on lignite extraction and total related methane emissions in 1988-2011.

Table 3.3.3. Lignite extraction and total methane emissions from lignite mines in 1988-2011.

Year	Lignite extraction [Gg]	CH_4 Emissions [Gg]
1988	73 970	0.94
1989	72 000	0.92
1990	67 680	0.86
1991	68 720	0.87
1992	66 900	0.85
1993	68 200	0.87
1994	66 780	0.85
1995	63 550	0.81
1996	63 850	0.81
1997	63 200	0.80
1998	62 880	0.80
1999	60 860	0.77
2000	59 490	0.76
2001	59 550	0.76
2002	58 240	0.74
2003	60 920	0.78
2004	61 190	0.78
2005	61 610	0.78
2006	60 850	0.77
2007	57 700	0.73
2008	59 500	0.76
2009	57 060	0.73
2010	56 520	0.72
2011	62 890	0.80

3.3.1.2.2. Fugitive emission from solid fuel transformation (1.B.1.b.)

Emissions from this subcategory was reported in 2.C.1.j. till the year 2010.

Processing emission of CO_2 from coking plants in the period 1990-2011 was estimated based on carbon budgets in the coking plants (tab. 3.3.4). Data concerning input and output are based on [Eurostat] and [GUS 1991a-2012a]. Coke productions for 1990-2011 were applied according to data in [Eurostat].

The Eurostat database does not cover energy balances for Poland for the years before 1990 so data on input and output in coking plants (i.e. coke output) applied for C balance in coke production process for the period: 1988-1989 were taken from IEA database [IEA].

The amounts of carbon in the input and output components used in C balances for entire period were calculated based on IPCC factors [IPCC 1997, IPCC 2006].

Fuels given as the input in C balance for coke production process (tab. 3.3.4) did not include the fuels for energy purpose of the process. Emission from coke production given in 1.A.1.c subcategory was related to the fuel consumption for energy purpose of the coke plants, so double counting should not be the case in GHG inventory.

CO_2 emission from coke production in Polish GHG inventory is split between two sub-categories and is reported under following sub-sectors:

- 1.A.1.c – includes the emission estimated based on fuel use, given in Eurostat database as *Consumption of the energy branch – Coke-oven and gas-works plants* (it means based on fuel consummated for own energy purpose)

- 2.C.1 – includes the emission calculated based on C balance (i.e. carbon emission = carbon content in transformation output – carbon content in transformation input)

CH_4 emission in the period 1990-2011 was estimated based on coke production volume from [Eurostat], while for 1988 and 1989 from [IEA]. For the entire period emission factor equal 0.5 kg CH_4/Mg coke produced [IPCC 1997; Workbook table 2-9] was applied.

Table 3.3.4. Carbon balance for coke production in years 1988-2011.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
INPUT [TJ]												
Coking coal	657996	639196	535538	448105	437665	405168	436596	451761	403902	423800	377787	338208
High Methane Natural Gas	0	1239	0	0	0	0	0	0	0	0	0	0
Coke			969	542	1767	1568	2394	2337	1824	1682	2109	1482
Blast furnace gas	0	152	0	0	0	0	0	0	0	0	0	0
Tar	390	306	0	0	0	0	0	0	0	0	0	0
Industrial waste	7	0	0									
NCV [MJ/kg]												
Coking coal	29.47	29.48	29.41	29.41	29.41	29.41	28.49	29.36	29.36	29.45	29.54	29.48
INPUT – Material-specific carbon content [kg C/GJ]												
Coking coal	26.02	26.02	26.02	26.02	26.02	26.02	26.06	26.03	26.03	26.02	26.02	26.02
High Methane Natural Gas	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Blast furnace gas	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Tar	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Industrial waste	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
INPUT – Carbon contents in charge components [Gg]												
Coking coal	17122.5	16633.2	13937.2	11661.8	11390.1	10544.3	11378.1	11757.8	10512.1	11028.5	9829.9	8800.9
High Methane Natural Gas	0.0	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coke	0.0	0.0	28.6	16.0	52.1	46.3	70.6	68.9	53.8	49.6	62.2	43.7
Blast furnace gas	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tar	8.6	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial waste	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carbon contents in charge – SUM [Gg]	**17131.4**	**16668.9**	**13965.7**	**11677.7**	**11442.2**	**10590.6**	**11448.7**	**11826.7**	**10565.9**	**11078.2**	**9892.1**	**8844.6**
OUTPUT [TJ]												
Coke	471498.3	455828.6	385206.0	323646.0	315381.0	292838.0	326468.0	329973.0	294662.0	300248.0	277761.0	238488.0
Coke-Oven Gas	118914.6	117040.4	96832.0	84743.0	82307.0	75753.0	84002.0	84767.0	76036.0	79286.0	73457.0	62989.0
Tar	27580.0	27429.3	22885.3	20268.2	20648.1	19071.4	21146.6	21265.0	19831.9	19600.4	17949.6	16264.8
Benzol	7701.5	7230.9	6166.9	5150.7	5646.2	5159.1	6010.6	6056.5	5446.7	5428.6	4856.9	4524.7
OUTPUT – Material-specific carbon content [kg C/GJ]												
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Coke-Oven Gas	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Tar	22	22	22	22	22	22	22	22	22	22	22	22
Benzol	23	23	23	23	23	23	23	23	23	23	23	23
OUTPUT – Carbon content in products [Gg]												
Coke	13909.2	13446.9	11363.6	9547.6	9303.7	8638.7	9630.8	9734.2	8692.5	8857.3	8193.9	7035.4
Coke-Oven Gas	1545.9	1521.5	1258.8	1101.7	1070.0	984.8	1092.0	1102.0	988.5	1030.7	954.9	818.9
Tar	606.8	603.4	503.5	445.9	454.3	419.6	465.2	467.8	436.3	431.2	394.9	357.8
Benzol	177.1	166.3	141.8	118.5	129.9	118.7	138.2	139.3	125.3	124.9	111.7	104.1
Carbon content in products – SUM [Gg]	**16239.0**	**15738.2**	**13267.7**	**11213.6**	**10957.9**	**10161.7**	**11326.3**	**11443.3**	**10242.6**	**10444.1**	**9655.5**	**8316.1**
C process emission[Gg]	**892.4**	**930.7**	**698.0**	**464.2**	**484.3**	**428.8**	**122.4**	**383.4**	**323.3**	**634.1**	**236.6**	**528.4**
CO_2 process emission[Gg]	**3272.1**	**3412.6**	**2559.5**	**1701.9**	**1775.9**	**1572.4**	**448.8**	**1405.9**	**1185.5**	**2324.9**	**867.5**	**1937.6**
Coke output [Gg]	17007	16499	13516	11356	11066	10275	11455	11578	10339	10535	9746	8368
EF [kg CO_2/Mg of coke]	**192**	**207**	**189**	**150**	**160**	**153**	**39**	**121**	**115**	**221**	**89**	**232**

Table 3.3.4. (cont.) Carbon balance for coke production in years 1988-2011.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
INPUT [TJ]												
Coking coal	366814	362343	353752	410854	405806	335694	383094	405666	392453	277057	383177	366592
High Methane Natural Gas	0	0	0	0	0	0	0	0	0	0	0	0
Coke	2024	1055	1710	1568	1710	2138	2366	2651	3050	1938	3021	2964
Blast furnace gas	0	0	0	0	0	0	0	0	0	0	0	0
Tar	0	0	0	0	0	0	0	0	0	0	0	0
Industrial waste											3.5	
NCV [MJ/kg]												
Coking coal	29.62	29.53	29.53	29.56	29.55	29.51	29.59	29.50	29.57	29.56	29.49	29.52
INPUT – Material-specific carbon content [kg C/GJ]												
Coking coal	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.0
High Methane Natural Gas	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Blast furnace gas	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Tar	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Industrial waste	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
INPUT – Carbon contents in charge components [Gg]												
Coking coal	9543.2	9428.2	9204.6	10689.9	10558.7	8735.0	9967.2	10555.8	10211.0	7208.7	9970.8	9538.8
High Methane Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coke	59.7	31.1	50.4	46.3	50.4	63.1	69.8	78.2	90.0	57.2	89.1	87.4
Blast furnace gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial waste	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Carbon contents in charge – SUM [Gg]	**9602.9**	**9459.3**	**9255.1**	**10736.2**	**10609.1**	**8798.1**	**10037.0**	**10634.0**	**10301.0**	**7265.9**	**10060.1**	**9626.3**
OUTPUT [TJ]												
Coke	255702.0	254961.0	248606.0	288192.0	287765.0	239514.0	273971.0	289788.0	287138.0	202094.0	280554.0	267245.0
Coke-Oven Gas	68849.0	69008.0	65570.0	75091.0	72947.0	61947.0	71712.0	76950.0	73935.0	53376.0	73008.0	69642.0
Tar	17003.0	17232.6	16462.6	18188.1	17417.0	14590.0	16211.0	17342.0	15721.0	11838.0	16475.0	15269.0
Benzol	2498.5	4788.6	4474.8	5253.3	5358.3	4403.2	3803.7	5315.6	4711.9	3373.4	4892.6	4518.8
OUTPUT – Material-specific carbon content [kg C/GJ]												
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Coke-Oven Gas	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Tar	22	22	22	22	22	22	22	22	22	22	22	22
Benzol	23	23	23	23	23	23	23	23	23	23	23	23
OUTPUT – Carbon content in products [Gg]												
Coke	7543.2	7521.3	7333.9	8501.7	8489.1	7065.7	8082.1	8548.7	8470.6	5961.8	8276.3	7883.7
Coke-Oven Gas	895.0	897.1	852.4	976.2	948.3	805.3	932.3	1000.4	961.2	693.9	949.1	905.3
Tar	374.1	379.1	362.2	400.1	383.2	321.0	356.6	381.5	345.9	260.4	362.5	335.9
Benzol	57.5	110.1	102.9	120.8	123.2	101.3	87.5	122.3	108.4	77.6	112.5	103.9
Carbon content in products – SUM [Gg]	**8869.8**	**8907.7**	**8651.4**	**9998.8**	**9943.8**	**8293.2**	**9458.5**	**10052.9**	**9886.0**	**6993.7**	**9700.4**	**9228.9**
C process emission[Gg]	**733.2**	**551.6**	**603.7**	**737.4**	**665.3**	**504.9**	**578.4**	**581.2**	**415.0**	**272.2**	**359.7**	**397.4**
CO_2 process emission[Gg]	**2688.3**	**2022.6**	**2213.4**	**2703.8**	**2439.6**	**1851.2**	**2120.9**	**2130.9**	**1521.8**	**998.1**	**1318.7**	**1457.0**
Coke output [Gg]	8972	8946	8723	10112	10097	8404	9613	10168	10075.0	7091	9844	9377
EF [kg CO_2/Mg of coke]	**300**	**226**	**254**	**267**	**242**	**220**	**221**	**210**	**151**	**141**	**134**	**155**

3.3.1.2.3. Fugitive emissions from fuels – coke oven gas (CRF sector 1.B.1.c)

Tier 1 method has been used for calculation of fugitive emissions from coke oven gas system [IPCC 2000] while emission factors presented in table 3.3.5. have been taken from domestic case study [Steczko 1994]. Activity data for 1990-2011 come from [EUROSTAT]. For years: 1988-1989 the activity data come from [IEA] database.

Table 3.3.5. Emission factors for CO_2 and CH_4 from coke oven gas system.

Gas system	**Emission factors [Gg/PJ]**
CO_2	
gas processing	0.000194
gas transmission	0.020629
gas distribution	0.038056
CH_4	
gas processing	0.000546
gas transmission	0.057977
gas distribution	0.106954

For coke-oven gas subsystem there is no possibility to add activity data in PJ in the CRF Reporter database, but only in Gg. This conversion into Gg was done only for CRF Reporter purposes (emission is estimated on the PJ activity data basis) the mentioned change has no impact on emissions.

3.3.1.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.3.1.4. Source-specific QA/QC and verification

QA/QC and verification are integral parts of the inventory and has been elaborated in line with the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories(2000)*.
Activity data used in the GHG inventory concerning sector 1.B.1 come from Eurostat database which is fed by the Central Statistical Office (GUS) and from Polish Geological Institute - National Research Institute (PIG-PIB). GUS and PIG-PIB are responsible for QA/QC of collected and published data. Activity data applied in GHG inventory are regularly checked and updated if necessary according to adjustments made in Eurostat database.
Generally QC procedures follow QA/QC plan presented in Annex 5.

3.3.1.5. Source-specific recalculations

Emission from Coke Production has been removed from sub-category 2.C.1.j into 1.B.1.b.

3.3.1.6. Source-specific planned improvements

Analysis for possibility of updating the emission factors for the systems of coke-oven gas.

3.3.2. Fugitive emissions from oil and natural gas (CRF sector 1.B.2)

3.3.2.1. Source category description

Fugitive emission from oil and gas include fugitive emissions from production, transport and refining of oil, from production, processing, transmission, distribution and underground storage of gas as well as from venting and flaring of gas and oil.

3.3.2.2. Methodological issues

3.3.2.2.1 Fugitive emissions from fuels – oil (CRF sector 1.B.2.a)

Tier 1 method has been used for calculation of fugitive emissions from oil system [IPCC 2000]. Activity data come from [EUROSTAT]. For years: 1988-1989 the activity data come from [IEA] database.

Table 3.3.6. Activity data for emission from oil system.

Year	Production [PJ]	Production [Gg]	Import [Gg]	Transport [Gg]	Input to oil refineries [PJ]
1988	6,58	159	14 989	15 148	618.65
1989	6.48	157	14 725	14 882	628.43
1990	6.74	160	13 126	13 286	541.29
1991	6.66	158	11 454	11 612	494.50
1992	8.49	200	13 052	13 252	557.96
1993	9.96	235	13 674	13 909	566.70
1994	12.04	284	12 721	13 005	570.26
1995	12.37	292	12 957	13 249	569.38
1996	13.41	317	14 026	14 343	617.52
1997	12.25	289	14 713	15 002	630.96
1998	15.28	360	15 367	15 727	679.88
1999	18.44	434	16 022	16 456	710.35
2000	27.82	653	18 002	18 655	778.58
2001	32.70	767	17 558	18 325	765.73
2002	30.99	728	17 942	18 670	757.04
2003	32.56	765	17 448	18 213	743.06
2004	37.78	886	17 316	18 202	772.60
2005	36.19	848	17 912	18 760	775.14
2006	33.98	796	19 813	20 609	855.68
2007	30.74	721	20 885	21 606	857.63
2008	32.20	755	20 787	21 542	887.32
2009	29.33	687	20 098	20 785	866.70
2010	29.31	687	22 688	23 375	974.43
2011	26.26	617	23 792	24 409	1021.41

CO_2 and CH_4 factors used for estimation of emissions from oil production have been taken from country study [Żebrowski 1994] while for oil transmission and refining default factors were used from [IPCC 2000] (tab. 3.3.7).

Table 3.3.7. Emission factors for CO_2 and CH_4 from oil production and transmission.

Oil system	Emission factors
CO_2	
production [Gg/PJ]	6.3150
transmission [Gg/m^3]	0.00049
CH_4	
production [Gg/PJ]	0.0618
transmission [Gg/m^3]	0.0054
refining [Gg/PJ]	0.0007

3.3.2.2.2 Fugitive emissions from fuels – natural gas (CRF sector 1.B.2.b).

Estimation of CO_2 and CH_4 emissions from systems of high-methane and nitrified natural gases was carried out based on *Tier 1* method [IPCC 2000]. Activity data for 1990-2011 come from [EUROSTAT]. For years 1988-1989 activity data come from [IEA] database. Activity data are given in table 3.3.8.

Table 3.3.8. Activities for natural gas system [TJ]

Year	Production [TJ]	Total consumption [TJ]
1988	156 573	405 930
1989	144 980	398 477
1990	99 559	374 206
1991	111 294	348 944
1992	107 174	324 987
1993	136 948	341 385
1994	129 763	343 987
1995	132 689	376 592
1996	131 473	395 454
1997	134 150	394 289
1998	136 013	398 345
1999	129 883	387 833
2000	138 724	416 993
2001	146 204	434 447
2002	149 433	423 419
2003	151 197	471 462
2004	164 428	497 416
2005	162 630	512 234
2006	162 463	526 764
2007	163 147	523 124
2008	154 487	526 109
2009	153 980	505 027
2010	154 617	536 108
2011	161 186	537 434

Emission factors for both gas systems were taken from country study [Steczko K. 1994] for production. processing and distribution and from [Steczko 2003] for transmission and underground storage (only CH_4) and are listed in tables 3.3.9. and 3.3.10.

Table 3.3.9. Emission factors for CO_2 and CH_4 from high-methane gas system.

Gas system	Emission factors [Gg/PJ]
CO_2	
Gas production	0.000402
Gas processing	0.014368
Gas transmission	0.000558
Underground gas storage	0.000011
Gas distribution	0.001234
CH_4	
Gas production	0.100848
Gas processing	0.000004
Gas transmission	0.055135
Underground gas storage	0.001433
Gas distribution	0.309945

Table 3.3.10. Emission factors for CO_2 and CH_4 from nitrified natural gas system.

Gas system	Emission factors [Gg/PJ]
CO_2	
Gas production	0.000060
Gas processing	0.051321
Gas transmission	0.000192
Gas distribution	0.000558
CH_4	
Gas production	0.034307
Gas processing	0.101227
Gas transmission	0.035733
Gas distribution	0.317671

3.3.2.2.3 Fugitive emissions from fuels – Venting and Flaring (CRF sector 1.B.2.c)

Venting and Flaring in oil subsystem

CO_2 emission from venting and N_2O emission from flaring were calculated in oil subsystem. Emission factors for both emissions were taken default from [IPCC 2000].

CO_2 EF from venting:	$1.2*10^{-5}$	$Gg/10^3m^3$
N_2O EF from flaring:	$6.4*10^{-7}$	$Gg/10^3m^3$

Extraction of oil is used as activity data and is in accordance with whole oil subsystem. Other emissions from venting and flaring in oil subsystem are included in 1.B.2.a.

CO_2 process emission from refineries and flaring was included into sub-category 1.B.2.C.2. This emission were estimated based on the verified reports for refineries. which participate in EU ETS [KOBiZE 2011]. These values amounted to: 1553.6 Gg for 2011. 991.9 Gg for 2010. 1093.0 Gg for 2009. 1091.6 Gg for 2008. 956.5 Gg for 2007. 1143.1 Gg CO_2 in 2006 and 1082.3 Gg CO_2 in 2005. respectively. CO_2 emission from refineries reported as process emission mainly resulted from the following processes: hydrogen production. regeneration of catalysts and after-burning gases from asphalt production.

Flaring in natural gas subsystem

N_2O emissions from flaring in gas extraction and consumption were calculated in natural gas subsystem. Emission factors for those emissions were taken default from [IPCC 2000].

N_2O EF from flaring in gas extraction:	$2.1*10^{-8}$	$Gg/10^6m^3$
N_2O EF from flaring in gas consumption:	$5.4*10^{-8}$	$Gg/10^6m^3$

Extraction and consumption of natural gas are used as activity data and are in accordance with whole natural gas subsystem. Other emissions from venting and flaring in natural gas subsystem are included in 1.B.2.b.

3.3.2.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.3.2.4. Source-specific QA/QC and verification

See chapter 3.3.1.4.

3.3.2.5. Source-specific recalculations

Emission from flaring in oil subsystem has been removed from subsector 2.G into sub-category 1.B.2.C.2.

3.3.2.6. Source-specific planned improvements

Analysis for possibility of updating the emission factors for the systems of natural gas.

4. INDUSTRIAL PROCESSES (CRF SECTOR 2)

4.1. Source category description

Following categories from sector 2 have been identified as key sources (excluding LULUCF):

2.A.1 - Cement Production (CO_2 emission), share in total GHG emission	1.8%
2.B.1 - Ammonia Production (CO_2 emission), share in total GHG emission	1.0%
2.C.1 - Iron and Steel Production (CO_2 emission), share in total GHG emission	1.4%
2.F.1 - Refrigeration and Air Conditioning Equipment (HFC emission), share in total GHG emission	1.5%

Share of these categories in total Poland's GHG emissions is 5.7%.

Figure bellow shows GHG emission trend in *Industrial processes* sector.

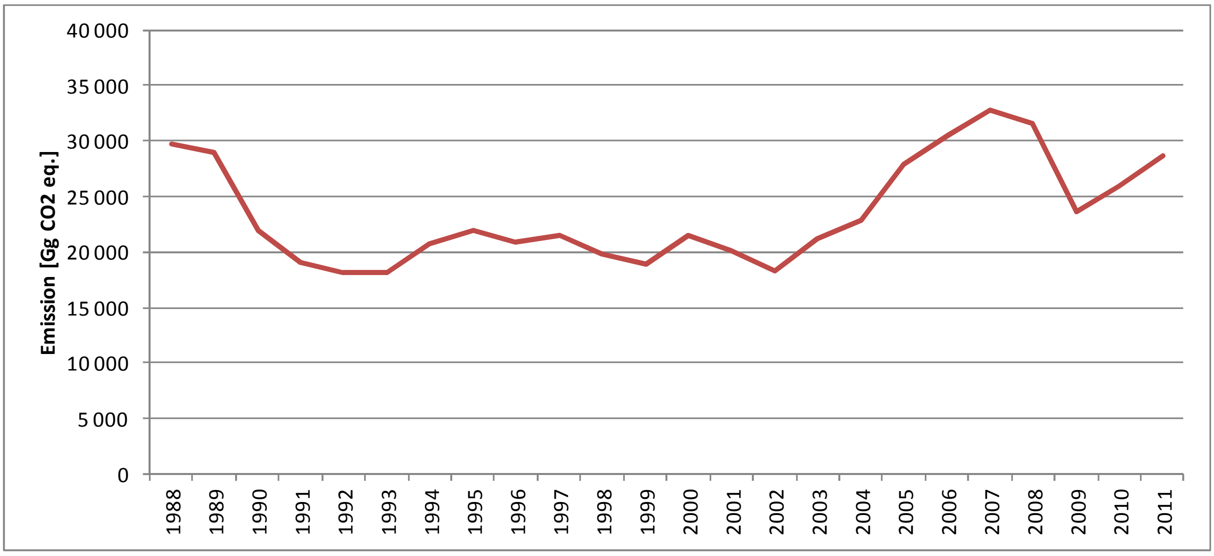

Figure 4.1.1. Emission trend in *Industrial processes* sector in period 1988 – 2011

Figure 4.1.2 shows GHG emissions according to subcategories of sector 2:

- 2.A. Mineral Products
- 2.B. Chemical Industry
- 2.C. Metal Production
- 2.D. Other Production
- 2.E. Production of halocarbons and SF_6
- 2. F. Consumption of halocarbons and SF_6
- 2.G. Other.

For estimation of the 2011 emission in sector 2. *Industrial Processes,* CO_2 process emission data were used from installations which take part in the EU ETS. Emissions based on such data were estimated in the following subcategories:

– subcategory 2.A. *Mineral Products*: 2.A.1. *Clinker Production*, 2.A.3. *Limestone and Dolomite Use* and from subcategory 2.A.7. *Other*: *Glass Production*, *Ceramics materials production*

- subcategory 2.C. *Metal Production*: processes included into *Iron and Steel Production* (2.C.1) such as: sinter production, pig iron production, steel production in basic oxygen process, steel production in electric arc furnace process
- subcategory 2.D. *Other Production*: 2.D.1. *Pulp and Paper*
- subcategory 2.G. *Other* – this subcategory includes data containing CO_2 process emissions from installations which take part in emission trading scheme that cannot be included in subcategory 2.A-2.F; for example emissions from refineries (process emissions, discharges and flaring)

Emissions in individual subcategories in period 1988 – 2011 are shown in figure 4.1.2

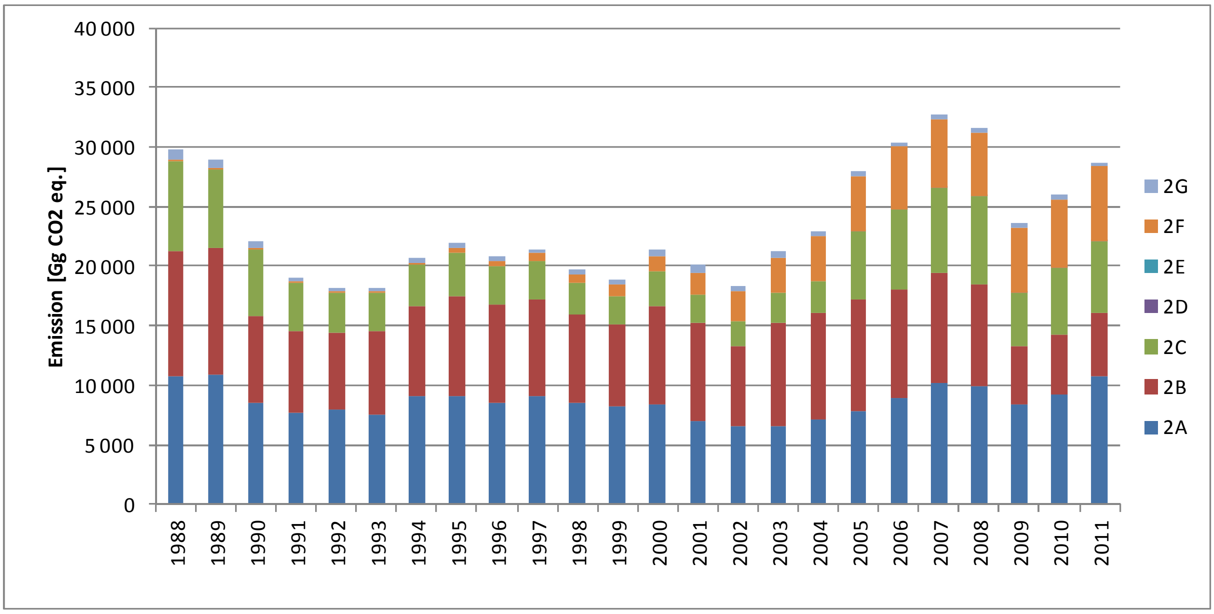

Figure 4.1.2. GHG emissions from *Industrial processes* in 1988-2011 according to subcategories

4.2. Mineral Products (CRF sector 2.A)

4.2.1. Source category description

Estimation of emissions in 2.A. *Mineral products* is carried out in sub-categories listed below:

a) *Cement Production* (2.A.1)
b) *Lime Production* (2.A.2)
c) *Limestone and Dolomite Use* (2.A.3)
d) *Soda Ash Production and Use* (2.A.4)
e) *Other* (2.A.7)

Subsector 2.A.1. *Cement Production* is by far the largest contributor to emissions from this category (see figure 4.2.1) – about 69% in 2011.

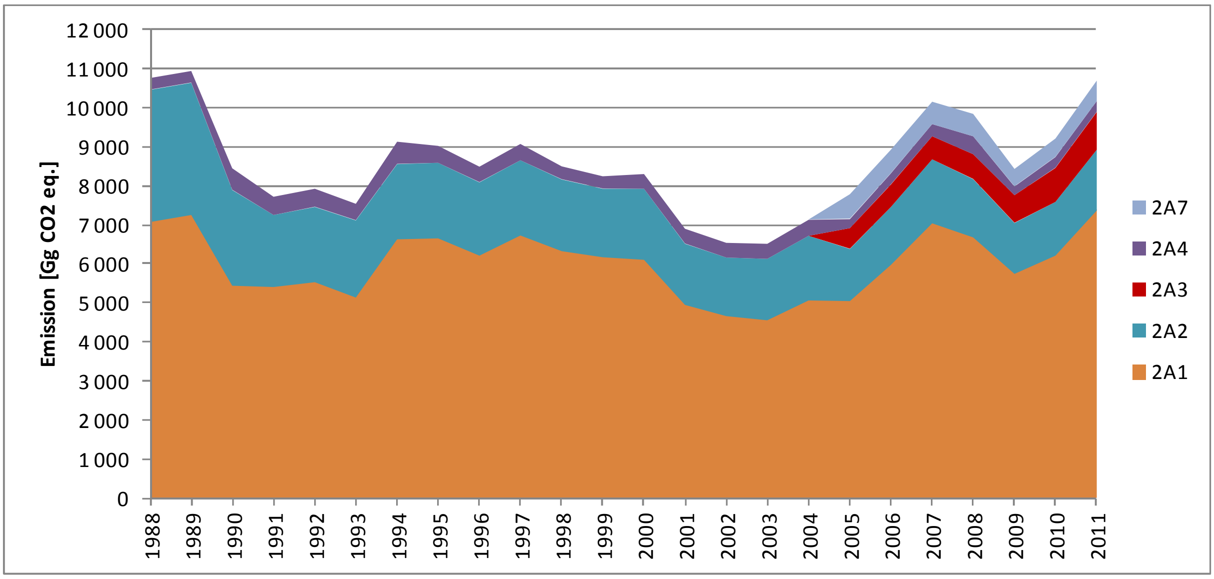

Figure 4.2.1. Emissions from *Mineral Products* sector in years 1988-2011 according to subcategories.

4.2.2. Methodological issues

4.2.2.1. Cement Production (CRF sector 2.A.1)

CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2011 for installation of clinker production, which participate in the EU ETS [KOBiZE 2012]. This emission was estimated as 7379.4 Gg CO_2. Data on clinker production was taken from [GUS 2012b].

The clinker production in period 1988-2011 is shown on figure 4.2.2. Data on clinker production for the entire inventoried period was taken from [GUS 1989b-2012b].

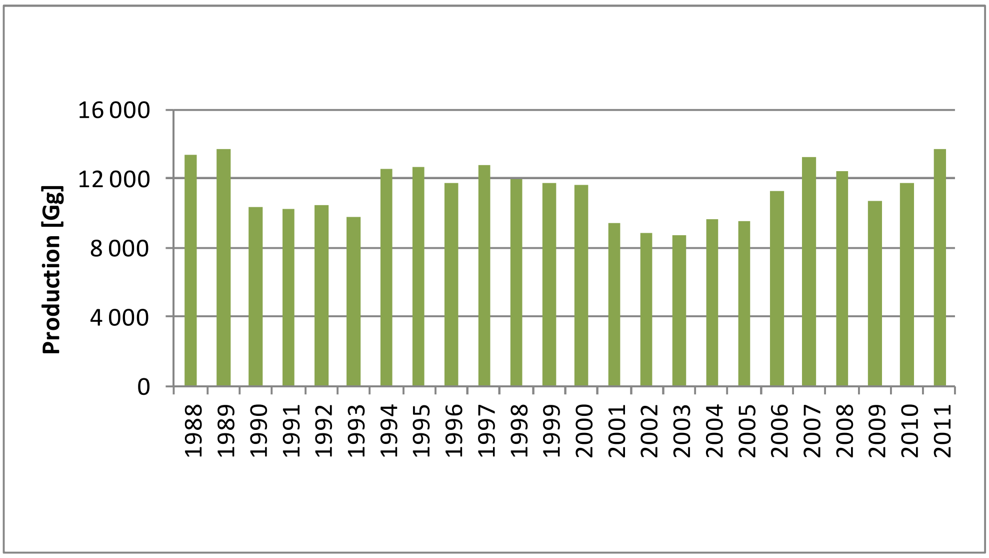

Figure 4.2.2. Clinker production in 1988-2011

CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2011 for installations which participate in EU ETS. For other years emissions were estimated based on clinker production and emission factors. Emission factors which were used to estimate CO_2 process emissions from subcategory 2.A.1 are given bellow:

- for years: 1988-2000 – emission factor equal 529 kg CO_2/Mg of clinker – average from country specific factors for years: 2001-2004 (2001 – 531 kg CO_2/Mg, 2002 – 530 kg CO_2/Mg, 2003 – 528 kg CO_2/Mg, 2004 – 527 kg CO_2/Mg)
- for years: 2001-2004 - country specific factors (given above) from [IMMB 2006].

CO_2 emissions from clinker production in period 1988-2010 are shown on figure 4.2.3.

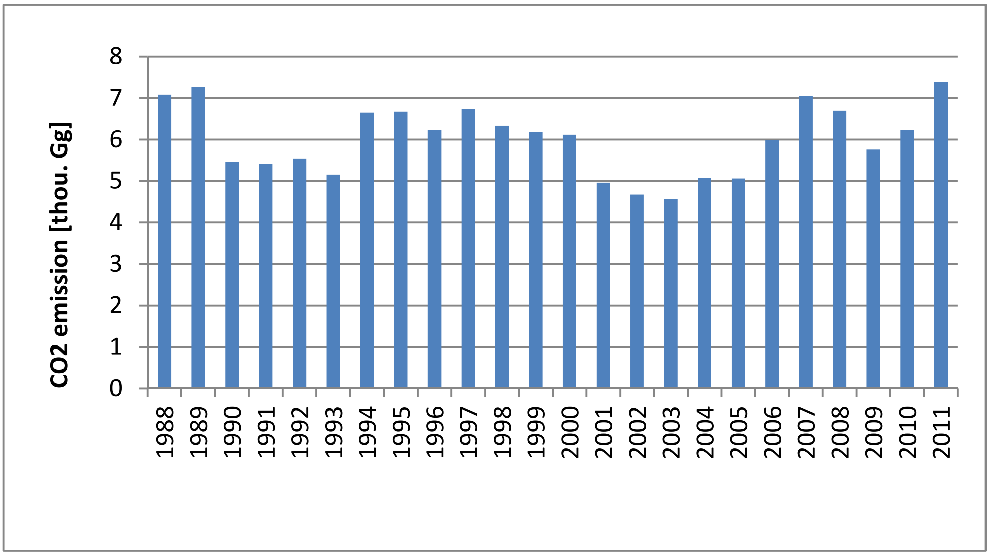

Figure 4.2.3. CO_2 process emission for clinker production in 1988-2011

4.2.2.2. Lime Production (CRF sector 2.A.2)

Emission of CO_2 from lime production was calculated based on data on lime production from [GUS 2011b]. The applied emission factor is estimated according to IPCC recomendations [IPCC 2000] as following:

$$EF = (0.85 * 0.75 + 0.15 * 0.86) * 1000 = 767 \text{ kg } CO_2/\text{Mg of lime.}$$

Data about production was taken from statistical yearbooks [GUS 1989b-2012b] – for entire period (figure 4.2.4). The same value of emission factor equal 767 kg CO_2/Mg of lime was used for all years. CO_2 emissions in period 1988-2011 are shown on figure 4.2.5.

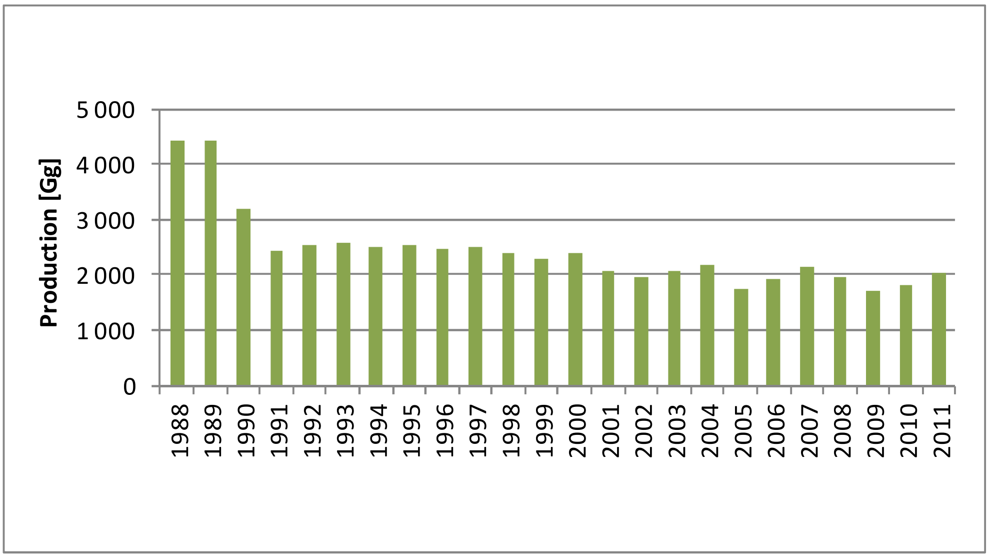

Figure 4.2.4. Lime production in 1988-2011

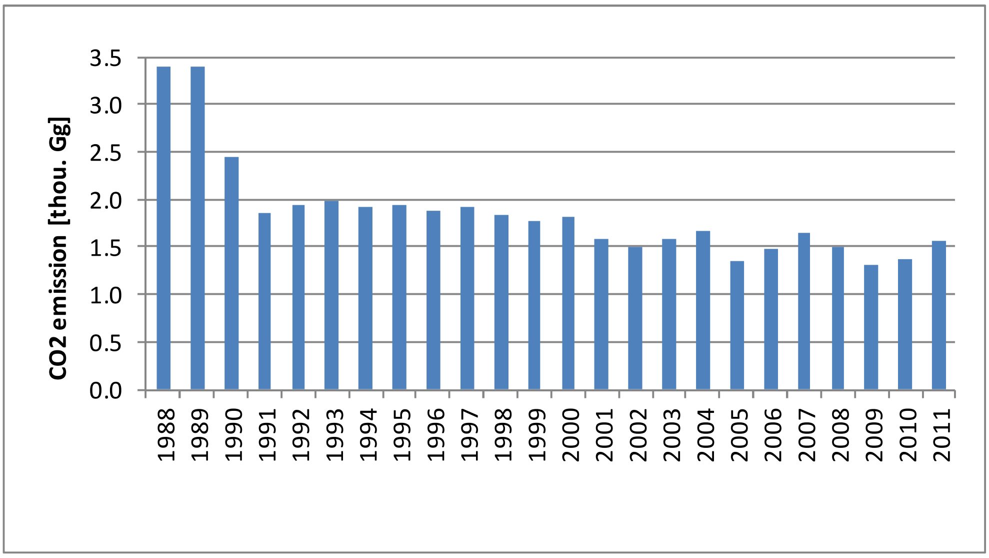

Figure 4.2.5. CO_2 process emission for lime production in 1988-2011

4.2.2.3. Limestone and Dolomite Use (CRF sector 2.A.3)

In this subcategory there were used only emissions from limestone and dolomite use in sulphur removal installations in power industry installation that participate in EU ETS. Emissions for this subcategory in GHG inventory correspond to emissions from the EU ETS verified reports. For 2011 the emission value was 972.1 Gg, for 2010: 873.6 Gg, for 2009: 706.7, for 2008: 634.9 Gg CO_2, for 2007: 590.3 Gg CO_2, for 2006: 580.0 Gg CO_2, and for 2005 it was 531.4 Gg CO_2. It should be noted that this emission constitutes only part of total emission from limestone and dolomite use. The rest of it was included into other categories where these minerals are used. These other categories include inter alia: metal production (iron ore sinter production, pig iron in blast furnace, steel production, casting), mineral industry (glass and ceramics production). CO_2 emission values from limestone and dolomites use in 2011 in other categories mentioned above were as follows:

- from iron ore sinter production: 414.9 Gg
- from pig iron and steel production: 7.3 Gg
- from steel cast production: 6.8 Gg
- from glass production: 183.0 Gg
- from ceramics production: 37.1 Gg (part of this CO_2 emission comes from calcium and magnesium carbonates but included in other minerals than limestone and dolomite e.g. in clay, loam, basalt)
- from paper production: 8.1 Gg

CO_2 emission from limestone and dolomite use according to information given above was estimated for 2011 at approximately 1630 Gg (including the emissions from calcium and magnesium carbonates that were included in other minerals than limestone and dolomite).

CO_2 emissions concerning limestone and dolomite use in production of glass, ceramics and paper includes only the emission from installations covered by EU ETS.

Apart from carbonates of calcium and magnesium, the other carbonates were also used in glass and ceramics production. CO_2 emissions from those carbonates were included in subcategories 2.A.7.

4.2.2.4. Soda Ash Production and Use (CRF sector 2.A.4)

In Poland, soda ash is produced in the Solvay Process. Emission of CO_2 from this process was assumed as 0. CO_2 emission from soda ash use was estimated based on assumption that amount of soda ash used is equal to soda ash production. Data on soda ash production was taken from [GUS 2012e]. Value of emission factor taken for inventory calculation it is 415 kg CO_2/Mg of soda ash used. This emission factor is recommended in [IPCC 1997].

For the entire period: 1988-2011 data on soda ash production from G-03 reports and default emission factor 415 kg CO2/Mg of soda ash used were applied for CO_2 emission estimations (figure 4.2.6). For the years 2005-2011, emissions of CO_2 from soda carbonates included in other subcategories (2.A.7 and 2.D) were subtracted from sub-sector 2.A.4. These subtracted CO_2 emission values are following: for 2011: 182.0, for 2010: 164.7 Gg, for 2009: 148.4 Gg, for 2008: 137.4 Gg, for 2007: 187.3 Gg, for 2006: 144.2 Gg and for 2005: 184.8 Gg . Activity data were reduced respectively to subtracted emission as well.

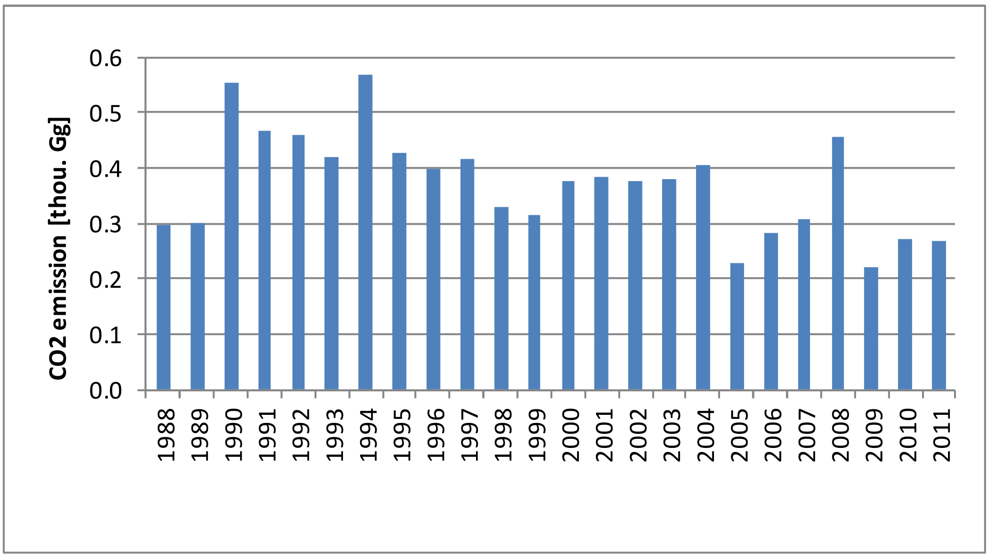

Figure 4.2.6. CO_2 emission from soda ash use and production in 1988-2011 (excluding soda ash use accounted in glass, ceramics and paper productions)

4.2.2.5. Production of Other Mineral Products (CRF sector 2.A.7)

- *Glass production*

CO_2 emission from glass production was taken from the verified reports for 2011 for installation of glass and glass wool production, which participate in the emission trading scheme [KOBIZE 2012]. In 2011 this emission amounted to 365.5 Gg. In 2010 emission taken from the verified reports for installations participating in the emission trading scheme was 304.2 Gg, for 2009: 273.4 Gg, for 2008: 344.9 Gg CO_2, 350.1 Gg CO_2, for 2007, 339.2 Gg for 2006 while 343.5 Gg CO_2 in 2005. For years 1988-2004 this emission was not estimated.

- *Ceramics materials production*

CO_2 emission from production of ceramics materials was calculated based on the verified reports for 2011 for installation of ceramics production, which participate in EU ETS [KOBIZE 2012]. This emission value was equal to 166.1 Gg. For the years 2005-2010, the emissions were also taken from the verified reports for installations participating in EU ETS and amounted as follows: 172.4 Gg for 2010, 169.1 Gg CO_2 for 2009, 228.2 Gg CO_2 for 2008, 228.5 Gg CO_2 for 2007, 260.9 Gg CO_2 for 2006 and 284.7 Gg CO_2 for 2005. For years: 1988-2004 the emissions in this subcategory were not estimated.

4.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2011 for IPCC sector *2.Industrial processes* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6.
Recalculation of data for years 1988-2010 ensured consistency for whole time-series.

2011	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
2. Industrial Processes	**21 029.08**	**14.56**	**3.49**	6.1%	16.8%	29.5%
A. Mineral Products	10 711.41			11.1%		
B. Chemical Industry	3 968.60	12.90	3.43	7.1%	19.0%	30.1%
C. Metal Production	6 006.06	1.66	0.06	6.5%	10.1%	20.5%
D. Other Production	8.20			5.0%		
G. Other	334.81			5.0%		

4.2.4. Source-specific QA/QC and verification

Activity data used in the GHG inventory concerning industry sector come from yearbooks published by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. Data on selected production is compared to data collected from installations/entities covered by the EUETS. Depending on type of emission factor and *Tier* method applied in the GHG inventory, EF is compared with plant specific emission factor or the default one, respectively.

Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE). Additionally data on industrial production is compared with public statistics in case where entire sector is covered by EUETS.
Calculations in industry sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

4.2.5. Source-specific recalculations

- for the year 2009 lime production value was corrected based on updated statistical data [GUS 2012b], what resulted in CO2 emission decrease by 9.5 Gg in subcategory 2.A.2

4.2.6. Source-specific planned improvements

- Continuation of actions related to collection of more detailed information on the type of input materials used in lime production.
- Further attempt to complete CO_2 process emission data from glass and ceramics production in the period 1988-2004
- Further development of methodology of EU ETS data implication in GHG inventory

4.3. Chemical Industry (CRF sector 2.B)

4.3.1. Source category description

Estimation of emissions in 2.B. *Chemical Industry* are carried out in sub-categories listed below:

a) *Ammonia Production* (2.B.1)
b) *Nitric Acid Production* (2.B.2)
c) *Adipic Acid production* (2.B.3)
d) *Carbide Production* (2.B.4)
e) *Other* (2.B.5)

Subsectors 2.B.1. *Ammonia Production* is the largest contributors to emissions from this category (see figure 4.3.1) – over 79% in 2011. Adipic acid was produced up to 1994.

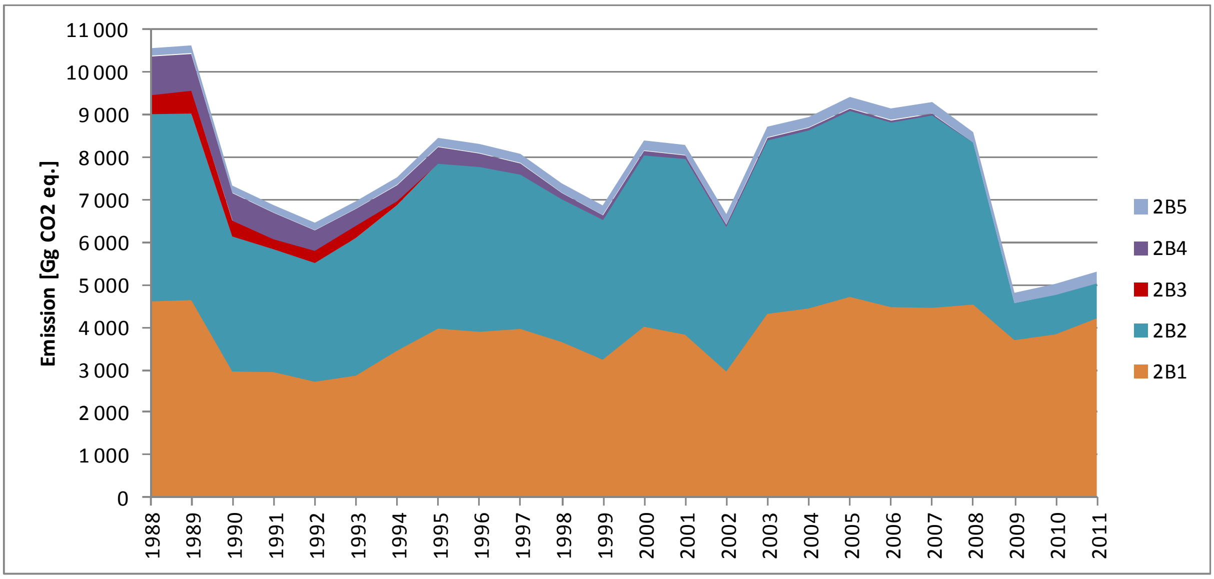

Figure 4.3.1. Emissions from *Chemical Industry* category in years 1988-2011 according to subcategories

4.3.2. Methodological issues

4.3.2.1. Ammonia Production (CRF sector 2.B.1)

CO_2 emissions for ammonia production are estimated based on the data on natural gas use in this process (natural gas consumption for the years 1988-2011 was presented in Annex 3). The amount of natural gas consumption expressed in volume units was taken from [GUS 2012e]. To estimate carbon content in natural gas, the emission factor 0.525 kg C/m^3 from IPCC [IPCC 1997] was used. So the process emission was calculated using the following formula:

$$E_{CO2} = Z_{natural\ gas} * 0.525*44/12$$

where:

E_{CO2} – CO_2 process emission from ammonia production [Mg]
$Z_{natural\ gas}$ – natural gas use [thousands m^3]

This method was used for all years: 1988-2011. In years 1989-1990, also coke-oven gas was used for ammonia production and this fact was reflected in the inventory calculations (Annex 3). The coke-oven gas consumption was taken in energy units – also based on G-03 reports – and the carbon content factor is taken from IPCC [IPCC 1997].

CO_2 process emissions in the period: 1988-2011 are shown in figure 4.3.2.

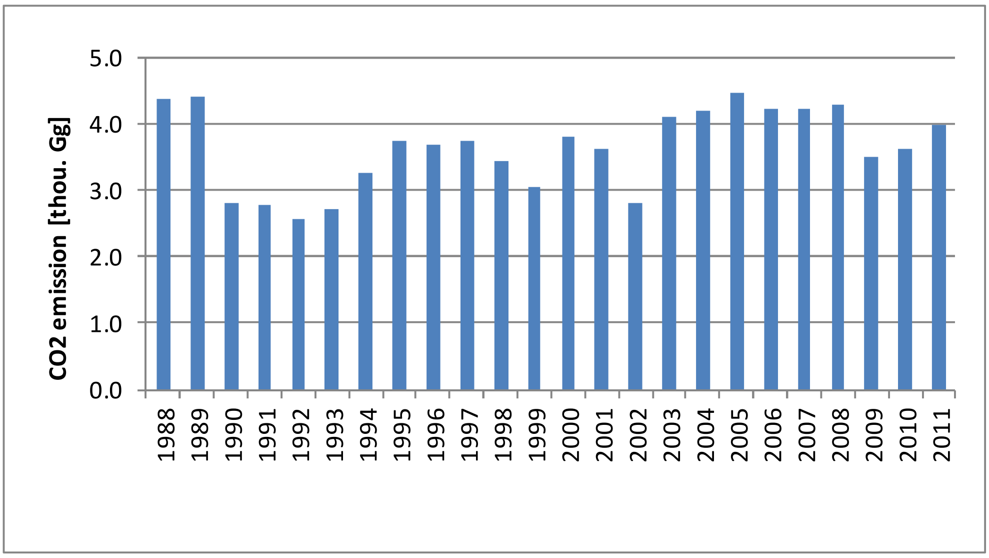

Figure 4.3.2. CO_2 process emission for ammonia production in 1988-2011

CH_4 process emissions for ammonia production were estimated for all years based on data on ammonia production from G-03 reports (figure 4.3.3) and emission factor 4.9 kg CH_4/Mg NH_3 [CITEPA 1992].

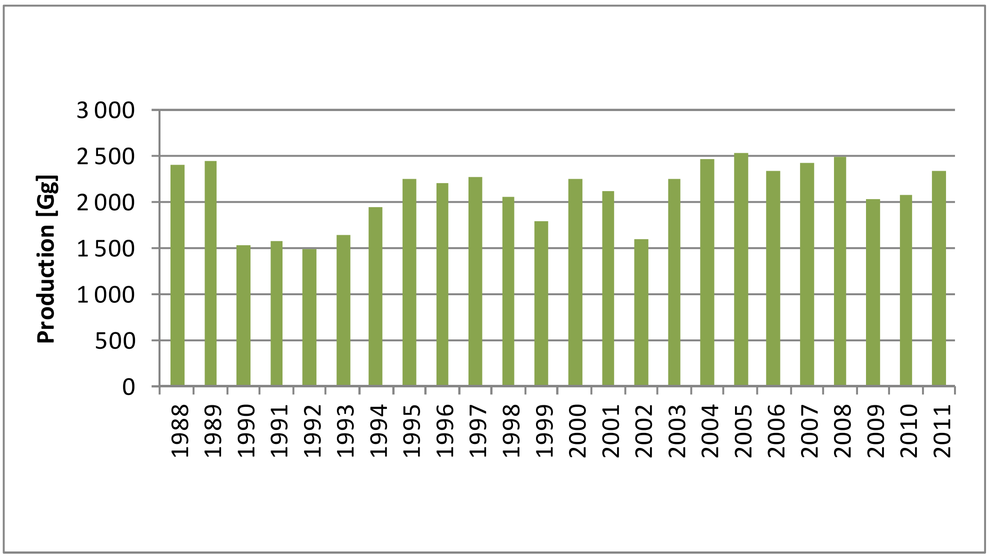

Figure 4.3.3. Production of ammonia in 1988-2011

According to Polish expert ammonia production is not a source of N_2O emission in Poland [Kozłowski 2001].

4.3.2.2. Nitric Acid Production (CRF sector 2.B.2)

Estimation of N_2O emission from nitric acid production for 2011 was based on annual HNO_3 production data from [GUS 2012b]. The applied country specific emission factor: 1.23 kg/Mg nitric acid was estimated based on the reports from all producers of HNO_3 [KOBiZE 2012]. The N_2O emission factors for years 2005-2010 were calculated also based on mentioned reports provided by installations of nitric acid production. The values of N_2O EFs applied for the years 2005-2010 were as follows: for 2005: 6.36 kg/Mg nitric acid, for the year 2006: 6.37 kg/Mg HNO_3, for 2007: 6.43 kg/Mg nitric acid, for 2008: 5.40 kg/Mg $HNO_{3,}$ 1.31 kg/Mg nitric acid for 2009 and 1.35 kg/Mg HNO_3 for 2010.

Emission factors mentioned above were estimated as weighted average of plant specific emission factors obtained from all nitric acid producers (from 5 installations located in 4 enterprises).

Decrease of the N_2O EF value from nitric acid production in 2008 and its significant drop in 2009 - 2011 are the result of the implementation of the JI projects. N_2O catalytic decompose inside the oxidation ammonia reactor is the abatement technology applied in these installations.
Individual data obtained from nitric acid producers is confidential, so was not published in the NIR (it could be available for ERT review purpose only).

For the period 1988-2004, N_2O EF amounted to 6.47 kg/Mg nitric acid was applied. This country specific emission factor was taken from [Kozłowski 2001].

Activity data (i.e. HNO_3 production) for estimation of nitrous oxide emissions in 2.B.2 subcategory were taken from [GUS 1989b-2012b] for the entire period 1988-2011. The amount of production and N_2O emissions from nitric acid production are shown in figures 4.3.4 and 4.3.5, respectively.

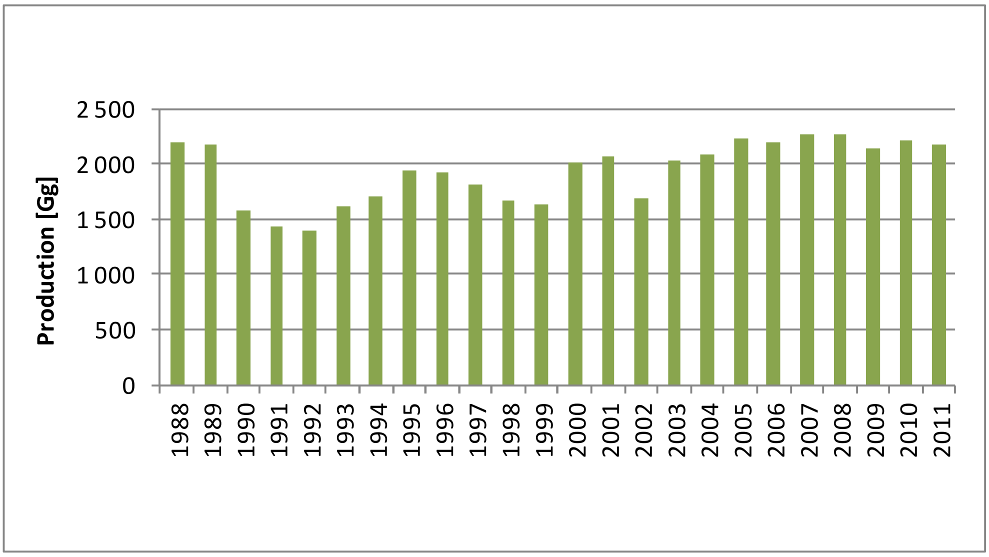

Figure 4.3.4. Production of nitric acid in 1988-2011

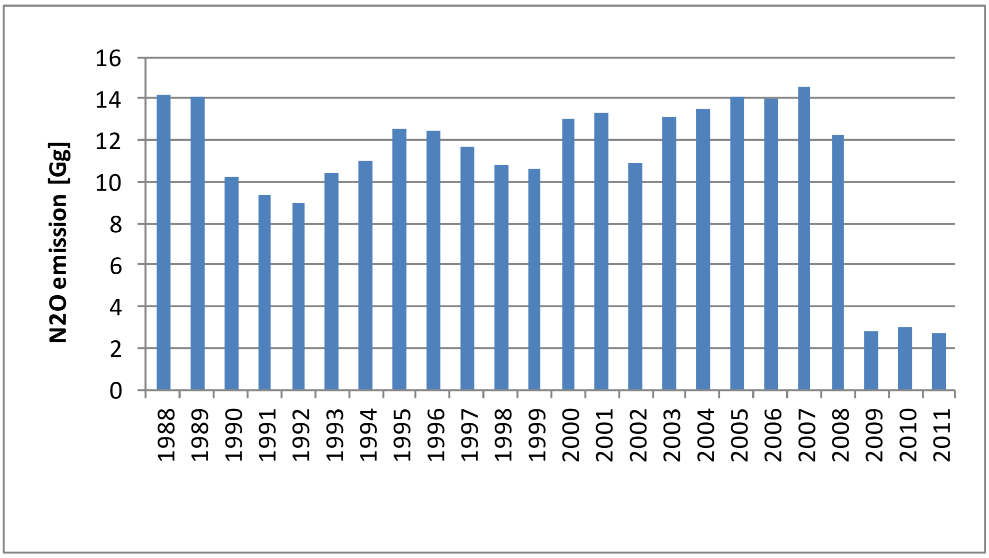

Figure 4.3.5. N_2O process emission for nitric acid production in 1988-2011

4.3.2.3. Carbide Production (CRF sector 2.B.4)

CO_2 emission from 2.B.4 category was estimated for years 1988-2007 based on annual production amounts taken from [GUS 1989b-2009b]. Starting from 2008 carbide is no longer produced in Poland. For CO_2 emission estimation in entire period 1988-2010, EF equal 2190 kg CO2/Mg of carbide (i.e.: 1090 kg CO_2/Mg carbide from production + 1100 kg CO_2/Mg carbide from use) [IPCC 1997] was applied.

4.3.2.4. Production of Other Chemical Products (CRF sector 2.B.5)

- *Carbon Black Production*

CH_4 emission from production of carbon black was estimated based on annual carbon black production from [GUS 2012e]. The emission factor, which is equal 11 kg CH_4/Mg carbon black, was taken from [IPCC 1997].

Carbon black production values for 1988-1999 were taken from [GUS 1989b-2000b]. Activity data for later years come from [GUS 2001e-2012e].
The emission factor of 11 kg CH_4/Mg was applied for calculation of CH_4 emission for the entire period 1988-2011.

- *Ethylene Production*

Emission of CO_2 from ethylene production was calculated based on ethylene annual production from [GUS 2012b]. Emission factor was taken from [CITEPA 1992]. Its value is 0.3 kg CO_2/Mg ethylene produced.

For the entire time series 1988–2011 the same activity data source – GUS publications [GUS 1989b-2012b] and the same emission factor were applied.
Default CH_4 EF from [IPCC 1997], equal 1 kg CH_4/Mg, was applied for estimation of methane emission for entire period 1988-2011.

- Caprolactam Production

Data on annual caprolactam production for inventory calculation purpose was taken from [GUS 2012b]. Applied country specific emission factor of N_2O, which value is 4.74 kg N_2O/Mg caprolactam produced, was assessed based on the Polish study [Kozłowski 2001].
For the entire time series the same activity data source – GUS publications [GUS 1989b-2012b] and the same emission factor were applied.

- Methanol Production

CH_4 emission from methanol production was estimated based on data on annual production from [GUS 2012b] and CH_4 EF equal 2 kg CH_4/Mg [IPCC 1997]. For all years the same emission factor of 2 kg CH_4/Mg methanol was used [IPCC 1997] while data on methanol production were taken from national statistics [GUS 1989b-2012b].

- Styrene Production

Methane emissions from styrene production for the entire period 1988-2011 were estimated by applying the same emission factor of 4 kg CH_4/Mg styrene [IPCC 1997]. Data on styrene production applied for emission estimation for 1995-2011 was taken from G-03 questionnaires [GUS 1996e-2012e], while for previous years (1988-1994) the activity data were obtained directly from the only styrene producer (personal communication).

4.3.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.3.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.3.5. Source-specific recalculations

- For the years 2009 and 2010 data for 2.B.4 category was corrected (i.e. deleted) according to information that since 2008 carbide has been not produced in Poland.

4.3.6. Source-specific planned improvements

- Analysis concerning the possibility of elaboration of country specific EF for natural gas and application of it to CO_2 emission estimation from ammonia production (2.B.1 IPCC category).

4.4. Metal Production (CRF sector 2.C)

4.4.1. Source category description

Estimation of emissions in 2.C. *Metal Production* are carried out in sub-categories listed below:

a) *Iron and Steel Production* (2.C.1)
   - Iron Ore Sinter Production (2.C.1.a)
   - Steel Cast Production (2.C.1.c)
   - Iron Cast Production (2.C.1.d)
   - Pig Iron Production In Blast Furnaces (2.C.1.e)
   - Basic Oxygen Furnace Steel Production (2.C.1.f)
   - Electric Furnace Steel Production (2.C.1.g)
   - Coke Production (CRF sector 2.C.1.j)

b) *Ferroalloys Production* (2.C.2)

c) *Aluminium Production* (2.C.3)

d) *Other* (2.C.5)

Subsector 2.C.1. *Iron and Steel Production* is by far the largest contributor to emissions from this category (see figure 4.4.1) – about 91% in 2011.

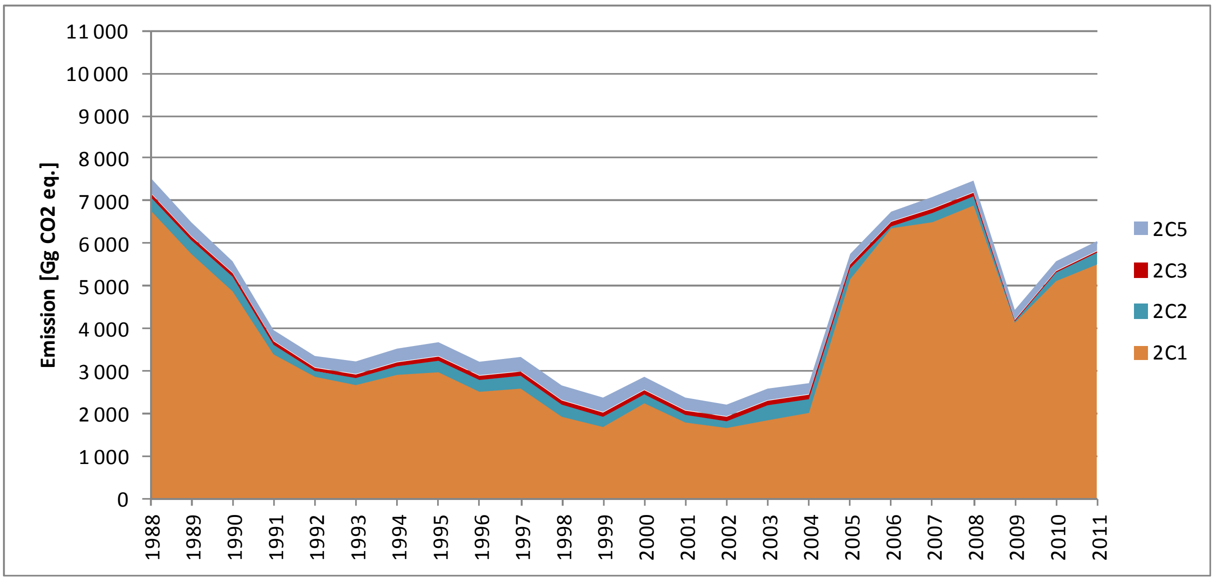

Figure 4.4.1. Emissions from *Metal Production* sector in years 1988-2011 according to subcategories

4.4.2. Methodological issues

4.4.2.1. Iron Ore Sinter Production (CRF sector 2.C.1.a)

Carbon dioxide process emissions from iron ore sinter production for 2011 come from the verified reports on annual emissions of CO_2 from iron ore sinter installations in EU ETS [KOBiZE 2012]. The values of annual iron ore sinter productions were also taken from production amounts indicated in the verified reports.

Based on verified reports of CO_2 emissions elaborated for the purpose of emission trading scheme, also emissions and production within this subcategory for years 2005-2010 were estimated.

In 2.C.1.a sub-category for 2005-2011, CO_2 emission values, consistent with total CO_2 emissions from the verified reports for sintering plants were taken (without the exclusion of coke and other fuel consummated for sinter belt heating). For that reason, the consumption of fuels in sintering plants (taken from the verified reports), which was included in energy balance as part of final energy consumption in *Iron and steel* sector, was subtracted from activity data in 1.A.2.a to avoid double counting.

Amounts of fuels (in PJ) consumed in sintering plants are as follows:

	2005	2006	2007	2008	2009	2010	2011
coke	8.499	8.957	8.638	7.103	5.473	6.493	6.439
anthracite	0.587	0.856	0.962	1.695	0.718	1.604	2.574
blast furnace gas	0.133	0.107	0.115	0.116	0.070	0.081	0.085
coke oven gas	0.369	0.294	0.285	0.279	0.224	0.292	0.329

Due to exclusion the significant part of above mentioned fuels from activity data in 1.A.2.a, CH_4 and N_2O emissions related to these fuels, were added to emissions in the respective subcategories of 2.C.1. These emissions were estimated according to methodology applied for emission calculation in 1.A.2.a sub-sector.

Emissions [Gg] related to consumption of fuels mentioned above are as follows:

	2005	2006	2007	2008	2009	2010	2011
CH_4	0.091	0.099	0.096	0.088	0.024	0.081	0.091
N_2O	0.014	0.015	0.014	0.013	0.004	0.012	0.014

Emissions of CO_2 for the years 1988-2004 were calculated (using carbon balance method) based on data (amount of feedstock material and output from production process) from questionnaires regarding to installations included into the EU ETS collected by the National Administration of Emission Trading Scheme [KOBiZE 2012]. The activity data for iron ore sinter production for years: 2001-2004 were taken according to information reported in above mentioned questionnaires, and for 1988-2000 data from G-03 reports were taken.

Amounts of iron ore sinter production and CO_2 emission values estimated from iron ore sintering for the years 1988-2011 are presented in table 4.4.1.

For the entire period 1988-2011 emissions of CH_4 were also estimated from iron ore sinter production. The default emission factor for CH_4 (0.07 kg/Mg), was taken from [IPCC 2006]. For the years 2005-2011, CH_4 emissions from fuels shifted from 1.A.2.a to 2.C.1.a subcategory are also added to CH_4 process emission. Values of these shifted emissions are presented above.

Table 4.4.1. Iron ore sinter production [Gg] and CO_2 emissions from sinter production in years 1988-2011 [Gg]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production	14107.3	12992.5	11779.4	8 612.7	8 621.7	7 628.2	8 787.4	8 646.6	8 318.6	8 980.8
CO_2 emission	1069.2	735.8	834.0	671.4	618.7	569.7	631.2	677.4	652.2	662.7
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Production	6 882.1	6 475.9	8 078.7	7 352.8	7 616.9	7 732.2	8 590.6	6 168.4	6 907.8	6 954.0
CO_2 emission	492.4	522.0	619.8	516.5	545.5	636.6	645.5	1 269.2	1 386.4	1 386.1
	2008	**2009**	**2010**	**2011**						
Production	6 306.4	4362.6	5837.3	6512.8						
CO_2 emission	1 656.0	1151.1	1444.4	1564.2						

4.4.2.2. Steel Cast Production (CRF sector 2.C.1.c)

The data on CO_2 process emissions from steel cast production as well as on amount of cast steel was estimated according to the methodology given in [Holtzer 2007]. CO_2 emission estimated in mentioned study concerns only melt process of alloy since this is main sources of process emission. CO_2 emission occurring at pouring into moulding sands is not included. Estimation of emission in [Holtzer 2007] was based on following assumption:

- metal yield for particular years from period 1988-2010 equals 41.7-46.1% (cast steel production was calculated based on the yield value and steel cast production published in [*Modern Casting*]);

- in electric arc furnaces 97% steel for casts is melted while in induction furnace only 3%;

- average consumption of electrodes in electric arc furnace was assumed as 8 kg/Mg of liquid steel (according to information from Polish foundries: 6 – 12 kg/Mg liquid steel);

- during melting of steel in electric arc furnace average 0.5% of carbon burns out (this is 5 kg/Mg liquid steel).

Data applied for estimation of CO_2 process emission from steel casts and CO_2 emissions values for entire period 1988-2011 were presented in table 4.4.2.

Table 4.4.2. Activity data for estimation of CO_2 process emission from steel casting in 1988-2011

Year	Liquid steel Mg	Liquid steel melted in electric arc furnace, Mg	Liquid steel melted in induction furnace, Mg	Electrode consumption, Mg	CO_2 emission from burning out of electrodes, Mg	Amount of carbon burn out, Mg	CO_2 emission from burn out of carbon, Mg	Total CO_2 emission from melting of steel, Gg
1988	641 892	622635	19 257	4981	18 264	3113	11 415	29.679
1989	538 289	522 140	16 149	4177	15 316	2611	9573	24.889
1990	434 685	421 644	13 041	3373	12 368	2108	7730	20.098
1991	225 968	219 189	6779	1754	6430	1096	4018	10.448
1992	165 766	160 793	4973	1286	4717	804	2948	7.664
1993	150 473	145 959	4514	1168	4281	730	2676	6.957
1994	159 910	155 113	4797	1241	4550	776	2844	7.394
1995	175 901	170 624	5277	1365	5005	853	3128	8.133
1996	193 919	188 101	5818	1505	5518	941	3449	8.966
1997	178 378	173 027	5351	1384	5075	865	3172	8.248
1998	140 090	135 887	4203	1087	3986	679	2491	6.477
1999	123 874	120 158	3716	961	3525	601	2203	5.728
2000	124 775	121 032	3743	968	3550	605	2219	5.769
2001	122 748	119 066	3682	953	3493	595	2183	5.675
2002	109 009	105 739	3270	846	3102	529	1939	5.040
2003	111 511	108 166	3345	865	3173	541	1983	5.156
2004	117 354	113 833	3521	911	3339	569	2087	5.426
2005	133 187	129 191	3996	1034	3790	646	2369	6.158
2006	132 747	128 765	3982	1030	3777	644	2361	6.138
2007	142 198	137 932	4266	1103	4046	690	2529	6.575
2008	140 349	136 139	4210	1089	3993	681	2496	6.489
2009	123 538	119 832	3706	959	3515	599	2197	5.712
2010	148 132	143 688	4444	1150	4215	718	2634	6.849
2011	156 923	152 215	4708	1218	4465	761	2791	7.256

4.4.2.3. Iron Cast Production (CRF sector 2.C.1.d)

The data on CO_2 process emissions from iron cast production as well as on amount of cast iron was estimated according to the methodology from [Holtzer 2007]. Estimation of CO_2 emissions concerns only melting process of alloy since this is the main source of process emission. CO_2 emission occurring at pouring the liquid metal into the moulding sands was not taken into consideration. Carbon dioxide emission values for particular years were estimated based on the following assumptions [Holtzer 2007]:

- metal yield values for given types of cast iron in period 1988-2011 were as follow: 67-72% for gray iron, 47.9-50.7% for ductile cast iron, 32.3-34.5% for malleable cast iron (total amount of melted cast iron for particular year was calculated based on iron cast production [*Modern Casting*] and metal yield value);
- part of coke in charge is 15% (150 kg/Mg metal charge),
- part of $CaCO_3$ in charge is 25% of coke addition (3.75% of metal charge),
- yield of liquid metal from cupola is 95% (melting loss 5%),
- part of cast iron melted in cupola was assumed at 80% for the years: 1988 – 1998; for the following years this share significantly dropped from 77.3% in 2000 to approx. 40% lately.
- C content in coke for charge was 85-90%.

Data applied for calculation of CO_2 process emission from iron casting production and CO_2 process emission value for 1988-2011 were presented in the table 4.4.3.

Table 4.4.3. CO_2 process emission from cast iron production in years 1988-2011

Year	Liquid cast iron Mg	Liquid cast iron melted in cupola, Mg	Metal charge into cupola Mg	Coke consumption Mg	$CaCO_3$ consumption Mg	CO_2 emission from $CaCO_3$ decomposition Mg
1988	2 185 633	1 748 506	1 840 533	276 080	69 020	30.369
1989	1 855 655	1 484 524	1 562 657	234 399	58 560	25.784
1990	1 525 676	1 220 541	1 284 780	192 717	48 179	21.199
1991	1 039 006	831 205	874 952	131 243	32 811	14.437
1992	1 013 144	810 405	653 058	127 959	31 990	14.075
1993	1 005 974	804 779	847 136	127 070	31 768	13.978
1994	1 057 558	846 046	890 575	133 586	33 397	14.694
1995	1 137 438	909 950	957 842	143 676	35 919	15.804
1996	1 073 413	858 730	903 927	135 589	33 897	14.915
1997	1 054 730	843 784	888 194	133 229	33 307	14.655
1998	904 220	723 376	761 448	114 217	28 554	12.564
1999	882 894	589 000	620 000	93 000	23 250	10.230
2000	982 735	760 000	800 000	120 000	30 000	13.200
2001	984 608	519 334	546 667	82 000	20 500	9.020
2002	876 968	456 000	480 000	72 000	18 000	7.920
2003	865 238	412 934	434 667	65 200	16 300	7.172
2004	893 865	395 200	416 000	62 400	15 600	6.864
2005	914 745	369 835	389 300	58 400	14 600	6.424
2006	962 163	367 334	386 667	58 000	14 500	6.380
2007	1 019 085	383 800	404 000	60 600	15 150	6.666
2008	1 084 065	437 532	460 560	69 084	17 271	7.599
2009	805 076	279 145	293 837	44 076	11 019	4.848
2010	968 676	368 472	387 865	58 180	14 545	6.400
2011	1 029 929	391 772	412 391	61 859	15 465	6.804

CH_4 emission for entire period 1988-2011 was estimation based on EF = 0.20 kg CH_4/Mg. This EF was taken from [Radwański 1995].

4.4.2.4. Pig Iron Production in Blast Furnaces (CRF sector 2.C.1.e)

CO_2 emission for 2011 from pig iron production was taken from the verified reports prepared by installations included in EU ETS. Like in case of sintering plants (2.C.1.a) also in 2.C.1.e total CO_2 emission without excluding emission from fuels used for energy purpose of this process, was assumed. Pig iron is produced in the integrated steel plants, so additional information was needed for application of data from the verified reports. This additional data for separation of blast furnace process and steel production in integrated steel plants were received directly from plants.

CO_2 emission value from pig iron production in 2011 was estimated at 3026,1 Gg. Emission values for the years 2005-2010 were estimated according to methodology applied for 2011 and amounted to: 2952.7 Gg for 2005, 3700.3 Gg for 2006, 3879.2 Gg CO_2 for 2007, 4284.6 Gg for 2008, 2259.5 Gg for 2009 and 2836.7 Gg for 2010.
Amounts of fuels (in PJ) used in blast furnace process, included in 2.C.1.e sub-category and subtracted from activities data of 1.A.2.a to avoid the double counting, were as follows:

	2005	2006	2007	2008	2009	2010	2011
hard coal (including anthracite)	0.482	3.647	3.036	2.174	1.496	2.072	3.405
natural gas	2.829	0.109	0.742	0.143	0.040	0.012	0.028
coke	38.816	44.040	42.791	39.332	24.283	27.442	30.114
coke oven gas	3.264	3.884	5.569	4.813	0.000	3.716	3.658

Fuel amounts given above do not include the coke, which is given in Eurostat database as input into blast furnaces, because inclusion of emission from this part of coke in 2 IPCC sector does not result in double counting and should not be subtracted from the activity of 1.A.2.a.

Due to exclusion of fuels listed above from activity data in 1.A.2.a, the emissions of CH_4 and N_2O from these fuels were included in 2.C.1.e to avoid underestimation of total emission amount. These emissions were estimated according to methodology applied for emission calculation in 1.A.2.a sub-sector.
Emissions [in Gg] for the years 2005-2011, mentioned above, are as follows:

	2005	2006	2007	2008	2009	2010	2011
CH_4	0.399	0.481	0.465	0.420	0.258	0.299	0.339
N_2O	0.060	0.072	0.069	0.063	0.039	0.045	0.051

CO_2 process emission from pig iron production for 1988-2004 was based on carbon balance in the blast furnace process. Values concerning input and output for this balance were taken from statistical data (pig iron production for the entire period from [GUS 1989e-2005e], BF gas production for 1988-1989 from [IEA] and for 1990-2004 from [Eurostat], coke input for 1988-2004 – corrected data from Energy Market Agency (ARE). For sinter assumed that use in the BF process relates to sinter production. Amounts of limestone, dolomites and iron ore for BF carbon balance were estimated based on technological factors taken from literature [Szargut J. 1978]. Carbon contents in components of charge and output were calculated base on C EF from IPCC guidelines (for BF gas and coke from [IPCC 1997], for pig iron from [IPCC 2000], for limestone and dolomites from [IPCC 2006]) and country specific values for iron ore [Szargut J. 1978] and sinter (data from plants). Pig iron production for the entire period was taken from [GUS 1989e-2012e]. The data for 2011 amounted to 3974,9 Gg, for 2010 - 3638.0 Gg, for 2009 - 2983.5 Gg, for 2008 – 4933.8 Gg, for 2007 – 5804.4 Gg, while for 2005 and 2006: 4481.2 Gg and 5543.4 Gg, respectively. Pig iron production, CO_2 emission values and other data concerning BF process applied in C balance for period 1988-2004 were presented in table 4.4.4.

Table 4.4.4. Carbon balance for blast furnace process in years: 1988-2004

	1988	1989	1990	1991	1992	1993	1994	1995	1996
CHARGE – Technological indicators [kg/kg of steel]									
Roasted ore	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880
Dolomite	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454
Limestone	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974
Manganese ore	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716
CHARGE – amount used in process in given year									
Sinter [Gg]	14 107.3	12 992.5	11 779.4	8 612.7	8 621.7	7 628.2	8 787.4	8 646.6	8 318.6
Roasted ore [Gg]	1 929.3	1 783.7	1 627.5	1 222.3	1 214.9	1 183.1	1 331.3	1 399.4	1 233.6
Dolomite [Gg]	907.7	839.2	765.7	575.1	571.6	556.6	626.4	658.4	580.4
Limestone [Gg]	999.6	924.1	843.2	633.3	629.4	612.9	689.7	725.0	639.1
Manganese ore [Gg]	734.8	679.3	619.8	465.5	462.7	450.6	507.0	533.0	469.8
Coke [TJ]	186 338	179 462	157 424	107 026	102 005	95 394	110 405	113 863	97 656
CHARGE – C content									
Sinter [kg/kg]	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Roasted ore [kg/kg]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
Dolomite [kg/kg]	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Limestone [kg/kg]	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200
Manganese ore [kg/kg]	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262
Coke [kg/GJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
CHARGE – total C content [Gg]									
Sinter	15.5	14.3	13.0	9.5	9.5	8.4	9.7	9.5	9.2
Roasted ore	21.7	20.1	18.3	13.8	13.7	13.3	15.0	15.8	13.9
Dolomite	118.0	109.1	99.5	74.8	74.3	72.4	81.4	85.6	75.5
Limestone	119.9	110.9	101.2	76.0	75.5	73.6	82.8	87.0	76.7
Manganese ore	19.2	17.8	16.2	12.2	12.1	11.8	13.3	13.9	12.3
Coke	5 497.0	5 294.1	4 644.0	3 157.3	3 009.1	2 814.1	3 256.9	3 359.0	2 880.8
C IN CHARGE – SUM	5 791.4	5 566.3	4 892.2	3 343.4	3 194.2	2 993.5	3 459.1	3 570.8	3 068.3
OUTPUT IN GIVEN YEAR									
Pig iron [Gg]	**10 262.4**	**9 487.6**	**8 656.7**	**6 501.5**	**6 462.0**	**6 292.9**	**7 081.2**	**7 443.5**	**6 561.9**
Blast furnace gas [TJ]	74 521	71 771	62 970	42 811	40 802	38 157	44 162	45 545	39 062
OUTPUT – C content									
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Blast furnace gas [kg/GJ]	66	66	66	66	66	66	66	66	66
OUTPUT – total C content [Gg]									
Pig iron	410.5	379.5	346.3	260.1	258.5	251.7	283.2	297.7	262.5
Blast furnace gas	4 918,4	4 736,9	4 156.0	2 825.5	2 692.9	2 518.4	2 914.7	3 006.0	2 578.1
C IN OUTPUT – SUM	5 328,9	5 116,4	4 502.3	3 085.6	2 951.4	2 770.1	3 197.9	3 303.7	2 840.6
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [Gg]	462,5	449,9	389.9	257.9	242.8	223.4	261.1	267.0	227.8
CO_2 EMISSION [Gg]	**1 696**	**1 650**	**1 430**	**945**	**890**	**819**	**957**	**979**	**835**
CO_2 EMISSION FACTOR [kg/Mg]	**165**	**174**	**165**	**145**	**138**	**130**	**135**	**132**	**127**

Table 4.4.4. (cont.) Carbon balance for blast furnace process in years 1988-2004

	1997	1998	1999	2000	2001	2002	2003	2004
CHARGE – Technological indicators [kg/kg of steel]								
Roasted ore	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880
Dolomite	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454	0.088454
Limestone	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974	0.0974
Manganese ore	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716	0.0716
CHARGE – amount used in process in given year								
Sinter [Gg]	8 980.8	6 882.1	6 475.9	8 078.7	7 352.8	7 616.9	7 732.2	8 590.6
Roasted ore [Gg]	1 394.6	1 180.5	993.1	1 223.0	1 023.3	995.7	1 061.4	1 208.3
Dolomite [Gg]	656.2	555.4	467.2	575.4	481.4	468.5	499.4	568.5
Limestone [Gg]	722.5	611.6	514.5	633.6	530.1	515.9	549.9	626.0
Manganese ore [Gg]	531.1	449.6	378.2	465.8	389.7	379.2	404.2	460.2
Coke [TJ]	103 297	85 722	70 447	92 633	79 759	71 879	77 578	84 590
CHARGE – C content								
Sinter [kg/kg]	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Roasted ore [kg/kg]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
Dolomite [kg/kg]	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Limestone [kg/kg]	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200
Manganese ore [kg/kg]	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262
Coke [kg/GJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
CHARGE – total C content [Gg]								
Sinter	9.9	7.6	7.1	8.9	8.1	8.4	8.5	9.4
Roasted ore	15.7	13.3	11.2	13.8	11.5	11.2	12.0	13.6
Dolomite	85.3	72.2	60.7	74.8	62.6	60.9	64.9	73.9
Limestone	86.7	73.4	61.7	76.0	63.6	61.9	66.0	75.1
Manganese ore	13.9	11.8	9.9	12.2	10.2	9.9	10.6	12.0
Coke	3 047.3	2 528.8	2 078.2	2 732.7	2 352.9	2 120.4	2 288.6	2 495.4
C IN CHARGE – SUM	3 258.7	2 707.0	2 228.9	2 918.4	2 508.9	2 272.8	2 450.5	2 679.5
OUTPUT IN GIVEN YEAR								
Pig iron [Gg]	**7 418.0**	**6 279.4**	**5 282.3**	**6 505.3**	**5 442.8**	**5 296.4**	**5 645.9**	**6 426.9**
Blast furnace gas [TJ]	41 319	34 289	28 179	37 053	31 904	28 752	31 031	33 836
OUTPUT – C content								
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Blast furnace gas [kg/GJ]	66	66	66	66	66	66	66	66
OUTPUT – total C content [Gg]								
Pig iron	296.7	251.2	211.3	260.2	217.7	211.9	225.8	257.1
Blast furnace gas	2 727.1	2 263.1	1 859.8	2 445.5	2 105.7	1 897.6	2 048.0	2 233.2
C IN OUTPUT – SUM	3 023.8	2 514.3	2 071.1	2 705.7	2 323.4	2 109.5	2 273.9	2 490.3
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [Gg]	235.0	192.8	157.8	212.7	185.5	163.3	176.6	189.3
CO_2 EMISSION[Gg]	**862**	**707**	**578**	**780**	**680**	**599**	**648**	**694**
CO_2 EMISSION FACTOR [kg/Mg]	**116**	**113**	**110**	**120**	**125**	**113**	**115**	**108**

4.4.2.5. Basic Oxygen Furnace Steel Production (CRF sector 2.C.1.f)

Amount of CO_2 process emission from basic oxygen furnace steel production in 2011 was taken from the verified reports from steel plants participating in EU ETS. Like in case of sintering plants and blast furnace process also in 2.C.1.f total CO_2 emission, without excluding emission from fuels used for energy purpose of this process, was assumed. Specification of information and excluding data on steel production from total balance was needed to use data from the verified reports. Additional data, taken directly from plants, enabled this kind of operation and estimation of emission from basic oxygen furnace steel production. CO_2 process emission from basic oxygen furnace steel production in 2011 was 510.7 Gg (in addition to process emission, this also includes emission from continuous steel casting in basic oxygen furnace steel plants). CO_2 emission values for 2005-2010 were estimated in line with the method applied for 2011. The values of CO_2 emissions for 2005-2010 are as follows: 547.5 Gg for 2005, 843.4 Gg for 2006, 766.9 Gg for 2007, 500.2 Gg for 2008, 373,1 Gg for 2009 and 451.6 for 2010.

Basic oxygen steel production in 2005-2011 amounted to: 4892.7 Gg, 5766.4 Gg, 6187.9 Gg, 5225.1 Gg, 3235.7 Gg, 3994.7 Gg, and 4423.6 Gg respectively [GUS 2006b-2012b].

Amounts of fuels (in PJ) used in production of steel in basic oxygen furnaces, included in 2.C.1.f sub-category and subtracted from activities data of 1.A.2.a to avoid the double counting are as follows:

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
natural gas	0.540	0.598	0.701	0.499	0.661	0.506	0 .664
coke	0.216	0.254	0.236	0.216	0.000	0.434	0 .000
coke oven gas	0.609	0.654	0.607	0.625	0.385	0.489	1 .114
blast furnace gas	0.105	0.101	0.115	0.001	0.002	0.000	0 .000

Due to exclusion of fuels listed above from activity data in 1.A.2.a, the emissions of CH_4 and N_2O from these fuels were included in 2.C.1.f to avoid underestimation of total emission amount. These emissions were estimated according to methodology applied for emission calculation in 1.A.2.a sub-sector.

Emissions mentioned above (expressed in Gg) are as follows:

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CH_4	0.003	0.004	0.004	0.003	0.001	0.005	0,002
N_2O	0.0004	0.0005	0.0005	0.0004	0.0001	0.0008	0,0002

For years 1988-2004, CO_2 process emission from basic oxygen furnace steel production was estimated on the basis of carbon balances (table 4.4.5) prepared by Polish Steel Association (HIPH) [HIPH 2007]. In these balances, amount of steel production for each year were taken from CIBEH S.A. In the frames of national statistics program (Annex to Ordinance of Council of Ministers of 2004) CIBEH provides specialized statistical research for iron and steel industry (since 2004 data published by national statistics (GUS) are coherent with data given by CIBEH). Technological factors for consumption of pig iron in oxygen furnace process are also taken from CIBEH (data were available only for 1988-1999, for the later years amount from 1999 was taken). Values for consumption of scrap were calculated on the basis of data from MG-08 questionnaire – consumption of raw materials used in production of metallurgy products (because the obligation of fulfilling the questionnaire has been in force since 1999, the full data series is available only from 1998; for previous year (1988-1997) the value from 1998 was assumed). Because of the lack of data in national statistics, the output of oxygen furnace gas was assumed on the basis of the rate: amount of produced oxygen furnace gas to amount of produced steel. It was based on steel plants reports included in EU ETS.

4.4.2.6. Electric Furnace Steel Production (CRF sector 2.C.1.g)

Process emissions of CO_2 from steel production in electric furnaces in 2011 were taken from the verified reports prepared by installations included in EU ETS. The amount of emissions for 2011 was estimated at 351.0 Gg. Values of emissions for 2005-2010, were also taken from the verified reports. These values were as follows: 311.4 Gg CO_2 for 2005, 361.5 Gg CO_2 for 2006, 397.4 Gg for 2007, 387.8 Gg for 2008, 315.1 Gg for 2009 and 338.7 Gg for 2010. In addition to process emissions from electric furnaces, these values could include also emissions from continuous steel casting and from off-furnace steel treatment. Emissions in 2.C.1.g include also emissions from combustion of fuels, which are classified in the sector *Iron and steel production* in the statistics, so the amounts of the fuels presented below [expressed in PJ] were subtracted from activity data in 1.A.2.a to avoid double counting:

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
hard coal (including anthracite)	0.261	0.336	0.511	0.582	0.019	0.023	0.027
coke	0.036	0.032	0.032	0.062	0.055	0.011	0.000

Due to exclusion of above mentioned fuels from activity data in 1.A.2.a the emissions of CH_4 and N_2O from these fuels were added to emissions in 2.C.1.g. These emissions were estimated according to methodology applied for emission calculation in 1.A.2.a subcategory.

Emissions mentioned above (in Gg), for the years 2005-2011, are as follows:

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CH_4	0.003	0.004	0.005	0.006	0.001	0.0003	0.0003
N_2O	0.0004	0.0006	0.0008	0.0010	0.0001	0.00005	0.00004

Annual electric furnace steel production in 2005-2011 amounted to: 3 443.2 Gg for 2005, 4 225.3 Gg for 2006, 4 432.8 Gg for 2007, 4 502.3 Gg for 2008, 3892.8 Gg for 2009, 4001.4 Gg for 2010 and 4352.9 Gg for 2011 [GUS2006b-GUS 2012b].

Activity data on steel production in electric furnaces and on CO_2 emissions related to this process in 1988-2004 are presented in table 4.4.6 and come from [HIPH 2007]. Activity data come from CIBEH S.A. and are compatible with national statistic publications (GUS).

Data used in budgets (table 4.4.6) on graphite electrodes used, ferroalloys, limestone and anthracite are taken directly from steel plants (installations – members of the Polish Steel Association). Data on steel scrap and coke use come from CIBEH S.A. (scrap use was estimated based on MG-08 questionnaires like for BOF steel; because of the lack of detail data up to 1997, scrap use factor from 1998 was applied for 1988-1997).

CH_4 emission from steel production in electric furnaces was assessed for entire time series 1988-2010 based on country specific emission factor of 0.12 kg CH_4/Mg steel produced [FEWE 1994]. Results of measurements carried out in Polish steel plants were the sources of this emission factor [Olczak 1993].

For the years 2005-2011, CH_4 emissions from fuels shifted from 1.A.2.a to 2.C.1.g subcategory are also added to CH_4 process emission. Values of these shifted emissions are presented above.

Table 4.4.5. Carbon balance for steel production in basic oxygen process in years 1988-2004

	1988	1989	1990	1991	1992	1993	1994	1995	1996
CHARGE									
Pig iron [Mg]	6 437 194	6 274 714	6 212 430	4 835 755	5 279 309	5 205 226	5 873 001	6 440 439	5 669 525
Scrap [Mg]	1 895 954	1 841 725	1 840 367	1 468 313	1 595 404	1 573 016	1 796 072	1 962 554	1 725 579
Coke-carbon pick-up [Mg]	0	0	0	0	0	0	0	0	0
Technological indicator [Mg/Mg of steel]									
Pig iron	0.867	0.870	0.862	0.841	0.845	0.845	0.835	0.838	0.839
Scrap	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554
Coke	0	0	0	0	0	0	0	0	0
Material-specific carbon content									
Pig iron [Mg C/Mg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Scrap [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Coke [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Carbon contents in charge components [Mg C]									
Pig iron	257 488	250 989	248 497	193 430	211 172	208 209	234 920	257 618	226 781
Steel scrap	7 584	7 367	7 361	5 873	6 382	6 292	7 184	7 850	6 902
Coke	0	0	0	0	0	0	0	0	0
Carbon contents in charge – SUM [Mg]	265 072	258 355	255 859	199 303	217 554	214 501	242 104	265 468	233 683
OUTPUT									
Steel [Mg]	**7 424 676**	**7 212 315**	**7 206 995**	**5 750 006**	**6 247 703**	**6 160 031**	**7 033 534**	**7 685 488**	**6 757 479**
BOF Gas [thous. m^3]	259 384	251 965	251 779	200 878	218 266	215 203	245 719	268 495	236 075
Technological indicator									
BOF Gas [thous. m^3/Mg of steel]	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349
Material-specific carbon content									
Steel [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
BOF Gas [Mg C/TJ]	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Carbon content in products [Mg C]									
Steel	29 699	28 849	28 828	23 000	24 991	24 640	28 134	30 742	27 030
BOF Gas	118 824	115 425	115 340	92 022	99 988	98 584	112 564	122 998	108 146
Carbon content in products – SUM [Mg]	148 522	144 274	144 168	115 022	124 978	123 225	140 698	153 740	135 176
C emission from steel production [Mg]	116 549	114 081	111 691	84 281	92 576	91 277	101 406	111 728	98 507
CO_2 process emission from steel production [Gg]	**427.386**	**418.336**	**409.570**	**309.058**	**339.475**	**334.711**	**371.857**	**409.707**	**361.227**
CO_2 EMISSION FACTOR [kg CO_2/Mg of steel]	**57.56**	**58.00**	**56.83**	**53.75**	**54.34**	**54.34**	**52.87**	**53.31**	**53.46**

Table 4.4.5. (cont.) Carbon balance for steel production in basic oxygen process in years 1988-2004

	1997	1998	1999	2000	2001	2002	2003	2004
CHARGE								
Pig iron [Mg]	6 311 208	5 233 149	4 640 291	6 491 867	5 440 047	5 296 410	5 629 786	6 304 253
Scrap [Mg]	1 923 174	1 588 976	1 303 910	1 657 053	1 366 064.9	1 360 557	1 424 125	1 608 909
Coke-carbon pick-up [Mg]	0	0	0	0	1 201	2 645	4 286	1 689
Technological indicator [Mg/Mg of steel]								
Pig iron	0.838	0.841	0.851	1.047	1.070	1.095	1.078	1.088
Scrap	0.2554	0.2554	0.2391	0.2437	0.2346	0.2346	0.2346	0.2346
Coke	0	0	0	0	0.0002	0.0005	0.0007	0.0002
Material-specific carbon content								
Pig iron [Mg C/Mg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Scrap [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Coke [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Carbon contents in charge components [Mg C]								
Pig iron	252 448	209 326	185 612	259 675	217 602	211 856	225 191	252 170
Steel scrap	7 693	6 356	5 216	6 628	5 464	5 442	5 696	6 436
Coke	0	0	0	0	992	2 184	3 539	1 395
Carbon contents in charge – SUM [Mg]	260 141	215 682	190 827	266 303	224 058	219 483	234 427	260 000
OUTPUT								
Steel [Mg]	**7 531 274**	**6 222 532**	**5 452 751**	**6 799 681**	**5 822 518**	**5 799 042**	**6 069 985**	**6 857 583**
BOF Gas [thous. m^3]	263 108	217 386	190 494	237 549	203 412	202 592	212 057	239 572
Technological indicator								
BOF Gas [thous. m^3/Mg of steel]	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349
Material-specific carbon content								
Steel [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
BOF Gas [Mg C/TJ]	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Carbon content in products [Mg C]								
Steel	30 125	24 890	21 811	27 199	23 290	23 196	24 280	27 430
BOF Gas	120 530	99 585	87 265	108 821	93 183	92 807	97 143	109 748
Carbon content in products – SUM [Mg]	150 655	124 475	109 076	136 020	116 473	116 003	121 423	137 178
C emission from steel production [Mg]	109 486	91 207	81 751	130 283	107 585	103 479	113 004	122 822
CO_2 process emission from steel production [Gg]	**401.486**	**334.456**	**299.781**	**477.747**	**394.514**	**379.458**	**414.384**	**450.388**
CO_2 EMISSION FACTOR [kg CO_2/Mg of steel]	**53.31**	**53.75**	**54.98**	**70.26**	**67.76**	**65.43**	**68.27**	**65.68**

Table 4.4.6 Carbon balance for steel production in electric arc furnace in years 1988-2004

	1988	1989	1990	1991	1992	1993	1994	1995	1996
CHARGE									
Steel scrap [Mg]	2 980 592	2 623 615	2 674 982	2 260 467	2 001 450	2 368 569	2 743 833	2 991 568	3 068 664
EAF carbon electrodes [Mg]	5 402	4 755	4 848	4 097	3 627	4 293	4 973	5 422	5 562
Ferroalloys [Mg]	6 688	5 887	6 002	5 072	4 491	5 315	6 157	6 713	6 886
Coke – carbon pick-up [Mg]	2 800	4 100	4 180	3 000	1 000	4 300	3 900	1 365	1 400
Calcium and magnesium carbonate [Mg]	29 806	26 236	26 750	22 605	20 014	23 686	27 438	29 916	30 687
Anthracite carbon pick-up [Mg]	17 884	15 742	16 050	13 563	12 009	14 211	16 463	17 949	18 412
Technological indicators									
Scrap [Mg/Mg of steel]	1.1587	1.1587	1.1587	1.1587	1.1587	1.1587	1.1587	1.1587	1.1587
EAF carbon electrodes [Mg/Mg of steel]	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021
Ferroalloys [Mg/Mg of steel]	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Coke – carbon pick-up [Mg/Mg of steel]	0.0011	0.0018	0.0018	0.0015	0.0006	0.0021	0.0016	0.0005	0.0005
Calcium and magnesium carbonate [Mg/Mg scrap]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Anthracite carbon pick-up [Mg/Mg scrap]	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Material-specific carbon content									
Scrap [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
EAF carbon electrodes [Mg C/Mg]	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Ferroalloys [Mg C/Mg]	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
Coke – carbon pick-up [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Calcium and magnesium carbonate [Mg C/Mg]	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Anthracite carbon pick-up [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Carbon contents in charge components [Mg C]									
Steel scrap	11 922	10 494	10 700	9 042	8 006	9 474	10 975	11 966	12 275
EAF carbon electrodes	4 430	3 899	3 975	3 359	2 974	3 520	4 078	4 446	4 561
Ferroalloys	17	15	16	13	12	14	16	17	18
Coke – carbon pick-up	2 312	3 385	3 452	2 477	826	3 551	3 220	1 127	1 156
Calcium and magnesium carbonate	3 877	3 413	3 480	2 940	2 603	3 081	3 569	3 891	3 992
Anthracite carbon pick-up	12 108	10 658	10 866	9 182	8 130	9 621	11 146	12 152	12 465
Carbon contents in charge – SUM [Mg]	34 666	31 865	32 488	27 014	22 551	29 261	33 004	33 600	34 466
OUTPUT									
Steel [Mg]	**2 572 388**	**2 264 300**	**2 308 632**	**1 950 887**	**1 727 343**	**2 044 184**	**2 368 054**	**2 581 861**	**2 648 398**
Material-specific carbon content									
Steel [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon content in products [Mg C]									
Steel	10 290	9 057	9 235	7 804	6 909	8 177	9 472	10 327	10 594
Carbon content in products – SUM [Mg]	10 290	9 057	9 235	7 804	6 909	8 177	9 472	10 327	10 594
C emission from steel production [Mg]	24 377	22 807	23 254	19 211	15 642	21 084	23 532	23 273	23 873
CO_2 process emission from steel production [Gg]	**89.389**	**83.635**	**85.272**	**70.446**	**57.359**	**77.317**	**86.292**	**85.341**	**87.541**
CO_2 EMISSION FACTOR [kg CO_2/Mg steel]	**34.75**	**36.94**	**36.94**	**36.11**	**33.21**	**37.82**	**36.44**	**33.05**	**33.05**

Table 4.4.6. (cont.) Carbon balance for steel production in electric arc furnace in years 1988-2004

	1997	1998	1999	2000	2001	2002	2003	2004
CHARGE								
Steel scrap [Mg]	3 367 519	3 611 532	2 660 359	3 538 030	3 024 402	2 872 406	2 178 588	4 177 197
EAF carbon electrodes [Mg]	6 103	6 546	5 933	6 896	5 899	5 378	6 125	7 814
Ferroalloys [Mg]	7 556	8 104	7 345	8 538	7 304	6 659	7 583	9 674
Coke – carbon pick-up [Mg]	1 536	4 500	4 800	16 774	14 348	13 082	18 319	20 299
Calcium and magnesium carbonate [Mg]	33 675	36 115	26 604	35 380	30 244	28 724	21 786	41 772
Anthracite carbon pick-up [Mg]	20 205	21 669	15 962	21 228	18 146	17 234	19 607	37 595
Technological indicators								
Scrap [Mg/Mg of steel]	1.1587	1.1587	0.9417	1.0774	1.0767	1.1215	0.7470	1.1226
EAF carbon electrodes [Mg/Mg of steel]	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021
Ferroalloys [Mg/Mg of steel]	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Coke – carbon pick-up [Mg/Mg of steel]	0.0005	0.0014	0.0017	0.0051	0.0051	0.0051	0.0063	0.0055
Calcium and magnesium carbonate [Mg/Mg scrap]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Anthracite carbon pick-up [Mg/Mg scrap]	0.006	0.006	0.006	0.006	0.006	0.006	0.009	0.009
Material-specific carbon content								
Scrap [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
EAF carbon electrodes [Mg C/Mg]	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Ferroalloys [Mg C/Mg]	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
Coke – carbon pick-up [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Calcium and magnesium carbonate [Mg C/Mg]	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Anthracite carbon pick-up [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Carbon contents in charge components [Mg C]								
Steel scrap	13 470	14 446	10 641	14 152	12 098	11 490	8 714	16 709
EAF carbon electrodes	5 005	5 367	4 865	5 655	4 837	4 410	5 022	6 407
Ferroalloys	20	21	19	22	19	17	20	25
Coke –carbon pick-up	1 269	3 716	3 963	13 850	11 847	10 802	15 126	16 761
Calcium and magnesium carbonate	4 380	4 698	3 461	4 602	3 934	3 736	2 834	5 434
Anthracite carbon pick-up	13 679	14 671	10 807	14 372	12 286	11 668	13 275	25 453
Carbon contents in charge – SUM [Mg]	37 823	42 919	33 756	52 654	45 021	42 124	44 991	70 789
OUTPUT								
Steel [Mg]	**2 906 324**	**3 116 918**	**2 825 084**	**3 283 944**	**2 809 078**	**2 561 171**	**2 916 596**	**3 720 899**
Material-specific carbon content								
Steel [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon content in products [Mg C]								
Steel	11 625	12 468	11 300	13 136	11 236	10 245	11 666	14 884
Carbon content in products – SUM [Mg]	11 625	12 468	11 300	13 136	11 236	10 245	11 666	14 884
C emission from steel production [Mg]	26 197	30 451	22 456	39 518	33 785	31 879	33 325	55 905
CO_2 process emission from steel production [Gg]	**96.066**	**111.664**	**82.345**	**144.912**	**123.888**	**116.900**	**122.202**	**205.004**
CO_2 EMISSION FACTOR [kg CO_2/Mg steel]	**33.05**	**35.83**	**29.15**	**44.13**	**44.10**	**45.64**	**41.90**	**55.10**

4.4.2.7. Coke Production (CRF sector 2.C.1.j)

Processing emission of CO_2 from coking plants in the period 1990-2011 was allocated into 1.B.1 *Fugitive emission from solid fuels* subcategory.

4.4.2.8. Ferroalloys Production (CRF sector 2.C.2)

Emission of CO_2 concerning ferroalloys production was estimated based on annual ferrosilicon production taken from [GUS 2012b]. Applied emission factor of 3900 kg CO_2/Mg ferrosilicon, was taken from [IPCC 1997] – *Workbook*, tab. 2-17 for ferrosilicon – 75% Si.

CH_4 emission was estimated based on emission factors from [IPCC 2006] – tab. 4.4.7 which is equal 1 kg CH_4/Mg ferrosilicon – 75% Si.

In the period 1988-2010 CO_2 and CH_4 process emission from ferroalloys production was estimated also based on annual ferrosilicon production taken from [GUS 1989b-2011b] (figure 4.4.2) and emission factors as in year 2011.

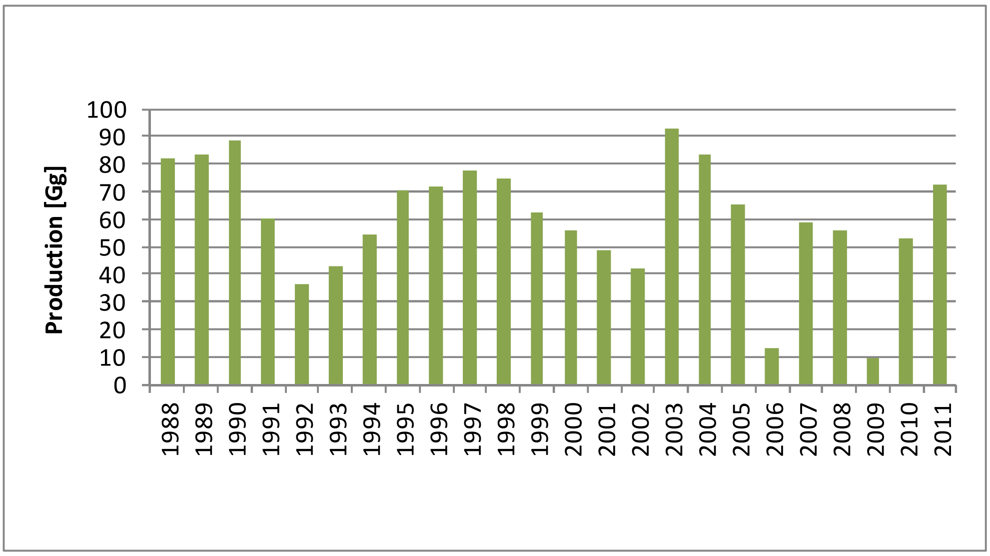

Figure 4.4.2. Production of ferrosilicon in 1988-2011

4.4.2.9. Aluminium Production (CRF sector 2.C.3)

Calculation of CO_2 emission from primary aluminium production for 2011 is based on the data on aluminium production published in [GUS 2012b]. The emission factor, which is equal 1.8 Mg CO_2/Mg primary aluminium, was taken from [IPCC 1997] as the value recommended for Soderberg process.

CO_2 process emissions from aluminium production for 1988-2011 were estimated according to the above mentioned description. The amount of emissions for the entire trend is shown in figure 4.4.3.

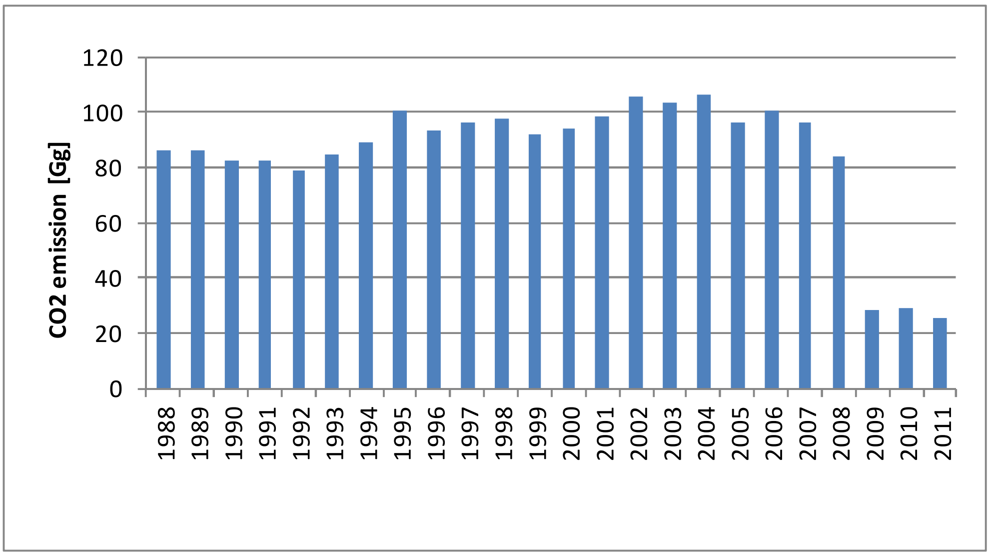

Figure 4.4.3. CO_2 process emission for aluminium production in 1988-2011

4.4.2.10. Other Metals Production (CRF sector 2.C.5)

- *Zinc production*

Process emission of CO_2 from zinc production was estimated based on annual zinc production taken from GUS [GUS 2012b]. The emission factor comes from [IPCC 2006] – table 4.24 and is 1.72 Mg CO_2/Mg zinc.

For the entire period 1988-2011 data source on zinc production as well as the emission factor remain the same. The trend of process emissions from zinc production is given in figure 4.4.4.

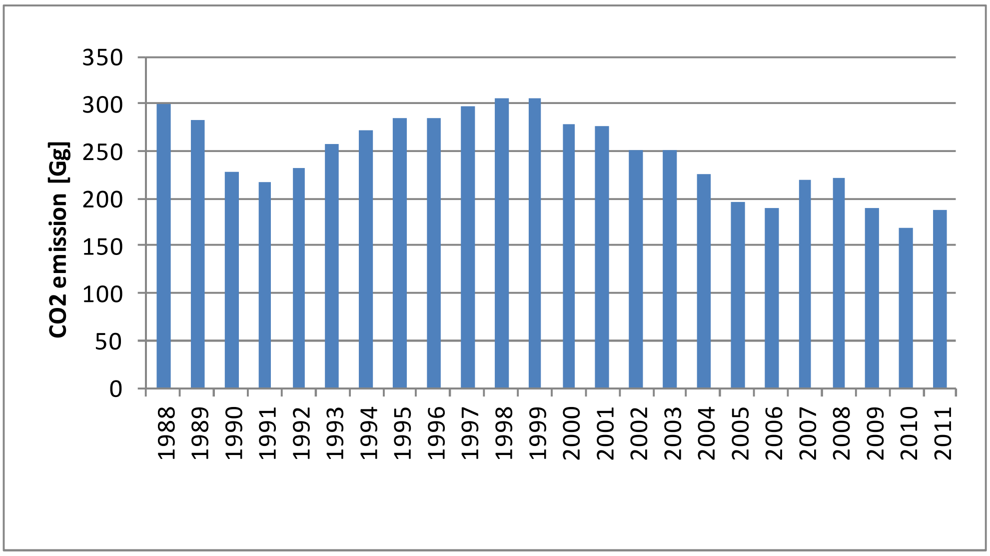

Figure 4.4.4. CO_2 process emission for zinc production in 1988-2011

- *Lead production*

Process emission of CO_2 from lead production was estimated based on annual lead production taken from GUS [GUS 2012b]. The default emission factor of 0.52 Mg CO_2/Mg lead from [IPCC 2006] – table 4.21 was applied.

For the entire period 1988-2011 the same emission factor was used. Data on lead production come from [GUS 1989b-2012b]. The trend of process emissions from lead production is given in figure 4.4.5.

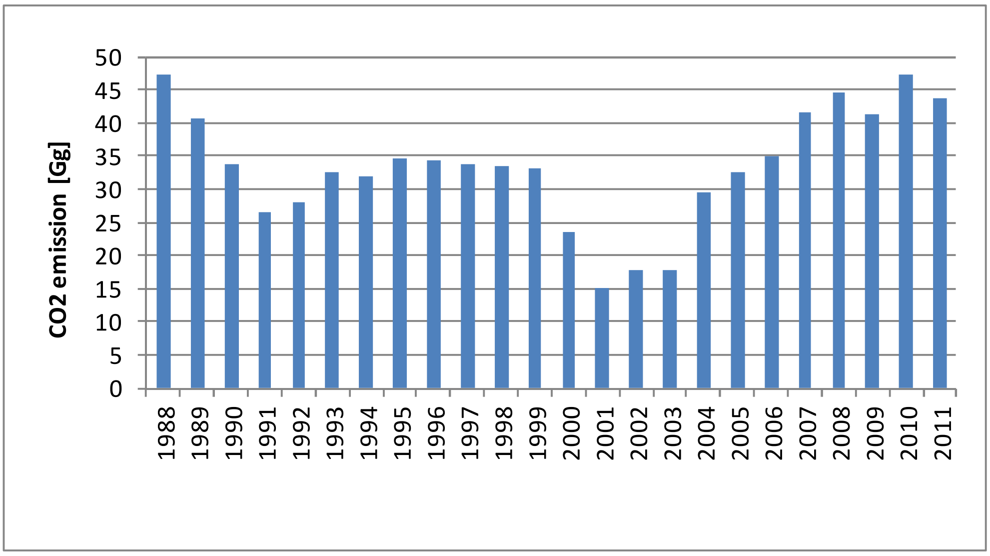

Figure 4.4.5. CO_2 process emission for lead production in 1988-2011

4.4.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.4.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.4.5. Source-specific recalculations

- for entire period 1988-2011, process emission of CO_2 and CH_4 from coke production was reallocated from 2.C.1 category into 1.B.1,
- for the years 2007 and 2009, AD and relating emission values in 2.C.3. *Aluminium production* were corrected
- for the year 2007 values of oxygen steel production was corrected

4.4.6. Source-specific planned improvements

- Further attempt to improve the comparability of data in particular subsectors of 2.C.1 (sinter, steel and pig iron productions) between periods 1988-2004 and 2005-2011 (for which ETS data was applied) to get the data comparability for the entire time period in both 2.C.1 and 1.A.2.a categories.

4.5. Other Production (CRF sector 2.D)

- *Pulp and paper production* (CRF 2.D.1)

CO_2 process emissions from pulp and paper production for 2011 and for 2005-2010 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS [KOBiZE 2012]. These emissions were as follows: 8.2 Gg for 2011, 8.6 Gg CO_2 for years 2010 and 2009, 6.3 Gg CO_2 for 2008 and below 0.1 Gg CO_2 for the years 2005-2007.

4.6. Consumption of Halocarbons and SF_6 (CRF sector 2.F)

4.6.1 Source category description

Emissions of HFC, PFCs and SF_6 are estimated based on official activity data available at public statistics (GUS) and data collected by surveys among importers and exporters of CFCs and F-gases. In case of refrigeration and air-conditioning equipment containing HFCs, some information concerning e.g. amounts of gas used, are collected by experts among main domestic producers and importers/exporters [Mąkosa 2012]. This chapter also includes description of PFC emission from IPCC 2.C.3 Aluminum production described under PFC section below. Most of the emission factors used in the national GHG inventory are default IPCC values, except CF4 and C2F6 emission from aluminum production, where country specific factors where applied.

4.6.2 Methodological issues

HFC

The national GHG inventory covers the following emission sources for HFCs:

- aerosols (technical and medical),
- foams,
- fire-fighting equipment (fire extinguishers),
- solvents (introduced in submission 2013)
- and the dominating sub-sector in terms of emission volume: refrigeration and air-conditioning equipment (2.F.1).

For transparency reasons and due to importance of the emissions from the refrigeration and air-conditioning equipment – the main assumptions for estimates were described with more details below. Activity data and assumptions made within the sector were revised in 2013. Amount of input in each equipment type was given in table 4.6.1.

Table 4.6.1. Amount of input in each equipment type

Equipment type	F-gas input per piece of equipment [kg]
Domestic refrigerators	0.14
Domestic freezers	0.14
Commercial refrigeration	3.1
Stationary air-conditioning	2.0
Passenger cars with air-conditioning	1.2
Public transport	1.5
Trucks	1.5
Trailers	5.5
Wagon, tank, cold rooms	5.5
Cargo railway cars	5.5
Tram cars	5.5
Equipment used for refrigeration	5.5

Estimates of the amount of each gas in selected equipment type assumption on shares of gases (or their mixes) were applied (see table 4.6.2. and 4.6.3 below)

Table 4.6.2. Share of gases and mixes for commercial refrigerators

Gas or mix	Percent of mix	HFC-125 amount	HFC-134a amount	HFC-143a amount	HFC-32 amount
407c	10	4	4	2	0
410a	70	35	0	0	35
HFC-134a	20	0	20	0	0
Amount of gas applied to estimates		38	25	2	35

Table 4.6.3. Share of gases and mixes for stationary air-conditioning

Gas or mix	Percent of mix	HFC-125 amount	HFC-134a amount	HFC-143a amount	HFC-32 amount
404a	30	12	1	17	0
507a	40	20	0	20	0
HFC-134a	30	0	30	0	0
Amount of gas applied to estimates		35	30	35	0

The final assumptions on percent of refrigeration equipment where HFC-32, 125, 134a and 143a were used was shown in tables 4.6.4-4.6.7 below.

Table 4.6.4. Percent of equipment in which HFC-32 was used

Type of equipment	Percent of equipment in which HFC-32 was used																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Stationary air-conditioning	0	0	0	0	0	25	30	35	35	35	35	35	35	35	35	35	35

Table 4.6.5. Percent of equipment in which HFC-125 was used

Type of equipment	Percent of equipment in which HFC-125 was used																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Commercial air-conditioning	0	0	5	10	15	20	20	25	30	25	30	30	30	30	29	28	27
Stationary air-conditioning	0	0	0	0	0	25	30	35	35	35	38	38	38	38	38	38	38

Table 4.6.6. Percent of equipment in which HFC-134a was used

Type of equipment	Percent of equipment in which HFC-134a was used																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Domestic refrigerators	50	70	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0
Domestic freezers	50	70	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0
Commercial air-conditioning	30	30	30	30	30	30	30	30	30	30	30	30	30	30	29	28	27
Stationary air-conditioning	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Passenger cars with air-conditioning	15	20	25	30	40	50	60	60	70	70	80	80	90	90	100	100	100
Public transport	10	10	20	25	30	30	30	30	40	40	40	50	50	50	60	60	60
Trucks	0	0	15	20	25	25	25	30	30	30	0	40	40	50	50	50	50

Type of equipment	Percent of equipment in which HFC-134a was used																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Trailers	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25
Wagon, tank, cold rooms	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25
Cargo railway cars	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25
Tram cars	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25
Equipment used for refrigeration	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25

Table 4.6.7. Percent of equipment in which HFC-143a was used

Type of equipment	Percent of equipment in which HFC-143a was used																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Commercial air-conditioning	0	0	7	15	20	25	25	35	35	35	40	40	40	40	39	39	38
Stationary air-conditioning	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2

Table 4.6.8 shows aggregated national total HFCs emissions over 1995-2011 expressed in CO_2 equivalents and HFCs emission in sub-sector: 2.F.1 Refrigeration and Air Conditioning Equipment. Prior to 1995, HFCs were not used in Poland.

Table 4.6.8. HFCs emissions in 2.F.1 Refrigeration and Air Conditioning Equipment and in Total

Year	HFCs emissions in 2.F.1 Refrigeration and Air Conditioning Equipment [Gg CO_2 eq.]	Total HFCs emissions [Gg CO_2 eq.]
1995	173.98	189.90
1996	212.69	292.49
1997	299.39	415.91
1998	396.00	505.30
1999	614.67	724.26
2000	1026.82	1127.78
2001	1545.97	1717.39
2002	2037.70	2221.21
2003	2632.03	2723.42
2004	3115.71	3482.23
2005	3594.69	4424.87
2006	4115.27	5053.80
2007	4826.12	5641.57
2008	4489.74	5114.06
2009	4991.22	5453.34
2010	5470.10	5694.34
2011	6044.53	6210.80

PFC

The national GHG inventory covers the following emission sources for PFCs: fire extinguishers (C_4F_{10}) and primary aluminium production (CF_4, C_2F_6). The dominating source of emission of PFC gases in Poland is IPCC sector 2.C.3 Aluminium production (tables: 4.8c and 4.9a). Activities on aluminium production were taken from [GUS 2010b]. *Tier 1* method and the newly introduced country specific emission factors were used for estimation of PFC emissions:

for CF4 EF = 0.373 kg/Mg aluminium produced
for C2F6 EF = 0.027 kg/Mg aluminium produced

Above country specific emission factor are based on installations reporting under EU ETS.

Table 4.6.9 shows aggregated national total PFCs emissions over 1988-2011 expressed in CO2 equivalents and PFCs emission in sub-sector: 2.C.3 Aluminium Production. The use of PFCs in fire extinguishers began in 1996. Prior to 1996, the only known source of PFCs was primary aluminium production.

Table 4.6.9. PFCs emissions in 2.C.3 Aluminium Production and in Total

Year	PFCs emissions in 2.C.3 Aluminium Production [Gg CO_2 eq.]	Total PFCs emissions [Gg CO_2 eq.]
1988	127.55	127.55
1989	127.77	127.77
1990	122.88	122.88
1991	122.40	122.40
1992	116.61	116.61
1993	125.47	125.47
1994	132.33	132.33
1995	148.96	148.96
1996	138.79	139.45
1997	143.30	149.56
1998	144.79	150.87
1999	136.25	145.27
2000	139.89	151.88
2001	145.94	168.74
2002	157.17	177.61
2003	153.00	172.31
2004	157.52	175.86
2005	143.22	160.65
2006	149.52	166.08
2007	142.68	158.41
2008	124.90	139.85
2009	45.04	59.24
2010	42.64	56.13
2011	37.07	49.88

SF_6

As concerns SF_6 the national GHG inventory covers the following emission sources: electrical equipment and magnesium foundries. Data on Mg casting were obtained from yearbooks of *Modern Casting*. The following emission factors [IPCC 2000] were used for calculation of SF_6 emission:

Electrical equipment manufacturing – EF = 0.06 Mg/Mg of SF_6 used

Electrical equipment use – EF = 0.05 Mg/Mg SF6 in use (1995), EF = 0.02 Mg/Mg (since 1996)

Mg casting – EF = 1kg SF_6 /Mg of cast.

Table 4.6.10 includes the activity data used for estimation of PFC and SF6 emissions over the period: 1988-2011.

Table 4.6.10. Activity data used for estimation of PFCs and SF_6 emissions

Activity characteristic for the source sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
2.C. Metal production														
3. Aluminium Production [Gg]	47.72	47.80	45.97	45.79	43.63	46.94	49.51	55.73	51.92	53.61	54.17	50.97	52.34	54.60
4. SF_6 Used in Magnesium foundries – amount of imported SF_6 [Mg]							320	400	400	345	291	236	181	127
2.F Consumption of HFC, PFC and SF_6														
8. Electrical equipment – amount of SF_6 in use [Mg]								11.00	14.02	17.05	20.07	23.10	26.12	28.70
8 Electrical equipment – amount of imported SF_6 [Mg]								0.00	0.60	0.60	2.00	2.33	2.66	3.30

Activity characteristic for the source sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2.C. Metal production										
3. Aluminium Production [Gg]	58.80	57.24	58.93	53.58	55.94	62.51	46.73	16.85	15.95	13.87
4. SF_6 Used in Magnesium foundries – amount of imported SF_6 [Mg]	72	46	20	30	65	100	100	100	100	100
2.F Consumption of HFC, PFC and SF_6										
8. Electrical equipment – amount of SF_6 in use [Mg]	32.04	33.75	36.45	40.57	46.23	48.63	51.32	55.80	57.97	61.50
8. Electrical equipment –amount of imported SF_6 [Mg]	4.16	2.50	3.59	5.16	6.89	3.54	3.89	5.86	3.50	4.99

Table 4.6.5 shows aggregated national total SF6 emissions over 1994-2011 expressed in tones compared to SF_6 emission in sub-sector: 2.F.8 *Electrical Equipment*. The use of SF6 in magnesium foundries began in 1994. There is no data available on SF6 use prior to 1994.

Table 4.6.5. SF_6 emissions in 2.F.8 Electrical Equipment and in Total

Year	SF_6 emissions in 2.F.8 Electrical Equipment [t]	Total SF_6 emissions [t]
1994	-	0,58
1995	0,55	1,28
1996	0,32	1,04
1997	0,38	1,00
1998	0,52	1,05
1999	0,60	1,03
2000	0,68	1,01
2001	0,77	1,00
2002	0,89	1,02
2003	0,82	0,91

Year	SF_6 emissions in 2.F.8 Electrical Equipment [t]	Total SF_6 emissions [t]
2004	0,94	0,98
2005	1,12	1,18
2006	1,34	1,46
2007	1,18	1,37
2008	1,26	1,44
2009	1,47	1,65
2010	1,37	1,55
2011	1,53	1,71

4.6.3. Uncertainties and time-series consistency

Simplified analysis were made for industrial gases HFC, PFC and SF6, where uncertainty assumptions were applied directly to emission values of each pollutant. Due to lack of available information, simplified approach has to be used and country recognizes need of additional analysis in this sector as planned improvement for future inventories. More details on uncertainty assessment of whole inventory are given in annex 6.

	HFC Emission [Gg of CO_2 eq.]	PFC Emission [Gg of CO_2 eq.]	SF_6 Emission [Gg of CO_2 eq.]	HFC Emission uncertainty [%]	PFC Emission uncertainty [%]	SF_6 Emission uncertainty [%]	HFC Emission absolute uncertainty [Gg of CO_2 eq.]	PFC Emission absolute uncertainty [Gg of CO_2 eq.]	SF_6 Emission absolute uncertainty [Gg of CO_2 eq.]
TOTAL	6 824.19	76.97	37.07	**43.6%**	**83.6%**	**89.1%**	2 976.53	76.97	32.73
2. Industrial Processes	6 824.19	76.97	37.07	43.6%	83.6%	89.1%	2 976.53	76.97	32.73
C. Metal Production		62.77	4.35	0.0%	100.0%	100.0%		62.77	
3. Aluminium Production		62.77	4.35		100.0%	100.0%		62.77	4.35
F. Consumption of Halocarbons and SF6	6 824.19	14.20	32.73	43.6%	100.0%	100.0%	2976.53	14.20	32.73
1. Refrigeration and Air Conditioning Equipment	4 195.31			50.0%			2097.66		
2. Foam Blow ing	330.67			50.0%				0.00	
3. Fire Extinguishers	16.60	14.20		50.0%	1				
4. Aerosols/ Metered Dose Inhalers	178.23			50.0%			89.12		
8. Electrical Equipment			32.73			100.0%			32.73
9. Other - Potential emissions as a proxy for actual emission	2 103.38			100.0%			2103.38		

4.6.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.6.5. Source-specific recalculations

Revised activity data was applied for activities of HFC, PFC and SF6 as a result project leading to improvement of emission estimates for f-gases. Analysis and new updated activities were introduced in sectors:

- aerosols (technical and medical),
- foams,
- fire-fighting equipment (fire extinguishers),
- solvents (newly introduced)
- and refrigeration and air-conditioning equipment.

No other recalculations were made in that sector since last submission.

4.6.6. Source-specific planned improvements

Continuing ongoing project on revision and extending dataset for f-gases.

4.7. Other Processes (CRF sector 2.G)

4.7.1. Source category description

In this category associated CO_2 emissions concerning use of lubricants and waxes in the period 1988-2011 were included.

CO_2 emission from refineries, previously reported in this subcategory, was allocated into 1.B.2. *Fugitive emissions from oil and natural gas.*

4.7.2. Methodological issues

Associated CO_2 emissions concerning use of lubricants and waxes were estimated according to the method described in chapter 3.7.

4.7.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.7.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.7.5. Source-specific recalculations

- CO_2 emission from refineries, previously reported in this subcategory (for the years 2005-2010), was allocated into 1.B.2. *Fugitive emissions from oil and natural gas.*

4.7.6. Source-specific planned improvements

Methodological changes are not planed in this IPCC category in the nearest future.

5. SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

5.1. Overview of sector

There are no sources from sector 3, which are identified as key sources.

The use of solvents is one of the main sources of NMVOC emissions and is associated with following processes:

- Paint application
- Degreasing and dry cleaning
- Chemical Products, Manufacture and Processing
- Other solvents use.

The GHG emission sources in Solvent and Other Product Use sector involve:

- CO_2 emission from the following activities: 3.A Paint application, 3.B Degreasing and dry cleaning, 3.C Chemical Products, Manufacture and Processing, 3.D Other solvents use (Fat edible and non-edible oil extraction, Other non-specified),

- N_2O emission from D.1.Use of N_2O for Anaesthesia.

Total emission of GHG in this sector in 2011 was estimated to 789 Gg CO_2 equivalent. This emission decreased by 21,6% from year 1988 to 2011 (Figure 5.1). This is mostly due to decrease of using solvents in paint applications (by 34%) (Figure 5.2).

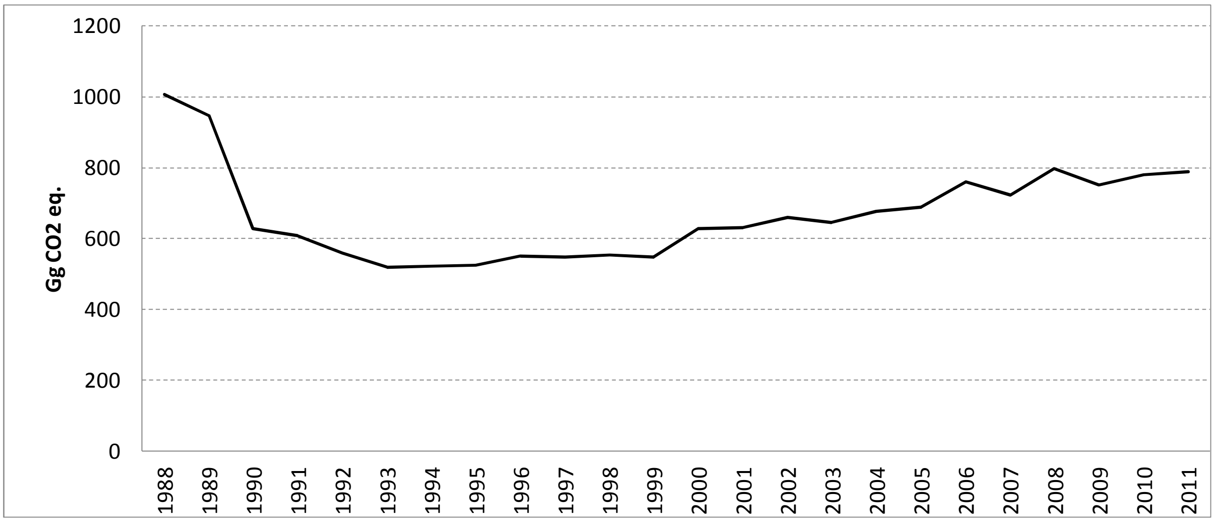

Figure 5.1. GHG emission from Solvent and Other Product Use sector in 1988-2011.

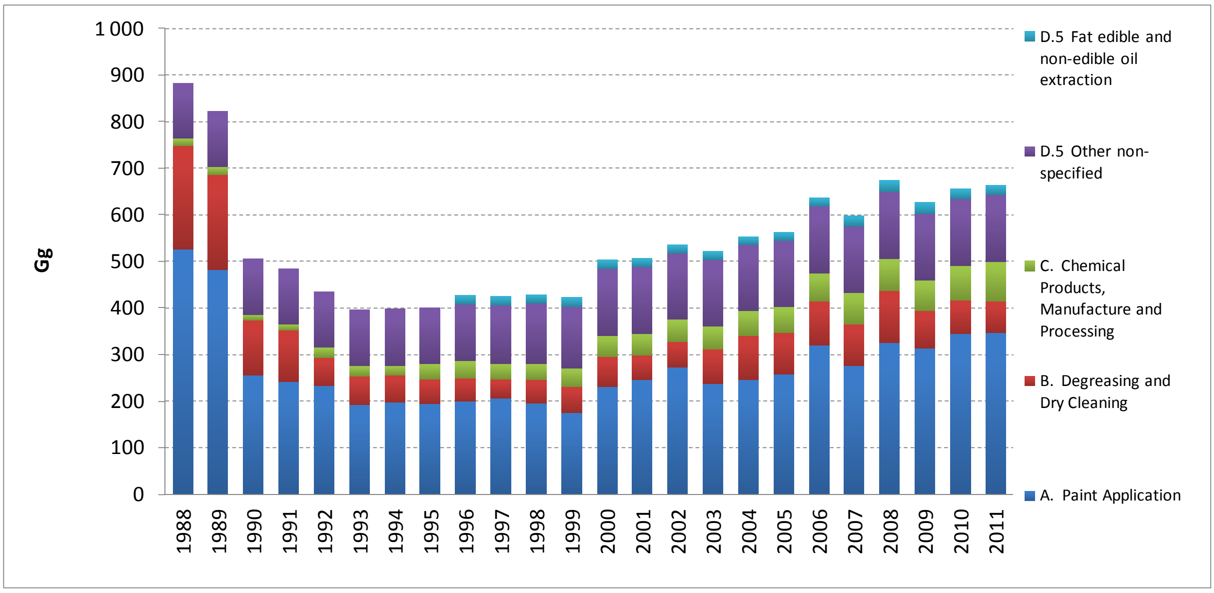

Figure 5.2. CO_2 emission from Solvent and Other Product Use sector in 1988-2011.

5.2 Paint application (CRF sector 3.A)

5.2.1. Source category description

Paint application includes the following processes:

- cars production,
- car repair,
- use in households,
- coil coating,
- ship building,
- wood painting,
- other applications in industry,
- other non-manufacturing applications.

In the national inventory all of these processes are considered jointly with the division on the use of paints based on organic solvents and water-based paints.

5.2.2. Methodological issues

Calculations of CO_2 emissions within Sector 3., using the common methodology, were carried out on the basis of results of NMVOC emissions [EMEP 2012]. CO_2 emission factor was determined assuming, that carbon content in NMVOC is 85%. Then carbon content has been calculated in a stoichiometric way to CO_2. Calculations were made in accordance with the following formula:

$$\mathbf{CO_2 = 0.85 * 44/12 * NMVOC}$$

where:

CO_2 – carbon dioxide emission from particular subsectors,
NMVOC – NMVOC emission from particular subsectors.

5.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2011 for IPCC sector *3.Solvents and other product use* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. In this sector due to lack of information on activities, uncertainty assumptions were applied directly to emission data. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6.
Recalculation of data for years 1988-2010 ensured consistency for whole time-series.

2011	CO_2 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	N_2O Emission uncertainty [%]
3. Solvent and Other Product Use	**664.67**	**0.40**	15.0%	50.0%

5.2.4. Source-specific QA/QC and verification

Activity data concerning solvent use for period 1988-1999 was taken from Institute for Ecology of Industrial Areas which performs its own QA/QC activities.
For years 2000-2011 the activity data was estimated by the National Centre for Emission Managment (KOBIZE) based on data from Central Statistical Office and emission factors developed by the Institute for Ecology of Industrial Areas (IETU).
Comparison of methodology applied with other countries experiences was made. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

5.2.5. Source-specific recalculations

Recalculations for the years 2000 – 2010 were made as result of the correction of activity data. Emission trend is consistent with the submission to:

- the European Union in the framework of reporting to the Directive 2001/81/EC of European Parliament and the Council of 23 October 2001 on national emission ceilings for certain pollutants (reported in NFR system, available at: http://cdr.eionet.europa.eu/pl/eu/nec/envuvvsda)
- the Convention on Long-range Transboundary Air Pollution (LRTAP) (available at: http://cdr.eionet.europa.eu/pl/un/EMEP%20emissions%20data/envuumgmw).

5.2.6. Source-specific planned improvements

Any possible improvements will be related to further development of NMVOCs emissions methodology.

5.3. Degreasing and dry Cleaning (CRF sector 3.B)

5.3.1. Source category description

Degreasing and dry cleaning include:

- degreasing metals,
- chemical cleaning,
- production of electronic components,
- other industrial cleaning processes.

In the Polish national inventory the first two processes were considered. It was assumed that "degreasing metals" include also solvents used for other purposes in industrial processes, which were not included separately in the inventory report for NMVOC (eg., electronic industry, textile, leather, etc.).

5.3.2. Methodological issues

See chapter 5.2.2.

5.3.3. Uncertainties and time-series consistency

See chapter 5.2.3.

5.3.4. Source-specific QA/QC and verification

See chapter 5.2.4.

5.3.5. Source-specific recalculations

See chapter 5.2.5.

5.3.6. Source-specific planned improvements

See chapter 5.2.6.

5.4. Chemical products, manufacture and processing (CRF sector 3.C)

5.4.1. Source category description

The national inventory includes emissions from the following processes:

- polyvinylchloride processing,
- polystyrene foam processing,
- rubber processing,
- pharmaceutical products manufacturing,
- paints manufacturing.

5.4.2. Methodological issues

See chapter 5.2.2.

5.4.3. Uncertainties and time-series consistency

See chapter 5.2.3.

5.4.4. Source-specific QA/QC and verification

See chapter 5.2.4.

5.4.5. Source-specific recalculations

See chapter 5.2.5.

5.4.6. Source-specific planned improvements

See chapter 5.2.6.

5.5. Other solvents use (CRF sector 3.D)

5.5.1. Source category description

The category "Other use of solvents" includes following processes:

- solvents in the household use (except paint)
- oil extraction (production of fats and oils)

N2O emission from anaesthesiology was minor and was estimated based on: Strategy of reduction of GHG emission until 2020 in the division into separate gases (N2O, HFCs, PFCs and SF6) and sectors- Institute of Environmental Protection [IOŚ 2001].

5.5.2. Methodological issues

See chapter 5.2.2.

5.5.3. Uncertainties and time-series consistency

See chapter 5.2.3.

5.5.4. Source-specific QA/QC and verification

See chapter 5.2.4.

5.5.5. Source-specific recalculations

See chapter 5.2.5.

5.5.6. Source-specific planned improvements

Further analysis of possibilities to amend data covering N_2O used in anaesthesiology.

6. AGRICULTURE (CRF SECTOR 4)

6.1. Overview of sector

The GHG emission sources in agricultural sector involve: enteric fermentation of domestic livestock (CH_4), manure related to livestock management (CH_4 and N_2O), agricultural soils (N_2O) and agricultural residue burning (CH_4 and N_2O). Emission categories like: rice cultivation and prescribed burning of savannas were skipped as do not occur in Poland.

Following categories from sector 4 have been identified as key sources (excluding LULUCF):

4.A - Enteric Fermentation (CH_4 emission), share in total GHG emission	2.3%
4.B - Manure Management (CH_4 emission), share in total GHG emission	0.7%
4.B - Manure Management (N_2O emission), share in total GHG emission	1.3%
4.D.1 - Direct Soil Emissions (N_2O emission), share in total GHG emission	3.1%
4.D.3 - Indirect Soil Emissions (N_2O emission), share in total GHG emission	1.2%

Share of these categories in total Poland's GHG emissions is 8.6%.

Total emissions of methane and nitrous oxide presented as carbon dioxide equivalent amounted to 34 929,80 Gg in 2011 and decreased since 1988 by 31.2%. Strong decrease in emissions in Poland occurred after 1989 when economic transformation began shifting from centrally planned economy to the market one (Fig. 6.2). The cost-effectiveness of agricultural production deeply changed then – up to 1989 agricultural production was generally subsidised on the state level. Since 1990 the prices for agricultural products as well as for agricultural means of production (like mineral fertilisers or machines) became the market ones and the subsidies were cut off. Deterioration of macroeconomic conditions for agricultural production in early 1990-ties during the restructuring of the state economy triggered changes in structure of agricultural farms since 1989. The big state agricultural farms became economically ineffective in a new market conditions so they were constantly eliminated. Also production of many small family farms became cost-ineffective so for instance the process of leaving the animal production by small farms started. On the other hand - gradual development of private and collective farms breeding large livestock herds begun. Still almost 70% of Polish farms are smaller than 5 hectares (Fig. 6.1).

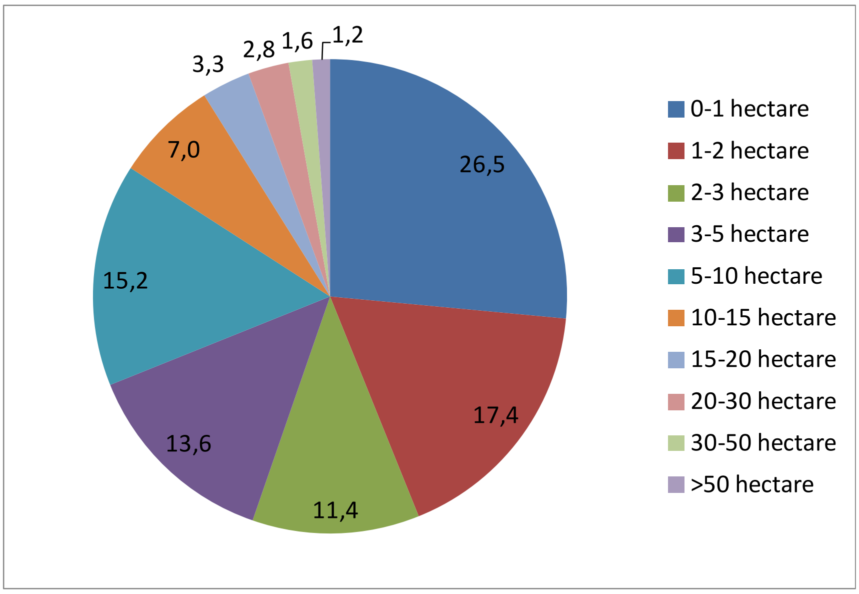

Figure 6.1. Share of farms according to area [%]

Dramatic decrease of livestock numbers was observed after 1989 – the cattle population decreased almost by half − from over 10 million in 1988 up to 5.7 million in 2002. Since 2002, just before accessing Poland to the European Union (in 2004), population of dairy cattle stabilized when the limits of milk production were known in advance what stabilized the milk market. In same time sheep population drop by 94% (from 4 million in 1988 up to 0,2 million in 2011). Especially sheep breeding became unprofitable − the wool up to 1989 was highly subsidised so sheep farming was related mostly to wool production and over 70% of sheep farms' income was related to wool sale. Small domestic demand for sheep meat also caused retreat from sheep breeding.

Additional reasons for decreasing the agricultural production in 1990-ties were export limitation for Eastern markets, deterioration of relationship between prices for agricultural products and prices for means of production as well as increased competition of imported food from Western Europe.

Since 2004, when Poland joined the European Union, the key factor influencing the Polish agriculture and rural areas is the EU Common Agricultural Policy aiming at improvement of productivity through introducing technical progress and stabilisation of agricultural market.

Interannual changes between 2010−2011 showed an increase in global agricultural production by 1.3%. This increase was caused by growth in crop production of 5.5% with simultaneous decrease in animal production of 3.5%. In 2011, comparing to the previous year, total crop harvest dropped by 1.7% while basic cereals including mix cereals dropped by 3.3%. That was caused by lower crop yields – cereal yields per ha decreased by 3.7%, while basic cereals including cereal mix − by 5.7%. Potato production increased by 10.8% as a result of increment of sawn area by 1.4% and higher yielding by 9%. Also sugar beet production grew by 17.1% due to higher yields (by 18.8%). Rape and agrimony production was limited by 16.5% resulting from decreasing sawn area (by 12.3%) and lower yields per ha by 5.1%.

In 2011 animal production for slaughter has increased by 1.5% comparing to previous year what was caused by increase in production in poultry meat (by 3.4%), beef (by 1.1%) as well as swine meat (by 0.7%). In 2011 increase in milk production was noted by 1.1% and wool by 25% while eggs production dropped by 6.8%. In 2011, with lower supply of beef livestock (drop in purchase by 9.6%), mean prices for beef increased by 20.6%. In 2011 supply for pork meat increased by 4.9% together with mean prices which grew by 16.2%. Also average prices for milk purchase were higher by 14.6% than in 2010.

In 2011 growing market prices for beef stimulated farmers to continue production of cattle for slaughter. Low cost-effectiveness of swine production related to maintaining of high prices for forage characterised pigs breeding in 2011 [GUS R1 2012].

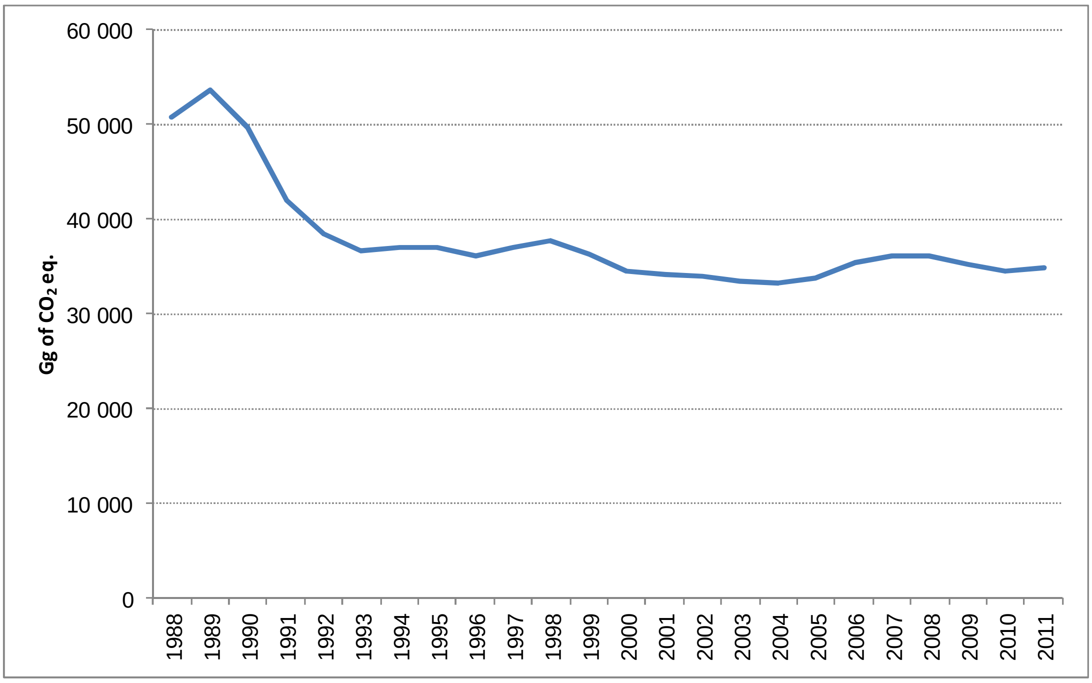

Figure 6.2. Total greenhouse gas emissions from the Polish agriculture in 1988-2011 presented in CO_2 equivalent

Most of methane emissions originate from enteric fermentation (76.7%) and about 23.2% is related to manure management. Share of field burning of agricultural residues represent only 0.1% of emissions (Fig. 6.3).

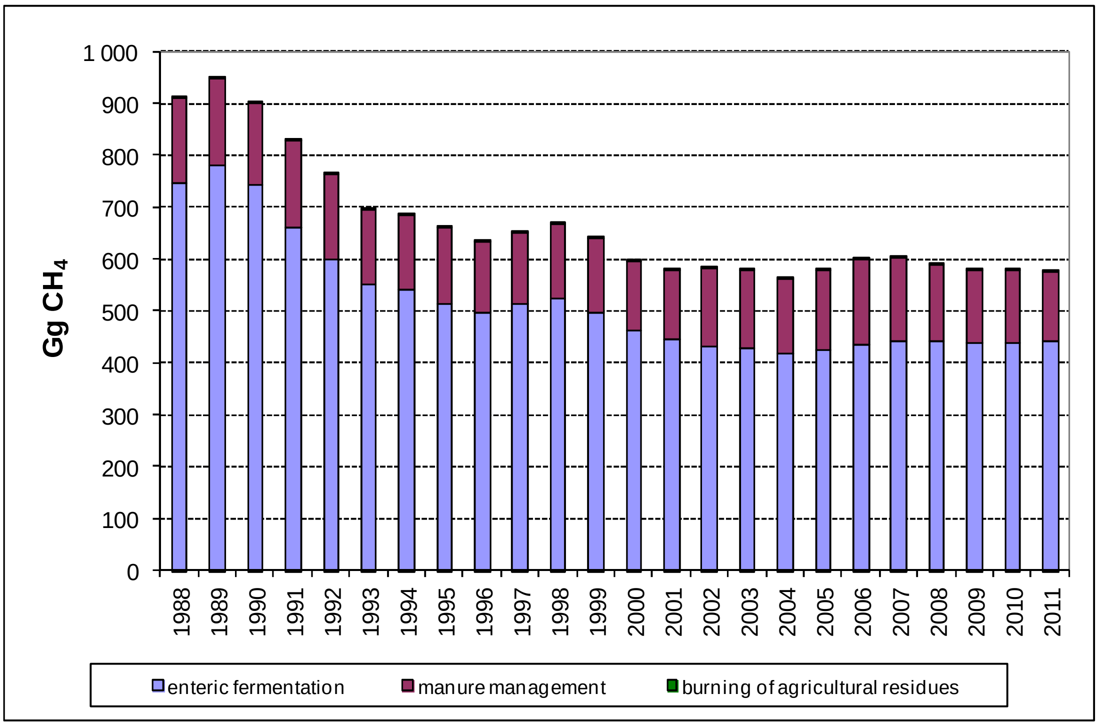

Figure 6.3. Methane emissions from the Polish agriculture in 1988-2011 according to subcategories

As concerns the nitrous oxide emissions, the main source of emissions in 2011 is agricultural soils responsible for 77.6% while manure management – for 22.4%. Emissions from field burning of agricultural residues are negligible (Fig. 6.4).

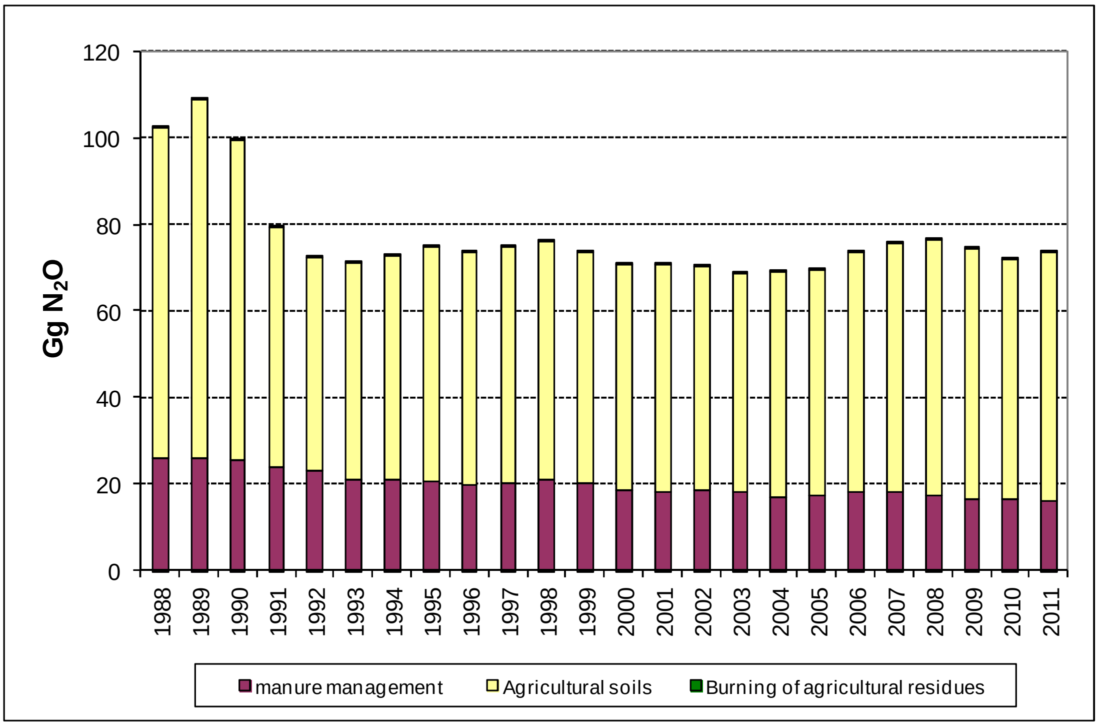

Figure 6.4. Nitrous oxide emissions from the Polish agriculture in 1988-2011 according to subcategories

6.2. Enteric Fermentation (CRF sector 4.A)

6.2.1. Source category description

CH_4 emissions from animals' enteric fermentation in 2011 amounted to 442.2 Gg CH_4 and decreased since 1988 by 40.7%. Majority of CH_4 emissions, more than 90%, come from enteric fermentation caused by cattle. The main driver influencing CH_4 emissions drop from enteric fermentation is the decrease of livestock population since 1988. The biggest change over time relates to the sheep breeding where cut of emissions is about 94% in 1988-2011. At the same time CH_4 emission reduction for dairy cattle amounted for 59%.

Table 6.1. Trends in CH_4 emissions from enteric fermentation in 1988-2011 [Gg CH4]

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Total
1988	444.79	218.65	33.32	0.90	18.92	29.41	745.98
1989	464.97	235.10	34.03	0.90	17.51	28.25	780.76
1990	450.69	211.05	32.26	0.90	16.94	29.20	741.03
1991	412.78	171.90	24.82	0.90	16.90	32.80	660.10
1992	378.45	154.57	14.80	0.90	16.20	33.13	598.05
1993	353.97	142.82	9.97	0.90	15.14	28.29	551.09
1994	344.32	147.86	6.92	0.90	11.20	29.20	540.40
1995	317.79	146.15	5.66	0.90	11.45	30.63	512.58
1996	310.00	143.39	4.40	0.90	10.24	26.95	495.87
1997	315.43	155.44	3.94	0.91	10.04	27.20	512.95
1998	319.88	162.25	3.58	0.93	10.10	28.75	525.49
1999	307.01	148.63	3.12	0.91	9.92	27.81	497.39
2000	281.20	142.23	2.86	0.88	9.89	25.68	462.76
2001	277.07	128.69	2.78	0.86	9.83	25.66	444.89
2002	265.31	129.03	2.62	0.97	5.94	27.94	431.80
2003	268.87	123.11	2.56	0.96	5.99	27.91	429.40
2004	260.83	121.73	2.52	0.88	5.78	25.48	417.22
2005	262.48	127.47	2.53	0.71	5.62	27.17	425.98
2006	266.12	133.38	2.40	0.65	5.53	28.32	436.40
2007	267.01	139.48	2.60	0.72	5.92	27.19	442.92
2008	269.39	141.42	2.56	0.68	5.86	23.14	443.04
2009	261.12	147.36	2.26	0.59	5.36	21.42	438.12
2010	258.78	150.99	2.03	0.54	4.75	22.30	439.16
2011	259.43	155.37	2.01	0.56	4.58	20.26	442.22
share [%] in 2011	58.67	35.13	0.45	0.13	1.04	4.58	100.00
change [%] 1988-2011	-41.67	-28.94	-93.96	-37.89	-75.80	-31.10	-40.72

6.2.2. Methodological issues

Activity data for 2011 applied in this category come from national statistics (Central Statistical Office) [GUS R2 2011] and were compiled on the basis of:

- generalized results of the sample survey on land use, sown area, and livestock, conducted in June 2011 in individual farms,
- generalized results of panel sample surveys on livestock in individual farms, i.e. the surveys on cattle, sheep and poultry in June and the surveys on pigs at the end of July,
- statistical reports in the scope of livestock in state-owned and cooperative farms, and in companies with public and private property share,
- information from voivodship experts about the horses and goats stock.

Generally activity data for entire inventoried period comes from the Central Statistical Office from analogous publication like for 2011. Due to lack of data on goats population in 1988-1995 and in

1997, data for 1996 was taken for the period 1988−1995. Additionally the mean value from 1996 and 1998 was calculated for 1997. Since 1998 goats population is available on an annual basis. Trends of animal population (excluding cattle) in 1988−2011 is given in table 6.2.

Table 6.2. Trends of selected livestock population in 1988-2011

Years	Livestock population [thousands]				
	Sheep	Goats	Horses	Swine	Poultry
1988	4 377	179	1 051	19 605	246 175
1989	4 409	179	973	18 835	265 976
1990	4 159	179	941	19 464	228 021
1991	3 234	179	939	21 868	221 088
1992	1 870	179	900	22 086	203 373
1993	1 268	179	841	18 860	198 352
1994	870	179	622	19 466	199 423
1995	713	179	636	20 418	192 438
1996	552	179	569	17 964	209 454
1997	491	182	558	18 135	203 585
1998	453	186	561	19 168	201 773
1999	392	181	551	18 538	202 904
2000	362	177	550	17 122	198 095
2001	343	172	546	17 105	206 727
2002	345	193	330	18 629	198 783
2003	338	192	333	18 605	146 321
2004	318	176	321	16 988	130 289
2005	316	142	312	18 112	125 073
2006	301	130	307	18 881	141 808
2007	332	144	329	18 129	150 620
2008	324	136	325	15 425	145 496
2009	286	119	298	14 279	140 826
2010	258	108	264	14 865	132 196
2011	251	112	254	13 509	143 557

Due to methodological changes in collecting statistical data on cattle population (apart from dairy cattle) performed in 1998 by Central Statistical Office some inconsistency in population trend of other cattle was noticed what was revealed in jump of the weighted mean CH_4 emission factor in 1997/1998 for this animal subcategory (tab. 6.4). So in response to recommendations of the Expert Review Team below explanation is given prepared by the Department of Agriculture of the Central Statistical office regarding to sudden change in population number of young cattle under 1 year between 1997 and 1998.

Since 1998 the frequency and dates of collecting data on livestock population was changed from quarterly up to twice a year: on 1 June and 1 December (following EU recommendations in calendar and frequency). Due to the change of dates of cattle registry introduced in 1998, the registry did not take into consideration the calves born in June and December. Up to 1997 cattle population included calves at the end of II and IV quarters born in June and December**.** This means that quantity of total cattle population as well as amount of calves under 1 year in June (and in December) of 1997 and 1998 are not fully comparable due to different reference periods.

Also in 1998 there were defined new categories of cattle structure herd. Group of calves under 1 year introduced in 1998 is not comparable with two groups: calves < 6 months and calves from 6 months up to 1 year defined in 1997. The factor of threshold weight of 300 kg for calves was defined, not only the date of birth is taken into account in grouping of animals. This means that calves under 1 year exceeding 300 kg were categorized in group under 1 year up to 1997 while these calves were categorized in group 1−2 years since 1998.

Apart from the issue of changing registry calendar and definitions of cattle subcategories in 1998 there was a decreasing trend observed since 1997/1998 in cattle population resulting from unfavourable economic conditions on a beef market. Since the end of 1997 the changes in cattle breeding were undertaken by producers directed to temper the cattle population in response to maintaining low prices of cattle for slaughter on the market. There was observed escalated trend of getting off the cattle by farmers: purchase of matured cattle for slaughter increased in 1998, comparing to 1997, by 7,9% and calves by 28,3%.

In 1998, as a consequence of measures undertaken by the beef producers aiming at limiting of cattle breeding, cattle population decreased by 4.8% between 30 June 1997 and 1 June 1998. In the following years further reduction of cattle herds were observed. Since 2005 cattle population started to slowly increase, and since 2007 has stabilised on the level of about 5700–5760 thousand in June.

Trends for cattle population with detail breakdown for non-dairy cattle is given in table 6.3 with the division for two periods: 1988-1997 and 1998-2011. It can be seen that there is a big share of young cattle in total non-dairy cattle in Poland what influences relatively low weighted mean CH_4 emission factor (table 6.5).

Table 6.3. Trends of cattle with detail breakdown for non-dairy cattle population in 1988-1997 and 1998-2008 [thousands]

	Dairy cattle	**Non-dairy cattle total**	calves <0.5 yr	young cattle 0.5-1 yr	heifers > 1 yr	bulls > 1 yr	matured bulls >2 yr
1988	4 806	**5 516**	2075	1575	1062	724	80
1989	4 994	**5 739**	2009	1576	1173	883	98
1990	4 919	**5 130**	1767	1374	1129	774	86
1991	4 577	**4 267**	1568	1093	951	590	66
1992	4 257	**3 964**	1592	1020	792	504	56
1993	3 983	**3 660**	1467	959	703	478	53
1994	3 863	**3 833**	1586	976	738	480	53
1995	3 579	**3 727**	1458	1032	684	498	55
1996	3 461	**3 675**	1408	1108	662	447	50
1997	3 490	**3 817**	1365	1047	729	608	68

	Dairy cattle	**Non-dairy cattle total**	young cattle under 1 yr	young cattle 1-2 yr	heifers > 2 yr	matured bulls >2 yr
1998	3 542	**3 413**	1799	1235	280	99
1999	3 418	**3 137**	1647	1108	283	99
2000	3 098	**2 985**	1572	1101	231	81
2001	3 005	**2 729**	1472	973	210	74
2002	2 873	**2 660**	1384	1084	142	50
2003	2 897	**2 592**	1349	932	229	81
2004	2 796	**2 557**	1309	916	246	86
2005	2 795	**2 688**	1425	978	209	76
2006	2 824	**2 782**	1428	1040	224	90
2007	2 787	**2 909**	1473	1072	265	99
2008	2 806	**2 950**	1502	1102	263	83
2009	2 688	**3012**	1472	1204	238	99
2010	2 656	**3068**	1457	1244	276	92
2011	2 626	**3136**	1481	1300	242	113

In the estimation of CH_4 emissions from enteric fermentation two types of approaches were applied – in case of horses, goats and swine, the IPCC *Tier 1* method was applied using default CH_4 Emission Factors [IPCC 1997] as given below:

Animal	Emission Factor [kg CH_4/head/year]
Horses	18.0
Goats	5.0
Swine	1.5

Emission from poultry's enteric fermentation was not estimated as the IPCC do not provide the guidelines.

More detailed, IPCC *Tier 2* method, was applied in calculation of methane emissions from enteric fermentation from cattle and sheep. Here country specific emission factors were calculated based on specific gross energy intake (GE) values estimated for selected cattle sub-categories [IPCC 2000, equation 4.14]:

$$EF = (GE * Y_m * 365 \text{ days/yr}) / (55.65 \text{ MJ/kg } CH_4)$$

where:

EF – emission factor, kg CH4/head/yr
GE – gross energy intake, MJ/head/day
Ym – methane conversion rate which is the fraction of gross energy in feed converted to methane.

Gross energy intake (GE) was calculated [IPCC 2000, equation 4.11] separately for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other mature cattle (over 2 years). Parameters required for estimation of GE factor for dairy cattle like pregnancy [GUS R1 2012], milk production [GUS R1 2012], percent of fat in milk [GUS M 2012] come from national statistics. Digestible energy (DE – expressed as a percent of gross energy) for dairy cattle was estimated by expert from the National Research Institute of Animal Production [Walczak 2006] and vary from 58.6% in 1988 through 60% in 1995 up to 62.8% in 2004 and afterwards due to diet improving. As concerns non-dairy cattle, DE parameters are as following: young cattle up to 1 year – 68.6%, bovines between 1–2 years and older cows – 62.4%, other matured cattle – 59.1%. Methane conversion rate (Y_m) was adopted from [IPCC 2000, table 4.8] as 6% for cattle and 7% for sheep.

Methane emission factor for dairy cattle, established based on the above described methodology, vary from 92.6 CH_4/animal/year in 1988 up to 98.8 kg CH_4/animal/year in 2011, following GE changes, and is slightly higher than IPCC default one (81 kg CH_4/animal/year) because of using country specific parameters for calculations (tab. 6.3). For non–dairy cattle GE factor was calculated for every subcategory based on country specific parameters like mean mass and daily weight gain [Walczak 2006]. Methane emission factors for entire trend for non-dairy cattle in form of weighted mean values, mean mass and GE are presented in table 6.4. The values of EFs vary from 39.8 kg CH_4/animal/year in 1988 up to 49.6 kg CH_4/animal/year in 2011. Relatively low EF (IPCC default is 56 kg CH_4/animal/year) depends on high share of youngest cattle (< 1 year) within this category (53% in 1998 and 47% in 2011) (table 6.5).

Table 6.4. Average annual milk production, daily gross energy intake (GE) and CH_4 emissions factors for dairy cattle in 1988–2011

Years	Average milk production [litres/cow/yr]	GE gross energy intake [MJ/cow/day]	EF emission factor [kg CH_4/animal/year]
1988	3165	235.17	92.55
1989	3260	236.59	93.11
1990	3151	232.82	91.62
1991	3082	229.17	90.19
1992	3015	225.91	88.90
1993	3075	225.83	88.87
1994	3121	226.49	89.13
1995	3136	225.63	88.79
1996	3249	227.60	89.57
1997	3370	229.66	90.38
1998	3491	229.49	90.31
1999	3510	228.25	89.82
2000	3668	230.65	90.77
2001	3828	234.30	92.20
2002	3902	234.66	92.35
2003	3969	235.76	92.78
2004	4082	237.05	93.29
2005	4147	238.64	93.91
2006	4200	239.46	94.24
2007	4292	243.45	95.81
2008	4351	243.96	96.01
2009	4455	246.86	97.15
2010	4487	247.61	97.44
2011	4618	251.05	98.79

Table 6.5. Trends of emission factors for cattle with detail breakdown of non-dairy cattle population in 1988-1997 and 1998-2008 [kg CH4/head/yr]

	Non-dairy cattle weighted mean	calves <0.5 yr	young cattle 0.5-1 yr	heifers > 1 yr	bulls > 1 yr	matured bulls >2 yr
1988	39.64	20.33	42.51	51.84	68.46	61.28
1989	40.97	20.33	42.51	51.84	68.46	61.28
1990	41.14	20.33	42.49	51.82	68.43	61.24
1991	40.29	20.33	42.48	51.80	68.41	61.20
1992	38.99	20.33	42.46	51.78	68.39	61.16
1993	39.02	20.33	42.45	51.75	68.36	61.12
1994	38.58	20.33	42.43	51.73	68.34	61.08
1995	39.21	20.33	42.42	51.71	68.31	61.04
1996	39.02	20.33	42.40	51.68	68.29	61.00
1997	40.72	20.33	42.39	51.66	68.26	60.96

	Non-dairy cattle weighted mean	young cattle under 1 yr	young cattle 1-2 yr	heifers > 2 yr	matured bulls >2 yr
1998	47.54	31.85	69.77	45.55	60.92
1999	47.38	31.84	69.74	45.52	60.88
2000	47.65	31.83	69.72	45.49	60.84
2001	47.16	31.82	69.70	45.46	60.80
2002	48.51	31.80	69.67	45.43	60.76
2003	47.51	31.79	69.65	45.40	60.71
2004	47.61	31.77	69.61	45.36	60.66
2005	47.42	31.78	69.62	45.37	60.67

	Non-dairy cattle weighted mean	young cattle under 1 yr	young cattle 1-2 yr	heifers > 2 yr	matured bulls >2 yr
2006	47.94	31.77	69.61	45.35	60.65
2007	47.95	31.78	69.62	45.38	60.68
2008	47.94	31.78	69.62	45.37	60.67
2009	48.92	31.78	69.62	45.38	60.68
2010	49.21	31.78	69.63	45.38	60.68
2011	49.55	31.78	69.62	45.37	60.67

For sheep GE factor was calculated for two subcategories: lambs up to 1 year and mature sheep above 1 year and presented in table 6.6 as the weighted mean value. Weighted mean emission factors for sheep for 1988–2011 oscillate around IPCC default value of 8 kg CH_4/animal/year (7.6 in 1988 up to 8.1 kg CH_4/animal/year in 2011). The characteristics like mean mass or daily mass gain of animals come from country case study [Walczak 2006], wool production come from national statistics [GUS M 2012].

Table 6.6. Daily gross energy intake (GE) and CH_4 emissions factors for sheep in 1988–2011

Years	GE gross energy intake (Weighted mean) [MJ/animal/day]	EF emission factor (Weighted mean) [kg CH_4/animal/year]
1988	17.36	7.61
1989	17.55	7.72
1990	17.61	7.76
1991	17.46	7.67
1992	17.89	7.91
1993	17.80	7.87
1994	17.96	7.95
1995	17.94	7.94
1996	17.99	7.97
1997	18.07	8.02
1998	17.88	7.91
1999	17.95	7.95
2000	17.89	7.91
2001	18.28	8.12
2002	17.33	7.59
2003	17.29	7.57
2004	17.87	7.91
2005	18.05	8.02
2006	17.97	7.97
2007	17.70	7.82
2008	17.85	7.90
2009	17.84	7.90
2010	17.75	7.86
2011	18.06	8.01

6.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2011 for IPCC sector *4.Agriculture* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6.
Recalculation of data for years 1988-2010 ensured consistency for whole time-series.

2011	CH_4 [Gg]	N_2O [Gg]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
4. Agriculture	**576.83**	**73.60**	28.4%	58.2%
A. Enteric Fermentation	442.22		34.4%	
B. Manure Management	133.77	16.48	44.6%	148.9%
D. Agricultural Soils		57.09		61.5%
F. Field Burning of Agricultural Residues	0.84	0.03	25.2%	112.8%

6.2.4. Source-specific QA/QC and verification

Activity data related to livestock population and any additional parameters like milk productivity or cattle pregnancy come from national statistics prepared by the Central Statistical Office. Data like livestock population, crop production, nitrogen fertilizers use and others are available in several publications that were cross-checked. Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.2.5. Source-specific recalculations

Activity data on share of cattle using pastures for 2010 were corrected.

6.2.6. Source-specific planned improvements

No further improvements are planned at this time.

6.3. Manure Management (CRF sector 4.B)

6.3.1. Source category description

CH_4 emissions related to animal manure management in 2011 amounted to 133.8 Gg and decreased since 1988 by 17.7%. Most of CH_4 emissions in 2011 come from manure generated by swine - 58.1%. Again the biggest change over time in CH_4 emissions relates to sheep breeding where cut of emissions amounted to 94% in 1988-2011 (tab. 6.7).

Table 6.7. Trends in CH_4 emissions from manure management according to livestock categories in 1988-2011

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total
1988	28.16	11.01	0.70	0.02	1.46	102.21	19.20	162.78
1989	29.51	14.86	0.72	0.02	1.35	98.41	20.75	165.63
1990	27.68	8.25	0.68	0.02	1.31	101.92	17.79	157.65
1991	25.23	8.88	0.52	0.02	1.31	114.75	17.24	167.96
1992	22.41	7.82	0.31	0.02	1.25	116.15	15.86	163.83
1993	19.93	6.67	0.21	0.02	1.17	99.40	15.47	142.87
1994	19.37	6.70	0.14	0.02	0.86	102.81	15.55	145.47
1995	17.86	6.24	0.12	0.02	0.88	108.07	15.01	148.20
1996	16.52	7.83	0.09	0.02	0.79	95.28	16.34	136.88
1997	17.67	5.90	0.08	0.02	0.78	96.40	15.88	136.72
1998	16.75	6.70	0.08	0.02	0.78	102.10	15.74	142.17
1999	19.99	6.52	0.07	0.02	0.77	98.96	15.83	142.14
2000	19.26	6.52	0.06	0.02	0.76	91.59	15.45	133.67
2001	18.86	6.09	0.06	0.02	0.76	91.70	16.12	133.61
2002	26.77	6.22	0.06	0.02	0.46	100.08	15.51	149.11
2003	32.12	6.04	0.05	0.02	0.46	100.16	11.41	150.27
2004	35.92	6.59	0.05	0.02	0.45	91.65	10.16	144.84
2005	36.47	6.86	0.05	0.02	0.43	100.96	9.76	154.55
2006	36.27	7.20	0.05	0.02	0.43	106.73	11.06	161.76
2007	37.58	7.19	0.05	0.02	0.46	104.57	11.75	161.62
2008	38.39	7.40	0.05	0.02	0.45	88.92	11.35	146.57
2009	36.89	7.64	0.05	0.01	0.41	85.30	10.98	141.29
2010	34.71	8.09	0.04	0.01	0.37	87.38	10.31	140.92
2011	36.06	8.4	0.04	0.01	0.35	77.67	11.20	133.77
share [%] in 2011	26.96	6.30	0.03	0.01	0.26	58.07	8.37	100.0
change [%] 1988-2011	+28.06	-23.50	-94.29	-50.00	-76.03	-24.1	-41.67	-17.82

Generally decreasing trend is observed in CH_4 emission from manure management of the most livestock sub-categories except cattle. Despite decreasing cattle population, the increasing share of liquid systems in the inventoried period caused certain rise of emissions.

6.3.2. Methodological issues

The source of activity data i.e. animal population was taken from the public statistics [GUS R2 2011] (tab. 6.2). Country specific data on the animal waste management systems (AWMS) come from [Walczak 2006, 2009, 2011, 2012].

The fractions of manure managed in given AWMS for cattle were assessed on an annual basis for period 1988-2002 and 2004−2009, data for 2003 was interpolated between 2002 and 2004. The share of pastures and solid storage were assessed for the key years: 1988-1989 and for 2004-2011 and the values in-between were interpolated (tab. 6.8).

As concerns swine manure management systems the share of liquid and solid storage was estimated based on AWMS shares and pigs population for age categories for 1988 [Walczak 2006]. Data for 2004−2011 was taken from [Walczak 2011, 2012]. Data for years between 1988 and 2004 interpolation was made.

For other animals permanent shares of AWMS were taken: for sheep - 20% on pastures and 80% solid storage, for goats and horses 22% on pastures and 78% on solid storage and for poultry 11% on liquid systems and 89% on solid storage based on average 2004−2009 [Walczak 2011].

Table 6.8. Fractions of manure managed in given AWMS for cattle and swine for 1988−2011 [%]

	Dairy cattle			Other cattle			swine		
	liquid	solid	pasture	liquid	solid	pasture	liquid	solid	pasture
1988	2.8	75.2	22.0	4.9	77.1	18.0	22.3	77.7	0.0
1989	2.8	75.2	22.0	6.8	75.2	18.0	22.4	77.6	0.0
1990	2.7	76.1	21.2	3.2	79.2	17.6	22.4	77.6	0.0
1991	2.7	76.9	20.4	5.1	77.7	17.2	22.5	77.5	0.0
1992	2.5	77.9	19.6	5.0	78.2	16.8	22.5	77.5	0.0
1993	2.3	78.9	18.8	4.4	79.2	16.4	22.6	77.4	0.0
1994	2.3	79.7	18.0	4.2	79.8	16.0	22.6	77.4	0.0
1995	2.3	80.4	17.2	3.8	80.6	15.6	22.7	77.3	0.0
1996	2.1	81.5	16.4	5.6	79.2	15.2	22.7	77.3	0.0
1997	2.4	82.0	15.6	3.0	82.2	14.8	22.8	77.2	0.0
1998	2.1	83.1	14.8	3.4	82.2	14.4	22.8	77.2	0.0
1999	3.3	82.7	14.0	3.7	82.3	14.0	22.9	77.1	0.0
2000	3.7	83.1	13.2	4.0	82.4	13.6	23.0	77.0	0.0
2001	3.7	83.9	12.4	4.3	82.6	13.2	23.0	77.0	0.0
2002	6.8	81.6	11.6	4.4	82.8	12.8	23.1	76.9	0.0
2003	8.6	80.5	10.8	4.5	83.1	12.4	23.1	76.9	0.0
2004	10.5	79.5	10.0	5.2	83.0	11.8	23.2	76.8	0.0
2005	10.6	79.4	10.0	5.2	82.8	12.0	24.0	76.0	0.0
2006	10.3	79.7	10.0	5.2	83.1	11.7	24.4	75.6	0.0
2007	10.7	79.2	10.0	4.8	83.1	12.0	25.0	75.0	0.0
2008	10.9	79.1	10.0	4.9	83.1	11.9	24.9	75.1	0.0
2009	10.8	79.2	10.0	4.8	83.1	12.0	25.9	74.1	0.0
2010	10.1	79.6	10.3	5.1	82.9	12.1	25.5	74.5	0.0
2011	10.6	79.1	10.3	5.2	82.9	11.9	24.9	75.1	0.0

In Poland prevail small farms where drylot systems for animal management are commonly used. Liquid systems are applied only at big farms, having more than 120 animals. Development of such big milk farms in early 2000-ies influenced increase of CH_4 emissions from manure management for dairy cattle since 2002.

6.3.2.1. Estimation of CH_4 emissions from manure management

The *Tier 1* methodology and the default emission factors, as given below, were used for estimation of CH_4 emissions from manure management of horses, goats and poultry [IPCC 1997] (tab. 6.8). The IPCC *Tier 2* methodology was used to establish domestic CH_4 emission factors for cattle, sheep and swine applying equation 4.17 from [IPCC 2000]:

$$EF = Vs * 365 \text{ days/year} * Bo * 0{,}67 \text{kg/m3} * \Sigma MCF * MS$$

where:

EF – emission factor (kg CH_4/animal/year),

Vs – average daily volatile excreted solids estimated using domestic GE for cattle and sheep (for swine the default value was applied [IPCC 1997, tab. B–6],
Bo – maximum CH_4 production capacity for manure produced by animal [IPCC 1997, tab. B–3, 4, 6, 7],
MCF – methane conversion factors for each manure management system for cool climate [IPCC 2000, tab. 4.10].
MS – fraction of Animal species/category in given AWMS

Examples of above mentioned parameters and emission factors for livestock are shown in table 6.9.

Table 6.9. Methane-producing potential (B_o), volatile solids excreted (Vs) and CH_4 emission factors for manure management in 2011

Livestock	**Bo Methane-producing potential [m^3 CH_4/kg Vs]**	**Vs Volatile Solids Excreted [kg dm/animal/day]**	**EF Emission Factor [kg CH_4/animal/year]**
Dairy cattle	0.24	4.66	13.73
Non-dairy cattle	0.17	2.18	2.69
Sheep	0.19	0.36	0.17
Goats	0.17	0.28	0.12
Horses	0.33	1.72	1.39
Swine	0.45	0.50	5.97
Poultry	0.32	0.10	0.08

At the figure 6.5 changes of CH_4 emission factors for dairy cows and non-dairy cattle in 1988–2011 are presented, where increase since 1990[th] is stimulated by rising share of liquid waste management systems. In case of sheep methane emission factor for entire inventoried period was around 0.17 kg CH_4/animal/year.

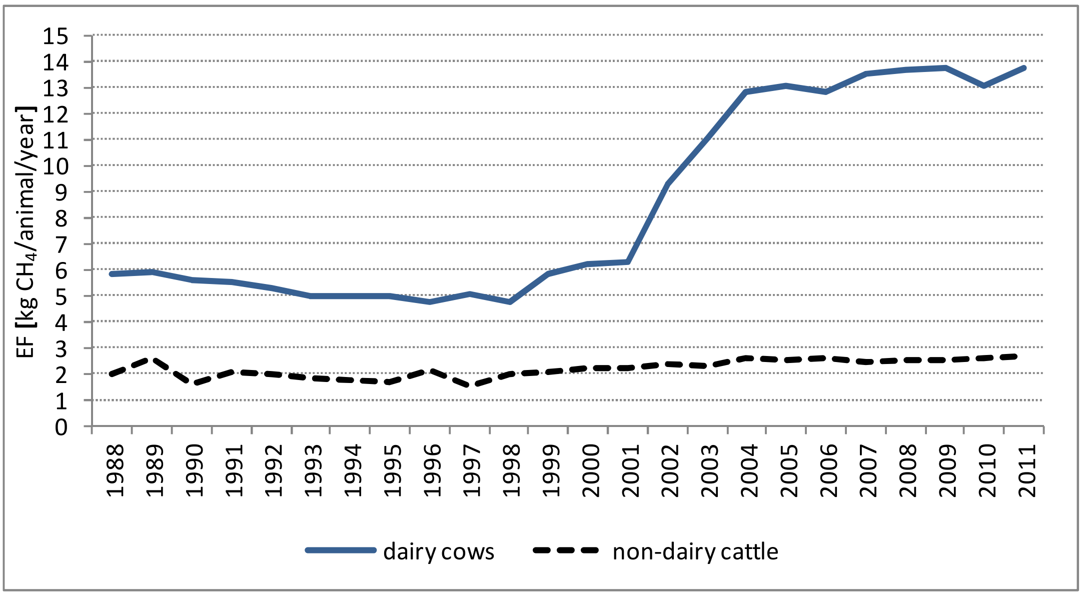

Figure 6.5. Methane emission factors from manure management for dairy cows and non-dairy cattle in 1988–2011

6.3.2.2. Estimation of N_2O emissions from manure management

Nitrous oxide emissions from manure management in 2011 were estimated based on recommended IPCC methodology [IPCC 1997] using domestic data on animal waste management systems for animal categories (tab. 6.8) [Walczak 2009, 2011, 2012]. Following the ERT recommendation made in 2009 country specific values of nitrogen content in animals manure (Nex) were applied.

Nnitrogen excretion rate (Nex) for cattle, horses and swine were calculated with the use of SFOm model, where the amount of animals manure were determined for livestock categories and utility sub-groups based on quantity, sort and digestibility of fodder applied. Then the nitrogen content in livestock manure was assessed based on manure management systems of collection and storage used [Jadczyszyn i in. 2000]. For goats the weighted mean value estimated for sheep in 1988-2011 was used. For poultry Nex parameters come from publication [Jadczyszyn et al 2009]. Country specific Nex values are given in table 6.10 and they are in line with parameters published in [UNECE 2001]. These Nex parameters have been applied for entire time series as there are no updated studies performed in this area.

Table 6.10. Nitrogen excreted (Nex) in manure by livestock

Livestock	Nex [kg/head/year]
Dairy cattle*:	
up to 3.5 thous. kg milk/cow/year	70.30
3.5- 4 thous. kg milk /cow/ year	75.90
4 - 6 thous. kg milk /cow/ year	86.70
above 6 thous. kg milk /cow/ year	119.30
Non-dairy cattle*:	
calf (0-3 months)	4.09
calf (3-6 months)	8.64
heifer (6-12 months)	22.20
heifer (12-24 months)	42.40
bull (6-18 months)	22.80
bull (> 24 months)	45.70
Sheep*:	
lamb (6-12 months)	3.81
sheep (> 1 year)	7.63
Goats	6.70
Horses*:	
light weight horses	26.16
heavy weight horses	29.27
Swine*:	
sows	15.50
sows with 18 litters	37.20
suckling pigs (20-30 kg)	6.69
piglets (30-70 kg)	14.76
butcher hogs (70-110 kg)	14.76
Poultry**:	
laying hens	0.382
broilers	0.262
turkeys	0.916
ducks	0.408
geese	0.447

* [Jadczyszyn i in. 2000]
** [Jadczyszyn 2009]

Default values of N_2O emission factors for management systems from [IPCC 2000, table 4.12] were applied (table 6.11).

Table 6.11. Factors of N_2O–N emission for various manure management systems [IPCC 2000]

Animal Waste Management Systems	Emission factor [kg N_2O-N/kg N]
Liquid systems	0.001
Solid storage and dry lot	0.020

6.3.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 6.2.3.

6.3.4. Source-specific QA/QC and verification

Activity data related to livestock population come from national statistics prepared by the Central Statistical Office. Data on Animal Waste Management Systems are elaborated by the National Research Institute of Animal Production which develops activities aiming at obtaining representative data on the production of main livestock categories. Collection of this data is based on appointing a suitable monitoring for various institutions like statistical office, Farmers Chambers, Centres for Agricultural Advice and Veterinary Inspection. Partially monitoring is covered also by Institute's employees.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.3.5. Source-specific recalculations

Parameters related to Animal Waste Management Systems were updated for 2010 based on information from National Research Institute of Animal Production database.

6.3.6. Source-specific planned improvements

Estimation of GHG emissions related to animal manure for pigs subcategories.

6.4. Agricultural Soils (CRF sector 4.D)

6.4.1. Source category description

Nitrous oxide emissions from agricultural soils amounted to 57.1 Gg N_2O in 2011 and dramatically decreased after 1989 and then stabilized since 1992 with slight increase in 2006−2008 (figure 6.6). There are a few main driving forces influencing emissions variability during entire inventoried period: nitrogen fertilizers use, livestock population, area of N–fixing crops and cultivated histosols.

As a result of economic transformation of the Polish economy in 1989 significant changes were observed in relation to crop production and usage of agricultural land. For instance the decrease of agricultural land of which share in total country area changed from 59.2% in 1989 up to 54% in 1996, also significant increase of fallow land was noted - in 1989 the share of fallow land in agricultural land was 1.1% while in 2002 - 13.6%. Between 1990 and 2002 the decrease of sown area by 3.5 million hectares occurred, also the decrease of mineral fertilisers' use drop from 164 kg per 1 ha of agricultural land in 1989/90 to 93 kg in 2001/02. Since 1988 production of certain crops in Poland changed noteworthy – potatoes cultivation dropped by 73% up to 2011 while maize production increased by 1073% (table 6.12).

Table 6.12. Main crops production in 1988−2011 in Poland [Gg]

	wheat	barley	maize	oats	rye	triticale	cereal mixed	millet & buckwheat	pulses edible	pulses feed	potatoes	rape & agrimony	All vegetables	All fruits
1988	7582	3804	204	2222	5501	1731	3387	73	108	457	34707	1199	5179	2168
1989	8462	3909	244	2185	6216	2404	3466	72	120	495	34390	1586	5067	2078
1990	9026	4217	290	2119	6044	2721	3554	43	116	493	36313	1206	5259	1416
1991	9270	4257	340	1873	5900	2449	3683	39	133	547	29038	1043	5637	1873
1992	7368	2819	206	1229	3981	1711	2612	36	98	282	23388	758	4518	2385
1993	8243	3255	290	1493	4992	1894	3200	50	107	304	36270	594	5823	2705
1994	7658	2686	189	1243	5300	1631	3026	30	66	149	23058	756	5198	2109
1995	8668	3278	239	1495	6288	2048	3844	45	101	167	24891	1377	5746	2115
1996	8576	3437	350	1581	5653	2130	3520	51	97	180	27217	449	5253	2781
1997	8193	3866	416	1630	5299	1841	4105	49	97	163	20776	595	5136	2887
1998	9537	3612	497	1460	5663	2058	4274	58	111	178	25949	1099	6096	2517
1999	9051	3401	599	1447	5181	2097	3914	60	99	218	19927	1132	5457	2387
2000	8503	2783	923	1070	4003	1901	3084	74	93	171	24232	958	5721	2247
2001	9283	3330	1362	1305	4864	2698	4060	58	88	123	19379	1064	5428	3413
2002	9304	3370	1962	1486	3831	3048	3608	40	95	134	15524	953	4537	3018
2003	7858	2831	1884	1182	3172	2812	2812	44	66	172	13731	793	4870	3309
2004	9892	3571	2344	1430	4281	3723	4322	72	77	193	13999	1633	5283	3521
2005	8771	3582	1945	1324	3404	3903	3916	83	66	187	10369	1450	5220	2923
2006	7060	3161	1261	1035	2622	3197	3379	59	60	146	8982	1652	4919	3212
2007	8317	4008	1722	1462	3126	4147	4257	96	75	210	11791	2130	5475	1694
2008	9275	3619	1844	1262	3449	4460	3673	82	56	179	10462	2106	5023	3843
2009	9790	3984	1706	1415	3713	5234	3884	93	60	212	9703	2497	5601	3749
2010	9408	3397	1994	1516	2852	4576	3339	146	88	268	8188	2229	4878	2826
2011	9339	3326	2392	1382	2601	4235	3373	109	84	251	9362	1862	5575	3414

More than 71% of N_2O emissions here are related to direct soil cultivation, while about 27% are generated in indirect emission processes. Only 2.5% come from animal manure left on pastures. The main sources of N_2O emissions estimated relate to direct soil cultivation covering:

- Synthetic fertilizers use,
- Animal manure applied to soils,
- Biological nitrogen fixation by legumes,
- Incorporation of crop residues after harvest,
- Application of sewage sludge on agricultural soils.

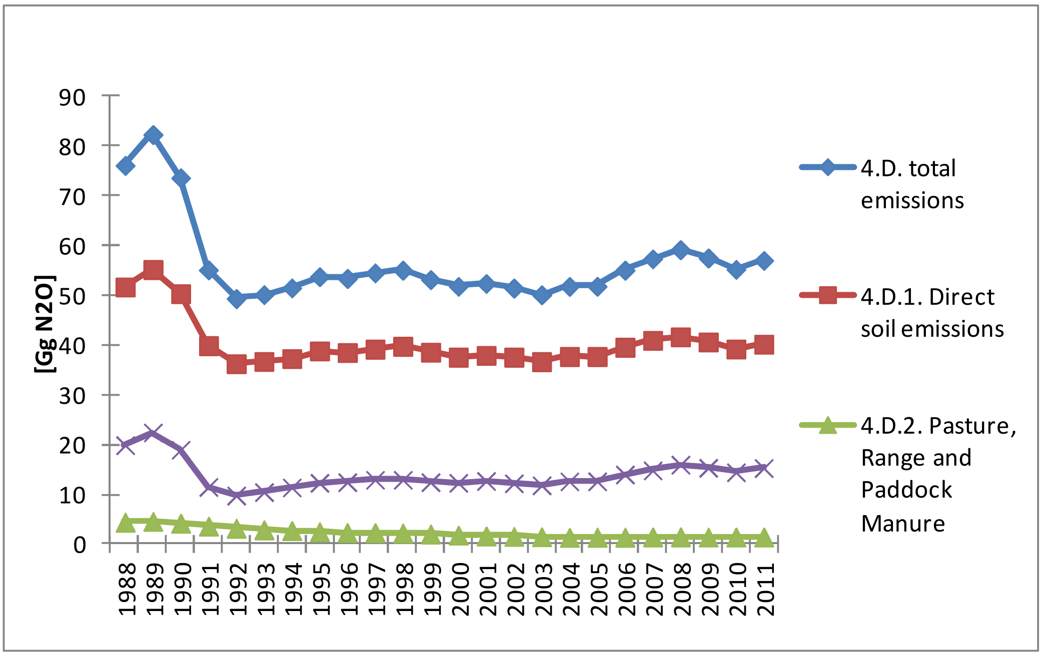

Figure 6.6. N_2O emissions from agricultural soils for 1988–2011

6.4.2. Methodological issues

6.4.2.1. Direct Soil Emissions - Synthetic Fertilizers (CRF sector 4.D.1.1)

N_2O emission from synthetic fertilizers was estimated based on the amount of nitrogen synthetic fertilizer applied to agricultural fields published in [GUS 2012]. Data regarding consumption of mineral fertilizers are elaborated on the basis of reporting from production and trade units, statistical reports of agricultural farms: state-owned, co-operatives and companies with share of public and private sector, expert's estimates as well as Central Statistical Office estimates. Present level of fertilizing is still lower than it was in 1988−1989. The drop of nitrogen fertilizers use in 1989−1992 amounted to 41% and gradually increased up to 2007. Since 2008 again slight decrease is observed (table 6.13). Projected use of nitrogen fertilisers is close to the present level [5RR 2010, table 5.8]. The recommendations following agricultural good practice elaborated by the Ministry of Agriculture and Rural Development contain the rules for rational use of fertilisers, free consultancy system for farmers in this area, while the largescale farms are obliged to elaborate fertilizing plans [5RR 2010, chapter 4.9.2].

Table 6.13. Nitrogen fertilizers use in 1988–2011 in Poland **[Gg N]**

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1 335	1 520	1 274	735	619	683	758	836	852	890	891	862
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
861	895	862	832	895	895	996	1 056	1 142	1095	1028	1091

The *Tier 1a* method was applied [IPCC 2000] to calculate N_2O emissions from synthetic nitrogen fertilizers use in Poland. First the amount of consumed synthetic fertilizer was adjusted by the fraction that volatilises as NH_3 and NO_x:

$$F_{SN} = N_{FERT} * (1 - Frac_{GASF})$$

where:

F_{SN} - amount of synthetic fertilizer applied to soils adjusted for volatilisation
N_{FERT} - amount of synthetic fertilizer consumed annually
$Frac_{GASF}$ - fraction of synthetic fertilizer that volatilises as NH_3 and NO_x

$Frac_{GASF}$ was taken from [IPCC 1997, table 4-19] and equals 0.1 kg NH_3-N+NO_x-N / kg synthetic fertilizer N applied. The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from synthetic fertilizers use.

Nitrous oxide emissions regarding synthetic fertilizers use in 2011 was about 19.3 Gg N_2O and comparing to 2010 emissions was higher by 6% because of increased use of nitrogen fertilizers. General trend in N_2O emissions follows nitrogen fertilizers use and amounts to 26.9 Gg N_2O in 1989 to 10.9 Gg N in 1992.

6.4.2.2. Direct Soil Emissions - Animal Manure applied to soils (CRF sector 4.D.1.2)

Animal manure nitrogen used as fertilizer was estimated according to *Tier 1a* method recommended in the guidelines [IPCC 2000, equation 4.23]:

$$F_{AM} = \Sigma_T(N_{(T)} * Nex_{(T)}) * (1 - Frac_{GASM}) * (1 - Frac_{GRAZ})$$

where:

F_{AM} - animal manure nitrogen used as fertilizer, adjusted for volatilisation
$\Sigma_T(N_{(T)} * Nex_{(T)})$ - total amount of animal manure nitrogen produced annually
$Frac_{GASM}$ - fraction of animal manure nitrogen that volatilises as NH_3 and NO_x
$Frac_{GRAZ}$ - fraction of animal manure nitrogen deposited onto soils by grazing livestock

$Frac_{GASM}$ was taken from [IPCC 1997, table 4-19] and equals 0.2 kg NH_3-N+NO_x-N/kg of N excreted by livestock. $Frac_{GRAZ}$ indicator is estimated as a fraction of nitrogen left on pastures by livestock in total nitrogen excreted, this parameter was modified following ERT review 2003. Trend of $Frac_{GRAZ}$ is given in table 6.14.

Table 6.14. Trend of fraction of livestock N excreted and deposited onto soil during grazing ($Frac_{GRAZ}$)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
$Frac_{GRAZ}$	0,135	0,137	0,131	0,119	0,112	0,111	0,105	0,098	0,096	0,093	0,089	0,085
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
$Frac_{GRAZ}$	0,081	0,075	0,070	0,068	0,066	0,065	0,064	0,066	0,069	0,071	0,071	0,072

The total amount of nitrogen in animal manure was calculated based on animal population (tables 6.2, 6.3) and the country specific values of nitrogen excretion for each type of animal (table 6.10). The data on fraction of manure managed in each AWMS applied in Poland are the country specific data taken from Polish studies [Myczko 2001, Walczak 2006, 2009, 2011, 2012] (table 6.8). The fraction of animal manure burned for fuel was neglected because it is not the case in Poland. The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from animal manure applied to soils.

Nitrous oxide emissions from animal manure applied to soils in 2011 was about 9.5 Gg N_2O and constantly decreases. This is caused by decreasing trend of livestock population, mainly cattle and sheep after 1989 (see tables 6.2, 6.3).

6.4.2.3. Direct Soil Emissions - nitrogen fixed by crops (CRF sector 4.D.1.3)

Following ERT recommendation N_2O emission from N-fixing crops was calculated using *Tier1b* [IPCC 2000, equation 4.26] for each crop type:

$$F_{BN} = Crop_{BF} * (1 + Res/Crop) * Frac_{DM} * Frac_{NCRBF}$$

where:

F_{BN} - amount of nitrogen fixed by N-fixing crop cultivated annually
$Crop_{BF}$ - N-fixing crop yield
Res/Crop - residue to crop product mass ratio specific to each crop type
$Frac_{DM}$ - fraction of dry matter in the aboveground biomass specific to each crop type
$Frac_{NCRBF}$ - fraction of total aboveground biomass of N-fixing crop that is nitrogen specific to each crop type

Data on N-fixing crops yields is published in [GUS R3 2012]. Factors like: residue/crop ratio (Res/Crop), dry matter fraction ($Frac_{Dm}$) and fraction of crop biomass that is N ($Frac_{NCRBF}$) were taken from the Polish case studies [Loboda 1994, IUNG 2012] and they are consistent with factors applied for CH_4 and N_2O emissions estimation in subcategory 4.F Field burning of crop residues (see chapter 6.5 and table 6.20). Residue/Crop ratio (Res/Crop) for crops cultivated for forage is taken as 0 according to [IPCC 2000] as the entire plants are harvested as product for forage.

The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from N-fixing crops.

Emissions from N-fixing crops in 2011 amounted for 0.4 Gg N_2O and have been at the similar level since 2003. But comparing to 1988 values N_2O emissions decreased by about 70% what is related to declining of area sawn by N-fixing plants especially those planted for forage for decreasing livestock population.

6.4.2.4. Direct Soil Emissions - Crop Residue (CRF sector 4.D.1.4)

Following ERT recommendation N_2O emission from crop residue returned to soils was estimated using *Tier1b* method from [IPCC 2000, equation 4.29]:

$$F_{CR} = Crop_Y * Frac_{DM} * Res/Crop * Frac_{NCRO} * (1 - Frac_{BURN} - Frac_R)$$

where:

F_{CR} - amount of nitrogen in crop residues returned to soils

$Crop_Y$ - crop yield
$Frac_{DM}$ - fraction of dry matter in the aboveground biomass specific to each crop type
Res/Crop - residue to crop product mass ratio specific to each crop type
$Frac_{NCRO}$ - fraction of crop biomass that is nitrogen
$Frac_{BURN}$ - fraction of crop residues burned
$Frac_R$ - fraction of total above-ground crop biomass that is removed from the field as a crop product

Statistics like $Frac_{DM}$, Res/Crop, $Frac_{NCRO}$ and $Frac_{BURN}$ are given in table 6.20 and were taken from country studies [Łoboda 1994, IUNG 2012] where experimental and literature data as well as default emission factors were used. Fraction of total above-ground crop biomass that is removed from the field as a crop product (FracR) were consulted with the Institute of Soil Science and Plant Cultivation – State Research Institute and is presented in table 6.15.

Table 6.15. Fraction of total above-ground crop biomass that is removed from the field as a crop product ($Frac_R$) according to crops/group of crops

crop	FracR	crop	FracR
wheat	0.70	sugar beet	0.25
rye	0.70	rape	0.10
barley	0.70	other oil-bearing	0.10
oats	0.70	flux straw	0.90
triticale	0.70	tobacco	0.65
cereal mixed	0.70	hop	0.01
millet & buckwheat	0.70	hey from greenland	0.95
maize	0.10	hey from pulses	0.95
pulses edible	0.01	hey from legumes	0.95
pulses feed	0.01	vegetables	0.10
potatoes	0.01		

In table 6.16 and CRF Table4.Ds2 the weighted mean values are presented for each year depending on crop production in a given year:

Table 6.16. Weighted mean $Frac_R$ for Poland for 1988–2011

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
$Frac_R$	0.46	0.45	0.45	0.47	0.45	0.41	0.45	0.45	0.44	0.48	0.45	0.47
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
$Frac_R$	0.42	0.48	0.47	0.49	0.50	0.50	0.50	0.50	0.52	0.52	0.53	0.53

Activity data concerning crop production was taken from national statistics [GUS R3 2012] (table 6.12). The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from crop residues.

Emission from crop residues in 2011 was 2.2 Gg N_2O and is on the similar level since 1995.

6.4.2.5. Direct Soil Emissions - Cultivation of Histosols (CRF sector 4.D.1.5)

The area of cultivated histosols in Poland was estimated as a case study for the purposes at national inventory [Oświecimska–Piasko 2008]. Based on information collected from Computer database on peatlands in Poland "TORF" as well as from system of Spatial Information on Wetlands in Poland the area of histosols was assessed for mid–1970s and mid–1990s. The area from which N_2O emissions were calculated covers histosols as agricultural lands cultivated and/or irrigated. So the area of such area was 882.6 thousand ha in mid–1970–ties and 769 thousand ha in mid–1990–ties. The area of histosols was then interpolated for 1976−1994.

Additionally the area of cultivated histosols was assessed for 2015 for the purpose of GHG emission projections which amounts to 680 thousand ha [PLNC5 2010]. Similarly to the previous period interpolation of histosol areas was applied between 1995 and 2015.

The default emission factor for Mid-Latitude Organic Soils of 8 kg N_2O-N/ha [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from cultivation of histosols.

Nitrous oxide emissions from cultivated histosols in Poland in 2011 was about 8.8 Gg N_2O and is falling since 1988 because of continuous progress of mineralization of organic matter as well as increasing area of histosols occupied by forest and scrub communities following cultivation termination of these areas.

6.4.2.6. Direct Soil Emissions - Sewage Sludge applied to soils (CRF sector 4.D.1.6)

According to the recommendation made by the Expert Review Team performing the review of the Polish inventory in 2009, the N_2O emissions from the application of the sewage sludge as the fertilizer in agriculture has been estimated. Activity data on the amount of sewage sludge applied on the fields were taken from GUS [GUS 2012d] and regards both - industrial and municipal sewage sludge applied in cultivation of all crops marketed, including crops designed to produce fodder as well as this applied in cultivation of plants intended for compost production. Consistent reporting of data concerning application of sewage sludge in agriculture starts in 2003, so the emissions within this subcategory were estimated only since that year.

The method applied for the N_2O emission estimation is the IPCC *Tier 1b* with a default emission factor of 0.0125 kgN_2O-N/kg N input to agricultural soils [IPCC 2000, table 4.17].The following formula was used for calculation of nitrogen input from sewage sludge application on agricultural soils:

$$N_{SEWSLUDGE} = S_{SLUDGE} * S_N$$

where:

$N_{SEWSLUDGE}$ - nitrogen input to agricultural soils by sewage sludge application
S_{SLUDGE} - amount of sewage sludge applied to agricultural soils
S_N - nitrogen content in dry matter

The mean N content in sewage sludge was taken as 2.61% from publication [Siebielec, Stuczyński 2008] where analysis of nitrogen content in domestic sewage sludge applied in agriculture was made. The study covered a group of 60 biosolids collected in 2001-2004 from 43 municipal sewage treatment plants. The same N content was assumed for both – municipal and industrial sewage sludge because majority of it applied in agriculture (about 76%) come from municipal treatment plants.

In Poland application of sewage sludge as fertilizer is relatively small, but is increasing – from 105 thousand tonnes of dry matter in 2003 up to 177 thousand tonnes of dry matter in 2011. Emissions of N_2O for this subcategory amounted to 0.1 Gg N_2O in 2011 and contributed only 0.2% of N_2O emissions from category 4.D Agricultural soils.

6.4.2.7. Agricultural Soils - Pasture, Range and Paddock Manure (CRF sector 4.D.2)

Emission of N_2O resulting from animal wastes left on pastures is calculated based on animal population (tables 6.2, 6.3). Total amount of nitrogen in animal excreta (Nex) was estimated based on country specific parameters presented in table 6.10. The data on fraction of manure related to grazing animals was presented in chapter 6.3.2.2, table 6.8. The following the formula was used for estimation of N_2O-N emissions from manure left on pastures:

$$N_2O\text{-}N_{GR} = Nex_{GR} * EF_{GR}$$

where:

$N_2O\text{-}N_{GR}$ - N_2O-N emissions from animal manure
Nex_{GR} - nitrogen excreted by livestock during grazing
EF_{GR} - N_2O-N emission factor for manure deposited directly on soils

The default N_2O-N emission factor for pasture range and paddock is 0.02 kg N_2O-N/kg N excreted and was applied [IPCC 2000, table 4-12].

Table 6.17. Nitrogen excreted during grazing in 1988–2011

Year	N exretion - grazing [kg N/yr]	Year	N exretion - grazing [kg N/yr]
1988	142 164 138	2000	59 088 009
1989	147 119 412	2001	53 705 989
1990	135 188 526	2002	51 187 708
1991	116 551 052	2003	49 010 112
1992	103 876 903	2004	44 951 412
1993	93 153 734	2005	45 819 751
1994	88 086 641	2006	46 237 121
1995	80 907 486	2007	47 636 726
1996	75 706 597	2008	47 787 629
1997	74 415 749	2009	46 865 275
1998	73 204 953	2010	47 441 306
1999	66 691 007	2011	47 183 369

Emissions in 2011 from pasture, range and paddock manure were 1.5 Gg N_2O and stabilized since 2002. This value is much lower than in 1988 by about 60% what was caused by decreasing livestock population as well as decreasing percentage of livestock grazed.

6.4.2.8. Agricultural Soils - indirect N_2O emissions (CRF sector 4.D.3)

Indirect N_2O emissions - atmospheric deposition (CRF sector 4.D.3.1)

Atmospheric deposition of nitrogen compounds fertilises soils and surface waters resulting in enhanced biogenic N_2O formation.

Following ERT recommendation related to inclusion of sewage sludge applied on agricultural soils the *Tier 1b* method and equation 4.32 [IPCC 2000] were used for assessing indirect emissions of N_2O from atmospheric deposition:

$$N_2O_{(G)}\text{-}N = \{(N_{FERT} * Frac_{GASF}) + [(\Sigma_T(N_{(T)} * Nex_{(T)}) + N_{SEWSLUDGE}] * Frac_{GASM}\} * EF_{AD}$$

where:

$N_2O_{(G)}$-N – N_2O-N emissions produced from atmospheric deposition of N

N_{FERT} – total amount of synthetic nitrogen fertilizer applied to soils
$\Sigma_T(N_{(T)} * Nex_{(T)})$ – total amount of animal manure nitrogen excreted
$N_{SEWSLUDGE}$ - nitrogen input to agricultural soils by sewage sludge application
$Frac_{GASF}$ - fraction of synthetic fertilizer that volatilises as NH_3 and NO_x
$Frac_{GASM}$ - fraction of animal manure nitrogen that volatilises as NH_3 and NO_x
EF_{AD}– emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces

Nitrogen amounts from synthetic fertilizers, livestock manure amounts and sewage sludge applied to soils correspond to values presented in chapters 6.4.2.1, 6.4.2.2 and 6.4.2.6 respectively. $Frac_{GASF}$ equals 0.1 kg NH_3-N+NO_x-N/kg synthetic fertilizer N applied and $Frac_{GASM}$ equals 0.2 kg NH_3-N+NO_x-N/kg of N excreted by livestock and both are default values taken from [IPCC 1997, table 4-19]. The default emission factor EF_{AD} equal 0.01 kg N_2O-N/kg NH_4-N and NO_x-N deposited was used for calculation of N_2O-N emissions produced from atmospheric deposition of N [IPCC 2000, table 4.18].

Table 6.18. Volatized nitrogen from fertilizers, animal manure and sewage sludge applied to soils

Year	Volatized N [kg N/yr]	Year	Volatized N [kg N/yr]
1988	161 932 828	2000	97 917 602
1989	181 423 882	2001	100 241 198
1990	154 437 705	2002	96 437 542
1991	96 810 210	2003	93 551 166
1992	82 675 381	2004	99 141 738
1993	86 930 747	2005	99 331 066
1994	93 417 328	2006	109 566 740
1995	99 781 497	2007	115 982 381
1996	100 341 319	2008	124 703 390
1997	103 883 150	2009	119 905 377
1998	103 740 991	2010	113 166 265
1999	99 538 201	2011	119 469 570

Indirect N_2O emissions - Nitrogen Leaching and Run-off (CRF sector 4.D.3.2)

Part of the nitrogen is lost from agricultural soils through leaching and runoff, and gets to the groundwater, rivers and wetlands resulting in biogenic production of N_2O.

Following ERT recommendation related to inclusion of sewage sludge applied on agricultural soils the *Tier 1b* method and equation 4.36 [IPCC 2000] were used for assessing indirect emissions of N_2O from leaching and runoff:

$$N_2O_{(L)}\text{-}N = [N_{FERT} + (\Sigma_T(N_{(T)} * Nex_{(T)}) + N_{SEWSLUDGE}] * Frac_{LEACH} * EF_{LR}$$

where:

$N_2O_{(L)}$-N – N_2O-N emissions produced from leaching and runoff of N
N_{FERT} – total amount of synthetic nitrogen fertilizer applied to soils
$\Sigma_T(N_{(T)} * Nex_{(T)})$ – total amount of animal manure nitrogen excreted
$N_{SEWSLUDGE}$ - nitrogen input to agricultural soils by sewage sludge application
$Frac_{LEACH}$ - fraction of nitrogen applied on soils that leaches as NH_3 and NO_x
EF_{LR}– emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces

Nitrogen amounts from synthetic fertilizers, livestock manure amounts and sewage sludge applied to soils correspond to values presented in chapters 6.4.2.1, 6.4.2.2 and 6.4.2.6 respectively. $Frac_{LEACH}$ equals 0.3 kg N/kg synthetic fertilizer N applied and is the default value taken from [IPCC 1997, table 4-24]. The default emission factor EF_{LR} equal 0.025 kg N_2O-N/kg N leached and runoff was used for calculation of N_2O-N emissions produced from leaching and runoff of N [IPCC 2000, table 4.18].

Table 6.19. Nitrogen losses through leaching and runoff from fertilizers, animal manure and sewage sludge applied to soils

Year	N losses [kg N/yr]	Year	N losses [kg N/yr]
1988	443 149 241	2000	276 026 403
1989	500 135 824	2001	284 611 797
1990	422 756 558	2002	273 956 312
1991	255 465 316	2003	265 126 749
1992	216 863 071	2004	282 962 608
1993	232 846 120	2005	283 246 599
1994	253 825 992	2006	313 750 110
1995	275 072 246	2007	332 373 572
1996	278 311 979	2008	358 355 085
1997	289 324 725	2009	344 168 065
1998	289 261 486	2010	323 949 398
1999	278 607 302	2011	342 869 355

Total indirect emission in 2011 was about 15.3 Gg N_2O and was gradually increasing since 1992 after significant drop in 1988−1992. The biggest influence here has the amount of nitrogen fertilisers use in the inventoried period.

6.4.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 6.2.3.

6.4.4. Source-specific QA/QC and verification

Activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Central Statistical Office. Overall final estimation of cereals and potatoes output was verified by means of simulative calculation of crops quantity according to the distribution of output between: sale, sowing/planting, fodder and self consumption. Final estimation of sugar beets, rape and turnip rape, and some species of industrial crops were verified with procurement data for these crops. Estimation of fodder crops output in private farms, conducted by local experts of CSO, was additionally verified by the calculation of fodder crops according to the directions of their use. Total area of fodder crops comprises the area of meadows, pastures and field crops for fodder. This area does not include the area of cereals, potatoes, and other agricultural crops, a part of which was directly or indirectly used for fodder.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.4.5. Source-specific recalculations

Slight recalculations were made related to correction of parameters like dry matter fraction of N-fixing crops in 4.D.1.3 as well as related to correction and update of AWMS influencing 4.D.2 and 4.D.3 subcategories.

6.4.6. Source-specific planned improvements

Presently no improvements are planned.

6.5. Field Burning of Agricultural Residues (CRF sector 4.F)

6.5.1. Source category description

Greenhouse gas emissions in 2011 from field burning of agricultural residues amounted for 0.84 Gg CH_4 and 0.03 Gg N_2O and were similar to that in 2010. The share of GHG emissions from field burning of agricultural residues in total agricultural emissions is 0.1%. The trend of GHG emissions within this category is presented on figure 6.7 and fluctuates following the annual crop production.

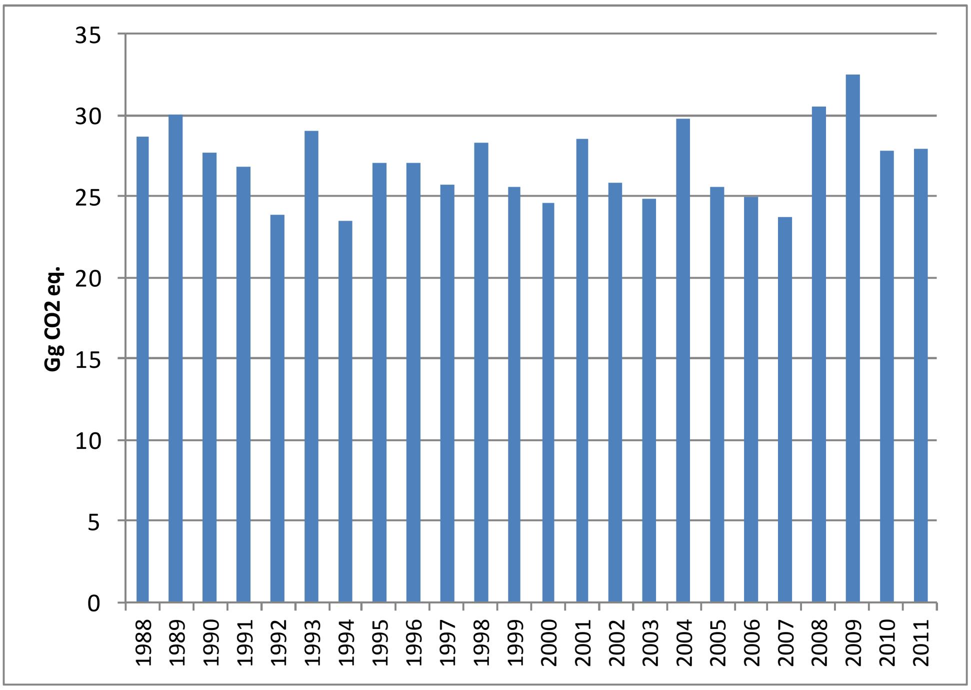

Figure 6.7. CH_4 and N_2O emissions from field burning of agricultural residues presented as CO_2 equivalent

6.5.2. Methodological issues

While estimating GHG emissions in this subcategory only methane and nitrous oxide are taken into account assuming that carbon dioxide released during burning of crop residues is reabsorbed during the next growing season.

Estimation of CH_4 and N_2O emissions from burning of agricultural residues in fields is based on methodology described in [IPCC 1997]. For domestic purposes 43 crops were selected for which residues can potentially be burned [Łoboda *at al* 1994]. Within this group certain plants were excluded for which residues can be composted or used as forage. So finally there were selected 38 crops which were than aggregated into 32 groups containing cereals, pulses, tuber and root, oil-bearing plants, vegetables and fruits potentially could be burned on fields.

Activity data on crop production comes from public statistics [GUS R3 2012]. Factors applied for emissions calculation were taken from country studies [Łoboda 1994, IUNG 2012] where experimental and literature data as well as default emission factors were used. These values for selected crops are presented in the table 6.20.

Table 6.20. Selected crop residue statistics employed in GHG estimation from field burning of agriculture residues (4.F) and direct soil emissions related to N fixing crops (4.D.1.3) and crop residues returned to soils (4.D.1.4)

Crops	Residue to crop ratio	Dry matter fraction	Fraction burned in fields	Fraction oxidized	Carbon fraction of residue	Nitrogen fraction of residue
winter wheat	0.90	0.85	0.005	0.90	0.4853	0.0068
spring wheat	0.85	0.85	0.005	0.90	0.4853	0.0068
rye	1.40	0.86	0.005	0.90	0.4800	0.0053
spring barley	0.80	0.86	0.005	0.90	0.4567	0.0069
oats	1.10	0.86	0.004	0.90	0.4700	0.0075
triticale	1.10	0.86	0.005	0.90	0.4853	0.0063
cereal mixed	0.90	0.86	0.004	0.90	0.4730	0.0071
buckwheat & millet	1.70	0.86	0.002	0.90	0.4500	0.0090
maize	1.30	0.52	0.002	0.90	0.4709	0.0094
edible pulses	0.90	0.86	0.001	0.90	0.4500	0.0180
feed pulses	1.30	0.85	0.001	0.90	0.4500	0.0203
potatoes	0.10	0.25	0.100	0.85	0.4226	0.0203
rape	1.20	0.87	0.030	0.90	0.4500	0.0068
other oil-bearing crops	3.50	0.87	0.030	0.90	0.4500	0.0068
flax straw	0.25	0.86	0.001	0.90	0.4500	0.0072
tobacco	1.25	0.50	0.002	0.85	0.4500	0.0180
hop	4.00	0.25	0.020	0.90	0.4500	0.0158
hay from greenland	0.05	0.23	0.001	0.90	0.4500	0.0198
hay from pulses	0.05	0.23	0.001	0.90	0.4500	0.0203
hay from clover and lucerne	0.05	0.23	0.001	0.90	0.4500	0.0275
other ground vegetables	0.35	0.15	0.010	0.90	0.4500	0.0248

6.5.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 6.2.3.

6.5.4. Source-specific QA/QC and verification

Activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Central Statistical Office. Overall final estimation of cereals and potatoes output was verified by means of simulative calculation of crops quantity according to the distribution of output between: sale, sowing/planting, fodder and self consumption. Final estimation of sugar beets, rape and turnip rape, and some species of industrial crops were verified with procurement data for these crops. Estimation of fodder crops output in private farms, conducted by local experts of CSO, was additionally verified by the calculation of fodder crops according to the directions of their use. Total area of fodder crops comprises the area of meadows, pastures and field crops for fodder. This area does not include the area of cereals, potatoes, and other agricultural crops, a part of which was directly or indirectly used for fodder.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.5.5. Source-specific recalculations

No recalculations were made.

6.5.6. Source-specific planned improvements

No improvements are planned presently.

7. LAND USE, LAND USE CHANGE AND FORESTRY (SECTOR 5)

7.1. Overview of sector

Data included in this inventory is based on statistical data presented in statistical journals published by the Central Statistical Office. The data relating to the land area by the type of usage (in accordance with the methodology recommended by IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry) is based on:

- generalized results of land use and sown area survey conducted in June on private farms,
- data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land, introduced in the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454). The consecutive regulations, classifications of land were changed inter alia due to adoption of international standards. Beginning with the data for 1997 on, the registers of land are prepared by the Chief Office of Geodesy and Cartography as well as voivodship branches of geodesy and land management. The data are presented, taking into consideration geodesic area.

Considering country's total area of about 31.3 million hectares, land used for agricultural purposes was equal to 17.2 million hectares. Private owners managed 16.6 million hectares of the total area of land, including individual farms managing approximately 15.4 million hectares of land, while the public sector farms had slightly more than 0.5 million hectares of the total land area. Land area managed by farmers, compared with data from 2010 was reduced by 560.6 thousand ha, i.e. by 3.2%.

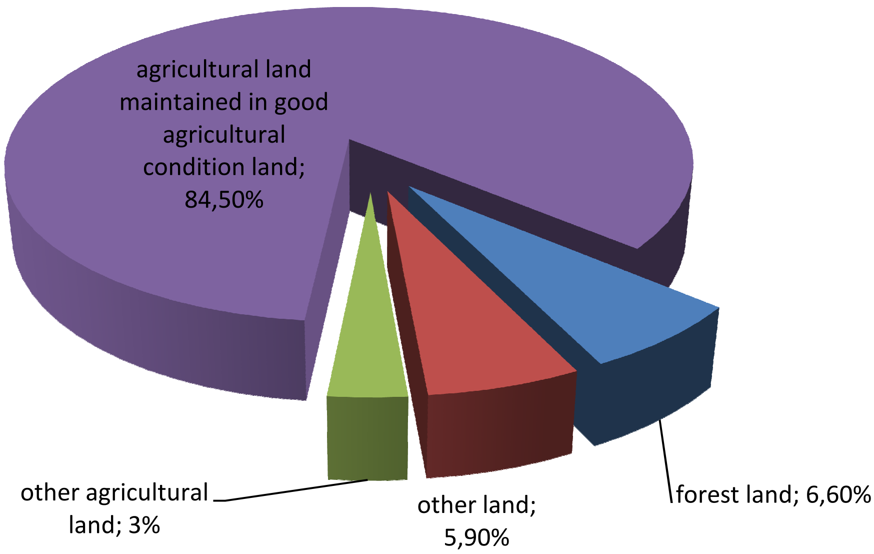

Fig. 7.1 Land use scheme in agricultural farms.

Source: Land use, crop area and livestock in 2011. Central Statistical Office 2011.

7.1.1. The National Agricultural Census

Basic results of Agriculture Census of 2011 indicates:

- decrease in the total area of land in agricultural use of farms from 19.3 million ha up to about 18.1 million ha, which amounts to 1.3 million ha and 6.5%, with a simultaneous decrease in number of farms by 656 thousand – it is about 22.4%, of which 262 thousand farms are those having up to 1 ha of agricultural area, and 394 thousand farms with more than 1 ha of agricultural area. These changes result from process of land accumulation by large farms (more than 20 ha), as well as from land use change into non- agricultural purposes such as for development, rood project etc.
- change in the structure of agricultural farms relate to significant decline, compared to the 2002, in the number of smallest farms with is 0-1 ha agricultural land (by more than 262 thousand farms which is decrease of 1.9%), there is also a significant decrease in the number of farms with area of agricultural land 1-2 ha (by 175 thousand meaning the decrease of 2.6%). On the other hand there is observed increase by nearly 12 thousand (about 1%) farms with 30 ha or more of agricultural land. Number of farms having 20-30 ha of agricultural lands, remains at a similar level.
- the highest percentage of farms in the farm structure is still those with 5 ha of agricultural lands amounting for 70%, slightly more than 25% are the farms with the area from 5 ha to 20 ha, while 5.5% are those having 20 ha and more.
- total agricultural land accounted to 85.8% of the total area of holdings, 7.2% of the area are forest and forest land, other land amounts to 7% of the total area of farms,
- reduction in the agricultural area from 16.9 million ha to 15.5 million ha (by almost 1.4 million ha constituting 8.3%),
- the overall agricultural area is dominated by the sown area is amounting for 67.3%, permanent grassland area is 17% and 4.2% of permanent pastures. The share of areas covered by orchards is 2.4%, fallow land surface is 2.9% whereas garden surface is 0.3%, lands improperly used amounted to 5.8% od total agricultural area,
- increase in permanent grassland area from 2.5 million ha to2.6 million ha (by about 98 thousand ha and 3.9%), with a decrease in permanent grassland area on farms up to 15 ha of agricultural land as well as increase of permanent grassland area on the farms from other area groups. The largest increase of permanent grassland areas has been observed in the farms from 30-50 ha (45.4%). This increased grassland area resulted from limiting permanent pastures areas.
- decrease of permanent pastures from 1.0 million ha to 0,7 million ha (over 376 thousand ha and 36.5%) in all groups of agricultural land holdings. The greatest decrease in permanent pastures area was recorded in the farms up to 5 ha. This is caused by changes in livestock feeding from pastures into indoor management.
- increase of forest area and forest land is about 1.3 million ha, which means more than 93 thousand (7.7%). This increase was observed in all types of farms − on farms up to 5 ha it was rise by 17.3%, while the highest increase was observed in farms from 30-50 ha amounted to 39%. Decrease of forest area and forest land was observed only in farms from 7-15 ha. It shows that Afforestation occurs mostly on those farms were agricultural production is not longer profitable.
- Increase of the rest of lands up to 1.3 million ha amounted to over 49 thousand ha (4%). The highest increase occurred in the smallest farms up to 1ha (95.5%). Agricultural activities in small farms become unprofitable and change to non-agricultural purposes is occurring.

7.1.2. The greenhouse gas inventory overview of the Land Use, Land-Use Change and Forestry (LULUCF) sector

The greenhouse gas inventory of LULUCF sector comprises emissions and removals of CO2 due to overall carbon gains or losses in the relevant carbon pools of the predefined six land-use categories. The liming of agricultural lands is included in the LULUCF sector, as well. The non-CO2 emissions from biomass burning and disturbance associated with land-use conversion to cropland are also to be reported here. These activities altogether resulted in 24 170 Gg net removal of CO2 equivalent in 2011

Table 7.1. Total CO_2 emissions and removals from LULUCF sector in 2011

Greenhouse gas source and sink categories	2011		
	Net CO_2 emissions/removals	CH_4	N_2O
	(Gg)		
5. Total Land-Use Categories	-24 170.53	107.1	0.03
5A. Forest Land	-31 019.63	0,59	0,01
1. Forest Land remaining Forest Land	-24 553.42	0.55	0.01
2. Land converted to Forest Land	-6 466.21	0,04	0,00
5B. Cropland	3 316.71	IE	IE
1. Cropland remaining Cropland	3 216.48	IE	IE
2. Land converted to Cropland	99,86	IE	IE
5C. Grassland	220.88	0.06	0.00
1. Grassland remaining Grassland	410.25	0.06	0.00
2. Land converted to Grassland	-189.36	IE	IE
5D. Wetlands	3 145.92	106.45	0.02
1. Wetlands remaining Wetlands	2 903.41	IE	IE
2. Land converted to Wetlands	242.50	106.45	0.02
5E. Settlements	165.99	NO	NO
1. Settlements remaining Settlements	-84.83	NO	NO
2. Land converted to Settlements	250.82	NO	NO
5F. Other Land	NO	NO	NO
1. Other Land remaining Other Land	NO	NO	NO
2. Land converted to Other Land	NO	NO	NO
5G. Other	NO	NO	NO

IE – included elsewhere, NO – not occurring

The most important sub-category as the main source of removal in the sector is 5.A Forest Land. The bulk of the CO_2 removal is generated in living biomass in 5.A.1 Forest Land remaining Forest Land category. The large sink is mainly due to the fact that the total increment of the growing stock in forest lands is always higher than the annual harvest.

7.1.3. Country area balance in 2011

Table 7.2. Country area balance in 2011

Year	2011
Greenhouse gas source and sink categories	Area [ha]
5. Total land-use categories	
5.A. forest land	
total forest land	9 329 175
5.A.1. forest land remaining forest land	8 646 391
5.A.2. land converted to forest land	682 784
total organic soils on forest land, of which	249 280
on forest land remaining forest land	231 036
on land converted to forest land	18 244
5.B. cropland	
total cropland area	14 182 922
5.B.1. cropland remaining cropland	14 154 067
5.B.2. land converted to cropland	28 855
total organic soils on cropland, of which	539 163
on cropland remaining cropland	538 066
on land converted to cropland	1 096
5.C. grassland	
total grassland area	4 173 030
5.C.1. grassland remaining grassland	4 119 061
5.C.2. land converted to grassland	28 855
total organic soils on grassland, of which	158 638
on grassland remaining grassland	156 586
on land converted to grassland	2 052
5.D. wetlands	
total wetlands area	1 368 797
5.D.1. wetlands remaining wetlands	1 313 683
5.D.2. land converted to wetlands	55 114
total organic soils on wetland, of which	281 100
on wetlands remaining wetlands	269 782
on land converted to wetlands	11 318
5.E. settlements	
total settlements area	2 120 234
5.E.1. settlements remaining settlements	1 892 052
5.E.2. land converted to settlements	228 182
5.F. other Land	93 809
Country area balance	**31 267 967**

Data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land prepared by the Chief Office of Geodesy and Cartography as well as voivodship branches of geodesy and land management. The data are presented, taking into consideration geodesic area [GUS; Environmental Protection 2012].

Since 2001 Land Register considered as an internal part of National Land Identification System (O. J. of 2001 No. 38, item 454) introduced range differences in relation to previous years consisting mainly in classification of built-up rural areas as agricultural land (therefore classified as „built-up and urban areas”), land under ponds (classified as „inland lentic waters”) and ditches (which were classified separately) [GUS; Environmental Protection 2012].

Table 7.3 Geodesic status, directions and changes of land use as of 1 January 2012.

Specification	2011		2012		
	[thou. ha]	[per capita in ha]	[thou. ha]	[per capita in ha]	increase (+) or decrease(-) in thou. Ha in relation to 2011
Total area of the country	31 268	0.81	31268	0.81	-
Agricultural land	**118 870**	**0.49**	**18825**	**0.49**	**-45**
arable land. orchards. permanent meadows and pastures	18 130	0.47	18 086	0.46	-44
arable land	13 921	0.36	13 891	0.36	-30
orchards	295	0.01	292	0.01	-3
permanent meadows	2 287	0.06	2 280	0.06	-7
pastures	1 627	0.04	1 622	0.04	-5
agricultural built-up areas	532	0.01	530	0.01	-2
lands under ponds	72	0	75	0	3
lands under ditches	135	0	134	0	-1
Forest land as well as woody and bushy land	**9 570**	**0.25**	**9600**	**0.25**	**30**
forests	9 305	0.24	9329	0.24	24
woody and bushy land	265	0.041	270	0.01	5
Lands under waters	**645**	**0.052**	**646**	**0.02**	**1**
marine internal	79	0	79	0	-
surface flowing	504	0.01	506	0.01	2
surface standing	62	0	61	0	-1
Built-up and urbanised areas	**1572**	**0.04**	**1590**	**0.04**	**18**
residential areas	287	0.01	297	0.01	10
industrial areas	113	0	114	0	1
other built-up areas	128	0	133	0	5
urbanised unbuilt areas	54	0	54	0	-
recreational areas	65	0	65	0	-
transport areas	896	0.02	899	0.02	3
roads	781	0.02	784	0.02	3
rail areas	103	0	102	0	-1
other	13	0	13	0	-
minerals	29	0	29	0	-
Ecological arable land	**35**	**0**	**35**	**0**	**-**
Wasteland	**480**	**0.01**	**479**	**0.01**	**-1**
Miscellaneous land	**96**	**0**	**94**	**0**	**-2**

Source: GUS; Environmental Protection 2012

Table 7.4 Changes in the land use structure as of 1 June 2011 [GUS; Environmental Protection 2012].

Years	Grand total	Agricultural land total	Agricultural land of wehich arable land	Forests nad woody land	Other
	percentage [%]				
1938	100.0	65.9	52.7	21.8	12.3
1946	100.0	65.6	51.3	20.8	13.6
1950	100.0	65.6	51.3	21.9	12.5
1960	100.0	65.5	51.2	24.5	10.0
1970	100.0	62.5	48.3	27.3	10.2
1980	100.0	60.3	46.7	27.7	12.0
1990	100.0	59.3	45.7	28.0	12.7
1995	100.0	57.4	44.4	28.2	14.4
200	100.0	57.0	43.9	28.8	14.2
2005	100.0	50.9	39.1	29.3	19.8
2010	100.0	49.6	35.0	29.8	20.6
2011	100.0	49.4	35.3	29.9	20.7

Source: GUS; Environmental Protection 2012

7.1.4. Land uses classification for representing LULUCF areas

With regard to the fact that for the reporting purposes to the United Nations Framework Convention on Climate Change and the Kyoto Protocol it is required to match national land-use categories (according to the Minister of Regional Development and Construction of 29 March 2001 on the registration of land and buildings (Journal of Laws No. 38, item. 454) to the appropriate categories of land use consistently to the IPCC guidelines (Chapter 3.2.1. GPG for LULUCF), following combination was prepared on the basis of the combination presented in table 7.5.

Table 7.5 Combination of land use classification systems.

IPCC category	National Land Identification System
5A forest land	forest land
5B cropland	arable land, orchards,
5C grassland	permanent meadows and pastures; woody and bushy land
5D wetland	land under waters (marine internal, surface stands); land under ponds; land under ditches;
5.E settlements	agricultural build-up areas; build-up and urbanized areas; ecological arable land; wasteland
5F Other land	miscellaneous land

7.1.5. Key categories

Key category assessment for LULUCF category is included in Attachment 1.

7.2. Forest Land (CRF sector 5.A.)

7.2.1. Source category description

Calculation for this category based on IPCC methodology described in the chapter 3.2.GPG LULUCF. GHG balance in this category is a net sink. In 2011 net CO_2 for this category estimated sink was equal to 31 019 Gg CO_2.

7.2.1.1. Area of forest land in Poland in year 2011

Forest land reported under subcategory 5.A. is classified as a "forest" consistent to Art. 3 of *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59 as amended). This assessment is consist with internationally adopted standard which takes into account the forest land associated with forest management, consistent with the abovementioned regulations the forest land area in Poland, as of 1 January 2012, was equal to 3 329 175 ha [GUS Environmental protection 2012]. Forest area excluding land associated with forest management as of 31 December 2011, was equal to 9 143,6 [GUS; Forestry 2012] ha. This corresponds to a forest cover equal to 29,2%. Fig. 7.2 is presenting forest cover by provinces.

Table 7.6. Forest land area by provinces

No	Voivodship	Unit	2008	2009	2010	2011
	Total	[ha]	9 251 404	9 275 786	9 304 762	9 329 174
1.	**Dolnośląskie**	[ha]	606 104	607 327	608 387	609 279
2.	**Kujawsko-pomorskie**	[ha]	425 207	426 170	427 147	427 843
3.	**Lubelskie**	[ha]	568 601	572 620	576 420	579 237
4.	**Lubuskie**	[ha]	706 788	707 583	708 201	709 002
5.	**Łódzkie**	[ha]	386 172	387 711	388 597	389 350
6.	**Małopolskie**	[ha]	439 126	438 280	439 765	440 114
7.	**Mazowieckie**	[ha]	802 158	804 912	808 810	812 973
8.	**Opolskie**	[ha]	257 858	258 170	258 246	258 399
9.	**Podkarpackie**	[ha]	671 363	674 450	677 953	680 166
10.	**Podlaskie**	[ha]	621 718	624 856	626 532	627 235
11.	**Pomorskie**	[ha]	676 165	677 673	678 226	679 898
12.	**Śląskie**	[ha]	400 709	399 592	399 954	401 747
13.	**Świętokrzyskie**	[ha]	331 492	332 089	332 487	332 980
14.	**Warmińsko-mazurskie**	[ha]	752 146	755 050	760 064	763 567
15.	**Wielkopolskie**	[ha]	778 863	780 795	783 340	784 649
16.	**Zachodniopomorskie**	[ha]	826 934	828 508	830 633	832 735

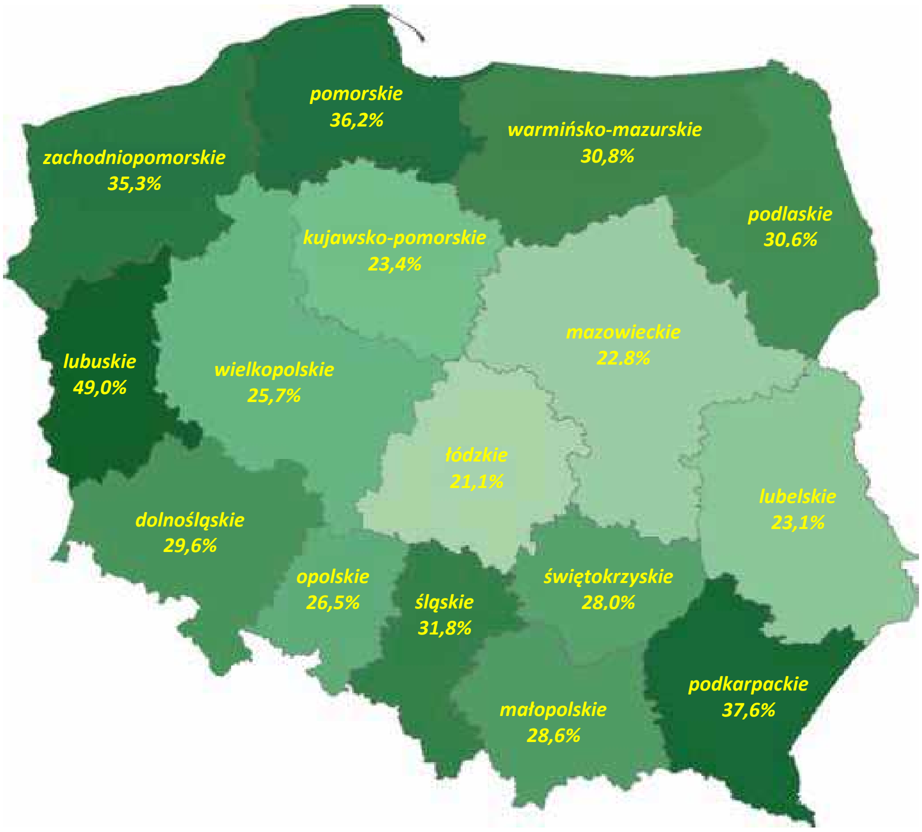

Fig. 7.2. Forest cover by provinces

Source: GUS; Forestry 2012

Total area of forest land classified Poland to the group of countries with the largest forest area in the region (following France, Germany and Ukraine).

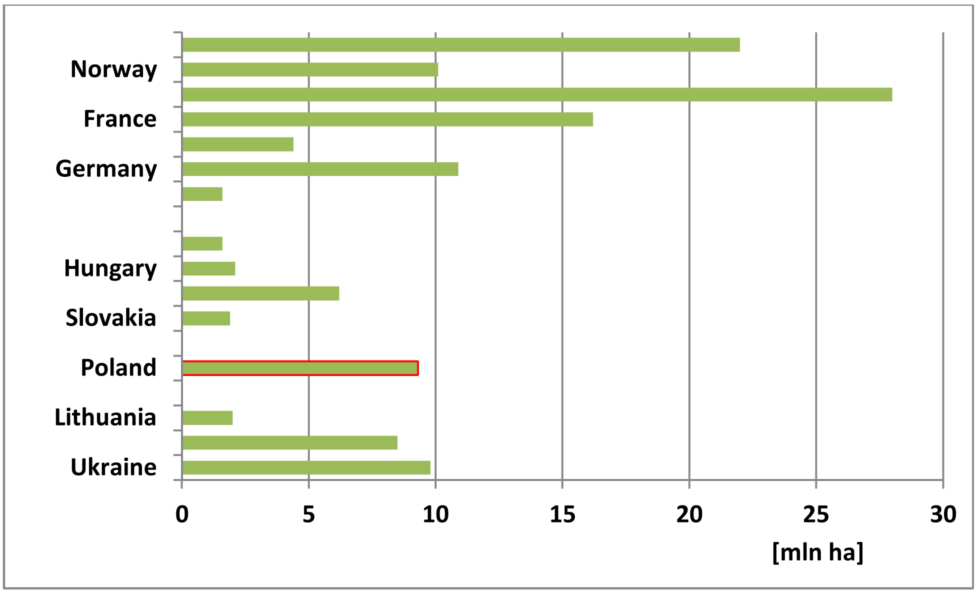

Fig. 7.3. Comparison of total Forest land area

Source: State of Europe's Forests 2011. Status & Trends in Sustainable Forest Management in Europe

Presented information regarding to the forest cover among the countries (with respect to the surface of the land without the inland waters, according to international standard) are less diversified than the absolute size of the forest land area. Among the analyzed countries some are characterized by significantly higher forest cover mainly due to the high share of land unsuitable area for other uses than forestry, including wetlands and upland (Scandinavian countries, Austria, Slovakia). Lower than the Polish forest cover is characterizing Ukraine, Hungary and Romania, and western countries - France and the United Kingdom. Determined according to international standard Polish forest cover at the end of 2011 was 30.5% and was lower than the European average (32% without the Russian Federation).

7.2.1.2. Category area changes

Table7.7 Total forest land area

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	8660500	8667000	8678500	8693900	8706300	8718200	8715024	8724217
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	8741530	8778706	8809429	8861245	8877142	8903555	8915629	8968157
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	9031089	9106365	9152905	9164084	9224110	9251403	9275784	9304761

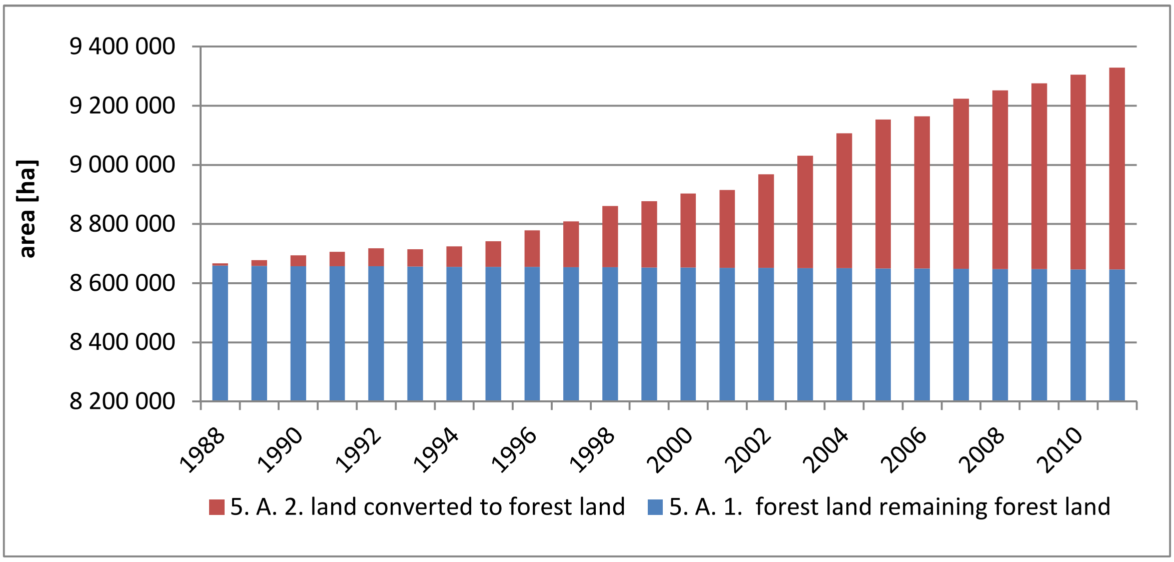

Fig. 7.11. Forest land area changes in time period 1988-2011

7.2.1.3. Ownership structure

With regard to their ownership structure [Fig.7.4], 81.3% of forests land in Poland is publicly-owned, of which 77.4% are forests under the management of the State Forests. [GUS; Forestry 2012]
The structure of forest ownership for the whole post-war period has changed slightly. In comparison to 1995, the share of private ownership of forests has been increased by 1.6% and adequately by the same amount the share of public ownership of forests decreased.. The detailed structure of forest ownership in Poland is shown in Fig. No. 7.4:

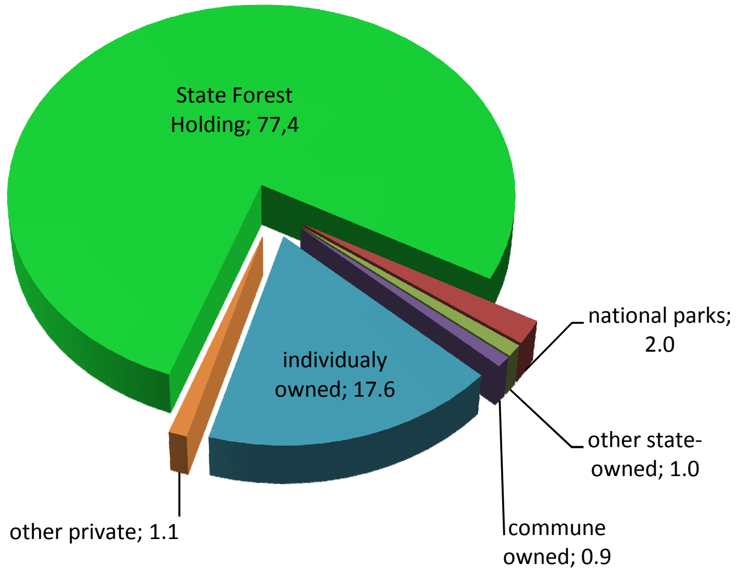

Fig. 7.4. Structure of forest ownership in Poland in %
Source: GUS Forestry 2012

The share of privately-owned forests in Poland varies among the regions (Fig. 7.5) – the greatest is in the Mazowieckie Province – 43.8% of its total forest area (354 700 ha), Malopolskie Province – 43.7% (188 800 ha) and Lubelskie Province – 40.5% (234 400 ha). The lowest share of privately-owned forests is in the Lubuskie Province – 1.5% (10 300 ha), Zachodniopomorskie Province – 2.19% (16 700 ha) and Dolnoslaskie Procince – 2.9% (17 200 ha) [GUS; Forestry 2012].

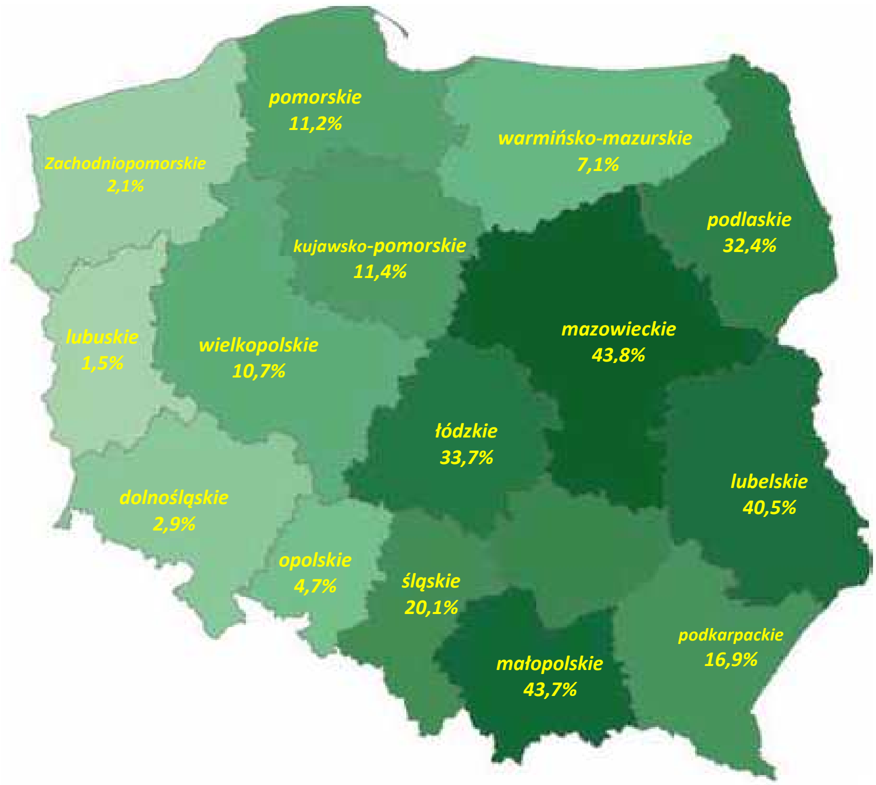

Fig. 7.5. Share of private forests in total forest area in provinces
Source: Forests in Poland 2011; CILP 2012

7.2.1.4. Habitat structure

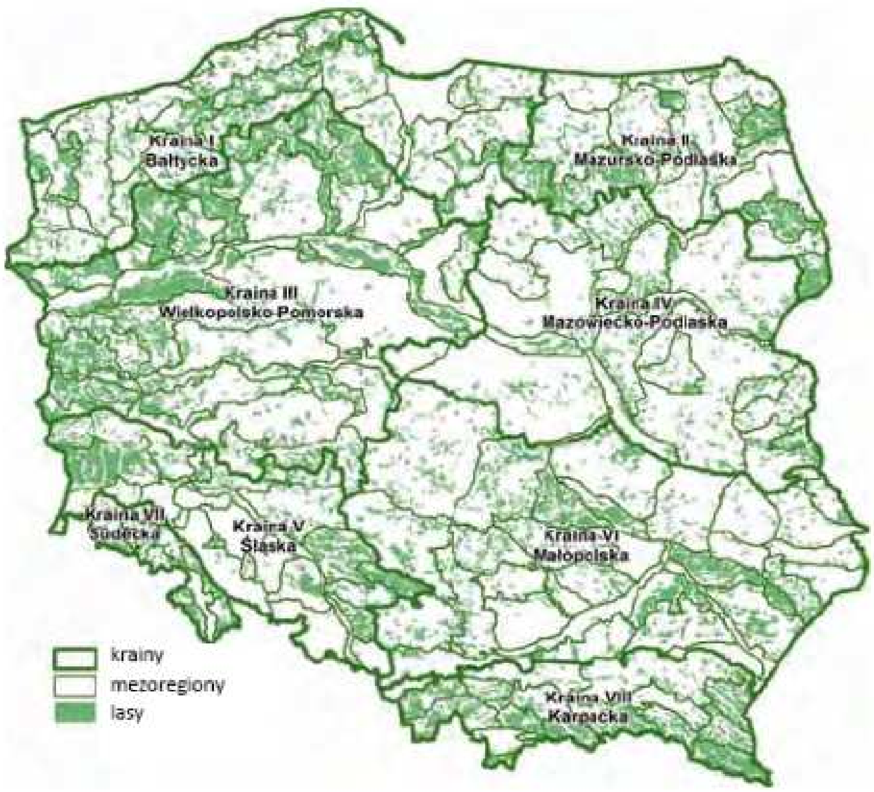

Fig.. 7.6. Regionalization of natural-forest in 2011.
Source: Report on the state of forests in Poland in 2011.CILP 2012

The diversity of growing conditions for forests in Poland is linked to the natural-forest habitats allocations and is presented on Fig. 7.6

Poland has mainly retained forests on the poorest soils, which is reflected in the structure of forest habitat types. Coniferous habitats prevail, accounting for 52.1% of the total forest area, while broadleaved habitats cover 47.9% . In both groups, a further distinction is made between upland habitats which occupy 5.5% of the forest area and mountain habitats which occupy 8.7%. Similar proportions occur in the State Forests. Coniferous species dominate in polish forests, accounting for 70.8% of the total forest area. Poland offers optimal climatic and site conditions for pine (62.2% of the state forests area) within its euro-asiatic natural range, which resulted in development of a number of important ecotypes (e.g. the taborska pine or the augustowska pine).[Report 2012]

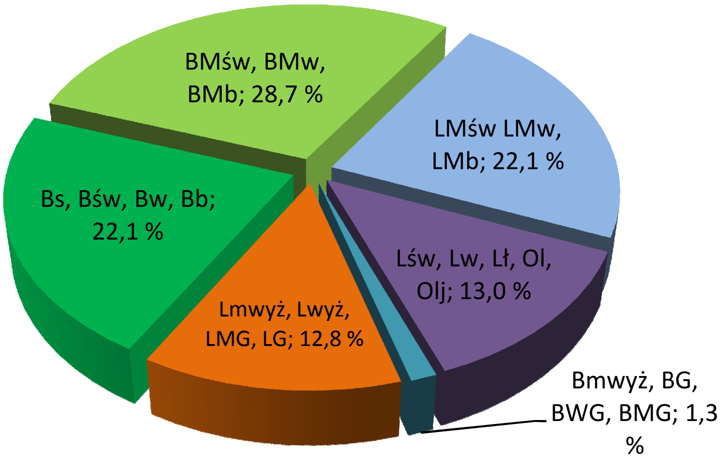

Fig.. 7.7.. Forest habitats structure in 2011.
Source: GUS; Forestry 2012

Legend:
Bb – bog (pine) forest
BG – montane coniferous forest
BMb – mixed coniferous bog forest
BMG – montane mixed coniferous forest
BMśw – fresh mixed coniferous forest
BMw – moist mixed coniferous forest
BMwyż – upland mixed coniferous forest
Bs – dry coniferous forest
Bśw – fresh coniferous forest
Bw – moist coniferous forest
BWG – high-mountain coniferous forest
LG – montane broadleaved forest
Lł – riparian forest
LMb – mixed broadleaved bog forest
LMG – montane mixed broadleaved forest
LMśw – fresh mixed broadleaved forest
LMw – moist mixed broadleaved forest
LMwyż – upland mixed broadleaved forest
Lśw – fresh broadleaved forest
Lw – moist broadleaved forest
Lwyż – upland broadleaved forest
Ol – alder forest
OlJ – alder-ash forest

7.2.1.5. Species composition

The geographical distribution of habitats is, to a great extent, reflected in the spatial structure of dominant tree species. Apart from the mountain regions where spruce (west) and spruce and beech (east) are the main species in stand composition, and a few other locations where stands have diversified species structure, in most of the country stands with pine as the dominant species prevail. Coniferous species dominate in Polish forests, accounting for 70.3% of the total forest area (Fig. 7.8). Poland offers optimal climatic and site conditions for pine within its Euro-Asiatic natural range, which resulted in development of a number of important ecotypes (e.g. the Taborska pine or the Augustowska pine). Pine accounts for 60.4% of the area of forests in all ownership categories, for 62.2% in the State Forests and for 57.7% in the privately-owned forests.

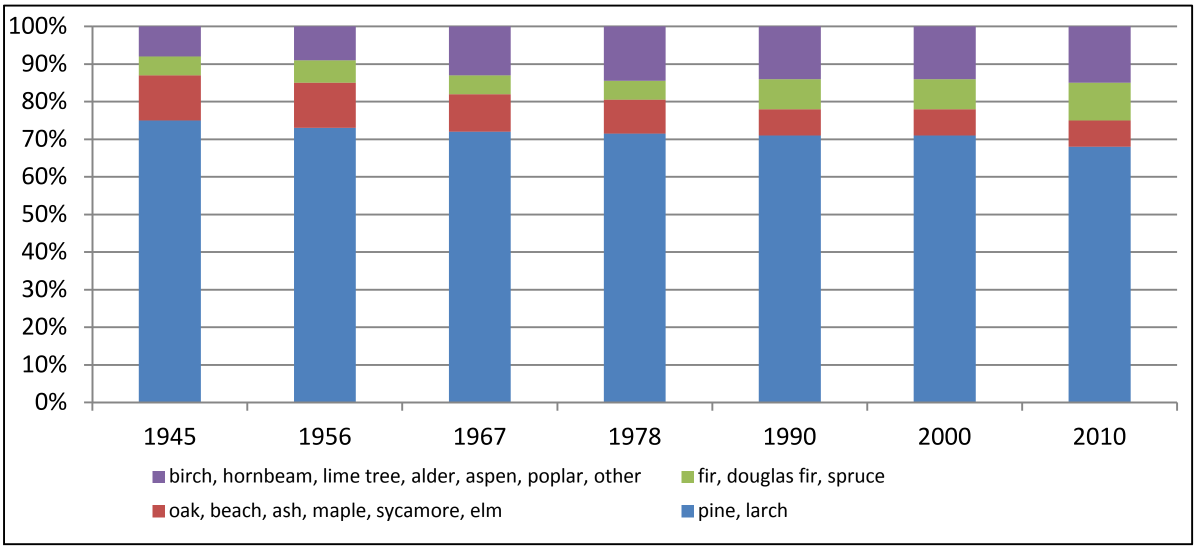

Fig. 7.8 Spatial structure of dominant tree species
Source: GUS; Forestry 2012

Since 1945 forest species structure has undergone significant changes, expressed, inter alia, by increased share of stands for deciduous trees. Considering state forests, where it possible to trace this phenomenon on the basis of annual updates of forest land area and timber resources, total area of deciduous stands increased from 13 to 23.2%. Despite the increase in the surface of deciduous forests, their share is still below potential, arising from the structure of forest habitats.

7.2.1.6. Age structure

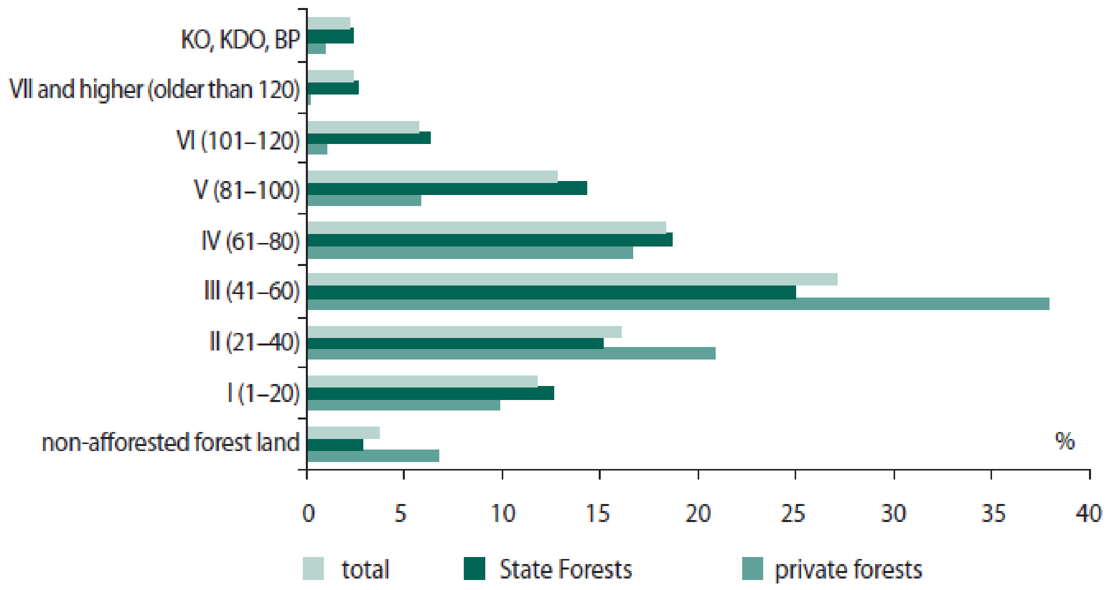

Fig. 7.9 Areal share of stands by age class

Source Report on the state of forests in Poland in 2011.CILP 2012

Stands aged 41–80 years, representing age classes III and IV prevail in the age structure of forests and cover 26.7% and 18.5% of the forest area respectively. Moreover, stands aged 41–80 years are dominating the forests of all ownership forms and private forests, with their share equal to nearly 40%. Stands older than 100 years, including stands in the restocking class (KO), stands in the class for restocking (KDO) and stands with selection structure (BP), account for 11.7% of the forest area managed by the State Forest. The share of non-afforested land accounts for 2.3%.

7.2.1.7. Structure of timber resources by volume

According to the Large-Scale Forest Inventory, timber resources in the forests under all forms of ownership in the years 2007 –2011 amounted to 2 372 million m^3 of gross merchantable timber, including 1 886 million m^3 in the state forests and 368 million m^3 in private forests.

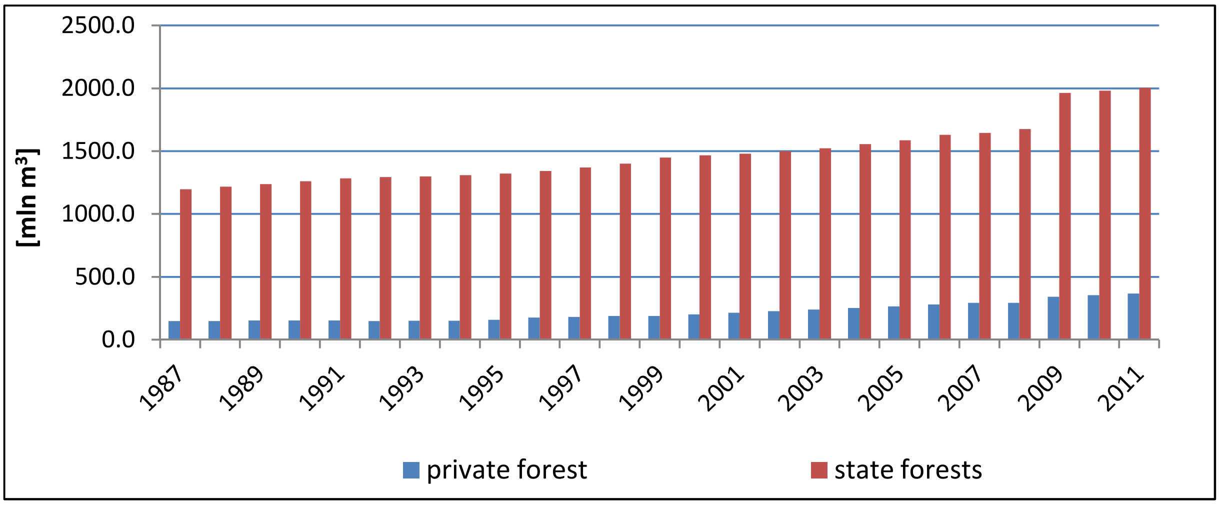

Fig. 7.10. Timber resources in Poland's forests in 1967-2011, in millions of m^3 of gross merchantable timber.

Source: GUS Forestry 1988-2012, Forest Management and Geodesy Bureau, National Forest Inventory 2011

As of 1 January 2012 (the latest update), the estimated timber resources in the forests managed by the State Forest Holding amounted to 1 748 million m^3 of gross merchantable timber *[Annual update of forest area and forest resources in state forests as on 1 January 2012].* Values for the years 2000-2006 for the private forest were interpolated on the basis of available data. The recorded growth is, to some extent, the consequence of the application of more precise inventory methods.

7.2.2. Information on approaches used for representing land area and on land-use databases used for the inventory preparation

According to the description given in chapter 3.2.1.1.1.3 of the GPG for LULUCF [IPCC 2003] managed forest land areas associated with the forestry activities in Poland is identified using Tier 3. Geographic boundaries encompassing units of land subject to multiple activities are indentified based on data published in the *Data on the condition and changes in the registered intended use of land* developed on the basis of annual reports on land, introduced by the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454). The consecutive regulations and classifications of land were modified, inter alia, due to adoption of international standards. Beginning with data for 1997 on, the registers of land were prepared by the Head Office of Geodesy and Cartography as well as by the voivodship branches of geodesy and land management. The data are presented taking into consideration geodesic area. With respect to data sources, the activity data was taken from the National Forest Inventory and related forestry databases. These databases contain data by species or species group and age class.

7.2.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

With regard to the regulations of art. 3 of the Act on Forests of September 28th 1991 [Dz. U. z 2011 nr 34, poz. 170 as amended], forest land is the area:

1) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
    a. designated for forest production, or
    b. constituting a Nature Reserve or integral part of a National Park, or
    c. entered on the Register of Monuments;
2) of contiguous area greater than or equal to 0.10 ha, associated with forest management.

This subcategory includes entire land with woody vegetation consistent with thresholds used to define forest land in the national GHG inventory with :

- minimum area: 0.1 hectare,
- minimum width of forest land area: 10 m
- minimum tree crown cover: 10% with trees having a potential to reach a minimum height of 2 metres at maturity in situ. Young stands and all plantations that have yet to reach a crown density of 10 percent or a tree height of 2 metres are included under forest. Areas normally forming part of the forest area that are temporarily un-stocked as a result of human intervention, such as harvesting or natural causes such as wind-throw, but which are expected to revert to forest are also included.

7.2.4. Forest Land remaining Forest Land (CRF sector 5.A.1)

GHG balance in this category is a net sink. In 2011 net CO_2 sink was about 24 553 Gg CO_2. For the methodologies used, see following chapters

7.2.4.1 Methodological issues

Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis.

7.2.4.2. Subcategory area

Table 7.8 Area changes in the subcategory forest land remaining forest land.

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
[ha]	8659181	8658498	8657885	8657526	8656996	8656425	8655751
Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
[ha]	8655349	8654933	8654353	8653868	8653467	8652749	8652224
Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
[ha]	8651807	8651118	8650466	8649994	8649407	8648810	8656008
Year	**2009**	**2010**	**2011**				
[ha]	8667548	8683010	8695165				

Table 7.9 Area changes of land subject to the activity FM

No	Voivodship	Unit	2008	2009	2010	2011
	Total	[ha]	8 669 333	8 668 690	8 668 139	8 667 535
1.	Dolnośląskie	[ha]	567 970	567 578	566 762	566 068
2.	Kujawsko-pomorskie	[ha]	398 454	398 277	397 922	397 500
3.	Lubelskie	[ha]	532 826	535 142	536 982	538 157
4.	Lubuskie	[ha]	662 319	661 272	659 747	658 719
5.	Łódzkie	[ha]	361 875	362 335	362 010	361 737
6.	Małopolskie	[ha]	411 497	409 595	409 677	408 900
7.	Mazowieckie	[ha]	751 689	752 231	753 472	755 316
8.	Opolskie	[ha]	241 634	241 273	240 577	240 073
9.	Podkarpackie	[ha]	629 123	630 308	631 568	631 928
10.	Podlaskie	[ha]	582 601	583 959	583 665	582 751
11.	Pomorskie	[ha]	633 623	633 320	631 822	631 679
12.	Śląskie	[ha]	375 498	373 439	372 590	373 255
13.	Świetokrzyskie	[ha]	310 635	310 354	309 739	309 365
14.	Warmińsko-mazurskie	[ha]	704 823	705 632	708 061	709 414
15.	Wielkopolskie	[ha]	729 859	729 692	729 745	729 001
16.	Zachodniopomorskie	[ha]	774 906	774 283	773 802	773 676

Considering the provisions of the decision 9/CP.2 `Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration` where it is decided that the four Parties that have invoked Article 4.6 of the Convention, which requested in their first communications for flexibility to use base years other than 1990, Poland has chosen the year 1988 as a starting point for the transitional period according to the IPCC 2003 guidelines). Party applied 20-years default transition period which has been applied to all land use categories including forests.

With regard to those provisions some differences in Convention and Kyoto reporting occurred. According to the Article 3.4 of the Kyoto Protocol the net changes in greenhouse gas emissions by sources and removals by sinks resulting from human-induced activities related in the agricultural soils and the land-use change and forestry categories (Forest Management) for its first commitment period, provided that these activities have taken place since 1990. Considering those requirements Poland under the Kyoto Protocol is reporting the area of forest land subject to Forest Management in 1990 (with the changes which have occurred since 1990) and in the Convention reports forest area in the subcategory 5.A.1. FL_FL for the year 1988 with the further changes, which has been selected by Poland as the base year for Convention purposes. This value has increased since the year 1988 until 1990.

7.2.4.3. Living biomass

Increment

Annual change in stock in forest for all ownership forms was estimated based on data published in Statistical Year Book [Central Statistical Office 2012]. Data sources contains tables descriing forest resources by areas and age classes. Stock change estimation (m^3/ha/year) for all forests ownership forms is considering information on volume of forests resources and annual harvests.

To minimize the recorded growth of forest resources being to some extent, the consequence of the application of more precise inventory methods ten-year average of annual stock change (comparing to 10 years Forest Management cycles)was applied, to reduce the level of uncertainties related to the annual estimation of forest resources at country level.

The results of estimations of annual changes in stocks are presented in the graph bellow (Fig. 7.11).

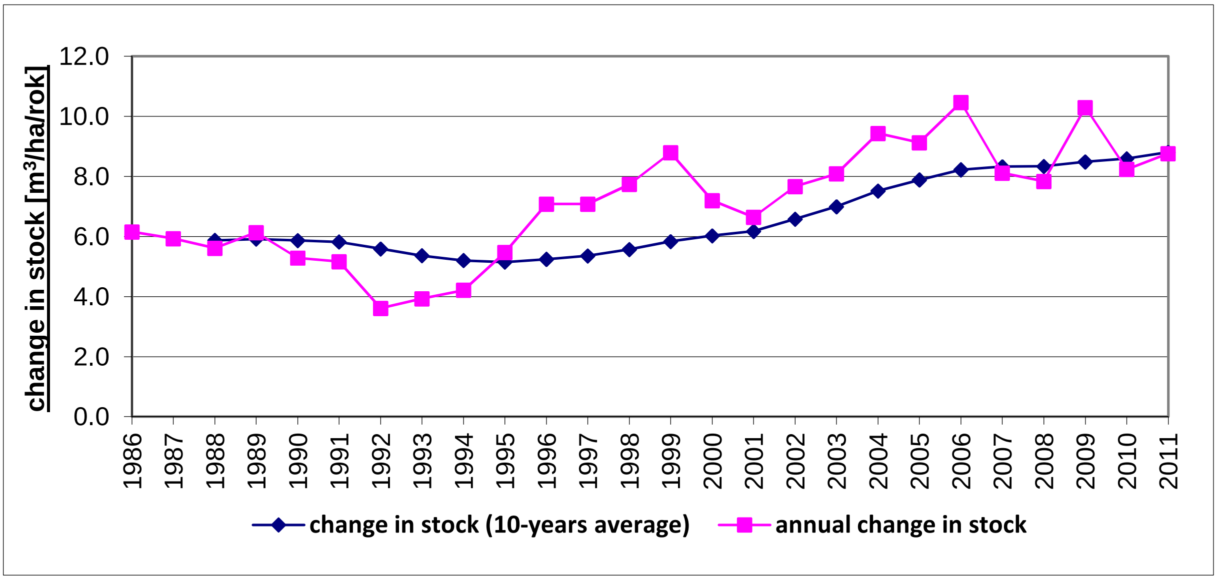

Fig. 7.13. Changes of stock volumes for the period 1986 – 2011

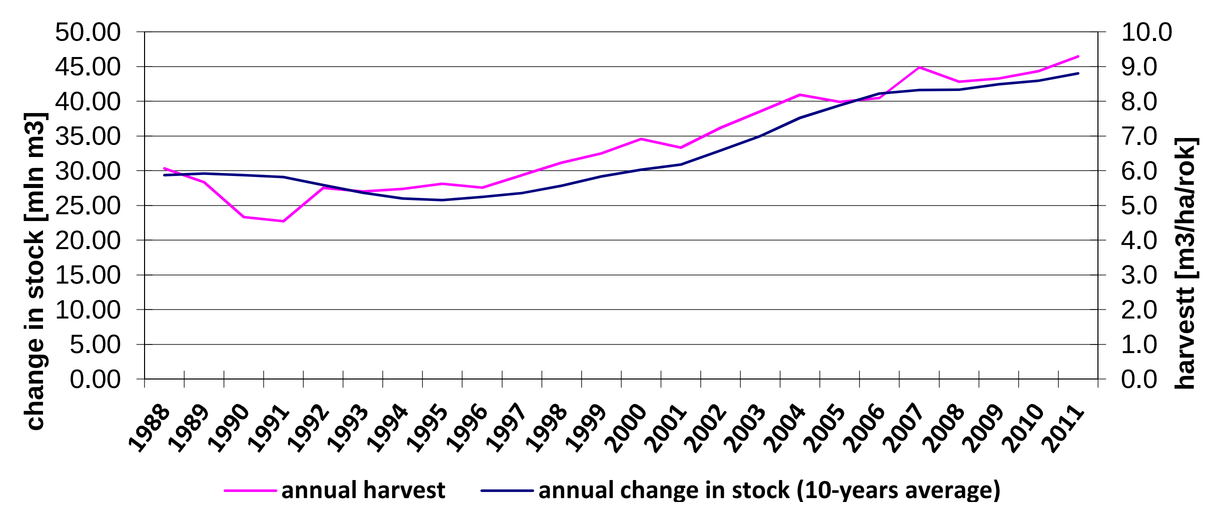

Fig. 7.14. Comparison of annual stock changes and harvests

The recorded growth is, to some extent, the consequence of the application of more precise inventory methods. Nevertheless, the impact of increasing harvesting rate on forest environment is complex, frequently synergic. Moreover, the reaction from the moment of occurrence of a logging factor can be delayed. This creates a big difficulty in interpreting the observed phenomena, particularly the direct cause relationships. Recent studies and observations demonstrate that periodically intensified occurrence of increasing harvesting rate is not visible in the trend of steady increase of annual increment. However it is important to highlight that methodology for biomass annual increase calculations should be still improved, among others for better estimation of long and short term trends.

7.2.4.4. Basic wood density

Basic wood density was calculated based on weighted mean of wood density by wood species (national ratio). To calculate the basic air-dry wood density values, in the specific gravity of dry wood and shrinkage of the total volume were used for each species. To keep consistency for the entire time period estimation were based on date available for the State Forests (Annual update of forest area and woody biomass in State Forests at 1 January *[Forest Management and Geodesy Bureau. Warszawa. 1969-2012]* and extrapolated for all ownership structure. Scheme for weighted mean wood density calculation is presented in table below:

Table 7.10. Scheme for weighted mean wood density calculation, by wood species in Poland based on data describing timber resources

Species	Air-dry wood density [t/m^3]	Volume of thick [thous. m^3]	Share of each species in weighted mean wood density [t/m^3]
	A	B	E=A*B
Pine	0.43	1250832.3	0.29810
Spruce	0.38	104881.9	0.02288
Fir	0.36	51915.7	0.01049
Beech	0.57	105705.7	0.03410
Oak	0.57	123518.8	0.03869
Hornbeam	0.63	4694.6	0.00172
Birch	0.52	75348.1	0.02201
Alder	0.43	71122.6	0.01711
Poplar	0.35	1393.4	0.00034
Aspen	0.36	4141.3	0.00082
Total	-	1793554.4	-
Weighted mean wood density			**0.446319**

7.2.4.5. Biomass expansion factor

Harvest of thick and growing stock was converted into biomass separately using different expansion factors, for converting volumes of extracted roundwood BEF_2 (national factor – table 7.4.) and conversion of annual net increment (including bark) BEF_1 (default factor [IPCC 2003]).

Table 7.11. Scheme for calculation of expansion factors for harvest of thick BEF_2

Biomass expansion factor for converting volumes of extracted round wood to total aboveground biomass (including bark) BEF_2 – coniferous species	A	BEF_2 default	1,3
Biomass expansion factor for converting volumes of extracted round wood to total aboveground biomass (including bark) BEF_2 – deciduous species	B	BEF_2 default	1,4
Harvesting ratio [net timber] / [coniferous species]	C	[tys. m^3]	26278
Harvesting ratio [net timber] / [deciduous species]	D	[tys. m^3]	8599
Harvesting ratio [net timber] / [total]	E	[tys. m^3]	37,18
Biomass expansion factor for converting volumes of extracted round wood to total aboveground biomass (including bark) BEF_2	F= ((A*C)+(B*D))/E		**1,3763**

Consist with the method Tier 2, when forest land remaining forest land or biomass carbon is a key category, country-specific estimates of activity data and emission/removal factors should be applied. Considering that basic wood density [tonnes d.m/m^3 of merchantable volume] as a key element of the equation 3.2.3 (p. 3.24 of GPG for LULUCF) was updated taking into account specific national forest species diversity. Party was able to implement accurate estimates using national research on wood density. The same approach was has been used for the BEF's. BEF_2 as a key element of the equation 3.2.3 (p. 3.24 of GPG for LULUCF) was updated taking to account specific national forest species diversity. This approach allows to refer to the share of conifers and deciduous forest species in country forest ecosystems. Methodology for calculation of expansion factors should is being improved, among others, for better estimation of long and short term trends.

For calculations there were used default factors as below:

- fraction of elementary carbon in dry matter 0.5 [IPCC 2003].
- fraction of biomass left in forest to decay 0.1 [IPCC 2003].

Average belowground to aboveground biomass ratio was calculated by use of volume of thick for conifers and broadleaves and multiplying it by adequate factors (conifers – 0.2. broadleaves – 0.24 [IPCC 2006]).

7.2.4.6. Dead organic matter

According to the Tier 2 method (IPCC GPG LULUCF 2003) and basing on the results of National Forest Inventory for all ownership forms which provided information on average thickness of dead wood in forest land (about 5.8 m^3/ha for all ownership form of forests), net carbon stock change for this pool was estimated based on IPCC methodology described in the chapter 3.2.GPG LULUCF – Equation 3.2.12. page 3.34.

7.2.4.7. Mineral soils

IPCC 2003 soils types structure has been assigned to the country data concerning habitats structure. Data used for the calculation process has been collected for the period 1968-2011. Estimations are based on soil types area (divided into the high activity soils, low activity soils, sandy and wetland). It is assumed that other specified soils types (in GPG for LULUCF) do not occur in Poland.

Table 7.12. Forest habitant types in Poland with the assignment to IPCC soils types

Soil type	Forest habitat types
High Activity Soils	Fresh mixed forest, moist mixed forest, mixed upland forest, mountain mixed forest, fresh broadleaved forest, moist broadleaved forest upland forest, mountain forest
Low Activity Soils	Moist coniferous forest, mountain coniferous forest, high- mountain coniferous forest, 0,5*fresh mixed coniferous forest, moist mixed coniferous forest, upland mixed coniferous forest, mountain mixed coniferous forest
Sandy	Dry coniferous forest, fresh coniferous forest 0,5* fresh mixed coniferous forest
Wetland	Marshy coniferous forest, boggy mountain coniferous forest, boggy mixed coniferous forest, boggy mixed forest, alder forest, ash- alder swamp forest, mountain alder forest, floodplain forest, mountain floodplain forest

Table 7.13. Percentage share of soil types by land use system (for time t and t–20)

Soil types by IPCC	2011 (t)	1991 (t-20)
High Activity Soils	45,1	33,6
Low Activity Soils	17,9	19,3
Sandy	32,5	43,2
Wetland	4,5	3,9
Sum	**100,0**	**100,0**

Carbon stock rates in forest soils were taken as default factors from [IPCC 2003] and corrected to domestic conditions by experts (Table 7.7). For calculations there were used default factors as below:

- adjustment factor reflecting the effect of a change from the native forest to the forest type in state i. j ($f_{forest\ type}$) - 1.0 [IPCC 2003].
- adjustment factor reflecting the effect of management intensity or practices on forest in state i. j ($f_{man\ intensity}$) - 1.0 [IPCC 2003].
- adjustment factor reflecting the effect of a change in the disturbance regime to state i. j with respect to the native forest($_{f\ dist\ regime}$) 1.0 [IPCC 2003].

Table 7.14 Soil organic carbon content by land use system and soil types

Land-use/management system	Soil types by IPCC	Carbon in soils [Mg C/ha]
		Default IPCC
Forest management	High Activity Soils	50
	Low Activity Soils	33
	Sandy	34
	Wetland	87

Results of the analysis determining the direction and rate of change in SOC content indicate that the C stock in the 1m layer of mineral soils derived from sand under the coniferous forests is with the range 65 -90 Mg C*ha-1, comparable results are obtained for the deciduous. The C stock in the 1m layer of mineral soils derived from soil under the deciduous forests with the range 65-115 Mg C*ha-1. Average C stock in the 1m layer of mineral soils derived from soils under the deciduous forests with high activity clay are with the range 140-250 Mg C*ha-1. Presented results were obtained from the country study ”The balance of carbon in the biomass of the main forest-forming species in Poland” Poznań, Kórnik, Warszawa, Kraków, Sękocin 2011. However, the results will be the subject of further analysis and testing.

7.2.4.8. Organic soils

The area of cultivated histosols in Poland was estimated as a case study for the purposes at national inventory [Oświecimska–Piasko 2008]. Based on information collected from Computer database on peatlands in Poland "TORF" as well as from system of Spatial Information on Wetlands in Poland the area of histosols was assessed for mid–1970s and mid–1990s. The area from which N_2O emissions were calculated covers histosols as agricultural lands cultivated and/or irrigated. So the area of such area was 882.6 thousand ha in mid–1970–ties and 769 thousand ha in mid–1990–ties. The area of histosols was then interpolated for 1976−1994.

Additionally the area of cultivated histosols was assessed for 2015 for the purpose of GHG emission projections which amounts to 680 thousand ha [PLNC5 2010]. Similarly to the previous period interpolation of histosols areas was applied between 1995 and 2015. Since 1970-ties area of histosols occupied by forest and scrub communities is increasing. In 1970-ties it was equal 170 800 ha. in 1990-ties – 214 400 ha. Also proportion of and scrub communities at organic soils are increasing from 12% at the beginning of 1970-ties to 16.5 % in 1990-ties.

Total organic soils area in 2011 was estimated for ha with the following split for subcategories: forest land remaining forest land – 229 632 ha land converted to forest land – 17 468 ha. Emissions from organic soils on forest land were estimated with the default EF contained in the table 3.2.3 p. 3.42 in GPG for LULUCF

7.2.4.9. Biomass burning

According to the article 30 of *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59) "... forests, areas of land within forests and areas up to 100 m from the forest edge shall be subject to proscriptions on activities capable of giving rise to danger, and in particular:

1) the starting of fires away from places designated for that purpose by a forest owner or District Forest Manager;
2) the use of a naked flame;
3) the burning of surface soil layers or remnants of vegetation...".

In relation to this record it is assumed that controlled biomass burning does not occur on forests. Adequate cells were filled with the notation keys "NO"

CH_4, N_2O, CO and NO_x emissions from uncontrolled forest fires were calculated using following equation (IPCC 2003, page 3.49. equation 3.2.20):

Table 7.15. Emissions ratios for calculation CH_4, N_2O, CO and NO_x emissions from forests fires [tab. 3.A.1.16.GPG LULUCF, IPCC 2003]

Compound	Ratio [g/kg d.m]		
CH_4	7.1	default	[IPCC 2003]
CO	112.0	default	[IPCC 2003]
N_2O	0.11	default	[IPCC 2003]
NO_x	0.6	default	[IPCC 2003]

7.2.5. Land converted to Forest Land (CRF sector 5.A.2)

GHG balance in this category is a net sink. In 2011 net CO_2 sink was approximately 6 466 Gg CO_2. For the methodologies used, see following chapters.

7.2.5.1 Methodological issues

Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis.

7.2.5.2. Subcategory area

Table 7.16. Land converted to forest land (cumulative area).

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	7819	20002	36015	48774	61204	58599	68466	86181
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	123773	155076	207377	223675	250806	263405	316350	379971
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	455899	502911	514677	575300	595395	608236	621751	634010

Table 7.17 Cropland converted to forest land (cumulative area).

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	6040	15451	27835	37700	47297	45256	52842	66496
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	95500	119624	159749	172273	193181	202992	243618	292643
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	351289	387740	397165	444565	460372	470210	480504	489875

Table 7.18. Grassland converted to forest land (cumulative area)

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	1779	4551	8180	11074	13907	13343	15624	19684
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	28273	35453	47629	51402	57626	60413	72732	87328
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	104610	115171	117513	130735	135023	138026	141247	144135

Considering the provisions of the decision 9/CP.2 `Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration` where it is decided that the four Parties that have invoked Article 4.6 of the Convention, which requested in their first communications for flexibility to use base years other than 1990, Poland has chosen the year 1988 as a starting point for the transitional period according to the IPCC 2003 guidelines). Party applied 20-years default transition period which has been applied to all land use categories including forests.

With regard to that total increment of the forest area since 1988 is corresponding to the area of land converted to forest land during the years 1988-2011.

According to the Article 3.3 of the Kyoto Protocol, the net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to the Afforestation, Reforestation and Deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. Increment in total forest land area considered as the FM area in the 1990, adopted as the starting point for reporting under the Kyoto Protocol has exceeded the 1988`s FL_FL area by 26 900 [ha] and this difference has remained constant.

Table 7. 19. Area of land subject to the afforestation/ reforestation activity.

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
[ha]	16013	28772	41202	37455	47322	65037	102629	133932
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
[ha]	186233	202531	229662	242261	295206	358827	434755	481767
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**		
[ha]	493533	554156	582070	607094	636622	661640		

7.2.5.3. Living biomass

Annual change in stock in forest for all ownership forms was estimated based on data published in Statistical Year Book [Central Statistical Office 2012]. Data sources contains tables describing forest resources by areas and age classes. Stock change estimation (m^3/ha/year) for all forests ownership forms is considering information on volume of forests resources and annual harvests.

Annual changes in carbon stocks in living biomass in land converted to forest land were calculated with the equation 3.2.26 (p. 3.53 of GPG for LULUCF).

7.2.6. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2011 for IPCC sector *5.Land-Use Change and Forestry* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. This year uncertainty assumptions were applied directly to on activities and emission factors, instead of emission as in previous years. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6. Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

Table 7.20. Results of the sectoral uncertainty analysis in 2011

2011	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
5. Land-Use Change and Forestry	**-24170.50**	**107.10**	**0.03**	26.7%	79.7%	58.2%
A. Forest Land	-31019.63	0.59	0.01	20.6%	80.2%	80.2%
B. Cropland	3316.34			20.6%		
C. Grassland	220.88	0.06	0.00	20.6%	80.2%	80.2%
D. Wetlands	3145.92	106.45	0.02	20.6%	80.2%	80.2%
E. Settlements	165.99			20.6%		
F. Other Land						

7.2.7. Category-specific QA/QC and verification

Basing on the current recommendations from the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories, following elements of quality assurance and control were defined for the inventory of national activities in this area:

- performing an inventory of institutions. is responsible for coordinating QA / QC
- general procedures for quality control inventory QA / QC (using Tier 1).
- a detailed set for the category of sources. quality control procedures (using Tier 2)

Most of the input data used in the inventory process comes from official national statistics in the statistical studies of Central Statistical Office, reports of Forest Management and Geodesy Bureau. In case of deviations from the trend, more detailed checks are carried out concerning data input. This situation has occurred in the year 2009 for the studies presented in the official statistical volume of forest resources as a result of changes in methodology for their estimation. Presented data as a result of using National of State Forest Inventory of all forms of ownership become an official source of national statistics. In addition, for the annually calculated emissions are compared with the corresponding values from the previous years (trend of emissions), and in the event of any unexpected changes they are examined in more detail. For the detailed information see chapter QA/QC.

7.2.8. Recalculations

Fallowing recalculation in the inventory for year 2011 in land use, land use change and forestry sector were made:

- For the years 1988-2011 in relation to the previous inventory report for the year 2009, encompassing units of land subject to multiple activities were indentified based on data published in the *Data on the condition and changes in the registered intended use of land* developed on the basis of annual reports on land, introduced by the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454). Data used for estimation was divided by proveniences (voivodships).
- Party set 20-years default transition period which has been applied to all land use categories
- Estimates of carbon stock change in mineral soils on forest land were updated considering the default SOC_{ref} factors. Nevertheless, Party is considering this factor for further improvements)

7.2.9. Planned improvements

With the connection to the first cycle of National Forest Inventory of all ownership forms, executed in a 5-year cycles but updated annually, a continuous analysis of the conventional statistics and indicators will be performed on the basis of the collected material and the use of the collected data to estimate emissions and removals from the forestry sector with regard to actions under Article. 3.3 and 3.4 of the Kyoto Protocol. It should be added that the results of NFI are a valuable source of reliable information on forest resources (i.e. dead wood on forest land. which are used in the National Inventory of greenhouse gases). In addition, research projects will be able to allow a precise determination of changes in carbon content in forest litter, and also allows verification of the conventional factors used to determine changes in carbon content in forest soils. Moreover Party is considering the revision of in-country specific SOC factors. Such an eventuality is dictated by many factors and processes that are determining the direction and rate of change in SOC content when vegetation and soil management practices are changed. Ones that may be important for increasing SOC storage include (1) increasing the input rates of organic matter, (2) changing the decomposition of organic matter inputs that increase LF-OC in particular, (3) placing organic matter deeper in the soil either directly by increasing belowground inputs or indirectly by enhancing surface mixing by soil organisms, and (4) enhancing physical protection through either intra-aggregate or organo-mineral complexes. At the moment considering the ongoing in-country research, there is not enough data currently available to precisely describe factors defined above and to determine the amount of carbon accumulating in any large region or even some particular plot of land. Subsequent analysis will be possible at the end, the ongoing national studies concerning SOC in forest soils. Party is considering described factor as necessary for further improvements.

7.3. Cropland (CRF sector 5.B.).

7.3.1. Source category description

Calculation for category 5.D. is based on IPCC methodology described in the chapter 3.3. of the GPG LULUCF.

7.3.1.1. Cropland remaining Cropland (CRF sector 5.B.1.)

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 3 316 $GgCO_2$.

7.3.1.2. Land converted to Cropland (CRF sector 5.B.2.)

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 99 $GgCO_2$

7.3.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.3.1.1.1.3. IPCC "Good Practice Guidance for Land use, land use change and forestry - LULUCF GPG, 2003" Poland has selected Approach 2, considering the set of information's available in the register of land and buildings

7.3.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

Agricultural land consists of:
- agricultural land maintained in good agricultural condition – in accordance with the standards (agricultural land maintained in good agricultural condition includes: arable land. orchards. fixed meadows and pastures. which are cultivated);
- other agricultural land (not divided according to types). i.e. agricultural land currently not utilised and not maintained in good agricultural condition (previously used as agricultural land but no longer utilised for agricultural purposes for economical. social or other reason. but could be reintroduced to the agricultural production using farm resources).

Land areas defined as a cropland are:
- arable land includes land which is cultivated, i.e. sowed and fallow land. Arable land should be maintained in good agricultural condition. Cultivated arable land is understood as land sowed or planted with agricultural or horticultural products, willow and hops plantations, area of greenhouses, area under cover and area of less than 10 a, planted with fruit trees and bushes, as well as green manure,
- fallow land includes arable land which are not used for production purposes but are maintained in good agricultural condition.

Orchards include land with the area of at least 10 a, planted with fruit trees and bushes, as well as nurseries of fruit trees and bushes (maintained in good agricultural condition).

Table7.21. Land subject to the category cropland remaining cropland

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	14702000	14679000	14664129	14645060	14627394	14608054	14588801	14568139
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	14544172	14523065	14496039	14467344	14442660	14405469	14368785	14368785
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	14342111	14320133	14300495	14287699	14266202	14232629	14187447	14154067

Table 7.22 Land subject to the category land converted to cropland (cumulative area).

Year	1988	1989	1990	1991	1992	1993	1994	1995
[ha]	0	0	0	0	0	0	0	0
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	0	0	0	0	0	0	0	28855
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	28855	28855	28855	28855	28855	28855	28855	28855

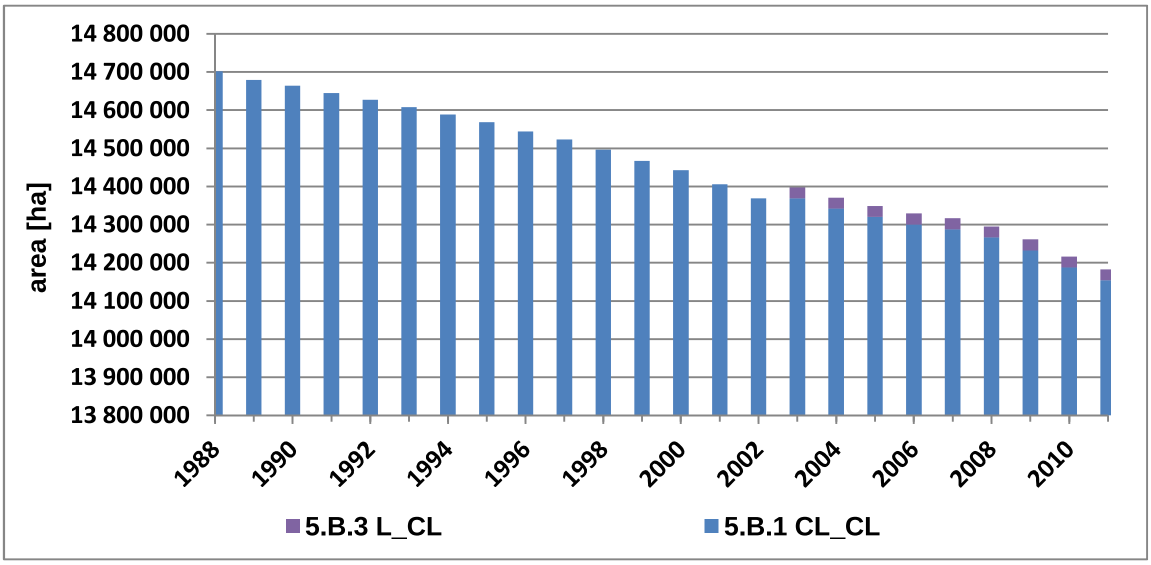

Figure. 7.15. Cropland area changes

There has been only one recorded growth of cropland area in 2003, when the total cropland area increased by 28 855 ha – converted from grassland.

7.3.4. Methodological issues

7.3.4.1. Living organic matter

Annual carbon stock change in living biomass was calculated based on cropland area covered by perennial woody biomass (orchards). Annual growth rate for perennial woody biomass was calculated using equation 3.3.1.1.1.1. IPCC 2003. For calculations there were used default factors as below:

- biomass accumulation rate – 2.1 [tC/ha] table 3.3.2 GPG LULUCF page 3.71,
- harvest/maturity cycle – 30 [year] table 3.3.2 GPG LULUCF page 3.71,
- biomass carbon loss – 63 [t/ha*yr] table 3.3.2 GPG LULUCF page 3.71.

7.3.4.2. Mineral soil

Agricultural land valuation classes with the assignment to IPCC soils types.

- High Activity Soils - soils having appreciable contents of high activity clays (eg. 2:1 expandable clays such as montmorillonite) which promote long-term stabilization of organic matter, particularly in many carbon-rich temperate soils.
- Low Activity Soils - soils with low-activity clays (eg., 1:1 non-expandable clays such as kaolinite and hydropus oxide clays of iron and aluminum) which have a much lower ability to stabilize organic matter and consequently respond more rapdly to changes in the soil's

carbon balance. Among these are highly-weathered acid soils of subtropical and tropical regions.

- Sandy soil - Soils with less than 8% clay and more than 70% sand, which generally have low structural stability and low capacity to stabilize carbon.
- Wetland - Mineral soils which have developed in poorly-drained, wet environments. They have reduced decomposition rates and high organic matter contents. If drained for agriculture they are subject to large losses of carbon.

Estimation of area of different soil types (high activity soils, low activity soils, sandy and wetland) is based on area of soil valuation classes (Table 7.20). Then percentage fraction of all soil types in croplands was calculated.

Table 7.23. Agricultural land by soil valuation classes in Poland according to GPG LULUCF

Soil type	Soil valuat ion classes
High Activity Soils	I, II, III
Low Activity Soils	IV
Sandy	V
Wetland	other

Valuation classes of agricultural land describe the quality of land in terms of value to agricultural production. Class I corresponds to the highest agricultural value and class VI to the lowest. Valuation classes of agricultural land are presented in table 7.21.

Table 7.24 Valuation classes of agricultural land in Poland

Valuation classes		1976	1979	1985	1990	2000
		thos ha				
Total						
Total		19349.4	19200.5	18945	18804.8	18536.9
I		71	70.7	70	68.7	67.8
II		547.6	551.1	550.3	544.1	536.4
III		4153.2	4152.1	4199.1	4201.6	4201.9
IV		7627.5	7611.8	7545.6	7493.4	7402.9
V		4522	4441	4310.3	4267.2	4197.2
VI		2428.1	2373.8	2269.7	2229.8	2114.9
land not classified		0	0	0	0	15.8
Arable land and orchards						
Total		15173.7	15073.4	14818	14682.8	14451.1
I		69	68.5	67.4	66.5	65
II		480	483.8	485	482.2	479.6
III		3621.5	3618.9	3643.7	3650.7	3664.6
IV		5961	5924.2	5807.6	5743.4	5640.2
V		3151.8	3114.5	3018.3	2976.2	2908.3
VI		1890.4	1863.5	1796.1	1763.8	1682.6
land not classified						10.8
Permanent Meadow and Pastures						
Total		4175.7	4127.1	4126.9	4122	4085.8
I		2	2.2	2.6	2.2	2.8
II		67.6	67.3	65.3	61.9	56.8
III		531.7	533.2	555.4	550.9	537.3
IV		1666.5	1687.6	1738	1750	1762.7
V		1370.2	1326.5	1292	1291	1288.9
VI		537.7	510.3	473.6	466	432.3
land not classified						5

Source: Central Statistical Office-Environmental Protection 2011, tab. 7(25), page 108

Table. 7.25. Soil organic carbon by land use system and soil types

Land-use/management system	Soil types by IPCC	Carbon in soils [Mg C/ha] Default IPCC
Agricultural crops	High Activity Soils	50
	Low Activity Soils	33
	Sandy	34
	Wetland	87

For calculations there were used default factors as below:

- stock change factor for land use or land-use change type in the beginning of inventory year - F_{LU}(0-T) = 0.82. [IPCC 2003 tab. 3.3.4. page 3.77].
- stock change factor for management regime in the beginning of inventory year – F_{MG}(0-T)=1.09 [IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for input of organic matter in the beginning of inventory year – F_I(0-T)=1.00 [IPCC 2003 tab. 3.3.4. page. 3.77].
- Stock change factor for land use or land-use change type in current inventory year – F_{LU}(0)= 0.82[IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for management regime in current inventory year –F_{MG}(0)=1.09. [IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for input of organic matter in current inventory year – F_I(0) = 1.00 [IPCC 2003 tab. 3.3.4. page 3.77].

7.3.4.3. Organic soils

The area of cultivated histosols in Poland was estimated as a case study for the purposes at national inventory [Oświecimska–Piasko 2008]. Based on information collected from Computer database on peatlands in Poland "TORF" as well as from system of Spatial Information on Wetlands in Poland the area of histosols was assessed for mid–1970s and mid–1990s. The area from which N_2O emissions were calculated covers histosols as agricultural lands cultivated and/or irrigated. So the area of such area was 882.6 thousand ha in mid–1970–ties and 769 thousand ha in mid–1990–ties. The area of histosols was then interpolated for 1976–1994. Additionally the area of cultivated histosols was assessed for 2015 for the purpose of GHG emission projections which amounts to 680 thousand ha [PL NC5 2010]. Similarly to the previous period interpolation of histosol areas was applied between 1995 and 2015.

N_2O emission from cultivation of histosols was estimated based on default emission factor for Mid-Latitude Organic Soils from [IPCC 2000]: 8 kg N_2O-N /ha. N_2O emission is reported in sector 4. Agriculture in subcategory 4.D.1.5.
To estimate CO_2 emission from cultivated organic soils were used default emission factor for cold temperate climate – 1.0 tC/ha*year [tab. 3.3.5 page 3.79 IPCC 2003] and equation 3.3.5 page 3.79 IPCC 2003.

7.3.4.4.Carbon emissions from agricultural lime application

The reported annual carbon emission from agricultural lime application is calculated as:

$$C = M_{limestone} * EF_{limestone} + M_{dolomite} * EF_{dolomite}$$

where:

$M_{limestone}$ – annual amount of sold limestone ($CaCO_3$) [Mg/yr]
$M_{dolomite}$ – annual amount of sold dolomite ($CaCO_3$) [Mg/yr]
$EF_{limestone}$ – emission factor for limestone – 0.120 [Mg C/ Mg limestone]
$EF_{dolomite}$ – emission factor for dolomite – 0.130 [Mg C/ Mg dolomite]

Domestic statistic publications contain only data of use of lime fertilizers in pure nutrient (CaO), that it was necessary to convert these data into actual use of fertilizers [Radwański 2006b]. It was assumed that lime – magnesium fertilizers ($CaMg(CO_3)_2$) contains 89.1% of $CaCO_3$ and 10.9% of $MgCO_3$. Carbon (C) is converted to carbon-dioxide (CO_2) by the conversion factor 44/12.
Annual CO_2 emission in 2011 from agricultural lime application was 387 Gg CO_2. Emission from agricultural lime application is reported together with lime application in Grassland.

7.3.4.5. CH_4, N_2O, CO and NO_x emissions

CH_4, N_2O, CO and NO_x emissions from cropland fires are reported in subcategory 5.C.1.

Poland there is no controlled burning of cropland.

7.3.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.2.5

7.3.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.2.6

7.3.7. Recalculations

Detailed information contain chapter 7.2.7

7.3.8. Planned improvements

Detailed information contain chapter 7.2.8

7.4. Grassland (CRF sector 5.C.)

7.4.1. Source category description

Calculation for category 5.C. based on IPCC methodology described in the chapter 3.4. GPG LULUCF.

7.4.1.1. Grassland remaining Grassland (CRF sector 5.C.1.)

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 410 $GgCO_2$.

7.4.1.2. Land converted to Grassland (CRF sector 5.C.2.)

GHG balance in this was identified as a net CO_2 sink. Net CO_2 balance was equal to -189 $GgCO_2$.

7.4.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.4.1.1.1.3. IPCC "Good Practice Guidance for Land use, land use change and forestry - LULUCF GPG, 2003" Poland has selected Approach 2, considering the set of information's available in the register of land and buildings

7.4.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

Areas classified to Grassland – permanent meadows and pastures include land permanently covered with grass, but it does not include arable land sown with grass as part of crop rotation. Permanent meadows are understood as the land permanently covered with grass and mown in principle and in mountain area also the area of mown mountain pastures and meadows. Permanent pastures are understood as the land permanently covered with grass not mown but grazed in principle and in mountain area – also the area of grazed pastures and meadows. Permanent meadows and pastures classified to this category must be maintained in good agricultural condition.

Table 7.26 Area of land subject to the subcategory grassland remaining grassland

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	4315700	4308700	4295004	4287413	4286359	4286359	4286359	4285465
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	4278834	4277136	4277136	4271902	4263395	4242446	4242446	4242446
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	4225563	4208116	4185778	4156144	4153155	4146854	4139507	4133561

Table 7.27 Area of land subject to the subcategory land remaining grassland (cumulative area).

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	14500	14500	14500	14500	14500	20522	27046	27046
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	27046	27046	44840	44840	44840	44840	47339	53969
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	53969	53969	53969	53969	39469	39469	39469	39469

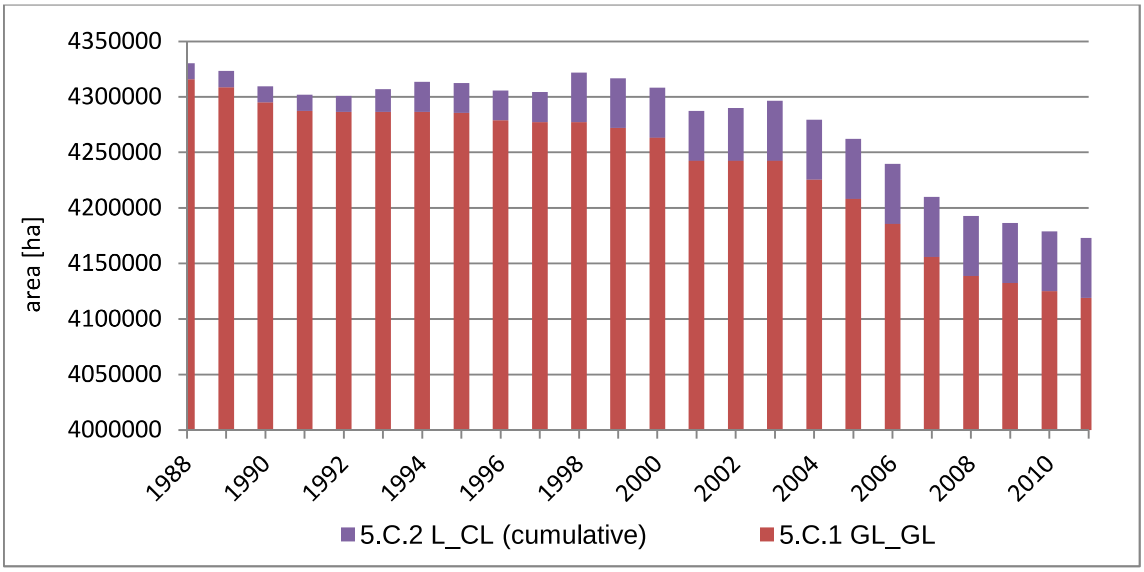

Fig. 7.16. Land area changes of permanent grasslands during the period 1988-2011

7.4.4. Methodological issues

7.4.4.1. Living organic matter

Emissions/removals from this subcategory were not estimated because in Poland there is no perennial woody biomass (conservative approach).

7.4.4.2. Mineral soil

Table 7.28. Soil organic carbon by land use system and soil types

Land-use/management system	Soil types by IPCC	Carbon in soils [Mg C/ha] SOC_{ref}
		Default IPCC
Grassland/Rangeland	High Activity Soils	50
	Low Activity Soils	33
	Sandy	34
	Wetland	87

For calculations there were used default factors as below:

- stock change factor for land use or land-use change type in the current of inventory year $F_{LU(0)}$ = 1.00 [IPCC 2003 tab. 3.4.5. page 3.118].
- stock change factor for management regime in the beginning of current year $F_{MG(0)}$ = 0.95 [IPCC 2003 tab. 3.4.5. page 3.118].
- stock change factor for input of organic matter in the beginning of current year $F_{I(0)}$ = 1.00 [IPCC 2003 tab. 3.4.5. page 3.118].

7.4.4.3. Organic soils

The area of cultivated histosols in Poland was estimated as a case study for the purposes if national inventory [Oświecimska–Piasko 2008].
To estimate CO_2 emission from cultivated organic soils the default emission factor was used for cold temperate – 0.25 tC/ha*year [tab. 3.3.6 page 3.118 IPCC 2003] and equation 3.4.10 page 3.114 IPCC 2003.

CO_2 emission from cultivated organic soils converted to grassland is also reported in subcategory 5.C.1.

7.4.4.4. Carbon emission from lime application

Carbon emission from lime application on grassland and land converted to grassland is reported together with cropland lime application in subcategory 5.B.1.

7.4.4.5. Biomass burning

CH_4, N_2O, CO and NO_x emissions from fires were calculated using following equation (IPCC 2003, page 3.49. equation 3.2.20). This subcategory is covering the non-CO_2 emission from crop area, meadows and stubbles fires.

7.4.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.2.5

7.4.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.2.6

7.4.7. Recalculations

Detailed information contain chapter 7.2.7

7.4.8. Planned improvements

Detailed information contain chapter 7.2.8

7.5. Wetlands (CRF sector 5.D.)

7.5.1. Source category description

Calculation for category 5.D. is based on IPCC methodology described in the chapter 3.5. of the GPG LULUCF.

7.5.1.1. Wetlands remaining wetlands

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 2 903 $GgCO_2$.

7.5.1.1. Lands converted to Wetlands

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 242 $GgCO_2$.

7.5.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.5.1.1.1.3. IPCC "Good Practice Guidance for Land use, land use change and forestry - GPG for LULUCF, IPCC 2003" Poland has selected Approach 1, considering the set of information's available in the register of land and buildings.

7.5.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

This category includes land that is covered or saturated by water for all or part of the year and that does not fall into the forestland, cropland, grassland or settlements categories. It includes reservoirs as a managed subcategory and natural rivers and lakes as unmanaged subcategory.

Table 7.29 Area of land subject to the category wetland remaining wetland.

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	1322100	1322100	1322100	1322100	1322100	1322100	1322089	1322089
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	1322089	1320703	1320703	1320703	1320703	1317468	1317468	1317468
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	1317468	1317468	1316480	1316480	1317880	1320083	1321576	1324003

Table 7.30 Area of land subject to the category land remaining wetland.

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
[ha]	1400	6400	7893	10320	11288	12865	12865	15544
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	17549	17549	18372	21931	24828	24828	26687	40460
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	44349	44836	44836	48627	49053	44053	46120	44794

Changes of the wetlands area recorded for the period 1988-2011 are presented at the graph bellow (Fig. 7.13).

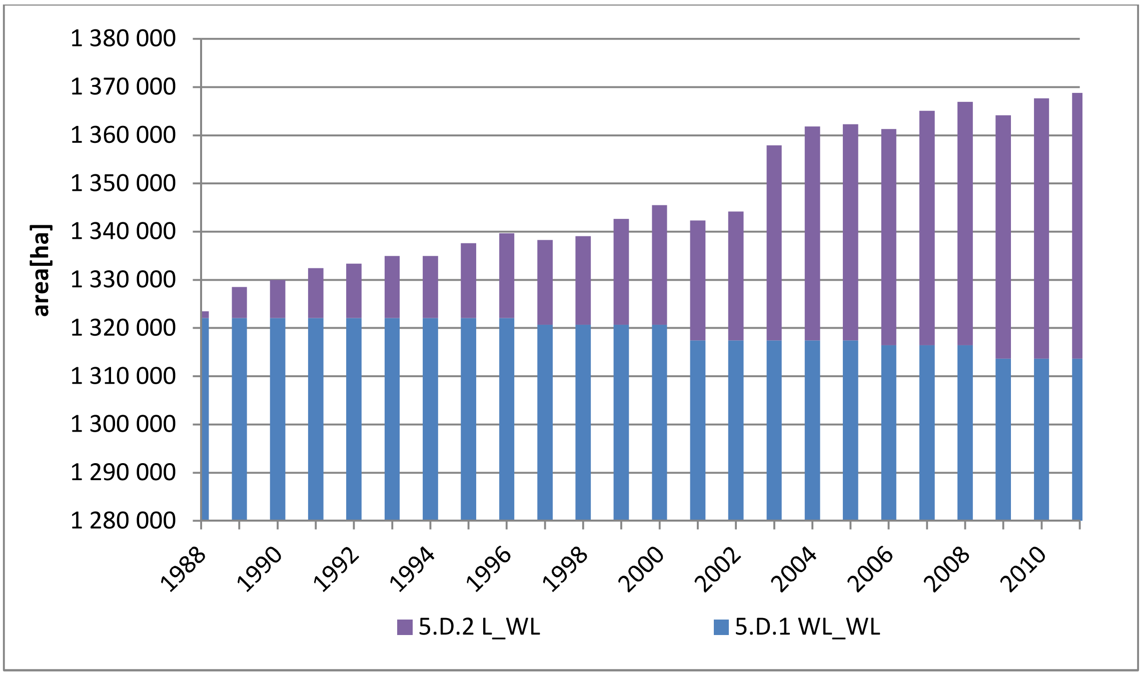

Fig. 7.17. Area of changes on Wetlands in period 1988-2011

According to IPCC 2003 wetlands are divided into organic soils managed for peat extraction and flooded lands. Area of organic soils managed for peat extraction in 2011 was 3 341 ha and area of flooded land was 852 992 ha.
Area of organic soils managed for peat extraction was estimated based on literature data and is presented in table 7.13.

Table 7.31 Area of organic soils managed for peat extraction in Poland

Year	1960[1]	1985[2]	1999[3]	2011
Area of organic soils managed for peat extraction [ha]	78 341	4 931	4 680	3312
in it:				
nutrient rich organic soils. in it:	67 120	4 225	4010	2838
low peat deposit	67 120	4 225	4010	2838
nutrient poor organic soils. in it:	11 220	706	670	474
transition peat deposit	2 116	930	883	625
high peat deposit	5 136	2 257	2142	1516
mix-typical peat deposit	3 055	1 343	1275	902
other peat deposit	913	401	381	269

[1] “Characteristic of peat deposit in Poland” IMUZ Falenty 1996
[2] „Peat lands and peat”. Publication of Agricultural Academy in Poznań. Ilnicki P. Poznań 2002
[3] Central Statistical Office - Environmental Protection 2011

CO_2 and N_2O emissions are estimated from organic soils managed for peat extraction. This area was 78 341 ha in 1960-ties and 1 200 ha at the end of 1990-ties. Area of organic soils managed for peat extraction between years 1960-1999 was calculated using interpolation, and because of lack of data, for years 2000-2008 value from year 1999 was taken. Since 1999 national statistics contain data on area of organic soils managed for peat extraction It need to be highlighted that data from national statistics are consistent with the previously estimated values of organic soils managed for peat extraction.

Table 7.32. Area of organic soils managed for peat extraction in period 1999-2011

Year		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Area of organic soils managed for peat extraction:, in this:	[ha]	4680.0	5178.0	2912.0	5138.0	5141.0	5508.0	5107.0	3429.0	3433.0	3410.0	3311.0	3314.0	3312.0
Rich organic soli	[ha]	4009.7	4436.4	2494.9	4402.1	4404.7	4719.1	4375.6	2937.9	2941.3	2921.6	2836.8	2839.4	2838.0
Poor organic soli	[ha]	670.3	741.6	417.1	735.9	736.3	788.9	731.4	491.1	491.7	488.4	474.2	474.6	474.6

Source: Central Statistical Office - Environmental Protection 2000-2011

7.5.4. Methodological issues

7.5.4.1. Wetlands remaining wetlands

Emission calculations are based on equation 3.5.5. page 3.138 IPCC 2003.
For calculations there were used default emission factors for cold climate as below:

Table7.33. Emission factors for the subcategory wetland remaining wetland

Symbol	Unit	Emission factor	Source
$EF_{peatNrich}$	[t C/ha*year]	1.1	table 3.A.3.2. page 3.280 IPCC 2003
$EF_{peatNpoor}$	[t C/ha*year]]	0.2	

Symbol	Unit	Emission factor	Source
$EF_{peatNrich}$	[kgN_2O/ha*year]	1.8	table 3.A.3.4. page 3.284 IPCC 2003
$EF_{peatNpoor}$	[kgN_2O/ha*year]	0.1	

Area of flooded lands was estimated based on statistical yearbook of Environmental Protection [GUS Environmental Protection]. Area of flooded land include:

- land under internal marine waters,
- land under surface flowing waters, which covers land under waters flowing in rivers, mountain streams, channels, and other water courses, permanently or seasonally and their sources as well as land under lakes and artificial water reservoirs. from or to which the water course flow,
- land under surface lentic water. which covers land under water in lakes and reservoirs other than those described above,
- land under ponds including water reservoirs (excluding lakes and dam reservoirs for water level adjustment) including ditches and areas adjacent and related to ponds,
- land under ditches including open ditches acting as land improvement facilities for land used in agricultural production.

CO_2 emission calculations are based on equation 3.A.3.8. page 3. 287, IPCC 2003. For calculations default emission factors for cold climate were used as presented below:

Table7.34 Emission factors for the subcategory wetland remaining wetland

Symbol	Unit	Emission factor	Source
$E(CO_2)diff$	[kg CO_2/ha*day]	9.3	table 3.A.3.5. page 3.290 IPCC 2003
$E(CO_2)diff$	[Gg CO_2/ha*day]	0.0000093	

CH_4 emission calculations are based on equation 3.A.3.9. page 3. 287. IPCC 2003. For calculations there were used default emission factors for cold climate as below:

Table7.35 Emission factors for the subcategory wetland remaining wetland

Symbol	Unit	Emission factor	Source
$E(CH_4)diff$	[kg CH_4/ha*day]	0.2	table 3.A.3.5. page 3.290 IPCC 2003
$E(CH_4)diff$	[Gg CH_4/ha*day]	0.0000002	
$E(CH_4)diff$	[kg CH_4/ha*day]	0.14	table 3.A.3.5. page 3.290 IPCC 2003
$E(CH_4)diff$	[Gg CH_4/ha*day]	0.00000014	

N_2O emission from flooded land was not estimated because there is no domestic emission factor for average daily diffusive emissions. Also in IPCC 2003 this factor is sign as „not measured" [IPCC 2003 page 3.290 tab. 3.A.3.5.]

7.5.4.2. Land converted to Wetlands (CRF sector 5.D.2.)

For calculations default emission factors were used as presented below:

- carbon fraction of dry matter CF = 0.5 [IPCC 2003. page 3.140],
- Living biomass in land immediately before conversion to flooded land B_{Before} = 2.4 t dm/ha [GPG LULUCF table 3.4.2., page 3.109],
- Living biomass immediately following conversion to flooded land B_{After} = 0 t dm/ha [IPCC 2003. page 3.140].

7.5.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.2.5

7.5.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.2.6

7.5.7. Recalculations

Detailed information contain chapter 7.2.7

7.5.8. Planned improvements

Detailed information contain chapter 7.2.8

7.6. Settlements (CRF sector 5.E.)

7.6.1. Source category description

Calculation for category 5.D. is based on IPCC methodology described in the chapter 3.6. of the GPG LULUCF.

7.6.1.1. Settlements remaining Settlements (CRF sector 5.E.1.)

GHG balance in this was identified as a net CO_2 sink. Net CO_2 balance was equal to -84,83 $GgCO_2$.

7.6.1.2. Land converted to Settlements (CRF sector 5.E.1.)

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 250 $GgCO_2$.

7.6.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.6.1. IPCC "Good Practice Guidance for Land use, land use change and forestry - GPG for LULUCF, IPCC 2003" Poland has selected Approach 1, considering the set of information's available in the register of land and buildings.

7.6.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

This category includes all developed lands, including transportation infrastructure and human settlements refers to:

- residential areas include land not used for agricultural and forest production, put under dwelling buildings, devices functionally related to dwelling buildings (yards, drives, passages, playgrounds adjacent to houses), as well as gardens adjacent to houses.
- industrial areas include land put under buildings and devices serving the purpose of industrial production.
- other built-up areas include land put under buildings and devices related to administration. not listed under residential and industrial areas.
- undeveloped urbanised areas include land that is not built over, allocated in spatial management plans to building development and excluded from agricultural and forest production
- recreational and resting areas comprise the following types of land not put under buildings:
- areas of recreational centers,. children playgrounds, beaches, arranged parks, squares, lawns (outside street lanes);
- areas of historical significance: ruins of castles, strongholds, etc.
- sport grounds: stadiums, football fields, ski-jumping take-offs, toboggan-run, sports rifle-ranges, public baths etc.
- area for entertainment purposes: amusement, grounds, funfairs etc.
- zoological and botanical gardens;
- areas of non-arranged greenery, not listed under woodlands or land planted with trees or shrubbery
- transport areas including land put under:

- roads: national roads; voivodship roads; poviat roads; communal roads; roads within housing estates; access roads to agricultural land and woodlands and to facilities of public utility; stopping and manoeuvring yards next to railway stations, bus stations and airports, maritime and river ports and other ports, as well as universal accesses to unloading platforms and storage yards,
- railway grounds,
- other transport grounds.

Table 7.36 Land area subject to the category settlements remaining settlements.

Year	1988	1989	1990	1991	1992	1993	1994	1995
[ha]	1950512	1955367	1959358	1965803	1970983	1978571	1982781	1982778
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	1980365	1976975	1981016	1986646	1991568	1962927	1950572	1934994
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	1923629	1925797	1936284	1946346	1968323	1992855	2019856	2037882

Table 7.37 Land area subject to the category forest land converted to settlements (cumulative area).

Year	1988	1989	1990	1991	1992	1993	1994	1995
[ha]	1319	2002	2615	2974	3504	4075	4749	5151
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	5568	6148	6633	7034	7752	8277	8693	9382
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	10034	10506	11093	11690	10992	10951	10889	11134

This area refers to the conversion of forest land to other categories of land use. Within the national statistical surveys that category of land use change is considered as the exclusion of forest land for non –forestry purposes. Therefore it is assumed that the forest land is converted only to settlements.

Table 7.38 Land area subject to the category cropland converted to settlements (cumulative area).

Year	1988	1989	1990	1991	1992	1993	1994	1995
[ha]	7658	14992	20928	26144	32724	40417	46784	48203
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	49414	50395	51710	53429	54930	56805	58572	60447
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	62687	65469	68075	71993	67776	62502	58397	55027

This area refers to the conversion of cropland to other categories of land use. Within the national statistical surveys that category of land use change is considered as the exclusion of agricultural land for non –forestry purposes and no-agricultural purposes.

Table 7.39 Land area subject to the category wetland converted to settlements(cumulative area).

Year	1988	1989	1990	1991	1992	1993	1994	1995
[ha]	11	39	120	143	149	181	222	688
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
[ha]	753	954	1054	1793	2468	3520	4613	5463
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
[ha]	6668	7934	9403	10999	12944	14132	15155	16191

This area refers to the conversion of wetland to other categories of land use. Within the national statistical surveys that category of land use change is considered as the exclusion of land under waters for non –forestry purposes and no-agricultural purposes.

7.6.4. Methodological issues

7.6.4.1. Settlements remaining Settlements

Living biomass

Calculations for carbon stock changes in living biomass were based on crown cower area method (urban green area – GUS 2012 Environmental Protection). Carbon stock changes in living biomass were calculated based on equation 3.a.4.1. page 3.295 [IPCC 2003.]. For calculations were used default accumulation rate C_{RF}=1.8 t C/ha were used [IPCC 2003, page 3.297].

7.6.4.2. Land converted to Settlements (CRF sector 5.E.2.)

Net emissions in this subcategory are equal to 250Gg CO_2. The fundamental equation for estimating change in carbon stocks associated with land-use conversions has been explained in other sections of this chapterwith regard to land converted from forest land, cropland and grassland, respectively. The same decision tree and the same basic method were applied to estimate change in carbon stocks in forest land converted to settlements.

Living biomass

Carbon stock changes in living biomass were indicated as included in carbon stock changes in living biomass under the subcategory 5.A.1.1 Assigned biomass losses are included in the data concerning historical harvesting rate in subcategory 5A. This method follows the approach in the IPCC Guidelines (Section 5.2.3, Forest and Grassland Conversion) where the amount of living aboveground biomass that is cleared for expanding settlements is estimated by multiplying the forest area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (C_{Before}) and that in the settlements after conversion (C_{After}).

Soils

GHG emissions and removals balance from soils were estimated with the same factors as described in the chapter 7.2.

7.6.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.2.5

7.6.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.2.6

7.6.7. Recalculations

Detailed information contain chapter 7.2.7

7.6.8. Planned improvements

Detailed information contain chapter 7.2.8

7.7. Other land

Emissions/removals from this subcategory were not estimated. It is included to match overall consistency of country land area.

8. WASTE

8.1. Overview of sector

The GHG emission sources in waste sector involve: CH_4 emission from solid waste disposal on land, CH_4 and N_2O emissions from wastewater handling and CO_2 and N_2O emissions from waste incineration.

Following category from sector 6 have been identified as key source (excluding LULUCF):

6.A - Solid Waste Disposal on Land (CH_4 emission), share in total GHG emission 1.8%

Total emission of GHG as carbon dioxide equivalent amounted to 9745.25 Gg in 2011 and decreased since 1988 by 6.2% (Figure 8.1). The biggest changes in emissions occurred in 1999-2000. This is due to change of emission factors in Domestic and Commercial Wastewater subsector in 2000. The change was caused by new researches, although, those new emission factors are not suitable for previous years.

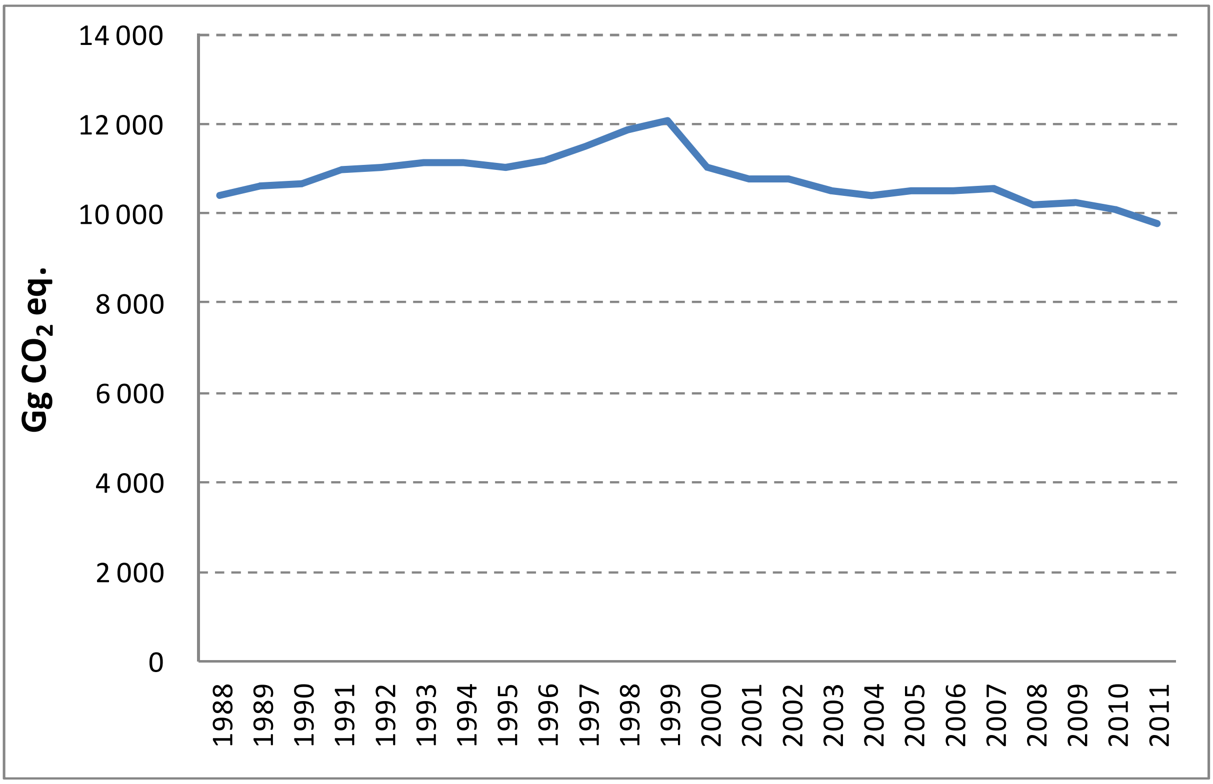

Figure 8.1. GHG emissions from waste sector in 1988-2011

Between years 1988 and 2011 decrease of GHG emissions appeared in subcategory 6.B (by 22.5%) and 6.C (by 59.7%). Only subcategory 6.A increased since 1988 (by 5.1%) (Figure 8.2).

The trend of emissions from sector 6.A is mostly conditioned by activity data: amount of waste generated and collected, that was biggest in the year 2000 due to development of the Poland's economy as well as the waste collection system. The decrease of emissions after that year is related with development of recycling system (resulting in decrease of amount of landfilled MSW) and the decrease of waste generation.

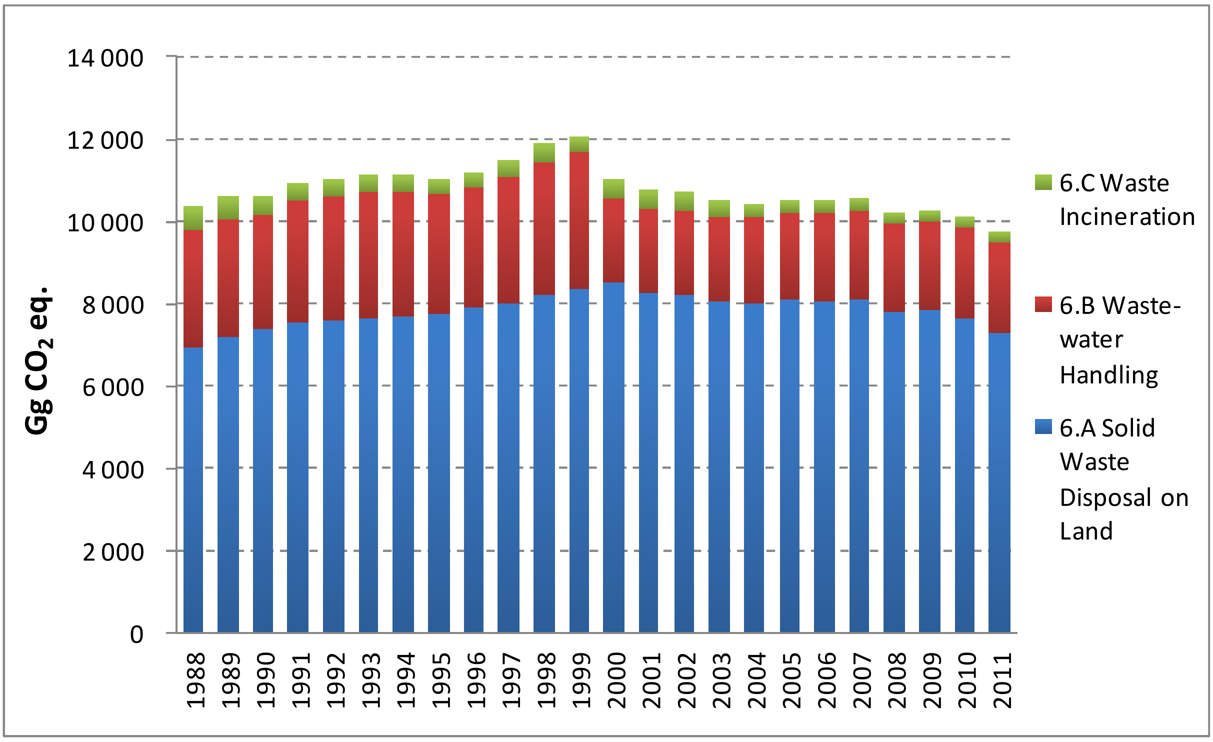

Figure 8.2. GHG emissions from waste sector divided to subcategories

The main driver of emission change in sector 6.B is the Domestic and Commercial Wastewater subsector. The main reason of emission decrease is the abovementioned change of emission factors. Apart from that the trend of emissions from this sector is growing.

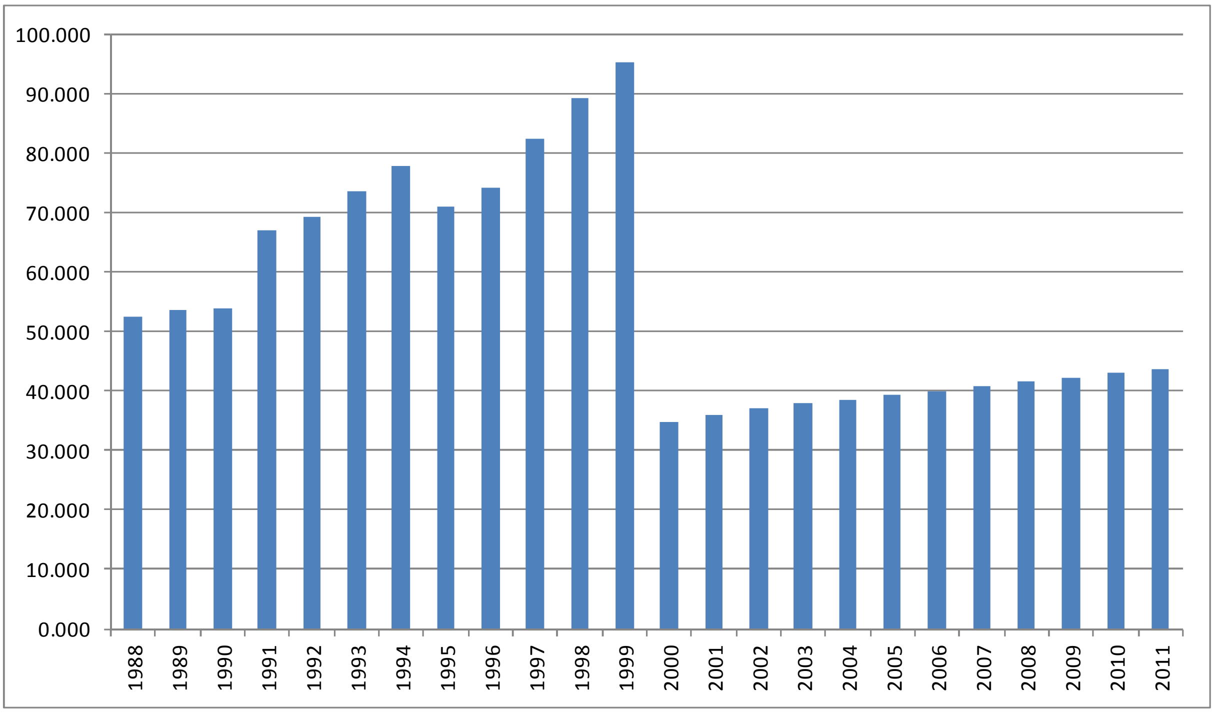

Figure 8.3. Methane emission form the 6.B.2.1 subsector [Gg]

The basic legal regulatory for waste management in Poland is the Act on waste (Dz.U. z 2010 nr 185 poz. 1243) describing the ways of waste treatment leading to human and environmental protection.

8.2. Solid Waste Disposal on Land (CRF sector 6.A)

8.2.1. Source category description

The 6.A subcategory share in total waste sector is 74.8% and it involves methane emissions from Managed Waste Disposal on Land (30.3% share of 6.A), Unmanaged Waste Disposal on Land deep (48.2% share of 6.A), Uncategorized MSW Disposal on Land (16.5% share of 6.A.) and Industrial Waste Disposal on Land (5% share of 6.A). This sector includes emission from disposal of sewage sludge on land which is mentioned in chapter 8.2.2.
The biggest change in trend emissions was in years 2000-2001 (Figure 8.2). This is due to decrease of amount of landfilled waste in 2001 (by 1 150 Gg).

8.2.2. Methodological issues

8.2.2.1 Managed Waste Disposal on Land and Unmanaged Waste Disposal on Land deep

The methane emissions from solid waste disposals were calculated using the IPCC Waste Model (Tier 2) published in [IPCC 2006]. The model establishes multiyear series when methane is generated from organic matter decomposition in anaerobic conditions.

The emission of CH_4 is diminished by recapturing of this gas for energy purposes. The data on recovered methane are based on responses to questionnaires of Central Statistical Office on energy combustion.

The following indicators were used for estimation of CH_4 emissions:

- DOC – degradable organic carbon in the year of deposition (table 8.1, default value [IPCC 2006])
- DOC_f – fraction of DOC that can decompose (fraction) (table 8.1, default value [IPCC 2006])
- MCF – CH_4 correction factor for aerobic decomposition in the year of deposition (table 8.2, default value [IPCC 2006])
- OX – Oxidation Factor reflecting the amount of CH_4 from solid waste disposal sites that is oxidized in the soil or other material covering the waste (table 8.3, default value [IPCC 2006])
- k – reaction constant [IPCC 2006] (table 8.3)
- F – fraction of CH_4 by volume, in generated landfill gas (fraction) [IPCC 2006] (table 8.3)
- R – methane recovery was taken from [GUS OZE 2012].

Table 8.1. DOC and DOC_f indicators

DOC (Degradable Organic Carbon)	Range	Default	Adopted Value
Food waste	0.08-0.20	0.15	0.15
Garden	0.18-0.22	0.2	0.2
Paper	0.36-0.45	0.4	0.4
Wood and straw	0.39-0.46	0.43	0.43
Textiles	0.20-0.40	0.24	0.24
DOC_f		0.5	0.5

Table 8.2. MCF indicators of organic carbon in disposed waste

Unmanaged, shallow	Unmanaged, deep	Managed	Managed, semiaerobic	Uncategorised
0.4	0.8	1	0.5	0.6

Table 8.3. Indicators k, F and OX assumed for calculations

Methane generation rate constant (k)	Range	Default	Value
Food waste	0.1–0.2	0.185	0.185
Garden	0.06–0.1	0.1	0.1
Paper	0.05–0.07	0.06	0.06
Wood and straw	0.02–0.04	0.03	0.03
Textiles	0.05–0.07	0.06	0.06
Delay time (months)		6	6
Fraction of methane (F) in developed gas		0.5	0.5
Oxidation factor (OX)		0	0-1*

* since 2001 managed SWDSs fulfill requirements of [IPCC 2006] to be treated as "well-managed" SWDSs for which the 0.1 value of oxidation factor is default

Activities used for estimation of CH_4 emissions from solid waste disposals contain:

- Population – number of population was taken from [GUS 2012],
- Collected Municipal Solid Wastes (MSW) was taken from National Statistics. Because of lack of data for years 1971-1973 data were interpolated on a basis of data from 1970 and 1974. The same method was used for 1976. In domestic statistics data were given in dam^3. To recalculate data into Gg a conversion factor was used. According to GUS this conversion factor is 0.26 Mg/m^3,
- Generated municipal solid waste – for the years 1970 – 2004 data was extrapolated according to amount of collected MSW [GUS 2012d],
- Municipal solid waste on landfills fulfilling requirements of Landfill Directive 1999/31/EC,

In 2011, according to statistical data [GUS 2012d], collected municipal solid wastes go to four different pathways:

- 1% goes to incineration,
- 4% goes to biological treatment,
- 79% goes to landfills,
- 16% is recycled.

Table 8.4. Data sources for amount of municipal waste

Years	[Gg]	Data source		Data source
1970	6496,65	extrapolation	4113,98	[GUS 1987]
1971	7007,31	extrapolation	4624,65	interpolation
1972	7517,98	extrapolation	5135,31	interpolation
1973	8028,64	extrapolation	5645,98	interpolation
1974	8539,31	extrapolation	6156,64	[GUS 1974d]
1975	9171,63	extrapolation	6788,96	[GUS 1986d]
1976	9780,66	extrapolation	7397,99	interpolation
1977	10389,69	extrapolation	8007,03	[GUS 1981d]
1978	11085,50	extrapolation	8702,83	[GUS 1981d]
1979	11435,29	extrapolation	9052,63	[GUS 1981d]
1980	12251,38	extrapolation	9868,72	[GUS 1986d]
1981	12397,09	extrapolation	10014,42	[GUS 1986d]
1982	12711,74	extrapolation	10329,07	[GUS 1986d]
1983	12924,57	extrapolation	10541,91	[GUS 1986d]
1984	13247,21	extrapolation	10864,54	[GUS 1986d]
1985	13469,61	extrapolation	11086,95	[GUS 1986d]
1986	13929,53	extrapolation	11546,86	[GUS 1987]
1987	14260,12	extrapolation	11877,45	[GUS 1989d]
1988	14466,84	extrapolation	12084,18	[GUS 1989d]
1989	14383,62	extrapolation	12000,95	[GUS 1990d]
1990	13480,95	extrapolation	11098,28	[GUS 1996]
1991	13020,64	extrapolation	10637,98	[GUS 1996]
1992	13003,67	extrapolation	10621,00	[GUS 1996]
1993	13027,33	extrapolation	10644,66	[GUS 1996]
1994	13397,31	extrapolation	11014,64	[GUS 1996]
1995	13367,67	extrapolation	10985,00	[GUS 2005d]
1996	14003,89	extrapolation	11621,22	[GUS 1997d]
1997	14566,11	extrapolation	12183,44	[GUS 1998d]
1998	14658,44	extrapolation	12275,77	[GUS 1999d]
1999	14699,57	extrapolation	12316,90	[GUS 2000d]
2000	14608,67	extrapolation	12226,00	[GUS 2005d]
2001	13491,67	extrapolation	11109,00	[GUS 2005d]
2002	12891,37	extrapolation	10508,70	[GUS 2005d]
2003	12307,67	extrapolation	9925,00	[GUS 2005d]
2004	12141,67	extrapolation	9759,00	[GUS 2005d]
2005	12169,00	[GUS 2012d]	9352,00	[GUS 2006d]
2006	12235,00	[GUS 2009d]	9877,00	[GUS 2007d]
2007	12264,00	[GUS 2010d]	10083,00	[GUS 2011d]
2008	12194,00	[GUS 2011d]	10036,00	[GUS 2011d]
2009	12053,00	[GUS 2012d]	9265,00	[GUS 2012d]
2010	12038,00	[GUS 2012d]	10044,00	[GUS 2012d]
2011	12128,80	[GUS 2012d]	9827,60	[GUS 2012d]

Distribution of solid waste disposal sites for managed and unmanaged ones until year 2001 was made in accordance to elaboration [Gworek 2003]. According to this publication 14% of disposal sites are managed, 86% are unmanaged.

Since 2001 Poland was implementing the Landfill Directive (1999/31/EC) and, as a result, the share of unmanaged SWDSs started to decrease (landfills fulfilling requirements of the Directive are considered to be “managed”). In accordance to data from Waste Management Department of

Ministry of Environment about amount of MSW landfilled on landfills fulfilling requirements of the Directive the share of MSW on managed and unmanaged SWDSs was updated.

Tabela 8.5. Amount of waste collected and landfilled on managed SWDS

Year	Collected MSW [Gg]	MSW landfilled on managed SWDS [Gg]	Share
2001	data unavailable	data unavailable	20%*
2002	data unavailable	data unavailable	26%*
2003	10753,0	3414,0	32%
2004	9029,3	5207,5	58%
2005	8623,1	5210,0	60%
2006	7824,4	5903,3	75%
2007	9227,8	7411,4	80%
2008	8947,2	7584,8	85%
2009	8543,6	7379,9	86%
2010	8577,6	7885,3	92%
2011	7649,8	6979,1	91%

* interpolated data

Composition of waste was made on the basis of publication [Rosik-Dulewska Cz. 2000] and on the basis of publication by [Rzeczyński B. 1996]. From the first publication composition of waste in 1985 was taken:

food	30%
garden	3%
paper	14%
wood	5%
textile	2%
plastics, other inert	46%

From the second publication, information on change in composition of metals and plastics during 20 years was taken (11.8% decrease from 1992 to 1972), and interpolation for the years until 2000 was made (table 8.6). Data for 2001-2003 are based on National Waste Management Plan 2003 [KPGO 2003], for 2004-2008 on [KPGO 2010], and for 2008-2012 on [KPGO 2014].

Table 8.6. Composition of municipal solid waste

Year	Food	Garden	Paper	Wood	Textile	Plastics, and other inert
1970	32%	5%	16%	6%	4%	39%
1971	32%	5%	16%	6%	4%	39%
1972	32%	5%	16%	6%	4%	39%
1973	31%	5%	15%	6%	3%	39%
1974	31%	4%	15%	6%	3%	40%
1975	31%	4%	15%	6%	3%	41%
1976	31%	4%	15%	6%	3%	41%
1977	31%	4%	15%	6%	3%	42%
1978	31%	4%	15%	6%	3%	42%
1979	31%	4%	15%	5%	3%	43%
1980	31%	4%	15%	5%	3%	43%
1981	30%	4%	14%	5%	2%	44%
1982	30%	4%	14%	5%	2%	44%
1983	30%	3%	14%	5%	2%	45%
1984	30%	3%	14%	5%	2%	45%
1985	30%	3%	14%	5%	2%	46%
1986	29%	3%	14%	5%	2%	47%
1987	29%	3%	14%	5%	2%	47%
1988	28%	3%	14%	4%	2%	48%
1989	27%	3%	15%	4%	2%	49%
1990	26%	3%	15%	4%	2%	49%
1991	26%	3%	15%	4%	2%	50%
1992	25%	3%	15%	4%	2%	51%
1993	24%	3%	15%	4%	2%	52%
1994	24%	3%	15%	4%	2%	52%
1995	23%	3%	15%	4%	2%	53%
1996	22%	3%	16%	4%	2%	54%
1997	21%	2%	16%	4%	2%	54%
1998	21%	2%	16%	3%	3%	55%
1999	20%	2%	16%	3%	3%	56%
2000	19%	2%	16%	3%	3%	56%
2001	18%	2%	16%	3%	3%	57%
2002	18%	2%	16%	3%	3%	57%
2003	18%	2%	16%	3%	3%	57%
2004	24%	2%	20%	2%	2%	50%
2005	24%	2%	20%	2%	2%	50%
2006	24%	2%	20%	2%	2%	50%
2007	24%	2%	20%	2%	2%	50%
2008	33%	3%	14%	1%	3%	46%
2009	33%	3%	14%	1%	3%	46%
2010	33%	3%	14%	1%	3%	46%
2011	33%	3%	14%	1%	3%	46%

Abovementioned composition of municipal solid waste is used in IPCC Waste Model to calculate amounts of each fraction of waste deposited at SWDSs, and finally - amounts of CH_4 generated by each fraction.

Recovery of methane was assumed on the basis of [GUS OZE 2012].

Following the ERT 2009 recommendations emission from sewage sludge sent to landfills was assumed for years 1995-2011.
Emission from sewage sludge was estimated on the basis of [IPCC 2006] methodology, using IPCC Waste Model. Emission factors were default [IPCC 2006] (table 8.6).

Table 8.7. Sewage sludge emission factors

DOC	reaction constant (k)
0.05	0.185

Other parameters were assumed as for municipal solid waste.

The activity data was taken from Central Statistical Office annuals – Environment Protection (in 2011 from [GUS 2012d], for years 1998, 1999 and 2001 there was a lack of data and interpolation had to be done).

Table 8.8. Sewage sludge activity data

Year	Amount of sewage sludge disposed on landfills [Gg]
1995	1 471
1996	1 419
1997	2 184
1998	1 983
1999	1 783
2000	1 582
2001	1 573
2002	1 565
2003	1 510
2004	1 511
2005	1 330
2006	1 271
2007	991
2008	696
2009	605
2010	553
2011	534

Extrapolating the amounts of sewage sludge disposed on landfills prior to 1995 is not possible due to lack of distinct trend (see below fig. 8.3.) and country specific circumstances.

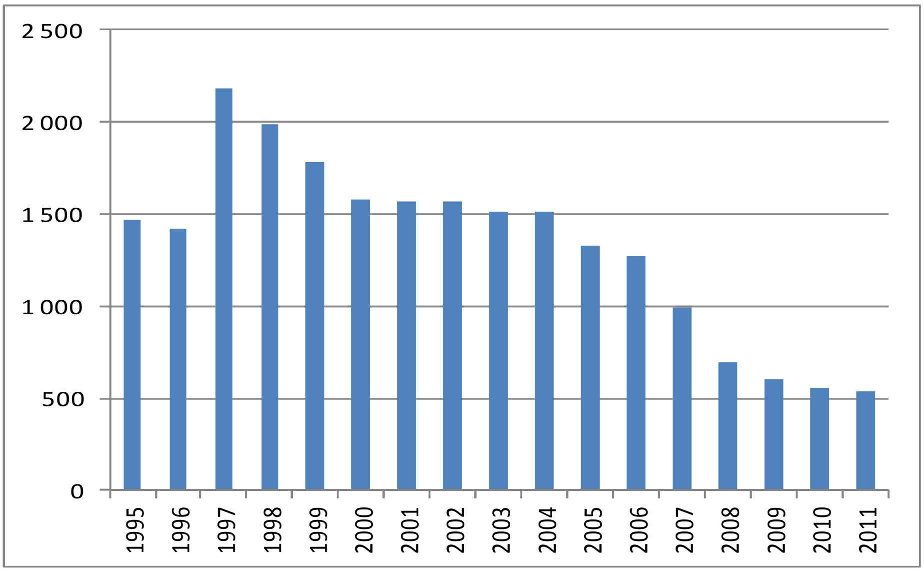

Figure 8.4. Amount of sewage sludge disposed on landfills [Gg]

8.2.2.2 Industrial Waste

Methodology is based on 2006 IPCC Guidelines [IPCC 2006]. Estimations were made using the IPCC Waste Model in MS Excel. Because the model originally doesn't calculate the emission from industrial waste for each type of waste (there is only possibility to put total amount of waste), so the emission from industrial waste was calculated in the same way as municipal waste (according to IPCC Guidelines it is correct). So the waste model was used separately to calculate emissions from municipal and industrial waste.

According to IPCC Guidelines there is CH4 emission only from few types of industrial waste:

- paper and cardboard,
- textiles,
- food,
- wood,
- tobacco,
- rubber (only synthetic).

In national inventory activity data were taken from Central Statistical Office annuals – Environment Protection. Time series is 1975-2011. Before year 1975 there were no data on industrial waste.

Table 8.9. Composition of industrial wastes [Gg]

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert	Total	Source of activity data
1975	2 671.2	226.1	78.0	67.2	0.0	0.0	3 042.5	[GUS 1975d]
1976	3 390.7	173.6	79.5	51.5	0.0	0.0	3 695.3	[GUS 1976d]
1977	4 226.3	216.6	107.3	110.3	0.0	0.0	4 660.5	[GUS 1977d]
1978	4 841.5	163.1	87.2	201.0	0.0	0.0	5 292.8	[GUS 1978d]
1979	4 551.0	164.9	94.9	87.6	0.0	0.0	4 898.4	[GUS 1979d]
1980	3 727.0	198.4	88.1	93.2	0.0	0.0	4 106.7	[GUS 1981d]
1981	4 337.8	161.4	47.9	79.2	0.0	0.0	4 626.3	[GUS 1982d]
1982	3 741.9	273.5	47.7	82.4	0.0	0.0	4 145.5	[GUS 1983d]
1983	3 519.6	380.0	60.7	66.4	0.0	0.0	4 026.7	[GUS 1984d]
1984	3 373.1	319.2	50.7	78.8	0.0	0.0	3 821.8	[GUS 1985d]
1985	3 483.9	295.9	61.5	81.5	0.0	0.0	3 922.8	[GUS 1986d]
1986	1 273.3	347.2	102.2	144.9	0.0	0.0	1 867.6	[GUS 1987d]
1987	1 258.9	381.4	123.6	87.5	0.0	0.0	1 851.4	[GUS 1988d]
1988	1 498.3	409.2	106.0	137.8	0.0	0.0	2 151.3	[GUS 1989d]
1989	1 235.3	492.9	108.5	70.2	0.0	0.0	1 906.9	[GUS 1990d]
1990	1 211.5	408.2	90.9	42.2	0.0	0.0	1 752.8	[GUS 1991d]
1991	1 385.1	407.0	65.6	40.1	0.0	0.0	1 897.8	[GUS 1992d]
1992	938.9	363.2	23.9	53.4	81.4	11.5	1 472.3	[GUS 1993d]
1993	1 058.9	339.0	17.6	34.0	36.1	13.1	1 498.7	[GUS 1994d]
1994	855.3	277.1	19.1	21.6	21.2	10.4	1 204.7	[GUS 1995d]
1995	705.3	240.3	35.2	25.9	19.2	17.5	1 043.4	[GUS 1996d]
1996	791.0	266.9	30.9	29.2	19.5	12.1	1 149.6	[GUS 1997d]
1997	624.3	258.2	23.0	24.7	17.5	13.3	961.0	[GUS 1998d]
1998	612.3	464.5	20.9	21.3	8.2	27.9	1 155.1	[GUS 1999d]
1999	467.5	729.1	24.5	12.5	5.2	30.1	1 268.9	[GUS 2000d]
2000	430.6	446.3	21.7	6.9	3.3	31.7	940.5	[GUS 2001d]
2001	330.9	363.0	13.5	2.8	2.8	23.4	736.4	[GUS 2002d]
2002	295.7	356.5	15.3	1.7	0.9	16.3	686.4	[GUS 2003d]
2003	275.6	275.2	13.6	1.2	0.6	18.2	584.4	[GUS 2004d]

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert	Total	Source of activity data
2004	294.3	186.2	10.1	1.9	0.7	0.7	493.9	[GUS 2005d]
2005	314.4	144.5	7.6	4.5	0.7	0.6	472.3	[GUS 2006d]
2006	244.1	119,4	3,9	2,0	0,3	1,9	371.6	[GUS 2007d]
2007	219.6	105.5	3.5	0.3	0.1	1.8	330.8	[GUS 2008d]
2008	151.6	72.1	3.1	0.3	0.0	1.5	228.6	[GUS 2009d]
2009	88.3	100.3	2.0	0.0	0.0	1.6	192.2	[GUS 2010d]
2010	85.2	175.0	1.4	0.0	0.0	2.2	263.8	[GUS 2011d]
2011	61,1	125,9	1,5	0,0	0,1	2,4	191,0	[GUS 2012d]

For years 1977 and 1978 in annual there were no data on amount of industrial waste from separate industries, but there were data on waste amount from resorts. But the data were aggregated – in textile resort there were data for textiles and leather products, in forests and wood resort there were data on wood and on pulp and paper. Disaggregating of these data was made on the basis of adequate data from years 1976 and 1979. Also the percentages of food waste in a food resort were taken from 1976 and 1979.

The percentage of waste which goes to tailing ponds was taken from Environmental Protection annual for 1981 [GUS 1981d].

food	paper	wood	textile
98%	42%	1%	0%

On the basis of waste amount from each industry sector and the percent of waste which goes to tailing ponds the composition of waste was made.

Table 8.10. Composition of industrial waste

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert
1975	16%	40%	23%	20%	0%	0%
1976	23%	34%	26%	17%	0%	0%
1977	20%	29%	25%	26%	0%	0%
1978	20%	20%	18%	42%	0%	0%
1979	25%	26%	26%	24%	0%	0%
1980	20%	31%	24%	25%	0%	0%
1981	28%	30%	15%	26%	0%	0%
1982	21%	44%	13%	23%	0%	0%
1983	17%	53%	14%	16%	0%	0%
1984	18%	49%	13%	21%	0%	0%
1985	18%	45%	16%	21%	0%	0%
1986	5%	43%	21%	31%	0%	0%
1987	6%	48%	27%	19%	0%	0%
1988	6%	47%	21%	27%	0%	0%
1989	5%	59%	22%	14%	0%	0%
1990	6%	60%	23%	11%	0%	0%
1991	8%	64%	18%	11%	0%	0%
1992	5%	53%	6%	13%	20%	3%
1993	7%	62%	5%	11%	11%	4%
1994	7%	64%	8%	9%	8%	4%
1995	6%	56%	14%	10%	8%	7%
1996	6%	59%	12%	11%	7%	5%

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert
1997	5%	62%	9%	10%	7%	6%
1998	3%	75%	6%	6%	2%	8%
1999	2%	84%	5%	2%	1%	6%
2000	3%	78%	6%	2%	1%	10%
2001	3%	81%	5%	1%	1%	9%
2002	2%	84%	6%	1%	0%	7%
2003	3%	80%	7%	1%	0%	9%
2004	5%	85%	8%	1%	1%	1%
2005	6%	81%	7%	4%	1%	1%
2006	6%	84%	5%	2%	0%	2%
2007	6%	86%	5%	0%	0%	3%
2008	6%	84%	6%	1%	0%	3%
2009	3%	92%	3%	0%	0%	3%
2010	2%	95%	1%	0%	0%	2%
2011	2%	93%	2%	0%	0.1%	3%

All of the input parameters are default based on 2006 IPCC Guidelines [IPCC 2006].

Abovementioned composition of municipal solid waste is used in IPCC Waste Model to calculate amounts of each fraction of waste deposited at SWDSs, and finally - amounts of CH_4 generated by each fraction.

Table 8.11. DOC and DOC_f indicators

DOC (Degradable Organic Carbon)	Range	Default	Adopted Value
Food waste	0.08-0.20	0.15	0.15
Paper	0.36-0.45	0.4	0.4
Wood and straw	0.39-0.46	0.43	0.43
Textiles	0.20-0.40	0.24	0.24
Rubber	0.39	0.39	0.39
DOC_f		0.5	0.5

Table 8.12. MCF indicators of organic carbon in disposed waste

Unmanaged, shallow	Unmanaged, deep	Managed	Managed, semiaerobic	Uncategorised
0.4	0.8	1	0.5	0.6

Table 8.13. Indicators k, F and OX assumed for calculations

Methane generation rate constant (k)	Range	Default	Value
Food waste	0.1–0.2	0.185	0.185
Paper	0.05–0.07	0.06	0.06
Wood and straw	0.02–0.04	0.03	0.03
Textiles	0.05–0.07	0.06	0.06
Rubber	0.02–0.04	0.03	0.03
Delay time (months)		6	6
Fraction of methane (F) in developed gas		0.5	0.5
Oxidation factor (OX)		0	0

8.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2011 for IPCC sector *6.Waste* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6.
Recalculation of data for years 1988-2010 ensured consistency for whole time-series.

2011	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
6. Waste	**225.98**	**400.03**	**3.61**	51.0%	78.3%	51.7%
A. Solid Waste Disposal on Land		347.16			89.2%	
B. Wastewater Handling		52.88	3.58		88.1%	52.2%
C. Waste Incineration	225.98		0.03	51.0%		21.7%

8.2.4. Source-specific QA/QC and verification

Activity data concerning solid waste disposals and sewage sludge come from Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. In some cases of solid waste comparison is made between national statistical data and National Waste Management Plan. Activity data on waste incineration is based on external expert’s research involving questionnaires from individual entities. Country specific emission factors involved in estimation of GHG emissions from waste water treatment are based on external expert’s analysis of questionnaires from individual entities.

The attempt has been undertaken to ensure internal consistency between different treatment pathways of waste and sewage sludge. Calculations in waste sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

8.2.5. Source-specific recalculations

- for the whole estimation period included emissions from uncategorized MSW,
- share of managed and unmanaged SWDSs since year 2001 was updated,
- modified methodology of estimation of methane emission from “well-managed” disposal sites (the OX factor).

8.2.6. Source-specific planned improvements

- development of methodology of estimation emissions from industrial waste landfilled in tailing ponds.
- exploring the case of imported waste in the country’s waste stream.
- adding estimation of emissions from furniture and leather manufacture.

8.3. Waste Water Handling (CRF sector 6.B)

8.3.1. Source category description

The 6.B subcategory share in total waste sector is 23% and it involves methane emission from industrial wastewater (9% share of 6.B), methane emission from domestic and commercial wastewater (41% share of 6.B) and N_2O emission from human sewage (50% share of 6.B).

8.3.2. Methodological issues

8.3.2.1. Industrial wastewater (CRF sector 6.B.1)

Data on amount of industrial wastewater from separate branches and on biological treatment of organic wastewater were taken from national statistics [GUS 2012d]. Data on employment and production from some branches were taken from national statistics [GUS 1989-2011].

Table 8.15. Amount of industrial wastewater in [million m^3]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Mining and quarrying	548	426,5	519	470	453	392	382	378	362	340	336	362,3
Iron and steel	94,2	119,6	99,8	73,1	51,4	47	45,8	44,4	43	43,9	25,3	13,2
Non-iron metals	48,7	86,1	39,7	67,8	66,2	59,7	128	134	142	172	188	184,8
Synthetic fertilizers	123	118,3	92,5	58,4	53,5	48,5	51,3	41,5	48,5	51,9	52,3	52,6
Food products: Meat & Poultry	3,3	3	2,7	3,2	5,4	4,6	3,9	4	4,2	4,2	3,9	4
Food products: Fish Processing	1,6	1,5	1,3	1,2	1,1	0,9	0,8	0,3	0,4	0,2	0,1	0,1
Food products: Vegetables & Fruits	14,2	12	10	8,5	7,4	8	7,4	8,3	7,8	7,7	9,4	7,5
Food products: Vegetable Oils	3,7	2,5	1,5	1	0,5	2,1	1,2	1	3,6	4,8	2,5	3,2
Food products: Dairy Products	19,5	20,6	19,7	17,7	16,2	15,3	14,2	13,2	12,5	12,2	12,3	11,4
Food products: Sugar	23,7	21	20,4	13,9	10	11	7,9	7,7	6,5	5,7	6,1	4,9
Food products: Soft Drinks	4,1	4,2	4,3	5	5,8	2,3	2,6	2,4	2,6	2,9	2,7	2,6
Food products: Beer & Malt	4	4	4,3	4	4	3,6	2,7	2,1	1,7	1,7	1,6	1,4
Food products: Other	2,7	5,72	3,7	2,6	0,6	1,5	1,6	1,5	0,9	1,1	2,5	0,5
Textiles	14,2	13,86	11,1	8,2	9	7,8	7,3	6,4	5,7	5,2	4,7	3,1
Leathers	6,3	5,666	4,7	4,2	3	2,6	1,7	1,6	1,3	1,1	0,7	0,7
Wood and Paper	195	199,1	184	168	146	132	129	121	117	114	106	90,3
Petroleum Refineries	43,2	43,38	38,7	40	36,6	33,6	32,6	33,2	28,1	25,1	24,3	20,3
Organic Chemicals	126	224,1	107	120	108	97,7	101	98,6	94,3	81,5	63,1	55,9
Plastics & Resins	17,4		17,6	15,8	15,7	15,1	14,6	12,6	6,7	9,2	10,3	8,4
Other non-metallic	58,2	59,6	53,3	43,9	31	28	29,6	29,3	28,8	32,9	27,9	29,8
Manufacturing of Machinery and Transport Equipment	53,6	54,6	50,3	42,1	32,6	30,7	29,5	27	25,9	26,5	25,1	22
Other	90,9	91,32	95,2	89,8	79,8	82,7	104	94,5	115	110	161	116,7
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Mining and quarrying	350	332	293	272	261	267	272	271	242,6	252,9	283,2	286,2
Iron and steel	14,2	14,8	13,3	9,6	8,2	6,5	7,4	10,8	8,3	12,8	16,5	13,2
Non-iron metals	184	187	184	155	135	132	132	133	130,8	128,4	147,3	166,4
Synthetic fertilizers	51,7	49,7	50,3	46	49,4	48,6	50,7	52,6	176,3	121,3	49,8	48,1
Food products: Meat & Poultry	3,6	3,4	3,4	3,5	4,1	4,3	4,6	4,8	5	5,8	6,6	6,5
Food products: Fish Processing	0,1	0,1	0,1	0,1	0,1	0	0	0	0	0	0	0
Food products: Vegetables & Fruits	7,5	7,2	6,4	7,8	6,8	6,6	7	6,8	6	6,1	5,8	5,8
Food products: Vegetable Oils	2,4	0,7	0,3	0,2	0,3	0,3	0,4	0,4	0,6	0,8	0,7	0,6
Food products: Dairy Products	11,3	11,7	11,3	11,5	13	13,5	13,8	14,4	14,2	14,2	14,5	13,8
Food products: Sugar	4	2,9	2,7	2,7	2,2	1,8	1,4	1,9	2,7	3,2	2,6	3,1
Food products: Soft Drinks	2,5	2,1	2,2	3,1	2	2,1	2,1	1,9	1,6	1,8	1,6	2,2

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Food products: Beer & Malt	1,3	1,3	1,4	1,2	1,2	1,3	1,7	1,4	1,4	1,1	2,4	10,3
Food products: Other	0,8	0,7	0,7	0,8	3,3	2,8	2,3	2,4	2,6	2,1	36,1	35,3
Textiles	2,6	2,1	1,7	1,6	1,5	1,6	1,3	0,7	0,6	0,4	0,3	0
Leathers	1,1	1,2	0,9	0,8	0,6	0,7	0,6	0,6	0,4	0,5	0,4	0,3
Wood and Paper	81,7	76,9	77,1	71,5	70,9	68,9	69,7	67,6	64,7	66,8	64,2	66,3
Petroleum Refineries	17,8	18,1	16,8	17,4	19,6	19,3	20,7	23	20,9	21,3	23,1	23,1
Organic Chemicals	47,7	42,4	42	38,3	36	38,4	38,6	39,1	35,5	29,4	35,6	38
Plastics & Resins	7,8	4,7	2,7	2,5	2,5	2,4	2,2	2,3	1,9	1,8	2,1	2,4
Other non-metallic	32,3	34,2	38	31,9	37,4	36,3	43,2	39,4	46,1	39,9	46,8	48
Manufacturing of Machinery and Transport Equipment	12	10,4	9,1	8,1	6,8	7	4,4	4,2	3,7	2,1	2,8	2,7
Other	121	130	126	120	129	128	128	148	141,7	168,4	183,2	164,9

Total organic product is derived from amount of wastewater from each industry, COD concentration in organic wastewater and wastewater produced per unit product by industry.

Table 8.16. Emission factors on wastewater and sludge

	COD concentration in organic wastewater	Methane correction factor from wastewater	Maximum CH_4 producing capacity form wastewater	Methane emission factor for wastewater	Methane correction factor from sludge	Maximum CH_4 producing capacity form sludge	Methane emission factor for sludge
	kg/m3		kg CH_4/kg ChZT	kg CH_4/kg ChZT		kg CH_4/kg ChZT	kg CH_4 kg ChZT
Mining and quarrying	0.60	0.10	0.25	0.030	0.32	0.25	0.080
Iron and steel	0.75	0.10	0.25	0.030	0.32	0.25	0.080
Non-iron metals	0.67	0.10	0.25	0.030	0.32	0.25	0.080
Synthetic fertilizers	0.82	0.10	0.25	0.030	0.32	0.25	0.080
Food products: Meat & Poultry	3.00	0.20	0.25	0.050	0.36	0.34	0.120
Food products: Fish Processing	2.50	0.15	0.25	0.040	0.68	0.34	0.231
Food products: Vegetables & Fruits	2.82	0.20	0.25	0.050	0.35	0.29	0.102
Food products: Vegetable Oils	0.79	0.34	0.25	0.090	0.65	0.34	0.221
Food products: Dairy Products	2.88	0.16	0.25	0.040	0.32	0.34	0.109
Food products: Sugar	2.51	0.52	0.25	0.130	0.38	0.34	0.129
Food products: Soft Drinks	1.49	0.10	0.25	0.030	0.2	0.34	0.068
Food products: Beer & Malt	3.81	0.10	0.25	0.030	0.20	0.34	0.068
Food products: Other	2.77	0.22	0.25	0.060	0.39	0.34	0.133
Textiles	0.90	0.12	0.25	0.030	0.24	0.25	0.060
Leathers	3.31	0.29	0.25	0.070	0.24	0.25	0.060
Wood and Paper	2.71	0.11	0.25	0.030	0.12	0.25	0.030
Petroleum Refineries	0.37	0.15	0.25	0.040	0.08	0.25	0.020
Organic Chemicals	3.00	0.15	0.25	0.040	0.08	0.25	0.020

	COD concentration in organic wastewater	Methane correction factor from wastewater	Maximum CH_4 producing capacity form wastewater	Methane emission factor for wastewater	Methane correction factor from sludge	Maximum CH_4 producing capacity form sludge	Methane emission factor for sludge
	kg/m3		kg CH_4/kg ChZT	kg CH_4/kg ChZT		kg CH_4/kg ChZT	kg CH_4 kg ChZT
Plastics & Resins	3.70	0.15	0.25	0.040	0.08	0.25	0.020
Other non-metallic	2.50	0.10	0.25	0.030	0.32	0.25	0.080
Manufacturing of Machinery and Transport Equipment	4.97	0.10	0.25	0.030	0.32	0.25	0.080
Other	0.77	0.10	0.25	0.030	0.32	0.25	0.080

Data on share of aerobic and anaerobic wastewater treatment method and recovery of methane in industrial wastewater treatment was taken from expert opinion [Przewłocki, 2007].

Methodology is consistent with Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Workbook [IPCC 1997] and publication [Przewłocki, 2007], and based on COD default emission factors. For some branches, were the COD EF was not available country specific data were used [Rueffer, 1998].

8.3.2.2. Domestic and Commercial Wastewater (CRF sector 6.B.2)

CH_4 emission from domestic and commercial wastewater was based on methodology [IPCC 1997]. Amounts of degradable organic components for wastewater and for sludge were estimated basing on the data on population connected to sewage treatment plants and on the rate of the each type of sewage treatment plants in municipal wastewater treatment. These data were taken from [GUS 2009d]. Activity data are presented in table 8.17. Default value of organic load in biochemical oxygen demand per person, which is equal to 60 g BOD/person/day [IPCC 2000], was taken for the calculations. Fraction of BOD that readily settles and is removed as sludge was estimated basing on the report [Bernacka 2005] (the country specific value – BOD = 369 g O_2/m^3).

Methane emission factors calulated according to abovementioned report [Bernacka 2005] are:

- wastewater – 0.030 kg CH_4 / kg BOD_5,
- sludge – 0.488 kg CH_4 / kg BOD_5.

The default value (0.6 kg CH_4/kg BOD) of maximum methane producing capacity was applied for estimation of sludge and wastewater emission factors. Fractions of wastewater and sludge anaerobically treated with and without methane recovery are estimated according to [Bernacka 2005]. These values are as follows: percentage of wastewater anaerobically treated – 5%, fractions of sludge anaerobically degraded – 81.3% of which with methane recovery – 83.5%.

Total organic product is derived from amount of population using wastewater plants, organic load in biochemical oxygen demand per person and fraction of BOD.

Table 8.17. Activity data for domestic and commercial wastewater

Year	Municipal waste discharged into collection system [mln m^3]	% treated wastewater
1988	2 478.1	52.75
1989	2 443.5	54.79
1990	2 313.9	60.11
1991	2 166.1	62.91
1992	2 075.3	64.08
1993	1 981.4	64.68
1994	1 999.2	63.81
1995	1 852.4	67.89
1996	1 751.8	71.04
1997	1 691.9	75.32
1998	1 655.5	79.21
1999	1 589.9	81.31
2000	1 494.0	83.23
2001	1 425.3	86.12
2002	1 353.1	88.01
2003	1 323.7	87.56
2004	1 293.6	89.07
2005	1 273.6	89.51
2006	1 265.2	91.33
2007	1 265.5	92.78
2008	1 254.4	93.22
2009	1224.7	96.43
2010	1297.8	95.73
2011	1258,8	95,58

N_2O emission from humane sewage was calculated according to default method [IPCC 1997]. Country population was taken from [GUS 2011] and value of protein consumption per capita per year was taken from FAO database. For years 2010-2011 protein consumption was assumed on the level of 2009 data (lack of data in FAO database after 2009). Default values were used for fraction of nitrogen in protein and for N_2O emission factor [IPCC 2000].

8.3.3. Uncertainties and time-series consistency

See chapter 8.2.3.

8.3.4. Source-specific QA/QC and verification

See chapter 8.2.4.

8.3.5. Source-specific recalculations

No recalculations for the sector were made.

8.3.6. Source-specific planned improvements

- further improvement of methodology of estimating emissions from industrial wastewater

8.4. Waste Incineration (CRF sector 6.C)

8.4.1. Source category description

The 6.C subcategory share in total waste sector is 2% and it involves CO_2 and N_2O emissions from incineration of municipal, industrial and medical waste and sewage sludge. Biogenic emission of CO_2 is not included in total emission and in 2011 amounts to 72 Gg.

8.4.2. Methodological issues

Waste incineration was estimated based on IPCC methodology [IPCC 2000] and domestic case study [Wielgosiński 2003]. Emission factors for CO_2 from incineration of municipal waste were taken from other country's experience [Background Papers, IPCC]. The rest of emission factors as default were taken from [IPCC 2000]. Biogenic and non-biogenic content of waste for municipal waste was assumed on a basis of national case study [Wielgosiński 2003]. For industrial, medical waste and sewage sludge this content was taken from [IPCC 2000]. The activity data for municipal, industrial waste and sewage sludge were calculated using data for 2009 from [Wielgosiński G. 2011] and statistical data [GUS 2012d] on incinerated municipal waste, industrial waste and sewage sludge for 2011. Activity data on incinerated medical waste were calculated on the basis of data for 2009 from [Wielgosiński G. 2011] and on the basis of number of hospital beds and average use of hospital bed in 2011 from national statistics [GUS 2012d].

Table 8.18. Activity data in 2011 [Gg]

Type of waste	Amount of waste incinerated
municipal	39,4
industrial	115,40
medical	31,85
sewage sludge	44,21

Table 8.19. Biogenic and non-biogenic content of waste

Non-biogenic waste	
municipal	0.7
industrial	0.9
medical	0.4
Biogenic waste (1-nonbiogenic)	
municipal	0.3
industrial	0.1
medical	0.6
sewage sludge	1

Table 8.20. Emission factors

Incineration of municipal waste	
CO_2 [Gg CO_2/Gg of waste]	1
N_2O [kg N_2O/Gg]	8
Incineration of industrial waste - CO_2 [Gg CO_2/Gg of waste]	
C Content of Waste	0.5
Efficiency of Combustion	0.995
N_2O [kg N_2O/Gg]	210
Incineration of medical waste - CO_2 [Gg CO_2/Gg of waste]	
C Content of Waste	0.6
Efficiency of Combustion	0.95
Incineration of sewage sludge - CO_2 [Gg CO_2/Gg of waste]	
C Content of Waste	0.3
Efficiency of Combustion	0.95
N_2O [kg N_2O/Gg]	800

Table 8.21. Composition of incinerated waste

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Non-biogenic													
- municipal waste	Gg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- industrial waste	Gg	291.68	268.17	225.77	201.40	191.25	189.08	189.72	192.50	195.46	195.34	208.89	172.62
- medical waste	Gg	22.58	22.06	22.41	22.05	21.39	21.69	21.81	21.44	21.32	20.88	20.73	19.91
Biogenic													
- municipal waste	Gg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- industrial waste	Gg	32.41	29.80	25.09	22.38	21.25	21.01	21.08	21.39	21.72	21.70	23.21	19.18
- medical waste	Gg	33.87	33.09	33.61	33.07	32.08	32.54	32.71	32.17	31.98	31.32	31.09	29.87
- sewage sludge	Gg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.38	31.94

Table 8.21. Composition of incinerated waste (cont.)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Non-biogenic													
- municipal waste	Gg	2.03	18.20	25.20	29.12	30.10	31.07	28.89	30.66	28.57	28.21	28.63	27.57
- industrial waste	Gg	222.21	214.11	223.29	177.35	131.40	144.00	143.60	142.38	111.44	107.52	102.66	103.86
- medical waste	Gg	20.38	10.76	7.28	8.20	10.72	11.77	8.84	10.13	9.80	11.44	11.09	12.74
Biogenic													
- municipal waste	Gg	0.87	7.80	10.80	12.48	12.90	13.31	12.38	13.14	12.24	12.09	12.27	11.82
- industrial waste	Gg	24.69	23.79	24.81	19.71	14.60	16.00	15.96	15.82	12.38	11.95	11.41	11.54
- medical waste	Gg	30.58	16.14	10.92	12.30	16.08	17.66	13.27	15.19	14.71	17.15	16.64	19.11
- sewage sludge	Gg	34.10	86.90	86.90	86.90	91.90	75.30	75.30	73.15	7.82	26.15	34.45	44.21

Following the ERT 2009 recommendation all activity data were recalculated to dry matter basis (except AD used to calculate CO_2 emission from incineration of industrial waste).
Waste combusted for energy purposes are included in Energy sector and treated as a fuel. Information on used EFs is included in NIR report under the Annex 2.

8.4.3. Uncertainties and time-series consistency

See chapter 8.2.3.

8.4.4. Source-specific QA/QC and verification

See chapter 8.2.4.

8.4.5. Source-specific recalculations

No recalculations for the sector were made.

8.4.6. Source-specific planned improvements

- research on usage of activity data from Central Waste System for emissions estimation.

9. OTHER (CRF SECTOR 7)

No other sectors were identified in the Polish GHG inventory.

10. RECALCULATIONS AND IMPROVEMENTS

10.1. Explanations and justifications for recalculations

10.1.1. GHG inventory

Interannual inventory recalculations are usually caused by continuous improvement of methodology and corrections of time series consistency. Also activity data elaborated by the Central Statistical Office (which is the main source of data), Eurostat and Energy Market Agency undergoes regular correction of historical trends. Recalculations are made also in response to the international review of GHG inventory performed on a regular basis.

Specific information on recalculation within CRF sectors are given in sectoral chapters 3-8 and in CRF table 8. The percentage change caused by recalculation with respect to the previous submission, has been calculated as follows:

$$\text{Change} = 100\% \times [(LS-PS)/PS]$$

where:

LS = Latest Submission (for 1988−2011 inventory submitted in NIR 2013)
PS = Previous Submission (for 1988−2010 inventory submitted in NIR 2012)

10.1.2. KP-LULUCF inventory

Changes made for 2008−2010 in relation to previous Submission 2012 covered in particular:

- Emission estimation of CO_2, CH_4 and N_2O caused by fires occurred in forest land for the following subcategories:
  1) A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period
  2) B.1. Forest Management
- Using more detail information on the area of particular land-use categories related to adjusting areas of specific subcategories based on registered intended use of land.

10.2. Implications for emission levels and trends

10.2.1. GHG inventory

The main reason for GHG emissions recalculations made in 2013 was correction of activity data in sectors 1.A.1 and 1.A.2 for *Other petroleum products* arising from avoiding double counting related to change in data aggregation on fuel use in the present statistical balances. Additionally attribution of diesel oil used by road tractors for agricultural purpose was corrected between sectors 1.A.3.b *Road transport* and 1.A.4.c.ii *Off-road vehicles and machinery in agriculture* (see chapters: 3.2.6.5, 3.2.7.5, 3.2.8.5). Also amendment of activity data based on Eurostat in Energy and Industry sectors were done. Important element in CO_2 increase since last Submission was methodological modifications made in LULUCF sector. Change of net sink in mineral soils pool was mainly driven by the introduction of default SOC ref factors. Carbon stock changes, where relevant , dropped by 80% in comparisons to the previous estimates.

Given above reasons influenced the most changes of emissions of CO_2, CH_4 and N_2O presented at figures 10.1−10.3 in 1988−2010 submitted in 2012 comparing to analogous series submitted in 2013.

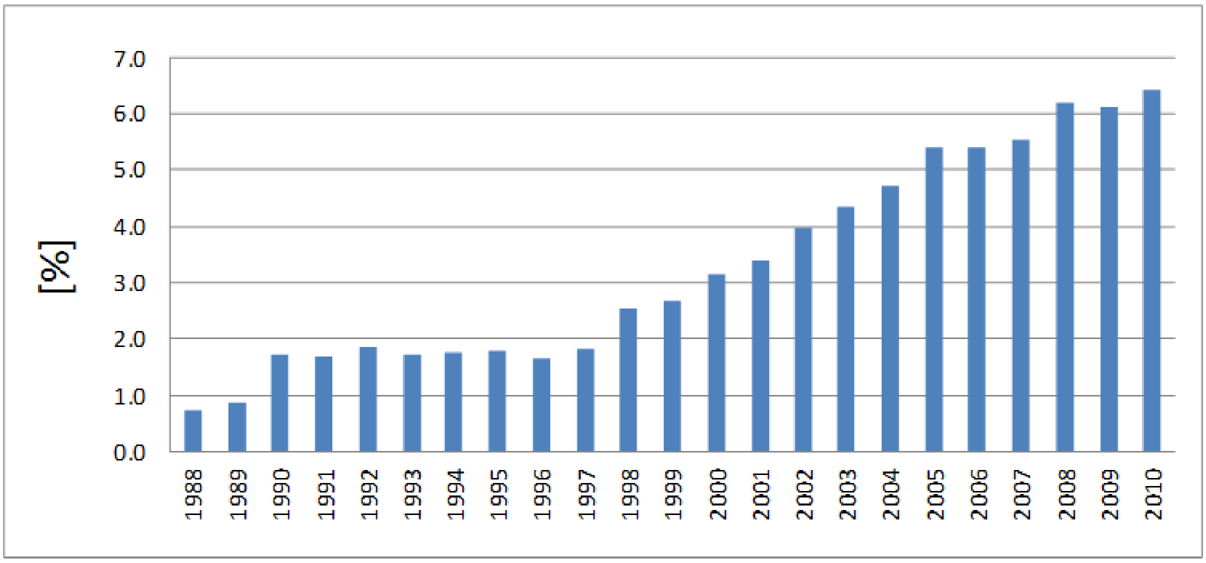

Figure 10.1. Recalculation of CO_2 for entire time series made in CRF 2013 comparing to CRF 2012

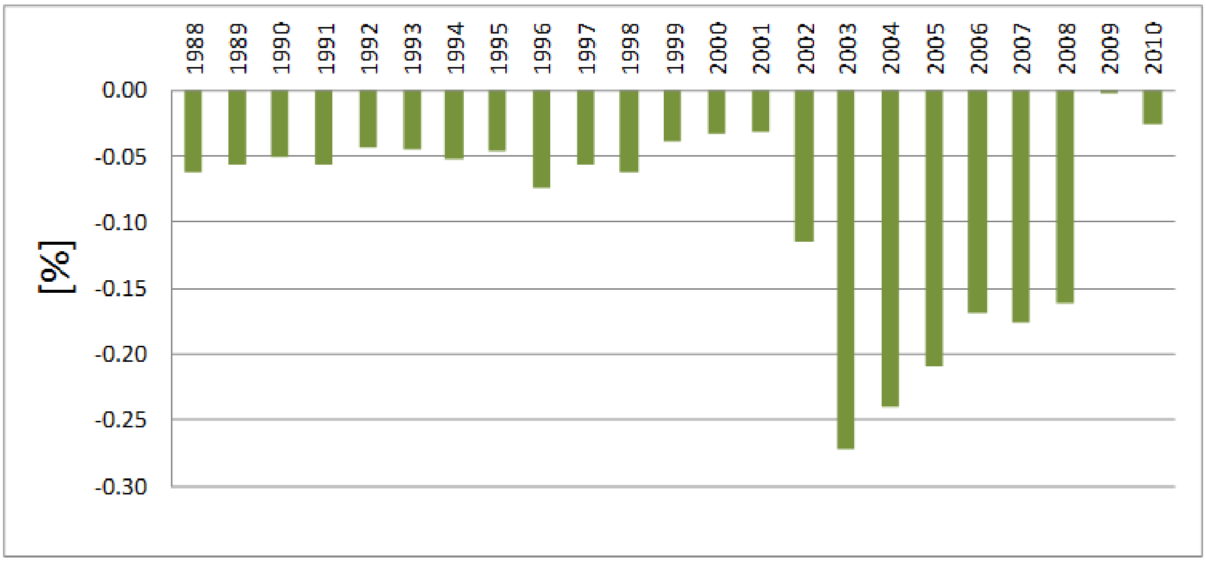

Figure 10.2. Recalculation of CH_4 for entire time series made in CRF 2013 comparing to CRF 2012

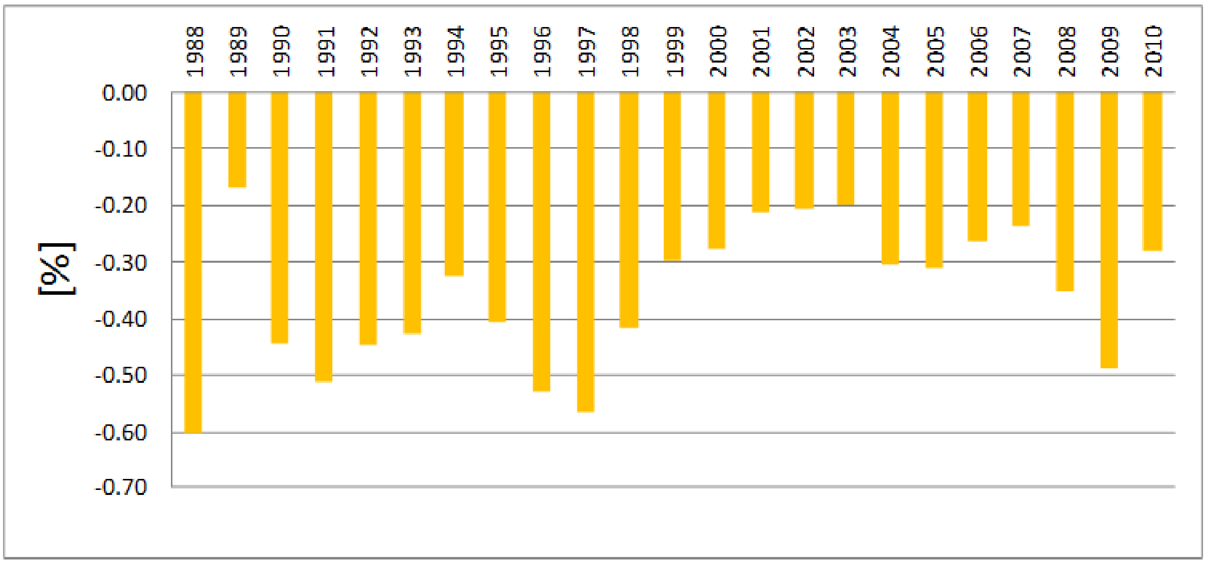

Figure 10.3. Recalculation of N_2O for entire time series made in CRF 2013 comparing to CRF 2012

10.2.2. KP-LULUCF inventory

As a result of recalculations for KP−LULUCF sector decrease in net emissions for 2008−2010 was observed. The main reason for recalculations was application of more detailed data on specific land-use pattern according to information given in chapter 11.1.2. Net emissions of CO_2 related to more detailed estimations resulted in emissions decrease by 50.5% comparing to Submission 2012. Data on emissions of non-CO_2 gases did not change.

10.3. Implications for emission trends

10.3.1. GHG inventory

Recalculations made in 2013 did not influenced the change in GHG emission trend in 1988−2010 as they are made in consistent manner as relates to activity data and methods used ensuring comparability of results in entire series. Changes for particular years are minor (Fig. 10.4).

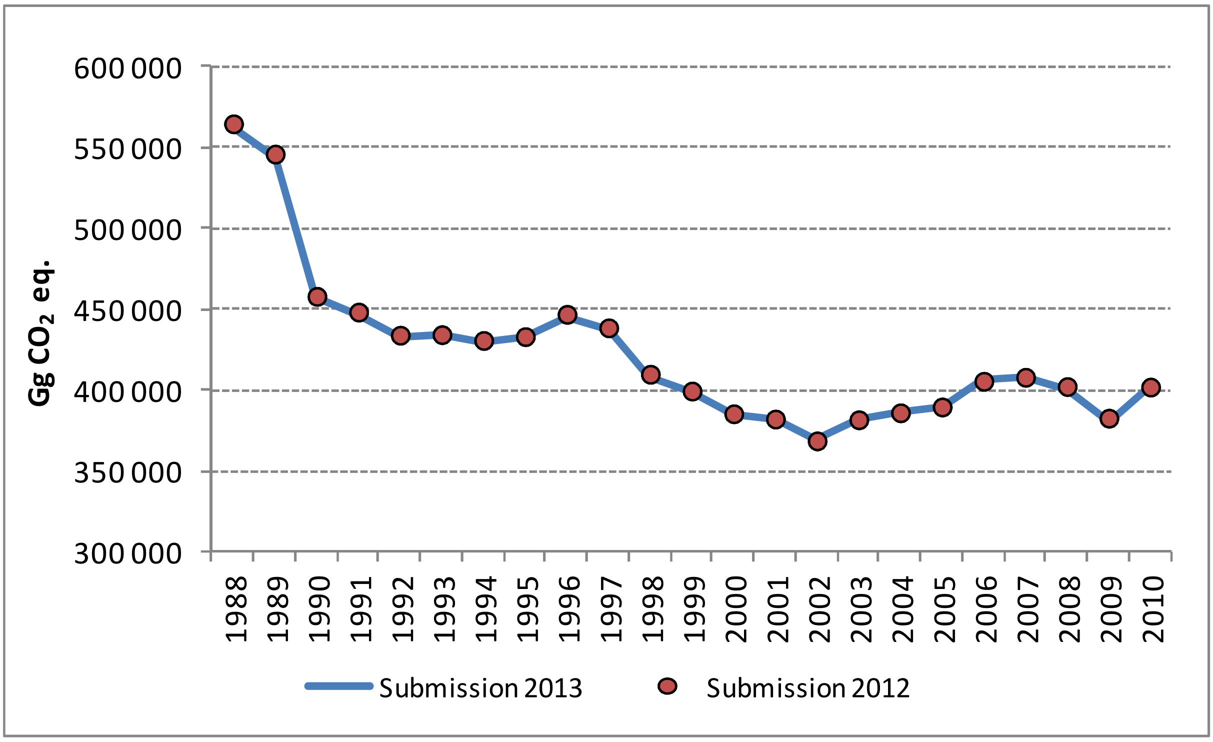

Figure 10.4. GHG emission trends according to Submissions made in 2013 and 2012

10.3.2. KP-LULUCF inventory

Net CO_2 emissions/removals related to elaborating the calculations in more detail decreased by 50.5% comparing to Submission 2012. Net emissions of other gases did not change.

10.4. Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1. GHG inventory

Table 10.1. The list of recommendations resulting from previous ERTs and its implementation status

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
general	ARR/2012/POL Para 10, 16	The ERT noted that table 7 of the NIR with a key category analysis has not been provided for the base year (1988) as planned according to the previous review report. The ERT recommends that the Party provide the key category analysis for the base year in its next annual submission.	Key category analysis for 1988 is given	Annex 1
general	ARR/2012/POL Para 11	The ERT encourages the Party to update the structure of the NIR to be in line with the annotated outline of the NIR, including reporting elements under the Kyoto Protocol, in order to improve completeness of reporting.	NIR outline has been extended with the elements of KP-LULUCF reporting	ES.2.2 ES.3.2
general	ARR/2012/POL Para 15	The ERT reiterates the encouragement of the previous review reports to consider performing a tier 2 key category analysis for the next annual submission in order to incorporate the impact of uncertainties into the analysis.	Tier 2 uncertainty analysis for the year 2011 was prepared on the basis of submission 2013. This analysis was under consultations under cross country EU project "KP Reporting Assistance for EU Member States". Publication of the results, finalizing text with the methodology description and finally incorporation of the analysis into NIR is planned in August 2013.	
general	ARR/2012/POL Para 17	Poland reported the use of the key category analysis including LULUCF for determining whether the associated activity under the Kyoto Protocol should be considered as key. On this basis, Poland has identified afforestation and reforestation, and forest management as key categories. As has been noted by the previous review report, Poland does not report the use of a qualitative assessment as suggested by the IPCC good practice guidance for LULUCF (para. 5.4.4). The ERT encourages the Party to include such an assessment in the next annual submission.	The issue is under consideration	

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
general	ARR/2012/POL Para 19	Other planned improvements regarding uncertainties, reported for several submissions, have still not been implemented, such as: the collection of new data needed to finalize the analysis based on the Monte Carlo simulation method; changing the description of assumptions and procedures of the uncertainty analysis to cover more details than in previous reports; deeper investigation of data for industrial gases; and the collection of data and setting up of a model for Kyoto Protocol, Article 3, paragraphs 3 and 4, uncertainty estimates. In response to a question raised by the ERT during the review, Poland stated that a new uncertainty evaluation model has already been elaborated and is being finalized, so an updated analysis using the Monte Carlo methodology will be performed for the 2013 annual submission.	Planned improvements that have been implemented: 1) the collection of new data needed to finalize the analysis based on the Monte Carlo simulation method 2) deeper investigation of data for industrial gases 3) setting up of a model for Kyoto Protocol, Article 3, paragraphs 3 and 4, uncertainty estimates. Planned improvements under implementation: 1) changing the description of assumptions and procedures of the uncertainty analysis to cover more details than in previous reports	
general	ARR/2012/POL Para 26	The ERT reiterates the previous recommendation that Poland disaggregate the information on recalculations, uncertainties, QA/QC activities and planned improvements at category-specific level, and include the information regarding KP-LULUCF reporting in the NIR, as set out in the annotated outline of the NIR, including reporting elements under the Kyoto Protocol.	NIR outline has been presented in more detail	
general	ARR/2012/POL Para 30	Moreover, Poland has not provided a table with a compilation of previous review recommendations and planned and performed actions in response to these recommendations, as was encouraged by the previous ERT. During the review week, Poland stated that it will include such a table in the next annual submission. The ERT welcomes this information, as it will increase the transparency of the Party’s actions in response to the review process.	It has been included	10
general	ARR/2012/POL Para 146	The ERT noted that in the previous review report, Poland was advised that the commitment period reserve calculation should be reported based on data in the most recent inventory submission and recommends that Poland include consistent information on its commitment period reserve in its next annual submission.	There are technical problems with introducing the new CPR based on the newest GHG inventory into the registry. Only CPR approved by ERT can be introduced.	1.1.3 12.5
general	ARR/2012/POL Para 149	Report any changes in the information provided under Article 3.14.	The chapter has been revised.	15
1A	ARR/2012/POL Para 37	The ERT recommends that Poland report in the next submission where the emissions from military use of fuel are allocated.	There is no official information on data concerning use of fuels on military purposes. This data are confidential.	

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
1A	ARR/2012/POL Para 38, 50	The current ERT reiterates the recommendation of the previous review report that Poland improve the transparency of the energy chapter of the NIR by describing and interpreting the significant fluctuations in the emission trends of the key categories and by providing the underlying assumptions, including references, for the use of country-specific EFs and other data in the next annual submission.	Source data for elaboration of equation that connect NCV of fuels with C content, they are presented for every request of the ERT. This data are individual data from enterprises and should be recognized as confidential.	
1A	ARR/2012/POL Para 39	The NIR still does not provide an explanation for the large drop in fuel consumption between 1989 and 1990; it is not clear whether this is a result of differences in data collection and processing methodology between IEA and Eurostat or a real drop in sectoral activities. The ERT reiterates the recommendations of the previous review reports that Poland, in the next NIR, describe in further detail how time-series consistency is ensured in the energy sector when using the three data sets.	Emission data for years 1988-1989 will be updated in next submission. Significant changes in fuel use between years 1989 and 1990 are not rather result of change data source (IEA for Eurostat), but beginning of transformation process in Poland.	
1A	ARR/2012/POL Para 41	The ERT recommends that Poland improve the reporting of details on the annual QA/QC measures implemented in the sector and provide information in the next annual submission on the cross-checks made between the national statistics data, Eurostat data and the EU ETS data, as well as information on any validations of EFs by comparison with the EU ETS data.	Comparison of statistical data on fuel consumption and data concerning fuel use from EU ETS reports for particular sub-sector is difficult i.a. due to aggregation method. In statistical data fuels are split according to use of them for production of commercial and non-commercial heat while in the EU ETS installations provided data on total fuel use without any split. NCVs for particular fuels are also often different in statistical data and in EU ETS reports, what made more difficult the comparison analysis. Any doubts related to energy balances are explained with Agency responsible for collecting this data.	3.2.6.4
1A	ARR/2012/POL Para 49	The ERT recommends that Poland consider the EU ETS data as a possible source for developing country-specific EFs or at least to report the use of the data for verification purposes.	Analysis of the possibility of country specific EF elaboration for the significant fuels in Polish fuel structure are planned.	3.2

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
1A	ARR/2012/POL Para 51	The ERT reiterates the recommendation of the previous review report that AD and emissions from industrial and municipal waste (non-biogenic) be reported under other fuels. It further reiterates the recommendation that Poland, in the next annual submission, ensure consistent reporting between iron and steel under the manufacturing industries and construction category in the energy sector and iron and steel production under the metal production category in the industrial processes sector across the entire time series.	Industrial and municipal waste (non-biogenic fraction) are reported, according to ERT recommendation, under other fuels. The change was made for entire period. Efforts for improving the comparability of data in particular subsectors of 2.C.1 (sinter, steel and pig iron productions) between periods 1988-2004 and 2005-2011 (for which ETS data was applied) are continued. Poland participates in EU *Project on assistance to MS with KP reporting – Energy Sector*, where was raised problem EU ETS data implementation for inventory purpose. This June will be organised the meeting connected with this issue.	3.1 Annex 2
	ARR/2012/POL Para 52	The ERT recommends that Poland include clarification about the calculation and reporting of recovered CH4 processing under the energy and waste sections in the next NIR.	In *Energy sector* there are included wastes that are used as fuels. Biogas (i.a. from landfills), which is consumed for heat or energy production is included in energy statistic as well. Detailed information on consumption of these fuels is presented in Annex 2 of the NIR.	3.2 Annex 2
1A RA/SA	ARR/2012/POL Para 43 ARR/2011/POL Para 39 ARR/2010/POL Para 36	The ERT recommends that Poland gives explanations regarding the factors contributing to a difference greater than 2.0 per cent.	More detail explanations on differences is given	3.2.1
1A RA/SA	ARR/2012/POL Para 44 ARR/2011/POL Para 40 ARR/2010/POL Para 35	The ERT encourages Poland, with a view to improving comparability and transparency of the reported information, to report all relevant data in CRF table 1.A(b) in the available mass/volume units and provide the energy conversion factors used.	All relevant data in CRF table 1.A(b) are given in mass unit (where it was possible).	CRF table 1.A(b)
1A RA/SA	ARR/2012/POL Para 36, 45	The ERT recommends that consistency between the IEA data used for 1988 and 1989 and the Eurostat data used for 1990–2010 is ensured in the next annual submission. For 2010 an omission for jet kerosene for international bunkers is noted for the reference approach. The ERT recommends that this error be corrected in the next annual submission.	As the emissions for the base year 1988 were approved in 2007 for the AAU purposes this data was not updated since that time. For 1988-1989 only IEA data are available so still data sources will not be coherent. Agency responsible for elaborating energy balances for PL confirmed that data before 1990 will not be updated. IEA data for years 1988, 1989 would be updated in next submission. Jet kerosene for bunker has been amended.	CRF table 1.A(b)
1A RA/SA	ARR/2010/POL Para 37	The ERT recommends that Poland report total natural gas consumed in the natural gas line of the reference approach table in the CRF tables in order to ensure comparability	It is corrected since Submission 2011	CRF table 1.A(b)

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		and consistency with the UNFCCC reporting guidelines and the Revised 1996 IPCC Guidelines.		
1A	ARR/2012/POL Para 46 ARR/2011/POL Para 41 ARR/2010/POL Para 38	The ERT encourages Poland to collect information on scheduled flights from the national aviation authorities and verify with the information from the European Organization for the Safety of Air Navigation or other relevant international organizations, in order to develop an accurate method to split domestic fuel use and international aviation bunker fuels.	Cooperation has been already initiated with ULC (The Civil Aviation Authority of the Republic of Poland) to collect relevant data to develop method to split domestic/international aviation. Analysis is under way. According to the initial estimations based on EUROCONTROL data on fuel use share of jet kerosene used for domestic aviation in Poland amounts to the value assumed by PL (5%).	3.2.8.2.1
1A, 2G	ARR/2012/POL Para 48, 76	Report emissions from lubricants and paraffin waxes consistently across energy and industrial processes sectors	It has been corrected.	CRF table 1.A(d) and 2(I)
1A3b	ARR/2012/POL Para 53 ARR/2011/POL Para 47 ARR/2010/POL Para 44	Ensure that the entire time series for road transportation is calculated using fuel sold with consistent CO2 EFs Regarding the CO2 EFs used for road transportation, previous review reports recommended that Poland clarify how the EF for gasoline is derived for each year of the time series (the methodology used to determine the carbon content) and report in the NIR of its next annual submission on the types of gasoline and the amounts sold. The previous review report further recommended that Poland revise the entire time series using consistent EFs for diesel oil or explain the differences in the value of the IEFs in the NIR of its next annual submission.	Poland uses AD based on fuel sold for whole time series. More detail explanations is given.	3.2.8.2
2.A.1	ARR/2012/POL Para 64	The ERT reiterates the recommendation of the previous review reports that Poland provide the EU ETS data, including country-specific methodologies, EFs and other background information used in the calculation of the emissions from cement production in the NIR in the next annual submission, together with information on the data verification activities applied for the category.	CO_2 emission value is directly taken from EU ETS reports for cement installations (all installation for clinker production are covered by EU ETS). Activity data are taken from statistical yearbook. EU ETS is still developed and additional, detailed information on clinker production are still collected. Analysis based on longer trend will be more comprehensive, such case studies are carried on.	
2.A.2	ARR/2012/POL Para 65	The ERT notes that Poland used the method and default EFs provided in the IPCC good practice guidance. However, given that lime production is a key category for Poland, the ERT recommends that the Party use the country-specific quicklime (CaO) content of high-calcium lime, the dolomitic ‘quick’ lime (CaO.MgO) content of dolomitic lime and the proportion of lime types (CaO/CaO.MgO ratio) in its calculations. The ERT recommends that in the next annual submission Poland describe and clearly	The detailed data on lime production will be still analyzed as far as new data will be collected in EUETS submissions and in national database on emissions.	

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		document the method and equations used.		
2.B.1	ARR/2012/POL Para 66	Given that ammonia production is a key category for Poland, the ERT reiterates the recommendation of the previous review report that, in accordance with the IPCC good practice guidance, plant- or country-specific carbon content for the natural gas and coke oven gas used in ammonia production should be developed.	Analysis of the possibility of country specific EF elaboration for the significant fuels in the Polish fuel structure is planned.	4.3.6
2.B.1	ARR/2012/POL Para 67	The ERT reiterates the recommendation in the previous review reports that Poland explains the trend of ammonia production and variability of the EF in the next annual submission.	This fluctuation is the result of economy market situation as well as product demand	
2.B.1	ARR/2012/POL Para 68	Noting the confidentiality of the part of the information for the category, the ERT recommends that Poland improve transparency of the NIR by providing additional information on the methodology and equations used, the number of nitric acid plants and the types of N2O abatement technology used, as well as an explanation for any unusual trend in the IEF and emissions.	Description is extended	4.3.2.2
2.C.1	ARR/2012/POL Para 69	The NIR is not clear on how the emissions from iron and steel production are estimated using the EU ETS data and how time-series consistency is maintained. The ERT reiterates the recommendations in the previous review reports that Poland include this information in its next annual submission	CO_2 emission values for: sinter, pig iron and steel production is directly taken from EU ETS reports for these installations (all installation from mentioned above are covered by EU ETS). AD for pig iron and steel production are taken from statistics, while for sinter production from EU ETS reports. Analysis on time-series consistency are still ongoing.	4.4
2.C.1	ARR/2012/POL Para 70	Poland indicated that in 2010 fuel from sintering plants (specifically coke and anthracite) were not subtracted from iron and steel (energy) and that it will amend section 4.4.2.1 to include this information. The ERT strongly recommends that Poland address this issue as it would lead to overestimation of CO2 emissions.	This issue is under investigation. The inquiry was made about this problem to sinter producer as well as into Central Statistical Office. Analysis is under way.	
2.C.1	ARR/2012/POL Para 71	Poland still lists the reallocation of CO2 emissions from fuel used in sinter, steel and pig iron production from the energy to the industrial processes sector for the period 1988 to 2004 among its planned improvements. The ERT recommends that the Party resolve the time-series consistency issue in the next annual submission.	Analysis for improving the comparability of data in particular subsectors of 2.C.1 (sinter, steel and pig iron productions) between periods 1988-2004 and 2005-2011 (for which ETS data was applied) is still continued. Poland participates in the EU *Project on assistance to MS with KP reporting – Energy Sector*, where problem of implementation of the EU ETS data was raised for inventory purpose. This June special meeting is planned connected with this issue.	
2.G	ARR/2012/POL Para 77	The previous review report recommended that the CO_2 process emission and flaring emission from refinery be reallocated under	CO_2 process emission and flaring emission from refineries were removed from 2.G. category into 1.B IPCC	3.3.2

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		the category fugitive emissions from oil, natural gas and other sources under the energy sector. The ERT reiterates this recommendation.	category.	
2.G	ARR/2011/POL page 20	The ERT recommends that Poland reallocates the CO2 emissions from processes in refinery plants reported under the category other to the category fugitive emissions from oil, natural gas and other sources under the energy sector in its reporting of CO2 emissions in its next annual submission.	Relocation has been done and data are removed to 1.B.2.C.2.	3.9.
3.D.1.	ARR/2010/POL page 12	Implement and complete an expert study on N2O use for anaesthesiology.	Survey is under way searching for data in the National Database on Emissions of GHG and other substances as well as sources reporting in frames of state programme of statistical research.	5.5.
4	ARR/2012/POL Para 81	The ERT recommends that Poland include information about performed recalculations within each subcategory of the NIR in the next annual submission.	Explanations on recalculations is given according to subcategories	6.2.5, 6.3.5, 6.4.5, 6.5.5
4	ARR/2012/POL Para 82 ARR/2011/POL Pkt. 75 ARR/2010/POL Para 67	it was recommended that Poland improve the structure of the agriculture chapter in the NIR in line with the UNFCCC reporting guidelines, and report the uncertainty estimates, QA/QC activities and improvements planned by category in the NIR.	Structure of the NIR is made for all sectors in more detail breakdown, also for Agriculture	6.2.4, 6.3.4, 6.4.4, 6.5.4
4	ARR/2012/POL Para 83 ARR/2011/POL Para 74 ARR/2010/POL Para 66	The ERT reiterates the recommendation made in previous review reports that Poland provide clear explanatory information on country-specific EFs, AD and methodologies used for the emissions estimation for the key categories in the next annual submission	More information of AD and methodologies is given in chapters "Methodological issues"	6.2.2, 6.3.2, 6.4.2, 6.5.2
4.A	ARR/2012/POL Para 86	Poland provided additional information describing inter-annual changes. The ERT recommends that Poland include an analysis of the inter-annual changes of population size in the next annual submission.	Information is included	6.1, 6.2.2
4.A	ARR/2012/POL Para 87 ARR/2011/POL Para 78 ARR/2010/POL Para 69	For non-dairy cattle ... additional information on the types of cattle included under non-dairy cattle, including animal numbers as well as the CH4 EFs by type would need to be included for replication of the estimates.	Information is included	6.2.2
4.A	ARR/2010/POL para 70	The ERT recommends that Poland use the Central Statistical Office as the main source of AD for the whole time series in the future, in order to ensure time-series consistency.	Public statistics is the source of data for animal production for entire series	6.2.1
4.A	ARR/2011/POL Para 79	Poland used data from GUS and from the National Research Institute of Animal Production to harmonize the time series, but inconsistencies, especially for young cattle, still occurred even in this reference database, mostly between data for the years 1988-1997 and data for the years 1998-2008. In the previous review report, Poland was recommended to explain in further detail the	Explanation was given in NIR 2012 as well as in NIR 2013	6.2.2

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		inconsistencies in the time series caused by the incorporation of the AD from the National Research Institute of Animal Production in its next NIR. However, this issue was not addressed in the 2011 submission wherefore the ERT reiterates this recommendation.		
4.A	ARR/2011/POL Para 77	In its estimation of CH4 emissions from enteric fermentation of goats, horses, swine and poultry, Poland reports average CH4 conversion rates (Ym) as .NE. instead of .NA. Considering that the emissions are estimated using the IPCC default EFs, the ERT encourages Poland to correct the notation key in its next annual submission.	Notation keys are corrected	CRF table 4.A
4.B	ARR/2012/POL para 90 ARR/2011/POL Para 80 ARR/2010/POL Para 71	The ERT reiterates the recommendations in previous review reports that Poland document the country-specific data used for estimating the emissions of significant animal categories and provide a more detailed description of its AWMS, and further recommends that the Party include information on the livestock population, nitrogen (N) excretion rates and AWMS for the entire time series in the next annual submission.	Extended information is given	6.3.2
4.B	ARR/2010/POL Pkt. 72	The reported data for animal waste management systems for dairy cattle for 2002–2006 is the mean value assessed for this period and is significantly higher than for the previous years. The ERT recommends that Poland include these explanations regarding the unusual trends in its next NIR.	Explanation is given	6.3.2
4.B	ARR/2012/POL para 91	The ERT noted some mistakes/inconsistencies in the reporting of N excretion per AWMS in CRF table 4.B(b) for sheep (for 2000 and 2004) and non-dairy cattle (for 2006 and 2007). In response to a question raised by the ERT during the review week, Poland provided corrected calculations with revised allocation of N excretion per AWMS. The ERT recommends that Poland include the corrections in the next annual submission in order to improve the accuracy of its reporting.	Data has been corrected	CRF Table 4.B(b)
4.B	ARR/2012/POL para 92	The ERT noted that Poland has reported an incorrect AWMS allocation percentage in CRF table 4.B(a) for the entire time series. In response to a question raised by the ERT during the review week, Poland explained that the incorrect reporting is due to a technical problem with the CRF Reporter and the Party provided the ERT with the correct values of the AWMS allocation. The ERT encourages Poland to solve the problem and include the correct allocation percentages in the next annual submission.	There is a technical issue related to introducing data into CRF. Percentage numbers are put in, as the output big numbers appear. For instance liquid system for dairy cattle for 2011 amounts to 10,576...% but in CRF this number looks like: 10 576 724 447 928 500	
4.D	ARR/2012/POL para 93	The ERT recommends that Poland include in the NIR of its next annual submission a justification of the use of FracGRAZ for the entire time series in order to ensure	Table with FracGRAZ trend is given (6.14) with additional information above table	6.4.2.1

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		transparency.		
4.D.1	ARR/2010/POL Para 75	The ERT noted that, after a significant decrease in the use of synthetic fertilizers in the early 1990s, the use of synthetic fertilizers has increased again since 2005. The trend is unusual, because it is contrary to the trend in other developed countries and does not correlate with the trend of plant production that is decreasing. The ERT encourages Poland to discuss this issue at the national level and to include an explanation for this trend in its next NIR.	More information on nitrogen fertilisers use in Poland is given	6.4.2.1
4.D.1.3	ARR/2012/POL Para 94 ARR/2011/POL Pkt. 82 ARR/2010/POL Pkt. 76	The ERT notes, as pointed out in the previous review report, that the description in the NIR of how these estimates have been calculated is not transparent and complete, because it does not include sufficient background data on the country-specific values for the AD (crops cultivated) and parameters (N content and fraction of crop biomass removed from the fields) used for the estimation of N2O emissions from crop residues and N-fixing crops. The ERT recommends that Poland include this information in its next annual submission. The ERT also encourages Poland to disaggregate N-fixing crops to specific species (peas, beans, soybean) as the basis for its emission estimates and to include a description of the weighted mean values of FracNCRO and FracNCRBF in its next NIR.	Crop production is given in table 6.12. N content is given in table 6.20. FracR is presented for individual crops in table 6.15 and weighted mean for all crops for entire series in table 6.16. This subcategory has not been disaggregated into individual N-fixing crops as it was recommended by ERT due to lack of detail activity data in public statistics for pulses edible. For pulses for forage there are activity data published in division for: alfalfa, clover, serradilla. Nevertheless country specific indicators like: Residue/crop ratio, Dry matter fraction, FracNCRBF, FracNCRO are available only for entire groups "forage pulses" and "edible pulses". If new data or case studies will be available more detail calculations will be made. N2O emissions from N-fixing crops (4.D.1.3) constitute about 1% of N2O emissions from 4.D. Agricultural soils and are not qualified as the key source within finer granulation of the Polish GHG inventory.	6.4.2.3, 6.4.2.4
4.D	ARR/2012/POL Para 95	The ERT recommends that Poland include in the N2O emission calculation the correct FracR for the entire time series and include appropriate documentation on the changes in the NIR of the next annual submission.	More data is presented in NIR 2013 (tables 6.15 and 6.16) for FracR for individual crops as well as weighted mean for entire series for	6.4.2.4 CRF table 4.Ds2
4.D.3	ARR/2010/POL Pkt. 77	The ERT encourages Poland to make further steps to improve its estimates using country-specific EFs for N leaching and runoff.	Survey on Polish research in this area is under way	
5	ARR/2012/POL Para 101	The ERT reiterates the recommendation that Poland provide more detailed information on carbon stock changes in land	More detailed information is given in the section 7.2.5 in the NIR 2013	7.2.5

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		converted to forest land in its next annual submission.		
5	ARR/2012/POL Para 102	The ERT reiterated the recommendation in the previous review reports that Poland continue its efforts to improve its land area identification system in order to provide consistent time series on land use and land-use change.	More detail information is given in the section 7.1.4 in the NIR 2013	7.1.4
5	ARR/2012/POL Para 103	The ERT strongly recommends that Poland address this issue by setting a single transition period and separate estimations for each land remaining in the category longer than the transition period and land converted to the category within the transition period.	Party set 20-years default transition period which has been applied to all land use categories	7.2; 7.3; 7.4; 7.5; 7.6;
5	ARR/2012/POL Para108	The ERT commends this effort made by Poland to improve the transparency and accuracy of reporting of ne carbon stock change and reiterates the recommendation made in the previous review reports that the Party provide in its next annual submission the sources of AD and justification for the country-specific value for the carbon stock change in soils, as well as a rationale for the increase in the value.	Party applied default SOC_{ref} factors for estimation CSC in subcategories linked to forest land.	7.2; 7.6;
5	ARR/2012/POL Para 109	The ERT commends Poland for the improvement of DOM carbon stock changes and recommends that the Party improve the time-series consistency for the next annual submission.	More detailed information is given in the section 7.2.5 in the NIR 2013	7.2.5
5	ARR/2011/POL Para 86	The ERT reiterates the recommendations in the previous review reports that Poland provide these explanations in its next annual submission in order to increase the transparency of its recalculations.	More detail information is given in the section 7.2 in the NIR 2013	7.2
5	ARR/2011/POL Para 87	The ERT reiterates the recommendation in the previous review report that Poland continue its efforts to improve its land area identification system in order to provide a consistent time series on land use and land-use change, including a consistent time series on land-use change.	More detail information is given in the section 7.1.4 in the NIR 2013	7.1.4
5	ARR/2011/POL Para 89	The ERT recommends that Poland include this information together with more detailed explanations of the calculation of the country specific soil organic carbon change rates in its next annual submission.	Party applied default SOC_{ref} factors for estimation CSC in subcategories linked to forest land.	7.2; 7.6;
6.	ARR/2012/POL Para 114 ARR/2011/POL Para 97 ARR/2010/POL Para 94	The trends are not explained transparently in the NIR. The ERT reiterates the recommendation in the previous report that Poland provide this information in the NIR of its next annual submission.	The explanation of trends is given in NIR.	8.1
6.A	ARR/2012/POL Para 117 ARR/2011/POL Para 99	The ERT reiterates the recommendation made in the previous review reports that Poland increase the transparency of the NIR by providing in the NIR of the next annual submission explanatory information to justify the choices of the national EFs and the	The information on QA/QC and verification, recalculations, planned improvements and uncertainties, as well as legislation and methane recovery are included in NIR.	8.1 8.2.2.1 8.2.3 8.2.4 8.2.5 8.2.6

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		methodologies used for the estimation of emissions within the sector, and include the information on QA/QC and verification, recalculations, planned improvements and uncertainties (currently not included in the waste chapter) at the category level in line with the UNFCCC reporting guidelines. The ERT also recommends that Poland provide a detailed description of waste flows, describe in its NIR the legislative and regulatory measures for waste management and clearly report the CH4 recovered that is used for energy purposes.		
6.A	ARR/2012/POL Para 120 ARR/2011/POL Para 104	The ERT noted that, although a good deal of information relating to the waste generated and its composition is provided in the NIR, it is not clear how this information is used in the estimation of CH4 emissions from SWDS. The ERT reiterates its recommendation from the previous review report that Poland provide a clear description of the steps taken in the inventory calculations in the NIR of the next annual submission.	The description of usage of composition of waste in the calculations was provided in NIR.	8.2.2.1 8.2.2.2
6.A	ARR/2012/POL Para 123	The ERT strongly recommends that the Party include the imported waste in the country's waste stream, explore the type of waste, waste composition and treatment methods and improve the transparency of its reporting when describing the allocation of emissions across different categories.	The case of imported waste is under consideration.	-
6.A	ARR/2012/POL Para 124	Poland does not estimate emissions from biodegradable waste coming from the manufacture of furniture, leather and related products. The ERT encourages the Party to further explore the composition of industrial waste, include all biodegradable waste, in the waste model and provide revised emission estimates from all biodegradable sources.	Possibility of estimation emissions from furniture and leather manufacture is still analyzed.	-
6.A	ARR/2012/POL Para 125 ARR/2011/POL Para 103	The ERT noted that in the report from the Central Statistical Office for 2010 it is indicated that waste is disposed of on plant-specific and other landfills such as dumps, slag heaps and tailing ponds. The IPCC good practice guidance provides an MCF for uncategorized SWDS and the Party is encouraged to estimate emissions from the entire amount of industrial waste and provide such information in its next annual submission. The Party is also encouraged to update the percentages of waste going to landfills rather than using the GUS 1981 allocation.	The research on waste collected in tailing ponds (percentages, composition etc.) is being continued.	-
6.A	ARR/2012/POL Para 127	The ERT recommends that the Party estimate emissions from sewage sludge going to landfill for the entire time series and document the estimates in its next annual submission. The ERT suggests that where no AD are available (prior to 1995) Poland could use the suggested methods in the IPCC good practice guidance to estimate these AD (e.g.	Explanation to following recommendation was given in the NIR.	8.2.2.1

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
		by extrapolating the values).		
6.B	ARR/2012/POL Para 128	The emissions from domestic and commercial wastewater dropped by 63.4 per cent in 2000. Poland explained that it has been using a new EF since 2000 only, based on newly available research. Details of the research or information on how time-series consistency has been assured has not been provided in the NIR. The ERT noted that, based on the information provided in the CRF tables, it appears that the decrease in emissions is due to changes in the volume of CH4 recovered in wastewater handling facilities, not a change in the EF. The ERT reiterates its recommendation of the previous review report that Poland provide in the NIR more information on the study, including a more detailed explanation how time-series consistency has been ensured.	Improvement of this Chapter is still under elaboration.	
6.B	ARR/2012/POL Para 129 ARR/2011/POL Para 107 ARR/2010/POL Para96	Poland explained that the CH4 IEF for industrial wastewater varies because the wastewater production of the different industries varies annually. Poland also explained that the EFs as well as the data on CH4 recovery from industrial wastewater handling are based on expert judgement. The ERT reiterates the recommendations in the previous review report and strongly recommends that Poland provide additional information on the methodologies and country-specific parameters as well as detailed information on the expert judgement used in the NIR of its next annual submission in order to improve the transparency of its reporting.	Improvement of this Chapter is still under elaboration.	
6.C	ARR/2012/POL Para 131	The ERT encourages the Party to include information on the composition of incinerated waste and EFs in its next annual submission.	Composition of incinerated waste and EFs are provided in NIR	8.4.2

10.4.2. KP-LULUCF inventory

Table 10.2. The list of recommendations resulting from previous ERTs and its implementation status

CRF sector	Paragragh in Review report	Recommendation	POL response	NIR chapter
KP	ARR/2012/POL Para 133	The ERT welcomed Poland's intention to improve its land identification system and reiterates the recommendation of the previous review team that Poland improve the information in the NIR on how available data are used to estimate land areas and area changes.	More detail information is given in the section 7.1.4 in the NIR 2013	7.1.4
KP	ARR/2012/POL Para 136	The ERT welcomes this improvement and reiterates the recommendation in the previous review report that Poland provide transparent information to justify the assumptions on the carbon stock changes in mineral soils and the emissions from organic soils	More detail information is given in the section 7.1.4 in the NIR 2013	7.1.4
KP	ARR/2012/POL Para 142	The ERT strongly recommends that the Party include information to demonstrate that forest management activities under Article 3, paragraph 4, of the Kyoto Protocol are not accounted for under activities under Article 3, paragraph 3, in accordance with paragraph 9(c) of the annex to decision 15/CMP.1, in its next annual submission and improve the transparency and completeness of the reporting.	More detail information is given in the section 11.4.3 in the NIR 2013	11.4.3
KP	ARR/2011/POL Para 110	The ERT recommends that Poland improve the information in the NIR on how available data are used to estimate areas and area changes to comply with the requested information of decision 15/CMP.1, and that all units of land and areas of land are identifiable as requested by decision 15/CMP.1, annex, paragraph 6, and by decision 16/CMP.1, annex, paragraph 20.	More detail information is given in the section 7.1.4 in the NIR 2013	7.1.4

10.5. Changes in methodological description

The major changes in methodological descriptions that have been made since the last Polish submission in 2012 are presented below in aggregated form.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methododological descriptions compared to the previous year NIR	Please tick where this is also reflected in recalculations compared to the previous year CRF	If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc
Total (Net Emissions)			
1. Energy			
A. Fuel Combustion (Sectoral Approach)			
1. Energy Industries			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methododological descriptions compared to the previous year NIR	Please tick where this is also reflected in recalculations compared to the previous year CRF	If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc
2. Manufacturing Industries and Construction			
3. Transport			
4. Other Sectors			
5. Other			
B. Fugitive Emissions from Fuels			
1. Solid Fuels			
2. Oil and Natural Gas			
2. Industrial Processes			
A. Mineral Products			
B. Chemical Industry			
C. Metal Production			
D. Other Production			
E. Production of Halocarbons and SF6			
F. Consumption of Halocarbons and SF6			
G. Other			
3. Solvent and Other Product Use			
4. Agriculture			
A. Enteric Fermentation			
B. Manure Management			
C. Rice Cultivation			
D. Agricultural Soils			
E. Prescribed Burning of Savannas			
F. Field Burning of Agricultural Residues			
G. Other			
5. Land Use, Land-Use Change and Forestry			
A. Forest Land	√	√	- for the whole time series a default SOC ref factors were used - for the detailed explanation see NIR 2013 chapter 7.2.4
B. Cropland			
C. Grassland			
D. Wetlands			
E. Settlements			
F. Other Land			
G. Other			
6. Waste			
A. Solid Waste Disposal on Land	√	√	- for the whole estimation period added emissions from uncategorized MSW, - share of managed and unmanaged SWDSs since year 2001 was updated, - modified methodology of estimation of methane emission from "well-managed" disposal sites (the OX factor); see NIR 2013 chapter 8.2.2.1
B. Waste-water Handling			
C. Waste Incineration			
D. Other			
7. Other (as specified in Summary 1.A)			

PART II:
SUPPLEMENTARY INFORMATION
REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11. KP-LULUCF

11.1. General information

The information provided in this chapter follows the requirements set in ”Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol” (Annex to decision 15/CMP.1, FCCC/KP/CMP/2005/8/Add.2).

11.1.1. Definition of a forest and any other criteria for reporting under Articles 3.3 and 3.4 of the Kyoto Protocol

For the needs of reporting to Articles 3.3 and 3.4 of the Kyoto Protocol, Poland selected the following minimum values for the forest definition[1]:

- minimum forest land area: 0,1 hectare
- minimum width of forests land area[2]: 10 m
- minimum tree crown cover: 10% with trees having a potential to reach a minimum height of 2 meters at maturity in situ. Young stands and all plantations that have yet to reach a crown density of 10 percent of tree height of 2 meters are included under forest. Areas normally forming part of the forest area that are temporarily un-stocked as result of human intervention, such as harvesting or natural causes such as wind-throw, but which are expected to revert to forest are also included.

This forest definition is in line with the submission made by Poland to FAO (for the Global Forest Resource Assessment 2000 and 2005).

Consist with the regulations of art. 3 of the Act on Forests of September 28th 1991 [Dz. U. z 2011 nr 34, poz. 170 as amended], a forest is a land

1) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
   - designated for forest production, or
   - constituting a Nature Reserve or integral part of a National Park, or
   - entered on the Register of Monuments;
2) associated with forest management, but occupied in the name thereof by buildings or building sites, melioration installations and systems, forest division lines, forest roads, land beneath power lines, forest nurseries and timber stores; or else put to use as forest car parks or tourist infrastructure.

[1] These values are not in contradiction to forest definition in the Polish law [*Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item 59)* as amended].
[2] Excluding small private properties, private land given to State Forest [Państwowe Gospodarstwo Leśne Lasy Państwowe] or land belonging to Agriculture Real Estate Agency [Agencja Nieruchomości Rolnych Skarbu Państwa].

11.1.2. Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

Poland selected the optional activity of Forest Management (FM) under Article 3.4 of the Kyoto Protocol to be included in the accounting for the first commitment period, but does not elect any other activities: Cropland Management, Grazing Land Management and Revegetation.
Poland intends to account for the entire commitment period for the activities under article 3.3 (Afforestation, Reforestation and Deforestation) and for Forest Management activity under Article 3.4.

11.1.3. Description of how the definitions of each activity under Article 3.3 and each elected activity under Article 3.4 have been implemented and applied consistently over time

The definitions given below refer to those caused by human activities that increase or reduce the areas of forest land.

a) Afforestation

Afforestation refers to the conversion of land not fulfilling the forest definition to forest land according to the following assumptions:

- area of the transformed land is at least equal to 0.1 ha,
- transformed land remained without cover of forest vegetation for at least 50 years, until 31.12.1989 year
- transformation is directly caused by intended human activity.

Land area subject afforestation activity is represented by the total increase of forest area since 1990 to 2011. Natural succession as a result of the cessation of agricultural activities is considered as a direct human activity. Natural succession allows to:

- preserve natural forest vegetation (plantations) in forests, as well as natural marshlands and peatlands;
- to reintroduce natural forest vegetation.

Moreover, natural succession recognized as an element controlled by human activities, promotes the achievement of the sustainability of forest vegetation habitats launched on former farmland in particular, by reducing the scale of the risks posed by the roots of insect pests (grubs) and susceptibility to infectious diseases of trees (root hub). Nevertheless, if natural succession is a subject of land use change to forest land, legal conditions (Act on Forests of September 28th 1991 [Dz. U. z 2011 nr 34, poz. 170 as amended] are required to be meet. Described land use conversion is registered as a reclassification in the land register.

b) Reforestation

Reforestation refers to the conversion of land not fulfilling the forest definition to forest land according to the following assumptions:

- area of the transformed land is at least equal to 0.1 ha,
- transformed land remained without cover of forest vegetation for less than 50 years, until 31.12.1989 year
- transformation is directly caused by intended human activity

c) Deforestation

Deforestation refers to the conversion of forest land to other categories of land use. Within the national statistical surveys that category of land use change is considered as the exclusion of forest land for non –forestry purposes. The assumptions used to determine the size of deforestation are as follows:

- transformed the area remains covered with forest vegetation on 01.01.1990,
- transformation is directly caused by intended human activity.

Deforestation is strictly limited by the national law on forest [*Act on Agricultural and Forest Land Protection (O. J. of 1995, No 16, item78) as amended*]. Any exceptions for transition forest land to any other land use category need legal authorization. The authorization documents are collected by the county offices *(starostwa powiatowe)* in cases when forests do not constitute Treasury property and in the Regional Direction's of the National Forest Holdings when forests constitute Treasury property. Information on areas underlining the deforestation processes are annually reported to the Central Statistical Office.

d) Forest Management

Forest management has been defined in paragraph 1 (f) of the Annex to Decision 16/CMP.1 as a system of practices aimed as management of forests, including their ecological (including protection of biodiversity), economic and social functions conducted in a sustainable manner. Sustainable forest management as described in the *Act on Forest Forests of 28 Sep 1991...* sets out principles for the retention, protection and augmentation of forest resources, as well as for the management of forests and other elements of the environment in reference to the national economy.

Sustainable forest management practices, consistent to the provisions of this *Act on Forests*..., apply to all forests irrespectively of their form of ownership. Such activities carried out mainly by the State Forest National Forests Holding result in biomass increase leading to growth of carbon sequestration. Increasing forest area as well as activities aiming at saving forest resources in Poland support this process. The following main activities are performed within forest management by the General Direction of The State Forests:

- increasing of the area undergrowth plants,
- change of species structure from monoculture to multi-species-stands rebuilding,
- introducing second storey into one storey stands,
- using the maximum age for cutting main species of trees,
- if it is advisable not to harvesting some parts of stands above their normal cutting age,
- if it advisable using selective cutting instead of clear cutting method,
- leaving residues on cutting area,
- developing of natural regeneration,
- enhancing forest fire prevention.

All forest land in Poland is considered as managed and in addition all forest land is a subject to the Forest Management plans, as a part of sustainable forest management prepared by National State Forest Holding, as well as Simplified Forest Management plans (in cases when forests do not constitute Treasury property) are approved by the Ministry of Environment.

11.1.4. Description of precedence conditions and/or hierarchy among Article 3.4 activities, and how they have been consistently applied in determining how land was classified

Since only one activity of the listed Article 3.4 Activities was elected by Poland, no precedence conditions among Article 3.4 activities are applicable.

11.2. Land-related information

11.2.1. Spatial assessment unit used for determining the area of the units of land under Article 3.3

According to the description given in chapter 4.2.2.2 of the GPG for LULUCF [IPCC 2003] land areas associated with LULUCF activities in Poland are identified using Reporting Method 2. Geographic boundaries encompassing units of land subject to multiple activities are indentified based on data published in the *Data on the condition and changes in the registered intended use of land* developed on the basis of annual reports on land, introduced by the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454). The consecutive regulations and classifications of land were modified, inter alia, due to adoption of international standards. Beginning with data for 1997 on, the registers of land were prepared by the Head Office of Geodesy and Cartography as well as by the voivodship branches of geodesy and land management. The data are presented taking into consideration geodesic area.

With regard to the regulations of art. 3 of the Act on Forests of September 28th 1991 [Dz. U. z 2011 nr 34, poz. 170 as amended], forest land considered a subject to the forest management is the area:

3) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
    a. designated for forest production, or
    b. constituting a Nature Reserve or integral part of a National Park, or
    c. entered on the Register of Monuments;
4) of contiguous area greater than or equal to 0.10 ha, associated with forest management.

Provisions of this act allow to standardize the definition of forest land as a part of land use scheme. Party has established a system of regulations allowing to indentify, collect, process, report and publish data of land use in the annual statistics. Annual summary reports on land use areas submitted by the Head Office of Geodesy and Cartography are prepared on the basis of regulations of *Act on geodesy and cartography [**Dz.U. 1989 nr 30 poz. 163 as ammended]*** constituting the basis for the statistical publications fulfilling requirements of National Land Identification System.

Summary reports refer to the information contained in the Land Register (O. J. of 2001 No. 38, item 454), introducing range differences in relation to previous years. Summary data are collected annually and apply to all categories of land. Data on the condition and changes in the registered intended use of land for the years before 2002 were developed on the basis of annual reports on land, introduced by the Regulation of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813) for the years 1997 -2001 and by the Regulation of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), for the years before 1997.

11.2.2. Methodology used to develop the land transition matrix

Annually updated data from National Record of land and buildings are related only to activities directly caused by intended human intervention in land use at the level of cadastral unit. Any changes in land use categories are recorded with the attribute of the area being a subject of any type of conversion and are constituting a basis for the of annual reports on land prepared by the Head Office of Geodesy and Cartography. Data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land are published as the official statistical information by the Central Statistical Office. Publications of the different categories of land use, are subsequently used to determine the direction of changes in land use.

Considering the area of the country and its specific conditions, there is no applicable stratification that would justify reporting on smaller than a country-level unit. This is also supported by the attributes of the available activity data. However, the land-use representation and land-use change identification system developed for the KP and UNFCCC reporting purposes permit a truly detailed spatial assessment and identification of AR and D activities at the level of the individual cadastral units.

Reporting requirements under the United Nations Framework Convention on Climate Change and the Kyoto Protocol requires to match national land-use categories (according to the Decree of the Minister of Regional Development and Construction of 29 March 2001 in the records land and buildings (Journal of Laws No. 38, pos. 454) to the appropriate IPCC land use categories (Section 3.2.1. GPG for LULUCF).

According to the abovementioned requirements assumptions are as follows:

1) Afforestation / reforestation
   - 5 (KP-I) A.1.1. cropland converted to forest land *[arable land converted to forest land]*
   - 5 (KP-I) A.1.1. grassland converted to forest land *[permanent meadows and pasture converted to forest land]*
2) Deforestation
   - 5 (KP-I) A.2. forest land converted to settlements *[forest land designated for non-agricultural and non-forest purposes]*
3) Forest management
   - 5 (KP-I). B.1. forest land remaining forest land

Poland under the Kyoto Protocol reports the area of forest land subject to Forest Management in 1990 with the changes which have occurred since 1990. Nevertheless, under the Convention reporting the forest area for the base year has been used for the subcategory 5.A, namely area of forest land for the year 1988 with the further occurred changes. Value of increased forest area between the years 1988 and 1990 is constituting the difference between those two reporting systems. The same AD was used for the Convention and Kyoto Protocol reporting purposes.

11.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

National Forest Inventory (in Polish: "Wielkoobszarowa inwentaryzacja stanu lasu") is carried out by the Forest Management and Geodesy Bureau, according to the assumptions contained in the *Instruction for the preparation of the large scale national forest inventory* (in Polishb "Instrukcja wykonywania wielkoobszarowej inwentaryzacji stanu lasu") approved by the Minister of Environment. First cycle of inventory was based on the instruction approved by Minister of Environment on 05 February 2005. Second cycle of inventory has been prepared on the basis of the instruction approved by Minister of Environment on 10 June 2010.

Described above instructions emphasizes the needs of carrying out the large-scale inventories of the forest according to the Art. 13a of the *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59) requiring State Forests to prepare the periodic large-scale inventories of forests taking into account the needs for evaluation and periodical controlling of forests.

Measurements and observations are made on permanent sample plots. The basis to determine the surface network of sample plots is a system of permanent observation plots (ICP Forest) for damage assessment in forests, consistent with the European Union regulations (ie. the network 16x16 km).

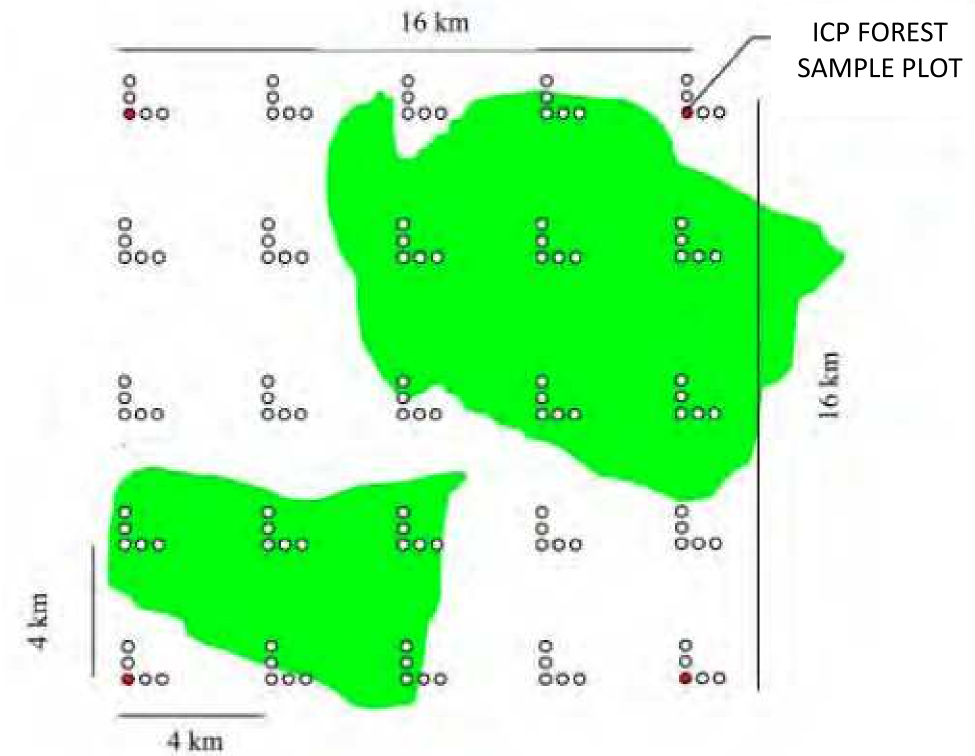

Figure 11.1. The general layout of sample plots.

The network of sample plots for large-scale inventory system was concentrated to 4x4 km specifying the coordinates of the single plot in the system WGS 84 and PUWG 1992. The individual sample plot was assumed schematically in the system of routes deployed in the network 4x4 km, while within each line (shaped L with equal arms) is located within 200 meters five sample plots

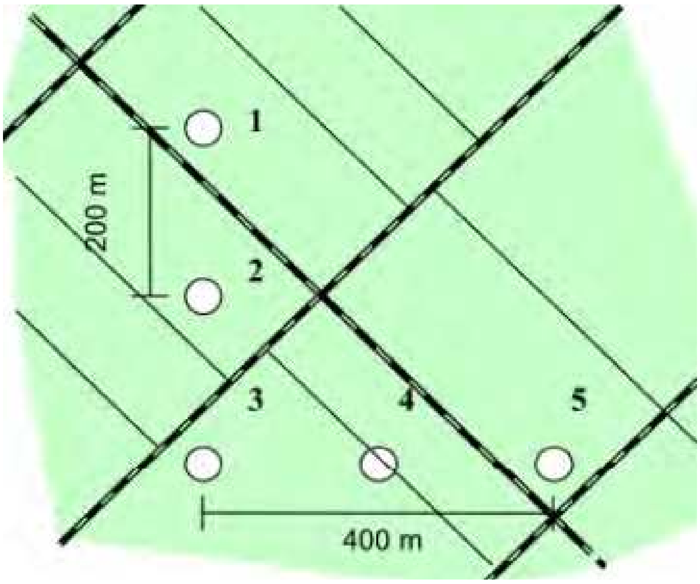

Figure 11.2. Routes system with the background of the sample plots distribution

Almost 28,052 sample plots have been established in Polish forests during the current inventory process, over the past 5 years. Location of every single sample plots in the area marked on the map began form designing and identifying marker points (from the start determinate by the location of individual sample plots). After long term stabilization and marking of single points (by punching a metal tube about 1 inch in diameter and 30 cm into the ground and punching the nails in his neck the next three root trees) there were measured offsets (using the azimuth and distance) to the centre of each sample plots while, with the centre of the surface were fixed just like the location of the marker point. Location of sample plots were made mostly by GPS receivers, starting from the point of marker and navigation on the ground to the next trial area where it was possible to read the GPS coordinates with appropriate measurement parameters. In this place it was marked as an intermediate point, which was stabilized in the same manner as marker point.
Localizations of sample plots was possible by using the centre of trial area using compass and tapes based on readings (azimuth and distance) from the GPS receiver, with the measuring of sample plots only if routes system with the background of the sample plots distribution was established on forest land consist with Records of lands and buildings (Reg. accepted by the Minister of Regional Development and Construction of 29 March 2001).

In 2010, which was as first year of measurement in the second cycle of large-scale forest inventory, sample plots established in 2005 were again measured in accordance with the *Instruction for preparation*... (Ministry of Environment, 2010). New sample plots were established with the latest *Instruction for preparation*... (Ministry of Environment, 2010) on land where conversion from land not fulfilling the forest definition to forest land had occurred. Sample plots established on forest land excluded for non–forestry purposes were verified and removed from sample plots measurement process. Verification was made possible by more detailed land use maps at the level of single cadastral units which were used for identification of sample plots.
Data on the condition and changes in the registered intended use of land with the connection to the existing inventory systems are adequate to meet all the land reporting requirements of the Kyoto Protocol. Nevertheless, results of National Forest Inventory cycles related to the main geographical units (natural-forest lands regions), administrative (provinces) or administrative-economic units (Regional Directorates of State Forests), do not enable to present estimates of the net balance of greenhouse gas emissions in more detailed scale than in a national scale. Described situation is a result of given high level of the forest land data aggregation.

11.3. Activity-specific information

11.3.1. Description of the methodologies and the underlying assumptions used

11.3.1.1. Description of the methodologies and the underlying assumptions used

Methods for estimating greenhouse gas emissions from forest land, land converted to forest land and forest land converted to settlements are based on available official statistics, published by the Central Statistical Office. Data on the condition and changes in the registered intended use of land was developed on the basis of annual reports on land, introduced in the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454). The consecutive regulations, classifications of land were changed inter alia due to adoption of international standards. Beginning with data for 1997 on, the registers of land were prepared by the Chief Office of Geodesy and Cartography as well as by the voivodship branches of geodesy and land management. The data are presented, taking into consideration geodesic area.

The linkage between the *AR*, *D* and *FM* activities and the reporting based on land use categories under the Convention, generally always represent A/R as a land-use conversion from a land-use category other than forest land to the land use category of forest land. Similarly, *D* is an activity when forest land is converted to other types of land-use, as shown above. These links are retained consistently for the entire reporting period, similarly as for the adopted methodology. This ensures consistent and independent treatment of the activity data and methodologies across the Kyoto Protocol for the first commitment period, as well as for the reporting period under the Convention, i.e., since 1988.

Although the system of land-use representation and land-use identification is basically identical for both KP and Convention reporting, there are some notable differences that have implications for the reported areas of KP activities. These differences are imposed by the specific requirements for the reporting of LULUCF activities under the Kyoto protocol, namely:

i. AR activities that qualify under KP accounting are only those commenced since 1990.
ii. AR land must be traced under KP reporting, i.e., it never enters the land registered under FM activity.

11.3.1.2. Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

According to the article 30 of *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59) "... forests, areas of land within forests and areas up to 100 m from the forest edge shall be subject to proscriptions on activities capable of giving rise to danger, and in particular:

4) the starting of fires away from places designated for that purpose by a forest owner or District Forest Manager;
5) the use of a naked flame;
6) the burning of surface soil layers or remnants of vegetation...".

In relation to this record it is assumed that controlled biomass burning does not occur on land subject to AR, D, and FM activities, therefore carbon pools for these activities were filled with notation keys NO in NIR 1 table (KP–LULUCF CRF). However, methods of GHG emissions estimation from wildfires on forest land as a result of natural disasters were provided in the suitable chapter of NIR (7.2).

The size of forest land with the relation to legitimacy of fertilization on forest land in a large scale causing that fertilization is limited only to the forest nurseries where use of fertilizers is a part of intensive production technology. In this situation, to prevent the possibility of double emission estimation in conjunction with the sector "Agriculture", it is assumed that fertilization on forest land is not affected. To keep correctness in CRF tables notation keys NO (not occurring) were used in the table NIR 1 and connected tables for all indicated activities for fertilization on forest land.

With the current estimation of GHG balance from forests under Kyoto Protocol, carbon stock changes in litter were included as internal part of carbon stock changes in mineral soils. Provided inclusion of carbon stock changes in litter as a part of carbon stock changes in mineral soils allows to specify direction of changes in elementary carbon in mineral forest soils. To keep correctness in CRF tables notation keys IE (including elsewhere) were used in the table NIR1 and related litter pools for all activities on forest land.

11.3.1.3. Information on whether or not indirect and natural GHG emissions and removals have been factored out

The indirect and natural GHG emissions and removals were not factored out.

11.3.1.4. Changes in data and methods since the previous submission (recalculations)

For the years 2008-2010 in relation to the previous inventory report for the year 2009, encompassing units of land subject to multiple activities were indentified based on data published in the *Data on the condition and changes in the registered intended use of land* developed on the basis of annual reports on land, introduced by the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454).

Additionally, Party applied default SOCref factors for estimation CSC in subcategories linked to forest land .This change has resulted in final estimates of csc in mineral soils, to decrease by 80% in comparison to the 2012

11.3.1.5. Uncertainty estimates

Uncertainty analysis for the revised year 2011 for IPCC sector *5.Land-Use Change and Forestry* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. This year uncertainty assumptions were applied directly to on activities and emission factors, instead of emission as in previous years. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6.
Recalculation of data for years 1988-2010 ensured consistency for whole time-series.

Table 11.1. The results of the analysis of uncertainty for sector 5 LULUCF under the Kyoto Protocol

2011	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
5. Land-Use Change and Forestry	**-40599.31**	**106.39**	**0.03**	24.3%	79.8%	59.9%
A. Forest Land	-47611.27	0.47	0.01	20.6%	80.2%	80.2%

11.3.1.6. Information on other methodological issues

The method used to estimate emissions/removals from Afforestation, Deforestation and Forest Management activities are of the same as those used for the UNFCC reporting.

11.3.1.7. The year of the onset of an activity, if after 2008

Not applicable.

11.4. Article 3.3

11.4.1. Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

The annually updated cadastral information from the National Record of Lands and Buildings refers exclusively to intentional, i.e., human-induced interventions into land use. These interventions are thereby reflected in the corresponding records, including the time attribute, collected and summarized at the level of cadastral units. Summarised area of land use changes at the level of cadastral units are annually reported as a official statistical data by the Central Statistical Office

11.4.2. Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Since no remote sensing technology is directly involved in the KP LULUCF emission inventory, there is no issue related to distinguishing harvesting or forest disturbance from deforestation. Harvesting and forest disturbance always occur on Forest land, while deforestation is a cadastral change of land use from Forest Land to other categories of land use. In Polish GHG inventory deforestation is determined by the subcategory Forest land converted to Settlements.

11.4.3. Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

The actions referred to the deforestation under Article 3.3 of the Kyoto Protocol and the provisions of Article 5 of the *Act on Agricultural and Forest Land Protection (O. J. of 1995, No 16, item78 as amended*) require a formal decision to exclude individual forest plots as administrative units of forestry production. National legal considerations indicate deforestation as a process of administrative changes in land use category, while the temporary deprivation of the forest land of forest cover cannot be equated with deforestation process and should be treated as part of sustainable forest management.

Any deforestation in terms of land use change in the in-country land use scheme requires an official decision. Hence, no permanent loss of forest cover may occur prior this approval, which is reflected in cadastral land use. A temporary loss of forest cover up to an area of 2 [ha] ha may occur as part of forest management operations on Forest land (units of land subject to *FM*), which is not qualified as deforestation in terms of Art. 3.3. KP LULUCF activity. Nevertheless, forest owners (art. 13.1 of the Act on Forests of September 28th 1991 [Dz. U. z 2011 nr 34, poz. 170 as ammended) shall be obliged to ensure the permanent maintenance of forest cover, as well as continuity of utilization, and in particular:

1) to preserve forest vegetation (plantations) in forests, as well as natural marshlands and peatlands;
2) to reintroduce forest vegetation (plantations) in forest areas within five years of a stand being cleared;
3) to tend and protect forest, including against fire;
4) to convert and rebuild stands, where these are not in a condition to ensure achievement of the objectives of forest management set out in the Forest Management Plan, Simplified Forest Management Plan or Decision;
5) to make rational use of forests in a manner permanently ensuring optimal discharge of all the functions thereof, by means of:
   a) the harvesting of wood within limits not exceeding a forest's productive capabilities,
   b) the harvesting of raw materials and by-products of forest use, in a manner providing for biological renewal, and also ensuring protection of forest-floor vegetation.

Size of final felling as a area of the feelings at the country level that have lost forest cover but which is not yet classified as deforested is presented in the table below.

Table 11.2. Size of final felling.

Year	Land area [thos. ha]
2008	44.5
2009	49.3
2010	47.6
2011	48.7

11.5. Article 3.4.

11.5.1. Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

Poland adopted the broad definition (FCCC/CP/2001/13/Add.1;IPCC 2003) of FM. It reads "Forest management" is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in sustainable manner". This decision implies that entire forest area in the country is subject to FM interventions, as guided by the *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59)

11.5.2. Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year

Not applicable for Poland (notation key NA in Table NIR 1)

11.5.3. Information relating to Forest Management.

All operations related to Forest management are conducted under strict provisions contained in the framework of the *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59) as amended.

11.6. Other information

11.6.1. Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Key categories related to activities in accordance with Article. 3.3 and 3.4 of the Kyoto Protocol were presented in the Chapter 7.2 of NIR 2011. There are two key categories, relating to changes in land use (land used for agricultural purposes-cropland and grassland converted to forest land). For activities covered under Article. 3.4 key categories remain forest land remaining forest land. However, it should be noted that Poland has chosen to account for the entire commitment period for the activities under article 3.3 (Afforestation, Reforestation and Deforestation) and for Forest Management as activity under Article 3.4, after the first commitment period 2008-2012 which will allow more accurate assessment of the activities due to periodic measurements and conducted research in the Polish forestry sector, including obtaining updated results relating to the growth of forest resources using standardized methods of measurement forest resources. Indicated improvements are to be expected with the connection to the results of ongoing work related to the successive stages of National Forest Inventory for all ownership forms.

11.7. Information relating to Article 6

There are no Article 6 activities concerning the LULUCF sector in Poland.

12. Information on accounting of Kyoto units

12.1. Background information

In order to meet Annex I Parties obligations of reporting on holdings and transactions with Kyoto Protocol Units within the Polish registry, the following chapters present relevant data on the topic.
It should be noted that in 2012, there was a consolidation of national registries of EU countries. Thus, in the reporting year following changes took place: location of the registry as well as the software used and all technical procedures. Change of the system took place in June of the reporting year. On 20.06.2012 the consolidated system was eventually launched. European Commission is the provider and technical operator of the system. All data concerning account holders, installations, authorized representatives, units and their transfers stored so far in the national registry has been transferred to the new system during the migration process. All the information submitted in the annual report, including those relating to the transaction, CDM notifications and accounting of Kyoto units are based on data derived from the consolidated Union Registry.

12.2. Summary of information reported in the SEF tables

In accordance with paragraph 11 of the annex I.E to Decision 15/ CMP.1 SEF report on Kyoto units accounted on and transferred to and from accounts in Polish registry in year 2012 was generated via Union Registry application; it has been attached in Annex 7 of this report.

12.3. Discrepancies and notifications

In accordance with respective paragraphs of the annex I.E to Decision 15/CMP.1 additional information was provided:

a) *paragraph 12: List of discrepant transactions*
   No discrepant transactions occurred in 2012.
b) *paragraph 13 & 14: List of CDM notifications*
   No CDM notifications occurred in 2012.
c) *paragraph 15: List of non-replacements*
   No non-replacements occurred in 2012.
d) *paragraph 16: List of invalid units*
   No invalid units exist as at 31 December 2012.
e) *paragraph 17: Actions and changes to address discrepancies*
   No actions were taken or changes made to address discrepancies for the period under review.

12.4. Publicly accessible information

In accordance with Part E of Annex I to Decision 13 / CMP.1 the following information have been made available to the public by the National Centre for Emissions Management acting as the administrator of Polish part of the Union Registry at the indicated link (http://www.kobize.pl/rejestr-uprawnien/raporty-publiczne.html):

a) *paragraph 45: Account information*
   In this report following information were provided:
   - *paragraph 45 (a): Account name: the holder of the account*
   - *paragraph 45 (b): Account type: the type of account (holding, cancellation or retirement)*
   - *paragraph 45(c): Commitment period: the commitment period with which a cancellation or retirement account is associated*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART45.pdf)

Moreover, the information can be reviewed by data searching module on EUTL website under following URL: http://ec.europa.eu/environment/ets/account.do

In accordance with Annex III of COMMISSION REGULATION (EU) No 920/2010 of 7 October 2010 for a standardized and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council, with amendments (OJ L 270, 29.11.2011, as amended) account identifier is not displayed.
In accordance with Annex IX of the same regulation information on representatives assigned to an account should be made visible to the public only to the request of an account holder. Therefore, such information as: representative's full name, address, telephone number, fax number and email address became confidential.

b) *paragraph 46: Article 6 project information*
   - *paragraph 46 (a): Project name*
   - *paragraph 46 (b): Project location - the Party and town or region in which the project is located*
   - *paragraph 46 (c): Years of ERUs issuance as a result of the Article 6 project*
   - *paragraph 46 (d): Reports - downloadable electronic version of all publicly available documentation relating to the project*

These information are available in the report - *Joint Implementation (JI) project information*
(reference: https://dokumenty.kobize.pl/projekty_ji/index.htm)

c) *paragraph 47: Holding and transaction information*
   - *paragraph 47 (a): The total quantity of ERUs, CERs, AAUs and RMUs at the beginning of the year*
     (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_a.pdf)
   - *paragraph 47 (b): The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3*
     (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_b_h_k.pdf)
   - *paragraph 47 (c): The total quantity of ERUs issued on the basis of Article 6 projects*
     (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)
   - *paragraph 47 (d): The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring registries*
     (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_d_f.pdf)
     Detailed information on particular transfers shall be displayed from 15 January onwards of year (X+5).
     (This information can be reviewed by data searching module on EUTL website under following URL: http://ec.europa.eu/environment/ets/transaction.do)
   - *paragraph 47 (e): The total quantity of RMUs issued on the basis of each activity under Article 3*
     (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)
   - *paragraph 47 (f): The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring registries*
     (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_d_f.pdf)
     Detailed information on particular transfers shall be displayed from 15 January onwards of year (X+5).
     (This information can be reviewed by data searching module on EUTL website under following URL: http://ec.europa.eu/environment/ets/transaction.do)
   - *paragraph 47 (g): The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

- *paragraph 47 (h): The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3*
  (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_b_h_k.pdf)
- *paragraph 47 (i): The total quantity of other ERUs, CERs, AAUs and RMUs cancelled*
  (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)
- *paragraph 47 (j): The total quantity of ERUs, CERs, AAUs and RMUs retired*
  (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)
- *paragraph 47 (k): The total quantity of ERUs, CERs and AAUs carried over from the previous commitment period*
  (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_ART47_b_h_k.pdf)
- *paragraph 47 (l): Current holdings of ERUs, CERs, AAUs and RMUs in each account*
  Information on holdings of ERUs, CERs, AAUs and RMUs at the end of reporting year by account type is available under following URL:
  https://dokumenty.kobize.pl/raporty/Public_ART47_l.pdf

d) paragraph 48: Authorized Legal Entities Information
(reference: https://dokumenty.kobize.pl/raporty/Public_ART48.pdf)

Moreover, the information can be reviewed by data searching module on EUTL website under following URL: http://ec.europa.eu/environment/ets/account.do

12.5. Calculation of the commitment period reserve (CPR)

After reviewing the Polish inventory for year 2009 in September 2011, and the approval of the national emissions of 383 224 704 tones of eq. CO2 reserve was calculated as 1 916 123 520 tones of CO2 equivalent. It was entered in the National Registry on October 14, 2011, and remained unchanged till the end of 2012.
The new value of reserve − 2 012 046 833 tons of eq. CO2 − has been calculated on the basis of the 2010 emissions (402 409 367 tones of CO2 eq.), which were revised and approved in the course of the review performed in 2012. In connection with the consolidation of national registries to a common Union Registry in June 2012, entering to the system of a new value of the commitment period reserve is possible only on the International Transaction Log (International Transaction Log - ITL) side. This new value of the CPR has been introduced into the system when report FCCC/ARR/2012/POL became available on UNFCCC website.

12.6. KP-LULUCF accounting

Accounting of net emissions and removals of CO_2 related to activities under Articles 3.3 and 3.4 of the Kyoto Protocol will be made in 2014 for the entire commitment period 2008−2012. This way of reporting enables more exact assessment of activities taking into account cyclic measurements and case studies undertaken in the Polish forestry sector.

13. Information on changes in national system

There were no changes in the national system for GHG inventories in Poland since the last NIR was issued.

14. INFORMATION ON CHANGES IN NATIONAL REGISTRY

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Parties' registries - in particular Decision 13/CMP.1 and decision 24/CP.8.

With a view to complying with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011, in addition to implementing the platform shared by the consolidating Parties, the registry of EU has undergone a major re-development. The consolidated platform which implements the national registries in a consolidated manner (including the registry of Poland) is called Consolidated System of EU registries (CSEUR) and was developed on the basis of the following modalities:

1. Poland retains its organization designated as its registry administrator to maintain the national registry and remains responsible for all the obligations of Parties that are to be fulfilled through registries;
2. Each Kyoto unit issued by Poland in a consolidated system continues to carry identifier of the Party of origin in its unique serial number;
3. Poland retains its own set of national accounts. Each account within the national registry keeps a unique account number comprising the identifier of the Party ('PL') and a unique number within the Party;
4. Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;
5. The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;
6. All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:

   With regards to the data exchange, each national registry connects to the ITL directly and establishes a distinct and secure communication link through a consolidated communication channel (VPN tunnel);

   The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes such that those actions cannot be disputed or repudiated;

   With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;

   The data storage architecture also ensures that the data pertaining to a national registry of Poland are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;

   In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

Following the successful implementation of the CSEUR platform, the 28 national registries concerned were re-certified in June 2012 and switched over to their new national registry on 20 June 2012. During the go-live process, all relevant transaction and holdings data were migrated to the CSEUR platform and the individual connections to and from the ITL were re-established for each Party.

The following changes to the national registry of Poland have therefore occurred in 2012, as a consequence of the transition to the CSEUR platform:

a) *paragraph 32.(a): Change of name or contact*

No change in the name or contact information of the registry administrator occurred during the reported period.

b) *paragraph 32.(b): Change of cooperation arrangement*

Following changes of cooperation arrangement occurred during the reported period:

The EU Member States (including Poland) who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway have decided to operate their registries in a consolidated manner. The Consolidated System of EU registries was certified on 1 June 2012 and went to production on 20 June 2012.

A complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of Poland and all consolidated national registries. This description includes:

- Readiness questionnaire
- Application logging
- Change management procedure
- Disaster recovery
- Manual Intervention
- Operational Plan
- Roles and responsibilities
- Security Plan
- Time Validation Plan
- Version change Management

The documents above are provided as an appendix to this National Inventory Report of Poland.
A new central service desk was also set up to support the registry administrators of the consolidated system. The new service desk acts as 2nd level of support to the local support provided by Poland. It also plays a key communication role with the ITL Service Desk with regards notably to connectivity or reconciliation issues.

c) *paragraph 32.(c): Change to the database or the capacity of national registry*

During the reported period changes to the database and to the capacity of the national registry have occurred.

In 2012, Polish registry has undergone a major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR).

The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of Poland and all consolidated national registries. The documentation is annexed to this submission.
During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to **successful certification on 1 June 2012.**

d) paragraph 32.(d): Change of conformance to technical standards

The overall change to a Consolidated System of EU Registries triggered changes of the registry software and required new conformance testing. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of Poland and all consolidating national registries. The documentation is annexed to this submission.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES. All tests were executed successfully and lead to successful certification on 1 June 2012.

e) paragraph 32.(e): Change of discrepancies procedures

The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated **manual intervention** document. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of Poland and all consolidating national registries. The documentation is annexed to this submission.

f) paragraph 32.(f): Change of Security

The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated **security plan**. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of Poland and all consolidating national registries. The documentation is annexed to this submission.

g) paragraph 32.(g): Change of list of publicly available information

No change to the list of publicly available information occurred during the reporting period.

h) paragraph 32.(h): Change of Internet address

Following change of the registry Internet address occurred during the reporting period:

The new internet address of the Polish registry is:
https://ets-registry.webgate.ec.europa.eu/euregistry/PL/index.xhtml

i) paragraph 32.(i): Change of data integrity measure

The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated **disaster recovery plan.** The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of Poland and all consolidating national registries. The documentation is annexed to this submission.

j) paragraph 32.(j): Change of test results

Following changes regarding test results occurred during the reported period:

On 2 October 2012 a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production of CSEUR. The trusted account list adds to the set of security measures available in the CSEUR. This measure prevents any transfer from a holding account to an account that is not trusted.

15. Changes in information on minimization of adverse impacts in accordance with Article 3.14

According to chapter I.H of the annex to the decision 15/CMP.1 and recommendation of ERT from 2011 below Poland provides new information (since the last NIR 2012) on how it is implementing its commitment under Article 3.14 of the Kyoto Protocol related to striving to implement its commitment under Article 3.1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries.

The Ministry of Environment implements the project *GreenEvo - Green Technology Accelerator,* which is in line with the idea of the Poznań Technology Transfer Strategy whose acceptance was one of the achievements of the Poznań conference COP14. It assumes increasing the efficiency of technology transfer through good identification of the developing countries' needs in this regard. By executing the project, the Ministry of Environment practically implements the assumptions of the most important strategic environmental document, State Environmental Policy, regarding technology transfer and conduction of environmental activities.

Moreover, the Ministry of Environment, observing the potential of native companies at the market of environmentally friendly technologies strives, in the most effective way, to support the development and promotion of green entrepreneurs. Apart from GreenEvo mentioned above, in 2013, jointly with the National Fund for Environmental Protection and Water Management (NFOSiGW) and National Centre for Research and Development (NCBR) the programme called GEKON (Ecological Concepts Generator) was initiated. It is aimed at developing financial support for scientific and industrial consortia related to the search and implementation of environmentally friendly technologies.

Additionally, among activities undertaken in Poland aiming at minimization of adverse social, environmental and economic impacts on developing country Parties, there is implementation of the Polish government’s declaration regarding so called *fast start financing*. This is one of the elements of the Copenhagen Accord on December 2009 concerning financial support provided by the developed countries in 2010−2012 to the developing countries for the implementation of their climate policies. In frames of this declaration Poland mobilised 12.75 million EUR in 2010-2012.

Furthermore in 2012 the Polish climate development support amounted to 7.546 million EUR. The activities in frames of bilateral co-operation were realised covering 6.656 million EUR. Poland continued the project in the area of climate change adaptation in China amounted to 5.816 million EUR in 2012. Other adaptation projects were carried out in Armenia, Ethiopia, Kenya, Kyrgyzstan, Nigeria and Palestine on 380 thousands EUR. Poland was also involved in the climate change mitigation projects in Autonomous Republic of Crimea, Egypt, Moldova, Tanzania, Ukraine with the 400 thousands EUR. Projects aimed at adaptation and mitigation were accomplished in Azerbaijan and Democratic People's Republic of Korea with the amount of 60 thousands EUR.

Poland supported financially international organisations acting in climate change combat with 890 thousands EUR.

There should be mentioned also that in September 2012 the Ministry of Foreign Affairs appointed interdepartmental coordination group for the *Policy Coherence for Development (PCD)*. This action is aimed at eliminating incoherent actions in the area of development policy thus resulting in minimizing negative impact on developing countries.

ABBREVIATIONS

AWMS	Animal waste management system
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
CRF	Common reporting format
DOC	Degradable organic component
ERT	Expert Review Team
GHG	Greenhouse Gases
IE	Included elsewhere
KOBiZE	National Centre for Emissions Management
LULUCF	Land use, land-use change and forestry
MCF	Methane correction factor (Waste)
MCF	Methane Conversion Factor (Agriculture)
MSW	Municipal solid waste
NA	Not applicable
NE	Not estimated
NO	Not occurring
NMVOC	Non-methane volatile organic compounds
SWDS	Solid waste disposal site

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Annex 1. Key categories in 2011

The source categories in all sectors, are identified to be *key sources* on the basis of their contribution to the total level and/or trend assessment. The methodology of reporting key categories is based on IPCC Good Practice Guidance (IPCC 2000), Tier 1. Poland's key category analysis guides the inventory preparation and is used to set priorities for the development of more advanced methodologies.

From source categories which have been identify as key sources in level assessment, the most important are:
- Stationary combustion Solid Fuels,
- Transport Road Transportation,
- Stationary combustion Gaseous Fuels.

Emission from these sources made up 70.5% of the total GHG emissions in Poland expressed in units of CO_2 equivalents. Combustion of solid, gaseous and liquid fuels in stationary sources, made up 63.2% of the total GHG emissions. Combustion of solid fuels in stationary sources alone, made up 52.5% of the total GHG emissions.

The most important source categories in trend assessment are:
- Stationary combustion Solid Fuels,
- Transport Road Transportation,
- Stationary combustion Gaseous Fuels.

Share of these sources in national total made up 52.50%.

7.A1 - 7.A3 IPCC Good Practice Guidance tables, concerning level and trend assessment are listed below.

Level Assessment without category 5 in year 2011

		IPCC Source Categories	Direct GHG	Emission in 2011	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	209 678.76	0.5250	0.52
2	1.A.3.b	Transport Road Transportation	CO2	47 001.15	0.1177	0.64
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	24 722.14	0.0619	0.70
4	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 997.79	0.0451	0.75
5	4.D.1	Direct Soil Emissions	N2O	12 480.23	0.0312	0.78
6	4.A	Enteric Fermentation	CH4	9 286.65	0.0233	0.80
7	2.A.1	Cement Production	CO2	7 379.39	0.0185	0.82
8	6.A	Solid Waste Disposal on Land	CH4	7 290.34	0.0183	0.84
9	1.B.1.a	Coal Mining and Handling	CH4	6 991.31	0.0175	0.86
10	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	6 044.53	0.0151	0.87
11	2.C.1	Iron and Steel Production	CO2	5 465.93	0.0137	0.89
12	4.B	Manure Management	N2O	5 108.51	0.0128	0.90
13	4.D.3	Indirect Soil Emissions	N2O	4 757.65	0.0119	0.91
14	1.B.2.b	Natural Gas	CH4	4 444.00	0.0111	0.92
15	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 181.79	0.0105	0.93
16	2.B.1	Ammonia Production	CO2	3 968.43	0.0099	0.94
17	4.B	Manure Management	CH4	2 809.12	0.0070	0.95

Level Assessment without category 5 in year 1988

		IPCC Source Categories	Direct GHG	Emission in 1988	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	381 352.60	0.6784	0.68
2	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 745.55	0.0316	0.71
3	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	0.0293	0.74
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	0.0292	0.77
5	1.A.3.b	Transport Road Transportation	CO2	16 068.28	0.0286	0.80
6	4.D.1	Direct Soil Emissions	N2O	16 047.46	0.0285	0.83
7	4.A	Enteric Fermentation	CH4	15 665.63	0.0279	0.85
8	4.B	Manure Management	N2O	8 033.03	0.0143	0.87
9	2.A.1	Cement Production	CO2	7 081.72	0.0126	0.88
10	6.A	Solid Waste Disposal on Land	CH4	6 933.95	0.0123	0.89
11	2.C.1	Iron and Steel Production	CO2	6 769.61	0.0120	0.90
12	4.D.3	Indirect Soil Emissions	N2O	6 185.77	0.0110	0.92
13	2.B.2	Nitric Acid Production	N2O	4 386.47	0.0078	0.92
14	2.B.1	Ammonia Production	CO2	4 357.99	0.0078	0.93
15	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 259.58	0.0076	0.94
16	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 206.57	0.0075	0.95
17	1.A.3.c	Transport Railways	CO2	3 853.56	0.0069	0.95

Level Assessment with category 5 in year 2011

		IPCC Source Categories	Direct GHG	Emission in 2011	Absolut Value of Current Year Estimate	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	209 678.76	209 678.76	0.4765	0.48
2	1.A.3.b	Transport Road Transportation	CO2	47 001.15	47 001.15	0.1068	0.58
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	24 722.14	24 722.14	0.0562	0.64
4	5.A.1	Forest Land remaining Forest Land	CO2	-24 553.42	24 553.42	0.0558	0.70
5	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 997.79	17 997.79	0.0409	0.74
6	4.D.1	Direct Soil Emissions	N2O	12 480.23	12 480.23	0.0284	0.76
7	4.A	Enteric Fermentation	CH4	9 286.65	9 286.65	0.0211	0.79
8	2.A.1	Cement Production	CO2	7 379.39	7 379.39	0.0168	0.80
9	6.A	Solid Waste Disposal on Land	CH4	7 290.34	7 290.34	0.0166	0.82
10	1.B.1.a	Coal Mining and Handling	CH4	6 991.31	6 991.31	0.0159	0.83
11	5.A.2	Land converted to Forest Land	CO2	-6 466.21	6 466.21	0.0147	0.85
12	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	6 044.53	6 044.53	0.0137	0.86
13	2.C.1	Iron and Steel Production	CO2	5 465.93	5 465.93	0.0124	0.88
14	4.B	Manure Management	N2O	5 108.51	5 108.51	0.0116	0.89
15	4.D.3	Indirect Soil Emissions	N2O	4 757.65	4 757.65	0.0108	0.90
16	1.B.2.b	Natural Gas	CH4	4 444.00	4 444.00	0.0101	0.91
17	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 181.79	4 181.79	0.0095	0.92
18	2.B.1	Ammonia Production	CO2	3 968.43	3 968.43	0.0090	0.93
19	5.B.1	Cropland remaining Cropland	CO2	3 216.48	3 216.48	0.0073	0.93
20	5.D.1	Wetlands remaining Wetlands	CO2	2 903.41	2 903.41	0.0066	0.94
21	4.B	Manure Management	CH4	2 809.12	2 809.12	0.0064	0.95
22	5.D.2	Land converted to Wetlands	CH4	2 235.46	2 235.46	0.0051	0.95

Level Assessment with category 5 in year 1988

		IPCC Source Categories	Direct GHG	Emission in 1988	Absolut Value of Current Year Estimate	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	381 352.60	381 352.60	0.6454	0.65
2	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 745.55	17 745.55	0.0300	0.68
3	5.A.1	Forest Land remaining Forest Land	CO2	-17 179.67	17 179.67	0.0291	0.70
4	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	16 443.14	0.0278	0.73
5	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	16 408.68	0.0278	0.76
6	1.A.3.b	Transport Road Transportation	CO2	16 068.28	16 068.28	0.0272	0.79
7	4.D.1	Direct Soil Emissions	N2O	16 047.46	16 047.46	0.0272	0.81
8	4.A	Enteric Fermentation	CH4	15 665.63	15 665.63	0.0265	0.84
9	4.B	Manure Management	N2O	8 033.03	8 033.03	0.0136	0.85
10	2.A.1	Cement Production	CO2	7 081.72	7 081.72	0.0120	0.87
11	6.A	Solid Waste Disposal on Land	CH4	6 933.95	6 933.95	0.0117	0.88
12	2.C.1	Iron and Steel Production	CO2	6 769.61	6 769.61	0.0115	0.89
13	4.D.3	Indirect Soil Emissions	N2O	6 185.77	6 185.77	0.0105	0.90
14	5.B.1	Cropland remaining Cropland	CO2	5 420.00	5 420.00	0.0092	0.91
15	2.B.2	Nitric Acid Production	N2O	4 386.47	4 386.47	0.0074	0.92
16	2.B.1	Ammonia Production	CO2	4 357.99	4 357.99	0.0074	0.92
17	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 259.58	4 259.58	0.0072	0.93
18	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 206.57	4 206.57	0.0071	0.94
19	1.A.3.c	Transport Railways	CO2	3 853.56	3 853.56	0.0065	0.95
20	1.B.2.b	Natural Gas	CH4	3 432.87	3 432.87	0.0058	0.95

Trend Assessment without category 5 in 2011

		IPCC Source Categories	Direct GHG	Base Year Estimate	Emission in 2011	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	381 352.60	209 678.76	0.5250	0.1807	31.74893	0.32
2	1.A.3.b	Transport Road Transportation	CO2	16 068.28	47 001.15	0.1177	0.1333	23.42131	0.55
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	24 722.14	0.0619	0.0502	8.81884	0.64
4	6.A	Solid Waste Disposal on Land	CH4	546.27	7 290.34	0.0183	0.0255	4.48903	0.68
5	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	0.00	6 044.53	0.0151	0.0223	3.92117	0.72
6	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 745.55	17 997.79	0.0451	0.0220	3.86853	0.76
7	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	6 991.31	0.0175	0.0154	2.69856	0.79
8	6.B	Wastewater Handling	N2O	6 933.95	1 108.44	0.0028	0.0133	2.33143	0.81
9	2.A.1	Cement Production	CO2	7 081.72	7 379.39	0.0185	0.0095	1.67162	0.83
10	1.A.3.c	Transport Railways	CO2	3 853.56	367.43	0.0009	0.0083	1.45696	0.84
11	2.B.2	Nitric Acid Production	N2O	4 386.47	823.66	0.0021	0.0079	1.39544	0.86
12	1.B.2.b	Natural Gas	CH4	3 432.87	4 444.00	0.0111	0.0078	1.37265	0.87
13	4.D.1	Direct Soil Emissions	N2O	16 047.46	12 480.23	0.0312	0.0059	1.03625	0.88
14	1.B.2.d	Other	CO2	0.00	1 553.60	0.0039	0.0057	1.00784	0.89
15	4.A	Enteric Fermentation	CH4	15 665.63	9 286.65	0.0233	0.0049	0.86749	0.90
16	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 259.58	4 181.79	0.0105	0.0048	0.83884	0.91
17	6.B	Wastewater Handling	CH4	0.00	1 110.38	0.0028	0.0041	0.72032	0.92
18	2.B.1	Ammonia Production	CO2	4 357.99	3 968.43	0.0099	0.0037	0.65715	0.92
19	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 206.57	1 861.86	0.0047	0.0037	0.64280	0.93
20	2.A.3	Limestone and Dolomite Use	CO2	0.00	972.06	0.0024	0.0036	0.63059	0.94
21	6.C	Waste Incineration	CO2	1 723.17	225.98	0.0006	0.0035	0.61149	0.94
22	2.C.1	Iron and Steel Production	CO2	6 769.61	5 465.93	0.0137	0.0032	0.56763	0.95
23	1.A.1, 2, 4	Stationary combustion Biomass	CH4	229.44	1 000.61	0.0025	0.0031	0.54817	0.95

Trend Assessment with category 5 in 2011

		IPCC Source Categories	Direct GHG	Base Year Estimate	Emission in 2011	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	381 352.60	209 678.76	0.4765	0.2278	39.7726	0.40
2	1.A.3.b	Transport Road Transportation	CO2	16 068.28	47 001.15	0.1068	0.1067	18.6255	0.58
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	24 722.14	0.0562	0.0380	6.6399	0.65
4	5.A.1	Forest Land remaining Forest Land	CO2	-17 179.67	-24 553.42	0.0558	0.0358	6.2442	0.71
5	5.A.2	Land converted to Forest Land	CO2	-49.51	-6 466.21	0.0147	0.0196	3.4198	0.75
6	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	0.00	6 044.53	0.0137	0.0184	3.2152	0.78
7	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	6 991.31	0.0159	0.0161	2.8051	0.81
8	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 745.55	17 997.79	0.0409	0.0145	2.5327	0.83
9	1.A.3.c	Transport Railways	CO2	3 853.56	367.43	0.0008	0.0076	1.3335	0.85
10	2.B.2	Nitric Acid Production	N2O	4 386.47	823.66	0.0019	0.0075	1.3022	0.86
11	4.A	Enteric Fermentation	CH4	15 665.63	9 286.65	0.0211	0.0073	1.2757	0.87
12	6.A	Solid Waste Disposal on Land	CH4	6 933.95	7 290.34	0.0166	0.0065	1.1268	0.88
13	2.A.1	Cement Production	CO2	7 081.72	7 379.39	0.0168	0.0064	1.1155	0.89
14	1.B.2.b	Natural Gas	CH4	3 432.87	4 444.00	0.0101	0.0057	1.0018	0.90
15	1.B.2.d	Other	CO2	0.00	1 553.60	0.0035	0.0047	0.8264	0.91
16	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 206.57	1 861.86	0.0042	0.0039	0.6786	0.92
17	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 259.58	4 181.79	0.0095	0.0031	0.5343	0.92
18	2.A.3	Limestone and Dolomite Use	CO2	0.00	972.06	0.0022	0.0030	0.5171	0.93
19	2.A.2	Lime Production	CO2	3 395.60	1 560.82	0.0035	0.0030	0.5170	0.93
20	4.B	Manure Management	N2O	8 033.03	5 108.51	0.0116	0.0027	0.4699	0.94
21	1.A.1, 2, 4	Stationary combustion Biomass	CH4	229.44	1 000.61	0.0023	0.0025	0.4412	0.94
22	5.B.1	Cropland remaining Cropland	CO2	5 420.00	3 216.48	0.0073	0.0025	0.4395	0.95
23	5.D.1	Wetlands remaining Wetlands	CO2	2 794.69	2 903.41	0.0066	0.0025	0.4356	0.95

IPCC Source Categories		Direct GHG	Level Assessement - L, Trend Assessment - T		Level Assessement
			2011		1988
	ENERGY				
1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Solid Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Other Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Liquid Fuels	CH_4			
1.A.1, 2, 4	Stationary combustion Solid Fuels	CH_4		T	L
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CH_4			
1.A.1, 2, 4	Stationary combustion Biomass	CH_4		T	
1.A.1, 2, 4	Stationary combustion Other Fuels	CH_4			
1.A.1, 2, 4	Stationary combustion Liquid Fuels	N_2O			
1.A.1, 2, 4	Stationary combustion Solid Fuels	N_2O			
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	N_2O			
1.A.1, 2, 4	Stationary combustion Biomass	N_2O			
1.A.1, 2, 4	Stationary combustion Other Fuels	N_2O			
1.A.3.a	Transport Civil Aviation	CO_2			
1.A.3.b	Transport Road Transportation	CO_2	L	T	L
1.A.3.c	Transport Railways	CO_2		T	L
1.A.3.d	Transport Navigation	CO_2			
1.A.3.e	Transport Other	CO_2			
1.A.3.a	Transport Civil Aviation	CH_4			
1.A.3.b	Transport Road Transportation	CH_4			
1.A.3.c	Transport Railways	CH_4			
1.A.3.d	Transport Navigation	CH_4			
1.A.3.e	Transport Other	CH_4			
1.A.3.a	Transport Civil Aviation	N_2O			
1.A.3.b	Transport Road Transportation	N_2O			
1.A.3.c	Transport Railways	N_2O			
1.A.3.d	Transport Navigation	N_2O			
1.A.3.e	Transport Other	N_2O			
1.A.5.b	Other Mobile	CO_2			
1.A.5.b	Other Mobile	CH_4			
1.A.5.b	Other Mobile	N_2O			
1.B.1.a	Coal Mining and Handling	CH_4	L	T	L
1.B.1.b	Solid Fuel Transformation	CO_2			
1.B.1.b	Solid Fuel Transformation	CH_4			
1.B.1.c	Other	CO_2			
1.B.1.c	Other	CH_4			
1.B.2.a	Oil	CO_2			
1.B.2.a	Oil	CH_4		T	
1.B.2.b	Natural Gas	CO_2		T	
1.B.2.b	Natural Gas	CH_4	L	T	L
1.B.2.c	Venting and Flaring	CH_4		T	
1.B.2.c	Venting and Flaring	N_2O			
	INDUSTRIAL PROCESSES				
2.A.1	Cement Production	CO_2	L	T	L
2.A.2	Lime Production	CO_2		T	
2.A.3	Limestone and Dolomite Use	CO_2		T	
2.A.4	Soda Ash (production)	CO_2			
2.A.7	Other (ETS Data; Bricks, Tiles And Ceramics Materials production)	CO_2		T	
2.B.1	Ammonia Production	CO_2	L	T	L
2.B.1	Ammonia Production	CH_4		T	
2.B.2	Nitric Acid Production	N_2O			L
2.B.3	Adipic Acid Production	N_2O			
2.B.5	Other	CO_2			
2.B.5	Other	CH_4			
2.B.5	Other	N_2O			
2.C.1	Iron and Steel Production	CO_2	L	T	L
2.C.1	Iron and Steel Production	CH_4		T	
2.C.1	Iron and Steel Production	N_2O			
2.C.2	Ferroalloys Production	CO_2			

IPCC Source Categories		Direct GHG	Level Assessement - L, Trend Assessment - T		Level Assessement
			2011		1988
2.C.2	Ferroalloys Production	CH_4			
2.C.3	Aluminium Production	CO_2			
2.C.3	Aluminium Production	PFC			
2.C.4	SF6 Used in Aluminium and Magnesium Foundries	SF_6			
2.C.5	Other	CO_2			
2.D	Other Production	CO_2			
2.G	Other	CO_2			
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	L	T	
2.F.2	Foam Blowing	HFC			
2.F.3	Fire Extinguishers	HFC			
2.F.3	Fire Extinguishers	PFC			
2.F.4	Aerosols/Metered Dose Inhalers	HFC			
2.F.8	Electrical Equipment	SF_6			
2.F.9	Potential emissions as a proxy for actual emissions	N_2O			
	SOLVENT AND OTHER PRODUCT USE				
3.A	Paint Application	CO_2			
3.B	Degreasing and Dry Cleaning	CO_2			
3.C	Chemical Products, Manufacture and Processing	CO_2			
3.D	Other	CO_2			
3.D	Other	N_2O			
	AGRICULTURE				
4.A	Enteric Fermentation	CH_4	L	T	L
4.B	Manure Management	CH_4	L	T	
4.B	Manure Management	N_2O	L	T	L
4.D.1	Direct Soil Emissions	N_2O		T	L
4.D.2	Animal Production	N_2O	L	T	
4.D.3	Indirect Soil Emissions	N_2O		T	L
4.F	Field Burning of Agricultural Residues	CH_4		T	
4.F	Field Burning of Agricultural Residues	N_2O	L		
	LAND USE CHANGE AND FORESTRY				
5.A.1	Forest Land remaining Forest Land	CO_2		T	L
5.A.1	Forest Land remaining Forest Land	CH_4		T	
5.A.1	Forest Land remaining Forest Land	N_2O	L		
5.A.2	Land converted to Forest Land	CO_2		T	
5.A.2	Land converted to Forest Land	CH_4			
5.A.2	Land converted to Forest Land	N_2O	L		
5.B.1	Cropland remaining Cropland	CO_2		T	L
5.B.2	Land converted to Cropland	CO_2		T	
5.C.1	Grassland remaining Grassland	CO_2			
5.C.1	Grassland remaining Grassland	CH_4			
5.C.1	Grassland remaining Grassland	N_2O			
5.C.2	Land converted to Grassland	CO_2	L		
5.D.1	Wetlands remaining Wetlands	CO_2		T	
5.D.2	Land converted to Wetlands	CO_2	L	T	
5.D.2	Land converted to Wetlands	CH_4		T	
5.D.2	Land converted to Wetlands	N_2O		T	
5.E.1	Settlements remaining Settlements	CO_2			
5.E.2	Land converted to Settlements	CH_4			
5.E.2	Land converted to Settlements	N_2O	L		
	WASTE				
6.A	Solid Waste Disposal on Land	CH_4		T	L
6.B	Wastewater Handling	CH_4		T	
6.B	Wastewater Handling	N_2O			
6.C	Waste Incineration	CO_2			
6.C	Waste Incineration	N_2O	L		

Annex 2. Fuel consumption and GHG emission factors from selected categories of CRF sector 1.A

Table 1. Fuel consumption [PJ] in 1.A.1.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	1822.106	1788.457	1597.240	1574.444	1504.529	1364.716	1317.391	1205.058	1267.444	1221.135	1155.693	1125.964
Lignite	569.854	576.649	555.587	561.502	548.623	550.751	539.277	529.124	533.077	530.661	535.230	521.068
Hard coal briquettes (patent fuels)	5.016	3.900	2.520	0.322	0.117	0.059	0.059	0.000	0.000	0.059	0.000	0.000
Brown coal briquettes	0.354	0.247	0.140	0.060	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.274	21.900	21.641	16.329	9.562	3.107	4.094	4.738	7.157	7.949	10.768	16.210
Fuel wood and wood waste	16.695	15.123	14.571	14.384	17.265	13.783	14.051	1.322	2.656	3.293	3.673	3.398
Biogas	0.004	0.006	0.014	0.003	0.024	0.000	0.006	0.125	0.137	0.088	0.204	0.349
Industrial wastes	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878	3.393	3.267	3.809	3.082
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	14.062	12.959	12.626	12.968	10.944	8.864	7.524	7.239	6.954	5.301	4.076	2.850
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.184	0.230
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.780	0.737	0.597	0.597	0.554	0.426	0.383	0.341	1.150	1.661	1.534	1.577
Fuel oil	73.433	71.102	65.360	61.280	56.400	55.080	55.600	25.840	27.720	27.280	17.600	16.720
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	1.252	1.156	0.990	0.743	0.644	0.842	1.238	0.050	0.000	0.000	0.000	0.000
Coke oven gas	5.568	6.565	7.126	7.555	8.863	8.144	13.147	12.828	13.975	16.450	13.697	16.078
Blast furnace gas	28.221	26.733	22.377	12.797	13.378	10.239	13.190	5.905	3.218	3.306	3.060	3.286
Gas works gas	0.659	0.579	0.167	0.129	0.335	0.085	0.037	0.021	0.005	0.002	0.000	0.000
Fuels												
Liquid fuels	75.465	72.994	66.947	62.620	57.598	56.348	57.221	26.231	28.870	28.987	19.318	18.527
Gaseous fuels	21.274	21.900	21.641	16.329	9.562	3.107	4.094	4.738	7.157	7.949	10.768	16.210
Solid fuels	2445.838	2416.088	2197.783	2169.777	2086.989	1942.858	1890.625	1760.175	1824.673	1776.914	1711.756	1669.246
Other fuels	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878	3.393	3.267	3.809	3.082
Biomass	16.699	15.129	14.585	14.387	17.289	13.783	14.057	1.447	2.793	3.381	3.877	3.747
Total	**2563.017**	**2529.984**	**2306.221**	**2272.027**	**2178.792**	**2022.754**	**1972.873**	**1796.469**	**1866.886**	**1820.498**	**1749.528**	**1710.812**

Table 1. (cont.) Fuel consumption [PJ] in 1.A.1.a category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	1118.163	1127.286	1091.937	1144.769	1122.123	1105.919	1159.978	1145.487	1057.079	1030.535	1092.598	1052.952
Lignite	504.999	512.219	494.038	518.250	514.275	533.979	525.818	501.140	521.178	494.048	477.467	517.018
Hard coal briquettes (patent fuels)	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.627	28.242	38.700	45.496	53.667	57.039	52.808	49.653	51.052	51.828	52.230	57.071
Fuel wood and wood waste	3.461	4.886	4.809	5.799	8.905	17.500	21.180	25.434	38.251	55.083	66.119	79.893
Biogas	0.443	0.563	0.615	0.843	1.293	1.820	2.021	2.305	3.038	3.123	3.653	4.440
Industrial wastes	3.273	3.369	4.629	2.964	4.038	5.219	5.205	4.783	4.711	5.095	5.493	5.780
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.384	0.368	0.367	0.403
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.080	0.040
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.995	1.710	1.254	0.912	0.599	0.342	0.171	0.143	0.086	0.058	0.057	0.029
Liquid petroleum gas (LPG)	0.184	0.184	0.184	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.960	2.045	2.300	2.173	1.534	1.193	1.150	0.724	0.809	0.938	0.852	1.022
Fuel oil	13.680	14.680	13.200	11.920	9.800	8.080	7.960	7.280	7.400	6.680	7.400	6.920
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	17.094	17.080	16.420	18.032	16.955	14.373	18.322	19.908	21.740	17.488	23.685	21.972
Blast furnace gas	4.317	4.976	4.783	5.715	6.665	4.146	8.323	5.965	9.766	7.443	9.793	10.671
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	15.824	16.909	15.684	14.139	11.334	9.273	9.110	8.004	8.209	7.658	8.332	7.982
Gaseous fuels	21.627	28.242	38.700	45.496	53.667	57.039	52.808	49.653	51.052	51.828	52.230	57.071
Solid fuels	1646.568	1663.271	1608.461	1687.678	1660.617	1658.759	1712.612	1672.643	1609.849	1549.572	1603.600	1602.642
Other fuels	3.273	3.369	4.629	2.964	4.038	5.219	5.205	4.783	5.095	5.463	5.860	6.183
Biomass	3.904	5.449	5.424	6.642	10.198	19.320	23.201	27.739	41.289	58.206	69.772	84.333
Total	**1691.196**	**1717.240**	**1672.898**	**1756.919**	**1739.854**	**1749.610**	**1802.936**	**1762.822**	**1715.494**	**1672.727**	**1739.794**	**1758.211**

Table 2. Fuel consumption [PJ] in 1.A.1.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	0.114	0.113	0.046	0.090	0.069	0.245	0.068	1.302	1.451	1.349	0.629	0.586
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244	10.832
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163	0.438	0.310
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.520	1.080	1.286	1.804
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.028	0.028	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.092	0.184
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.043	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.043	0.043	0.000	0.085	0.085	0.170	0.170	0.213	0.341	0.085
Fuel oil	14.872	13.867	11.440	10.560	15.760	12.800	11.960	32.400	40.520	32.200	39.840	35.080
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	8.619	9.052	7.475	7.623	8.514	9.257	10.445	12.029	8.960	10.197	6.287	6.386
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.081	0.051
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	23.490	22.919	18.958	18.226	24.274	22.185	22.490	44.642	50.170	43.736	47.846	43.627
Gaseous fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244	10.832
Solid fuels	0.142	0.140	0.046	0.119	0.069	0.245	0.068	1.302	1.451	1.349	0.710	0.637
Other fuels	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163	0.438	0.310
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**33.750**	**32.941**	**25.897**	**20.156**	**26.533**	**24.040**	**24.408**	**49.425**	**53.720**	**47.777**	**57.238**	**55.406**

Table 2. (cont.) Fuel consumption [PJ] in 1.A.1.b category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	0.208	0.070	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.023	0.023
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	12.110	11.354	10.124	12.770	15.454	14.482	14.900	20.816	18.816	17.381	19.232	27.975
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.219	0.095	0.253	0.176	0.221	0.285	0.224	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.042	0.084	0.040	0.126	0.909	0.674	0.911	0.906	1.392	1.720	0.600	1.190
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.276	0.000	0.046	0.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092
Motor gasoline	0.132	0.000	0.000	0.132	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline												
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.363	0.383	0.852	0.341	0.980	0.298	0.724	0.170	0.426	0.213	0.128	0.170
Fuel oil	36.160	42.280	42.560	43.520	43.120	42.560	41.720	44.080	43.560	44.160	46.560	39.280
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	9.059	10.445	10.049	10.049	11.633	10.692	12.969	16.583	17.424	15.246	22.869	21.533
Coke oven gas	0.069	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	47.032	53.192	53.547	54.260	56.642	54.267	56.324	61.739	62.802	61.339	70.157	62.265
Gaseous fuels	12.110	11.354	10.124	12.770	15.454	14.482	14.900	20.816	18.816	17.381	19.232	27.975
Solid fuels	0.277	0.140	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.023	0.073
Other fuels	0.219	0.095	0.253	0.176	0.221	0.285	0.224	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**59.638**	**64.781**	**63.947**	**67.206**	**72.317**	**69.034**	**71.448**	**82.555**	**81.618**	**78.743**	**89.412**	**90.313**

Table 3. Fuel consumption [PJ] in 1.A.1.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	12.314	10.347	10.425	7.912	6.205	23.487	57.593	58.698	59.891	56.159	53.263	44.994
Lignite	0.416	0.057	0.078	0.132	0.073	0.322	0.303	0.336	0.370	0.333	0.296	0.286
Hard coal briquettes (patent fuels)	0.023	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.035	0.018	0.020	0.020	0.000	0.040	0.020	0.020	0.040	0.040	0.020	0.020
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.085	0.085	0.085	0.085
Natural gas	13.736	15.364	12.371	12.432	14.665	12.354	17.401	14.850	23.269	21.155	17.779	19.458
Fuel wood and wood waste	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.003	0.003	0.003	0.003	0.005
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.028	0.023	0.022
Industrial wastes	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.151	0.155
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.080	0.040	0.080
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.173	0.522	0.619	0.537	0.285	0.513	1.226	0.884	0.599	0.143	0.086	0.029
Liquid petroleum gas (LPG)	0.095	0.095	0.092	0.092	0.092	0.046	0.046	0.046	0.046	0.000	0.046	0.046
Motor gasoline	0.090	0.090	0.088	0.088	0.088	0.176	0.308	0.264	0.088	0.088	0.044	0.044
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.043	0.043	0.043	0.043	0.043	0.043	0.000	0.000	0.043	0.043
Diesel oil	2.167	1.993	1.831	2.130	2.258	4.388	3.536	3.749	3.238	2.812	2.215	1.789
Fuel oil	0.241	0.040	0.040	0.040	0.080	0.360	0.280	0.160	0.160	0.080	0.520	0.160
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	50.866	50.938	43.557	38.488	39.121	34.604	40.489	37.038	35.105	37.000	33.710	29.871
Blast furnace gas	5.632	4.440	3.961	1.995	1.430	2.123	2.488	1.954	1.582	1.893	1.695	0.847
Gas works gas	0.005	0.008	0.005	0.180	0.010	0.120	0.000	0.006	0.061	0.019	0.017	0.013
Fuels												
Liquid fuels	2.592	2.218	2.094	2.393	2.561	5.013	4.213	4.262	3.697	3.145	2.993	2.247
Gaseous fuels	13.736	15.364	12.371	12.432	14.665	12.354	17.401	14.850	23.269	21.155	17.779	19.458
Solid fuels	70.465	66.330	58.694	49.264	47.124	61.209	102.119	98.936	97.648	95.587	89.087	76.060
Other fuels	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.151	0.155
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004	0.014	0.031	0.026	0.027
Total	**86.857**	**83.914**	**73.165**	**64.089**	**64.354**	**78.895**	**123.979**	**118.236**	**124.786**	**120.056**	**110.036**	**97.947**

Table 3. (cont.) Fuel consumption [PJ] in 1.A.1.c category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	34.648	32.658	16.819	19.618	13.900	12.331	9.542	17.495	12.424	7.456	2.061	2.667
Lignite	0.420	0.307	1.000	0.625	0.542	0.175	0.204	1.380	1.766	0.908	1.442	1.666
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.043	0.000	0.043	0.128	0.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	19.491	12.987	12.515	9.741	11.190	10.106	10.363	9.681	9.239	8.858	10.321	9.949
Fuel wood and wood waste	0.006	0.039	0.029	0.008	0.004	0.002	0.011	0.057	0.020	0.134	0.349	0.162
Biogas	0.027	0.012	0.018	0.018	0.016	0.012	0.015	0.028	0.017	0.003	0.000	0.000
Industrial wastes	0.010	0.008	0.005	0.013	0.000	0.000	0.029	0.042	0.051	0.015	0.016	0.022
Municipal waste - non-biogenic fraction	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.080	0.000	0.040	0.040	0.040	0.080	0.040	0.040	0.040	0.040	0.040	0.080
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.171	0.029	0.000	0.114	0.057	0.029	0.000	0.029	0.656	0.000	0.000	0.057
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.046	0.000	0.046	0.000	0.000
Motor gasoline	0.044	0.044	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.789	1.577	1.235	1.235	1.107	1.321	1.278	1.236	1.363	1.491	1.619	2.045
Fuel oil	0.240	0.080	0.360	0.240	0.160	0.280	0.040	0.160	0.000	0.000	0.080	0.040
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	32.634	33.111	32.027	36.095	36.410	32.796	36.410	39.839	39.605	28.051	38.485	33.977
Blast furnace gas	0.840	0.149	0.086	0.021	0.030	0.042	0.045	0.037	0.000	0.000	0.000	0.000
Gas works gas	0.005	0.004	0.004	0.004	0.004	0.003	0.004	0.005	0.006	0.012	0.012	0.009
Fuels												
Liquid fuels	2.196	1.701	1.722	1.643	1.435	1.681	1.404	1.482	1.403	1.577	1.739	2.165
Gaseous fuels	19.491	12.987	12.515	9.741	11.190	10.106	10.363	9.681	9.239	8.858	10.321	9.949
Solid fuels	68.738	66.258	49.936	56.477	50.943	45.376	46.205	58.785	54.457	36.427	42.000	38.376
Other fuels	0.014	0.008	0.005	0.013	0.000	0.000	0.029	0.042	0.051	0.015	0.016	0.022
Biomass	0.037	0.052	0.047	0.026	0.020	0.014	0.026	0.085	0.037	0.137	0.349	0.162
Total	**90.476**	**81.006**	**64.225**	**67.900**	**63.588**	**57.177**	**58.027**	**70.075**	**65.187**	**47.014**	**54.425**	**50.674**

Table 4. Fuel consumption [PJ] in 1.A.2.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	2.367	1.278	1.138	1.243	1.494	9.159	8.513	25.320	28.922	23.636	21.085	19.075
Lignite	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993	21.440
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006	0.004
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941	0.498	0.000	0.000	0.008
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	12.180	9.642	10.457	22.192	28.043	28.794	32.927	26.543	24.387	28.697	23.567	22.254
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.043	0.645	0.043	0.000
Diesel oil	0.130	0.130	0.170	0.128	0.170	0.341	0.554	0.767	0.895	0.554	0.298	0.341
Fuel oil	18.208	15.474	11.000	7.800	5.280	4.280	2.960	2.040	0.960	4.720	1.600	1.800
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	32.570	30.997	26.038	22.091	22.568	21.605	25.480	27.686	24.404	24.257	24.742	15.875
Blast furnace gas	43.812	40.192	36.484	27.903	25.909	25.676	28.350	37.610	34.205	36.120	29.520	24.034
Gas works gas	4.316	3.219	2.174	1.462	0.718	0.613	0.067	0.068	0.080	0.059	0.007	0.000
Fuels												
Liquid fuels	18.338	15.604	11.170	7.928	5.450	4.621	3.514	2.850	1.898	5.965	1.941	2.187
Gaseous fuels	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993	21.440
Solid fuels	95.245	85.329	76.291	74.910	78.732	85.847	95.337	117.227	111.998	112.778	98.921	81.238
Other fuels	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941	0.498	0.000	0.000	0.008
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006	0.004
Total	**190.249**	**167.610**	**144.391**	**123.568**	**117.247**	**120.318**	**128.109**	**147.262**	**140.298**	**147.025**	**124.861**	**104.877**

Table 4. (cont.) Fuel consumption [PJ] in 1.A.2.a category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	18.262	14.701	12.424	12.593	17.281	10.050	4.797	7.789	0.517	3.248	1.909	2.484
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.029	0.029	0.029	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	22.024	18.329	15.463	14.827	19.969	17.091	20.301	21.281	19.758	15.864	16.403	16.542
Fuel wood and wood waste	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.277	0.706	1.195	1.654	0.965	1.015	1.313	0.993	0.474	0.187	0.203
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	25.542	21.135	21.290	22.514	22.886	3.428	3.099	5.675	2.199	3.565	5.209	2.766
Liquid petroleum gas (LPG)	0.184	0.184	0.230	0.184	0.138	0.000	0.000	0.000	0.046	0.046	0.046	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline												
Jet kerosene	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.511	0.170	0.128	0.128	0.128	0.085	0.128	0.085	0.085	0.085	0.085	0.085
Fuel oil	1.040	0.640	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	17.574	16.994	15.122	16.132	15.368	8.401	7.938	7.425	4.342	4.787	4.283	3.923
Blast furnace gas	31.874	26.768	23.876	25.282	27.109	19.000	20.372	28.394	18.668	10.088	12.220	11.503
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	1.821	0.994	0.358	0.312	0.266	0.085	0.128	0.085	0.131	0.131	0.131	0.131
Gaseous fuels	22.024	18.329	15.463	14.827	19.969	17.091	20.301	21.281	19.758	15.864	16.403	16.542
Solid fuels	93.252	79.627	72.741	76.550	82.644	40.879	36.235	49.282	25.726	21.688	23.621	20.675
Other fuels	0.000	0.277	0.706	1.195	1.654	0.965	1.015	1.313	0.993	0.474	0.187	0.203
Biomass	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001	0.000	0.000
Total	**117.100**	**99.233**	**89.271**	**92.888**	**104.537**	**59.022**	**57.680**	**71.962**	**46.609**	**38.159**	**40.342**	**37.551**

Table 5. Fuel consumption [PJ] in 1.A.2.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	1.411	1.323	0.455	0.565	0.850	1.916	1.771	4.172	4.285	3.907	3.331	3.117
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.639	5.660
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026	0.010
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361	2.164	2.070
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	9.754	8.730	6.014	5.216	2.280	2.793	6.413	6.327	6.612	6.584	6.384	5.928
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000
Diesel oil	0.043	0.043	0.043	0.043	0.128	0.085	0.128	0.170	0.213	0.213	0.256	0.170
Fuel oil	0.643	0.764	0.760	0.800	0.800	0.760	0.800	0.720	0.680	0.640	0.520	0.560
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.461	0.437	0.397	0.178	0.186	0.043	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.375	0.341	0.042	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	0.686	0.807	0.803	0.843	0.928	0.845	0.928	0.890	0.939	0.896	0.776	0.730
Gaseous fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.639	5.660
Solid fuels	12.001	10.832	6.908	5.965	3.316	4.752	8.184	10.499	10.897	10.491	9.715	9.045
Other fuels	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361	2.164	2.070
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026	0.010
Total	**19.195**	**17.827**	**12.749**	**11.924**	**5.971**	**8.072**	**15.257**	**18.986**	**19.504**	**19.214**	**18.320**	**17.515**

Table 5. (cont.) Fuel consumption [PJ] in 1.A.2.b category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	3.108	3.790	2.560	2.115	1.092	0.024	0.024	0.589	0.000	0.000	0.000	0.250
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.814	5.700	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.852	6.048	6.674
Fuel wood and wood waste	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	2.268	2.551	2.739	2.539	1.800	1.003	1.004	0.982	1.252	1.119	0.994	0.987
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	6.071	6.156	6.156	5.928	5.957	5.814	6.042	6.441	6.641	6.270	6.042	6.213
Liquid petroleum gas (LPG)	0.046	0.092	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline												
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.256	0.170	0.170	0.128	0.170	0.170	0.170	0.170	0.170	0.170	0.213	0.170
Fuel oil	0.560	0.520	0.400	0.320	0.400	0.400	0.400	0.160	0.160	0.160	0.120	0.120
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	0.862	0.782	0.616	0.494	0.656	0.616	0.616	0.376	0.376	0.376	0.379	0.336
Gaseous fuels	5.814	5.700	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.852	6.048	6.674
Solid fuels	9.179	9.946	8.716	8.043	7.049	5.838	6.066	7.030	6.641	6.270	6.042	6.502
Other fuels	2.268	2.551	2.739	2.539	1.800	1.003	1.004	0.982	1.252	1.119	0.994	0.987
Biomass	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**18.134**	**18.984**	**17.661**	**16.944**	**15.910**	**13.925**	**14.570**	**15.131**	**14.811**	**13.617**	**13.463**	**14.499**

Table 6. Fuel consumption [PJ] in 1.A.2.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	9.197	9.059	7.216	6.623	4.550	13.125	7.945	70.221	71.191	63.913	54.992	50.522
Lignite	0.056	0.038	0.039	0.038	0.027	0.047	0.029	0.428	0.460	0.389	0.429	0.138
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408	9.041
Fuel wood and wood waste	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Industrial wastes	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	9.593	9.808
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.600	2.880	3.440	2.520
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.763	4.530	2.679	1.967	1.853	1.881	1.938	3.477	2.964	1.454	1.539	1.625
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.258	0.344	0.172	0.086	0.043
Diesel oil	1.430	1.387	0.980	0.852	0.767	0.724	0.724	0.937	1.065	1.065	1.406	1.321
Fuel oil	6.109	6.150	2.720	1.880	2.760	2.480	3.600	8.160	9.320	9.360	17.560	15.680
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	3.515	1.878	0.396	3.465	5.445	4.455	0.198	1.584	6.584	9.653	18.513	19.602
Coke oven gas	1.053	0.993	0.701	0.522	0.440	1.548	0.276	0.729	0.784	0.140	0.174	0.131
Blast furnace gas	0.148	0.136	0.047	0.010	0.006	0.011	0.014	0.023	0.004	0.013	0.004	0.007
Gas works gas	0.190	0.230	0.214	0.192	0.133	0.126	0.110	0.070	0.052	0.000	0.000	0.000
Fuels												
Liquid fuels	11.054	9.414	4.096	6.197	8.972	7.748	4.522	10.939	19.913	23.130	41.005	39.166
Gaseous fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408	9.041
Solid fuels	12.407	14.986	10.896	9.352	7.009	16.738	10.312	74.948	75.455	65.909	57.138	52.423
Other fuels	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	9.593	9.808
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.001	0.000
Total	**42.469**	**45.949**	**37.111**	**38.514**	**37.462**	**52.567**	**41.967**	**113.796**	**118.933**	**114.419**	**117.145**	**110.438**

Table 6. (cont.) Fuel consumption [PJ] in 1.A.2.c category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	50.115	48.485	45.458	27.959	28.709	30.107	27.683	28.785	46.079	44.061	49.706	49.273
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	9.464	8.481	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762	12.043	14.220
Fuel wood and wood waste	0.000	0.000	0.001	0.153	0.102	0.165	0.000	0.121	0.000	0.058	0.058	0.053
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	10.332	10.968	10.093	9.914	8.749	6.901	7.851	6.875	7.233	8.575	8.137	7.371
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.480	0.480	0.280	0.240	0.000	0.040	0.040	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.029	1.710	1.739	1.568	1.881	1.454	2.964	1.938	1.169	0.884	0.827	1.340
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092	0.138	0.138
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.000	0.044
Aviation gasoline												
Jet kerosene	0.000	0.043	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.022	4.729	4.217	4.303	3.877	3.749	4.047	3.706	3.664	4.516	4.132	3.578
Fuel oil	13.520	7.360	7.640	7.080	7.320	3.920	3.920	3.600	0.640	1.120	0.640	0.720
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	23.315	20.543	20.741	21.830	22.424	18.266	21.335	22.473	19.157	20.889	17.177	15.890
Coke oven gas	0.050	0.150	0.285	0.635	0.606	0.608	0.547	0.658	0.654	0.483	0.627	0.616
Blast furnace gas	0.011	0.008	0.004	0.013	0.019	0.006	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	38.337	33.155	32.921	33.453	33.621	25.975	29.342	29.779	23.461	26.705	22.087	20.370
Gaseous fuels	9.464	8.481	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762	12.043	14.220
Solid fuels	50.205	50.353	47.486	30.175	31.215	32.175	31.194	31.381	47.902	45.428	51.160	51.229
Other fuels	10.332	10.968	10.093	9.914	8.749	6.901	7.851	6.875	7.233	8.575	8.137	7.371
Biomass	0.000	0.000	0.001	0.153	0.102	0.165	0.000	0.121	0.000	0.058	0.058	0.053
Total	**108.338**	**102.957**	**97.700**	**80.152**	**81.185**	**73.320**	**77.440**	**76.927**	**86.633**	**90.528**	**93.485**	**93.243**

Table 7. Fuel consumption [PJ] in 1.A.2.d category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	1.639	1.940	1.548	1.741	1.379	4.524	3.836	22.318	22.233	23.979	18.936	17.528
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563	1.007
Fuel wood and wood waste	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476	15.545
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.331	0.247	0.257	0.285	0.257	0.314	0.285	0.285	0.257	0.143	0.086	0.000
Liquid petroleum gas (LPG)	0.047	0.047	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.092	0.184	0.092
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.086	0.000	0.000	0.000	0.000
Diesel oil	0.087	0.087	0.043	0.085	0.043	0.043	0.085	0.128	0.596	0.980	1.108	0.809
Fuel oil	1.246	1.166	1.280	1.200	1.320	1.560	1.400	2.360	1.040	1.040	1.320	1.320
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.004	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.001	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.003	0.003	0.003	0.014	0.002	0.000	0.000	0.000	0.004	0.000	0.000	0.000
Fuels												
Liquid fuels	1.380	1.300	1.369	1.331	1.409	1.692	1.531	2.620	1.682	2.112	2.612	2.221
Gaseous fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563	1.007
Solid fuels	1.976	2.192	1.811	2.043	1.640	4.841	4.123	22.605	22.495	24.122	19.022	17.528
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476	15.545
Total	**3.811**	**3.858**	**3.282**	**3.435**	**3.075**	**8.179**	**7.514**	**40.894**	**40.875**	**43.802**	**38.673**	**36.301**

Table 7. (cont.) Fuel consumption [PJ] in 1.A.2.d category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	15.696	15.564	14.317	14.050	13.797	13.430	11.592	9.452	7.850	8.515	9.950	11.096
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.211	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.834	5.030	4.585
Fuel wood and wood waste	15.938	15.138	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.171	19.117	18.686
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.049	0.069
Industrial wastes	0.000	0.011	0.106	0.109	0.150	0.125	0.123	0.118	0.137	0.155	0.158	0.169
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.040	0.040	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.029	0.029	0.029	0.057	0.029	0.029	0.029	0.029	0.029	0.000	0.029	0.000
Liquid petroleum gas (LPG)	0.138	0.092	0.046	0.046	0.092	0.046	0.092	0.184	0.046	0.092	0.092	0.092
Motor gasoline	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline												
Jet kerosene	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.596	0.469	0.426	0.469	0.469	0.341	0.383	0.426	0.298	0.298	0.256	0.213
Fuel oil	1.360	1.480	1.560	1.600	1.680	1.600	1.600	1.720	1.640	1.600	1.640	1.680
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	2.180	2.041	2.032	2.203	2.241	2.027	2.115	2.330	1.984	1.990	1.988	1.985
Gaseous fuels	1.211	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.834	5.030	4.585
Solid fuels	15.725	15.593	14.346	14.107	13.826	13.459	11.621	9.481	7.879	8.515	9.979	11.096
Other fuels	0.000	0.011	0.106	0.109	0.150	0.125	0.123	0.118	0.137	0.155	0.158	0.169
Biomass	15.938	15.138	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.189	19.166	18.755
Total	**35.054**	**34.228**	**34.567**	**36.463**	**37.831**	**36.510**	**36.214**	**34.660**	**34.551**	**34.683**	**36.321**	**36.590**

Table 8. Fuel consumption [PJ] in 1.A.2.e category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	25.199	31.694	31.914	35.940	32.724	55.643	53.801	73.024	88.777	78.207	64.659	46.327
Lignite	0.085	0.104	0.058	0.019	0.018	0.369	0.195	0.265	0.380	0.250	0.317	0.237
Hard coal briquettes (patent fuels)	0.023	0.023	0.000	0.000	0.000	0.205	0.205	0.059	0.029	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839	15.051	12.927	10.694	9.255
Fuel wood and wood waste	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.101	0.069
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.020
Industrial wastes	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.080	0.040	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	3.609	3.569	3.335	2.936	2.651	3.249	2.708	2.565	3.192	2.850	2.081	1.710
Liquid petroleum gas (LPG)	0.047	0.047	0.046	0.046	0.046	0.046	0.092	0.138	0.184	0.184	0.276	0.460
Motor gasoline	0.448	0.269	0.132	0.088	0.132	0.176	0.132	0.176	0.176	0.044	0.088	0.044
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086	0.000	0.000	0.000	0.000
Diesel oil	2.123	1.560	1.235	1.022	0.895	1.193	1.065	0.895	5.410	5.155	6.773	7.412
Fuel oil	1.849	1.648	1.640	1.480	1.320	3.280	3.920	6.120	2.720	2.400	2.680	2.280
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.336	0.120	0.111	0.125	0.124	0.102	0.003	0.025	0.004	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.027	0.032	0.051	0.014	0.001	0.001	0.000	0.000	0.003	0.000	0.000	0.000
Fuels												
Liquid fuels	4.468	3.524	3.053	2.636	2.393	4.695	5.209	7.415	8.570	7.863	9.857	10.196
Gaseous fuels	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839	15.051	12.927	10.694	9.255
Solid fuels	29.279	35.542	35.469	39.034	35.518	59.569	56.912	75.938	92.385	81.307	67.057	48.274
Other fuels	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000	0.000	0.000	0.000	0.000
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.104	0.089
Total	**35.829**	**41.084**	**40.583**	**43.749**	**40.353**	**67.589**	**69.360**	**87.274**	**116.100**	**102.172**	**87.712**	**67.814**

Table 8. (cont.) Fuel consumption [PJ] in 1.A.2.e category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	43.417	40.020	41.803	39.030	36.095	35.894	30.864	31.182	26.777	25.813	25.906	25.613
Lignite	0.191	0.149	0.192	0.175	0.129	0.092	0.074	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950	21.610	22.128
Fuel wood and wood waste	0.049	0.062	0.060	0.323	0.373	0.214	0.239	0.164	0.365	0.192	0.441	0.534
Biogas	0.063	0.042	0.037	0.063	0.074	0.068	0.072	0.084	0.094	0.109	0.101	0.145
Industrial wastes	0.001	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.029	1.368	1.539	1.340	1.226	0.969	0.855	0.912	0.656	0.656	0.627	0.542
Liquid petroleum gas (LPG)	0.690	0.874	1.426	1.380	1.564	1.426	1.196	0.920	1.012	0.966	0.828	0.782
Motor gasoline	0.132	0.044	0.088	0.088	0.000	0.044	0.044	0.044	0.044	0.044	0.044	0.000
Aviation gasoline												
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	7.285	7.199	6.816	6.816	6.134	5.368	4.473	4.047	4.473	3.110	2.854	2.343
Fuel oil	2.520	2.720	2.960	3.040	3.280	3.160	2.920	2.760	2.000	1.440	1.240	1.360
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	10.627	10.837	11.290	11.324	10.978	9.998	8.633	7.771	7.529	5.560	4.966	4.485
Gaseous fuels	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950	21.610	22.128
Solid fuels	43.637	41.557	43.534	40.545	37.450	36.955	31.793	32.094	27.433	26.469	26.533	26.155
Other fuels	0.001	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.112	0.104	0.097	0.386	0.447	0.282	0.311	0.248	0.459	0.301	0.542	0.679
Total	**64.871**	**63.875**	**67.411**	**67.330**	**65.039**	**64.691**	**59.360**	**60.727**	**56.146**	**53.280**	**53.651**	**53.447**

Table 9. Fuel consumption [PJ] in 1.A.2.f category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	158.685	147.564	111.152	109.155	98.584	157.660	157.182	160.662	192.053	169.694	131.898	109.929
Lignite	1.052	0.841	0.331	0.714	0.274	0.815	0.392	0.783	0.749	0.574	0.470	0.316
Hard coal briquettes (patent fuels)	0.233	0.139	0.088	0.029	0.000	0.000	0.000	0.000	0.030	0.000	0.000	0.000
Brown coal briquettes	0.123	0.089	0.060	0.060	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	52.767	50.455	40.219	34.460	36.058	39.907	38.844	40.694	40.860	41.717	44.737	40.269
Fuel wood and wood waste	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.978	6.529	8.199	8.237	8.606
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.001	0.002	0.000
Industrial wastes	0.464	0.504	0.090	0.035	0.401	0.548	1.738	2.491	2.819	1.180	2.300	2.045
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	1.527	0.965	0.000	0.000	0.000	0.000	0.000	0.000	0.120	1.840	1.720	0.760
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	39.594	37.976	26.732	21.345	22.115	21.118	18.039	15.732	16.758	12.624	12.112	10.886
Liquid petroleum gas (LPG)	0.189	0.142	0.138	0.092	0.092	0.092	0.230	0.184	0.184	0.506	0.690	1.104
Motor gasoline	1.747	1.613	1.100	1.276	0.880	0.924	0.528	1.012	0.616	2.288	0.748	0.352
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.043	0.172	0.215	0.172	0.559	0.258	0.301	0.258	0.215
Diesel oil	15.817	14.430	11.289	9.542	8.008	8.434	8.051	9.542	20.193	18.232	15.123	13.079
Fuel oil	9.767	10.008	6.320	4.640	5.960	7.280	8.040	11.120	6.960	7.400	10.440	9.480
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	5.183	4.599	3.774	2.804	2.075	1.708	0.537	0.935	0.531	0.363	0.999	0.810
Blast furnace gas	0.140	0.118	0.101	0.106	0.079	0.108	0.120	0.053	0.053	0.036	0.010	0.005
Gas works gas	5.382	4.817	4.002	3.593	2.918	2.414	2.152	1.804	1.034	0.502	0.331	0.304
Fuels												
Liquid fuels	29.047	27.157	18.847	15.593	15.112	16.945	17.021	22.417	28.331	30.567	28.979	24.990
Gaseous fuels	52.767	50.455	40.219	34.460	36.058	39.907	38.844	40.694	40.860	41.717	44.737	40.269
Solid fuels	210.393	196.143	146.240	137.806	126.085	183.863	178.462	180.009	211.248	183.833	145.860	122.290
Other fuels	0.464	0.504	0.090	0.035	0.401	0.548	1.738	2.491	2.819	1.180	2.300	2.045
Biomass	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.980	6.530	8.200	8.239	8.606
Total	**302.785**	**283.728**	**212.377**	**193.867**	**182.733**	**246.291**	**239.479**	**250.591**	**289.788**	**265.497**	**230.115**	**198.200**

Table 9. (cont.) Fuel consumption [PJ] in 1.A.2.f category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.010	73.100	60.843	55.377	54.257	51.254	49.569	60.408	51.067	37.446	39.399	44.522
Lignite	0.267	0.158	0.125	0.055	0.009	0.009	0.019	0.000	0.072	0.163	0.313	0.646
Hard coal briquettes (patent fuels)	0.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029
Brown coal briquettes	0.040	0.020	0.020	0.040	0.040	0.040	0.040	0.060	0.120	0.100	0.080	0.200
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	46.522	50.177	52.506	56.740	60.829	62.287	65.056	66.426	66.574	64.617	68.129	68.610
Fuel wood and wood waste	10.111	10.991	12.592	11.999	12.445	12.028	11.167	13.030	13.999	14.035	17.759	19.784
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.000	0.000
Industrial wastes	2.624	2.337	2.595	3.984	3.491	4.413	8.840	6.906	8.560	9.108	10.539	11.799
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.003	0.013	0.717	1.620	1.777	0.378	4.419	4.512	5.017
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.001	0.029	0.123	1.338
Other petroleum products	0.240	0.040	0.080	0.080	0.120	0.080	0.120	0.080	0.080	0.040	0.120	0.120
Petroleum coke	0.000	0.000	0.000	4.416	3.232	7.072	3.584	1.568	1.152	2.752	1.792	0.064
Coke	12.310	7.210	6.326	6.640	5.784	3.220	3.904	5.329	3.361	2.735	2.906	2.906
Liquid petroleum gas (LPG)	1.978	1.840	2.714	2.622	2.990	2.208	1.610	1.472	1.564	1.426	1.564	1.564
Motor gasoline	0.308	0.176	0.132	0.220	0.176	0.176	0.220	0.132	0.088	0.176	0.264	0.132
Aviation gasoline												
Jet kerosene	0.129	0.129	0.086	0.043	0.043	0.086	0.129	0.086	0.043	0.043	0.043	0.043
Diesel oil	12.312	11.758	11.843	12.353	12.311	12.567	12.866	11.716	11.247	10.906	10.480	11.247
Fuel oil	7.480	7.400	7.440	7.240	7.360	7.000	5.520	3.600	3.680	3.240	3.320	3.120
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.417	0.917	0.783	0.862	1.941	1.480	1.528	1.673	1.570	1.266	1.634	1.890
Blast furnace gas	0.011	0.003	0.003	0.000	0.013	0.013	0.000	0.000	0.000	0.007	0.009	0.012
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	22.447	21.343	22.295	26.974	26.232	29.189	24.049	18.654	17.854	18.583	17.583	16.290
Gaseous fuels	46.522	50.177	52.506	56.740	60.829	62.287	65.056	66.426	66.574	64.617	68.129	68.610
Solid fuels	107.114	81.408	68.100	62.974	62.044	56.016	55.060	67.470	56.190	41.717	44.341	50.205
Other fuels	2.624	2.337	2.595	3.987	3.504	5.130	10.460	8.683	8.938	13.527	15.051	16.816
Biomass	10.111	10.991	12.592	11.999	12.445	12.028	11.169	13.036	14.001	14.067	17.882	21.122
Total	**188.818**	**166.256**	**158.088**	**162.674**	**165.054**	**164.650**	**165.794**	**174.269**	**163.557**	**152.511**	**162.986**	**173.043**

Table 10. Fuel consumption [PJ] in 1.A.4.a category

Fuels	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Hard coal	207.331	163.252	54.547	62.166	54.214	50.334	34.666	34.267	25.608	18.696	16.200	15.104
Lignite	0.540	0.390	0.000	0.000	0.000	0.017	0.091	0.025	0.026	0.009	0.009	0.009
Hard coal briquettes (patent fuels)	5.748	1.581	0.000	0.000	0.000	0.000	0.000	0.322	0.000	0.000	0.000	0.000
Brown coal briquettes	0.548	0.476	0.420	0.000	0.000	1.780	1.820	1.940	0.240	0.540	0.120	0.520
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769	37.697
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	12.312	11.719	11.560	10.046	9.028	8.437	8.553
Biogas	0.084	0.123	0.379	0.187	0.206	0.062	0.249	0.423	0.579	0.599	0.648	0.663
Industrial wastes	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003	0.004
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.640
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	80.500	77.452	34.713	28.264	40.068	33.402	27.332	25.878	26.220	28.643	13.481	12.227
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	1.334	0.782	0.782	1.748	1.564	2.070
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.980	4.260	6.177	7.583
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	1.417	1.135	1.224	1.088	0.877	0.428	0.123	0.053	0.034	0.127	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.937	0.330	0.312	0.554	0.576	0.091	0.014	0.014	0.014	0.072	0.041	0.005
Fuels												
Liquid fuels	0.000	0.000	0.000	0.000	0.000	0.000	1.334	0.782	1.762	6.088	7.741	10.293
Gaseous fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769	37.697
Solid fuels	297.022	244.616	91.216	92.072	95.735	86.052	64.046	62.499	52.142	48.087	29.851	27.865
Other fuels	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003	0.004
Biomass	0.084	0.123	0.379	0.187	0.206	12.374	11.968	11.983	10.625	9.627	9.085	9.216
Total	**312.319**	**257.484**	**105.886**	**103.317**	**107.142**	**110.326**	**87.010**	**88.524**	**83.424**	**88.058**	**79.449**	**85.075**

Table 10. (cont.) Fuel consumption [PJ] in 1.A.4.a category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	13.355	13.460	21.676	21.539	22.502	25.405	29.320	25.291	28.763	31.393	36.517	31.093
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.475	0.702
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.380	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	38.567	49.971	61.001	67.057	69.570	68.410	63.517	65.489	71.250	75.746	83.433	78.138
Fuel wood and wood waste	8.514	5.736	5.747	5.752	6.028	6.171	4.580	5.482	5.012	7.098	7.929	7.818
Biogas	0.678	0.860	0.683	0.700	0.558	0.343	0.505	0.291	0.876	0.848	0.994	1.078
Industrial wastes	0.004	0.091	0.092	0.060	0.002	0.022	0.000	0.000	0.000	0.092	0.019	0.011
Municipal waste - non-biogenic fraction	0.020	0.000	0.009	0.011	0.000	0.000	0.000	0.000	0.037	0.000	0.000	0.035
Municipal waste – biogenic fraction	0.019	0.000	0.010	0.014	0.013	0.030	0.028	0.029	0.008	0.000	0.000	0.000
Other petroleum products	0.880	3.000	0.360	1.720	2.000	0.000	0.000	0.000	0.000	0.000	0.314	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	8.265	3.819	8.123	8.180	5.928	2.679	2.879	2.594	2.081	2.138	2.109	1.824
Liquid petroleum gas (LPG)	2.300	3.266	3.358	5.520	5.014	4.600	5.244	4.922	4.462	3.772	3.404	3.312
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline												
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	13.249	14.910	18.957	16.657	14.186	13.121	23.089	22.706	22.706	21.556	26.966	25.219
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.040
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.001	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.005	0.004	0.003	0.004	0.003	0.003	0.003	0.014	0.018	0.017	0.017	0.018
Fuels												
Liquid fuels	16.429	21.176	22.675	23.897	21.200	17.721	28.333	27.628	27.168	25.328	30.764	28.571
Gaseous fuels	38.567	49.971	61.001	67.057	69.570	68.410	63.517	65.489	71.250	75.746	83.433	78.138
Solid fuels	22.005	17.283	29.822	29.723	28.433	28.087	32.203	27.900	30.863	33.550	40.119	33.637
Other fuels	0.024	0.091	0.101	0.071	0.002	0.022	0.000	0.000	0.037	0.092	0.019	0.046
Biomass	9.211	6.596	6.440	6.466	6.599	6.544	5.113	5.802	5.896	7.946	8.923	8.896
Total	**86.236**	**95.117**	**120.039**	**127.214**	**125.804**	**120.784**	**129.166**	**126.819**	**135.214**	**142.662**	**163.258**	**149.288**

Table 11. Fuel consumption [PJ] in 1.A.4.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	543.550	489.779	272.689	358.521	351.542	372.347	309.920	305.701	326.681	271.980	213.584	223.330
Lignite	2.911	1.180	0.526	0.042	0.000	2.956	4.403	4.279	3.420	2.626	1.772	1.286
Hard coal briquettes (patent fuels)	17.199	4.742	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	1.627	1.427	1.240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268	135.995
Fuel wood and wood waste	33.615	32.351	34.335	27.721	33.969	106.000	104.715	105.000	101.000	100.000	100.700	95.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	31.927	30.722	14.866	12.110	26.732	30.752	27.788	27.503	28.044	32.775	19.950	18.525
Liquid petroleum gas (LPG)	6.955	7.664	1.702	1.012	1.840	6.072	8.970	12.834	16.100	18.400	18.400	19.320
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000										
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.130	6.390	8.520	9.713
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	15.996	15.134	15.155	13.706	11.334	6.779	3.560	1.723	0.226	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	4.655	3.697	3.088	1.307	0.739	0.431	0.418	0.258	0.222	0.181	0.164	0.163
Fuels												
Liquid fuels	6.955	7.664	1.702	1.012	1.840	6.072	8.970	12.834	18.230	24.790	26.920	29.033
Gaseous fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268	135.995
Solid fuels	617.865	546.681	307.564	385.686	390.347	413.265	346.089	339.464	358.593	307.562	235.470	243.304
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	33.615	32.351	34.335	27.721	33.969	106.000	104.715	105.000	101.000	100.000	100.700	95.000
Total	**761.015**	**694.315**	**465.805**	**548.093**	**567.368**	**666.927**	**611.445**	**616.857**	**620.880**	**582.374**	**501.358**	**503.332**

Table 11. (cont.) Fuel consumption [PJ] in 1.A.4.b category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	166.013	184.731	171.709	164.455	175.723	203.593	236.664	216.419	234.225	233.649	284.655	230.777
Lignite	1.169	1.373	1.482	1.605	1.919	2.006	2.168	1.972	2.565	2.219	4.035	3.593
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857	148.427	135.471
Fuel wood and wood waste	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500	112.746	115.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	11.685	11.970	8.550	8.550	7.125	2.993	3.278	1.425	1.140	5.928	6.527	5.700
Liquid petroleum gas (LPG)	20.240	20.700	21.390	25.300	23.920	23.000	20.700	21.160	20.700	20.240	24.840	23.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline												
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	17.040	21.300	22.791	22.791	21.300	19.170	19.170	15.336	11.502	7.881	4.473	4.686
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.158	0.151	0.134	0.128	0.113	0.095	0.099	0.081	0.071	0.069	0.067	0.059
Fuels												
Liquid fuels	37.280	42.000	44.181	48.091	45.220	42.170	39.870	36.496	32.202	28.121	29.313	27.686
Gaseous fuels	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857	148.427	135.471
Solid fuels	179.025	198.225	181.875	174.738	184.880	208.687	242.209	219.897	238.001	241.865	295.284	240.129
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500	112.746	115.000
Total	**438.916**	**478.462**	**457.649**	**453.533**	**459.836**	**486.668**	**525.265**	**491.015**	**504.153**	**507.343**	**585.770**	**518.286**

Table 12. Fuel consumption [PJ] in 1.A.4.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	38.607	38.489	36.365	57.356	62.959	62.501	60.542	58.583	62.611	52.483	46.050	49.162
Lignite	1.581	1.139	0.844	1.018	0.911	0.814	1.642	1.698	1.299	1.292	1.419	1.097
Hard coal briquettes (patent fuels)	0.598	0.527	0.645	0.147	0.088	0.059	0.059	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.106	0.106	0.040	0.020	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.869	0.476
Fuel wood and wood waste	0.039	0.113	0.039	0.278	0.583	20.057	18.367	18.500	17.567	17.000	17.100	17.100
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.786	1.754	1.568	1.169	0.684	0.570	4.019	4.019	4.104	5.130	5.700	5.130
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.460	0.690	1.150	1.380	1.380	1.610
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.660	1.100	1.100	1.100	1.188	1.100	1.320
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	54.817	52.867	53.591	51.631	60.236	74.465	80.812	84.859	93.720	108.715	98.406	100.749
Fuel oil	10.277	9.481	9.231	8.179	7.133	18.066	22.052	13.957	8.242	10.974	8.862	8.674
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.012	0.010	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.001	0.002	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000
Fuels												
Liquid fuels	65.094	62.348	62.822	59.810	67.369	93.191	104.424	100.606	104.212	122.257	109.748	112.353
Gaseous fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.869	0.476
Solid fuels	42.690	42.027	39.465	59.712	64.662	63.946	66.262	64.300	68.014	58.905	53.170	55.389
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
Biomass	0.039	0.113	0.039	0.278	0.583	20.057	18.367	18.500	17.567	17.000	17.100	17.106
Total	**108.330**	**104.933**	**102.774**	**120.075**	**132.669**	**177.326**	**189.265**	**183.649**	**190.221**	**198.733**	**180.887**	**185.330**

Table 12. (cont.) Fuel consumption [PJ] in 1.A.4.c category

Fuels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	33.232	36.976	30.820	29.693	31.728	35.673	42.074	37.748	41.640	41.538	50.605	41.488
Lignite	0.939	1.236	1.395	1.528	2.086	2.188	2.489	2.125	2.770	2.485	1.667	1.337
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.059	0.029	0.029	0.059
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.040	0.040	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.536	0.777	0.914	1.197	1.182	1.084	1.492	1.841	1.900	1.577	1.486	1.531
Fuel wood and wood waste	17.100	19.043	19.010	19.017	19.878	19.038	19.977	19.060	19.024	19.030	21.088	23.931
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.012	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.013	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	3.420	3.705	2.850	2.850	1.995	1.140	1.425	0.855	0.827	0.855	0.941	0.998
Liquid petroleum gas (LPG)	1.840	2.300	2.760	3.220	3.220	3.220	2.300	2.300	2.346	2.070	2.300	2.346
Motor gasoline	1.364	0.924	0.264	0.308	0.220	0.264	0.308	0.220	0.220	0.220	0.044	0.044
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	111.186	103.859	103.518	104.370	106.457	108.630	80.940	74.550	74.550	72.420	72.292	72.931
Fuel oil	8.428	8.221	6.805	8.195	8.606	9.455	3.846	3.397	3.474	4.342	3.516	3.953
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels												
Liquid fuels	122.818	115.304	113.347	116.093	118.503	121.569	87.394	80.467	80.590	79.052	78.152	79.274
Gaseous fuels	0.536	0.777	0.914	1.197	1.182	1.084	1.492	1.841	1.900	1.577	1.486	1.531
Solid fuels	37.591	41.917	35.065	34.071	35.838	39.001	46.028	40.728	45.336	44.947	53.242	43.882
Other fuels	0.012	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	17.113	19.053	19.010	19.017	19.878	19.038	19.977	19.060	19.024	19.030	21.088	23.931
Total	**178.070**	**177.062**	**168.336**	**170.378**	**175.401**	**180.692**	**154.891**	**142.096**	**146.850**	**144.606**	**153.968**	**148.618**

Table 13. CO2 EFs [kg/GJ] for coal and lignite in 1.A.1.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	95.35	95.33	95.25	95.11	94.97	94.97	94.95	94.98	94.96	94.95	94.91	94.92
Lignite	111.39	110.82	109.87	109.76	109.28	109.90	110.03	108.95	109.04	108.90	108.41	108.31
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.97	94.97	94.94	94.93	94.98	94.95	94.92	94.97	94.98	94.90	94.97	95.01
Lignite	108.72	108.21	108.64	108.56	108.84	107.83	107.88	107.54	107.20	107.52	108.62	109.56

Table 14. CO2 EFs [kg/GJ] for coal and lignite in 1.A.1.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.64	94.76	94.64	94.81	94.72	94.86	94.64	94.59	94.58	94.55
Lignite												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.62	94.57	94.64							94.64	94.64	94.64
Lignite												109.53

Table 15. CO2 EFs [kg/GJ] for coal and lignite in 1.A.1.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	95.30	95.37	94.70	94.73	94.65	94.81	94.71	94.86	94.60	94.55	94.55	94.51
Lignite	111.39	110.71	103.84	105.02	106.21	104.86	103.76	108.93	109.01	105.71	108.39	103.45
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.59	94.54	94.51	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.67	94.69
Lignite	104.58	105.50	104.33	105.94	105.96	105.87	105.62	106.15	106.87	106.39	108.60	109.53

Table 16. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.54
Lignite				104.75						106.72		
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.62	94.57	94.55	94.53	94.59	94.33	94.44	94.48	94.76	95.10	95.53	94.61
Lignite												

Table 17. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.52	94.37	94.49	94.53	94.59	94.43	94.43	93.51				94.71
Lignite												

Table 18. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite	105.16	104.93	103.84	104.75	106.72	105.13	104.14	108.93	109.01	105.66	108.39	103.47
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.56	94.55	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.68	94.70
Lignite												

Table 19. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.d category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.68	94.70
Lignite												

Table 20. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.e category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.55
Lignite	105.14	104.92	104.14	104.75	106.72	104.90	103.84	108.93	109.01	105.67	108.39	103.40
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.44	94.69	94.75	94.67	94.70
Lignite	104.57	105.47	104.38	105.87	105.85	105.91	105.71					

Table 21. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.f category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.55
Lignite	105.15	104.93	103.89	105.15	106.18	104.84	103.66	108.93	103.02	105.68	108.39	103.40
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.46	94.69	94.75	94.68	94.70
Lignite	104.62	105.54	104.33	106.04	106.72	106.72	104.75	0.00	106.72	106.49	108.60	109.53

Table 22. CO2 EFs [kg/GJ] for coal and lignite in 1.A.4.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.71	94.64	94.80
Lignite	111.07	110.71				108.93	110.02	109.72	108.16	106.72	106.72	106.72
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.84	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.61	94.06
Lignite											109.72	109.61

Table 23. CO2 EFs [kg/GJ] for coal and lignite in 1.A.4.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.72	94.65	94.80
Lignite	111.07	110.71	109.64	109.40	0.00	108.61	109.92	108.97	108.20	108.42	108.46	108.59
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.85	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.61	94.06
Lignite	108.78	108.55	107.94	108.96	109.67	108.09	108.14	108.93	107.15	107.25	109.70	109.61

Table 24. CO2 EFs [kg/GJ] for coal and lignite in 1.A.4.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.71	94.65	94.80
Lignite	111.07	110.71	109.61	109.01	108.12	108.61	109.92	108.97	108.19	108.41	108.47	108.60
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.84	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.61	94.06
Lignite	108.76	108.54	107.93	108.98	109.67	108.09	108.14	108.93	107.15	107.25	109.71	109.61

Table 25. CO_2 EFs [kg/GJ] applied for other fuels in the years 1988-2011 for stationary sources in 1.A.1, 1.A.2 and 1.A.4 categories [IPCC 1997, IPCC 2006]

Fuels	**EF**
Hard coal briquettes (patent fuels)	92.71
Brown coal briquettes	92.71
Crude oil	72.60
Natural gasl	55.82
Fuel wood and wood waste	*109.76*
Biogas	*54.33*
Industrial wastes	*140.14*
Municipal waste - non-biogenic fraction	89.87
Municipal waste – biogenic fraction	*98.00*
Other petroleum products	72.60
Petroleum coke	99.83
Coke	106.00
Liquid petroleum gas (LPG)	62.44
Motor gasoline	68.61
Aviation gasoline	*69.30*
Jet kerosene	70.79
Diesel oil	73.33
Fuel oil	76.59
Feedstocks	72.60
Refinery gas	66.07
Coke oven gas	47.43
Blast furnace gas	240.79
Gas works gas	*44.18*

EF from [IPCC 2006] are marked in italics.

Table 26. CH_4 EFs [kg/GJ] applied for the years 1988-2011 for stationary sources [IPCC 2006]

Fuels	1.A.1	1.A.2	1.A.4.a	1.A.4.b-c
Hard coal	0.0010	0.0100	0.0100	0.3000
Lignite	0.0010	0.0100	0.0100	0.3000
Hard coal briquettes (patent fuels)	0.0010	0.0100	0.0100	0.3000
Brown coal briquettes	0.0010	0.0100	0.0100	0.3000
Crude oil	0.0030	0.0030	0.0100	0.0100
Natural gasl	0.0010	0.0010	0.0050	0.0050
Fuel wood and wood waste	0.0300	0.0300	0.3000	0.3000
Biogas	0.0010	0.0010	0.0050	0.0050
Industrial wastes	0.0300	0.0300	0.3000	0.3000
Municipal waste - non-biogenic fraction	0.0300	0.0300	0.3000	0.3000
Municipal waste – biogenic fraction	0.0300	0.0300	0.3000	0.3000
Other petroleum products	0.0030	0.0030	0.0100	0.0100
Petroleum coke	0.0030	0.0030	0.0100	0.0100
Coke	0.0010	0.0100	0.0100	0.3000
Liquid petroleum gas (LPG)	0.0010	0.0010	0.0050	0.0050
Motor gasoline	0.0030	0.0030	0.0100	0.0100
Aviation gasoline	0.0030	0.0030	0.0100	0.0100
Jet kerosene	0.0030	0.0030	0.0100	0.0100
Diesel oil	0.0030	0.0030	0.0100	0.0100
Fuel oil	0.0030	0.0030	0.0100	0.0100
Feedstocks	0.0030	0.0030	0.0100	0.0100
Refinery gas	0.0010	0.0010	0.0050	0.0050
Coke oven gas	0.0010	0.0010	0.0050	0.0050
Blast furnace gas	0.0010	0.0010	0.0050	0.0050
Gas works gas	0.0010	0.0010	0.0050	0.0050

Table 27. N_2O EFs [kg/GJ] applied for the years 1988-2011 for stationary sources in 1.A.1, 1.A.2 and 1.A.4 categories [IPCC 2006]

Fuels	EF
Hard coal	0.0015
Lignite	0.0015
Hard coal briquettes (patent fuels)	0.0015
Brown coal briquettes	0.0015
Crude oil	0.0006
Natural gasl	0.0001
Fuel wood and wood waste	0.0040
Biogas	0.0001
Industrial wastes	0.0040
Municipal waste - non-biogenic fraction	0.0040
Municipal waste – biogenic fraction	0.0040
Other petroleum products	0.0006
Petroleum coke	0.0006
Coke	0.0015
Liquid petroleum gas (LPG)	0.0001
Motor gasoline	0.0006
Aviation gasoline	0.0006
Jet kerosene	0.0006
Diesel oil	0.0006
Fuel oil	0.0006
Feedstocks	0.0006
Refinery gas	0.0001
Coke oven gas	0.0001
Blast furnace gas	0.0001
Gas works gas	0.0001

Annex 3. Calculation of CO_2 process emission from ammonia production

Activity data	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
natural gas	[10^3 m3]	2 184	2 230	1 447	1 447	1 337	1 401	1 688	1 942	1 907	1 937	1 789	1 587
natural gas	TJ	76 413	77 862	50 625	50 911	47 044	49 522	60 161	69 070	67 919	69 049	64 163	56 105
coke oven gas	[10^3 m3]	183 960	113 672	30 560									
coke oven gas	TJ	3 204	1 970	537									
CO_2 emission from natural gas use	Gg	4 205	4 294	2 786	2 786	2 575	2 698	3 251	3 740	3 672	3 729	3 444	3 055
CO_2 emission from coke oven gas use	Gg	153	94	26									
Total CO2 emission	Gg	4 358	4 388	2 811	2 786	2 575	2 698	3 251	3 740	3 672	3 729	3 444	3 055
Ammonia production	Gg	2389.353	2433.726	1531.552	1560.883	1480.798	1630.946	1945.470	2248.317	2185.188	2251.616	2047.948	1784.726
Implied EF of CO_2 process emission	[MgCO2/ Mg NH3]	1.82	1.80	1.84	1.78	1.74	1.65	1.67	1.66	1.68	1.66	1.68	1.71

Activity data	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
natural gas	[10^3 m3]	1 965	1 873	1 455	2 122	2 177	2 310	2 197	2 186	2	1 814	1 881	2 061
natural gas	TJ	70 483	68 096	52 144	76 053	77 817	82 219	78 591	78 072	79 351	63 478	67 234	73 798
coke oven gas	[10^3 m3]												
coke oven gas	TJ												
CO_2 emission from natural gas use	Gg	3783	3607	2802	4086	4191	4448	4230	4209	4276	3493	3623	3 968
CO_2 emission from coke oven gas use	Gg												
Total CO2 emission	Gg	3783	3607	2802	4086	4191	4448	4230	4209	4276	3493	3623	3 968
Ammonia production	Gg	2243.108	2103.805	1594.797	2246.505	2451.557	2523.790	2326.621	2417.543	2485.148	2010.891	2059.437	2321,849
Implied EF of CO_2 process emission	[MgCO2/ Mg NH3]	1.69	1.71	1.76	1.82	1.71	1.76	1.82	1.74	1.72	1.74	1.76	1,71

Annex 4. Energy balance data for main fuels in 2011

Energy balances in 2011 for several main fuels: lignite, natural gas, coke oven gas and blast furnace gas are given below. Similar balance data for hard coal are presented in Chapter 1.4.

Lignite consumption

National fuel balance	Lignite - Eurostat	
	10^3 Mg	TJ
In	62 917	526 116
From national sources	62 841	525 476
1) Indigenous production	62 841	525 476
2) Transformation output or return	0	0
3) Stock decrease	0	0
Import	76	640
Out	62 917	526 116
National consumption	62 708	525 013
1) Transformation input	61 800	517 019
a) input for secondary fuel production	0	0
b) fuel combustion	61 800	517 019
2) Direct consumption	908	7 994
Non-energy use	0	0
Combusted directly	908	7 994
Combusted in Poland	62 708	525 013
Stock increase	64	535
Export	145	1 212
Losses and statistical differences	0	-644

Net calorific value	MJ/kg	8.37

Natural gas consumption

National fuel balance	Natural gas - Eurostat
	TJ
In	565 772
From national sources	161 186
1) Indigenous production	161 186
2) Transformation output or return	0
3) Stock decrease	0
Import	404 586
Out	565 772
National consumption	538 621
1) Transformation input	66 865
a) input for secondary fuel production	0
b) fuel combustion	66 865
2) Direct consumption	471 756
Non-energy use	75 942
Combusted directly	395 814
Combusted in Poland	462 679
Stock increase	27 348
Export	989
Losses and statistical differences	-1 186

Coke oven gas consumption

National fuel balance	Coke Oven Gas - Eurostat
	TJ
In	0
From national sources	0
1) Indigenous production	0
2) Transformation output or return	0
3) Stock decrease	0
Import	0
Out	69 643
National consumption	67 517
1) Transformation input	21 972
a) input for secondary fuel production	0
b) fuel combustion	21 972
2) Direct consumption	45 545
Non-energy use	0
Combusted directly	45 545
Combusted in Poland	67 517
Stock increase	0
Export	0
Losses and statistical differences	2 126

Blast furnace gas consumption

National fuel balance	Blast furnace gas - Eurostat
	TJ
In	22 271
From national sources	22 271
1) Indigenous production	0
2) Transformation output or return	22 271
3) Stock decrease	0
Import	0
Out	22 271
National consumption	22 271
1) Transformation input	10 671
a) input for secondary fuel production	0
b) fuel combustion	10 671
2) Direct consumption	11 600
Non-energy use	0
Combusted directly	11 600
Combusted in Poland	22 271
Stock increase	0
Export	0
Losses and statistical differences	0

Annex 5. Quality Assurance and Quality Control Plan

Here are presented the basic elements of QA/QC plan which are to be implemented and co-ordinated by the National Centre for Emission Balancing and Management (KOBiZE), the unit responsible for Polish GHG inventory preparation. It follows the *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories* (2000) recommendations. The main procedures for QA/QC activities are described in chapter 5 of the *National programme for Quality Assurance and Quality Control of Polish GHG inventory* [QA-QC 2012] and the detail check procedures are contained below as the examples of QC procedures performed by KOBiZE experts.

General timeframes of annual inventory preparation (including checking procedures), approval and submission are presented in the table 1. The dates for particular stages are established based on country specific availability of statistical data as well as national (legal) and international obligations.

Table 1. Timetable for inventory preparation and check for the year n-2 (n – submission year).

Timing	Activity
June -15 December (year n–1)	→ Data and emission factors collection (estimation) → Check for consistency data → Initial calculations and checks of GHG emissions considering ERT recommendations → Submission to the Ministry of Environment for acceptance
15 January (year n–2)	→ Submission of PL GHG inventory for the year n-2 and elements of NIR to the European Commission (required by dec. 280/2004//EC Article 3.1)
15 December – 15 February (year n–2)	→ Elaboration of final inventory, additional checks and final corrections to the inventory, preparation of NIR and CRF tables → Submission to the Ministry of Environment for acceptance
15 March (year n–2)	→ Submission of complete National Inventory Report and CRF tables to the European Commission (required by dec. 280/2004//EC Article 3.1)
15 April* (year n–2)	→ Submission of PL GHG inventory for the year n-2 to the UNFCCC Secretariat (CRF and NIR) (required by dec. 18/CP.8)

** National GHG Inventory should be submitted to the UNFCCC Secretariat 6 weeks after 15 April at the latest, which is 27 May, to comply with the reporting obligations*

Each IPCC sector undergoes detail QC procedure which is carried out by performer for given category/subcategory. Check for correctness of data, emission factors and calculation results are performed several times during the following stages of inventory elaboration: during its preparation, after completing the calculations, after CRF tables generation and after NIR report completing. Additionally part of the data, especially for Energy sector, are checked by other KOBiZE experts than those making inventory who are responsible for other sectors. As a part of QA activity the inventory team cooperates with specialists from different institutes, associations and individual experts who are involved in verification of data and assumptions to the inventory (see table 3). Additionally full National Inventory Report with CRF tables jest verified by the Ministry of Environment and cooperating agencies before official approval and submission it to the European Commission and UNFCCC Secretariat.

Depending on methodology used for emission estimation within categories Tier 1 or Tier 2 check procedures are carried out. The extended QC procedure for checking the correctness of emissions estimations is used for these categories where country specific emission factors are established. This concerns the key categories especially for such sectors like: fuel combustion (1.A), transport (1.A.3), cement production (2.A.1), enteric fermentation (4.A), manure management (4.B), agricultural soils (4.D) and others. For GHG emission sources for which Tier 1 method is used for emission calculation also Tier 1 method is applied for inventory checks. The categorisation of IPCC inventory sectors for Tier 1 and Tier 2 quality control procedures is shown in table 2.

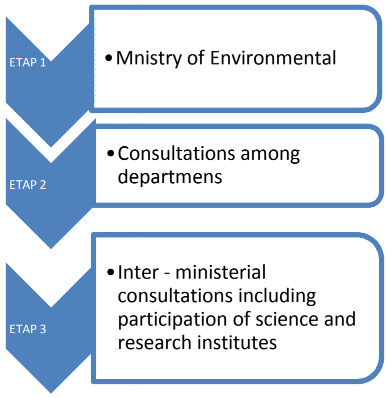
For the purposes of documentation of data and calculations QC the files are archived in electronic and hardcopy forms.

Table 2. Categorisation of IPCC sectors for Quality Control Tier 1 and Tier 2 procedures.

Categories checked following the Tier 1 procedure (according to table 4)	Categories checked following the Tier 2 procedure (according to table 5)
1.A.1,2,4,5.a stationary combustion (solid, liquid and gaseous fuels) (CH_4, N_2O) **1.A.3** transport (except 1.A.3.b) (CO_2, CH_4, N_2O) **1.A.3.b** road transport (CH_4, N_2O)	**1.A.1, 1.A.2., 1.A.4, 1.A.5.a** stationary combustion (solid, liquid and gaseous fuels) (CO_2) **1.A.3.b** road transport (CO_2)
1.B.1.c other (except 1.B.1.a) **1.B.2** oil and natural gas (except of 1.B.2.b) (CO_2, CH_4)	**1.B.1.a** coal mining and handling (CH_4) **1.B.2.b** natural gas (CH_4)
2.A.4 soda ash prod. (CO_2) **2.B.4** carbide prod. (CO_2) **2.B.5** other (CO_2, CH_4, N_2O) **2.C** Metal production (except 2.C.1) (CO_2, CH_4) **2.E+2.F** production and consumption of halocarbons and SF_6	**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.C.1** iron and steel production (CO_2)
3. Solvent and other product use	
4.B manure management (N_2O) **4.D.2** pasture, range and paddock manure (N_2O) **4.D.3** indirect soil emissions (N_2O) **4.F** field burning of agricultural residues (CH4, N_2O)	**4.A** enteric fermentation (CH_4) **4.B** manure management (CH_4) **4.D.1** direct soil emissions (N_2O)
5. LULUCF (except of 5.A) (CO_2, CH_4, N_2O)	**5.A** forest land (CO_2)
6.B wastewater handling (CH4, N_2O) **6.C** waste incineration (CO2, N_2O)	**6.A** solid waste disposal on land (CH_4)

Table 3. General plan for QC (KOBiZE) with QA (external review) activities within Polish GHG inventory.

Action within inventory frames for specific categories		internal QC (KOBiZE)	External check (outside of KOBiZE)
Activity data: Collection Introduction Reference description **Emission factors:** Choice Calculation Verification **Emission calculation**	1. Energy	experts on energy and industrial processes expert on energy and industrial processes for LRTAP expert on transport expert on waste	
	2. Industrial processes	expert on energy and industrial processes	
	3. Solvent and other product use	expert on waste	
	4. Agriculture	expert on agriculture	
	5. LULUCF	expert on LULUCF	
	6. Waste	expert on waste	
Elaboration of *key categories*		expert on waste	
Elaboration of *uncertainties*		expert on database	
Inserting data into CRF Reporter and data generation		expert on database	
Check of data processed by CRF Reporter against calculated data		expert for given category	
NIR preparation in Polish and English (including automatization)		experts on energy and industrial processes expert on agriculture expert on transport expert on waste expert on database expert on register	
Documentation & archiving of documentation		expert on database	



Annex 6. Uncertainty assessment of the 2011 inventory

Uncertainty analysis for the year 2011 was performed with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Chosen methodology is based on the assumptions that every value is independent (there is no correlation between values) and probability distribution is symmetric (probability of underestimation and overestimation is the same).
Conclusions from the 2005, 2008, 2009, 2010, 2011 reviews and latest centralized review in 2012 were taken into account.
Latest major changes applied to uncertainties follow the recommendations of Emission Review Team from October 2010, where uncertainties of emission factors in sector 1.A Fuel Combustion were revised and additional analysis was done for N2O factors. In general N2O uncertainty estimates were based on more restrictive assumptions to better reflect problems with data availability and quality.
For industrial gases (HFC, PFC, SF6) due to lack of appropriate information, uncertainty estimates were applied directly to emission values.

First stage of the estimates was to assign uncertainty to each activity data and emission factor. Next step was to estimate error propagation and its influence on national total emissions. To estimate error propagation from activity and emission factor to emission values, formula (1) was used.

$$U_{emission} = \text{square root } (U_{act}^2 + U_{EF}^2) \qquad (1)$$

where: $U_{emission}$ – uncertainty of emission value
U_{act} – uncertainty of activity value
U_{ef} – uncertainty of emission factor value

To estimate error propagation from sectoral emissions to national total, formula (2) was used

$$U_{emission} = \text{square root } (\Sigma\, (\text{Emission} * U_{emission})^2) / \Sigma\, \text{Emission} \qquad (2)$$

where: $U_{emission}$ – uncertainty of emission value in sector
Emission – emission from sector

As the base bottom level of analysis the following sectors were chosen:

- sector 1: levels 1.A.1, 1.A.2, 1.A.3., 1.A.4, 1.A.5 with disaggregation by fuel type (liquid, solid, gaseous, biomass etc.)
- sector 2: levels 2.A.1, 2.A.2 .... 2.C.3. (no estimates of emission from 2.D and 2.E)
- sector 3: top level only
- sector 4: 4.A.1, 4.A.2 .... 4.F.5
- sector 6: 6.A.1, 6.A.2; 6.B with disaggregation according to wastewater types and 6.C with disaggregation according to waste types.

Most of the estimates were based on default assumption described in methodology, but after investigation of socio-economic parameters literature data was applied to selected activities in sector *1. Energy* and for activities and emission factors in sector *2. Industrial processes.* Selected uncertainties for activities and factors in 6.C Waste/Waste Incineration were estimated with help expert's opinion in Emission Balancing and Reporting Unit (former National Emission Centre).

Results of analysis of error propagation of uncertainty of national totals is shown below:

CO_2 – 3.1%	CH_4 – 22.2%	N_2O - 48.8%
HFC - 48.7%	PFC - 78.6%	SF6 – 90.0%

Activity data
Most uncertain values of activity were assigned in category *4.F Agriculture/Field Burning of Agricultural Residues* and in *6.B Waste/Domestic and Commercial Wastewater* (30%). Lowest uncertainty values were assigned to *1.A.1 Energy/ Fuel Combustion,* especially in subsector 1.A.1 *Energy Industries* (2%,). In general Polish energy sector is responsible for 90 % of GHG emission and is covered with detailed national statistics, which allows to keep overall uncertainty of inventory low.

CO_2 emission factors
Most uncertain values for CO_2 emission factors were assigned in sector *6.C Waste incineration* (50%), *2.A. Cement Production* (15%) and *2.C Metal Production* (10%), the most precise values were reported in *1.A Fuel Combustion* (1-2%).
Low level of uncertainty of national total of CO_2 (3.1%) comes from the fact, that major part of emission comes from sector *1.A Fuel Combustion* where input data for activities and factors is the most precise (relatively 1-5% and 1-3%, excluding biomass).

CH_4 emission factors
Most uncertain values for CH_4 emission factors were assigned in sector 6.A Solid Waste Disposal on Land (100%), and 6.B. Wastewater Handling (100%), *1.A Fuel Combustion* (75%), 1.B Fugitive Emission from fuels (75%), *4.A. Enteric Fermentation* and *4.B Manure Management (50%).* The most precise values were in *2. Industrial Processes* (20%) and *4.F Field Burning of Agricultural Residues* (20%). In 2009 new sources were included to analysis in *2.C. Metal Production (sinter, electric furnaces, pig iron and basic oxygen furnaces)* as a result of incorporating to national emission inventories data from reporting for EU Emission Trading Scheme.
Uncertainty of CH_4 emission is app. 22.2% which is result of share of agriculture and waste sectors in national totals – emission factors in those sectors have high relatively uncertainty.

N_2O emission factors
Most uncertain values for N_2O emission factors were assigned in sector *4.B.11* and *4.B.12 Manure management* (150%), *4.D Agricultural Soils* (150%) and in *4.F Agriculture/Field Burning of Agricultural Residues* (150%), most precise values were applied in sector *2.C Metal Production (20%)*. Data available from polish part of EU Emission Trading Scheme reporting were taken into account during this analysis with relatively low uncertainty.
Highest value of uncertainty of national total occurred in N_2O (48.8%) and is a result of high uncertainty of the emission factors in sector of *Agriculture* (4.B.11 *Liquid systems*, 4.B.12 *Solid Storage and Dry Lot, 4.D Agricultural Soils* and *4.Field Burning of Agricultural residues* – 150%).

Industrial Gases
Simplified analysis were made for industrial gases HFC, PFC and SF6, where uncertainty assumptions were applied directly to emission values of each pollutant. Final results of analysis where as follows: HFC – 48.7%, PFC – 78.6% and SF6 – 90.0%. Due to lack of information, simplified approach has to be used and country recognizes need of additional analysis in this sector as planned improvement for future inventories.

Planned improvements in next revised submission 2013
- investigation of data for industrial gases
- collection of data and setting up model for KP art 3.3 and 3.4 uncertainty estimates

GHG inventory 2011 – Uncertainty analysis, part 1, sectors 1-3

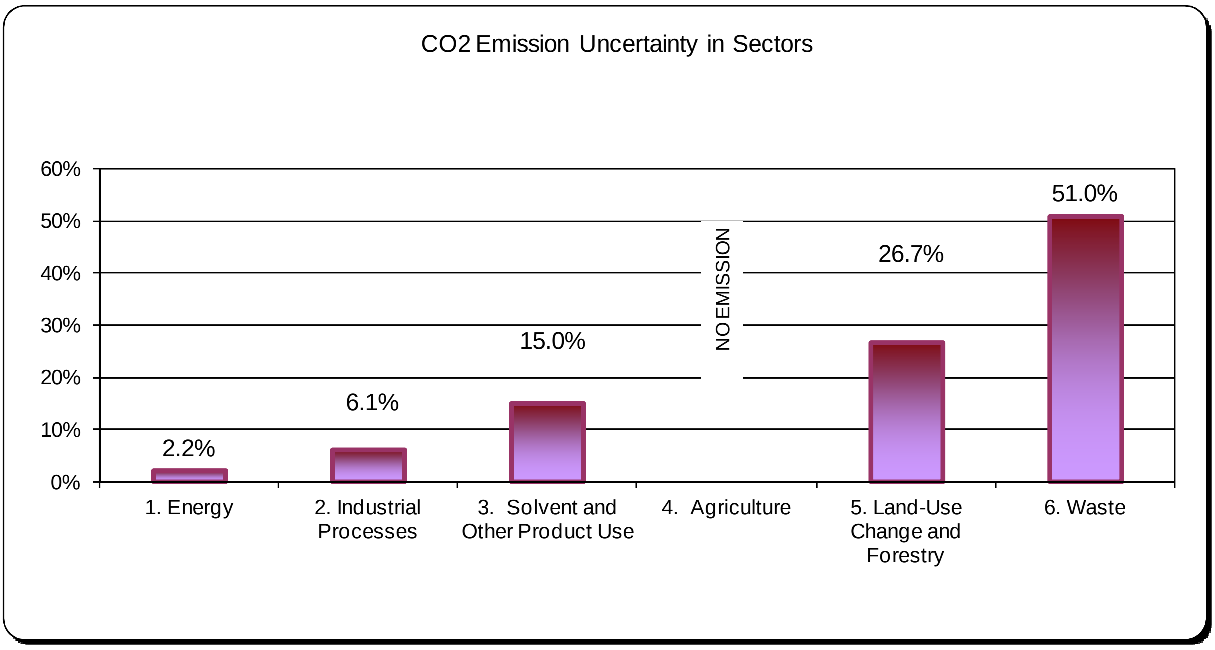
2011	Activity [TJ]	Activity uncertainty [%]	EF CO_2 [t/TJ]	EF CH_4 [kg/TJ]	EF N_2O [kg/TJ]	EF CO_2 Uncertainty [%]	EF CH_4 Uncertainty [%]	EF N_2O Uncertainty [%]	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]	CO_2 Emission absolute uncertainty [Gg]	CH_4 Emission absolute uncertainty [Gg]	N_2O Emission absolute uncertainty [Gg]
TOTAL									**306 138.93**	**1 799.38**	**87.90**	**3.1%**	**22.2%**	**48.8%**	9 407.51	400.30	42.91
1. Energy									**308 389.70**	**700.86**	**6.77**	2.2%	23.9%	22.7%	**6711.39**	**167.49**	**1.54**
A. Fuel Combustion									**304 568.18**	**144.66**	**6.77**	2.2%	12.0%	22.7%	6703.57	17.36	1.54
1. Energy Industries									173 821.99	4.50	2.76	3.4%	16.2%	11.2%	5857.58	0.73	0.31
Liquid Fuels	72 412	2.0%	73.23	2.40	0.45	2.0%	75.0%	75.0%	5 302.47	0.17	0.03	2.8%	75.0%	75.0%	149.98	0.13	0.02
Solid Fuels	1 641 091	2.0%	98.94	1.00	1.44	3.0%	13.5%	11.7%	162 367.64	1.64	2.37	3.6%	13.6%	11.9%	5854.25	0.22	0.28
Gaseous Fuels	94 995	2.0%	55.82	1.00	0.10	1.0%	17.0%	20.0%	5 302.57	0.09	0.01	2.2%	17.1%	20.1%	118.57	0.02	0.00
Biomass	84 495	15.0%	106.85	28.48	3.80	0.0%	24.0%	37.0%	9 028.05	2.41	0.32	15.0%	28.3%	39.9%		0.68	0.13
Other fuels	6 205	5.0%	136.87	30.00	4.00	3.0%	20.0%	25.0%	849.31	0.19	0.02	5.8%	20.6%	25.5%	49.52	0.04	0.01
2. Manufacturing Industries and Construction									31 062.53	3.70	0.52	2.4%	11.7%	14.6%	737.36	0.43	0.08
Liquid Fuels	43 597.00	3.0%	70.55	2.15	0.39	1.0%	41.8%	75.0%	3 075.92	0.09	0.02	3.2%	41.9%	75.1%	97.27	0.04	0.01
Solid Fuels	165 861.98	3.0%	103.99	9.02	1.35	2.0%	13.5%	11.7%	17 248.27	1.50	0.22	3.6%	13.8%	12.1%	621.90	0.21	0.03
Gaseous Fuels	132 759.33	4.0%	55.82	1.00	0.10	2.0%	17.0%	20.0%	7 410.56	0.13	0.01	4.5%	17.5%	20.4%	331.41	0.02	0.00
Biomass	40 609.00	15.0%	109.08	29.85	3.98	0.0%	24.0%	37.0%	4 429.65	1.21	0.16	15.0%	28.3%	39.9%		0.34	0.06
Other fuels	25 546.00	5.0%	130.27	30.00	4.00	3.0%	20.0%	25.0%	3 327.79	0.77	0.10	5.8%	20.6%	25.5%	194.04	0.16	0.03
3. Transport									47 987.70	5.04	1.91	5.8%	10.4%	75.0%	2798.14	0.53	1.44
Liquid Fuels	665 300.26	3.0%	71.35	7.39	2.84	5.0%	10.2%	75.0%	47 468.64	4.92	1.89	5.8%	10.6%	75.1%	2767.87	0.52	1.42
Solid Fuels	NA,NO	3.0%	NA	NA	NA	5.0%	13.5%	11.7%				5.8%	13.8%	12.1%	0.00	0.00	0.00
Gaseous Fuels	9 298.96	4.0%	55.82	1.00	0.10	2.0%	24.0%	37.0%	519.06	0.01	0.00	4.5%	24.3%	37.2%	23.21	0.00	0.00
Biomass	39 088.00	15.0%	70.80	3.00	NA	0.0%	50.0%	50.0%	2 767.43	0.12	0.02	15.0%	52.2%	52.2%	415.11	0.06	0.01
4. Other Sectors									51 695.95	131.41	1.58	2.9%	13.2%	28.0%	1501.10	17.33	0.44
Liquid Fuels	135 530.86	4.0%	70.98	5.69	3.65	1.0%	41.8%	75.0%	9 619.41	0.77	0.49	4.1%	42.0%	75.1%	396.62	0.32	0.37
Solid Fuels	317 648.00	4.0%	94.64	269.24	1.50	2.0%	13.5%	11.7%	30 062.85	85.52	0.48	4.5%	14.1%	12.4%	1344.45	12.04	0.06
Gaseous Fuels	215 140.00	4.0%	55.82	5.00	0.10	2.0%	17.0%	20.0%	12 009.01	1.08	0.02	4.5%	17.5%	20.4%	537.06	0.19	0.00
Biomass	147 827.00	15.0%	109.36	297.85	3.97		24.0%	37.0%	16 165.73	44.03	0.59	15.0%	28.3%	39.9%		12.46	0.23
Other fuels	46.00		101.89	300.00	4.00	3.0%	20.0%	25.0%	4.69	0.01	0.00	3.0%	20.0%	25.0%	0.14	0.00	0.00
5. Other									0.00	0.00	0.00	0.0%	0.0%	0.0%	0.00	0.00	0.00
Liquid Fuels	NO	5.0%	NA	NA	NA	1.0%	100.0%	75.0%	IE	IE	IE	5.1%	100.1%	75.2%	0.00	0.00	0.00
Solid Fuels	IE	5.0%	NA	NA	NA	2.0%	80.0%	11.7%	IE	IE	IE	5.4%	80.2%	12.7%	0.00	0.00	0.00
Gaseous Fuels	IE	5.0%	NA	NA	NA	2.0%	90.0%	20.0%	IE	IE	IE	5.4%	90.1%	20.6%	0.00	0.00	0.00
Biomass	IE	20.0%	NA	NA	NA	0.0%	95.0%	37.0%	IE	IE	IE	20.0%	97.1%	42.1%	0.00	0.00	0.00
B. Fugitive Emissions from Fuels									**3821.516**	**556.20**	**0.00**	8.5%	30.0%		324.02	166.59	0.00
1. Solid Fuels									2097.42	342.04	0.00	15.0%	48.6%		314.38	166.20	0.00
1. B. 1. a. Coal Mining and Handling															0.00	0.00	0.00
i. Underground Mines [Activity in Mt, EF in kg/t]	67.64	2.0%		4.91031			50.0%			332.12			50.0%		0.00	166.19	0.00
ii. Surface Mines [Activity in Mt, EF in kg/t]	62.89	2.0%		0.01273			50.0%			0.80			50.0%		0.00	0.40	0.00
1. B. 1. b. Solid Fuel Transformation [Activity in Mt, EF in kg/t]	NA								2095.84	4.69		15.0%	25.0%		314.38	1.17	
1. B. 1. c. Other [CO2 Emisson from Coking Gas Subsystem]	0.72	2.0%	2 192 303	6 161 377.66		10.0%	50.0%		1.58	4.43		10.2%	15.0%		0.16	0.67	
2. Oil and Natural Gas									1724.098	214.16	0.00	4.6%	5.3%	100.1%	78.45	11.40	0.00
1. B. 2. a. Oil															0.00	0.00	0.00
ii. Production [Activity in PJ, EFs in kg/PJ]	26.26	0.5%	6 315 000	61 800.00		6.6%	8.1%		165.819	1.62		6.6%	8.1%		10.98	0.13	0.00
iii. Transport [Activity in Gg]	24 409.00	0.5%	0.56911	6.2718		6.6%	8.1%		0.014	0.15		6.6%	8.1%		0.00	0.01	0.00
iv. Refining/storage [Gg]	1 021.41	0.5%		745.00		6.6%	8.1%		NA	0.76			8.1%			0.06	
1. B. 2. b. Natural Gas															0.00	0.00	0.00
i. Production / Processing [Activity in PJ, EFs in kg/PJ]	161.19	0.5%	23 246.01	95 245.23		6.6%	8.1%		3.747	15.35		6.6%	8.1%		0.25	1.25	0.00
ii. Transmission [Activity in PJ, EFs in kg/PJ]	537.43	0.5%	521.15	53 181.48		6.6%	8.1%		0.280	28.58		6.6%	8.1%		0.02	2.32	0.00
iv. Distribution [Activity in PJ, EF in kg/PJ]	537.43	0.5%	1 165.95	310 722.77		6.6%	8.1%		0.627	166.99		6.6%	8.1%		0.04	13.55	0.00
v. Other Leakage [Activity in PJ, EFs in kg/PJ]	537.43	0.5%	9.89	1 288.57		6.6%	8.1%		0.005	0.69		6.6%	8.1%		0.00	0.06	
1. B. 2. c. Venting - Oil	518.49	5.0%	12.00		1.19	6.6%		100.0%	0.006		0.00	8.3%		100.1%	0.00		0.00
1. B. 2. c. Flaring - Natural gas	4 685.64	5.0%			0.00			100.0%	IE,NO								
1. B. 2. d. Other (Process emission from refineries and flaring)	**NA**	**5.0%**	**NA**			**NA**			**1 553.60**			5.0%					
2. Industrial Processes									21 029.08	14.56161	3.494905	6.1%	16.8%	29.5%	1284.43	2.45	1.03
A. Mineral Products									10 711.41		0	11.1%			1191.76	0.00	0.00
1. Cement Production [Activity in kt, EF in t/t]	13 629.50	5.0%	0.54142811			15.0%			7 379.39			15.8%			1166.78	0.00	0.00
2. Lime Production [Activity in kt, EF in t/t]	2 036.30	10.0%				10.0%			1 560.82			14.1%			220.73	0.00	0.00
3. Limestone and dolomite Use [activitz in kt, EFs in t/t]	NA		NA	NA	NA				972.06			10.0%					
4. Soda Ash (production) [Activity in kt, EF in t/t]	644.55	10.0%	0.415			0.0%			267.49			10.0%			26.75	0.00	0.00
7. Other (ETS Data; Bricks, Tiles, Ceramic Materials and Glass production) [emission data only]									531.65			1.0%			5.32	0.00	0.00
B. Chemical Industry									3 968.60	12.90	3.43	7.1%	19.0%	30.1%	280.61	2.45	1.03
1. Ammonia Production [Activity in kt, EF in t/t]	2 321.85	5.0%	1.70916942	0.0049		5.0%	20.0%		3 968.43	11.38		0.070710678	20.6%		280.61	2.35	0.00
2. Nitric Acid Production [Activity in kt, EF in t/t]	2 168.12	2.0%			0.00			30.0%			2.66			30.1%	0.00	0.00	0.80
3. Adipic Acid Production [Activity in kt, EF in t/t]	NO	5.0%			0			10.0%	NO					11.2%			
4. Carbide Production (calcium carbide) [Activity in kt, EF in t/t]	NO	5.0%				5.0%			NO			0.070710678				0.00	0.00
5. Other (Carbon Black) [Activity in kt, EF in t/t]	42.15	5.0%		0.01100			20.0%			0.46			20.6%		0.00	0.10	0.00
5. Other (Ethylene) [Activity in kt, EF in t/t]	554.57	5.0%	0.0003	0.001		5.0%	20.0%		0.17	0.55		0.070710678	20.6%		0.01	0.11	0.00
5. Other (N2O for Medical Use) [Activity in kt, EF in t/t]	125.76	5.0%			IE	10.0%		20.0%		0.50	IE				0.00	0.00	IE
5. Other (Methanol) [Activity in kt, EF in t/t]	0.34	5.0%		0.002			20.0%			0.000688			20.6%		0.00	0.00	0.00
5. Other (Caprolactam) [Activity in kt, EF in t/t]	164.00	5.0%			0.00474			20.0%			0.78				0.00	0.00	
C. Metal Production									6 006.06	1.662617	0.060565	6.5%	10.1%	20.5%	387.86	0.17	0.01
1. Iron and Steel Production															0.00	0.00	0.00
Sinter [Activity in kt, EF in t/t]	6 512.75	5.0%	0.24	0.000080	NA	10.0%	20.0%	20.0%	1 564.16	0.52	0.009699	11.2%	20.6%	20.6%	174.88	0.11	0.00
Coke [Activity in kt, EF in t/t]	IE	5.0%	NA	NA		10.0%	20.0%		IE	IE		11.2%	20.6%		NA	NA	0.00
Open-heart Steel [Activity in kt, EF in t/t]		5.0%															
Electric Furnace Steel [Activity in kt, EF in t/t]	4 352.85	5.0%	0.08063	0.000120	0.0000000	10.0%	20.0%	20.0%	350.98	0.52	0.00	11.2%	20.6%	20.6%	39.24	0.11	0.00
Pig Iron [Activity in kt, EF in t/t]	3 974.93	5.0%	0.761	0.000085	0.0000127	10.0%	20.0%	20.0%	3 026.07	0.34	0.050647	11.2%	20.6%	20.6%	338.32	0.07	0.01
Iron Cast [Activity in kt, EF in t/t]	1 029.93	5.0%	0.007	0.0002		10.0%	20.0%		6.80	0.21		11.2%	20.6%		0.76	0.04	0.00
Steel Cast [Activity in kt, EF in t/t]	156.92	5.0%	0.04624			10.0%			7.26			11.2%			0.81	0.00	0.00
Basic Oxygen Furnace Steel [Activity in kt, EF in t/t]	4 423.60	5.0%	0.1	0.000000	4.0175E-08	10.0%	20.0%	20.0%	510.67	0.00	0.000178	11.2%	20.6%	20.6%	57.09	0.00	0.00
2. Ferroalloys Production [Activity in kt, EF in t/t]	72.67	5.0%	3.9	0.001		5.0%	20.0%		283.41	0.07		7.1%	20.6%		20.04	0.01	0.00
3. Aluminium Production [Activity in kt, EF in t/t]	13.87	5.0%	1.8			5.0%			24.96			7.1%			1.77	0.00	0.00
5. Other (Zinc Production) [Activity in kt, EF w t/t]	84.04	5.0%	0.5			5.0%			43.70			7.1%			3.09		
5. Other (Lead Production) [Activity in kt, EF w t/t]	109.34	5.0%	1.72			5.0%			188.061			7.1%			13.30		
D. Other Production									8.199			5.0%			0.41	0.00	0.00
G. Other									**334.81**			5.0%			16.74	0.00	0.00
3. Solvent and Other Product Use	140.42		NA						664.6701478		0.4	15.0%		50.0%	99.70		0.20

GHG inventory 2011 – Uncertainty analysis, part 2, sector 4-6

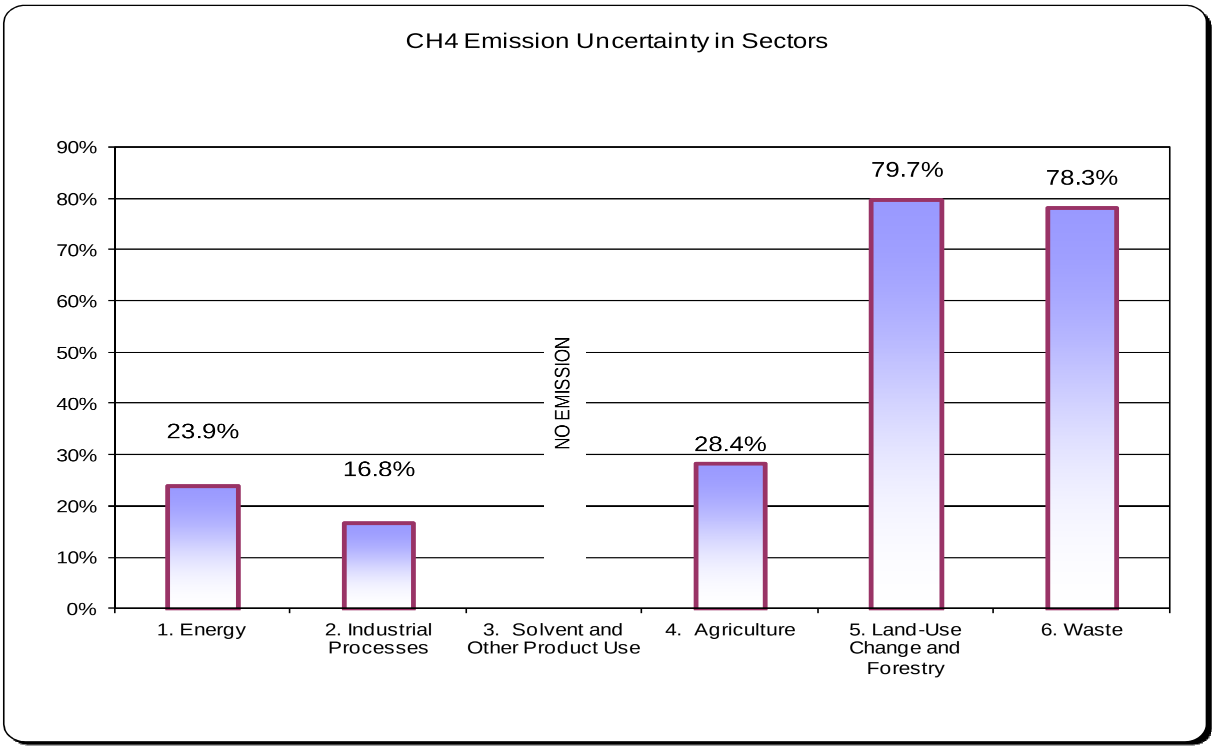
2011	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
4. Agriculture										**576.83**	**73.60**		28.4%	58.2%		163.60	42.82
A. Enteric Fermentation										442.22			34.4%			152.32	0.00
1. Cattle																0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2 626.0	5.0%		98.79			50.0%			259.43			50.2%			130.36	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	3 135.9	5.0%		49.55			50.0%			155.37			50.2%			78.07	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	251.0	5.0%		8.01			50.0%			2.01			50.2%			1.01	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	111.8	5.0%		5.00			50.0%			0.56			50.2%			0.28	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	254.4	5.0%		18.00			50.0%			4.58			50.2%			2.30	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	13 508.7	5.0%		1.50			50.0%			20.26			50.2%			10.18	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	143 557.3	5.0%		0.00			50.0%			0.00			50.2%			0.00	0.00
B. Manure Management										133.77	16.48		44.6%	148.9%		59.70	24.53
1. Cattle																0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2 626	5.0%		13.73			50.0%			36.06			50.2%			18.12	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	3 136	5.0%		2.69			50.0%			8.42			50.2%			4.23	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	251	5.0%		0.17			50.0%			0.04			50.2%			0.02	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	112	5.0%		0.12			50.0%			0.01			50.2%			0.01	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	254	5.0%		1.39			50.0%			0.35			50.2%			0.18	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	13 509	5.0%		5.75			50.0%			77.67			50.2%			39.03	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	143 557	5.0%		0.08			50.0%			11.20			50.2%			5.63	0.00
11. Liquid Systems [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%			0.000978			150.0%			0.13			150.1%		0.00	0.20
12. Solid Storage and Dry Lot [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%			0.020056			150.0%			16.35			150.1%		0.00	24.53
D. Agricultural Soils											57.09			61.5%		0.00	35.09
1. Direct Soil Emissions																0.00	0.00
Synthetic Fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	981 990 000	5.0%			0.01			150.0%			19.29			150.1%		0.00	28.95
Animal Wastes Applied to Soils [Activity in kg N, EF in kg N2O-N/kg N]	483 717 287	5.0%			0.01			150.0%			9.50			150.1%		0.00	14.26
N-fixing Crops [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	19 291 353	5.0%			0.01			150.0%			0.38			150.1%		0.00	0.57
Crop Residue [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	113 333 745	5.0%			0.01			150.0%			2.23			150.1%		0.00	3.34
Cultivation of Histosols [Activity in ha, EF in kg N2O-N/ha]	697 800	5.0%			8.00			150.0%			8.77			150.1%		0.00	13.17
2. Animal Production [Activity in kg N, EF in kg N2O-N/kg N]	4 614 480	5.0%			0.01			150.0%			0.09			150.1%		0.00	0.14
3. Indirect Emissions [Activity in kg N/yr, EF in kg N2O/kg N]	47 183 369	20.0%			0.31428571			150.0%			1.48			151.3%			2.24
4. Sewage sludge aplied to fields								150.0%			15.35						
F. Field Burning of Agricultural Residues										0.84	0.03		25.2%	112.8%		0.21	0.04
1. Cereals																0.00	0.00
Wheat [Activity in t of crop production, EF in kg/t dm]	9 339 205	30.0%		0.1107	0.0003		20.0%	150.0%		0.10	0.00		36.1%	153.0%		0.04	0.00
Barley [Activity in t of crop production, EF in kg/t dm]	3 325 886	30.0%		0.0943	0.0002		20.0%	150.0%		0.03	0.00		36.1%	153.0%		0.01	0.00
Maize [Activity in t of crop production, EF in kg/t dm]	2 392 066	30.0%		0.0382	0.0001		20.0%	150.0%		0.01	0.00		36.1%	153.0%		0.00	0.00
Oats [Activity in t of crop production, EF in kg/t dm]	1 381 592	30.0%		0.1067	0.0003		20.0%	150.0%		0.01	0.00		36.1%	153.0%		0.01	0.00
Rye [Activity in t of crop production, EF in kg/t dm]	2 600 676	30.0%		0.1734	0.0003		20.0%	150.0%		0.05	0.00		36.1%	153.0%		0.02	0.00
Other Cereals [Activity in t of crop production, EF in kg/t dm]	7 717 115	30.0%		0.1151	0.0003		20.0%	150.0%		0.09	0.00		36.1%	153.0%		0.03	0.00
2 Pulses (Other non-specified)	335 145	30.0%		0.0276	0.0002		20.0%	150.0%		0.00	0.00		36.1%	153.0%		0.00	0.00
3 Tuber and Root																0.00	0.00
Potatoes [Activity in t of crop production, EF in kg/t dm]	9 361 848	30.0%		0.0599	0.0005		20.0%	150.0%		0.06	0.00		36.1%	153.0%		0.02	0.01
Other Tuber and Root [Activity in t of crop production, EF in kg/t dm]	0	30.0%		0.0000	0.0000		20.0%	150.0%		0.00	0.00		36.1%	153.0%		0.00	0.00
5 Other																0.00	0.00
Fruits, Veget., Rape, Tabacco, Hop, Hey [Activity in t of crop prod., EF in kg/ t of crop]	7 415 952	30.0%		0.0660	0.0030		20.0%	150.0%		0.49	0.02		36.1%	153.0%		0.18	0.03
													0.0%	0.0%		0.00	0.00
5. Land-Use Change and Forestry									**-24 170.50**	**107.10**	**0.03**	26.7%	79.7%	58.2%	-6464.17	85.33	0.017
A. Forest Land	9 329.18	5.0%	-3.3250129	6.37208E-05	0.9872	20.0%	80.0%	80.0%	-31 019.63	0.59	0.01	20.6%	80.2%	80.2%	-6394.86	0.48	0.007
B. Cropland	14 182.92	5.0%	0.23382638	0	0.0000	20.0%			3 316.34			20.6%	5.0%	5.0%	683.68	0.00	0.000
C. Grassland	4 173.03	5.0%	0.05293129	1.38034E-05	0.2139	20.0%	80.0%	80.0%	220.88	0.06	0.00	20.6%	80.2%	80.2%	0.00	0.05	0.001
D. Wetlands	1 368.80	5.0%	2.29830703	0.077769477	13.8095	20.0%	80.0%	80.0%	3 145.92	106.45	0.02	20.6%	80.2%	80.2%	648.55	85.33	0.015
E. Settlements	2 120.23	5.0%	0.07828834	0	0.0000	20.0%			165.99			20.6%	5.0%	5.0%	34.22	0.00	0.000
F. Other Land	93.81	5.0%	0	0	0.0000				0.00			5.0%	5.0%	5.0%	0.00	0.00	0.000
6. Waste									**225.98**	**400.03**	**3.61**	51.0%	78.3%	51.7%	115.23	313.26	1.87
A. Solid Waste Disposal on Land										347.16			89.2%		0.00	309.78	0.00
1 Managed Waste Disposal on Land [Activity in Gg, EF in t/t MSW]	6 356.26	23.0%		0.016557014			100.0%			105.24			102.6%		0.00	107.99	0.00
2 Unmanaged Waste Disposal Sites - deep (>5 m) [Activity in Gg, EF in t/t MSW]	610.84	23.0%		0.27365938			100.0%			167.16					0.00	0.00	0.00
3 Other - Industrial Waste Disposal on Land [Activity in Gg, EF in t/t MSW]	107.79	23.0%		0.161652886			100.0%			17.42			102.6%		0.00	17.88	0.00
3 Other - Unclassified and Unmanaged Waste Disposal on Land [Activity in Gg, EF in t/t M	2 301.20	50.0%		0.02491431			100.0%			57.33							
										52.88	3.58		88.1%	52.2%	0.00	46.57	1.87
Industrial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	344.12			0.02			100.0%			9.14			100.0%		0.00	9.14	0.00
Domestic and Commercial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	554.11	30.0%		0.078925624			100.0%			43.73			104.4%		0.00	45.66	0.00
N2O from human sewage [Activity in 1000s of population, EF in kg N2O-N/kg sewage N produced]	38 538.00	15.0%			0.0000928			50.0%			3.58			52.2%	0.00	0.00	1.87
C. Waste Incineration									225.98		0.03	51.0%		21.7%	115.23	0.00	0.01
biogenic [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			71.95		0.01	51.0%		30.0%	36.69	0.00	0.00
plastics and other non-biogenic waste [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			225.98		0.02	51.0%		30.0%	115.23	0.00	0.01

Industrial gases inventory 2011 – Uncertainty analysis for HFC, PFC and SF_6.

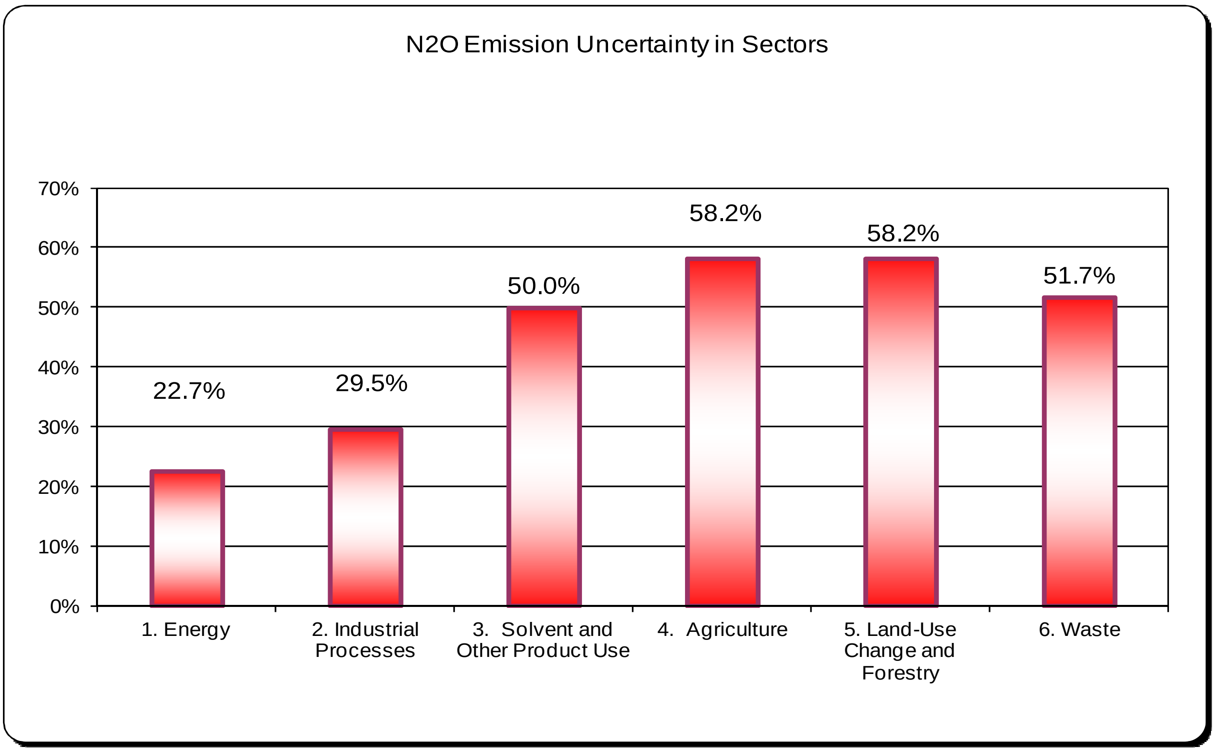
	HFC Emission [Gg of CO_2 eq.]	**PFC Emission [Gg of CO_2 eq.]**	**SF_6 Emission [Gg of CO_2 eq.]**	**HFC Emission uncertainty [%]**	**PFC Emission uncertainty [%]**	**SF_6 Emission uncertainty [%]**	**HFC Emission absolute uncertainty [Gg of CO_2 eq.]**	**PFC Emission absolute uncertainty [Gg of CO_2 eq.]**	**SF_6 Emission absolute uncertainty [Gg of CO_2 eq.]**
TOTAL	6 210.80	49.88	40.90	48.7%	78.6%	90.0%	3 022.83	49.88	36.56
2. Industrial Processes	6 210.80	49.88	40.90	48.7%	78.6%	90.0%	3 022.83	49.88	36.56
C. Metal Production		37.07	4.35		100.0%	100.0%		37.07	
3. Aluminium Production		37.07	4.35		100.0%	100.0%		37.07	4.35
F. Consumption of Halocarbons and SF6	6 210.80	12.81	36.56	48.7%	100.0%	100.0%	3 022.83	12.81	36.56
1. Refrigeration and Air Conditioning Equipment	6 044.53			50.0%			3 022.26		
2. Foam Blowing	24.21			50.0%			12.11		
3. Fire Extinguishers	27.27	12.81		50.0%	100.0%		13.64	12.81	
4. Aerosols/ Metered Dose Inhalers	110.59			50.0%			55.29		
5. Solvents	2.21			50.0%			1.10		
8. Electrical Equipment			36.56			100.0%			36.56
9. Other - Potential emissions as a proxy for actual emissions	1.99			100.0%			1.99		



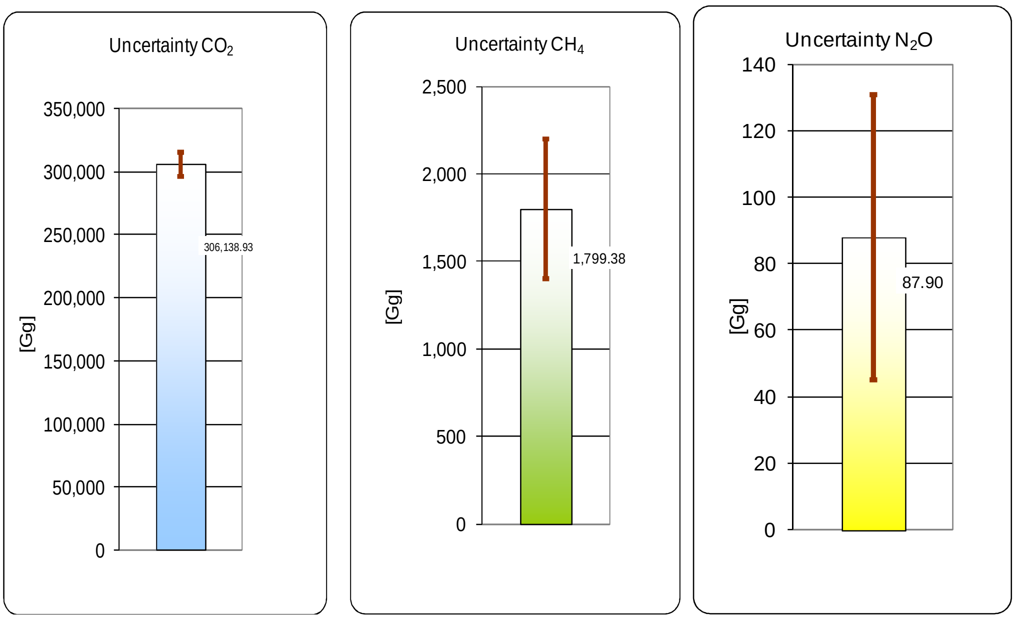
Results of uncertainty analysis in percents for CO_2 with sectoral split.



Results of uncertainty analysis in percents for CH_4 with sectoral split.

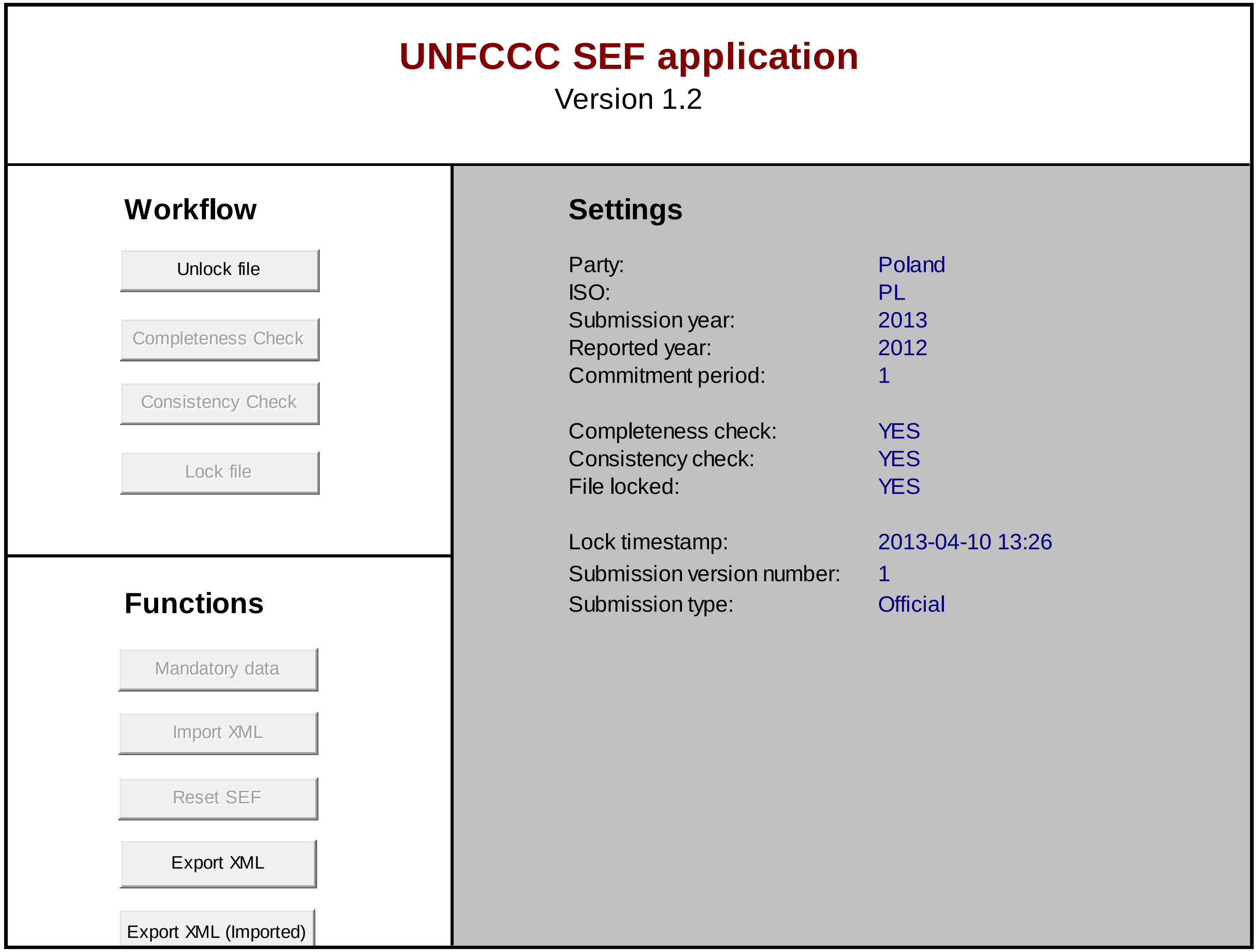


Results of uncertainty analysis in percents for N_2O with sectoral split



Emission results with uncertainties bars.

Annex 7. SEF report



Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Table 1. Total quantities of Kyoto Protocol units by account type at beginning of reported year

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Party holding accounts	1807357553	39940	NO	622258	NO	NO
Entity holding accounts	180897200	4413536	NO	19055773	NO	NO
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	NO	NO	NO	NO	NO	NO
Retirement account	564089355	2061462	NO	28839820	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal of storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	2552344108	6514938	NO	48517851	NO	NO

Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Table 2 (a). Annual internal transactions

Transaction type	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Article 6 issuance and conversion												
Party-verified projects		5913325					5913325		NO			
Independently verifed projects		NO					NO		NO			
Article 3.3 and 3.4 issuance or cancellation												
3.3 Afforestation and reforestation			NO				NO	NO	NO	NO		
3.3 Deforestation			NO				NO	NO	NO	NO		
3.4 Forest management			NO				NO	NO	NO	NO		
3.4 Cropland management			NO				NO	NO	NO	NO		
3.4 Grazing land management			NO				NO	NO	NO	NO		
3.4 Revegetation			NO				NO	NO	NO	NO		
Article 12 afforestation and reforestation												
Replacement of expired tCERs							NO	NO	NO	NO	NO	
Replacement of expired lCERs							NO	NO	NO	NO		
Replacement for reversal of storage							NO	NO	NO	NO		NO
Replacement for non-submission of certification report							NO	NO	NO	NO		NO
Other cancellation							NO	NO	NO	NO	NO	NO
Sub-total		5913325	NO				5913325	NO	NO	NO	NO	NO

Transaction type	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Retirement	NO	NO	NO	1000	NO	NO

Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Add registry | Delete registry | No external transactions

Table 2 (b). Annual external transactions

	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Transfers and acquisitions												
ES	24647	626539	NO	37500	NO	NO	80793795	20000	NO	569000	NO	NO
FR	2730899	1218069	NO	4762495	NO	NO	4085501	700764	NO	245568	NO	NO
EU	NO	518379	NO	24107	NO	NO	NO	1316640	NO	7681400	NO	NO
BG	1680708	2280366	NO	514227	NO	NO	1049320	3665082	NO	753580	NO	NO
GB	363039	2372575	NO	3026753	NO	NO	4516696	3242463	NO	365893	NO	NO
IT	63995	80000	NO	60000	NO	NO	153995	50000	NO	NO	NO	NO
DE	248809	54714	NO	1277483	NO	NO	1286208	135441	NO	176000	NO	NO
GR	98271	NO	NO	NO	NO	NO	NO	NO	NO	4211	NO	NO
NL	420000	396717	NO	423235	NO	NO	5088183	434602	NO	NO	NO	NO
CZ	812683	141406	NO	77046	NO	NO	2785890	NO	NO	NO	NO	NO
SK	908744	NO	NO	NO	NO	NO	193500	NO	NO	5000	NO	NO
BE	NO	NO	NO	NO	NO	NO	1000000	NO	NO	NO	NO	NO
LI	663002	513026	NO	NO	NO	NO	45000	717264	NO	NO	NO	NO
CH	NO	31046	NO	NO	NO	NO	NO	368807	NO	300000	NO	NO
HU	10000	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
FI	NO	NO	NO	NO	NO	NO	125000	NO	NO	NO	NO	NO
SI	NO	14690	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
JP	NO	NO	NO	NO	NO	NO	NO	1005686	NO	NO	NO	NO
DK	NO	NO	NO	NO	NO	NO	NO	737098	NO	NO	NO	NO
SE	NO	NO	NO	NO	NO	NO	NO	19804	NO	NO	NO	NO
UA	NO	922174	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sub-total	8024797	9169701	NO	10202846	NO	NO	101123088	12413651	NO	10100652	NO	NO

Additional information

	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Independently verified ERUs								NO				

Table 2 (c). Total annual transactions

	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Total (Sum of tables 2a and 2b)	8024797	15083026	NO	10202846	NO	NO	107036413	12413651	NO	10100652	NO	NO

Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Table 3. Expiry, cancellation and replacement

Transaction or event type	Expiry, cancellation and requirement to replace		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Temporary CERs (tCERS)								
Expired in retirement and replacement accounts	NO							
Replacement of expired tCERs			NO	NO	NO	NO	NO	
Expired in holding accounts	NO							
Cancellation of tCERs expired in holding accounts	NO							
Long-term CERs (lCERs)								
Expired in retirement and replacement accounts		NO						
Replacement of expired lCERs			NO	NO	NO	NO		
Expired in holding accounts		NO						
Cancellation of lCERs expired in holding accounts		NO						
Subject to replacement for reversal of storage		NO						
Replacement for reversal of storage			NO	NO	NO	NO		NO
Subject to replacement for non-submission of certification report		NO						
Replacement for non-submission of certification report			NO	NO	NO	NO		NO
Total			NO	NO	NO	NO	NO	NO

Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Table 4. Total quantities of Kyoto Protocol units by account type at end of reported year

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Party holding accounts	1889243137	6609664	NO	19194476	NO	NO
Entity holding accounts	NO	513187	NO	584749	NO	NO
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	NO	NO	NO	NO	NO	NO
Retirement account	564089355	2061462	NO	28840820	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal of storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	2453332492	9184313	NO	48620045	NO	NO

Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Table 5 (a). Summary information on additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
Starting values	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**
Issuance pursuant to Article 3.7 and 3.8	2648181038											
Non-compliance cancellation							NO	NO	NO	NO		
Carry-over	NO	NO		NO								
Sub-total	2648181038	NO		NO			NO	NO	NO	NO		
Annual transactions												
Year 0 (2007)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 1 (2008)	3952462	NO	NO	2161253	NO	NO	3206441	NO	NO	84000	NO	NO
Year 2 (2009)	17779729	114431	NO	9473211	NO	NO	43309348	113541	NO	530644	NO	NO
Year 3 (2010)	24545108	6130878	NO	15101585	NO	NO	52493428	3869202	NO	1628818	NO	NO
Year 4 (2011)	37148144	8656437	NO	24982121	NO	NO	80253156	4404065	NO	956857	NO	NO
Year 5 (2012)	8024797	15083026	NO	10202846	NO	NO	107036413	12413651	NO	10100652	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sub-total	91450240	29984772	NO	61921016	NO	NO	286298786	20800459	NO	13300971	NO	NO
Total	2739631278	29984772	NO	61921016	NO	NO	286298786	20800459	NO	13300971	NO	NO

Table 5 (b). Summary information on replacement

	Requirement for replacement		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Previous CPs			NO	NO	NO	NO	NO	NO
Year 1 (2008)		NO	NO	NO	NO	NO	NO	NO
Year 2 (2009)		NO	NO	NO	NO	NO	NO	NO
Year 3 (2010)		NO	NO	NO	NO	NO	NO	NO
Year 4 (2011)		NO	NO	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	NO	NO	NO	NO	NO

Table 5 (c). Summary information on retirement

Year	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Year 1 (2008)	NO	NO	NO	NO	NO	NO
Year 2 (2009)	NO	NO	NO	NO	NO	NO
Year 3 (2010)	379707621	245165	NO	14927693	NO	NO
Year 4 (2011)	184381734	1816297	NO	13912127	NO	NO
Year 5 (2012)	NO	NO	NO	1000	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO
Total	564089355	2061462	NO	28840820	NO	NO

Party	Poland
Submission year	2013
Reported year	2012
Commitment period	1

Add transaction | Delete transaction | No corrective transaction

Table 6 (a). Memo item: Corrective transactions relating to additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

Add transaction | Delete transaction | No corrective transaction

Table 6 (b). Memo item: Corrective transactions relating to replacement

	Requirement for replacement		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

Add transaction | Delete transaction | No corrective transaction

Table 6 (c). Memo item: Corrective transactions relating to retirement

	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs